Conservation of Bats in Attics

A practical guide

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„A madárbarát Magyarországért!"

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Content

Introduction

It may be surprising, but in some instances, the best way to protect an animal is to clean up after it and reduce the negative impact of its presence on the object it uses. This fact applies especially to certain species of European bats, which use buildings or attics for breeding. Their presence is often associated with several negative aspects. Accumulating droppings, damage to wooden structures, trusses, and often a strong smell create a situation that residents cannot use the attic for drying laundry or storage. It is, therefore, crucial to effectively eliminate these negative impacts. The following text aims to provide information about procedures that will allow problems of this kind to be solved quickly and effectively, or at least to limit them significantly — and simultaneously obtain the willingness of the owner of the building to coexist with bats.

When arriving at a building occupied by bats, the first thing to do is to find to what extent their presence threatens this building. For example, which bat species it is, the total amount of accumulated droppings over the last year, where the bats are located, and where they have a flight entrance. It is also essential to determine what problems their presence causes the owner. The situation in the unused attics of churches, mansions, or castles is different from that in the attics of apartment buildings, where the requirements for the use of space are generally diametrically different. We can then decide what measures to take. Sometimes it is sufficient to sweep and vacuum the attic every three to ten years. Other times, it is necessary to install a platform and carry out cleaning every year — and in exceptional cases, it is needed to delimit the attic space used by bats only to a particular part (usually at the owner's request). If we decide to install the platform, we must consider where and how to install it. With its appropriate location, it is possible to significantly improve the owners' comfort during regular use or maintenance of the building (for example, by placing it on the rafters or the beams above the bells). However, this also needs to be implemented so that it does not disturb the bats. It may sound not very easy, but it is straightforward, and the text of this practical guide will tell you how to do it. We tried to make its content clear and understandable thanks to wast amount of pictures, diagrams, and short texts. All the procedures mentioned here are efficient and reflect more than twenty years of experience.

The following chapters are divided according to the degree of impact on the attic by the presence of bats. The guide focuses on bat species that have significant fidelity to their shelters (even decades long). The first chapter focuses on species that provide fewer droppings or form smaller colonies. The second chapter will deal with the most significant problems — large colonies — especially of large bat species capable of producing vast amounts of guano. Here we also deal with various technical solutions for modifying shelters or the problem of flight entrances — how to take care of them or how to modify them so that pigeons cannot get into the attic. The final parts are devoted to many examples from practice when the solutions were perhaps non-standard, but they brought success and the desired effect.

We believe that the following pages will inspire you and help you implement measures so that satisfaction is not only on the side of people but also on the side of bats — that is our highest goal.

Authors

1. Bat colonies with negligible impact on the attic

As we mentioned in the introduction, it is necessary to consider to what extent the presence of bats harms the building — especially the volume and thickness of the layers of droppings (guano) on the wooden structures. In this chapter, we will focus mainly on cases with fewer droppings, creating only thin layers that dry quickly.

This is especially true for smaller bat species, such as the brown long-eared bat (*Plecotus auritus*) or the lesser horseshoe bat (*Rhinolophus hipposideros*). In the case of the brown long-eared bat, it is sufficient to carry out ordinary cleaning because it only forms small colonies of 10-40 females. Here it is not even necessary to protect the wooden structures because the guano dries well in thin layers (i.e., it does not retain moisture). Locally, however, there may be spots where a layer several centimeters thick can accumulate.

Among the species that do not significantly pollute the attic is the serotine bat (*Eptesicus serotinus*). Individuals of this species mainly use the marginal parts of the attic — crevices and points of contact between the walls and the roof.

The frequency of guano cleaning depends mainly on the size area of the space bats use. In the case of lesser horseshoe bat colonies of approximately 50–60 females, the intervals between individual cleanings can be 5–10 years. But if colonies are more than 100 females large, it should be done annually. If even during annual cleaning, droppings accumulate in such a thick layer that is hard to dry, we recommend installing a platform to capture it. You can find instructions on how to build and place this platform in the next chapters.

Cleaning the guano itself can be done with a broom and shovel. However, this method is very dusty, and even with a high-quality respirator, it is very unpleasant — we, therefore, recommend vacuuming the attic spaces. It is best to use an industrial vacuum cleaner — even if its purchase price is very high. Inexpensive vacuum cleaners can be a suitable alternative, but it is necessary to take the risk that they will burn internally during cleaning and become irreparable. We also have good experience with cheap types of fireplace vacuum cleaners with an input power of around 1200 W and a two-stage filter. They are designed for ash and to last a long time in a dusty environment. Their advantage is also that they are small and light, and it is possible to climb beams with them. We recommend choosing models with a suction hose at least 1.5 m long.

Fig. 1.1: *A non-drying layer of droppings on the wooden vault of the church. The church's wooden vault is located under the attic floor. In this church, there is a large colony of the lesser horseshoe bat, about 200 females in size. Any measures are challenging in such a space because walking on the wooden vault is impossible. The only thing that can carry a person safely is a brick ledge along the edge of the wall and wooden ribs made of boards.*

Fig. 1.2: *Three different attics with the presence of the brown long-eared bat. Fresh droppings are visible on the right — shiny dark black, while older droppings from previous years are gray. In all cases, this is accumulated droppings over 5–10 years.*

Fig. 1.3: *A colony of the lesser horseshoe bat of about 80 females in the small attic of a church tower can produce relatively thick layers of guano, given the small space. In such cases — if space allows — we recommend either installing a platform or at least cleaning it annually (it is not necessary to protect the beams). This photo shows the amount created during a single season.*

Fig. 1.4: *The first cleaning is the most demanding — without exception. It is necessary to deal not only with various kinds of mess (e.g., construction debris) but also to be patient with a large amount of dust that clogs the filters of the vacuum cleaners. If the situation is similar to this photo, we recommend covering the surface with a tarp after removing the old droppings.*

Another alternative is vacuum cleaners resembling industrial ones, with an input power of 1400-1600 W and a metal container. Models with a fabric bag as part of the equipment, which is stretched over a lamella paper filter and serves as a fine pre-filtration (e.g., Hecht), have also proven themselves. A crevice nozzle is very useful. After trying many types, the KÄRCHER nozzle with a width of 90 mm turned out to be the best — it is ergonomically very well designed and significantly increases work productivity. In addition, its diameter is compatible with many vacuum cleaners of other brands (but be careful, with fireplace vacuum cleaners with a narrower hose diameter, it is necessary to make a reduction).

Fig. 1.5: *Different types of vacuum cleaners and their accessories. Industrial models with a socket (a–c) are handy for connecting an additional lamp. The battery vacuum cleaner (d) is suitable for places without electricity. The fabric bag-stocking for the lamella paper filter near the engine can also be purchased as a spare part (e,f). KÄRCHER nozzle with a width of 90 mm (g). Most vacuum cleaners allow for the magnetic knocking of filters and store the dust in a plastic container, which can be quickly emptied.*

Sometimes we deal with cleaning inside buildings with no electricity. We can solve this in two ways: use battery vacuum cleaners — if there is not much to vacuum. It is necessary to choose carefully and focus on the suction power of at least 1000 l/s. The Ryobi R18PV-0, 18 V model with a suction power of 1,130 l/s, is ideal. It is necessary to remember that a maximum of 15 minutes of vacuuming is possible on a 4 Ah battery — therefore, it is essential to have more batteries purchased. Its advantage is mainly its small dimensions and weight, which allows us to climb beams easily.

However, if it is necessary to carry out a more significant number of cleanings — full-area vacuuming on at least three locations per year — we recommend buying an industrial vacuum cleaner of dust class L (or M) with a flow rate greater than 3500 l/min. It is enough to choose a single-motor model. But there are two- and three-motor models on the market with significantly increased suction power. Such a vacuum cleaner must have an automatic filter flap, which allows vacuuming in attics without interruption.

How to vacuum is unnecessary to describe — however, we would like to mention some specific aspects. Attics are often full of debris, so the suction nozzle, hose, and filters are often clogged. It is essential to realize that you will unclog the vacuum cleaner repeatedly. It gets on your nerves, so arm yourself with much patience. The suction nozzle for hoses gets clogged at the point of their connection or the beginning of the opening into the vacuum cleaner. To unclog these places is a

swift and straightforward operation, but there are cases when something gets stuck in the middle of the hose. The most effective way to clean the hose is to carry a large, heavy steel screw with you, which you insert into the hose from one side and gradually tap the screw to break through the clogged area. The screw must also fall out with the dirt on the opposite side of the hose.

The filter is also often clogged. We, therefore, recommend vacuum cleaners with two-stage filtration. If the vacuum cleaner's suction power has decreased significantly, it has either a full reservoir or a filter blocked by fine dust particles. Remove the fabric filters and tap them on a wooden beam or wall. For a stocking strung on a lamella filter, it has proven effective to sweep it with a whisk. Sometimes it is necessary to clean the filter even every 5 minutes — it usually lasts 15-20 minutes in operation. Vacuum cleaners with single-stage filtration only have a lamellar paper filter, which can not be cleared entirely by knocking — but this is enough for efficient work. After work, clean the vacuum cleaner and blow out the filters using a compressor. We shot the paper lamella filters with an air stream — all the joints between the lamellas. With such care, vacuum cleaners will last for several years.

Fig. 1.6: *Demonstrations of guano cleaning up after bats. Vacuuming the droppings of the brown long-eared bat with a small fireplace vacuum cleaner (←). Vacuuming the droppings of the lesser horseshoe bat with a Hecht vacuum cleaner from the wooden vault of the church (→). You may notice the use of a clip light attached to the handle of the vacuum cleaner and powered from the outlet on the vacuum cleaner.*

2. Bat colonies with a significant impact on the attic

Only very exceptionally and with huge colonies, a large attic area is contaminated with guano. As a rule, bats have the habit of using only one or two microclimatically different sites in a single attic. It means that they only occur in certain well-defined parts in the attic, under which there is a significant accumulation of guano. This fact is handy for us — we know precisely where to install the platforms. Installation of platforms is essential for the greater mouse-eared bat (*Myotis myotis*), which is one of the largest species and often creates colonies of hundreds to thousands of females. Based on many years of experience with this bat, we know that 100-120 females with their offspring produce approximately 50 liters of guano per year (i.e., one large bag). Bats of smaller species, such as Geoffroy's bat (*Myotis emarginatus*) and The lesser horseshoe bat (*Rhinolophus hipposideros*), produce slightly fewer droppings. With Geoffroy's bat, it is almost always necessary to build a platform for cleaning because even though their numbers are generally smaller, they only like to use particular attic sites where their droppings are layered. For the lesser horseshoe bat, a platform is needed only if more than 100 females are on the site. The platform will make it possible to plan cleaning even with an interval of several years.

As we mentioned above, bats use only particular sites in attics. They prefer the area under beams or near the roof's ridge. They also prefer similar sites in churches, or for example, use sites where the roof connects to the side of the tower. In larger colonies, it is not unusual for bats to hang out over a larger area, either on the underside of the roof sheathing or the battens under the ceramic tiles. In baroque towers (so-called onions), bats mostly use the upper part of the dome, where they hang on the formwork. On hot days, they look for places where they can cool off. Chimney walls, masonry shields, or other walls (e.g., near stairs) are best suited for this purpose. Hanging freely on the beams is probably the least attractive for them. The favorite sites are primarily on the southwest or west side of the building, but position of the colony can vary on the buildings according to the different microclimatic conditions of the shelter.

