



VIACON ACADEMY

WEBINAR SERIES - AUTUMN 2021

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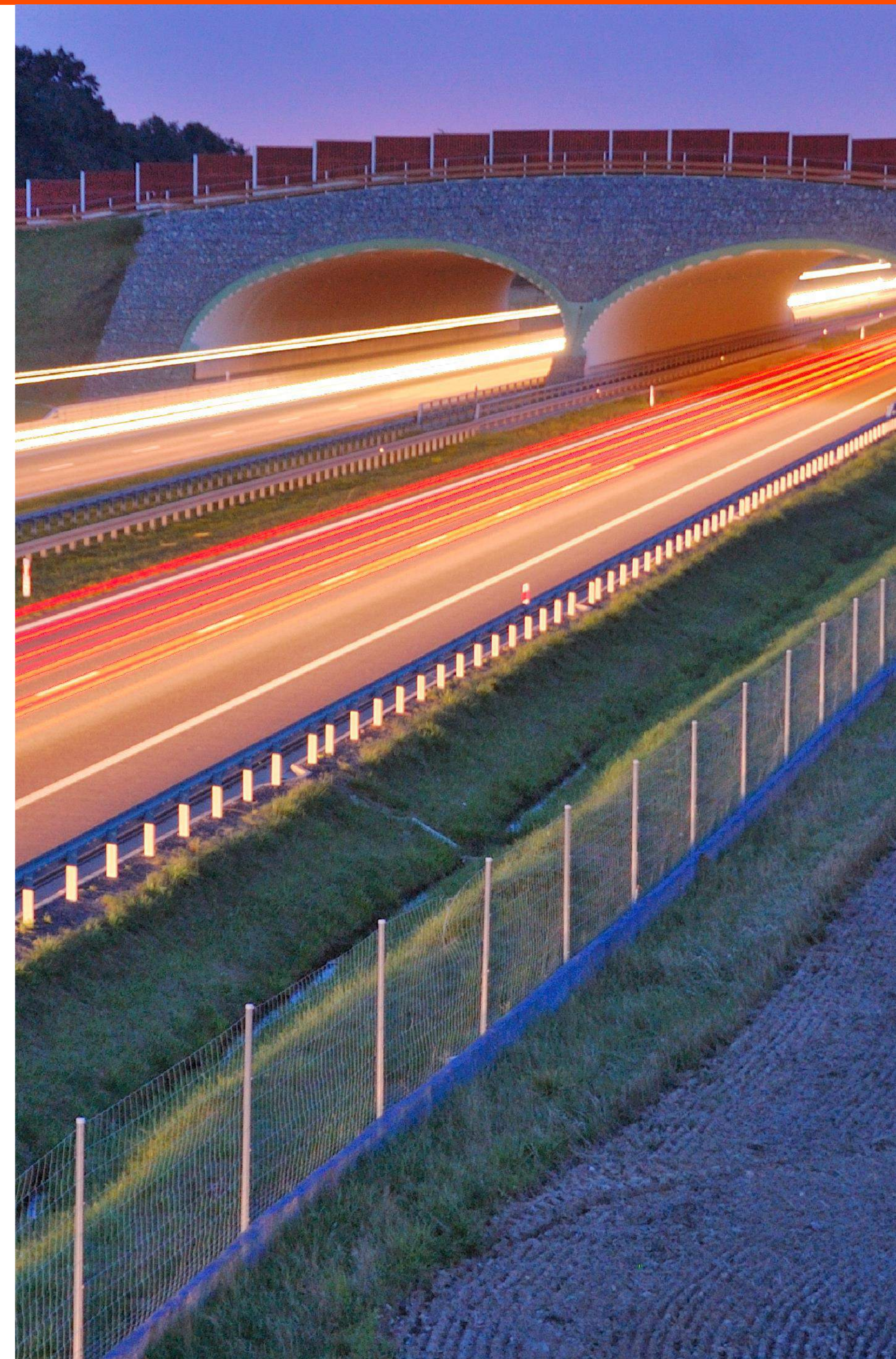
Constructing connections.
Consciously.

ViaCon Group

The ViaCon Group is an international provider of state-of-the-art innovative engineering solutions to build:

- culverts,
- bridges,
- grade separations,
- wild and rural crossings,
- tunnels etc.,

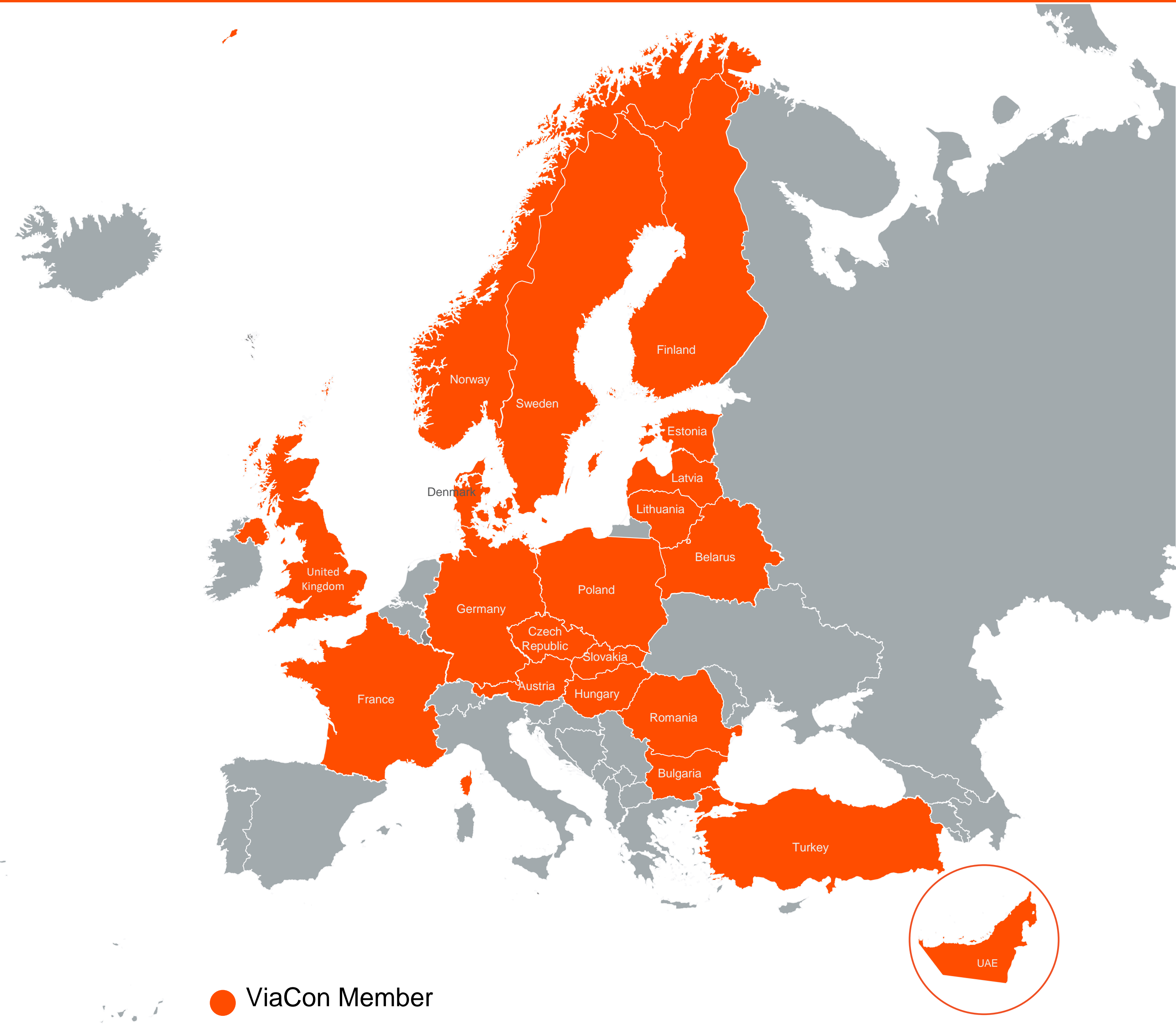
in addition to GeoTechnical and StormWater Solutions, using our corrugated steel and plastic pipes, as well as corrugated steel structures.



ViaCon's Geography

Year of becoming a part of ViaCon Group:

- 1986 - Sweden and Norway
- 1994 - Finland
- 1997 - Poland, Lithuania, Latvia, Estonia
- 2002 - Czech Republic
- 2007 - Hungary
- 2010 - Romania
- 2011 - Bulgaria
- 2014 - Turkey
- 2015 - Denmark
- 2018 - United Arab Emirates
- 2019 - France
- 2021 - Germany, Great Britain



ViaCon's Geography

- ViaCon Member
- ViaCon Partner
- ViaCon Projects (apart from Member and Partner countries)

ViaCon's Solution Offerings



With more than 30 years of civil engineering experience, we provide specialized, world-class **Bridges and Culverts** solutions that are **strong** and **durable**, **cost-efficient**, and **sustainable**.



Our state-of-the-art **Geotechnical solutions** and products help solve all issues in the field of geotechnical engineering. Our solutions range from **soil reinforcement** to **landfills** and **much more**.



With our outstanding technical and engineering prowess, ViaCon's **StormWater solutions** and products are designed to meet the challenges of stormwater management, ranging from **storing stormwater** to **infiltration** and **drainage**, to treating polluted **wastewater**.

Applicable Industries

We focus on constructing diverse solutions that match the needs of our customers and contribute to meeting the challenges of our changing world.

ViaCon's solutions are used by the following industries:



ROADS



RAILWAYS



FORESTRY



COASTAL AND
WATERWAY ENGINEERING



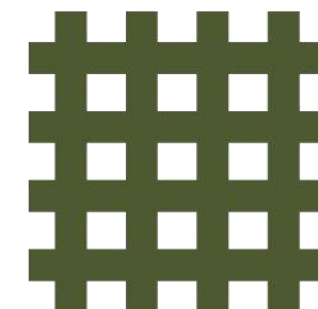
MINING



AGRICULTURE



ENVIRONMENT



MILITARY



BUILDING AND
INDUSTRIAL AREAS



AIRPORT



Webinar Agenda

1. Introduction to road Ecology
Why build Animal Crossings
2. Study of country regulations
3. How Wildlife Crossings are designed and built
4. What does **ViaCon** do
5. Ecological bridges examples.
6. Case study: 1st Animal overpass in Poland
7. Advantages of ViaCon Ecological Bridges
8. Q&A Session



An aerial photograph showing a multi-lane highway interchange. A large, curved concrete structure with multiple arched openings spans over the highway, serving as a wildlife crossing. The surrounding area is a dense forest of tall, thin trees. The highway has several lanes with white lane markings. A yellow construction vehicle is visible on the highway near the crossing.

Wildlife Crossings

Piotr Tomala, Onur Basar

8th December 2021

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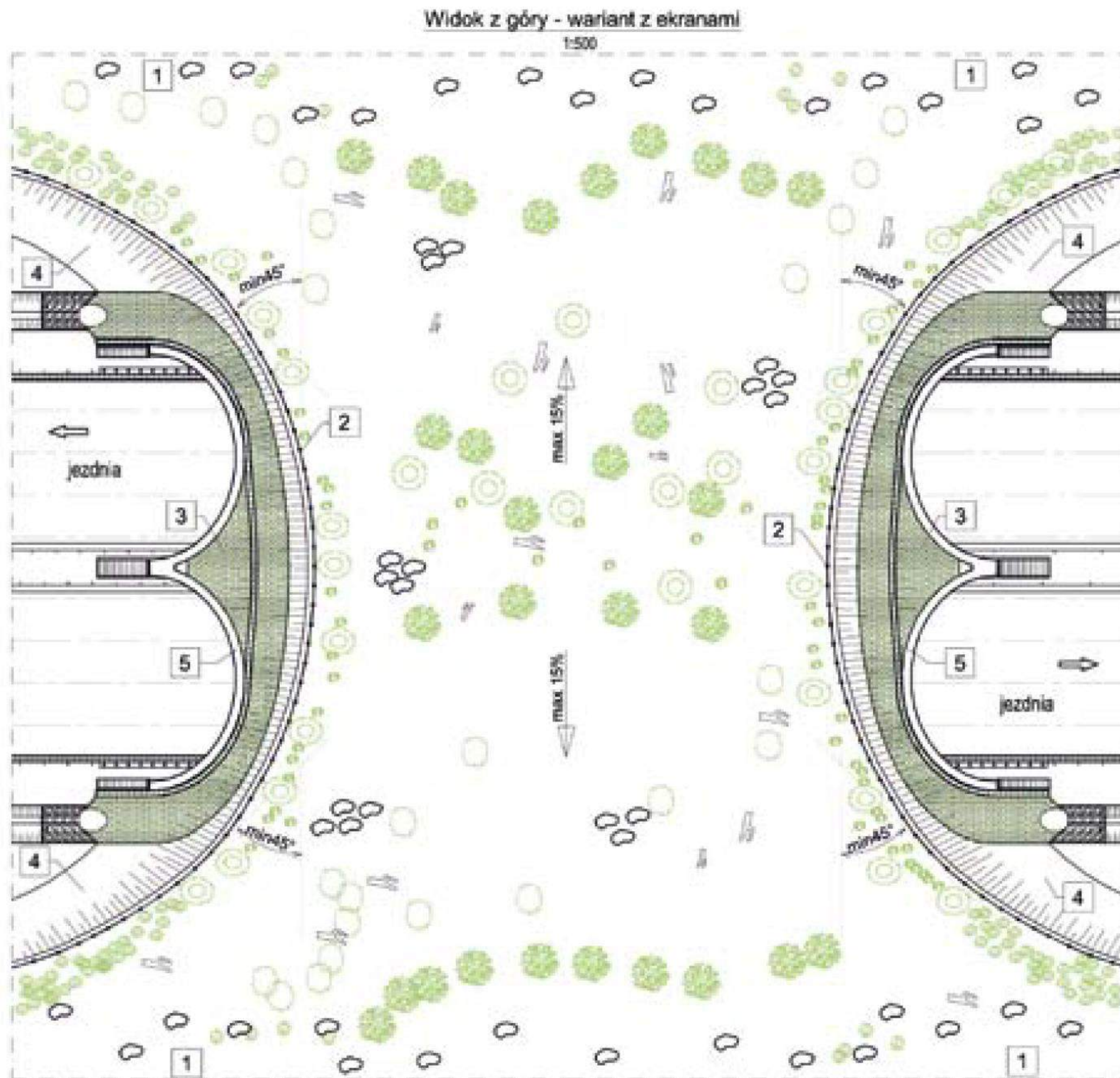
Introduction



The increasing number of motorways and express roads in Europe, especially in its Midwestern part, shows the scope of the challenge that road and environmental services of the entire European Union have to face.

Without an effective economic policy and legal changes in line with assumed responsibility for the natural environment, execution of the road system extension plan can be threatened.

Introduction



A possible solution can be achieved through construction of environmentally friendly bridge structures, of which two categories need to be considered:

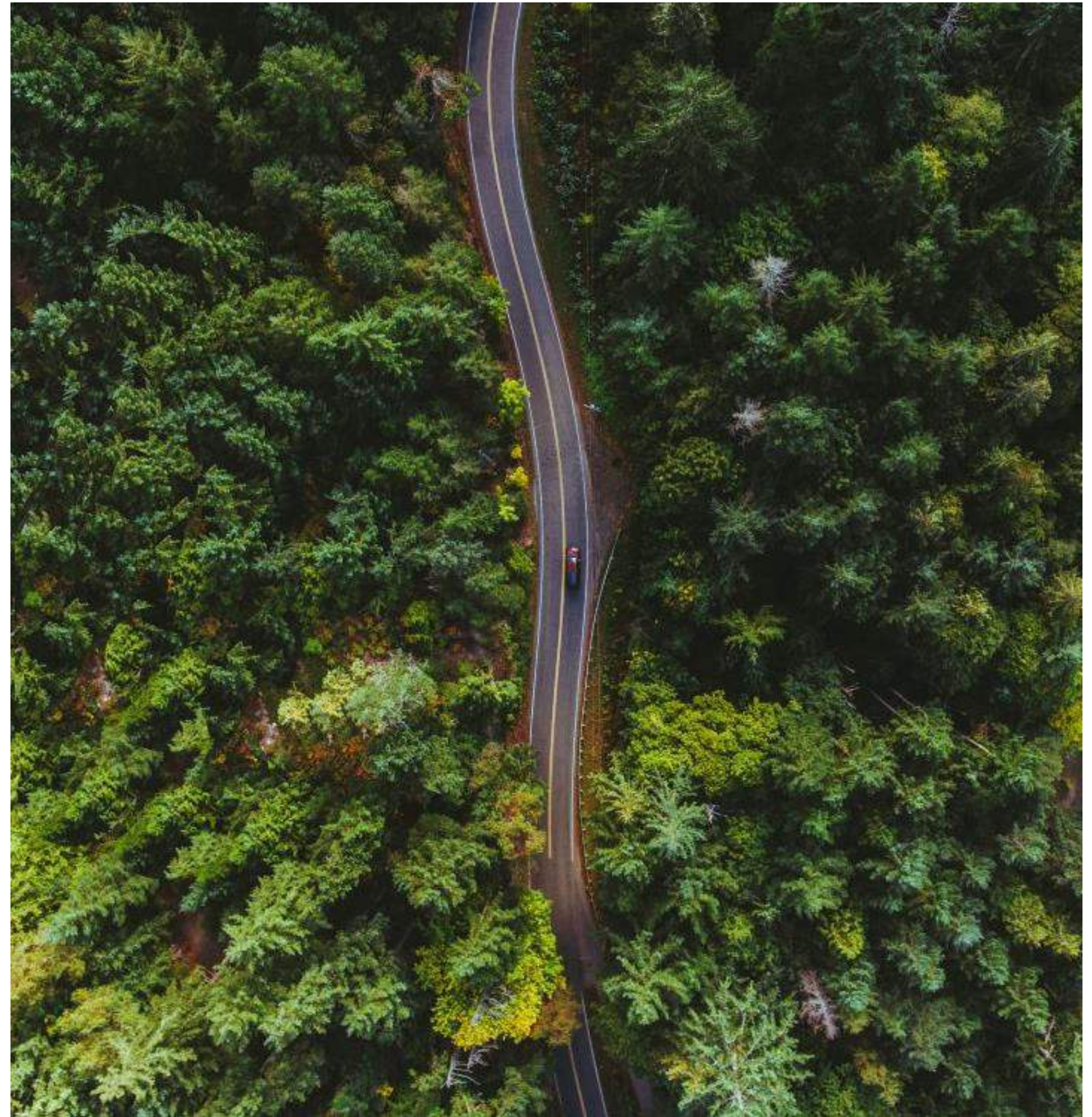
1. Execution of various types of bridges constructed on the basis of non-invasive technologies and from modern environmentally friendly materials.
2. Structures designed as animal crossings in the form of culverts, ditches, tunnels and even big bridges constructed within (or over) the roadway, the motorway network, in national parks and etc.



Road Ecology

- Today, transportation networks are one of the important criteria that show the development level of societies.
- The increase in the quality of life has increased the access needs of people.

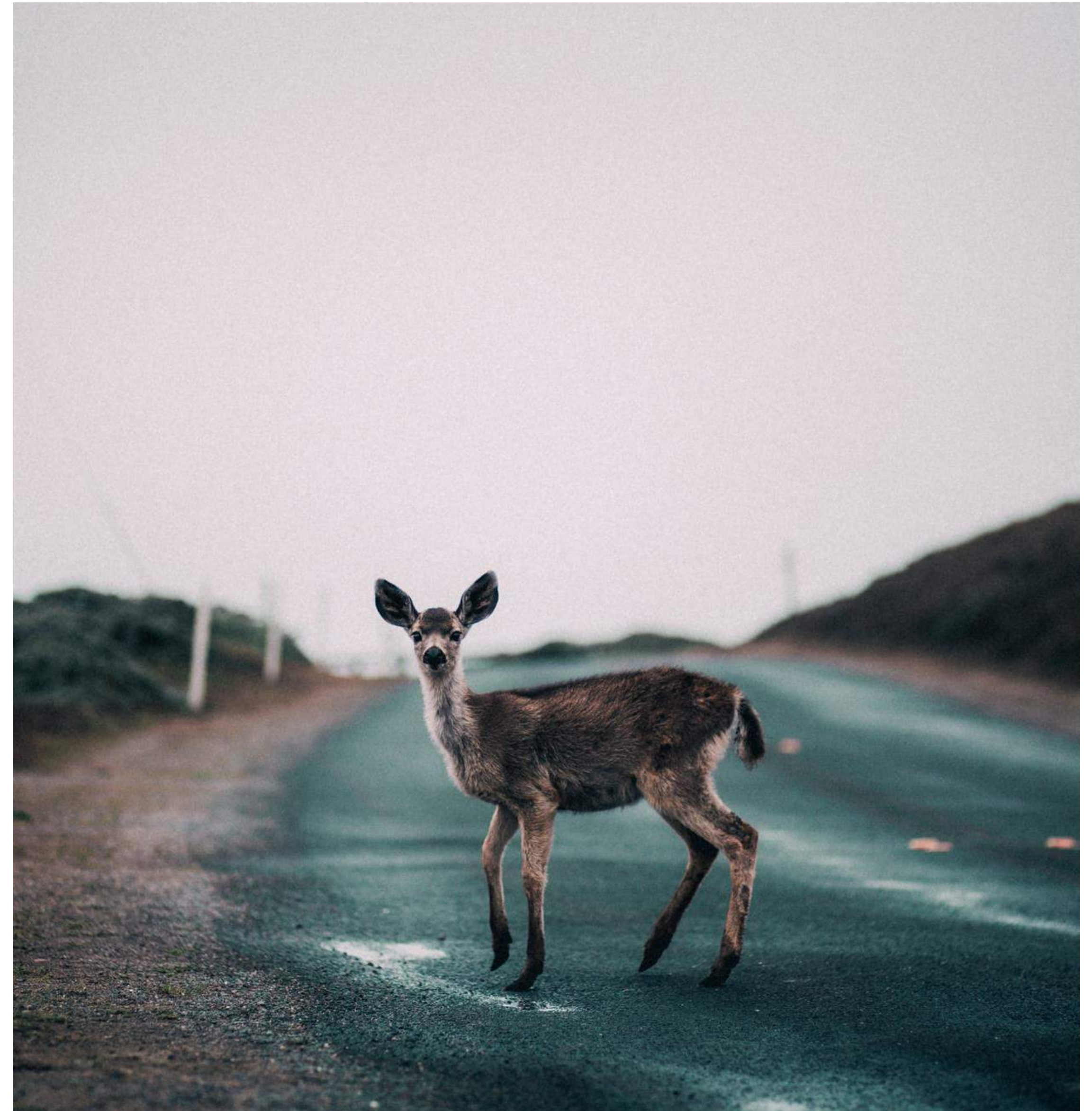
Photo: eledia.org



Healthy Ecosystem

- In many parts of the world, roads and traffic have a significant negative impact on the function of healthy ecosystems and the survival of species.
- These effects are not only the narrowing or fragmentation of living spaces but also the accidents that occur as a result of vehicle-wild-animal collisions on the roads.
- In particular, these accidents harm wildlife but also threaten human life and cause serious material damage.

Photo: eledia.org



Survival of Species

- Every year in the USA, nearly 2 million accidents occur in terms of all living groups, 29000 people are injured and more than 200 people die as a result of these accidents.
- In Europe, ungulates only were included in 500,000 accident records in 1995. In addition, many living things die.

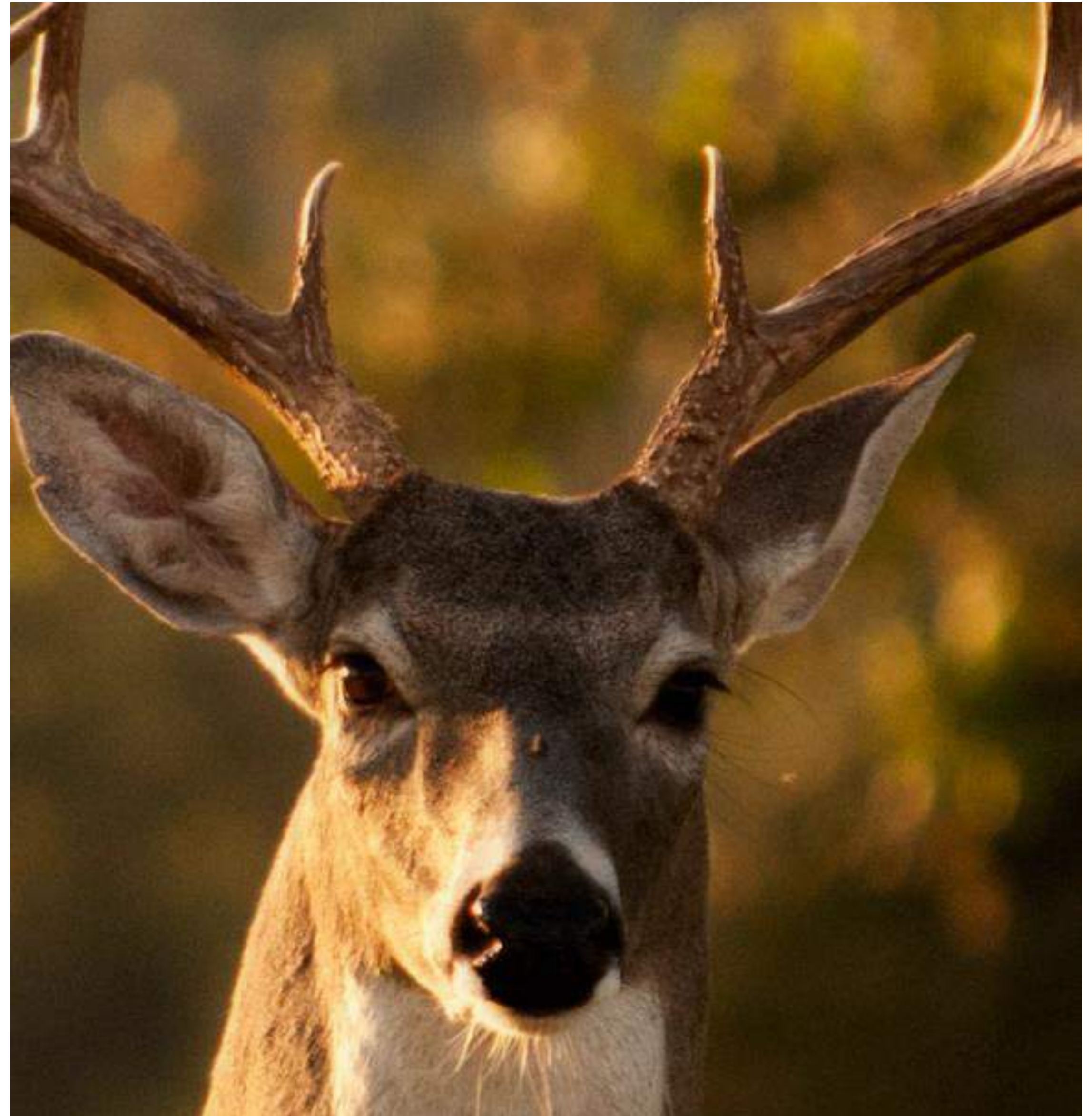


Photo: eledia.org

Survival of Species

- The creatures most exposed to these negative effects of transportation networks are the individuals of wildlife.
- These creatures, which continue their lives in a certain ecosystem, one day have to wake up to despair. A road running through their habitat has isolated them from their water sources and nutrients.
- Animals that want to reach the resources have to pass through these roads that divide their habitats into two, which is what I call the death pit. These transitions often fail.

Photo: eledia.org



Why build Animal Crossings

Photo: www.fotolia.pl



Road incidents involving wild animals are almost everyday life in the era of infrastructure expansion and growing traffic intensity. Especially in autumn, there is not a day without information about cars damaged after a collision with an elk or a deer.



