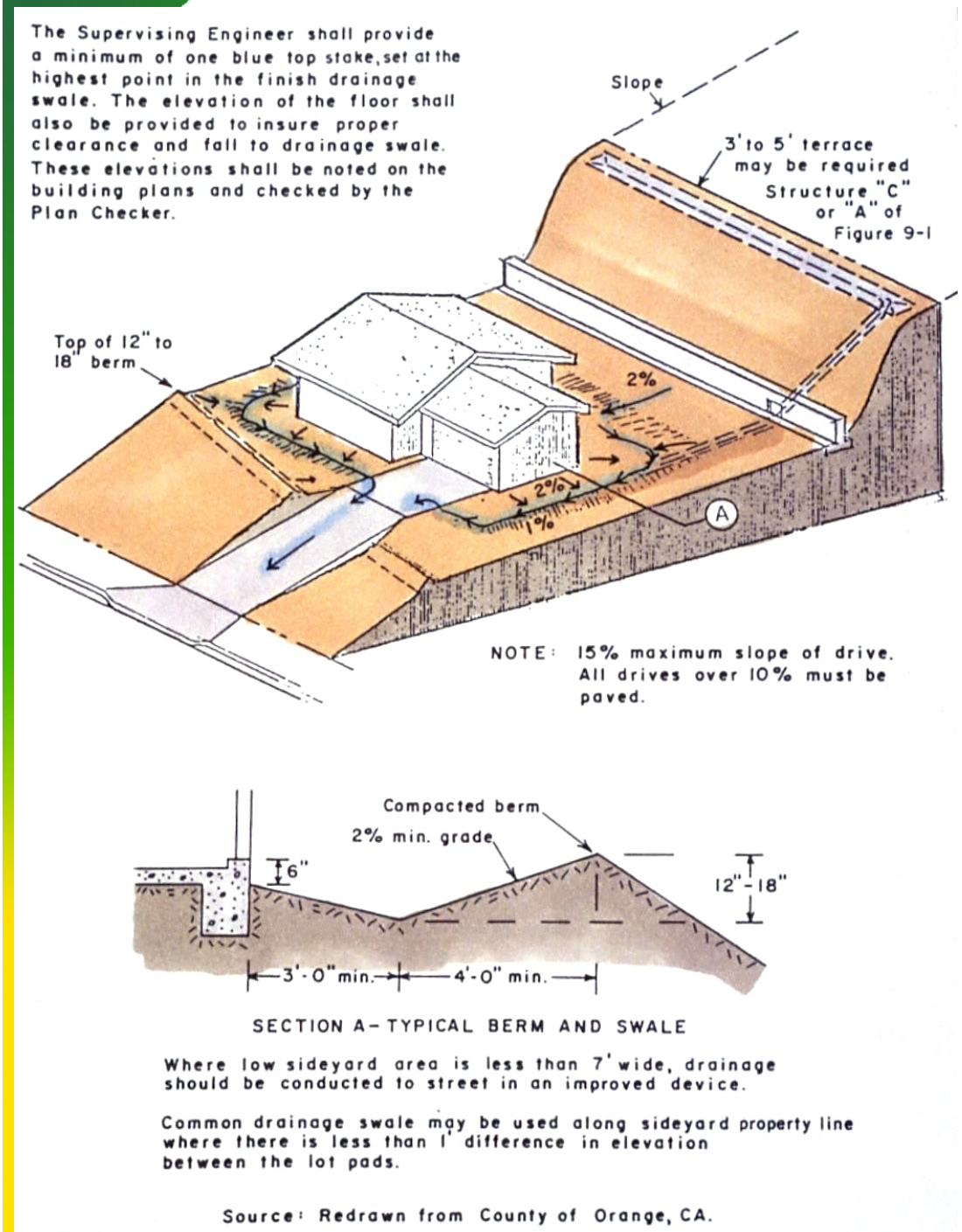
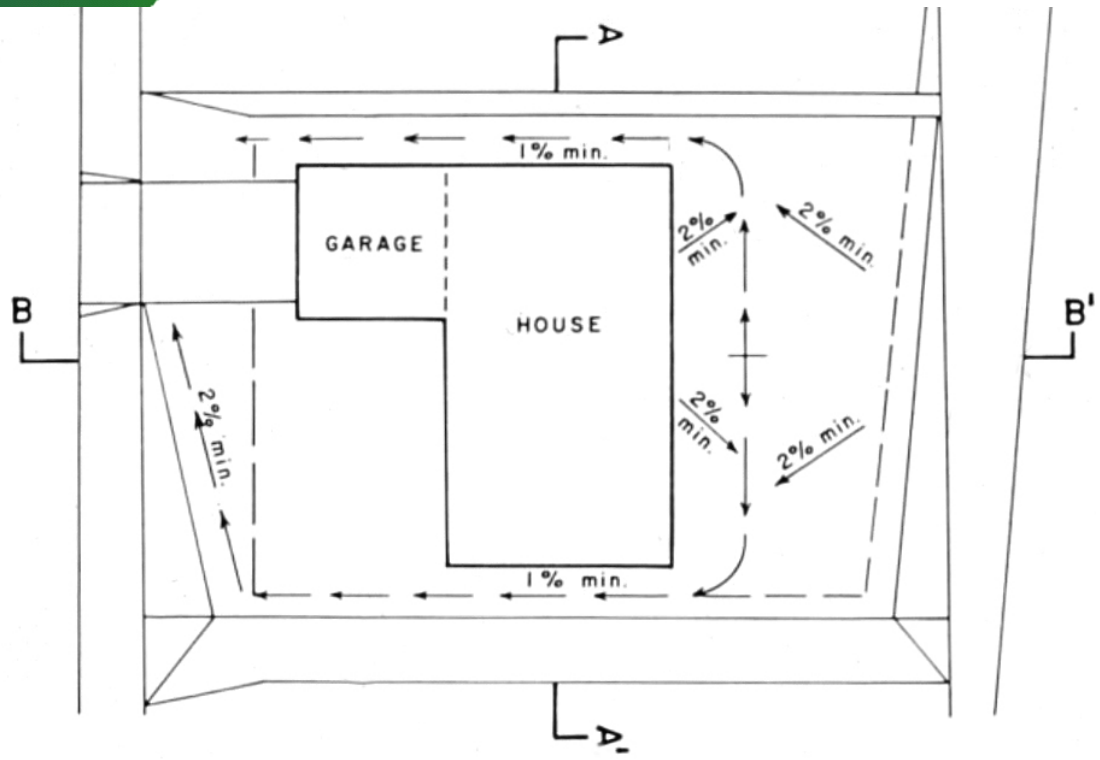
Part 3

