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BRoWSER: Base-lining Road Works Safety on European Roads

D7.1 - Report on national performance standards, guidance and contract documents

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CEDR Call2012: Safety
BRoWSER: Base-lining Road Works Safety on European Roads

Report on national performance standards, guidance and contract documents

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Authors of this deliverable:
Xavier Cocu, BRRC, Belgium
Brian Lawton, TRL, United Kingdom
Jill Weekley, TRL, United Kingdom
Maria Nogal, TCD, Republic of Ireland
Mojca Ravnikar Turk, ZAG, Slovenia
Matthias Zimmermann, KIT, Germany

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Contents

1 Introduction

1.1 The BRoWSER project

The project Base-lining Road Works Safety on European Roads (BRoWSER) was initiated as a response to the Description of Research Need (DoRN) for the CEDR Transnational Road Research Programme Call 2012 on Safety.

The aim of the CEDR Transnational Research Programme (2012 call) seeks "to significantly reduce risks to road workers with an objective of Zero Harm". BRoWSER addresses two of the topics within the 2012 Call under the heading of "Safety of road workers and interaction with road users". These are:

- Collect data on worker injuries and near misses by country, road administration and employer
- Understand the optimum road works layouts that enable road users to approach, travel through and exit works without causing injury to workers and others

The aim of the BRoWSER project is to help National Road Authorities (NRAs) enable a data-led approach to be taken to managing road worker safety. This knowledge of how road workers are exposed to risk from accidents and road user error is essential for effective safety management as it allows the real risks to be managed rather than those perceived to be the problem. The BRoWSER project focuses on the interaction between road workers and traffic and will allow consideration of road worker accidents, incidents and near misses (where available) alongside data for road works practices, network characteristics and road user accident data at road works.

1.2 Background

Examining what signing layouts road users experience when travelling through road works starts building an understanding of why accidents may happen. This may be critical to decreasing injuries to road users and road workers from accidents caused by poor signing layout or confusion between layouts in different member states. Therefore BRoWSER work package 7 intended to identify any particular common good practices, seek evidence for any significant differences such as omission of particular elements of signing or delineation and thus start to develop recommendations that will improve consistency between EU countries.

As explained after different national performance standards and guidance documents have been collated and analysed to determine similarities and differences for advance warning, geometry of the transition area, work zone safety distance and delineation, speed limit, etc. across European countries. This work particularly focussed on areas where similar arrangements are used to convey different messages, thus carrying a risk of confusion for the road user.

The work from WP7 also intends to enable comparison between EU countries with different standards and the national injury accident data for road workers and road users. It supports correlation studies to be carried out within WP8; i.e. try to determine whether there is a correlation in accident rates between countries with similar practicesand, in addition determine whether there is any link between the strength of legislation and number of accidents within road works.

1.3 This document

This document reports the work carried out within the work package 7 that basically consisted in a deep analyses of several national performance standards and guidance documents as detailed above.

Chapter 2 presents a detailed description of practices about road work signing and equipment for six typical and relevant road work situations: major, minor, mobile road works on motorway and on single carriageway (80/90 km/h) road as they are described in the standards of a selection of European countries for which the information was accessible to the project partners. This chapter covers Belgian (Flanders), German, Irish, Norwegian, Slovenian and British standards.

In its first part chapter 3 synthesises the rules applying to these road work type focusing on signing and delineation elements that both highly impact the road user perception and behavior and road worker safety. Chapter 3 continues on a parallel listing of common practices and significant differences for what concerns advanced warning, transition area/vehicles, temporary speed limit schemes and lateral safety distance, lane width & delineation of the work zone. A discussion about opportunities to improve road work signing consistency between countries ends this third chapter.

Finally aiming to support correlation studies to be carried out within the 8th work package (i.e. try to determine whether there is a correlation in accident rates between countries with similar practices and, determine whether there is any link between the strength of legislation and number of accidents within road works) chapter 4 introduces a tentative method to classify road work signing standards, particularly to be able grouping countries with similar practices, distinguishing countries with slightly and significantly differing practices and finally considering specifically the level of mandatory provision.

2 Overview of European signing layouts

As mentioned before this deliverable focusses on a comparison of national rules and guidance between EU countries to identify any particular common good practices and to seek evidence for any significant differences in specific elements of signing or delineation. As the final objective is to improve consistency of the signing layouts that road users experience between EU countries, the first step of the analysis, reported in this chapter, consisted of giving a detailed description of different important components of the road work environment; i.e. advance warning, geometry of the transition area, work zone safety distance and delineation, and how the speed limit should be managed following standards and guidance documents.
To further facilitate comparison across countries six typical and relevant road work scenarios are described:

1. Major RW (on 3 lanes) Motorway with Crossover (4+2 or 5+1);
2. Minor RW on (3 lanes) Motorway (slow lane closed);
3. Mobile RW on (3 lanes) Motorway (slow lane closed);
4. Major RW on single carriageway (80/90 km/h) road;
5. Minor RW on single carriageway (80/90 km/h) road;
6. Mobile RW on single carriageway (80/90 km/h) road.

This classification is built around three main road work types making use of the definitions adopted in the framework of the ERN-ROAD project STARs (Scoring traffic at road works).

Table 1: Definition of road works type as proposed by the STARs project (ERN-ROAD programme)

Type	**Definition**
Mobile	Mobile and intermittent road works of limited duration carried out using vehicles and / or mobile devices (such as TMA / LMCC) to create a safe working environment for short-term access to specific sections of the road.
Minor	Stationary (i.e. not mobile) road works that can only be carried out where conditions meet defined criteria in the appropriate national guidance. Definitions may be given in terms of traffic flow, visibility and/or the duration of the work.
Major	Road works that are in place for long periods, where workers may be behind an approved safety barrier and / or different equipment, layouts or techniques are used to manage traffic compared to minor works.

The correspondence between national classifications (for motorway road works) may be found for some countries in the STARs Deliverable 1 [1].

The analysis presented hereafter primarily addresses road work signing rules and guidance in the partners respective countries; i.e. Belgium (Flanders), Germany, Ireland, Slovenia and United-Kingdom. Data from Norway and Austria have also been collected; the latter however with a lower description level.

[1] STARS Deliverable 1 – "Defining the data requirements"; April 2012. (http://www.eranetroad.org/images/eranet/Downloads/stars_d1%20generic%20data%20requirements%20and%20scoring%20template%20specification.pdf)

Finally information has been received from a Liaison group composed of the English Highways Agency (HA), the Flemish Road Authority (AWV), the Dutch Road Autority (RWS) and the North Rhine Westphalia Road Authority (NRW). However since this was received very close to the delivery date, this information (i.e. Road Works in eight EU-countries. Chances for standardisation in guidelines. Arcadis, 2014) has not been included in this deliverable. Nevertheless all relevant information from this report will be considered and where appropriate included later in the process (BRoWSER WP12).

Following sections provide a complete description of rules and requirements for each country following the six road worka situations mentioned above.

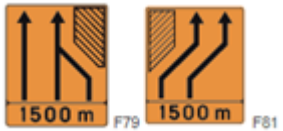
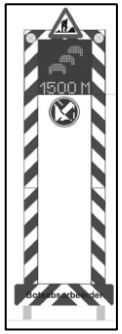
2.1 Major RW (on 3 lanes) Motorway with Crossover (4+2 or 5+1)

2.1.1 Belgium (Flanders)

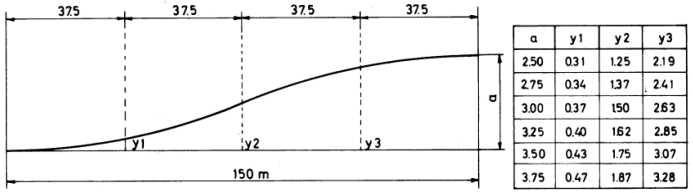
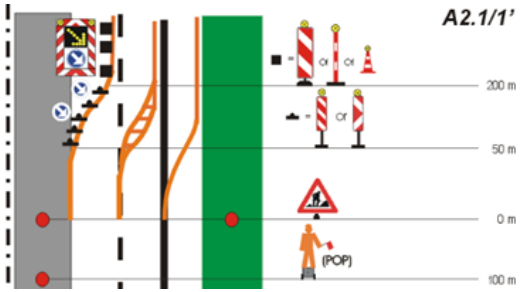
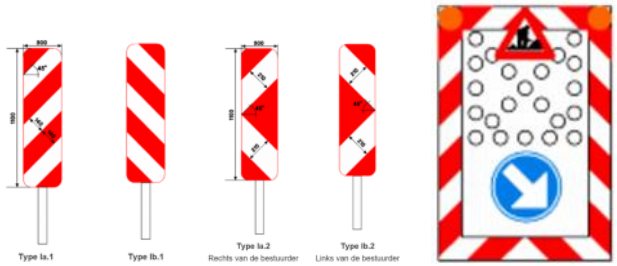
The rules described hereafter correspond to a category 1 (following the Belgian classification) road work executed on a 2 or 3 lanes motorway with a crossing of the central reserve (all traffic flowing in contraflow or not).

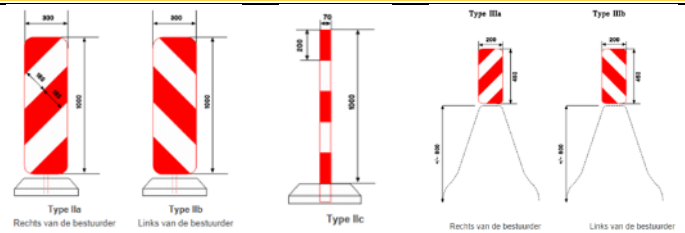
Main references:

- Decree of May 7th, 1999 on signing of road work activities (*MB 7 mei 1999 betreffende het signaleren van werken en verkeersbelemmeringen op de openbare weg*);
- Standard tender specifications (*Standaardbestek 250 versie 3.1. hoofdstuk X. 3 "signalisatie van werken"*); 2014 version.
- Schemes for signing of the more typical road works layouts (still valid for BE categories 1 to 5 but revision in progress ; *schematische weergave van in M.B. 7 mei 1999 tekstuele voorschriften en in SB 250 versie 2.2. voorziene aanvullingen: CD-ROM Werfsignalisatie 2000*).

Far-advance warning (type of signs & distance)	*General case (following standards)* The first road work warning sign is located 2500m upwards the start of the lane shift. A sign presenting general information about the road work is located 2000m upwards the work zone. Drivers are informed about the temporary lane management by use of F79 or F81 fixed road sign all along the far-advance warning area; i.e. 3000m, 1500m and 1000m upwards the start of the lane shift. For road works on motorways having a severe impact on traffic, a queue warning static sign must be installed (at roadside or above the lanes) up to 1 km upwards the likely start point of the longer normal queue. A queue warning vehicle or system must also be used during periods when queues happen (another pictogram is used in free-flowing traffic conditions). This vehicle is equipped with a TMA and LED lamps and its standard position is at least 200m upwards the start point of queues. The distance to the queue is continuously determined and accordingly  Temporary lane management signs  Queue warning static sign  Back of the queue warning vehicle Mobile trailer with VMS

	dynamically adapted on the LED matrix. <u>*Usual practice*</u> Additional <u>remotely operated mobiles trailers</u> are also often used far upwards of the road works or at interchanges to inform or warn drivers. 
Near-advance warning (type of signs & distance) - around last 300 m	<u>*General case (following standards)*</u> Along the near-advance warning area, drivers are informed about the <u>temporary lane management by use of a F79 or a F81 road sign 250m upwards the start of the lane shift and a F83 road sign 250m upwards the crossing of the central reserve</u>.  Temporary lane management signs in the near-advance warning area The Flemish RA specifies some rules regarding <u>transition zones</u>: When the number of lanes must be reduced, <u>traffic flows are still merged by inserting the fastest lane to the slowest lane</u>. In such a situation and when the road works are carried out on the slow lane, the interdistance between the 2 consecutive transition zones is 400m. The 400m interdistance between consecutive transition zones also applies for other situations; e.g. when, on 2-lane motorways, the 2 adjacent lanes need to be closed and the traffic shifted to the shoulder lane; when, on 3-lane (or more) motorways, fast and median lanes are closed and traffic shifted to right and shoulder lanes. <u>*Usual practice*</u> For road works on traffic sensitive motorways dynamic signs on gantries, portable speed displays and transversal rumble strips are regularly installed.  Dynamic signs on gantries and portable speed displays

Crossing of the central reserve/Lane shift geometry (angle, opening width, length, lane width, safety area)	*General case (following standards)* The taper is 150m long and the lane shift must be adapted to the lane width .  | a	y1	y2	y3
---	---	---	---
2.50	0.31	1.25	2.19
2.75	0.34	1.37	2.41
3.00	0.37	1.50	2.63
3.25	0.40	1.62	2.85
3.50	0.43	1.75	3.07
3.75	0.47	1.87	3.28	  Lane shift characteristics (following standard) A 1 m width neutral area is used between lanes when 2 (or more) adjacent lanes must be deviated. Yellow-Orange temporary marking are used to guide traffic and separate the temporary lanes. The lane shift must be delineated by panels (types Ia1, Ib1 or Ia2 or Ib2). The rules mentioned here above also apply to a crossing of the central reserve. Only for the first taper is additional signing needed; i.e. a frame sign with red&white strips, flashing lights and arrow.  Panels allowed for taper – Frame sign used at first lane shift *Usual practice* At a crossing of the central reserve or at a simple lane shift temporary concrete safety barriers are often installed at the right side in association with types Ia1, Ib1 or Ia2 or Ib2 panels.  Use of a temporary concrete safety barrier combined with type Ia.2 panel along the crossing of the central reserve

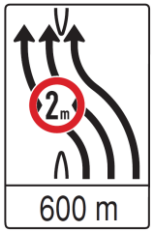
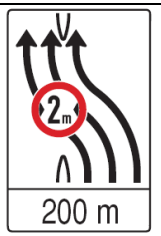
Work zone delineation	*General case (following standards)* The workplace must be delineated by panels (types IIa, b, c) or separation safety barrier. Type III).  Equipement allowed for work zone delineation
Work zone lateral safety distance	*General case (following standards)* The minimum lateral safety distance is 0,50m (minimum requirements). Larger lateral safety distance is used whenever possible.
Physical separation of the opposite traffic flows	*General case (following standards)* Safety barriers are used to separate two opposite traffic flows. Minimum requirement as regards to barriers performances is: at least T3 (containment level). The choice of the proper working width depends on the local conditions. In practice this will usually require a very limited working width (e.g. W2). At curves it is appropriate to use H2 barriers as the impact angle there is greater so the total impact energy is increased.
Work zone speed limit (scheme/reduction)	*General case (following standards)* Speed limit is steeply reduced from the posted speed limit 120 km/h to 90 km/h (-1100m) and 70 km/h (-500m). The 70 km/h speed limit sign placed 150m upwards the start of the lane shift may be replaced by 50 km/h depending on the local conditions. The sign is again repeated 50m upwards the start of the crossing of the central reserve. 70 or 50 km/h signs are repeated along the workzone; i.e. 250m after the crossover and every 500m/1000m for <2km / >2km long work zones respectively. A sign informing drivers about potential speed enforcement is placed close to the transition area.  Speed limit scheme  Information sign about potential speed control

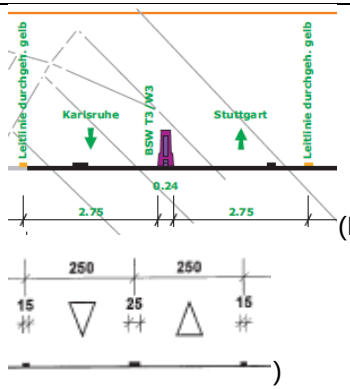
Temporary lane width	*General case (following standards)* Right (open to HGV) lane: 3,25m is recommended ; Other lanes: 3m is recommended. *Minimum requirement (following standards)* Right (open to HGV) lane: 3m. Other lanes: 2,75m.

2.1.2 Germany

The rules described hereafter correspond to a category D II/6 (following the German guideline RSA classification) road work executed on a 3 lanes motorway with partially closure of one carriageway with contraflow. An overview of the complete road work layout is provided in appendix 2.

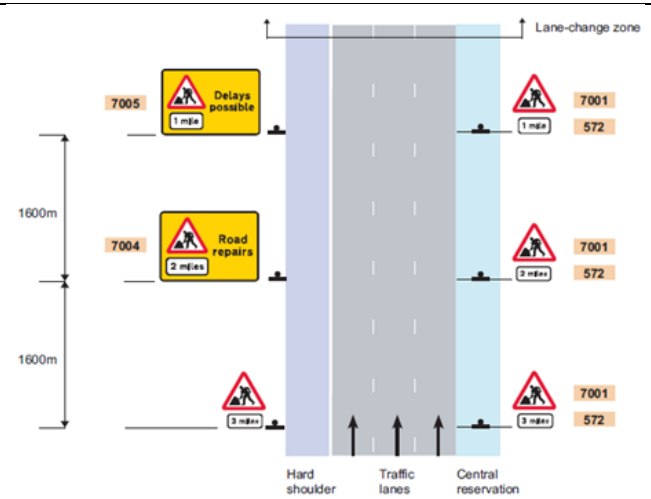
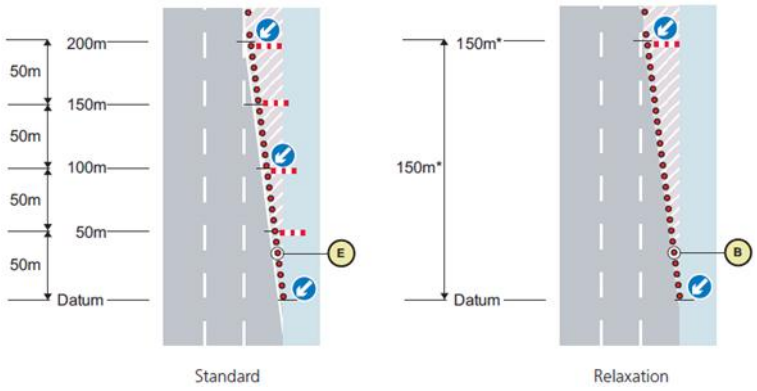
Main references: Guideline for securing of work zones (orig.: Richtlinien für die Sicherung von Arbeitsstellen (RSA), 1995)

Far-advance warning (type of signs & distance)	*General case (following standards)* Traffic (hard) sign “Construction site” 2000 and 800 m in advance Layout information signs 600, 400 (and 200) m in advance (hard signs). At layouts with upstream lane reduction information signs for lane reduction in this position, contraflow signs in near-advance warning position.	 
Near-advance warning (type of signs & distance) - around last 300 m	*General case (following standards)* Layout information signs 200 m in advance (hard signs)	

Crossing of the central reserve/Lane shift geometry (angle, opening width, length, lane width, safety area)	*General case (following standards)* Length: minimum 135m
Work zone delineation	*General case (following standards)* Safety panels, with speed > 80 km/h: temporarily safety barriers 
Work zone lateral safety distance	*General case (following standards)* 1 m to excavation edge * *: Draft workplace rule (occupational safety and health) to take account real lateral distances to road workers in discussion
Physical separation of the opposite traffic flows	*Usual practice* Temporarily safety barrier *Minimum requirement (following standards)* Double line marking.  (Minimum:)
Work zone speed limit (scheme/reduction)	80 km/h (700 m in advance: 100 km/h, 500 m in advance: 80 km/h) (Minimum in special cases: 60 km/h)
Temporary lane width (Overtaking Lane, Truck lane)	*General case (following standards)* 2,60 m/3,25 m *Minimum requirement (following standards)* :Minimum 2,50 m/3,00 m

2.1.3 Ireland

The Traffic Signs Manual – Chapter 8: Temporary Traffic Measures and Signs for Roadworks and TA 92 "Crossover and changeover design" stablish the following design parameters.

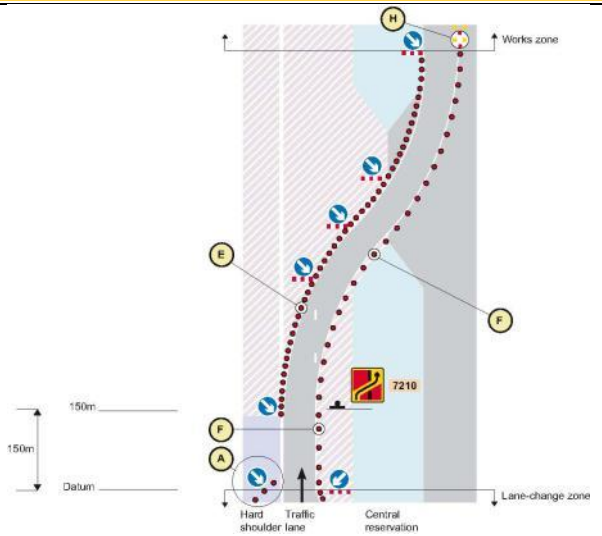
Far-advance warning (type of signs & distance)	- If queues are expected to extend more than 3km from the works, "road works" signs with distance plate "5 km" on the near side and the off side, placed 5 km in advance of the works – further signs with distance plate "6km", "7km" etc. should be placed as appropriate if queues are expected sometimes to extend this far; - a "road works ahead" sign, incorporating the "road works" sign with distance plate "3 km" on the near side, and a "road works" sign with distance plate on the off side, placed 3km in advance of the works; and a "road works ahead" sign, incorporating the "road works" sign with distance plate "1.5 km" on the near side, and a "road works" sign with distance plate on the off side, placed one mile in advance of the works.	
Near-advance warning (type of signs & distance) - around last 300 m	**Lane change zone:** **-** one "keep left/right" sign at the start of the taper. - one "lane closed" barrier with a high intensity warning light and a "keep left/right" sign at the end of each closed lane of the taper. - one "lane closed" barrier with a high every 50 m along the length of the taper, the barrier midway along the length of each closed lane to have a "keep left/right". **Case "single-lane crossover":** - "diversion of lane onto the other carriageway" sign (7210) located on the off side at the start of the	 Lane change zone

crossover.

- “keep left/right” sign at the start of the crossover; if this is placed in a closed lane, as opposed to a normally non-trafficked area such as the verge, a footway or a hard shoulder, then a “lane closed” barrier with a high intensity warning light should be added.

- a temporary mandatory speed limit will be in place; these signs should be continued from the lane-change zone; for the spacing of speed limit repeater signs.

- for crossovers with a sharp deviation, “sharp deviation of route” signs with “turn left/right” signs should replace the “lane closed” barriers and “keep left/right” signs.



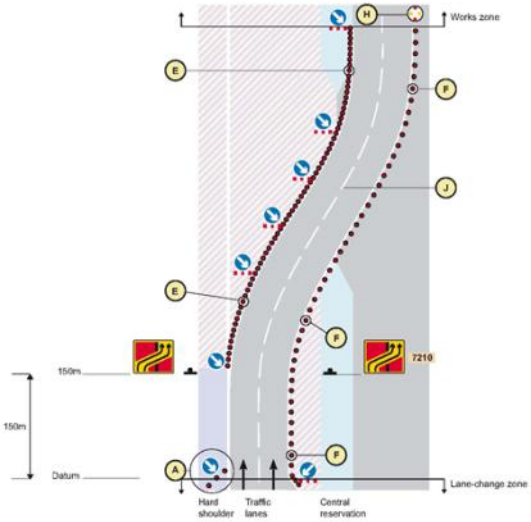
Case “single-lane crossover”

Case “two-lane crossover”:

- two “diversion of lanes onto the other carriageway” signs (7210) located on either side of the carriageway at the start of the crossover.

- “keep left/right” sign at the start of the crossover; if this is placed in a closed lane, as opposed to a normally non-trafficked area such as the verge, a footway or a hard shoulder, then a “lane closed” barrier with a high intensity warning light should be added.

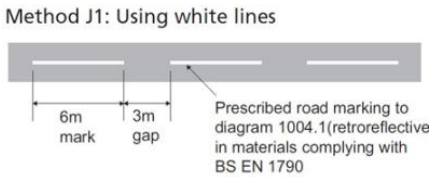
- a temporary mandatory speed limit will be in place; these signs should be continued from the lane-change zone; for the spacing of speed limit repeater signs.

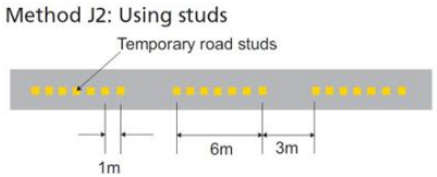
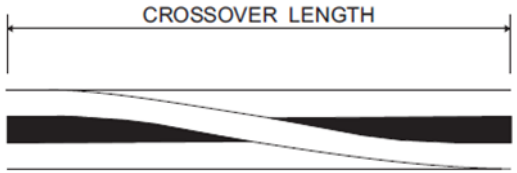


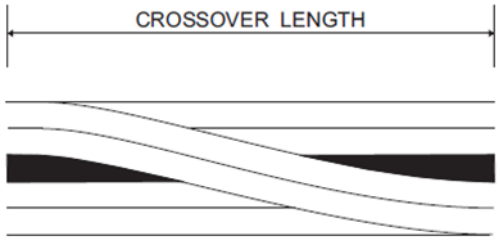
Case “two-lane crossover”

Detail B: Cone spacing: 1.5 m; Relaxion: 3 m.

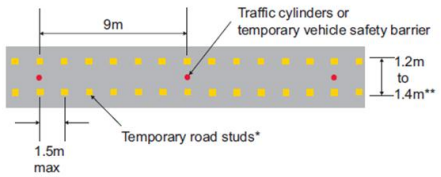
Detail E: Cone spacing: 1.5 m; Relaxion: 3 m.

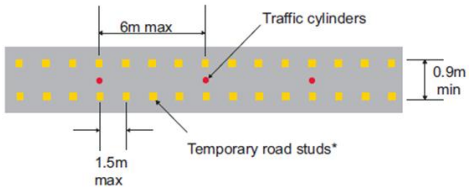
<table>
<tr><td></td><td>Detail F: Cone spacing: 9 m.
Detail J:
 


</td></tr>
<tr><td>Crossing of the central reserve/Lane shift geometry (angle, opening width, length, lane width, safety area)</td><td>The required crossover lengths may be calculated according:
- Off side lane into off side lane:
<table>
<tr><th>Step increase</th><th>Crossover length = paved length (m)</th></tr>
<tr><td>0</td><td>126</td></tr>
<tr><td>3</td><td>216</td></tr>
</table>


Off side lane into off side lane
- Lanes 2 & 3 into lanes 3 & 2:
<table>
<tr><th>Step increase</th><th>Crossover length = paved length (m)</th></tr>
<tr><td>0</td><td>153</td></tr>
<tr><td>3</td><td>261</td></tr>
</table>


Lanes 2 & 3 into lanes 3 & 2</td></tr>
<tr><td>Work zone delineation</td><td>The delineation of the work zone for the case of all traffic diverted by means of a crossover is not defined, as there is not any traffic close to the works zone.</td></tr>
<tr><td>Work zone lateral safety distance</td><td>The lateral clearance between the edge of the working space and that part of the carriageway being used by traffic should be not less than 1.2 m.</td></tr>
<tr><td>Physical separation of the opposite traffic flows</td><td>Detail H is used as the general case..</td></tr>
</table>

<table>
<tr><td></td><td>Detail K is used if narrow lanes are present.
 

DETAIL H
 

DETAIL K</td></tr>
<tr><td>Work zone speed limit (scheme/reduction)</td><td>The speed limit reduction is determined by the design speed according the following table:
<table>
<tr><th>Temporary mandatory speed limit</th><th>Design speed for crossover</th><th>Absolute minimum stopping distances for crossovers required</th></tr>
<tr><td>80 kph</td><td>85 kph</td><td>90 m</td></tr>
<tr><td>60 kph</td><td>70 kph</td><td>70 m</td></tr>
<tr><td>50 kph</td><td>60 kph</td><td>50 m</td></tr>
</table>
Temporary speed limits should generally be imposed 50 m in advance of the first sign at road works indicating a restriction or lane closure.
Speed restrictions should extend to 90 m.
In general, a temporary speed limit should not be introduced where the length of restriction would be less than 800 m.
Repeater signs at regular intervals along the length of the works are required. The recommended maximum spacing of repeater signs for temporary speed limits is as follows:
<table>
<tr><th>Temporary speed limit</th><th>Spacing of consecutive repeater signs on the same side of the carriageway</th><th>Spacing of consecutive signs on alternate sides</th></tr>
<tr><td>80 kph or more</td><td>maximum 700m</td><td>Maximum 450 m</td></tr>
<tr><td>60 kph</td><td>maximum 500m</td><td>Maximum 350 m</td></tr>
<tr><td>50 kph</td><td>maximum 400m</td><td>Maximum 250 m</td></tr>
</table></td></tr>
<tr><td>Temporary lane width</td><td>To 3.25 m (desirable minimum) or 3.0 m (absolute minimum)</td></tr>
</table>

2.1.4 Norway

Reference: Manual no. N301E Work on and along roads, Requirements and guidelines regarding warning and protection (Directorate of Public Roads, Roads and Transport Department, 2014) – Håndbok N301 Arbeid på og ved veg, Krav og retningslinjer til varsling og sikring (Statens vegvesen, 2014).

Associated references to the standards document are in (blue) brackets after each bit.

Far-advance warning (type of signs & distance)	Warning shall be such that road users can adapt their speed and driving behaviour in a timely manner according to the conditions present, and so that there is no doubt how to drive past the roadworks site. (3.0.0.1) A roadworks sign (Sign 110) is positioned at 700m prior to the start of the lane change zone and is supplemented with two flashing yellow signals (Signal 1098). Since the speed limit is greater than 70km/h, a speed limit advance warning sign (Sign 362) is positioned at 400m prior to the start of the lane change zone with a supplementary plate (802) showing the distance to the start of the speed limit. If the number of lanes available is reduced through the works (see layout 3.04 in appendix 3), there should also be a lane ends (Sign 532) positioned at 700m prior to the start of the lane change zone, supplementary (and below) the road works sign mentioned above. *Roadworks sign (Sign 110)* The sign 110 should be the first warning road users receive that roadworks are taking place. It can be repeated as needed and used in combination with supplementary plate 802 “Distance”, which shows the distance to the worksite, or supplementary plate 804 “Extent”, which shows the extent of the stretch of roadwork. The sign may also be used together with supplementary plate 808 “Text” to indicate what kind of roadwork is taking place. The texts to be used are discussed under sign 808. In combination with other signs, sign 110 shall be placed highest. Exceptions from this can be made when the sign is part of an element in a warning panel; cf. the section on combining warning equipment, or the symbol is used on a variable sign. (3.2.1.4) Sign 110 “Roadworks” 

Size of signs

Large size signs (LS) shall be used to warn of roadworks on motorways and roads with speed limits over 80 km/h.

Speed limit	30	40	50	60	70	80	90	100
Visibility (m)	30	40	50	70	90	100	120	140

Figure 3.1.2 Minimum requirements for a clear view to temporary road traffic signs in connection with roadworks.

On motorways, other multiple-lane roads and roads with high speed limits or heavy traffic, signs ought to be set up on both sides of the carriageway.

Signing speed limits (see Work Zone Speed Limit section for more information)

Advance warning: If the temporary speed limit is more than approx. 20 km/h lower than the local speed level, advance warning of the temporary speed limit should be given. If the temporary speed limit is not significantly lower than the speed level, advance warning is not necessary.

Any advance warning is done with sign 362 with a specification of the new speed limit, and a supplementary plate, 802 ”Distance”. The distance between the signs must be adjusted to the speed level and the local conditions, but shall not be less than 150 m.

On two-lane roads, the advance warning is placed on the right side of the road; on multilane roads, advance warnings should be used on both sides of the road.

(3.2.3.13)

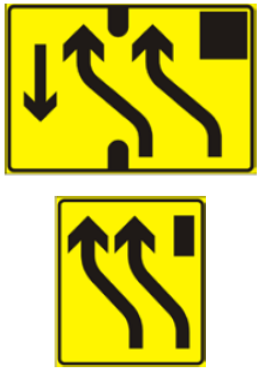
Flashing yellow signal (Signal 1098)

According to Section 24 of the Road Sign Regulations, the flashing yellow signal indicates that road users must pay particular attention and act cautiously. The signal can be used together with public traffic signs to indicate special traffic situations, or at locations where road users should be particularly cautious.

Signal 1098

Either one or two alternating flashing yellow lights shall be used when extra attention to a sign or sign combination is required.

(3.4.3.1)

	Lane ends (Sign 532) This sign shall be used to warn road users that the lane ends when one of several lanes in the same direction is temporarily closed. The sign requires that drivers in the lane that ends change lanes while yielding right of way. Where more than two lanes merge into one lane, the end of each individual lane shall be individually signed. In the interest of traffic safety, lane endings should be done from left to right. (3.2.5.3)  532.V01  532.V02
Near-advance warning (type of signs & distance) - around last 300 m	The speed limit signs should be positioned 100m prior to the start of the lane change zone. For more information on speed limits see the Work Zone Speed Reduction section. If the contraflow system does not involve a reduction in the number of lanes available for traffic (see layout 3.02 in appendix 3), the altered driving patterns sign (Sign 539) is shown prior to the start of the lane change zone. If the contraflow system does involve a reduction in the number of lanes available (see layout 3.04 in appendix 3), the lane ends sign (Sign 532) is repeated 300m prior to the start of the lane change zone and the altered driving patterns sign is positioned within the lane change zone. Where a lane is ending due to the road works, directional markings (Sign 904) can be used to show this change prior to the start of the lane change zone (see layout 3.04). *Altered driving patterns (Sign 539)* Sign 539 can be used to show temporary lane changes in connection with roadworks along a stretch of road, e.g. that the lane is diverted to the opposite side of the median or that a lane swings around the worksite. It shall only be used for temporary regulation and shall always have a yellowgreen background. The sign design shall be adapted to the conditions at the site. (3.2.5.4)  Signs 539

	Directional markings (Sign 904) Sign 904 can be used when it is particularly important to show the shape of the curve, especially if: • the radius changes (conjoined curves), • the curve is long (major change in direction), • there is little outside the road to show the shape of the curve.  904.H  904.V A minimum of 3 times sign 904 shall be used to show the change, and at least two signs shall be visible at once. Sign 904 can also be used to mark closure of a lane on a multi-lane road where the traffic is directed into another lane. (3.2.7.3)
Lane shift geometry (angle, length, lane width, safety area)	Basically shall warning panels be used to mark that one or more lanes are closed to traffic. Warning panels can also be used to indicate that parts of a lane or the road shoulder are closed, or to inform about on-going work. The start of the lane change zone is marked by two warning trailers, one on each side of the carriageway, each displaying the flashing light arrows (Signal 1100) and the mandatory lane signs (Sign 404). In addition there are barrier markers at the top and bottom of the warning panel. (Note that the lower barrier marker is not present when the directional markins are displayed in front to avoid confusion.) If the lanes are physically separated at this point, object markers (Sign 906) are used to highlight this (see layout 3.02) “Barrier marker” Sign 908 shall be used to mark barriers across or above the roadway. Background markers (Sign 902) may also be used to indicate lane changes (see layout 3.02). There is a minimum of 30m after the warning panels before the contraflow lane is directed to the opposing side of the carriageway. Directional markings (Sign 904) are used to indicate this. For layout 3.04, there is a two-step lane shift with the second shift positioned a minimum of 50m after the first (and again indicated using directional markings).

Warning panels and warning trailers

Warning panels are a combination of two closure markers (sign 930) and two alternating flashing yellow lights (signal 1098). In addition, the warning panel may be equipped with other traffic signs, for example a hazard sign with supplementary plate, information sign, mandatory sign or light arrow.

Warning panels can be mounted on temporary sign racks, on trailers (warning trailers) or on construction vehicles. They shall have two flashing yellow lights that flash alternately (signal 1098). The lights shall be turned on when the panel is in use, except when the light arrow is used or placed in or near a traffic signal that is in operation.

Construction machinery or vehicles with warning panels mounted on them shall in addition have at least one warning light that produces a flashing yellow light visible from all sides.

(3.6.2.1)

If sign 904 “Direction markers”, sign 906 “Barrier markers”, 940 “Traffic cones” or 942 “Traffic cylinders” are used just in front of the warning panel to mark that the road narrows, the lower panel with sign 930 “Closure markers” on the warning panel must be covered or concealed. This shall be done in order to avoid many red-yellow signs creating an untidy visual impression that is difficult for road users to interpret.

When the warning panel is not in use, no arrow symbol that may be misunderstood shall be shown, on either the sign or the signal.

(3.6.2.2)

Warning panel with:
- Signal 1098 “Flashing yellow light signal”
- Signal 1100 “Flashing light arrows”
- Sign 930 “Closure markers” and
- Sign 404.2 “Mandatory driving lane”

Warning panel with:
- Signal 1098 “Flashing yellow light signal”
- Sign 930 “Closure markers” and
- Sign 110 “Roadworks”

Examples of warning panels

Mandatory lane sign (Sign 404)

The sign can be used in connection with warning of roadworks in the following situations:

- At the termination of temporary medians to show the side of the sign on which traffic should pass.
- If there is a need to indicate the side on which traffic should pass an obstacle.

A smaller sign size than D=40 cm shall not be used for sign 404. An over-sized sign 404 can be used on warning panels and similar in connection with roadworks. The size is to be adapted to the warning panel. The sign shall not cover parts of other signs. Attention must be given to ensure that oversize signs do not obstruct visibility for drivers and pedestrians.

(3.2.4.1)

Flashing light arrows (Signal 1100)

Light arrows can be used on warning panels to specify the side of the panel on which the vehicle should pass. The same rules apply for use of light arrows as for sign 404. The signal can be used individually, but should be used together with sign 404 on roads with a high speed level.

When flashing light arrows are used, the warning panel must not simultaneously use a flashing yellow light.

Signal 1100

(3.4.4.1)

Barrier markers (Sign 908)

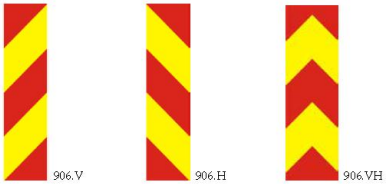
Used on the roadway the sign may be placed on booms, warning panels, vehicles or construction machinery. This marks that part of the carriageway or the entire carriageway is closed.

Sign 908

Sign 908 shall also be used to mark obstructions above the carriageway if the clearance above the carriageway is reduced to less than 5.0 m while work takes place.

(3.2.7.5)

Object markers (Sign 906)



Sign 906 can be used to mark:

- narrowing of a two-lane road,
- obstacles near the carriageway
- lane separators,
- a separator between the lane and the worksite,
- longitudinal and transverse protection.

When a lane on a multi-lane road is closed, sign 904 should be used instead.

Sign 906 can also be used as a speed-reducing device by placing the signs on both sides of the carriageway or lane with a reduced, special speed limit. There should be a distance of 2-4 m between signs.

The signs shall be placed so that the stripes point down toward the side on which traffic is to pass.

(3.2.7.4)

Background markers (Sign 902)

Sign 902 can be used to indicate unusually sharp turns (usually R<50 m and more than 45° directional change).

The signs shall be placed perpendicular to the driving direction into the curve, or in the vehicle's line of sight towards the sign.

(3.2.7.2)

The distance between signs for longitudinal warnings shall not be greater than shown in the following Figures.

Speed level	Metres between object markers
50/km/h and lower	6 m
60/km/h and lower	12 m

Figure 3.2.8 Maximum distance between object markers when they are used as longitudinal warning.

	<table><tr><th>Desired speed level</th><th>Metres between barrier markers</th></tr><tr><td>50/km/h and lower</td><td>2 m</td></tr><tr><td>60 km/h</td><td>4 m</td></tr><tr><td>70 km/h</td><td>6 m</td></tr></table> Figure 3.2.9 Recommended distance between object markers when they are used as speed-reducing devices
Work zone delineation	*Traffic cones and traffic cylinders (Signs 940 and 942)* Traffic cones and traffic cylinders can be used as longitudinal warning to mark: • a separator between two traffic directions, • protective measures, • other types of obstacles in the carriageway or on the pavement. For warnings when it is dark, sign 906 “Barrier markers” shall be used instead of traffic cones or traffic cylinders. The maximum distance between traffic cones and traffic cylinders along a worksite shall be determined in relation to the speed at the locations, but shall not be greater than shown in Fig. 3.2.9 (above) for barrier markers. If traffic cones or cylinders are to be used as visual speed reducing measures, they should be placed at distances as shown in Fig. 3.2.9. (3.2.8.1) Sign 940 “Traffic cone”  Sign 942 “Traffic cylinder”  *Buffer zone (in advance of works activity zone)* There shall always be a buffer zone in front of a worksite even if only warning equipment, and no protective equipment is used. There shall be no people, machinery or equipment in the buffer zone. The buffer zone’s length will depend on the expected speed level in the case of collisions and the type of protective equipment used.The buffer zone’s length will depend on what safety product is used. The protective equipment’s buffer zone shall be in accordance with specifications for the safety product, if this is standardised and tested. (4.1.1.1)

	Protection Transverse safety equipment may be: • vehicles placed in front of the worksite. • equipment specially developed to be transverse protection, placed on the carriageway, often energy absorbing. • vehicles with energy absorbing equipment mounted on them, placed in front of the worksite. At speed levels of 60 km/h or higher, the transverse protection shall be energy absorbing. For work on multi-lane roads with speed limits of 60 km/h and higher, impact attenuation vehicles shall be used as protection for short-term roadworks, including setting out or taking in warnings and protection for long-term roadworks. (4.1.1.3)
Work zone lateral safety distance	*Longitudinal protection* A risk analysis shall always be made to establish what types of protection and warning to use in the individual instances. • Protection shall be adapted to the different road user groups and local hazards. • There shall be a correlation between the protective measures and the speed limit past the worksite; a very low speed limit shall not be used to avoid using safety measures. • The warning shall be adapted to the hazards in question and the type of safety protection used. (4.0.0.2) Longitudinal protection is a physical obstacle in the form of guardrails, fencing or other barriers that shall ensure that road users: • do not enter the work area and inflict damage or injury on the workers, the equipment or structures. • do not injure themselves by driving into equipment, equipment or structures or by driving into a construction trench, etc. • do not enter the wrong parts of the road: over into an oncoming traffic lane or into areas for unprotected road users. Longitudinal protection ought to be used in the following situations: • when people work in an area that is very close to traffic, • when equipment or structures are located close to an area with traffic, and significant damage or injury will occur in collisions with these, • when there are construction trenches close to traffic, and significant damage will occur if a vehicle drives into the construction trench,

- when the terrain on the side of the road is such that guardrails will also be necessary for the finished road.
- when the altered alignment implies a high risk that the vehicle will enter the area for unprotected road users or oncoming traffic.

