UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

WASTE STORAGE FACILITY

(No.)

Code 313

DEFINITION

A waste storage impoundment made by constructing an embankment and/or excavating a pit or dugout, or by fabricating a structure.

PURPOSE

To temporarily store wastes such as manure, wastewater, and contaminated runoff as a storage function component of an agricultural waste management system.

CONDITIONS WHERE PRACTICE APPLIES

- Where the storage facility is a component of a planned agricultural waste management system
- Where temporary storage is needed for organic wastes generated by agricultural production or processing
- Where the storage facility can be constructed, operated and maintained without polluting air or water resources
- Where site conditions are suitable for construction of the facility
- To facilities utilizing embankments with an effective height of 35 feet or less where damage resulting from failure would be limited to damage of farm buildings, agricultural land, or township and country roads
- To fabricated structures including tanks, stacking facilities, and pond appurtenances

CRITERIA

General Criteria Applicable to All Waste Storage Facilities

Federal, State, and Local Laws. All planned activities shall comply with all federal, state, and local laws and regulations. The Alabama Department of Environmental Management (ADEM) Rules require owners/operators of animal feeding operations (AFO's) and associated waste management systems to fully implement and regularly maintain effective best management practices (BMP's) that meet or exceed NRCS technical standards and guidelines to prevent discharges and to ensure groundwater and surface water quality. AFO owners/operators who fail to implement BMP's or whose facilities discharge or have the significant potential to discharge to "waters of the state" can be required by ADEM or the Environmental Protection Agency (EPA) to implement effective corrective actions immediately. If preventive or effective actions are not fully implemented in a timely manner, civil penalties may be incurred by the owners/operators.

All construction activities must implement adequate stormwater management BMP's. In addition, to comply with the National Pollutant Discharge Elimination System (NPDES) Phase II Rule, all construction activities involving one acre or more of land disturbance shall have and follow a construction best management practices plan (CBMPP) until construction is complete and all disturbed areas are stabilized.

ADEM AFO rules require that operators retain records documenting that (1) all designs and plans for any structures were prepared and certified by a professional engineer registered in the State of Alabama (PE), (2) construction was supervised by a PE, (3) once construction was completed, a PE certified that the completed facility was constructed in accordance with the approved plans and met or exceeded good engineering practices and NRCS technical standards and guidelines, and (4) any modifications or repairs made to the structures were supervised and certified by a PE.

Location. To minimize the potential for contamination of streams, waste storage facilities should be located outside of floodplains. However,

if site restrictions require location within a floodplain, they shall be protected from inundation or damage from a 100-year flood event. Waste storage facilities shall be located so the potential impacts from breach of embankment, accidental release, and liner failure are minimized; and separation distances are such that prevailing winds and landscape elements such as building arrangement, landforms, and vegetation minimize odors and protect aesthetic values.

Waste storage facilities shall be located to meet the minimum buffer distance requirements from water(s), wells, property lines, and public or private facilities as defined in the ADEM Administrative Code, Chapter 335-6-7, as amended.

Storage Period. The storage period is the maximum length of time anticipated between emptying events. The minimum storage period shall be determined so as to prevent surface or groundwater pollution and be based on the timing required for environmentally safe waste utilization considering the climate, crops, soil, equipment, management, and local, state, and federal regulations. The minimum storage period shall be thirty (30) days for all methods of disposal, except milk parlor waste that is conveyed with sprinkler irrigation shall have a minimum storage period of seven (7) days.

Required Storage Volume. The required storage volume shall consist of the total of the following as appropriate:

- Manure, wastewater, and other wastes accumulated during the storage period.
- If the facility is uncovered, normal precipitation less evaporation on the surface area (at the required storage volume level) of the facility during the storage period. For storage ponds, precipitation on the maximum collection area inside the top of the pond, less evaporation on the average pond surface area during the storage period.
- Normal runoff from the facility's drainage area during the storage period.
- If the facility is uncovered, the 25-year, 24-hour storm volume (the volume resulting from the rainfall from the 25-year, 24-hour storm on the maximum collection area inside the top of the facility plus the runoff from any contributing drainage area from the 25-year, 24-hour storm).

  In accordance with ADEM's and EPA's concentrated animal feeding operation (CAFO) rules, a new large CAFO facility for swine, veal, and poultry must contain the volume from the 100-year, 24-hour storm. Large CAFO's are defined as those confining the following number of animals or more:

  - 1,000 veal calves
  - 2,500 swine weighing ≥ 55 pounds
  - 10,000 swine each weighing < 55 pounds
  - 30,000 laying hens or broilers
- Residual solids after liquids have been removed. A minimum depth of 6 inches shall be provided for tanks.
- Additional storage as may be required to meet management goals or regulatory requirements.

For determining the portion of the required storage volume that involves precipitation and evaporation, the storage period during the year that will produce the largest volume shall be used, based on average monthly precipitation and evaporation tables.

Inlet. Inlets shall be of any permanent type designed to resist corrosion, plugging, freeze damage, and ultraviolet ray deterioration while incorporating erosion protection as necessary. Inlets shall be designed to carry the peak rate of waste flow to the storage facility without leakage or other soil contact by the wastes, unless a portion of the inlet incorporates a wastewater treatment strip as part of the overall design.

Emptying Component. Some type of component shall be provided for emptying storage facilities. It may be a gate, pipe, dock, wet well, pumping platform, retaining wall, or ramp. Features to protect against erosion, tampering, and accidental release shall be incorporated as necessary.

Accumulated Solids Removal. Provision shall be made for periodic removal of accumulated solids to preserve storage capacity. The anticipated method for doing this must be considered in planning, particularly in determining the configuration of the facility and type of liner, if any.

Safety. Design shall include appropriate safety features to minimize the hazards of the facility. Entrance ramps shall be designed for safe entrance based on the type of equipment used.

Ramps used to empty liquids shall have a slope of 4 horizontal to 1 vertical or flatter. Those used to empty slurry, semi-solid, or solid waste shall have a slope of 10 horizontal to 1 vertical or flatter unless special traction surfaces are provided.

Warning signs, fences, ladders, ropes, bars, rails, and other devices shall be provided, as appropriate, to ensure the safety of humans and livestock. Ventilation and warning signs must be provided for covered waste holding structures, as necessary, to prevent explosion, poisoning, or asphyxiation. Pipelines shall be provided with a water-sealed trap and vent, or similar device, if there is a potential, based on design configuration, for gases to enter buildings or other confined spaces. Ponds and uncovered fabricated structures for liquid or slurry waste with walls less than 5 feet above ground surface shall be fenced and warning signs posted to prevent children and others from using them for other than their intended purpose.

Fencing shall be according to Alabama NRCS conservation practice standard Fence, Code 382, with safety as the objective. Warning signs shall be posted to deter anyone from using the facility for anything other than its intended purpose. A warning sign (90 in^2 minimum) shall be placed on each straight section of fencing, not to exceed a spacing of 300 feet.

Erosion Protection. To control erosion, embankments and disturbed areas surrounding the facility shall be vegetated according to Alabama NRCS conservation practice standard Critical Area Planting, Code 342.

Flexible Membranes. Flexible membranes shall meet or exceed the requirements of flexible membrane linings as specified in Alabama NRCS conservation practice standard Pond Sealing or Lining (Flexible Membrane), Code 521A.

Liners. Liners shall be designed and constructed in accordance with the Alabama NRCS conservation practice standard, Waste Treatment Lagoon, Code 359.

Seepage. Effluent seepage in amounts that would pollute surface or ground water shall be prevented by watertight construction or a low permeability liner, or shall be collected and utilized in a safe manner. Influent seepage in amounts that would infringe on designed storage capacity or disrupt the proper operation of the facility shall be prevented by watertight construction, a low permeability liner, or by site drainage.