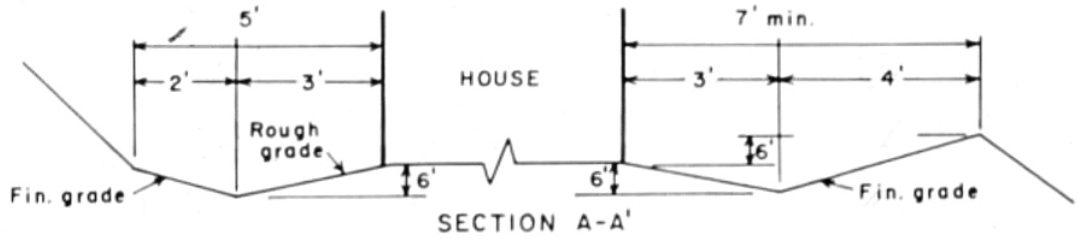
LOT DRAINAGE

UMR

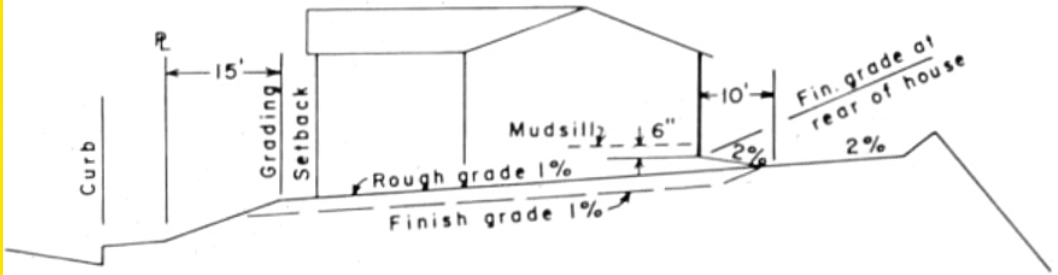


- **Lot Drainage** refers to the fine grading across a building pad and around structures so as to collect, convey and discharge surface waters in a controlled manner to prevent property damage



