NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

TERRACE
(Ft.)
CODE 600

Definition

An earth embankment, a channel, or a combination ridge and channel constructed across the slope.

Purpose

To: (1) reduce slope length, (2) reduce erosion, (3) reduce sediment content in runoff water, (4) improve water quality, (5) intercept and conduct surface runoff at a nonerosive velocity to a stable outlet, (6) retain runoff or moisture conservation,. (7) prevent gully development, (8) reform the land surface, (9) improve farmability, or (10) reduce flooding.

Conditions where practice applies

This practice applies where:

1. Water erosion is a problem,
2. There is a need to conserve water,
3. The soils and topography are such that terraces can be constructed and farmed with reasonable effort;
4. A suitable outlet can be provided, or
5. Runoff and sediment can damage land or improvements downstream or impair water quality.

Design criteria

Spacing. The maximum spacing for terraces for erosion control shall be determined by the following method:

1. $V.I. = xs + y$ or $H.I. = (xs+y)\left(\frac{100}{s}\right)$

Where:

V.I. = vertical interval in ft. (m)

H.I. = horizontal interval in ft. (m)
x = 0.6 (0.18) for area of state west of I-35
0.5 (0.15) for area of state east of I-35
s = land slope in percent
y = a variable with values from 1.0 to 4.0 (0.3 to 1.2)

Values of y are influenced by soil erodibility, cropping system, and crop management practices. Values of y are given in Table 1.

Refer to the "Revised Universal Soil Loss Handbook" for definitions of factors used in the Revised Universal Soil Loss Equation (RUSLE) and the procedure for determining soil loss.

NRCS, OK
May 1997

Table 1 "y" Values

	Values of y	
CP Factor	T/K ≥ 15.2	T/K < 15.2
< .22	4.0 (1.2)	3.5 (1.05)
.22 - .35	3.5 (1.05)	3.0 (0.9)
.36 - .43	3.0 (0.9)	2.0 (0.6)
> .43	2.0 (0.6)	1.0 (0.3)

CP factor is (C x P)

C factor is the cover-management factor. P factor is the support practice factor for contouring.

T/K is allowable soil loss ÷ soil erodibility factor. K is the adjusted soil erodibility factor contained in the RUSLE Handbook.

The horizontal spacing does not have to be less than 100 ft. (30 m) where the spacing is from channel to channel, nor shall it exceed 450 ft (135m). Within these limitations spacing may be increased as much as 10 percent to provide better alignment or location, to adjust for farm machinery, or to reach a satisfactory outlet. Spacing may be increased an additional 10 percent for terraces with underground outlets. The spacing shall be adjusted to provide for an even number of trips for anticipated row crop equipment and maximum opportunity for changing row widths. The likelihood of benching or steep slopes by tillage, land forming, and erosion shall be considered when determining the terrace interval. Where the contributing area is small, the top terrace may be spaced as much as 1.5 times the normal spacing.

For level terraces used for erosion control and water conservation, the spacing shall be determined as indicated above. Generally, level impounding type terraces are used in areas with less than 25 in. (635 mm) of rainfall and on slopes less than 3 percent. An x value of 0.8 (0;24) may be used for all level terraces used primarily to impound water.

For terraces on noncropland, the maximum spacing shall be governed by the capacity requirement.

Alignment. Terraces shall be parallel if feasible and as parallel as practicable. Curves shall be long and gentle to accommodate farm machinery. Land forming, extra cut or fill along the terrace line, multiple outlets, variations in grade, channel blocks, and other methods shall be used to achieve good alignment.

Field efficiency may be used to compare alternative terrace systems. Field efficiency is the ratio of time required to farm the field being planned, to that required to farm a rectangular field of the same acreage 1/2 mi. (0.8 km) long.

