

## **Attachment No. 1**

**Road safety audit methodology of the existing traffic organization at pedestrian crossings and in their surroundings**

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## **1. SUBJECT OF THE RESEARCH**

The subject of the research is the assessment of road safety at selected pedestrian crossings (without traffic lights) in the city of Warsaw.

## **2. LIST OF MEASURING EQUIPMENT**

For research, it is envisaged to use a rangefinder or a measuring wheel, a camera, a voice recorder.

## **3. RESEARCH SCOPE**

The audit will be carried out at pedestrian crossings indicated in the study "Inventory of pedestrian crossings without traffic lights on national, provincial and district roads in the city of Warsaw", by Biuro Prac Inżynierskich Spółka z o.o., Warsaw – as of 2015. The pedestrian crossings are located in the following districts: Targówek, Mokotów, Ursynów, Bielany, they will be numbered according to the Excel file attached to the submitted study: selection for the districts of Targówek, Mokotów, Ursynów, Bielany.xlsx.

## **4. AUDIT PROCEDURE**

The basis of the road safety audit process is an on-site inspection carried out by the Auditor in the field. Visions can be carried out from Monday to Saturday, excluding the time of precipitation. As part of the field work, it is necessary to collect data on the organization and geometry of road traffic, in connection with the directions of vehicle traffic. The above information will be collected on the form, the content of which will be described below. Each of the forms contains eight sheets, and the information to be obtained is grouped thematically so that the card is legible and understandable to auditors. The form is divided into 14 thematic blocks:

1. General information – name and surname of the person conducting the audit, details of the verifying auditor, date and time of the on-site inspection and the weather conditions prevailing during it.
2. Metric according to the inventory – according to the data received from the contracting authority: pedestrian crossings number; district, street on which it is located; street category and number of lanes.
3. Characteristics of the pedestrian crossing – location, determination of whether the roadway has the right of way, indication of the presence of a bicycle path and its location relative to the crossing, the presence of tram lines, indication of the type of track surface and surface behind and before the pedestrian crossing, determination of the condition of the surface, lighting elements, dimensions of the pedestrian crossing, geometry of the street in the area of the pedestrian crossing and measurement of the distance of the pedestrian crossing to the adjacent roadway (in the case of an intersection), determination of the speed of access and a description of the cross-section at the height of the pedestrian crossing.

4. Organization of vehicle traffic – indication of the direction of vehicle traffic – cars, trams and bicycles.
5. The presence of bus stops within the pedestrian crossing, if any, is an indication of their location and distance from the pedestrian crossing and the type – bus stop on the roadway or bus bay.
6. Vertical marking – inventory of vertical marking in the area of the pedestrian crossing.
7. Horizontal marking – type of marking, background of marking, condition of marking, if there is a narrowing of the pedestrian crossing is a determination of the location and type of narrowing and its width.
8. Stormwater drains – the number of rain drains and the assessment of dehydration.
9. The occurrence of devices for the disabled – ramps, facilities for the visually impaired.
10. Fencing and utility poles- division into types of devices and their location.
11. Parking – determination of the presence of parking divided into location: on the roadway, in the lane by the road, in the lane and at the crossing.
12. Visibility – indication of the visibility measured by the auditor, the visibility required and, if there is an indication of visibility limitations.
13. Opinion and comments of the auditor.
14. Photographic documentation.

Each card completed by the Chief Auditor will be checked/analyzed by the Review Auditor. In the event that the auditors' opinions diverge, the decision on the recommendation will be taken by the Project Steering Committee (composed of three auditors). The paper data will be transferred to the electronic database. The audit of each of the pedestrian crossings will take place using an identical form. The prepared form is attached to this methodology.

## **5. DEVELOPMENT OF RESULT AND CONCLUSIONS**

The results will be developed through the final assessment of each of the pedestrian crossings individually and in relation to the other ones. It will be possible to sort / segregate data in such a case as to be able to search from the database for all pedestrian crossings, e.g. with incomplete vertical markings or all where there is increased parking. The result of the study will be a final report containing summarized results and conclusions, as well as a database enabling independent data segregation. The aim of the research is to identify problem areas, determine the causes of problems and propose their solution. The evaluation envisages solutions in the field of:

- Complements to road markings,
- Shortening the length of the pedestrian crossing – narrowing the roadway, building an asylum,
- Revitalization of the road surface / tram track,
- Enlargement of the visibility area: driver – pedestrian, pedestrian – driver.
- Where it is justified to introduce a facility for people with disabilities,

- Indication of pedestrian crossings to transfer / liquidation,
- Other ...

The implementation of the above recommendations will require projects of new traffic organization and, in extreme cases, reconstruction / relocation / liquidation of the pedestrian crossing.

## 6. DETAILED EXPLANATIONS OF SELECTED ASSUMPTIONS ADOPTED FOR DATA COLLECTION

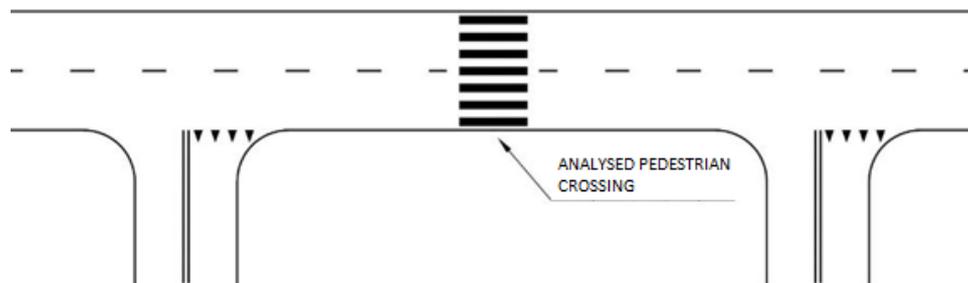
### 6.1 Characteristics of the pedestrian crossing

#### 6.1.1 Location of the pedestrian crossing

The location of the pedestrian crossings was classified, five categories were created:

- Between intersections (Fig. 6.1)
- At the entry / exit of the intersection,
- At the entry / exit of the roundabout,
- At the entry / exit of the estate,
- Other – if the location of the pedestrian crossing does not correspond to any of the above.

Categorization is related to the variation in speed on the approach to the pedestrian crossing depending on the location of the pedestrian crossing and will have an impact on the choice of method for assessing the visibility required.



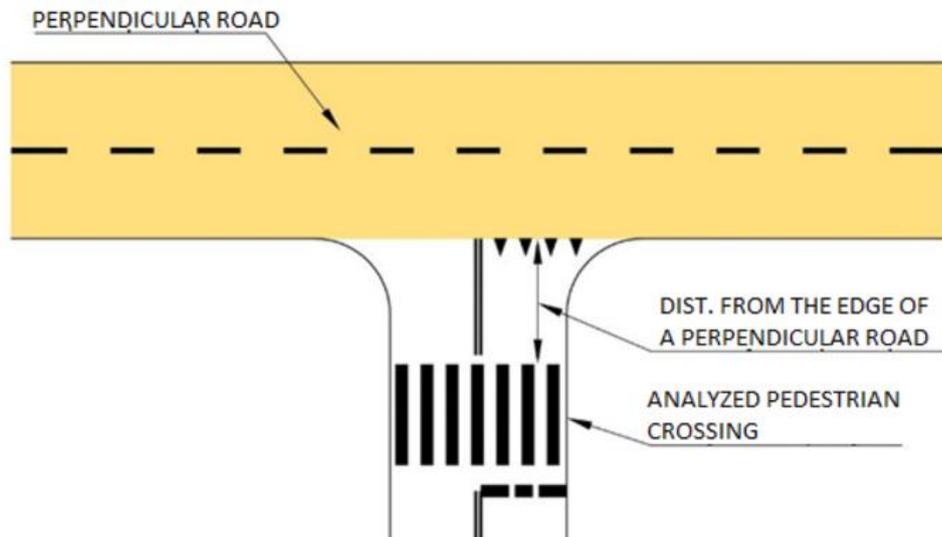
Rys. 6.1 Location of the pedestrian crossing between intersections.

#### 6.1.2 Distance from the edge of the perpendicular roadway

The work uses the concept of perpendicular road (Fig. 6.2). It is a perpendicular roadway (superior in terms of traffic organization) to the subordinate roadway on which the pedestrian crossing is located. Perpendicular road occurs when the pedestrian crossing is located at the entry or exit of the roundabout / intersection or at the estate. The distance from the edge of the audited pedestrian crossing to the perpendicular roadway should be described.

