NATURE AND LANDSCAPE MANAGEMENT STANDARDS		
SPECIAL MEASURES FOR SPECIES PROTECTION	**PERMANENT MEASURES TO PROVIDE ROADS WITH PERMEABILITY FOR AMPHIBIANS**	**SPPK E02 002:2021**
SERIES E		

Czech title: Trvalá opatření k zajištění prostupnosti komunikací pro obojživelníky
German title: Dauermaßnahmen zur Sicherung der Durchlässigkeit von Straßen für Amphibien

The standard contains principles of use of permanent operator-free barriers and adjacent migration structures for protection of amphibians and other small animals particularly in connection with linear structures and road transport (prevention of collision with automobiles, assurance of territorial permeability).

References:

Act no. 114/1992 Coll. on Nature and Landscape Protection, as amended
Act no. 100/2000 Coll. on Environmental Impact Assessment, as amended
Act no. 183/2006 Coll. on Spatial Planning and Building Rules (Building Act), as amended
Act no. 254/2001 Coll. on Waters and on amendment of certain acts, as amended
Act no. 89/2012 Coll., the Civil Code, as amended
TP180 (2006): Migrační objekty pro zajištění průchodnosti dálnic
Anděl P., Belková H., Gorčicová I., Hlaváč V., Libosvár T., Rozínek R., Šikula T, Vojar J. (2011): Průchodnost silnic a dálnic pro volně žijící živočichy. Evernia, Liberec, 154 pp.
Hlaváč V., Anděl P. (2001): Metodická příručka k zajišťování průchodnosti dálničních komunikací pro volně žijící živočichy. Metodika AOPK ČR, 51 pp.
Hlaváč V., Anděl P. (2008): Mosty přes vodní toky. AOPK ČR, Kraj Vysočina, 28 pp.
Hlaváč V., Anděl P., Libosvár T., Šikula T., Pešout P., Bartonička T., Dostál I., Strnad M., Uhlíková J. (2020): Doprava a ochrana fauny v ČR. Metodika AOPK ČR, 293 pp.
Zavadil V., Sádlo J., Vojar J. (2011): Biotopy našich obojživelníků a jejich management. Metodika AOPK ČR, 178 pp.

Standard development:
Developed for the NCA CR by the Faculty of Environmental Sciences, Czech University of Life Sciences Prague

External examiner:
Doc. Mgr. Lumír Gvoždík Ph.D. – ÚBO AV ČR

Authorial collective:
Doc. Ing. Jiří Vojar, Ph.D., Roman Rozínek, Mgr. Antonín Krása, Mgr. Lenka Jeřábková, Ing. Jana Kloubcová, Ph.D.

Illustrations:
Jiří Šeda

Documentation for the standard development is available in the NCA CR library.

Standard approved on:

RNDr. František Pelc
Director of NCA CR

Table of contents

1. Standard purpose and contents

1.1 Standard definition

The standard "Permanent measures to provide roads with permeability for amphibians" contains principles of use of permanent guiding barriers and adjacent migration structures (culverts, bridges, etc.) for protection of migrating amphibians (and other small animals) particularly in connection with linear structures and road transport.

1.2 Definition of permanent barriers

Permanent guiding barriers are operator-free technical devices made of various materials and installed permanently primarily along roads, and other structures as the case may be. Permanent barriers are usually implemented together with adjacent migration structures, or on their own, to guide animals into existing migration structures or substitute biotopes.

1.3 Definition of migration structures

Migration structure refers to a building structure by means of which amphibians and other animals safely negotiate roads and other structures. In light of their position in relation to the road, they include underpasses (tube and frame culverts, tubosider culverts and bridges), overpasses (animal bridges) and crossings located in the road body.

1.4 Purpose of measures

The purpose of guiding barriers is to prevent entry of amphibians into areas where they can be at risk, and to guide them into migration structures by means of which their safe crossing of the road is facilitated. They are permanent preventive measures helping avoid collisions between amphibians and cars and supporting accessibility of biotopes necessary for permanent existence of their populations. Unlike mobile barriers, built most commonly in cases of temporary danger to amphibians during construction (see standard SPPK E 02 001 Installing and operating mobile seasonal barriers along roads to protect amphibians), permanent devices are applied in amphibian protection against traffic on functioning roads (newly built or renovated).

