

Proposed Design and Considerations for Use of Amphibian and Reptile Tunnels in New England

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2003

Based on experience with salamander tunnels used in Amherst, MA, and knowledge of other amphibian tunnels in Europe and elsewhere the following underpass design is proposed for facilitating overland passage of amphibians and reptiles (See figures 1, 2 and 3). It is important to note that this design has not been extensively tested and that future work may indicate the need to significantly change this design.

1. The tunnel should be in the form of a box culvert at least 2'x 2' square and should be the minimum length necessary to accommodate safety issues and achieve other design features. The culvert would most likely be made of concrete although other materials are probably acceptable. A proper base must be used to prevent disruption of the road surface due to frost heaves.
2. The tunnel should be open at the top and fitted with an iron grate that would sit flush with the road surface. The iron grate must allow ample rain, light and air circulation into the culvert.
3. Sandy soil (sandy loam) should be used to cover the bottom of the tunnel to provide a more natural substrate for travel.
4. Wing walls should angle out from each end of the tunnel at approximately 45 degrees.
5. Vertical retaining walls at least 18" high should angle out away from the wing walls at a broad angle for a length of 100-200 feet. The tops of these retaining walls should be flush with the ground surface on the side closest to the road, and present a vertical surface to migrating animals at least 18" high.
6. Ideally, crossing structures should be placed no more than 200 feet apart, although for many species a greater distance between structures may be acceptable.

It is important to note that amphibian and reptile tunnels are experimental techniques for conservation. In New England we know that they work for spotted salamanders. We suspect that they will work equally well for other mole salamanders if they are well designed. A recent study in California of mole salamander use of tunnels indicated that the tunnels were ineffective, probably because the fence system was parallel to the road and failed to adequately funnel salamanders to the passage structures.

A 2'x 2' tunnel is actually quite small with a very small openness ratio (cross-sectional area divided by length). It is hoped that the inclusion of an open top (essential for meeting the moisture requirements of many amphibians) will help compensate for the confining nature of these passages. The challenge of highway mitigation is always a matter of getting the most out of limited mitigation dollars. Because many amphibians and reptiles have limited mobility there are considerable drawbacks to concentrating mitigation efforts at a single location. If they prove effective, small low-

cost reptile and amphibian structures would make it more practical to create multiple structures, perforating sections of roadway rather than relying on single passages.

Preliminary tests have indicated that this tunnel design may work for painted turtles, but that fence designs for turtles must be carefully considered. A very large tunnel is reported to be used by spotted turtles in Eastern MA. There are early indications that a tunnel and wall system in eastern MA does not work for Blanding's turtles, even though the tunnel is quite large. In Europe, toads and newts will use tunnels. These structures have not been adequately tested for other species such as small mammals (shrews, moles, voles, etc), snakes, box turtles and several other species of turtles (wood, spotted, snapping etc.).

It is known that particular design features may be necessary to facilitate tunnel use by certain species. Size, placement, moisture, hydrology, temperature, and noise have all been demonstrated to affect wildlife use of underpasses. Until a tunnel design is tested for a wide variety of species they are not recommended for wide application. If the tunnel does not meet the needs of a wide variety of species fences, necessary to channel some wildlife to the tunnels, may actually act as barriers to movement for other species.

Therefore, tunnels are only recommended when:

1. There is a documented need
 - Is there a known population at risk?
 - Is there a known crossing point?
 - Are rare species involved?
 - Will traffic volumes be high enough to represent a serious threat?
 - Are we dealing with a species that is vulnerable to additive mortality from roads (e.g. species characterized by low reproductive potential and high adult survival rates like turtles and mole salamanders)?
2. The benefits for a particular species outweigh the risks to other species that may have their movements blocked if the tunnels don't function as intended.
3. The tunnel system is carefully designed, located and constructed.
4. An adequate maintenance plan is in place.

Until tunnels have been tested and shown effective for a range of small wildlife, use of tunnels is not recommended for most sub-division or light volume access roads.