(4.2.1.1)

Guardrails

When guardrails are used, they shall only be used in accordance with the user instructions and under the conditions that apply for approval of the product. Guardrails shall be mounted as intended, with respect to both connecting the individual parts of the guardrail and anchoring it to the base.

There shall always be an area behind the guardrail corresponding to the guardrail's workspace, and in this area there shall be no machines, workers, stored equipment, structures or construction trenches that could lead to injury or damage should there be a collision with the guardrail resulting in it being pushed into this area.

(4.2.1.2)

Safety zone

A simplified calculation of safety zones is used for roadworks according to the rules in Manual 231 Rekkverk [Guardrails]. The safety zone is measured from the edge of the carriageway (white stripe). The following values are used for the safety zone in roadwork areas:

Speed limit (km/h)	<=50	60	70	80	90	100
Safety zone (m)	3	6	7	8	9	10

Figure 4.2.1 Simplified safety zone in connection with roadworks

In the safety zone in connection with roadworks, there shall not be hazards such as:

- construction pits deeper than 1 m,
- steep slopes, height differences that should normally be protected with guardrails, cf. Manual 231,
- heavy objects that are dangerous to collide with in the case of driving off the road: rock crags, construction machinery, structures.

If such hazards do exist in the safety zone, additional protective measures such as guardrails or a lower speed level must be used.

	Special rules for protecting road workers Road workers shall not work closer to the edge of the carriageway than 3 m for more than one hour when the speed limit is over 50 km/h, if they are not protected by guardrails or are in a machine. When road workers work for longer periods in the safety zone on roads with speed limits of 80 km/h, the speed limit shall be lowered to 70 km/h.
Physical separation of the opposite traffic flows	*Markings* In the case of long-term work that results in road users being directed contrary to existing road markings, or where the road markings are misleading, either this marking shall be altered or removed, or warning equipment shall be used that clearly shows where driving shall take place contrary to the road markings. If barrier lines have to be crossed during short-term works, or if driving is to take place on the wrong side of the road or over a yellow centre line, the temporary lane shall be marked with barrier markers on both sides. To ensure satisfactory optical guidance, temporary carriageway reflectors can be placed on the carriageway while the work takes place. In such instances, the permanent markings shall be removed or covered. (3.3.0.1)
Work zone speed limit (scheme/reduction)	*Speed limit (Sign 362 and Sign 364)* Sign 362, Speed limit, shall be set up on both sides of the road where the speed limit is reduced. Terminating a special speed limit with sign 364 can be done by placing a sign only on one side. (3.2.3.14) The end of limit sign is positioned 25m after the end of the lane change zone. Sign 362 "Speed limit:"  Sign 364 "End of special speed limit" 

	Use of speed limits near roadworks The need to lower the speed limit in connection with roadworks shall be evaluated on the basis of concern for the safety of workers and road users. The speed limit shall not be set lower than is necessary to maintain acceptable safety while passing the worksite. The stretch of road with a lower speed limit shall not be longer than necessary. In order to make a lower speed limit effective, other speed reducing measures, such as narrowing the lane or adding speed humps, should also be considered. Such measures shall be used if the average speed proves to be over the specified speed limit, or the speed level (85% fractile) is more than 5 km/h above the speed limit. (3.2.3.7) *Selecting the speed limit* For both layouts included in this scenario, the speed limit is selected as 50km/h 50 km/h is used for shorter stretches of road where geometry, road surfacing or possible safety measures are so poor that a higher speed cannot be justified. However stretches of road with 50 km/h due to poor standard should not be longer than 1 km. 50 km/h is also used during periods of the day when construction machinery is often on or very near the carriageway, or unprotected workers are less than 3 m from the carriageway. In such situations, the speed limit should be raised to 70 km/h when there is no work being done. On stretches of road with a temporary speed limit of 50 km/h, visual speed-reducing measures should be used in addition to speed limit signs to ensure that the speed level does not become significantly higher than the speed limit. (3.2.3.11) *Repeats* Temporary speed limits in connection with road work shall be repeated at a maximum of 250 m apart. Repeats are placed on the right side of the road. On roads with several lanes in the same direction, the repeat signs shall be set up on both sides of the carriageway. (3.2.3.15)
Temporary lane width	The contraflow lane must be a minimum of 3.5m (for layout 3.02)

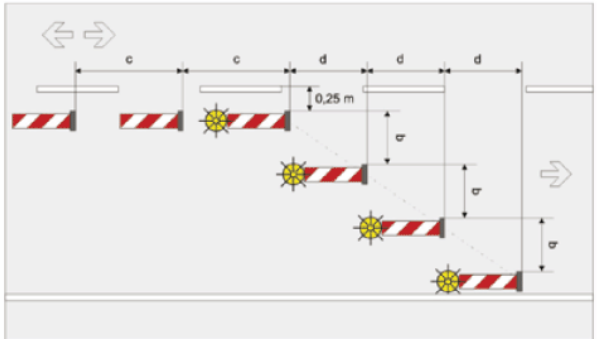
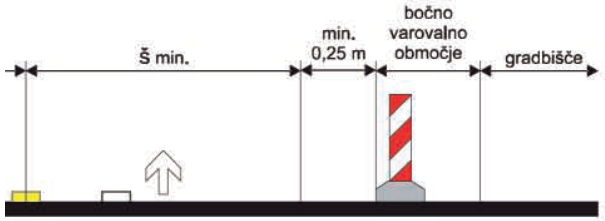
2.1.5 Slovenia

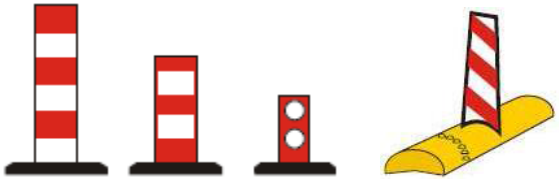
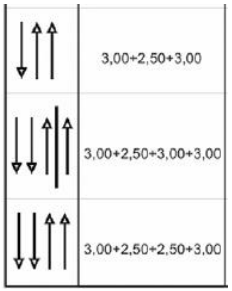
Rules are set in 'Regulations on the Method of Marking and Protecting Roadworks on Public Roads and Impediments in Road Traffic' and amendments, issued in 2006 and its amendmends in 20068 and 2010. ('Pravilnik o načinu označevanja in zavarovanja del na javnih cestah in ovir v cestnem prometu', Uradni list RS, št. 116/06, 88/08 in 109/10).

There are no standard traffic management schemes for 3 lanes motorway. Most of the motorways have two lanes. In case of a three lane motorway the left overtaking lane is merged with the right overtaking lane, then standard scheme - type C2+2 (2006) is applied. The detailed schemes are presented in appendix 4. In case of 3 lane motorway with a crossover a combination of scheme type A4 (page 1) and type C2+2 will be used.

On motorways the usual practice follows the standard schemes.

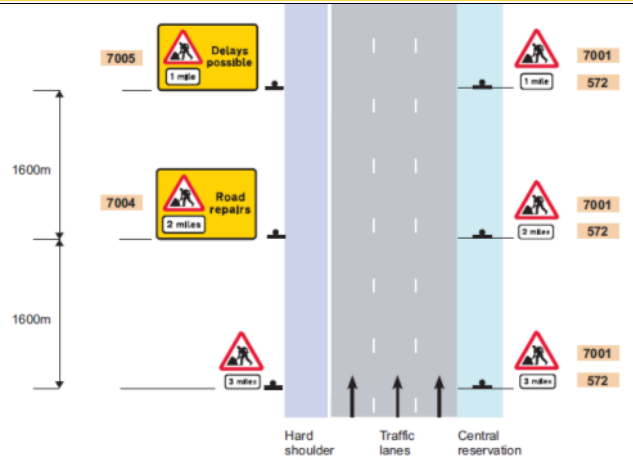
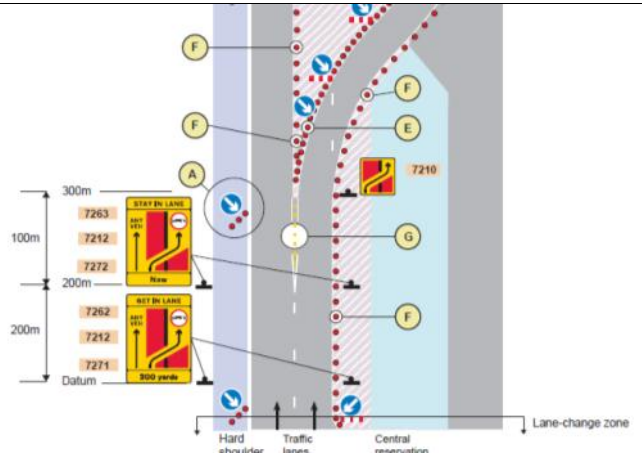
Far-advance warning (type of signs & distance)	*General case (following standards)* Traffic sign (hard sign, yellow background) with flashing light on top "Construction site" 2600m and 1400 m in advance with warning light. Layout information signs 1200m, 700m, 400m (and 100m) in advance (hard signs). An general information sign is also installed upwards the road work area. *Usual practice* Also information tables and stationary traffic management system are used.	
Near-advance warning (type of signs & distance) - around last 300 m	*General case (following standards)* Layout information signs 100 m in advance (hard sign, yellow background) *Usual practice* Following standard layout	

Crossing of the central reserve/Lane shift geometry (angle, opening width, length, lane width, safety area)	*General case (following standards)* The speed limit depends on road elements - usually 60km/h (in case of large crossfall 40km/h). The lanes are delimited with temporary yellow markings.
Work zone delineation	*General case (following standards)* Safety panels (most common) or safety barriers. The distance between panels is defined in guidelines. The distance should be 20m at workzone section and 10m at lane closures. Panels with flashing light at lane closure section. 
Work zone lateral safety distance	*General case (following standards)* The distance between the road markings and workzone is not defined * (according to general safety rule – 100cm from excavation edge). The distance between the temporary road markings (traffic lane) and safety panels is 0,25m. *: However the regulations on the provision of health and safety at work at temporary or mobile construction sites state: “At the upper edge of excavation (more than 100cm deep) it is mandatory to provide at least 100 cm wide safety zone”.  

Physical separation of the opposite traffic flows	*General case (following standards)* The work zone must be delineated by panels or by a safety barrier. *Minimum requirement (following standards)* Prefabricated security markers (class RA3 reflectivity) 
Work zone speed limit (scheme/reduction)	*General case (following standards)* 100 km/h (800m in advance), 80 km/h (600 m in advance), 60 km/h (100 m in advance) (at crossings minimum in special cases: 40 km/h) *Usual practice*. The speed is usually not controlled in workzones. The radar speed sign (typically used at locations of fixed radar devices for speed enforcement; cf. picture at right) is also rarely used in workzones. 
Temporary lane width (Overtaking Lane, Truck lane)	*General case (following standards)* 2,50 m – overtaking lane, 3,00 m truck lane 

2.1.6 United Kingdom

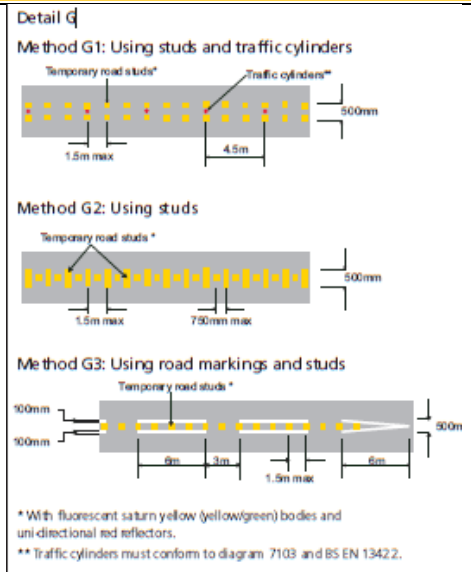
The Traffic Signs Manual Chapter 8 provides guidance on 'Traffic Safety Measures and Signs for Road Works and Temporary Situations'. It includes references to all the relevant legislation, such as the Traffic Signs Regulations and General Directions. The Highways Agency, the national road authority for England, also issues Interim Advice Notes (IANs), which update and/or clarify sections of Chapter 8, from time to time; these are then incorporated into the next edition of what is often referred to simply as 'Chapter 8'.

Far-advance warning (type of signs & distance)	If queues are expected to extend more than two miles from the works, “road works” signs with distance plate “3 miles” on the near side and the off side, placed three miles in advance of the works – further signs with distance plate “4 miles”, “5 miles” etc. should be placed as appropriate if queues are expected sometimes to extend this far; A “road works ahead” sign, incorporating the “road works” sign with distance plate “2 miles” on the near side, and a “road works” sign with distance plate on the off side, placed two miles in advance of the works; and A “road works ahead” sign, incorporating the “road works” sign with distance plate “1 mile” on the near side, and a “road works” sign with distance plate on the off side, placed one mile in advance of the works”.  Where queuing is not expected the 3 mile “road works” sign is not required.
Near-advance warning (type of signs & distance) - around last 300 m	None between the 1 mile sign and the beginning of the crossover.
Crossing of the central reserve/Lane shift geometry (angle, opening width, length, lane width, safety area)	**Splitting lanes** Studs and cylinders, or studs and road markings, to Detail G for a minimum length of 100 m up to the “nose” of the divide – there are two options: 1) using studs and traffic cylinders – a minimum of 50 m of Detail G2 followed by a minimum of 50 m of Detail G1; or 2) using studs and road markings – a minimum of 100 m of Detail G3; A “diversion of right-hand lane onto the other carriageway” sign with “GET IN LANE” top panel and a “200 yds” bottom panel is located on both sides of the carriageway 200 m from the start of Detail G – the signs can include an indication of a motorway exit if appropriate; 

A “diversion of right-hand lane onto the other carriageway” sign with “STAY IN LANE” top panel and a “NOW” bottom panel is located on both sides of the carriageway at the start of Detail G – the signs can include an indication of a motorway exit if appropriate;

A “diversion onto the other carriageway” sign is located on the off side at the start of the crossover;

A temporary mandatory speed limit will be in place.



Single-lane crossover

A “diversion of lane onto the other carriageway” sign located on the off side at the start of the crossover;

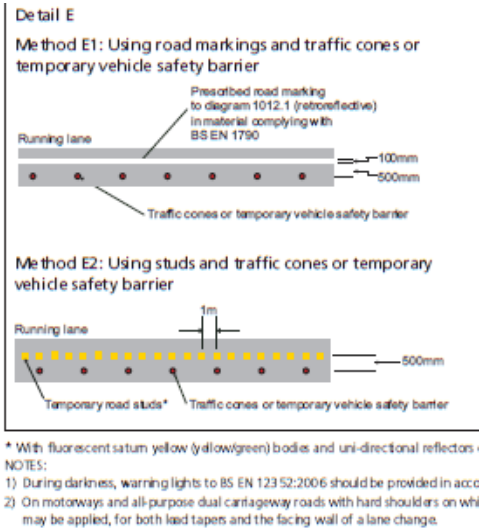
Coning to Detail E is used on the near side;

Coning to Detail F is used on the off side;

If a buffer zone is present the coning to Detail F on the off side is followed by cylinders and studs to Detail H (as shown), Detail K is used if narrow lanes are present; if a buffer lane is present, then the coning to Detail F is followed by coning to Detail C1;

One “keep left/right” sign at the start of the crossover; if this is placed in a closed lane, as opposed to a normally non-trafficked area such as the verge, a footway or a hard shoulder, then a “lane closed” barrier with a high intensity warning light should be added;

One “lane closed” barrier with a high intensity warning light



and a “keep left/right” sign at the end of the crossover;

One “lane closed” barrier with a high intensity warning light and a “keep left/right” sign at the end of each lane crossed; in this context the central reservation is equivalent to either one or two lanes crossed, depending on its width; and

A temporary mandatory speed limit will be in place;

For crossovers with a sharp deviation, “sharp deviation of route” signs with “turn left/right” signs should replace the “lane closed” barriers and “keep left/right” signs.

Where the hard shoulder is not used for a works entry, and works access signs are not in place, an additional Detail A should be placed at the start of the coning blocking the hard shoulder.

Two-lane crossover

Two “diversion of lanes onto the other carriageway” signs located on either side of the carriageway at the start of the crossover;

Coning to Detail E is used on the near side;

Coning to Detail F is used on the off side;

If a buffer zone is present, the coning to Detail F on the off side is followed by cylinders and studs to Detail H (as shown); Detail K is used if narrow lanes are present; if a buffer lane is present, then the coning to Detail F is followed by coning to Detail C1;

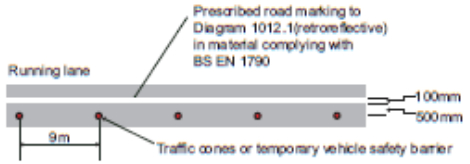
One “keep left/right” sign at the start of the crossover; if this is placed in a closed lane, as opposed to a normally non-trafficked area such as the verge, a footway or a hard shoulder, then a “lane closed” barrier with a high intensity warning light should be added;

One “lane closed” barrier with a high intensity warning light and a “keep left/right” sign at the end of the crossover;

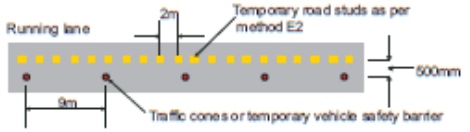
One “lane closed” barrier with a high intensity warning light

Detail F

Method F1: Using road markings and traffic cones or temporary vehicle safety barrier

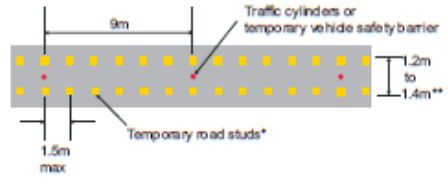


Method F2: Using studs and traffic cones or temporary vehicle safety barrier



NOTES:
1) During darkness, warning lights to BS EN 12352:2006 should be provided accordance with Table A1.3 (Appendix 1).

Detail H



* With fluorescent saturn yellow (yellow/green) bodies and uni-directional amber reflectors.
See also Detail G1.

** This dimension may be reduced to a minimum of 0.7m on two-lane dual carriageway roads only except when a temporary vehicle safety barrier is used.

Note: For narrow lane contra-flow buffer zones cylinder case, see Detail K below.

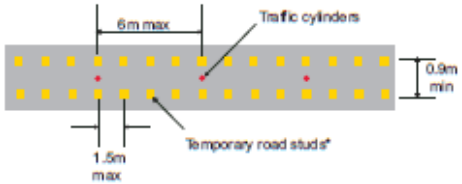
and a “keep left/right” sign at the end of each lane crossed; in this context the central reservation is equivalent to either one or two lanes crossed, depending on its width;

White lining or temporary studs to Detail J used as road marking between lanes;

A temporary mandatory speed limit will be in place; and

Where the hard shoulder is not used for a works entry, and works access signs are not in place, an additional Detail A should be placed at the start of the coning blocking the hard shoulder.

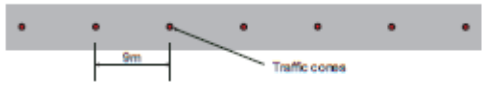
Detail K



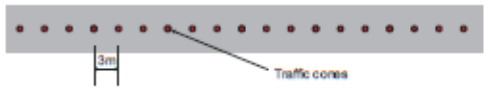
* With fluorescent saturn yellow (yellow/green) bodies and reflectors which are:
i bi-directional when delineating a tidal lane; and
ii uni-directional in all other cases

Detail C

Method C1:



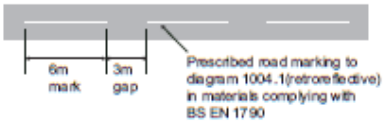
Method C2:



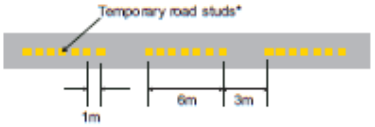
NOTES:
1) During darkness, warning lights to BS EN 12352:2006 should be provided in accordance with Table A1.3 (Appendix 1).
2) For relaxation to Detail C1 see Table A1.3 (Appendix 1).

Detail J

Method J1: Using white lines

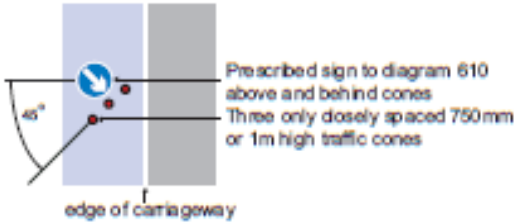


Method J2: Using studs**

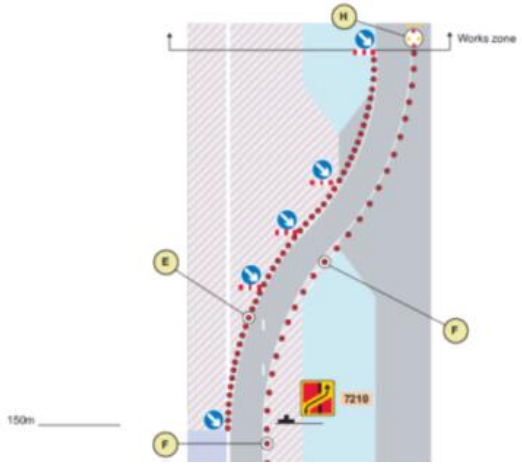


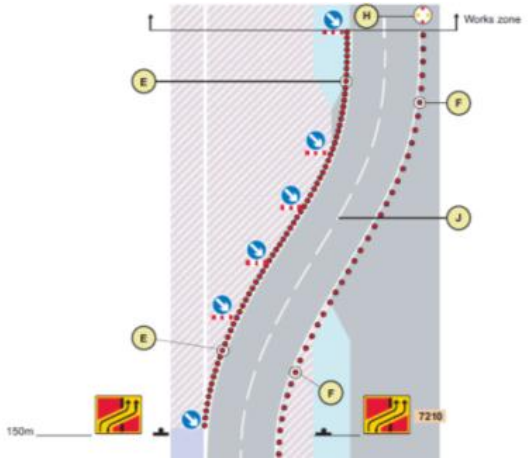
* With fluorescent saturn yellow (yellow/green) bodies and uni-directional white reflectors.
** Not to be used for situations where continual over-running by traffic is expected.
(For roads with a permanent speed limit of 40mph or less then the marking is t diagram 1004, i.e. 4m mark, 2m gap)

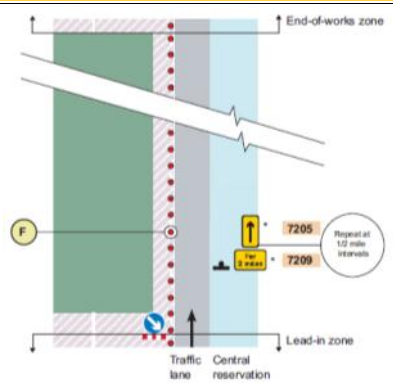
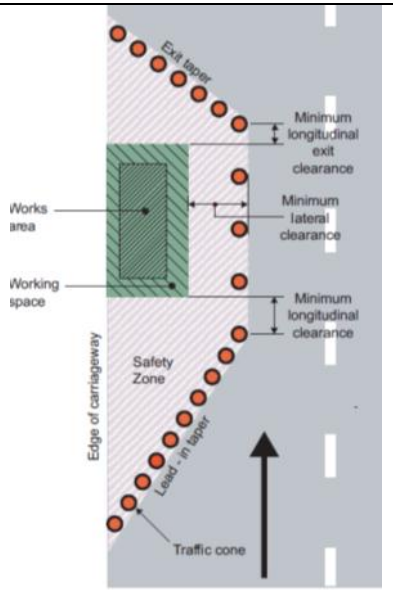
Detail A

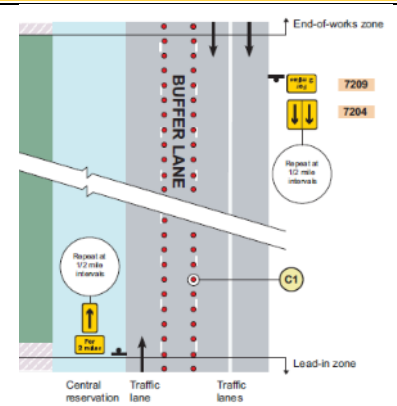
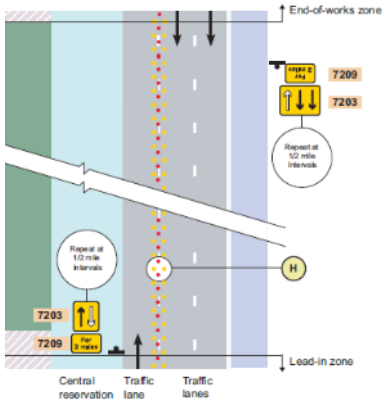


NOTES:
1) During darkness, a single warning light to BS EN 12352:2006 should be provided.
2) Traffic cones should conform to diagram 7101.1 and to BS EN 13422.





Work zone delineation	If the running lane is adjacent to the works, then coning to Detail F is used – if existing carriageway markings are suitably located and in good condition then Detail C1 may be used; A sign indicating the number of lanes open to traffic with distance plate "For x miles" is required located on the off side at ½ mile intervals; and Where a temporary mandatory speed limit is in place, signs should be continued from the lead-in zone;	
Work zone lateral safety distance	For all roads with a permanent speed limit of 50 mph or more, the lateral clearance between the edge of the working space and that part of the carriageway being used by traffic should be not less than 1.2 m Where it is reasonably practicable to provide additional clearance this should be done. In reaching a decision on what additional space, if any, may be provided, due regard should be paid to any possible consequences for the safety of road users and also to possible additional costs, including extra delay to road users. The latter will arise if there is insufficient capacity in the road space left available to traffic.	

Physical separation of the opposite traffic flows	**With a buffer lane** For a running lane adjacent to a buffer lane, coning to Detail C1 is used placed inside the existing road marking – where existing road markings are not suitable coning to Detail F is used. Signs are not used; A sign indicating the number of lanes open to traffic with distance plate is required; this combination is repeated every ½ mile on the central reservation for vehicles required to cross over and use the secondary carriageway; and In the secondary direction a sign indicating the number of lanes open to traffic, one of which uses the hard shoulder with distance plate is required; this combination is repeated every ½ mile on the near side. A temporary mandatory speed limit will be in place.   **With a buffer zone** The overall width of the contra-flow buffer zone may be reduced from 1.2 m to 0.9 m but 1.2 m should be used where width permits and desirable minimum lane widths have been accommodated; If the running lane is adjacent to a buffer zone, then cylinders and studs to Detail H are used; (coning to Detail E is used at the diversion of the primary carriageway, to and from the buffer zone, whilst coning to Detail F is used on the secondary carriageway in advance of and following the buffer zone); Where the diverted carriageway is adjacent to a buffer zone, signs indicating the number of lanes open to traffic and off side contra-flow working with distance plate are placed on the central reservation for primary carriageway traffic using the secondary carriageway; if HGV restrictions apply then this sign is replaced by the restriction sign;

	In the secondary direction a sign indicating the number of lanes open to traffic and off side contra-flow working with distance plate is required; this combination is repeated every ½ mile on the near side; and A temporary mandatory speed limit will be in place
Work zone speed limit (scheme/reduction)	Contra-flow sections of road should be subject to a mandatory speed limit (normally 50 mph).
Temporary lane width	Works on dual carriageway roads may require some traffic lanes to be reduced in width to less than 3.0 m. Whenever this situation arises, advance warning of the narrow lanes should be given. In most situations it will be necessary to re-mark the carriageway showing the new lanes. Signs incorporating the "NARROW LANES" panel may also be used for cases where the lane reduction is less severe. If the lane width is less than 3.0 m the symbol indicating a temporary width restriction should be included for the appropriate lane or lanes.

2.2 Minor RW on (3 lanes) Motorway (slow lane closed)

2.2.1 Belgium (Flanders)

The rules described hereafter correspond to a category 5 (following the Belgian classification) road work executed on a 2 or 3 lanes motorway (with closure of one lane). An overview of the road work layout is provided in appendix 1.

Main references:

- Decree of May 7th, 1999 on signing of road work activities (*MB 7 mei 1999 betreffende het signaleren van werken en verkeersbelemmeringen op de openbare weg*);
- Standard tender specifications (*Standaardbestek 250 versie 3.1. hoofdstuk X. 3 "signalisatie van werken"*); 2014 version.
- Schemes for signing of the more typical road works layouts (still valid for BE categories 1 to 5 but revision in progress ; *schematische weergave van in M.B. 7 mei 1999 tekstuele voorschriften en in SB 250 versie 2.2. voorziene aanvullingen: CD-ROM Werfsignalisatie 2000*).

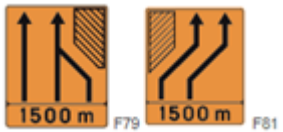
<table>
<tr>
<td>Far-advance warning (type of signs & distance)</td>
<td>
<u>General case (following standards)</u>

Drivers are informed about the <u>temporary lane management by use of F79 or F81 fixed road sign</u> all along the far-advance warning area; i.e. <u>1500m and 750m upwards the start of the lane shift.</u>

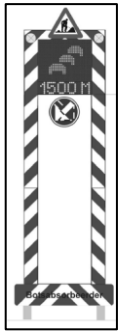
A <u>queue warning vehicle or system</u> must also be used during periods when queues happen (another pictogram is used in free-flowing traffic conditions). This vehicle is equipped with a TMA and LED lamps and its standard position is at least 200m upwards the start point of queues. The distance to the queue is continuously determined and accordingly dynamically adapted on the LED matrix.

<u>Usual practice</u>

Existing VMS are often used to inform or warn drivers far upwards of the road works or at interchanges.



Temporary lane management signs



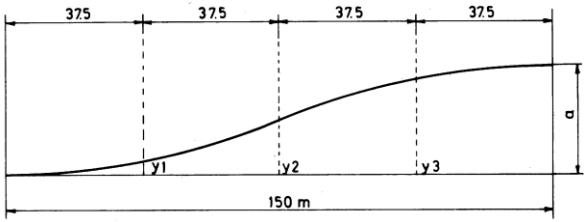
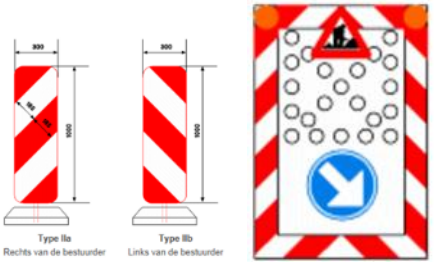
Back of the queue warning vehicle
</td>
</tr>
<tr>
<td>Near-advance warning (type of signs & distance) - around last 300 m</td>
<td>
<u>General case (following standards)</u>

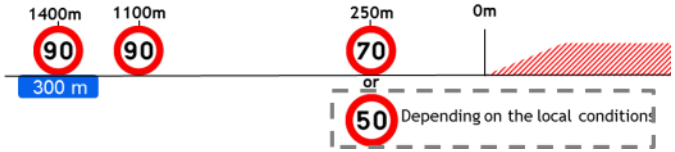
Along the near-advance warning area, drivers are informed about the <u>temporary lane management by use of a F81 road sign 150m upwards the start of the lane shift</u>.

Temporary lane management signs in the near-advance warning area

The Flemish RA specifies some rules regarding <u>transition zones</u>:

When the number of lanes must be reduced, <u>traffic flows are still merged by inserting the fastest lane to the slowest lane</u>. In such a situation and when the road works are carried out on the slow lane, the interdistance between the 2 consecutive transition zones is 400m.
</td>
</tr>
</table>

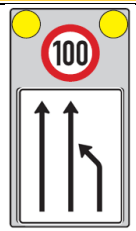
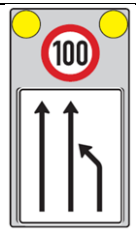
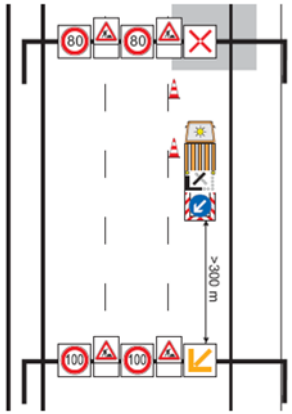
Crossing of the central reserve/Lane shift geometry (angle, opening width, length, lane width, safety area)	*General case (following standards)* The taper is 150m long and the lane shift must be adapted to the lane width.  a | y1 | y2 | y3 2.50 | 0.31 | 1.25 | 2.19 2.75 | 0.34 | 1.37 | 2.41 3.00 | 0.37 | 1.50 | 2.63 3.25 | 0.40 | 1.62 | 2.85 3.50 | 0.43 | 1.75 | 3.07 3.75 | 0.47 | 1.87 | 3.28 Cones are used between lanes when 2 (or more) adjacent lanes must be deviated. Cones are also used to guide traffic when the temporary lane management do not correspond to the existent permanent marking. The lane shift must be delineated by panels (types Iia and Iib). For the first taper is additional signing needed; i.e. a frame sign with red&white strips, flashing lights and arrow.  Panels allowed for taper – Frame sign used at first lane shift
Work zone delineation	*General case (following standards)* The workplace must be delineated by cones (type IId).  Equipement used for work zone delineation
Work zone lateral safety distance	*General case (following standards)* The minimum lateral safety distance is 0,50m (minimum requirements). Larger lateral safety distance is used whenever possible.
Physical separation of the	*General case (following standards)*

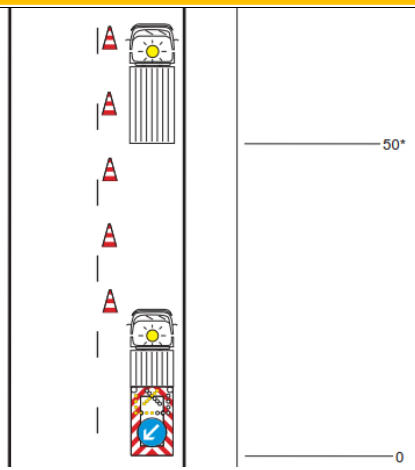
opposite traffic flows	Not relevant.
Work zone speed limit (scheme/reduction)	*General case (following standards)* Speed limit is steeply reduced from the posted speed limit 120 km/h to 90 km/h (-1100m) and 70 km/h (-250m). The 70 km/h speed limit sign placed 250m upwards the start of the lane shift may be replaced by 50 km/h depending on the local conditions. . 70 or 50 km/h signs are repeated along the workzone; i.e. 250m after the crossover and every 500m/1000m for <2km / >2km long work zones respectively. A sign informing drivers about speed enforcement is placed only when the speed control is going on.  Speed limit scheme  Information sign about on-going speed control
Temporary lane width	*General case (following standards)* Right (open to HGV) lane: 3,25m is recommended ; Other lanes: 3m is recommended. *Minimum requirement (following standards)* Right (open to HGV) lane: 3m. Other lanes: 2,75m.

2.2.2 Germany

The rules described hereafter correspond to a category D III/2a (following the German guideline RSA classification) road work executed on a 2 or 3 lanes motorway with closure of the right lane). An overview of the complete road work layout is provided in appendix 2. In cases of limited visibility of the pre-warning elements on the right side (for example as a result of a high truck density) layout D III/2b is used with the near-advance elements of D III/2a and also later speed reduction signs at the central reserve.

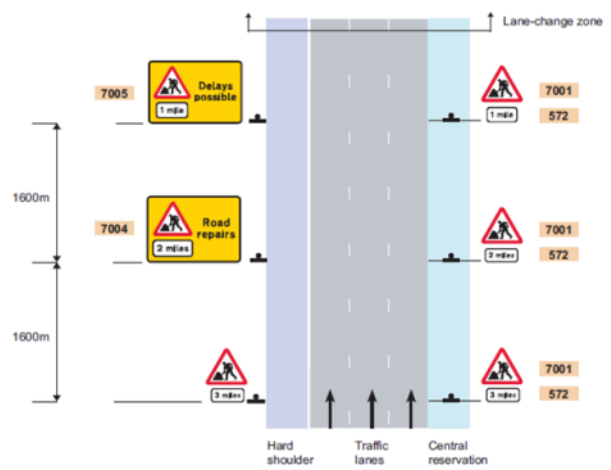
Main references: Guideline for securing of work zones (orig.: Richtlinien für die Sicherung von Arbeitsstellen (RSA), 1995)

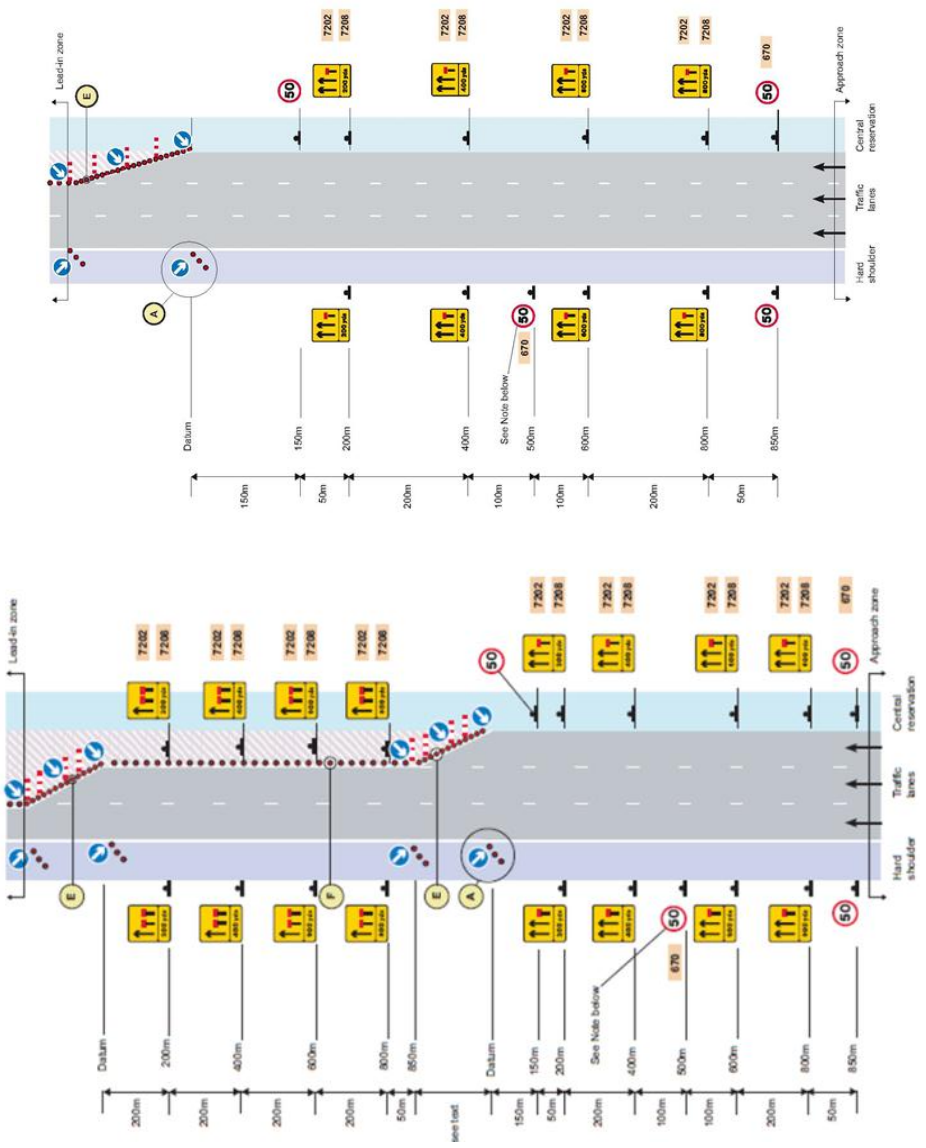
Far-advance warning (type of signs & distance)	*General case (following standards)* Drivers are informed about the temporary lane management by use of pre-warning panels; i.e. between 600 and 1.000 m (depending on sight distance) upwards the start of the lane shift. *Usual practice* In areas with stationary traffic management system this is used for work zone information.	 
Near-advance warning (type of signs & distance)	*General case (following standards)* Only with sight distance to safety trailer less than 400 m: Drivers are informed about the temporary lane management by use of pre-warning panels; i.e. between 300 and 600 m (depending on sight distance) upwards the start of the lane shift. *Usual practice* In areas with stationary traffic management system this is used for lane closure information.	 

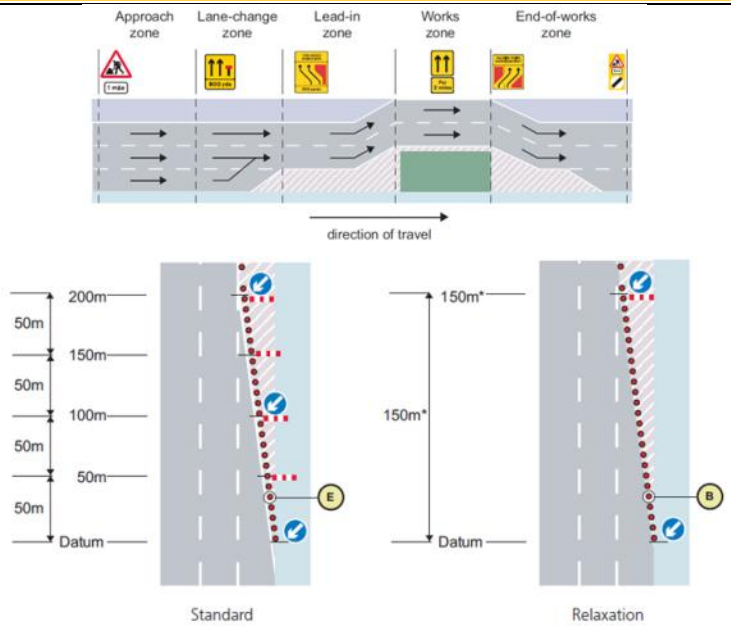
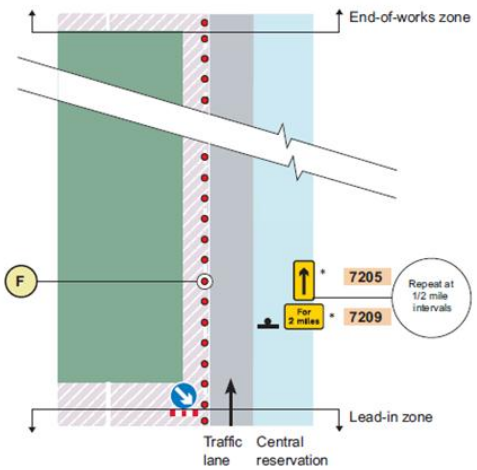
Lane shift geometry (angle, length, lane width, safety area)	*General case (following standards)* Lane shift without marking, so no lane shift geometry information are fixed. Minimum lateral distance between safety and working vehicle of 50m, without truck in front of the safety trailer 100 m. No fixed lane width in guideline, but effort of minimum width 2,75 because white marking is relevant. 
Work zone delineation	*General case (following standards)* The workplace must be delineated by cones (motorway: height 750mm). 
Work zone lateral distance	*General case (following standards)* The minimum lateral safety distance is 0,50m (minimum requirements). Larger lateral safety distance is used whenever possible.
Work zone speed limit (scheme/reduction)	*General case (following standards)* 100 km/h
Temporary lane width	*General case (following standards)* The temporary lane width is the same as the regular lane width If cones have to be situated left of the closed lane marking, a residual lane width of at least 3 m must remain.