1.5 Standard content

The standard pays attention to permanent measures to provide transport infrastructure with permeability for amphibians and other small animals, specifically migration structures and permanent barriers. It describes factors influencing the effectiveness of measures (cases where their construction makes sense and where it does not). It deals with location of permanent barriers and migration structures, their technical parameters, materials and construction methods as well as subsequent inspections of their functionality.

2. Legal framework

2.1 Act no. 114/1992 Coll.

Act no. 114/1992 Coll. on Nature and Landscape Protection, as amended (NLPA). As part of general protection of animals, natural persons and legal entities are required to proceed in construction work and transport to avoid excessive injury and death of animals (or destruction of their biotopes) which can be prevented with technically and economically accessible means. Unfortunately, this happens frequently due to inappropriate methods of execution of permanent barriers and migration structures (e.g., sunken ends of culverts, which are a trap for most animals). Pursuant to the NLPA, disturbing, injuring and killing of individuals of specially protected species (SPS) is forbidden, and their biotopes are protected as well. Construction and, most importantly, operation of measures must not affect SPS species negatively. Transfer of adults or development stages of animals is only permitted under expert supervision based on a valid exemption under Section 56 of the NLPA.
Construction of permanent barriers and adjacent structures should also respect protection of other interested protected by the NLPA, such as trees, prominent landscape features and specially protected areas. In the case of any conflict with the NLPA, implementation of such measures requires statements, position statements or decisions of applicable nature protection authorities.

2.2 Act no. 100/2000 Coll.

Act no. 100/2000 Coll. on Environmental Impact Assessment, as amended. Permanent barriers and migration structures are usually part of a construction project. The impact of the overwhelming majority of transport structures (not only) on organisms is assessed as part of the EIA process under the EIA Act. If a plan is not subject to the EIA process, an assessment of the impacts of the intended intervention is made pursuant to Section 67 of Act no. 114/1992 Coll. (chapter 4.2). The necessity of assessing impacts of a plan on landscape permeability for organisms arises from the European Union EIA Directive (2011/92/EU), as amended by Directive 2014/52/EU.

2.3 Act no. 183/2006 Coll.

Pursuant to **Act no. 183/2006 Coll. on Spatial Planning and Building Rules, as amended (Building Act)**, permanent barriers and migration structures are built structures, so their execution is governed by the Building Act. The devices are mostly built together with another construction project, so that their appearance and location are assessed and permitted as part of the project planning process (chapter 4). Barriers and migration structures built separately (on an existing road) will typically be assessed as part of the zoning and building permit proceeding.

2.4 Act no. 254/2001 Coll.

Act no. 254/2001 Coll. on Waters and on amendment of certain acts, as amended (Waters Act), defines protection of surface waters and groundwater. Barriers and migration structures affecting interests protected by the Waters Act (e.g., structures interfering with watercourses or hydraulic conditions, located on land containing a watercourse bed, etc.) may require a permit, approval or binding position statement of a water management authority, depending on their characteristics. Before implementation, the water management authority can be asked for a statement whether the execution is possible from the point of view of interests protected by the Waters Act, and under what conditions if any.

2.5 Act no. 89/2012 Coll.

Act no. 89/2012 Coll., the Civil Code, as amended, defines, among other things, rights and obligations in connection with ownership. When building permanent barriers and adjacent structures on land other than one's own, one needs to respect protection of other people's ownership rights and request the owners' consent to implementation of the measures in the preparatory phase.

3. Factors affecting application of permanent measures

A number of measures or combinations of measures can be applied in connection with protection of amphibians crossing roads, e.g., traffic signage, simple collection of individuals on the road, construction of a substitute biotope, use of mobile barriers (see standard SPPK E 02 001 Installing and operating mobile seasonal barriers along roads to protect amphibians) or permanent barriers in combination with culverts or other migration structures. Execution of permanent devices (barriers and migration structures) is only possible and expedient under certain combinations of conditions; alternative solutions are applicable in other cases (see chapter 3.6). Of course, the construction and subsequent inspection of the measures must not endanger road traffic safety and fluency and must not hinder summer and winter road maintenance. The following factors are critical when deciding on use of permanent devices:

- availability of land for construction of permanent devices, or owners' consent,
- construction of separate barriers/migration structures vs execution as part of linear construction projects,
- financial demand of the measure,
- number of endangered/saved individuals,
- technical difficulty of the measure,
- availability and suitability of alternative solutions.