Photo: ADAC



Why build Animal Crossings



Photo: Tomasz Wojda

The most common incidents involve the roe deer and wild boar



Photo: Arkadiusz Boimski

The relationship between the expansion of road infrastructure and the increase in traffic volume and the number of incidents involving animals seems indisputable.

How much does it cost?



Road collision costs with an animal according to UDOT (USA)

- costs of a human fatal accident: USD 3 million / person
- traffic delay costs: 17.50 USD / person / hour
- Average collision delay cost per lane: \$ 37,000 / lane / hour

Profitability analysis according to UDOT (USA)

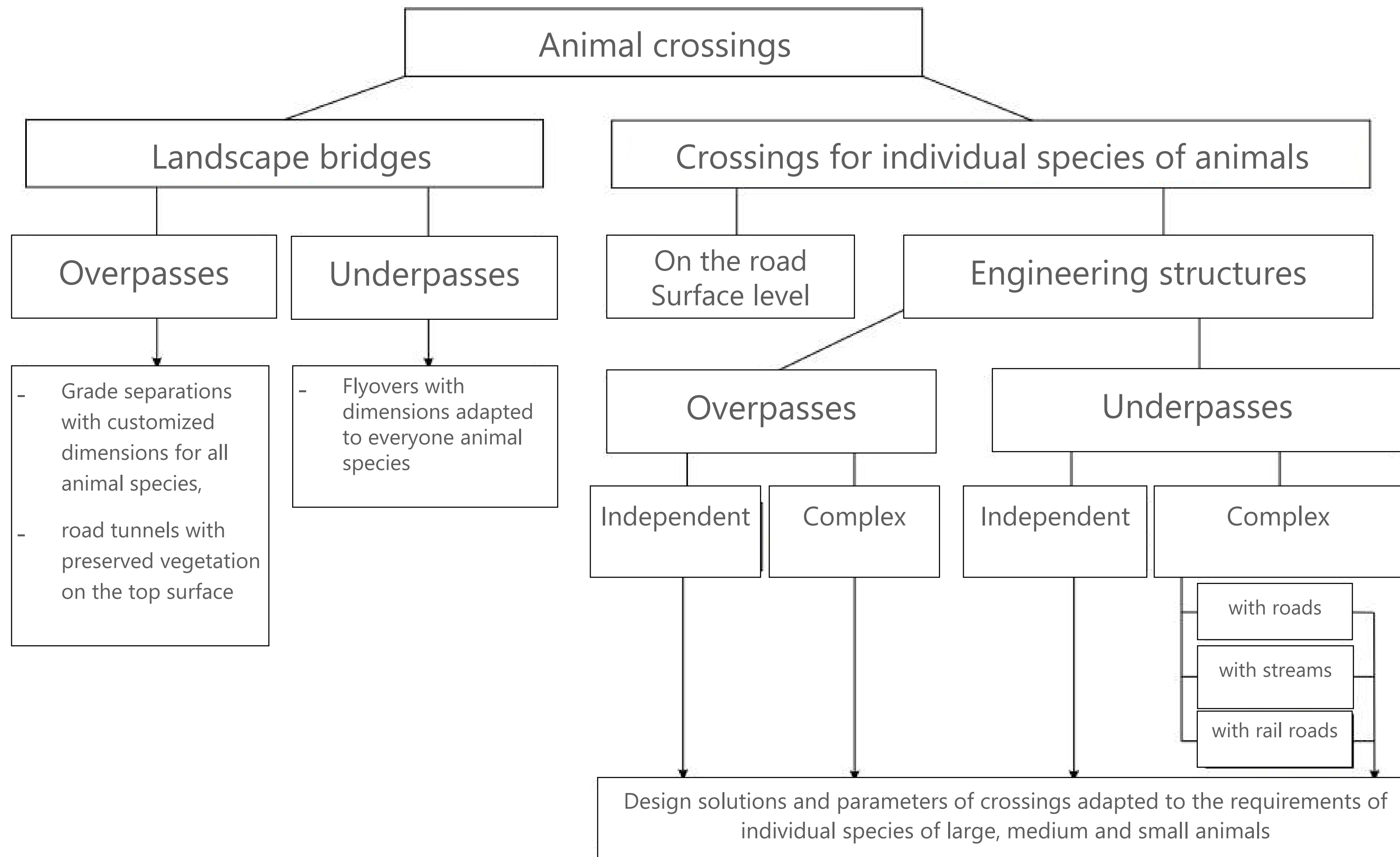
- Profit and cost account

$F = \text{Profits} / \text{Costs}$

$F = (\text{Average collision cost} * \text{design life}) / (\text{Estimated cost of prevention actions})$

$$F \geq 2.0$$

Types of Animal Crossings



Types of Animal Crossings

Explanation of symbols

A- Entrances – approach zones

B – Area of crossing

C – Soil embankment – an acoustic and anti-glare screen

D - Fencing

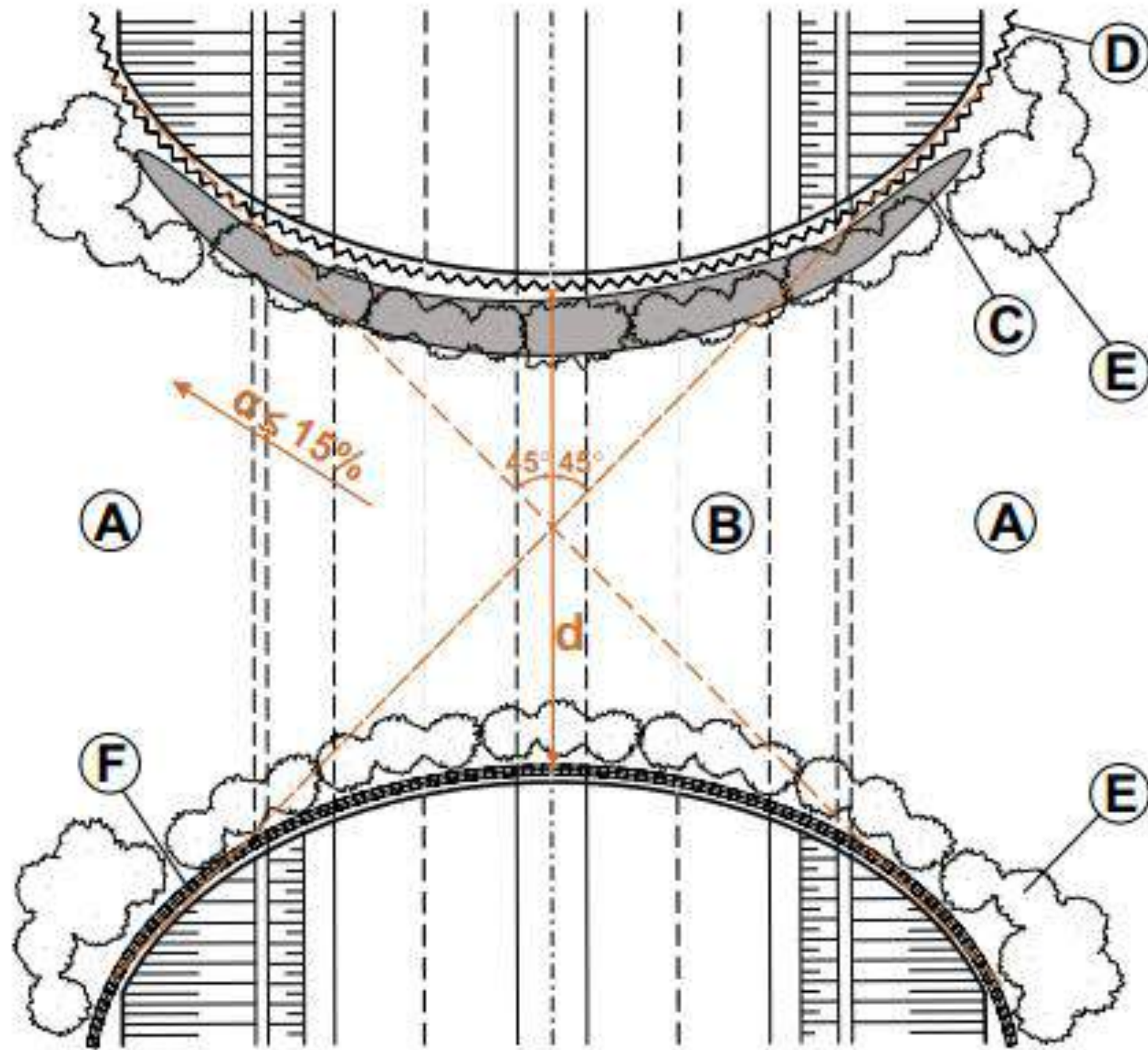
E - Cover and homing vegetation

F- option I: anti-glare screen + acoustic screen

d- Effective width

α - Angle of expansion of the transition surface and approach zones

a – maximum slope inclination

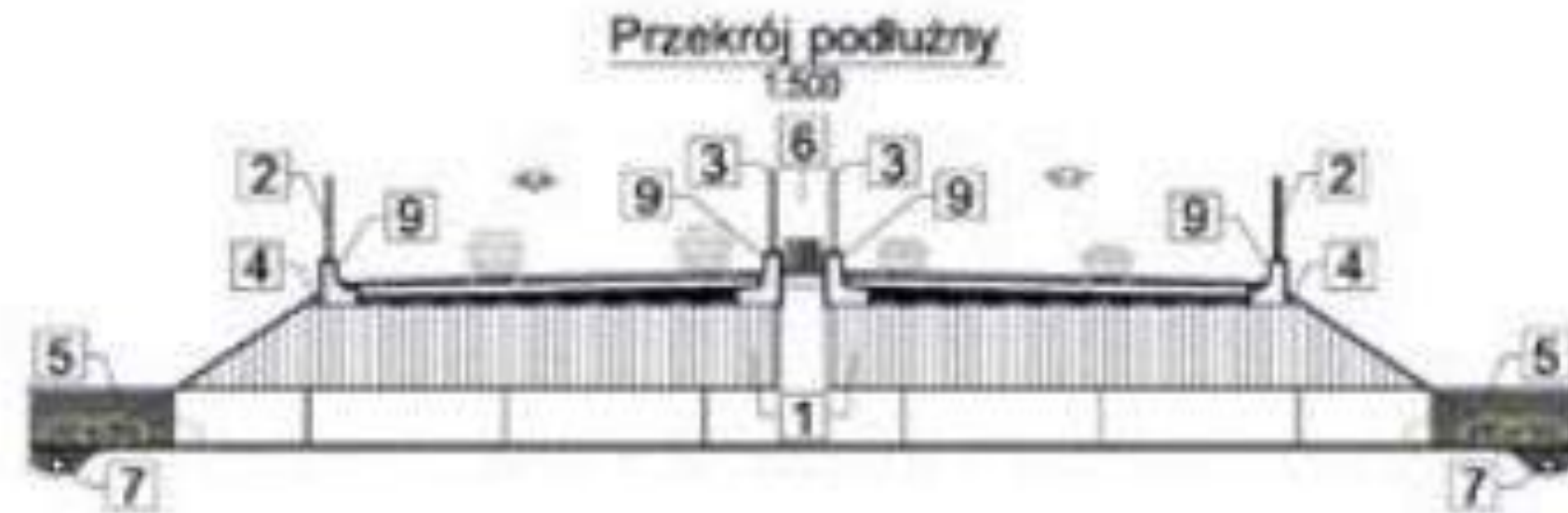


Types of Animal Crossings

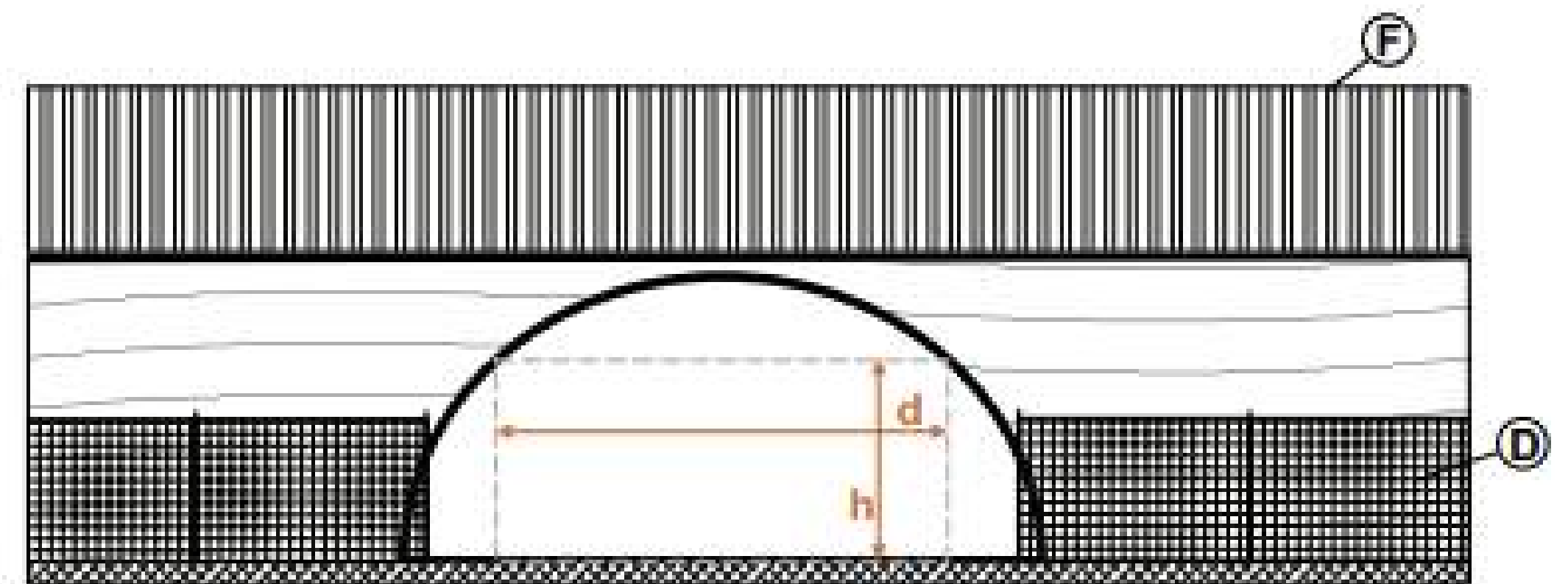
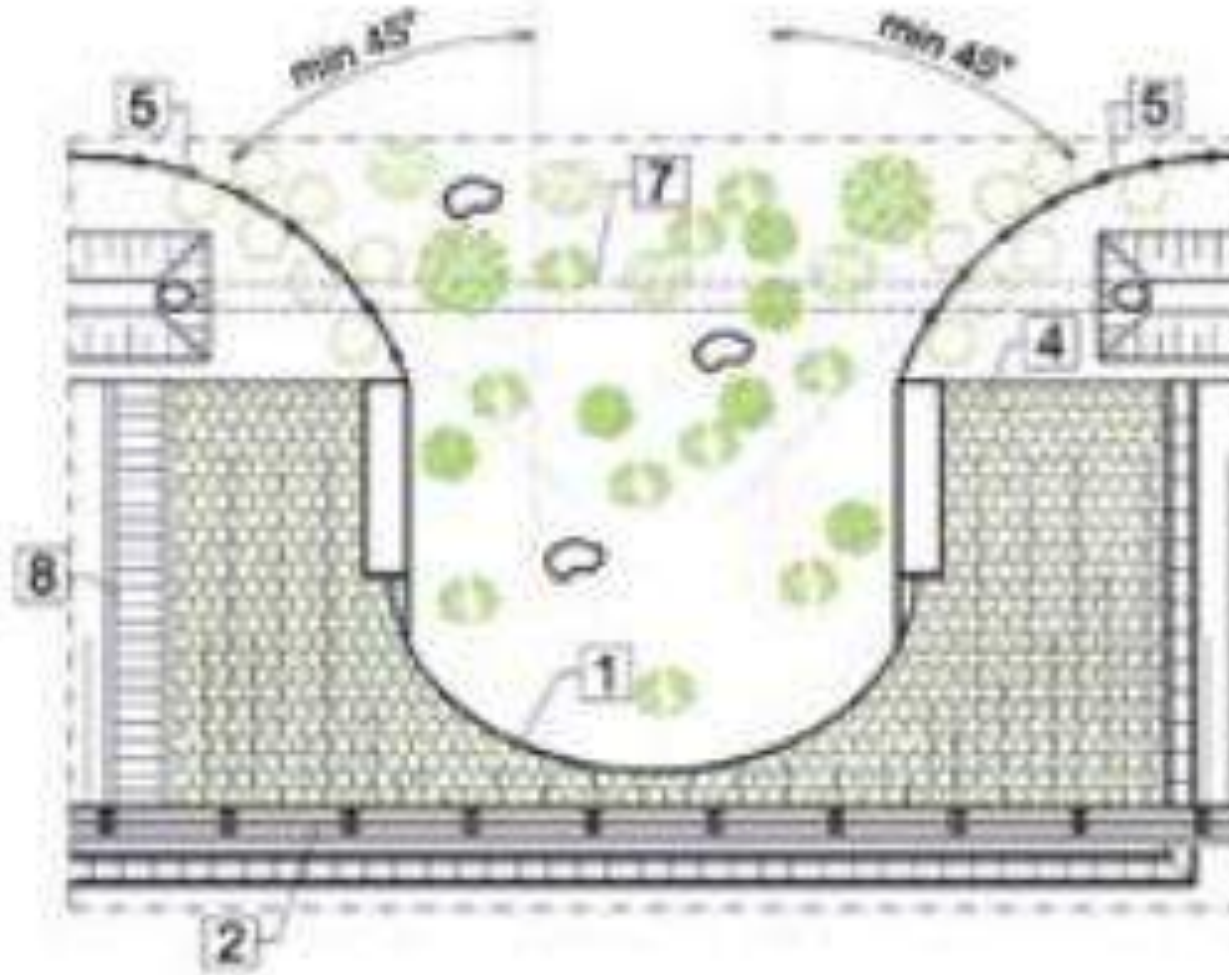
Explanation of symbols

D - security fence - a steel mesh fence, which is a continuation of the fence along the road, appropriately modified in the area of crossings.

F- anti-glare screen + acoustic screen



Widok z góry 1:250

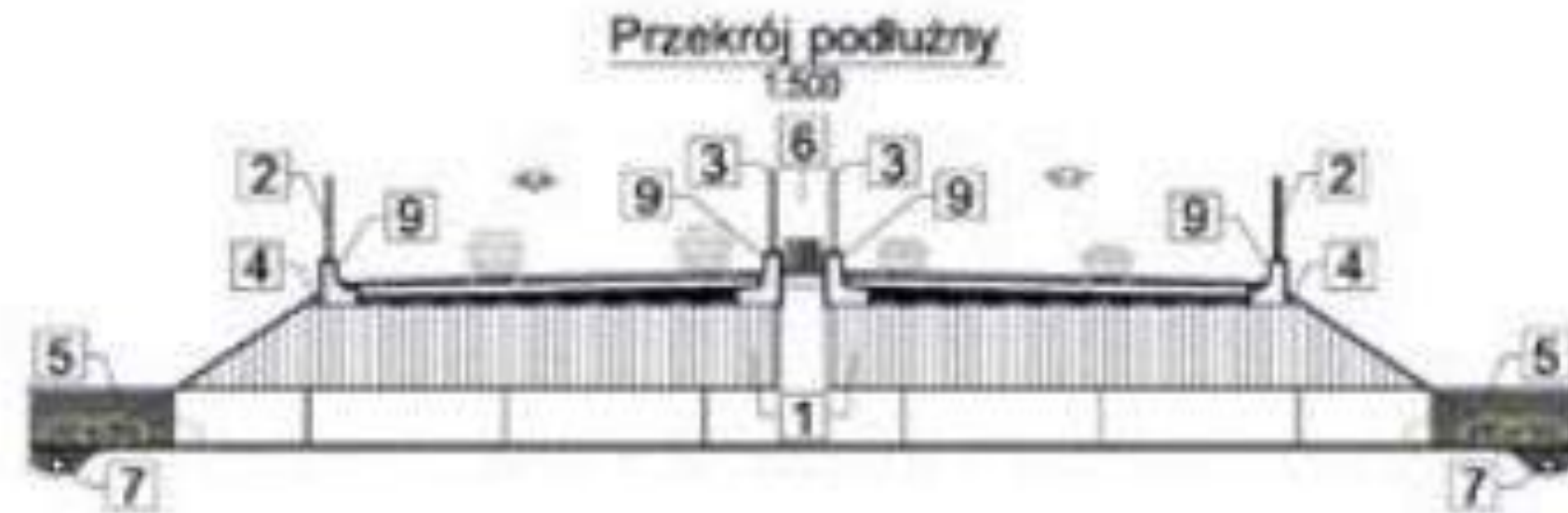


Types of Animal Crossings

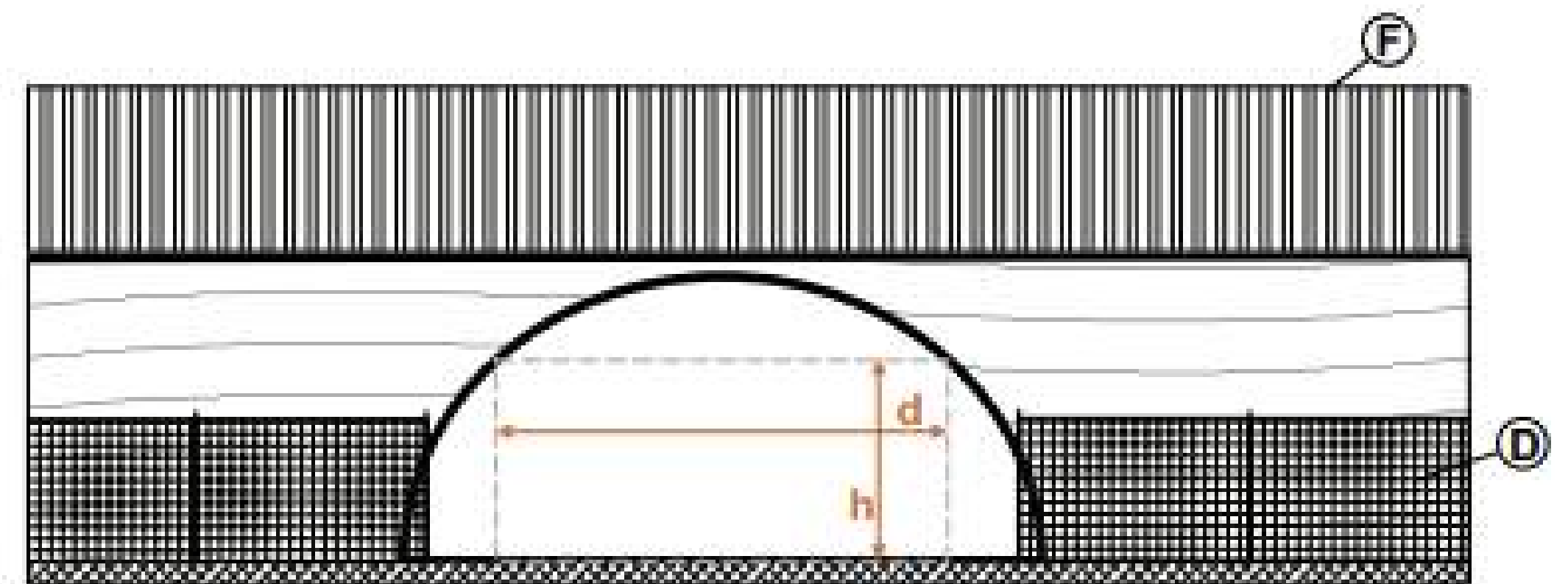
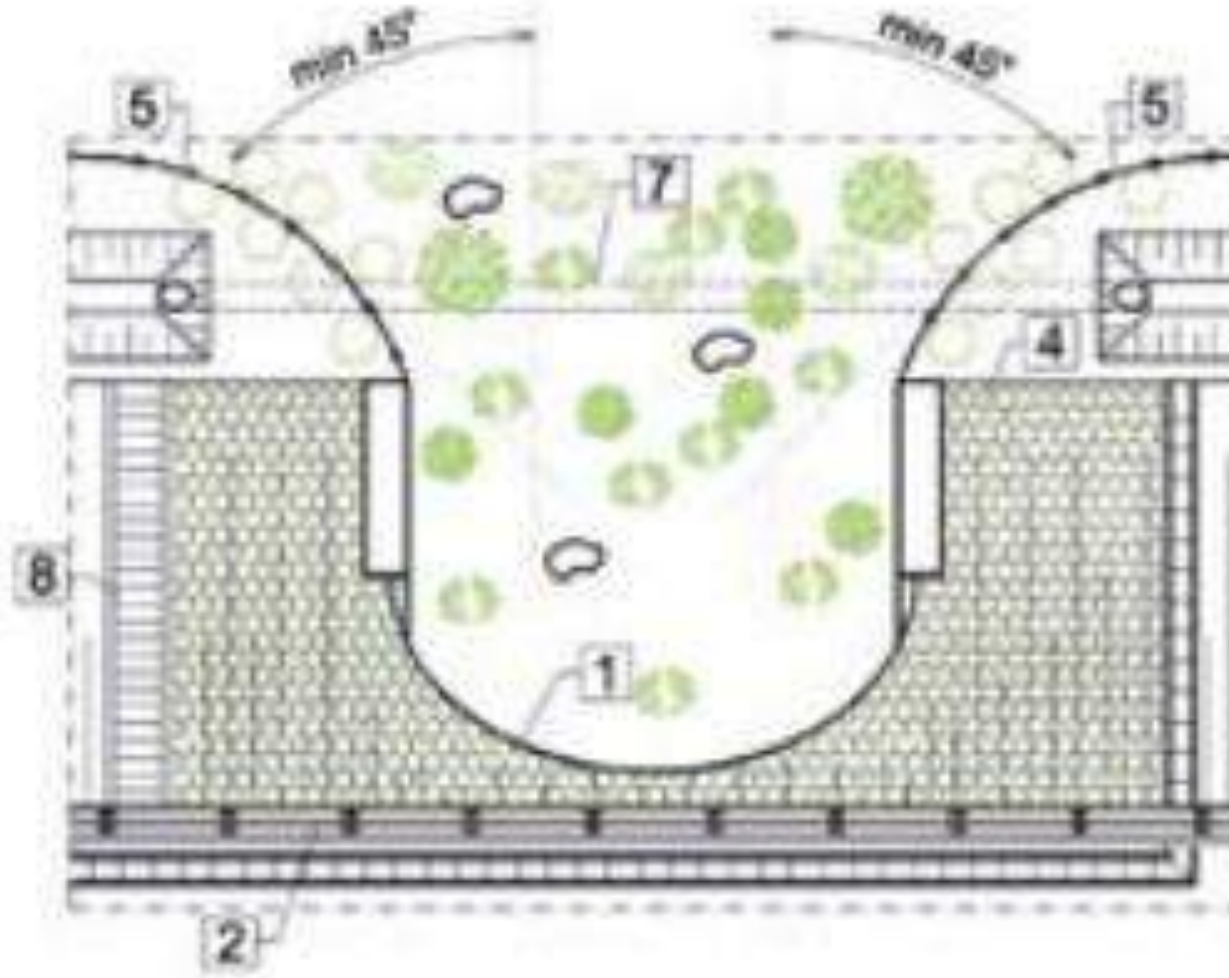
Explanation of symbols

D - security fence - a steel mesh fence, which is a continuation of the fence along the road, appropriately modified in the area of crossings.

F- anti-glare screen + acoustic screen



Widok z góry 1:250



Types of Animal Crossings



Factors determining the effectiveness of animal passages

1. Location of crossing,
2. Parameters and design solutions,
3. Development of the area and harmony with the surroundings,
4. The level of emission,
5. Human use.