For smaller roads and driveways, the most important design feature to consider is curbing. Granite curbs and some traditional curbing can act as a barrier to amphibian and hatchling turtle movements. In MA and Canada large numbers of salamanders have been intercepted in their migrations by curbs and catch basins. Use of Cape Cod berms rather than traditional curbing may be one solution. Alternatively, where storm water management systems require more traditional curbing, it may be possible to design in escape ramps on either side of each catch basin.

Use of large embedded culverts or open bottom structures (arches or bridges) at stream crossings may also help facilitate wildlife movement for species that naturally follow streams (without

requiring fences). The goal is to use structures that preserve the natural stream bottom. Provided that the structures are large enough and don't constrict the stream channel, maintaining a natural stream bottom will likely facilitate movement of salamanders, fish, turtles and stream invertebrates through the culvert. Culverts wide enough to allow for some dry ground on one or both sides of the stream will be even more effective for facilitating wildlife passage in general.

There is a need for much more research before a design for reptile and amphibian passage can be put forward for use with high confidence. In the meantime, where roads and highways threaten amphibian or reptile populations, we must experiment with designs based on our best guesses. Whenever passage structures are used it is very important that they are monitored to determine their effectiveness. For the time being, trial and error is the chief source of information we have for designing passage structures. If you have information about amphibian and reptile use of crossing structures that you are willing to share, please contact me at:

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Figure 1.