Fig. 2.1: *In attics with large colonies of large bat species, unmissable piles of guano are formed. The attic of the primary art school in České Dub. This pile consisted of 1.5 tons of guano (←). The pile in Vysoké Veselí — although smaller, was located in an apartment building where the tenants regularly cleaned the attic before our arrival. In the background, you can see the tarp that the tenants hung up to keep the bats from flying all over the attic space (→).*

Fig. 2.2: *Bat guano dries well in thinner layers, but thicker layers retain moisture. If such a pile is on a wooden structure, it represents a significant problem. In some cases, regular sweeping by broom is sufficient (←). In others, it is necessary to cover the beams with protection (→) after removing the guano.*

Fig. 2.3: *Bats often use specific attic sites under the roof ridge (←) or near the beams (→). In church towers, we mostly found bats near the beams.*

Fig. 2.4: *In many churches, the roof sheathing is attached to the side of the wall — it is a very popular site for bats (←). More numerous colonies are often found hanged in rows and on a larger area from below on the roof sheathing (→).*

Fig. 2.5: *In the summer, the brick parts in the attics overheat the least. Bats cool down there on hot days. It is also the case with this group of the greater mouse-eared bat hanging from the chimney (←). Free hanging of bats on beams are probably the least common, but it is very characteristic of Geoffroy's bat (→).*

3. How to build a platform?

3.1 Preparations — first cleaning

The first cleaning is done before the platform is built. It's a difficult task, often associated with removing debris hidden under piles of droppings. The problem is estimating the amount of guano accumulated over the past years — or decades. If the guano lies on a flat surface, it is not a problem, but if it lies on the upper side of the vault, then a realistic estimate is very complicated. A correct estimate is critical to ensure enough bags and to plan the necessary time and number of workers. It is required to have a means of transport for guano disposal or storage. It is advisable to warn the building owner at the beginning that if you underestimate the amount of old guano, the first cleaning may be divided into several stages.

Thick plastic bags designed for construction debris are essential for the first cleaning. They are mostly available in two sizes: 900×1300 mm; 250 l or 650×1200 mm; 130 l. Due to the risk of bag rupturing during handling, those with a smaller volume have proven better for us. The strength of the bags mainly depends on the thickness of the material, which should be at least 0.100 mm (i.e., 100 microns), but ideally 0.200 mm (i.e., 200 microns). For binding, we use the so-called miller's knot. It is elementary — we put a fox loop on the closed neck of the bag, wrap both free ends of the twine around the neck of the bag in the opposite direction and tie it with a regular knot. A smaller bag can hold roughly 10 to 12 kg of guano (depending on humidity), and a larger bag can hold up to 20 kg.

We put the guano in the bags with the help of shovels, then sweep the area, and we can clean the corners with a vacuum cleaner. Vacuuming guano residues during the first cleaning is often impossible due to humidity so we can do it every one to three years. It is essential to remember to remove droppings in elevated places, i.e., especially on collar ties or other beams.

If possible, we carry out the first cleaning in the fall and install the platform in the spring before the arrival of the bats — so that the space can dry out. It has been shown that the guano from the first cleaning can be put into manure by the farmers, provided that it does not contain any large pieces of bricks, stones, metal, glass, or plastic particles. It does not matter if there is a small amount of plaster or decayed wood. However, if the guano is contaminated with garbage, the only way to get rid of it is to transport it to a managed waste dump.

Fig. 3.1: *An example of what the first cleaning can look like — there is often a lot of debris in the guano.*

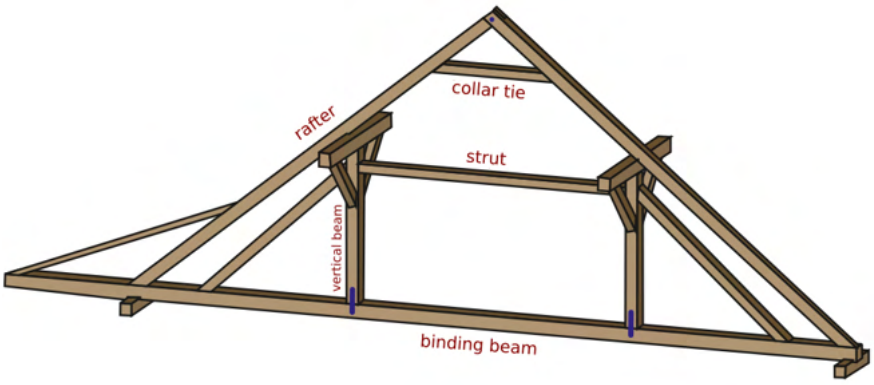

Fig. 3.2: *In the descriptions of this manual, the names of individual types of truss components are often used. To increase comprehensibility, we have placed a diagram of one truss in this place. In this case, it is the so-called full truss. Other trusses can connect it with a simpler construction (although the spacer is missing). A very specific structure is when individual struts cross each other — such an element is called Andrew's cross.*

3.2 Where to place the platform?

Logically, the platform should be placed where the droppings fall. However, when choosing a site, it is necessary to consider the owner's needs during the maintenance. The platform's location also differs between the ordinary attic and the attic spaces of the tower.

In the attic space, the platform placement is usually simple — technically and in terms of access to the installation site. In many cases, it turned out to be a suitable solution to place the platform on the elevated part of the truss (on the rafters, spacers) so that the owners or managers of the building could walk under it and not have to wade in piles of guano. However, such placement is not always possible.

Keep in mind that there should be at least 2.5 meters of free space from the surface of the platform to the ridge of the roof, and at the same time, the paltform should not come closer than one meter to the roof cover (at least from one side of the platform). These dimensions must be maintained so that the bats have enough space to fly above the platform and along it. At the same time, try to avoid blocking air circulation throughout the attic. If we place the platform too close to the roof ridge, we will limit air circulation, and bats may permanently move under it. Such resettlement under the platform can also occur for a short time, even with well-placed platforms, during scorching summer days. In this case, we build the second — lower platform level. However, it is often enough to spread a semi-permeable DTB foil on the attic floor.

Another factor that can prevent us from placing the platform on the joists or spacers is that this beam is present in only some bonds and was only used in full bonds (a full bond is usually only every fourth to sixth). In such cases, there are two options: add the missing slats (we do not recommend adding additional spacers) or place the subfloor on the attic floor. We put a platform on the attic floor, or the beams, even if the attic space is shallow.

The platform can be placed in the attic symmetrically in the direction of its axis under the ridge or asymmetrically when it is shifted from the axis of the attic towards the bat site. If there is an unprotected beam or strut above the floor, it is necessary to consider the protection of these beams against the harmful effects of guano.

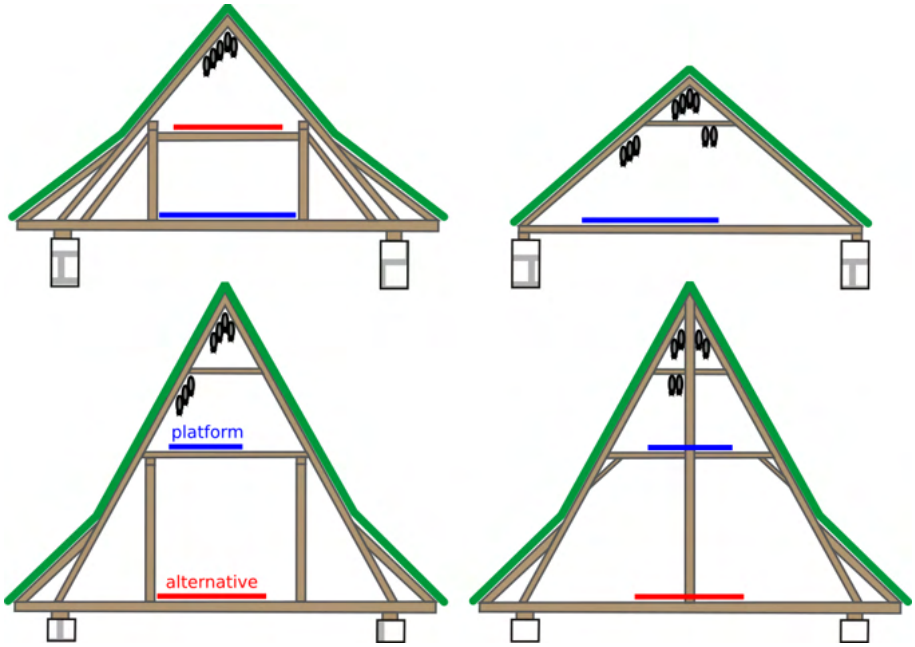

Fig. 3.3: *Several model examples of how to place the platform in different types of trusses.*

In the tower the platform placement is usually complicated and very laborious. It is often necessary to plan a two- or three-level platform from the beginning to catch most of the droppings and, simultaneously, ensure a free arrival corridor for bats into the roof of the tower (e.g., through louvered windows, which are often a flight entrance). In such spaces, the owner wants to protect either the bells or the clock mechanism — therefore, the platforms must be placed in the higher parts of the tower.

As we mentioned above, we conceive the platforms as multi-level. One level protects the tower's center, and the other creates a walkway. Which will be the bottom and which will be the top must be decided according to the situation on the site. The two platform levels should partially vertically overlap — this will ensure that the guano will fall from the higher platform to the lower one. The flight corridor should have a minimum profile of 1×1 meters without the presence of a beam that would create an obstacle for the flight of bats. In some cases, the corridor can only be secured by placing the individual platform levels within 2/3 of the vertical profile of the tower, and the passages between the individual levels are not directly above each other. It is advisable to keep them on opposite sides.

Parts of the attic adjacent to the side of the tower are a relatively frequent site for bats. The platform placement here is not difficult — with one exception — the situation when a staircase leads to the attic under the bat site. If the space allows, it is advisable to cover this staircase with a roof, which also serves as a platform for catching droppings. There must be at least 2 meters of free space between this platform and the roof shell (in exceptional cases, 1.5 meters is also sufficient).

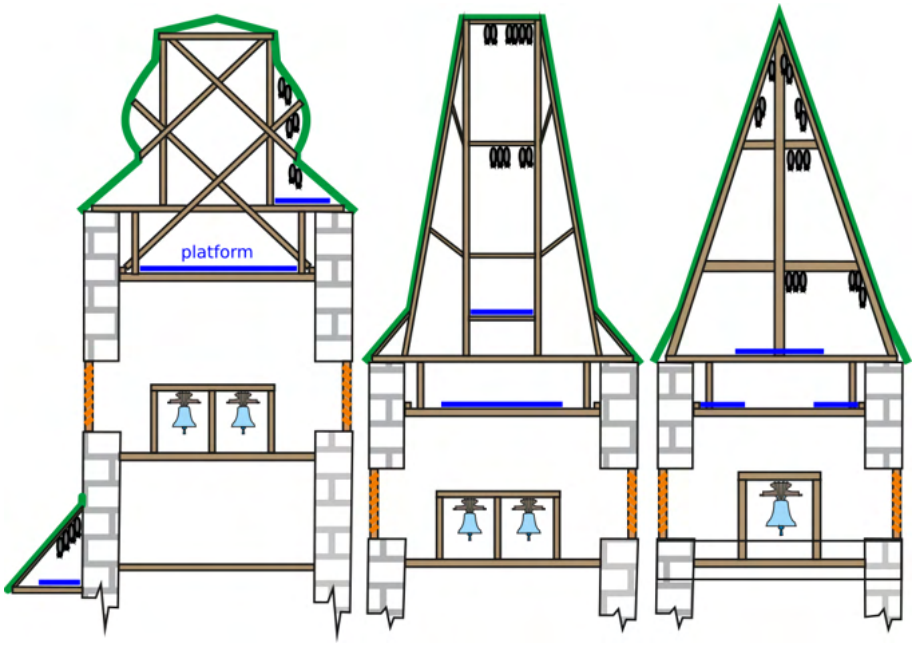

Fig. 3.4: *Several model examples of how to place the platform in different types of truss constructions in the tower.*

3.3 Necessary material and technical equipment

Based on many years of experience, we will present a specific platform construction in this section. This platform is efficient and, simultaneously, has the most straightforward installation. By default, the platform consists of a surface of OSB boards, ordinary boards, or second-class floor boards with tongue-and-groove. All these components can be covered with a protective layer — depending on the amount of guano, it is either linoleum or vapor-permeable DTB foil — or just treated with a coating against moisture, mold, and fungus.