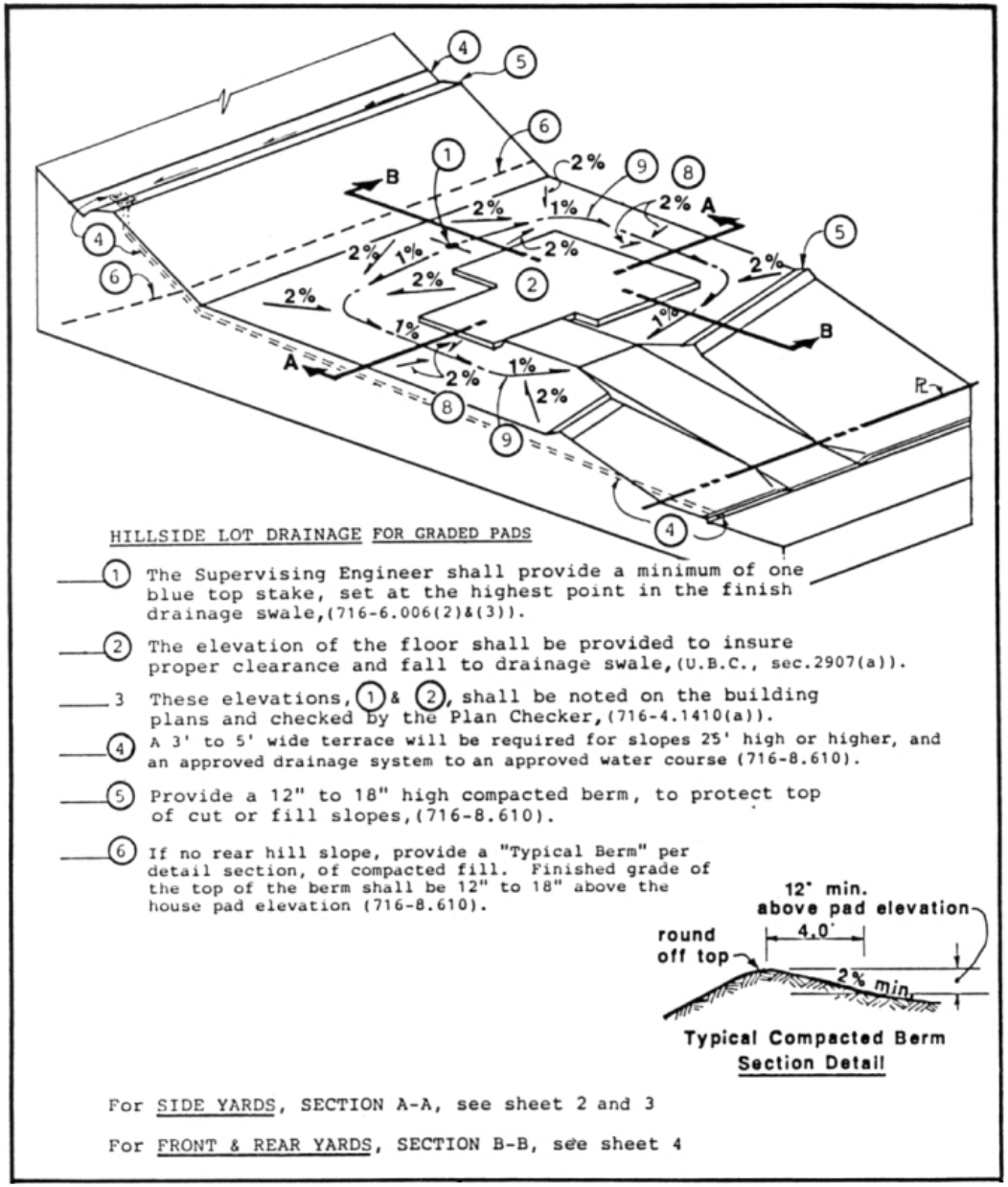


SECTION A-A'



SECTION B-B'

- **Lot pads should be sloped at least 2% to promote drainage after grass takes root. Vegetation tends to build up root mats that inhibit runoff after several years, necessitating maintenance**



- Finish grading should address final grades around the structure footprint as well as the lot pad.
- Grades must be steep enough to allow for subsequent landscaping
- Grades of less than 2% should be paved or use piped conveyance

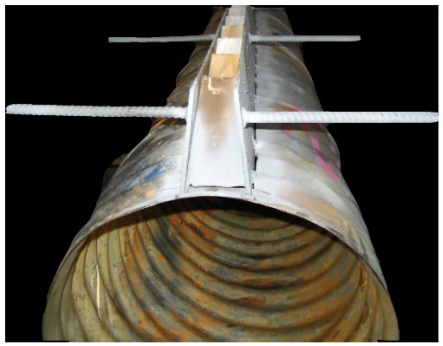
- Example of offsite drainage leading towards a structure. In such cases substantive drainage improvements are usually needed to collect and convey the imposed discharge

UMR

- **Slotted Drain Pipes** are one of the best solutions to collect and convey sheet runoff from paved surfaces, as shown here

UMR

Slotted Drains common on highways and runways to catch sheet runoff



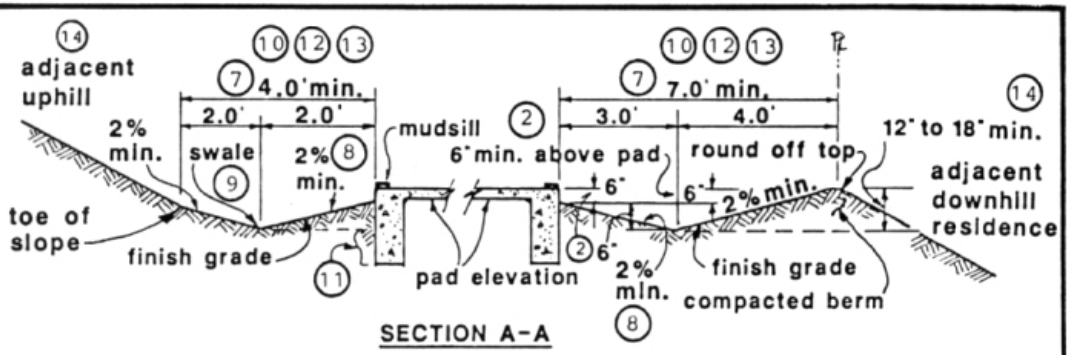
- Slotted drains are very useful to collect runoff from paved surfaces, especially when lots are situated below adjacent grade

- **Be wary of situations where structures are placed below the grade of the adjoining street. Below-grade structures are very prone to drainage problems.**

UMR

- When hardened surfaces, like driveways or sidewalks slope towards the structure **slotted drains** should be installed across the threshold to collect runoff.

UMR



SECTION A-A

SIDE YARDS:

(7) All building setbacks from slopes shall be in accordance with Danville Grading Code (716-8.422; 716-8.424):

"Building and Structures shall be set back from excavation or fill slopes a minimum of 4 feet plus one fifth the vertical height of the slope with a maximum of 10 feet" (716-8.422(c)).

(8) At structure, sloping away from the structure, to be 2% slope minimum,(716-8.606).

(9) All drainage swales around structure to be 1% min. slope, and drain toward the street (716-8.606).

(10) Where there is a low side yard area, less than 7 feet wide, drainage should be conducted from backyard to front yard to the street via an improved drainage device (716-8.602).

