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## **Working Party on Inland Water Transport**

### **Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation**

#### **Thirty-seventh session**

Geneva, 16–18 June 2010

Item 4 of the provisional agenda

## **RULES FOR WATERWAY MARKING ON THE SAVA RIVER BASIN**

### **Note by the secretariat**

1. The secretariat received from the Sava Commission a copy in English of the “Guidelines for Waterway Signs and Markings applied on the Sava River” and put it on the UNECE website as Informal document No. 1. The Working Party may wish to consider the Sava Guidelines, compare them with Resolution No. 59 “Guidelines for Waterway Signs and Marking” (ECE/TRANS/SC.3/169) and decide if the annex to Resolution No. 59 should be updated.

1. Секретариатом была получена от Савской комиссии копия «Инструкции по установке знаков на водном пути в бассейне реки Савы» на английском языке, которая была установлена на вебсайте Рабочей группы SC.3/WP.3 в качестве Неофициального документа №1. Рабочая группа возможно пожелает рассмотреть данную Инструкцию, сравнить ее с Резолюцией №59 «Инструкция по сигнальным знакам, регулирующим судоходство по водным путям» (документ ECE/TRANS/SC.3/169) и решить, не следует ли обновить приложение к Резолюции № 59.



**Conscious** of the importance of the Sava River for the economic, social and cultural development of the region,

**Desirous** of development of the inland navigation on the Sava River,

**Having regard** to the European Agreement on Main Inland Waterways of International Importance (AGN), and in particular Annex III thereof,

**Believing** that public authorities can contribute significantly to the development of the waterway of the Sava river through their engagement to the provision and maintenance of an appropriate waterway based on internationally agreed classifications and parameters,

**In accordance with** Article 16 Paragraph 1 (a) and 2 of the Framework Agreement of the Sava River Basin and Article 9 Paragraph 4 of the Protocol on the Navigation Regime to the Framework Agreement of the Sava River Basin, the International Sava River Basin Commission (hereinafter: Sava Commission) on its VIII Special Session held on November 12-13, 2007, has adopted the following

### **DECISION – 31/07**

on adoption of

#### **RULES FOR WATERWAY MARKING ON THE SAVA RIVER BASIN**

1. Text of the Rules for Waterway Marking on the Sava River Basin is attached to this Decision as its integral part.
2. Parties shall adopt the measures necessary to implement this Decision and notify the Sava Commission.
3. This Decision shall be binding for the Parties unless any of the Sava Commission members withdraws his vote within 30 days after the decision has been adopted, or informs the Sava Commission that the Decision is subject to the approval of the relevant authority of his State.

If any of the Sava Commission members withdraws his vote within 30 days after the decision has been adopted, or informs the Sava Commission that the Decision is subject to the approval of the relevant authority of his State, the

Sava Commission Secretariat shall, thereof, inform all other Sava Commission members.

4. If no member withdraws his vote nor informs the Sava Commission that the Decision is subject to the approval of the relevant authority of his State, the Decision shall enter into force on December 13, 2007.
5. Upon entry into force, this Decision shall be binding in its entirety and directly applicable in the Parties.
6. The Sava Commission Secretariat shall notify the Parties of the entry into force of the Decision.

Ref. No: 1S-8-D-07-7/1-3

**Zagreb, November 13, 2007**

**Mr. Kemal Karkin**  
**Chairman of the Sava Commission**



A handwritten signature in blue ink, appearing to read 'Kemal', is written over a horizontal line. The signature is cursive and somewhat stylized.



**Doc. No.: 1S-8-O-07-28/1-3**  
**November 13, 2007**  
**Original: ENGLISH**

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# **RULES FOR WATERWAY MARKING ON THE SAVA RIVER BASIN**

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# **Chapter 1**

## **GENERAL**

### **Article 1.0**

The present Rules shall be applied on the waterways on the Sava River from the river kilometer 0.00 to the river kilometer 586.00, on the Kolubara River from the river kilometer 0.00 to the river kilometer 5.00, on the Drina River from the river kilometer 0.00 to the river kilometer 15.00, on the Bosna River from the river kilometer 0.00 to the river kilometer 5.00, on the Vrbas River from the river kilometer 0.00 to the river kilometer 3.00, on the Una River from the river kilometer 0.00 to the river kilometer 15.00 and on the Kupa River from the river kilometer 0.00 to the river kilometer 5.00.

### **Article 1.1**

In terms of the objective pursued, the marking comprises two categories of signs:

- (a) signs used to regulate navigation on the waterway, set out in Annex 7 to the Navigation Rules on the Sava River Basin, and
- (b) signs for the waterway marking, set out in Annex 8 to the Navigation Rules on the Sava River Basin.

### **Article 1.2**

The signs set out in Annex 7 to the Navigation Rules on the Sava River Basin are prohibitory, mandatory, restrictive, recommendatory or informative signs and auxiliary signs.

### **Article 1.3**

In accordance with article 5.01 to the Navigation Rules on the Sava River Basin, boatmen shall obey the requirements and take into account the recommendations or indications brought to their attention by these signs.

### **Article 1.4**

The signs and signals on the water and bank marks of Annex 8 to the Navigation Rules on the Sava River Basin are used to indicate the limits, the direction and the depth of the fairway and, in addition, are used to mark obstacles and permanent structures on the fairway or its vicinity.

### **Article 1.5**

The number of bank marks and signs and signals on the water and the plan for their on-site location shall meet the requirements of navigational safety.

### **Article 1.6**

The choice of the mark and the establishment of their number depends on the local characteristics of the waterway and the function of the mark. Their installation shall be effected in such a way as to ensure visibility from one mark to the next.

### **Article 1.7**

The luminous range of lights is established by the competent authorities of the respective countries in terms of local navigational conditions. In calculating the luminous range, the atmospheric transmission coefficient 0.6 should be used over a distance of 1 nautical mile.

### **Article 1.8**

In principle, the colours of lights should be kept with the recommendations of the International Commission on Illumination ("Colours of light signals", in ICI publication No. 2.2 (T.C. 1.6) 1975).

### **Article 1.9**

The marks shall be installed by the competent authorities which shall:

- (a) regularly observe the state of the river bed and the changes taking place in it, and correct the positioning of the signs and marks on the basis of the results of these observations, and, where necessary, add the additional so that they indicate the fairway dimensions;
- (b) regularly measure the depth and the width of the marked fairway and provide boatmasters with the necessary information concerning the minimum channel depths and widths and the river level regime;
- (c) establish the plan for installation of signs and marks in their respective sectors and establish the type and number of signs and signals on the water and bank marks to be used, in terms of the requirements of navigational safety and local conditions;
- (d) ensure the uninterrupted operation of all signs and signals on the water and bank marks;
- (e) timely inform the boatmasters of the date of the installation and removal of signs and signals, of all alterations to their number, type, positioning and lighting, and the rules they establish permitting the passage of vessels in restricted sections where meeting and passing are prohibited.

## **Chapter 2**

### **REQUIREMENTS TO BE MET BY SIGNS AND MARKS AND THE PLAN FOR THEIR INSTALLATION**

#### **Article 2.1**

Marking shall be continuously (by day and night) in operation all along the navigable section of the river, as of the waterway is free from ice until the ice appears; it shall be corrected as changes occur in the waterlevel and in the fairway.

#### **Article 2.2**

During periods of high water and icing, the regular marking removed to preserve it from possible damage shall be replaced, as far as possible, by marker posts and spars, the topmarks and colours of which shall correspond to those adopted for the respective side of the fairway.

#### **Article 2.3**

The bank marks and the additional signs and signals on the water shall, if possible, operate until navigation becomes completely impossible because of ice.

#### **Article 2.4**

The positioning of the signs shall, as already said, be effected so as to ensure the day and night visibility from one sign to the next.

#### **Article 2.5**

Signs and signals on the water shall be installed so as to ensure the safety of vessels on the fairway.

#### **Article 2.6**

Buoys shall be unsinkable and shall remain unsinkable in all storms, and their main body shall therefore be watertight; they shall not only float but also be stable, i.e. conserve a vertical position as far as possible and not be tipped excessively by waves and wind.

#### **Article 2.7**

The basic condition that the plan for the installation of the signs and marks shall meet is to ensure the safety of the vessels and the continuity of traffic, by day and by night, throughout the sailing season and to give the boatmasters clear and unambiguous indications concerning the direction and the limits of the fairway.

#### **Article 2.8**

The plan for the installation of the signs and marks shall be prepared in such a way as to permit a rational combination of bank marks and signs and signals on the water. When the plan is drawn up, it should be based on the conditions of navigation, and specific hydrographical and hydro meteorological conditions, the need to ensure

the established dimensions of the fairway and create the necessary conditions for the safety and continuity of navigation of all river vessels.

#### **Article 2.9**

Bank marks serve to guide the boatmasters and to indicate the direction of the fairway. Signs and signals on the water supplement the bank marks in sectors where, in order to ensure the safety of navigation, it is essential to indicate not only the direction of the fairway but also its limits, and to mark places where there are obstacles.

#### **Article 2.10**

In preparing the plan for the installation of signs and marking, the following requirements should be taken into account:

- (a) Only the signs set out in Annexes 7 and 8 to the Navigation Rules on the Sava River Basin are to be used to mark the fairway and regulate navigation; in exceptional cases, special additional bank marks may also be used, provided, however, that the marks are not in contradiction with those contained in the Navigation Rules on the Sava River Basin;
- (b) The dimensions of the marked fairway shall correspond to the dimensions published by the competent authorities;
- (c) The choice of where the signs are to be placed shall be based on the most recent measurements, acquired experience and available data on the state of the fairway, critical points, water levels, etc.;
- (d) Signs and marker lights shall be visible, whatever the level of the water, at all points of the fairway and as long as may be necessary for the guidance of boatmasters.

#### **Article 2.11**

The marking plan shall contain information on type of the placed signs, bank/rim whereon placed, river kilometre of the set-up and recapitulation of all signs and signals on the water and bank signs used whilst marking.

#### **Article 2.12**

If there is a subsequent drop in the level of the water, reconnaissance soundings shall be taken on some sections of the river in order to check whether the positioning of the signs is adequate and to establish whether the marking needs to be supplemented by new signs.

#### **Article 2.13**

The frequency of these soundings shall be determined by changes in water level. The more rapid the drop in levels, the more frequent the soundings need to be.

## **Chapter 3 VISIBILITY OF SIGNS AND LIGHTS**

#### **Article 3.1**

Whatever the position of the vessel in relation to the sign or the marker light, the characteristics of the sign or light shall remain unchanged. For daytime signs, these characteristics are: the form (topmark) and the colour; for signs and signals at night: the type and colour of the lights.

#### **Article 3.2**

The forms and the colours of the topmarks and the types and colours of the lights are set out in detail in Annexes 7 and 8 to the Navigation Rules on the Sava River Basin.

