NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

TERRACE
(Ft.)
CODE 600

DEFINITION

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

PURPOSE

This practice may be applied as part of a resource management system to support one or both of the following:

- Reduce soil erosion
- Retain runoff for moisture conservation

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- Soil erosion by water is a problem
- There is a need to conserve water
- The soils and topography are such that terraces can be constructed and farmed with reasonable effort
- A suitable outlet can be provided
- Excess runoff is a problem

CRITERIA

General Criteria Applicable To All Purposes

Terraces shall be planned, designed, and constructed to comply with all federal, state, and local laws and regulations.

Spacing. The maximum spacing for terraces shall not exceed the distances shown in Table A:

Condition 1 – Areas with defined drainage patterns resulting in concentrated flows and conventional tillage and/or stubble mulch practices.

Condition 2 – Areas with defined drainage patterns and no-till farming.

Condition 3 – Areas with long broad slopes resulting in sheet flow runoff with fallow cropping, up and downhill tillage, 200 to 500 pounds residue.

Condition 4 – Areas with long broad slopes resulting in sheet flow runoff with continuous cropping or wheat fallow cropping, cross-slope farming with stubble mulch (1,000+ pounds residue).

Condition 5 – Landowners practicing no-till and cross-slope farming on long broad slopes.

Spacing is defined as the horizontal distance between the centerline of the ridge tops of adjacent terraces. Spacing along a terrace may be adjusted to provide better alignment or location, to adjust for farm machinery, or to reach a satisfactory outlet.

TABLE A
MAXIMUM HORIZONTAL SPACING FOR TERRACES (Feet)

Slope (%)	Condition 1	Condition 2	Condition 3	Condition 4	Condition 5
0-4	400	600	400	600	600
4-6	400	600	300	600	600
6-9	300	400	200	400	600
9-12	250	400	200	400	500
12-14	200	300	200	250	400
14-18	200	250	200	200	300
>18	200	200	200	200	200

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

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For terraces on non-cropland, the maximum spacing shall be governed by the capacity requirement for the selected spacing.

Alignment. Cropland 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, channels blocks, and segmenting level terraces or other methods shall be used to achieve good alignment. Level terraces do need to be a continuous terrace. Alignments should be adjusted at hogbacks by ending one segment of a terrace and beginning another terrace on the other side. The alignment of terraces across small draws should be adjusted by increasing fill heights across the draw to eliminate sharp curves.

Capacity. The terrace shall have enough capacity to control the runoff from a 10-year frequency, 24-hour storm without overtopping. The capacity shall be increased by the estimated 10-year sediment accumulation, unless sediment is removed through maintenance. Terrace systems designed to provide flood protection or to function with other structures shall have the appropriate design capacity. When the capacity of a gradient terrace is determined by the formula Q = AV and the V is calculated using Manning's formula, a minimum 'n' value of 0.035 shall be used for bare channels. Agricultural Handbook Number 667, Stability Design of Grass-lined Open Channels, Chapter 7 of the Engineering Field Handbook or equivalent shall be used for vegetated channels. The design capacity for level terraces storing runoff from cropland shall be the larger of either the 10-yr 24-hour runoff or 1 inch of runoff, except where no-till is being practiced. With no-till farming the runoff shall be the larger of either the10-yr 24-hour runoff or 0.75 inch of runoff. On cropland with tillage pans the soil hydrologic group shall be adjusted to represent a higher runoff potential.

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 ridge shall have a minimum width of 3 ft. (1 m) at the design elevation. The steepest slope of a vegetated front or back ridge slope is 2 horizontal:1 vertical. Terrace ridges, especially those with steep back slopes, can be very hazardous. All cropped terrace slopes that are to be farmed shall be no steeper than those on which farm equipment can operated safely. Potential hazards must be brought to the attention of the responsible person. The recommended side slope for farmed terraces is 6:1 or flatter and shall not be steeper than 4:1. 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.

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.