(11) In no case shall the flow line (bottom of swale) within 5 feet of a footing, be lower than the bottom of a footing.

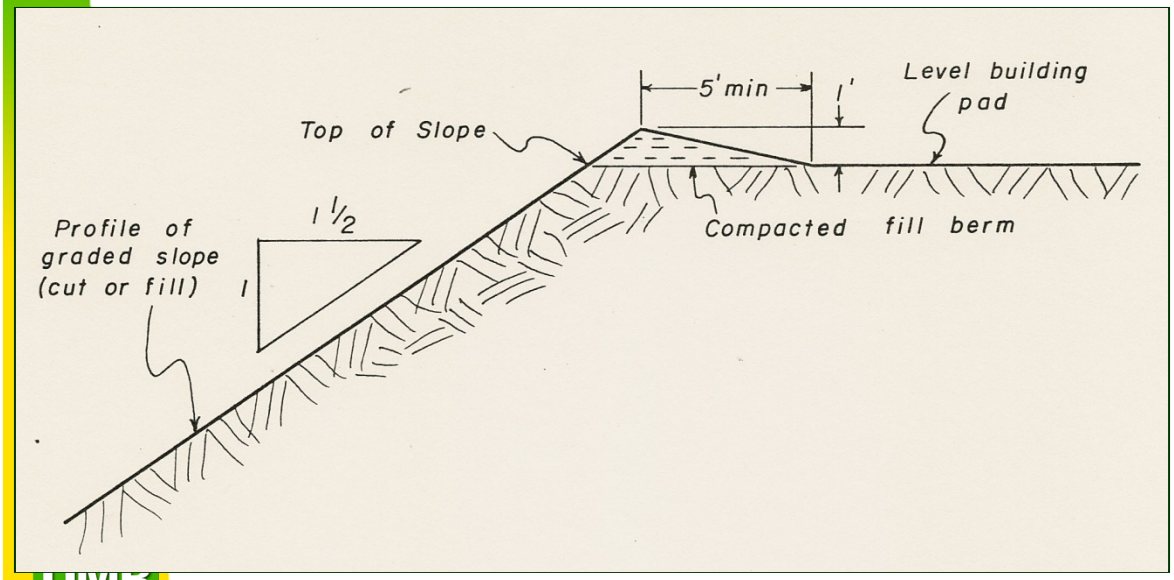
(12) The setback from the toe of a slope maybe reduced to 4'min. if an improved drainage device (i.e., concrete) is used (716-8.602).

(13) When a stoop, fireplace, or portion of the building extends within the minimum established drainage setbacks, then a paved drainage swale, a catch basin and pipe, or other similar drainage device is required,(716-8.614).

(14) Be sure all drainage of lot does not drain onto neighboring properties, and all drainage shall be conveyed to a storm drain or approved system (i.e., paved street, or natural creek), (716-8.604).

- Drainage swales should be provided adjacent to building foundations, to collect and convey runoff away from the building
- Such swales need to either be paved or maintained in perpetuity

UMR

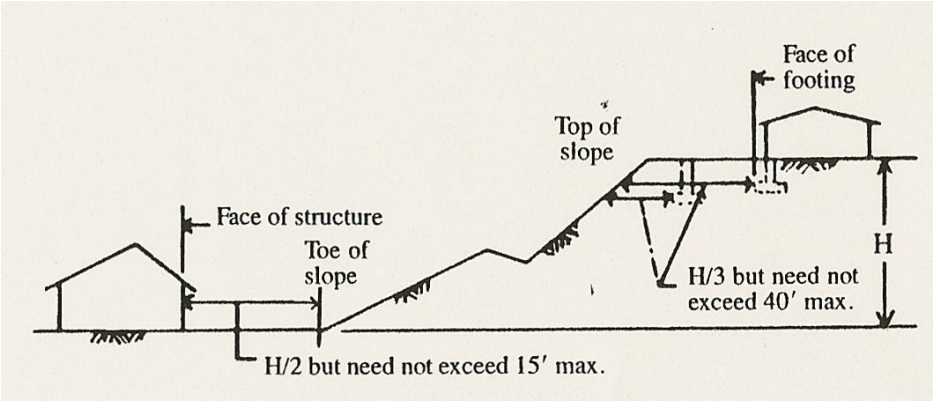


Crest berms

- Fill slopes should be constructed with **crest berms** (shown here) or paved interceptor ditches, with the lot pad sloped in the opposite direction (toward the street).