#### 6.1.3 Speed on perpendicular roadway

As part of the collected data, the permissible speed on this roadway is determined. Determining the above parameters will allow to assess the speed at which vehicles turning to the analyzed pedestrian crossing arrive.



Rys. 6.2 Perpendicular roadway

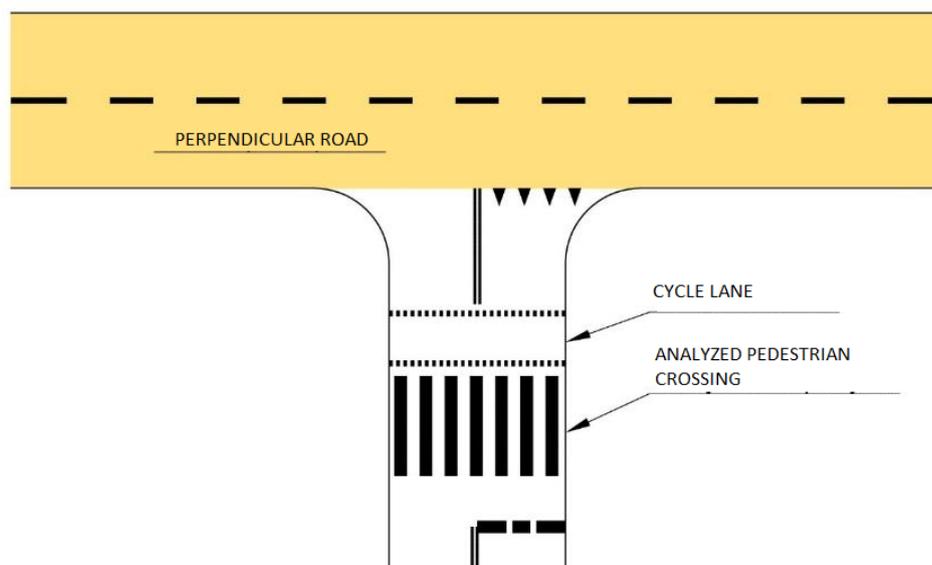
#### 6.1.4 Roadway with the right of way

The next information in the paragraph "Characteristics" refers to the roadway on which the pedestrian crossing is located. The auditor describes whether the roadway has the right of way – this is reflected in the speed that vehicles reach on the way to the crossing, on the main roadway they are higher, so the risk is greater.

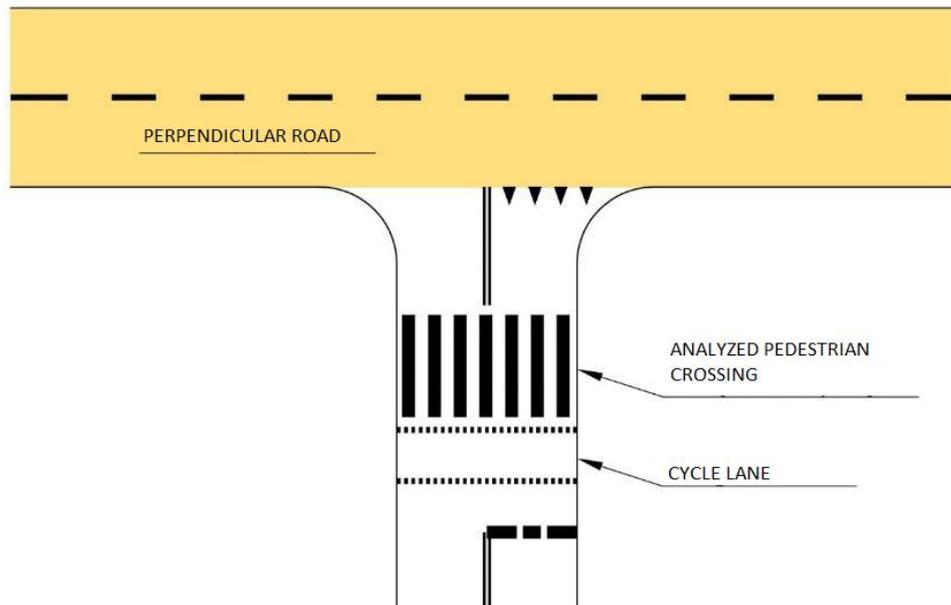
#### 6.1.5 Bicycle path and its location

The database contains information on the surroundings of the pedestrian crossing and its technical condition. The possibility of cycling and the location of the bicycle path relative to the pedestrian crossing are specified, the following locations are possible:

- Between the intersection and the pedestrian crossing (Figure 6.3),
- Behind the pedestrian crossing (from the side opposite to the intersection or the main road, Fig. 6.4).



Rys. 6.3 Bicycle path between the pedestrian crossing and the intersection.



Rys. 6.4 Bicycle path behind the pedestrian crossing.

#### 6.1.6 Track surface

When there is a tram track at the crossing, information is recorded in the base how many tracks run through the pedestrian crossing and what surface they have. Surface types are predefined in the form.

#### 6.1.7 Road surface behind and before the passage and its condition

Information about the surface before and after the pedestrian crossing is also collected. The type of surface and its condition are determined. Surface types are predefined in the form. A three-stage subjective Scale of the Auditor's assessment was used – good (does not require renovation), sufficient (the surface will soon require renovation), bad (surface for renovation).

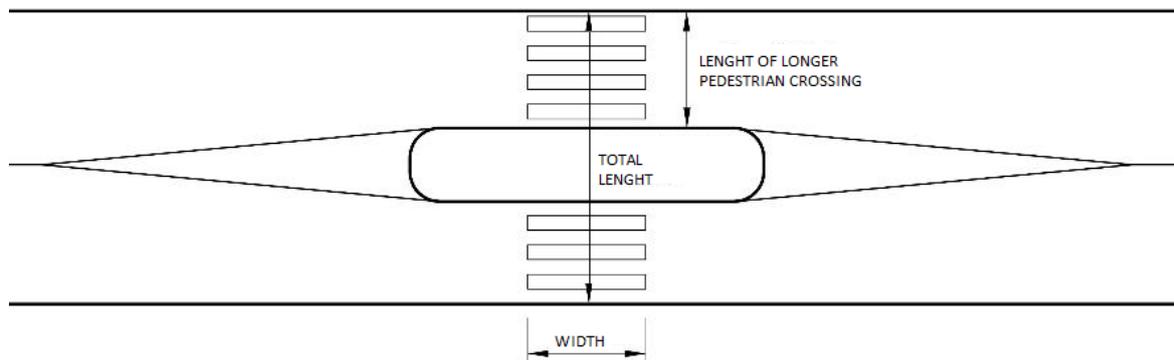
#### 6.1.8 Street geometry in the pedestrian crossing area and speed

Further information concerns the geometry of the street in the area of pedestrian crossing:

- Road curve – a pedestrian crossing located on the arch,
- Straight - a pedestrian crossing located on a straight section,
- turning road priority

In addition, the permissible speed according to the organization of traffic is determined. The exception are exits from the gates of plants, petrol stations, parking lots where theoretically there are no restrictions. Depending on the zoning and geometry, it is recommended to come a discretionary value. In most cases, it will be 20 (residential zone) or 30 km / h.

The widths and lengths of the pedestrian crossing must also be specified (Figure 6.5).



Rys. 6.5 Width and length of the pedestrian crossing.

The total length of the pedestrian crossing is measured in the middle of the width of the pedestrian crossing and determines the distances between the outer curbs of the roadway (the island of asylum elevated and "painted" are included in the total length of the pedestrian crossing). The length of a longer pedestrian crossing is the section that a pedestrian must cross a wider road in the case of an island of asylum other than one marked with a road marking.

Example 1. If there is a cross-section: 2 lanes (6 m), an asylum island (2 m), 3 lanes (9 m), the following data will be entered:

- Total length of pedestrian crossing 17 m
- Length of longer pedestrian crossing 9 m.

Example 2. If there is a cross-section: 2 lanes (6 m), an asylum island (2 m), 2 lanes (6 m), the following data will be entered:

- Total length of pedestrian crossing 14 m
- Length of longer pedestrian crossing 6 m.

Example 3. If there is a cross-section: 1 lane (3 m), no asylum island (0 m), 1 strip (3 m), the following data will be entered:

- Total length of pedestrian crossing 6 m
- Length of longer pedestrian crossing 6 m.