Capacity. The terrace shall have enough capacity to control the runoff from a 10-year frequency, 24-hour storm without overtopping. For terraces with underground

NRCS, OK
May 1997

outlets, the capacity shall be increased by the estimated 10-year sediment accumulation, unless provisions are made to maintain the design capacity through maintenance. Terrace systems designed to provide flood protection or to function with other structures shall have adequate capacity to control a storm of a frequency consistent with the potential hazard. When the capacity is determined by the formula Q = AV and the V is calculated by using Manning's formula, an n value of 0.06 shall be used for-bare channels; and SCS-TP-61, Handbook of Channel Design for Soil and Water Conservation, or equivalent, shall be used for vegetated channels.

Cross section. The terrace cross section shall be proportioned to fit the land slope, the crops grown, and the farm machinery used. Additional height shall be added if necessary to provide for settlement, channel sediment deposits, ridge erosion, the effect of normal tillage operations, and safety. The opening at the outlet end of gradient and open-end level terraces shall have a cross section equal to that specified for the terrace channel.

New or reconstructed terraces shall meet the minimum dimensions given in Table 2 or the specified dimensions of individually designed terraces.

Upper and lower slopes of the terrace shall be approximately the same except when a grass back slope is used. The side slopes of the excavated channel shall be approximately the slopes of the terrace ridge with the exception of a grass slope. The height given in Table 2 may be reduced by 10 % for fully settled terraces.

Where new terraces are added to or constructed below existing terraces as part of the terrace system, the existing terraces shall meet the following:

1. Visual inspection shows that the terraces are functioning properly and do not have ridge breaks or excessive channel blocks, and a cross section of the point which appears to be weakest in the existing terrace system shows that the existing terraces meet one of the following combinations:

	Ridge Height (ft.)	Channel Cross Sectional Area (ft.)
a.	0.7	20
b.	0.8	18
c.	0.9	17
d.	1.0	16

2. Or, individual terrace designs show that the existing terraces meet channel capacity and grade requirements of this standard.

Terraces that do not meet the requirements listed above should be reconstructed to meet requirements for new terraces.

End closures. Level terraces may have open ends, partial end closures, or complete end closures. Partial and complete end closures shall be used only on soils and slopes where the stored water will be absorbed by the soil without appreciable crop damage,or where underground outlets are provided.

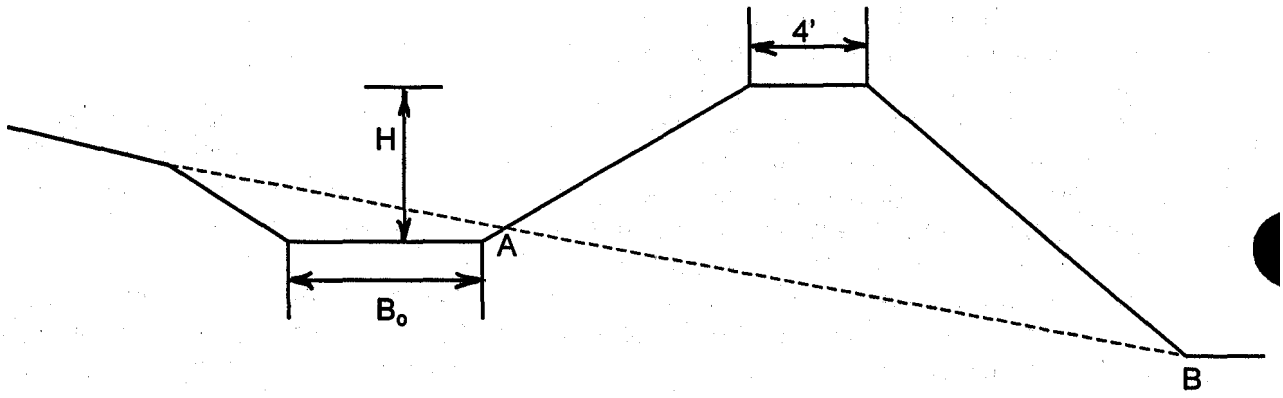
If terraces with closed or partly closed ends are specified, the end closures must be installed before the terraces are completed. The end closures shall be designed so that the water flows over the end closure before overtopping the terrace ridge.