This is an insufficient setback from a descending slope

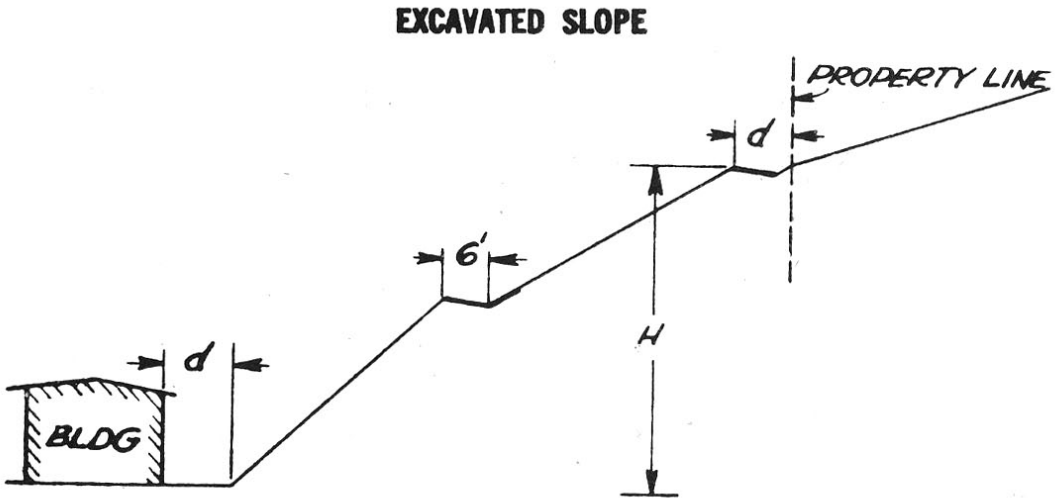
Structural Setbacks from slopes



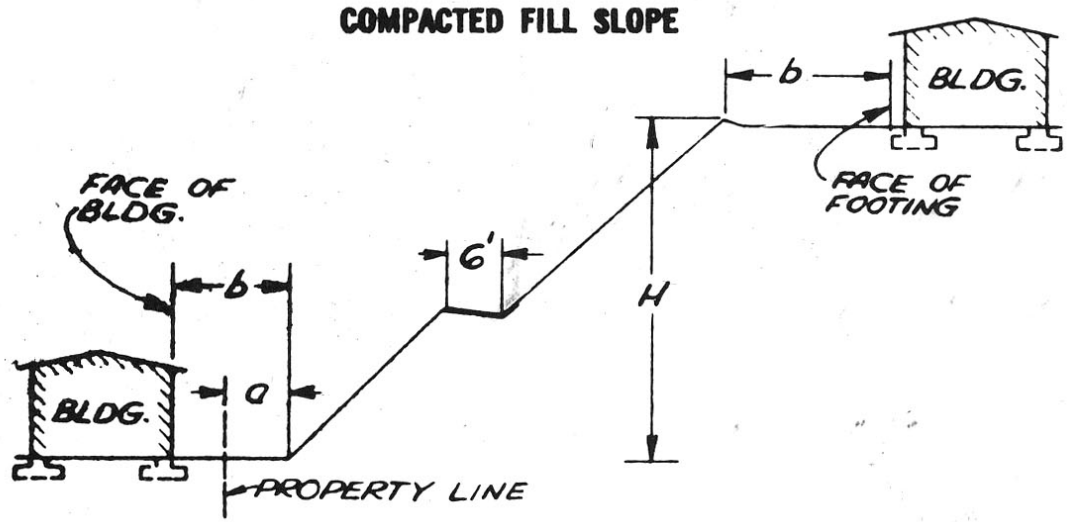
Pre-1994 structural setbacks in the old Uniform Building Code

- ***Structural setbacks*** are important to protect structures from damage associated with normal slope creep and settlement
- The minimum structural setback should be 10 feet for slopes 20 or more feet high

Structural Setbacks



REQUIRED SETBACKS			
H FEET	FILL SLOPES		CUT SLOPES
	a	b	d
0-15	1'6"	3'	3'
15-50	H/10	H/5	H/5
Over 50	H/10	H/5	10'



- The 1964 Uniform Building Code (UBC) established minimum structural setbacks from the crest and toe of descending slopes, as a function of slope height
- Note the difference between cut and fill slopes