#### **Article 3.3**

Sketches of the signs are given in the Annex 1 to these Rules. The numbering of the sketches corresponds to the numbering of the signs given in Annexes 7 and 8 to the Navigation Rules on the Sava River Basin.



## Conditions of visibility and dimensions of signs<sup>1/</sup>

### Article 3.4

The basic requirement to be met by signs and marking is the guarantee of good visibility of all signs and signals by day or night.

### Article 3.5

There are three degrees of visibility of signs and signals:

- (a) When, because of the distance, the sign is no more than a blotch on the background and neither shape nor colour can be distinguished (dotted outline);
- (b) When the sign is visible and its shape and outline can be seen, but the colour remains unclear;
- (c) When the shape and colour of the sign can be seen distinctly.

### Article 3.6

Due to the proper orientation of the boatmaster, it is necessary to ensure the visibility of second and third degree. Accordingly, the type and dimensions of signs should be selected.

### Article 3.7

The degree of visibility of a sign, as of any object, depends primarily on the size of the viewing angle, the colour contrast, the contrast in luminance and weather conditions.

### Article 3.8

In order to ensure the visibility of first degree, it is necessary to see the sign under 1' angle by day and under 10' angle by night.

### Article 3.9

Detailed form and colour of the sign (visibility of second and third degree) are identified even under larger angles.

### Article 3.10

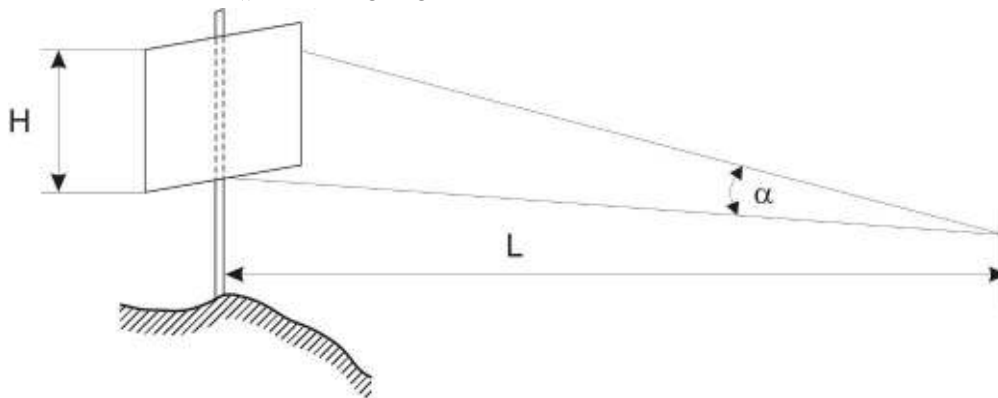
The largest angle of distinction by day for simple shapes (quadrant, triangle, circle, etc.) shall be within 3.5' – 5' scale, and for complex shapes (numbers, letters, etc.) within 5' – 8' scale. For boatmaster to be able to recognize (without any optical aids) shape of the sign at appropriate distances and visibility, the above-mentioned implies that following formula can be used for calculation of the sign' dimension:

$$H = L \cdot \operatorname{tg} \alpha \cong L \cdot \sin \alpha$$

H (m) – height of the sign;

L (m) – distance;

$\alpha$  (') – viewing angle.



<sup>1/</sup> The competent authorities may provide for values of the height and width.

Values for H (m) in function of L (m) and  $\alpha$  (°) are presented in the Table 1.

**Table 1:**

For simple shapes (quadrant, triangle, circle, etc.)	L(m) \ $\alpha$ (°)	500	1000	2000
	3	0.44	0.87	1.74
4	0,58	1.16	2.32	
5	0.73	1.45	2.90	

#### **Article 3.11**

The Table 1 shows that shape of sign with dimension H = 0,5 m is recognizable at distance L = 500m and viewing angle  $\alpha = 4^\circ$ ; when L = 1000m then H = 1m, etc.

If there are simple drawings (dot, line, arrow) on the signs, 15% visibility reduction must be taken into account, while at the complex drawings it shall be 30%.

#### **Article 3.12**

The least dimensions should be:

- (a) For boards of the bank marks regulating the navigation on inland waterways given in Annex 7 to the Navigation Rules on the Sava River Basin in accordance with Annex 1 to the these Rules.
- (b) For navigation marks marking the fairway and marking the obstacles to navigation given in Annex 8 to the Navigation Rules on the Sava River Basin
  - 1) Minimal dimensions of figures for recognizing buoys:
    - Height of figure > 0.60m;
    - Width of figure > 0.35m;
    - Height from the water level to the highest extent of buoy > 1m;
  - 2) Minimal dimensions of marker posts and spars are given in Annex 1 to these Rules;
- (c) For bank marks/ marking the fairway and the obstacles to navigation given in Annex 8 to the Navigation Rules on the Sava River Basin:
  - 1) Minimal height of the lower rim of board down-to the ground is 3m. At high water-levels, height of the water level up-to the lower rim of board should not be less than 1.5m;
  - 2) Minimal dimensions of boards and topmarks are given Annex 1 to these Rules.

#### **Article 3.13**

Examples of the minimum measurements for the signs are given in the Annex to these Rules. Alphanumeric characters on traffic signs should intend to provide a standard for the various traffic signs.

#### **Article 3.14**

As in regard to the signs and signals of Annex 7 and Annex 8 to the Navigation Rules on the Sava River Basin, unlighted buoys and unlighted bank mark boards shall be covered with reflective material. Light buoys and lighted bank mark boards may also be covered so. The colours of these materials shall correspond to those established for the buoy lights or the boards. In all cases, the topmarks of light buoys shall be covered with reflective paint or material.

#### **Article 3.15**

In order to ensure that bank marks are clearly visible, their dimensions shall be determined in terms of their purpose, the distance between the fairway and the banks, the nature of the region and the characteristics or other specific conditions of the sector in question.

### Article 3.16

The good visibility of a sign or signal depends on the contrast between the luminance of the sign or signal and the background. This shall be taken into consideration in choosing a site for signs and signals. For example, of two boards, one red and the other white, positioned one beside the other against a light background, the red board will be more visible and visible at a greater distance than the white board while, in contrast, the white board will be easier to see than the red board against a dark background.

### Article 3.17

The visibility of signs and signals regulating navigation on the waterway shall be ensured at night by lighting them with fixed directional white lights, operating uninterruptedly and positioned so that the light does not incommode the boatmasters.<sup>2/</sup>

### Article 3.18

If electric lighting cannot be used, the sign boards shall be covered with reflective material of a corresponding colour on which the symbol shall be clearly visible to vessels.

### Article 3.19

Luminance and its regularity are also important from the point of view of the visibility of signs and signals. When boards are lighted, it should be ensured that the shade of their colour is unchanged. The luminance of the sign or signal perceived, like that of any object, depends not only on the lighting but also on the capacity of the surface of the sign to reflect the light waves falling on it. This shall be taken into consideration when the signs are painted; this shall be done in such a way that the surface of the sign is smooth and reflects the light properly and is not dull and covered with an uneven coat of paint.

## Conditions for the visibility of lights

### Article 3.20

The visibility of lights is determined by their strength and by weather conditions.

### Article 3.21

The equation set out in Annex 5 to the Navigation Rules on the Sava River Basin may be used to establish the minimum luminous intensity required to obtain the desired visibility.

### Article 3.22

Since intensity of lights should be bigger for the colour lights produced by application of filters, the stronger source of light is needed. Table 2 shows intensity of source of light calculated for conditions of atmosphere under light haze:

**Table 2:**

Visibility (m)	Intensity of light (cd)	Intensity of source of light (cd)		
	White light	White light	Red light	Green light
500	0.06	0.06	0.40	0.60
1000	0.25	0.25	1.70	2.50
2000	1.40	1.40	9.30	14.00
3000	4.20	4.20	28.00	42.00
4000	9.80	9.80	65.00	99.00
5000	20.00	20.00	133.00	200.00

<sup>2/</sup> The competent authorities may waive these requirements.

### **Article 3.23**

As already pointed out in the first part - General - the colours of the lights shall, in principle, conform to the recommendations of the International Commission on Illumination (“Colours of light signals”, in ICI publication No. 22 (T.C. 1.6) 1975).

### **Article 3.24**

Marking lights are fixed or flashing lights. The luminous range of flashing lights is less than that of fixed lights with the same luminous intensity. Flashing lights can nevertheless be seen more easily and attract the boatmaster’s attention more readily, especially when surrounded by lights of neighbouring localities.

### **Article 3.25**

The duration of the flash of a signal light shall not be less than 0.5 seconds. Shorter flashes, even if they are frequent, are tiring the boatmaster’s eyes and hinder orientation. Long and infrequent flashes on the other hand also hinder orientation, since, while waiting for the next flash, the boatmaster cannot be sure that he is still proceeding in the desired direction.

### **Article 3.26**

Details of the characteristics of signal lights used can be found in Annex 8 to the Navigation Rules on the Sava River Basin.

## **Obligation not to hinder road and rail traffic**

### **Article 3.27**

Signs and marking shall be installed in such a way that their lights do not hinder the movements of other modes of transport if the road runs close to the river.

### **Article 3.28**

In a sector in which a road or a railway runs close to a river, the installation of all the above-mentioned signs and signals shall be carried out in consultation with the respective competent authorities.

## **Chapter 4 INSTALLATION OF SIGNS AND MARKING IN CHARACTERISTIC SECTIONS OF THE RIVER**

### **General**

#### **Article 4.1**

Signs have two possible orientations, namely:

- (a) parallel to the axis of the fairway;
- (b) perpendicular to the axis of the fairway.

#### **Article 4.2**

Signs of type (a) are predominantly prohibitory or indicative signs, and are placed on the side of the fairway to which the prohibition or the indication applies.

#### **Article 4.3**

Most signs are positioned as described under (b), and generally do not apply to one side of the fairway only. These signs are erected at right angles to the axis of the fairway so that they are visible to a user when under way.

#### Article 4.4

The use of a particular sign or signal on the water or bank mark and how it is installed depends, on the one hand, on the local features of the river (speed of current, variation in levels, meanders, width of the bed, existence of sills, branches, islands, etc.), and, on the other hand, on the density of traffic in a given sector and the form and size of convoys.

#### Article 4.5

The position of each sign or signal on the water indicating the side of the fairway shall be determined on the basis of the marking installation plan based on the results of measurements. Depths within the limits of the width of the marked fairway shall under no circumstances be less than the minimum depth reported for the sector in question.

#### Article 4.6

When signs and signals are installed on the water, it is essential to take the direction of the current into account. If the current flows in the direction of an obstacle, the sign or signal shall always be placed a long way from the navigational hazard (obstacle); if, on the other hand, it flows in the opposite direction, the sign or signal shall be placed nearer.

#### Article 4.7

Bank marks, which are used in two-way navigation, should be oriented in parallel to the axis of the fairway. In some cases (better visibility) angle between the mark and the axis of the fairway can be  $10^\circ$  or less. (Figure 1, a signs ).

