Designing subsoil drains

Discharge area: Subsoil drains

- Decide where to discharge the water
- Design UP from discharge point (minimum 1:70)
- Have uniform fall on all pipes

Discharge area: Subsoil drains

- Open drain
- Creek
- Be aware what will happen during flooding
- Discharge must be above level
- Design the drain FROM the discharge point upward
- Uniform fall on all pipes

Subsoil drain pattern:

- Favoured design
- 30-45% angle
- Small laterals into larger main
- Flexible corrugated tile
- Joints are offset from each other

Determining pipe sizing

- Manufacturers supply max flow performance
- As pipe length increases, friction loss increases
- Main runs with the slope
- Laterals run across slope

A fall of .5ft in 49.5 ft is 1:99

- Efficient and simple
- Laterals same distance apart
- Uniform drainage for the whole area

Calculating pipe required

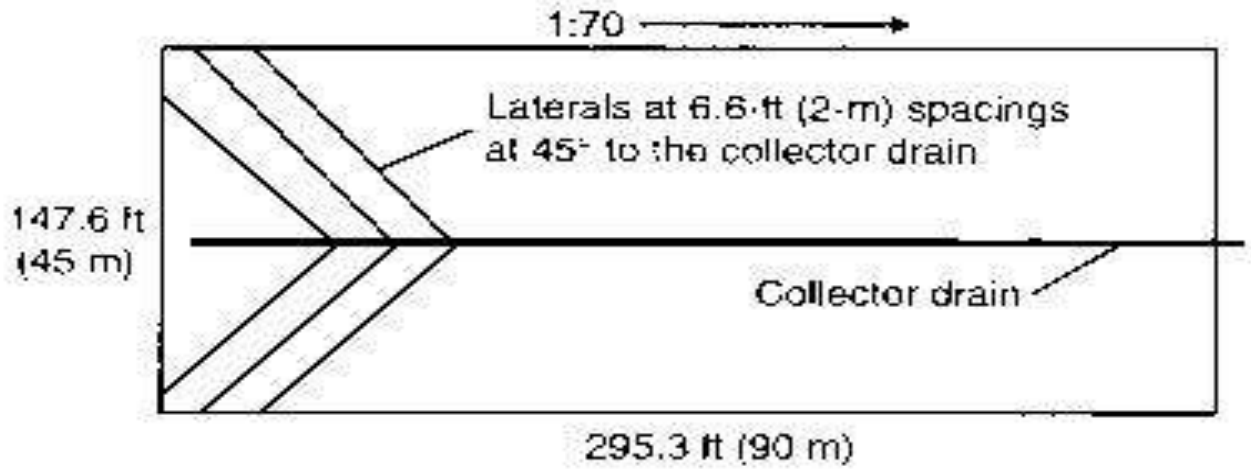

Figure 8.3. An area 147.6 ft × 295.3 ft (45 m × 90 m) with a central collector drain with laterals spaced 6.6 ft (2 m) apart at 45° to the collector pipe.

How to size pipe

- Assume area of 1ac (43,560ft sq)
- Uniform slope of 1:70, down 295 ft. no cross fall
- Subsoil drains spaced at 6.6ft, topsoil at 12” HC 2”/hr
- Rainfall event of 2”/hr