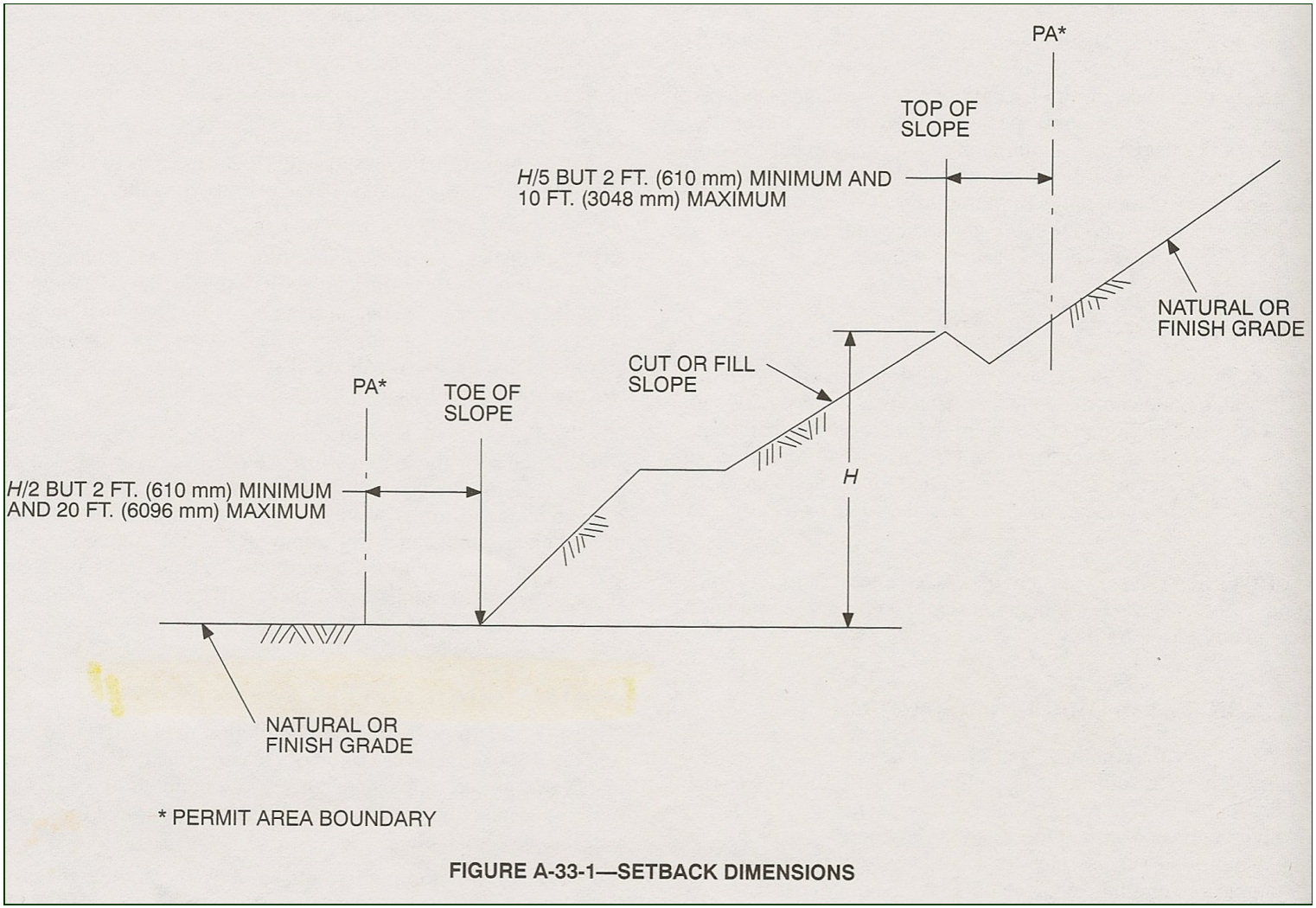
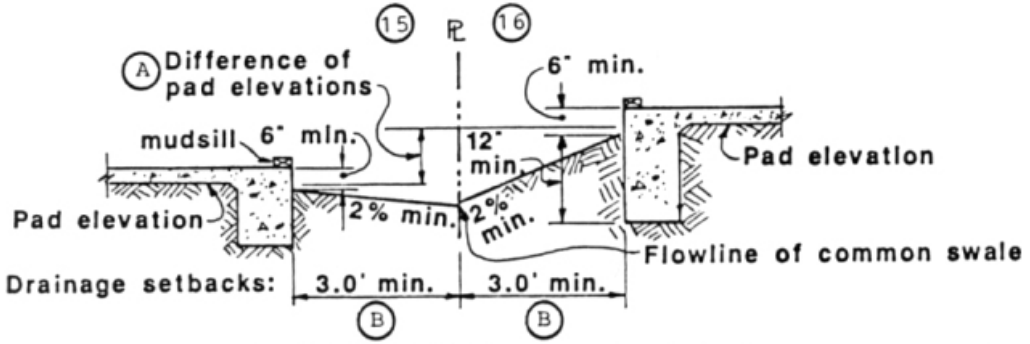


FIGURE A-33-1—SETBACK DIMENSIONS

- **Structural setbacks** from crest and toe of slopes set forth in the in the 1997 UBC and 2001 IBC. Note 2 ft minimum and 20 ft maximum setback form toe of slope, and 2 to 10 ft from crest of slope

UMR



SECTION A-A, Common Swale Option

SPECIAL SIDE YARD CASES:

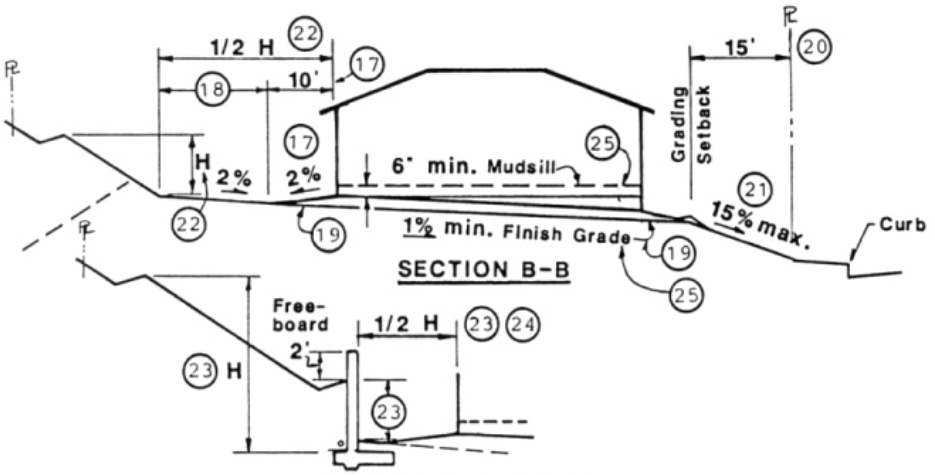
(15) Common drainage swale may be used along side yard property line where there is less than one foot difference in elevation between lot pads.

When the difference in pad elevation is: (A)	then the drainage set back is: (B)
0.6'	3.0'
0.8'	4.0'
1.0'	5.0'

and a common side yard drainage swale may be used.

(16) When the pad elevations (A) are greater than one foot, then a common side yard drainage swale MAY NOT be used.