We tend to create a raised edge on the platform to prevent droppings from falling over and make cleaning easier (we don't have to worry about something getting over the edge when sweeping). Sometimes different vertical beams or struts pass through the platform, which must be protected. Collars made of vapor-permeable DTB foil have proven themselves for us.

Rarely, there is also a chimney in the middle of the floor. In such a case, it is advisable to create an inclined surface from the boards, which prevents droppings from falling into the cracks near the chimney and protects its heel. There are cases when more straightforward protection is entirely sufficient, and instead of a platfrom, we can just spread a tarp.

The materials and equipment listed below are the ones we have tried and recommend using. We will try to summarize all its pros and cons, or wherever it is appropriate to use it:

- **OSB panels:** These make it relatively easy to assemble the platform. Thanks to their large surface, the platform is more stable than a platform made of ordinary boards. It is advisable to choose panels with tongue-and-groove, which connect well and, at the same time, increase strength. They are usually available in the following dimensions: 2500×675 mm, 2500×625 mm, 2050×625 mm, and various thicknesses. Since the floor must be walkable, we recommend choosing boards with a thickness of at least 22 mm. To save costs, a thickness of 18 mm can also be used, but with thinner panels, it is necessary that the spacing between the beams is not greater than 80 cm. If we use panels only to reinforce the existing platform, we can use boards with 12 or 15 mm thickness.

- **Wooden boards and prisms:** If the owner or representatives of the monument office request that OSB boards cannot be used on the platform, then it is necessary to assemble the floor from solid boards or tiles. We often base such a platform with prisms, which serve as a basic base grid or adjust the height in places where the connecting beams or joists are not in the same plane. The requirements for the quality of boards and prisms are minimal. The lowest quality class material (B, C / II., III.) can be used. Planed or rough boards (spruce, pine) with a thickness of at least 19 mm can be used. We recommend choosing wider boards (120–240 mm). Another use of boards is, for example, the creation of a raised edge of the platform — here, thinner boards or slats are sufficient. As in the case of OSB panels, the tongue groove increases the strength and stability of the platform and improves its walkability.
- **Wooden slats:** We use them only when constructing the raised edge of the platform. If only the lower edge is enough, we create it from 24×48 mm (or 30×50 mm) boards built vertically. If we want a higher edge, we lean another board with a width of approximately 100 mm against this lath.
- **Linoleum:** It is used as an impervious surface for the platform, mainly where a large amount of excrement is collected. Thinner linoleums are more suitable because they are lighter and bend well (although we do not recommend bending linoleum at raised edges, as it cracks after time). Linoleum in the store may be cut to any length in all commonly available widths (2 m, 3 m, and 4 m).
- **Vapor-permeable DTB foil:** The low-diffusion JUTAFOL DTB® roofing foil consists of a reinforcing grid, two layers of a unique film, and a protective non-woven fabric on the underside. It is the only vapor-permeable foil that is not decomposed by bat urine. It perfectly protects covered surfaces or components of the truss — at the same time, it allows the transfer of moisture from its lower part to the top (it is impermeable from top to bottom). The reinforcing grid gives it significant strength. We can use it instead of linoleum to cover the platform area where colonies produce fewer droppings. Furthermore, it can be used to protect structural elements such as raised platform edges, protective collars for vertical beams, exposed beams or struts above the floor, and others. It is delivered as standard in a roll with a width of 150 cm and a length of 50 m — that is, 75 m^2.
- **Material for joining components:** Different screws (e.g., 4.5×45, 4.5×50, 4.5×70, 4.5×80, 5×80, 5×120), clips for staplers, or silicone for sealing the overlap of linoleum in place connection of two pieces.
- **Protective coatings:** During the reconstruction of attic spaces or the additional construction of a platform to capture guano, it is often necessary to treat beams and wooden surfaces against wood-destroying insects and fungi. In attics with reproductive colonies, it is required to use as least toxic as possible substances.

  Most of the products currently on the market contain relatively safe substances. However, they are harmless to health only after they have completely dried. On the contrary, during application and shortly after, they can cause severe irritation or even permanent damage to the mucous membranes and skin. Therefore, wood treatment mustn't take place during the period when bats are present or shortly before the arrival of bats at the site in spring. The suitable period for application is, therefore, the period September-February. **After treating the beams, it is necessary to ensure sufficient ventilation of the attic space so that the solvents can completely evaporate (at least 14 days!).** For safety, it is advisable to paint the treated wood with a covering paint — especially those parts of the beams where bats regularly rest and come into direct contact with the treated wood.

  Relatively harmless substances recommended for use in attics inhabited by bats include boron compounds (boric acid and its salts; borax) and synthetic pyrethroids (permethrin, cypermethrin, deltamethrin). Quaternary ammonium salts, propiconazole, IPBC, and dichlofluanid can be used as fungicides.

These substances are contained, for example, in the following products available on the market: Lignofix (producer Stachem), Bochemit QB (producer Bochemie), Boronit (producer Pragochem), Drevosan (producer Metrum). From a health point of view, Wolmanit CX-10 is a highly safe preparation (used for wood for children's playgrounds).
Treatment of wood with toxic substances based on organochlorides (e.g., dieldrin, lindane) was one of the leading causes of the death of bats and the decline of their populations in the past. **Currently, the use of dieldrin and lindane is strictly prohibited! Another unsuitable substance is pentachlorophenol (PCP). Tebuconazole-based fungicides can also cause specific health problems in bats.**

Below are the tools that have proven helpful for us when installing platforms. Considering the current high technical quality of cordless tools, we recommend preference to them over classic corded ones. Choose one manufacturer that offers all the necessary tools and then use the same type of battery cell for everything. Then you need to buy a few extra battery cells.

Fig. 3.5: *Necessary tools. A cordless drills are essential for pre-drilling and screwing* ***(a,b)****. Different types of saws for adjusting the dimensions of boards — circular* ***(c)****; straight line* ***(d)****; tail* ***(e)****. Bevel plane* ***(f)****. Folding ladder for access to elevated places* ***(g)****. Other small tools for greater work efficiency* ***(h–k)****.*

- **Cordless drill:** The essential and most important tool. Suitable for screwing individual components and pre-drilling, which is necessary especially for laths so that they do not crack during screwing.
- **Electric impact wrench:** If you will deal with the issue of platform construction for a long time or build many of them, you will appreciate the advantage of an impact wrench. This device allows you to screw more easily and quickly.
- **Circular saw:** When solving the platform, it is often necessary to adjust the boards or slats to the required length and width.
- **Reciprocating saw:** It will serve very elegantly if it is necessary to create a precise cutout in the platform around a beam or a post. It is also possible to use the so-called tail saw.
- **Planer:** If we attach an inclined board to the chimney or the wall, it is necessary to plane its edge at an angle so that the boards fit together better.
- **Stapler:** Useful when attaching linoleum or DTB foil to individual parts of the platform. Using simple manual staplers is very effective and fast — in practice, electric staplers have

not proven themselves. Nevertheless, it is necessary to buy high-quality professional staplers. The cheap ones may break before you finish the first platform.

- **Extension cord:** In the case of using electric tools, an extension cable is also essential equipment. We recommend an extension cord with winding on a drum and more than two sockets, a length of at least 40m and a load of max. 16 A / 3680 W (min. 4.3 A / 1000 W, 230 V).
- **Ladders:** A solid aluminium folding ladder up to a height of at least 4.2 m (when unfolded) and a load capacity of at least 150 kg is useful. A classic one-piece or two-piece will allow access to higher places in the attic or the tower.
- **Other small tools:** Other small tools are also necessary for construction. We will try to list the most crucial: i) a retractable knife, which is irreplaceable when cutting linoleum or cutting DTB foil — can also be used to cut wooden parts of the floor; ii) the meter and the line cord (the so-called string) are irreplaceable when creating long straight lines; iii) Protractor or mitre square for transferring exact angles; iv) high-quality lights, or at least a headlamp — since we install the platforms in attics where it is dark.

3.4 Platform installation procedure

Platform surface: As mentioned above, the platform surface comprises either ordinary boards or OSB panels. However, the size of the access to the attic is also important when choosing the dimensions of the platform boards. That's why we recommend carefully measuring entrance openings or entrance spiral staircases.

The platform is most often placed on horizontal beams as low as possible, mainly due to the roof's ventilation. Remember that the platform must be safe to walk on. If the gap between the beams is more than 80 cm, we choose boards with a thickness of at least 22 mm. We can use boards with a thickness of 18 mm for narrower gaps. It is necessary to build supporting structures for gaps with a width of more than 120 cm.

If the platform must be raised, its beams can only be supported in the marginal parts of the vault in the place of the so-called backfill or on the heels of vault belts. Platforms and their supporting structures must not rest on the central parts of domes (vaults). The flexibility of the boards also allows us to copy various unevennesses caused by the beams or straining beams placed at different heights — the resulting surface of the platform is thus slightly wavy. However, even the flexibility of boards has its limits, and sometimes you cannot avoid supporting them on beams. If the boards are connected to each other in the space between the beams, then the reinforcement strengthens the joint.

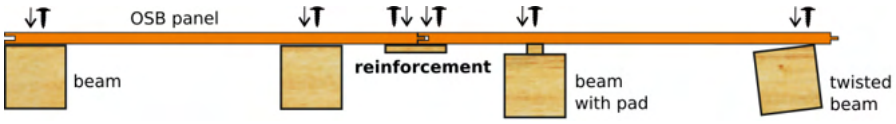

Fig. 3.6: *Scheme of laying a platform made of OSB plates on beams in a longitudinal section.*

Fig. 3.7: *Reinforcement strengthens the boards at the joint. It usually consists of a board placed under the platform at the point where the boards are joined.*

To prevent the platform from bending, strengthening the individual boards in their centre with reinforcement is possible. If it is necessary to protect the bells in the tower with platforms, it is necessary to preserve as much ventilation as possible. It is suitable to use the tilted boards to deflect the falling guano. In towers with a dense tangle of beams — no more than 40–50 cm apart — we can also use thinner boards (15 mm or even 12 mm).

In many cases, it is necessary to fasten the boards to the beam. You can do it with screws as long as it does not conflict with the requirements of the Monument Board. **In historic buildings, however, we fundamentally avoid drilling into the rafters and existing wooden structures!** Platforms in those buildings just lay on wooden beams and are stabilized by their weight in the given place. In certain cases, it is possible to lay the prisms loosely on parts of the historic truss and attach the boards exclusively to them with screws.

