Part 9

SUBDRAIN DESIGN AND LAYOUT

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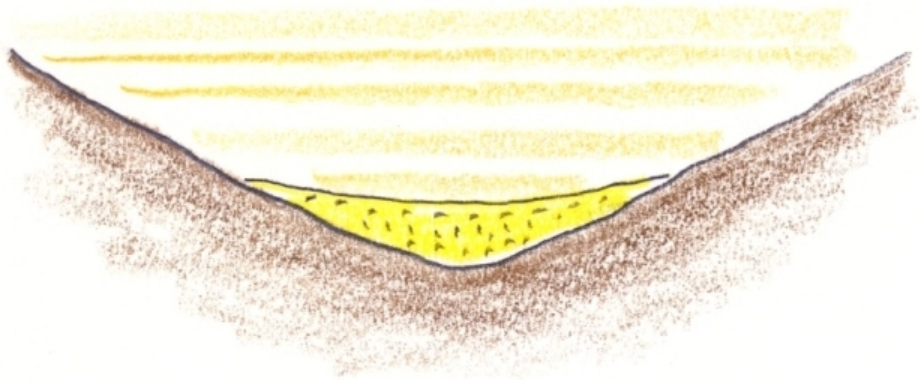
SUBDRAIN EVOLUTION



LATE 1940's

CLEAN GRAVEL
IN VALLEY BOTTOM

- **Early subdrainage often consisted of placing free-draining material, mostly gravel and rock, in the axis of filled swales, as sketched above. These began to be employed in the late 1930s.**

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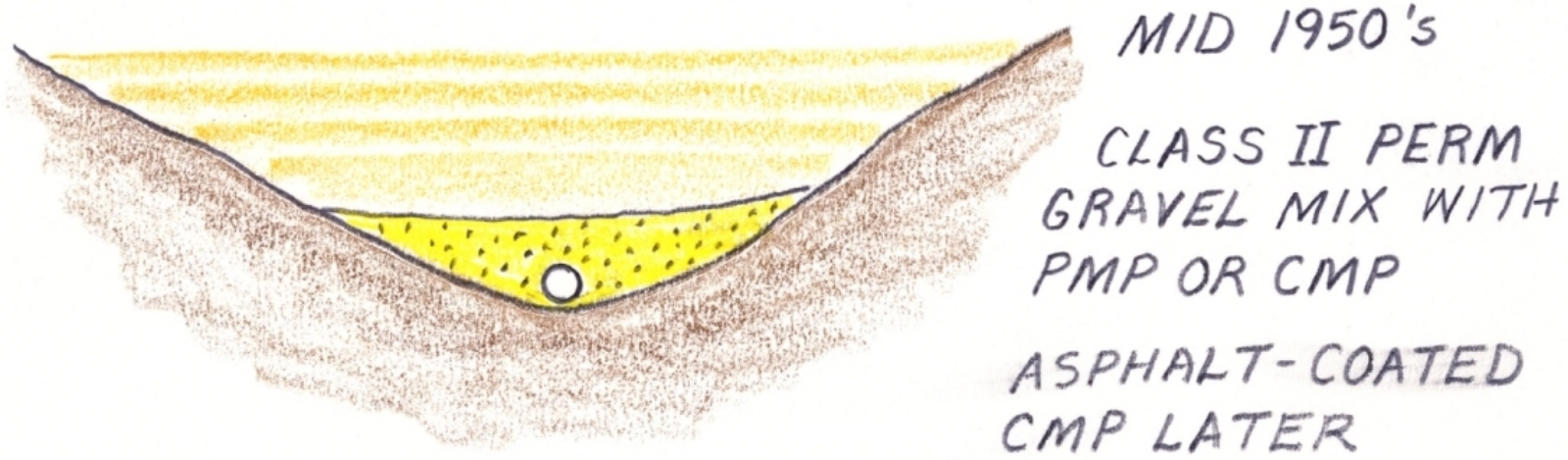

- **In the mid to late 1950s soil mechanics pioneers like Harry A. Cedargren developed permeable gravel mixtures which were intended to be self-filtering**

SELF-FILTERING PERMEABLE GRAVEL DRAIN MIXES

Sieve Size	Percent Passing*
1”	100
¾”	90-100
3/8”	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

*CA Div Hwys Class 2 Permeable Mixture recommended by H. A. Cedargren and adopted as Caltrans Std Spec 68-1.025 in 1958

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LIMITATION ON PERCENT FINES

- A key component of the **Class 2 permeable mix** is limiting the percent passing the No. 200 sieve to less than 3 percent by weight, meaning that the material has to be essentially free of silt or clay.
- This was because lab tests performed by revealed that small percentages of silt and clay sized material exert great impact on permeability. A material with 6 percent passing the No. 200 sieve can be expected to have 1/3 to 1/5 the permeability of a mixture limited to 3% fines.