Table 2 - Diminsions for Field Terraces

Percent Slope	Height above Channel Ft. (m)	Channel Bottom Width Ft. (m)	Cross Section Area of Channel Ft 2 -(m)	Width Standar Ft. (m)	Broadbase Ft. (m)
4% or less	1.2 (0.36)	8 (2.4)	20 (1.86)	22 (6.7)	30 (9.1)
4.1 to 8	1.4 (0.42)	8 (2.4)	20 (1.86)	20 (6.1)	28 (8.5)
8.1 to 10	1.0 (0.30)	4 (1.2)	10 (0.93)	20 (6.1)	28 ((8.5)
10.1 to 12	1.0 (0.30)	4 (1.2)	10 (0.93)	20* (6.1)	28 ((8.5)

*Use permanently vegetated grass back slope and top for terace ridge.
Back slope would be 3:1 or steeper. .

Note: Add 0.2 ft. (0.06m) to height above channel for terraces with closed ends.



Typical Cross Section

H = Height, top of terrace to bottom of water channel. Measurements for H to be made 2 ft. (0.6m) from center of ridge to a point where the channel has the required bottom width. All rod readings taken to determine terrace heights shall be taken in a heel print that has had the person's full weight in it.

B_o = Channel bottom width.

X = Cross sectional area of the channel. Use H as in typical cross section.

A = End of front slope of terrace ridge.

B = Back slope at natural ground line.

W = Base width of terrace ridge (A to B)

NRCS, OK
May 1997

Partial end closures shall not be more than half the effective height of the terrace ridge. Complete end closures are more than half the height of the ridge. The cross section of the closures may be less than the terrace cross section.

Channel grade. Channel grade shall be determined by one of the following methods:

1. The maximum channel grade in the lower reaches of farmed channels shall not exceed 0.6 percent and the maximum channel velocity for farmed channels shall be nonerosive for the soil and planned treatment. Maximum velocity shall be computed using Manning's Formula using an n value of 0.035 and shall not exceed the following:

    a. 2.5 ft./s (0.75 m/s) for erosion resistant soils (c, sic, sc, cl).

    b. 2.0 ft./s (0.6 m/s) for average soils (l, sil, sicl, scl)

    c. 1.5 ft./s (0.45 m/s) for easily eroded soils (sl, fsl, vfsl).

2. Maximum channel velocities for permanently vegetated channels shall not exceed those used for grassed waterways.

Channels grades may be uniform or variable. Channel velocity shall not exceed that which is nonerosive for the soil and planned treatment. For short distances and in upper reaches, channel grades or velocities may be increased to improve alignment. If terraces have an underground outlet, water and sediment will pond in the channel, thus reducing the velocity and allowing steeper channel grades near the outlet. Minimum grades shall be such that ponding in the channel because of minor irregularities will not cause serious damage to crops or delay field operations.

Terrace length. The volume of water stored in level terraces is proportional to the length. Therefore, it is necessary that the length be held within reason so that damage in case of a break is minimized. Level terrace length shall not exceed 3,500 ft. (1,000 m) unless the channel is blocked at intervals not exceeding 3,500 ft. (1,000 m).

Gradient terrace length is controlled by capacity and the nonerosive velocity requirements. Maximum length for gradient terraces of the size shown in Table 2 shall be governed by the following:

1. For terrace grades ≤ 0.3 percent.

    a. For runoff curve number 70, 3500 ft. (1,000 m).

    b. For runoff curve number 75, 3,500 ft. (1,000 m) except grades ≤ 0.10 percent refer to Figure 1.

    c. For runoff curve number 80, refer to Figure 2.

NRCS, OK
May 1997

d. For those cases where the combination of terrace length and spacing exceeds the limitations specified in b. and c. above, you may increase H to 1.4 ft. (0.42m) and the cross section area of the channel to 27 ft.2 (2.51 m2) for a maximum length of 3,500 ft. (1,000 m).