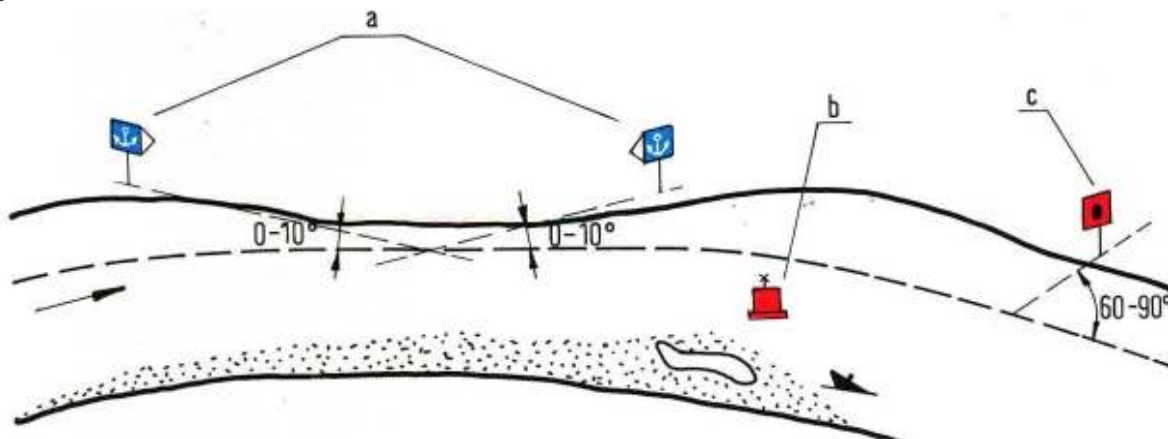
#### Article 4.8

Bank marks, which are used in one-way navigation, should be oriented perpendicular to the axis of the fairway. In some cases (better visibility) angle between mark and the axis of the fairway can not be less than  $60^\circ$  (Figure 1, sign c).

#### Article 4.9

Obstacles on the sides of the fairway are always marked with signs or signals on the water. When the obstacle is indicated by a single sign, it shall be placed on the downstream extremity of the obstacle, on the channel side (Figure 1, sign b).

Figure 1



#### Article 4.10

As a rule, lighted buoys or unlighted buoys shall be used to mark the upstream and downstream extremities of sills, banks that narrow the fairway, alluvial channels, banks protruding into the fairway, piles of stones, reefs, water supply engineering structures, and underwater hazards or obstacles (sunken vessels, anchors, etc.).

#### Article 4.11

Marker posts and spars shall be used as additional signs supplementing the buoys in order to give a clearer indication of the limits of the fairway over difficult sills and in order to mark the underwater obstacles. In some cases and in some sectors, buoys may be replaced by marker posts or spars.

#### **Article 4.12**

In order to avoid damage to buoys during the period when ice is carried down, they should be replaced by spars or marker posts.

#### **Article 4.13**

On the river sections with day and night navigation, forks, junctions and the centreline of the fairway, along with obstacles to navigation lying within the fairway, shall be marked by light buoys or bank lights. Signs and signals on the water shall be installed at such a depth and at such a distance from the obstacle that the safety and ease of movement of vessels shall be guaranteed at night and in poor visibility.

#### **Article 4.14**

On sections where the fairway is narrow, the preference shall be given to marks on the banks.

#### **Article 4.15**

Each sign or signal on the bank shall be established following the reconnaissance of the area and selection of the most appropriate site. The need to ensure the visibility of the sign whatever the level of the water should be taken into consideration.

#### **Article 4.16**

Where it is necessary to ensure the good visibility of the symbol on the sign over a long distance, both for vessels proceeding upstream and vessels proceeding downstream, two boards may be installed on the sign pole at an angle to each other, one pointing upstream and the other downstream.

#### **Article 4.17**

In selecting the site of a sign or signal on the bank, account shall be taken of the need to ensure the easy maintenance and to protect it against ice and flooding.

#### **Article 4.18**

Before a bank sign or signal is installed, the depth in the area in front of it and in the direction it indicates shall always be measured.

#### **Article 4.19**

As a general rule, the objective is that only the network of signs and signals on the bank shall provide an uninterrupted indication of the position of the fairway as a whole, while the signs and signals on the water shall help the boatmasters to determine the limits of the channel.

### **Marking of alluvial channels**

#### **Installation of cross-channel fairway signs and bank lights**

#### **Article 4.20**

Cross-channel fairway signs and bank lights may be used in alluvial channels in order to indicate that the fairway crosses over from one bank to the other (signs featured in B.1, B.2, B.3, B.4 in Annex 8 to the Navigation Rules on the Sava River Basin).

#### **Article 4.21**

Alluvial channels are marked by bank lights and cross-channel fairway signs when the fairway is sufficiently broad, its safety is ensured, and when the direction only requires to be indicated approximately.

#### **Article 4.22**

Bank lights and cross-channel fairway signs shall be selected in such a way as to differentiate cross-channel fairways in terms of their length, in other words in terms of the distance between two neighbouring signs. The length of the cross-over is relative, since it depends on the width of the fairway.

#### Article 4.23

The cross-channel fairway signs and bank lights have best results on distances up-to 3km. On such sections cross-channel fairway signs and bank lights (without signs on the water) can be placed under conditions when the disposable width is more than two times bigger than the width of the fairway.

#### Article 4.24

If disposable width is less than double width of the fairway, cross-channel fairway signs and bank lights (without signs on the water) cannot be placed on distance larger than 1–1.5 km.

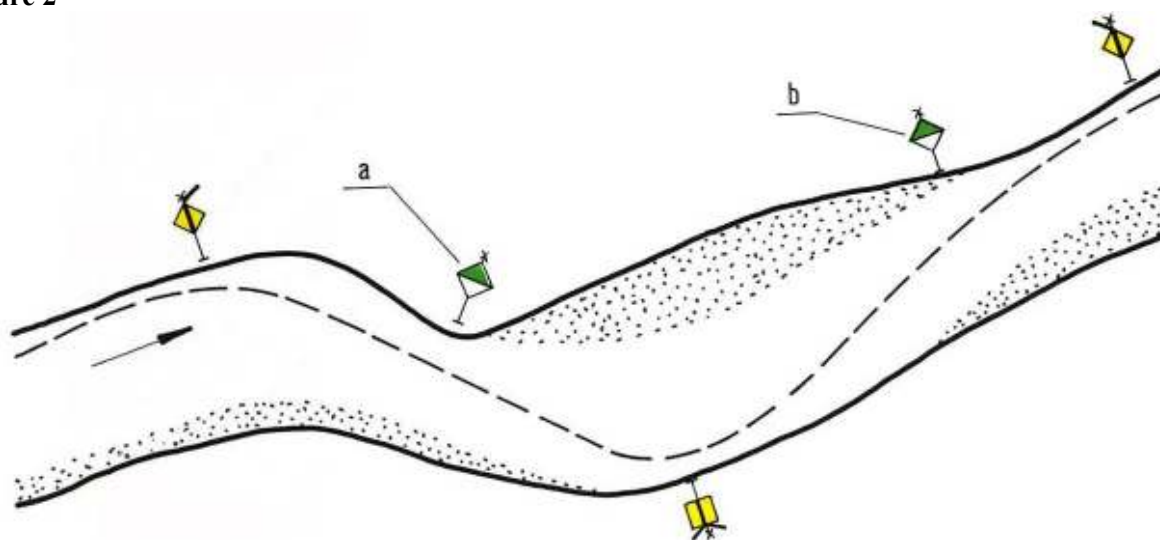
#### Article 4.25

If distance between two neighbouring cross-channel fairway signs is larger than calculated visibility, and when navigation line is passing nearby the bank, the bank lighted sign, which additionally marks the position of the navigation line, is placed between those two neighbouring cross-channel fairway signs (Figure 2, sign a).

#### Article 4.26

The bank lighted sign is also being placed when the fairway is passing nearby the bank (Figure 2, sign b).

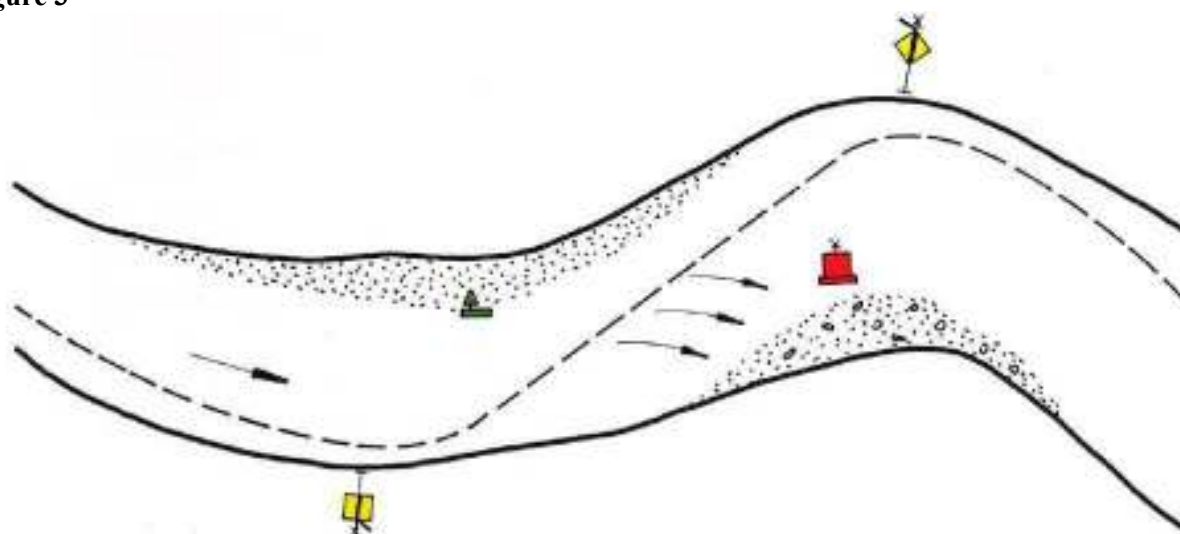
Figure 2



#### Article 4.27

In case when the direction of the current makes the angle with fairway, when strong side winds or something alike occur, fairway can be additionally marked by navigation marks according to the local conditions (Figure 3).