2.2.3 Ireland

The Traffic Signs Manual – Chapter 8: Temporary Traffic Measures and Signs for Roadworks stablishes for the case Lane-change zone for a single lane closure on a dual carriageway road for which the national speed limit applies, the following design parameters.

Far-advance warning (type of signs & distance)	- If queues are expected to extend more than 3km from the works, "road works" signs with distance plate "5 km" on the near side and the off side, placed 5 km in advance of the works – further signs with distance plate "6km", "7km" etc. should be placed as appropriate if queues are expected sometimes to extend this far; - a "road works ahead" sign, incorporating the "road works" sign with distance plate "3 km" on the near side, and a "road works" sign with distance plate on the off side, placed 3km in advance of the works; and - a "road works ahead" sign, incorporating the "road works" sign with distance plate "1.5 km" on the near side, and a "road works" sign with distance plate on the off side, placed one mile in advance of the works. 
Near-advance warning (type of signs & distance)	- Wicket signs indicating the closed lane with distance panel "800 m" on the near side and the off side, placed 800 m in advance of the works lead taper. These signs, with appropriate distance plates (600 m, 400 m and 200 m), are placed at 600 m, 400 m and 200 m in advance of the works lead taper. - When lanes are closed using stepped taper lane closures, a second set of wicket signs indicating the closed lane with distance plate "800 m" on the near side and off side, is placed 800 m in advance of the works. These signs are repeated, with the appropriate distance plate, at 200 m intervals to a point 200 m in advance of the works. Detail E: Cone spacing: 1.5 m; Relaxion: 3 m.


Lead-in zone
Approach zone
Central reservation
Traffic lanes
Hard shoulder
Datum
See Note below
7202
7208
50
670
150m
200m
400m
500m
600m
800m
850m

Lane shift geometry (angle, length, lane width, safety area)	Lane change zone: - one “keep left/right” sign at the start of the taper. - one “lane closed” barrier with a high intensity warning light and a “keep left/right” sign at the end of each closed lane of the taper. - one “lane closed” barrier with a high every 50 m along the length of the taper, the barrier midway along the length of each closed lane to have a “keep left/right”. Length of taper is 200 m/lane closed. When lanes are closed using stepped taper lane closures, the distance between the closures is a minimum of 800 m. Detail B and E: Cone spacing: 1.5 m; Relaxion: 3 m.	 Lane change zone
Work zone delineation	- a sign indicating the number of lanes open to traffic with distance plate “For x km” is required located on the off side at 800m intervals. - where a temporary mandatory speed limit is in place, signs should be continued from the lead-in zone; for the spacing of speed limit repeater signs. Detail F: Cone spacing: 9 m	

Work zone lateral distance	The lateral clearance between the edge of the working space and that part of the carriageway being used by traffic should be not less than 1.2 m.
Work zone speed limit (scheme/reduction)	The temporary speed limit sign, which will generally be 80kph, is to be placed on the near side and on the central reservation 50 m in advance of the first sign indicating lane closures or restrictions. The distance between successive repeater signs on the same side of the carriageway should not exceed 700 m, with a maximum of 450 m between consecutive repeater signs on alternate sides of the carriageway.
Temporary lane width	To 3.25 m (desirable minimum) or 3.0 m (absolute minimum)

2.2.4 Norway

Reference: Manual no. N301E Work on and along roads, Requirements and guidelines regarding warning and protection (Directorate of Public Roads, Roads and Transport Department, 2014) – Håndbok N301 Arbeid på og ved veg, Krav og retningslinjer til varsling og sikring (Statens vegvesen, 2014)

Associated references to the standards document are in (blue) brackets after each bit.

Far-advance warning (type of signs & distance)	The roadworks sign (Sign 110) is positioned at 700m prior to the start of the lane change zone and is supplemented with two flashing yellow signals (Signal 1098). This sign is also supplemented with the lane ends sign (Sign 532) positioned below the road works sign, and a supplementary plate 802 showing the Distance to the start of the lane change zone. *For more information from standards on the following elements, see Section 2.1.4* – *Roadworks sign (Sign 110)* – *Size of signs* – *Flashing yellow signal (Signal 1098)* – *Lane ends (Sign 532)*
Near-advance warning (type of signs & distance) - around last 300 m	The lane ends sign (Sign 532) is repeated at 300m prior to the start of the lane change zone, again with supplementary plate 802 showing the distance. The speed limit signs are positioned 100, prior to the start of the lane change zone. (There is no advance warning of the speed limit as it is set at 70 km/h) (see Work Zone Speed Limit section for more information)
Lane shift geometry (angle, length, lane width, safety area)	The lane change zone is marked by cones and a warning trailer (two protection vehicles are used in total). The warning panel displays the mandatory lane sign (Sign 404), flashing yellow lights (Signal 1098) and barrier markers (Sign 908) at the top and bottom of the panel.

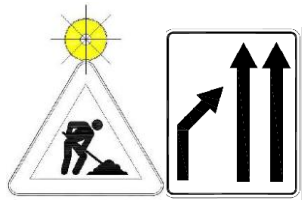
	For more information from standards on the following elements, see Section 2.1.4 – *Warning panels and warning trailers* – *Mandatory lane sign (Sign 404)* – *Barrier markers (Sign 908).*
Work zone delineation	*For more information from standards on the following elements, see Section 2.1.4:* – *Traffic cones and traffic cylinders (Signs 940 and 942)* – *Buffer zone (in advance of works activity zone)* – *Protection* For this scenario, there are two warning trailers, with the first warning trailer fitted with an impact attenuator (see layout 3.09).
Work zone lateral safety distance	In this scenario there is no additional longitudinal protection (see layout 3.09) – *Longitudinal protection* – *Special rules for protecting road workers*
Physical separation of the opposite traffic flows	N/A
Work zone speed limit (scheme/reduction)	The end of limit sign (Sign 364) is positioned 25m after the end of the works zone. *For more information from standards on the following elements, see Section 2.1.4:* – *Speed limit (Sign 362 and Sign 364)* – *Use of speed limits near roadworks* – *Repeats* – *Selecting the speed limit* For this scenario the speed limit is selected as 70km/h. 70 km/h is used as a special speed limit to mark that roadworks are underway on the stretch of road and that safety is reduced due to a lack of guardrails, storage of machines and equipment just outside the carriageway and similar. The 70 km/h speed limit shall not be used if there are no risks along the stretch of road that call for a lowering of the speed limit. On roads with speed levels of over 80 km/h, the 70 km/h speed limit is usually supplemented by speed-reducing measures such as closely spaced barrier markers to ensure that the speed level is approximately the same as the speed limit.

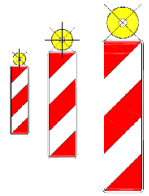
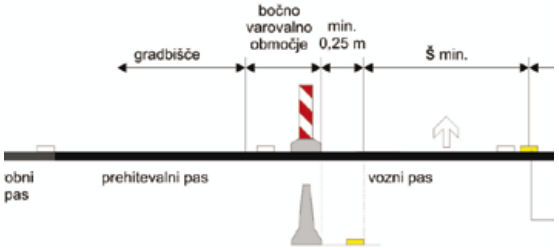
	The speed limit should be removed when road workers have come so far that the road appears safer than the adjacent road stretches without special speed limits. The stretch of road with a speed limit of 70 km/h should not be longer than necessary and not over 5 km in length. (3.2.3.9)
Temporary lane width	N/A

2.2.5 Slovenia

Rules are set in 'Regulations on the Method of Marking and Protecting Roadworks on Public Roads and Impediments in Road Traffic' and amendments, issued in 2006 ('Pravilnik o načinu označevanja in zavarovanja del na javnih cestah in ovir v cestnem prometu', Uradni list RS, št. 116/06, 88/08 in 109/10).

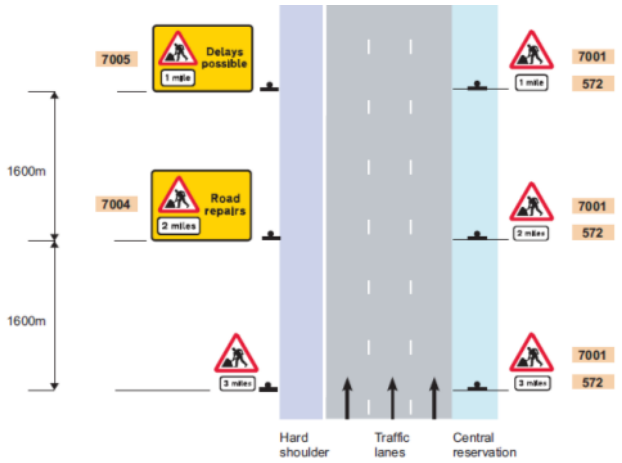
Standard traffic management scheme on 3 lanes motorway – slow lane closed is designated as type A-3 (2006) for roadworks lasting more than one day. On motorways the usual practice follows the standard schemes.

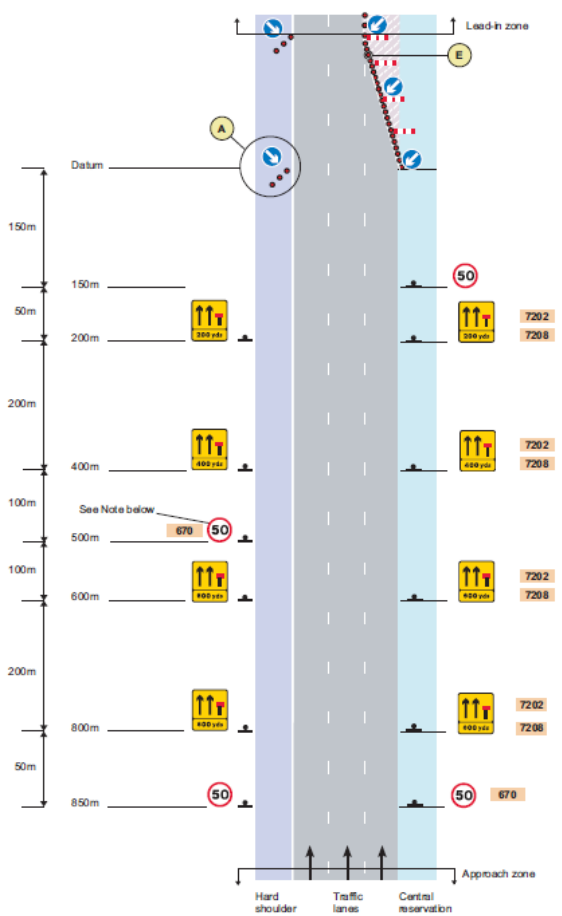
Far-advance warning (type of signs & distance)	*General case (following standards)* Traffic sign "Construction site" 2300m and 1100 m in advance with warning lights (yellow). Layout information signs 900m, 600m (and 200m) in advance (hard signs, yellow background). *Usual practice* Also stationary traffic management system is used for advance work zone information.	
Near-advance warning (type of signs & distance)	*General case (following standards)* Layout information signs 100m in advance (hard signs, yellow background) *Usual practice* Following standard layout.	

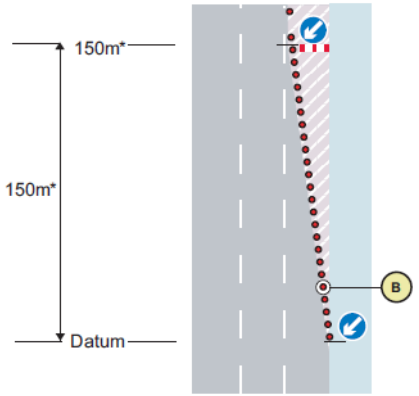
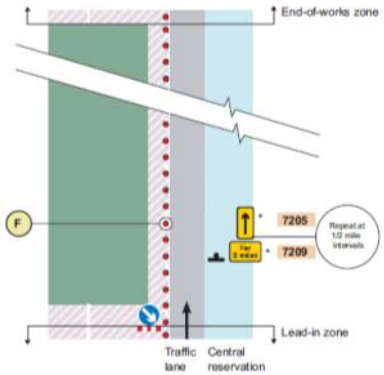
Lane shift geometry (angle, length, lane width, safety area)	*General case (following standards) and practice* According to standard layout.
Work zone delineation	*General case (following standards)* Safety panels (most common) or safety barriers. The distance between panels should be 20m at workzone section and 10m at lane closures. Panels with flashing warning light at lane closure section. 
Work zone lateral distance	*General case (following standards)* The distance between the road markings and workzone is not defined (according to general safety rule – 100cm from excavation edge). The distance between the temporary road markings (traffic lane) and safety panels is 0,25m. 
Work zone speed limit (scheme/reduction)	*General case (following standards)* 100 km/h (1000m in advance), 80 km/h (800 m in advance) 80 km/h (500 m in advance) as a reminder
Temporary lane width	*General case (following standards)* 2,75 m + 3,0 m *Minimum requirement (following standards)* Minimum 2,50 m + 3,00 m

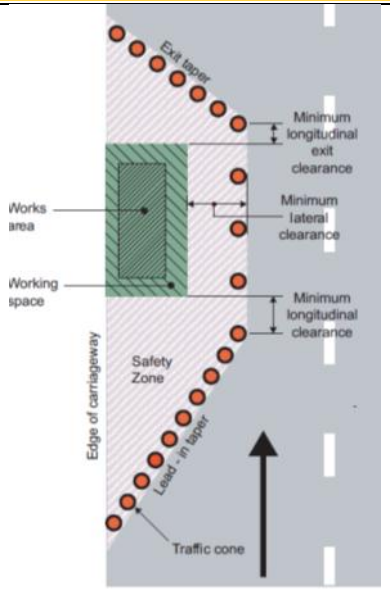
2.2.6 United Kingdom

The Traffic Signs Manual Chapter 8 provides guidance on 'Traffic Safety Measures and Signs for Road Works and Temporary Situations'. It includes references to all the relevant legislation, such as the Traffic Signs Regulations and General Directions. The Highways Agency, the national road authority for England, also issues Interim Advice Notes (IANs), which update and/or clarify sections of Chapter 8, from time to time; these are then incorporated into the next edition of what is often referred to simply as 'Chapter 8'.

Far-advance warning (type of signs & distance)	If queues are expected to extend more than two miles from the works, "road works" signs with distance plate "3 miles" on the near side and the off side, placed three miles in advance of the works – further signs with distance plate "4 miles", "5 miles" etc. should be placed as appropriate if queues are expected sometimes to extend this far; A "road works ahead" sign, incorporating the "road works" sign with distance plate "2 miles" on the near side, and a "road works" sign with distance plate on the off side, placed two miles in advance of the works; and A "road works ahead" sign, incorporating the "road works" sign with distance plate "1 mile" on the near side, and a "road works" sign with distance plate on the off side, placed one mile in advance of the works. Where queuing is not expected the 3 mile "road works" sign is not required, and the advance signs signing may be omitted and replaced with 1 mile "road works" signs	

Near-advance warning (type of signs & distance)	Four pairs of advance lane closure signs are required: wicket signs indicating the closed lane with distance panel “800 yards” on the near side and the off side, placed 800 m in advance of the works lead taper. These signs, with appropriate distance plates (600 yards, 400 yards and 200 yards), are placed at 600 m, 400 m and 200 m in advance of the works lead taper; and Signing to Detail A is located on the hard shoulder opposite the “keep left/right” sign at the start of the taper and at the end of the taper.	

Lane shift geometry (angle, length, lane width, safety area)	Length of taper is 150 m/lane closed; Coning to 3 m spacing, Detail B; and One “keep left/right” sign at the start of the taper; One “lane closed” barrier with a high intensity warning light and a “keep left/right” sign at the end of each closed lane of the taper.	
Work zone delineation	If the running lane is adjacent to the works, then coning to Detail C1 is used – if existing carriageway markings are suitably located and in good condition then Detail F may be used;	

Work zone lateral distance	For all roads with a permanent speed limit of 50 mph or more, the lateral clearance between the edge of the working space and that part of the carriageway being used by traffic should be not less than 1.2 m Where it is reasonably practicable to provide additional clearance this should be done. In reaching a decision on what additional space, if any, may be provided, due regard should be paid to any possible consequences for the safety of road users and also to possible additional costs, including extra delay to road users. The latter will arise if there is insuffi cient capacity in the road space left available to traffic.	
Work zone speed limit (scheme/reduction)	Temporary mandatory speed limits are not required for minor works.	
Temporary lane width	Works on dual carriageway roads may require some traffic lanes to be reduced in width to less than 3.0 m. Whenever this situation arises, advance warning of the narrow lanes should be given. In most situations it will be necessary to re-mark the carriageway showing the new lanes. Signs incorporating the “NARROW LANES” panel may also be used for cases where the lane reduction is less severe. If the lane width is less than 3.0 m the symbol indicating a temporary width restriction should be included for the appropriate lane or lanes.	

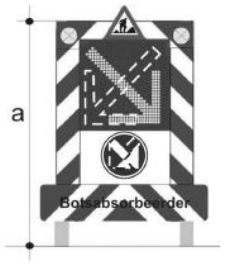
2.3 Mobile RW on (3 lanes) Motorway (slow lane closed)

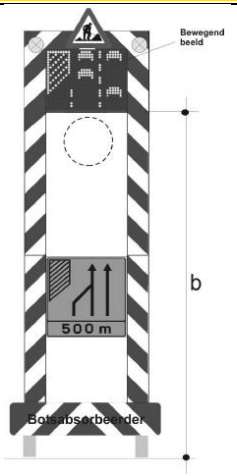
2.3.1 Belgium (Flanders)

The rules described hereafter correspond to a category 6 (following the Belgian classification) road work executed on a 2 or 3 lanes motorway (with closure of one lane). An overview of the road work layout is provided in appendix 1.

Main references:

- Decree of May 7th, 1999 on signing of road work activities (*MB 7 mei 1999 betreffende het signaleren van werken en verkeersbelemmeringen op de openbare weg*);
- Standard tender specifications (*Standaardbestek 250 versie 3.1. hoofdstuk X. 3 "signalisatie van werken"*); 2014 version.
- Schemes for signing of the mobile road works on motorway (*Dienstorder MOW/AWV/2009/16 inzake werfsignalisatie op autosnelwegen en niet-autosnelwegen >90 km/u. ; Bijlage autosnelwegen*)

Lane shift geometry Safety vehicle(s): presence, number, type & characteristics Distance between the Work vehicle and the Safety vehicle(s)	<u>*General case (following standards)*</u> The works vehicle or work area must be preceded by 2 safety vehicles mounted with TMA; they are operating respectively 30m and 80m upstream the works and are not aligned (to improve the visibility of both TMA).  Back of a TMA safety vehicle Any safety vehicle can't be used as a works vehicle. The safety and advance warning vehicles monted with a TMA must comply to some strict characteristics: NCHRP 350 test level 3 for the TMA; around 9.000 kg, length of 6m for the supporting vehicle.  TMA safety vehicles location dfor Mobile road works on Flemish motorways

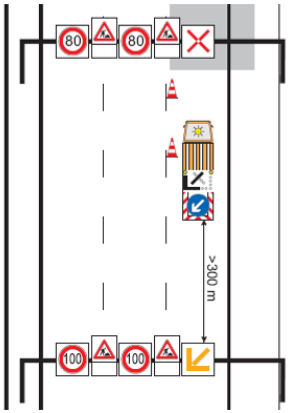
Advance warning: sign & distance	*General case (following standards)* The road work and safety vehicles (with TMA as mentioned above) must be preceeded by an advance warning vehicle, located 500m upwards on the shoulder (emergency) lane. The advance warning vehicle must also be mounted with a TMA and equipped with a dynamic LED matrix (displaying the temporary lane management). *Usual practice* Existing VMS are often used to inform or warn drivers far upwards of the road works or at interchanges.  Back of a TMA advance warning vehicle
Work zone speed limit (scheme/reduction)	*General case (following standards)* Where existing permanent VMS are available is the speed limit decreased up to 90 km/h (or less following the traffic circumstances). The 90km/h speed limit announced upwards or even preceeded by a 100 km/h ou 110 km/h speed limit. The speed limit may also be decreased up to 90 km/h when road works are carried out on the slow and middle lanes. In that situation a second advance warning vehicle (informing about the approaching speed limit) has to be used 500m upstream of the advance warning vehicle mentioned before.
Lateral safety distance Work zone delineation	The minimum requirement for lateral safety distance is 0,50m.

2.3.2 Germany

The rules described hereafter correspond to a category D III/2a (following the German guideline RSA classification) road work executed on a 2 or 3 lanes motorway with closure of the right lane). An overview of the complete road work layout is provided in appendix 2. The layout for minor and mobile work zones is equal with the exception, that traffic cones are unnecessary in mobile work zones.. In cases of

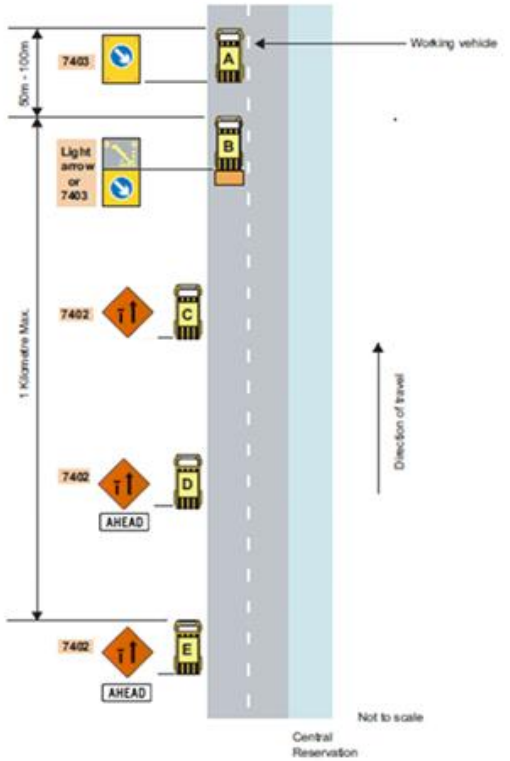
limited visibility of the pre-warning elements on the right side (for example as a result of a high truck density) layout D III/2b is used with the near-advance elements of D III/2a and also later speed reduction signs at the central reserve.

Main references: Guideline for securing of work zones (orig.: Richtlinien für die Sicherung von Arbeitsstellen (RSA), 1995)

Lane shift geometry Safety vehicle(s): presence, number, type & characteristics Distance between the Work vehicle and the Safety vehicle(s)	*General case (following standards)* 1 safety vehicle Distance between work and safety vehicle: 50 m, if parked without towing vehicle: 100 m *Usual practice* In areas with less sight distances use of a 2. Safety vehicle 
Advance warning: sign & distance	*General case (following standards)* Drivers are informed about the temporary lane management by use of pre-warning panels; First element between 600 and 1.000 and in cases of sight distances of less than 400 m a second element between 300 and 600 m (depending on sight distance) upwards the start of the lane shift.  *Usual practice* In areas with stationary traffic management system this is used for lane closure information. 
Work zone speed limit (scheme/reduction)	*General case (following standards)*: 100 km/h
Lateral safety distance Work zone delineation	*General case (following standards)* The minimum lateral safety distance is 0,50m (minimum requirements). Larger lateral safety distance is used whenever possible.

2.3.3 Ireland

The Traffic Signs Manual – Chapter 8, part 2: Temporary Traffic Measures and Signs for Roadworks stablishes for the cases of (a) Mobile Lane Closure on a dual carriageway road without a hard shoulder and (b) Mobile Lane Closure on a dual carriageway road with a hard shoulder, the following design parameters.

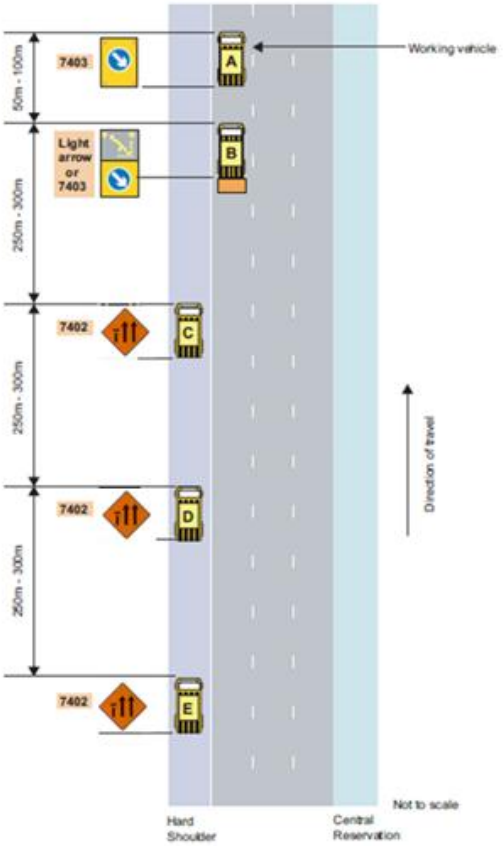
Lane shift geometry	n/a
Advance warning: sign & distance	<u>Mobile Lane Closure on a dual carriageway road without a hard shoulder:</u> Three vehicle or trailer-mounted signs are required on the near side, off the carriageway, up to one kilometre from the initial block vehicle that is positioned in the carriageway: • initial two (or more) signs to diagram 7402 (Near-side lane (of two) closed) showing supplementary plate “Ahead”; • final advance sign to diagram 7402 (Near-side lane (of two) closed) with no supplementary plate; and • one block vehicle B carrying a light arrow sign (or sign to diagram 7403 (Keep right)) 50 m – 100 m in advance of the working vehicle A carrying sign to diagram 7403 (Keep right).  Mobile lane closure on a dual carriageway road without a hard shoulder (plan MLC1)

Mobile Lane Closure on a dual carriageway road with a hard shoulder:

Three vehicle or trailer-mounted signs are required on the hard shoulder in advance of the initial block vehicle that is positioned on the carriageway:

• three vehicle or trailer-mounted signs to diagram 7402 (Near-side lane (of three) closed) showing supplementary plate “800 m”, “500 m” and “200 m” spaced at intervals of 250 m to 300 m starting 200 m to 250 m in advance of the initial block vehicle B; and

• one block vehicle B carrying a light arrow sign (or sign to diagram 7403 (Keep right) 50 m – 100 m in advance of the working vehicle A carrying sign to diagram 7403 (Keep right).



Mobile lane closure on a dual carriageway road with a hard shoulder (plan MLC2)

Supplementary plate “Ahead”

Safety vehicle(s): presence, number, type & characteristics	<u>Mobile Lane Closure on a dual carriageway road without a hard shoulder:</u> Vehicles C, D and E should preferably be evenly spaced with a spacing no closer than 200 m or greater than 350 m. These vehicles will move from their current positions to the next available hard standing as the work progresses whilst maintaining an overall distance of no more than one kilometre from vehicle B. Advance sign vehicles should be positioned so that approaching drivers are able to see, at any instant, at least two consecutive signs. If, in extreme circumstances, suitable stopping points are not available for all three advance warning vehicles then Vehicle D may be omitted. This decision should be based on a site specifi c risk assessment. Vehicle D should always be used unless there are very sound reasons not to do so.
Distance between the Work vehicle and the Safety vehicle(s)	According to the scheme for each case (cf. schemes above) - Mobile Lane Closure on a dual carriageway road without a hard shoulder - Mobile Lane Closure on a dual carriageway road with a hard shoulder
Work zone speed limit (scheme/reduction)	n/a
Lateral safety distance Work zone delineation	n/a

2.3.4 Norway

Reference: Manual no. N301E Work on and along roads, Requirements and guidelines regarding warning and protection (Directorate of Public Roads, Roads and Transport Department, 2014) – Håndbok N301 Arbeid på og ved veg, Krav og retningslinjer til varsling og sikring (Statens vegvesen, 2014)

Far-advance warning (type of signs & distance)	In this scenario there are no signs greater than 300m in advance of the works (see layout 3.13).
Near-advance warning (type of signs & distance) - around last 300 m	A warning trailer is positioned on the hard shoulder at 300m prior to the start of the works (indicated by the second warning trailer and impact attenuator). The warning panel displays the roadworks sign (Sign 110), supplemented with two flashing yellow signals (Signal 1098). It also displays the lane ends sign (Sign 532) positioned below the road works sign, and a supplementary plate 802 showing the Distance to the start of the lane change zone. *For more information from standards on the following elements, see Section 2.1.4:* – *Roadworks sign (Sign 110)* – *Size of signs*

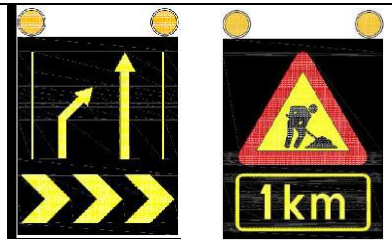
	– *Flashing yellow signal (Signal 1098)* – *Lane ends (Sign 532)*
Lane shift geometry (angle, length, lane width, safety area)	The start of the works area is marked by the second warning vehicle, this time positioned in the live lane and fitted with an impact attenuator. This warning panel displays the flashing light arrows (Signal 1100), the mandatory lane sign (Sign 404) along with flashing yellow lights (Signal 1098) and barrier markers (Sign 908) at the top and bottom of the panel. A third warning vehicle is positioned downstream of the second vehicle in the same lane. This warning panel displays the mandatory lane sign (Sign 404), flashing yellow lights (Signal 1098) and barrier markers (Sign 908) only and is not fitted with an impact attenuator. *For more information from standards on the following elements, see Section 2.1.4:* – *Barrier markers (Sign 908)* – *Flashing light arrows (Signal 1100)* – *Warning panels and warning trailers* – *Mandatory lane sign (Sign 404)*
Work zone delineation	As discussed above, this scenario uses three vehicles, the first providing advance warning and positioned on the hard shoulder. The second vehicle is fitted with an impact attenuator and is positioned in the live lane. The third vehicle is positioned downstream in the same lane, creating a buffer zone for the works. *For more information from standards on the following elements, see Section 2.1.4:* – *Buffer zone (in advance of works activity zone)* – *Protection*
Work zone lateral safety distance	*For more information from standards on the following elements, see Section 2.1.4:* – *Longitudinal protection* – *Special rules for protecting road workers*
Physical separation of the opposite traffic flows	n/a
Work zone speed limit (scheme/reduction)	n/a
Temporary lane width	n/a

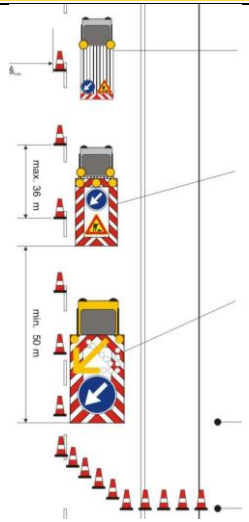
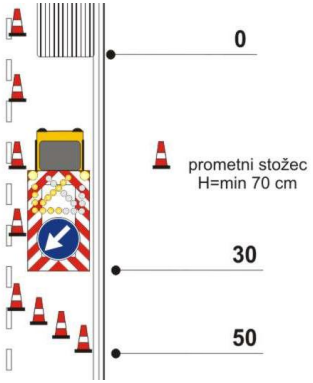
2.3.5 Slovenia

Rules are set in 'Regulations on the Method of Marking and Protecting Roadworks on Public Roads and Impediments in Road Traffic' and amendments, issued in 2006 ('Pravilnik o načinu označevanja in zavarovanja del na javnih cestah in ovir v cestnem prometu', Uradni list RS, št. 116/06, 88/08 in 109/10). Standard traffic management scheme - type V-2 (2006) for roadworks during daylight conditions and K-2 and K-3 for roadworks lasting more than 2 hours (e.g. protection of stopped vehicle).

The detailed schemes are presented in Appendix 4. On motorways the usual practice follows the standard schemes.

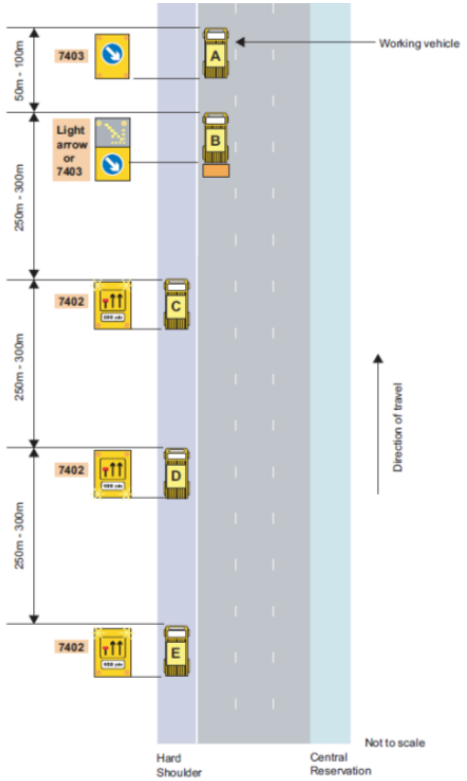
Standard scheme - type V-2 for roadworks during daylight conditions is described below.

Lane shift geometry	*General case (following standards)* Lane shift in 20m using cones with minimum height 50cm (type V-2). Type K-2, K-3 lane shift in 20m using cones with minimum height 70cm. *Usual practice* It was suggested to the authorities that the lane shift distance should be more than 20m. 
Advance warning: sign & distance	*General case (following standards)* Temporary traffic sign 1000m in advance with warning light. *Minimum requirement (following standards)* See type K2 – cones and traffic sign – road narrowing at distance 500m. *Usual practice* Also stationary traffic management system is used for advance work zone information. 
Safety vehicle(s): presence, number, type & characteristics	*General case (following standards)* 2 safety vehicles with trailer and information panel *Minimum requirement (following standards)* See type K2 – 1 safety vehicle, cones and traffic sign at distance 500m. *Usual practice* Following standards 

Distance between the Work vehicle and the Safety vehicle(s)	*General case (following standards)* V-2 distance between work zone and beginning of road closure – more than 80m. *Minimum requirement (following standards)* type K2 – minimum 50m  Type V-2  Type K-2
Work zone speed limit (scheme/reduction)	*General case (following standards)* 100 km/h (1000m in advance), 80 km/h (300 m in advance) or 100 km/h (1000m in advance), 80 km/h (500 m in advance), 60 km/h (200 m in advance) *Minimum requirement (following standards)* See – type K2 - 80 km/h (300 m in advance)
Lateral safety distance Work zone delineation	Not defined Cones at least 50cm high, usually 75cm high

2.3.6 United Kingdom

The Traffic Signs Manual Chapter 8 provides guidance on 'Traffic Safety Measures and Signs for Road Works and Temporary Situations'. It includes references to all the relevant legislation, such as the Traffic Signs Regulations and General Directions. The Highways Agency, the national road authority for England, also issues Interim Advice Notes (IANs), which update and/or clarify sections of Chapter 8, from time to time; these are then incorporated into the next edition of what is often referred to simply as 'Chapter 8'.

Lane shift geometry	See below
Advance warning: sign & distance	Three vehicle or trailer-mounted signs are required on the near side in advance of the initial block vehicle that is positioned in the carriageway: The three vehicle or trailer-mounted signs show supplementary plate "800 yds", "500 yds" and "200 yds" spaced at intervals of 250 m to 300 m starting 200 m to 250 m in advance of the initial block vehicle B; and The block vehicle B carries a light arrow sign 50 m – 100 m in advance of the working vehicle A which carries a sign. 
Safety vehicle(s): presence, number, type & characteristics	See above

Distance between the Work vehicle and the Safety vehicle(s)	See above
Work zone speed limit (scheme/reduction)	Not applicable in light traffic flow. A temporary speed limit reduction of 20mph is recommended if there is not light traffic flow. Low traffic flow is where the traffic flow is not more than 1,200 vehicles per hour per traffic lane left open where the HGV content is less than 10%, or 1,000 vehicles per hour per traffic lane left open where the HGV content is between 10% and 30%, or 900 vehicles per hour per lane left open where the HGV content is greater than 30%.
Lateral safety distance Work zone delineation	A lateral clearance or safety zone of not less than 1.2 m should be provided between the working space and the carriageway remaining open to traffic Where appropriate, steps should be taken to ensure that the workforce does not stray into the safety zone, e.g. when a team member is acting as a lookout When work is undertaken on foot on a hard shoulder a lateral clearance or safety zone of not less than 1.2 m should be provided between the working space and the carriageway open to traffic.

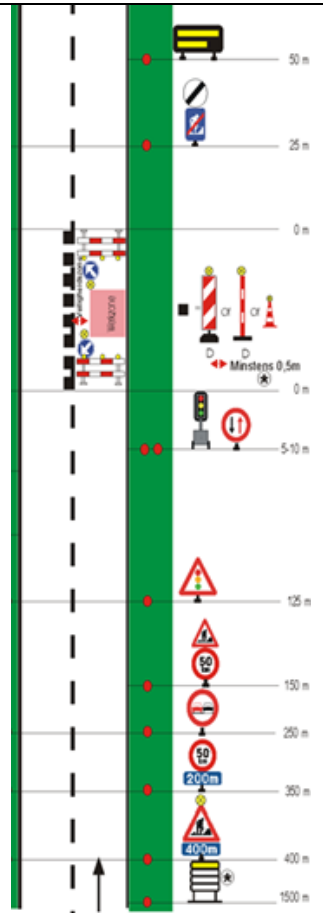
2.4 Major RW on single carriageway (80/90 km/h) road

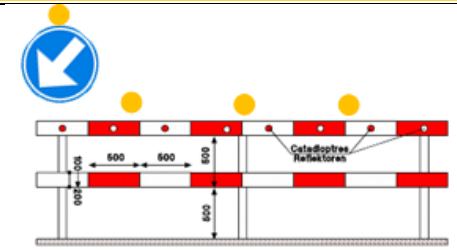
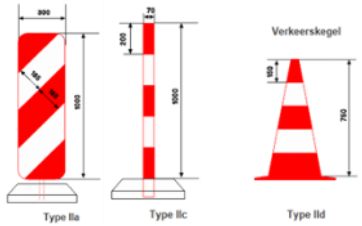
2.4.1 Belgium (Flanders)

The rules described hereafter coorespond to a category 2 (following the Belgian classification) road work executed on a single carriageway (2 lanes) road. One lane being closed, the traffic flow is regulated by temporary traffic lights. These rules applies for road with posted speed limit between 50km/h and 90 km/h. An overview of the road work layout is provided in appendix 1.

Main references:

- Decree of May 7th, 1999 on signing of road work activities (*MB 7 mei 1999 betreffende het signaleren van werken en verkeersbelemmeringen op de openbare weg*);
- Standard tender specifications (*Standaardbestek 250 versie 3.1. hoofdstuk X. 3 "signalisatie van werken"*); 2014 version.
- Schemes for signing of the more typical road works layouts (still valid for BE categories 1 to 5 but revision in progress ; *schematische weergave van in M.B. 7 mei 1999 tekstuele voorschriften en in SB 250 versie 2.2. voorziene aanvullingen: CD-ROM Werfsignalisatie 2000*).

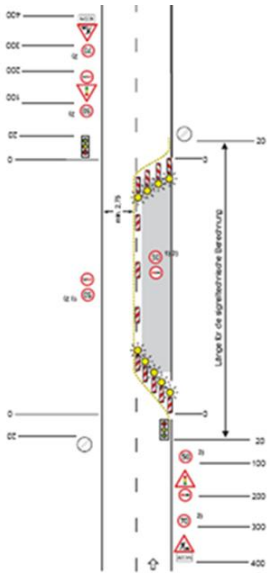
Far-advance warning (type of signs & distance)	*General case (following standards)* A sign presenting general information about the road work is located 1500m upwards the work zone. 400m upwards the work zone, drivers are warned about the upcoming work zone through a A31 sign (road work at 400m).	
Near-advance warning (type of signs & distance) - around last 300 m	*General case (following standards)* A C35 sign (interdiction to overtake) is installed 250 m upward the work zone. A A31 sign (road work) is installed 150 m upwards the work zone. A A33 sign (traffic light) is installed 125 m upwards the work zone. The traffic light is itself installed in the vicinity of the lane closure, together with a priority sign (as a substitute in case of traffic light failure). The same sequence of signs is installed along the opposite side.	Advance area and closure signing

Lane shift geometry (angle, length, lane width, safety area)	*General case (following standards)* A fence is being used to close the lane 5 to 10 m downwards the traffic light. The fence is equipped with red & white reflective strips, flashing lights and a D1 (obligatory deviation) sign. The end of the work zone is delimited by the same equipment.  Fence at start and end of the work zone
Work zone delineation	*General case (following standards)* The work zone is longitudinaly delimited by Type IIa, IIc panels or cones IId.  Panels and cones used for the longitudinal delineation
Work zone lateral safety distance	*General case / Minimum requirement (following standards)* The minimum lateral safety distance is 0,50m (minimum requirements). Larger lateral safety distance is used whenever possible.
Physical separation of the opposite traffic flows	Not relevant
Work zone speed limit (scheme/reduction)	*General case (following standards)* A C45 sign (50 km/h speed limit) is installed 150 m upward the work zone. This sign is announced 200m upwards.
Temporary lane width	*General case (following standards)* The width of the open lane is normally keeped unchanged.