STUDY OF COUNTRY REGULATIONS

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Study

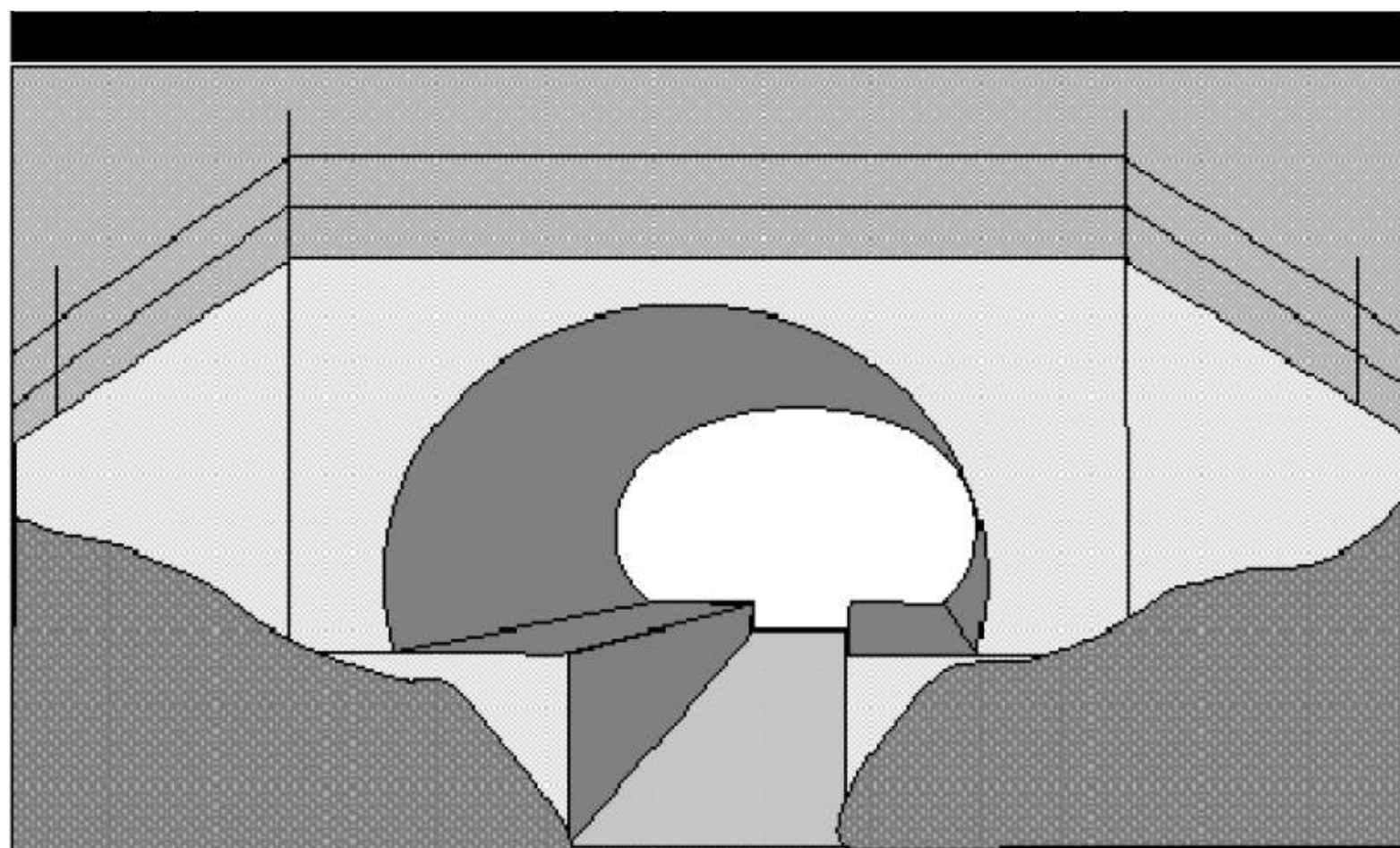
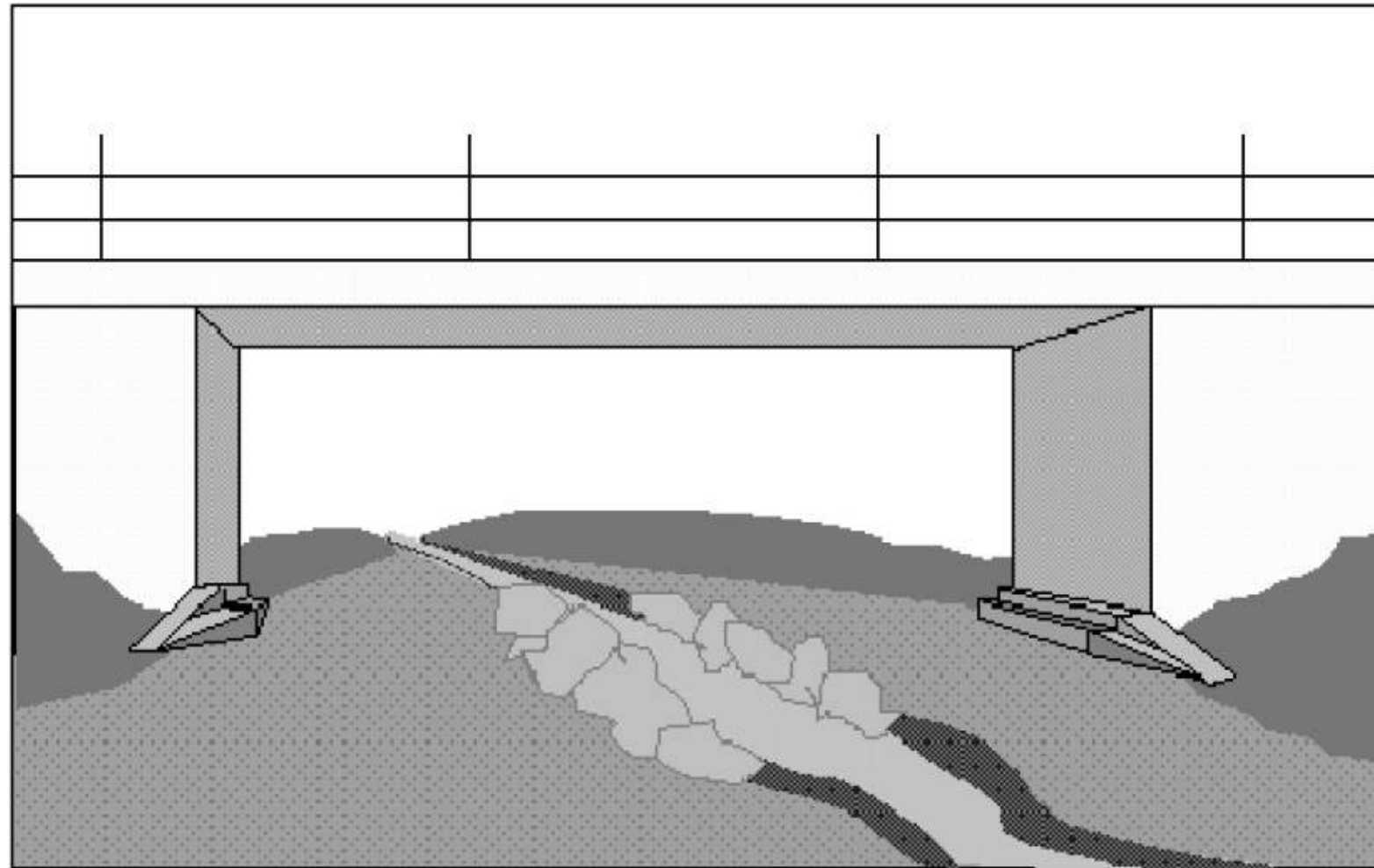


Analysis of technical regulations in the following countries

- **Great Britain,**
- **Spain,**
- **France,**
- **Germany,**
- **Slovakia,**
- **USA,**
- **Australia,**
- **Poland**

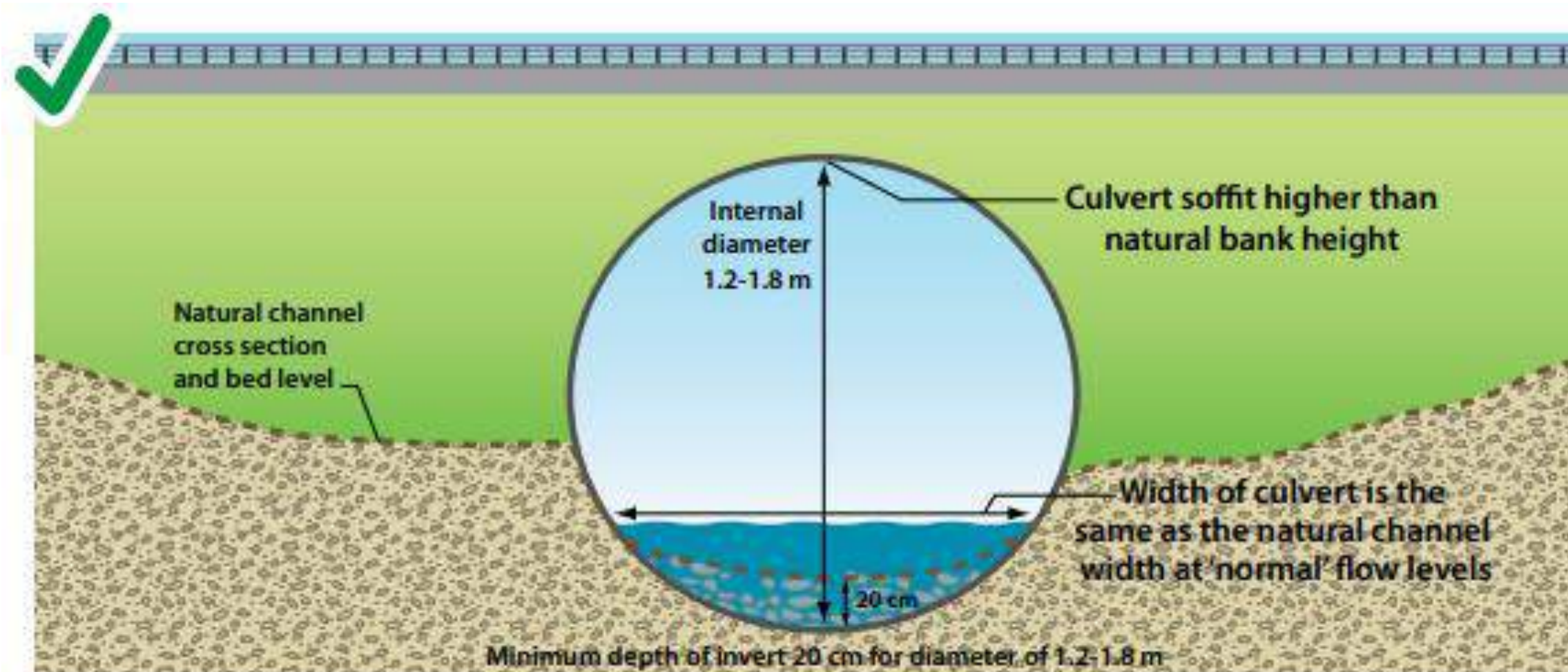
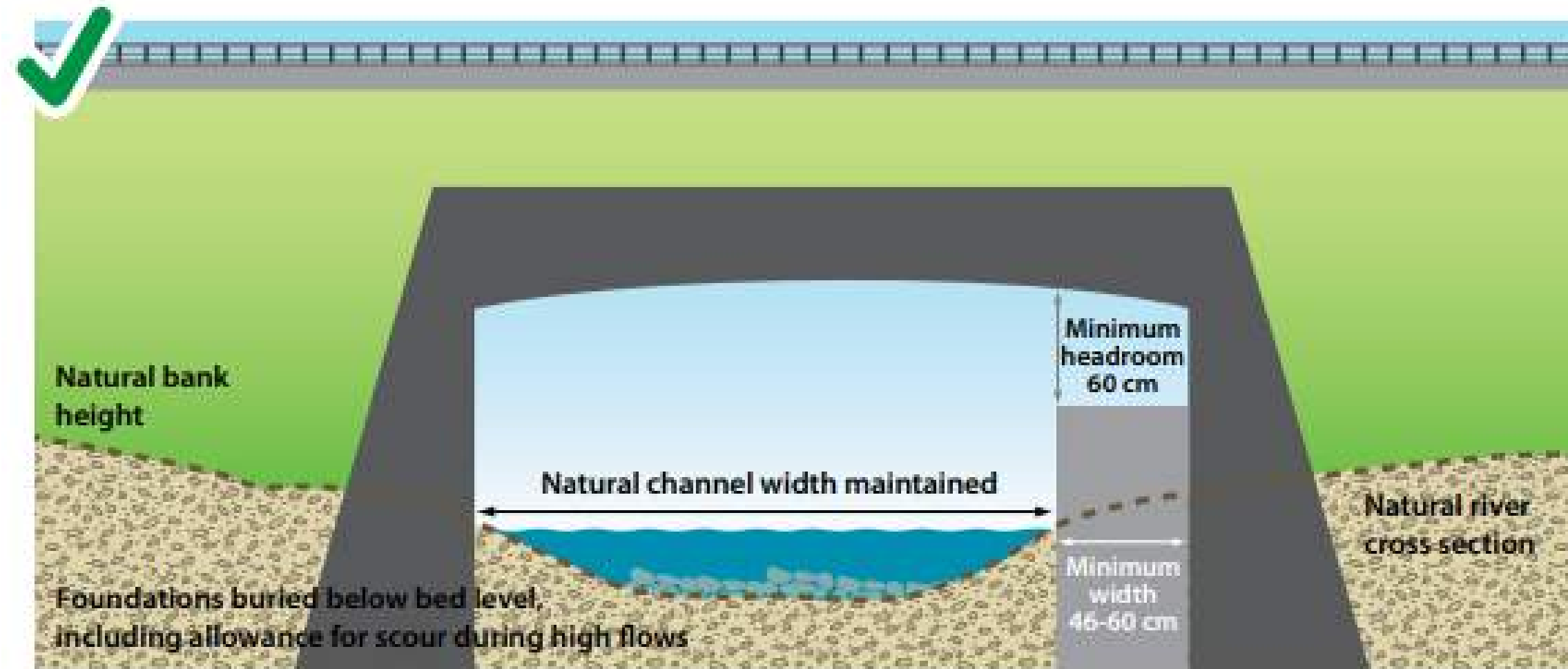
in terms of the design and development of animal over- and underpasses.

Study (Great Britain)



- The British Basic Regulations provide a general code of conduct for the design of communication facilities within animal habitats of different species.
- Shaping the under-bridge space to enable animal migration. Visible additional shelves within the walls of the abutments.
- The recommended way of developing culverts and small vault bridge structures.

Study (Great Britain)



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- Shaping the under-bridge space to enable animal migration. Visible additional shelves within the walls of the abutments.
- The recommended way of developing culverts and small vault bridge structures.

Study (Spain)



- The legislation in force in Spain is intended mainly for use in informational analysis and research related to environmental impact assessment, as well as in the design of renovation and reconstruction of existing communication systems.
- The document is mainly intended for professionals involved in the planning, design, construction, maintenance and operation of public roads in Spain.

Photo: An example of the development of an overpass for large wild animals

Study (Spain)

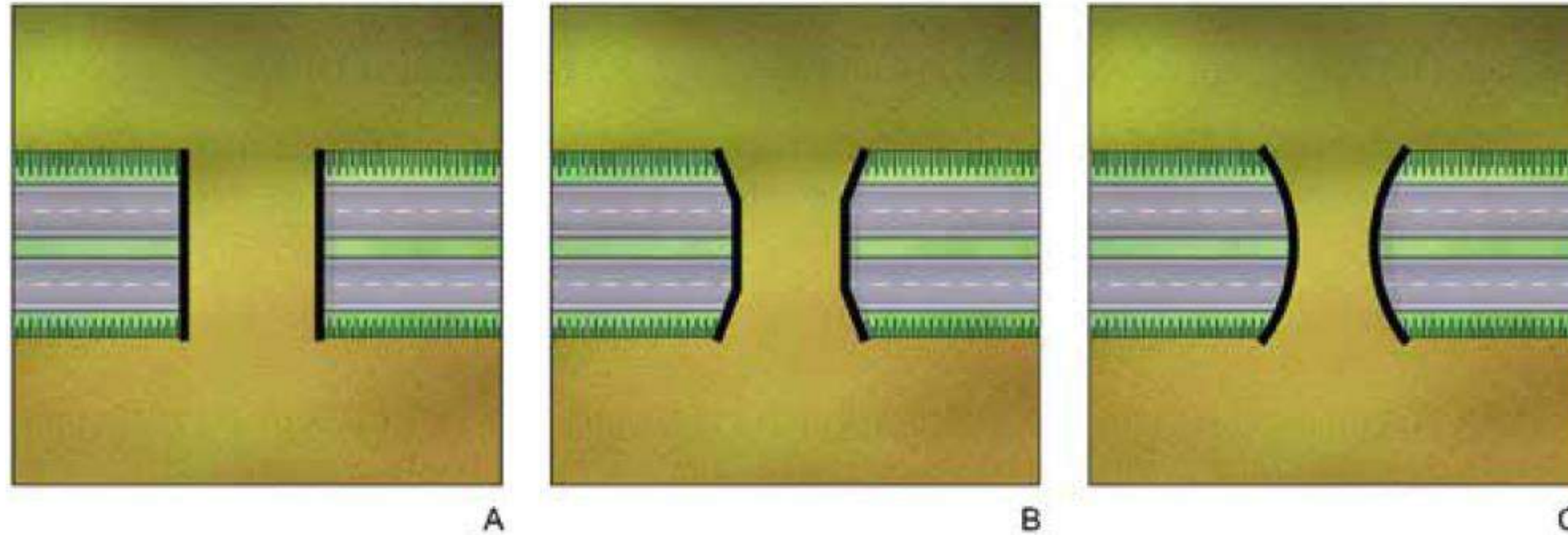


Photo: Recommended geometric shaping of animal crossings

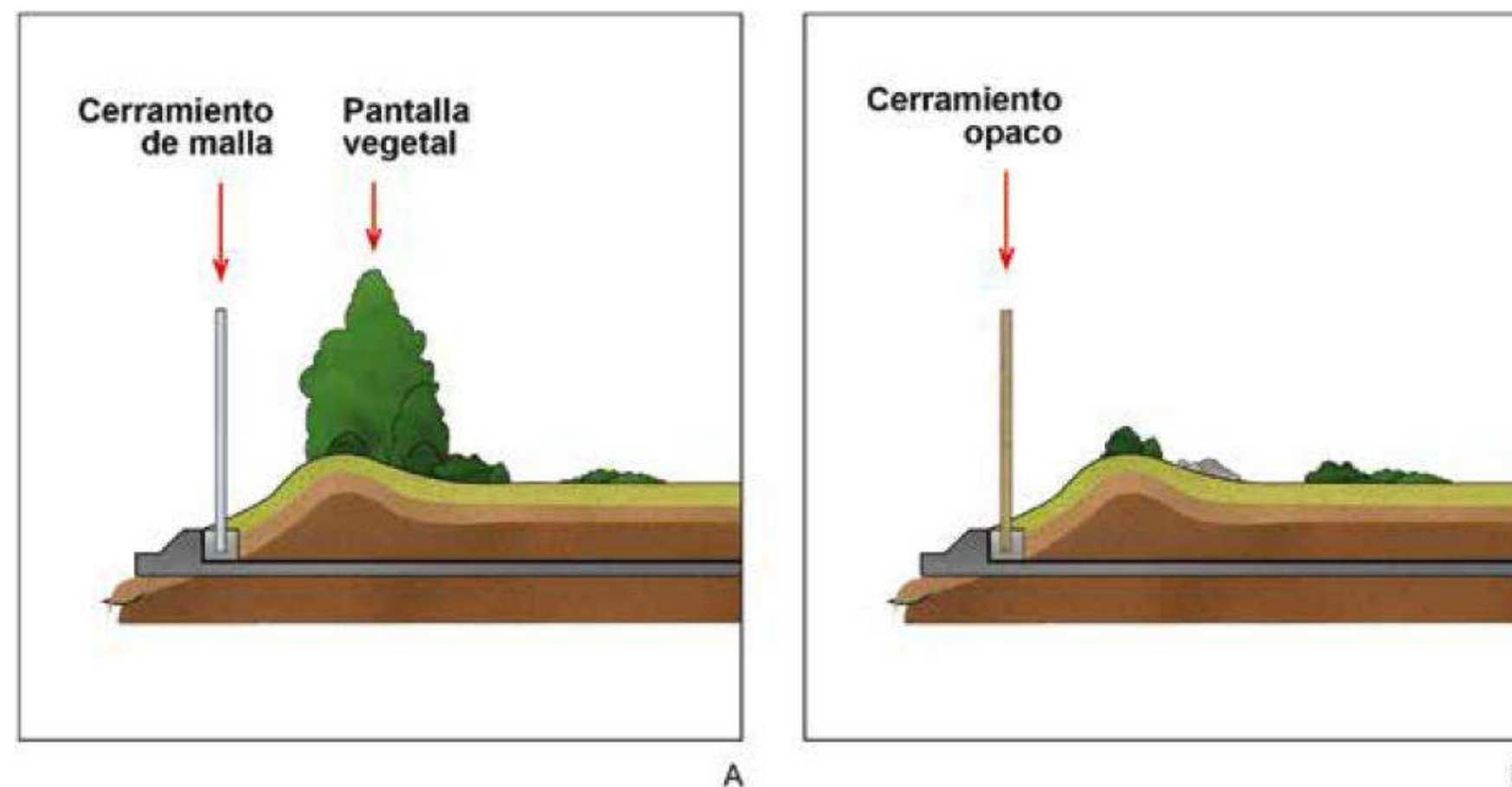
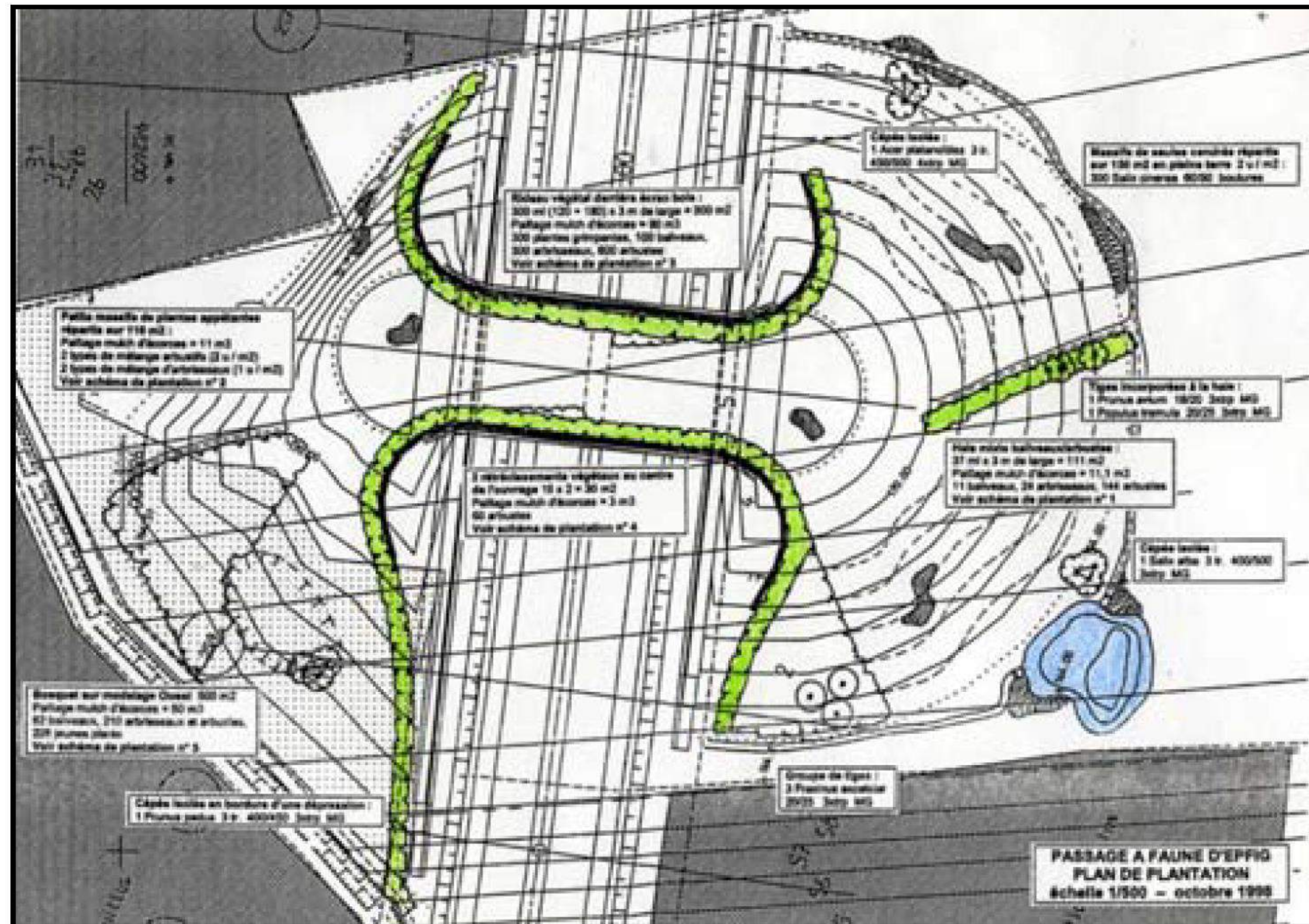


Photo: Recommended shaping of the top surface of animal crossings in the area of anti-dazzling screens

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- The document is mainly intended for professionals involved in the planning, design, construction, maintenance and operation of public roads in Spain.

Study (France)



- According to French regulations, the development of animal crossings focuses primarily on elements aimed at eliminating the possibility of fauna intrusion into the communication route.

Photo: An example of the geometric shaping of the animal crossing (design)

Study (France)

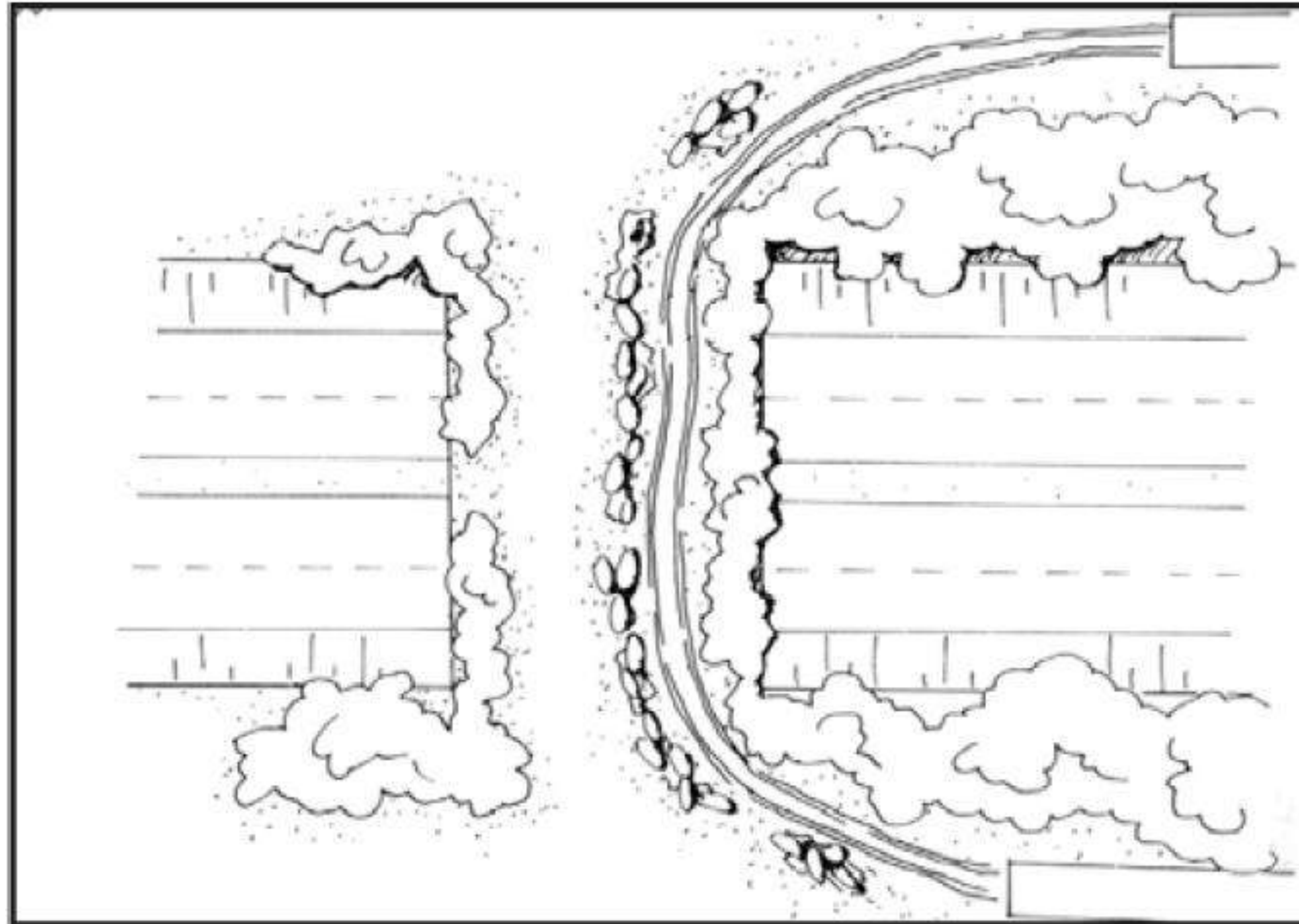


Photo: Recommended development of animal integrated overpass (combined function with a separate migration zone)

- According to French regulations, the development of animal crossings focuses primarily on elements aimed at eliminating the possibility of fauna intrusion into the communication route.