3.1 Availability of land for construction of devices, owners' consent

Permanent devices can only be built on the investor's land or with the land owners' consent. Use of municipal, region- or state-owned land is preferable.

3.2 Construction of separate devices vs execution as part of linear construction projects

It is most expedient to build permanent devices as part of construction of new roads or renovation of existing ones. However, if traffic on an existing road kills great numbers of amphibians (see below) and the necessary funds for construction of permanent devices are assured, the measure has to be implemented even without a renovation project for the road in question.

3.3 Financial demand of the measure

Construction of permanent barriers for amphibian protection is a seemingly relatively high one-time investment. However, the amount is negligible in comparison with the total costs of the construction works. Within 15-20 years, the costs of building permanent barriers equal the costs of annual construction of temporary barriers (including the price of labour). This applies if a temporary barrier is installed only for the spring migration period. With longer mobile barrier

installation (to capture the returning adult migration later in spring or even moving metamorphosed juveniles in summer), the rate of return on a permanent measure is reduced to 5 years. Thus, permanent barriers are among the most financially effective measures, particularly where new roads are being built. At the same time, they protect a much higher proportion of individuals compared to temporary barriers, because they are installed permanently and handle all their movements throughout the year.
As concerns migration structures, it is expedient to deal with road crossability for animals using multifunction structures, used by multiple categories of animals.

3.4 Number of endangered/saved individuals

Permanent barriers and adjacent migration structures are justified in areas with proven periodic migration of considerable numbers of amphibians. This means hundreds to thousands of adults per season; it may be less for endangered and critically endangered species. The species composition and estimates of numbers of potentially endangered individuals should be known from previous surveys, implemented as part of project planning (e.g., in the course of the EIA or other assessment) or from capturings using temporary barriers during construction. Amphibians are known for significant fluctuation in numbers, which is why such a survey should be made at least in two consecutive seasons for large construction projects with high potential risk.

3.5 Technical difficulty of the measure

Technical conditions for construction of permanent barriers are sometimes so difficult that it is not expedient to implement the measure. This applies in situations where the road corridor is too narrow with no space for barriers. Similarly, underpasses cannot be built where there is a risk of their permanent flooding. Implementation of measures in municipalities is also problematic, as it is in areas with multiple on and off ramps concentrated.

3.6 Availability and suitability of alternative solutions

Implementation of permanent devices is typically considered in areas where large numbers of amphibians are at risk (see above). That is why only a few alternative solutions exist. In particular, they include mobile barriers (see standard SPP E 02 001 Installing and operating mobile seasonal barriers along roads to protect amphibians) and substitute reproduction biotopes (see 3.6.1), including combinations of these measures. Other solutions, such as traffic signs or simple collection of individuals on the road, are ineffective in such cases.

3.6.1 Substitute reproduction biotopes

3.6.1.1 The principle of this measure is the construction of a new reproduction biotope (water body) on the same side of the road where the amphibians' terrestrial biotopes are situated (particularly wintering sites). The purpose is to direct amphibian reproduction to the new aquatic biotopes without the need for crossing the road or structure.

3.6.1.2 Some amphibian species (e.g., the common toad) have a strong tendency to find for their reproduction the same water body where they developed as larvae. For this reason, it is advisable to combine, at least in the first three years, construction of a substitute reproduction biotope with mobile barriers (see standard SPPK E 02 001 Installing and operating mobile seasonal barriers along roads to protect

amphibians), which prevent amphibians crossing the road on their way to their original reproduction biotope. In the first three years, it is advisable to let amphibians spawn in the original place and then transfer their developmental stages (eggs, larvae) to the new biotope, where they complete their development. This is a time-consuming and professionally demanding measure, only possible under the supervision of an experienced expert.

4. Documentation parameters and project planning

Permanent devices are built mostly together with transport infrastructure. Their appearance and location are thus assessed and permitted as part of the road project itself. It is a long-term process, in which the construction plans are progressively refined (see Hlaváč et al., 2020). The migration study is one of the recommended instruments for assessing impacts on a construction project on landscape permeability for organisms. A migration study involves identification of animal movements in the area affected by the construction project and of migration profiles (i.e., places where animal migration routes cross the planned construction project), as well as an assessment of spatial requirements of animals for crossability of linear structures and design of measures for sufficient crossability. A classification of different migration study types for project planning, their specific contents and objectives follows.

