

Enviro Span and Slope Gradients

Closed Bottom (circular CSP or HDPE) Culverts and Stream Slope Gradients:

Maximum slope gradients for culverts normally refer to circular (closed bottom) culverts, which have particular effects on stream flow. Circular culverts, if simply installed at the same gradient as the natural stream course, can generate excessive stream velocities due to both their low coefficient of friction and the venturi effect. If attention is not paid to these two **cumulative effects**, then they can cause a number of problems as shown below.

- Excessive velocities at the outlet can lead to scouring and subsequent undermining of the outlet. The result is often referred to as a perched culvert. This can have the effect of creating a full stop to fish passage. The following photo shows a perched culvert offering no chance of fish passage.



- If the stream in question is already at the maximum slope and velocity for fish passage and a CSP or HDPE closed bottom culvert is installed, it will have the effect of increasing stream velocity above the maximum for fish passage. This again, can create a full stop to fish passage.
- There are various references (State and Provincial regulations in both USA and Canada, as well as culvert design tables for engineers) available for determining the maximum slope of a CSP or HDPE closed bottom culvert installation to allow continued fish passage. These references refer only to closed bottom culverts and do not apply to open bottom structures.



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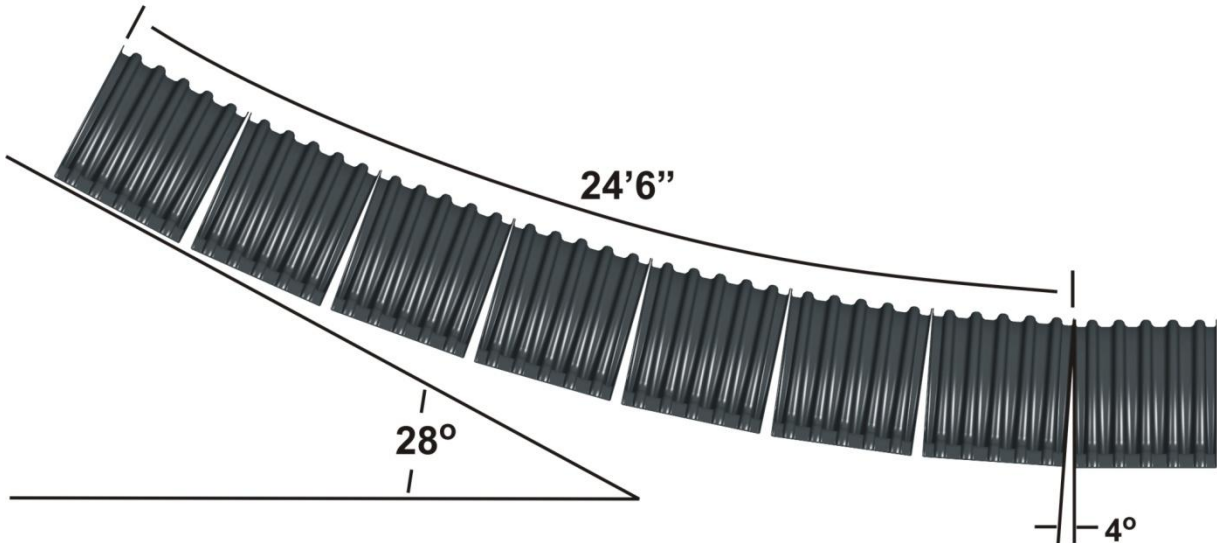
Enviro Span, like other bottomless stream crossings, retains the natural stream bottom. This means that the question of slope for an Enviro Span installation is rendered moot. No matter the stream gradient at the point of crossing, Enviro Span will not alter the existing condition. Therefore, if fish passage is feasible at the point of crossing in the natural condition, then it will remain so after installation of the open bottomed structure. If fish passage is not possible in the natural condition, then it too will remain so after installation of the open bottomed structure. The following photo shows a bottomless culvert that has no effect on natural fish passage because it leaves the natural streambed in place



Finally, with regard to maximum physical slope at a crossing, Enviro Span can be installed as steeply as the side slope of the subgrade. Essentially, if the subgrade will remain stable at the point of crossing, then the Enviro Span installation will also remain stable.

Enviro Span

Cumulative vertical rise using the standard connector system



Note: A continuous, cumulative vertical rise can be achieved with Enviro Span by taking advantage of the purpose built joint flexibility of the system. Each consecutive module will allow a 4 degree vertical tilt so that, for example, a 28 degree vertical angle can be achieved within the distance of 7 modules or 24' 6" (per the diagram). Footings may be adapted (depending upon the material) as needed to accommodate the changing slope. For example with steel pipe, it may be cut into module length pieces and welded with a 4 degree joint for as many sections as are required to achieve the desired vertical pitch. The system will allow the same angles to be achieved on a downslope as well.

Disclaimer.

The accuracy or applicability of all information contained herein is intended as a guide and is not guaranteed. Enviro Span assumes no obligation or liability for this information. All statements may be considered as recommendations but not as warranty. Users of our products should perform their own tests to determine the suitability for their particular purposes. Under no circumstances shall Enviro Span be responsible for any damages, and in no event shall it be liable for consequential damages. Buyer acknowledges and agrees that the buyer or its customers are responsible for the location in which Envirospan is installed and the buyers or its customer are responsible to insure that the goods are installed and maintained in accordance with all site conditions, local codes, permitting requirements, specifications, guidelines recommendations and all other applicable laws including backfill, overfill and compaction.