Foundations consisting of bedrock with joints, fractures, or solution channels shall be separated from the bottom of the floor slab or liner by a minimum of one foot of low permeability soil [type III or IV as described in the National Engineering Handbook (NEH), Part 651, Agricultural Waste Management Field Handbook (AWMFH), Chapter 7 and Appendix 10D] or by an alternative that will achieve equal protection.

Additional Criteria for Waste Storage Ponds

Hazard Classification. The area downstream of the embankment must be evaluated carefully to determine the impact a sudden breach of the proposed embankment would have on both structural and environmental features and to public safety (see the section "Considerations" of this standard). This evaluation must consider all improvements and those improvements that may reasonably be expected to be made during the useful life of the structure. The results of this examination provides for the proper hazard classification of the embankment. Only hazard class "a" embankments are to be designed under this standard. See National Engineering Manual (NEM), Part 520 for guidance concerning documentation of hazard class determination.

Soils and Foundation. The pond lining shall have a permeability of $1x10^{-7}$ cm/sec or less, or a maximum allowable operational specific discharge of no more than 0.0028 ft/day. (NOTE: These rates may be reduced one order of magnitude due to manure sealing). The pond shall be located in soils that shall not exceed these rates or shall be sealed by a low permeability liner. Where possible, avoid sites with gravelly soils and shallow soils over fractured or cavernous rock. A detailed soils investigation with special attention to the water table depth and seepage potential must be considered in each design. Soil investigations must evaluate soils to a depth no less than 2 feet below the final grade of any excavation. Subsurface investigation in soils underlain by the Demopolis or Mooreville Chalk formations of the Selma Chalk group in the Blackland Prairie major land resource area may terminate at a depth of 1 foot below the surface of the chalk.

Information and guidance on controlling seepage from waste storage ponds can be found in the AWMFH, Chapter 7 and Appendix 10D.

Waste Storage Ponds Constructed in High Water Table Soils. Waste storage ponds constructed in high water table soils will be considered only as a last site alternative and shall be based on a detailed risk assessment. The risk assessment shall include an analysis of the potential for ground water pollution considering the hydrogeology, ground water transmissivity, soil permeability, etc. The pond shall have a bottom elevation that is a minimum of 2 feet above the seasonal high water table unless features of special design are incorporated that address buoyant forces, pond seepage rate and non-encroachment of the water table by contaminants. Decisions to install waste storage facilities in high water table soils without liners must provide reasonable assurances that the facility will not cause surface or ground water pollution. The water table may be lowered by use of perimeter drains, if feasible, to meet this requirement.

If during the risk assessment it is determined that the site is a potential hazard to ground water pollution, it shall be designed with a liner to prevent contamination of ground water. Methods to maintain the liner integrity shall be incorporated in the design.

The storage volume for waste storage ponds constructed in high water table soils shall be the volume above the natural high water level elevation unless perimeter drains are utilized to lower the ground water level.

Inlet. Inlets may be push-off ramps, paved slopes, or pipe inlets. Paved slopes shall be no flatter than 4 horizontal to 1 vertical (4:1) and will not be used when appreciable bedding materials are used.

Pipe inlets may be concrete, aluminum, or plastic as required in Alabama NRCS conservation practice standard Pond, Code 378.

All pipes shall be designed to carry the required flow and shall be installed on a slope of 1% or greater and preferably 1.5% or greater. Where solids are being conveyed, the pipe diameter shall be sized to prevent plugging. Minimum pipe diameter will be 6 inches. Wye or tee fittings shall be placed at a maximum spacing of 150 feet to facilitate cleanout of the pipe in case of blockage. The inlet pipe should extend a sufficient distance from the shoreline to ensure good distribution. Pipes shall be installed far enough below the ground surface to avoid freezing or be provided with other protective measures.

The slope of the pond and the liner at the pipe inlet shall be protected from erosion by paving, by extending the pipe to a point where the discharge will not fall on the slope, or by using a flexible down pipe at the pipe discharge during filling. Permanent measures shall be used to protect liners during initial filling and after periodic emptying. Pipes shall be supported on pilings of pressure treated wood, steel, concrete, or masonry and anchored to prevent dislodging or flotation. Piling installation shall maintain liner integrity.

Pumped inlets shall be sized to meet the requirements of the pumping equipment. Larger diameter gravity loading pipes for solids and liquids shall outlet at the bottom of the pond, and the effective head (vertical difference between the top of the drop inlet and the required storage volume elevation) shall be no less than 4 feet.

Maximum Operating Level. The maximum operating level for waste storage ponds shall be the pond level that provides for the required storage volume less the 25-year, 24-hour storm volume (the 100-year, 24-hour storm volume, if applicable).

Freeboard. Freeboard is the vertical distance between the settled top of dike of a waste storage pond and the designed liquid level in the pond with the auxiliary spillway or overflow structure operating at the design discharge. This distance shall be a minimum of 1 foot.

Embankments. The height of the embankment shall be increased during construction by the amount needed to ensure that the designed height will be maintained after settlement. This increase shall not be less than 5 percent. The combined side slopes of the settled embankment shall not be less than 5 horizontal to 1 vertical (5:1), and neither slope shall be steeper than 2 horizontal to 1 vertical (2:1) unless special provisions are made to provide stability. The top of the dike shall slope slightly toward the outside dike slope in order to direct as much rainfall as possible from the waste storage pond. All slopes must be designed to be stable. Where embankments are to be mowed; 3 horizontal

to 1 vertical (3:1) or flatter slopes are recommended.

The minimum embankment top width shall be as shown in Table 1. If the embankment top is to be used as a road, the minimum top width shall be 16 feet for one-way traffic and 26 feet for two-way traffic, and provisions shall be made for protecting the auxiliary spillway from damage. Guard rails or other safety measures shall be used where necessary.

Table 1. Embankment Top Width

Total Height of Embankment (ft.)	Minimum Top Width, (ft.)
<15	8
15 to <20	10
20 to <25	12
25 to <30	14
30 to 35	15

Compaction of the embankment fill material shall be in accordance with the specified design requirements for compaction and moisture content. As a minimum compaction shall be equivalent to, or better than, the following:

1. Layers of loose fill shall not exceed 9 inches in thickness before compaction. Compaction shall be accomplished by routing the hauling and spreading equipment over the fill in such a manner that every point on the surface of each layer of fill will be traversed by not less than 2 complete passes of the loaded equipment traveling in a direction parallel to the main axis of the fill.
2. If a minimum required density is specified, each layer of fill shall have the moisture adjusted and be compacted as necessary to obtain the density. Special equipment shall be used, if needed, to obtain the required moisture content and degree of compaction.

Excavations. Side slopes shall be stable and shall not be steeper than 2 horizontal to 1 vertical (2:1) unless provisions are made to provide stability.

Runoff Exclusion. A low embankment shall be constructed if needed to exclude uncontaminated surface runoff from the pond. The embankment shall meet the criteria contained in the section "Embankments" of this standard.

Outlet. No outlet shall automatically release stored material from a level below the surface elevation of the required storage volume. Outlets from the waste storage pond shall be designed to resist corrosion and plugging. Manually operated outlets shall be of a permanent type designed to resist corrosion and plugging.

Multiple cells. When multiple cells are used, the volume of the primary cell shall be the sum of the manure, wastewater, and other wastes accumulated during the storage period plus the planned solids accumulation between cleanout events, minimum. The remaining volumes shall be in the following cell(s), with normal precipitation, storm volumes, and freeboard being designed and maintained in the final cell. All cell(s) prior to the final cell shall have 1 foot minimum freeboard with the overflow structure passing the 25-year, 24-hour storm, but do not require an auxiliary spillway.