2. For terrace grade of 0.4 percent, 2,000 ft. (600m).

3. For terrace grade of 0.5 percent, 1,000 ft. (300m).

4. Where terraces of greater length than specified under 1., 2. or 3. above are required, individual designs shall be prepared.

Outlets. All terraces shall have adequate outlets. Open-end and partially closed-end terraces shall be designed to outlet upon well protected pastures, meadows, or wooded areas, or into a grassed waterway or outlet, or a combination of the above with mechanical structures. In all cases, the outlet must convey runoff from the terrace system to a point where the outflow will not cause damage. Closed end terraces do not require a vegetated outlet, but an emergency spill area shall be provided so that end closures can be readily opened in case draining the system becomes necessary.

The water surface in the terrace shall not be lower than the water surface in the outlet at their junction when both are operating at design flow.

Outlets shall be established prior to terrace construction. However, if the technician determines that it is technically sound, and provided the outlet is to be established the next season to vegetation, the terraces may be constructed immediately following shaping of the outlet in any of the following cases:

1. Where terraces are constructed in areas having an average annual rainfall of 25 in. (635 mm) or less.

2. Where the waterway is on a slope of less than 2 percent, and the design velocity with E retardance is 3 ft./s (0.9 m/s) or less.

3. Where a natural drain is to be established as a waterway and terracing the land will not materially increase the amount of water to be carried by the drain and the spill is not more than 1.0 ft. (0.3 m) above the bottom of the drain.

Underground outlets may be used on gradient or level terraces. The outlet consists of an intake and an underground conduit. An orifice plate, increase in conduit size, or other features shall be installed as needed to control the release rate and prevent excessive pressure when more than one terrace discharges into the same conduit. The discharge, when combined with the storage, shall be such that a 10-year frequency, 24-hour storm will not overtop the terrace, and growing crops will not be damaged significantly by standing water. The release time shall not exceed 48 hours for the design storm. Shorter periods may be necessary for some crops, depending on soils characteristics and water tolerance of crops to be grown.

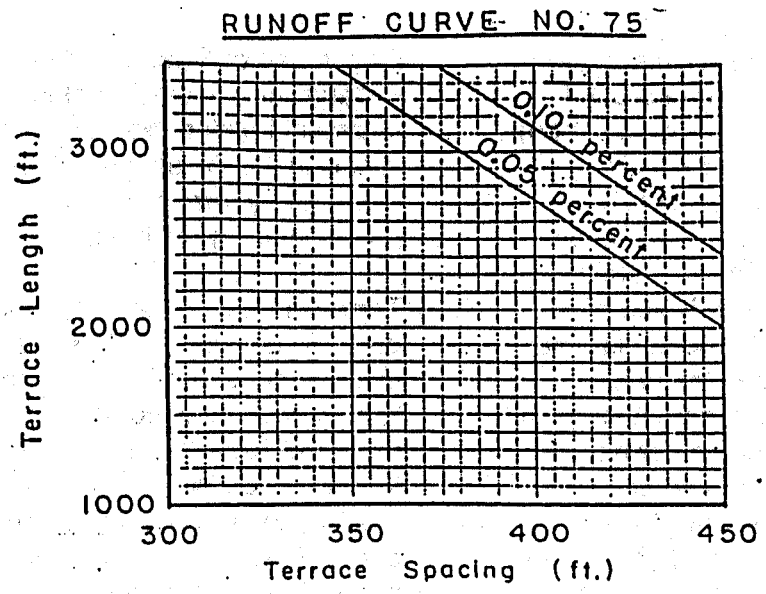


Figure 1. Combination of maximum terrace length and spacing for channel grades of 0.05 and 0.10 percent.