Figure 3



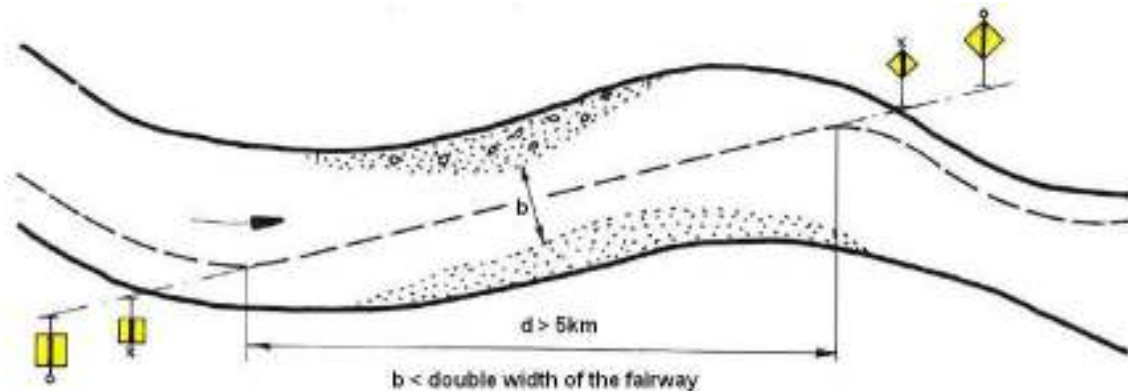
#### Article 4.28

If the fairway at longer transitions goes through the river centre or stingingly crosses from one to another bank, then cross-channel fairway signs (B.5, B.6), which better mark the transition, can be placed.

#### Article 4.29

The advantage is given to cross-channel fairway signs (B.5, B.6) in case of straight-line sections longer than 5 km, where disposable width is less than double width of the fairway. In that case and when the bank configuration allows so, the cross-channel fairway signs are placed on both margins of transition (Figure 4).

Figure 4



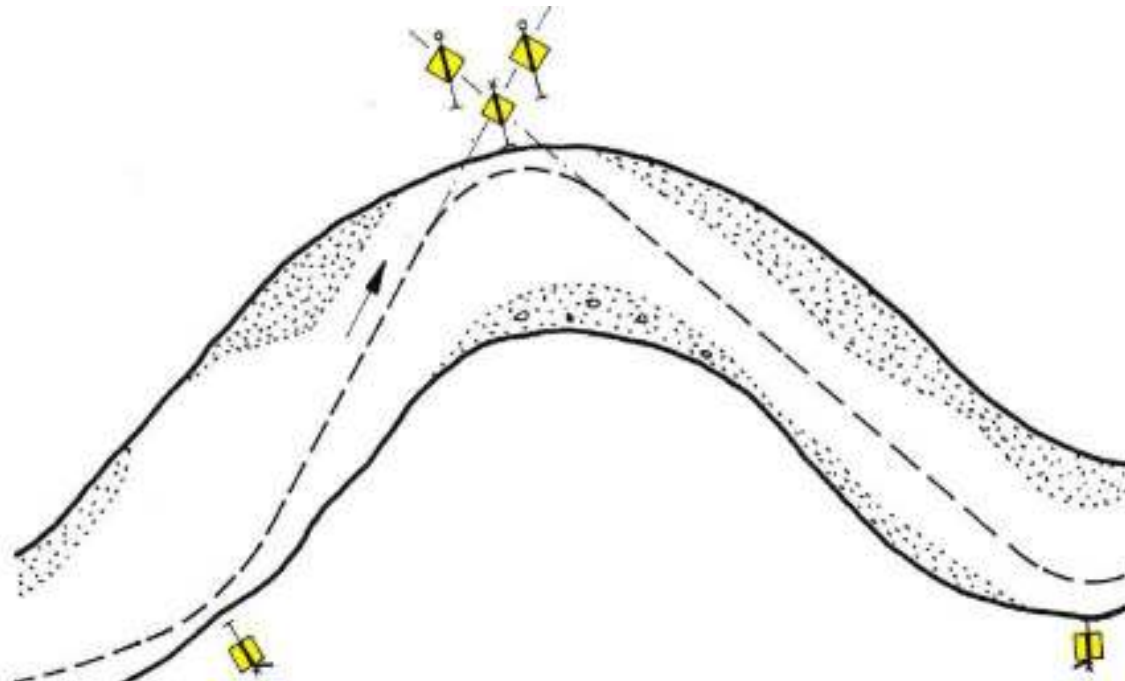
#### Article 4.30

Cross-channel fairway signs (B.5, B.6) are also placed when certain obstacles to navigation or other hazards narrowing the fairway occur.

#### Article 4.31

On section where the navigation line re-crosses to the opposite bank immediately after transition to the opposite bank, three cross-channel fairway signs (the front should have two boards) are mandatory placed (Figure 5). In that case, lights of the back cross-channel fairway signs should be strictly directed to the fairway axis: one to upstream and other one to downstream.

Figure 5





**Article 4.32**

Due to accurate estimate of position of three cross-channel fairway signs longer than 4 km, special formula is applied.

**Article 4.33**

Interrelation of the front and back signs at hidden routes shorter than 4 km is presented in Table 3.

**Table 3:**

L(m)	d(m)	h <sub>0</sub> (m)	a(m)	2a(m)
200	17	8.50	2.6	5.0
300	25	8.70	4.0	8.0
400	33	8.85	5.2	10.5
500	42	9.00	6.5	13.0
600	50	9.10	8.0	16.0
700	58	9.20	9.0	18.0
800	67	9.35	10.0	20.0
900	75	9.50	12.0	24.0
1000	83	9.60	13.0	26.0
1500	125	10.25	19.0	38.0
2000	166	10.90	26.0	52.0
2500	207	11.50	33.0	66.0
3000	250	12.15	39.0	78.0
3500	290	12.75	46.0	92.0
4000	330	13.40	52.0	104.0
> 4000	760	14.20	25.0	50.0

L (m) – maximal distance when cross-channel fairway signs can be used;

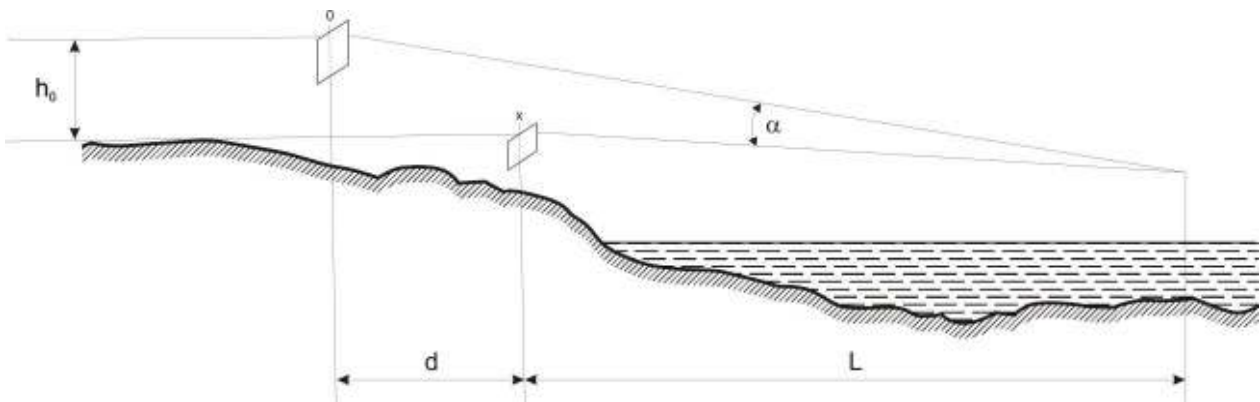
d (m) – distance between front and back signs (is approximately  $\frac{1}{12} L$ );

h<sub>0</sub> (m) – height between lights of front and back sign;

a (m) – distance necessary for vessel to adjust the course if doesn't go along the cross-channel fairway;

α (°) – viewing angle.

Table 3 is made under assumption that the observer's sight is 5m above the water level, and light of the lower (front) sign is 8m above the water level.



**Article 4.34**

Value "a" describes accuracy of the route and it's of significance while navigating through a narrow fairway. Accuracy is, in principle, increased by approaching the cross-channel fairway signs.

#### Article 4.35

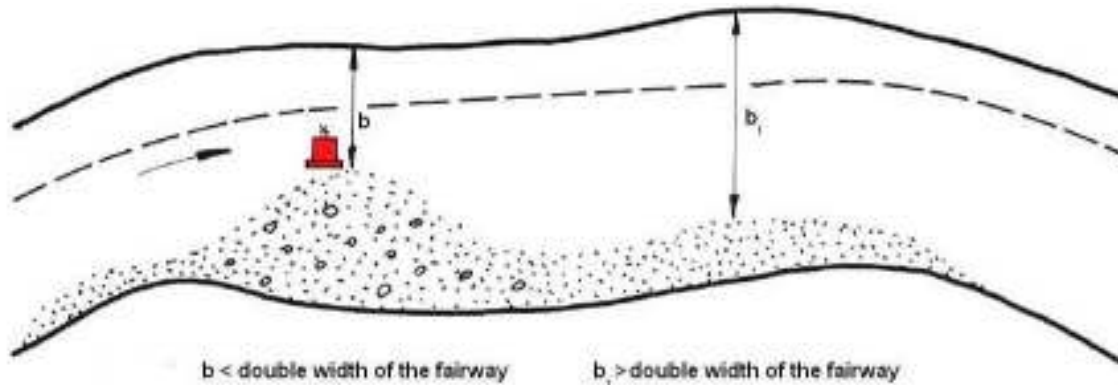
Due to good recognition of cross-channel fairway signs and their lights by night, the viewing angle  $\alpha$  (°) cannot be less than 4'.

#### Installation of signs and signals on the water

#### Article 4.36

In sectors of alluvial channels, where the channel passes along the middle of the river bed, or along the bank or passes slowly from one bank to the other, signs and signals on water are used to mark formations in the river bed or obstacles, both natural and artificial, on the sides of the channel (banks, shores, islands, stones, sunken vessels, wrecks of bridges, etc.), when these obstacles protrude into the fairway and reduce its width (Figure 6).

Figure 6



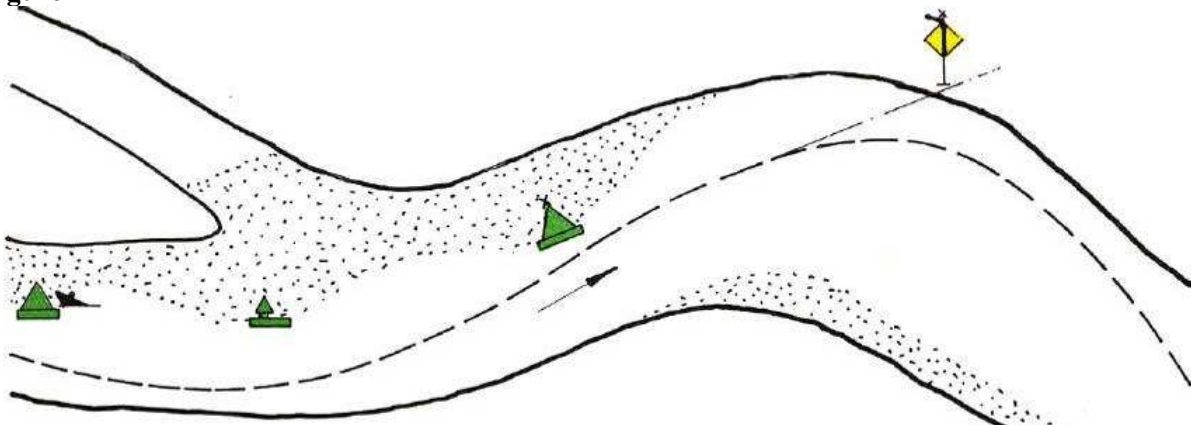
#### Article 4.37

These underwater obstacles are marked in sectors of alluvial channels by signs and signals on the water if, within the limits of width indicated above, the depth of water over such obstacles does not exceed the minimum depth reported for the sector. If the obstacle is not very wide a light signal shall be installed on the water on its upstream section. A marker post or a spar may be installed on its downstream section, depending on its length.