4.1 Strategic migration study (SMS)

– developed at the level of strategic environmental impact assessment (SEA). It contains an analytical map showing relevant phenomena from territorial analytical documents, notably specially protected areas, Natura 2000 territories (Sites of Community Importance and Special Protection Areas) as well as SPS biotopes of national importance (phenomenon 36), including large mammal SPS (phenomenon 36b). The SMS identifies problems from a supraregional point of view, particularly collisions between supraregional ecological networks and transport infrastructure.

4.2 Framework migration study (FMS)

– made as part of EIA documentation or assessment of planned interventions pursuant to Section 67 of the NLPA. In this stage, field investigation is used to identify migration profiles and design basic principles of assurance of migration permeability of the territory, i.e., location and type of proposed migration structures, compensatory measures (if any) as alternatives to construction of migration structures (e.g., substitute reproduction biotopes; see chapter 3.6.1).

4.3 Detailed migration study (DMS)

– made as part of the documentation for zoning decision. In conjunction with the previous project planning stages, the DMS contains designs for specific parameters (dimensions) and technical details of migration structures. It deals with connectivity of migration structures to surrounding landscape and other types of measures (notably fencing and permanent barriers). Availability of land necessary for the measure implementation is crucial.

4.4 Separate detailed drawing of migration measures (SDDMM)

– made as part of the project implementation documentation. It contains details of technical design of migration structures and related measures, notably the method of vegetation

modifications, guiding elements, modifications under bridges, shelters for animals, modifications to watercourses under bridges, connection of migration structures to fencing and permanent barriers, etc.

5. Permanent barriers

5.1 Basic technical parameters and requirements

Permanent barriers are a technical measure with the purpose of preventing entry of small animals into areas where they can be at risk, and guiding them into culverts or other migration structures. Basic parameters of permanent barriers are defined below.

5.1.1 A permanent barrier has to effectively prevent amphibians climbing or jumping over it. The standard height of barriers above ground is 50 ± 5 cm; it is 70 ± 5 cm in areas with the presence of the agile frog.

5.1.2 The top barrier border prevents animals, notably newts, climbing over it, as they can overcome a barrier without a top border easily. They are made on the side from which the animals approach the barrier (i.e., opposite their migration direction) by folding the barrier material twice to produce an inverse U-shape (see Annex).

5.1.3 The bottom barrier edge prevents animals burrowing under the barrier. This can be done by embedding at least 10 cm of the bottom edge into the ground. It is more appropriate to make the bottom border by bending about 30 cm of the bottom portion of the barrier on the same side as the top border (see Annex). The advantage is reduced overgrowing of the immediate surroundings of the barrier with vegetation that (not only) amphibians could use to overcome the barrier.

5.2 Permanent barrier materials

The barriers have to be functional in the long run and resilient to weather, not subject to shape deformation and temperature expansion, permit installation separately or on fence posts, be able to overcome elevation differences, sharp angles, minor watercourses and drainage blocks.

5.2.1 The above requirements are met by permanent barriers made of galvanised steel sheets 0.8 mm thick, composed of two-metre sections. This barrier can overcome drainage blocks and minor watercourses, and is also suitable for complicated terrain. It can be connected to every type of culvert and bridge, including gabion walls. Two basic heights are available: 50 and 70 cm. The barrier has a top and bottom border (see Annex).

5.2.2 Plastic is a less suitable material; it is resilient to weather, but it expands and shrinks with temperature, forming gaps between joints. Conventional concrete barriers are resistant to expansion, but are very heavy and difficult to handle. Polymer concrete materials are an alternative, known for long service life. As with concrete barriers, their application is limited to flat terrain.

5.3 Permanent barrier installation

5.3.1 Installation dates

5.3.1.1 Permanent barriers can be installed in any season, unless the ground is frozen or too muddy. It is most advisable to install the barriers only after all landscaping is completed. In the case of fencing installation, such as along motorways, it is advisable to build permanent barriers together with the fence and fasten it to the fence posts (see below).

5.3.2 Location

5.3.2.1 Permanent barriers and migration structures are located where the road intersects amphibian movement routes and where great numbers of individuals would be at risk due to road traffic (see chapter 3.4). Amphibian migrations very often follow watercourses.