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HYDRAULIC EFFICIENCY

- Harry Cedargren recognized that hydraulic efficiency of subdrains depends upon the **effective hydraulic conductivity** of the adjacent **native materials**.
- For example, Class 2 Permeable mixtures generally exhibit hydraulic conductivity that averages about 5.0 x 10-2 cm/sec. Clean crushed rock (3/4" x 1.5" gravel) supports an average hydraulic conductivity of about 2 cm/sec.
- This range suggests that an equivalent volume of clean gravel could transmit about **40 times** as much water as the Class 2 permeable mix to transmit the same volume of water that a single cubic foot of the clean gravel.

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- In the mid 1960s contractors began using asphalt coated perforated corrugated metal pipes (cmp) for subdrain collectors, to retard long-term corrosion of such pipes.
- Not of much value in long term

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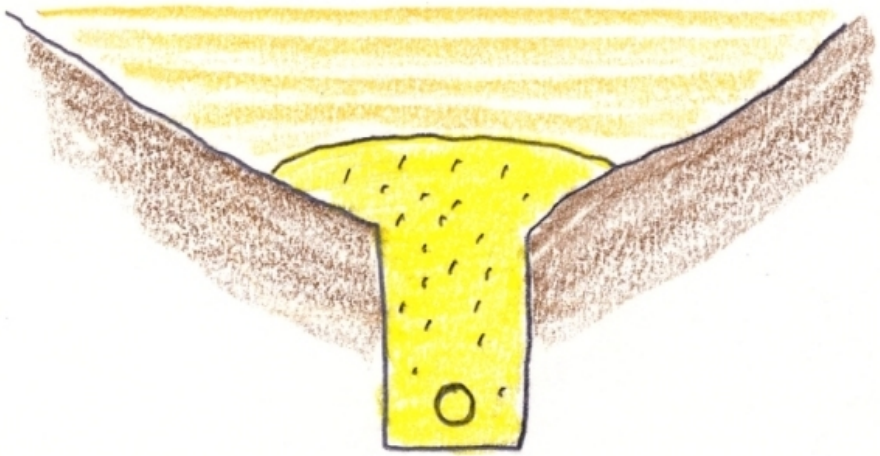

TRENCH SUBDRAIN
W/ PERF CONDUIT
CLASS II PERM
BACKFILL
PVC - 1960's
ABS - 1970's

- **Polyvinyl Chloride (PVC)** plastic pipes were gradually introduced for use as subdrain collectors beginning in the late 1960s.
- In the 1970s **Acrylonitrile-Butadiene-Styrene (ABS)** pipes became increasing utilized in sanitary sewer applications, which has carried over into subdrainage work