#### Article 4.38

The signs and signals on the water marking the underwater obstacles of considerable length are installed in such a way that the parts situated closest to the channel are marked by light signals between which unlighted signs are placed, thus enabling a given obstacle to be marked completely (Figure 7).

Figure 7



#### Article 4.39

In parts of the river bed where the shore opposite of the other one followed by the channel is bordered by an inshore bank, which favours upstream navigation in calm water, the bank is marked by signs and signals on the water independently of the width of the bed.

**Article 4.40**

In sectors of alluvial channels, the bank marking system in periods of high water generally remains the same as in periods of lowest water level, except in sectors where, when water levels are high, it is advisable to find another channel with better navigational features. In this case, the selected channel shall be marked appropriately.

**Shallow water marking**

**Article 4.41**

Same principle, as to other sections, according to which set of marks must ensure continuous marking of the fairway, shall apply to shallow water.

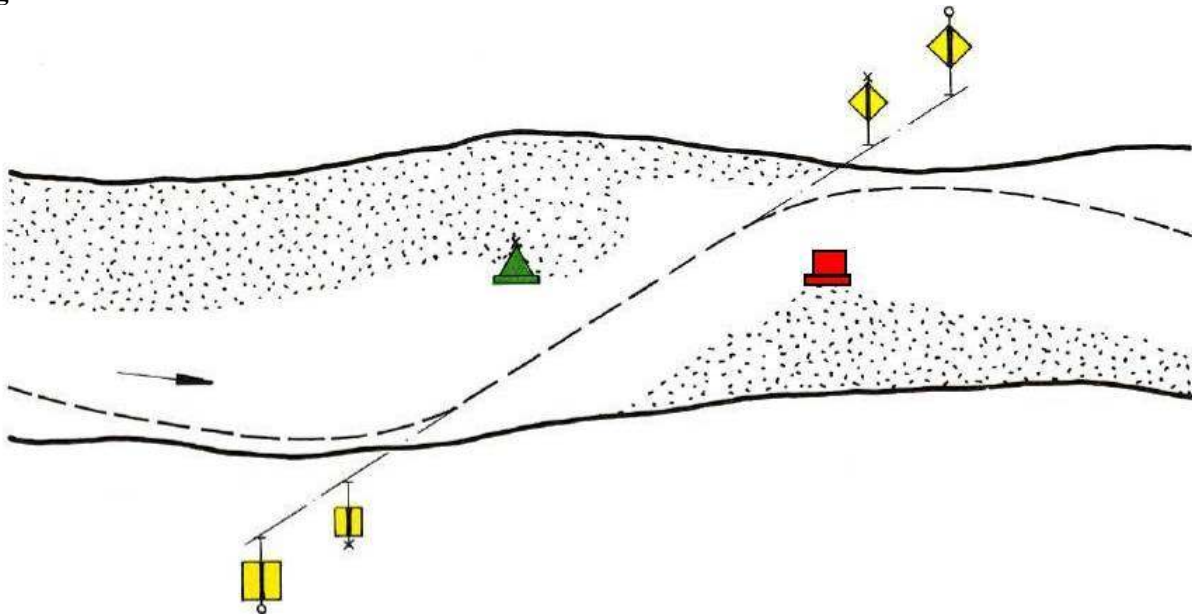
**Article 4.42**

Fairway in shallow water can be marked by cross-channel fairway signs, bank marks and signs and signals on the water.

**Article 4.43**

Alternately placed shallow water may also be marked by cross-channel fairway signs, with sufficient disposable width in which vessels are passing in straight-line (Figure 8).

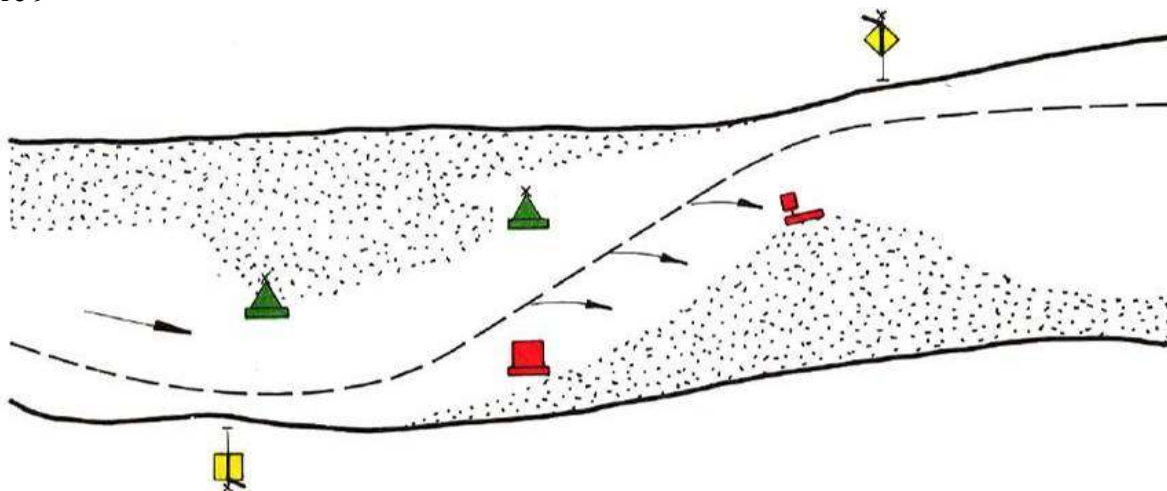
**Figure 8**



**Article 4.44**

Fairway passing over the shallow water is usually marked by signs and signals on the water (Figures 8 and 9).

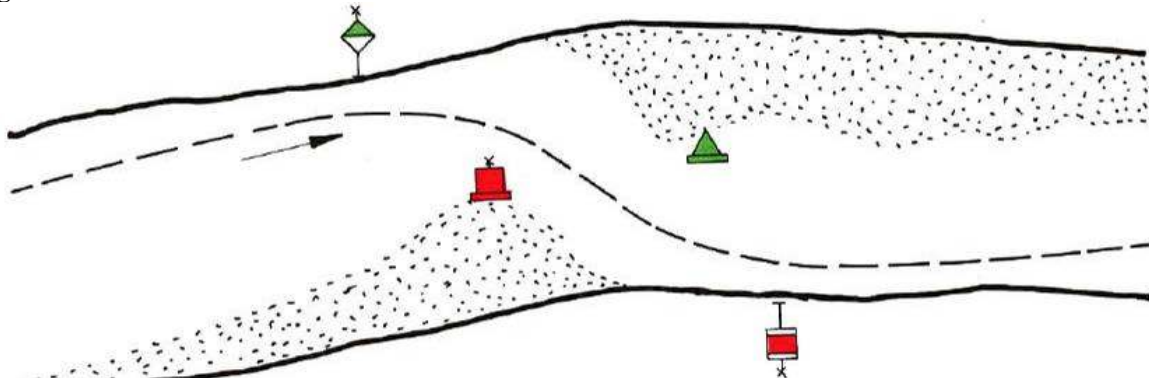
**Figure 9**



#### Article 4.45

If the fairway is passing between sandbars, which get deeply into the riverbed, in straight-line, it's necessary to place at least two signs on the water on the entry and exit of such section: one on the top of the upstream and other one on the top of the downstream sandbar (Figure 10).

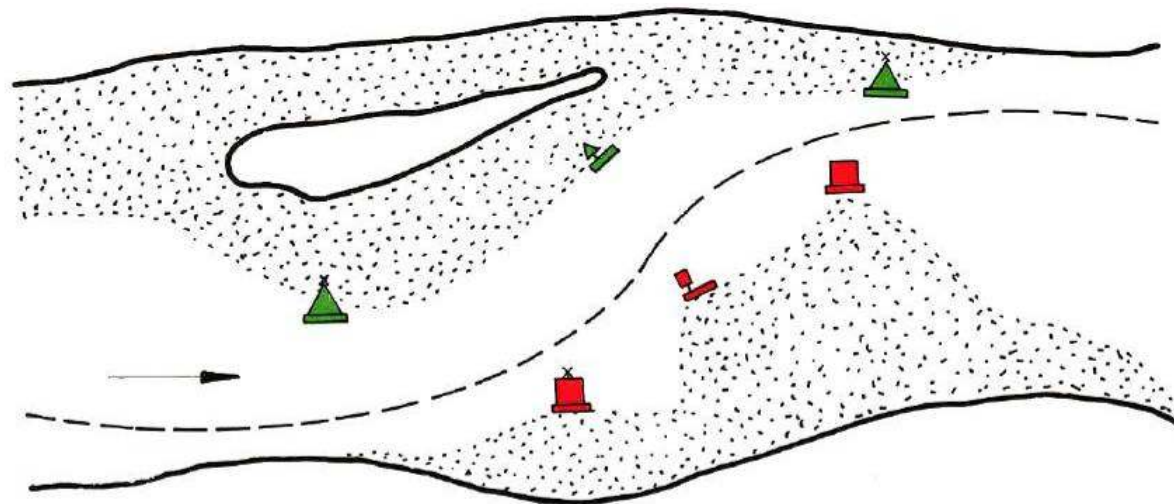
Figure 10



#### Article 4.46

If the fairway is curved in the section between sandbars, it's necessary to place additional signs on the water (Figure 11).

Figure 11



#### Article 4.47

The additional signs on the water shall be placed on the entry and exit of rugged sections with sandbars, which also characterize the side streams.

#### Article 4.48

In case when application of cross-channel fairway signs is impossible, the fairway may be marked by signs or signals on the water, on one or both sides, depending on width of the fairway and hydrological conditions.

## Marking of the vicinity of bridges and passages through bridges

### Article 4.49

The navigation of vessels and towed or pushed convoys in the vicinity of bridges and through bridge passages requires particular attention and precautions on the part of boatmasters because of the narrow fairway. These sections must, therefore, be marked with the greatest care.

### Article 4.50

The basic condition to be met to ensure safe passage through bridges is the marking of the direction of the fairway and also its sides, where necessary. Signs and signals on the water and on the banks may be used in addition to boards and lights for marking the navigable passage through bridges.

### Article 4.51

The choice and positioning of the signs depends in each case on local conditions in the bridge section.