5.3.2.2 The most important amphibian migration profiles in the study area are identified in the framework migration study (chapter 4.2). Moreover, pinpointing the location of permanent barriers and migration structures is assisted by temporary barriers, installed during the road construction. A permanent barrier is built in sections where mobile barriers captured the most individuals.

5.3.2.3 When building permanent barriers, it is necessary to minimise areas creating spaces between the barrier and the ground (e.g., when crossing ditches with drainage blocks). Such places increase the chance for animals to escape, thus reducing the barrier effectiveness. The risk of escape can be reduced using bridges, chains and plastic strips, but they must not pose an obstacle to the flow.

5.3.2.4 When building fencing along a road simultaneously, it is preferable to route permanent barriers together with the fence (instead of producing two parallel lines), with the bottom part of the fence comprising the permanent barrier, installed on the fence posts. This is a cheaper solution and it also facilitates maintenance around the road.

5.3.2.5 If the road is on an embankment, it is preferable to locate both the fence and the permanent barrier at the foot of the slope and so connect it smoothly to the migration structure without having to cross ditches.

5.3.2.6 Permanent barriers are installed on both sides of the linear structure if expedient.

5.3.3 Connectivity to migration structures

Adjoining migration structures are most commonly various types of culverts and bridges, to which animals are guided by permanent barriers.

5.3.3.1 Permanent barriers have to be linked tightly to such structures to prevent creation of spaces permitting entry of small animals into the road area.

5.3.3.2 Culvert entrances and exits have to be step-free, without vertical settling pools, networks of branches, adjacent impermeable slopes into watercourse beds, etc.

6. Migration structures

6.1 Migration structure categories and types

Migration structures may differ in many parameters, such as dimensions, profile shape (tube vs frame culverts) and whether they carry a permanent watercourse or occasional flow or are entirely dry. By these various aspects, migration structures are divided as follows:

6.1.1 By migration structure design procedure

To ensure crossability, it is necessary to use original/initial migration structures, followed by optimised structures; special structures are used only if no other solution is possible.

6.1.1.1 Original/initial (multi-purpose) – these structures are designed for reasons other than crossability for animals, e.g., to cross watercourses, roads, railways or terrain features. Enabling of animal migration is a secondary effect.

6.1.1.2 Optimised (multi-purpose) – original structures that are partially modified in order to increase their effectiveness in terms of provision of crossability of the structure for animals. They include technical modifications (increasing dimensions, modification under bridge, etc.) as well as addition of special guiding elements (e.g., barriers or vegetation strips).

6.1.1.3 Special (single-purpose) – structures designed exclusively for the purpose of road crossability for animals.

6.1.2 By passage position in respect of the road

6.1.2.1 Underpasses – underneath the road and the traffic level (tube and frame culverts of various shapes and dimensions, covered steel structures – tubosiders, and road bridges). Culverts in particular are the most common migration structures designed to assure crossability of roads for amphibians and other small animals.

6.1.2.2 Overpasses – above the road and the traffic level (animal bridges or wildlife crossings). These are extensive and costly migration structures, designed almost exclusively for protection or larger vertebrates, particularly SPS of mammals.

6.1.2.3 At road level – crossings embedded into the road superstructure, so-called amphibian tunnels. The crossing is made of solid or

slitted polymer concrete elements. Slitted crossings are more appropriate, as they receive light and amphibians prefer them. However, they are more prone to contamination with petroleum products and salts, which harm amphibians. Compared to a culvert, this is a much small migration structure; sufficient light in slitted crossings is provided by a grate at the road surface level, designed to carry traffic loads. Since these crossings are easily clogged, their periodic inspection and maintenance is necessary.

6.2 Migration structure location and connection to surroundings

6.2.1 Suitable location selection

6.2.1.1 Designs for location of migration structures are based on the framework migration study and have to respect natural routes of animal migration, i.e., a migration structure should be located precisely at the amphibian migration route. Thus, structures designed outside their routes are of limited to minimum effect.

6.2.1.2 In areas of major spread amphibian migration (e.g., where the road crosses a meadow wetland), it is appropriate to locate adequate migration structures as close together as possible, ideally up to 100 m, always following watercourses.