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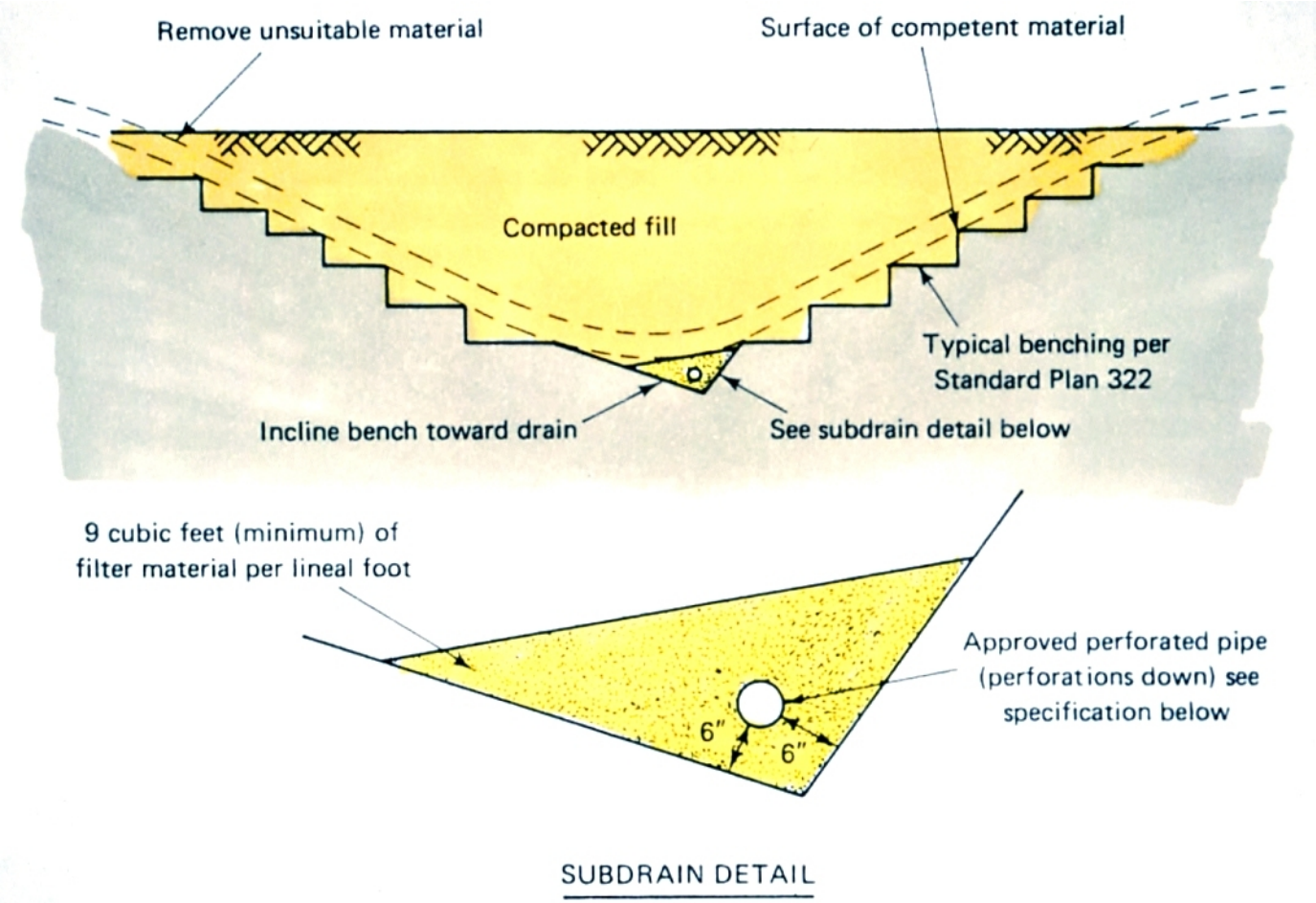

SUBDRAIN DETAIL

- **In 1964 the Uniform Building Code began requiring 9 cubic feet of Class 2 filter material per lineal foot of subdrain, with at least 6 inches of bedding beneath the perforated collector pipe**

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- Subdrains can be laid out on keyway benches using any variety of techniques; such as lime or chalk to mark the desired trench line

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- After excavation, the subdrain trench should be inspected to see if intercepts the desired horizons and checked for longitudinal gradient using a hand level

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- A 6 inch bed of free draining material is placed in the floor of the subdrain trench prior to laying the perforated collector pipe

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- This shows placement of a perforated ABS collector pipe in the subdrain trench, prior to placement of any free-draining filter material. Collected water moves through the filter material, not necessarily through the perforated pipe. The pipe simply allows inspection of the system's operability.

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- After placing the bedding and the perforated collector pipe with cleanout risers, the entire subdrain trench is backfilled with free draining material and compacted