Embankment Waste Storage Pond and Spillway. Embankment waste storage ponds (those having a maximum operating level against the embankment of 3 feet or more above natural ground) shall be provided with an auxiliary spillway, overflow structure, or combination to protect the embankment from overtopping when the pond is at the maximum operating level and a 25-year, 24-hour storm volume (the 100-year, 24-hour storm volume, if applicable) is exceeded. The crest of the auxiliary spillway or overflow structure shall be located at or above an elevation that will contain the 25-year, 24-hour storm volume (the 100-year, 24-hour storm volume, if applicable). This elevation shall be a minimum of 1 foot above the maximum operating level. The auxiliary spillway, overflow structure, or combination shall be designed to pass the 25-year, 24-hour storm volume while maintaining the required minimum freeboard of one foot.

The auxiliary spillway shall be placed in undisturbed soil when possible. When it must be placed in fill material, precautions shall be taken to insure the integrity of the structure. When locating the auxiliary spillway, areas near the waste storage pond corners and the side containing the inlet shall be avoided, if possible.

Pipe auxiliary spillways shall be 6-inch minimum diameter and equipped with trash racks, antivortex devices, and antiseep collars and may be steel, concrete, aluminum, or plastic as required in

Alabama NRCS conservation practice standard, Pond, Code 378.

Excavated Waste Storage Pond. Excavated waste storage ponds (those having a maximum operating level against the embankment of less than 3 feet above natural ground) do not require an auxiliary spillway, overflow structure, or freeboard unless they are in a series of multiple cells (see the section "Multiple Cells" in this standard) or have an outside drainage area (include overflow protection as for an embankment waste storage pond). The vertical distance from the maximum operating level to the settled top of the embankment shall provide storage for the 25-year, 24-hour storm volume (the 100-year, 24-hour storm volume, if applicable) or be a minimum of 1 foot, whichever is greater.

Emptying Facilities. Some type of facility shall be provided for emptying the waste storage pond (see the requirements in the section "Safety" of this standard).

Where agitators are used in ponds with liners, the tip of the propeller shall be a minimum of 3 feet from the liner surface or the liner shall be protected by a concrete pad. The agitator shall be positioned so that agitated flow will not cause scouring of an adjacent slope

Provision shall be made for periodic removal of accumulated solids to preserve storage capacity. The anticipated method for doing this must be considered in planning, particularly in determining the size and shape of the pond and type of liner.

Waste removed from storage facilities shall be utilized in accordance with Alabama NRCS conservation practice standard, Nutrient Management, Code 590.

Staff Gage. A staff gage shall be placed in the waste storage pond with a marker for the maximum operating level allowed and the level of the auxiliary spillway, if applicable. The staff gage will have incremental marks which will coincide with a stage-storage curve for the operator's use in monitoring waste volumes in the pond. The minimum drawdown level will also be marked on the staff gage. The markings and the stage-storage curve shall be referenced and described in the operation and maintenance (O&M) plan.

Additional Criteria for Fabricated Structures

Service Life and Durability. Planning, design, and construction shall ensure that the structure is sound and of durable materials commensurate with the anticipated service life, initial and replacement costs, (O&M) costs, and safety and environmental considerations.

Guidance in evaluating the service life of various materials is given in Table 2. The materials indicated meet the requirements of this standard. The service life of materials not shown shall be based on performance data.

Table 2. Service Life of Various Materials

Service life	Material[1/]
Short (minimum of 10 years)	Wood; masonry, including concrete staves; flexible membranes; glass/fiber reinforced plastics/resins; steel coated with zinc, epoxy, vinyl, and asphalt; reinforced concrete.
Medium (minimum of 20 years)	Reinforced concrete; glass fused steel.
Long (minimum of 50 years)	Reinforced concrete; flexible membranes with earth covers.

[1/] The durability and estimated life of reinforced concrete is a function of the design criteria and the quality of the concrete. A key aspect affecting durability is corrosion of the reinforcement which is directly related to cracking (design stress) and the reinforcement cover.

Foundation. The foundations of fabricated waste storage facilities shall be proportioned to safely support all superimposed loads without excessive movement or settlement.

Where a non-uniform foundation cannot be avoided or where applied loads may create highly variable foundation loads, settlement should be calculated from site specific soil test data. Index tests of site soil may allow correlation with similar soils for which test data is available. If no test data is available, presumptive bearing strength values for assessing actual bearing pressures may be obtained from

Table 3 or another nationally recognized building code. In using presumptive bearing values, adequate detailing and articulation shall be provided to avoid distressing movements in the structure.

Watertightness. Applications such as tanks that require watertightness shall be designed and constructed in accordance with standard engineering and industry practice appropriate for the construction materials used to achieve this objective.

Structure Loading. Waste storage structures shall be designed to withstand all anticipated loads including internal and external loads, hydrostatic uplift pressure, concentrated surface and impact loads, water pressure due to seasonal high water table, and frost or ice pressure and load combinations in compliance with this standard and applicable local building codes.

Table 3. Presumptive Allowable Bearing Stress Values [1/]

Foundation Description	Allowable Stress
Crystalline Bedrock	12,000 psf
Sedimentary Rock	6,000 psf
Sandy Gravel or Gravel	5,000 psf
Sand, Silty Sand, Clayey Sand, Silty Gravel, Clayey Gravel	3,000 psf
Clay, Sandy Clay, Silty Clay, Clayey Silt	2,000 psf

[1/] Basic Building Code, 12th Edition, 1993, Building Officials and Code Administrators, Inc. (BOCA)

The lateral earth pressures should be calculated from soil strength values determined from the results of appropriate soil tests. Lateral earth pressures can be calculated using the procedures in NRCS Technical Release (TR) - 74. If soil strength tests are not available, the presumptive lateral earth pressure values indicated in Table 4 shall be used.

Lateral earth pressures based upon equivalent fluid assumptions shall be assigned according to the following conditions:

- **Rigid frame or restrained-wall.** Use the values shown in Table 4 under the columns "Frame Tanks", which give pressures comparable to the at-rest condition.

- **Flexible or yielding wall.** Use the values shown in Table 4 under the columns "Freestanding Walls", which give pressures comparable to the active condition. Walls in this category are designed on the basis of gravity for stability or are designed as a cantilever having a base wall thickness to height of backfill ratio not more than 0.085.

  Internal lateral pressure used for design shall be 65 lbs/ft^2 where the stored waste is not protected from precipitation. A value of 60 lbs/ft^2 may be used where the stored waste is protected from precipitation and will not become saturated. Lesser values may be used if supported by measurement of actual pressures of the waste to be stored. If heavy equipment will be operated near the wall, an additional two feet of soil surcharge shall be considered in the wall analysis.

If the facility is to have a roof, snow and wind loads shall be as specified in "Minimum Design Loads for Buildings and Other Structures," Standard No. 7-02, ASCE. If the facility is to serve as part of a foundation or support for a building, the total load shall be considered in the structural design.

Structural Design. The structural design shall consider all items that will influence the performance of the structure, including loading assumptions, material properties, and construction quality. Design assumptions and construction requirements shall be indicated on the plans.