### Article 4.52

The installation of marking signs in the vicinity of bridges and the buoying of navigable passages shall comply with the following conditions:

- (a) In order to indicate permission to use the navigable passage of a bridge, only signs A.10, D.1 or D.2 in Annex 7 to the Navigation Rules on the Sava River Basin shall be used;
- (b) The installation of marking signs shall be based on depth and current direction measurements, both in the immediate vicinity of the bridge and in the approach sections;
- (c) The positioning of the signs installed in the vicinity of a bridge shall be modified in due course, as conditions of navigation change;
- (d) If, when approaching the bridge or the navigable passage, the direction of the current forms an angle with the bridge, giving rise to eddies around the pillars of the bridge, the signs on the water shall be installed so as to indicate the direction of the eddies.

### Article 4.53

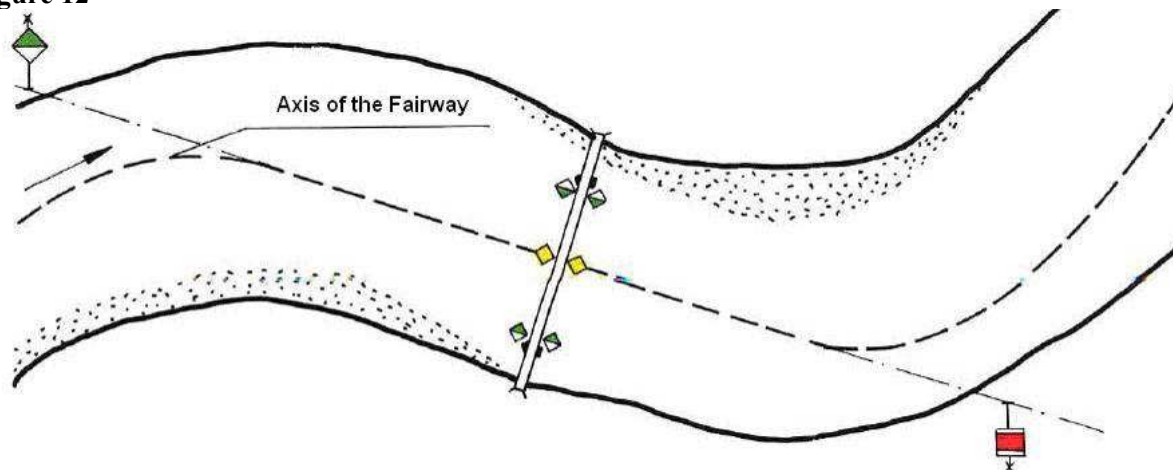
Signs and signals may be installed on the water at the approach to the navigable passage to give an exact indication of the position of the channel.

### Article 4.54

Examples of placement of the mentioned signs on the water or bank marks marking the section nearby the bridges:

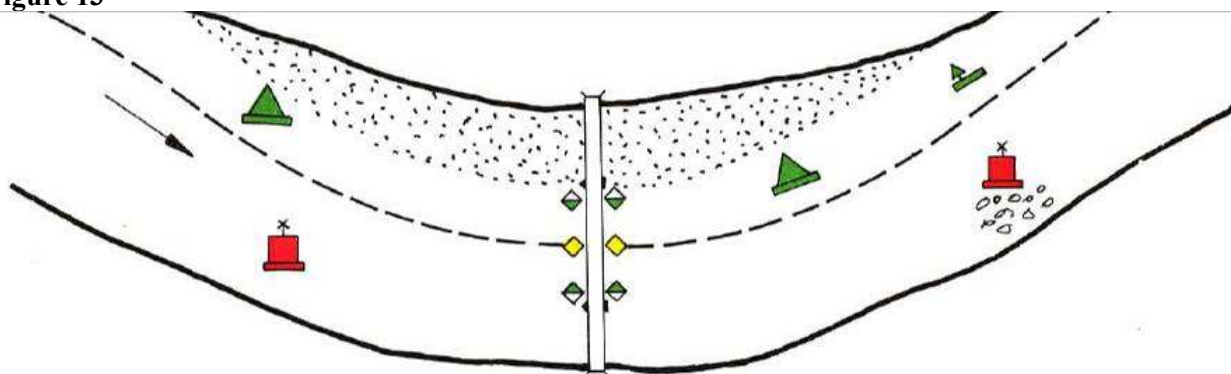
- (a) If bridge is in inflexion, the direction of vessels passing through the bridge passages may be marked by signs on the water (B.1, B.2 Annex 8 to the Navigation Rules on the Sava River Basin) (Figure 12).

Figure 12



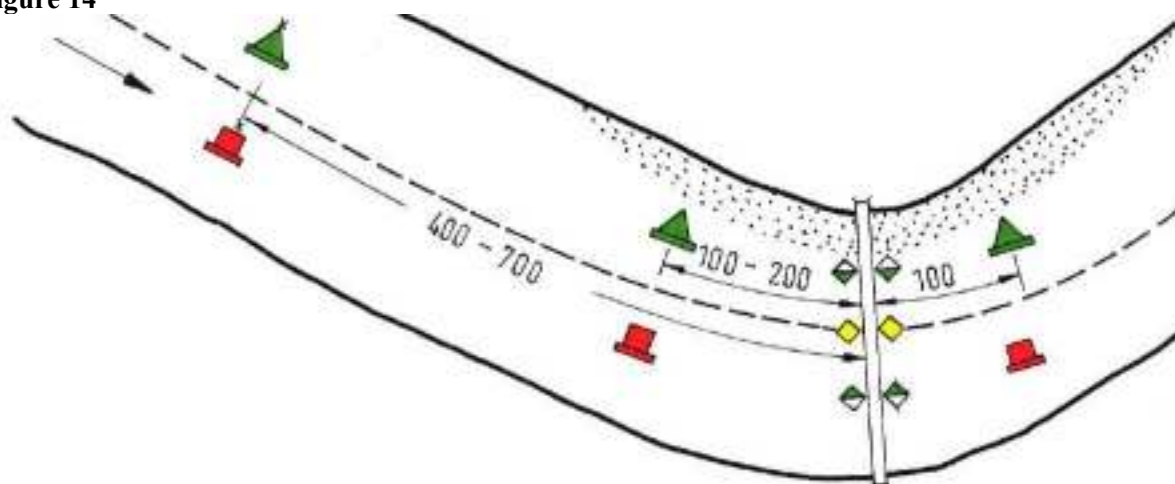
- (b) If, due to larger curvature of the fairway or some other reasons, marking by the afore-mentioned signs is not possible, signs and signals on the water (buoys, etc.), placed in order to follow the current, may be used (Figure13).

**Figure 13**



- (c) If the bridge is positioned on section where the current makes angle with fairway, marking may be done by two pairs of buoys upstream of the bridge. Pair of buoys closer to the bridge is placed on 100m - 200m distance upstream of bridge, and second pair on 400m - 700m upstream of bridge. Buoys more distant from the bridge are placed in order to follow the river flow jointly with the closer pair of buoys. Another pair of buoys may be placed downstream of bridge on 100m distance from the bridge (Figure 14).

**Figure 14**



### **Installation of signs and signals on the water restricting the anchoring points**

#### **Article 4.55**

Where there is increased intensity of vessels' traffic and the substantial accumulation of vessels in inner harbour basins of ports, not only signs and signals on the banks should be used in order to restrict the berthing places, but also signs and signals on the water.

#### **Reference numbers on buoys and markers**

#### **Article 4.56**

The use of alphanumeric characters and capital letters on buoys and markers is recommended. Where both letters and figures are used, their heights should be the same. Where two such combinations occur, as on junction markers, a hyphen should be used.

#### **Article 4.57**

Characters should not be less than 200 mm high, white on red or green buoys, or black on yellow buoys.

#### **Article 4.58**

The characters on a lighted buoy can be black on a white background. Signs are usually affixed to special nameplates. It is recommended that the characters are displayed on both sides of buoys.

#### **Marking the dangerous places**

#### **Article 4.59**

Different signs and signals on the water and bank marks, as well as the C.1, C.2 and C.3 bank marks, shall be used for marking the dangerous places (Annex 8 to the Navigation Rules on the Sava River Basin).

#### **Article 4.60**

Mark C.3 shall be placed on upstream and downstream part of the river island, which separates the riverbed into two navigable branches, as well as on the river-mouth of canals and navigable tributaries.

### **Chapter 5**

## **INSTALLATION OF RADAR REFLECTORS ON MARKING SIGNS AND SIGNALS**

#### **Article 5.1**

Signs on the water and on the banks shall be equipped with radar reflectors to ensure their visibility.

#### **Article 5.2**

When marking signs equipped with radar reflectors are installed, account must be taken of the furthest distance between the vessel and the sign in terms of the perception of the sign on the radar screen.

#### **Article 5.3**

In order to ensure danger-free passage through bridges, buoys equipped with radar reflectors shall be placed on both sides of the passage, not less than 15-20 metres upstream and downstream from the bridge, or passages through bridges shall be marked with radar reflectors installed on the bridge itself. Every effort should be made to install them by means of supports on the framework of bridges to mark the navigable passage through the bridge.

#### **Article 5.4**

Navigational hazards and water supply engineering structures (sunken vessels, groynes, cross-beams, etc.) located in the river bed should also be marked by signs equipped with radar reflectors. If the groynes or cross-beams marked by radar reflector signals are located along one of the banks while the fairway follows the opposite bank, which is low and flat, the radar reflector signals may also be placed on that bank so as to facilitate the orientation of vessels navigating by radar.

#### **Article 5.5**

In general, when radar reflectors are used on marking signs and signals, the rule that these reflectors shall not modify the form or size of the sign or signal should be observed. Their colour shall also correspond to the colour of the sign or signal in question.

#### **Article 5.6**

Practical experience has shown that there is a need for, at least, two standard sizes of reflectors on buoys and markers. Recommended dimensions are as follows.

type 1: tip to tip height 420 mm

type 2: tip to tip height 800 mm

#### **Article 5.7**

The square plate referred to above has a hypotenuse of 300 or 565 mm respectively and sides of 210 or 400 mm respectively. The reflector should be placed in the lying position to maximize its reflectivity.

## **Chapter 6**

### **IMAGE DISPLAY TECHNIQUES**

#### **General recommendations**

##### **Article 6.1**

New image display techniques may be used subject to a following conditions.

- (a) The technique must comply with the provisions of the Navigation Rules on the Sava River Basin;
- (b) Deviation from the original colours is possible for some signs when implementing a new technique. This is dealt within the descriptions of the relevant signs;
- (c) Because new display techniques sometimes make use of images composed of many pixels, special consideration needs to be given to image design;
- (d) A general characteristic of the new display techniques is that the text and images can be controlled remotely; variable images are possible within a single display. Phantom effects, i.e. reflective effects and illusions caused by the incidence of sunlight, can be controlled.

Examples of the new Image Display Techniques are given in the Annex 2.