Some parts of the floors can be intentionally easily removable to allow easy access to certain places where regular inspection or service work is required [Fig. 3.8-middle]. We lay linoleum or semi-permeable DTB foil in the final phase on the platform. It is most effective to attach these surface layers with staples. At the edges of the linoleum, staples can be spaced 10–20 cm apart. In places where two layers of linoleum or DTB foil are overlapped — while the overlap should be at least 5 cm wide — we choose a greater density of staples, 2-3 cm apart. Sometimes we can glue the linoleum together at the connection point using transparent silicone, ensuring the joint is waterproof. If the linoleum is wavy somewhere, carefully straighten it and staple it — if you leave the unevenness, it will soon start to tear and crack. It is not always necessary to cover platforms made of solid boards with linoleum or foils — it is sufficient to treat them with a protective surface coating.

Fig. 3.8: *This platform was built in the church tower, where the truss and bells were heavily polluted by guano. Vertically placed prisms were used as a base on which solid spruce boards with tongue-and-groove were laid (↑). The removable part of the platform allows easy access to places where regular inspection or service work is required (centre). We do not need to cover floors made of solid boards with linoleum and foils — they can be treated with a protective surface coating that is harmless to health (↓).*

Fig. 3.9: *The platform made of OSB panels laid on the horizontal beams in the church's attic. You can notice that three whole panels and one narrow strip are used for the width — it is placed once on the right and then on the left of the platform so that the individual joints of the boards do not connect. The panels' cut can only be on the edge of the platform.*

Raised edge: Equip the platform with a raised edge — it prevents guano from falling during sweeping. We choose the edge's height according to the colony's size and the amount of guano. With slats 30×30 mm or 24×48 mm, the height of the edge will be 3–5 cm. If a 10 cm edge is needed, we can create it with a board resting on the batten (perpendicularly or diagonally). It is necessary to protect the raised edge against the influence of guano. Do not bend the linoleum on it — it will crack. It is convenient to wrap the edge in DTB foil — by attaching the strip of foil to the bottom of the batten using staples, then screwing it to the edge of the platform, and finally throwing the strip of DTB foil over the top of the raised edge, which we secure behind the edge with staples. DTB foil allows us to wrap even the ends of the fabrics easily.

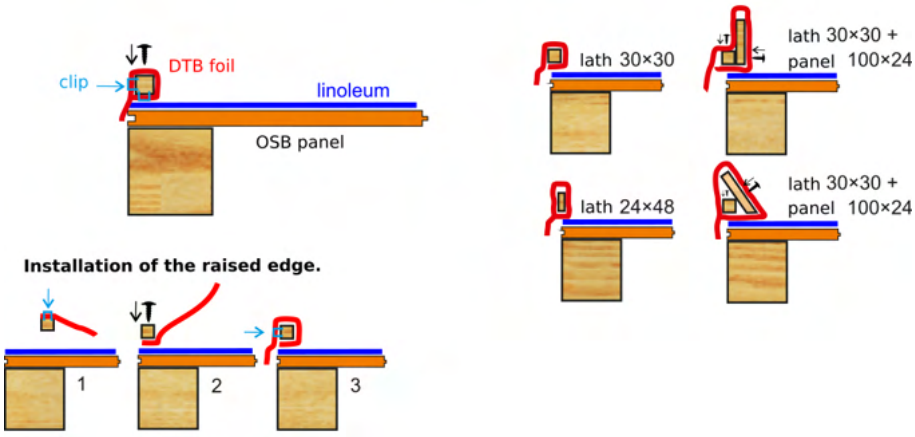

Fig. 3.10: *Diagram of the raised edge of the platform in section (↑ left). Examples of the construction of a raised edge from different materials (↑ right). The procedure for installing the raised edge of the platform — 1. attach the DTB foil to the batten (pay attention to the reverse and obverse, so it is correctly attached).; 2. screwing the batten to the platform; 3. flipping and attaching the DTB foil with a stapler (↓ left). Warning: The screws must always be covered under the DTB foil!*

Fig. 3.11: *The platform covered with linoleum, whereas it's beginning near the wall is slanted. With such a bend, the linoleum must be carefully pressed into the corner before you attach it, so it does not tear later. A raised edge is already installed on the platform - however, we recommend to install edge later - on the top of the linoleum.*

Fig. 3.12: *Installation of a raised edge from a 30x30mm lath and its gradual packaging in DTB foil (←). An example of the installation of a raised edge made of lath and a slanted board — the whole thing is then wrapped in DTB foil (→).*

Chimney and wall protection: Bats' favourite habitats are gable walls and chimneys, where they hang on hot days to cool off. A thicker layer of droppings forms near the bottom of the chimney or the wall. The construction of the platform protects these masonry parts of the building and prevents guano from falling between the wall and the platform itself. The solution is to place a board at an angle and attach it to the platform with a screw — so that the board also creates pressure on the wall. To avoid stains, the lower and upper edges of the board must be placed diagonally, while the edge to the wall must have a sharper angle than the edge to the floor. Connecting two obliquely placed surfaces where difficult-to-measure angles are formed is difficult. In this case, we recommend planning the side edges as well — the boards then go together more easily. If there is a leak between the wall and the board (for example, due to uneven masonry), it is possible to fill the joint with transparent silicone — it solves the problem very quickly and elegantly. If there is less guano somewhere, it is possible to supplement the chimney or the wall near the platform's edge, for example, with a sealing PVC strip intended primarily for the edges of the kitchen countertop.

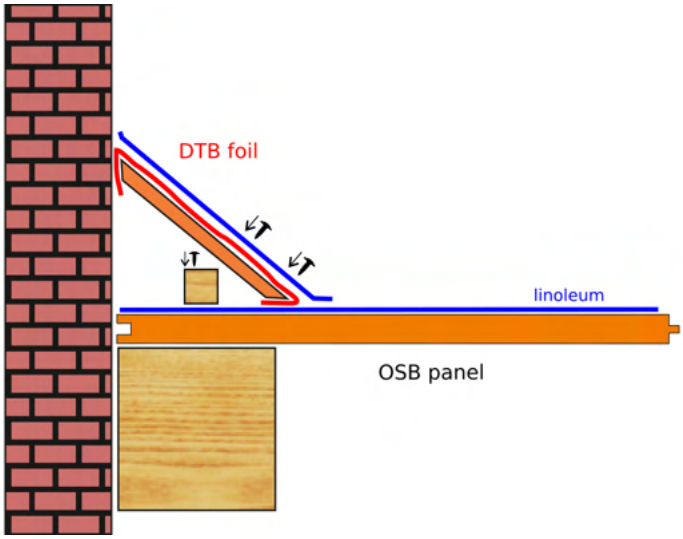

Fig. 3.13: *Diagram of the construction of the protection of walls and chimneys in section. Warning: The screws must always be covered with DTB foil or linoleum!*

Fig. 3.14: *Diagonally laid boards protect chimney - they are around the entire chimney (←). The boards are covered with DTB foil, on which a strip of linoleum is still attached (→).*

Protection of vertical beams: Sometimes you cannot avoid it, and one or more beams pass through the platform. It complicates the installation and the laying of linoleum. Protecting beams from the negative impact of droppings is also necessary. The best solution is to wrap the beam in its lower part near the platform using a strip of DTB foil in a collar. We fasten the strips with staples to the beam and to the platform. It is okay to layer several strips of DTB foil on top of each other.

Fig. 3.15: *Protective collar made of DTB foil on the vertical beam passing through the platform.*

Protection of collar-ties: A large amount of droppings can accumulate on the collar ties under the roof ridge — thus, it is necessary to protect them. Sometimes it is needed to deal with other horizontal beams as well. Two effective methods are available today. The first one is simpler and cheaper in terms of installation and labour — we attach strips of DTB foil to the cleaned and dried beams using staples so that its lower edges exceed the lower level of the beam by at least 1 cm. The second is a bit more laborious and significantly more expensive — it involves splitting PVC pipes and using metal brackets to secure them above the beams. However, if we consider the complexity of this solution and the high price, such a protective element complicates the workers' movement along the beams during maintenance. Moreover, bats can crawl under these plastic components — so we recommend it only in specific cases.

Fig. 3.16: *Protection of collar ties above the platform using a strip of DTB foil (←). Alternative solution with split PVC pipes (→).*

Protection of the groove of beams and surfaces in the dome of the tower: There are many attic components — in addition to those listed above — where bat droppings accumulate and must be protected. These are often different grooves of the beams or other elements, such as the internal surface of the baroque's tower dome, St. Andrew's cross, or rafters. DTB foil offers many solutions — with the help of cutting, bending and layering, you can achieve perfect truss protection. In addition, it is a vapour-permeable foil — it does not let moisture into the beam and, at the same time, allows it to dry. Thanks to the fibreglass grid, it is strong and durable.

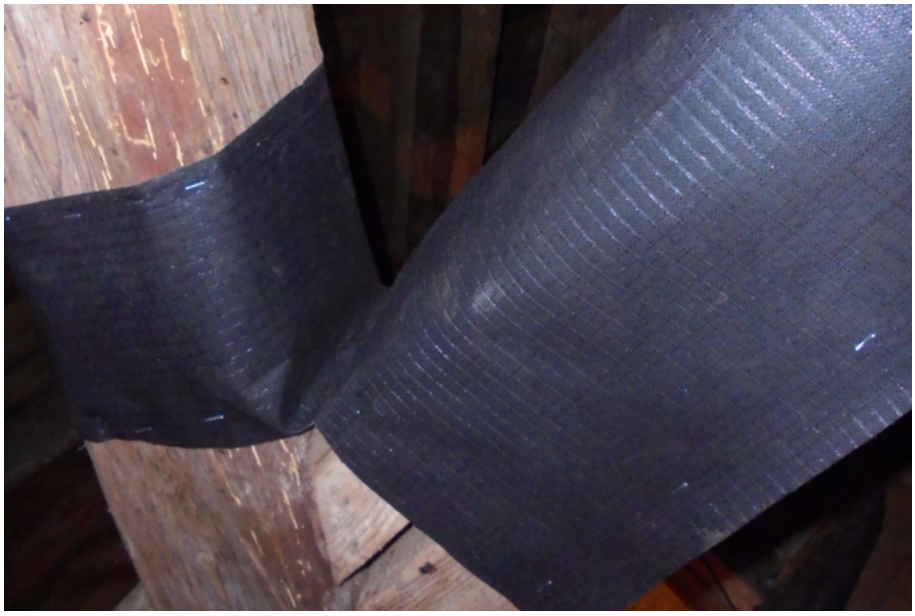

Fig. 3.17: *Even in this way, it is very easy to protect the groove of the beam using DTB foil.*

Fig. 3.18: *This is an example of using DTB foil to protect places in the tower where bat droppings fall. In addition to the horizontal beams of St. Andrew's cross, the lower part of the tower dome is also covered with this foil.*

Tarpaulins: In places with a smaller amount of droppings, it is sufficient to stretch tarpaulins with eyelets. These tarps are strong enough, and the guano can be easily removed from them. Because they are placed in the darkness of the attic, they are not destroyed by UV radiation. In some cases, it is enough to solve the problem with bat droppings exclusively using tarpaulins. In some cases, we can combine stretched tarpaulins with platforms. However, it is necessary to be careful that they are not installed in poorly ventilated spaces where moisture can condense, or they can easily prevent the required air circulation in the attic. Tarpaulins can be purchased in various sizes, often 2×3 m, 2×8 m, 3×4 m — exceptionally even larger. We can use two different methods to anchor them — either we fasten them to the beams using screws and wooden battens (the lath placed from the upper side above the tarpaulin ensures that it does not tear), or we use the metal eyelets on its edge, through which we pull a cable (4-6 mm diameter) through which we secure the tarpaulin to by the surrounding beam so that it is taut. If we need an eye in the sheet in a place other than the original one from the manufacturer, we can complete the eye using a punch (10-12 mm) and a riveting set with spare eyes, which can be easily purchased.