### 6.1.9 Cross-section

The cross-section is described in the selected main direction of movement of the vehicle, it is described from left to right and is located in the axis of pedestrian crossing, possible elements of the cross-section are distinguished:

- Bus bays – left and right sides,
- Parking bays – left and right sides,
- Lanes for bicycles – left and right sides,

- Carriageways – number of lanes – left and right sides,
- Refuge island – type and width
  - a. Raised,
  - b. On the road level
  - c. Marking,
  - d. Refuge island,
  - e. Refuge island with trams

Examples of the elements of cross-section are shown on Fig. 6.6 - 6.12.



Rys. 6.6 Cross-sectional elements – example I.



Rys. 6.7 Cross-sectional elements – example II.



Rys. 6.8 Cross-sectional elements – example III.



Rys. 6.9 Cross-sectional elements – example IV.



Rys. 6.10 Cross-sectional elements – example V.



Rys. 6.11 Cross-sectional elements – example VI.



Rys. 6.12 Cross-sectional elements – example VII.

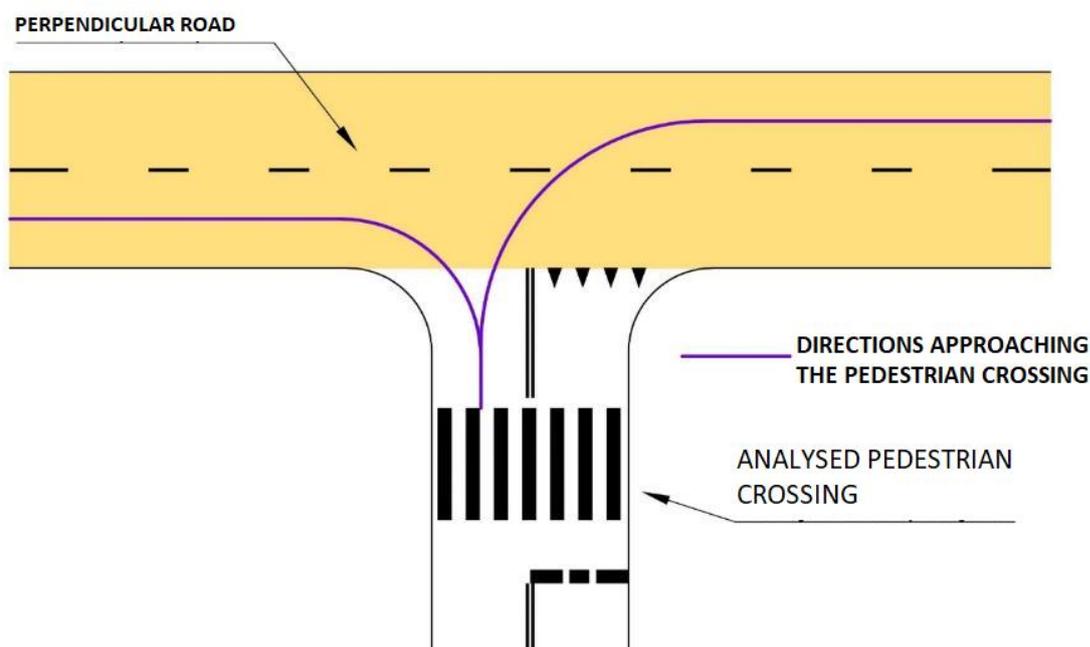
## 6.2 Organization of vehicle traffic

The paragraph concerns information on the organization of traffic on the roadway on which the crossing is located. The direction of movement of wheeled vehicles, rail vehicles and bicycle traffic is taken into account. Directions were adopted in accordance with geographical directions.



Rys. 6.13 Direction of movement of vehicles.

The parameter "number of relations descending from the intersection towards the pedestrian crossing" has been specified, which refers to the situation where there is a perpendicular roadway. The parameter is used to assess the risk from how many directions a pedestrian is exposed to potential danger.



Rys. 6.14 Directions approaching the pedestrian crossing– 2 relations.

### 6.3 Bus stops

The information concerns the location of bus stops on/by the roadway on which the crossing is located and on/by the perpendicular roadway (if any). If there is a bus stop on the roadway on which the crossing is being audited, the form should contain information on where exactly the stop is located (behind / before the crossing), what is its type and at what distance from the pedestrian crossing it is located. Bus stops are described for all possible directions of vehicle traffic. The presence of bus stops, especially located in the roadway, is to be taken into account when assessing the visibility conditions at the crossing.

### 6.4 Vertical marking and warning signals

The database collects information on vertical marking in the area of the crossing and concerning only markings related to pedestrian traffic marking. Every possible direction of travel of vehicles should be subjected to the inventory, any deficiencies in the marking should be indicated in the opinion of the auditor. The condition of the marking is assessed using a 2-step scale – good / bad. If there are warning signals at the crossing, they should also be taken into account when inventorying the road markings. The number of inventoried warning signals shall be described and whether the sign is working correctly shall be stated.

## 6.5 Road markings

### 6.5.1 Type, background, condition, other

The data to be collected shall collect the type and assessed status of road markings at and before the crossing. The types of road markings and their background shall be included in the form. The condition of the marking is subjectively assessed by the Auditor using a three-point scale – good, sufficient, bad.

### 6.5.2 Narrowing of the roadway – "shortening the pedestrian crossing"

In this part of the data entry you will find information on road narrowing in the area of the pedestrian crossing (if any). The auditor determines what type of narrowing occurs in a given place and what width it has. The types of narrowing are defined in the form. Narrowings are indicated separately for the left and right aisles. The parties were defined by means of a predetermined direction of the main traffic of vehicles.



Rys. 6.15 Example of narrowing - the left side of the passage, the elevated island with a width x m.

## 6.6 Rain drains

The auditor collects information on the number of rain drains and the presence of narrow-node sewage. The auditor evaluates the drainage at the crossing using a two-point scale: correct/incorrect. As drainage, it was correct to assume those where the drains are located outside the pedestrian crossing area, and their location makes them receive rainwater before the pedestrian crossing. In addition, it is assessed whether there are no rainwater stagnation or the risk of their formation in the area of the pedestrian crossing.

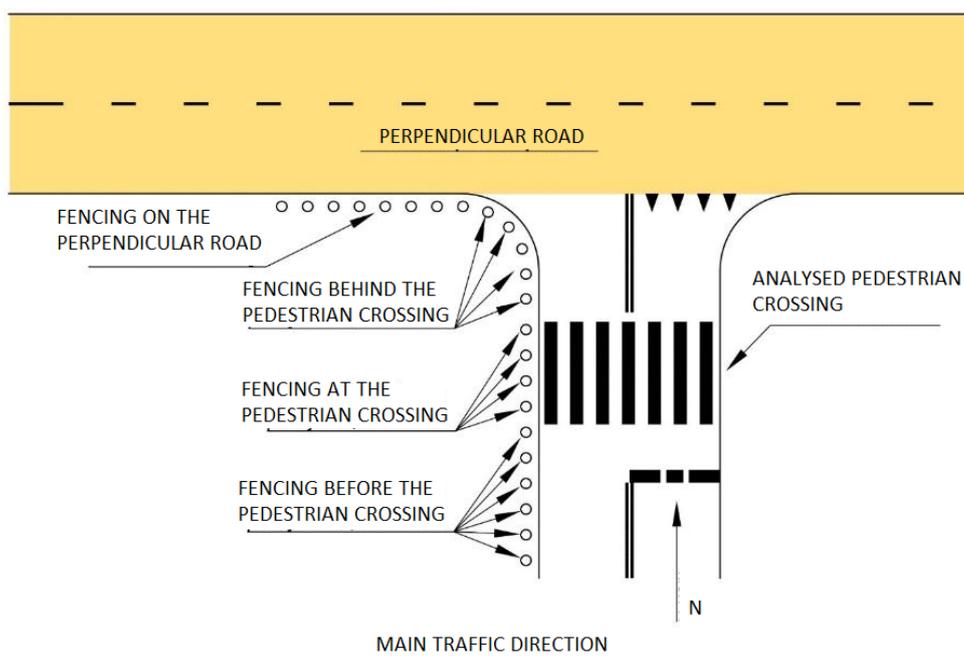
## 6.7 Facilities for the disabled / restrictions

Pedestrian crossings should be analyzed for facilities for the disabled. It should be assessed whether the basic needs of the physically disabled – ramps and for the blind – guide plates (fields of attention, others) have been taken into account. The left and right sides of the

pedestrian crossing and the area of the asylum island (if any) should be analysed. Again, the parties were designated using a predetermined direction of the main traffic of vehicles. The list includes information on which pedestrian crossings are equipped with the above-mentioned facilities and where there is a lack of them.