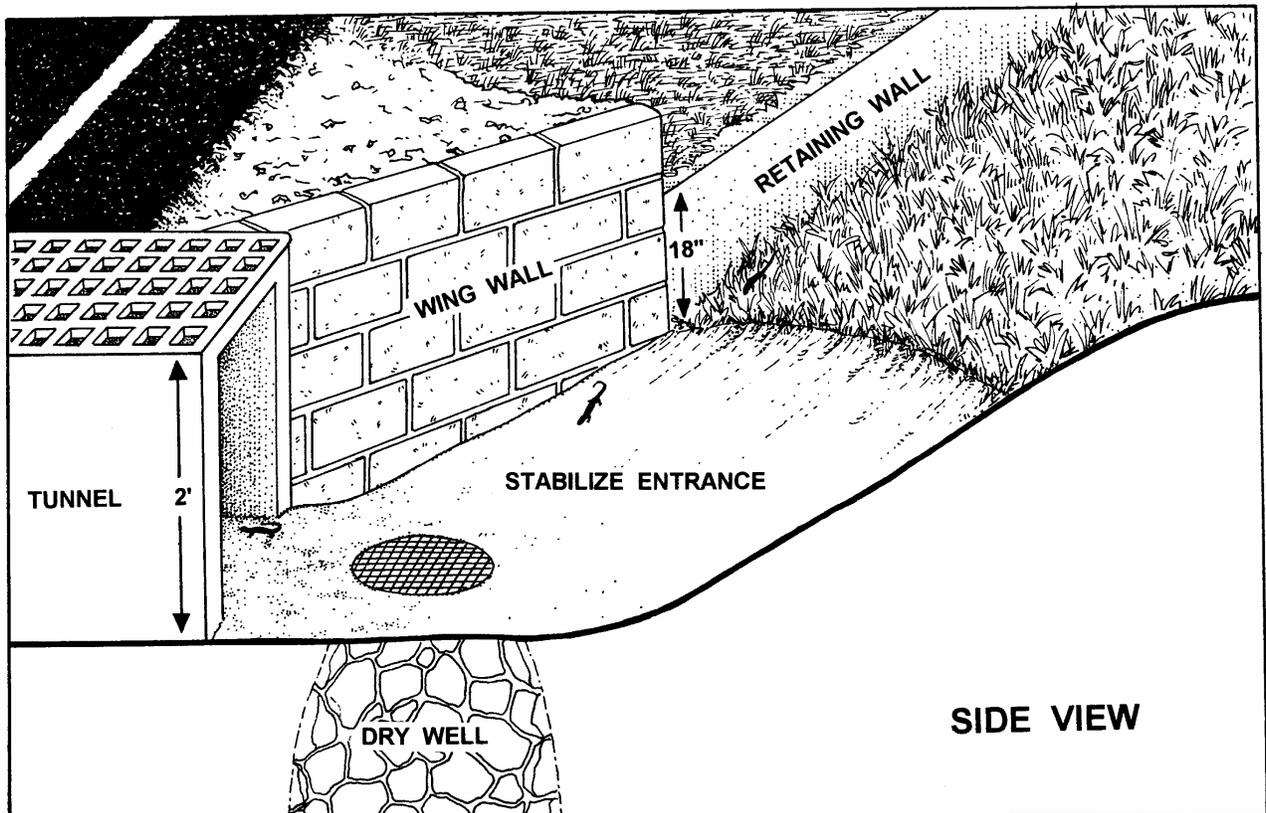


Figure 2.

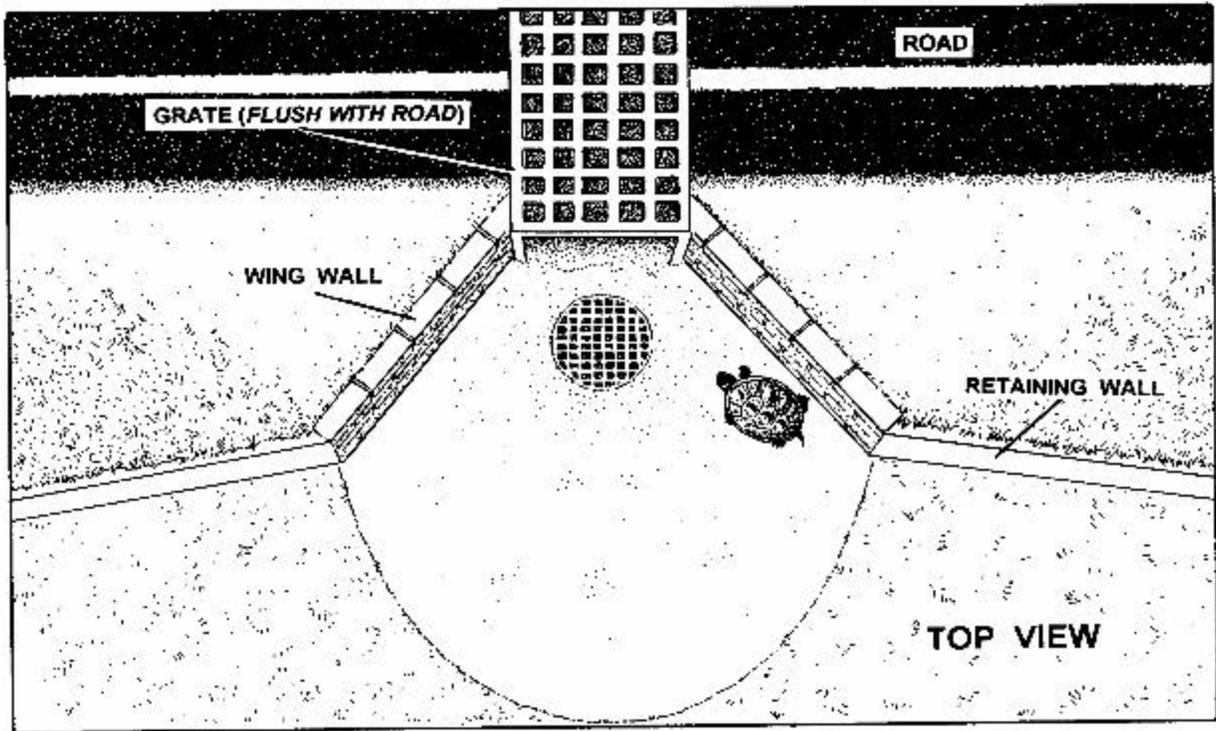


Figure 3.