Fig. 3.19: *The tarpaulin is anchored with the help of prisms to the collar ties — here, it is sufficient to anchor only at the ends of the tarpaulin — along the tarpaulin is a footbridge made of boards to ensure access during cleaning.*

4. Technical solutions to other problems

4.1 Prevention of guano spillage into the church's interior

Sacred buildings have vaults of various types and shapes on their ceilings. The stone ribs of the vaults (mostly symmetrically grooved) fit directly into the perimeter walls and are joined at the top into a circular opening, which can be filled with so-called crown stone. From the attic, we can see this opening (or stone) in the centre of the vault, through which a hanging chandelier is lowered into the interior of the church, or this opening serves only to ventilate the ceiling.

It is not rare that we come across the debris, such as dust and guano from the attic, falling into the church's interior through this opening. This happens when the opening is insufficiently sealed with polyurethane foam or rags. A suitable method to cover the opening is one that does not prevent air circulation and ventilation of the church — but at the same time prevents further pollution of the interior. Installing a chimney roof consisting of a head (roof) and a cover plate as a whole or separately in two parts has proven itself. The cover plate size should be at least 220×220 mm, the pipe diameter at least 100 mm, and its height at least 100 mm. We then adjust the roof or cover plate on-site using a nailer's tool according to the shape and local circumstances. It is necessary to cover the pipe with a thick mesh so that bats cannot fly into the opening. The roof does not have to be fixed to the vault. It is sufficient to load it with stones or bricks. Before installing the roof, clean the opening thoroughly with an industrial vacuum cleaner.

Fig. 4.1: *Before installing the canopy, thoroughly clean the opening with an industrial vacuum cleaner (↑). An example of covering an opening with a chimney cap. The pipe must have a thick covering mesh that protects the opening from the entry of bats (centre). We adjust the roof or cover plate on-site using a nailer's tool according to the local circumstances (↓).*

4.2 Partition of the attic

In cases where the house residents actively use the attic — for storage, drying clothes, etc. — it is possible to solve their coexistence with bats with a relatively simple construction that divides the attic into two parts, and only one part remains accessible to bats. This division can be made either with a solid wall made of boards or simply stretching a tarp. When placing this partition, several important rules must be taken into account. The partition must not create a barrier between the flight entrance and where bats often stay. After installing the partition, there should still be enough space so that it does not significantly affect the microclimate necessary for raising the young (consult the chiropterologist about the size of the space left). It is also essential to seal all the cracks in the partition wall — if bats find such a crack, they will use it!

Fig. 4.2: *Partition of the attic space with a board wall. A mesh in the door and near the shield ensures natural air flow - the microclimate, therefore, remains unchanged.*

4.3 Flight entrances

Preservation of flight entrances is the alpha and omega of bat colony protection. Often, even a tiny change in the flight entrance or its surroundings can mean the complete extinction of the colony. In many cases, the colony disappears after replacing the roof covering — even if it was replaced by a new one of the same type. Extinction can also be caused by replacing individual roof elements, such as window sill. The reason is one essential but unobtrusive detail — the old roofing and window sills already had a porous, rough surface after years. The new covering is smooth, and bats cannot catch and hold on to it. Therefore, after replacing the covering, we recommend creating a grid of unplanned materials on its surface around the flight entrance — or roughen its surface sufficiently with various construction adhesives or a sander. Another type of intervention that can destroy a bat colony is the effort to prevent pigeons from entering the attic — because they cause enormous damage there. The practice has shown that it is possible to end the presence of pigeons and, at the same time, preserve the presence of bats. There are two solutions! The first solution involves placing blinds made of unplaned boards with a spacing of 40-60 mm in the entrance, which is enough for the bat to climb through, but the pigeon will not pass through. The second solution is the possibility of equipping the entrance with a net or mesh with 40-60 mm meshes. Mesh is better

if it is old and rusted — smooth or plastic-coated mesh is unsuitable, as bats cannot get hold of it effectively. Based on previous experience, we recommend combining mesh and nets with blinds.

Fig. 4.3: *Blinds installed in the flight entrance prevent pigeons from entering. These blinds are fixed only with small wooden wedges — thanks to this, bats can also climb the wall around the blinds (←). A slatted grate located at the flight entrance of a large bat colony on a new glazed roof covering (centre). Rusted mesh does not cause any problems for bats when climbing (→).*

If we are going to place only mesh in the flight entrance, it is better to choose welded with fixed meshes — and in the case of selecting a net, the type with non-slip knots. With knitted meshes, crawling bats often get stuck and die.

Today, there are many effective entrance modifications. These include, for example, using a grid made of rough metal bars, wooden laths or installing opposing wooden boards. When choosing the method of adjustment of the flight entrance, it is necessary to proceed carefully and choose the best solution for the given case.

WARNING! You cannot install blinds, nets or mesh in the flight entrances of the lesser horseshoe bat colonies (*Rhinolophus hipposideros*)! Horseshoe bats always fly through openings — they cannot crawl through — and would, therefore, not accept this change. Always remember that you need to find the right opening — the one that bats actually use. Although it may appear to be the most likely window, it may be just a crack under the roof overhang.

Fig. 4.4: *A sad view from the church tower - an improperly closed entrance with rabbit mesh was fatal for the colony of the lesser horseshoe bats.*

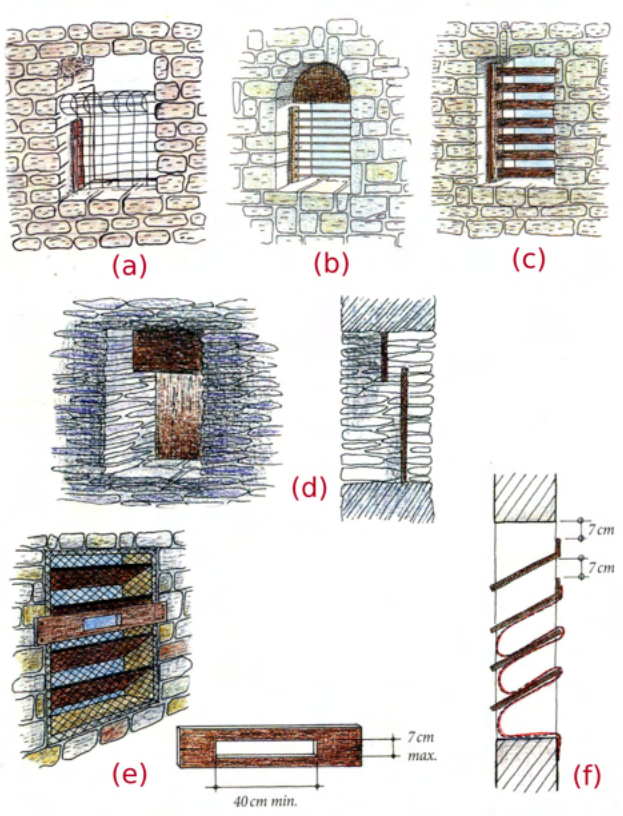

Fig. 4.5: *Examples of securing windows against pigeons: (a) bent mesh; (b) metal rods; (c) wooden panels, (d) opposing boards or different adjustments of blinds (e; f) - modified according to Flairon et al. 1995: taken from the publication Bats in buildings - Reconstruction and problem solving; publisher: ČESON).*


NEZATVÁRAŤ !
OTVOR PRE NETOPIERE
Spoločnosť pre ochranu netopierov na Slovensku

5. Information panels

The practice forced us to equip attics used by bats with information panels. What is their role in nature? Why is it essential to protect them? Such information can save the colony from construction interference caused intentionally or out of sheer ignorance. Sometimes the building owner — despite regular communication with representatives of nature protection — sends construction workers to the attic without a legal exception for reconstruction — which is a blatant violation of the law. The panels contain information about the fact that there is a breeding colony of bats in the object (name of the species; colony size) and a list of structural interventions for which the so-called exception to the law is required. Important information is also the contact of a person who regularly monitors the site and can answer questions — and help provide this exception. This contact person often supervises the reconstruction works so that they are carried out sensitively, and the colony is not damaged. Panels are usually placed in a highly visible place where no one can miss them. It is also important to mark the locations of the flight entrances - so that they are not interfered with in any way.

Fig. 5.1: *Information panels in the Czechia, Slovakia, Hungary and Poland.*

6. Examples from practice

6.1 Cleaning and Platforms

In the previous chapters, you learned how to take care of the breeding colonies of bats so that there is no damage to the buildings where they settled. The main attention was given to the care of locations with a large number of bats and where it is, therefore, necessary to build a platform to protect the attic.

Despite the fact that this is a detailed guide discussing the essential elements used (platform area, its location, raised edge, etc.), in practice, you may encounter certain non-standard conditions. It is always necessary to adapt to the given space and, if possible, to the owners' wishes. This chapter will therefore present several already implemented measures from several countries of Central Europe, which are somewhat interesting, non-standard, but high-quality. Individual measures will be illustrated with photos of the original and subsequent states after installation. We supplement the photos with a short comment.

(MILEŠOV; CZ) In 2020, we were asked by the construction technician of the Litoměřice Vicariate to solve the problem of the newly formed colony of the greater mouse-eared bat (*Myotis myotis*) in the attic of the church of St. Anthony of Padua in Milešov. The platform is an example of the simplest and most common solution. It is placed in the middle of the attic under the ridge of the roof across the entire church and placed on the horizontal beams. The biggest challenge was getting the material into the attic, as the only access was a square opening in the church vault about 7 meters above the choir with a diagonal of 72 cm.

To create as little cutting waste as possible, two dimensions of tongue-and-groove boards were used, namely 0.675×2.5 m and 0.625×2.05 m. The joints of the boards, which are outside the beam, were strengthened with a reinforcement.

Fig. 6.1: *Getting the material to the attic through the small opening in the vault above the choir was difficult. This was done with the help of a pulley and one person on the window sill, who guided the boards so that they passed diagonally through the opening in the vault.*

Fig. 6.2: *Condition before (←) and after (→) installation of the platform. This measure was implemented very soon after bats occupied the attic. The number of bats and guano is small. The platform's capacity is also sufficient for a larger colony of bats. If the number of bats does not increase dramatically, cleaning is only necessary once every three years.*

Fig. 6.3: *The state before the implementation of measures around the support beam of the tower (↑). The finished platform — the central support beam and the raised edge of the platform are wrapped in DTB foil — the surface is protected by linoleum (↓).*

Fig. 6.4: *Bats often hang on the rafters under the ridge, so a large amount of droppings is caught on the collar ties (←). Simple protection of the collar ties using a strip of DTB foil attached to the beams with a stapler (→).*

(BĚLÁ POD BEZDĚZEM; CZ) The attic of the Gothic Church of the Ascension of St. Cross in Bělá pod Bezdězem was inhabited by a large colony of the greater mouse-eared bat (*Myotis myotis*), which consists of around 1000 females and roughly 700–900 young. They produce about 12 bags of guano every year. The bat colony mainly uses the space under the ridge of the roof above the nave. Due to its size, it was necessary to build a large platform. In the place where there are the most bats, it is made up of OSB panels placed on collar ties, and in the place where there are fewer bats, a tarp with a width of 2 m is placed. There is a bridge along the tarp to enable cleaning. Due to its large size, the platform was built in two stages — between 2015 and 2016.