2.4.2 Germany

The rules described hereafter correspond to a category C I/5 (following the German guideline RSA classification) road work executed on a single carriageway (2 lanes) road. One lane being closed, the traffic flow is regulated by temporary traffic lights. These rules applies for road with regular speed limit between 70km/h and 100 km/h. An overview of the complete road work layout is provided in appendix 2.

Main references: Guideline for securing of work zones (orig.: Richtlinien für die Sicherung von Arbeitsstellen (RSA), 1995)

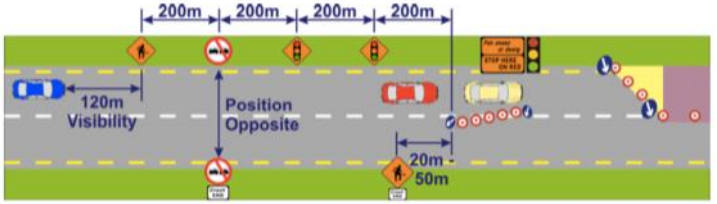
Far-advance warning (type of signs & distance)	*General case (following standards)* Drivers are informed about the work zone in general; i.e. 400 m upwards the start of the lane closure.	
Near-advance warning (type of signs & distance) - around last 300 m	*General case (following standards)* Drivers are informed about the work zone traffic managmement i.e. 200 m upwards the start of the lane closure.	
Lane shift geometry (angle, length, lane width, safety area)	*General case (following standards)* Length of shift 10*width of the closed lane	
Work zone delineation	*General case (following standards)* Safety panels	
Work zone lateral safety distance	*General case (following standards)* 1 m to excavation edge * *: Draft workplace rule (occupational safety and health) to take account real lateral distances to road workers in discussion	
Physical separation of the opposite traffic flows	*Not relevant*	
Work zone speed limit (scheme/reduction)	50 km/h (300 m in advance: 70 km/h, 100 m in advance: 50 km/h)	

Temporary lane width	*General case (following standards)* 2,75 m (without traffic lights: 3,00 m)

2.4.3 Ireland

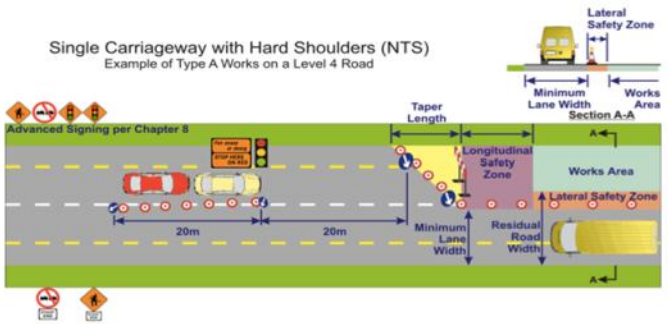
The Guidance for the Control and Management of Traffic at Road Works (GCMTRW) stablishes for the case of Single Carriageway with Road works Type A (full-time) and B (part-time) with speed limit of 80 or 100 km/hr, the following design parameters.It is noted that the classification Level 3 and 4 is related to the ADT(average daily traffic).

Far-advance warning (type of signs & distance)	*General case (following standards)* The first sign is a "Road Works Ahead" signs (WK001) with Supplementary Plate P002, stating the distance over which the works may be encountered. The second closely spaced sign is a "Road Works Ahead" sign (WK001) with Supplementary Plate P082, stating the type of operation in progress. Preferably, these signs should be within 1 km of the works but never more than 2 km. Additional signs may be placed on the verge at intervals between the first set of signs and the road works. *Usual practice* Driver information signs informing of the reason for the works and possible delays should be set back from the edge of the running carriageway by a distance greater than or equal to the width of the lateral safety zone applicable to the works. When a variable message sign is located in the hard shoulder, an angled line of cones (3 or 4 cones across



Example of Type A Shuttle Working with Temporary Traffic Signals on a Level 4 Road (NTS)

<table>
<tr><td></td><td>the hard shoulder) should be placed 25 m in advance of the sign and immediately in front of the sign.</td></tr>
<tr><td>Near-advance warning (type of signs & distance) - around last 300 m</td><td><u>General case (following standards)</u>
Sign Visibility: 120 m
Number of signs: 4
Cumulative distance: 800 m
Distance between advance signs: 200 m</td></tr>
<tr><td>Lane shift geometry (angle, length, lane width, safety area)</td><td><u>General case (following standards)</u>
Where shuttle working is required to facilitate works, a 45 degree taper shall be used on both approaches in conjunction with a suitable method of traffic control.
Where applicable, the hard shoulder should always be closed as part of any near-side lane closure. It is recommended that the length of the closure of the hard shoulder be kept to a minimum as it is an area for traffic to use in an emergency. To deter traffic from using the hard shoulder in advance of the works, angled lines of cones (3 or 4 cones across the hard shoulder) may be used 25 m to 50 m in advance of the start of the taper.
Two-way operation of traffic should be maintained, where possible according Table 4.2.1.
Table 4.2.1 – Minimum carriageway widths for two-way and shuttle working with traffic control
<table>
<tr><th></th><th>Normal traffic including buses and HGVs</th><th>Cars and light vehicles only</th></tr>
<tr><td>Two-way working</td><td>6.75 m desirable minimum
6.0 m absolute minimum</td><td>5.5 m desirable minimum
5.0 m absolute minimum</td></tr>
<tr><td>Shuttle working</td><td>3.7 m maximum
3.25 m desirable minimum
3.0 m absolute minimum</td><td>3.7 m maximum
2.75 m desirable minimum
2.5 m absolute minimum</td></tr>
</table>
Taper at lane (m): minimum 1 in 55
Taper at hard shoulder (m): minimum 1 in 30
Longitudinal Safety zone (m): 60
Lateral Safety zone (m): 1.2</td></tr>
</table>

	 *Minimum requirement (following standards)* When the two-way operation of traffic cannot be achieved, the through passage should be further restricted by the use of cones to a single traffic lane not less than 3.0 m but not exceeding 3.7 m, and alternate oneway traffic (shuttle working) should be introduced using the most appropriate method of traffic control.
Work zone delineation	For continuously progressing operations, such as road strengthening and resurfacing operations, the boundary between the safety zone and the works area may be marked using temporary lining or an additional row of cones (traffic tape may also be used). For operations at a fixed location, the boundary between the safety zone and the works area should be marked by a barrier or fence. A row of cones at 6 or 12 m centres should be used to delineate the centreline of unmarked surfaces on roadways wider than 7.3 m. Depending on the length, duration and complexity of the works, temporary carriageway markings and/or temporary reflecting roadway studs may also be used to indicate the edge of the route to be followed. Steady state lamps should be used in unlit areas (blinking/flashing lamps should only be used at an isolated hazard location). *General case (following standards)* Maximum cone spacing at tapers: 3 m Maximum cone (longitudinal): 12 m Maximum lamp spacing at tapers: 6 m Maximum lamp (longitudinal): 12 m Table 4.2.2: Sign and cone sizes for temporary traffic management arrangements **Permanent Speed Limit** / **Sign Size (diamond or circular)** / **Cone height** 80 or 100 km/h (Level 3) / 600 or 750 mm / 750 mm 80 or 100 km/h (Level 4) / 750 or 900 mm
Work zone lateral safety distance	Lateral Safety zone (m): 1.2
Physical separation of the opposite	Cones or lamps (unlit areas)

<table>
<tr><td>traffic flows</td><td>Maximum cone (longitudinal): 12 m
Maximum lamp (longitudinal): 12 m</td></tr>
<tr><td>Work zone speed limit (scheme/reduction)</td><td><u>General case (following standards)</u>

It is recommended that any mandatory speed reduction introduced should not exceed two steps below the permanent speed limit (e.g., a permanent limit of 100 km/h would be reduced to a Road Works Speed Limit of 80 or 60 km/h). A Road Works Speed Limit should not normally be less than 50 km/h.

Speed restrictions should extend throughout the works area on single carriageway roads to a point 45 m beyond the end of the temporary traffic management arrangement.

A temporary speed restriction should not be introduced where the length of the restriction would be less than 400 m. At sites where the length of road affected is 800 m or longer, repeater signs should be placed at regular intervals.</td></tr>
<tr><td>Temporary lane width</td><td>Two-way operation of traffic should be maintained, where possible according Table 4.2.1.
Table 4.2.1 – Minimum carriageway widths for two-way and shuttle working with traffic control
<table><tr><th></th><th>Normal traffic including buses and HGVs</th><th>Cars and light vehicles only</th></tr><tr><td>Two-way working</td><td>6.75 m desirable minimum
6.0 m absolute minimum</td><td>5.5 m desirable minimum
5.0 m absolute minimum</td></tr><tr><td>Shuttle working</td><td>3.7 m maximum
3.25 m desirable minimum
3.0 m absolute minimum</td><td>3.7 m maximum
2.75 m desirable minimum
2.5 m absolute minimum</td></tr></table></td></tr>
</table>

2.4.4 Norway

Reference: Manual no. N301E Work on and along roads, Requirements and guidelines regarding warning and protection (Directorate of Public Roads, Roads and Transport Department, 2014) – Håndbok N301 Arbeid på og ved veg, Krav og retningslinjer til varsling og sikring (Statens vegvesen, 2014)

Far-advance warning (type of signs & distance)	In this scenario there are no warning signs greater than 300m in advance of the road works.
Near-advance warning (type of signs & distance) - around last 300 m	In this scenario the advance warning of the works is very different depending on whether signals are being used to alternate the direction of traffic flow (layout 2.03) or whether narrow lanes are being used to maintain traffic flow in both directions (layout 2.01). (For the former scenario, the distance between the two sets of traffic

signals is maximum 800m).

In the non-signalised scenario, the first warning is located at 200m prior to the start of the works and consists of the road works sign (Sign 110) positioned above the 'altered driving patterns' sign (Sign 539) and supplemented with a Distance plate (802). At 100m before the start of the works the speed limit sign is displayed. The same warning signs are displayed in corresponding positions on the other side of the carriageway.

In the signalised scenario, at 200m before the start of the works the road works sign (Sign 110) is displayed above the temporary traffic lights ahead sign (Sign 132). At 125m before the start of the works, the speed limit sign is displayed.

The road works sign (Sign 110) can be displayed along with the queue ahead sign (Sign 149) upstream of these signs 'as required'.

In this signalised scenario, the same signs are displayed in corresponding positions in the other direction on the carriageway. In addition mandatory lane signs (Sign 404) on both sides of the lane and associated object markers (Sign 906) are displayed 30m before the start of the works.

For more information from standards on the following elements, see Section 2.1.4:

- *Roadworks sign (Sign 110)*
- *Size of signs*
- *Altered driving patterns (Sign 539)*
- *Signing speed limits (see Work Zone Speed Limit section for more information)*

"Temporary traffic lights ahead" (Sign 132)

The sign shall be used as advance warning of temporary traffic lights. The speed limit sign when signal regulation is used shall be maximum 60 km/hr.

Sign 132 "Temporary traffic lights ahead"

Queue sign (Sign 149)

The sign can be used where there is special risk of queues in connection with roadworks, where the end of the queue may be at a place with poor visibility, for example, just behind a swing, over a hilltop or after a tunnel. The sign may use the supplementary plate 804 "Extension"

Sign 149 "Queue"

The sign should normally be combined with sign 110, as the first warning

	of roadworks that may result in a queue. (3.2.1.10)
Lane shift geometry (angle, length, lane width, safety area)	In the non-signalised scenario the start of the lane shift zone is marked by an object marker (Sign 906) and a mandatory lane sign (Sign 404) keeping drivers in the right hand lane. (This also marks the start of the works in the other direction). In the signalised scenario, the start of the lane change zone is marked by a warning panel displaying yellow flashing lights (Sign 1098) and a barrier marker (Sign 908) at the top of the panel. This panel is situated 20m upstream of the transverse protection and buffer zone. In the non-signalised scenario, a warning panel is situated 12m after the start of the lane change zone at the end of the taper. This panel displays a mandatory lane sign (Sign 404), flashing yellow signals (Signal 1098) and a barrier marker (Sign 908) at the top of the panel. *For more information from standards on the following elements, see Section 2.1.4:* – *Mandatory lane sign (Sign 404)* – *Object markers (Sign 906)* – *Warning panels and warning trailers* – *Flashing yellow signal (Signal 1098)* – *Barrier markers (Sign 908)*
Work zone delineation	In both the signalised and non-signalised scenarios, there is a required gap of 20m between the warning panel and additional transverse protection (with associated buffer zone in advance of the works zone). There is no specific length given for the buffer zone. *For more information from standards on the following elements, see Section 2.1.4:* – *Traffic cones and traffic cylinders (Signs 940 and 942)* – *Buffer zone (in advance of works activity zone)* – *Protection*

Work zone lateral safety distance	*For more information from standards on the following elements, see Section 2.1.4:* – *Longitudinal protection* – *Guardrails* – *Safety zone* – *Special rules for protecting road workers* In this scenario there is no indication of other minimum distances required.
Physical separation of the opposite traffic flows	For the non-signalised scenario (layout 2.01) unspecified longitudinal protection is in place to separate the opposing traffic flows. *For more information from standards on the following elements, see Section 2.1.4* – *Markings*
Work zone speed limit (scheme/reduction)	In this scenario the selected speed limit is 50km/h for both signalised works (layout 2.03) and non-signalised works (layout 2.01). In this scenario, the end of limit sign is positioned between the end of the works zone and before the speed limit sign for traffic in the opposite direction. *For more information from standards on the following elements, see Section 2.1.4:* – *Speed limit (Sign 362 and Sign 364)* – *Use of speed limits near roadworks* – *Selecting the speed limit* – *Repeats*
Temporary lane width	Narrow lanes are used where traffic signals are absent to maintain the two-way flow of traffic (see layout 2.01). No indication is given for minimum width. When signals are used (see layout 2.03) the minimum width for the remaining carriageway is 3.5m

2.4.5 Slovenia

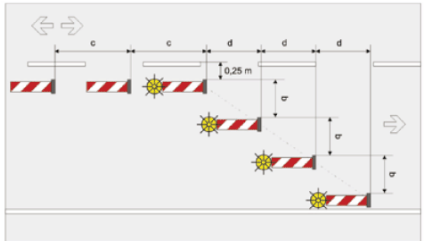
Road works on single carriageway (80/90km/h) roads (national roads) must be booked into the centralized 'Schedule of road works' and approved by Directorate of the Republic of Slovenia for Roads (DRSC) before the beginning of road works. The application for permission of national roads closures are discussed in 'The road act' issued in 2010 and amendments ('Zakon o cestah', Ur.l.RS No 109/10, 48/12 in 36/14).

At least 15 days before the intended road closure the applicant must deliver the necessary documents to DRSC. Application must also include detail plan of temporary traffic scheme (The 'detail plan' must be designed by a company registered for design of roads) and The

duly completed ‘Record sheet for road closure’ – ‘Evidenčni list zapore’ and approved time-table of execution of works - except for short-term road closures (with duration of less than 6 days).

Rules are set in ‘Regulations on the Method of Marking and Protecting Roadworks on Public Roads and Impediments in Road Traffic’ and amendments, issued in 2006 (‘Pravilnik o načinu označevanja in zavarovanja del na javnih cestah in ovir v cestnem prometu’, Uradni list RS, št. 116/06, 88/08 in 109/10).

Some of the possible traffic management schemes for roadworks outside populated areas are designated with Z (see Appendix 4). Most common for major roadworks is type Z-1, which is described below (the length of work zone is not limited). The actual layout depends of visibility, traffic and road characteristics and is approved case by case.

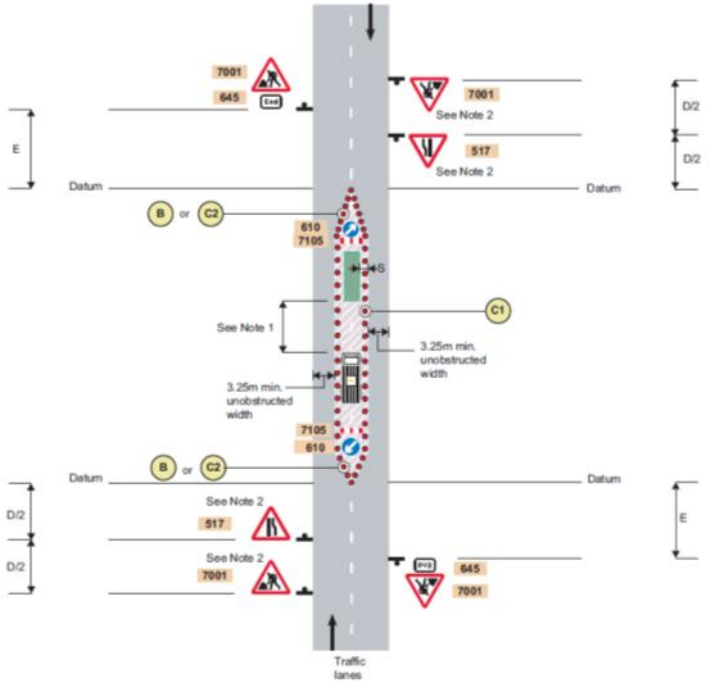
Far-advance warning (type of signs & distance)	*General case* Traffic (hard) sign “Construction site” with warning light 400m upwards the start of the lane closure. 
Near-advance warning (type of signs & distance) - around last 300 m	*General case* work zone traffic management (hard) sign 200m upwards the start of the lane closure. 
Lane shift geometry (angle, length, lane width, safety area)	*General case* A 45 degree taper shall be used on the approach at the closed lane. The work zone must be delineated by panels (with warning lights at transition areas).
Work zone delineation	*General case (following standards)* Safety panels. The distance between panels should be 15m at workzone section and 2,5m at lane closures. Panels with flashing light at lane closure section. Specified case by case. 

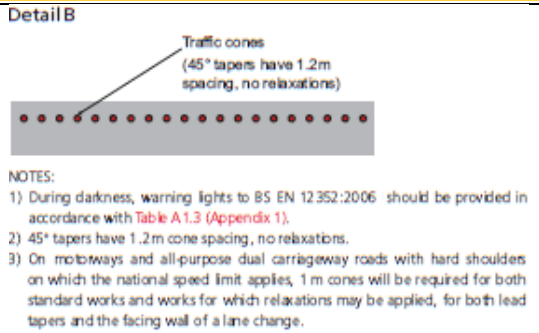
Work zone lateral safety distance	*General case* Not specified – case by case. According to general safety rule – 100cm from excavation edge.
Physical separation of the opposite traffic flows	Not relevant
Work zone speed limit (scheme/reduction)	*General case* 70 km/h (300m in advance), 50 km/h (100 m in advance) *Usual practice* Case by case.
Temporary lane width	*General case* 3,0m - Specified case by case.

2.4.6 United Kingdom

The Traffic Signs Manual Chapter 8 provides guidance on 'Traffic Safety Measures and Signs for Road Works and Temporary Situations'. It includes references to all the relevant legislation, such as the Traffic Signs Regulations and General Directions. The Highways Agency, the national road authority for England, also issues Interim Advice Notes (IANs), which update and/or clarify sections of Chapter 8, from time to time; these are then incorporated into the next edition of what is often referred to simply as 'Chapter 8'.

Far-advance warning (type of signs & distance)	On single carriageway roads on which the speed limit is 50 mph or more, the first sign in advance of the works should be at between 275 and 450 m (D). Two advance signs are normally required; A "road works" sign on the near side only in both directions; a distance plate is required for roads with a permanent speed limit of 50 mph or more; and A "road narrows" sign on the near side only in both directions; on roads with a permanent speed limit of 50 mph or more a distance plate is required.

	 NOTES: 1. If the permanent speed limit is 30 mph or less, minimum clearance is 2.0 m. If the permanent speed limit is 40 mph or more, minimum clearance is 5.0 m. 2. A distance plate to diagram 572 is required for roads with a permanent speed limit of 50 mph or more.
Near-advance warning (type of signs & distance) - around last 300 m	See above

Lane shift geometry (angle, length, lane width, safety area)	Coning to Detail C2 or Detail B with 45° tapers is used A "keep left/right" sign is placed on the near side at the start of the taper; and A "lane closed" barrier with a "keep left/right" sign is placed at the end of the taper behind the cones – the "keep left/right" sign should be mounted directly above the barrier sign or may be placed in front of the barrier or the last cone of the taper. If a conspicuous vehicle is parked at the works behind the taper then the barrier may be omitted; and On congested roads, if it is impracticable to provide the full taper then the taper may be reduced to an angle of not more than 45° to the kerb using coning to Detail B. 
Work zone delineation	Coning to Detail C1 is used to mark the edge of the works area safety zone. No additional signing is required.
Work zone lateral safety distance	1.2m
Physical separation of the opposite traffic flows	See above
Work zone speed limit (scheme/reduction)	A temporary speed limit reduction of 20mph is recommended.
Temporary lane width	A minimum of 3.25m unobstructed lane width is required.

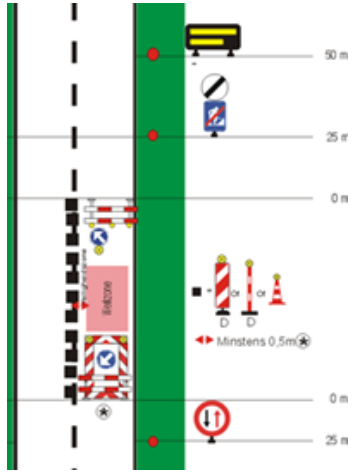
2.5 Minor RW on single carriageway (80/90 km/h) road

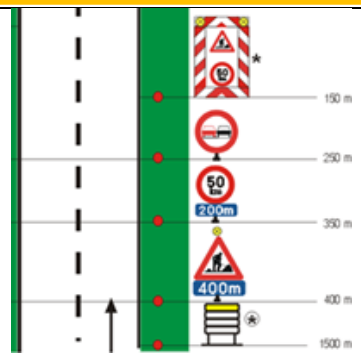
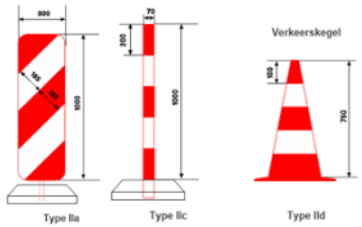
2.5.1 Belgium (Flanders)

The rules described hereafter coorespond to a category 2 (following the Belgian classification) road work executed on a single carriageway (2 lanes) road. One lane being closed, the traffic flow is regulated by priority signs. These rules applies for road with posted speed limit between 50km/h and 90 km/h. An overview of the road work layout is provided in appendix 1.

Main references:

- Decree of May 7th, 1999 on signing of road work activities (*MB 7 mei 1999 betreffende het signaleren van werken en verkeersbelemmeringen op de openbare weg*);
- Standard tender specifications (*Standaardbestek 250 versie 3.1. hoofdstuk X. 3 "signalisatie van werken"*); 2014 version.
- Schemes for signing of the more typical road works layouts (still valid for BE categories 1 to 5 but revision in progress ; *schematische weergave van in M.B. 7 mei 1999 tekstuele voorschriften en in SB 250 versie 2.2. voorziene aanvullingen: CD-ROM Werfsignalisatie 2000*).

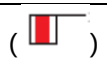
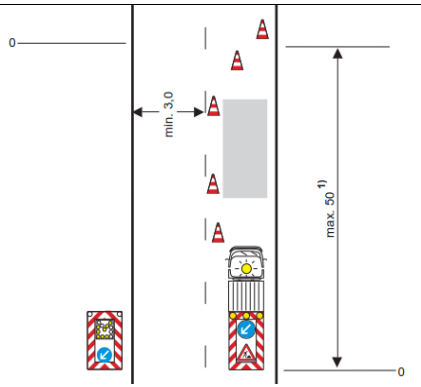
Far-advance warning (type of signs & distance)	*General case (following standards)* A sign presenting general information about the road work is located 1500m upwards the work zone. 400m upwards the work zone, drivers are warned about the upcoming work zone through a A31 sign (road work at 400m).	
Near-advance warning (type of signs & distance) - around last 300 m	*General case (following standards)* A C35 sign (interdiction to overtake) is installed 250 m upward the work zone. A frame sign with red & white strips, flashing lights, A31 (road work) and C43 (speed limit) sign is installed 150 m upwards the work zone. A priority sign (B19) is installed 25 m upwards the work zone to regulate traffic flow. The same sequence of signs is installed along the opposite side.	

Lane shift geometry (angle, length, lane width, safety area)	*General case (following standards)* A fence is being used to close the lane 25 m downwards the priority sign. The fence is equipped with red & white reflective strips and complemented by a second frame sign with red & white strips, flashing lights and a D1 (obligatory deviation) sign. The end of the work zone is only delimited by a fence equipped with red & white reflective strips, flashing lights and a D1 sign.  Advance area and closure signing
Work zone delineation	*General case (following standards)* The work zone is longitudinaly delimited by Type Iia, Iic panels or cones Iid.  Panels and cones used for the longitudinal delineation
Work zone lateral safety distance	*General case / Minimum requirement (following standards)* The minimum lateral safety distance is 0,50m (minimum requirements). Larger lateral safety distance is used whenever possible.
Physical separation of the opposite traffic flows	Not relevant
Work zone speed limit (scheme/reduction)	*General case (following standards)* A C45 sign (50 km/h speed limit) is installed 150 m upward the work zone. This sign is announced 200m upwards.
Temporary lane width	*General case (following standards)* The width of the open lane is normally keeped unchanged.

2.5.2 Germany

The rules described hereafter correspond to a category C II/2 (following the German guideline RSA classification) road work executed on a single carriageway (2 lanes) road. One lane being closed, the traffic flow is regulated by signs. These rules applies for road with regular speed limit between 70km/h and 100 km/h. An overview of the complete road work layout is provided in appendix 2.

Main references: Guideline for securing of work zones (orig.: Richtlinien für die Sicherung von Arbeitsstellen (RSA), 1995)

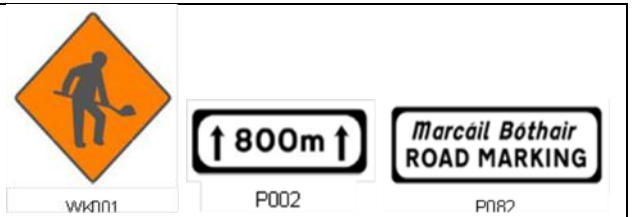
Far-advance warning (type of signs & distance)	*General case (following standards)* A far-advance warning is only used where the sight distance on the safety trailer is less than 200 m. 
Near-advance warning (type of signs & distance)	*General case (following standards)* Beacon with waving warning flag 
Lane shift geometry (angle, length, lane width, safety area)	Lane shift without marking, so no lane shift geometry information are fixed. Maximum length of traffic section with oncoming traffic 50m. 
Work zone delineation	*General case (following standards)* The workplace must be delineated by cones (motorway: height 500 mm). 
Work zone lateral distance	*General case (following standards)* 0,50 m.
Work zone speed limit (scheme/reduction)	*General case (following standards)* No temporary speed limit

Temporary lane width	*General case (following standards)* minimum 3,00 m.

2.5.3 Ireland

The Guidance for the Control and Management of Traffic at Road Works (GCMTRW) stablishes for the case of Single Carriageway with Road works Type C (short duration) with speed limit of 80 or 100 km/hr, the following design parameters. It is noted that the classification Level 3 and 4 is related to the ADT(average daily traffic).

Far-advance warning (type of signs & distance)	*General case (following standards)* The first sign is a "Road Works Ahead" signs (WK001) with Supplementary Plate P002, stating the distance over which the works may be encountered. The second closely spaced sign is a "Road Works Ahead" sign (WK001) with Supplementary Plate P082, stating the type of operation in progress. Preferably, these signs should be within 1 km of the works but never more than 2 km. Additional signs may be placed on the verge at intervals between the first set of signs and the road works. *Usual practice* Driver information signs informing of the reason for the works and possible delays should be set back from the edge of the running carriageway by a distance greater than or equal to the width of the lateral safety zone applicable to the works. When a variable message sign is located in the hard shoulder, an angled line of cones (3 or 4 cones across the hard shoulder) should be placed 25 m in advance of the sign and immediately in front of the sign.
Near-advance warning (type of signs & distance)	*General case (following standards)* Sign Visibility: 120 m



<table>
<tr><td></td><td>Number of signs: 3
Cumulative distance: 600 m
Distance between advance signs: 200 m</td></tr>
<tr><td>Lane shift geometry (angle, length, lane width, safety area)</td><td><u>General case (following standards)</u>

Where shuttle working is required to facilitate works, a 45 degree taper shall be used on both approaches in conjunction with a suitable method of traffic control.

Where applicable, the hard shoulder should always be closed as part of any near-side lane closure. It is recommended that the length of the closure of the hard shoulder be kept to a minimum as it is an area for traffic to use in an emergency. To deter traffic from using the hard shoulder in advance of the works, angled lines of cones (3 or 4 cones across the hard shoulder) may be used 25 m to 50 m in advance of the start of the taper.

Two-way operation of traffic should be maintained, where possible according Table 4.2.1.

Taper at lane (m): minimum 1 in 40
Taper at hard shoulder (m): minimum 1 in 20
Longitudinal Safety zone (m): 45
Lateral Safety zone (m): 1.2

<u>Minimum requirement (following standards)</u>

When the two-way operation of traffic cannot be achieved, the through passage should be further restricted by the use of cones to a single traffic lane not less than 3.0 m but not exceeding 3.7 m, and alternate oneway traffic (shuttle working) should be introduced using the most appropriate method of traffic control.</td></tr>
<tr><td>Work zone delineation</td><td>For continuously progressing operations, such as road strengthening and resurfacing operations, the boundary between the safety zone and the works area may be marked using temporary lining or an additional row of cones (traffic tape may also be used). For operations at a fixed location, the boundary between the safety zone and the works area should be marked by a barrier or fence.

Table 4.2.2: Sign and cone sizes for temporary traffic management arrangements
<table><tr><th>Permanent Speed Limit</th><th>Sign Size (diamond or circular)</th><th>Cone height</th></tr><tr><td>80 or 100 km/h (Level 3)
80 or 100 km/h (Level 4)</td><td>600 or 750 mm
750 or 900 mm</td><td>750 mm</td></tr></table>
A row of cones at 6 or 12 m centres should be used to delineate the centreline of unmarked surfaces on roadways wider than 7.3 m. Depending on the length, duration and complexity of the works, temporary carriageway markings</td></tr>
</table>

<table>
<tr><td></td><td>and/or temporary reflecting roadway studs may also be used to indicate the edge of the route to be followed.

Steady state lamps should be used in unlit areas (blinking/flashing lamps should only be used at an isolated hazard location).

<u>General case (following standards)</u>

Maximum cone spacing at tapers: 3 m
Maximum cone (longitudinal): 12 m
Maximum lamp spacing at tapers: 6 m
Maximum lamp (longitudinal): 12 m</td></tr>
<tr><td>Work zone lateral distance</td><td>Lateral Safety zone (m): 1.2</td></tr>
<tr><td>Work zone speed limit (scheme/reduction)</td><td>It is recommended that any mandatory speed reduction introduced should not exceed two steps below the permanent speed limit (e.g., a permanent limit of 100 km/h would be reduced to a Road Works Speed Limit of 80 or 60 km/h). A Road Works Speed Limit should not normally be less than 50 km/h.

Speed restrictions should extend throughout the works area on single carriageway roads to a point 45 m beyond the end of the temporary traffic management arrangement.

A temporary speed restriction should not be introduced where the length of the restriction would be less than 400 m. At sites where the length of road affected is 800 m or longer, repeater signs should be placed at regular intervals.</td></tr>
<tr><td>Temporary lane width</td><td>Two-way operation of traffic should be maintained, where possible according Table 4.2.1.
Table 4.2.1 – Minimum carriageway widths for two-way and shuttle working with traffic control
<table><tr><th></th><th>Normal traffic including buses and HGVs</th><th>Cars and light vehicles only</th></tr><tr><td>Two-way working</td><td>6.75 m desirable minimum
6.0 m absolute minimum</td><td>5.5 m desirable minimum
5.0 m absolute minimum</td></tr><tr><td>Shuttle working</td><td>3.7 m maximum
3.25 m desirable minimum
3.0 m absolute minimum</td><td>3.7 m maximum
2.75 m desirable minimum
2.5 m absolute minimum</td></tr></table></td></tr>
</table>

2.5.4 Norway

Reference: Manual no. N301E Work on and along roads, Requirements and guidelines regarding warning and protection (Directorate of Public Roads, Roads and Transport Department, 2014) – Håndbok N301 Arbeid på og ved veg, Krav og retningslinjer til varsling og sikring (Statens vegvesen, 2014)

Far-advance warning (type of signs & distance)	In this scenario there are no warning signs greater than 300m in advance of the road works (see layout 2.10).
Near-advance warning (type of signs & distance) - around last 300 m	In this scenario, the first warning sign is the road works sign (Sign 110) located at 150m before the start of the works. This sign is supplemented with the road narrows sign (Sign 106) and a supplementary plate displaying further information as unspecified text. At 100m before the start of the works, the speed limit sign is displayed on both sides of the carriageway. These signs are also displaying in the corresponding positions on the other side of the carriageway for traffic travelling past the works in the other direction. *For more information from standards on the following elements, see Section 2.1.4* – *Roadworks sign (Sign 110)* – *Size of signs* – *Signing speed limits (see Work Zone Speed Limit section for more information)* *"Road narrows" (Sign 106)* In the case of roadworks, sign 106.1 may be used regardless of which side of the road the work is taking place. For major works or works of a longer duration that entail a narrowing of one side of the road, signs 106.2 and 106.3 may be used. When signs 106.2 and 106.3 are used, they shall be set up correctly in accordance with the side of the road that narrows. (3.2.1.1) 

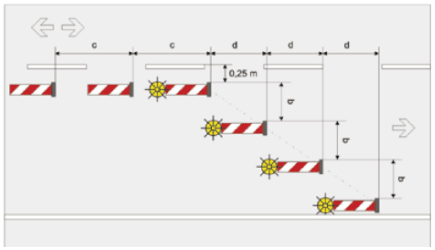
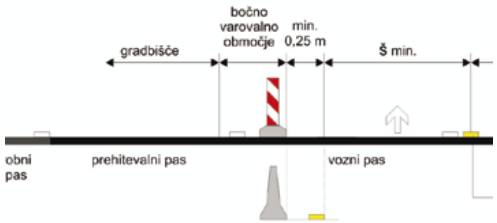
Lane shift geometry (angle, length, lane width, safety area)	In this scenario, the start of the works zone is marked by a warning vehicle in the live lane fitted with an impact attenuator. The warning panel displays a text sign, flashing yellow signals (Signal 1098) and barrier markers (Sign 908) at the top and bottom of the panel. *For more information from standards on the following elements, see Section 2.1.4:* – *Warning panels and warning trailers* – *Barrier markers (Sign 908)* – *Flashing yellow signal (Signal 1098)*
Work zone delineation	In this scenario, as mentioned above, there is a warning vehicle with impact attenuator at the start of the works zone. There is a buffer zone of unspecified length between this warning vehicle and the start of the actual works activity. *For more information from standards on the following elements, see Section 2.1.4:* – *Traffic cones and traffic cylinders (Signs 940 and 942)* – *Buffer zone (in advance of works activity zone)* – *Protection*
Work zone lateral safety distance	In this scenario, there is no longitudinal protection specified (see layout 2.10). *For more information from standards on the following elements, see Section 2.1.4:* – *Longitudinal protection* – *Special rules for protecting road workers*
Physical separation of the opposite traffic flows	n/a
Work zone speed limit (scheme/reduction)	*For more information from standards on the following elements, see Section 2.1.4:* – *Speed limit (Sign 362 and Sign 364)* – *Use of speed limits near roadworks* – *Selecting the speed limit* In this scenario the selected speed limit is 50km/h In this scenario, the end of limit sign is positioned between the end of the works zone and before the speed limit sign for traffic in the opposite direction.
Temporary lane width	n/a

2.5.5 Slovenia

Road works on single carriageway (80/90km/h) roads (national roads) must be booked into the centralized 'Schedule of road works' and approved by Directorate of the Republic of Slovenia for Roads (DRSC) before the beginning of road works. The application for permission of national roads closures are discussed in 'The road act' issued in 2010 and amendments ('Zakon o cestah', Ur.l.RS No 109/10, 48/12 in 36/14).
Rules are set in 'Regulations on the Method of Marking and Protecting Roadworks on Public Roads and Impediments in Road Traffic' and amendments, issued in 2006 ('Pravilnik o načinu označevanja in zavarovanja del na javnih cestah in ovir v cestnem prometu', Uradni list RS, št. 116/06, 88/08 in 109/10).

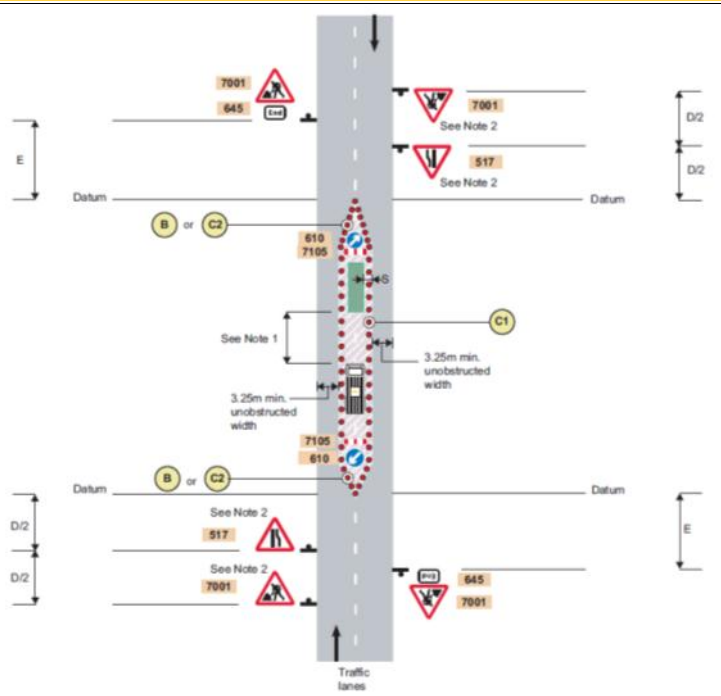
Some of the possible traffic management schemes for roadworks outside populated areas are designated with Z (see Appendix 4). Most common for major roadworks is type Z-2, which is described below (the length of work zone is limited to 80m). The actual layout depends of visibility, traffic and road characteristics and is approved case by case.

Far-advance warning (type of signs & distance)	*General case* Traffic (hard) sign "Construction site" with warning light 400m upwards the start of the lane closure *Usual practice* Case by case. 
Near-advance warning (type of signs & distance)	*General case* Priority rules (hard) sign 20m upwards the start of the lane closure. 
Lane shift geometry (angle, length, lane width, safety area)	*General case* A 45 degree taper shall be used on the approach at the closed lane. The work zone must be delineated by panels (with warning lights at transition areas).

Work zone delineation	*General case* Safety panels. The distance between panels should be 15m at workzone section and 2,5m at lane closures. Panels with flashing light at lane closure section. The distance between panels should be 10m at workzone section and 1,0m at lane closures, if the road section is within urban area. Specified case by case. 
Work zone lateral distance	*General case* The distance between the road markings and workzone is not defined (according to general safety rule – 100cm from excavation edge). The distance between the temporary road markings (traffic lane) and safety panels should be 0,25m. 
Work zone speed limit (scheme/reduction)	*General case (following standards)* 70 km/h (300m in advance), 50 km/h (100 m in advance) *Usual practice* Case by case.
Temporary lane width	*General case (following standards)* 2,75 m

2.5.6 United Kingdom

The Traffic Signs Manual Chapter 8 provides guidance on 'Traffic Safety Measures and Signs for Road Works and Temporary Situations'. It includes references to all the relevant legislation, such as the Traffic Signs Regulations and General Directions. The Highways Agency, the national road authority for England, also issues Interim Advice Notes (IANs), which update and/or clarify sections of Chapter 8, from time to time; these are then incorporated into the next edition of what is often referred to simply as 'Chapter 8'.

Far-advance warning (type of signs & distance)	On single carriageway roads on which the national speed limit applies, the first sign in advance of the works should be at between 275 and 450 m. Two advance signs are normally required; A “road works” sign on the near side only in both directions; a distance plate is required for roads with a permanent speed limit of 50 mph or more; and A “road narrows” sign on the near side only in both directions; on roads with a permanent speed limit of 50 mph or more a distance plate is required.  NOTES: 1. If the permanent speed limit is 30 mph or less, minimum clearance is 2.0 m. If the permanent speed limit is 40 mph or more, minimum clearance is 5.0 m. 2. A distance plate to diagram 572 is required for roads with a permanent speed limit of 50 mph or more.
Near-advance warning (type of signs & distance)	See above
Lane shift geometry (angle, length, lane width, safety area)	Coning to Detail C2 or Detail B with 45° tapers is used A “keep left/right” sign is placed on the near side at the start of the taper; and A “lane closed” barrier with a “keep left/right” sign is placed at the end of the taper behind the cones – the “keep left/right” sign should be mounted directly above the barrier sign or may be placed in front of the barrier or the last cone of the taper. If a conspicuous vehicle is parked at the works behind the taper then the barrier may be omitted; and On congested roads, if it is impracticable to provide the full taper then the taper may be reduced to an angle of not more than 45° to the kerb using coning to Detail B.

Work zone delineation	Coning to Detail C1 is used to mark the edge of the works area safety zone. No additional signing is required.
Work zone lateral distance	1.2m
Work zone speed limit (scheme/reduction)	A temporary speed limit reduction of 20mph is recommended.
Temporary lane width	A minimum of 3.25m unobstructed lane width is required.

2.6 Mobile RW on single carriageway (80/90 km/h) road

2.6.1 Belgium (Flanders)

The rules described hereafter coorespond to a category 6 (following the Belgian classification) road work executed on a single carriageway (2 lanes) road. One lane being closed due to mobile road works. These rules applies for road with posted speed limit between 50km/h and 90 km/h. An overview of the equipment needed on the road work vehicle is provided in appendix 1.