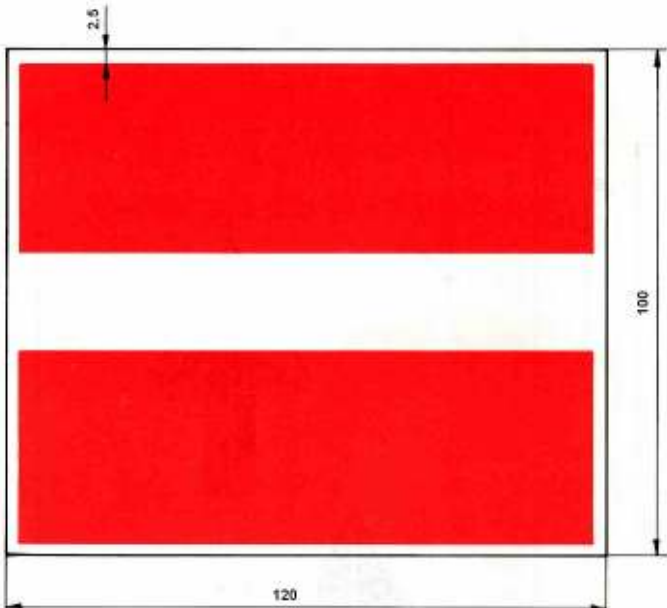
**ANNEX 1**  
**Measurements of boards for signs (example)**

In principle, boards may be surrounded with a white strip 2.5 to 4.5 cm broad or a black strip 1.0 cm broad in order to improve the visibility of the symbols appearing on special bank signs.

In special cases, where the field conditions allow or demand it, the dimensions of the marking signs can be increased for max. 50% or decreased for max. 50% (locking aspect ratio).

Table 1 Dealing with the examples of marking signs showing their size and codes of the marking signs with the same size and complying with the provisions of the Navigation Rules on the Sava River Basin.

**Table 1:**

Codes of the marking signs with the same size (120x100 cm)	A.1.
white strip 2.5cm: A.1. C.5. E.1.	 <p>The diagram shows a rectangular sign board with a total width of 120 cm and a total height of 100 cm. A white horizontal strip, 2.5 cm wide, is positioned at the top. Below this strip are two red rectangular areas, one above the other, separated by a white gap. The red areas are symmetrically placed within the board's dimensions.</p>

**Codes of the marking signs  
with the same size (100x100cm)**

**B.7.**

white strip 2.5cm:

A.5. A.5.1. A.6. A.7.  
A.8. A.9. A.12. A.13.  
A.14. A.15. A.16. A.17.  
A.18. A.19. A.20.

B.5. B.6. B.7. B.8.  
B.9. B.11.a. B.11.b.

C.1. C.2. C.3. C.4.

white strip 4.5cm:

E.2. E.5. E.5.1. E.5.3.  
E.5.4. E.5.5. E.5.6. E.5.7.  
E.5.8. E.5.9. E.5.10. E.5.11.  
E.5.12. E.5.13. E.5.14. E.5.15.  
E.6. E.7. E.7.1. E.8.  
E.9. E.10. E.11. E.13.  
E.14. E.15. E.16. E.17.  
E.18. E.19. E.20. E.21.  
E.22. E.23. E.24.

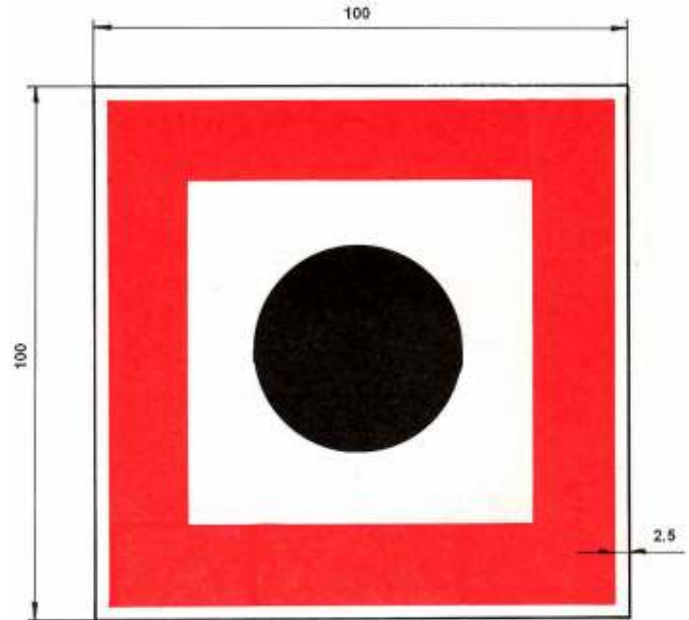
no strip:

B.1.

white strip (only above and under) 3.0cm:

B.3.

B.5. (80x80cm and 100x100cm)



**Codes of the marking signs  
with the same size (100x100cm)**

**D.2.**

white strip 2.5cm:

A.10.

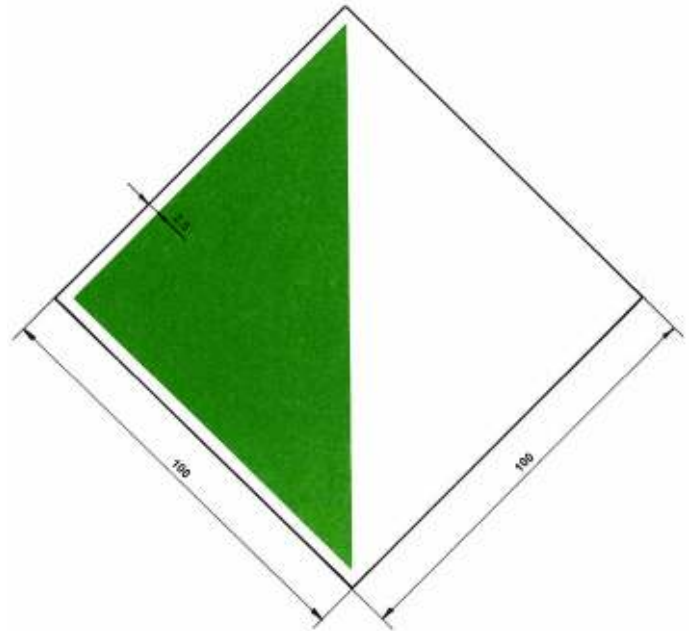
white strip 2.5cm and black strip 1.0cm:

D.1.a. D.1.b. D.2.

no strip:

B.2. B.4.

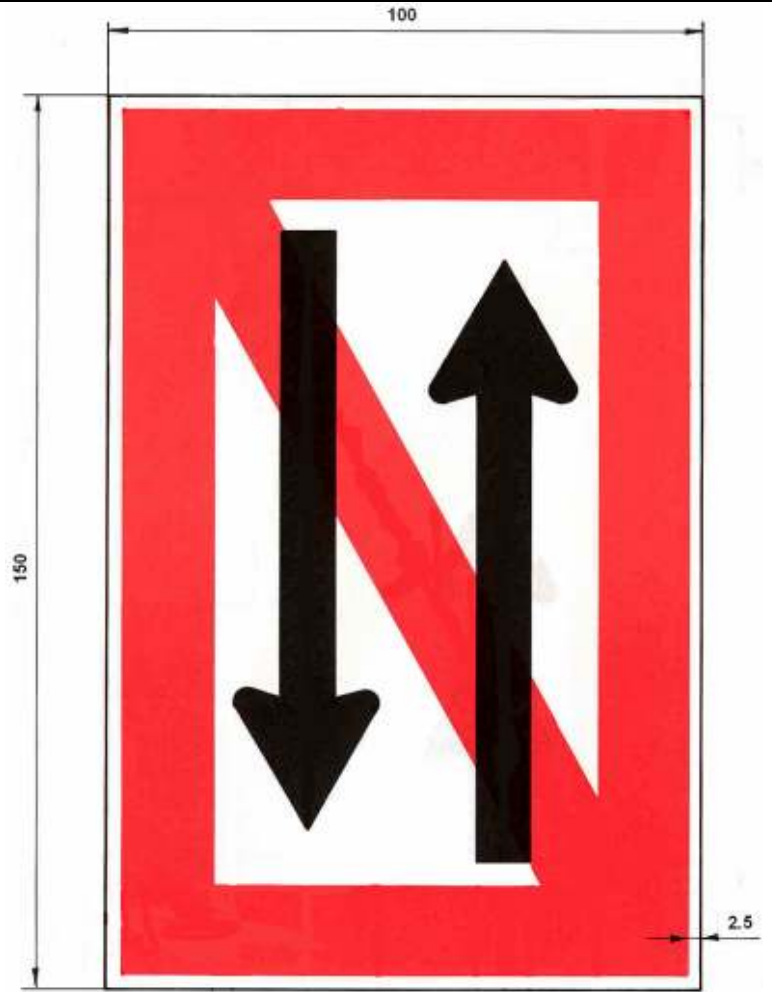
B.6. (80x80cm and 100x100cm)



**Codes of the marking signs with the same size (100x150cm and 150x100cm)**

**A.7.**

- A.2.      A.3.      A.4.      A.4.1.
- B.1.      B.2.a.    B.2.b.    B.3.a.
- B.3.b.    B.4.a.    B.4.b.
- white strip 2.5cm:
- white strip 4.5cm:
- D.3.
- E.3.      E.4.a.    E.4.b.



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**Codes of the marking signs  
with the same size (200x100cm)**

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**E.5.2.**

white strip 4.5cm:  
E.5.2.