The platform was assembled from OSB panels 0.625×2.5m with a tongue-and-groove, and it narrows where fewer bats are above it. Its placing on the collar ties makes it possible to walk through the attic during regular use of the building and not wade through the guano. Thanks to this, both people and bats have more peace of mind.

Fig. 6.5: *A platform composed of OSB panels laid on beams. The raised edge was created before laying the linoleum (←). Finished platform with soft linoleum bent over a raised edge. The photo also shows the sloping end of the floor near the gable wall (→).*

Fig. 6.6: *Strips of protective foil on the collar ties (←). A stretched tarp (2×8 m) along which there is a boardwalk to clear the guano.*

(ČERMNÁ; CZ) Neo-Gothic Church of St. Václav in Čermná is inhabited by the greater mouse-eared bats (*Myotis myotis*). We can find them in the tower and the attic above the nave. A simple platform was created in the tower. An interesting solution is in the attic, where platform extends over the nave with a flat ceiling. The attic floor is paved with bricks, and above it is a service gangway. There are also holes in the floor for ventilation. Beneath the bat colony, these holes were filled with guano. The support structure attaches the platform to the service footbridge, allowing maintenance.

Fig. 6.7: *Original state. Guano is on the floor, the catwalk, and the vents (↑). The support structure for the platform is connected to the footbridge. On one side, it is built on uprights (centre). A strip of DTB foil protects the railing. There is a slight height difference between the platform and the technical bridge, which is covered by a strip of DTB foil. (↓).*

(TURNOV; CZ) The baroque church of St. Mikuláš in Turnov boasts a massive tower, where a colony of 40 female bats (*Myotis myotis*) resides above the three bells. Their droppings made the bells very dirty. That is why a platform was installed on St. Andrew's cross high above the bells.

Fig. 6.8: *Original state (↑). A simple platform covered with white linoleum catches most of the droppings (centre). Above the platform is a tangle of beams, which had to be protected by strips of DTB foil against guano (↓).*

(LOBENDAVA; CZ) Bats often use church towers. Such is the case with the Church of the Visitation of the Virgin Mary in Lobendava. A colony of 800 females with young resides in this small baroque tower with a typical bulbous shape. There are several problems here — first, a large amount of droppings in a small space. Second, a tangle of beams on which the droppings are layered. There is also an undesirable effect on the clock's mechanism — and last but not least, it is necessary to preserve the arrival corridor of bats (at the level of the clock in the middle of the tower).

For this reason, the protective elements were placed on three vertical levels. The highest level consists of beams (both horizontal and inclined) used to strengthen the tower with the lower arch of the dome. At this level, all areas — threatened by the accumulation of guano — were protected by DTB foil. In the middle, above the clockwork, a platform was created from OSB panels with a raised edge 10 cm wide (see project drawing). This platform is covered with linoleum, also laid on top of the wall. Roughly 80-90% of the guano is captured at this level. The last level is around the clockwork, where DTB foil has been placed on the platform to prevent droppings from falling below. This allows the watch operator to maintain order around the clockwork — at the same time, the flight corridor from the entrance to the centre of the tower remains preserved.

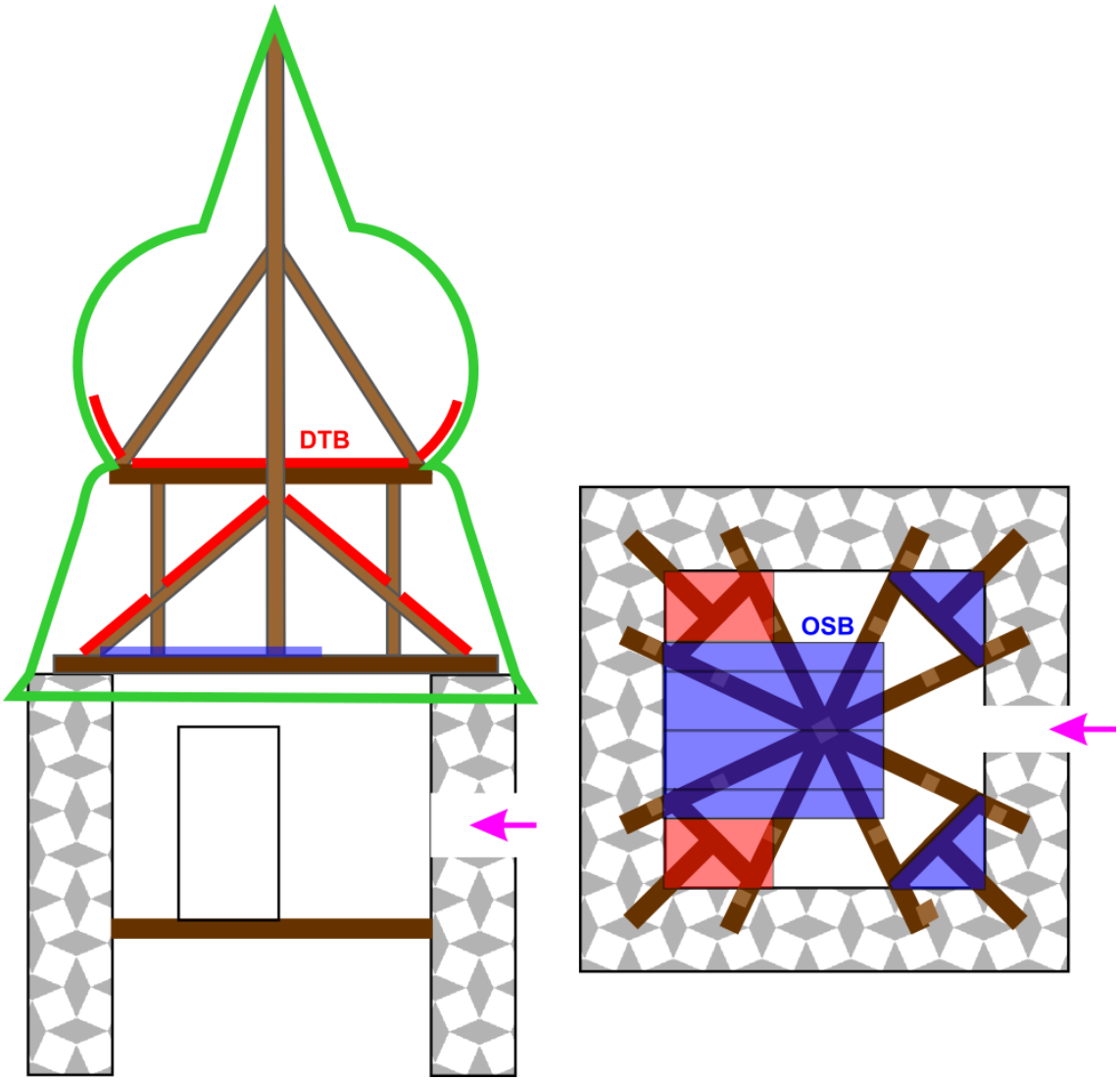

Fig. 6.9: *Project sketch with clearly visible multi-level stratification of the platform.*

Fig. 6.10: *The platform above the clock has a 10 cm wide edge. After the first season, it turned out that the height of the platform edge was correctly estimated. The vertical beams passing through the platform also have a protective collar.*

Fig. 6.11: *In the highest level of the tower, the beams are covered with DTB foil, and the formwork of the tower's dome in the lower arch is protected in the same way.*

(LIBUŇ; CZ) At the church of St. Martin in Libuň, we dealt with the platform under a colony of the greater mouse-eared bat (*Myotis myotis*) with a size of 450 females. That's a really large size, considering the small space. Guano was on the wooden structures and the clockwork mechanism — causing clocks to stop. The platform shields the clock mechanism and allows the clearing, whereas this structure has four horizontal levels. The lowest is the tower's floor area, which is covered with a vapour-permeable DTB foil and serves as the last catchment area for droppings that fall from higher levels. The second level — about 1.6 m higher — consists of two platforms (yellow on the project drawing) created using OSB panels and boards placed on the tower's trusses. These platforms are covered with linoleum without a raised edge. The third level is only slightly higher (in red on the project drawing) and is made up of a square area inserted between the central vertical beams of the tower. It is also covered with linoleum. The last — the fourth level — is no longer shown in the drawing, but it protects horizontal and inclined beams using DTB foil.

Fig. 6.12: *The lowest level before the cleaning. At first glance, there is a small layer of droppings because the owner cleaned it himself to keep the clock mechanism running (←). Cleaned area of the lowest level — you can see that the space here is narrow. Subsequently, the entire surface was covered with DTB foil (→).*

Fig. 6.13: *A view of the installed OSB panels in the second and third levels. The same place, but already covered with linoleum (←). The third level is covered with black, and the second with white linoleum (→).*

(POVRLY; CZ) Bats in residential homes can be a bigger problem than bats in church attics. This was undoubtedly the case of a house in Povrly, where the roof was renovated, and the bats started to inhabit a very unsuitable space.

The roof consists of shaped ceramic tiles placed on battens. Following the technological procedure, an ordinary vapour-permeable foil was stretched between the battens and the beams. Two hundred female bats (*Myotis myotis*) began to use the space between this foil and the tiles. Their droppings accumulated in this space, which also caused damage to the vapour-permeable foil. As the bats crawled over it, they tore it, and their urine dissolved it. In some places, only remnants of it remained. The residents' requests to use the attic as storage or for drying laundry were incompatible with the presence of bats.

The chosen solution to the problem is at the limit of what the bats can accept — but it makes it possible to save this colony, and at the same time, the attic is available to the house's residents. The hatch is a narrow gap under the northeast gable of the roof, from where the bats reach the middle of the attic. It was decided to create a large shed, separating them from the rest of the space. First, thorough cleaning and vacuuming of the guano, which had accumulated between the vapour-permeable foil and the tiles, was carried out.

After that, it was possible to proceed with the construction of the shed. We started with installing boards, with the help of which the space between the collar ties was thickened — the shed was then built on them. A platform made of OSB panels was then laid over the collar ties, to which we attached side walls made of other OSB panels using battens.

The space for bats was between the shield and the chimney. Part of it was covered with OSB panels, and another part near the roof gable was exposed to the roof tiles. As a result, two sites with different temperatures were created in the shed — warmer near the gable and colder near the chimney. The entire space was enclosed by a front wall with an entrance opening. The bottom of the shed is covered with linoleum. The small gable window was darkened. Since OSB panels are too smooth and would not suit bats, slats with horizontal grooves were installed in the hut.