Main references:

- Decree of May 7th, 1999 on signing of road work activities (*MB 7 mei 1999 betreffende het signaleren van werken en verkeersbelemmeringen op de openbare weg*);
- Standard tender specifications (*Standaardbestek 250 versie 3.1. hoofdstuk X. 3 "signalisatie van werken"*); 2014 version.
- Schemes for signing of the more typical road works layouts (still valid for BE categories 1 to 5 but revision in progress ; *schematische weergave van in M.B. 7 mei 1999 tekstuele voorschriften en in SB 250 versie 2.2. voorziene aanvullingen: CD-ROM Werfsignalisatie 2000*).

Lane shift geometry	Not relevant
Advance warning: sign & distance	No advance warning

Safety vehicle(s): presence, number, type & characteristics	*General case (following standards)* The works vehicle must be provided with 45° inclined red and white strips on its front and rear parts. These strips are provided with retroreflective products. This vehicle is also equipped with at least two yellow-orange flashing lights placed above the vehicle, a lights ramp and the A31 and D1 signs (cf. picture). If the works vehicle can't be provided with this equipment, it must be preceded by a safety vehicle that is appropriately equipped.  Works vehicle provided with 45° inclined red and white strips flashing lights, lights ramp and , A31 and D1 signs
Distance between the Work vehicle and the Safety vehicle(s)	Not relevant
Work zone speed limit (scheme/reduction)	No temporary speed limit.

2.6.2 Germany

The rules described hereafter correspond to a category C II/2 (following the German guideline RSA classification) road work executed on a single carriageway (2 lanes) road. One lane being closed, the traffic flow is regulated by signs. These rules applies for road with regular speed limit between 70km/h and 100 km/h. An overview of the complete road work layout is provided in appendix 2. The layout for minor and mobile work zones is equal with the exception, that traffic cones are unnecessary in mobile work zones.

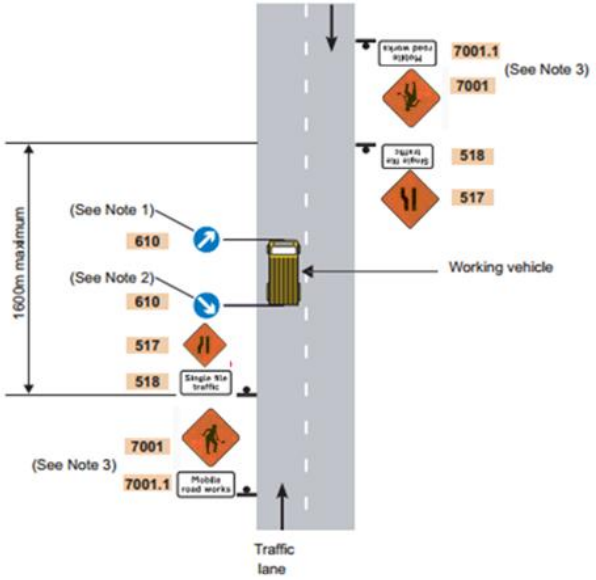
Main references: Guideline for securing of work zones (orig.: Richtlinien für die Sicherung von Arbeitsstellen (RSA), 1995)

Lane shift geometry	Not relevant
Advance warning: sign & distance	No advance warning
Safety vehicle(s): presence, number, type & characteristics	*General case (following standards)* 1 vehicle with safety trailer. 

Distance between the Work vehicle and the Safety vehicle(s)	<u>*General case (following standards)*</u> 10 m, depending on the weight of the safety vehicle. Trailer without safety vehicle: not possible with this layout.
Work zone speed limit (scheme/reduction)	<u>*General case (following standards)*</u> No temporarily speed limit signed.

2.6.3 Ireland

The Traffic Signs Manual – Chapter 8, part 2: Temporary Traffic Measures and Signs for Roadworks stablishes for the single vehicle works on single carriageway roads considering two cases; (a) the basic layout and (b) with STOP/GO traffic control, the following design parameters.

Lane shift geometry	n/a
Advance warning: sign & distance	(a) <u>The basic layout:</u> • a "Road-works ahead" sign (7001) with a "distance over which hazard extends" supplementary plate (570) on near side only in both directions. A supplementary plate to diagram 7001.1, showing the type of mobile operation taking place, "for" and a distance, may be used in place of the plate to diagram 570; and • a "road narrows" sign (517) with supplementary plate "Single file traffic" (518) on near side only in both directions. Additional signs may be required to suit the carriageway alignment and at junctions.  Single vehicle works on a single carriageway road, basic layout (plan SVW1) Notes: 1. Use of a sign to diagram 610(Keep left) on the front of the working vehicle is optional. It may only be used on

	roads with a maximum speed limit of 50 km/h or less. 2. The sign to diagram 610(Keep right) on the back of the working vehicle may only be used on roads with a maximum speed limit of 50 km/h or less. 3. This sign is to be repeated at approximately 400 m intervals. Additional signs may be required to suit the carriageway alignment and at junctions. The supplementary plate to sign diagram 7001(Road-works ahead) may also show a distance. 4. An authorised vehicle mounted small light arrow sign may be used in place of signs to diagram 610(Keep right) and 7403 (a light arrow sign). 5. On roads with a speed limit of 60km/h or more, consideration should be given to fitting a LMCC (lorry-mounted crash cushion) and/or a sign to diagram 7403(a light arrow sign) on the working vehicle. If neither are provided an escort vehicle shall be employed. 6. Additional signs may be required to suit the carriageway alignment and at junctions.

With STOP/GO traffic control:

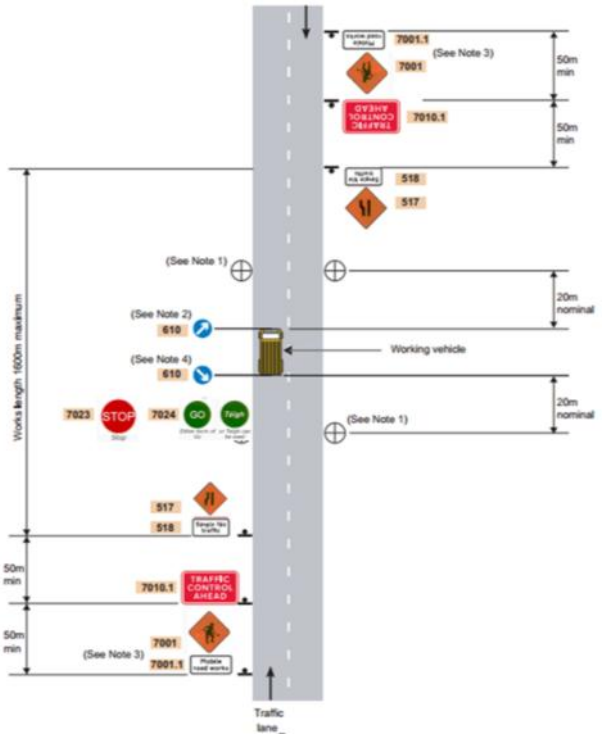
• a “Road-works ahead” sign (7001) with supplementary plate “Mobile road works” (7001.1) on the near side only in both directions;

• a “TRAFFIC CONTROL AHEAD” sign (7010.1) on near side only in both directions;

• a “road narrows” sign (517) with supplementary plate “Single file traffic” (518) on near side only in both directions; and

• a “STOP/GO” board (7023 7024) nominally 20 m in advance of the working vehicle.

The “Road-works ahead” sign (7001) with supplementary plate “Mobile road works” (7001.1) should be repeated at approximately 400 m intervals. Additional signs may be required to suit the carriageway alignment and at junctions. The supplementary plate (diagram 7001.1) may also show a distance.



Single vehicle worls on a single carriageway raod – “STOP/GO” (plan SVW2)

Notes:

1. Alternative “STOP/GO” operative location dependant upon carriageway alignment and visibility.

2. Use of the sign to diagram 610 (Keep right) on the front of the working vehicle is optional. It may only be used on roads with a maximum speed limit of 50 km/h or less.

3. This sign is to be repeated at approximately 400 m intervals. Additional signs may be required to suit the carriageway alignment and at junctions. The supplementary plate to sign diagram 7001(Road-works ahead) (diagram 7001.1) may also show a distance.

4. The sign to diagram 610(Keep right) may only be used on roads with a maximum speed limit of 50 km/h or less.

5. An authorised vehicle mounted small light arrow sign may be used in place of signs to diagram 610(Keep right) and 7403(a light arrow sign).

6. On roads with a speed limit of 60 km/h or more, subject to a risk assessment, consideration should be given to

	fitting a LMCC (lorry-mounted crash cushion) and/or a sign to diagram 7403 (a light arrow sign) on the working vehicle. If neither are provided an escort vehicle shall be employed.
Safety vehicle(s): presence, number, type & characteristics	The basic layout: Working vehicle signing: • a “keep right” sign (610) to the rear of the working vehicle or a sign to diagram 7403(a light arrow sign); and • optionally, “keep left” sign (610) to the front of the working vehicle. With STOP/GO traffic control: Working vehicle signing: • a “keep right” sign (610) to the rear of the working vehicle attached in accordance with regulation 14(1) or a sign to diagram 7403 (a light arrow sign). An authorised vehicle mounted small light arrow sign may be used in place of signs to diagram 610 and 7403 (a light arrow sign);and • optionally, a “keep left” sign (610) to the front of the working vehicle.
Distance between the Work vehicle and the Safety vehicle(s)	n/a
Work zone speed limit (scheme/reduction)	n/a

2.6.4 Norway

Reference: Manual no. N301E Work on and along roads, Requirements and guidelines regarding warning and protection (Directorate of Public Roads, Roads and Transport Department, 2014) – Håndbok N301 Arbeid på og ved veg, Krav og retningslinjer til varsling og sikring (Statens vegvesen, 2014)

Lane shift geometry	In this scenario there is no lane shift zone, the works comprise the works vehicle only. In both scenarios (with or without warning vehicle), the works vehicle also displays a warning panel which displays flashing yellow signals (Signal 1098) and barrier markers (Sign 908) at the top and bottom of the panel.

Advance warning: sign & distance	If no warning vehicle is being used (layout 2.14) – i.e. there is just the works vehicle - there should be advance warning between 0.1km and 2km before the works vehicle. This consists of the road works sign (Sign 110) and two supplementary plates displayed below, one showing the distance to the works vehicle and the other displaying further information as text. *For more information from standards on the following elements, see Section 2.1.4:* *Roadworks sign (Sign 110)* If a warning vehicle is used in advance of the works vehicle (layout 2.13), then this warning vehicle provides the first warning of the works for drivers and is located between 100m and 200m upstream of the works vehicle. This consists of a warning trailer, with impact attenuator. The warning panel displays the road works sign (Sign 110) with supplementary text plate and distance plate, along with flashing yellow signals (Signal 1098) and barrier markers (Sign 908) at the top and bottom of the panel. *For more information from standards on the following elements, see Section 2.1.4:* – *Warning panels and warning trailers* – *Flashing yellow signal (Signal 1098)* – *Barrier markers (Sign 908)*
Safety vehicle(s); presence, number, type & characteristics	See here above
Distance between the Work vehicle and the Safety (vehicle(s)	See here above
Work zone speed limit (scheme/reduction)	N/A

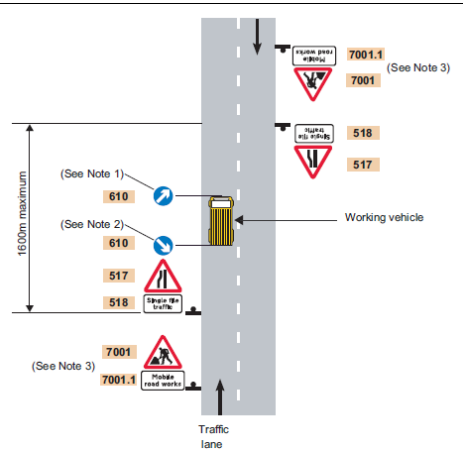
2.6.5 Slovenia

Rules are set in 'Regulations on the Method of Marking and Protecting Roadworks on Public Roads and Impediments in Road Traffic' and amendments, issued in 2006 ('Pravilnik o načinu označevanja in zavarovanja del na javnih cestah in ovir v cestnem prometu', Uradni list RS, št. 116/06, 88/08 in 109/10).
Rules for setting up a long-term road works area apply.

Lane shift geometry	Not relevant
Advance warning: sign & distance	*General case* No advance warning. The minimum height of cones (if used) is 30cm. *Usual practice* Aditional roadworks hard sign 0m to 3km ahead 
Safety vehicle(s): presence, number, type & characteristics	*General case (following standards)* 1 vehicle with safety trailer 
Distance between the Work vehicle and the Safety vehicle(s)	*Usual practice* From 0m to 50m.
Work zone speed limit (scheme/reduction)	*Usual practice* Speed limit sign 40km/h or 50km/h

2.6.6 United Kingdom

The Traffic Signs Manual Chapter 8 provides guidance on 'Traffic Safety Measures and Signs for Road Works and Temporary Situations'. It includes references to all the relevant legislation, such as the Traffic Signs Regulations and General Directions. The Highways Agency, the national road authority for England, also issues Interim Advice Notes (IANs), which update and/or clarify sections of Chapter 8, from time to time; these are then incorporated into the next edition of what is often referred to simply as 'Chapter 8'.

Lane shift geometry	The works vehicle used shall display a "keep left/right" sign conspicuously on the rear or front of the vehicle as appropriate to show approaching drivers which side to pass 
Advance warning: sign & distance	Two advance signs are required: A "road works" sign with a "distance over which hazard extends" supplementary plate on near side only in both directions. A supplementary plate showing the type of mobile operation taking place "for" and a distance, may be used in place of the plate; and A "road narrows" sign with supplementary plate "Single file traffic" on near side only in both directions. The distance between the signs should be sufficient to enable moving work to progress before the signs are moved and should not exceed 1 mile. The distance shown may be varied. Repeater signs may be required if the road alignment is poor.

Safety vehicle(s): presence, number, type & characteristics	Consideration should be given to fitting a lorry-mounted crash cushion (LMCC) to the working vehicle and/or any escort vehicle that may be employed. It should be noted that LMCCs may be inappropriate on roads with poor alignment, and less than 5.5 m wide, as they may create an additional hazard to road users. The working vehicle shall carry a sign on the rear.
Distance between the Work vehicle and the Safety vehicle(s)	Not applicable – single vehicle working only
Work zone speed limit (scheme/reduction)	A temporary speed limit reduction of 20mph is recommended

3 Common practices and significant differences of layout characteristics, signing or delineation across EU

In this chapter rules applying to major RW on motorway (with crossover), minor and mobile RW on motorway (slow lane closed) as well as to major, minor and mobile RW on single carriageway (80/90 km/h) road are synthesized (3.1). The focus is given to signing and delineation elements as both highly impact the road user perception and behavior. This information is taken from standards; no 'usual practices' are included in this section.

Section 3.1 is structured around the four following key topics for which harmonization opportunities may appear from listing the common practices and identifying significant differences (3.2):

- Advanced warning
- Transition area/Vehicles
- Temporary speed limit schemes
- Lateral safety distance, lane width & delineation of the work zone

A discussion about opportunities to improve road work signing consistency between countries (3.3) is provided at the end of this chapter.

3.1 Synthesis of practices

3.1.1 Major RW (on 3 lanes) Motorway with Crossover

a. Advanced warning (fixed signs & dynamic signing)

Country	Queue warning	RW warning 1	RW warning 2	Lane mgt 1	Lane mgt 2	Lane mgt 3	Lane mgt 4
Austria	At more than 1500 veh./h per residual lane	Static sign (yellow background)		Static sign (yellow background)		n/a	n/a
Distance to lane shift		1200m		-600m	-300m		
Belgium (Flanders)	Static sign & dynamic system	Static sign		Static sign (orange background)			
Distance to lane shift	At least -3000m	-2500m	At lane shift	-3000m	-1500m	-1000m	-250m
Germany	No guideline standard	Static sign (white background)	Static sign	Static sign (white background)		n/a	n/a
Distance to lane shift		2000m	-800m	-600m	-400m		
Ireland	"Road	"Road works"	"Road	"keep	Diversion of	n/a	n/a

	works" sign	sign	works" sign	left/righ" sign	lane onto the other carriageway sign		
Distance to lane shift	At least -5000m	-3000m	-1500m	0m	0m		
Norway* **	None	Road works ahead sign		Lane ends (if relevant)		Lanes diverge (if relevant)	
Distance to lane shift		-700m		-700m	-300m	0m	
Slovenia	No guideline standard	Static sign - yellow background	Static sign - yellow background	Static sign	Static sign		
Distance to lane shift		2600m	1400m,	-700m	-400m		
UK	Static "Road Works" sign	Static "Road Works Ahead" sign	Static "Road Works Ahead" sign	Static sign (yellow background)			n/a
Distance to lane shift	At least -3 miles (4,800m)	-2 miles (3,200m)	-1 mile (1,600m)	-200m	-100m	0m	

***For Norway the information relates to a crossover on a **2-lane** motorway.

b. Transition area

Advanced transition area

- Austria: When the number of lanes must be reduced, traffic flows are still merged by inserting the fastest lane to the slowest lane.
- Belgium (Flanders):
  - When the number of lanes must be reduced, traffic flows are still merged by inserting the fastest lane to the slowest lane;
  - The interdistance between the 2 consecutive transition zones is typically 400m long.
- Germany:
  - When the number of lanes must be reduced, traffic flows are still merged by inserting the fastest lane to the slowest lane;
  - The interdistance between 2 consecutive transition zones is not fixed
- Ireland:
  - 200m are required in each lane reduced.
  - When lanes are closed using stepped taper lane closures, the distance between the closures is a minimum of 800 m.
- Norway:
  - If there is no reduction in total number of lanes, the altered driving patterns sign is shown at the start of the lane change zone.

  - Where a contraflow does reduce the total number of lanes, the lane ends sign is repeated at 700m and 300m prior to the start of the lane change zone and the altered driving patterns sign is positioned within the lane change zone.

- Slovenia:
  - When the number of lanes must be reduced, traffic flows are still merged by inserting the fastest lane to the slowest lane;
  - The interdistance between 2 consecutive transition zones is not fixed
- UK: 150m are required in each lane reduced.

Lane shift *(including delineation and marking)*

- Austria:
  - The taper is minimum 120m long. A neutral area with a width of 1m is used between lanes when 2 (or more) adjacent lanes must be deviated;
  - The lane shift and crossing of the central reserve must be delineated by panels. Additional flashing lights are used before the taper.
- Belgium (Flanders):
  - The taper is 150m long and the lane shift must be adapted to the lane width. A 1 m width neutral area is used between lanes when 2 (or more) adjacent lanes must be deviated. Yellow-Orange temporary marking are used to guide traffic and separate the temporary lanes.
  - The lane shift and crossing of the central reserve must be delineated by panels (various types possible, cf. chapter 2.1.1). Additional signing is needed (i.e. a frame sign with red&white strips, flashing lights and arrow) for the first taper.
- Germany:
  - The taper is 135m long. A neutral area with a maximal width of 1.5m is used between lanes when 2 (or more) adjacent lanes must be deviated;
  - The lane shift and crossing of the central reserve must be delineated by panels. Additional flashing lights are used before the taper .
- Ireland:
  - The taper is delimited using cones with spacing of 1.5 m.
  - The lanes are delimited using cones with spacing of 1.5 m (left) and 9 m (right).
  - Signs of “diversion of lane onto the other carriageway“, speed limit, “keep left/right” and “lane closed” are provided.
  - The new lane is marked using white lines or using studs.
- Norway:
  - The start of the lane shift zone is marked by two warning trailers with flashing light arrows, mandatory lane change signs and barrier markers
  - There is a minimum distance of 30m after the trailers before the contraflow begins (marked by directional markings).
- Slovenia:
  - The taper is delimited using safety panels with spacing of 10m (at lane narrowing). The lead-in taper is usually 65m long.
  - The lane shift and crossing of the central reserve must be delineated by safety panels with warning (flashing) lights at the right side (slow lane) of a motorway.
- UK:
  - The taper is delimited using cones with spacing of 3 m.
  - One “keep left/right” sign is provided at the start of the taper

- One “lane closed” barrier with a high intensity warning light and a “keep left/right” sign at the end of each closed lane of the taper

c. Temporary speed limit schemes

Country	Original posted speed	Speed warning sign	Speed reduction – Step 1	Speed reduction – Step 2	Speed reduction – Step 3 (crossover)	Speed reduction – Step 4
Austria Distance to lane shift	n/a	n/a	**100 kph** -700m	**80 kph** -500m	80 kph (reminder) or 60 kph (special cases) -250m	n/a
Belgium (Flanders) Distance to lane shift	120 kph	90 kph at 300m -1400m	**90 kph** -1100m	**70 kph** -500m	70 kph (reminder) or 50 kph (local conditions) -150m	n/a
Germany Distance to lane shift	n/a	n/a	**100 kph** -700m	**80 kph** -500m	80 kph (reminder) or 60 kph (special cases) -100m	n/a
Ireland Distance to lane shift	120 kph		The reduction is related to the design speed of the crossover (i) 80 kph (ii) 60 kph (iii) 50 kph		Design speed of the crossover: (i) 85 kph (ii) 70 kph (iii) 60 kph	
Norway Distance to lane shift		50kph -400m,	**50kph** -100m			
Slovenia Distance to lane shift	130 kph	n/a	**100 kph** -800m	**80 kph** 600m	80 kph (reminder) at 300m 60 kph (special cases)	
UK Distance to lane shift	70mph	n/a	50mph -250m	n/a	n/a	n/a

d. Lateral safety distance, lane width & delineation of the work zone

- Austria:
  - No minimum requirement for lateral safety distance is fixed.
  - 3,25m is the regular lane width for lanes open to HGV. Lanes restricted to light vehicles have a minimum width of 2,75. In workzones with a length of less than 6km , the lane width can be reduced to 3,00/2,50 m.
  - The work zone must be delineated by panels or by a safety barrier.

- Belgium (Flanders):
  - The minimum requirement for lateral safety distance is 0,50m;
  - 3,25m and 3,00m wide lanes are recommended, respectively for lanes open to HGV and for lanes restricted to light vehicles (3,00m & 2,75m as a minimum);
  - The work zone must be delineated by panels (various types possible, cf. chapter 2.1.1) or by a safety barrier.

- Germany:
  - The minimum requirement for lateral safety distance is 0,50m; 1 m distance to excavation edge;
  - 3,25m is the regular lane width for lanes open to HGV, exceptional 3,00m. Lanes restricted to light vehicles have a minimum width of 2,50, actual practice are minimum width of 2,60 m for vehicles with a maximum width of 2,10 m
  - The work zone must be delineated by panels or by a safety barrier

- Ireland:
  - The lateral clearance between the edge of the working space and that part of the carriageway being used by traffic should be not less than 1.2 m.

- Norway:
  - Contraflow lane must be a minimum of 3.5m
  - There must be a buffer zone, but the length is unspecified.
  - The lateral safety distance is 3m

- Slovenia:
  - The minimum requirement for lateral safety distance not defined (1 m distance to excavation edge);
  - Speed limit depends on the width of lanes. 3,25m to 3,75m is the regular lane width for 80km/h. 3,0m to 3,24m is the regular lane width for 60km/h. If driving lane width is less than 3,0m the speed limit is 60km/h at workzone and 40km/h at crossover.
  - The work zone must be delineated by panels or by a safety barrier.

- UK:
  - The lateral clearance between the edge of the working space and that part of the carriageway being used by traffic should be not less than 1.2 m
  - Where it is reasonably practicable to provide additional clearance this should be done.
  - Works on dual carriageway roads may require some traffic lanes to be reduced in width to less than 3.0 m. Whenever this situation arises, advance warning of the narrow lanes should be given.
  - If the running lane is adjacent to the works, then coning is used.

3.1.2 Minor RW on (3 lanes) Motorway (slow lane closed)

a. <u>Advanced warning (fixed signs & dynamic signing)</u>

Country	Queue warning	RW warning 1	RW warning 2	Lane mgt 1	Lane mgt 2	Lane mgt 3	Lane mgt 4
Austria	No guideline standard			"close lane" sign (First warning with overhead display)		n/a	n/a
Distance to lane shift				500-600m	200-300m		
Belgium (Flanders)	Dynamic system	Static sign		Static sign (orange background)			
Distance to lane shift	Around -2500m	-2500m	At lane shift	-1500m	-750m	-150m	n/a
Germany	No guideline standard			"close lane" sign		n/a	n/a
Distance to lane shift				600-1000m	At sight distance < 400m: 300-600m		
Ireland	"Road works" sign	"Road works" sign	"Road works" sign	"close lane" sign	"close lane" sign	"close lane" sign	"close lane" sign
Distance to lane shift	At least -5000m	-3000m	-1500m	-800m	-600m	-400m	-200m
Norway		Road works ahead		**Lane ends sign**	Lane ends sign		
Distance to lane shift		-700m		-700m	-300m		
Slovenia	No guideline standard	Static sign (yellow background)	Static sign (yellow background	"close lane" sign	"close lane" sign		
Distance to lane shift		-2300m,	-1100m	-900m	-600m		
UK	"Road works" sign	"Road works ahead" sign	"Road works ahead" sign	Static sign (yellow background)			
Distance to lane shift	At least -3 miles	-2 miles	-1 mile	-800m	-600m	-400m	-200m

b. <u>Transition area</u>

Advanced transition area

- <u>Austria</u>: When the number of lanes must be reduced, at short term workzones the lane is inserted at the work zone side.

- Belgium (Flanders):
  - When the number of lanes must be reduced, traffic flows are still merged by inserting the fastest lane to the slowest lane;
  - The interdistance between the 2 consecutive transition zones is typically 400m long.
- Germany:
  - When the number of lanes must be reduced, at short term workzones the lane is inserted at the work zone side. Only in some regions also for work zones at the right lane in a first step the left (fast) lane is inserted, later the traffic lane ist shifted to the left;
  - The interdistance between 2 consecutive transition zones is typically 200m long .
- Ireland:
  - 200m are required in each lane reduced;
  - When lanes are closed using stepped taper lane closures, the distance between the closures is a minimum of 800 m .
- Norway: Lane ends sign is repeated at 300m prior to the lane shift zone
- Slovenia:
  - When the number of lanes must be reduced, traffic flows are still merged by inserting the fastest lane to the slowest lane;
  - The interdistance between beginning of transition zone and workzone should be 365m.
- UK: 150m are required in each lane reduced

Lane shift *(including delineation and marking)*

- Austria: The taper by cones is 100 m long, followed by a 50 m buffer zone in front of the safety vehicle (truck type) mounted with a light flashing arrow.
- Belgium (Flanders):
  - The taper is 150m long and the lane shift must be adapted to the lane width. Cones are used between lanes when 2 (or more) adjacent lanes must be deviated as well a to guide traffic when the temporary lane management do not correspond to the existent permanent marking.
  - The lane shift must be delineated by panels (various types possible, cf. chapter 2.2.1). Additional signing is needed (i.e. a frame sign with red&white strips, flashing lights and arrow) for the first taper.
- Germany:
  - No taper at minor road works. The lane shift is composed of a safety vehicle (truck type) mounted with a light flashing arrow.
- Ireland:
  - The taper is delimited using cones with spacing of 1.5 m;
  - The lanes are delimited using cones with spacing of 1.5 m (left) and 9 m (right);
  - Signs of speed limit, “keep left/right” and “lane closed” and “lane closed” barriers are provided.
- Norway:
  - The lane shift zone is marked by cones and a warning trailer (two protection vehicles are used in total), displaying the mandatory lane sign, flashing yellow lights and barrier markers.
  - The first warning trailer is fitted with an impact attenuator.

- Slovenia:
  - The taper is delimited using safety panels with spacing of 10m (at narrowing to maximum 20m). The lead-in taper is usually 100m long.
  - The lanes are delimited using temporary (yellow) markings.
- UK:
  - The taper is delimited using cones with spacing of 3m;
  - One "keep left/right" sign is provided at the start of the taper;
  - One "lane closed" barrier with a high intensity warning light and a "keep left/right" sign at the end of each closed lane of the taper.

c. Temporary speed limit schemes

Country	Original posted speed	Speed warning sign	Speed reduction – Step 1	Speed reduction – Step 2	Speed reduction – Step 3 (lane shift)	Speed reduction – Step 4
Austria Distance to lane shift	130 kph		**100 kph** **500-600m**	**80 kph** **200-300m**	n/a	n/a
Belgium (Flanders) Distance to lane shift	120 kph	90 kph at 300m -1400m	**90 kph** -1100m	**n/a**	**70 kph** or 50 kph (local conditions) -250m	n/a
Germany Distance to lane shift	No limit (130 kph recommended) (if 120 kph is posted, a layout without speed reduction is possible		**100 kph** **600-1000m**	**n/a**	n/a	n/a
Ireland Distance to lane shift	120 kph		**80 kph** -850m			
Norway Distance to lane shift		n/a	**70kph** -100m			
Slovenia Distance to lane shift	130 kph		**80 kph** -800m			
UK Distance to lane shift	n/a	n/a	n/a	n/a	n/a	n/a

d. Lateral safety distance, lane width & delineation of the work zone

- Austria:
  - No minimum requirement for lateral safety distance is fixed;
  - No official limit of lane width;
  - The work zone must be delineated by cones.
- Belgium (Flanders):
  - The minimum requirement for lateral safety distance is 0,50m;
  - 3,25m and 3,00m wide lanes are recommended, respectively for lanes open to HGV and for lanes restricted to light vehicles (3,00m & 2,75m as a minimum);
  - The work zone must be delineated by cones (cf. chapter 2.2.1).
- Germany:
  - The minimum requirement for lateral safety distance is 0,50m;
  - No official limit of lane width.
  - The work zone must be delineated by cones.
- Ireland: The lateral clearance between the edge of the working space and that part of the carriageway being used by traffic should be not less than 1.2 m.
- Norway:
  - There are two warning trailers, the first warning trailer fitted with an impact attenuator;
  - There must be a buffer zone, but the length is unspecified;
  - In this scenario there is no additional longitudinal protection.
- Slovenia:
  - The minimum requirement for lateral safety distance not defined (1m distance to excavation edge);
  - Speed limit depends on the lane width. 3,25m to 3,75m is the regular lane width for 80kph;
  - The work zone must be delineated by safety panels (at least 100cm heigh and 25cm wide).
- UK:
  - The lateral clearance between the edge of the working space and that part of the carriageway being used by traffic should be not less than 1.2 m;
  - Where it is reasonably practicable to provide additional clearance this should be done;
  - Works on dual carriageway roads may require some traffic lanes to be reduced in width to less than 3.0 m. Whenever this situation arises, advance warning of the narrow lanes should be given;
  - If the running lane is adjacent to the works, then coning is used.

3.1.3 Mobile RW on (3 lanes) Motorway (slow lane closed)

a. Advanced warning (fixed signs & dynamic signing)

*** Note that the information for Norway is for a 2-lane motorway.

- Austria:
  - The road work and safety vehicles are preceeded by an advance warning element, located 500 to 600m upwards on emergency lane. A second advance warning element is positioned 200 to 300m upwards the work zone;
  - The advance warning vehicle is equipped with a display showing the temporary lane management.
- Belgium (Flanders):
  - The road work and safety vehicles are preceeded by an advance warning vehicle, located 500m upwards on emergency lane;
  - The advance warning vehicle is mounted with a TMA and equipped with a dynamic LED matrix (displaying temporary lane management).
- Germany:
  - The road work and safety vehicles are preceeded by an advance warning vehicle, located 1.000 to 600m upwards on emergency lane. If the sight distance to the safety trailer is less that 400m, a second advance warning vehicle is positioned 600 to 300m upwards the work zone;
  - The advance warning vehicle is equipped with a static or dynamic (LED matrix) displaying showing the temporary lane management.
- Ireland:Three safety vehicles travelling in the hard shoulder, each of them situated between 250 to 300 meters from the previous one.
- Norway***: A warning trailer is positioned on the hard shoulder at 300m prior to the start of the works, displaying the road works sign, flashing yellow signals, lane ends sign and distance to works.
- Slovenia:
  - The road work and safety vehicles are preceded by an advance warning element, located 1000m upwards on emergency lane. The advance warning vehicle is equipped with a display showing the temporary lane management.
- UK:
  - Three vehicle or trailer-mounted signs are required on the near side in advance of the initial block vehicle that is positioned in the carriageway.

b. Transition area/Vehicles

- Austria: The works vehicle or work area is preceded by 1 safety vehicle, respectively 100m upstream the works.
- Belgium (Flanders):
  - The works vehicle or work area is preceded by 2 safety vehicles mounted with TMA; respectively 30m and 80m upstream the works and misaligned to improve the visibility of both TMA);
  - Safety and advance warning vehicles mounted with a TMA must comply to NCHRP 350 test level 3 for the TMA; weight around 9.000 kg, be at least 6m long.
- Germany: The works vehicle or work area is preceded by 1 safety vehicle, respectively 50m upstream the works.

- Ireland: The working vehicule is preceded by a safety vehicule in the same lane, maintaining a distance of between 50-100 meters from the vehicle work. Carrying a light arrow sign.
- Norway:
  - The start of the works is marked by a second warning vehicle, this time in the live lane and fitted with an impact attenuator. This displays the flashing light arrows, mandatory lane sign, flashing yellow lights and barrier markers.
  - A third warning vehicle is positioned downstream in the same lane, displaying mandatory lane signs, flashing yellow lights and barrier markers.
- Slovenia:
  - Two safety vehicles at distance of around 50 meters;
  - Cones are used to delimiante the work zone (cones must be positioned at lateral distance of maximum 36m. The transition aria should be 20m long.
- UK: The block vehicle carries a light arrow sign 50 m – 100 m in advance of the working vehicle which carries a sign.

c. Temporary speed limit schemes

- Austria: 80km/h
- Belgium (Flanders): Where existing permanent VMS are available is the speed limit decreased up to 90 km/h (or less following the traffic circumstances). The 90km/h speed limit announced upwards or even preceeded by a 100 km/h ou 110 km/h speed.
- Germany: 100 km/h. (If general limit is 120 kph and the sight distance > 800 m, a layout without a further speed limit and without pre-warning element is fixed in guideline, but practically used very seldom).
- Ireland: No temporary speed limit
- Norway: No temporary speed limit
- Slovenia: 80 km/h (when the width of unclosed width of driving lane is more than 3,0m). 60 km/h (when the width of unclosed width of driving lane is less than 3,0m).
- UK: Not applicable in light traffic flow. A temporary speed limit reduction of 20mph is recommended if there is not light traffic flow.

d. Lateral safety distance, lane width & delineation of the work zone

- Austria: No minimum requirement for lateral safety distance is fixed
- Belgium (Flanders): The minimum requirement for lateral safety distance is 0,50m.
- Germany: The minimum requirement for lateral safety distance is 0,50m .
- Ireland: n/a
- Norway: n/a
- Slovenia: No minimum requirement for lateral safety distance.
- UK:
  - A lateral clearance or safety zone of not less than 1.2 m should be provided between the working space and the carriageway remaining open to traffic;
  - Where appropriate, steps should be taken to ensure that the workforce does not stray into the safety zone, e.g. when a team member is acting as a lookout;

- When work is undertaken on foot on a hard shoulder a lateral clearance or safety zone of not less than 1.2 m should be provided between the working space and the carriageway open to traffic.

3.1.4 Major RW on single carriageway (80/90 km/h) road

a. <u>Advanced warning (fixed signs & dynamic signing)</u>

Country	RW warning 1	RW warning 2	Lane mgt 1	Lane mgt 2	Lane mgt 3	Lane mgt 4
Austria			Static sign – Traffic light in front	Static sign – overtaking interdiction		Traffic light
Distance to lane shift	-200 m		-200 m	-100 m		0 m
Belgium (Flanders)	Static sign		Static sign – overtaking interdiction	Static sign – Traffic light in front	Static sign – Priority rules	Traffic light
Distance to lane shift	-400m	-150m	-250m	-125m	-10m	-10m
Germany			Static sign – overtaking interdiction		Static sign – Traffic light in front	
Distance to lane shift	-400 m		-200 m	-200 m		-20 m
Ireland	Roadworks ahead sign	Roadworks ahead sign	Traffic control ahead sign	Overtaking interdiction sign	Sign – Traffic light in front	Sign – Traffic light in front
Distance to lane shift	-2km to -1km	-2km to -1km	-800m	-600m	-400m	-200m
Norway	Queue ahead (if necessary)	Road works sign	**Altered driving patterns sign** (if relevant)	Temporary traffic lights ahead (if relevant)	Mandatory lane signs	
Distance to lane shift	Unspecified	-200m	-200m	-200m	-30m	
Slovenia	Roadworks ahead sign			Overtaking interdiction sign	Sign – Traffic light in front	Traffic light
Distance to lane shift	-400 m			-200 m	-200m	0 m

UK Distance to lane shift	"Road works" sign -450m to -275m	"Road narrows" sign -225m to -137.5m	n/a	n/a	n/a	n/a

b. Transition area

Lane shift/closure

- Austria: A 45 degree taper shall be used on the approach at the closed lane. The work zone must be delineated by panels.
- Belgium (Flanders): The lane is closed by use of a fence equipped with red & white reflective strips, flashing lights and an obligatory deviation sign. (cf. chapter 2.4.1).
- Germany:
  - A 1:10 taper shall be used on the approach at the closed lane, 1:3 at the other side.
  - The work zone must be delineated by panels.
- Ireland: A 45 degree taper shall be used on both approaches in conjunction with a suitable method of traffic control. The taper will be delimited by cones or lamps (unlit areas).
- Norway: If there are traffic signals, the lane shift zone is marked by a warning panel with yellow flashing lights and barrier marker, 20m upstream of the buffer zone.If there are no traffic signals, the lane shift zone is marked by object marker and a mandatory lane sign. A warning panel with mandatory lane sing, yellow signals and barrier marker is at 12m from the start of the lane shift zone, at the end of the taper.
- Slovenia: A 45 degree taper shall be used on the approach at the closed lane. The work zone must be delineated by panels (with warning lights at transition areas).
- UK:
  - Coning with 45° tapers is used
  - A "keep left/right" sign is placed on the near side at the start of the taper; and
  - A "lane closed" barrier with a "keep left/right" sign is placed at the end of the taper behind the cones – the "keep left/right" sign should be mounted directly above the barrier sign or may be placed in front of the barrier or the last cone of the taper.

c. Temporary speed limit schemes

Country	Original posted speed	Speed warning sign	Speed reduction – Step 1	Speed reduction – Step 2	Speed reduction – Step 3 (lane shift)
Austria	50 to 100 kph		**70 kph**	**50 kph**	

Distance to lane shift			-100 m	-50 m	
Belgium (Flanders) Distance to lane shift	50 to 90kph	50 kph at 200m -350m	**50 kph** -150m	**n/a**	**n/a**
Germany Distance to lane shift	50 to 100 kph		**70 kph** -300 m	**50 kph** -100 m	
Ireland Distance to lane shift	(i)80 kph (ii)100 kph		(i)**60 or 50 kph** (ii)**80 or 60 kph** -850m		
Norway Distance to lane shift		None	**50kph** -100m or -125m		
Slovenia Distance to lane shift	80 or 90 kph		**70 kph** -300 m	**50 kph** -100 m	
UK Distance to lane shift	60mph	n/a	The speed limit might be reduced by 20mph*		n/a

*: Following the UK guidance document "works should be designed to minimise the risks to road users and the workforce. Having done so, implementation of a temporary mandatory speed limit should be considered, especially where the workforce is required to operate on the carriageway, or other vulnerable area". Therefore there is more emphasis on direct risk management than on speed management itself.

d. Lateral safety distance, lane width & delineation of the work zone

- Austria:
  - No minimum requirement for lateral safety distance is fixed;
  - The work zone is longitudinaly delimited by panels.
- Belgium (Flanders):
  - The minimum requirement for lateral safety distance is 0,50m;
  - The work zone is longitudinaly delimited by panels or cones (cf. chapter 2.4.1);
  - The lane width is normally unchanged
- Germany:
  - The minimum requirement for lateral safety distance is 0,50m;
  - The work zone is longitudinaly delimited by panels;
  - A minimum of 2,75m unobstructed lane width is required, 3m without traffic lights
- Ireland:
  - The lateral safety zone is 1,20m;
  - The longitudinal safety zone is 60m;
  - The work zone is longitudinaly delimited by cones or lamps (unlit areas).

- Norway:
  - There is a required gap of 20m between the warning panel and any additional transverse protection. There is no specific length given for the subsequent buffer zone.
  - No indication is given for minimum width when narrow lanes are used. When signals are used, the remaining lane must be min 3.5m.
- Slovenia: No minimum requirement for lateral safety distance.
- UK:
  - The lateral safety zone is 1.2m.
  - Coning is used to mark the edge of the works area safety zone.
  - A minimum of 3.25m unobstructed lane width is required.