Example of racetrack drainage

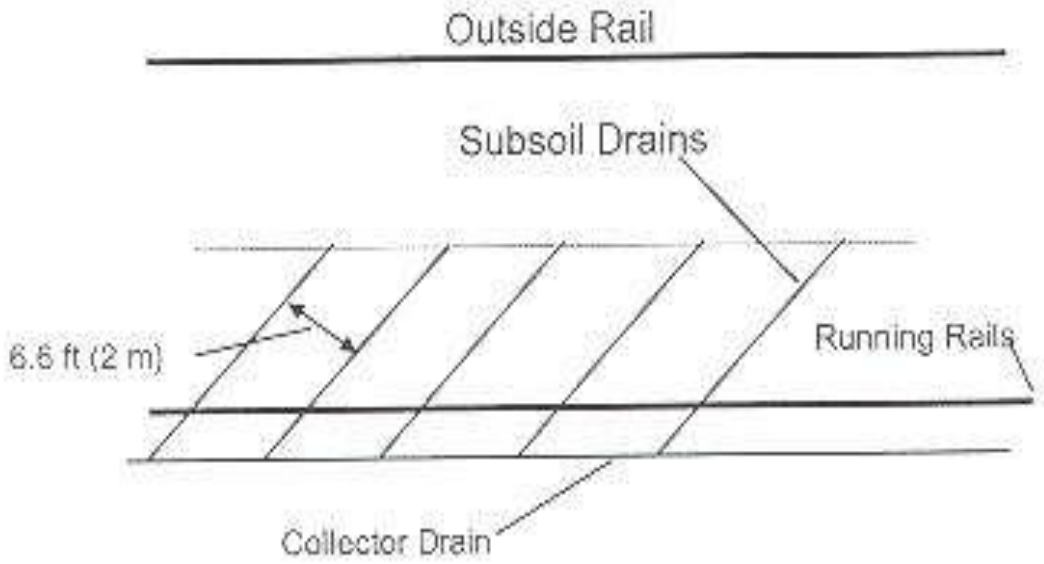

Figure 8.8. Subsoil drains installed on the inside 33 ft (10 m) of a racecourse.

Sizing drains

- High traffic area with subtle drain cover
- Off back of green
- Realistic sizing
- No additional labor for trimming/maintenance

Installing subsoil drains

Migration
Filter material
Installation techniques

Choosing the right filter material

- Filter material should bemade on the basis of type or sand that will surround it
- If the drain is in a fine soil, filter should be a coarse river sand- NOT GRAVEL!

Migration of particles

- Significant amount of fines enter the surrounding soil
- THIS moves fines into the pipe
- Quickly collapses the drain, often during first few waterings

Particle migration into coarser gravels

- Common mistakes:
  - Surround pipe with coarse gravel or crush
  - Pea gravel ¼ - 3/8” often specified
  - Overall, these gravels are too large!!