## 6.8 Fencing and utility poles

The paragraph of posts and fences is information on how parking possibilities have been limited at a given crossing. Several types of fences are distinguished – described in detail in the form. A scheme for determining the location of fences relative to the pedestrian crossing has been adopted and it is shown on the example in Figure 6.16.



Rys. 6.16 Fencing - example.

The reference point of the description of the fence in the area of the pedestrian crossing is the designated, main direction in which the vehicles go. On the basis of this direction, the sides of the placement of fences are determined. Each side is divided into three areas of placement of fences:

- before pedestrian crossing,
- at pedestrian crossing,
- after pedestrian crossing.

How the area "behind/before the pedestrian crossing" is described is determined by the chosen one main direction (vehicles). Each party shall be described in the form where there are no fences in the area concerned, the form shall bear the heading 'none'. If the analyzed pedestrian crossing is located in such a way that there is a perpendicular roadway, then the fences are also determined on the perpendicular roadway.

The example shown in Figure 6.16 shows a bar fence, to the left of the pedestrian crossing, occurring behind, before and at the crossing. Pillar fencing also occurs on a perpendicular roadway.

## 6.9 Parking

The form should describe parking. Individual types of parking are specified:

- Parking on the road: this is parking at the curb (does not block traffic, in the space of a wide roadway or at the curb in places separated by horizontal marking),
- Parking in the lane by the road: this is parking behind the curb: on sidewalks, greenery, decorated and unused spaces,
- Lane parking: this is parking that blocks traffic in the lane and vehicles have to change lanes to avoid the parked car,
- Parking on the pavement and on the roadway (one wheel),
- Parking at the crossing is parking on the "zebra" and in the waiting area before the pedestrian crossing blocking free access to the pedestrian crossing.
- Parking on a perpendicular roadway (if any) is such parking that could limit the visibility of a pedestrian crossing on a subordinate street from the perspective of a driver turning from the main roadway to a subordinate street to the right.

The point of reference is one main, designated direction of vehicles. On its basis, the left and right sides of parking are determined. Then, for each side, the designated parking areas are analyzed for the highlighted types of parking

Parking areas are understood as the location of parking relative to the pedestrian crossing (Fig. 6.17), the following are distinguished:

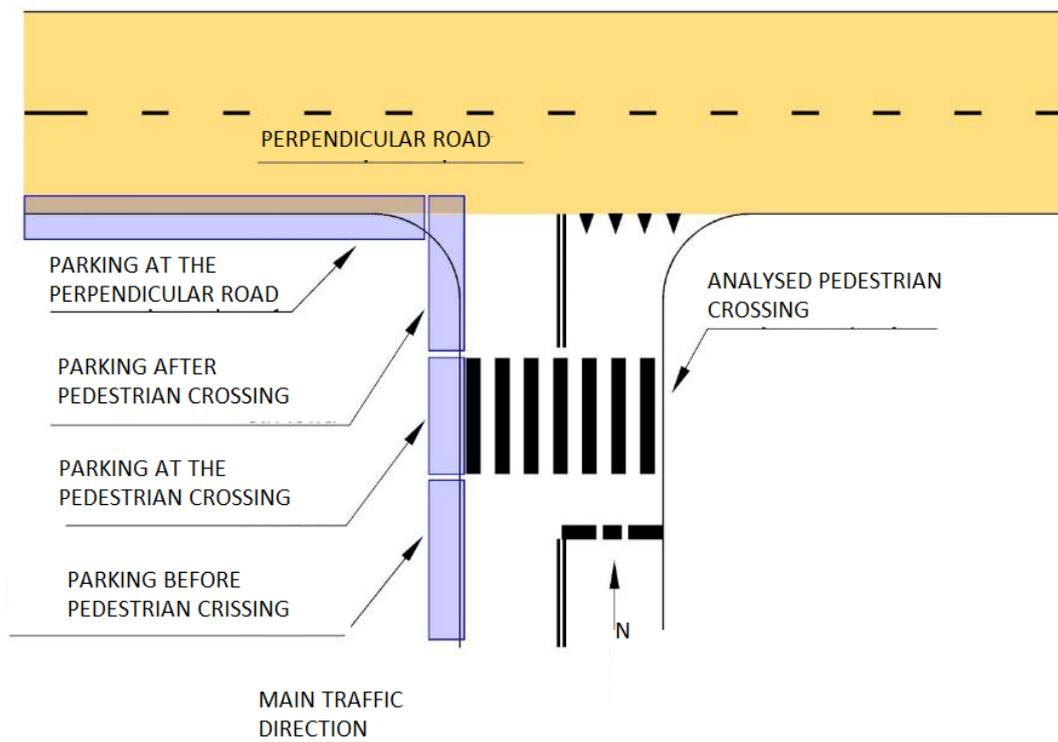
- Parking after pedestrian crossing,
- Parking before pedestrian crossing,
- Parking at pedestrian crossing,
- Parking on a perpendicular road (if there is).

As a result of a field audit, each of the areas should be analyzed for the available parking possibilities. In each of the areas, one of three parking states could occur:

- Vehicle parked and registered during the on-site inspection, indication of the distance of the parked vehicle to the passage,
- Vehicle not parked in a given area – unseen parking (NS) during a local inspection, but no physical restrictions (fences) to park and the situation in the field indicates that parking probably occurs,
- The vehicle is not parked in a given area and the lack of parking possibility (ND – not available) due to fences or other permanent obstacles – parking is not available.
- 

The description of parking as not found (NS) allowed to determine potential places where parking is possible, but just at the time of the vision in the field was not recorded.

Below is a diagram illustrating the Contractor's approach to the description of parking in the aisle area.



Rys. 6.17 Designated parking areas.

## 6.10 Visibility

### 6.10.1 Measured visibility

In terms of visibility, two groups of values should be considered – measured visibility and visibility required between the pedestrian and the driver. The auditor measures visibility in the field in real conditions using a rangefinder or measuring wheel. Visibility is measured between a point in the axis 1.0 m away from the edge of the roadway (assuming that a motorcyclist moves along this trajectory) and the point where there is a pedestrian waiting / entering the pedestrian crossing, i.e. 1.0 m from the edge of the road – on the sidewalk.

The auditor in the field determines and determines whether there are elements that limit visibility, such as:

- parking,
- trees,
- buildings,
- advertisements,
- bus stop,
- fencing,
- other.

### 6.10.2 Required visibility – theoretical assumptions

The visibility obtained from the measurement should be confronted with the required visibility. The method of determining the required visibility was developed on the basis of the Regulation of the Minister of Infrastructure and Development of 17 February 2015 on the Technical Conditions to be met by public roads and their location (hereinafter referred to as the Regulation) and on the basis of the Manual for pedestrian traffic organizers issued in 2014 at the request of the National Road Safety Council (hereinafter referred to as the Manual).

Four types have been developed to determine the required visibility depending on the location of the pedestrian crossing in relation to the oncoming vehicle and traffic organization:

- TYPE 1 – in a situation where the pedestrian crossing is located on the section between intersections or if the pedestrian crossing is located at the intersection, and the street with the analyzed crossing is a street with the right of way.
- TYPE 2 („rearward visibility”) – in a situation where the crossing is located at the intersection on a subordinate street and there is a situation where the driver driving on the main street can turn right from the road with priority to the pedestrian crossing on the subordinate road.
- TYPE 3 – in a situation where the pedestrian crossing is led through a tram track.
- TYPE 4 – at the access of the superior road and at exits from gates, exits, garages, petrol stations and other facilities where there is no signage with a permissible speed.

The values of the required visibility fields TYPE 1 are shown in Figure 6.18 – for a vehicle moving straight ahead and the required fields of visibility for a vehicle turning right to a pedestrian crossing from the main road (Fig. 6.19). Each table contains the following information:

- Longitudinal inclination of the roadway [%],
- Permissible speed on the roadway on which the pedestrian crossing is located [km/h],
- Visibility required for the dimensions indicated in the drawings [m].