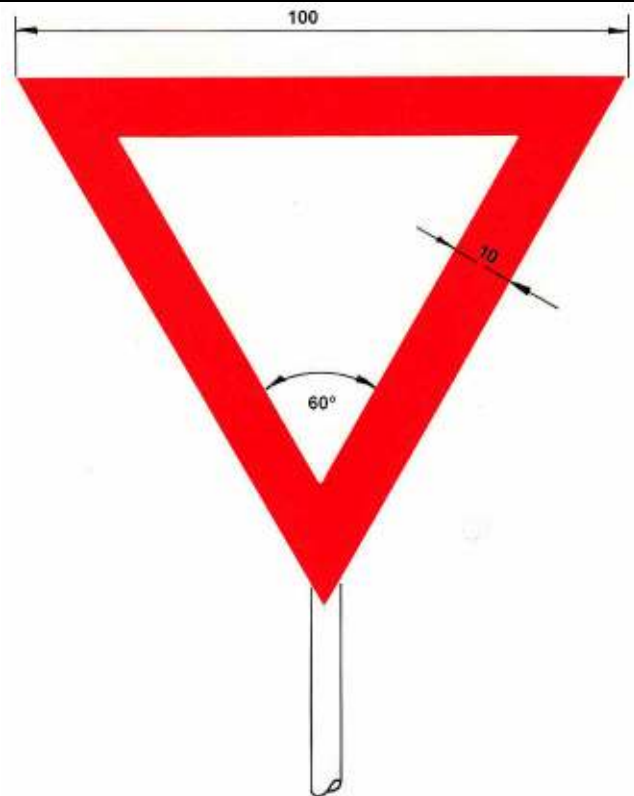
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**Codes of the marking signs with the  
same size (axaxa=100x100x100cm)**

---

**C.1.**

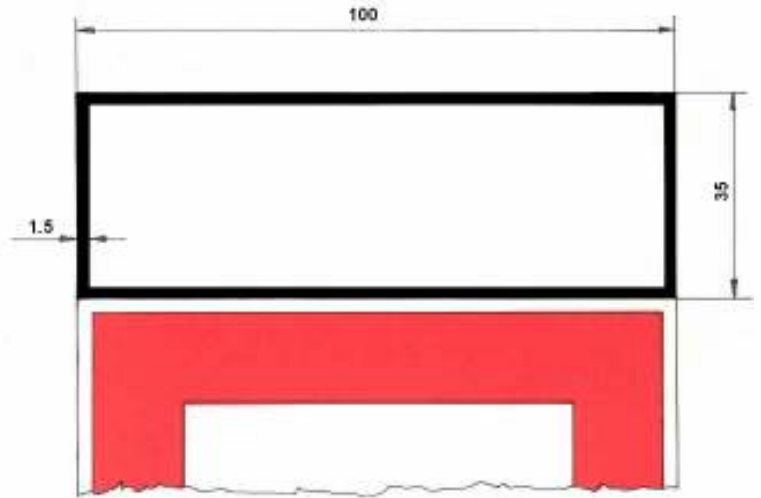
C.1.      C.2.      C.3.  
no strip:



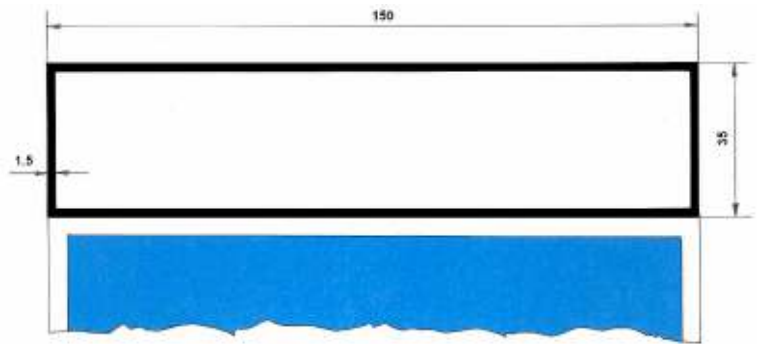
**Codes of the marking signs  
with the same size  
(100x35, 150x35 and 100x100x100cm)**

**Auxiliary Signs – Additional Panels**

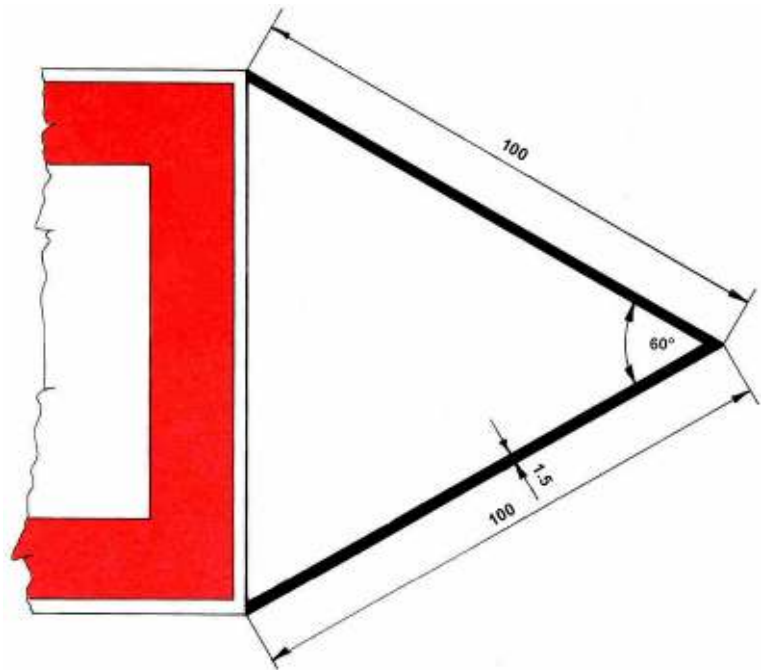
black strip 1.5cm



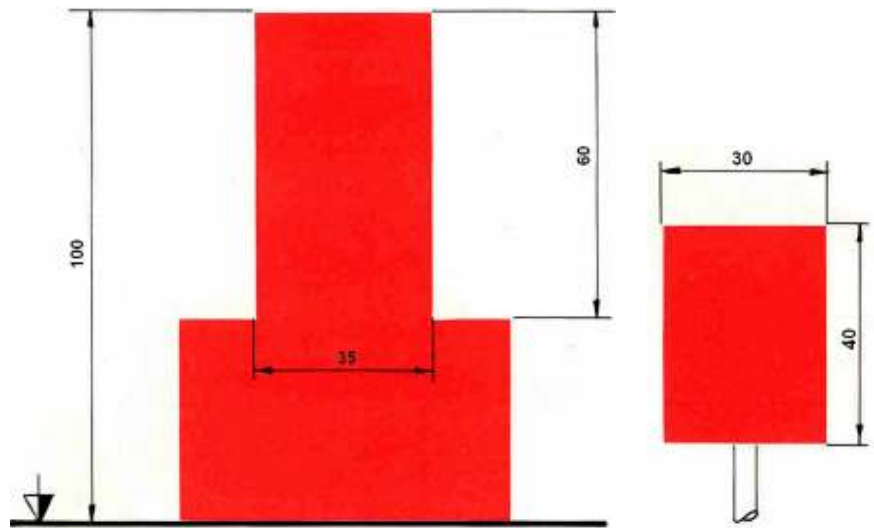
black strip 1.5cm



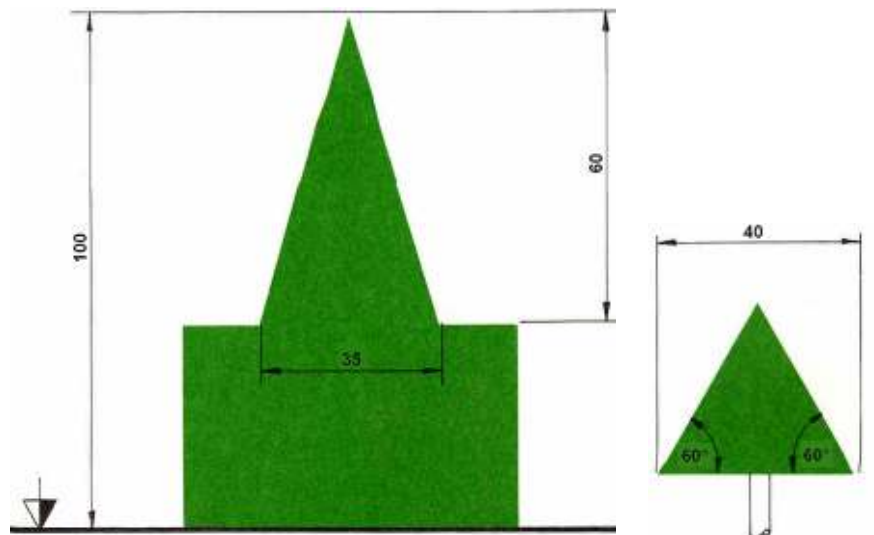
black strip 1.5cm



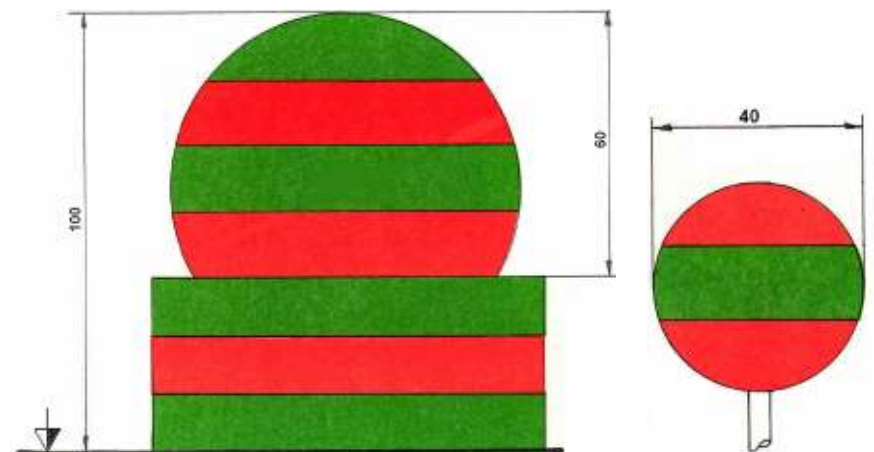
A.1.



A.2.



A.3.



## **ANNEX 2**

### **Examples of the new Image Display Techniques**

#### **Light guide technology**

Light guide technology, is mostly familiar from the matrix signalling devices positioned above roads. The images are displayed on lens arrays, linked by means of fibre optics (glass or plastic cable) to an optical device with, usually, a main and a back-up light. Every image is controlled from one or more optical devices. By switching the different optical devices on and off, different images, and therefore variable information, can be displayed.

Advantages:

- no mechanical/moving parts;
- low maintenance;
- high luminous intensity (adjustable);
- high-fidelity imaging;
- all-weather;
- socket can be located accessibly.

Disadvantages:

- relatively costly;
- limited number of images.

#### **Light emitting diode (LED)**

A LED is a small low voltage light source. Its visibility is limited by its angular aperture and the luminance of the LEDs. Images are made up of a large number of LEDs, each controlled separately. In other respects its properties are very similar to those of light guide technology.

Advantages:

- no mechanical/moving parts;
- low maintenance;
- simple control;
- high-fidelity imaging.

Disadvantages:

- limited range of display colours;
- light output affected by ambient temperature.

#### **Electromagnetic segmented display**

Any desired image can be displayed by reversing electromagnetic segments, one side of which is light and the other dark in colour. The angular aperture on these displays is wide, both horizontally and vertically.

Advantages:

- presentational flexibility;
- displays in all colours;
- easy to read;
- low energy usage;
- continues to display last image if power fails.

Disadvantages:

- displays must normally be kept in a conditioned cabinet because of moving parts;
- lighting required when dark.

### **Rotary drum display**

Rotary drum displays are suitable for displaying regularly changing configurations.

Advantages:

- IWPR configuration can be accurately reproduced;
- displays in all colours;
- good visibility.

Disadvantages:

- mechanical parts, so maintenance facilities are necessary;
- number of images limited;
- lighting required when dark.

### **Moving screens**

Moving screens can consist of a display with a large number of light dots (LED or bipolar segments), switched so as to form the arbitrary texts or diagrams. The text can also move, allowing a message of virtually unlimited length to be displayed.

Advantages:

- flexible, unlimited displays;
- no moving parts;
- all-weather.

Disadvantages:

- monochrome;
- relatively expensive.

Application: information on waiting times, operating times, etc.