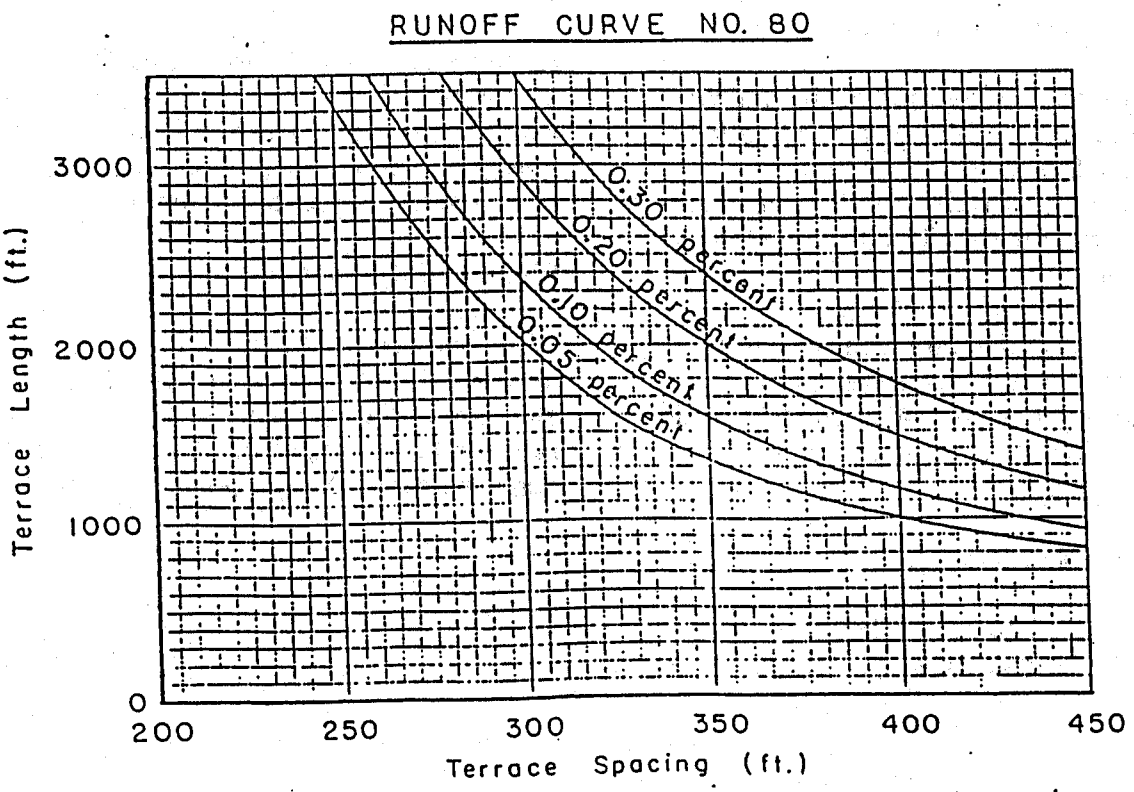


Figure 2. Combination of maximum terrace length and spacing for channel grades $\leq$ 0.30 percent.

NRCS,
OK
May
1997

The underground conduit shall meet the requirements specified for underground outlets (620) or for subsurface drains (606), or low-pressure underground plastic pipeline (430-EE). Conduits shall be installed deep enough to prevent damage from tillage equipment. The inlet shall consist of a vertical perforated pipe of a material suitable for the intended purpose. The inlet shall be located in the uphill direction far enough from the front slope of the terrace ridge, if farmed, to permit passage of farm machinery and, if necessary, provide for the anticipated accumulation of sediment and subsequent raising of the terrace ridge. The outlet of the conduit shall have adequate capacity for the design flow without causing erosion. Blind inlets may be used where they are effective, usually in well-drained soils.

Soil infiltration may be used as the outlet for level terraces. Soil infiltration must permit drainage of the design storm from the terrace channel with a reasonable period so that crops are not significantly damaged by standing water.

Combinations of different types of outlets may be used on the same system to maximize water conservation and to provide for economical installation of a more farmable system.

Safety and Maintenance

A program shall be established for maintaining terrace capacity, storage, ridge height, and outlets. Each inlet for underground outlets must be kept clean and sediment buildup redistributed so that the inlet is in the lowest place. Inlets damaged or cut off by farm machinery must be replaced or repaired immediately.