#### Visibility TYPE 1

Visibility in case of that the pedestrian crossing is located on the roadway on which the vehicle moves (Fig. 6.18) was developed on the basis of the Regulation § 168, a table of visibility distances allowing to stop the vehicle from an obstacle on the road. It was assumed that the vehicle is located 1.0 m from the edge of the roadway (motorcycles are included), the pedestrian is also 1.0 m from the edge of the roadway (on the sidewalk), in the middle of the width of the pedestrian crossing (based on the Manual page 111). In accordance with the Comments of the Ordering Party, it was established that the visibility requirements will be determined on the basis of the permissible speed value in the range from 20 to 70 km / h, which will be increased by safety factors. On the basis of measurements in the city of Warsaw, a table of exceeding the speed of drivers depending on the cross-section of the roadway was prepared. For the analysis, a V85 speed quantile was used on the available cross-sections of streets and on its basis it was determined if drivers exceed the permissible speed (value given

in %). The percentage of speeding determined the safety factor for a given speed and cross-section. A table is obtained for the following values:

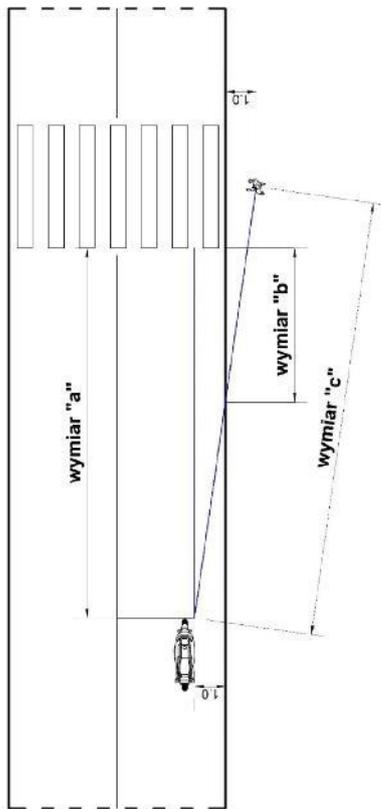
Tablica 6.1 Exceeding the speed of drivers depending on the cross-section - Warsaw

Cross-section	Speed limit	Exceed od the speed	Speed limit + safety factor
[-]	[km/h]	[%]	[km/h]
1x2	40	40%	56
<b>1x2</b>	<b>50</b>	<b>15%</b>	<b>58</b>
1x4	50	40%	70
2+1	50	10%	55
2x2	30	40%	42
<b>2x2</b>	<b>50</b>	<b>25%</b>	<b>63</b>
2x2	80	-6%	75
2x3	50	45%	73
2x3	60	40%	84

The burgundy color marks the cross-sections for which the largest research sample was obtained. The analysis showed that the more extensive the cross-section, the more often and significantly exceed the speed of the drivers. Hence, for the cross-section of two roadways of 3 lanes (2x3) the highest rates of 40 and 45% were obtained. The values contained in the table of the Regulation were interpolated so as to obtain values for the speed increased by a safety factor (understood as the value by which drivers exceed the speed on a given cross-section). The table is prepared for the value of deviations of the vetlets in the range from -8% to 8%. Figure 6.18 specifies three dimensions for the required visibility: 'a', 'b', 'c', which denote:

- Dimension "a" means the distance of the vehicle to the edge of the pedestrian crossing (measured in a straight line, parallel to the roadway) – the value of the dimension is determined by interpolation on the basis of the table from the Regulation and the Manual. The dimension on the basis of which the remaining distances were determined.
- Dimension 'c' is the distance between the vehicle and the pedestrian (each 1,0 m from the edge of the road) measured in a straight line.
- Dimension "b" is the distance from the transition to the point of intersection of the driver-pedestrian line of sight with a curb. At distance "b" in the space next to the roadway there should be no obstacles limiting visibility.

In the case of vehicles leaving large intersections with circular traffic, a speed of 40 km/h was assumed and no exceeding the speed limit was added.



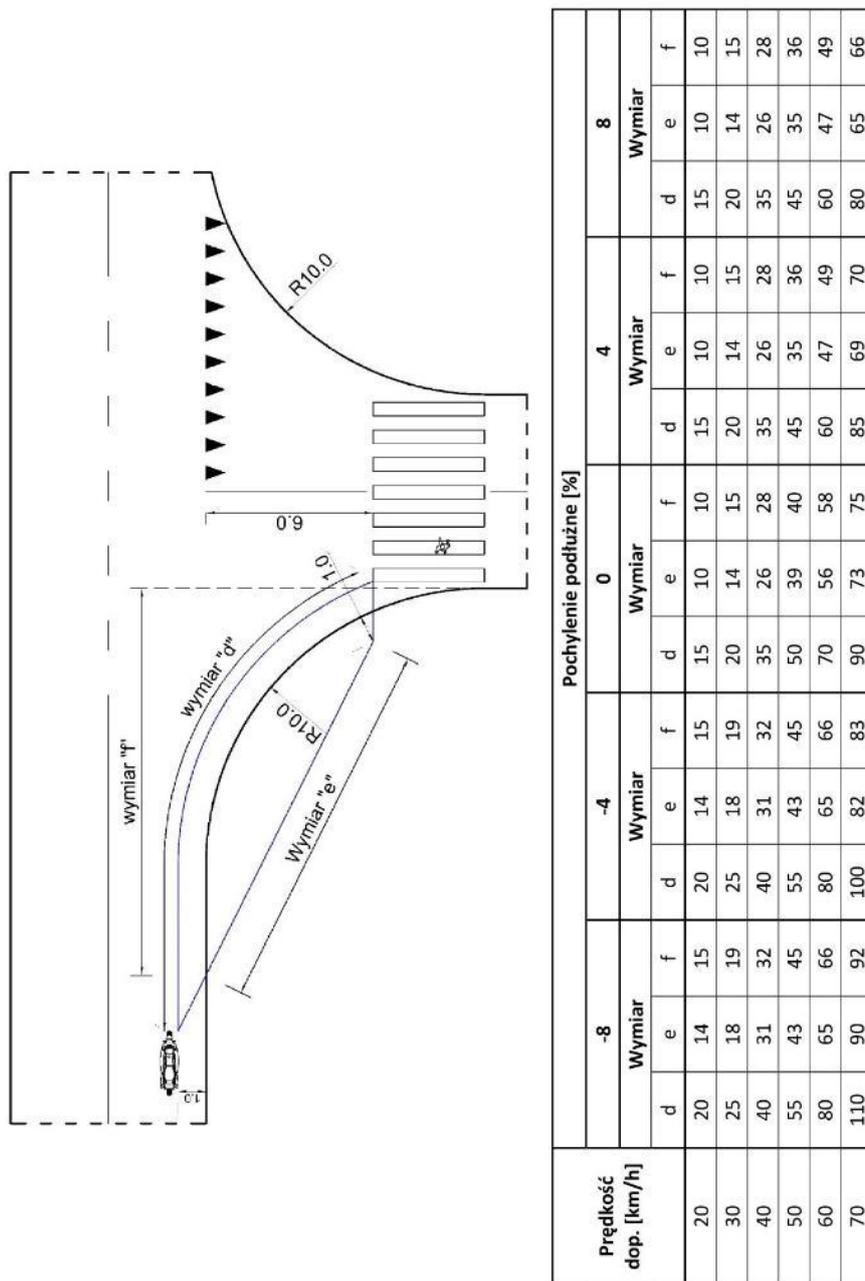
		Pochylenie podłużne [%]																	
		-8			-4			0			4			8					
Prędkość dop. [km/h]	Współczynnik bezpieczeństwa [%]	Prędkość dop. + wpólcz. bezp [km/h]						Widoczność wymagana [m]											
		Wymiar		Wymiar		Wymiar		Wymiar		Wymiar		Wymiar		Wymiar		Wymiar			
		a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
20	0%	20	9	22	20	9	22	15	7	17	15	7	17	15	7	17	15	7	17
30	0%	25	12	27	25	12	27	20	9	22	20	9	22	20	9	22	20	9	22
40	40%	44	21	46	44	21	46	40	19	42	37	18	39	37	18	39	37	18	39
40	0%	40	19	42	40	19	42	35	17	37	35	17	37	35	17	37	35	17	37
40	40%	69	34	71	69	34	71	61	30	63	53	26	55	53	26	55	53	26	55
50	0%	55	27	57	55	27	57	50	24	52	45	22	47	45	22	47	45	22	47
55	10%	68	33	70	68	33	70	60	29	62	53	26	55	53	26	55	53	26	55
58	15%	71	35	73	71	35	73	63	31	65	55	27	57	55	27	57	55	27	57
60	20%	80	39	82	80	39	82	70	34	72	60	29	62	60	29	62	60	29	62
63	25%	92	45	94	87	43	89	78	38	80	70	34	72	68	33	70	68	33	70
65	30%	95	47	97	90	44	92	80	39	82	73	36	75	70	34	72	70	34	72
73	45%	131	65	133	117	58	119	102	50	104	95	47	97	88	43	90	88	43	90
60	0%	80	39	82	80	39	82	70	34	72	60	29	62	60	29	62	60	29	62
84	40%	173	86	175	153	76	155	133	66	135	119	59	121	109	54	111	109	54	111
70	0%	110	54	112	100	49	102	90	44	92	85	42	87	80	39	82	80	39	82