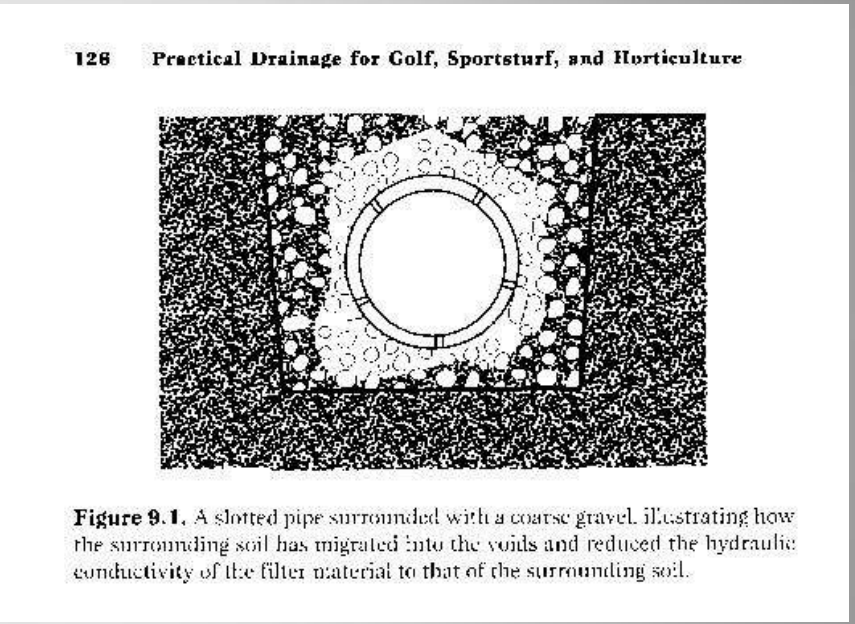

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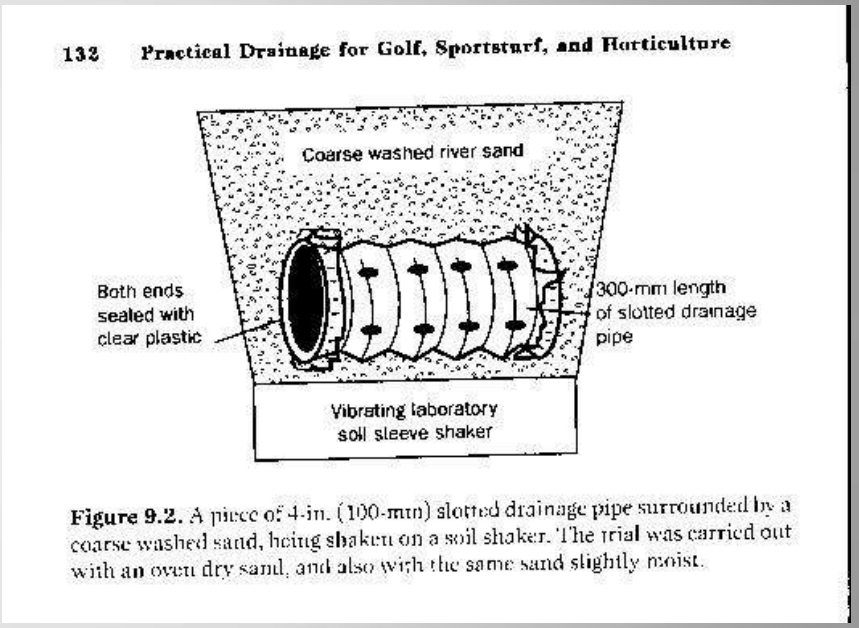
Figure 9.1. A slotted pipe surrounded with a coarse gravel, illustrating how the surrounding soil has migrated into the voids and reduced the hydraulic conductivity of the filter material to that of the surrounding soil.

Filter material entering pipe

- We are too worried about filter material entering the drain pipe
- If gravel is used, smaller particles will migrate into the large pores



When to use gravel filter material

Only in USGA spec greens

D15 of the gravel must not exceed the D85 of the sand zone

This is the “Bridging Factor”

Clean filter material

- Make sure no fines in the filter material
- Use HC of the filter material >100”/hr (sand withought fines)
- Misconception: Sand will not enter drain pipe except from above. Surface area of slots is less that 1% of pipe surface area.

Bridging factor

- If gravel is too coarse, bridging factor will be too high
- Using finer filter material prevents migration of particles from surrounding soil.

Diameter rating

- When installing subsoil drains, in any situation other than USGA sand, use clean washed sand. NOT pea gravel, or any gravel with a D15 less than 1mm.
- D15 means 15% of the filler is larger than the specified size, 85% spec.

Installing subsoil drains

- Cut into the area below the soil to be drained
- Make sure sides are vertical
- Avoid subsoil contamination
- Provide uniform slope

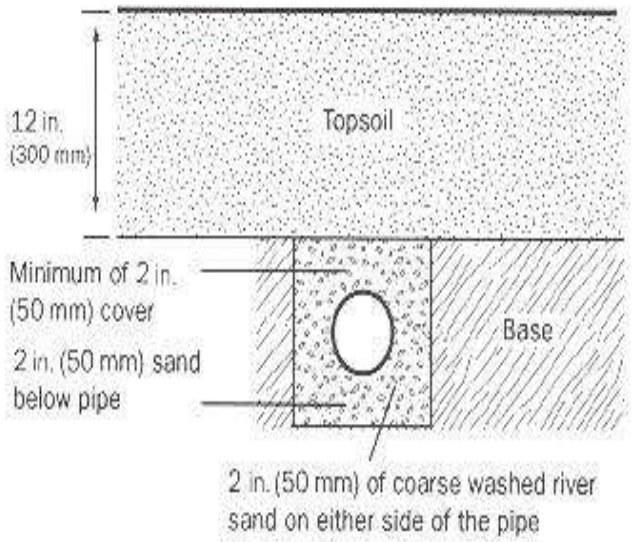


Figure 9.5. Subsoil drain cut into the base below the topsoil, with 2 in. (50 mm) of sand surrounding the pipe on all sides.