6.2.2 Structure connection to surroundings and effectiveness-supporting measures

It is important to integrate the structure into the landscape using supporting elements, e.g., guiding vegetation strips, landscaping and vegetation and creation of suitable hiding places (piles of branches or stones) around the structure. Of course, entrances into migration structures have to remain unobstructed to receive maximum light.

6.3 Migration structure construction parameters and principles

Parameters of migration structures have to respect ecological demands and capacities of species (notably environmental requirements, ability to overcome obstacles) that are to use them. Since permanent barriers are most frequently connected to various types of culverts, the following text deals with parameters and principles of building this type of migration structure in particular.

6.3.1 Multifunctionality

6.3.1.1 Structures usable by the widest possible range of animals are preferred, particularly if they carry permanent watercourses. The requirement in this case is to design a combined bottom profile with strips of solid land on both sides of the watercourse or their attachment to culvert walls, if technical conditions permit.

6.3.1.2 Suitable technical design. The problem with small vertebrates is usually not the size of structures, but their inappropriate design, e.g., permanently flooded culverts, variable gradient, presence of traps and barriers inside and along edges of structures in the form of wells, sunken ends or steps.

6.3.2 Preference of frame over tube culverts

6.3.2.1 In terms of structure efficiency, a frame culvert is much better, preferably of a rectangular shape (the width should exceed the height from the amphibian point of view). Compared to tube culverts, frame culverts have a wider bottom with the same height, where washed material on which the animals move forms sediments over a larger area. In addition, vertical walls of a frame culvert guide the animals better.

6.3.2.2 Tube culverts are absolutely inappropriate where a permanent watercourse is carried, as it will flood the entire bottom profile.

6.3.3 Dimensions and shape

The clear dimensions of a migration structure, depending on its diameter (for tube culverts) or width and height (for frame culverts) are chosen with a view to its length. With longer structures (e.g., under a motorway), the clear dimensions have to be increased accordingly. The following minimum culvert dimensions are recommended:

6.3.3.1 **Underpass length up to 10 m:** tube culvert, min. diameter 1000 mm, frame culvert 0.8 × 0.8 m,

6.3.3.2 **Underpass length above 10 m:** adequate increase; for motorways and roads on embankments, where the underpass length is 20 m or more, only frame culverts are suitable with min. dimensions 2.0 × 1.5–2.0 m (w × h).

The above dimensions refer to dry floor area, so they have to be increased accordingly if a watercourse is carried through the culvert.

6.3.4 Migration structure carrying a watercourse

6.3.4.1 Permanent watercourses can only be carried by frame culverts (e.g., Beneš), preferably of a complex trapeziform shape with sufficiently wide dry banks on both sides of the watercourse.

6.3.4.2 The watercourse should preferably remain in its natural condition and without technical modifications. Excessive length of technical modification to the watercourse above and below the migration structure is also inappropriate. If bank reinforcement is necessary, stone paving always has to be preferred over concrete. Always ensure smooth connection of dry banks inside the migration structure to surrounding ground.

6.3.5 Culvert material and bottom treatment

6.3.5.1 Culverts are mostly made of concrete or concrete elements. A culvert has to be built a good time ahead of its use by amphibians (at least three months; if built later, then it has to be flooded artificially to accelerate washing away of toxic substances released from concrete) and its bottom covered with earth, sand and stones.

6.3.5.2 In frame culverts, it is admissible to stabilize dry passage banks with stone set in concrete. It is recommended to place the stones

in the concrete so that they protrude about 2-5 cm above it and have (irregular) gaps of 2-5 cm between them. Such stabilised stones have to be covered with a continuous layer of earth thick enough to prevent the stones protruding above the surface.

6.3.6 Treatment of space under bridges for larger migration structures

This concerns bridges in particular. The limiting factor of usability of such structure for small vertebrates is not their dimensions, but inappropriate design.

6.3.6.1 It is important to prefer soft surfaces under bridges (earth, sand).

6.3.6.2 If the surface is hard (concrete, stone subgrade), it has to be covered with a layer of earth or sand about 5 cm thick for amphibians, or about 10 cm thick if used for migration by bigger animals, to make sure the hard materials do not protrude above the surface.

6.3.6.3 It is advisable to place piles of stones or wood at the sides of the structure, used as hiding places by small animals.