Rys. 6.18 Widoczność TYP 1, Widoczność na zatrzymanie przed przejście dla pieszych – pojazd na jezdni przed przejściem

### Visibility TYPE 2 (Fig 6.19)

Visibility for a vehicle turning right from the main road to a pedestrian crossing was also determined on the basis of the table contained in the Regulation § 168 – a table of visibility distance allowing the vehicle to stop in front of an obstacle on the roadway and based on the Manual – it was again assumed that both the vehicle and the pedestrian are located 1.0 m from the edge of the road. Visibility requirements are presented for the permissible speed in the range from 20 to 70 km / h and for the longitudinal inclination value in the range from -8% to 8%. In the absence of speed tests, safety factors were not adopted. It was assumed in simple terms that the turning radius at the intersection is 10.0 m, and the pedestrian crossing is 6.0 m away from the main road. Figure 6.19 specifies three dimensions for the required visibility: 'd', 'e', 'f'.

- Dimension "d" means the distance (measured after the turning path) of the vehicle to the edge of the pedestrian crossing (the vehicle is located 1.0 m from the edge of the road), the value of the dimension "d" is determined by the tables from the Regulation and the Manual. The dimension on the basis of which the remaining distances were determined.
- Dimension 'e' is the distance in a straight line between the vehicle and the pedestrian (each 1,0 m away from the edge of the road).
- Dimension "f" is the distance from the pedestrian crossing to the point of intersection of the driver-pedestrian line of sight with the curb line. At the distance "f" in the space next to the roadway there should be no obstacles limiting visibility.

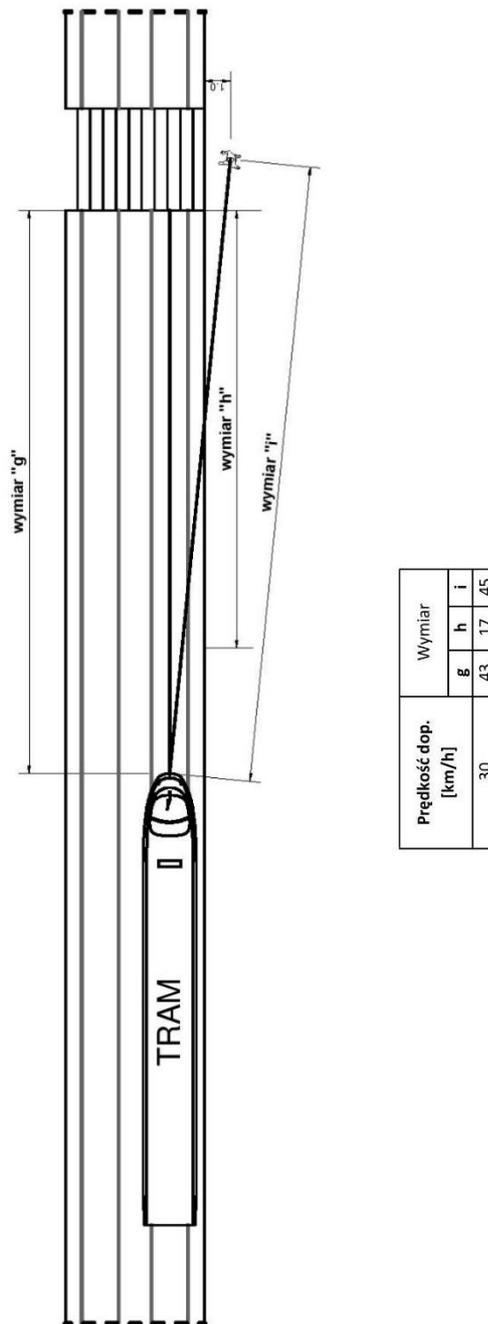


Rys. 6.19 Visibility at a stop before a pedestrian crossing – a vehicle turning from a perpendicular road,

### Visibility TYPE 3 (Fig 6.20)

Visibility at pedestrian crossings running through tram tracks has been developed on the basis of the table contained in Annex 3 to the Regulation of the Minister of Infrastructure of 2 March 2011 on the technical conditions of trams and trolleybuses and the scope of their necessary equipment. As in previous cases, it was assumed that the pedestrian is 1.0 m away from the edge of the roadway and is located in the middle of the pedestrian crossing with a width of 4.0 m. The visibility requirements are presented for a tram speed of 30 km/h. Figure 6.20 specifies three dimensions of the required visibility: "g", "h", "i".

- Dimension "g" means the safe length of the tram's braking distance, determined assuming that the vehicle stops at the edge of the pedestrian crossing (measured in a straight line, parallel to the track axis) – the value of the dimension is determined by taking into account the driver's reaction time and the actual length of the tram's braking distance, assuming a brake deceleration value of  $1.0 \text{ m/s}^2$  on the basis of the table contained in the above-mentioned Regulation. The dimension on the basis of which the remaining distances were determined.
- Dimension "h" is the distance from the pedestrian crossing to the point of intersection of the line of sight of the driver – pedestrian with the edge of the track. At the distance "h" in the space next to the track there should be no obstacles limiting visibility.
- The dimension "i" is the distance at which the driver's field of vision should be free of obstacles.



Rys. 6.20 Visibility at the stop of the tram before the pedestrian crossing.

#### Visibility TYPE 4

In a situation where the pedestrian crossing is located on a subordinate road at the intersection of the parent road with the subordinate road, the dynamics of vehicles reaching the crossing is completely different than on sections with priority. Drivers travelling on a subordinate road must slow down or stop before joining the traffic on the superior road. Therefore, on the basis of measurements on selected cross-sections, it was assumed that vehicles commuting to the

parent roadway (where they must give way to vehicles on the parent roadway) move at a speed of 40 km / h and no speeding value is added in this case. The field of visibility is determined according to the table for TYPE 1, however, assuming a permissible speed of 40 km / h without a safety factor.

In the case of exits from the gates of plants, petrol stations, parking lots where theoretically there are no administrative restrictions, the required visibility is determined according to the visibility of TYPE 1, but assuming a subjective speed value without a safety factor. Depending on the zoning and geometry, it is recommended to come a discretionary value. In most cases, it will be 20 km/h (residential zone) or 30 km/h.

### 6.10.2 Visibility required – simplifications

Simplified values may be adopted. It is allowed to take a 0% inclination with a slight inclination. Tables 6.2 to 6.5 present the adoption of simplified, often rounded values of the required visibility for individual types of visibility and types of sections.

Tablica 6.2 Simplified visibility values required – TYPE 1

Visibility type	Cross-section	Permissible speed [km/h]	Speeding [%]	V85 [km/h]	visibility marking	adopted visibility [m]
TYPE 1	1x2	30	-	-	c	35
TYPE 1	1x2	40	40%	56	c	65
TYPE 1	1x2	50	15%	58	c	65
TYPE 1	1x4	50	40%	70	c	90
TYPE 1	2+1	50	10%	55	c	60
TYPE 1	2x2	30	40%	42	c	40
TYPE 1	2x2	50	25%	63	c	80
TYPE 1	2x2	80	-6%	75	c	105
TYPE 1	2x3	50	45%	73	c	105
TYPE 1	2x3	60	40%	84	c	135

Tablica 6.3 Simplified visibility values required – TYPE 2

Visibility type	Permissible speed on the main road [km/h]	visibility marking	Adopted rearward visibility [m]
TYPE 2	20	e	10
TYPE 2	30	e	15
TYPE 2	40	e	25
TYPE 2	50	e	40
TYPE 2	60	e	55

TYPE 2	70	e	75
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Tablica 6.4 Simplified visibility values required – TYPE 3

Visibility type	Adopted speed[km/h]	visibility marking	Accepted visibility backwards [m]
TYPE 3	30	i	45

Tablica 6.5 Simplified visibility values required – TYPE 4

Visibility type	Traffic organization	Adopted speed [km/h]	visibility marking	visibility adopted [m]
TYPE 4 based on TYPE 1	Access to the intersection with the parent road	40	c	35
TYPE 4 based on TYPE 1	Exit from the gate, workplaces, parking lots	30	c	20
TYPE 4 based on TYPE 1	Exit from a small roundabout	30	c	20
TYPE 4 based on TYPE 1	Exit from the middle roundabout, central island	40	c	35

The visibilities not specified in the above tables shall be calculated on the basis of the rules adopted according to paragraph 6.10.1 for the selected type of visibility and for the most recent speed measurements available.