Installing subsoil drains

1. Clean vertical trenches
2. 2” of sand at bottom of trench
3. Even slope
4. Correct high/low points
5. Lay slits on BOTTOM of trench

*water enters pipe from the bottom

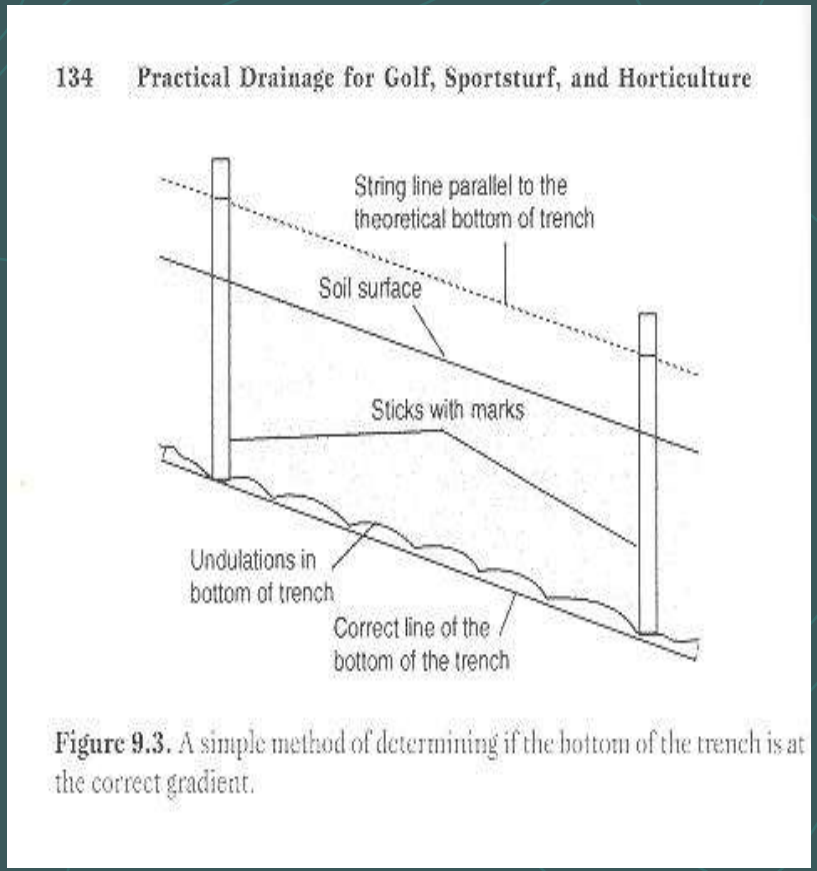


Figure 9.3. A simple method of determining if the bottom of the trench is at the correct gradient.

Installing subsoil drains

5. Cover the pipe with filter sand 2” surrounding
6. Firm down/light rolling
7. Use commercial joints

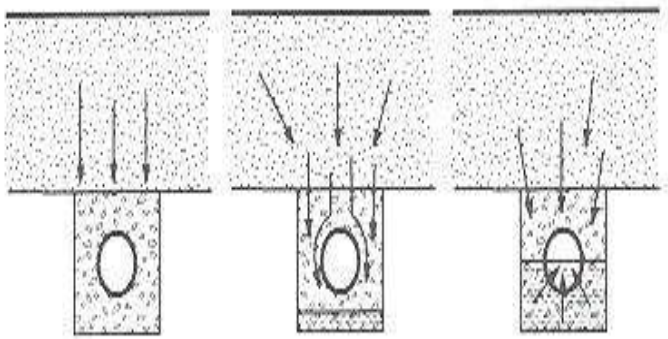


Figure 9.4. Water enters drainage pipes from the bottom via the surrounding filter material.

Geofabrics: Never wrap pipes

- Fabric on drains are unnecessary
- If correct sand has been used, fines will effectively pass through the drainage system
- Geo textile drastically reduces drainage rates

Types of pipes

- Flexible slotted (agricultural)
  - 2-8” diameter
  - Commonly used is 4” outer diameter
  - Slot size vary
  - These pipes self-clean, depositing fines though the ridges
  - This process will not block pipes

Types of drain pipes

- PVC solid drain pipe – Improved flow for collectors
- Multi flow – slit drainage
- Atlantis draincell

http://www.atlantiscorp.com.au/video

Common drainage mistakes

- Incorrect backfill material
- Incorrect pipe connectors
- Misunderstanding of surface and subsurface drainage

Common Drainage mistakes

- Assumption that more water moves laterally
- Improper fall calculation
- Insufficient fill below pipe
- *water fills the pipe from below……

Drainage installation mistakes

- “makeshift” connectors
- Improper joints
- Crushed tile

- All restrict flow

Common drainage mistakes

- Incorrect filter material promoting migration
- Fines of surrounding soil migrate into large pores
- Drainage lifetime dramatically reduced

Smart installation

- Small basin marks lateral connection
- Adds surface drainage outlet
- Easily accessed for flush, or sub-air vacumn

Sizing drains

- High traffic area with subtle drain cover
- Off back of green
- Realistic sizing
- No additional labor for trimming/maintenance

Slit Drainage

http://tdsdrainage.com/articles.html

What is Slit drainage?