Fabricated structures shall be designed according to the criteria in the following references as appropriate:

- Steel. "Manual of Steel Construction", American Institute of Steel Construction
- Timber. "National Design Specifications for Wood Construction", American Forest and Paper Association

- Concrete. "Building Code Requirements for Reinforced Concrete," ACI 318, American Concrete Institute
- Masonry. "Building Code Requirements for Masonry Structures," ACI 530, American Concrete Institute

Table 4. Lateral Earth Pressure Values [1/]

Soil		Equivalent fluid pressure ($lb/ft^2/ft$ of depth)			
		Above Seasonal High Water Table [2/]		Below Seasonal High Water Table [3/]	
Description [4/]	Unified Classification [4/]	Free-standing Walls	Frame Tanks	Free-standing Walls	Frame Tanks
Clean gravel, sand, or sand-gravel mixtures (maximum 5% fines) [5/]	GP,GW,SP,SW	30	50	80	90
Gravel, sand, silt, and clay mixtures (less than 50% fines) Course sands with silt and/or clay (less than 50% fines)	All gravel/sand dual symbol classifications and GM, GC, SC, SM, SC-SM	35	60	80	100
Low plasticity silts and clays with some sand and/or gravel (50% or more Fines) Fine sands with silt and/or clay (less than 50% fines)	CL, ML, CL-ML, SC, SM, SC-SM	45	75	90	105
Low to medium plasticity silts and clays with little sand and/or gravel (50% or more fines)	CL. ML, CL-ML	65	85	95	110
High plasticity silts and clays (liquid limit more than 50) [6/]	CH, MH	-	-	-	-

[1/] For lightly compacted soils (85% to 90% maximum standard density.) Includes compaction by use of typical farm equipment.
[2/] Also below seasonal high water table if adequate drainage is provided.
[3/] Includes hydrostatic pressure.
[4/] All definitions and procedures in accordance with ASTM D2488 and D653.
[5/] Generally, only washed materials are in this category.
[6/] Not recommended. Requires special design if used.

Concrete Slabs on Grade. Slab design shall consider the required performance and the critical applied loads with both the subgrade material and material resistance of the concrete slab. Where applied point loads are minimal and watertightness is not required, such as barnyard and feedlot slabs subject only to precipitation, and the subgrade is uniform and dense, the minimum slab thickness shall be 4 inches with a minimum joint spacing of 10 feet. Joint spacing can be increased if steel reinforcing is added based on subgrade drag theory as discussed in industry guidelines such as "Design of Slabs-on-Grade," ACI 360.

For applications where watertightness is required, such as floor slabs of storage tanks, the minimum thickness for uniform foundations shall be 5 inches and shall contain distributed reinforcing steel. The required area of such reinforcing steel shall be based on subgrade drag theory.

When heavy equipment loads are to be resisted and/or where a non-uniform foundation cannot be avoided, an appropriate design procedure as described in ACI 360 shall be used.

Concrete Repair. Concrete that will not meet its intended purpose due to honeycombed areas, voids, cracks, or other defects shall be replaced or repaired according to the "Concrete Repair Manual," 2nd Edition, ACI, or the "Guide to Concrete Repair," Bureau of Reclamation.

Quality Assurance for Concrete Structures. Quality assurance is essential during the installation of concrete structures to assure that the design expectations are met. For low or medium hazard structures that can be economically maintained and replaced, concrete design and construction shall be according to NEH Construction Specification 32, Structure Concrete. For high quality, complex, or critical structures, concrete design and construction shall be according to NEH Construction specification 31, Concrete for Major Structures.

Holding Tank. Holding tanks are used for liquid and slurry waste and may be open or covered, inside or outside of enclosed housing, or beneath slotted floors. Holding tanks shall be watertight or have their in-ground portion completely contained by a liner as described in the section "Liners" of this standard. As required by ADEM, a leak detection and groundwater monitoring system shall be installed under the facility, and secondary containment shall be provided for above-ground storage tanks.

Depending on the hazard involved to the environment, tanks shall be constructed of reinforced masonry, coated or glass-fused steel, or reinforced concrete. Tanks designed as buried structures shall have exterior drainage or a minimum safety factor of 1.3 against uplift, when empty.

Tanks may be designed with or without covers. Covers, beams, or braces that are integral to structural performance must be indicated on the construction drawings. The openings in covered holding tanks shall be designed to accommodate equipment for loading, agitating, and emptying, and shall have grills or secure covers for safety, odor, and vector control. Central loading from an elevation at or above the top of the sidewall of open holding tanks allows more complete and uniform filling, particularly with manure containing bedding. Steel and other corrodible materials shall be adequately protected with concrete, paint, or other protective coatings to prevent corrosion. Tank covers shall be designed to withstand both dead and live loads. The live load values for covers contained in ASAE EP378.3, Floor and Suspended Loads on Agricultural Structure Due to Use, and in ASAE EP393.2, Manure Storages, shall be the minimum used. The actual axle load for tank wagons having more than a 2,000 gallon capacity shall be used.

All structures shall be underlain by free draining material or shall have a footing located below the anticipated frost depth.

A minimum of 6 inches of residual solids storage shall be provided for tanks.

Stacking Facilities Solids stacking implies that the manure has a consistency that does not flow, but remains in place even during the wettest time of the storage period. Facilities receiving wet waste that will not stack to the designed height, with no provision for liquid separation, shall not be designed as stacking facilities.

Stacking facilities may be open or roofed and are used for wastes which behave primarily as a solid. The anticipated stacking angle of manure must be considered in determining the wall height.

Stacking facilities shall be constructed of durable materials such as reinforced concrete, reinforced concrete block, or treated lumber. They shall be designed with adequate safety factors to prevent failure due to internal or external pressures, including hydrostatic uplift pressure and imposed surface loads such as equipment which may be used within, on, or adjacent to the structure. Lumber shall not be used for walls which support moving stacking elevators or similar loads.

Structural design criteria for stacking facilities shall be in accordance with the criteria for the various materials listed in the section "Structural Design" of this standard.

Floor Slabs . Floors shall slope downward slightly from the entrance into the stacking facility. Suggested grade of the floor is 0.2 to 0.3 percent.

Timber Walls. All posts and lumber in contact with soil, wastes, or exposed to moisture shall be pressure-treated in accordance with the American Wood-Preservers' Association (AWPA) Standard C16, "Wood Used on Farms – Preservative Treatment by Pressure Processes". Posts shall have a minimum size of 4 inch by 6 inch (nominal) and be placed in the ground from 3 to 6 feet deep, depending on the design analysis. Posts for "mini-composters" shall have a minimum size of 4 inch by 4 inch (nominal). Side planking shall have a minimum thickness of 2 inches (nominal).

Due to the corrosive nature of chemical wood preservatives required after December 31, 2003, all bolts, washers, nuts, nails, and other hardware used in contact with treated wood shall be galvanized to meet ASTM Specifications A153 for fasteners and A653 Class G185 sheet metal for connectors, Type 304 or 316 (stainless) steel, or other type of material or coating as approved by the preservative manufacturer. Current information on specific fastener materials is available through links to the preservative manufacturers on the AWPA website at www.awpa.com. Aluminum should not be used in direct contact with treated wood.

Internal Drainage. Drainage of liquids, including rainfall from the stacking area (especially those without a roof), shall be collected in a tank or waste storage pond or be otherwise contained until final utilization. Collection may be accomplished by use of a timber wall with the boards installed vertically, leaving 3/4 inch cracks. The timber wall drainage section may be included in a concrete or masonry block wall. Design criteria shall be the same as for timber walls.

Poultry Litter Stacking Facilities. To prevent spontaneous combustion, poultry litter in the stacking facility should have less than 40 percent moisture, and dry litter and moist litter should not be layered. In addition, the height of the litter stack shall not exceed 5 to 7 feet, with litter to wood contact limited to 3 to 5 feet.

Design procedures for poultry litter stacking facilities are contained in the Alabama Poultry Waste Management - Waste Utilization and Facility Design Workbook.

CONSIDERATIONS

Location. Waste storage facilities should be located as close to the source of waste and polluted runoff as practicable. In addition, they should be located considering prevailing winds and landscape elements such as building arrangement, landform, and vegetation to minimize odors and visual resource problems.

It is highly recommended that waste storage facilities meet the minimum distance requirement from public or private facilities as shown in Table 5. These distances should be increased wherever possible in order to minimize any negative impacts of the storage facilities. In no case shall the facility siting distances be less than the minimum distance requirements as required by the ADEM Administrative Code Chapter 335-6-7, as amended. ADEM's regulatory minimum distances are summarized in the ADEM/NRCS Buffer Distance Summary for Animal Feeding Operations.