Study (Germany)



Photo: An example of development of the surface of a large animal crossing in Germany. Visible undeveloped lane used for monitoring of the crossing

- The rules for the location of animal crossings in Germany are similar to those in force in Spain. They are based primarily on the analysis of the course of migration corridors, and then on the basis of the macro-scale topography of the terrain, the indicative location of crossings in relation to the communication route.
- It should be borne in mind here that Germany is a highly urbanized country with a high land development factor for the agricultural industry.

Study (Germany)



Photo: Negelhof in Badenia. Road No B31n Animal Overpass.
www.panoramio.com

- These regulations assume that the analysis of the location of passages should be carried out on an individual basis, based on thorough field research with the participation of a large number of biology specialists.
- For this reason, there are very few consistent documents on the methods of the management of crossings.

Study (Slovakia)

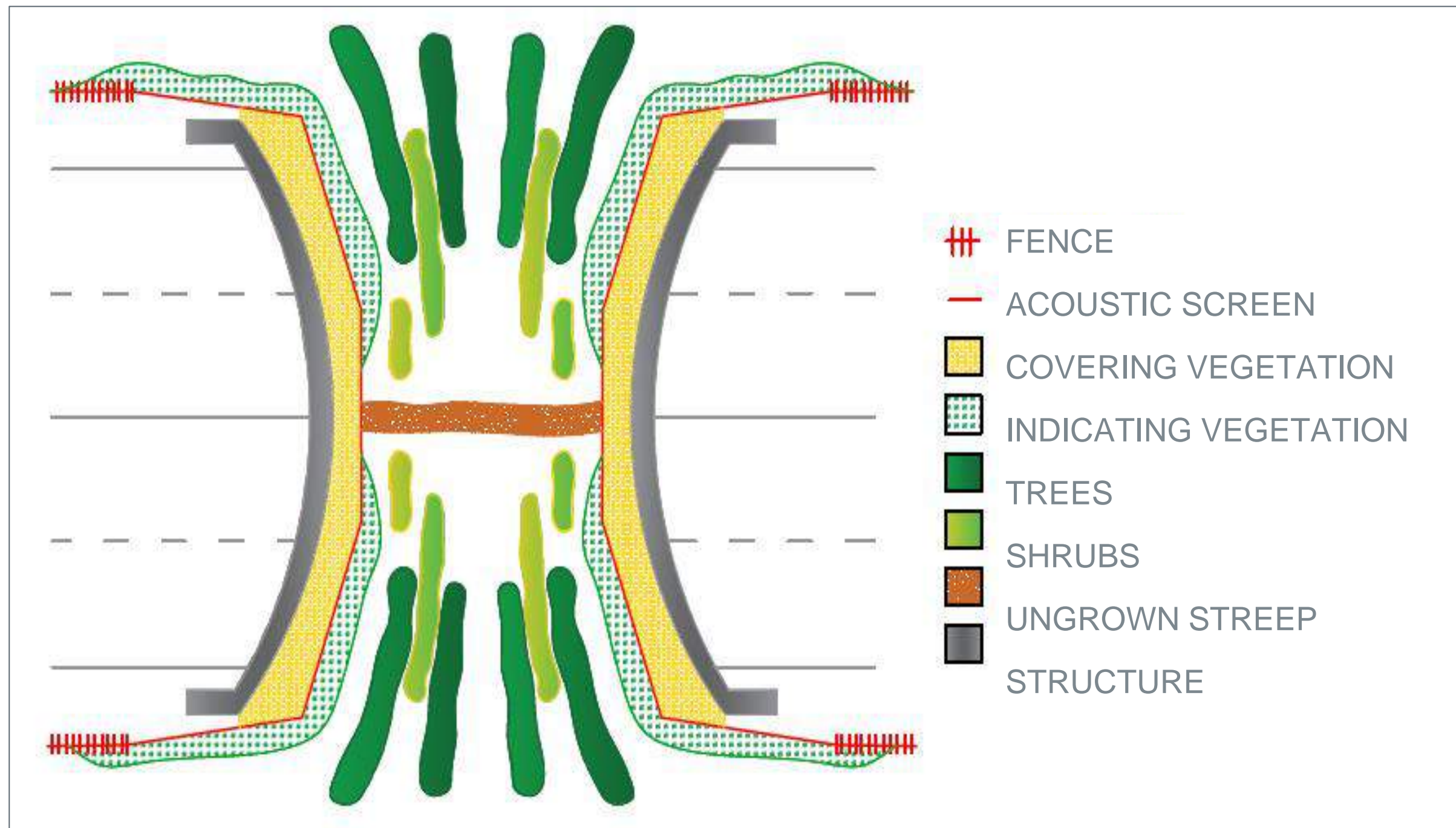


Photo: Shaping vegetation (plantings) for large animal crossings according to Slovak guidelines

- In the Slovak legislation, the assessment of the penetration of ecological roads is included in the documentation of the processes established at the stage of reports on the environmental impact of the investment. Its purpose is to define migration corridors: large and medium-sized mammals, predators and other vertebrates, taking into account the corridors of neighboring countries.
- When determining the type and location of crossings, the following categories of migration corridors can be distinguished:
- Category A - supra-regional migration routes,
- Category B - regional migration routes,
- Category C - local migration routes,
- Category D - main amphibian migration routes.

Study (USA)

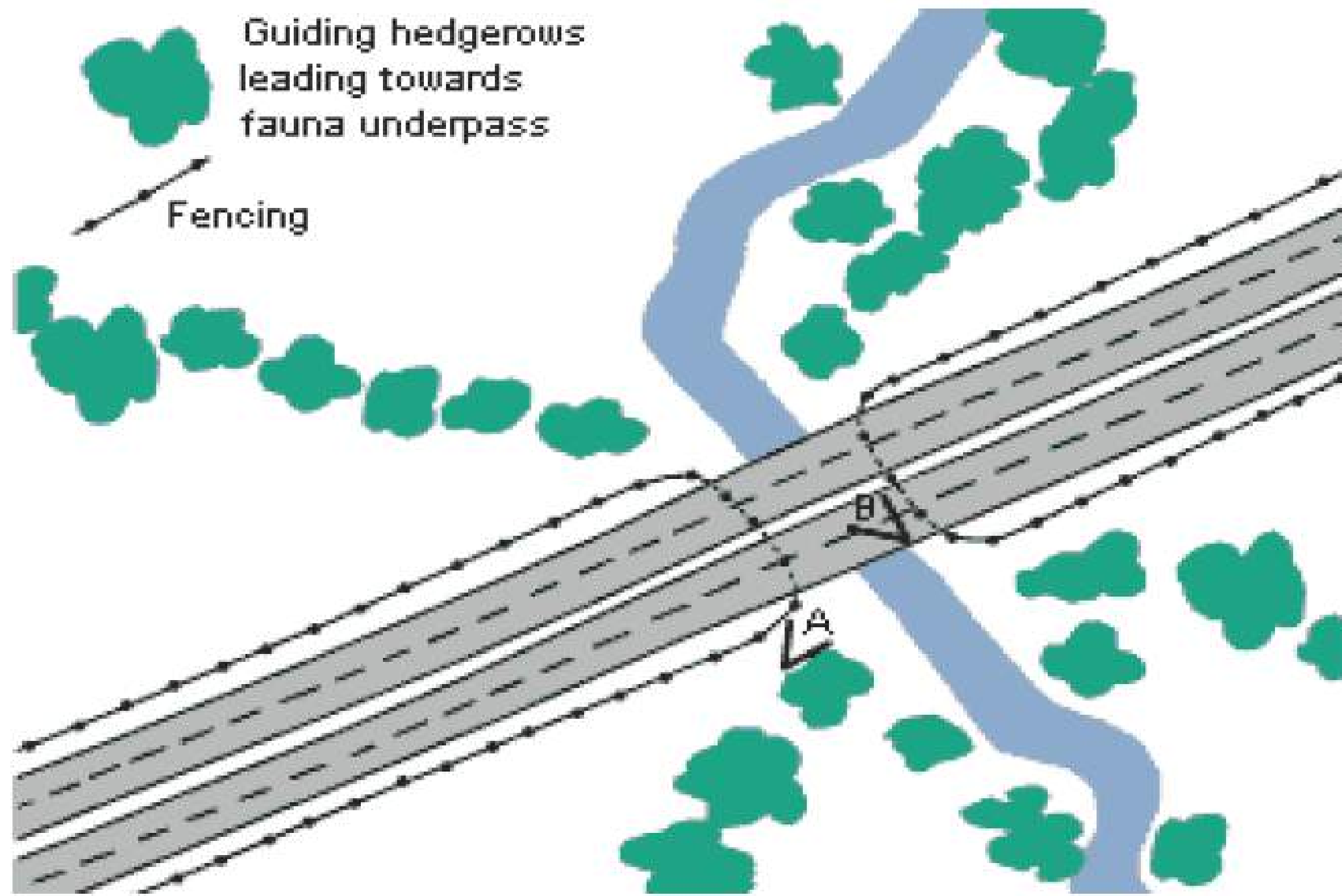


Photo: Basic principles of shaping animal passages according to US guidelines

According to the analyzed regulations in force in the United States, planning the location of animal crossings consists of a detailed analysis of, among others:

- aerial photos,
- topographic maps of the area,
- animal habitat maps,
- data on the migration of animals in their natural environment,
- data on previously performed ecological analyzes,
- animal mortality data,
- situational and altitude data.

Study (USA)

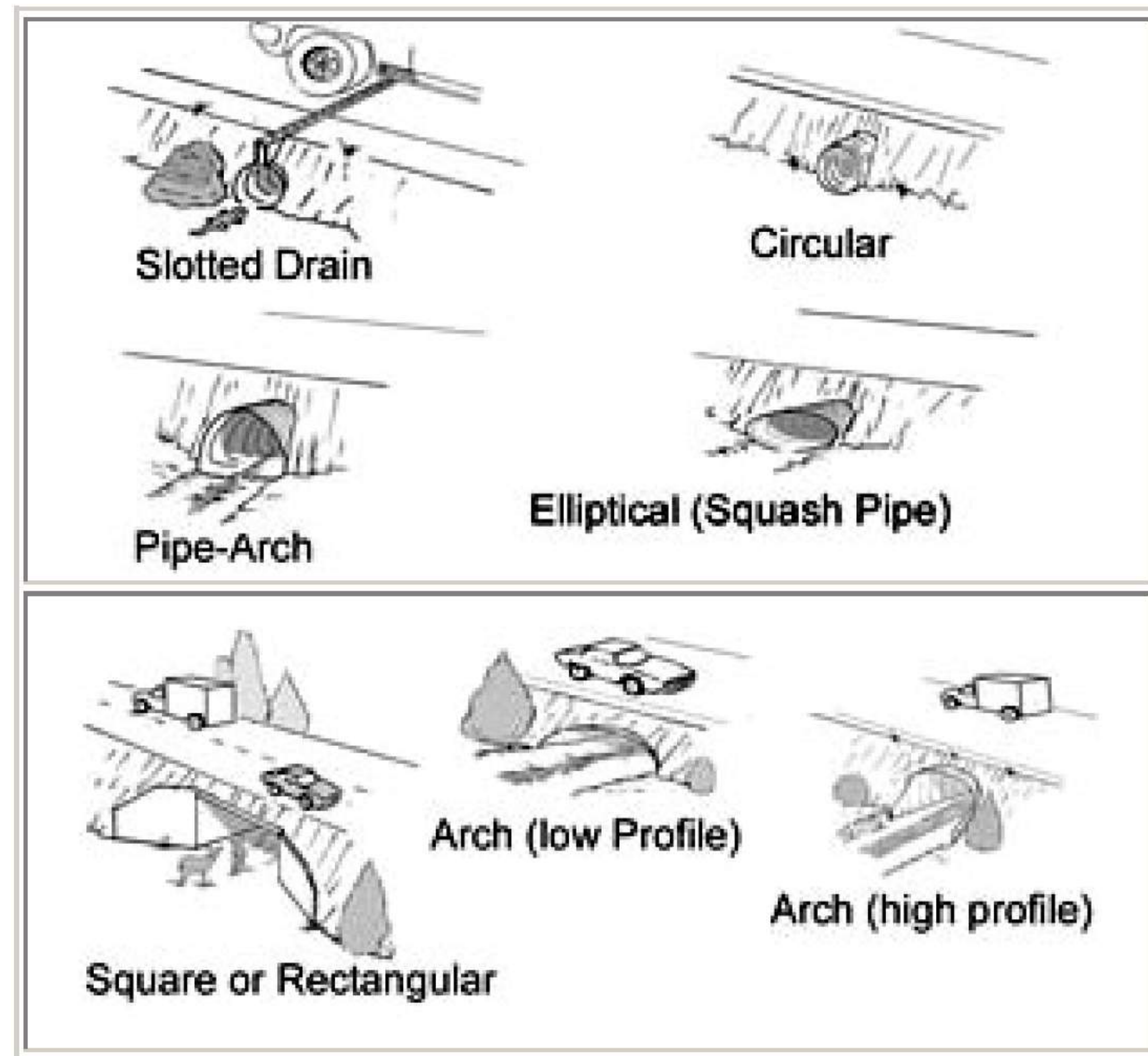


Photo: Basic types of animal underpasses according to US guidelines

According to the analyzed regulations in force in the United States, planning the location of animal crossings consists of a detailed analysis of, among others:

- aerial photos,
- topographic maps of the area,
- animal habitat maps,
- data on the migration of animals in their natural environment,
- data on previously performed ecological analyzes,
- animal mortality data,
- situational and altitude data.

Study (Australia)



Photo: Underpass without any shelf – dry underpass

According to the Australian regulations, the location of animal crossings should be based primarily on the analysis of the impact of the planned road investment on the natural environment, performed by specialists in the field of ecological research.

Due to Australia's mostly lowland topography, overpasses are rarely built. Mainly the underpasses are built. In the case of highways, in almost every case, the space under the bridge structures is adapted to the migratory needs of animals.

Study (Australia)

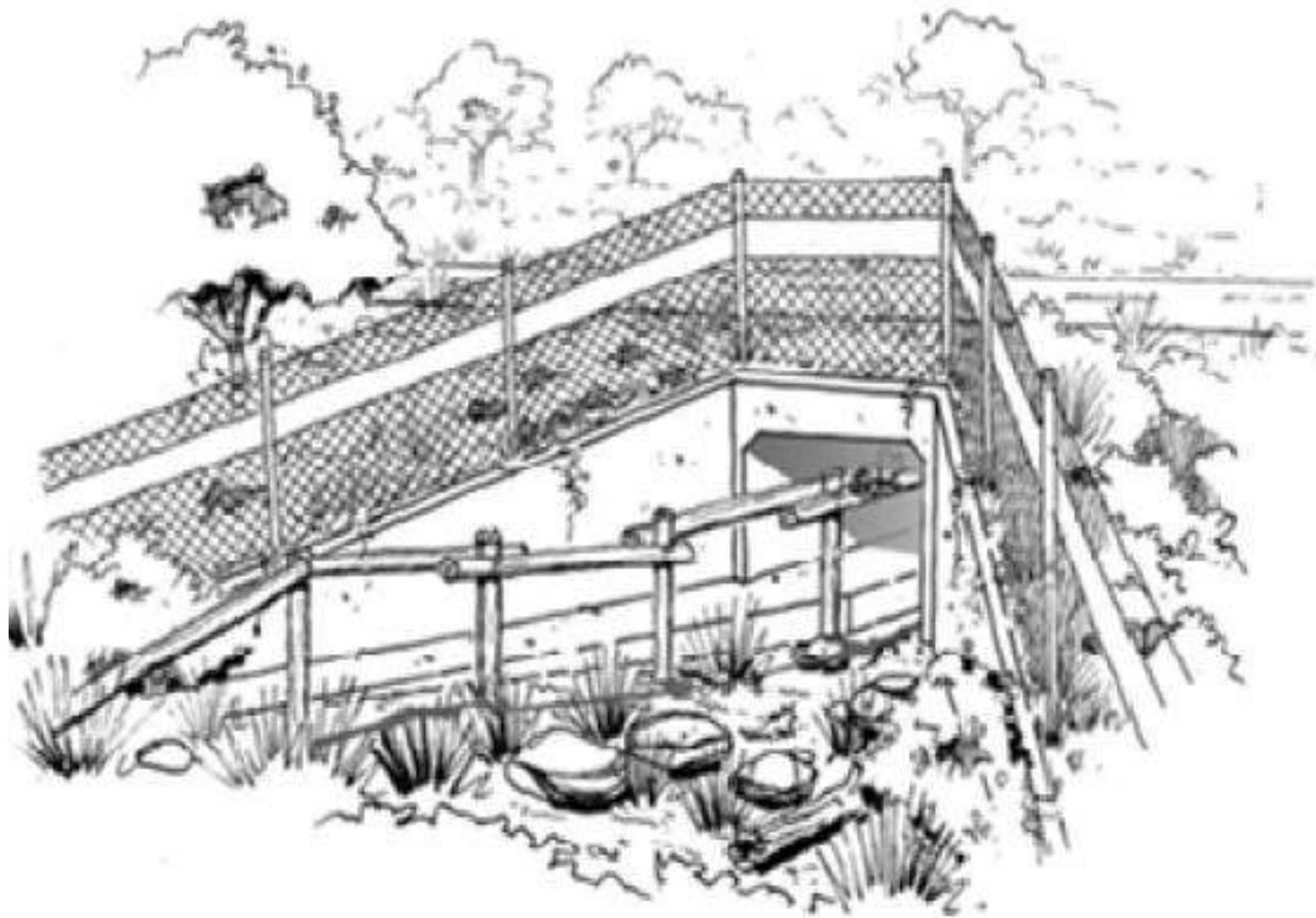


Photo: Underpass with single shelf and the ramp

According to the Australian regulations, the location of animal crossings should be based primarily on the analysis of the impact of the planned road investment on the natural environment, performed by specialists in the field of ecological research.

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Study (Australia)

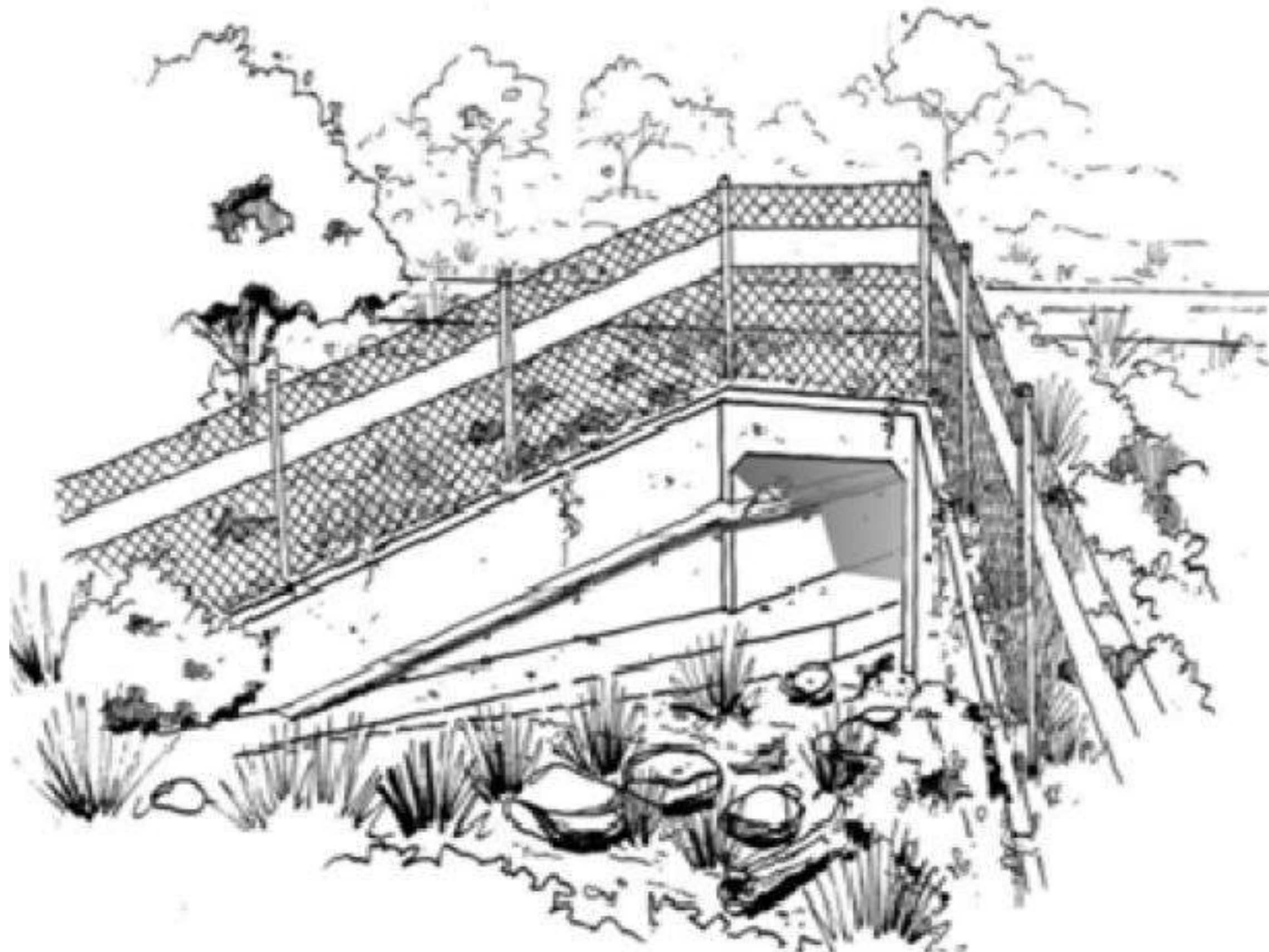


Photo: Underpass with double shelf on two elevations.

According to the Australian regulations, the location of animal crossings should be based primarily on the analysis of the impact of the planned road investment on the natural environment, performed by specialists in the field of ecological research.

Due to Australia's mostly lowland topography, overpasses are rarely built. Mainly the underpasses are built. In the case of highways, in almost every case, the space under the bridge structures is adapted to the migratory needs of animals.