- The remedial method of quickly removing surface water

- Often done on fairways, or sports fields constructed with heavier soil
- A means of “fixing” poorly drained sportfields

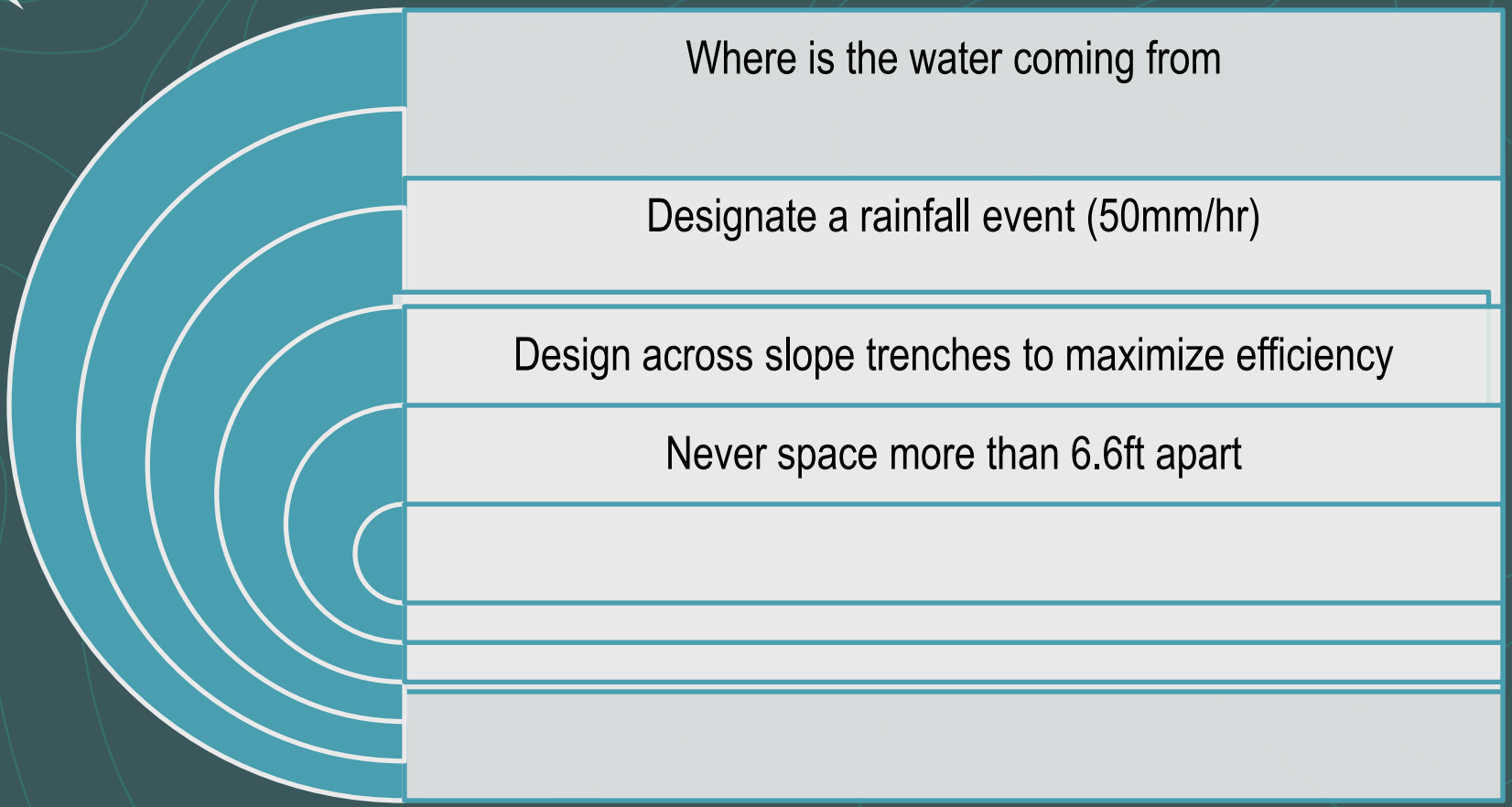
Slit drainage

- Series of narrow vertical trenches backfilled with sand
- Some have pipes in bottom
- Connected to larger connectors to stormwater outlets
- Many work for awhile, but then fail
- A method improving surface drainage

