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BAT GATE MODIFICATIONS AND NEW DESIGNS

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ABSTRACT

Bat gates have steadily evolved to provide increased security while becoming more ecologically transparent. Recently-developed modifications to the standard horizontal bat gate include cupola gates, flyover (or half) gates, bay-window gates, chute gates, and combinations such as a bay window with a chute. Gate location is critical, and the numbers of bats and timing of cave use are critical to the design. Engineering becomes more complicated with modifications, and novices should consult with experts before attempting to construct any bat gate. But almost any bat colony in any type of cave or mine can now be protected by a secure gate without negative impact to the cave ecosystem.

CHANGES IN THE BASIC DESIGN

Two major changes in the basic design have occurred since the last set of plans were revised (Bats and Mines, 1994). The first is the simplification of the locking mechanism by eliminating all moving parts and by moving the lock box to the front of the gate. This change reduces construction time, and is at least as secure as the old mechanism (FIGURE 1).

Figure 1. Lock box with Removable Bar removed for clarity. Photo by Jim Kennedy.

The second change is the basic design of the sill. Originally the sill was made of a 6" x 6" x ½" angle that was set level across the passageway with the back (away from the entrance) leg down. When slopes, such as walls or large pieces of breakdown, were encountered, the sill was stepped. The sill was supported by vertical legs with footers perpendicular to the sill (FIGURE 2). The main reason for this type of sill was to allow the gauging system (to accurately space horizontal bars) to work properly. The area of the footprint of the footers had to be large enough to support the load (weight) of the gate. Advancing technology and techniques now allow the sill to follow the contour of the floor. New gauging and accurate laser levels now allow the use of 4" angle rather than the previous 6" angle. The sill now lies with one side in contact with the mine or cave floor with the back leg up. The columns are welded to the back of this vertical leg. If the sill is

Figure 2. Old-style level Sill at McDowell Cave, Missouri. Photo by Jim Kennedy.

not in contact with bed rock, the sill is placed on a section(s) of EM-3 expanded metal (FIGURE 3). 4" x 4" x ⅜" angle may be attached perpendicular to the sill to stabilize the sill and to further distribute the load when necessary. Since the 6" angle was the most expensive component of the gate, and stepping of the sill is time consuming, the cost of most gate installations is reduced.

The third change, and a major one, is the modification of the original Basic and Cupola-style gates to accommodate entrances that are not entirely horizontal, nor entirely vertical. These modifications still allow for unimpeded airflow and maximum flight area for the bats, especially summer colonies of gray bats. These new designs are described and illustrated in the following section.

An additional change in the treatment of the gates is suggested. For various reasons it becomes necessary to replace some of the earliest gates with more modern ones. Problems have occurred during their removal because of the paints used on the structures. Some paints emit very toxic fumes when heated, endangering workers and polluting the cave or mine environment. For this reason, the use of cutting torches is sometimes dangerous and often impossible. The use of paint also requires frequent servicing and repainting. However, unprotected mild steel holds up well over long periods of time (decades) in most cave and mine environments and mild steel

Figure 3. New-style sloping Sill supported by Footers on Expanded Metal Grating in Beans Cave, Virginia. Photo by Jim Kennedy.

oxidation presents no hazard to the internal environment. For these reasons we recommend that gates NOT be painted, but if necessary, then only external gates be painted and only those where the geometry of the entrance will not allow paint contaminates (paint flakes, fumes, and dissolved paint chemicals) to enter.

NEW TYPES OF GATES — THE BASIC GATE FAMILY

Over the past few years several new designs, all versions of the basic angle iron gate, have emerged. With the understanding that the use of a gate is related to the bat population all of these designs are attempts to increase the unrestricted area of the gates.

The Shielded Gate — *(also known as Half Gate or Flyover Gate)* This is not really a new design but a variation of one which has been used before. The difference is the strength and security that it offers. Where the passage at the gate site is high, a standard gate is constructed with a shield at the top to prevent entry. The shield extends several feet in front of the gate and is constructed of expanded metal. This shield may be horizontal, angled, or vertical. The geometry and air flow characteristics of the passageway determines the angle of the shield. The vertical shield offers the most security and is the easiest to install but can cause some restriction of air flow if installed in the wrong place. The horizontal shield will not restrict air flow but be installed high enough to discourage the use of scaling devices (logs, small ladders, etc.). Extending the shield behind the gate is a big deterrent to use of scaling devices (FIGURE 4).