Study (Poland)

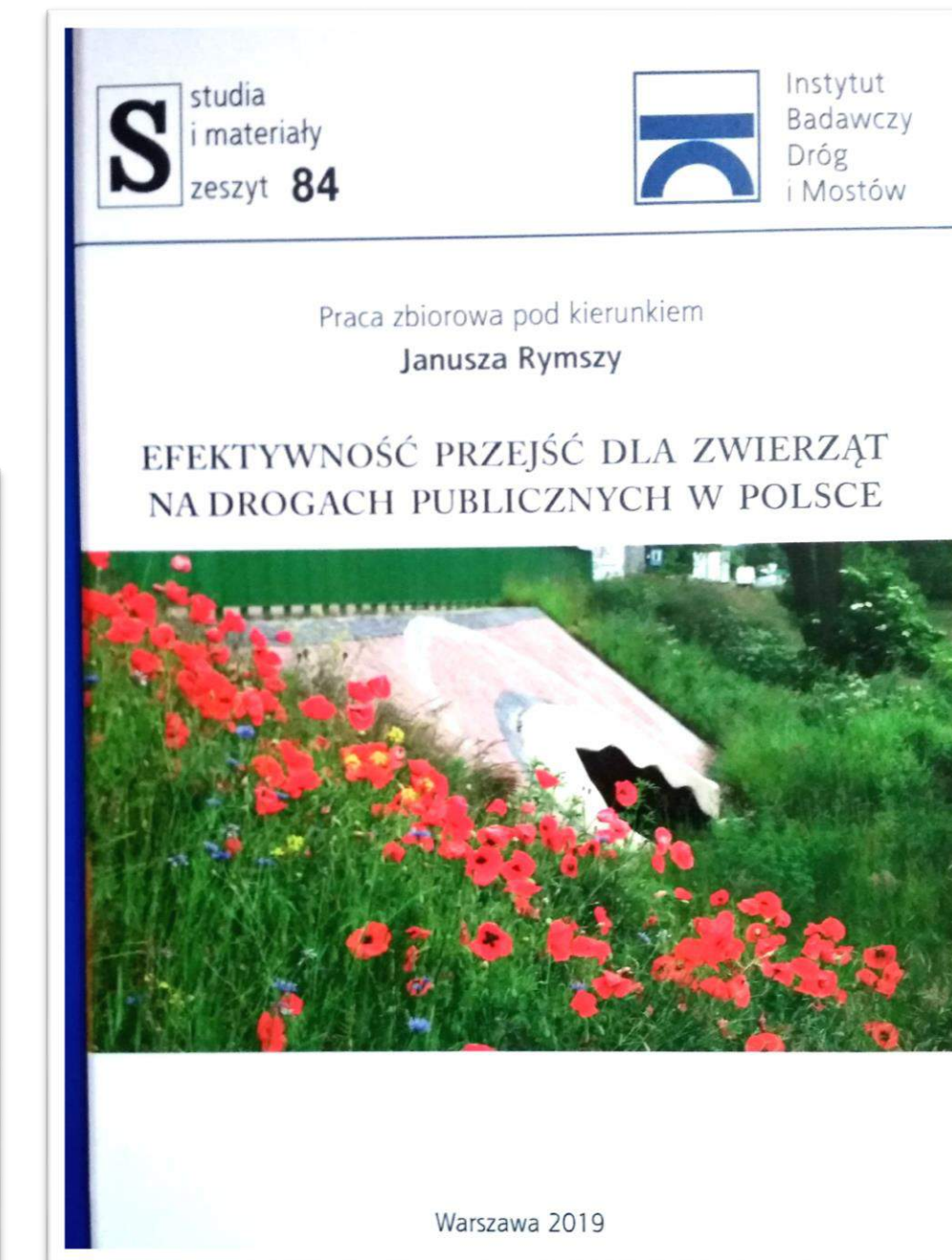
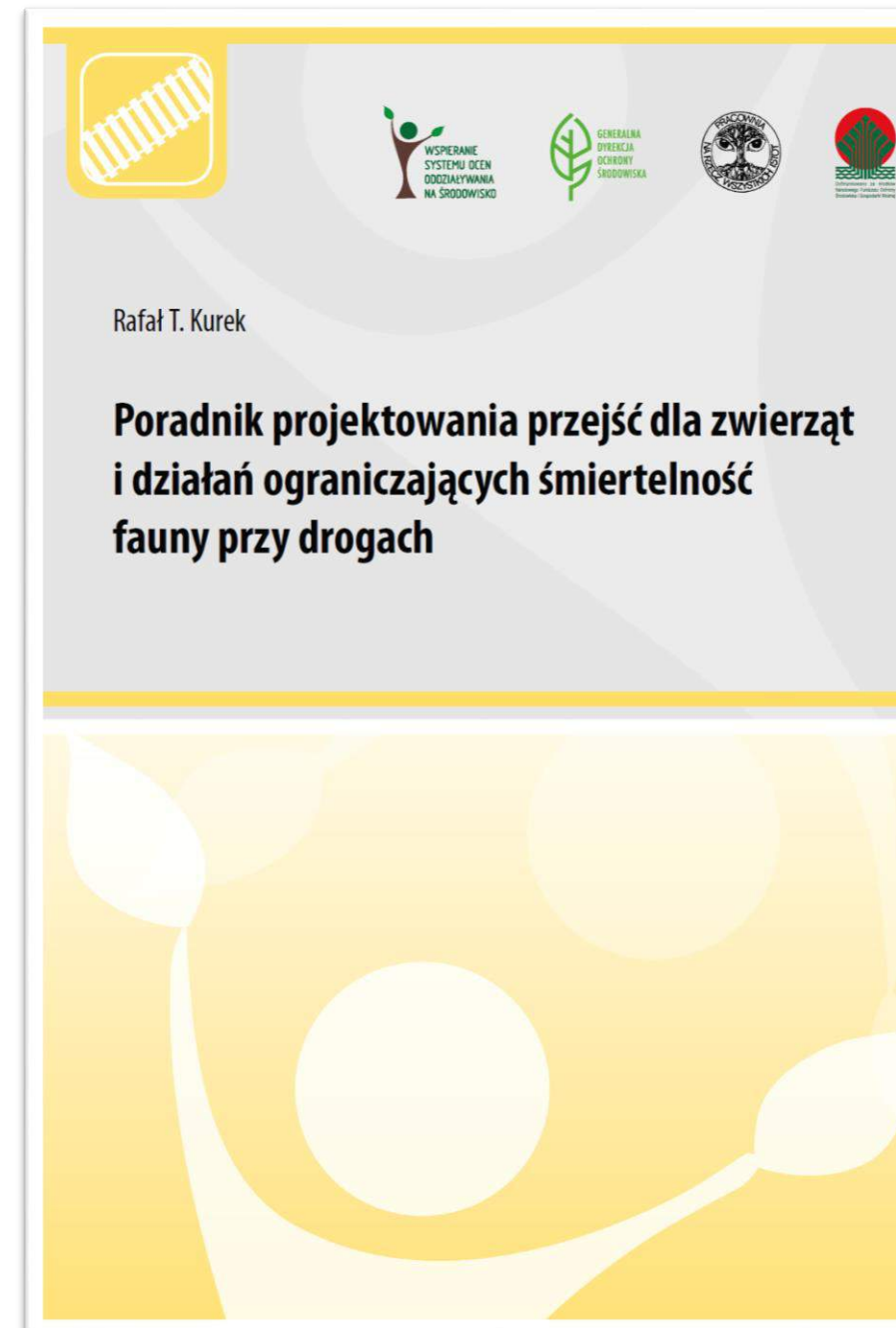
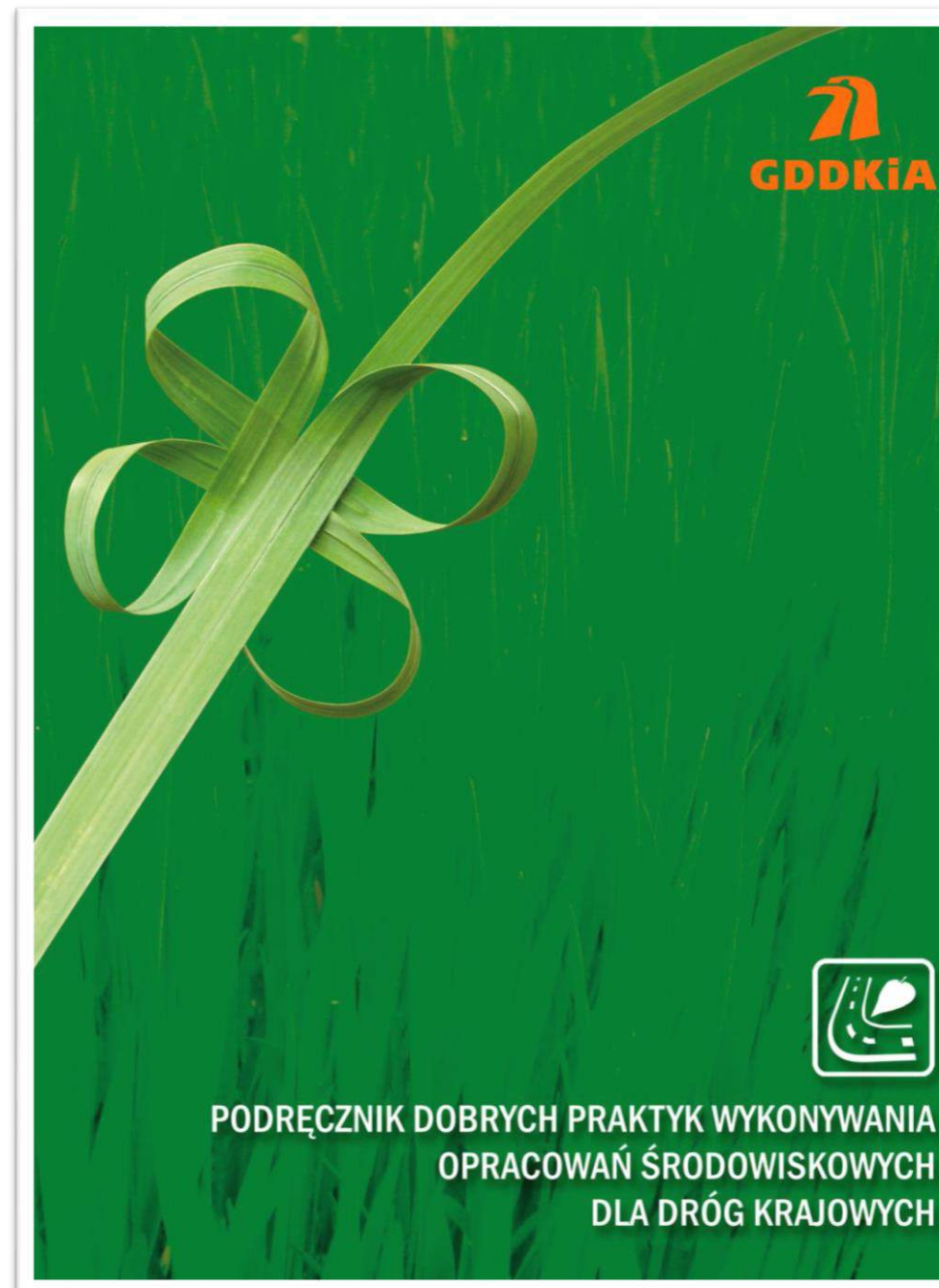


Photo: Available literature.

Study (Poland)

In accordance with Polish guidelines, determining the location of animal crossings takes place in two stages:

- Stage I - locating the conflict areas of the planned road, with ecological corridors and fauna habitat areasb)
- Stage II - detailed determination of the location of the planned crossings, on the basis of multi-criteria landscape valorization, in terms of the possibility of animal migration

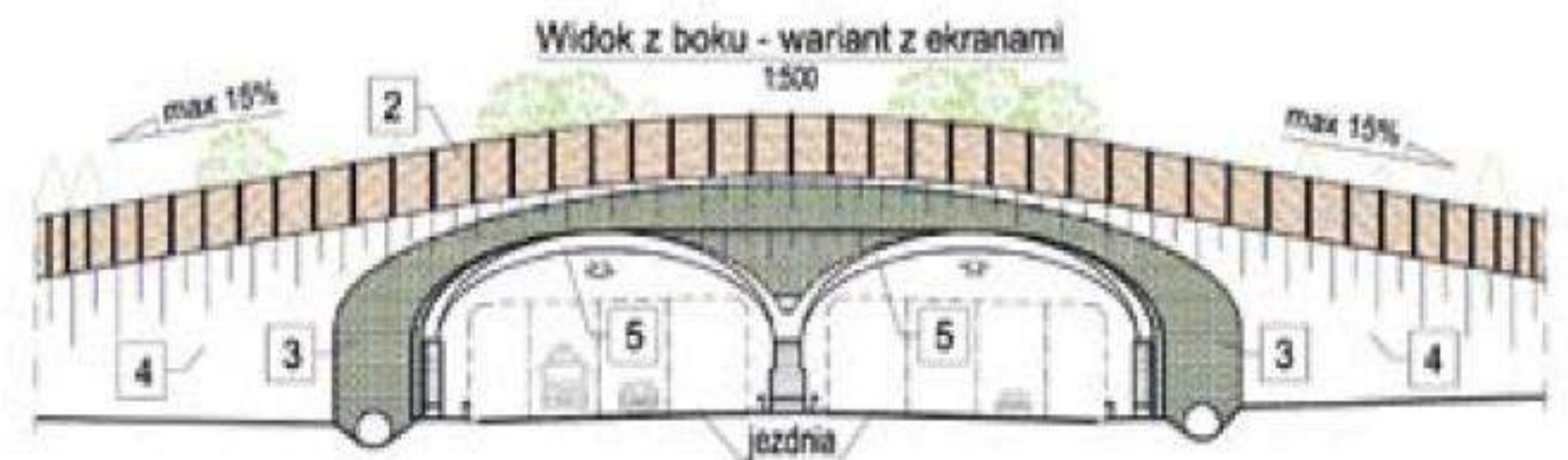
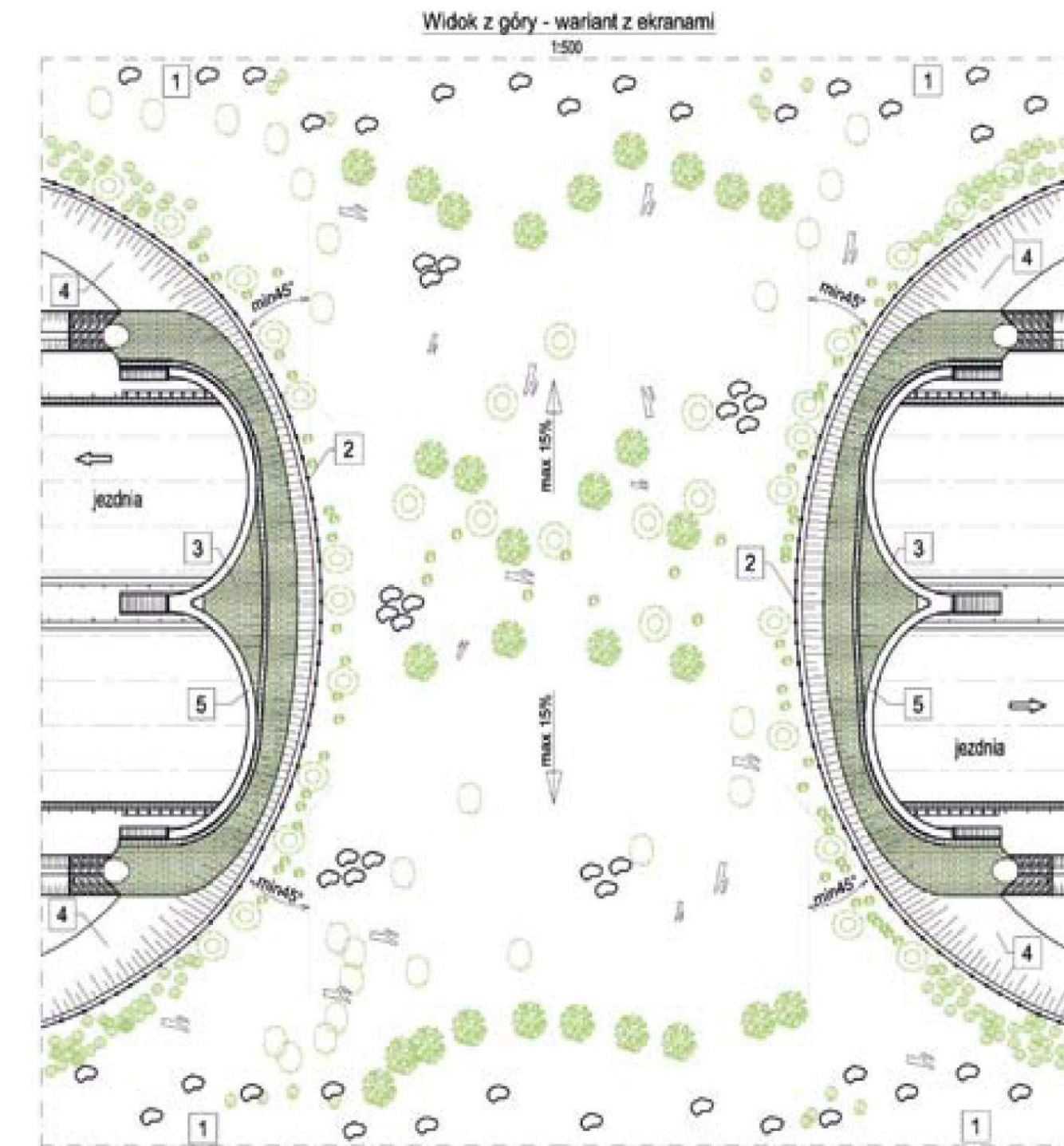
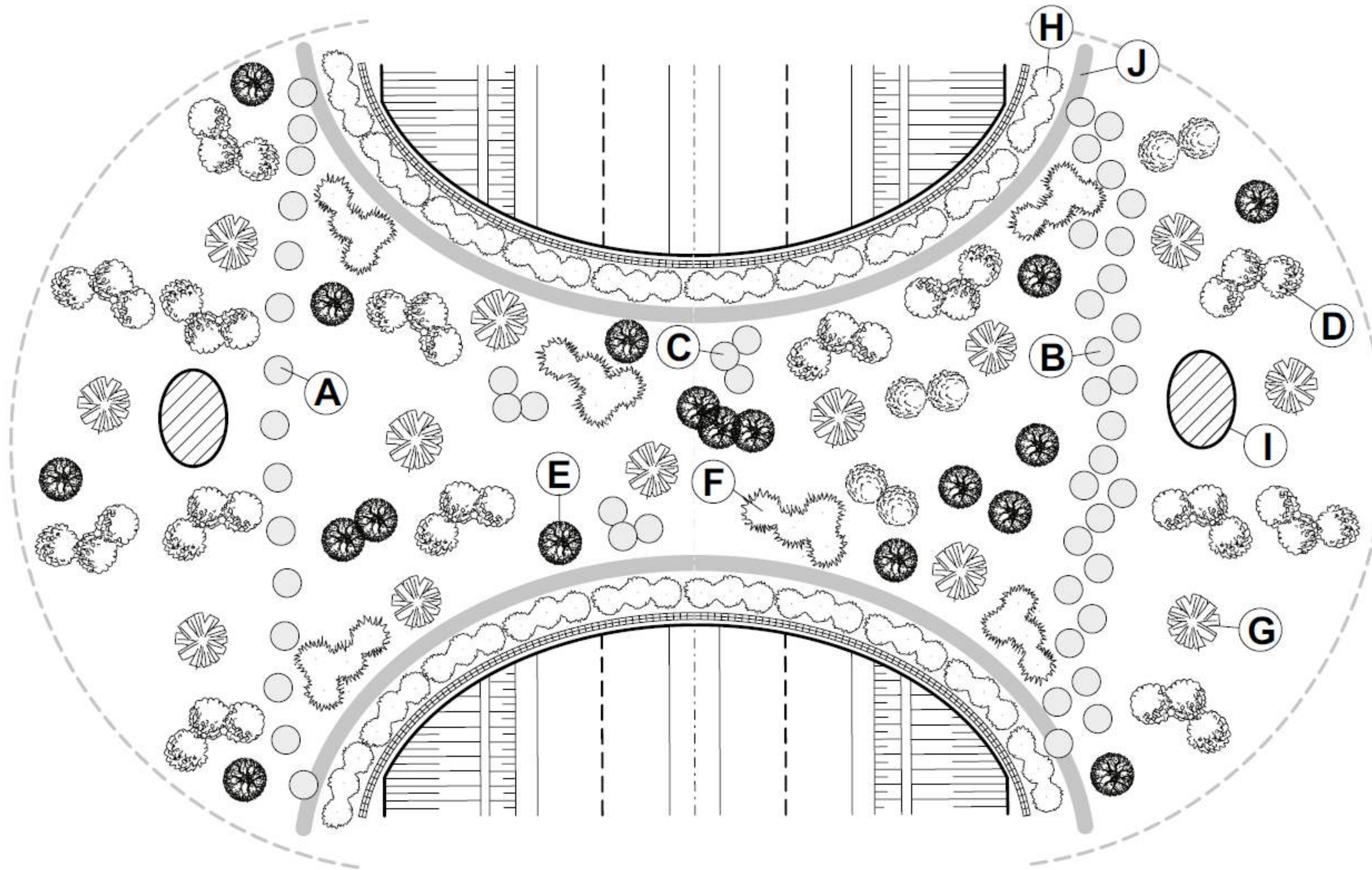


Photo: The optimal design solution of an animal overpass made of corrugated steel plates.

Study (Poland)



Explanation of symbols

- A- boulders protecting against passage - single row
- B - boulders protecting against crossings - multi-row system
- C - small groups of boulders with habitat-forming functions
- D - Deciduous shrubs - clump plantings
- E - Fruit trees and shrubs (low and medium-stemmed, e.g. wild apple varieties - single plantings
- F- Thorn bushes - clump plantings
- G - root stumps, piles of branches, boughs, dead logs
- H - Deciduous shrubs - row plantings
- I - pond (waterhole)
- J - narrow stripes sown only with grasses or with a mixture of grasses and legumes

Photo: Scheme of optimal development of the animal overpasses located in the forest area

Study Summary



After the comparative analysis of the technical regulations for the management of animal crossings, we can state that:

RECOMMENDED DESIGN OF THE UNDERPASSES

- There should be a guidance zone and a migration zone.
- The guiding zone should be lined on both sides with trees and shrubs (mixed plantings).
- It is recommended to use species resistant to periodic droughts.
- Directly in the migration zone, it is not recommended to use high vegetation - limiting the width and height of the passageway.
- Development of the migration zone should limit access to the crossing for motorists.

Study Summary



After the comparative analysis of the technical regulations for the management of animal crossings, we can state that:

RECOMMENDED DESIGN OF THE OVERPASSES

- It should be heterogeneous, connecting the open space of the migration zone with the side zones.
- The side and access zones should be lined with trees and shrubs in a linear manner.
- It is recommended to use at least two rows of staggered vegetation.
- In the migration zone, vegetation should constitute at least 30% of the cross-section of the transition.

- The geometric layout of the side zones should be - as far as possible - parallel (to facilitate orientation for birds and bats).
- In order to facilitate maintenance work, leave a free space between the planting line of the side zone and the anti-glare screens at least 1.0 m wide.
- Only native species of vegetation should be used to plant the overpasses.
- Whenever possible, trees and shrubs in the area of the investment should be used.

An aerial photograph of a snowy landscape. A road with two lanes runs vertically through the center. On either side of the road, there are patches of snow and clusters of evergreen trees. The scene is captured from a high angle, showing the texture of the snow and the dark green of the trees.

Wildlife Crossings

Piotr Tomala, Onur Basar

8th December 2021

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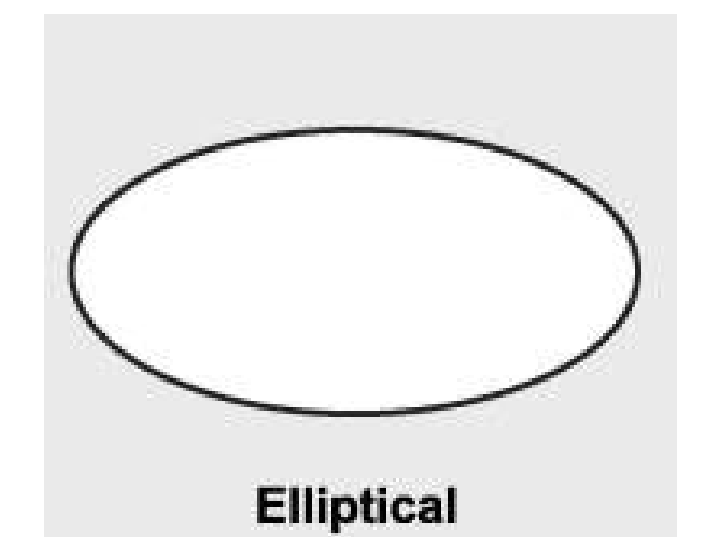
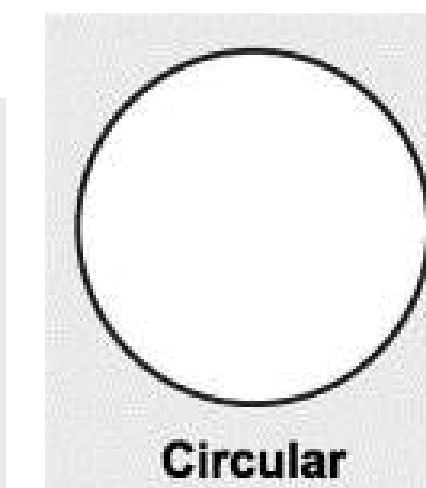
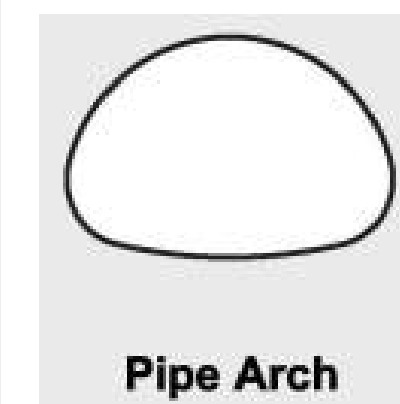
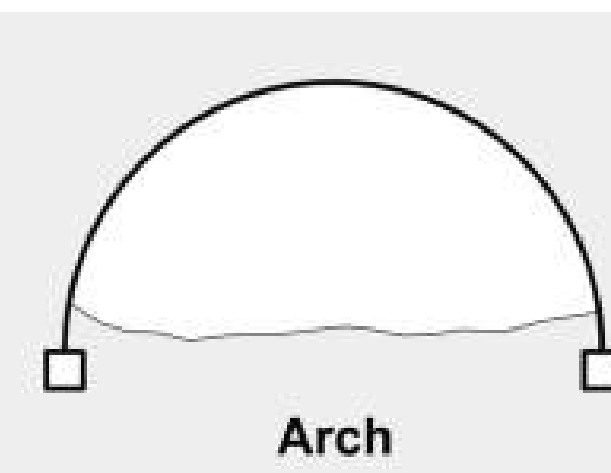
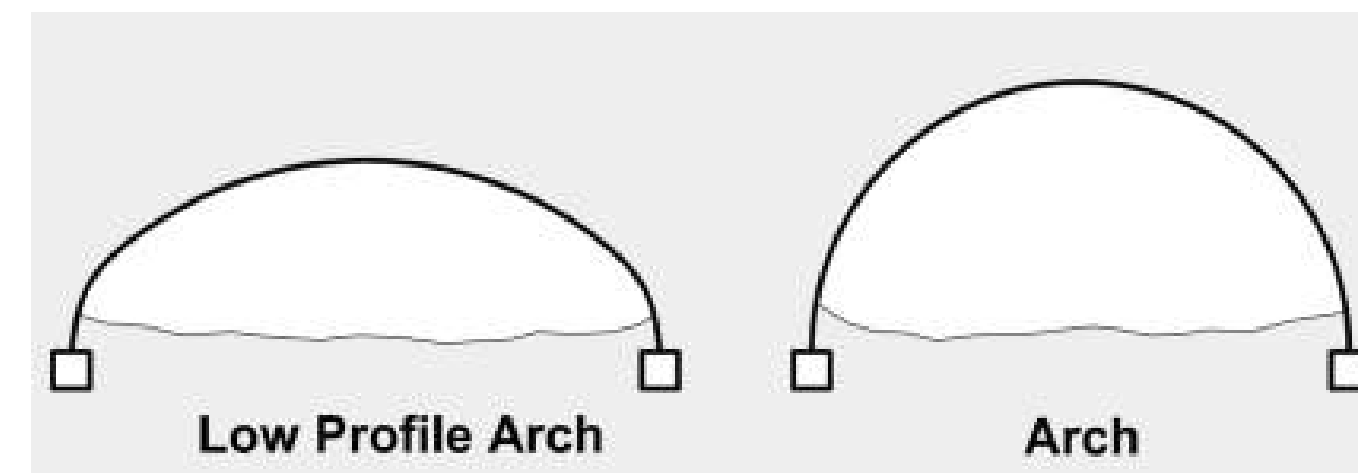
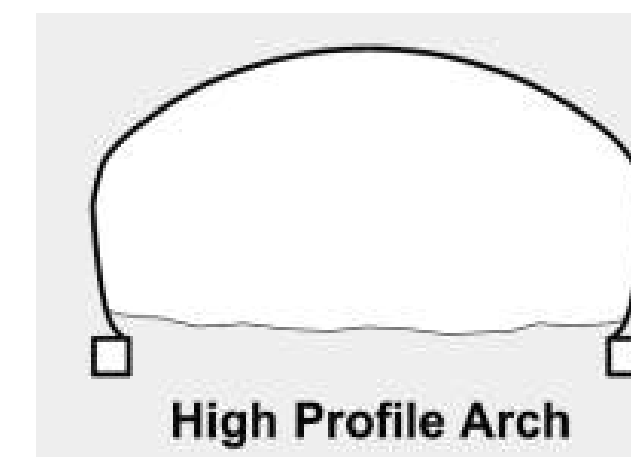
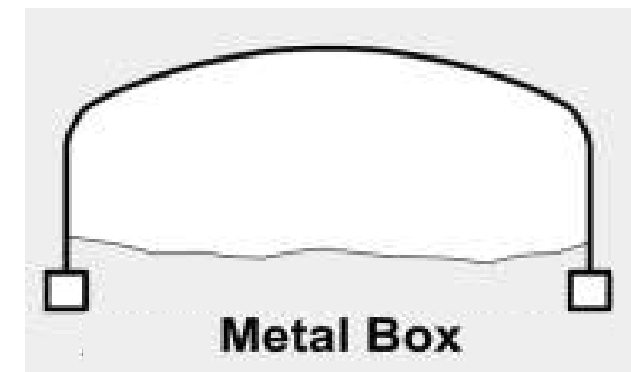
Types of Wildlife Crossings

- Based on species and number of living animals in the habitat;
 - Underpass
 - Overpass
 - Culvert
 - Viaduct
 - Bridge
- For big mammals and many other animals, the most suitable crossings are **Ecological Bridges**.



What does **ViaCon** do?

- Variety of Shapes & Sizes
- Wide range of spans (over 800 pcs catalogued steel profiles + custom shapes on demand; over 110pcs of Reinforced concrete profiles)



What can **ViaCon** build?



