Silt fence performance revisited

Extensive field documentation puts data from a controlled study to the test.

In August of 1999, two different silt fence installation methods were evaluated in a controlled field environment. The performance of silt fence installed using the Silt Fence Static Slicing Method was compared to the performance of silt fence installed using traditional trenching methods.

This large-scale evaluation project was overseen and coordinated by the Environmental Technology Evaluation Center (EvTEC), a program of the Civil Engineering Research Foundation (CERF), the research and technology transfer arm of the American Society of Civil Engineers (ASCE).

The field verification testing was supervised by TRI/Environmental Inc. The field testing included 51 test segments reflecting different soil types, different installation methods, and different hydraulic conditions. A slit-film geosynthetic silt fence material was used in all tests because it is the most common type utilized across the United States.

This original EvTEC field evaluation was a controlled experiment designed to limit the number of variables being tested. To this end, the trench depth, soil types, backfill conditions, and most other installation parameters were preselected based on industry standards to facilitate valid comparisons and the resulting conclusions.

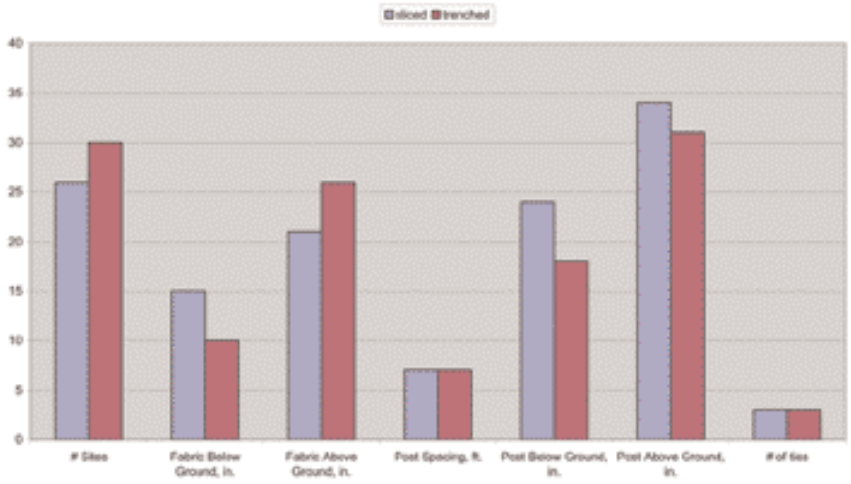
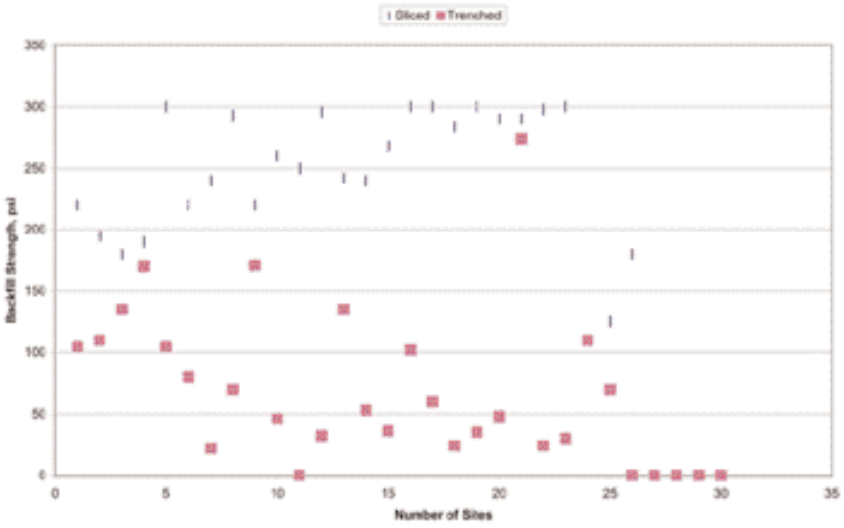


Figure 1. Comparison of average results of silt fence field survey installation measurements.

Figure 2. Compacted strength of backfill.



Conclusions from the EvTEC Verification Report

In general, the static slicing method was found to provide storm water runoff retention consistently as good as or better than the best-trenched installations, and far superior retention to common installations. Additionally, the static slicing method of installation was found to be a much more efficient, and therefore, cost-effective technique for silt fence installation when compared to a range of traditional trenching-based procedures.

The static slicing method also was found to offer practical advantages over traditional trenching based methods, such as maneuverability, minimal soil-handling and hand labor, consistent depth and compaction, and ease of installation in windy conditions, on steep side slopes, through rocky soils, and in wet soil conditions.

Performance trends from the original field evaluation provided a clear indication that a greater level of compaction (i.e. higher

density obtained) corresponds to better performance (i.e. greater water retention). System comparisons showed that slicing provided installations that had both higher densities and greater water retention than all trenching-based installations.

Trenching-based installations were affected by the inability to compact effectively when posts are installed first, when insufficient backfill material is placed in the trench, or when inadequate compaction effort is provided. It was noted that the installations using static slicing also required reasonable compaction efforts to perform properly.