6.3.7 Uniform gradient and no barriers inside the culvert

6.3.7.1 A uniform gradient of the culvert bottom permits water drainage and prevents permanent flooding. That is undesirable for culverts without a dry berm on both sides.

6.3.7.2 No steps higher than 5 cm can be created inside the structure.

6.3.7.3 While construction of hiding places is advisable for larger bridge structures (see above), it is pointless and undesirable for culverts. Exceptions are elements creating a dry path over a watercourse, attached directly to the culvert wall.

6.3.8 Culvert opening, no traps at its edges

6.3.8.1 It is essential to connect the migration structure to permanent barriers and fencing perfectly. The openings of these structures should be inside the fenced/protected area on principle.

6.3.8.2 Step-free entry and exit has to be arranged for the culvert or under the bridge on both sides. Any elevation steps, settling pools with vertical walls at the entrance or sunken wells at the exit are unacceptable (they may be a trap for small animals).

6.3.9 Parallel roads

A new road runs parallel to lower-class roads in many places. Thus, a frame culvert under a motorway continues as a frame culvert under those roads too. In such cases, the migration structure dimensions have to be increased accordingly. If technically possible, it is advisable to interrupt the enclosed culvert between the roads and direct movement of organisms between them with permanent barriers.

7. Functionality inspection and maintenance

7.1 Permanent barriers

7.1.1 Inspection dates and contents

7.1.1.1 Functionality of permanent barriers has to be checked, particularly at the end of winter, for any damage that might occur during winter.

7.1.1.2 In particular, check barrier integrity and identify any damage that reduces functionality of the measure (notably gaps at joints).

7.1.1.3 Critical sections are where barriers connect to migration structures and areas with complicate terrain shapes.

7.1.1.4 The inspection should include flow rates in longitudinal ditches where barriers cross them (they frequently become clogged during higher flow rates).

7.1.2 Functionality assurance

7.1.2.1 If any defect that might reduce the measure functionality is identified, it has to be eliminated immediately.

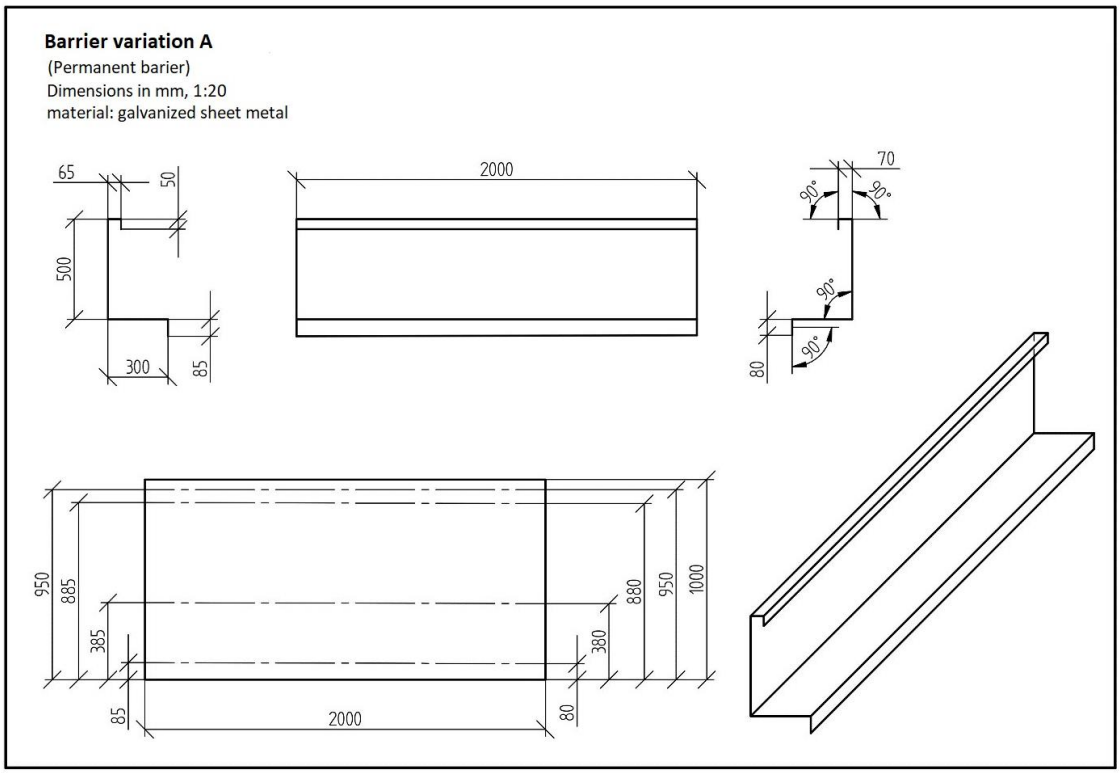
7.1.2.2 Besides, it is necessary to reduce shrubs and taller herbal vegetation near barriers, within approximately one metre on either side of a barrier, and at least two metres outside entrances into migration structures. Vegetation has to be mown to a height of around 10 cm and outside the main adult amphibian migration (i.e., outside March to May) and migration of freshly metamorphosed juveniles in early summer; i.e., the ideal time is August to September.