Circular



Horizontal Ellipse



Pipe-Arch



Underpasses



Regular Arch



Low-profile Arch

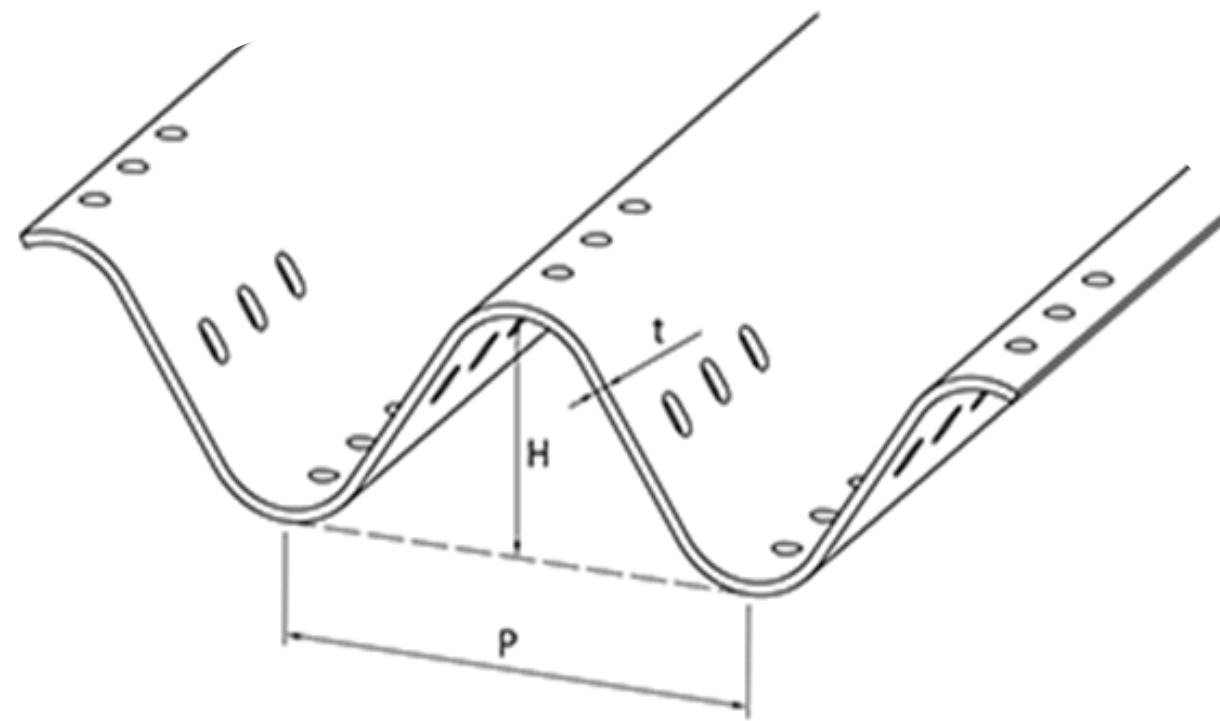


High profile Arch



Box

Corrugation



Diversification of the
corrugation



HelCor
68x13
125x26 [mm]

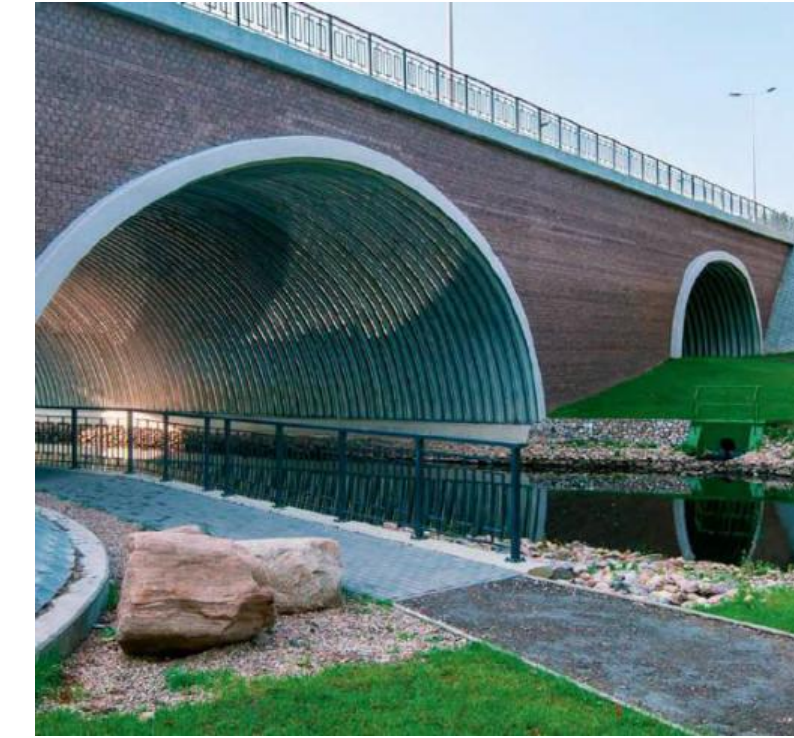
Closed-shape
profiles: Diameters
up to 3.9 m



MultiPlate
200x55 [mm]

Open-shape profiles:
Spans up to 12 m

Closed-shape
profiles: Spans up to
12 m



SuperCor
381x140 [mm]

Open-shape profiles:
Spans up to 25 m

Closed-shape profiles:
Spans up to 16 m



UltraCor
500x237 [mm]

Open-shape profiles:
Spans over 30 m

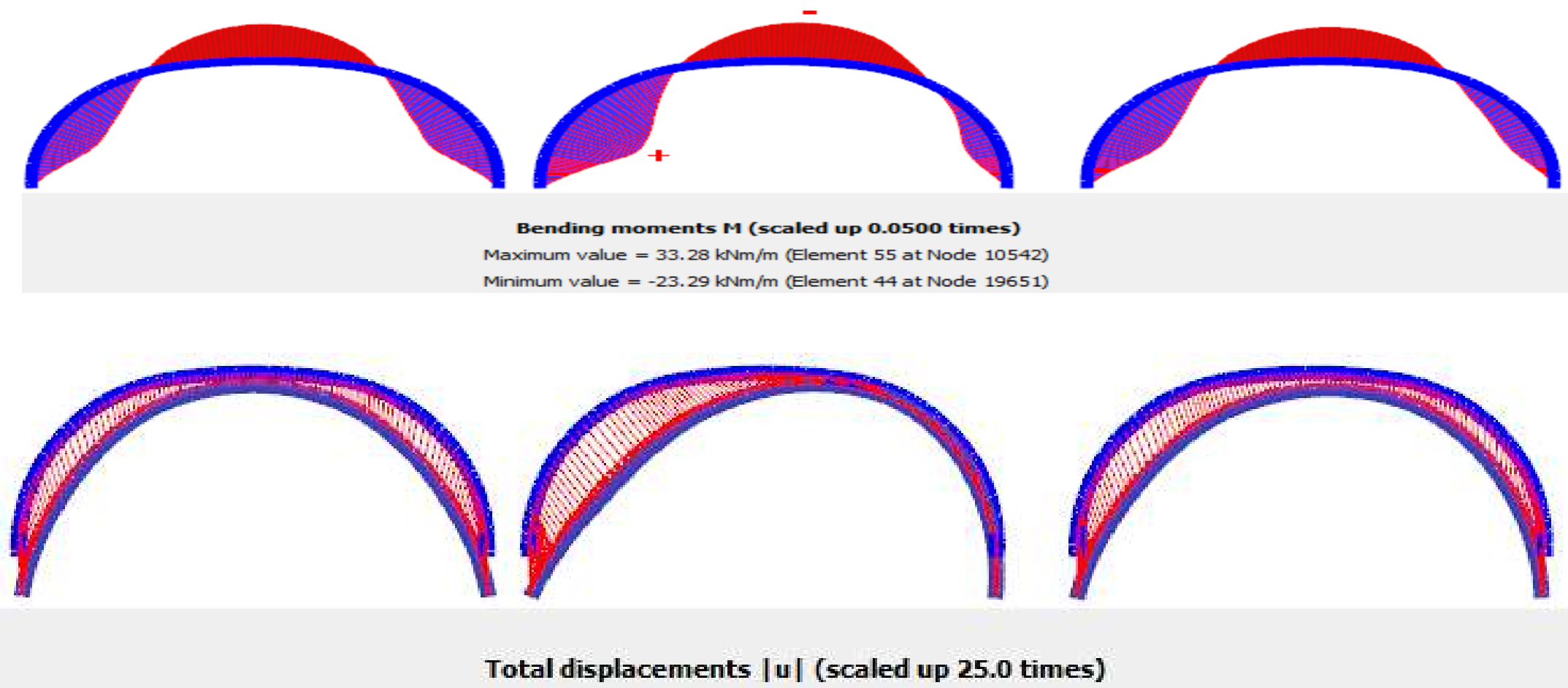
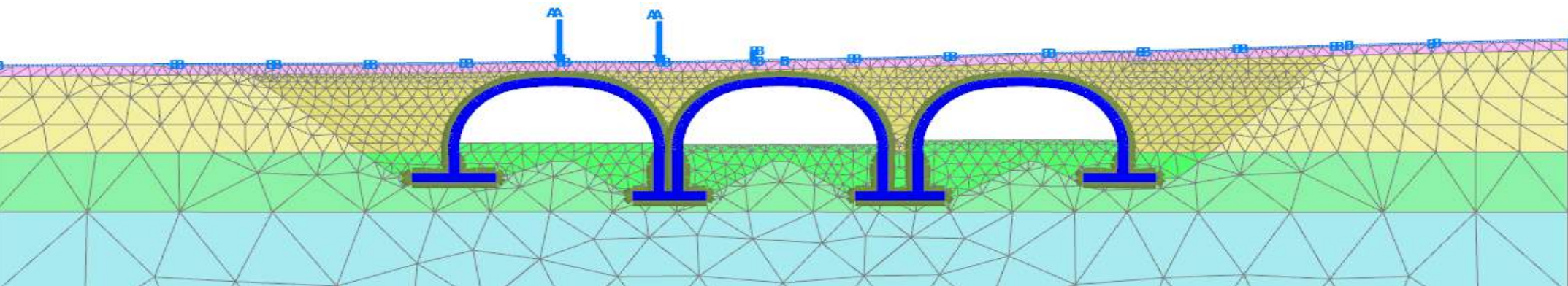
What can be built?



What can be built?



Design



S6-14

Canadian Highway Bridge
Design Code



Design of soil steel composite
bridges
Lars Pettersson Håkan Sundquist



Ecological Bridge – Conceptual Design

Design is developed according to the location of the bridge.

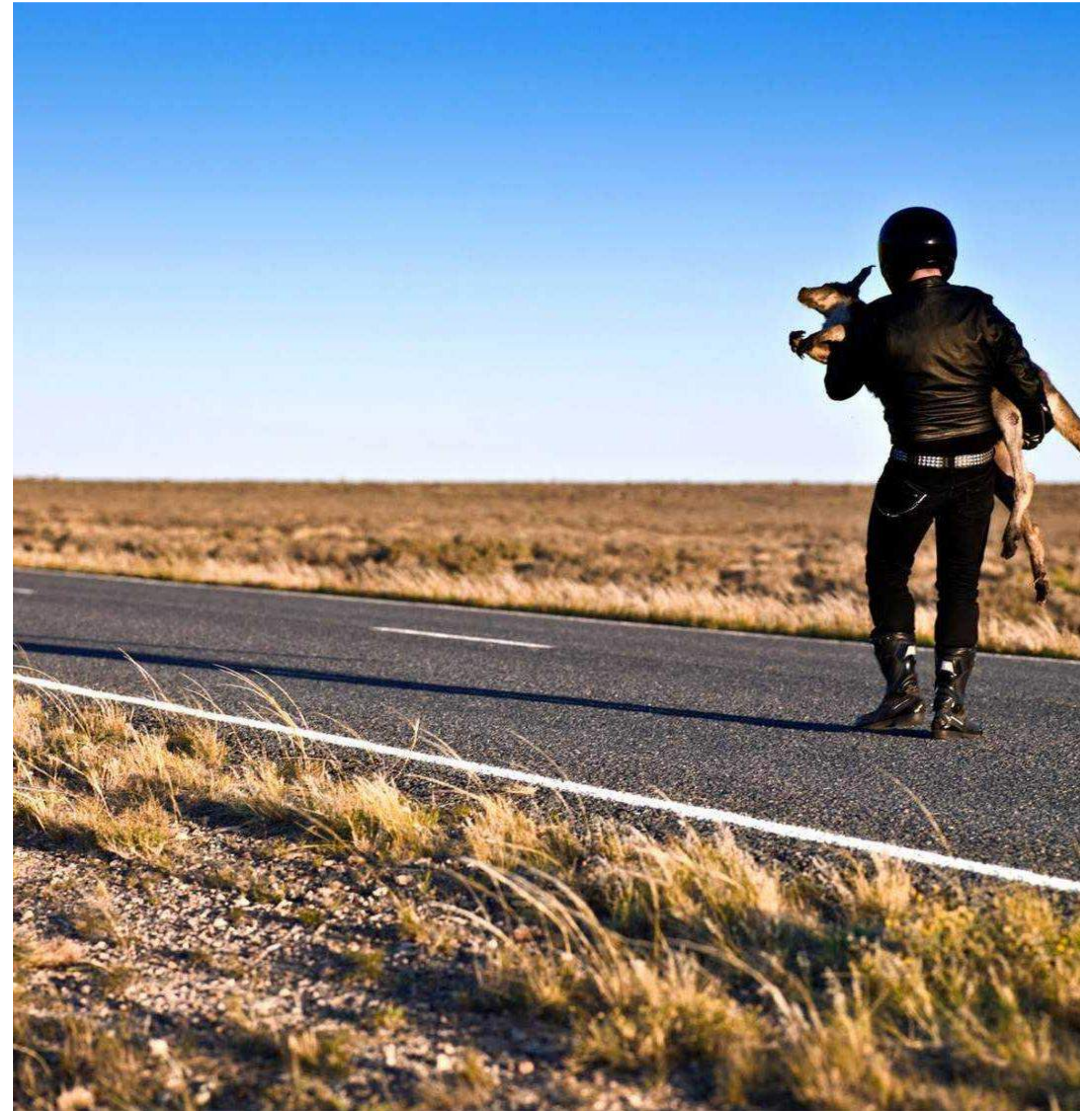
Location setting of the bridge is based on following inputs.

- Animal population in the surrounding.
- Animal migration routes crossing the road.
- Any previous incident of animals crossing the road.
- Findings during the site investigations and animal traces in the area by the road.



Location of the crossing plays an important role for the usage of the bridge!

- Location of the ecological bridges is extremely important to make it useful and effective for the environment and animals.
- The locations of ecological bridges should be determined according to the passage routes of wildlife.



Ecological Bridge Location of the passage



Wolf droppings

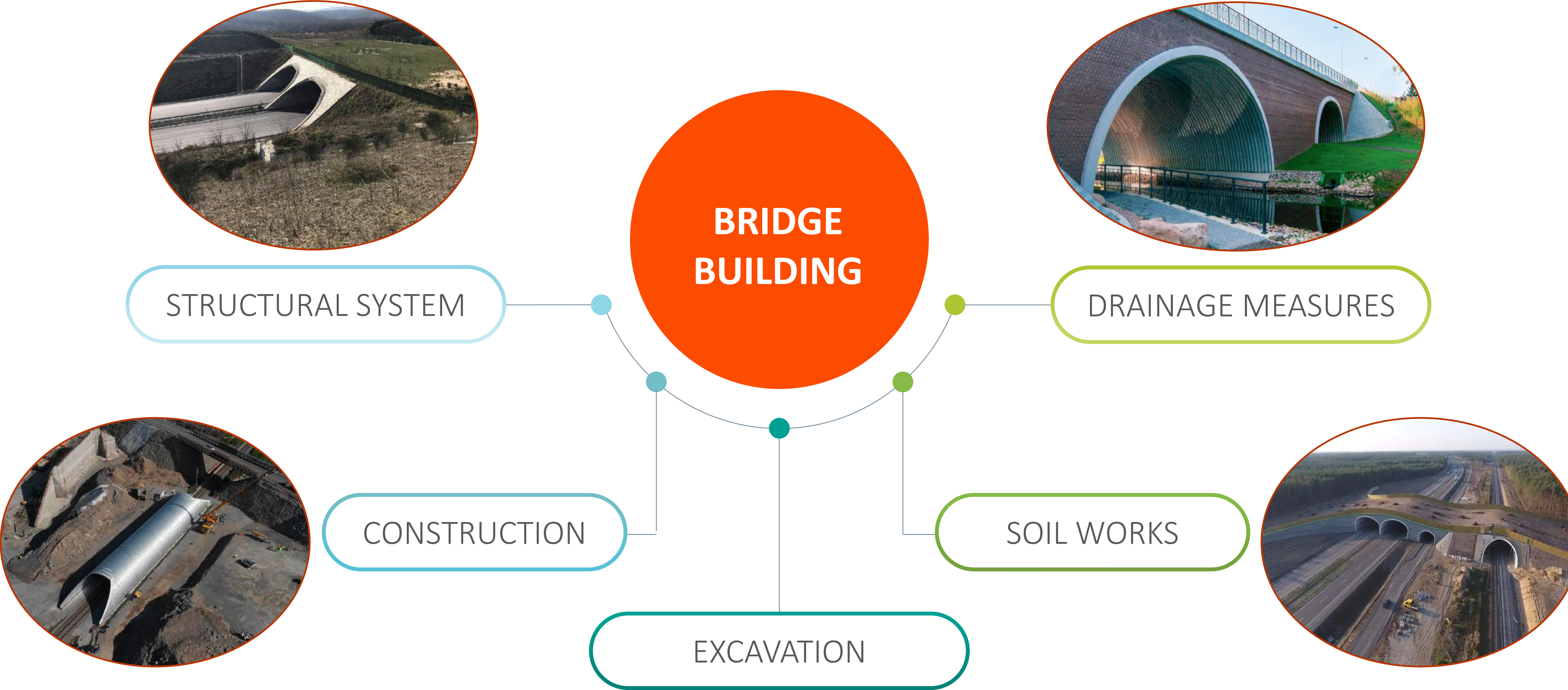


Red Deer dropping next to the fence by the road.



Wildcat droppings

Ecological Bridge BUILDING



Ecological Bridge Structural System

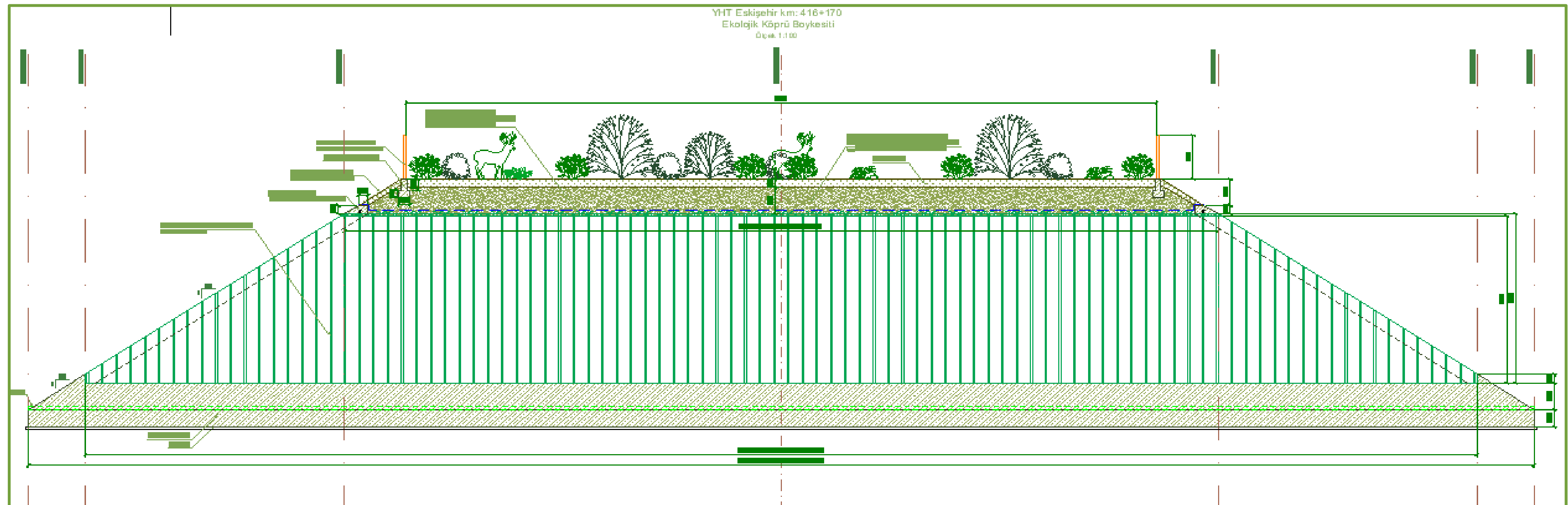
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Ecological Bridge - Structural Design

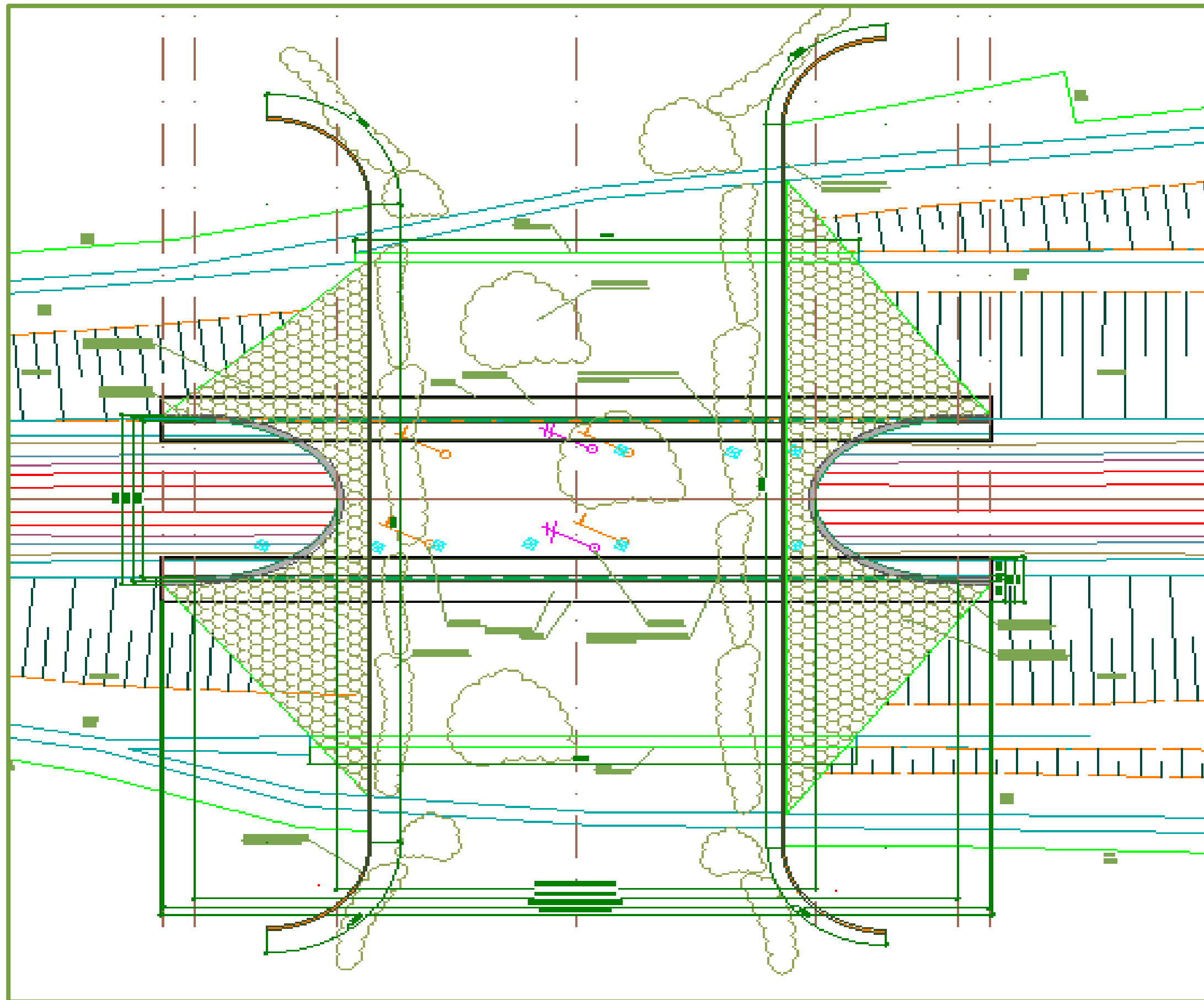
- Structural system
- Geometry
- Types of foundation
- Type of the facade and retaining structure

Longitudinal Profile

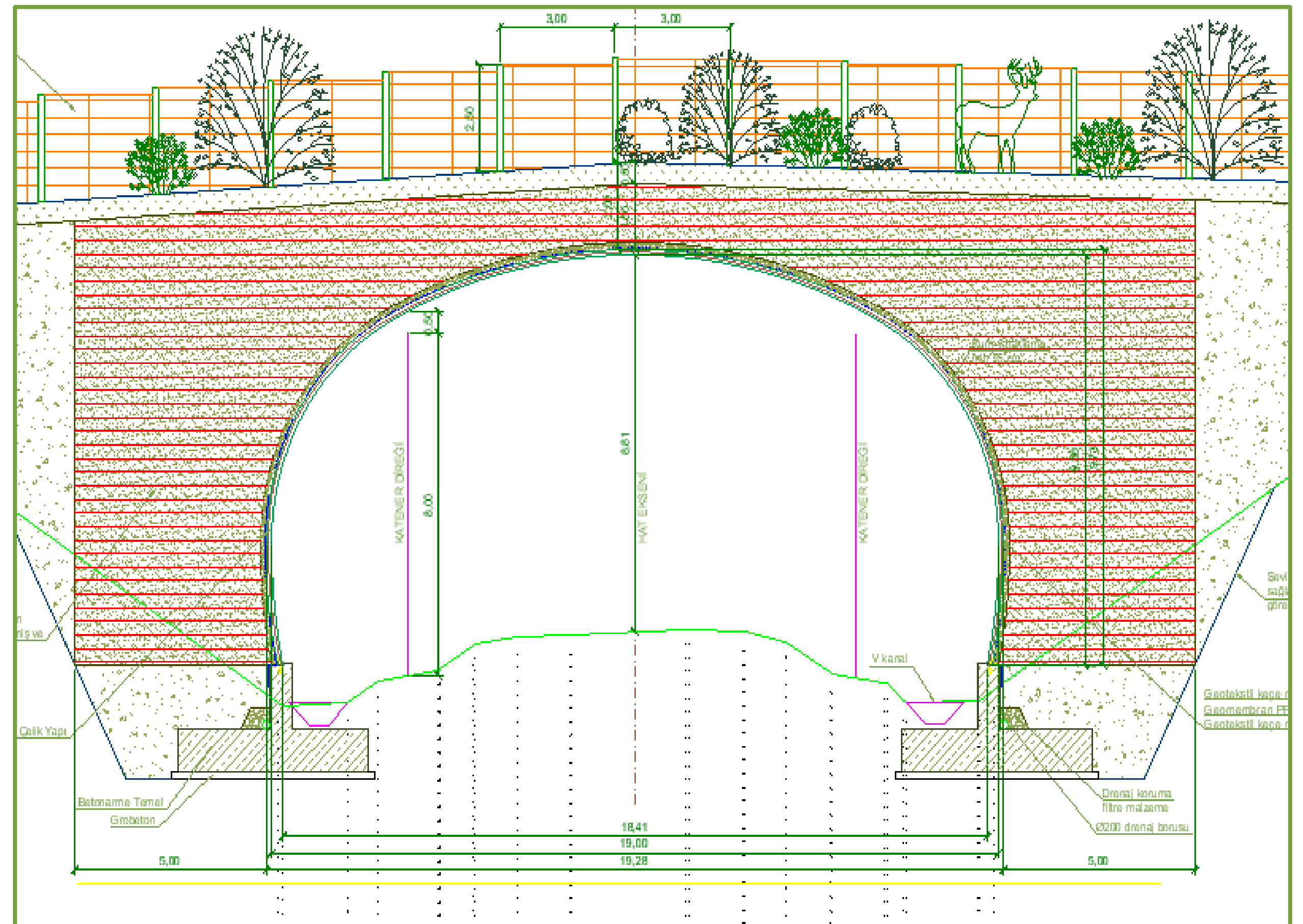


Ecological Bridge - Structural Design

Plan View



Cross Section



Ecological Bridge - Structural System



Photos: Osman Öner Sak

Ecological Bridge - Structural System



Photos: Osman Öner Sak

Ecological Bridge - Realization

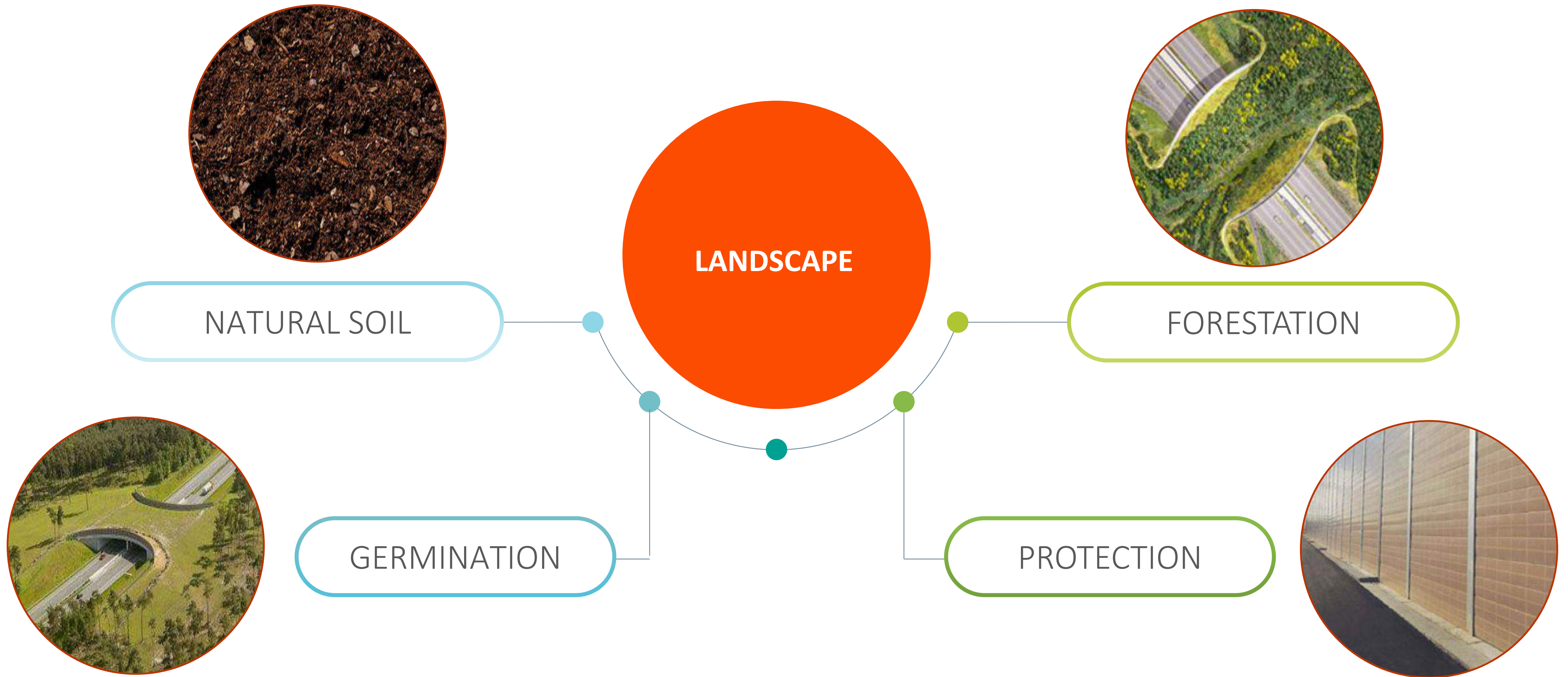
- Top Soil is added after the backfill is completed.
- Better adaptation to the existing environment increases the usage of the bridge and its positive impact to the wildlife.