During the original field evaluation, compaction densities were measured with a nuclear density gauge, and associated shear strengths were measured with a hand-held cone penetrometer. There was a significant correlation between the cone penetrometer readings and the nuclear density measurements. This suggested that the much easier, and less expensive, hand penetrometer can be effectively used as a field quality assurance tool.

However, the question remained: Do the conclusions drawn from such a controlled experiment reflect common, wide-spread field experience?

Follow-up field study in 12 states

In May 2002, a follow-up field study involving the inspection of randomly selected silt fence installations was performed by TRI/Environmental Inc. It included 56 sites in 12 states, reflecting different soil types, different installation methods, and different hydraulic conditions. The primary objective of the field study was to provide data on the "state of practice" of silt fence installation.

This "state of practice" could then be compared with the controlled experiment data to evaluate their relevance and consistency. Consistent data tends to confirm results and conclusions as valid, thus enabling decision makers to make informed decisions as to what to use and specify, or at least the associated risks of achieving a poor installation with one or the other.

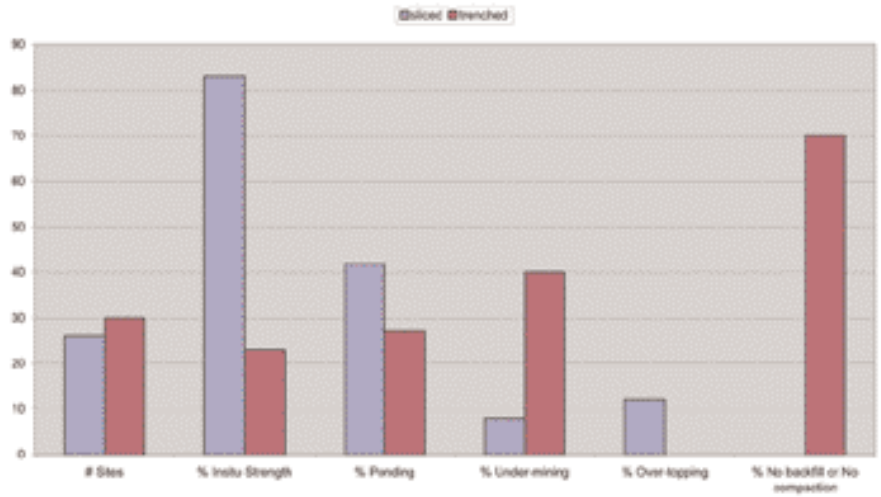


Figure 3. Comparison of average results of silt fence field survey performance measurements.

At the outset of the project, the following installation issues were determined to be relevant to silt fence performance:

- Extent of silt fence fabric burial;
- Backfill depth, type, and density;
- Visual indications of ponding, sedimentation, undermining, and/or overtopping.

Field study description

The field study was performed by Ken Bryce, a TRI technician, and included 56 sites in 12 states. The sites were randomly selected either from a selection of sites obtained from local silt fence installers or by chance observation when driving in a preselected city. The sites reflected many different soil types, installation methods, and hydraulic conditions.

Mr. Bryce used a tape measure and hand-held cone penetrometer, and he recorded nearly 1200 measurements and observations on data sheets. Additionally, pictures were taken of most sites.

Highlights and observations

- 70% of silt fence installations using trenching had no backfill or compaction.
- The other 30% of trenched installations having at least minimally compacted backfill had an average of 45% of the in situ soil strength in the backfill soil. (Range: 23% to 91%)
- 92+% of static-sliced installations received compaction effort sufficient to achieve an average of 86% of the in situ soil strength in the backfill soil. (Range: 60% to 100%)
- Less than 8% of silt fence installations using static slicing had no compaction. The installation equipment operator must wheel-roll the installation for compaction, as the slicing process does not inherently compact.
- At least 40% of trenched installations experienced (or will experience) undermining.
- Static-sliced installations experienced undermining only at points where the fabric had been damaged after installation.
- 42% of static-sliced installations had indications of effectively ponding runoff.
- 27% of trenched installations had indications of effectively ponding runoff.
- Generally, static slicing resulted in silt fence fabric and posts embedded more securely in the ground than when installing silt fence with trenching.
- Five non-buried installations were counted as trench-based installations because they were indicative of "state of practice" for trenching.

Conclusions

This field study involved the random selection and inspection of silt fences around the United States and was performed by TRI/Environmental Inc. The study included 56 sites in 12 states, reflecting different soil types, different installation methods, and different hydraulic conditions.

In general, the static slicing method of silt fence installation was found to provide more consistent results than common trenched installations. This consistency was manifested in more uniform silt fence fabric burial depth, substantially higher level of compaction of the soil adjacent to the buried fabric, and widespread indications of satisfactory performance.

Conversely, the trenched installations exhibited frequent inadequacy of both burial depth and soil compaction and, thus, not surprisingly, many more indications of being undermined by runoff.

The results appear to validate the findings of the earlier referenced EvTEC study as being applicable to the general use of silt fence around the United States, including the clear finding that substantial compaction of the soil adjacent to the buried silt fence is critical to satisfactory silt fence performance and is generally assured by static slicing. Additionally, it was found that most trench-based silt fence installations have insufficient backfill and/or backfill compaction. GFR

References

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