Terrace ridges, especially those with steep back slopes, can be very hazardous. For this reason, some farmers prefer steep front slopes, thus keeping machinery away from the steep back slopes. All cut and fill slopes that are to be farmed shall be no steeper than those on which farm equipment can operate safely. Any hazards shall be brought to the attention of the responsible person.

Vegetation

All areas to be vegetated shall be established to grass as soon as practicable after construction. The sod shall be maintained and trees and brush controlled by chemical or mechanical means.

Plans and Specifications

Plans and specifications for installing terraces shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

NRCS, OK
May 1997

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE GENERAL SPECIFICATIONS

TERRACE
(FT.)
CODE 600

Construction

All dead furrows, ditches, or gullies shall be filled before constructing the terrace or shall be part of the construction. All old terraces, fence rows, hedge rows, trees, and other obstructions shall be removed, as necessary, to install a farmable system. The banks of gullies and ditches to be crossed shall be sloped to a minimum of 1.5:1 before the fill is made.

The terraces shall be constructed to planned alignment, grade, and cross section with the specified overfill for settlement and the channel graded to drain reasonable well.

Any ditch or depression at the bottom of the back slope shall be filled and smoothed so that drainage will be away from the terrace and not parallel to it.

The entire cross section of the channel and ridge shall be uniform, full bodied, and smooth to the extent that farming operations may be accomplished with regular farm equipment. The slopes on excavated areas shall be approximately equal to the ridge slopes. The openings at the outlet end of the terrace shall have a cross section at least equal to that specified for the terrace channel. End closures, where specified, shall be made before the terrace is considered complete. The channel grade shall be constructed to such uniformity that unnecessary water impoundment will not be caused by blocks in the channel. Channel blocks or "highs" of 0.2 ft. (0.06 m) will be allowed in erosion resistant and average soil, and 0.3 ft. (0.09) in easily eroded soils, where such tolerance does not affect the minimum height requirements. Normal grades for gradient terraces are 0.15 to 0.20.

Where terraces are to be constructed across field ditches or gullies, channel lows will be permitted at these locations when the original ditch or gully is deeper than the normal cut to construct the terrace. Such lows will, therefore, not be used when checking terrace channel grade. The terrace ridge height shall be maintained across these lows in order to meet minimum height requirements.

Acceptable average grades for terraces are those within ± 0.10 ft. per 100 ft. of the design grade as long as there is a positive grade. This average grade shall be figured for the terrace length excluding 100 ft. on each end. A tolerance of ± 0.20 ft. per 100 ft. may be allowed for not more than 300 ft. consecutive length where this does not cause the average grade mentioned above to exceed the specified tolerance from design grade. A constructed grade of 0.6 percent may be allowed on the last 100 ft. (30 m) of the spill end.

NRCS, OK
May 1997

Provisions shall be made to prevent piping if underground conduits are located under terrace ridges. The underground conduit shall be placed deep enough to prevent damage by machinery for both the present and the future. In no case shall the conduit have less than 2 ft. (0.6 m) of cover. Mechanical compaction, water packing, trench sidewall sloping, and installation and backfill of conduit trenches early enough to allow adequate settlement are methods that can be used. The materials used for the inlet and conduit shall be suitable for the purpose intended (see standard 606 and 430-EE). Terrace ridges constructed across gullies or depressions shall be compacted by machinery travel or by other suitable means to insure proper functioning of the terrace. The surface of the finished terrace shall be reasonable smooth and present a workmanlike finish.

If necessary, topsoil shall be stockpiled and spread over excavations and other areas to facilitate restoration of productivity.

If vegetation is required, seedbed preparation fertilizing, seeding, and mulching shall comply with specifications in technical guides.

Terrace Removal

When terrace removal is required, the terrace ridge shall be removed so that there will not be any impoundment and the slope will not be greater than twice the land slope or 10:1, whichever is less.

NRCS, OK
May 1997