### 6.11 Subjective assessment

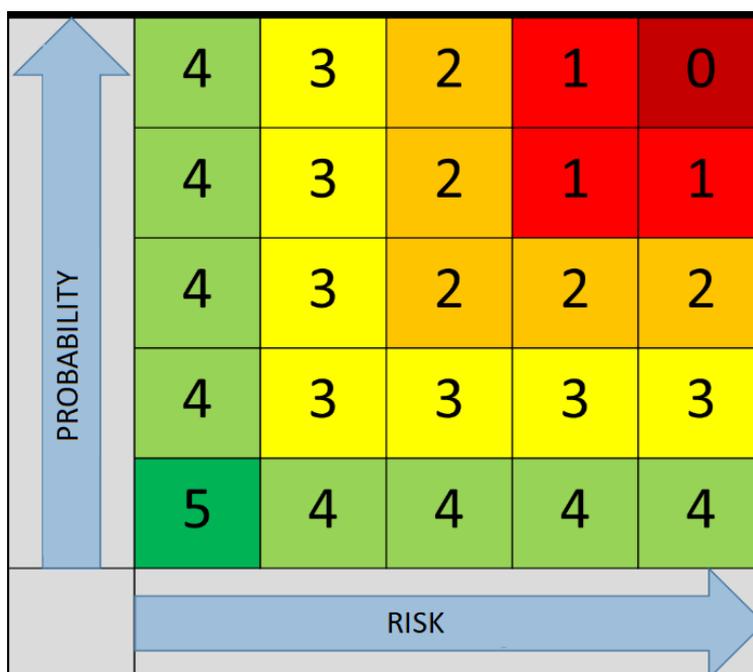
In the field, after the field vision, the Auditor in the form issues a subjective assessment to the pedestrian crossing. It should be emphasized that the infrastructure and organization of road traffic is not subject to assessment. The degree of threat to pedestrian safety with the existing infrastructure and the behavior of users is assessed. There are few cases that in terms of infrastructure (technical condition, traffic organization, visibility) the Auditor has nothing to complain about, but user behavior such as vehicle speeds, vehicle traffic intensity, pedestrian traffic pose a huge threat to pedestrians and cyclists.

A rating range of 0 to 5 was adopted. A rating of 0 indicates a very high risk of fatal road accidents involving vulnerable road users. Rating 5 implies a negligible risk of road accidents involving vulnerable road users, and if such an incident has already occurred, the effects should not be serious.

After issuing a field assessment, the Auditor reconsiders its legitimacy when entering data into the database in laboratory conditions and often corrects additional data based on the analysis, such as pedestrian traffic, vehicle traffic or information on road incidents. Evaluations are consulted among the Auditors through discussions and finally determined.

Tablica 6.6 Ratings given to threat levels of vulnerable traffic users

Asses sment	Description
0	Very high risk of vulnerable traffic users – serious risk of death in the event of a road accident.
1	High risk of vulnerable traffic users – risk of death in the event of a road accident.
2	Average risk of vulnerable traffic users – risk of death or injury in the event of a road accident.
3	Average risk of vulnerable traffic users – risk of injuries in the event of a road accident.
4	Low risk of road accidents
5	Very low risk of road accidents



Rys. 6.21 The principle of awarding grades.

### 6.12 Auditor's opinion

Finally, after analyzing all the data, the Auditor implements the basic text of the Audit, in which he indicates the risks, their level, potential effects of road accidents and proposes improvements aimed at increasing the level of road safety.

## 6.13 Base

### 6.13.1 Database basics

For all pedestrian crossings, a database is built according to the attached example. The database contains:

- pedestrian crossing number,
- auditor
- pedestrian crossing metric according to the inventory provided by the ordering party,
- GPS coordinates,
- link to the map,
- link to the transition card,
- subjective assessment of the transition,
- risks
- recommendations

### 6.13.2 Risks and recommendations

On the basis of an on-site inspection at pedestrian crossings, auditors assess the threats they have found in the infrastructure and user behavior. A set of predefined hazards and recommendations aimed at increasing the level of road safety has been developed.

Table 6.7 presents interpretations of hazard groups and Table 6.8 sets of predefined recommendations

Tablica 6.7 Description of risk groups- selected examples

RISK		CASE STUDIES
DEVICE	Lack or insufficient equipment for the disabled - ramp	<ol style="list-style-type: none"> <li>1. High pavement</li> <li>2. Uneven pavement on the edge.</li> </ol>
	Lack or insufficient equipment for the disabled - blind	<ol style="list-style-type: none"> <li>1. No guiding devices for the blind.</li> <li>2. Devices for the blind destroyed/keying tiles.</li> </ol>
VISIBILITY	Visibility - parking	<ol style="list-style-type: none"> <li>1. Vehicles reduce visibility.</li> <li>2. Potential parking reduces visibility.</li> </ol>
	Visibility - parking outside the immediate vicinity of the passage	<ol style="list-style-type: none"> <li>1. Parking on a perpendicular road, limiting visibility to the zone before the passage from the perspective of drivers leaving the perpendicular roadway to the crossing.</li> </ol>
	Visibility - fences/poles	<ol style="list-style-type: none"> <li>1. Fences, poles, ads that limit visibility.</li> </ol>

MARKING	Visibility - PT stops	1. Buses during the exchange of passengers at PT stops limit visibility.	
	Visibility - plants	1. Trees, shrubs, branches obscure visibility to the passage area, the pre-aisle zone or marking.	
	Visibility - other, large obstacles, buildings	1. Large structures limiting visibility: buildings, stairs, viaducts, etc.	
	Exits in the vicinity of the pedestrian crossing	1. Parking at exits, which physically can not be ruled out. 2. Vehicles entering traffic from exits before crossing limit visibility.	
	Parking at a pedestrian crossing	1. Vehicles parking on the "zebra". 2. Vehicles parking on the pavement in front of the pedestrian crossing – deliveries.	
	Vertical marking - lack, incomplete, in poor condition	1. Shields of signs destroyed. 2. No all or part of the marking. (applies only to group D-6 markings (a,b,c))	
	Vertical marking - obscured	1. Vertical marking obscured by greenery. 2. Vertical marking obscured by other markings. 3. Vertical markings obscured by fixed objects, parking vehicles, others.	
	Hozirontal markings - lack, incomplete	1. Road markings in poor condition. 2. No/incomplete road markings.	
	GEOMETRY	Unprotected pedestrian on the edge of the pedestrian crossing	1. Pedestrians waiting before crossing in a space not protected by a high curb (mainly "painted" surfaces or bituminous surfaces at the level of the surface).
		Too small width of the asylum	1. Island of asylum less than 2.0 m. 2. Island of asylum less than 2.5 m on streets with high-speed vehicles.
Too long pedestrian crossing		1. Long pedestrian crossings – through multiple lanes. 2. Long pedestrian crossings – disproportionately longer than the width of the roadway in the section preceding the crossing zone. 3. Pedestrian crossings through the islands	
Passage through min 3 lanes in one direction		1. Long pedestrian crossing through three or more lanes in one direction	

DRAINAGE	Lanes too wide	1. Lanes wider than required for driving
	Hazards arising from the geometry of the inlets of wheeled roadways	1. Long straights before the pedestrian crossing. 2. Large and very large turning radii at intersections and exits towards the pedestrian crossing.
	Painted surface that does not protect pedestrians	1. The place of waiting for pedestrians is marked with a level marking.
	Very high/high speed vehicles	1. Subjective assessment of expected too high than desired speeds in the area of the pedestrian crossing.
	Drains in the pedestrian crossing area, lowest point of the catchment area	1. Rain drains in the pedestrian crossing area. 2. Rain drains at the pedestrian crossing – rainwater flows through the passage towards the drain.
	Poor technical condition of the road surface	1. Defects in the road/pavement surface. 2. Uneven pavement/pavement.
OTHER	Lack of adequate accumulation area for turning vehicles	1. Too short distance between the crossing and the intersection – vehicles waiting to join the traffic or exiting the crossing will wait partially at the pedestrian crossing.
	Lack of continuity of the pedestrian route before / after the crossing	1. There is no furnished zone in front of the pedestrian crossing. 2. Too narrow sidewalk in front of the pedestrian crossing. 3. "Zebra" wider than the sidewalk in the waiting zone. 4. Lack of continuity of the route from the sidewalk through the "zebra" to the sidewalk.
	Lack of consistency of solutions in relation to neighboring passages	1. For example, leaving the crossing without asylum on a road with 3 or 4 lanes while the adjacent crossings are equipped with an asylum island.
	Pedestrian crossing "unnecessary" - duplicating adjacent	1. Pedestrian crossing, e.g. at the entrance gate to the factory 2. A pedestrian crossing that could be eliminated due to a safer parallel crossing.