Table 5. Minimum Distance Requirement for Waste Storage Facilities

Public or Private Use Facilities	Minimum Distance from Waste Storage Facility
Any public use area or DCSHP [1/]	700 feet – liquid 330 feet – dry new 165 feet - dry expansion
delete space	delete space
Well, up-gradient	100 feet - dry 150 feet - liquid
Well, down-gradient	300 feet
Natural Water Courses	200 feet
Milking Parlor	100 feet
Drainage Ditches	100 feet
Area specified by state or local ordinance	Greater of state or local distance or distance shown above

[1/] DCSHP: Non-owner existing occupied Dwelling, Church, School, Hospital, or Park

Solids Separation. To minimize frequency of solids removal from waste storage ponds, route wastes through a solid separator to remove solids. Separation facilities should have adequate capacity to store separated solids for a time period based on climate, equipment, clean out frequency, and method of disposal. Solid separators, settling basins, etc., shall be designed to prevent seepage to the groundwater.

Water Quantity. Waste storage facilities will have an affect on the water budget. The affect will be dependent upon the size of the waste storage facility. The waste storage facility will cause an increase in evaporation and a decrease in downstream runoff where drainage is designed to enter the facility. The waste storage facility will not increase water demand at the site.

Water Quality. The waste storage facility should have an overall positive impact on water quality by storing animal waste and polluted runoff until it can be safely applied to the land. Where ponds are used for waste storage, there can be a positive effect on water related wildlife habitat by providing open water bodies. Water quality can be adversely impacted during initial construction due to erosion of the site but will be minimal using proper construction pollution prevention measures.

Other Considerations. Non-polluted runoff should be excluded from the waste storage facility to the fullest extent possible, except where its storage is advantageous to the operation of the agricultural waste management system.

Development of an emergency action plan should be considered for waste storage facilities where there is a potential for significant impact from breach or accidental release. Where there is potential for significant impact, the plan shall include site specific emergency action plan provisions for minimizing the impact.

Due consideration should be given to economics, the overall waste management system plan, safety and health factors.

Considerations for Minimizing the Potential for and Impacts of Sudden Failure of a Waste Storage Facility or Accidental Release from the Required Volume

Features, safeguards, and/or management measures to minimize the risk of waste storage facility failure or accidental release, or to minimize or mitigate impact of this type of failure should be considered when any of the categories listed in Table 6 may be affected.

Table 6. Potential Impact Categories from Failure of a Waste Storage Facility or Accidental Release

1. Surface water bodies -- perennial streams, lakes, wetlands, and estuaries
2. Critical habitat for threatened and endangered species
3. Riparian areas
4. Farmstead, or other areas of habitation
5. Off-farm property
6. Historical and/or archaeological sites or structures that meet the eligibility criteria for listing in the National Register of Historical Places

The following should be considered either individually or in combination to minimize the potential of or the consequences of a sudden failure of a storage facility when one or more of the potential impact categories listed in Table 6 may be affected:

- An auxiliary spillway
- Additional freeboard
- Design storage volume for wet year rather than normal year precipitation
- Reinforced embankment - such as, additional top width, flattened and/or armored downstream side slopes
- Secondary containment
- Liquid level indicators or recorders

The following should be considered to minimize the potential for accidental release from the required volume through gravity outlets when one or more of the potential impact categories listed in Table 6 may be affected:

- Outlet gate locks or locked gate housing
- Secondary containment
- Alarm system
- Another means of emptying the required volume

Considerations for Minimizing the Potential of Waste Storage Pond Liner Failure or Fabricated Structure and Tank Leakage

Sites with categories listed in Table 7 should be avoided unless no reasonable alternative exists. Under those circumstances, consideration should be given to providing an additional measure of safety from pond, fabricated structure, or tank seepage when any of the potential impact categories listed in Table 7 may be significantly affected.

Table 7. Potential Impact Categories for Liner Failure and Leakage
1. Any underlying aquifer is at a shallow depth and not confined.
2. The vadose zone is rock.
3. The aquifer is a domestic water supply or ecologically vital water supply
4. The site is located in an area of solutionized bedrock such as limestone or gypsum

Should any of the potential impact categories listed in Table 7 be affected, consideration should be given to the following:

- A liner under the facility designed in accordance with procedures of AWMFH Appendix 10D with a thickness and coefficient of permeability so that final specific discharge is less than 0.0028 ft/day
- A flexible membrane liner over a clay liner
- A geosynthetic clay liner (GCL) flexible membrane liner
- A concrete liner designed in accordance with criteria for a watertight fabricated structure in this standard
- A leak detection and monitoring system installed under the facility to minimize the potential for undetected release of wastewater to groundwater

Considerations for Improving Air Quality

To reduce emissions of greenhouse gases, ammonia, volatile organic compounds, and odor:

- Use additional practices such as anaerobic digesters, covers, and composting facilities
- Use liquid/solid separation prior to discharge to storage ponds to reduce volatile solids (VS) loading and use composting of solids to further reduce gaseous emissions and odors
- Adjust pH below 7. This may reduce ammonia emissions from the storage pond but may increase odor when waste is surface applied

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use.

Engineering plans, specifications, and reports shall include the following as a minimum:

- Plan view of system layout
- Type and number of animals the structure is designed to serve
- Storage period
- Typical cross section(s) of waste storage pond and structures
- Structural details of components
- Construction specifications
- References to components supplied by others (pumps, etc.)
- Special safety requirements
- Vegetative requirements
- Quantities
- Drainage and grading plan
- CBMPP if one is needed
- Soil and foundation findings, interpretations, and reports
- O&M plan

OPERATION AND MAINTENANCE

An O&M plan shall be developed that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design. The waste storage facility shall be inspected periodically to ensure that all components are operating as planned.

The O&M plan shall contain the operational requirements for emptying the storage facility. It shall include maximum operating levels of the waste storage facility, clean-out intervals, operation requirements of structural components, etc. The O&M plan shall include the requirement that waste shall be removed from storage and utilized in locations, times, rates, and volumes in accordance with the overall waste management system plan. Records shall be kept of all waste applications according to Alabama NRCS conservation practice standard Nutrient Management, Code 590.

The O&M plan for ponds shall include the requirement that following storms, waste shall be removed at the earliest environmentally safe opportunity to ensure that sufficient volume is available to contain the 25-year, 24-hour storm (the 100-year, 24-hour storm if applicable). The plan shall also include an explanation of the use of the staff gage and stage-storage curve to indicate the operating levels and volumes in the storage pond.

The O&M plan for stacking facilities shall require that the structure be inspected at least twice each year when the facility is empty. Any wooden parts, hardware, or other replaceable parts which are damaged or show excessive wear or decay shall be replaced. Roof structures should be examined for structural integrity. Walls of composters and dry stacks that are constructed with lumber may need replacing during the life of the structure.

The embankment and other vegetated areas shall be mowed and fertilized to maintain a protective vegetative cover. Trees can cause leaks and safety hazards. Trees and shrubs should not be allowed to grow within a potential distance of their root zones to the embankment.