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

2. Maximum channel velocity for cultivated channels shall be nonerosive for the soil and planned treatment. Maximum velocity for erosion-resistant soils is 2.5 ft/s; for average soils, 2.0 ft/s; and for easily erodible soils, 1.5 ft/s. Velocity shall be computed by Manning's formula, using a maximum 'n' value of 0.035.

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 lower reaches of the channel, thus reducing the velocity in those reaches and allowing steeper channel grades within the impoundment area. Minimum grades shall be such that ponding in the channel caused by 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 feet unless the channel is blocked at intervals not exceeding 3,500 feet. Normally, the capacity and the nonerosive velocity requirements will control the gradient terrace length.

Outlets. All terraces must have adequate outlets.

Vegetated outlets may be used for gradient or open-end level terraces. Such an outlet may be a grassed waterway or other vegetated area. The outlet must convey runoff water to a point where the outflow will not cause damage. Outlets shall be installed and vegetation established before the terrace is constructed to provide a stable outlet. 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.

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 in the conduit. Terraces shall be designed to control a 10-year frequency, 24- hour storm without overtopping. The release time shall not exceed the inundation tolerance of the planned crops. If sediment retention is desired, adjust release rate according to particle size. Pipe outlets for gradient terraces must be designed for no less than the 10-yr 24-hour peak flow.

The underground conduit shall meet the requirements specified in Conservation Practice Standards, Underground Outlets 620 or Subsurface Drains 606. Conduits must be installed deep enough to prevent damage from tillage equipment. The inlet shall consist of a vertical perforated pipe or other structure suitable for the intended purpose. The inlet shall be located uphill of 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. 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.

Soil infiltration may be used as the outlet for level terraces. Soil infiltration must permit drainage of the design storm from the terrace channel within a reasonable period so standing water does not significantly damage crops.

Underground pipe outlets are required on level terraces when the average annual precipitation exceeds 16 inches and the soils have low permeabilities due to high clay content or hardpans or are shallow to rock.

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

Vegetation. All areas to be vegetated shall be established as soon as practicable after construction.

Drainage. Install subsurface drainage to stabilize terrace where needed. It shall be designed taking into consideration the effect of snowcatch and melt on water budget components.

CONSIDERATIONS

Consider adjusting the spacing to allow an even number of trips with the equipment.

Consider aligning terraces and/or installing subsurface drainage to correct seepage problems.

The release time for storm water stored in level terraces should not exceed 48 hours for the design storm. Shorter periods may be necessary for some crops, depending on soil characteristics and water tolerance of crops to be grown.

Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation and ground water recharge.

The type of outlet, time of water detention, geology, and topography of the site.

Effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances carried by runoff.

Effects of nutrients and pesticides on surface and ground water quality. Filtering effects of vegetation on movement of sediment and dissolved and sediment attached substances.

Short-term and construction-related effect on the quality of downstream water.

Effects on the movement of dissolved substances below the root zone and toward the ground water.

Potential for uncovering or redistributing toxic materials and low productive soils that might cause undesirable effects on the water or plants.

PLANS AND SPECIFICATIONS

Plans and specifications for installing terraces shall be in keeping with this standard and shall show layout, terrace cross-section details, grade if applicable, outlet detail or end block details, compaction requirements, etc.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be prepared for the operator.

The minimum requirements to be addressed in the operation and maintenance plan are:

1. Provide periodic inspections, especially immediately following runoff events.

2. Promptly repair or replace damaged components as necessary.

3. Maintain terrace ridge height and outlet elevations.

4. Remove sediment that has accumulated in the terrace to maintain capacity, a positive channel grade, and to maintain capacity where soil infiltration serves as the outlet.

5. 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.

6. Vegetation, where specified, shall be maintained and trees and brush controlled by chemical or mechanical means.

7. Vegetated outlets should be established before construction when feasible.

8. Keep machinery away from steep back sloped terraces. Keep equipment operators informed of all potential hazards.

REFERENCES

- Engineering Field Handbook

  Chapter 2, Estimating Runoff

  Chapter 8, Terraces

- Agricultural Handbook Number 667, Stability Design of Grass-lined Open Channels