- Swales between adjacent structures need to account for differing pad elevations, as shown at left.
- Never try to provide such recommendations using words alone, always try to provide a useful sketch
- Image shows side yard drainage swale between adjoining lots of differing elevation. Walls and fences may inhibit good drainage along “shared swales”



SECTION B-B DETAIL

Rear Yard:

17 Provide 2% grade from 6" below mudsill to 10' behind structure,(716-8.606).

18 Provide 2% grade from base of berm or slope, to rear drainage swale,(716-8.606).

19 Provide 1% swale to drain rear yard,(716-8.606).

Front Yard:

20 Provide 15' min. Grading Setback on front yard, from top of slope berm to Property Line,(716-8.604).

21 All driveways steeper than 10% grade must be paved, up to a maximum 15% grade.

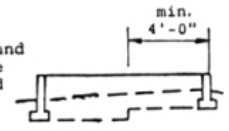
Foundations:

22 Foundation Setback, from cut, fill, or natural slopes, to be a minimum one half the slope "H" height, with 3'-0" min. setback to a 15'-0" max. setback, Or as recommended by the soil engineer or engineering geologist (U.B.C. 1985, Sec. 7011).

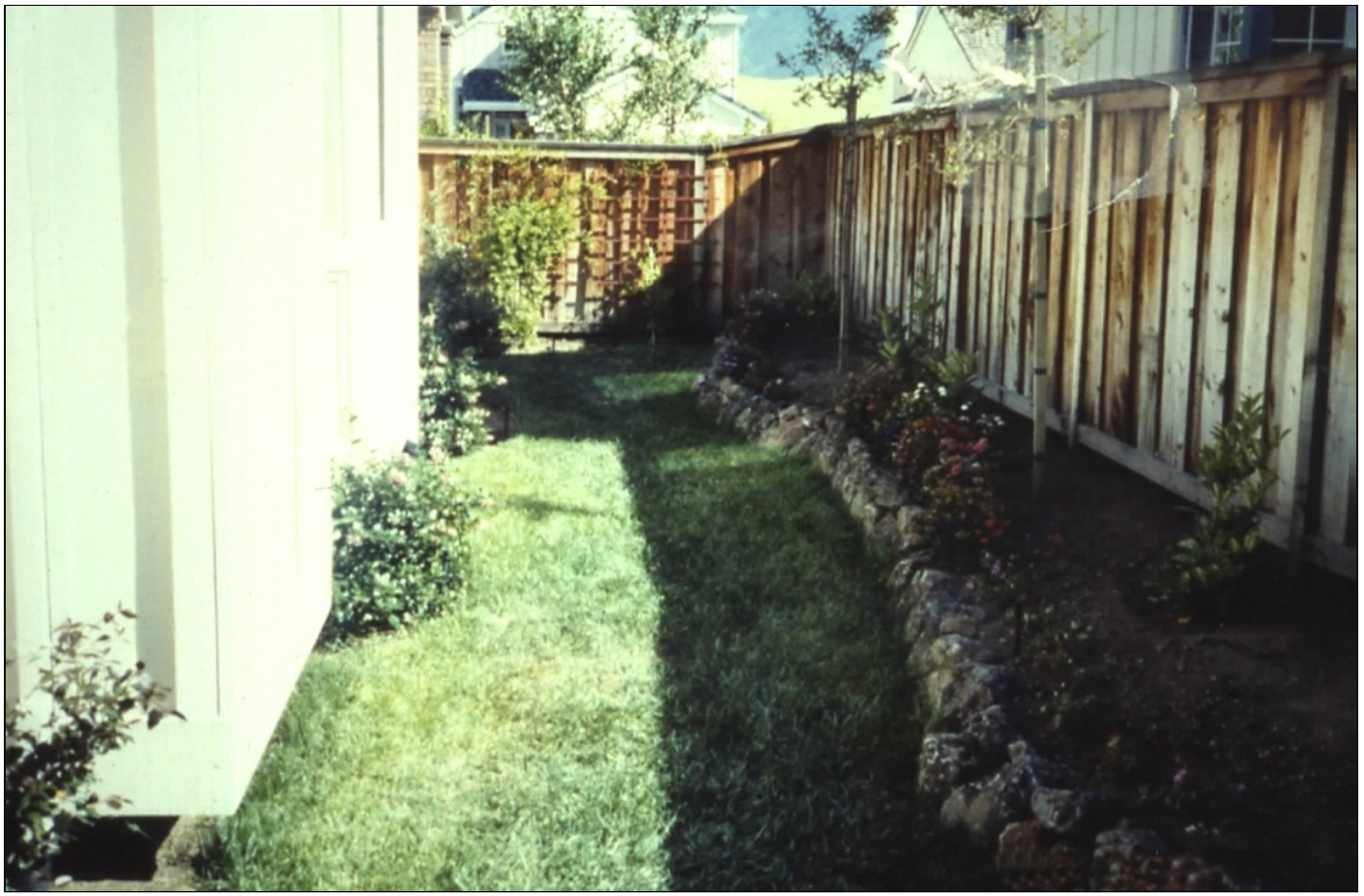
23 Where "H" exceeds 20'-0" slope height, provide a 4'-0" high min. designed retaining wall, and provide 2' high freeboard on top of the retaining wall to retain the toe of the slope, if the foundation is to be within 15' of the toe of the slope. (All retaining walls 3' or higher to be engineered, provide dwgs. and calculations).