<b>VISIBILITY</b>	Tamging-sensitive crossing and visibility limitations (not found during the inspection)	1. Subjective assessment that in the immediate area of the passage there may be parking, blowing up travelers, stopping.
	Other unusual described in the text	1. Other rare problems not covered by the predefined threat groups above.
	No comments	1. No serious road safety risks or technical defects.

Table 6.8 provides interpretations of groups of recommendations in the form of examples.

Tablica 6.8 Description of recommendation groups – selected examples

RECOMMENDATIONS		CASE EXAMPLE
<b>DEVICE</b>	Implementation or supplementation of equipment for people with disabilities - ramp	<ol style="list-style-type: none"> <li>1. Implementation of the ramp in a place where it does not exist.</li> <li>2. Improvement of uneven curb line at the edge of the pedestrian crossing.</li> <li>3. Widening of the existing ramp to the width of the P-10 marking.</li> </ol>
	Implementation of devices for the disabled - blind	<ol style="list-style-type: none"> <li>1. Implementation of devices for the blind.</li> <li>2. Improving the condition of existing devices for the blind.</li> </ol>
<b>VISIBILITY</b>	Visibility - increased parking supervision	<ol style="list-style-type: none"> <li>1. Applies to non-compliant parking that limits visibility.</li> </ol>
	Visibility - physical exclusion of parking possibilities	<ol style="list-style-type: none"> <li>1. Implementation of fences, posts to physically eliminate parking and in places where vehicles limit visibility.</li> </ol>
	Visibility - correction of fences/poles	<ol style="list-style-type: none"> <li>1. Elimination of fences that limit visibility.</li> <li>2. Use of lower fences (e.g. in the dividing strip before the pedestrian crossing).</li> <li>3. Rearrangement of poles that limit visibility to the zone before the pedestrian crossing (indicated mainly in cases of wide cross-sections, poles)</li> </ol>
	Visibility - changing the	<ol style="list-style-type: none"> <li>1. Changing the location of public transport stops in situations where the bus during the exchange of</li> </ol>

MARKING	location of TZ stops	passengers limits visibility to the crossing or zone before the pedestrian crossing.
	Visibility - removal of plants	<ol style="list-style-type: none"> <li>1. Removal of greenery that limits visibility to the crossing or zone before the pedestrian crossing</li> <li>2. Removal of greenery, which limits the visibility of vertical markings.</li> </ol>
	Visibility - changing the course of the road / removing permanent obstacles covering	<ol style="list-style-type: none"> <li>1. Reconstruction of a fragment of the street in the area of the pedestrian crossing.</li> <li>2. Removal of permanent obstacles such as advertising, advertising pylons.</li> </ol>
	Implementation, completion, replacement of vertical markings	<ol style="list-style-type: none"> <li>1. Implementation of the missing marking.</li> <li>2. Replacement of markings in poor condition.</li> </ol>
	Improving the visibility of road markings	<ol style="list-style-type: none"> <li>1. Rearrangement of the marking.</li> <li>2. Rearrangement of signage obscuring the marking at the pedestrian crossing.</li> <li>3. Removal of obstacles obscuring the marking.</li> </ol>
	Implementation, completion, restoration of road markings	<ol style="list-style-type: none"> <li>1. Implementation of marking when deficiency is recognized.</li> <li>2. Renewal of markings in poor technical condition.</li> </ol>
MARKING	Elevation of the pavement at the edge of the roadway	<ol style="list-style-type: none"> <li>1. Implementation of a pavement on the edge of the roadway with a ramp and a 10 – 12 cm section of the curb in front of the ramp.</li> </ol>
	Adapting the island of asylum to needs	<ol style="list-style-type: none"> <li>1. Expansion of asylum islands.</li> <li>2. Extension of asylum islands.</li> <li>3. Reconstruction of asylum islands.</li> </ol>
	Shortening the length of the pedestrian crossing	<ol style="list-style-type: none"> <li>1. The use of various measures to shorten the total length of the passage (narrowing the width of the lanes, closing the lanes, the implementation of the island of asylum, the transfer of the passage from the area of large turning curves, reducing the radii of the curves)</li> </ol>
	Calming vehicular traffic in the area of the crossing (asylum, island thresholds, etc.)	<ol style="list-style-type: none"> <li>1. Any physical means of reducing speed in the area of the pedestrian crossing (narrowing, asylum islands, narrowing of lanes, narrowing of cross-sections, island thresholds, elevated crossings)</li> </ol>
	Geometry correction/entry offset	<ol style="list-style-type: none"> <li>1. Changing the curves of the turn in the area of the pedestrian crossing.</li> <li>2. Reconstruction of the edge of the roadway.</li> <li>3. Reconstruction of the street in the area of the passage.</li> <li>4. Removal of exits from the passage or liquidation.</li> <li>5. Reconstruction of the intersection.</li> </ol>

DRAINAGE	Replacement of the painted surface with a surface elevated in the curb	<ol style="list-style-type: none"> <li>1. Replacing the areas excluded from traffic (in the area that a pedestrian would expect as on an asylum island) with an elevated asylum island.</li> </ol>
	Elimination of rain drains from the passage area	<ol style="list-style-type: none"> <li>1. Elimination of rain drains.</li> <li>2. Transfer of rain drains.</li> </ol>
	Elimination of the lowest catchment point from the passage area	<ol style="list-style-type: none"> <li>1. Changing the altitude solution in the pedestrian crossing area to eliminate the formation of rainwater stagnation.</li> <li>2. The use of other solutions that will eliminate the risk of puddles in the area of the pedestrian crossing.</li> </ol>
OTHER	Moving the passage away/to the edge of the main carriageway	<ol style="list-style-type: none"> <li>1. Adjustment of the distance of the passage from the perpendicular roadway in order to create a zone with a length of 4-6 m, accommodating 1 vehicle.</li> </ol>
	Change of the location of the passage / transfer to the opposite inlet	<ol style="list-style-type: none"> <li>1. Suggestions for changing the location of the transition to a place where you can get a higher level of security for vulnerable traffic users.</li> </ol>
	Ensuring the continuity of the walking route before and after the crossing	<ol style="list-style-type: none"> <li>1. Corrections of sidewalks before and after the pedestrian crossing to increase the comfort of movement.</li> <li>2. Construction of a sidewalk on the edge of the passage in cases where there is none.</li> <li>3. Adjusting the width of the pavement in the waiting area to the width of the P-10 marking</li> </ol>
	Improvement of the technical condition of the pavement surface	<ol style="list-style-type: none"> <li>1. Reconstruction of the pavement surface.</li> <li>2. Implementation of pavement surface.</li> <li>3. Renovation of the pavement surface.</li> </ol>
	Repair of the road surface in the area of the passage	<ol style="list-style-type: none"> <li>1. Renovation of the road surface through which the pedestrian crossing leads.</li> </ol>
	Crossing in the second level	<ol style="list-style-type: none"> <li>1. Implementation crossing in the second level. (NOTE: Auditors are aware that the construction of tunnels and footbridges is being abandoned, but this is one of the recommendations. Auditors consider the problem only in the context of the safety of</li> </ol>

		vulnerable street users. The decision always depends on the Contracting Person, who, apart from the road safety aspect, must also take into account numerous conditions.
	Traffic lights	1. Carefully install traffic lights. In most cases, indicated as one in many solutions.
	Elimination of the crossing/ suggested pedestrian crossing	1. Elimination of the pedestrian crossing. 2. Relocation of the pedestrian crossing.
	Other unusual described in the text	1. Other detailed or rare solutions (e.g. the construction of a Vienna stop).
	No comments	1. No comments or recommendations. The transition does not require urgent action. The level of security is accepted. The passage may have minor drawbacks.