REFERENCES

ACI 318, 360, 530
ADEM Administrative Code, Chapter 335-6-7, as amended
ADEM/NRCS Buffer Distance Summary for Animal Feeding Operations
Alabama NRCS Conservation Practice Standards:
- Critical Area Planting, Code 342
- Fence, Code 382
- Nutrient Management, Code 590
- Pond, Code 378
- Pond Sealing or Lining, Code 521A
- Waste Treatment Lagoon, Code 359

Alabama Poultry Waste Management – WasteUtilization and Facilities Design Workbook
ASAE Specifications: EP378.3, EP393.2
ASTM Specifications: A153, A185, A615, A653, C143, C309, D653, D698, D2488
AWPA Standard C16
"Basic Building Code,",12th Edition, Building Officials and Code Administrators, Inc.
"Concrete Repair Manual," 2nd Edition, ACI
EPA CAFO Final Rule, 40 CFR Parts 9, 122,123,412
"Guide to Concrete Repair," Bureau of Reclamation
"Manual of Steel Construction," American Institute of Steel Construction.
"Minimum Design Loads for Buildings and Other Structures," Standard 7-02, ASCE
"National Design Specifications for Wood Construction," American Forest and Paper Association.
NEM, Part 520, Streams and Channels
NEH, Part 642, Specifications for Construction Contracting:
- Concrete for Major Structures (cs031)
- Structure Concrete (cs032)

NEH, Part 651, Agricultural Waste Management Field Handbook (AWMFH), Chapters 7 and 10.
NPDES Phase II Rule
NRCS Technical Release - TR-74
"Standard Grading Rules for Southern Pine Lumber," Southern Pine Inspection Bureau
"Standard Specifications for Highway Construction," 2002 Edition, Alabama Highway Department

CONSTRUCTION SPECIFICATION

WASTE STORAGE FACILITY

SCOPE

This specification shall consist of the clearing, grubbing, excavation, backfill, concrete, forms, reinforcing steel, timber, trusses, sheet metal, fasteners, other appurtenances and services required for the construction of waste storage or waste conveyance structures (i.e., waste storage ponds, dry stacks, composters, tanks, flumes, etc.) and the disposal of all cleared and excavated materials. Construction shall be conducted in such a manner that erosion, water, air, and noise pollution will be minimized and held within legal limits as established by state and federal regulations, including NPDES permits. Where a construction best management practices plan (CBMPP) is prepared for the site, the provisions of the plan shall be followed.

All structures shall be constructed according to plans furnished by the Natural Resources Conservation Service (NRCS) and in accordance with the NRCS's engineering standards for these practices, as well as local building codes, state laws and regulations and current industry standards. Any deviation from the approved drawings and specifications must be approved by the engineer prior to construction.

SPECIFICATIONS FOR WASTE STORAGE PONDS

Clearing. All trees, brush, and stumps shall be removed from the site and spoil areas before excavation is performed. All material cleared from the area shall be disposed of by burning or removing from the site and stacking. All burning shall conform to regulations of Alabama state law.

Excavation. The completed excavation, berms, and placed banks (spoil disposal) of unsuitable material shall conform to lines, dimensions, grades, and slopes shown on the plans or staked on the site to the degree that skillful operation of the excavating equipment will permit. Runoff from outside drainage areas will be diverted from the waste storage pond.

Borrow material shall be obtained from within the storage pond site as much as practical. The bottom of the pond shall be as uniformly flat as possible. Any changes in slope of the pond bottom will be approved by the engineer responsible for design. Any excess borrow material will be disposed of by: (1) raising the height of or widening the embankments or by flattening the slopes; (2) blending with the diversion or levee; or (3) hauling off-site.

Dike or Levee Construction. The placing and spreading of fill material shall be started at the lowest point of the foundation and shall be brought up in approximately horizontal layers of loose fill not exceeding 9 inches in thickness before compaction. These layers shall be of approximately uniform elevation and shall extend over the entire area of fill. Construction equipment will be operated over the area of each layer in a manner that will result in the specified degree of compaction and a sufficiently watertight structure. Special construction equipment will be used when the required compaction cannot be obtained by routing of the construction equipment. Construction of the fill shall be undertaken only at such times that the moisture content of the fill material will permit satisfactory compaction. If the material is too dry or too wet, the fill material shall be manipulated (adding water, drying, disking, etc.) to obtain the desirable moisture content.

Liner Construction. Detailed specifications for liner construction will be specified in the plan by the design engineer.

Inlet and Outlet Structures. Inlet and outlet pipes, flumes, and troughs shall be placed to the lines and grades shown on the plans.

Ramp Installation. When used, an inlet ramp shall be constructed to the dimensions, lines, and grades shown on the plans or as otherwise specified.

Materials. All of the component parts of the inlet and outlet pipes and supports, ramps, fences, and other materials shall be specified on the plans and shall be installed in a workmanlike manner. Concrete for flumes shall be as specified below.

Concrete. This work shall consist of furnishing, forming, placing, finishing, and curing Portland cement concrete as required in the construction of the work. When concrete is used, the mixture shall be no less than a 5-bags-per-yard mix. Water content shall not exceed 6.0 gallons per sack. Concrete will be thoroughly rodded or vibrated to remove voids and consolidate the concrete.

For small batches the mixture shall consist of a standard brand of Type 1 Portland cement, washed sand and gravel, and clean water (suggested ratio of aggregates in mix: 94 pounds cement (1 bag), 6 gallons water, 170 pounds clean dry sand, 315 pounds dry gravel). Smaller batches shall consist of 1 part cement, 2 parts sand, 3 parts gravel, and water at the rate of 1 gallon per 16 pounds of cement.

Concrete shall not be placed when the atmospheric temperature may be expected to fall below 40^{O}F at the time concrete is delivered and placed at the work site.

All exposed surfaces of concrete shall be protected from the direct rays of the sun for at least the first 7 days. All concrete shall be cured by keeping it continuously moist for at least 7 days after placement. This moist curing can be accomplished by spraying with two coats of curing compound when other concrete will not be bonded to the treated surface.

Vegetation. Vegetative treatment shall be established as specified or as shown on the plans. Vegetation shall be applied as critical area planting and will include seedbed preparation, seeding, liming, fertilizing, and mulching.

Fencing. The waste storage pond shall be fenced when all construction work is completed. Permanent fencing shall be installed as specified in the plan with safety as the objective. A warning sign (90 in^2 minimum) shall be placed on each straight section of fencing, not to exceed a spacing of 300 feet, to alert the public to the hazards of the waste storage pond.

SPECIFICATIONS FOR WASTE STORAGE STRUCTURES

Clearing and Grubbing. All trees, brush, stumps, boulders, rubbish, and manure shall be removed from the foundation, storage, and spoil area(s) before excavation is performed. All material cleared from the area shall be disposed of by burning or burying on-site or hauling to an appropriate landfill. All burning shall conform to state and federal laws and regulations. Trees and other cleared vegetation will be cut flush with the ground surface in spoil areas. The foundation and/or storage area will have all stumps, roots, and vegetation removed. The general area around buildings will also require grubbing as necessary to complement the use intended for the structure. The limits of this grubbing will be staked by the engineer or his/her agent.

Excavation. Top soil excavated from the site will be stockpiled for later placement around the completed structure. Soils containing excessive organic material will be removed from the foundation area. The completed excavation and placement of spoil material shall conform as nearly to lines, dimensions, grades, and slopes shown on plans or staked on the ground as skillful operation of the excavating equipment will permit. Generally, spoil will be placed and spread to blend with the existing terrain of the spoil area. Runoff from outside drainage areas will be diverted from the excavation area.

Excavated surfaces too steep to be safe and stable if unsupported shall be supported as necessary to safeguard the work and workmen, to prevent sliding or settling of the adjacent ground, and to avoid damaging existing improvements. The width of the excavation shall be increased as necessary to provide space for sheeting, bracing, shoring, and other supporting installations. When the work is completed, such supporting installations shall be removed.

Fill

Placement. Earth material placed for pads, flooring, or foundations shall be good sandy clay or clayey sands and gravels free of detrimental

amounts of sod, roots, large stones, and other objectionable material. Highly plastic clay soils should be avoided.