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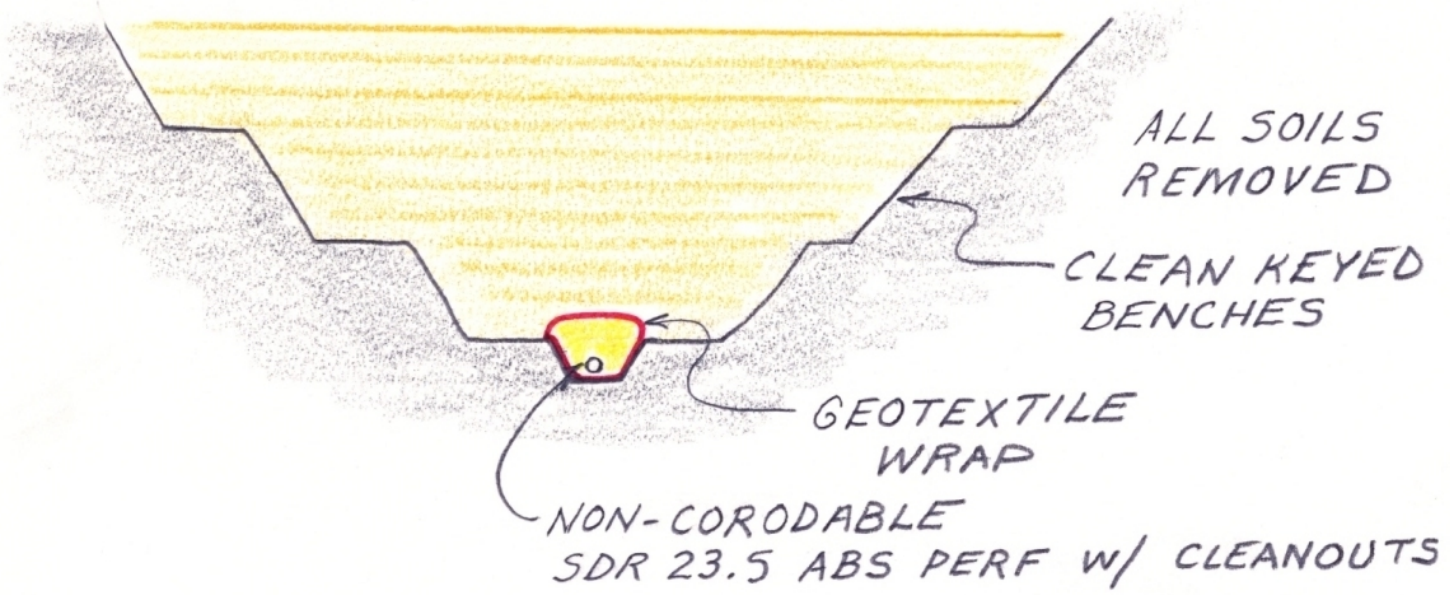

- Since the introduction of **geotextile filter cloths** in the early 1980s, it has become increasingly common to employ "cloth wraps" around free-draining material, such as crushed ¾" x 1-1/2" drainrock. Increasingly stiff ABS collector pipes are also becoming more common.

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- Subdrain excavations can be provided with filter cloths and collector pipes without entering the trenches. Trenches deeper than 5-1/2 feet should be shored before allowing workmen to enter them

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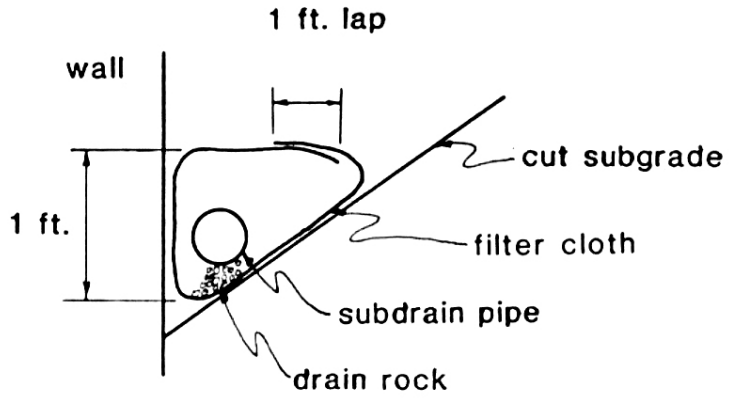
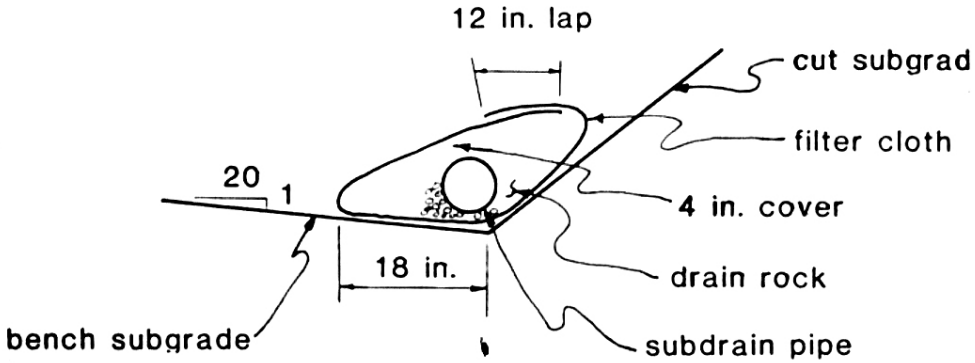


BEHIND WALL SUBDRAIN



KEY BENCH SUBDRAIN

- Geotextile filter wrapped subdrains have come to be known as "burrito drains"
- Drains should always be placed in low areas, where gravity flow is expected