Spacing

- The closer spaced, the better they work
- Average spacing is 6.6ft
- Ensure pipes at bottom of trench can accept the surface water

Design and planning steps



Typical slit and collector

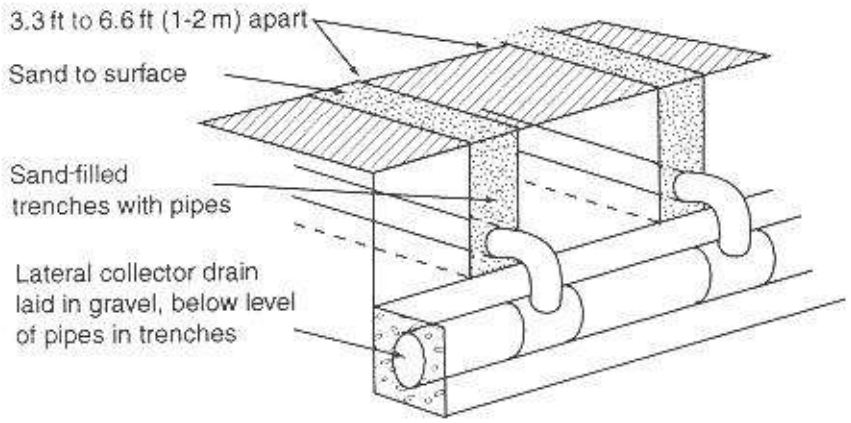


Figure 11.1. A typical cross section of a sand trench showing how it links with a larger collector drain.

Lateral direction

- Typical installation
- Laterals across slope
- Larger collector drain

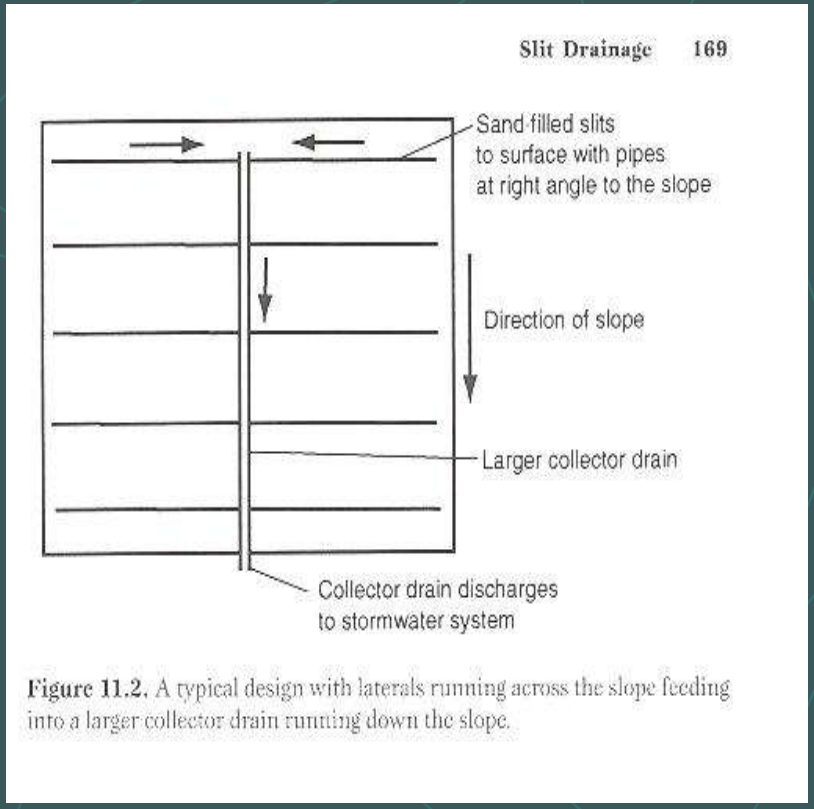


Figure 11.2. A typical design with laterals running across the slope feeding into a larger collector drain running down the slope.