Begin placing and spreading the fill material at the lowest point of the foundation and construct the fill in approximately horizontal layers not exceeding 9 inches of loose thickness unless otherwise specified. These layers shall be reasonably uniform in thickness and shall extend over the entire area of the fill. Operate the earth hauling or compacting equipment over each layer so that reasonable compaction of the fill material will be obtained. A minimum of two complete passes over each layer by the compacting equipment is required to obtain adequate compaction.

If a minimum required density is specified, each layer of fill shall be compacted as necessary to obtain that density. Special equipment shall be used if needed to obtain the required compaction.

All finished work shall be left in a neat and sightly condition. The outer edges and slopes of the fill shall blend with the surrounding landscape and complement the structure built upon it.

Moisture Control. All fill material shall have a moisture content sufficient for the required compaction. Fill material which is too dry shall be moistened by adding water or by thoroughly mixing with moist fill until an acceptable moisture level is obtained. Fill material which is too wet shall be allowed to dry naturally or shall be dried by disking or shall be thoroughly mixed with dry fill material until an acceptable moisture level is obtained.

The moisture content of the fill shall be maintained within the limits to:

1. Prevent bulking or dilatence of the material under the action of the hauling or compacting equipment.
2. Prevent adherence of the fill material to the equipment.
3. Ensure the crushing and blending of the soil clods and aggregation into a homogeneous mass.
4. Contain adequate moisture so that a sample can be hand molded without the mold oozing through the fingers or squeezing out any water.

Timber Fabrication and Installation

Above ground timber structures, such as litter dry stack facilities, shall be constructed on a firm foundation to the lines and grades shown on the plans. Dimensions and spacings shown on the plans and drawings are minimum requirements for the wind and snow loads. These dimensions and spacings may be altered if the result is a stronger structure, with prior approval of the engineer. In no case will the dimensions and spacings be modified in a way which would reduce the strength of the structure. All framing shall be true and exact. Timber shall be accurately cut and assembled to a close fit.

Appropriate bracing for safety and structural stability during construction shall be used.

Wood and Timber. All material shall be sound wood, free from decay, and of new quality. Good quality, used, pressure-treated lumber may be utilized for walls of composter bins and dry stack storage areas. All timber beams shall be dense, structural quality, and graded in accordance with the Standard Grading Rules for Southern Pine Lumber. Unless otherwise specified, all timber and lumber shall be furnished in American Standard dressed sizes. All sizes specified are nominal sizes.

All structural timber, posts, poles, and lumber, except roof girders, rafters, purlins, trusses, knee braces, and attic bracing shall be pressure treated. Treated timber and lumber shall be impregnated with the specified type and quantity of preservative as specified in AWPA Standard C16: Wood Used on Farms – Preservative Treatment by Pressure Processes.

Posts and poles shall be set plumb and to the depths shown on the drawings. Backfill around posts/poles shall be concrete or hand-tamped earth as shown on the drawings. Posts/poles shall be temporarily braced until girders, plates, or other members are installed to maintain plumb alignment.

Handling and Storing. All timber and lumber stored at the site of the work shall be neatly stacked on supports at least 12 inches above the ground surface and protected from the weather by suitable covering. Untreated material shall be so stacked and stripped as to

permit free circulation of air between the tiers and courses. Treated timber may be close-stacked. The ground underneath and in the vicinity of all stacks shall be cleared of weeds and rubbish. The use of cant hooks, peaveys, or other pointed tools, except end hooks, will not be permitted in the handling of structural timber or lumber. Treated timber shall be handled with rope slings or other methods which will prevent the breaking or bruising of outer fibers, or penetration of the surface in any manner.

Fasteners. Connections between wood members requiring bolts may be initially done with appropriately sized nails until such time as it is expedient to add the bolts, unless specified otherwise in the drawings. Bolts shall be added as soon as practicable, before the building is declared structurally sound, and before being accepted as complete. Nails and spikes shall be driven with just sufficient force to set the heads flush with the surface of the wood. Holes for machine bolts shall be bored with a bit of the same diameter as the bolt. Appropriately sized washers shall be used in contact with all bolt heads and nuts that would otherwise be in contact with the wood.

Pressure treated wood does not hold nails as well as untreated because the preservatives act as a lubricant. Spiral or annular ring shank nails shall be used in these connections because they have a higher withdrawal resistance. Nails to fasten rafters, girders, cleats, scabs, wooden sidewalls, and/or braces to the pressure treated poles shall be 20d to 40d size or as specified on the drawings. Untreated framing members shall be fastened to each other with 16d to 20d nails. Examples include roof purlins to rafters, and tie-down cleats or braces to rafters or girders. Various galvanized metal fasteners, with appropriate joist or deck nails, may be used to facilitate assembly, as approved by the engineer.

Due to the corrosive nature of preservatives required after December 31, 2003, all bolts, washers, nuts, nails, and other hardware used in contact with treated wood shall be galvanized to meet ASTM Specifications A153 for fasteners and A653 Class G185 sheet metal for connectors, Type 304 or 316 (stainless) steel, or other type of material or coating as approved by the preservative manufacturer. Current information on specific fastener materials is available through links to the preservative manufacturers on the AWPA website at awpa.com. Aluminum should not be used in direct contact with treated wood.

Trusses. Trusses may be metal or wood and shall be designed to handle the roof loads specified in the construction details and shall be installed on the spacing compatible with the design. Trusses shall have a minimum of 12 inches of overhang, and more is advisable. Trusses may be pre-fabricated, manufactured trusses. Used wooden trusses will not be allowed unless a new truss certification is provided by a registered professional engineer.

Manufactured trusses will be installed in accordance with the manufacturer's instructions. All trusses will be of a design approved by a registered professional engineer. A copy of the truss certification shall be provided to the NRCS approving authority prior to truss installation.

Truss anchorage and associated supports shall be as shown on the drawings or other acceptable methods as approved by the engineer.

Roofing. Roofing shall be galvanized metal in standard lengths and widths and shall be of new quality (without holes, rust, etc.). Roofing material shall be minimum 29 gauge and be ribbed for strength. Roofing shall be installed in accordance with manufacturer's recommendations. If any other type of roofing material is desired, it must first be approved by the engineer. Nails used to attach roofing material to the purlins shall be lead-headed nails, aluminum nails with neoprene washers, or other type as approved by the NRCS approving authority.

Steel Reinforcement

Reinforcement steel and welded wire fabric shall be new, clean, and free of oil, grease, paints, and flakey rust. Steel bars for concrete reinforcement shall be deformed billet-steel bars, conforming to ASTM Specification A615, Grade 40 or 60. Welded wire fabric shall conform to the requirements of ASTM Specification A185.

Reinforcement steel shall be accurately placed as specified and secured in position in a manner which will prevent its displacement during

placement of the concrete. If reinforcing steel is spliced, the splices shall provide an overlap equal to 30 times the diameter of the smaller bar in the splice and shall be tied at both ends of the splice. Steel reinforcement in concrete block walls shall be tied in place prior to laying the blocks. Dropping or placing required steel reinforcement into the holes of concrete blocks without properly overlapping and tying the steel together with the foundation steel is not acceptable. Field bending of steel will be permitted. Heating of steel for bending will not be permitted.

Reinforcement steel and welded wire fabric shall be suspended off the ground and other concrete contact surfaces by using scotches of concrete bricks, concrete blocks or pieces of blocks, wire stands, or other approved method prior to the placing of concrete. Scotches of stones, wood materials, earth, earth clods, clay bricks, scrap metal and other unapproved materials are not acceptable. During concrete placement welded wire reinforcement shall be pulled into the middle of the concrete or the position shown in the drawings. Unless otherwise specified, welded wire fabric shall be spliced by overlapping adjacent sections a minimum of six inches, or one full mesh plus 2 inches, whichever is greater. The splice length shall be measured from the center of the first transverse wire in one piece of fabric to the center of the first transverse wire in the lapped piece of fabric.