Ecological Bridge - Landscape



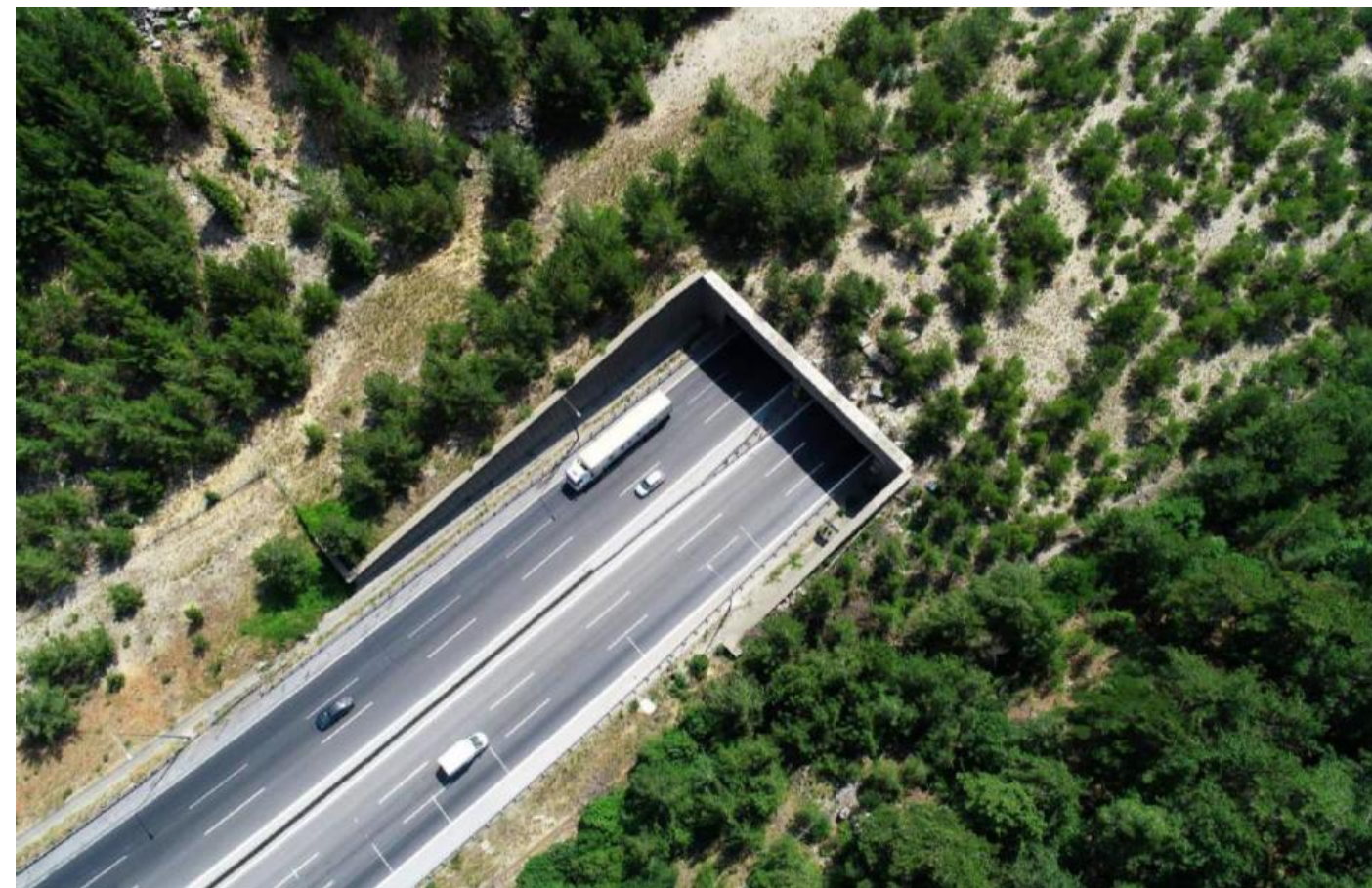
Ecological Bridge - Landscape



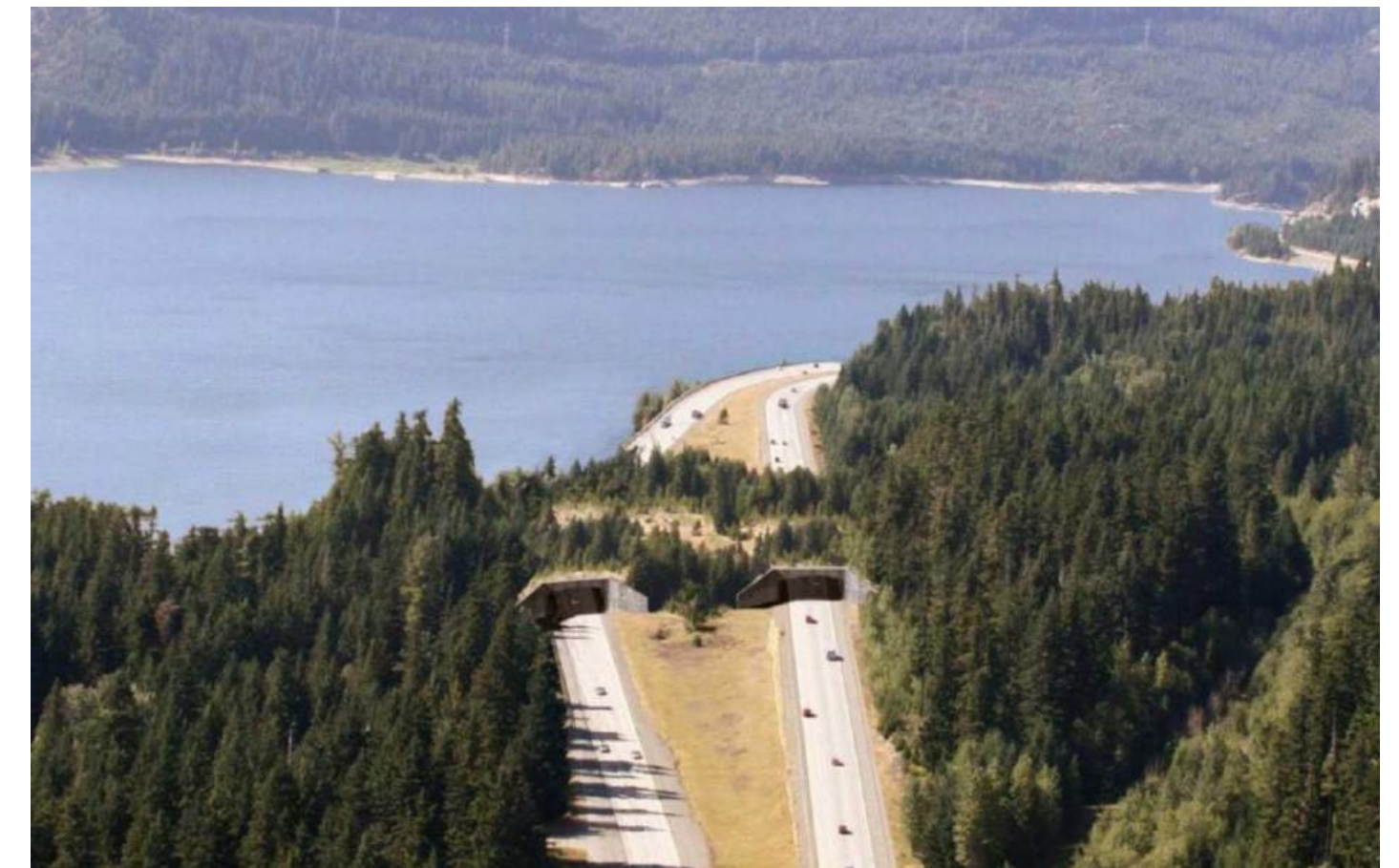
The crossing should match the environment!



Transition connections between habitats should be provided with bridges to be created in the size and range determined in accordance with the species density and number of individuals.

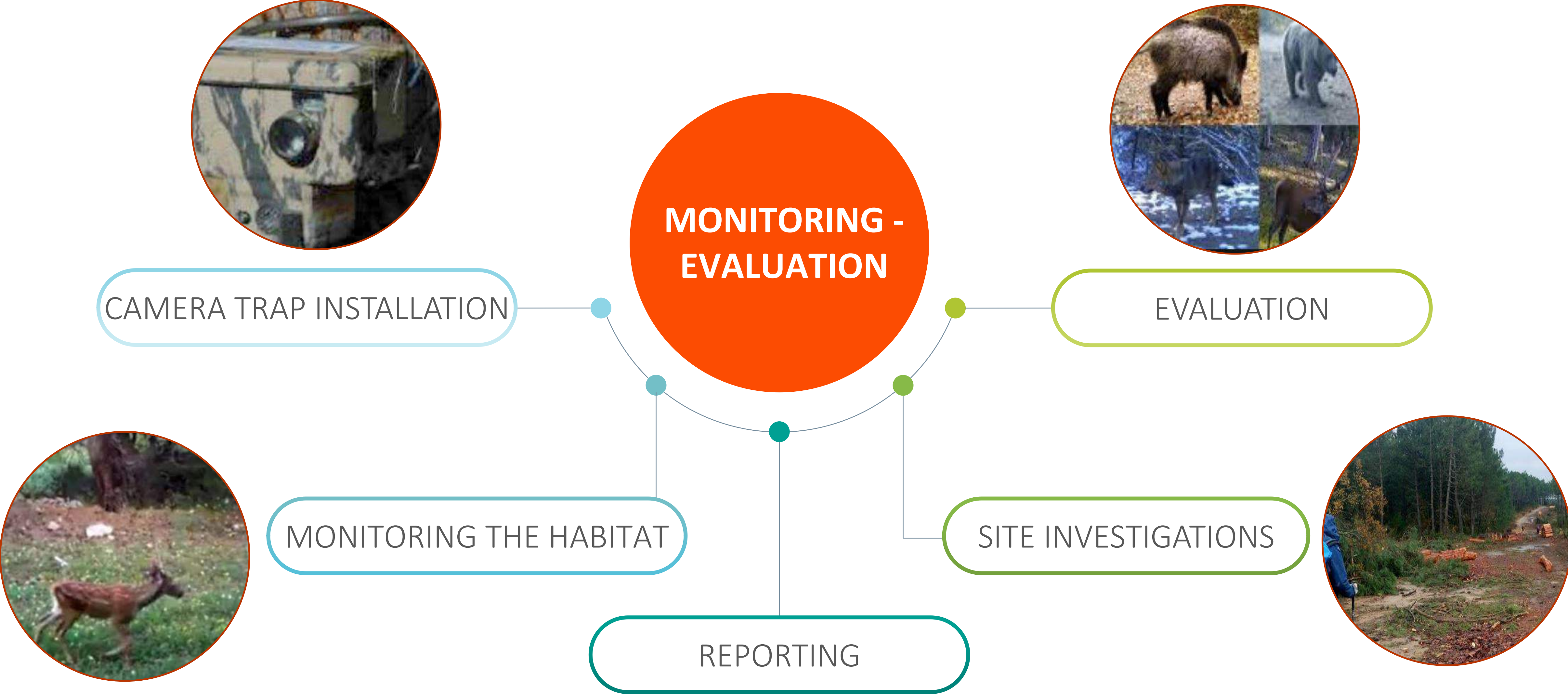


Ecological bridges should never be considered separately from the existing vegetation while designing the vegetation.



The application should not give a patch effect there. Vegetative designs should be made to direct the wildlife towards the bridge, and vegetative screens should ensure safe passage to them.

Ecological Bridge - During Service



Monitoring

- Monitoring of the bridge and its usage is very important.
- This gives an understanding whether
 - the bridge is used
 - design is correct
 - location is correct
- It also gives feedback about the type and size of the animals in the habitat.

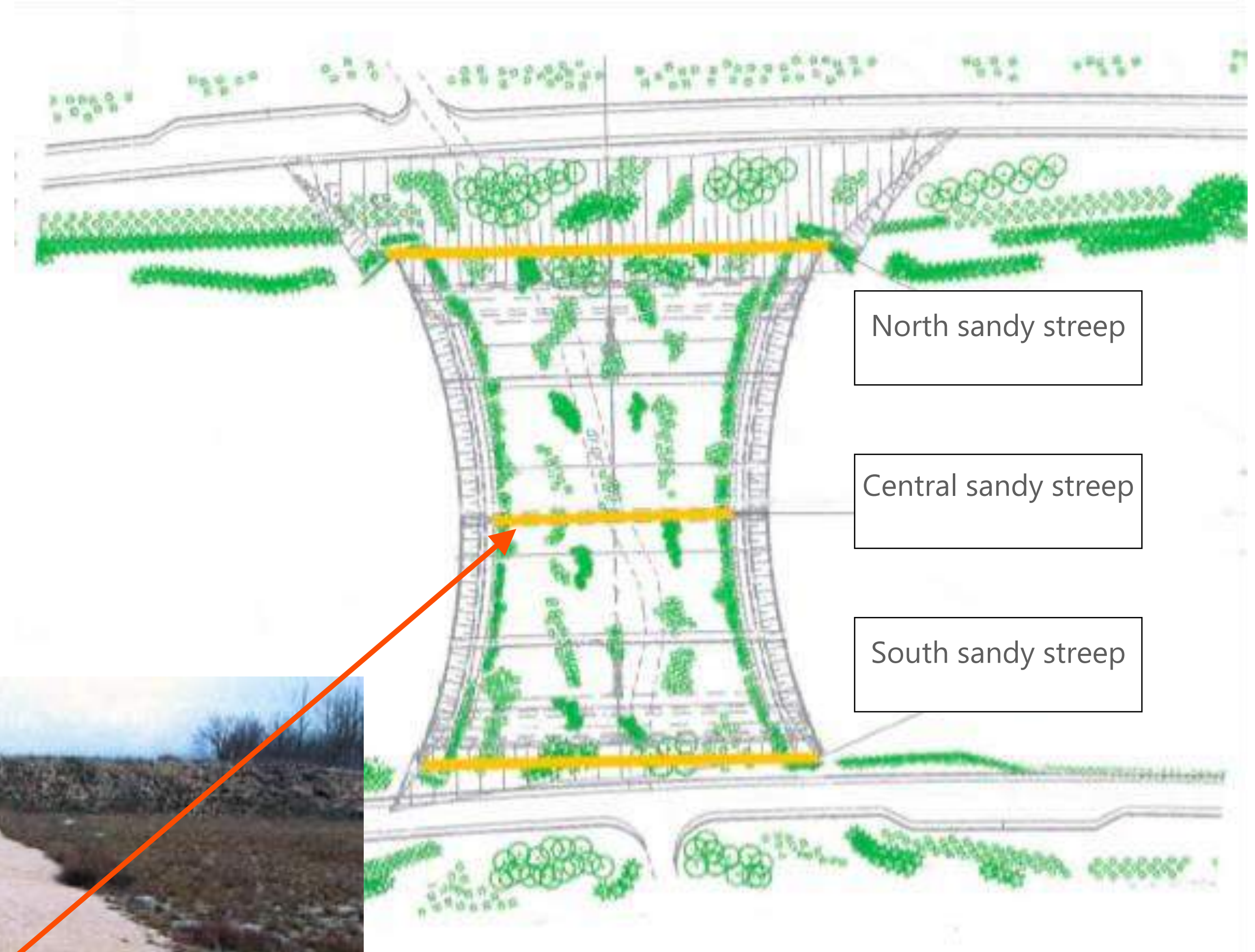


Photo Source: Monitoring przejść dla zwierząt Zakres, metodyka oraz harmonogram realizacji (translation: Monitoring of animal crossings. Scope, methodology and implementation schedule Rafał T. Kurek

Ecological Bridge Monitoring & Evaluation



Photos:
Turkish State Railways

Ecological Bridge Monitoring & Evaluation



Curiosity is a life saver



Boulders, locally available bushes and grass makes it feel "normal" and "safe" for animals



Migration routes are rebuild with the help of the bridge

Photos: Turkish State Railways



ECOLOGICAL BRIDGES EXAMPLES

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Natuurbrug Zanderij Crailoo **Ecological** **Bridge**

- The longest of the ecological bridges is the 'Natuurbrug Zanderij Crailoo' ecological bridge, which is 800 meters long and 50 meters wide, located in the Netherlands. Construction was completed in 2006.

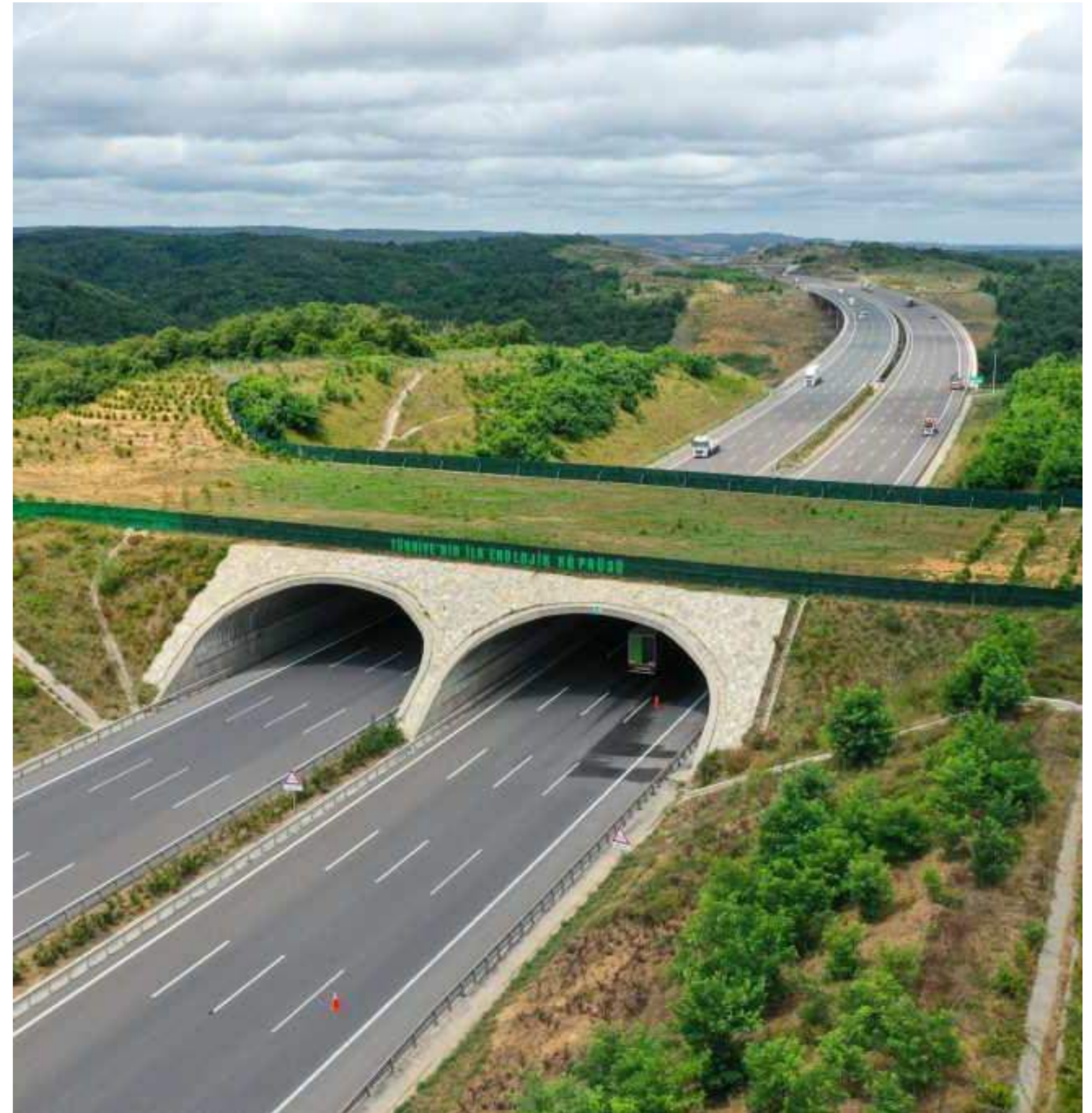
Photo: peyzax.com



Uskumruköy Ecological Bridge

- The first ecological bridge in Turkey is the 'Uskumruköy Ecological Bridge', which was implemented with the Northern Marmara Motorway Project.
- The bridge, which will prevent the destruction of green areas and reduce traffic accidents.

Photo: peyzax.com



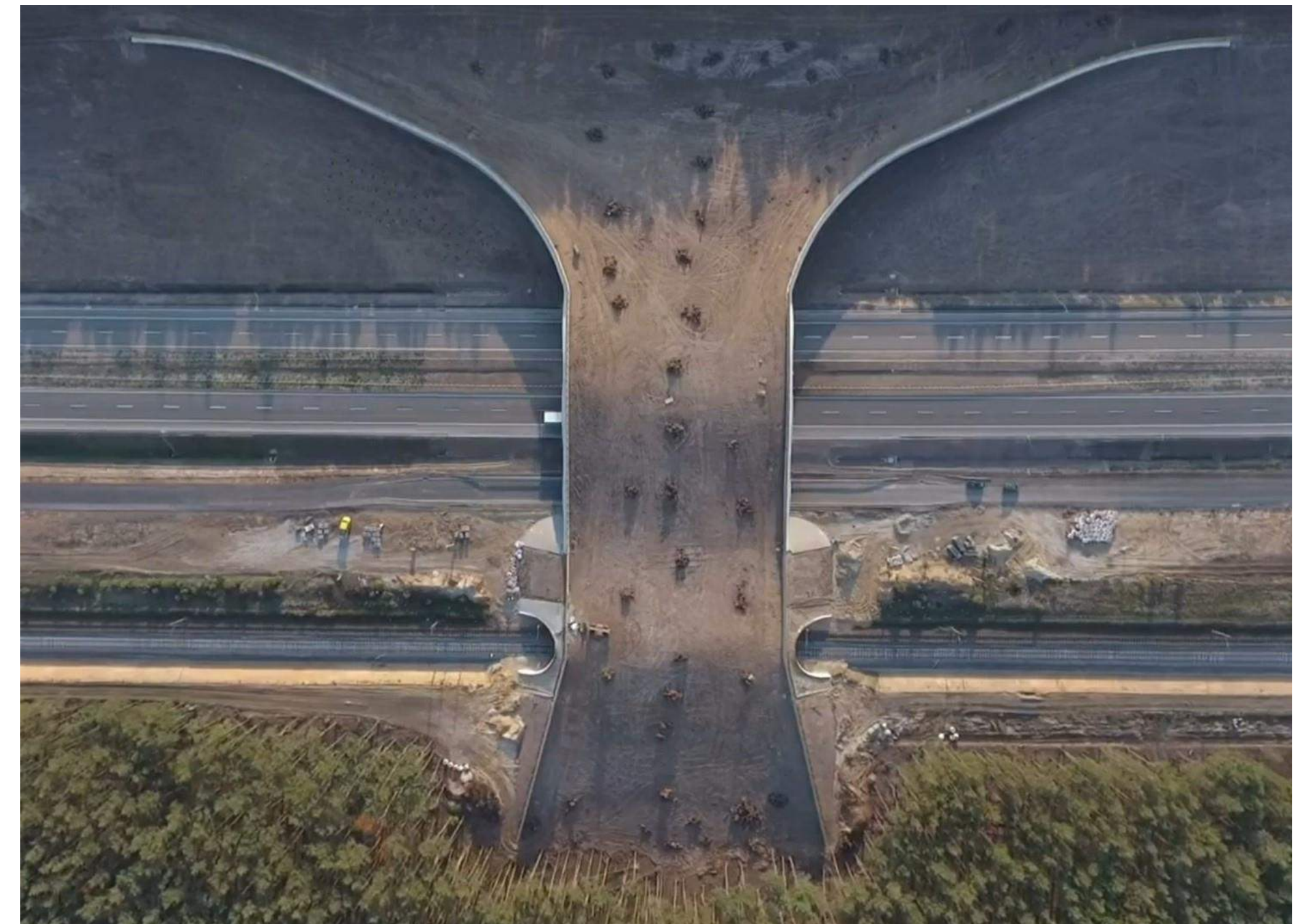
Uskumruköy Ecological Bridge



Photos: Ministry of Transportation of Turkey

Ecological Bridge - S5 Road, Poland

This bridge, is an ecological bridge passing both railway and motorway.

