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GENERAL CAVE GATE CONSIDERATIONS

Roy D. Powers, Jr.
Assistant Professor, Electronic Engineering Technology
Mountain Empire Community College
Big Stone Gap, Virginia

ABSTRACT

The requirements for effective cave gate designs that let the bats and other cave creatures in and out of the cave but keep unwanted people out, are listed and explained. The psychological factors in cave gates are explained in ways that would help one prevent attempts to reach the gate. Features that make cave gates difficult to circumvent will be demonstrated. The trade-offs of weak links versus medium strength weak links and the no true weak links methods will be compared, as well as other alternatives such as supervision, fencing, and other barriers. Cave protection situations where fences would be more desirable than gates, situations where no barriers are needed and situations where gate supervision may be required, are all weighed from a cost-effectiveness point of view.

INTRODUCTION

A cave should be gated only as a last resort and when other methods of protection will not suffice. Once it is determined that a cave must be gated, a careful determination must be made as to the type of gate to be selected.

Cave gates exist in three general categories, which are listed and defined below:

Type1 -- The token protection gate. Gates in this category provide little or no resistance to breaching. This type of gate may be violated with little effort, requiring no tools to effect entry. An example of this type is the fence gate.

Type 2 -- The minimum protection gate. Gates in this category require tools and greater effort to breach than the Type 1 gate. This type of gate may be breached with boltcutters, hacksaw, scissor jack, and possibly sledge hammers.

Type 3 -- Maximum protection gates. This type of gate requires a maximum of effort and specialized tools to effect breaching. This type of gate is engineered to defeat the most persistent type of vandal. It may have a reinforced concrete foundation integrated with a massive sill plate, and a heavy steel framework tied to the top, bottom, and sides of the passageway. The locking device and hinge pins are protected. All exposed edges of the steel framework, which might be attacked by hacksaws are hardened. Special tools such-as -cutting torches are required to defeat this type of gate.

DESIGN CONSIDERATIONS

The cave should determine the design of the gate. Most caves do not fall in the category of being "bat caves". This is not to say, however, that in the future bats will not elect to use them if they are available. It is suggested that all caves which have the possibility of future bat occupation be gated as if they were bat caves. The difference in construction cost and effort required to install a gate which is acceptable to bats is small. As population in caving areas increase, the traffic in the caves will increase, and it is conceivable that only a previously gated cave is acceptable to a displaced bat population.

EXPENSE

Cost is one factor which has, too often in the past, played a major role in determining the type of gates installed in caves.

A cave gate should be well thought out and properly designed before expense should enter into the design considerations. There are many engineering and cost trade offs that can be made, but these tradeoffs should have major considerations only at the last stage of design. Financing exists now from many sources. Several organizations exist which make funding for gates available. Among these are the Nature Conservancy, Cave Conservancy of the Virginias, the Fish and Wildlife Commission, and other state agencies. In some instances, the property owner himself is willing to share all or some of the cost. The materials for Madison and Fountain Caves (Augusta Co., Va.) were purchased by the owners. Large and small companies alike are willing to donate material. Southern Railroad, for example, has recently donated 300' of railroad steel to the Cave Conservancy of the Virginias to be used for gating projects. Individual donations are also a possibility. The steel for the Unthanks gate (Lee Co., Va.) was donated by an individual. Another source is the caving community itself. Fund raising projects by grottos and regions of the N.S.S. are distinct possibilities.

LOCATION

Location of the gate is determined by the geometry of the cave and the location of the features that are to be protected. There is no set rule to the location of the gate. There are advantages and disadvantages to any location. A gate at or near the entrance makes it easier to construct, maintain, and patrol. It also exposes the gate to many people who visit the front part of the cave and in some cases, visitors who would not normally visit the cave. A gate located in or near the entrance also exposes bats who are using the cave to predation by limiting their speed and maneuverability. A gate located a distance from the entrance has the disadvantage of more difficult construction and maintenance. It is more difficult to patrol and also gives a measure of privacy to the vandal intent on forced entry. It does, however, have the advantage of discouraging predation of bats and limits the exposure of the gate to a smaller population of persons entering the cave.

Cross-sectional area of the passageway is also a factor governing gate location. It is obvious that the larger the cross-sectional area, the greater the cost and effort required to construct the gate.

It has been standard practice in the past to gate the smallest cross-sectional area for the reasons given above. In addition to these reasons, the rational has been that this gives the vandal less room in which to work. This rationale may be correct, but it should not be a design consideration. A small work area makes it very difficult to properly construct a gate. The location should be chosen to facilitate proper construction as much as possible.