3.1.5 Minor RW on single carriageway (80/90 km/h) road

a. Advanced warning (fixed signs & dynamic signing)

Country	RW warning 1	RW warning 2	Lane mgt 1	Lane mgt 2	Lane mgt 3	Lane mgt 4
Austria	Only used if sight distance on the safety trailer is less than 200 m.				Use of a signal disk, if workzone length is not visible completely	
Distance to lane shift		-200m			-25m	
Belgium (Flanders)	Static sign	Included in a static frame sign with red&white strips, flashing lights	Static sign – overtaking interdiction	n/a	Static sign – Priority rules	n/a
Distance to lane shift	-400m	-150m	-250m		-25m	
Germany	Only used if sight distance on the safety trailer is less than 200 m.					
Distance to lane shift	-200m					
Ireland	Roadworks ahead sign	Roadworks ahead sign	Traffic control ahead sign	Overtaking interdiction sign	Sign – Traffic light in front	
Distance to lane shift	-2km to -1km	-2km to -1km	-600m	-400m	-200m	
Norway	Road works sign		Road narrows			

Distance to lane shift	-150m		-150m			
Slovenia	Roadworks ahead sign			Overtaking interdiction sign	Static sign – Road narrowing in front	Static sign – Priority rules
Distance to lane shift	-400 m			-200 m	-200m	0 m
UK	"Road works" sign	"Road narrows" sign	n/a	n/a	n/a	n/a
Distance to lane shift	-450m to -275m	-225m to -137.5m				

b. Transition area

Lane shift/closure

- Austria: The works vehicle or work area is preceded by a safety vehicle.
- Belgium (Flanders): The lane is closed by use of a fence equipped with red & white reflective strips and complemented by a frame sign with red & white strips, flashing lights and a D1 (obligatory deviation) sign (cf. chapter 2.5.1).
- Germany: A safety vehicle is located 10 m (depending on the weight of the safety vehicle) upwards of the work vehicle.
- Ireland: A 45 degree taper shall be used on both approaches in conjunction with a suitable method of traffic control. The taper will be delimited by cones or lamps (unlit areas).
- Norway:The start of the works zone is marked by a warning vehicle in the live lane fitted with an impact attenuator. This displays a text sign, yellow signals and barrier markers.
- Slovenia: -A 45 degree taper shall be used on the approach at the closed lane. The work zone must be delineated by panels (with warning lights at transition areas).
- UK:
  - Coning with 45° tapers is used
  - A "keep left/right" sign is placed on the near side at the start of the taper; and
  - A "lane closed" barrier with a "keep left/right" sign is placed at the end of the taper behind the cones – the "keep left/right" sign should be mounted directly above the barrier sign or may be placed in front of the barrier or the last cone of the taper.

c. Temporary speed limit schemes

Country	Original posted speed	Speed warning sign	Speed reduction – Step 1	Speed reduction – Step 2	Speed reduction – Step 3 (lane shift)
Austria Distance to lane shift	50 to 100 kph		**no**		
Belgium (Flanders) Distance to lane shift	50 to 90kph	50 kph at 200m -350m	**50 kph** -150m	**n/a**	**n/a**
Germany Distance to lane shift	50 to 100 kph		**no**		
Ireland Distance to lane shift	(i)80 kph (ii)100 kph		**(i)60 or 50 kph** **(ii)80 or 60 kph** -650m		
Norway .. Distance to lane shift		None	50kph -100m		
Slovenia Distance to lane shift	80 to 90 kph		**70 kph** -300 m	**50 kph** -100 m	
UK Distance to lane shift	60mph	N/A	Speed limit might be reduced to 40mph* Not defined	N/A	N/A

*: Following the UK guidance document "works should be designed to minimise the risks to road users and the workforce. Having done so, implementation of a temporary mandatory speed limit should be considered, especially where the workforce is required to operate on the carriageway, or other vulnerable area". Therefore there is more emphasis on direct risk management than on speed management itself.

d. Lateral safety distance, lane width & delineation of the work zone

- Austria: No minimum requirement for lateral safety distance is fixed
- Belgium (Flanders):
  - The minimum requirement for lateral safety distance is 0,50m;

- The work zone is longitudinaly delimited by panels or cones (cf. chapter 2.5.1);
- The lane width is normally unchanged.

- Germany:
  - The minimum requirement for lateral safety distance is 0,50m;
  - A minimum of 3.00m unobstructed lane width is required;
  - The work zone is longitudinaly delimited by cones.
- Ireland:
  - The lateral safety zone is 1,20m;
  - The longitudinal safety zone is 45m;
  - The work zone is longitudinaly delimited by cones or lamps (unlit areas).
- Norway: There is a buffer zone of unspecified length between the warning vehicle and the actual works activity.
- Slovenia: No minimum requirement for lateral safety distance.
- UK:
  - The lateral safety zone is 1.20m.
  - Coning is used to mark the edge of the works area safety zone.
  - A minimum of 3.25m unobstructed lane width is required.

3.1.6 Mobile RW on single carriageway (80/90 km/h) road

a. Advanced warning (fixed signs & dynamic signing)

- Austria: advanced warning only if sight distance is inadequate.
- Belgium (Flanders): no advanced warning
- Germany: no advanced warning
- Ireland:
  - The basic layout establishes two advance signs: a “road works” sign with a “distance over which hazard extends” supplementary plate on near side only in both directions; and a “road narrows” sign with supplementary plate “Single file traffic” on near side only in both directions.
  - The layout with STOP/GO traffic control establishes four advance signs: a “road works” sign with supplementary plate “Mobile road works” on the near side only in both directions; a “traffic control ahead” sign on near side only in both directions; a “road narrows” sign with supplementary plate “Single file traffic” on near side only in both directions; and a “STOP/GO” nominally 20 m in advance of the working vehicle
- Norway:
  - If a warning vehicle is being used, this is located 100-200m before the start of the works and is fitted with an impact attenuator, road works sign, barrier markers and yellow signals.
  - If no warning vehicle is being used, the road works sign is located between 0.1 and 2km prior to the works.
- Slovenia: usually advanced warning (if sight distance is inadequate).
- UK:
  - Two advance signs are required:
  - A “road works” sign with a “distance over which hazard extends” supplementary plate on near side only in both directions. A supplementary plate showing the type of

mobile operation taking place "for" and a distance, may be used in place of the plate; and
  - A "road narrows" sign with supplementary plate "Single file traffic" on near side only in both directions.
  - The distance between the signs should be sufficient to enable moving work to progress before the signs are moved and should not exceed 1 mile.
  - The distance shown may be varied. Repeater signs may be required if the road alignment is poor.

b. Transition area/Vehicles

- Austria: The works vehicle or work area is preceded by a safety vehicle.
- Belgium (Flanders):
  - The works vehicle is be provided with 45° inclined red and white retroreflective strips on its front and rear parts. It is also equipped with at least two yellow-orange flashing lights placed above the vehicle, a lights ramp and road work and deviation signs.
  - If the work vehicle can't be provided with this equipment, it must be preceded by a safety vehicle that is appropriately equipped.
- Germany: A safety vehicle is located 10 m (depending on the weight of the safety vehicle) upwards of the work vehicle.
- Ireland:
  - The basic layout establishes a working vehicle signing a "keep right" sign to the rear of the working or a sign to diagram (a light arrow sign); and optionally, "keep left" sign to the front of the working.
  - The layout with STOP/GO traffic control establishes a working vehicle signing a "keep right" sign to the rear of the working or a sign to diagram (a light arrow sign). An 121uthorized vehicle mounted small light arrow sign may be used in place of these signs; and optionally, a "keep left" sign to the front of the working vehicle.
- Norway: There is no lane shift zone, the works comprise the works vehicle only. The works vehicle displays flashing yellow signals and barrier markers.
- Slovenia: The works vehicle or work area is preceded by a safety vehicle.
- UK: The works vehicle used shall display a "keep left/right" sign conspicuously on the rear or front of the vehicle as appropriate to show approaching drivers which side to pass.

c. Temporary speed limit schemes

- Austria: no temporary speed limit
- Belgium (Flanders): no temporary speed limit
- Germany: no temporary speedlimit
- Ireland: no temporary speed limit
- Norway: no temporary speed limit
- Slovenia: a temporary speed limit reduction is usually set.
- UK: a temporary speed limit reduction of 20mph is recommended

3.2 Common practices and significant differences

Similar practices; i.e. conveying similar message to the road user, and significant differences across standards; i.e. omissions or differing practices, are presented here in parallel. Both similarities and differences result from the previous descriptive chapters (2 and 3.1) presenting practices across a selection of European countries and support the discussion about opportunities to improve road work signing consistency between countries.

3.2.1 Advance warning (fixed signs & dynamic signing)

Similar practices (conveying similar message)	**Significant differences** (omissions, differing practices)
Major RW on motorway: First RW warning sign typically installed between 3 to 2 km upwards of WZ (except for Norway), supplemented by a queue warning (or far advance RW warning) between 5 to 3 km upwards of the WZ. The road work warning sign is usually repeated when approaching the transition area. Pure road work warning is complemented by lane management signs installed at different locations depending on the country (cf. right column about differing practices)	Major RW on motorway: In Flanders queue warning is managed through dynamic systems where other countries report that the standards only impose the use of static signs. Germany reports having no standard on queue warning. Distance between successive signs differs largely between countries; e.g.: ○ In Flanders, drivers get a warning message around every 500m (from 3500m to 250m upwards the work zone. Particularly they are informed about the temporary lane management four times between 3000m to 250m; ○ Other countries report larger steps (1500m on average) between successive signs. Main differences refer to temporary lane management signing. Orange/yellow background are standard in some countries where others use white background.
Minor RW on motorway: The same RW warning philosophy applies as for major RW. Only location may shlightly differ. One should notice Germany and Austria seems having more differences between both RW types (cf. right	Minor RW on motorway: As for signing of major RW the distance between successive signs differs between countries. Germany, Austria and Norway outstandingly reports that standards do no include RW warning

column about differing practices). Their minor RW layout is more similar to the mobile RW layout.	before 1000m upwards the transition area.
Mobile RW on motorway: In all countries mentioned in this report the group road work vehicle/ safety (block) vehicle(s) is being preceded by at least one advance warning vehicle located a few hundred meter (from 300m to 1000m depending on the country) upwards on the emergency lane or on the shoulder. However the number of advance warning vehicles depends on the considered country (up to 3 in UK and IE; cf. differing practices).	Mobile RW on motorway: Standards for advance warning upwards of mobile RW largely differ across European countries (in number, location and equipment) as reported in chapter 3.1.3 §a. In Germany and Austria TMA are not usual. The back of the advance warning vehicle typically displays the temporary lane management. The signing might by static or dynamic. While the type of signs is quite similar (flashing lights, light arrow, lane management, road work sign) across the standards considered in this report, the design and colors of are not homogeneous (cf. chapter 2.3).
Major RW on single carriageway road: Along single carriageway roads RW warning is usually composed of “Road works ahead” and overtaking interdiction static signs. These signs are typically located in the last few 100m preceeding the lane reduction.	Major RW on single carriageway road: Along single carriageway roads RW warning are located in the last 400m preceeding the lane reduction, exept for Ireland (i.e. in the last 1000m).
Minor and mobile RW on single carriageway road: Standards are here more heterogeneous (likely linked to the lower impact such works have on the traffic; cf. differing practices at right column).	Minor RW on single carriageway road: As shown by the table in chapter 3.1.5 §a, some countries mentioned in this report use a sequence of “Road works ahead” and overtaking interdiction static signs along the last 400m (1000m for Ireland) upwards the transition areas, where Germany and Austria only uses an advance RW warning in case of limited sight distances. Mobile RW on single carriageway road: Where Flemish, German and Austrian standards do not impose any advance warning, UK,Ireland and Norway do; i.e. the basic layout establishes two advance signs with a distance over which hazard extends.

3.2.2 Transition area/Vehicles

Similar practices (conveying similar message)	**Significant differences** (omissions, differing practices)
Major RW on motorway: When the number of lanes must be reduced traffic flows are usually merged by inserting the fastest lane to the slowest one. Successive transition zones are used in case of multiple lane closures. The lane shift (typically from 120m to 265m depending on the number of shifted lanes) is progressively introduced through a combination of signing and equipment ranging from cones to panels and from marking to studs or even cylinders.	Major RW on motorway: The interdistance needed between successive transition zones (multiple lane closure) isn't homogeneous across Europe, as are the visual characteristics of the transition area; i.e.: Following the standards analysed for the purpose of this report, tapers may be delineated by panels (e.g. Germany, Austria, Slovenia & Flanders) or by cones (e.g. UK and Ireland). Safety barriers may be in use depending on the local conditions;much variation also exists to separate adjacent lanes: yellow/orange temporary marking with a neutral zone (e.g. Germany Austria, & Flanders) or a combination of marking and studs or studs and cylinder (UK and Ireland).
Minor RW on motorway: On short-term works the equipement used to shift a lane or guide traffic along adjacent lanes are typically quickly moveable devices like cones and panels.	Minor RW on motorway: One should notice that German standards specify that the lane shift is being composed of a safety vehicle (truck type) mounted with a light flashing arrow (i.e. no taper with cones). Warning trailer are used in Norway.
Mobile RW on motorway: In all countries mentioned in this report the road work vehicle is preceeded by a safety (block) vehicle mounted with a TMA and a light arrow sign, in Germany and Austria without TMA. The distance between these vehicles ranges from 50 to 100m. However the number of advance warning vehicles depends on the considered country (cf. differing practices).	Mobile RW on motorway: Standards mainly differ by the number (one or two) of safety vehicles use in the back of the work vehicle, by the distance between the vehicles, by the equipement used (with or without a TMA) and by the design of the signing used on the back side of the vehicle (cf. chapter 2.3).

Major RW on single carriageway road: On the majority of countries consulted the lane is closed through a transversal (90°) fence (i.e. Flanders) or a 45° taper (a 1:10 taper in Germany) executed with cones or panels (i.e.Ireland, Norway, Slovenia, UK). The visibility of both closure mecanisms is ensured; i.e. by reflective strips, flashing lights and/or lamps.	Major RW on single carriageway road: Transversal (90°) fence or a (45°) taper with executed with cones or panels are both practices found in Europe to close a lane on such road work. Warning trailers are also mentioned in the Nowegian standard.
Minor RW on single carriageway road: Standard practices are similar to the one deployed for major RW, except for Germany (cf. Significant differences at right column).	Minor RW on single carriageway road: As for minor RW on motorways Austrian, German and Norwegian standards specify that the lane must be closed shift by a safety vehicle (truck type) mounted with a light flashing arrow and not through a taper. Minor RW layout in Austria, Germany and Norway is more similar to the mobile RW layout.
Mobile RW on single carriageway road: The working vehicle must be appropriately signed; e.g. flashing lights, keep left/right sign. However the use of a preceeding safety vehicle is not mandatory in all the countries or depends on the local road conditions.	Mobile RW on single carriageway road: Standard practices largely differ, particularly about the signing of the work vehicle and the use (or not) of a safety vehicle (e.g. not mandatory in Flanders and Norway, well in Germany and optional in UK and Ireland depending on the local consitions).

3.2.3 Temporary speed limit schemes

Similar practices (conveying similar message)	**Significant differences** (omissions, differing practices)
Major RW on motorway: On the majority of countries the standard speed limit is 70 - 80 kph. An additional speed reduction, i.e. up to 50 – 60 kph in special cases is possible.	Major RW on motorway: In all the countries analysed in this report the speed limit decreases by successive steps of 20 to 30km/h. However the location of the speed limit signs (and therefore the length of the transition zones) is highly heterogeneous.

Minor RW on motorway: Standard speed limit is 70 – 80 kph, with the exception of Germany (100 km/h) and U-K (temporary speed limit not required).	Minor RW on motorway: More variation is observed here (as compared to major RW) for what concerns the speed limit reduction; the location of the speed limit signs being again highly heterogeneous.
Mobile RW on motorway: When in use the standard temporary speed limit is 80 – 100 kph.	Mobile RW on motorway: Half of the national standards analysed do not use any speed limit reduction (Austria, Ireland, Norway). Some others (UK, Flanders, Slovenia) temporarily install a (20 kph to 30 kph) speed reduction in some circumstances.
Major RW on single carriageway road: The standard temporary speed limit is 50 km/h. Depending on the original posted speed intermediate speed limits are being installed.	Major RW on single carriageway road: In UK standards there is more emphasis on direct risk management than on speed management itself. Again the location of the speed limit signs is highly heterogeneous, as for RW carried out on motorway.
Minor and mobile RW on single carriageway road: Standard speed limit is 50 km/h, with the exception of Germany and Austria (no speed limit).	Minor RW on single carriageway road: No temporary speed limit in Germany and Austria. In UK standards there is more emphasis on direct risk management than on speed management itself (i.e. reduction of speed limit is not mandatory).
Mobile RW on single carriageway road: The speed limit is usually not reduced for such RW.	

3.2.4 Lateral safety distance, lane width & delineation of the work zone

Similar practices (conveying similar message)	**Significant differences** (omissions, differing practices)
Major RW on motorway: Standard lane widths are 3,00 to 3,25 for HGV lanes, 2,75 (exceptionally 2,50m in Germany) to 3,00 for light vehicle lanes. Safety barriers only as an option (e.g. depending on the speed limit), standard delineation by panels or beacons.	Major RW on motorway: Two groups of countries with differing lateral safety distances: 50 cm in Flanders and Germany, 120 cm in UK and Ireland. A larger lateral clearance is even required in Norway (i.e. 3m). On the contrary Austrian and Slovenian standards do not fix a minimum requirement for lateral safety distance. Slovenian standards liaise lane width and speed limit requirements. UK allows using cones to separate work zone to traffic lane.
Minor RW on motorway: Standard lane widths are not defined, exceptionally in Flanders and Slovenia (liaise with speed limit). Standard delineation by cones, optionally (Slovenia, Belgium) by safety panels.	Minor RW on motorway: Two groups of countries with differing lateral safety distances: 50 cm in Flanders and Germany, 120 cm in UK and Ireland. Austrian, Norwegian and Slovenian standards do not fix a minimum requirement for lateral safety distance
Mobile RW on motorway: Standard delineation (if any) by cones.	Mobile RW on motorway: Two groups of countries with differing lateral safety distances (when specified by the standards): 50 cm in Flanders and Germany, 120 cm in UK.
Major and minor RW on single carriageway road: Standard lane widths are 2,75 to 3,25m, if defined. Standard delineation by cones or by safety panels.	Major and minor RW on single carriageway road: Two groups of countries with differing lateral safety distances(when specified by the standards): 50 cm in Flanders and Germany, 120 cm in UK and Ireland.

3.3 Discussion about opportunities to improve road work signing consistency between countries

The following elements emerged from the description and analysis of road work signing practices (following standards) in Austria, Belgium, Germany, Ireland, Norway, Slovenia and UK. Categorised under four key road work parameters they are considered as issues that should be addressed to improve the consistency of road work signing and equipment across Europe. Ideas for harmonisation of practices and equipment are given below and should provide benefit to road users and road workers safety.

Advanced warning

- Harmonisation of RW legibility particularly with respect to "amount" of signing, distances between successive signs used for RW warning and lane management and the background sign color (address questions: How much? Where? How?)
- In particular, more consistent location and use of equipment for advance warning upstream of mobile RW. Mobile road works on motorways often raise a lot of safety concerns, particularly when they are executed on the slow lane (used by the trucks). A lot of progress has already been done to help drivers detect the upcoming work zone in due time; e.g. vehicles carrying dynamic LED matrix, repetition of warning vehicles on the verge or emergency lane. Now it appears necessary to draw recommendations from these differing practices and where possible to target more homogeneity across Europe
- As mentioned under chapter 3.2.1 standards for signing of minor and mobile RW on single carriageway roads appear to be more heterogeneous than for motorways. However even if road works on lower class roads may appear to be less critical because supporting lower traffic volume and at lower speed road workers may also be at risk. More consistent signing based on the best European practices (i.e. a sequence of "Road works ahead" and "no overtaking" static signs along the last few 100m, or advance signs upstream of the mobile road work with a distance over which hazard extends, up to the use of a safety vehicle where required by the local conditions) is therefore also desirable for road works carried out along these roads .

Transition area/Vehicles

- The design of the central reserve crossing (or lane shift for minor road works) on motorways offers many opportunities to improve the consistency of road work signing across European countries. Indeed this type of road work leads to much variation in what concerns the lane shift geometry (should be adapted to the temporary posted speed limit and amount of road workers protection), the delineation and the equipement used to guide users of adjacent lanes. However at this stage it appears difficult to state what equipment performs best.
- Standard practices differ as regards to the safety vehicles deployed to close (a) lane(s) for mobile road works on motorways. As for advance warning recommendations should now be drafted based on the experience gained across Europe. Key issues are related to the number of safety vehicles deployed in the lane and the distance between them (road workers safety), the use of TMA (road user safety) and the design of the signing used on the rear of the vehicles (visibility and conspicuity of the work zone directly impacting both workers and users safety). This conclusion is also valid for mobile road

works on single carriageway roads where standard practices largely differ, particularly regarding the signing of the work vehicle and the use (or not) of a safety vehicle.The analyses of European standards reveal that different methods are being used to close a lane on single carriageway roads where major or minor works are executed; i.e. a transversal (90°) fence or a (45° or 1/10) taper with executed with cones or panels or a safety vehicle mounted with a light flashing arrow. This diversity of methods demonstrates again that these road work situations are good candidates for a better harmonisation of practices, based on an analysis of which ones best perform.

Temporary speed limit schemes

- For major road work on motorway a good homogeneity is achieved across Europe concerning the temporary speed limit (typically up to 70 - 80 kph) and the progression of how the speed reduction is introduced (steps of 20 to 30km/h). However a lack of homogeneity is evident concerning the location of the speed limit signs. Literature clearly demonstrates that driver behaviour is highly impacted by the credibility of the speed limit. This latter parameter should therefore be further considered and temporary speed limit signs located so as to introduce a smooth speed reduction as far as possible in line with road user driving expectations.
- Minor and mobile road work sites on motorways suffer from the same lack of homogeneity. On these sites even the speed limit reduction is highly variable from one country to another (e.g. 70kph up to 100 kph for minor RW or even no temporary speed limit reduction required). A more consistent approach may therefore be necessary, provided other road work characteristics (typically the equipment used to protect road workers) are taken into consideration.
- On single carriageway roads the standard temporary speed limit along major road works is 50 km/h (except for U-K that only recommends a speed limit reduction). Standards largely divergeconcerning the implementation of temporary speed limits for minor road works. For both types, a more consistent approach may be favourable to fit to drivers expectancy while ensuring road worker safety.

Lateral safety distance, lane width & delineation of the work zone

- Along major road works carried out on motorways the lateral safety distance, lane width & delineation of the work zone must be considered together as they usually depend on the total width of the carriageway, the dimension of the work zone, the space necessary for the movements of the work vehicles as well as on the need to access and exit from the work area. Homogeneisation of standards in these fields appears therefore difficult. However best practices could be identified for some typical scenarios. In these scenarios HGV lane widths ranging from 3,00 to 3,25m and from 2,75 to 3,00m for light vehicle lanes should be considered as standard. Decisions on lateral safety distance and selection of delineators should be supported by field experience and risk evaluation (for which detailed accident data are necessary).
- On motorways the work zones of minor road works are typically delimited by cones, optionally by panels. However data are missing to identify which equipment performs best. On one side road worker risk exposure can be limited by using quickly moveable equipment (e.g. cones) and on another side, road user perception of the work zone may be positively impacted by more visible equipment (e.g. safety panels). At this stage highly visible and quickly moveable solutions (e.g. min 70cm high cones with reflective strips) seems to be good practice.

- Considering the likely lower level of road worker protection (cf. discussion above) it seems reasonable to suggest reviewing the conditions for the (longitudinal) safety distance requirements for minor road work on motorways (they are currently not fixed in some countries) and, in a second step, considering how to homogenize them.

- These two last elements are also valid for mobile road works executed on motorways for which workers on foot are exposed to traffic.

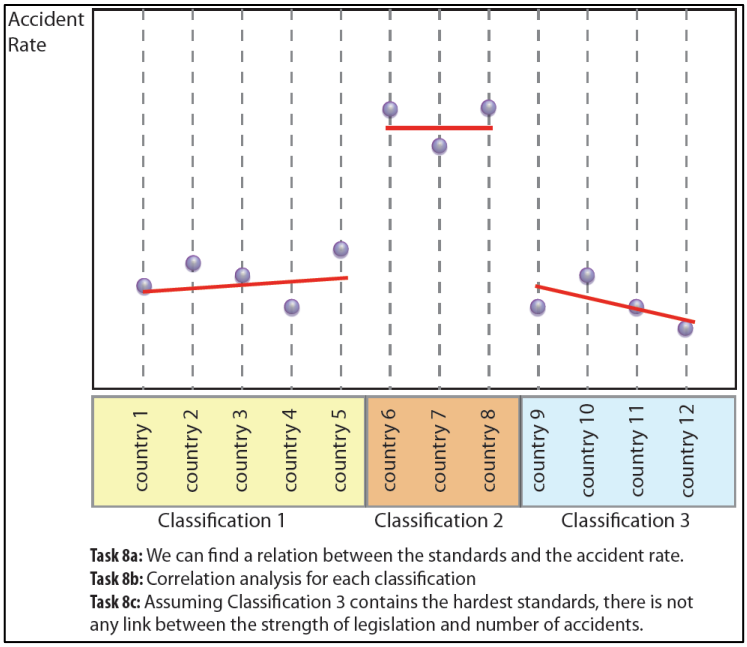
4 Classification of RW layout/signing standards

The descriptive analysis carried out during the work package 7 (cf. chapters 2 and 3.1) as well as the synthesis of common practices and significant differences provided in Section 3.2) provide a solid basis to enable comparison between EU countries with different standards and the national injury accident data for road workers and road users. It therefore supports correlation studies to be carried out within the work package 8 (i.e. trying to determine whether there is a correlation in accident rates between countries with similar practices and, in addition, determine whether there is any link between the strength of legislation and number of accidents within road works).

The upcoming work package will look further at the development of the most appropriate classification method at the same time as the parameters required to assess the road work accident ratio will be defined. Nevertheless from its beginning WP7 (and consequently this report) has been organised to help classify the RW layout/signing standards based on the different levels of mandatory provision within the individual requirements for each country, as suggested in the project proposal. The consortium has already discussed a provisional classification method that focusses on key elements for road workers and road user safety and this is discussed briefly below.

4.1 Provisional classification method

Basically the correlation studies need an appropriate method to classify different countries according to their standards, in particular to be able group countries with similar practices, distinguishing countries with slightly and significantly differing practices and finally considering specifically the level of mandatory provision (in other words the strength of legislation); as suggested by the following figure.



Philosophy behind the WP8 tasks - Illustration

The philosophy behind the classification method suggested during WP7 is presented below. Its feasibility will be further discussed and evaluated during WP8, in light of the development of the method to calculate the road work accident ratio.

Classifying the RW layout / signing standards is possible through the use of six matrices (one per combination of road / road work type discussed in the previous chapters), making use of a serie of classification elements (between five and eight depending of the type of road / road work; cf. tables below), all being key elements for road workers and road user safety.

Matrix for Major RW (on 3 lanes) Motorway with Crossover

Criteria	**Country A**	**Country B**	**Country Z**
Far-advance warning (type of signs & distance)	Value i…n		
Near-advance warning (type of signs & distance) - around last 300 m	Value j…m		
Crossing of the central reserve/Lane shift geometry (angle, opening width, length, lane width, safety area) Delineation and marking in the transition area (taper)	Value k…o		
Work zone delineation			
Work zone lateral safety distance			
Physical separation of the opposite traffic flows			
Work zone speed limit (scheme/reduction)			
Temporary lane width			
Total of ratings			

Matrix for minor RW on (3 lanes) Motorway (right lane closed)

Criteria	**Country A**	**Country B**	**Country Z**
Far-advance warning (type of signs & distance)	Value i…n		
Near-advance warning (type of signs & distance)	Value j…m		
Lane shift geometry (angle, length)	Value k…o		
Work zone delineation			
Work zone lateral distance			
Work zone speed limit (scheme/reduction)			
Temporary lane width			
Total of ratings			

Matrix for mobile RW on (3 lanes) Motorway (right lane closed)

Criteria	**Country A**	**Country B**	**Country Z**
Lane shift geometry	Value i…n		
Advance warning: sign & distance	Value j…m		
Safety vehicle(s): presence, number, type & characteristics	Value k…o		
Distance between the Work vehicle and the Safety vehicle(s)			
Work zone speed limit (scheme/reduction)			
Total of ratings			

Matrix for major RW on single carriageway (80/90 km/h) road

Criteria	Country A	Country B	Country Z
Far-advance warning (type of signs & distance)	Value i…n		
Near-advance warning (type of signs & distance)	Value j…m		
Lane shift geometry (angle, length)	Value k…o		
Work zone delineation			
Work zone lateral safety distance			
Work zone speed limit (Scheme/reduction)			
Temporary lane width			
Total of ratings			

Matrix for minor RW on single carriageway (80/90 km/h) road

Criteria	Country A	Country B	Country Z
Far-advance warning (type of signs & distance)	Value i…n		
Near-advance warning (type of signs & distance)	Value j…m		
Lane shift geometry (angle, length)	Value k…o		
Work zone delineation			
Work zone lateral safety distance			
Temporary lane width			
Work zone speed limit (scheme/reduction)			
Total of ratings			

Matrix for mobile RW on single carriageway (80/90 km/h) road

Criteria	Country A	Country B	Country Z
Lane shift geometry	Value i…n		
Advance warning: sign & distance	Value j…m		
Safety vehicle(s): presence, number, type & characteristics	Value k…o		
Distance between the Work vehicle and the Safety vehicle(s)			
Work zone speed limit (Scheme/reduction)			
Total of ratings			

4.2 Discussion

The main issue indeveloping this classification method is related to the identification of the possible “values” corresponding to the criteria listed below and the establishment of the associated “rating”; typically the problem how to decide on the boundaries between successive levels.

The three following examples illustrate these questions:

1. Far-advance warning - Distance
   - **Level 1**: first sign location <= 1000m
   - **Level 2**: 1000m<first sign location <= 2000m
   - **Level 3**: first sign location > 2000m

2. Near-advance warning (around last 300 m) - Lane management warning
   - **Level 1**: standard static warning sign
   - **Level 2m**: static warning sign with flashing lights and/or physical traffic management (e.g. rumble strips) and/or other warning device

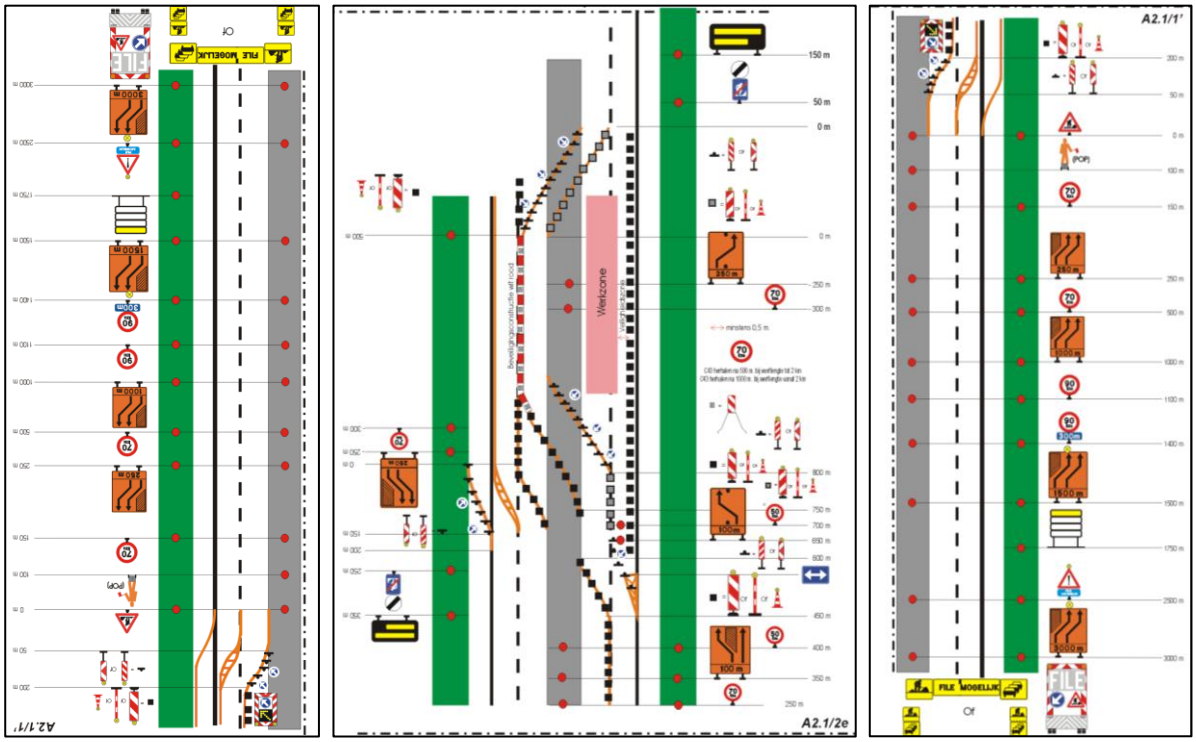
- **Level 3**: dynamic lane management and/or speed display and/or dedicated VMS

3. Work zone lateral safety distance
   - **Level 1**: <= 0,5 m
   - **Level 2**: > 0,5m & <=1,5m
   - **Level 3**:> 1,5m

At this stage, the most relevant option seems to be identify the range of values a specific parameter takes across the set of countries and decide on the level thresholds ensuring they discriminate between significantly diverging practices.

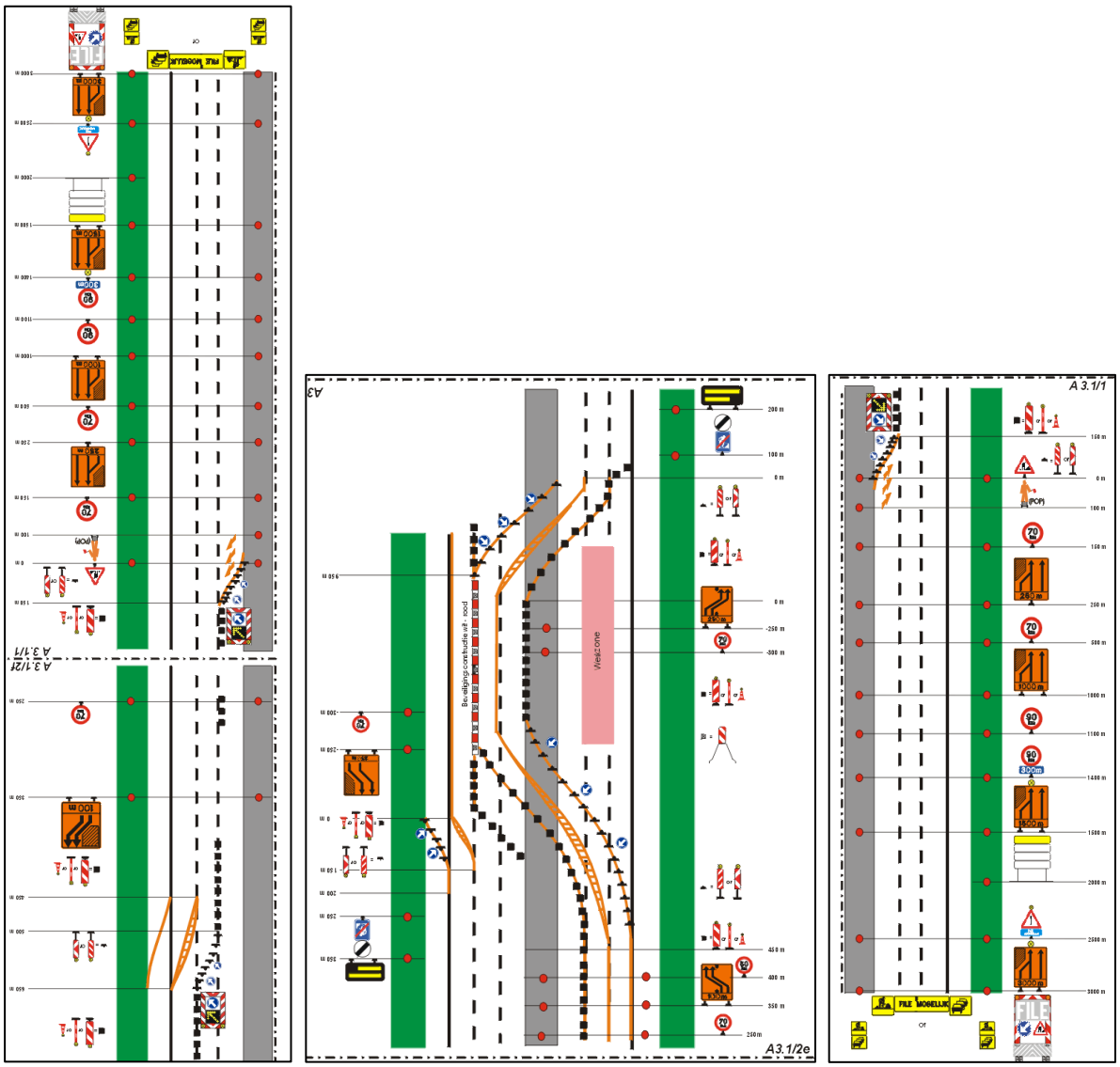
Appendix 1: Belgium (Flanders): Standard road work layout and signing

Major road work (BE category 1) on a 2 lanes Motorway with Crossover: Schemes for signing (Belgium-Flanders)
3+1 temporary layout



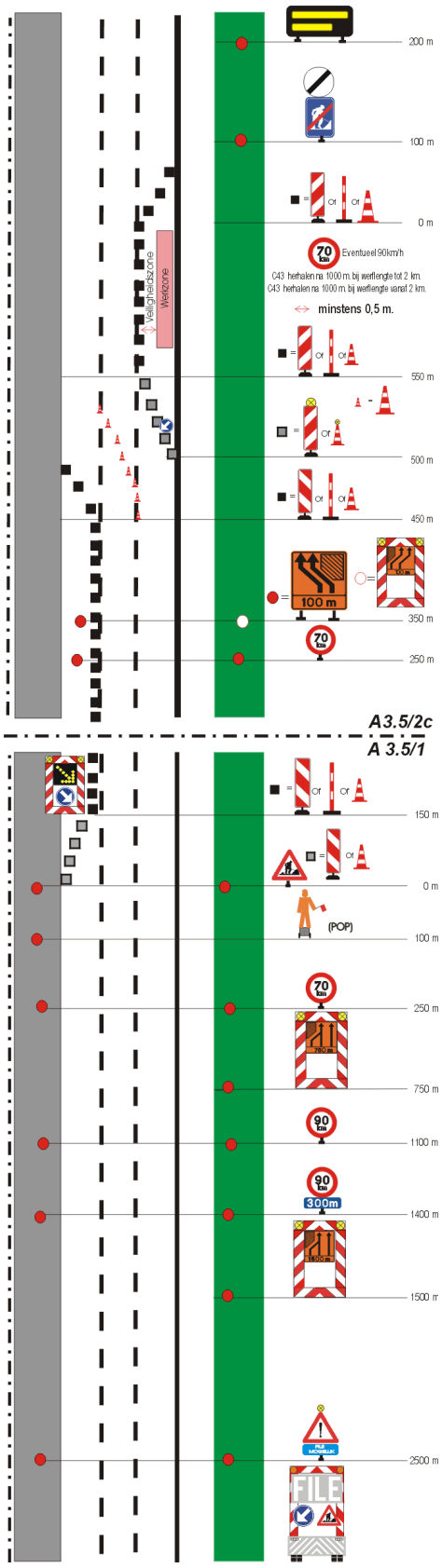
Source: *CD-ROM Werfsignalisatie 2000*
Type:
Autosnelwegen 2 x 2 rijstroken
Werken van 1ste categorie: werken van langere duur
Werken die het verkeer sterk hinderen (tenminste 1 rijstrook onttrokken aan het verkeer)
Doorsteek door middenberm met 1 rijstrook gebruik van pechstrook

Major road work (BE category 1) on a 3 lanes Motorway with Crossover: Schemes for signing (Belgium-Flanders)
4+0 temporary layout



Source: *CD-ROM Werfsignalisatie 2000*
Type:
Autosnelwegen 2 x 3 rijstroken
Werken van 1ste categorie: werken van langere duur
Werken die het verkeer sterk hinderen (tenminste 1 rijstrook onttrokken aan het verkeer)
Doorsteek door middenberm met 2 rijstroken

Minor road work (BE category 5) on a 3 lanes Motorway with closure of the slow lane: Schemes for signing (Belgium-Flanders)



Source: *CD-ROM Werfsignalisatie 2000*

Type:

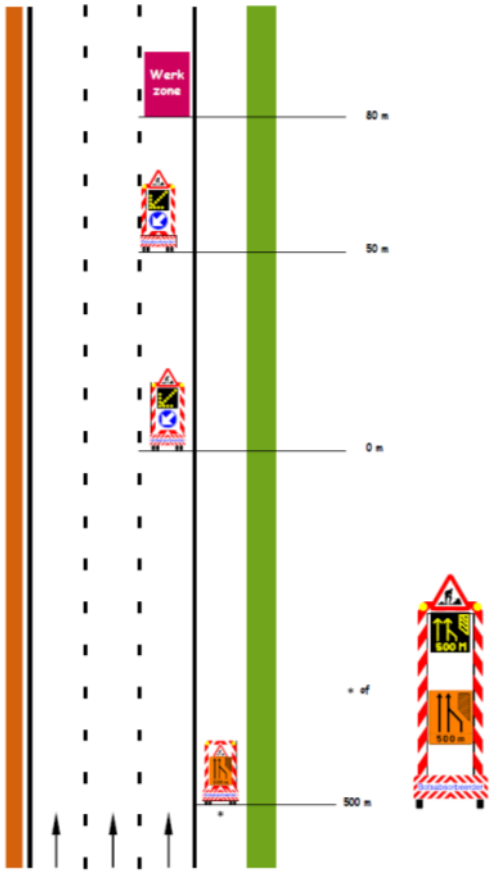
Autosnelwegen 2 x 3 rijstroken

Werken van vijfde categorie: werken uitgevoerd tussen het aanbreken van de dag en het vallen van de avond en wanneer het mogelijk is duidelijk te zien tot op een afstand van ongeveer 200m

Werken die het verkeer sterk hinderen

Afsluiten trage rijstrook

Mobile road work (BE category 6) on a 3 lanes Motorway with closure of the slow lane: Schemes for signing (Belgium-Flanders)

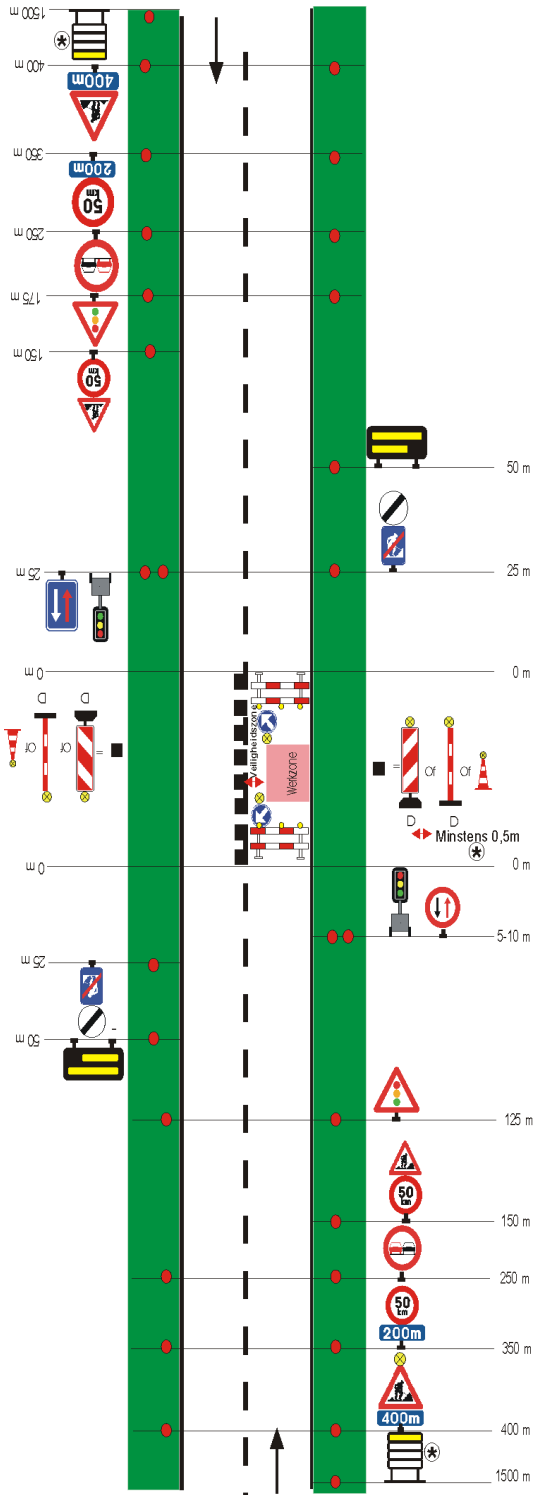


Source: *Werfsignalisatie op autosnelwegen- Werken 6de categorie; Bijlage 1 bij dienstorder MOW/AWV/2009/16*.