Slit Drainage: Greens

- Should ALWAYS include a pipe in the trench
- Use Geo fabric in the trenches below the pipes
- Sand in slits fits USGA specification
- Re sodded ONLY by washed turf

Trenching the surface

- All trench material removed
- Edges must remain sharp and clean
- Mound the sand in trench

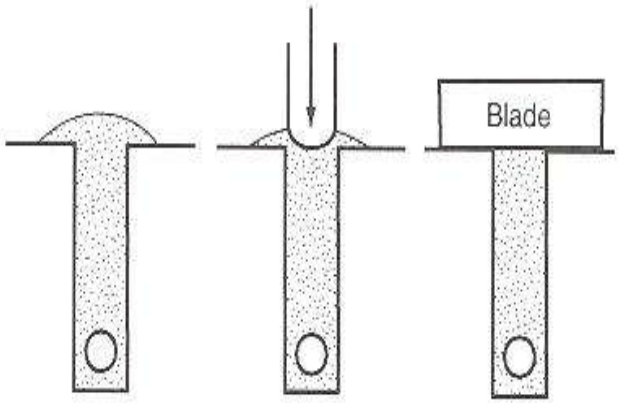


Figure 11.4. Sand slightly overfilling the trench, then compaction and levelling.

Perched water table in trenches? unecessary

- Grassing trench lines
- Gravel layer install
- Prevents drying
- Perches the table

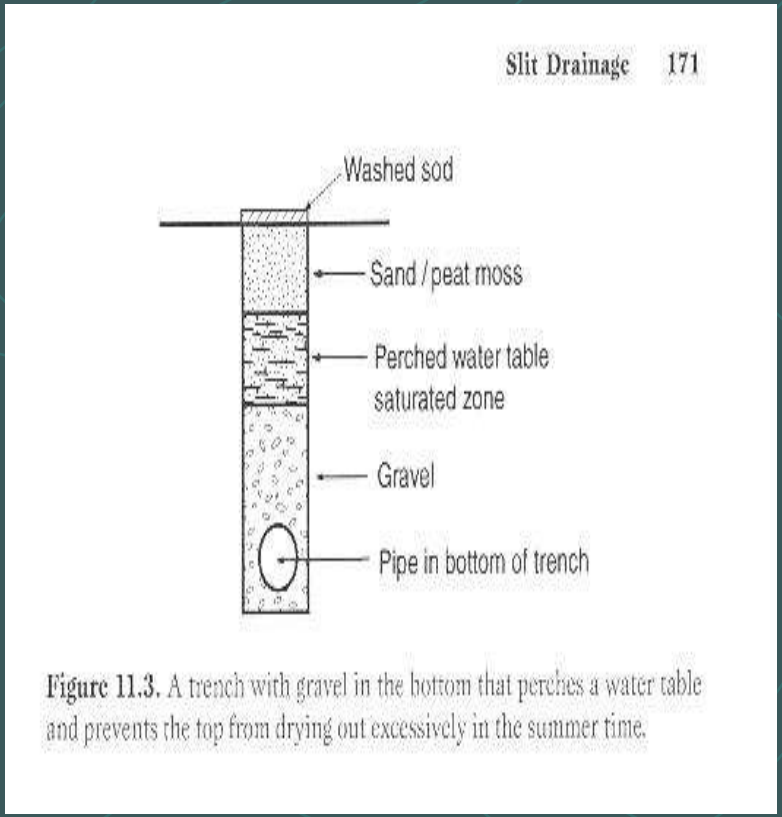


Figure 11.3. A trench with gravel in the bottom that perches a water table and prevents the top from drying out excessively in the summer time.

Summary of Slit drainage

- None further than 6.6ft
- Pipes in ALL trenches
- Design for excessive rainfall event
- Trench ACROSS slope
- Use only USGA sand
- Geofabric only at bottom of trench
- Re-sod trench with washed only

Summary continued

Slit drainage is SURFACE drainage	Topdressing must continue with sand used in the trenches	After time the sod must be stripped off the slits. (contamination)

Slit drainage on Fairways

Large areas sloping in one direction

Where surface slope exceeds 76yds

Where regrading/ insufficient funds an issue

In front of a boggy approach

Drainage

REVIEW

Name 2 examples of moisture-related diseases that can be avoided with good drainage.