Concrete

Design Mix. The concrete mixture shall be no less than 5-bags-per-yard mix. The water content shall not exceed 6 gallons per bag of cement in the mixture; however, the concrete mixture may be a similar mix selected from the "Master Proportion" table in the "Standard Specifications for Highway Construction," 2002 Edition, State of Alabama Highway Department. Any mix selected shall have a designed minimum 28 day compressive strength of 3,000 pounds per square inch (psi). The concrete shall contain a standard known brand of Portland cement with washed sand and gravel. Clean water shall be used in the mix. Calcium Chloride and other chemical admixtures for concrete will not be accepted unless expressly specified in the drawings or specifications.

Consistency. The amount of water used in the concrete shall be the minimum necessary to obtain the required workability. The consistency of the concrete shall be such that it can be worked readily into the corners and angles of the forms and around reinforcement but without permitting the materials to segregate or excess free water to collect on the surface. The slump shall be between 2 and 5 inches as tested by "The Test for Slump for Portland Cement Concrete", ASTM Specification C143.

Fiber Reinforced Concrete. Fiber shall consist of 3/4 inch length virgin homopolymer polypropylene fibers, either the collated fibrillated type or the monofilament type. The minimum rate of application is 1.5 pounds of fiber per cubic yard of concrete.

The addition of fiber to a concrete mix may cause an apparent reduction in slump. However, no additional water shall be added to the mix to improve workability. If needed, a suitable plasticizer should be added to the concrete mix. During placement the fiber mix will generally require more effort and vibration to move the mix and consolidate it into the forms due to the lower slump nature. Properly controlled internal vibration is acceptable, but external vibration of the forms and exposed surfaces is preferable to prevent fiber segregation.

If welded wire fabric is omitted from concrete slabs and only fiber additives are used, contraction joint spacing will be reduced from a maximum of 30 feet to a maximum of 15 feet in any direction. Sawn joints shall be 1/4 of the slab's thickness in depth. Formed joints shall be of a keyway type. Smooth vertical joints through the slab are not permitted.

Fiber additives in concrete do not take the place of structural steel reinforcement. Where steel reinforcement is shown on drawings it shall be placed as shown.

Forms. Forms shall be of wood, steel, or other approved material. Forms shall be true to line and grade, mortar tight, and sufficiently rigid to prevent objectionable deformation under load. Form surfaces shall be smooth, free from irregularities, dents, sags, or holes when used for permanently exposed surfaces. Rods used for internal ties shall be so arranged that, when

the forms are removed, metal will not be less than 1 inch from any concrete surface. Forms for walls and vertical sections 2 feet high and taller shall be stabilized with adequate tie rods, walers, cat-heads, and sufficient bracing to prevent shifting or movement of forms during placing of concrete.

Forms for exposed surfaces shall be coated with a non-staining form release agent that shall be applied before the concrete is placed. All excess release agent on the form surfaces and any on surfaces requiring bonding with concrete shall be removed.

All form removal shall be accomplished in such a manner as to prevent injury to the concrete. Forms for floor slabs and such work may be removed after a minimum of 24 hours. Forms for walls shall be left in place for a minimum of three days. All forms must be removed before final inspection of the work. All repair work must be done immediately after removal of forms.

Timing and Temperature. Concrete shall be placed within 1½ hours after introduction of water to the cement and aggregates. Concrete shall not be placed when the outside temperature is expected to fall below 40°F at the time the concrete is delivered and placed at the work site. Concrete shall not be exposed to freezing temperatures during the curing period. Concrete, when deposited in the forms during hot weather, will have a temperature not greater than 90°F at the time of placement. Ice may be used as a portion of the mixing water to control temperature provided all ice is melted in the mixing process. When the outside temperature reaches or exceeds 90°F., the concrete shall be placed within 45 minutes after batching.

Conveying and Placing. No concrete shall be placed until the approving official has given approval of the in-place subgrade, forms, reinforcing steel, and any other items involved or affected by the concrete placement.

Concrete shall be conveyed from mixer to forms as rapidly as practicable by methods which will prevent segregation or loss of ingredients by using hoppers and chutes, pipes, or "elephant trunks". There shall be no vertical drop greater than 5 feet.

Unless otherwise authorized, all concrete shall be placed upon clean, damp surfaces free from frost, ice, standing and running water, and never upon soft mud, dried porous earth, or fill that does not meet specified compaction requirements. Soft mud or other unacceptable foundation material shall be removed and replaced with gravel or other approved material. Concrete shall be deposited as close as possible to its final position in the forms. Concrete shall be thoroughly consolidated by rodding or mechanically vibrating the concrete in place supplemented by hand-spading and tamping to remove air voids. Vibrating equipment shall be used when pouring walls and other thin sections.

Concrete floor slabs may be placed at one time or may be poured in sections at different times. When steel reinforcement is specified for the floor slab, formed contraction joints shall be placed at intervals not to exceed 30 ft. in any direction unless otherwise specified. When steel is not used, joints shall be as specified in the section "Fiber Reinforced Concrete" of this standard. The formed edges of each section shall be keyed to lock the edges of adjacent sections together. The edge forms may be removable metal or wood forms having the required keyed shape or may be thin galvanized metal designed to be left in place. Smooth vertical edged joints will not be allowed.

Finishing. Defective concrete, honeycombed areas, voids left by the removal of tie rods, and unacceptable ridges left on concrete surfaces shall be repaired immediately after the removal of forms unless otherwise authorized and directed. Voids left by the removal of tie rods shall be reamed and completely filled with mortar.

Defective concrete shall be repaired by removing the unsatisfactory material and placing new concrete which shall be secured with keys, dovetails or anchors. Excessive rubbing of formed areas will not be permitted. All unformed surfaces of concrete, exposed in the completed work, shall have a wood float finish without additional mortar.

Curing. Concrete shall be prevented from drying for a curing period of at least 7 days after it is placed. All exposed surfaces of concrete shall be protected from the direct rays of the sun for at least these first 7 days. All concrete shall be cured by keeping continuously moist for the

entire curing period, or until curing compound is applied. Moisture shall be maintained by sprinkling, flooding, fog spraying, or by covering with materials kept continuously moist such as canvas, cloth mats, straw, sand, polyethylene, or other approved material. Wood forms (except plywood) left in place during the curing period shall be kept wet. Formed surfaces shall be thoroughly wetted immediately after forms are removed and shall be kept wet until patching and repairs are completed. Water or covering shall be applied in such a way that the concrete surface is not eroded or otherwise damaged.

If a curing compound is used, two coats of it will be applied to all concrete surfaces except construction joints and surfaces to which other concrete will be bonded. The compound shall be sprayed on the moist concrete surfaces as soon as free water has disappeared, but shall not be applied to any surface until patching, repairs, and finishing of that surface are completed. Curing compound shall meet the requirements of ASTM Specification C309, Type 2, white pigmented.

Landscaping and Vegetation

The area adjacent and in the immediate vicinity of the structure shall be shaped to blend with the natural surroundings and to complement the structure and work area around it. Shaping shall be in such a way as to drain or divert all overland and roof runoff safely from the structure and surrounding work area. All disturbed areas around the structure, including spoil areas, shall be vegetated and/or surfaced with gravel, chert, or some other acceptable covering as permitted by the NRCS approving authority. Spoil areas not used for farm traffic shall be vegetated.

Permanent vegetation will be established to the plant species and by methods prescribed by the approving official. All vegetating of disturbed areas will be done as critical area planting and shall include liming, fertilizing, seedbed preparation, seeding and mulching. Temporary vegetation may be used when conditions or seeding dates are not suitable for the establishment of permanent vegetation. Disturbed areas shall be mulched regardless of seeding dates.

If farm animals have access to the vegetated area, it will be appropriately fenced until vegetation is well established.