Type:

Autosnelwegen 2 x 3 rijstroken: doorgaand verkeer: werken op rechterrijstrook (2x3)

Major road work (BE category 2) on a single carriageway (50<posted speed≤90kph) road: Schemes for signing (Belgium-Flanders)



Source: *CD-ROM Werfsignalisatie 2000*

Type:

Niet-autosnelwegen

Max. toegelaten snelheid hoger dan 50 km/h en lager dan of gelijk aan 90 km/h

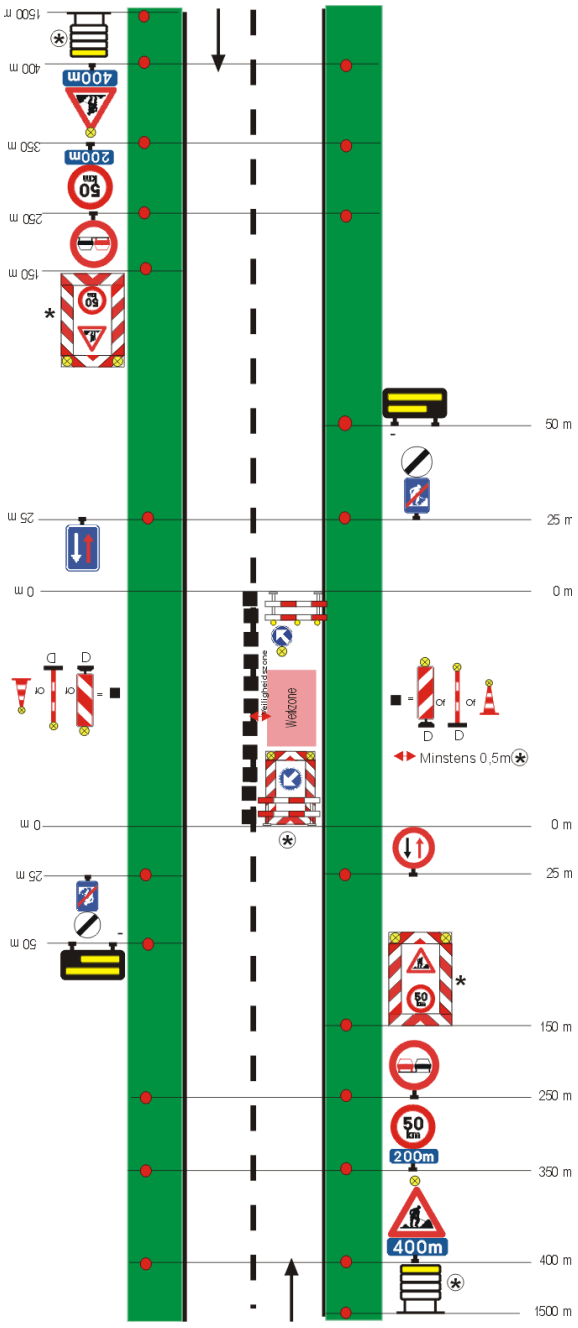
Werken van tweede categorie

Werken die het verkeer sterk hinderen: tenminste 1 rijstrook onttrokken aan het verkeer

Twee rijstroken

Afsluiten 1 rijstrook, regeling met 3-kleurige verkeerslichten

Minor road work (BE category 2) on a single carriageway (50<posted speed≤90kph) road: Schemes for signing (Belgium-Flanders)



Source: *CD-ROM Werfsignalisatie 2000*

Type:

Niet-autosnelwegen

Max. toegelaten snelheid hoger dan 50 km/h en lager dan of gelijk aan 90 km/h

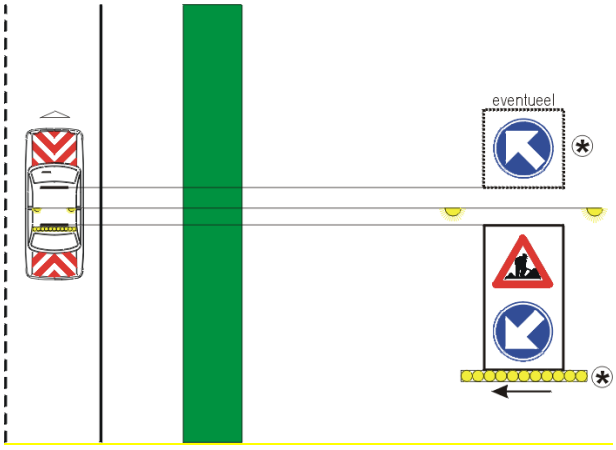
Werken van tweede categorie

Werken die het verkeer sterk hinderen: tenminste 1 rijstrook onttrokken aan het verkeer

Twee rijstroken

Afsluiten 1rijstrook, beurtelingse doorgang

Mobile road work (BE category 6) on a single carriageway (50<posted speed≤90kph) road: Schemes for signing (Belgium-Flanders)



Source: CD-ROM Werfsignalisatie 2000

Type:

Niet-autosnelwegen met toegelaten snelheid > 50 km/h en < 90 km/h

Werken van zesde categorie

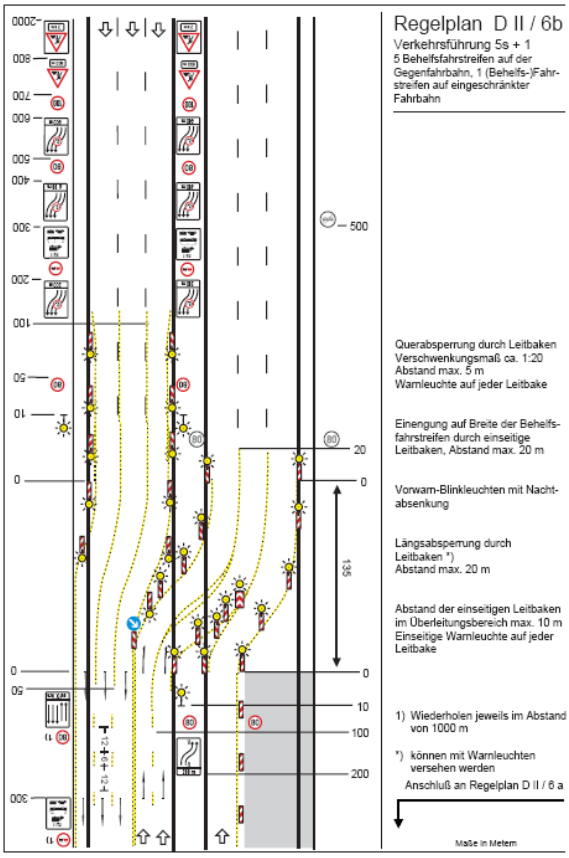
Werken die het verkeer sterk hinderen: tenminste 1 rijstrook onttrokken aan het verkeer

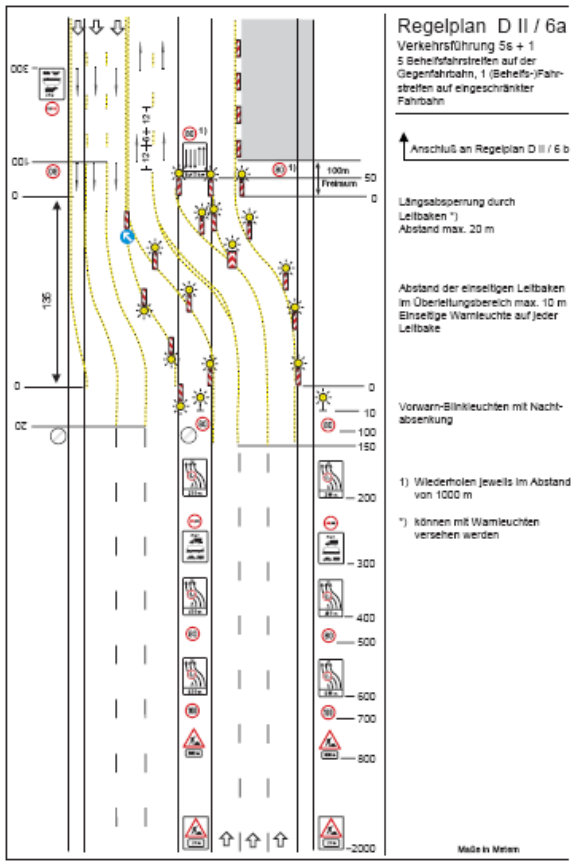
Twee rijstroken

Afsluiten 1 rijstrook, beurtelingse doorgang

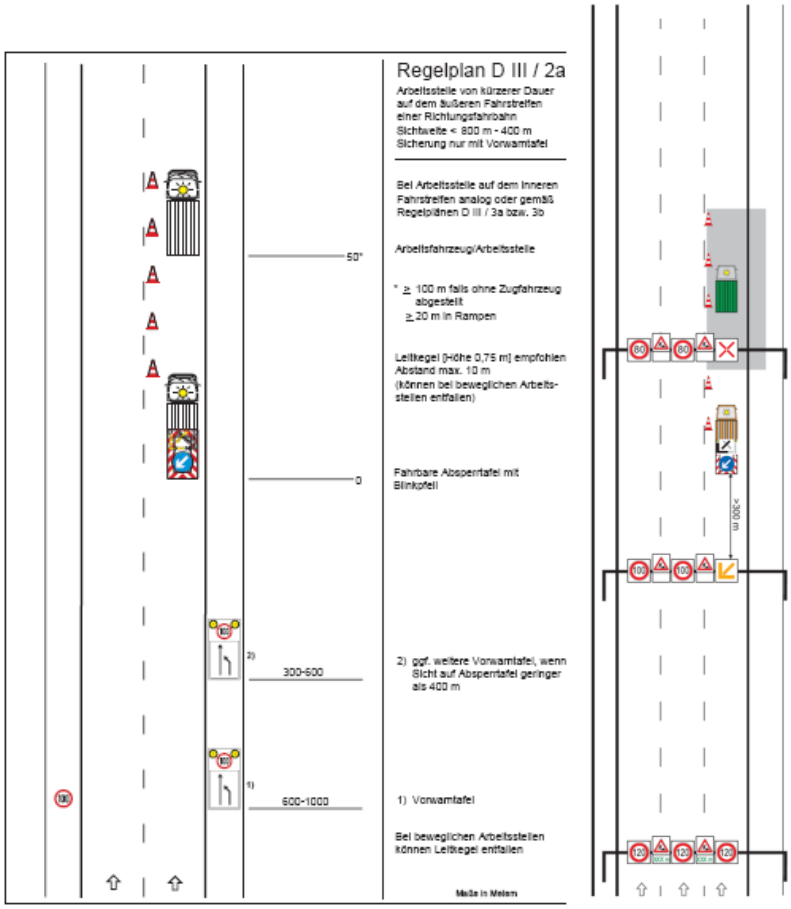
Appendix 2: Guideline layout definitions GERMANY (RSA 1995)

Long term road work zone (DE category D II/6a) on a 3 lanes Motorway with Crossover: Schemes for signing (5s+1)

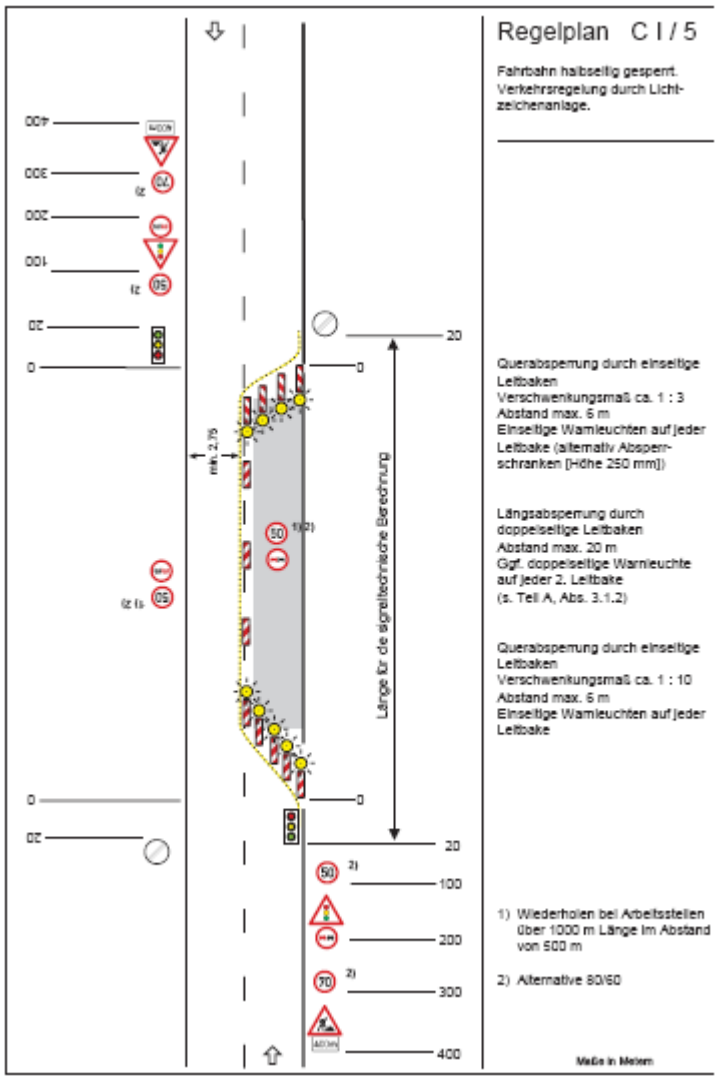




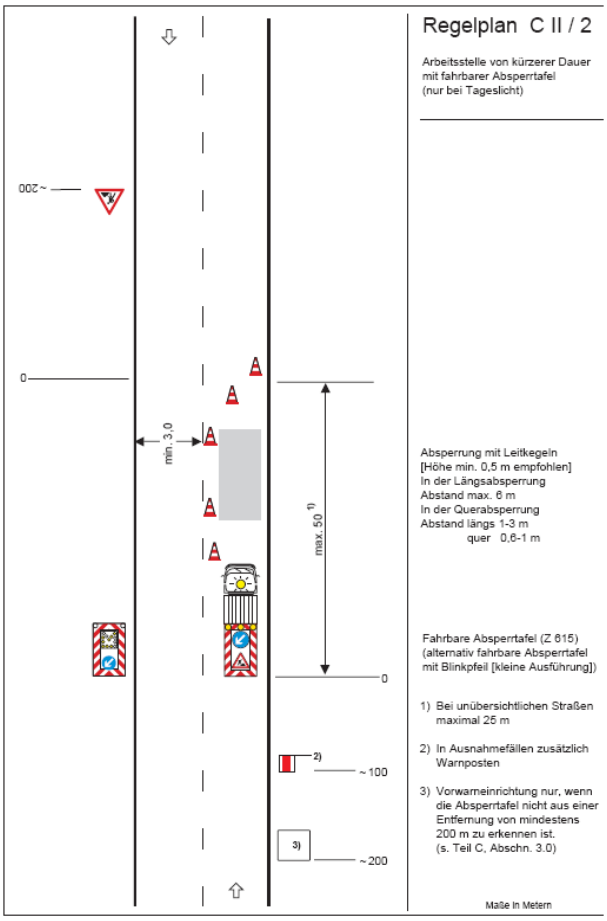
Short term or mobile road work zone (DE category D III/2a) on the slow lane of a 2 or 3 lanes Motorway: Schemes for signing



Long term road work zone (DE category C I/5) on a rural road with traffic signal: Schemes for signing

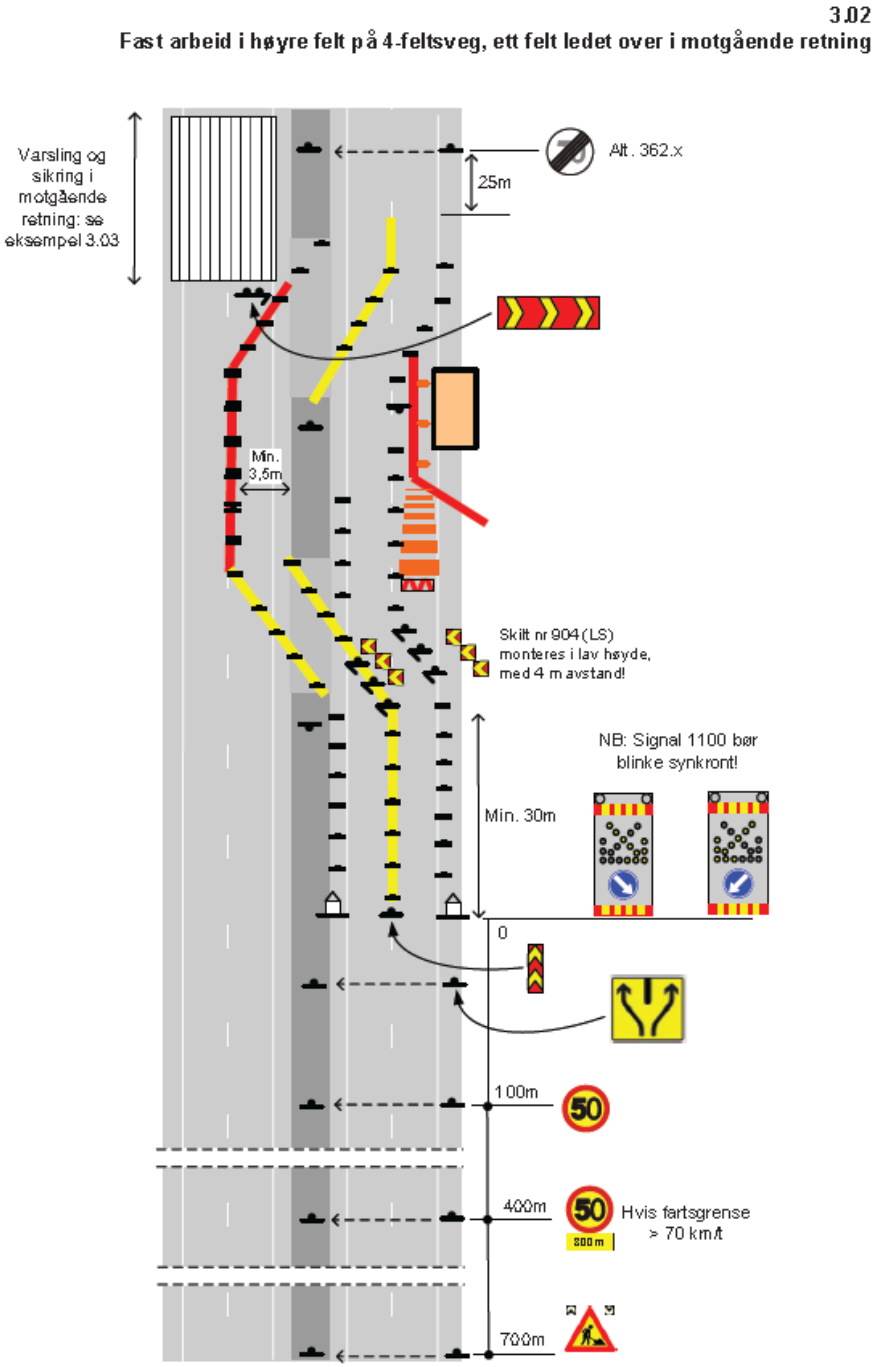


Short term or mobile road work zone (DE category C II/2) on a rural road without traffic signal: Schemes for signing

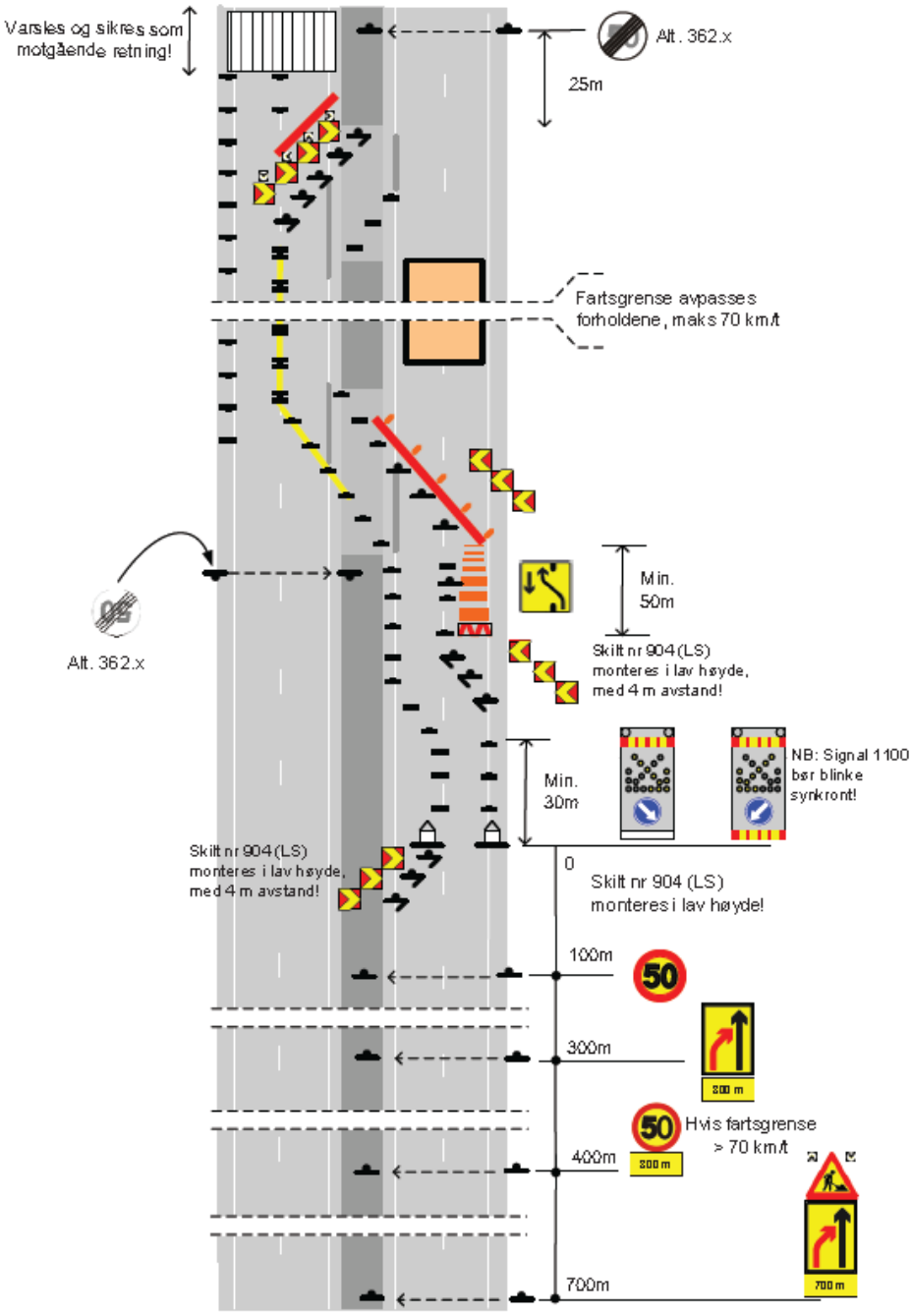


Appendix 3: Norway: Standard road work layout and signing

*Major works, **2-lane motorway**, with crossover*

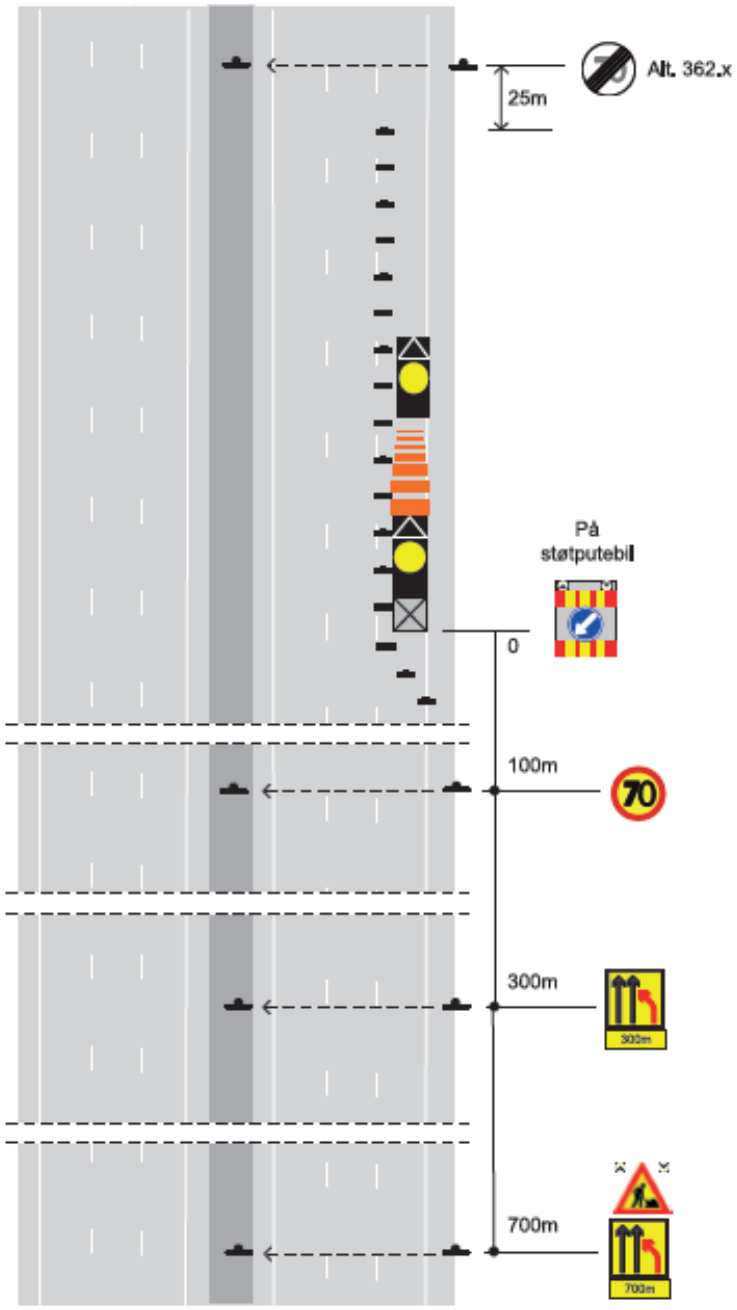


3.04
Fast arbeid i begge felt på 4-feltsveg



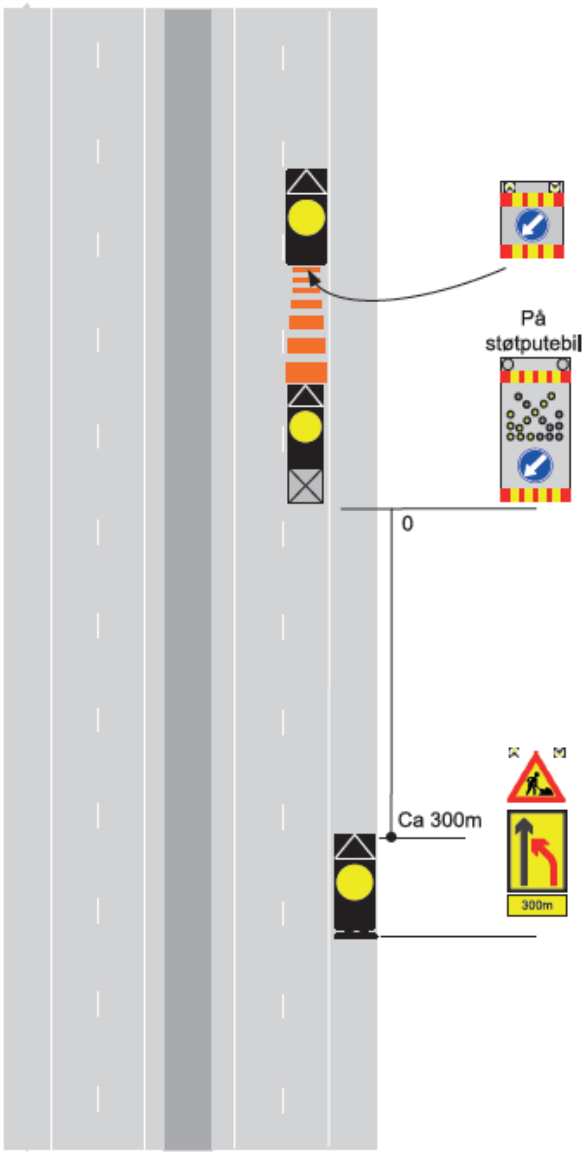
Minor works, 3-lane motorway, slow lane closed

3.09
Kortvarig arbeid i høyre felt på 6-feltsveg



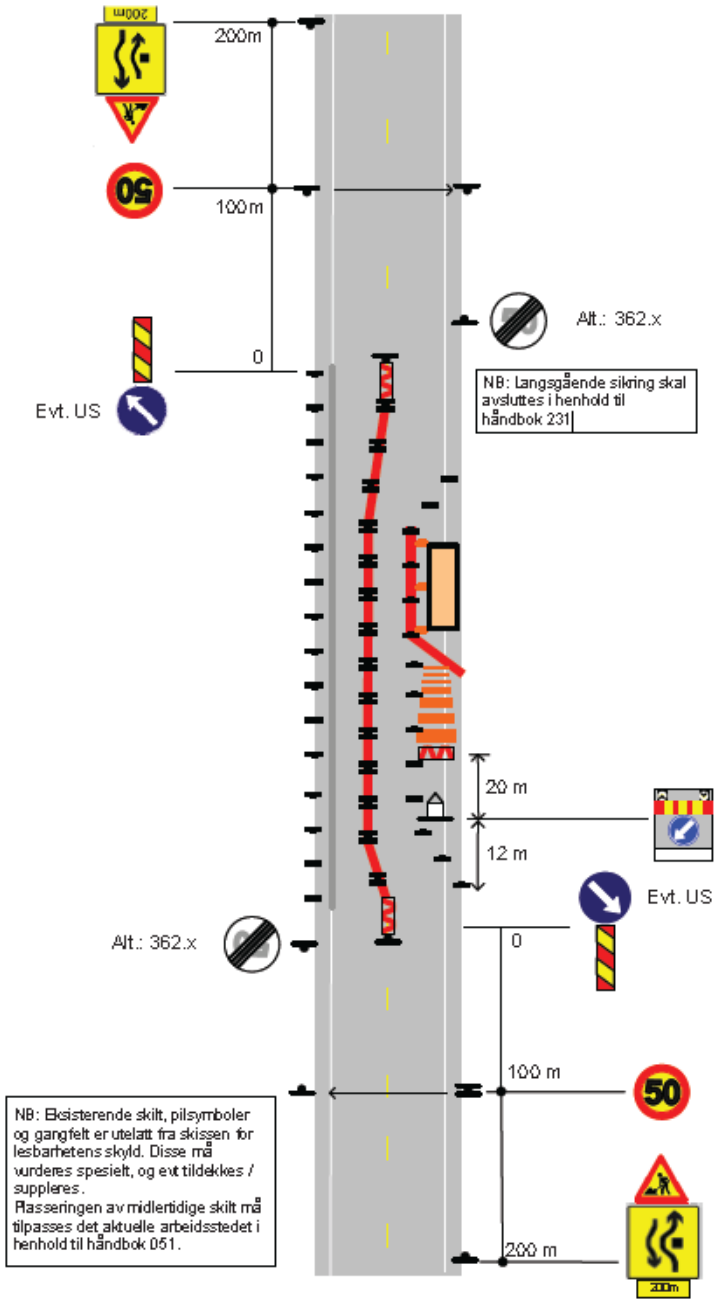
Mobile works, slow lane closed, 2-lane motorway

3.13
Bevegelig arbeid i høyre felt på 4-feltsveg

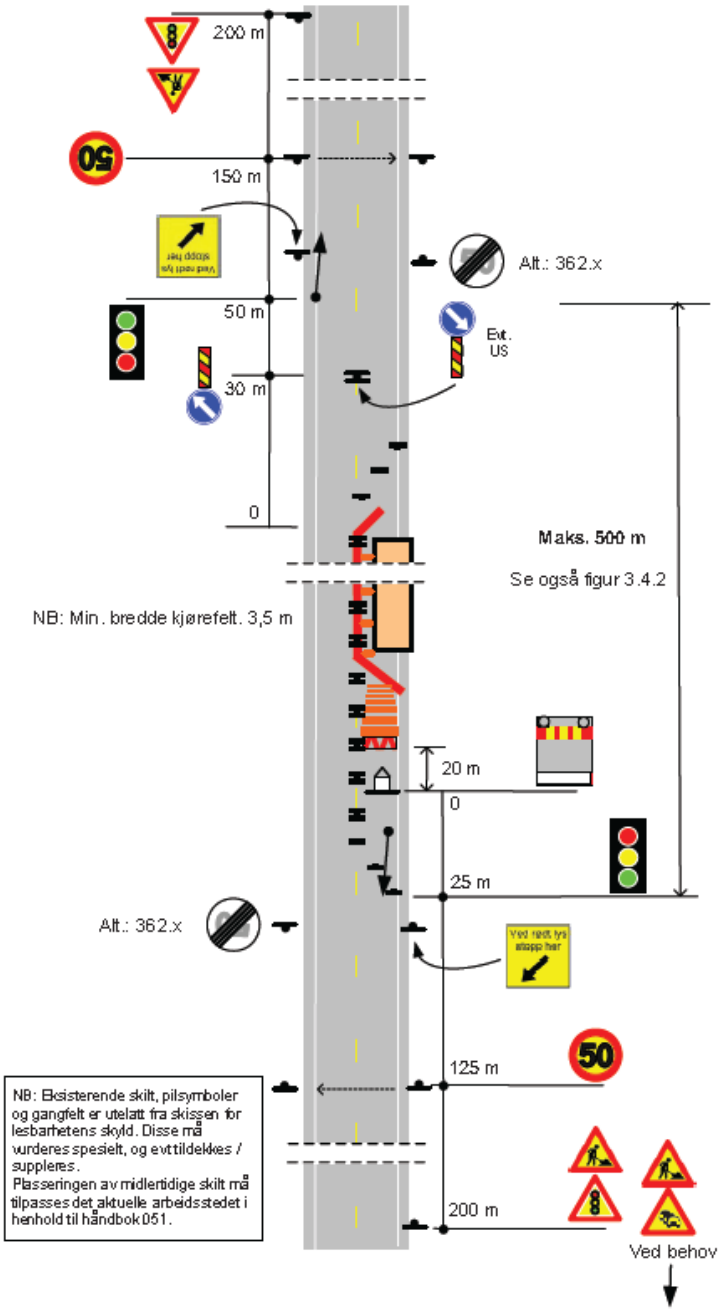


Major works, single carriageway, 80/90 km/h road

2.01
Fast arbeid

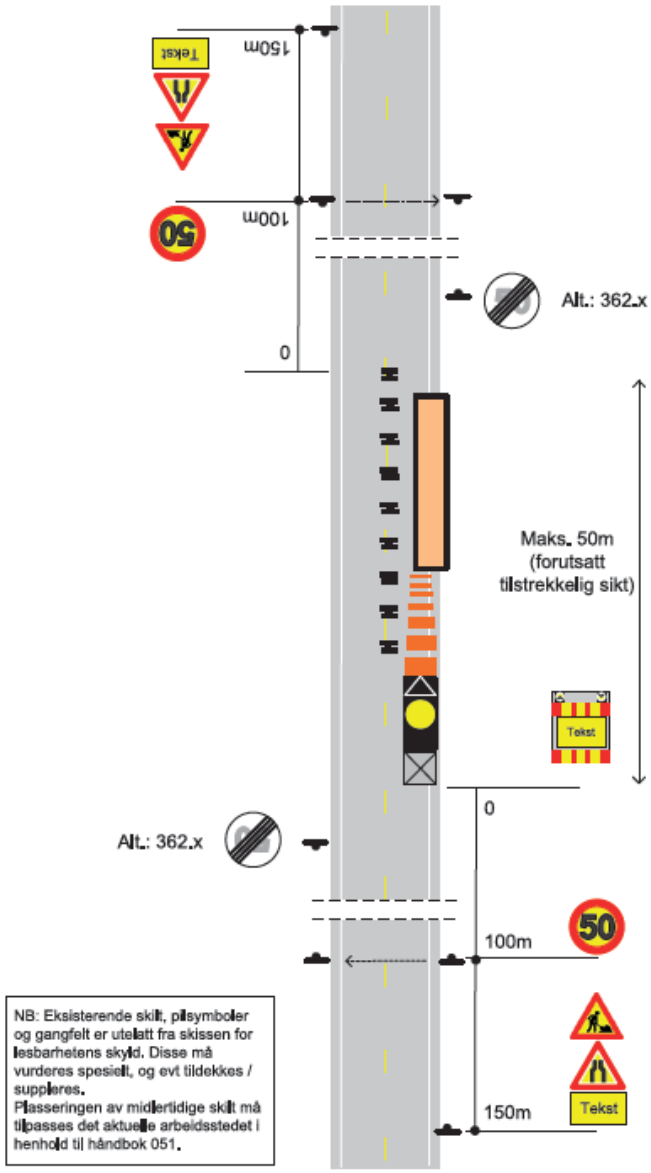


2.03
Fast arbeid med bruk av trafikklyssignaler



Minor works, single carriageway, 80/90km/h road

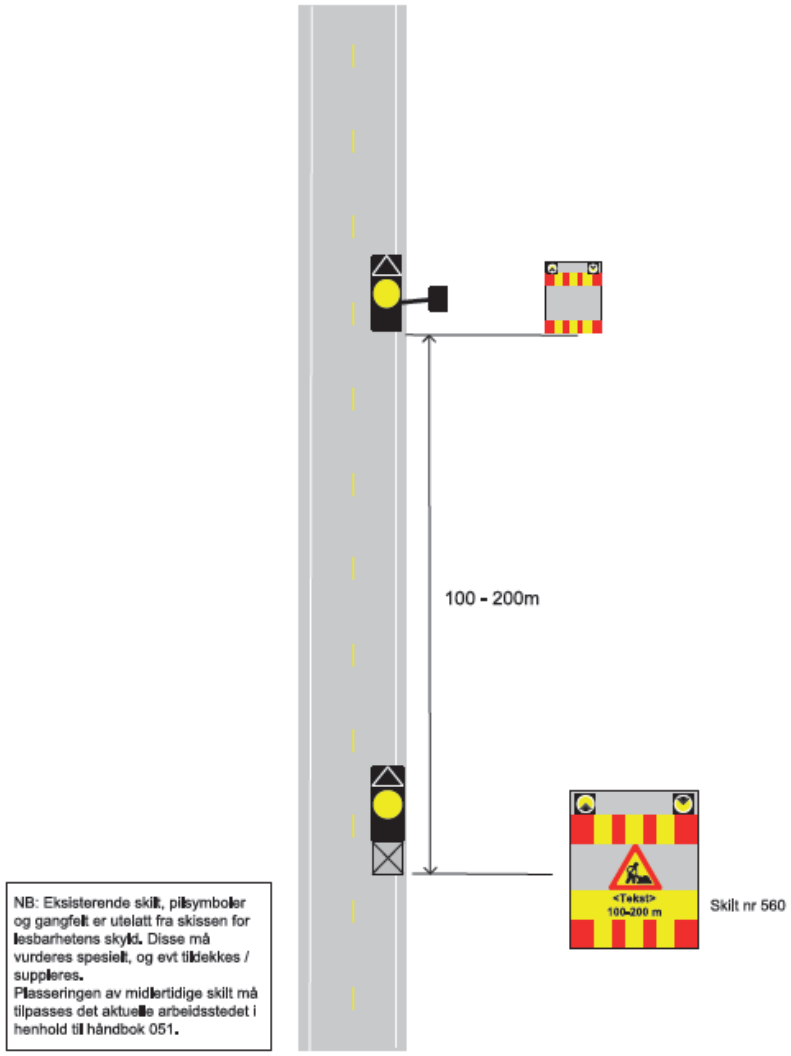
2.10
Kortvarig arbeid på/ved veg



Mobile works, single carriageway, 80/90 km/h road

With warning vehicle

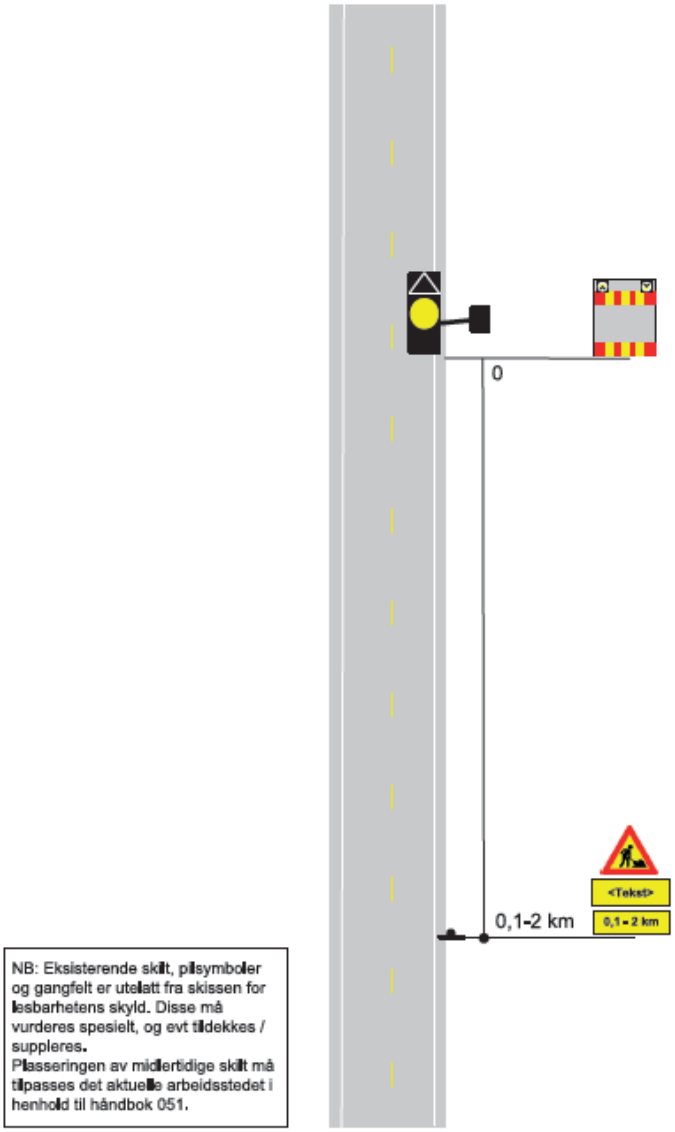
2.13
Bevegelig arbeid med bruk av varslingskjøretøy



NB: Eksisterende skilt, pilsymboler og gangfelt er utelatt fra skissen for lesbarhetens skyld. Disse må vurderes spesielt, og evt tildekkes / suppleres.
Plasseringen av midlertidige skilt må tilpasses det aktuelle arbeidsstedet i henhold til håndbok 051.