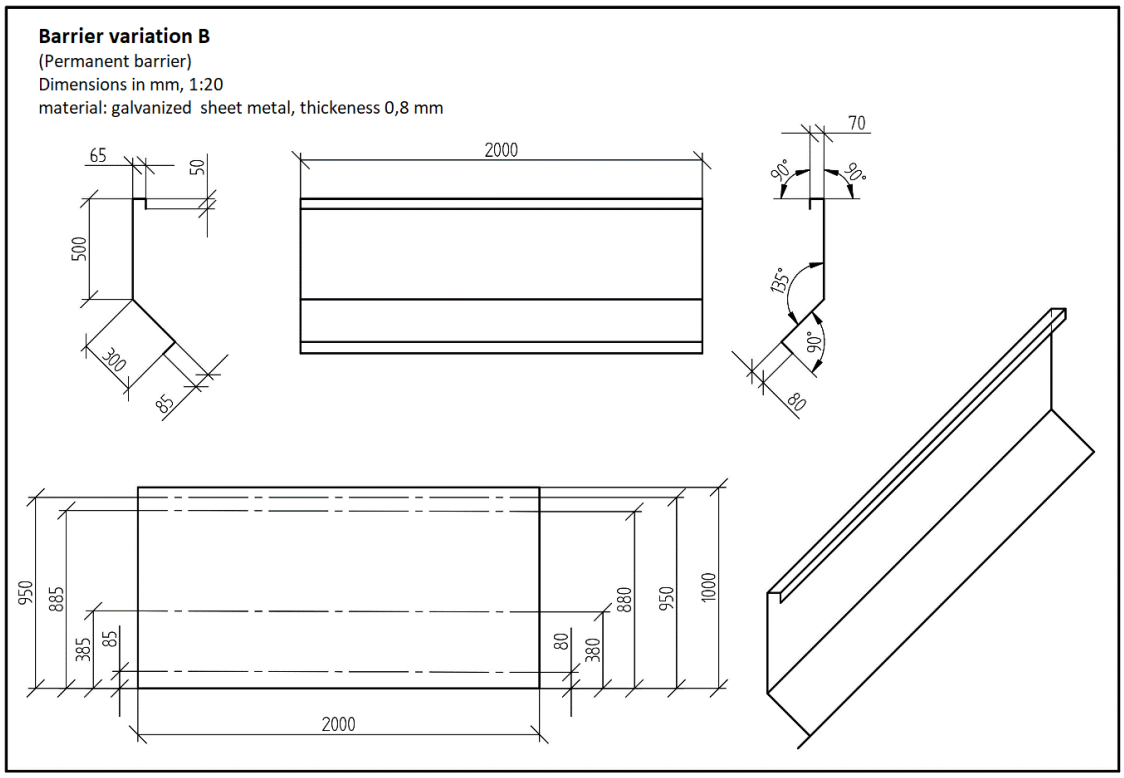
7.2 Migration structures

Similarly to permanent barriers, the functionality of migration structures has to be checked periodically. Besides their perfect connection to permanent barriers, it is essential to check their clearance and passability, particularly after heavier rain.

8. Annex: Drawings of barriers

The steel sheet barrier shown below is a utility model. Its unauthorised use is a punishable offence pursuant to Section 269 of Act no. 40/2009 Coll., Penal Code, as amended.





Kaplanova 1931/1
148 00 Praha 11
SPPK E02 001
www.standardy.nature.cz

2021