The Bay Window and Offset design — Although the angle iron gate does not restrict air flow it may reduce the available flight area, depending on the geometry of the entrance. One way to restore this area is to use these modifications. The offset design has been successfully used many

times. It can be as simple as angling the gate across the passage to increase the area of the gate. It can also consist of two sections angled to form a "V" (FIGURE 5).

Figure 4. Shield (both inner and outer) at top of Flyover Gate at Sauta Cave, Alabama. Note the use of temporary welded angle-and-plank scaffolding, which will be removed later. Photo by Jim Kennedy.

Figure 5. "V" gate providing additional flight space and allowing bats to avoid predators at Campbell Cave, Kentucky. Photo by Jim Kennedy.

The Bay Window design is a variation of the offset design and has several uses. The main uses of this design is to increase the flight space, and it also may be used to provide support for the cantilevers of the Chute-type gates, which are addressed later in this paper. If space permits, it may be used internally. If space does not permit it may be installed externally by placing a top on it. Do not use the top area in calculating the flyway area. Although some few bats will use the top, most seem to prefer horizontal exits.

Figure 6. Looking out the Bay Window Gate (here supporting a Chute) at Alexander Cave, Missouri. Note the increased surface area and therefore increase flight space. Photo by Jerry Fant.

The Chute Gate — Chute gates are used at sites which have very large populations such as gray bat maternity sites, or at sites where there are very small flyways. The Chute can be combined with a Bay Window or Cupola, which serves the function of increasing the flyway and supporting the cantilevers of the Chute. The Chute is angled upwards to a height which discourages entry from below. The top and sides of the Chute are extended beyond the floor to prevent entry from the sides or top. This is the most technical of all gate types and the most difficult to construct, and should only be attempted by very experienced bat gate builders.

The Window Gate — The Window Gate is a variation of the Chute Gate. It is used internally where there is sufficient width and ceiling height. The ceiling of the cave is the top of the "chute", and the sides are shielded. Use of this design permits full vertical column support and often permits easer side closure than a Shield-type of gate. This is also a difficult gate to build.

Figure 7. Chute Gate under construction at Bat Cave, Missouri. Photo by Jim Kennedy.

Figure 8. Window Gate on Bacon Cave, Virginia. Note that cave roof overhangs the Window, alleviating the need for expanded metal grating at the top. Photo by Jim Kennedy.

NEW TYPES OF GATES — THE CUPOLA GATE FAMILY

The Semi-Cupola Gate — A Cupola Gate is really just four Basic Gates arranged like a box, with a roof of either 4" angle-iron bars or expanded metal grating. A Semi-Cupola, therefore, is a cupola lacking one or two of the four sides (FIGURE 9). These are best for hillsides and sinkholes where the entrance is not quite vertical, but you still need to allow the bats lots of flight space and have extra surface area to prevent the build-up of leaf litter that may restrict airflow. This design is also useful for boxing around very small entrances that could be predator-prone with a traditional Basic gate, thereby giving emerging bats more directional options (FIGURE 10).

Figure 9. Semi-Cupola gate with angle-iron top at Zipper Pit, Virginia. Photo by Jim Kennedy.

The Folded Gate — This design takes the Semi-Cupola one step further, and only has a single side and a top (FIGURE 11). They are great for small sinkhole entrances used by a relatively small number of bats, but still essential for the cave microclimate.

The Flat Gate — If we take this concept to its inevitable final step, we now have a Flat Gate, which is a Cupola Gate with no sides at all (FIGURE 12). These gates may need to have a small bit of infrastructure constructed below to support a side or two, and to fill in any irregularities of the ground surface. But they are essentially flat on the ground and do not provide adequate flight space for bats. They are important, however, in restricting access through a particular opening while maintaining essential natural air movement through the underground ecosystem.

Figure 10. Semi-Cupola Gate being constructed over the very narrow entrance to Stay High Cave, Virginia. Photo by Jim Kennedy.

Figure 11. Folded Gate with angle-iron roof under construction at Dunbar Sandstone Mine #2, Pennsylvania. Photo by Jim Kennedy.

Figure 12. Flat Gate on Roadside Sink D, Texas. Photo by Jim Kennedy.

Conclusions — While the standard Basic Gate and Cupola Gate designs have been utilized for many years and have been proven to be highly effective in protecting important bat caves and allowing colony sizes to increase, they just don't work in all situations. These common-sense modifications of these designs, along with a few recently-developed design changes and new techniques, now allow us to afford the same level of protection for every cave and mine entrance encountered. All maintain critical airflow and have no impact on the cave microclimate, and have increased surface area to provide safe ingress and egress for bats.