Without warning vehicle

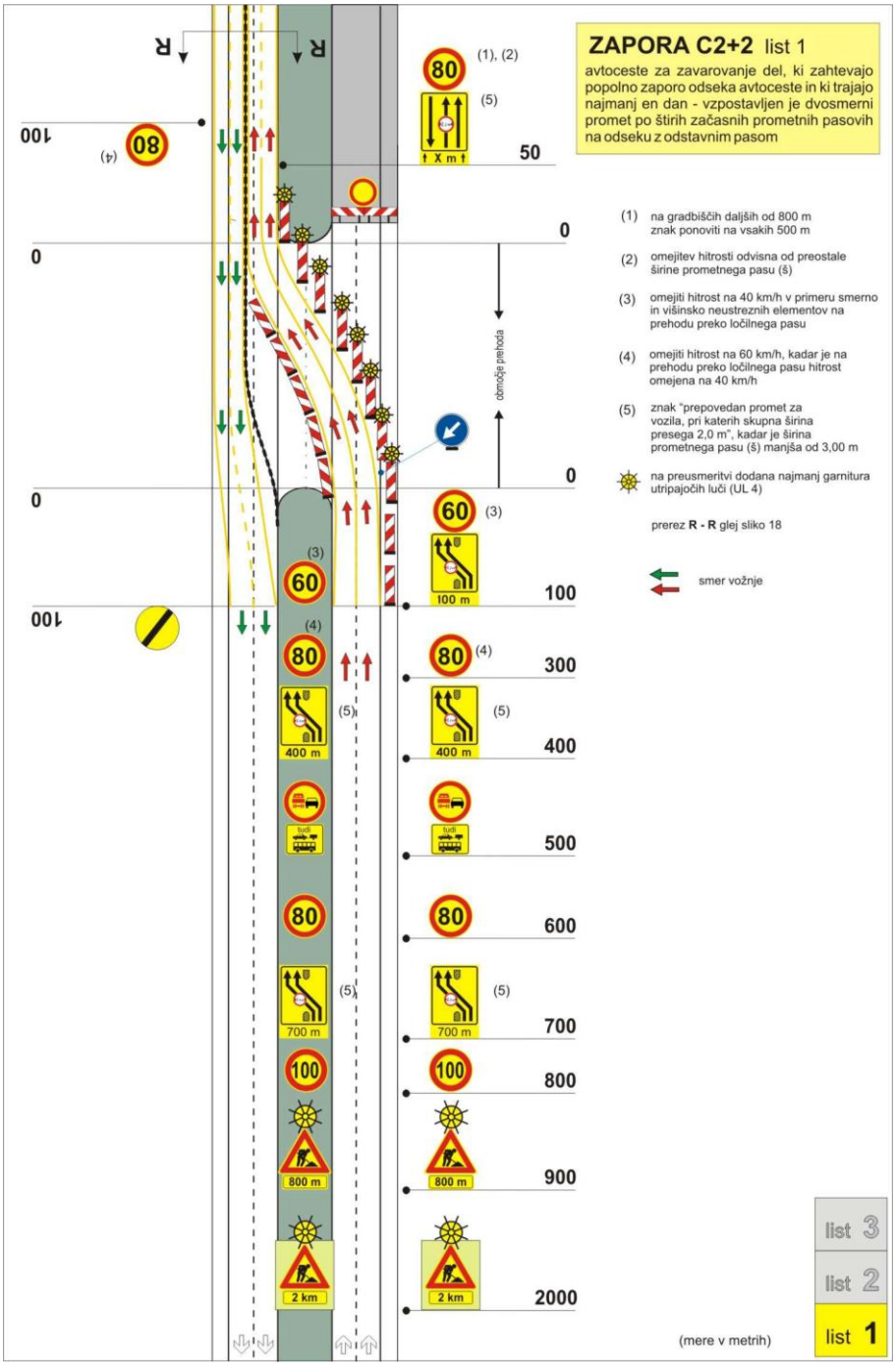
2.14
Bevegelig arbeid



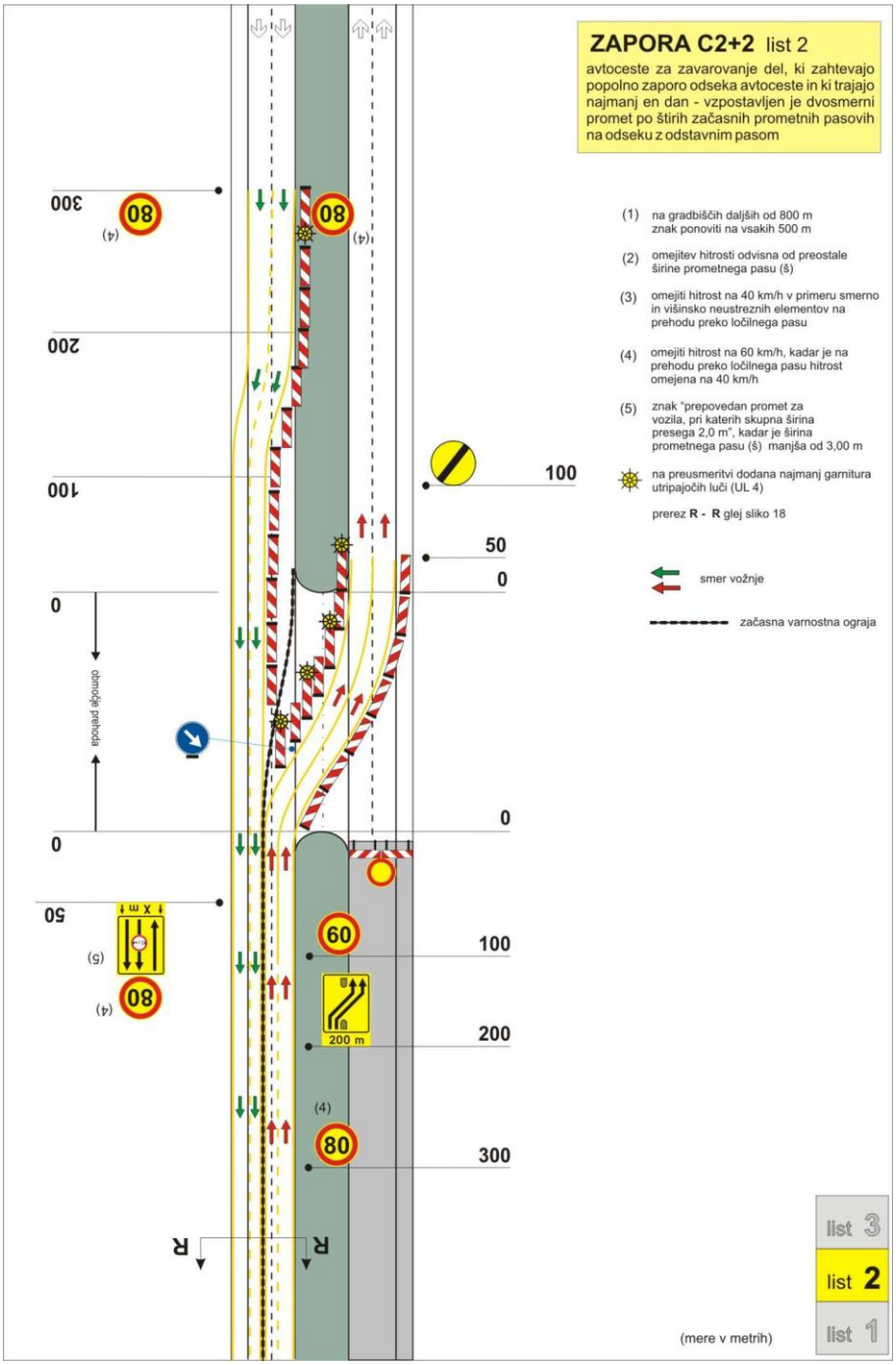
NB: Eksisterende skilt, pilsymboler og gangfelt er utelatt fra skissen for lesbarhetens skyld. Disse må vurderes spesielt, og evt tildekkes / suppleres.
Plasseringen av midlertidige skilt må tilpasses det aktuelle arbeidsstedet i henhold til håndbok 051.

Appendix 4: Slovenia: Standard road work layout and signing

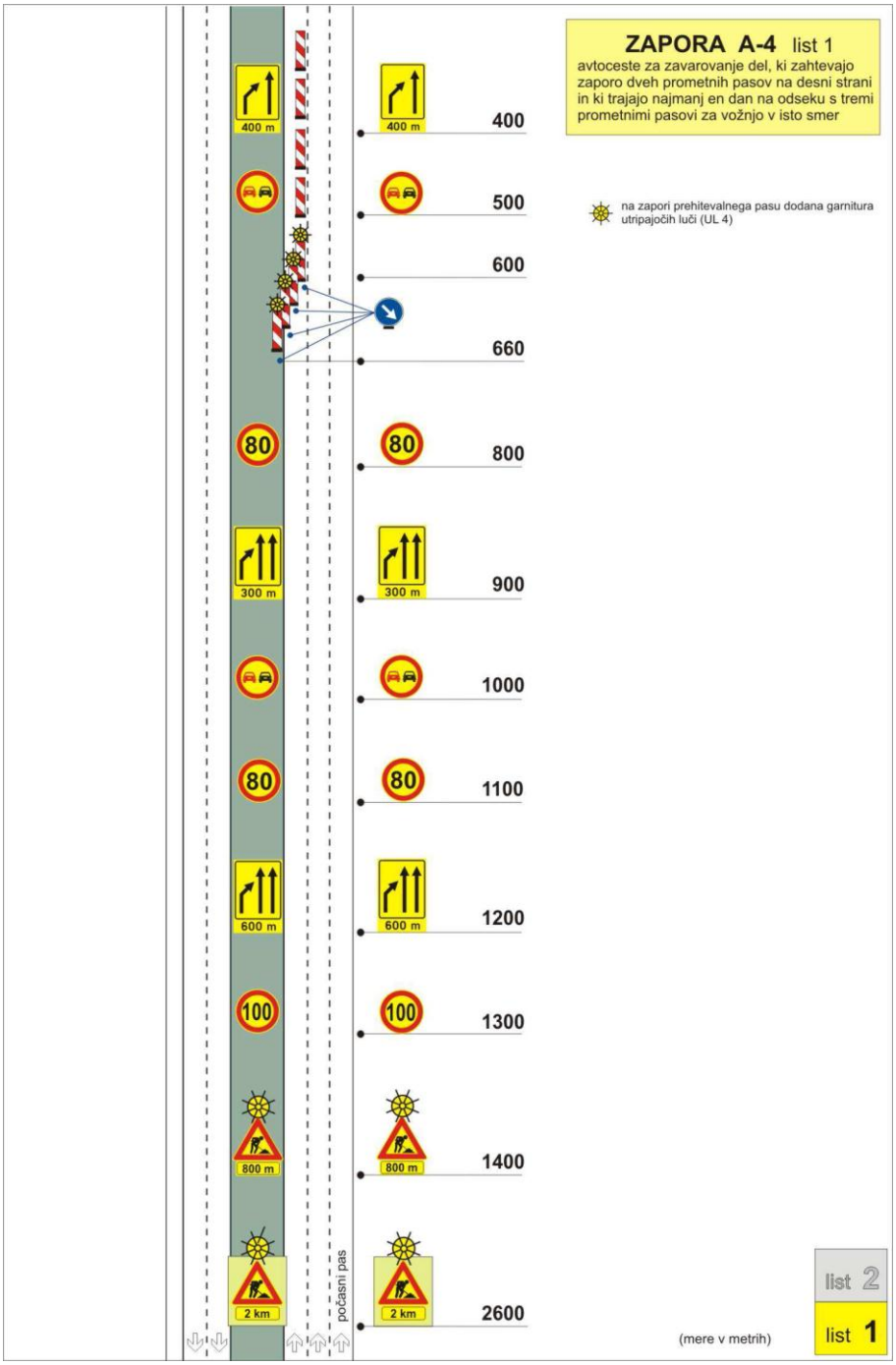
Major road work: Standard layout for motorways (2 driving lanes) for roadworks lasting more than one day – C2+2 part 1



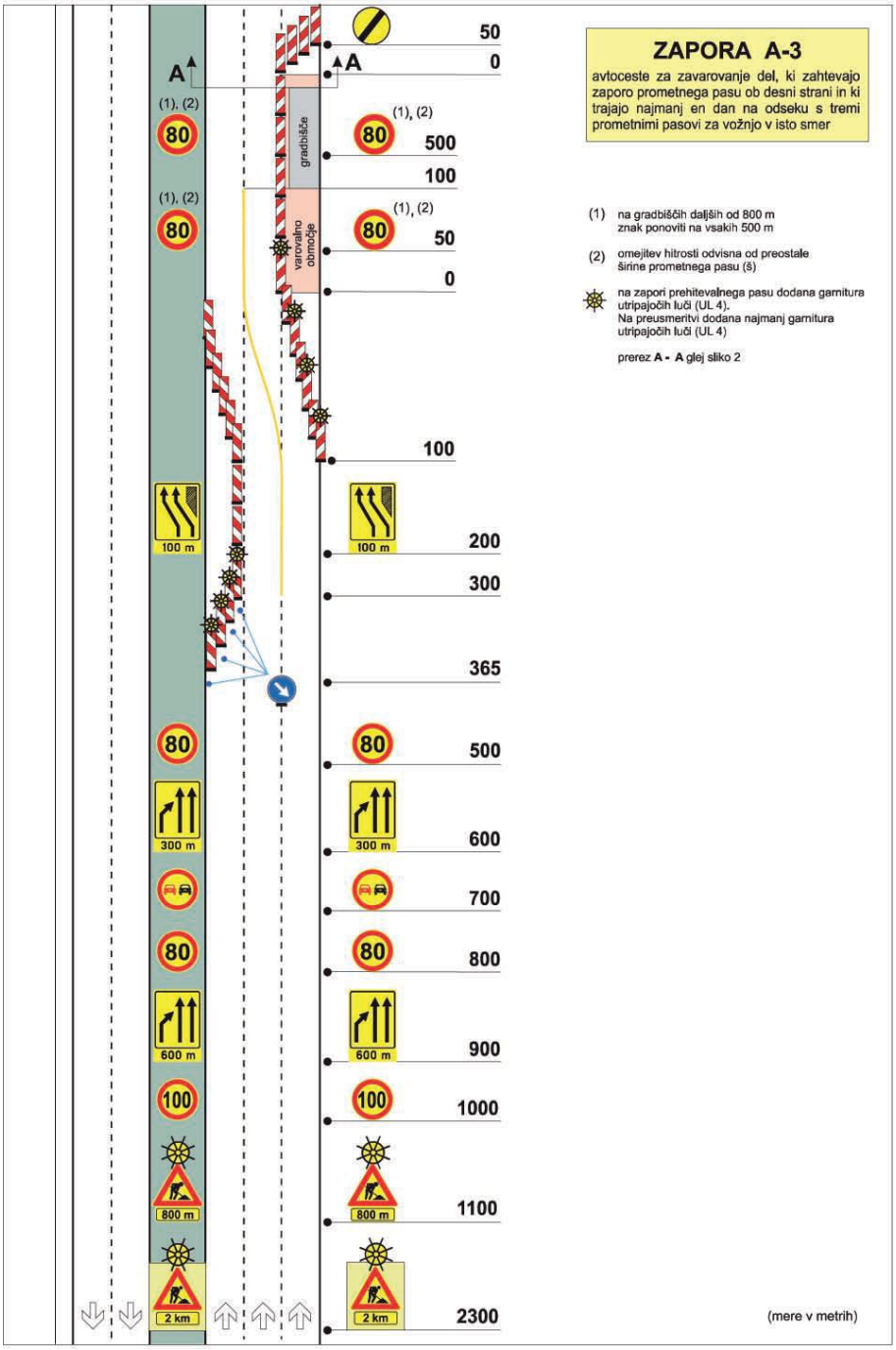
Standard layout for motorways (2 driving lanes) for roadworks lasting more than one day – C2+2 part 2



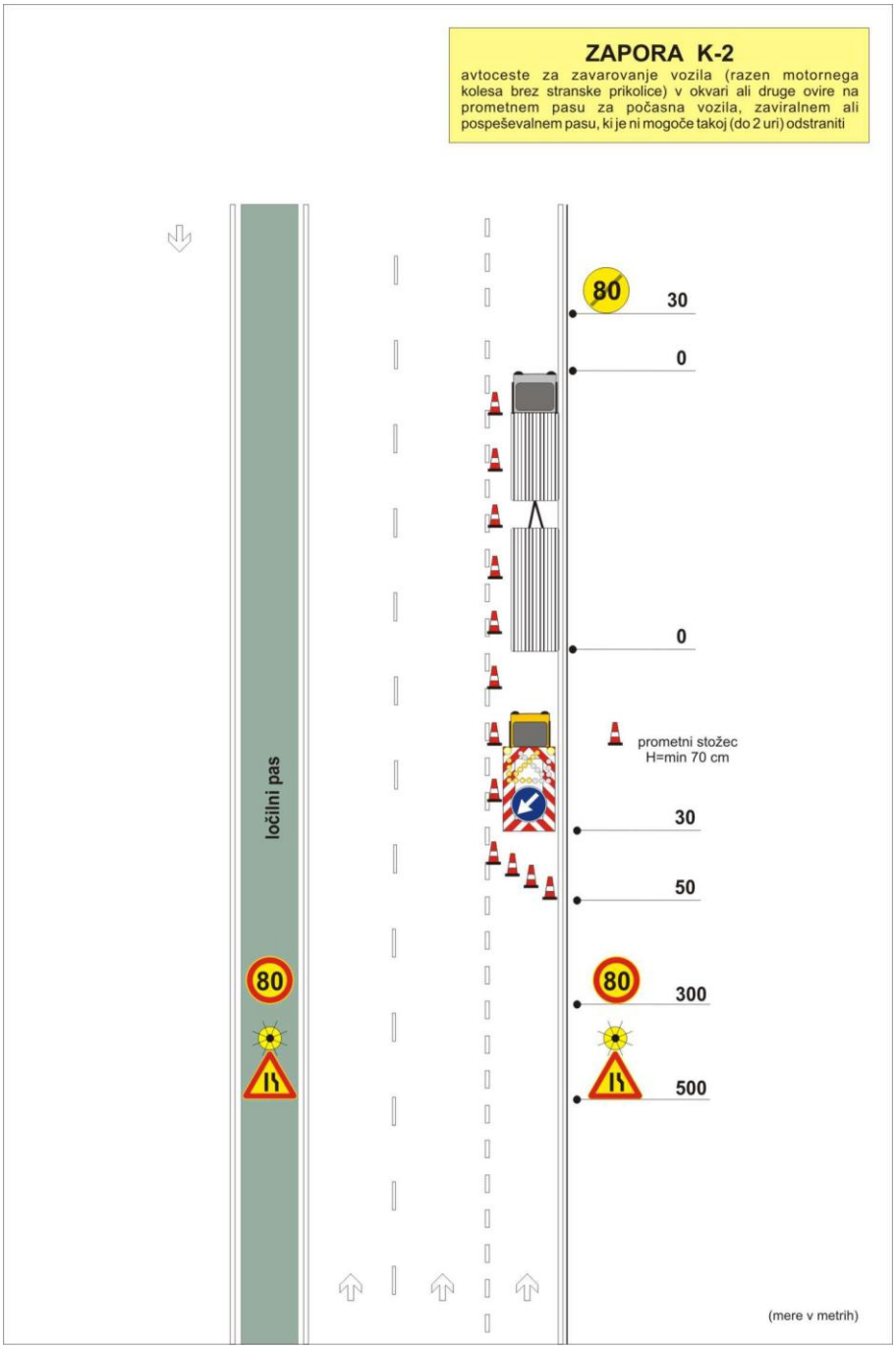
Standard layout for motorways (3 driving lanes) for closure of fast driving lane – type A4 (page 1)



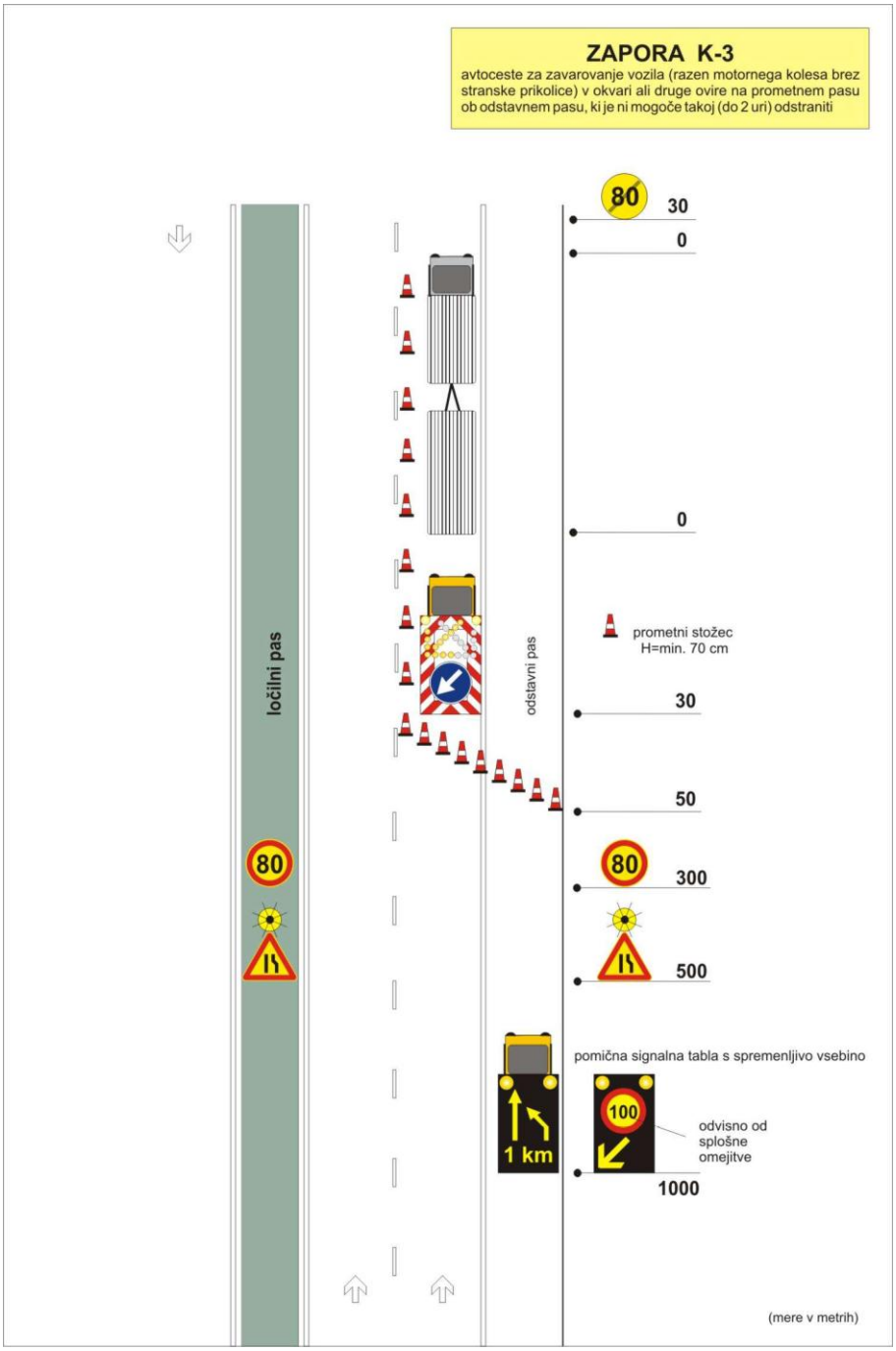
Standard layout for motorways (3 driving lanes) for minor roadworks lasting more than one day– type A-3



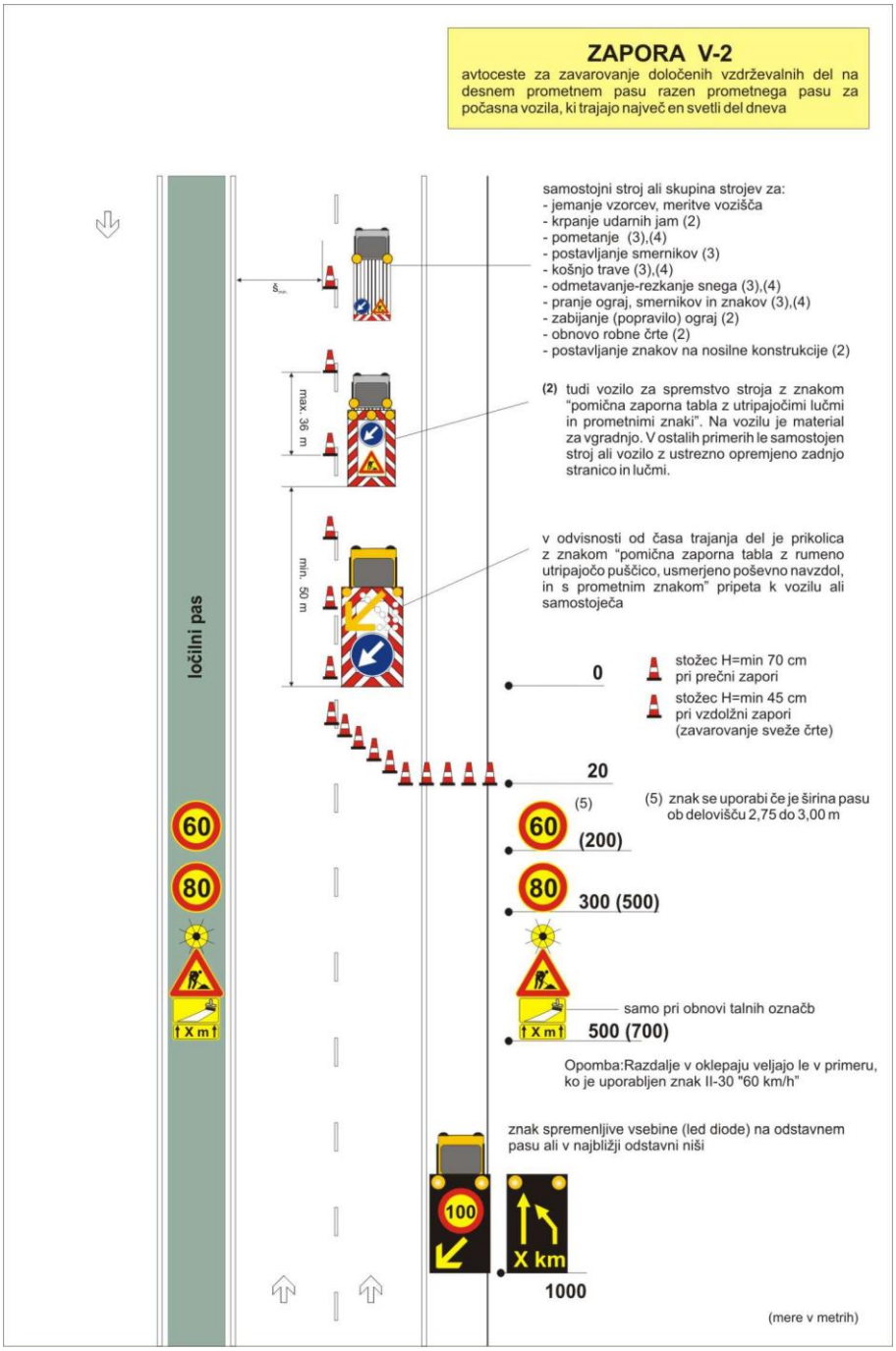
Standard layout for motorways (3 driving lanes) for roadworks or protection of a vehicle during daylight conditions – type K-2



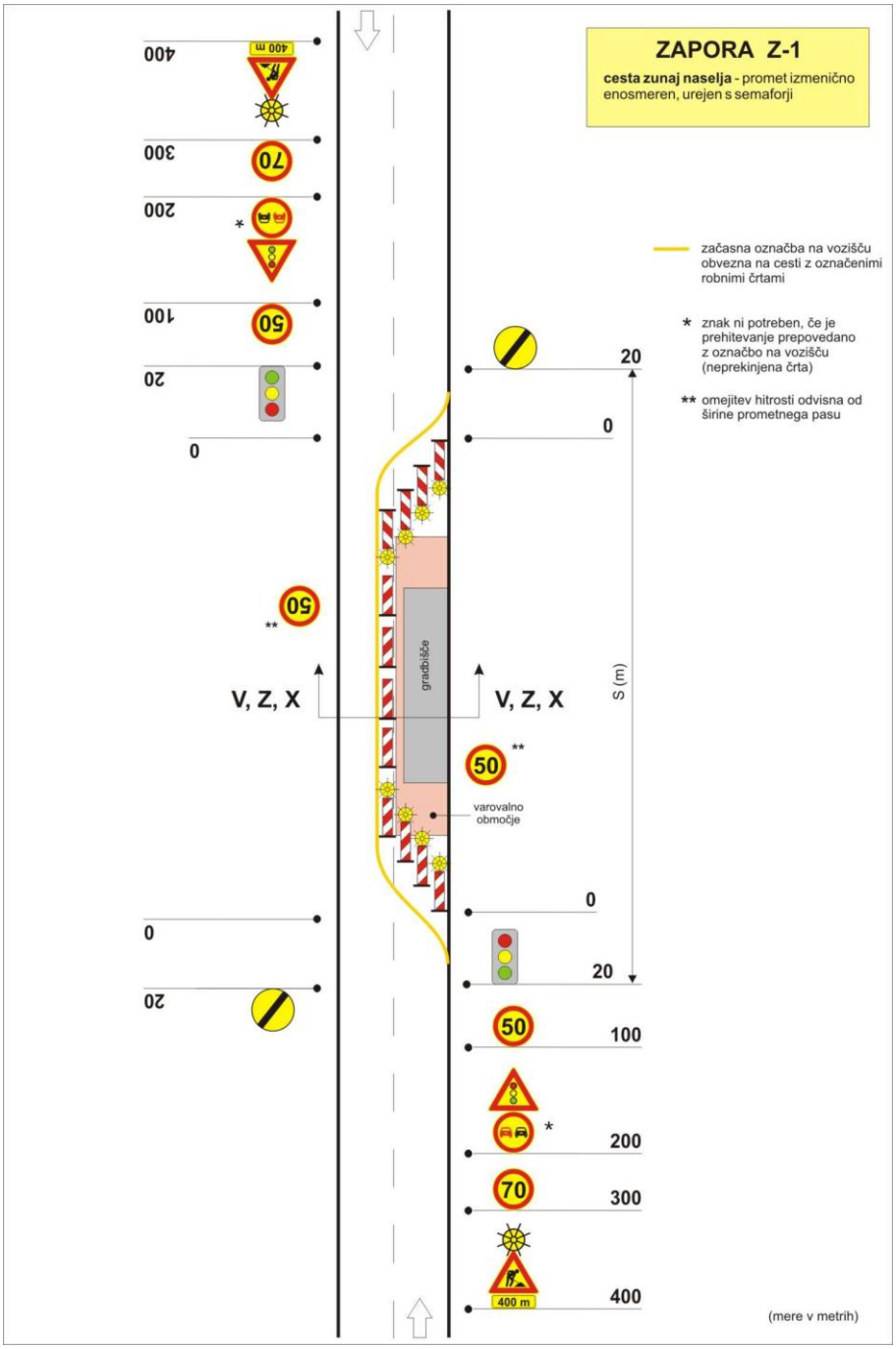
Standard layout for motorways (2 driving lanes) for roadworks roadworks or protection of a vehicle during daylight conditions – type K-3



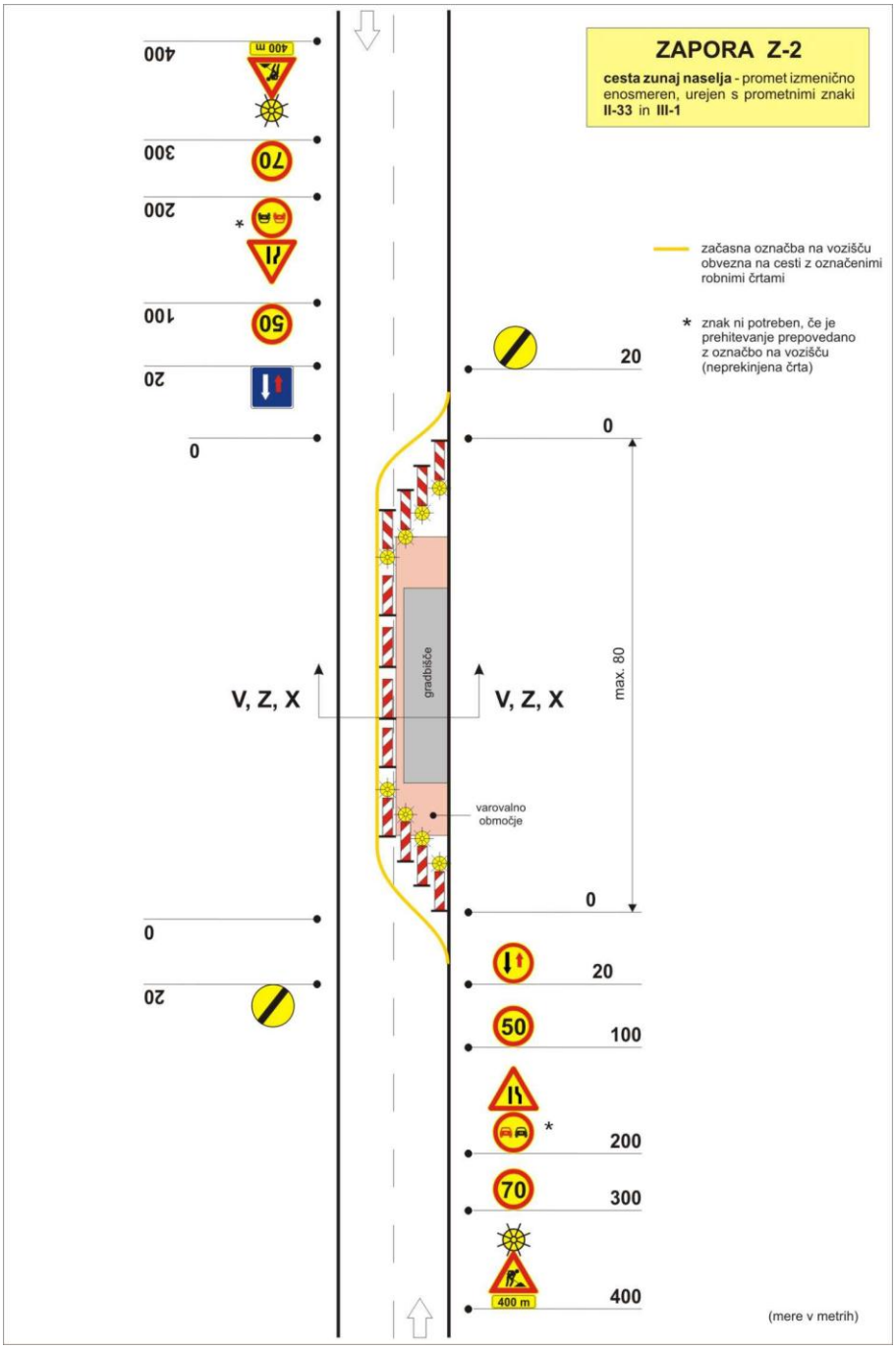
Standard layout for motorways (2 driving lanes) for mobile roadworks roadworks during daylight conditions – type V-2.



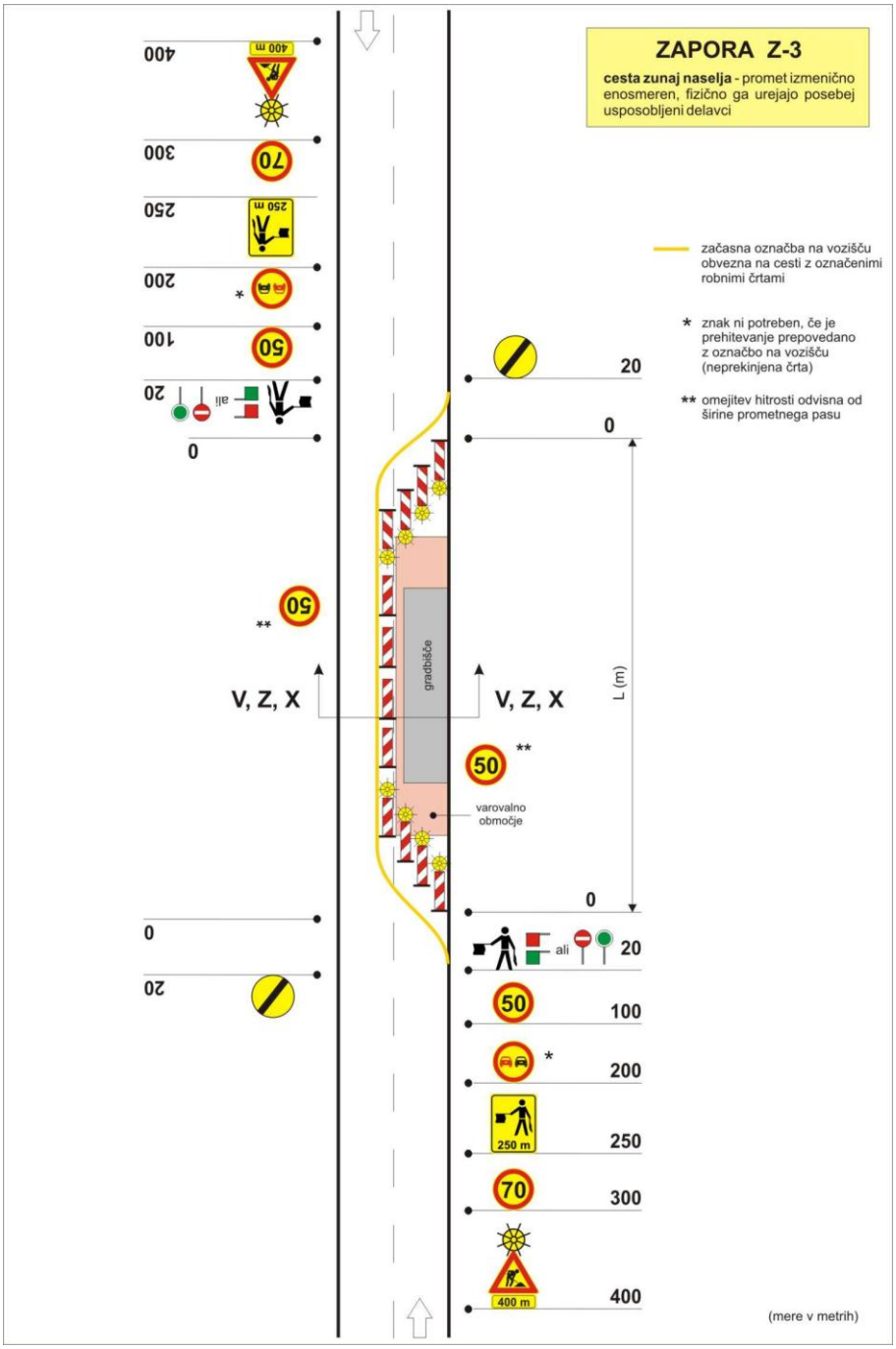
Standard layout for single carriage roads for roadworks (outside populated areas) – type Z-1.



Standard layout for single carriage roads for roadworks (outside populated areas) – type Z-2.



Standard layout for single carriage roads for roadworks (outside populated areas) – type Z-3.



Standard layout for single carriage roads for roadworks (outside populated areas) – type Z-4.