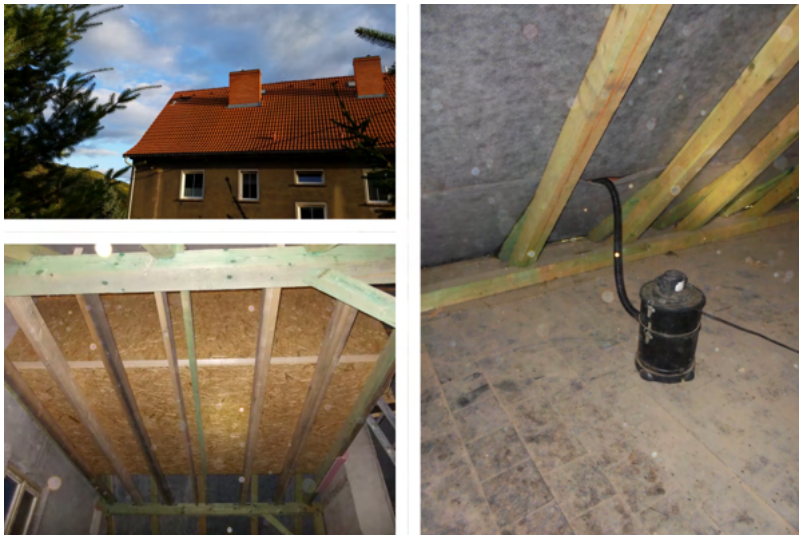

Fig. 6.14: *Direct access to the space between the vapour-permeable foil and the tiles was impossible, so the cleaning only took place with a vacuum cleaner (→). The original collar ties (and clamps) are only the green ones — we had to add the others so that the platform in the shed was safe to walk on.*

Fig. 6.15: *The shed's interior, where the platform is covered with linoleum — in the upper part, there are battens ready for bats to hang. The rear part is warmer and has exposed roof tiles. In the front part, the shed's ceiling is covered with OSB boards so that air flows behind them — this, together with the chimney wall, cools this part (←). A view of the location of the shed on the stilts in the attic. The inventory opening closes and is secured with a padlock (→).*

Fig. 6.16: *We sealed all the joints with polyurethane foam, even between the gable and the tiles. In this way, bats cannot get into the attic space under any circumstances.*

(DUBÁ; CZ) Another tenement house, where the coexistence of bats with residents was dealt with. The situation was simpler here because the attic is two-storey, and the upper floor is hardly usable due to low clearance. We created barriers, mostly just by stapling vapour-permeable foil, sometimes with polyurethane foam, so that the bats only stay on the upper floor.

Another problem was that the bat guano smelled all over the house. Ventilation and using vapour-permeable foil to divide the space isolated this smell only in the attic space — and significantly reduced its intensity. The biggest problem from the bats' perspective was the roof's reconstruction. The original light asbestos roofing was replaced with a new black one. At the same time, the structure was changed to a ventilated roof, but ventilation of the attic space under the ridge was not ensured. Thanks to this, the attic space was overheated. For the bat colony not to disappear, it was necessary to ensure ventilation of the upper part.

Therefore, about nine holes were cut in the lower formwork, which were then covered with a fine mosquito net. This prevented bats from crawling into the joints between the original formwork and the new covering. The measure was implemented in the spring of 2020 only in half of the attic. The rest was left as a warm space (unventilated). During the summer, it turned out that the solution suited the bats.

Fig. 6.17: *Cutting the original formwork with a jigsaw (←). It was necessary to cut and secure the vapour-permeable foil (→).*

Fig. 6.18: *Completed ventilation, where the mosquito net is secured with battens to the original formwork. Already during installation, you could feel the cold flowing air (←). Bats apparently like this measure (→).*

(LAŽANY; SK) The attic of the Roman Catholic Church of St. Imricha in the village of Lažany is only minimally polluted after years without cleaning. In the summer months, there is a colony of the lesser horseshoe bat (*R. hipposideros*) and the Geoffroy's bat (*M. emarginatus*). In the centre of the attic is a footbridge made of massive prisms and boards. When cleaning this space, an industrial vacuum cleaner has proven to be the best and does its job precisely.

Fig. 6.19: *The footbridge and its surroundings are polluted by guano (↑). An industrial vacuum cleaner is a practical tool for cleaning lightly soiled spaces (centre). The resulting state after cleaning the attic and vacuuming the footbridge (↓).*

(HERTNÍK; SK) Cleaning the four levels of the tower of the Roman Catholic Church of St. Catherine of Alexandria with an industrial vacuum cleaner. The tower of the church is used in the summer months by a colony of the greater mouse-eared bat (*M. myotis*). For colony and tower protection, it is necessary to consider building a platform above the bell structure. Otherwise, the laborious cleaning will have to be repeated every year.

Fig. 6.20: *Original condition — guano pollution is severe and damages the wooden structures and the mechanism of the bells.*

Fig. 6.21: *Thorough cleaning with an industrial vacuum cleaner.*

(LESNICA; SK) In huge attic spaces with numerous colonies of the greater mouse-eared bat (*M. myotis*) it is essential to look for ways to clean and remove guano-filled bags easier. In the Roman Catholic Church of St. Michal Archangel, we unloaded bags through the skylight and lowered them down the rope. There was no lack of thorough safety assurance of the worker who performed this activity. In 2012, the Interreg PL-SK international project was implemented here. The most important modernization and renovation works were carried out on the building, and large platforms were built in the church's attic to collect droppings. Walkways made of solid boards also ensured easy access to the platforms and made it easier to carry bags from the entire attic to the roof skylight. Finally, the footbridges were vacuumed with an industrial vacuum cleaner. This way, it was possible to remove 76 bags from the attic — i.e. approximately 1.5 tons of guano.

Fig. 6.22: *Transport of bags filled with guano using a rope.*

(PODHOROĎ; SK) The attic of the Greek Catholic Church of St. Peter and Pavle in the village of Podhorod' is used by a breeding colony of the greater mouse-eared bat (*M. myotis*) of approximately 350 females. The church has a wooden ceiling on which mineral wool insulation is laid and covered with bitumen foil. The segmented metal structure carries the weight of the ceiling. There are two wooden footbridges on the sides.

Bats in this shelter often change their habitat and pollute the central part of the attic along its entire length. Guano also accumulated under the stone wall of the gable wall and the tower wall — this is where the entrance to the tower is located. Due to the problematic removal of guano from insulating materials, we decided to build a large-scale platform to catch the droppings. The space was previously thoroughly cleaned — at the same time — metal parts were dried, rust removed with wire brushes and metal treated with an anti-corrosion coating.

Fig. 6.23: *The original condition of the attic. The foil in the background was originally used to catch guano. However, it prevented the necessary air circulation. Also, condensation caused wetting of the insulation. It was removed and replaced with a platfrom. Construction materail were transported into the tower through a small window. The rusting structures were cleaned with wire brushes and treated with anti-corrosion paint. Above the entrance to the tower, a platform made of spruce boards with an area of more than 70 m^2 was installed. It includes two service holes.*

(ĽUBOVEC; SK) The attic and the tower of the Greek Catholic Church of the Nativity of the Virgin Mary in the village of Ľubovec is inhabited by several bat species. The tower has a breeding colony of the greater mouse-eared bat (*M. myotis*) of approximately 300 females. The attic space is used by a colony of Geoffroy's bat (*M. emarginatus*), the lesser horseshoe bat (*R. hipposideros*), and the greater horseshoe bat (*R. ferrumequinum*). Only occasional cleaning is sufficient in the attic, in the tower was a problem with heavy contamination of the truss, the bell mechanism and the bells themselves. The guano fell to the bottom of the tower. In 2022, the construction of the platform was planned. Wooden boards were laid on beams and prisms. Due to the necessary air circulation, a gap of approximately 50 cm was left around the entire perimeter between the platform and the walls. There is also one service opening for cleaning and truss inspection.

Fig. 6.24: *The original state of the church tower contaminated by guano (↑). Cleaning the space under the platform and the bells with an industrial vacuum cleaner (centre). A platform for trapping guano was built above the bell structure (↓).*

(BŽANY — recreation area of Valkov; SK) On the shore of the Domaša water reservoir in the recreation area of Valkov, there is a small church — the Church of the Protection of the Blessed Virgin Mary with the largest known colony of Geoffroy's bat (*M. emarginatus*) in the world. The breeding colony consists of approximately 2000 females and their young. The back space of the attic, where the guano accumulates, was complicated to clean due to the broken brick vault, beams and a layer of construction debris in the base of the vault. In 2021, we decided to build a platform. Its surface was subsequently treated with a protective coating *lignofix* against fungi and pests. Since this is an area visited by tourists, an information panel was also installed in the location about the occurrence of bats and their importance for the ecosystem..

Fig. 6.25: *Transport of material for the platform construction (←). Maternal colony of Geoffroy's bats (M. emarginatus) in the attic of the church (→).*

Fig. 6.26: *The original contamination of the vault and its surroundings by guano (←). Foundation of the platform and adjusting its height above the vault (→).*

Fig. 6.27: *The finally assembled platform in the back part of the attic - the place where the colony of bats gathers (←). Underpinning the prisms with columns from board scraps (→).*

Fig. 6.28: *Panel with information about the bats in the church's attic and their importance to the ecosystem.*

(PRIEKOPA; SK) In the summer months, the attic of the Greek Catholic Church of the Nativity of the Blessed Virgin in the village of Priekopa is inhabited by smaller colonies of two species of bats - the grey long-eared bat (*Plecotus austriacus*) and the serotine bat (*Eptesicus serotinus*). Contamination with droppings is not significant, but mineral wool insulation is laid on the vault along the entire attic, making it impossible to vacuum. In 2022, we put a vapour-permeable foil over the insulation, separating the falling guano from the insulation and making cleaning easier. The droppings on the surface of the foil dries effectively and can be easily swept or vacuumed.

Fig. 6.29: *Insulation contaminated by guano. Cleaning such surface is practically impossible (↑). A loosely laid vapour-permeable foil that separates the falling guano from the insulation and facilitates cleaning in the future (↓).*

(KALINOV; SK) The attic of the Greek Catholic Church of the Dormition of the Blessed Virgin in the village of Kalinov is used for reproduction by smaller colonies of two species of bats - the greater mouse-eared bat (*M. myotis*) and the lesser horseshoe bat (*R. hipposideros*). Similar to the temple in the village of Priekopa, there is no significant pollution here. Still, cleaning such space is impossible by blown cellulose insulation, which covers the vaults in the entire attic. In 2022, we laid a vapour-permeable foil in the middle of the attic and its back part. It separates the falling guano from the insulation and thus allows the area to be cleaned.

Fig. 6.30: *Insulation contaminated by guano. Cleaning such space is practically impossible.*

Fig. 6.31: *Covering blown-in insulation with a vapour-permeable foil - separates the falling guano and enables cleaning.*

6.2 Adjustment of flight entrances

Maintaining flight entrances is key to protecting any bat colony. Any structural intervention can be very problematic from the point of view of the flight entrance, and it is necessary to pay a lot of attention to it. The following pages will present several options for taking care of flight entrances.

(ČESKÝ DUB; CZ) It would seem that a circular window with a diameter of 80 cm is ideal for bats to fly into the attic — but this is not the case. Female bats — especially when they are pregnant or flying with a cub — also sit in such an opening and climb over its lower edge. At this location, however, during the reconstruction, they installed a metal parapet in the window, which was slippery and made it impossible for bats to land and climb. This subsequently led to the extinction of the large colony of the greater mouse-eared bat (*M. myotis*). Therefore, a wooden slatted grate was additionally installed over the metal parapet. Thanks to this measure, a few individuals returned to the site.

Fig. 6.32: *Wooden slatted grate in the circular window.*

(KVÍTKOV; CZ) The roof covering was replaced on the municipal office building of the village of Kvítkov. Although the same type of covering was used (ceramic roof tiles), it was a fundamental change for the bats. The old tiles were porous on the surface with a rough surface. However, the new one is glazed and smooth. Therefore, a wooden slatted grate was installed in the flight entrance. The grate was secured with a wire that can be easily fixed under the tiles.