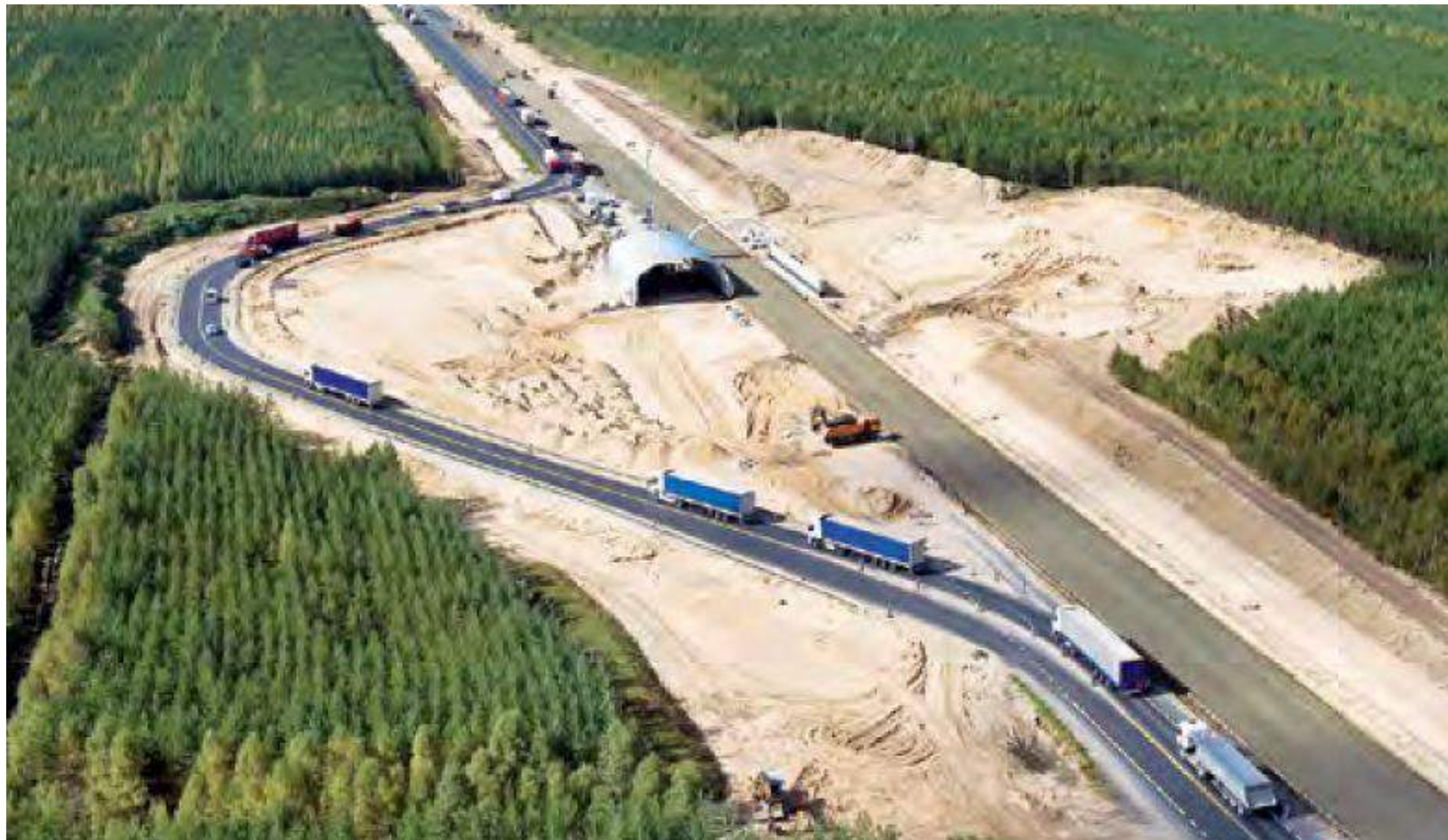


Ecological Bridge - S5 Road, Poland



Ecological Bridge - Nowy Tomyśl-Świecko, Poland

This bridge is an ecological bridge passing a motorway.



Ecological & Archeological Bridge

- Menemen Motorway, Turkey



Ecological & Archeological Bridge - Menemen Motorway, Turkey

This bridge is designed to be an ecologically friendly bridge where the ancient road remains will also be demonstrated over it.



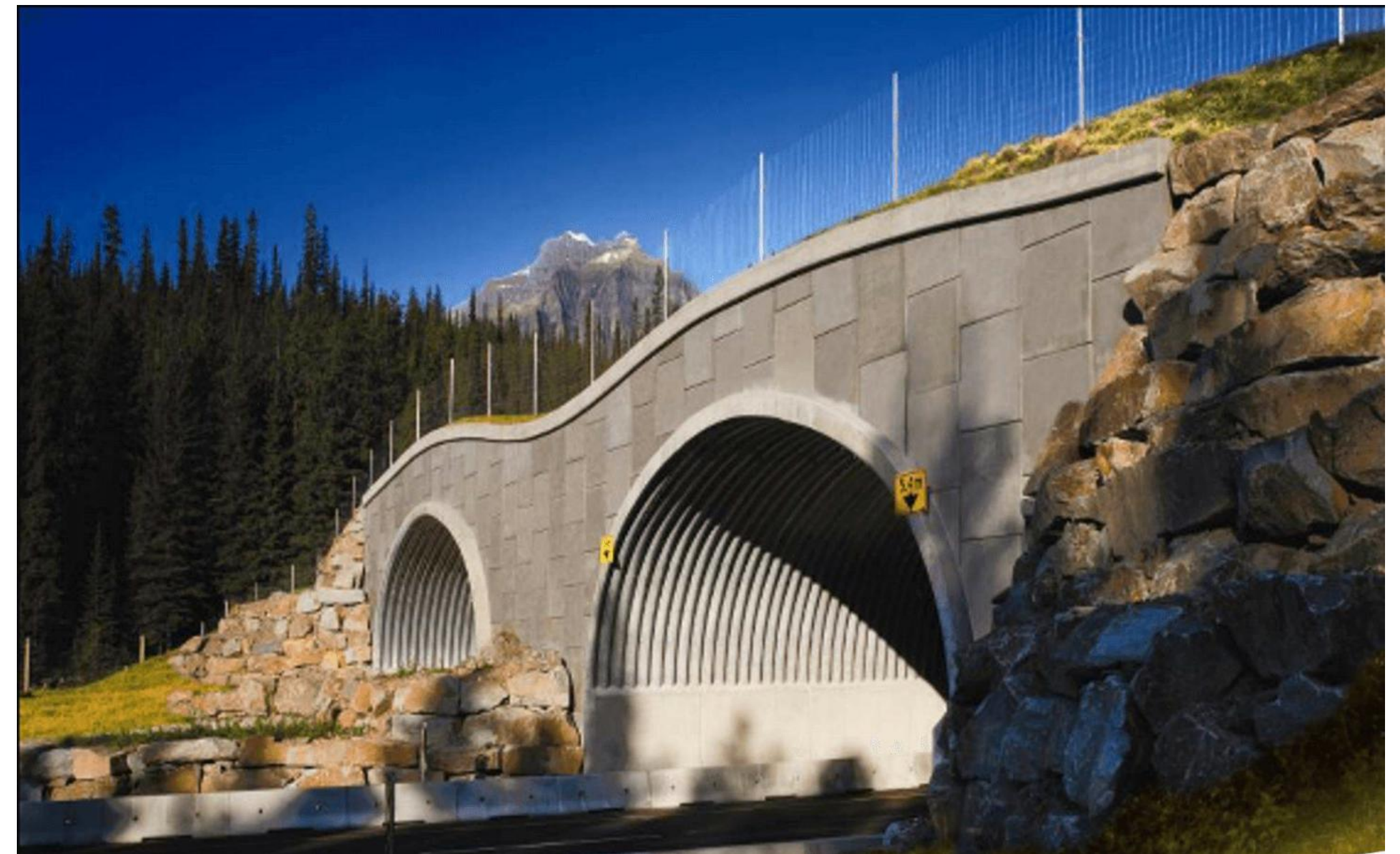
Ecological & Archeological Bridge - Menemen Otoyolu, Türkiye

- SuperCor profile has been used in the construction of the bridge.
- This is one of the first of its kind in terms of design principles.
- In addition to create a passage for the animals and other wild life individuals in the area it is also an open space museum for ancient road remains.



Ecological Bridge - Banff, Canada

SuperCor was used to pass the motorway for this ecological bridge.



An aerial photograph of a highway interchange. A central, wide, unpaved area, likely a wildlife crossing, runs vertically through the center of the interchange. This area is flanked by two sets of highway lanes that curve around it. To the left of the highway, there are railway tracks and a dense forest. The central area shows signs of construction or maintenance, with some equipment and materials visible.

Wildlife Crossings

Piotr Tomala, Onur Basar

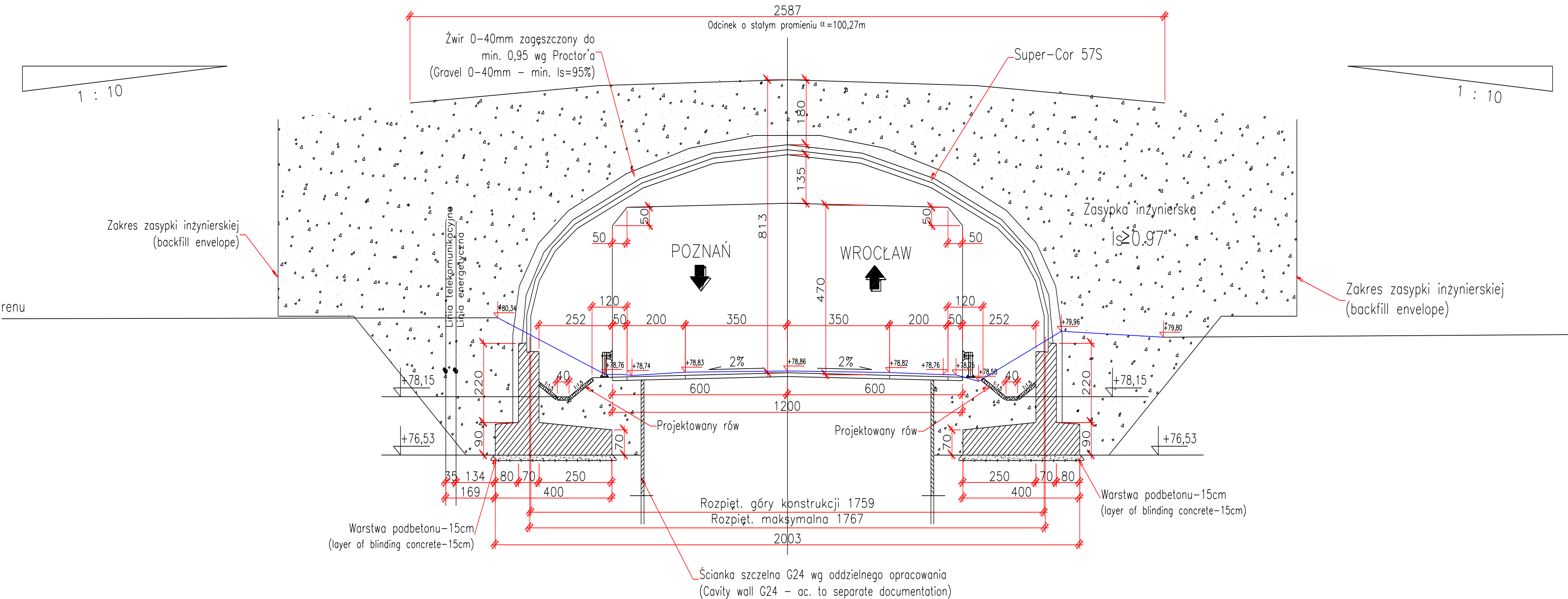
8th December 2021

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Case Study: 1st Animal Overpass in Poland

Animal overpass. National Road No5
INVESTOR GDDKiA o/ Poznań
Realization year 2003



Case Study: 1st Animal Overpass in Poland

Animal overpass. National Road No5
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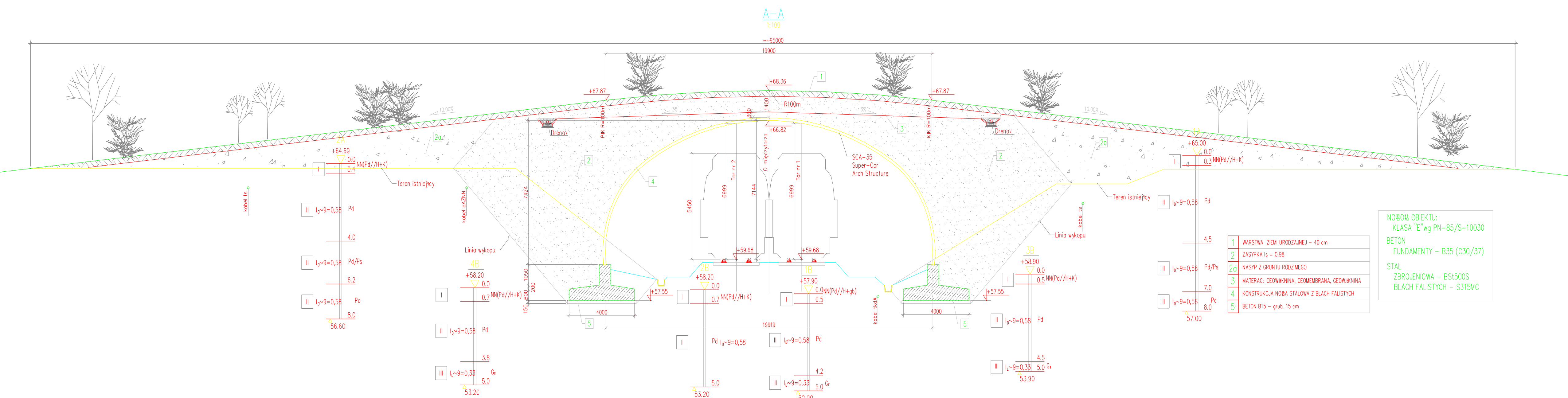
Case Study: 1st Animal Overpass in Poland

Animal overpass. National Road No5
INVESTOR GDDKiA o/ Poznań
Realization year 2003



Case Study: 1st Railway Animal Overpass in Poland

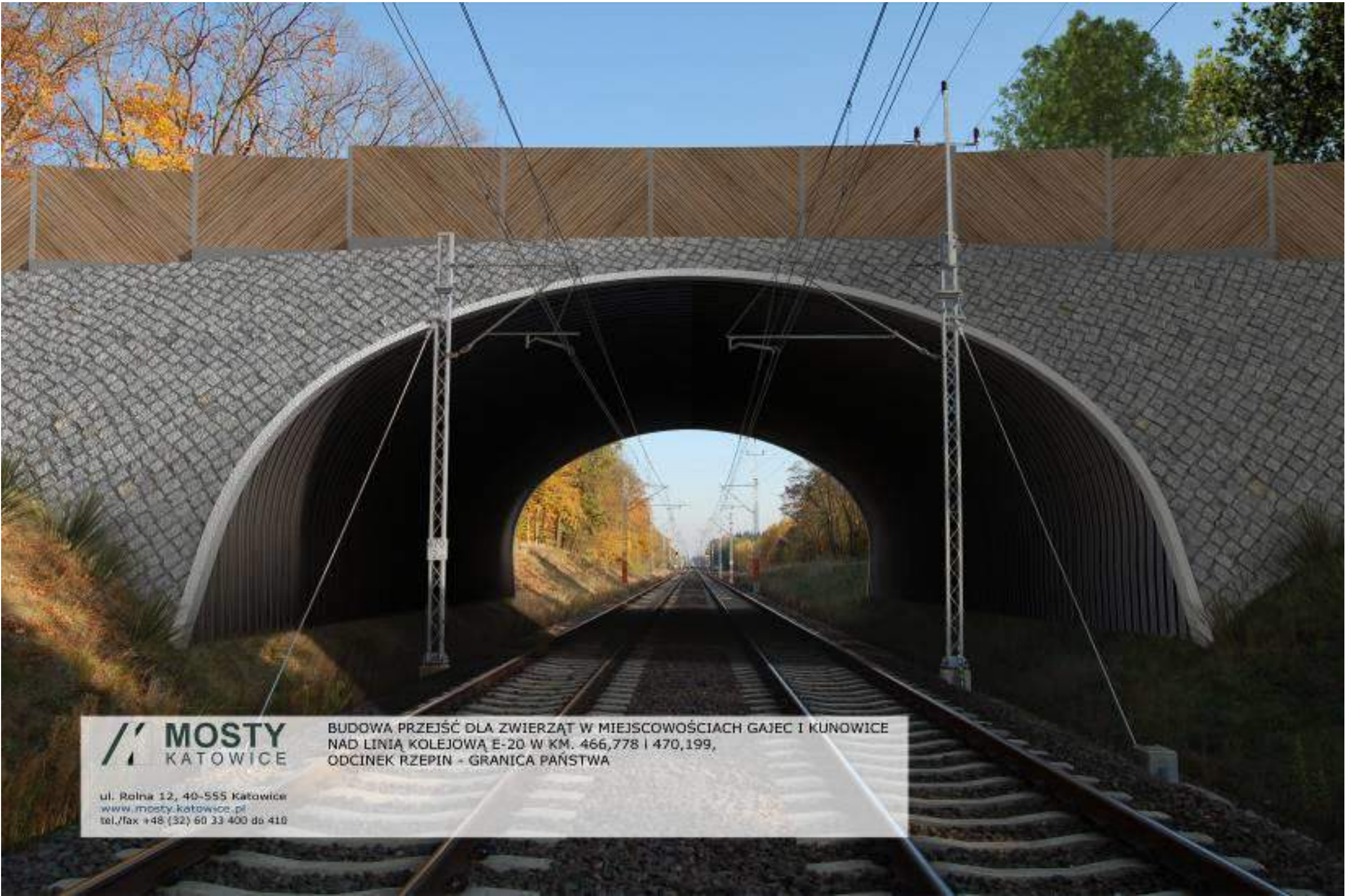
Animal overpass. International Railway Line E20
INVESTOR PKP PLK o/ Poznań
Realization year 2005



Case Study: 1st Railway Animal Overpass in Poland

Animal overpass. International Railway Line E20
INVESTOR PKP PLK o/ Poznań
Realization year 2005

	SuperCor SCA-35
Span [m]	20.0
Rise [m]	7.424
Corrugation [mm x mm]	381x140
Bottom length [m]	57.988 m (76 rings)



Case Study: 1st Railway Animal Overpass in Poland

Animal overpass. International Railway Line E20
INVESTOR PKP PLK o/ Poznań
Realization year 2005



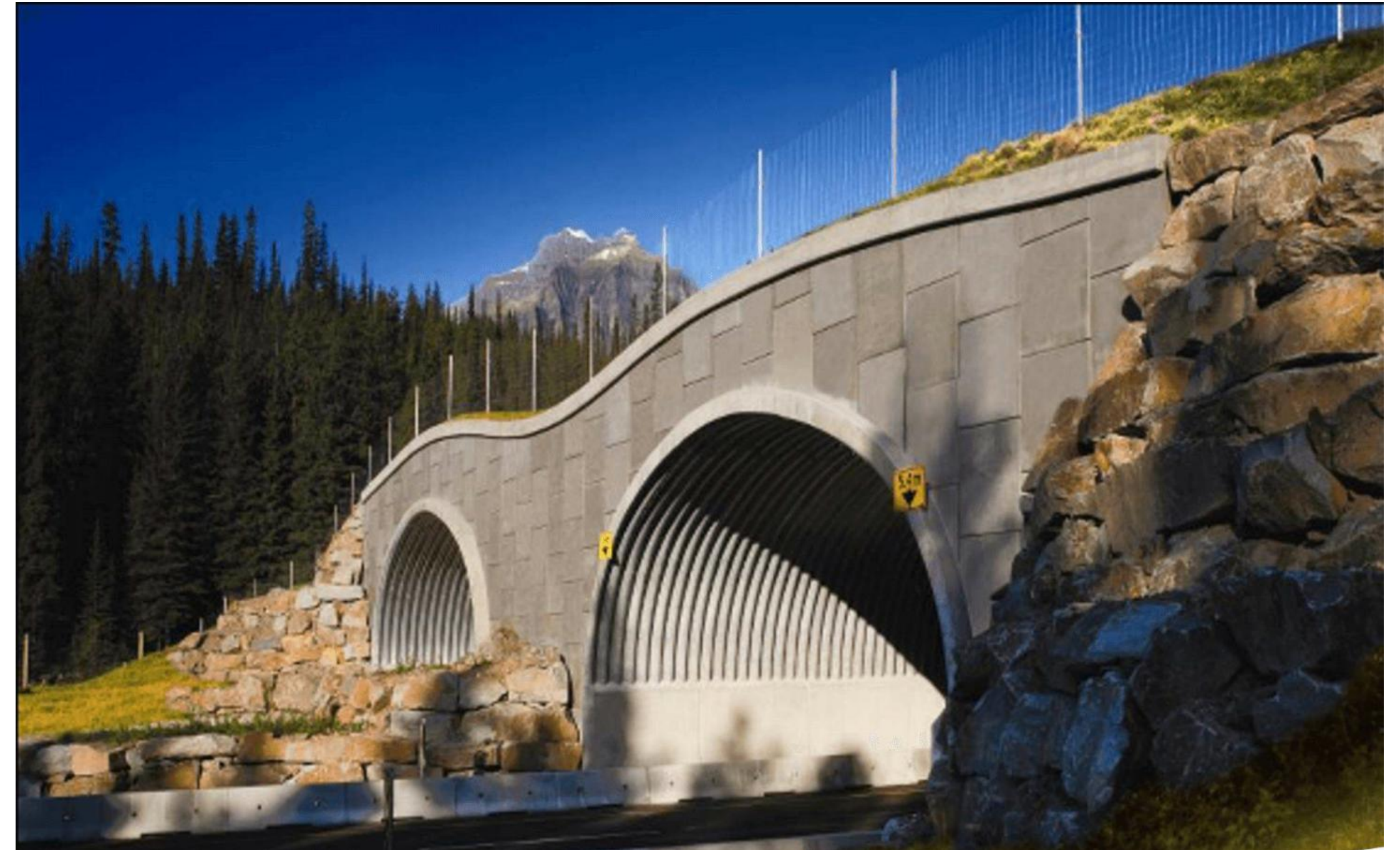
Case Study: 1st Railway Animal Overpass in Poland

Animal overpass. International Railway Line E20
INVESTOR PKP PLK o/ Poznań
Realization year 2005



Advantages of ViaCon Ecological Bridges

- Fast execution
- No complexity of the structure, only steel and locally available backfill material.
- Easy assembly.
- Re-usability of the material from the excavation.
- No major maintenance costs
- High load capacity
- Modular structure.
- Construction possibility in all **weather** and **environment** conditions.
- Ability to proceed construction without stopping the road traffic
- Resistance against seismic forces
- Long lifetime (up to 100 years)
- **Environment** friendly and **aesthetically** elegant.
- Design capacity, spans exceeding 30 m.
- Up to 50% more economic compared to the other types of solutions.



Acknowledgements

- Professor Alicja Sołowczuk
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Summary

- Societies impact wildlife
- Until recently, there were no strong initiatives to protect the environment
- Humans are seeking ways to mitigate risks to protect the existence of wildlife
- Wildlife crossings are one of the measures to protect our biodiversity
- All relevant and contributing stakeholders now have more awareness about the need and ways to protect our biodiversity
- ViaCon is committed to ... *Constructing Connections. Consciously.*



*“To restore stability to our planet, we must restore its **biodiversity**, the very thing we have removed. It is the only way out of this crisis that we ourselves have created. We must **rewild** the world!”*

— Sir David Attenborough

Q&A

- **Question 1: What is the general, average execution time to build a crossing?**

- It is not an easy question! Let me try to give understanding. Normally a viaduct crosses the ecological bridge let's say if it is 40 m wide minimum and it is a crossing to the motorway; as we have seen a lot of examples in the presentation we can say it can take 8-12 weeks to complete the construction from scratch. I hope it gives some kind of understanding. Additionally, we can say that it is 4 times faster compared to a conventional concrete solution.

- **Question 2: How is the location of a crossing decided?**

- The location of a crossing is chosen based primarily on the analysis of the course of migration corridors, and then on the basis of the macro-scale topography of the terrain, the indicative location of crossings in relation to the communication route. The following attributes are considered:
 - aerial photos,
 - topographic maps of the area,
 - animal habitat maps,
 - data on the migration of animals in their natural environment,
 - data on previously performed ecological analyzes,
 - animal mortality data,
 - situational and altitude data

Q&A

- **Question 3: When working near electrified railway power lines, do they get turned-off or bypassed?**

- Construction work on an active railway line always requires the traction electricity to be switched off. It is required by health and safety regulations.

Railway lines are quite heavily used with passing trains.

When working on the main or primary lines, the lower category or freight trains are diverted to detours.

IC trains and other important trains pass along the modernized section, however, with limited speed. During the passage of such a trains, the electricity is turned on, which is signaled by properly trained employees of the railway line technics or engineers. The resumption of construction work after the train has passed requires the same safety procedure.

- **Question 4: Can trucks or heavy equipment pass over the structure?**

- Yes. Such type of structures perform extremely well under heavy loads. There are a lot of such structures that have been there for years under motorways and rail roads.

- **Question 5: Can vegetation be planted on the structure?**

- This is a mandatory piece of the puzzle. Vegetation with shallow roots could be planted as per the recommendations of the biologists. Therefore, it is essential to involve biologists in the design process.

Q&A

- **Question 6: What option is better - an overpass or underpass?**

- Each type of facility has its own application and it cannot be considered in the category better or worse.

Anyway based on the macro-scale topography of the terrain, the indicative location (under or over) of crossings is to be chosen.

- **Question 7: What is the recommended size for a crossing?**

- It depends on the environmental study of the location. The golden rule is that large animals require much more free space to walk. And the dimensions of eco bridges are dependent on who will be using the crossing. This is usually described in the local regulations.

- **Question 8: What is the lifetime of this type of structure?**

- The design lifetime is set in the contract requirements, but in most cases investors require 100 years of lifespan for these structures. There is no problem in achieving this lifespan.

Q&A

- **Question 9: Can you confirm that arch type profiles suit better for vegetation comparing to regular rectangular shape overpasses?**
- Normally for regular rectangular structures we do not see too much soil on top. Here in arches, as the soil is a part of the structure can exist in it is also taking part in terms of the location of the media for the vegetation.
- **Question 10: How were these wildlife crossings funded?**
- Initially the reason of investing in such type of bridges/crossings was started by these incidents creating harm to humans before it negatively impacted on wildlife. The idea was to decrease the material damage too.

Later as we progressed, there is now more initiative to consider wildlife and its well-being as part of project design and funding. So we have seen a lot of wildlife crossings already funded and designed as part of the motorways or railways. In that respect, definitely the investor or the owner of the road or railway is taking part in the funding with the public support as well.
- **Last Question 11: Have you looked at the carbon footprint between a buried corrugated steel bridge and a traditional concrete overpass**
- Great question. We are currently already investigating this, together with some Research Institutes, to accurately calculate and compare the difference between the carbon footprint of buried corrugated steel structures vs. concrete structures. We will be ready to do such calculations and comparisons starting from 2022.