- Pythium root rot
- Pythium blight
- Rhizoctonia brown patch

Name 3 advantages to good drainage:

- less compaction to well-drained soil
- Better water absorption after a rainfall
- Improvement of subsoil moisture conditions

What is the name of the longest and deepest drains on a golf course?

Main Collector Drains

Where are the Collector Drains normally installed?

In the lowest-lying areas to be drained into irrigation source

How can Slit Drainage save an older green from being totally rebuilt?

allows excess water to escape before it can freeze and cause damage to the surface on older push-up style greens.

What is the limitation of slit drainage?

Trenches must remain open

- Routinely opened, or top dressed

What options are possible for this low lying “mogul” drainage repair?

- French drain
- Lateral to collector
- Re-grade and sod

WHAT IS THE SLOPE & RUN RULE OF THUMB WHEN DESIGNING DRAINAGE?

3% SLOPE, MINIMUM 1%, MAX RUN IS 1:70

Explain the relationship of a lateral, catch basin, and collector in fairway drainage.

Lateral is subsurface drainage system to meet the collector underground, a catch basin intercepts surface water and is connected to main collector

How do contour maps illustrate the best place for an irrigation pond?

Contour maps illustrate the lowest point on the golf course. Ideally, natural drainage will occur into this area.

Slit drains are often used on greens and fairways. Do they facilitate surface or subsurface drainage?

Slit drainage are surface water drainage

Following a slit drainage project, we sod the trenches…..True or False?

False

http://www.hydraway.net/video.php

HYDRAWAY DRAINAGE SYSTEM

Hydraway states their product is a subsurface drainage system. This statement is only minutely correct. Explain

- This is primarily a surface drainage system.
- Lateral movement of water in soil is so minute in comparison.

Hydraway states their backfill is coarse sand, providing an “additional filter” to remove clay fines in the soil. Although it does not *remove* fine particles, the design may minimize lateral movement of silt and clay. How?

The impermeable PVC one-sided tile may physically reduce lateral movement of fines from soil to the coarse sand.

Would the Hydraway system work without the tile? What advantages does the tile really offer?

- Yes, backfilling with coarse sand will facilitate equivalent surface drainage properties.
- The strength of the PVC tile will add to trench longevity by preventing collapse by repeated traffic

Although you have a trencher, trailer and loader, what other considerations may prompt hiring an outside contractor?

- They are liable for failed systems
- daily tasks will not suffer
- poor soils can add unknown expenses to the project-these are assumed by the contractor, paid by the job. (breakdowns, labor, design changes etc)

Although the advantages of using slit drainage as effective surface drainage outweight the disadvantages, what additional concerns may you have if performing this project on a putting green?

- **Trench lines should not be sodded unless with washed sod so not to contaminate coarse sand in the trench.**
- **Slit drainage is not a permanent solution, and *may* need to be done every couple of years.**

How can trees contribute to poor drainage?

by blocking sunlight and air circulation, which reduces both evaporation and transpiration of moisture from the turf canopy.

What can you do if your drainage problem is severe due to impermeable soil?

- Aggressive aeration,
  - deep tine and solid tine with sand topdressing will
  - Slit drainage project or reconstruction may be necessary to reduce cost of aggressive aerations.

Indicate probable cause, effect, and solution to this putting green issue.

1. The water cannot run off due to depressions or in this case, a high collar.
2. With no subsurface drainage, the water stays on the surface
3. Recommend collar renovation to facilitate surface runoff, core aeration to improve subsurface drainage.

This tee has negative drainage, and illustrates the tee access is bare. Indicate three solutions to improve the tee.

- Install cut-off drain at base of retaining wall
- Re-grade the tee to 1-3% slope
- Increase size of tee access to rotate traffic

What could be the cause, and how would you remedy to this fairway drain?

- the drain line was not graded correctly, and sits too low.
- Surface water enters the trench, but does not flow, causing localized anaerobic conditions commonly found where algae is present.
- The lateral needs to be dug up, and graded to recommended 3% slope.

What kind of drain would you employ here? Why?

A) French drain: 4" perforated drain tile, covered coarse sand
B) Adequate surface grate
C) Cut sod and re-grade 1-3% slope facilitate surface run-off to grate or off fairway