24 Beyond a 15' setback, a wall may not be required, unless recommended by the soil engineer or engineering geologist.

25 Foundations for all buildings where the surface of the ground slopes more than 10%, shall be level, and you shall provide a stepped foundation, in order that the floor is level, and the bottom of the footing is placed level, with a minimum horizontal step of 4'-0" (see U.B.C. 1985, Sec. 2907(c)).



- **The most common problem with building pads is the promotion of adequate drainage from behind the structure to the street, around the building. Drainage swales need to be created and maintained**



- Homeowners usually infill drainage swales with landscaping, diminishing the intent of fine grading. In this case a remnant of the swale remains, but the grass prevents easy runoff

UMR

- **Concrete flatwork and sidewalks can serve as effective drainage collectors if appropriately sloped away from the structure and towards the point of discharge**

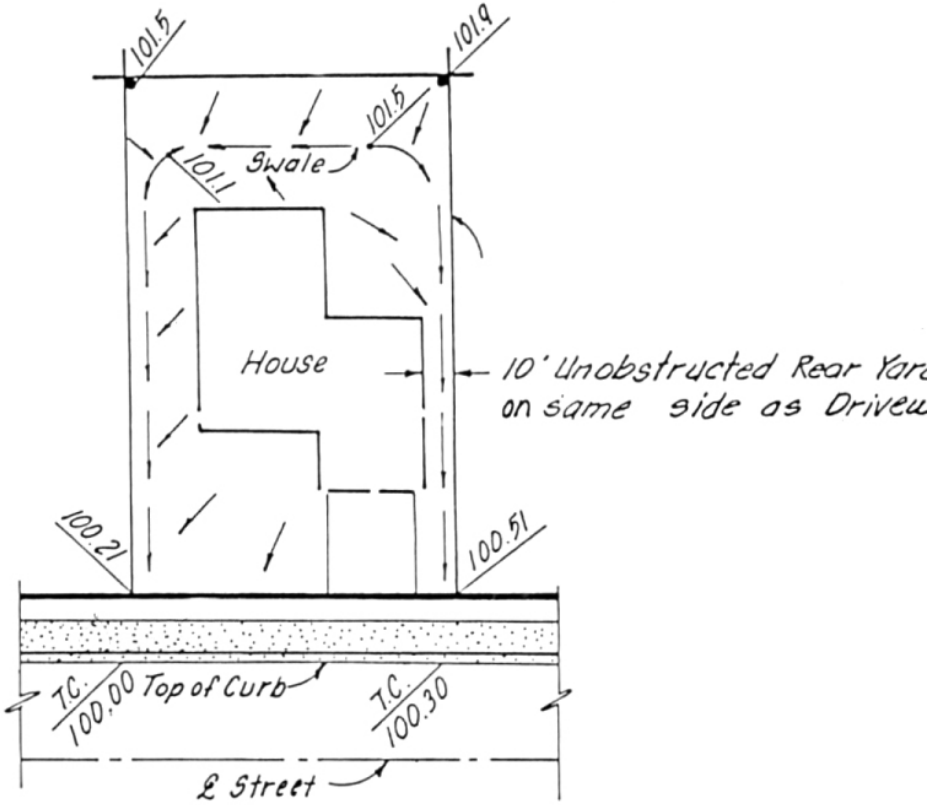
UMR

- Unpaved drainage swales tend to become mollified with time, gradually erasing effective drainage
- This shows an old earthen swale that has become infilled and no longer passes runoff to the desired location, causing ponding

- Example of poor side yard drainage and absence of maintained drainage swale
- Note ponding of water in landscaped area adjacent to the structure
- Paved sidewalks or drainage swales are best suited for long-term reliability

- This lot was equipped with graded side yard drainage swales, leading to drop inlets
- The inlets convey discharge to the street gutter, through a solid pipe, seen in the foreground, which passes through the curb

Water flows downhill



TYPICAL LOT DRAINAGE PATTERN
F.H.A. Type "A" Drainage
No Scale

- In general, runoff should be directed away from structures, to prevent ponding adjacent to foundations or concrete flatwork.
- Conveyance is usually towards the nearest paved street or natural watercourse

UMR

- This is an example of poor lot drainage, with the ground sloping towards the structure. Water has ponded next to the building and caused the concrete flatwork in the foreground to heave upward, exacerbating the problem. A slotted drain pipe should have been installed along the grade transition in left foreground.

UMR

- Drainage pipes should never be turned up (‘bubble-ups’) or discharged against curbs, as shown at left.
- Upper right: Chronic seepage across walkways creates a potential slip-and-fall hazard and is in violation of the IBC. Discharge from downspout leaders should be conveyed beneath sidewalks.

UMR

Seeping water across sidewalks

- The IBC recognizes that runoff should not be preferentially directed across sidewalks, because it can be a trip hazard; especially with algae growth or freezing temperatures.
- This shows a spring-fed seep that drips across the sidewalk year-round along O Highway, just south of Route 72 in Rolla. This one is on a steep grade, making it even more treacherous.

UMR

- Drop inlets are critical elements of most drainage collection systems
- They require perpetual maintenance and upkeep
- They may connect to piped conveyances
- Piped conveyances carry strict liability for any damages they cause

Drop Inlets require debris grates and constant maintenance

- Drop inlets should be provided with adequate **grillage** or **debris bollards** to prevent plugging by oversize debris

BOLLARDS

Bollards are concrete-filled pipes placed along debris basin spillways or just upstream of culvert entries to prevent the passage of large debris that could incapacitate or block such structures

UMR