If the features to be protected are remote or if they are contained in a discrete section of the cave, then the location of the gate should be chosen to keep as much of the cave open as possible. There is much opposition to gating from members of the caving community and from sport cavers alike. A gate should serve only to protect some feature or animal. Many gates that have been installed, restrict traffic through large areas and in some cases, whole caves, unnecessarily. This is very bad relations and can be avoided in many cases.

The final factor governing the location of the cave gate is air flow. Air flow must not be restricted in any way. One way of minimizing the effect of the gate on the air flow is to choose a location which lies between two cross-sectional areas that have greater restrictions than the gate. An example is the General Davis gate in Greenbrier Co., West Virginia.

GATE GEOMETRY

The size of the openings in the gate have been very well defined. A gate should have openings with a minimum vertical height of 6" and a minimum horizontal width of 24" (Tuttle 1976). This is the accepted minimum size opening that will permit bats to enter and exit flying. It is fortunate that the 6" dimension will effectively limit passage of the majority of the human population. Vertical bars have a greater disturbing effect on bats than horizontal bars. It is, therefore, desirable to have as few vertical bars as possible. The distance between vertical bars is governed by the strength and rigidity of the gate material.

AIR FLOW

There are many factors governing air flow in a cave system. Among these are volume, crosssectional area and shape, elevation differences between entrances, outside barometric pressure, and entrance size.

Temperatures within a cave are governed, in part, by the air flow in and out of the cave. Bats choose a particular cave for a variety of reasons but the main reason appears to be the temperature. If the air flow is altered, the temperature within is altered. Air flow also governs humidity, which not only affects the biota, but formations. For these reasons, it is of major importance that the air flow be unaltered.

Air flow is poorly understood by gate designers, gate builders, and speleologists. The greatest misconception is that air flow is proportional to cross-sectional area. This is not true of low to medium air velocity.

It is not yet determined how much restriction versus air velocity is permitted before air flow is seriously affected. It is conceivable that at low to medium velocities 20% is feasible and perhaps up to 40% at low velocities is acceptable.

The easiest way to address the air flow restriction problem is to design the gate so that air flow is not restricted but simply redirected. A design of this type is shown in Figure 1.

The air approaching the front of the gate is deflected upwards instead of being blocked, as it would be if the air encountered a flat plate normal to the air flow. This type of design would work well at even high velocities.

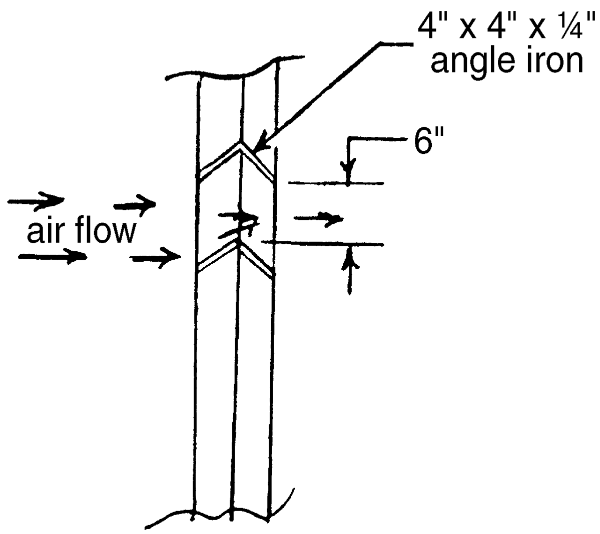

Figure 1

The cross-sectional area of the gate is effectively the sum of the area of the edges of the individual plates.

The use of angle iron permits greater spans, reducing the number of columns required. The square columns in this type design are rotated so that they deflect rather than restrict the air flow. One word of caution on using this type of design is that on 6" vertical spacing, the maximum size of angle iron should not exceed 4" on the back leg. If this dimension is exceeded, the air at high velocities may strike the back leg normal to the surface.

Using a design of this type along with careful location choice should solve all but the most severe air flow problems.

OTHER DESIGN CONSIDERATIONS

Water is the enemy of the gate. Water can cause locks to fail, hinges to freeze and the gate material to rust. The completed gate should be protected by paint or other preservative. Locks and hinges should be protected from direct moisture. Maintenance for any gate should be performed on a regular basis.

THE ACTIVE GATE

With the advent of inexpensive solid state low power electronics, a fourth type of gate is now feasable. The active gate is one which actually becomes active when the presence of people at the gate is detected or if a violation of the gate is attempted. Such a gate could deliver a harmless shock, sound a remote alarm or photograph the vandals. A gate could be designed to remain open until approached and then shut. Unlimited possibilities exist, depending only on the imagination and skill of the designer.