Fig. 6.33: *Wooden slatted grid fixed with wire under the roof tiles.*

(VYSOKÉ VESELÍ; CZ) The flight entrance was originally a crack above the wall under the roof. But the window under the ridge near the chimney was torn off by the wind, and nobody repaired it for quite a few years. Bats gradually got used to this hole and started using it as the main entrance. That's why we made a special dormer that can be folded down (for the chimney sweep's access to the chimney), prevents water from flowing in when it rains, and at the same time allows bats to get inside. The dormer is also provided with a mesh grate and covered with asphalt shingles on the outside and inside, which is rough enough for bats to climb.

Fig. 6.34: *A hinged dormer allows bats access to the attic.*

(BRANDÝS NAD ORLICÍ; CZ) This site has a colony of Geoffroy's bat (*Myotis emarginatus*). During the reconstruction of the attic apartment, a roof dormer was made to replace the missing original flight entrance leading through the broken window. This should allow better access for bats. The dormer is equipped with a strip of asphalt shingle, which serves as a surface on which bats can land and easily climb inside. An unplanned board is also prepared inside as a landing surface when climbing through the dormer window. The dormer is elevated so that after the roofing is changed to metal-shaped strips during the roof repair, the dormer will continue to be fully functional for bats.

Fig. 6.35: *A dormer as a replacement for a missing flight entrance.*

(LOBENDAVA; CZ) We mentioned the platform in this church in the previous chapter. The problem with the flight entrance — the oval window in the church tower through which the pigeons got in — was also solved here. We made an insert for the window with blinds from unplanned boards. The centre louvre is even extended inward as a landing pad for bats. The insert is anchored only with wedges and has a 3 cm wide gap around the perimeter, which allows bats to climb into the tower and up the wall.

Fig. 6.36: *Insert blinds from unplanned boards. The same solution, which effectively prevented pigeons from flying in, was implemented in the attic of the church in the village of Rožňavské Bystré (SK; →).*

(BĚLÁ POD BEZDĚZEM; CZ) The flight entrance does not have to be the only access to the attic from the outside. In this case, bats enter the church through the louvred windows in the tower and climb into the attic along the door. This door connects the space in the tower with the attic. For easier access, we created two circular and one rectangular opening in this door with a bat. This measure was also successful.

Fig. 6.37: *Flight entrances placed in the door.*

(SILICKÁ JABLONICA; SK) The attic of the reformed church was an important shelter of a mixed colony of about 300 bats, which consisted of the species of Geoffroy's bat (*Myotis emarginatus*), the Mediterranean horseshoe bat (*Rhinolophus euryale*) and the greater horseshoe bat (*Rhinolophus ferrumequinum*). Occasionally was present also serotine bat (*Eptesicus serotinus*). In the late 1990s, pigeons began to penetrate into the attic through the oval windows on the gable walls. The parish decided to protect the area from pigeons by installing a mesh. However, this inappropriate measure significantly impacted the bat colony, preventing access to the attic. The mesh (used for raising rabbits) even acted as a trap. Some individuals got caught and subsequently died trapped in the mesh. The colony broke up or was forced to find a new shelter. Some individuals inhabited a small space in the tower, where it is very difficult to ensure regular cleaning. At the end of the winter of 2022, we replaced the mesh with suitable flight openings — wide blinds made of unplanned wooden boards, which will allow the colony to return to the shelter and, at the same time, protect the attic from pigeons.

Fig. 6.38: *Church in Silicka Jablonica (↑). The mesh acted as a trap for bats and caused their deaths (←). Wide blinds made of unplanned wooden boards (→).*

(OČOVÁ; SK) In the tower of the Evangelical church in the village of Očová, there is a colony of the greater mouse-eared bat (*Myotis myotis*) of approximately 1000 females. Individuals fly through a gap between the slightly open wing of a metal blind on one of the tower windows. In 2020, we decided to create more flight entrances on three windows by sawing off one or two slats of the blind and fixing a wooden frame with a slot through which individuals can climb. The bats will get used to the new entrances over the next few months, and if the blinds on the windows need to be closed entirely in the future, the bats have these alternative entrances available.

Fig. 6.39: *Flight entrance in metal blinds.*

(ĽUBOVEC; SK) We can also afford larger flight entrances in a location with no problems with pigeons. The attic and the tower of the Greek Catholic Church of the Nativity of the Virgin Mary in the village of Ľubovec are inhabited by several species of bats - the breeding colony of the greater mouse-eared bat (*M. myotis*), Geoffroy's bat (*M. emarginatus*) and the lesser horseshoe bat (*R. hipposideros*). We chose to create a spacious flight entrance in the new window blinds.

Fig. 6.40: *Flight entrance in new window blinds (planned in advance).*

(HRABOVČÍK; SK) Bats often fly through the gaps between the slats of the window blinds covering the church towers' windows. The surface of metal or new varnished wooden blinds is usually too smooth, making the emergence from and arrival to the shelter much more difficult for bats. In such a case, it will help to apply paint or material with a rougher surface to one or more slats so that the bats can get a better grip when landing on the blind and climb through faster. We used a cut fibreglass mesh glued in spots with an adhesive suitable for exteriors and resistant to UV radiation. The net must be sufficiently close to the slats. It must not flutter freely in the space so that bats do not become entangled.

Fig. 6.41: *The fibreglass mesh allows bats to land on the blinds. It is glued with UV-resistant glue.*

(TRHOVIŠTE; SK) A crack is enough for large bats to crawl through, ideally if it is situated in connection with a stone wall or a plastered window pane where the surface is rough. Even with a piece of plexiglass, it is possible to reduce the flight entrance where there is a problem with the appearance of pigeons and where it is required to preserve the original lighting conditions in the tower.

Fig. 6.42: *Flight entrance reduced by plexiglass.*

(SZCZYRZYC; PL) Sunlight and street lights penetrating the bat roost from outside can limit the amount of attic space available to the animals. Therefore, constructing different types of covers for the flight entrances is important for protecting bats in attics. They are used in dozens of locations with the occurrence of lesser horseshoe bats (*R. hipposideros*) in Poland.

Fig. 6.43: *A shelter constructed of wooden boards with a dark coating in the attic of the Cistercian Abbey, including a shading screen for the shelter's interior.*

Fig. 6.44: *Shade screen on the bat flight entrance. At the same time, the modified flight entrance protects the bat shelter from predators (martens, owls) and prevents pigeons from entering the attic.*

6.3 Other types of measures

Fig. 6.45: *On hot days, bats like to cool off on walls and the walls of chimneys. To reduce the amount of guano on the floor, an OSB panel can be attached to the chimney using laths and dowels (Vysoké Veselí; CZ; ←). If the stand is too close to the wall and it is difficult to clean behind it, we can use an additional board in the place where the gap widens (Horná Police; CZ; →).*

Fig. 6.46: *This plastic strip is not installed to trap guano — it has a different purpose. The site had a problem with martens that kill bats. However, the martens could only get to the bats using a ladder. The slippery 1.5-meter-long plastic is an insurmountable obstacle for any marten (Frýdlant; CZ).*

Fig. 6.47: *Electrical installation, fire detectors — if installed under bats, they are very difficult to clean. It is, therefore, advisable to cover them with DTB foil (Horná Police; CZ).*

Fig. 6.48: *For smaller colonies or in small tower spaces, it is sufficient to divert the impact of droppings. In this case, bat guano falls from a hole in the vault in the church tower onto the floor where the bell mechanism is located. The board is used to deflect the impact of droppings away from these structures - concentrated droppings in this way can be removed more easily (Vyšná Kamenica; SK).*

Fig. 6.49: *Large bat colonies negatively affect attics, where the vapour-permeable foil is stretched under the roofing. At the same time, they pose a significant risk for bats - they tear them unintentionally with their claws and get caught in the damaged foil. Especially the young ones, they often get entirely entangled and die. This is an example of severe damage to foils in the attic of a church by a colony of the greater mouse-eared bat, the size of 2500 females. Damaged foils had to be removed (Sačurov; SK).*

Fig. 6.50: *The habitat choice of bats in the attic can also be guided by the additional construction of elements for holding and hanging individuals. In this case, it involved the installation of battens from the underside of the rafters so that bats do not damage the vapour-permeable foils. This measure can be efficient and effective, for example, in colonies of lesser horseshoe bats.*

Fig. 6.51: *Improving the shelter for bats can also consist in hanging the boxes in the attic. Wood-concrete boxes or boxes made of unplanned boards will provide a stable shelter for crevice bat species, in which the individuals will feel safe from predators.*

Fig. 6.52: *One type of micro shelter in the attic of the abbey is in the form of a small built-in space in a large attic. The floor is protected from guano by vapour-permeable foil (Szczyrzyc; PL).*

Fig. 6.53: *Another type of micro shelter installed in a former primary school is a built-up space in the roof's gable that ensures a stable microclimate and darkness in a large and well-lit attic space (←; Wojkova; PL). A micro-shelter "chandelier" in the attic of the church is made of a ceramic pot, which is especially popular with the Geoffroy's bat (→; Jaworzna; PL).*

Fig. 6.54: *Microshelter - stone tile located in the building of the marble factory, specially designed for the lesser horseshoe bat. It is suitable for installation horizontally or on the inside of roofs - or in other micro-locations (Szczyrzyc; PL).*

To effectively protect bats, it is essential to cooperate with the owners and managers of buildings and, last but not least, to express gratitude for accepting the presence of bats in sacred buildings. For this purpose, we awarded several dozen locations with a significant occurrence of bats with a "Bat Friendly Object" plaque of thanks, which represents the occurrence and protection of the colony and the preservation of this unique shelter for the colony in the future.

Fig. 6.55: *Plaque on the Parish Church of St. Martin in the village of Lemešany (↑). Presentation of the plaque of the Roman Catholic parish of St. Michael the Archangel in Lesnica (centre). Presentation of the plaque of the Greek Catholic parish in the village of Čabiny with the entire team of workers who participated in cleaning the church attic from guano (↓).*

Funding sources of the presented measures:

Several sources supported the implementation of the measures in the Czech Republic. One of them was the PPK program (Landscape Care Plan), which is financed by the Ministry of the Environment of the Czech Republic and is distributed through its service organization AOPK ČR (Nature and Landscape Protection Agency of the Czech Republic). This program is divided into two parts: PPK-A – finances allocated by individual PLA administrations (Protected Landscape Areas) in the form of a work contract, and PPK-B – the so-called a free country, where finances are allocated in the form of a subsidy for measures implemented only outside the PLA and NP.

Another significant source of support for these measures was subsidies or direct support from regional authorities, especially from the Liberec region, but also from Ústí and Central Bohemia. The source was also the ČSOP (Czech Union of Nature Conservators) Biodiversity program, where resources from the Ministry of the Environment, Forests of the Czech Republic, and other sponsors are pooled. Funds from this program were provided as subsidies.

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The presented modifications or examples from practice from Poland were developed by the Polish Society of Friends of Wild Animals "pro Natura" and installed within the LIFE PODKOWIEC+ project activities (LIFE12 NAT/PL/000060) between 2014 and 2018. These are proven solutions that bats depending on the location. They use it in the first or subsequent seasons, sometimes after 2–4 years. They are versatile and can be applied according to the specific needs arising in the shelter, while their parts are adjusted accordingly.

The ongoing LIFE PODKOWIEC TOWERS project (LIFE20 NAT/PL/001427) from 2021 to 2026 will develop adaptive solutions for bats installed in brand new, purpose-built bat shelters located in forests, such as bat towers, but also cabins and winter quarters.


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