

567—65.108(455B,459,459B) Manure storage structure design requirements. The requirements in this rule apply to all confinement feeding operation structures unless specifically stated otherwise.

65.108(1) Drainage tile removal for new construction of a manure storage structure. Prior to constructing a manure storage structure, other than storage of manure in an exclusively dry form, the site for the AFO structure shall be investigated for drainage tile lines as provided in this subrule. All applicable records of known drainage tiles shall be examined for the existence of drainage tile lines.

a. An inspection trench of at least ten inches wide shall be dug around the structure to a depth of at least 6 feet below the original grade and within 25 feet of the proposed outside of the toe of the berm prior to excavation for an unformed manure storage structure.

b. Drainage tile lines discovered during the tile inspection of an unformed manure storage structure shall be removed and rerouted in or in an area outside the inspection trench. All tiles within the inspection trench perimeter shall be removed or completely plugged with concrete, grout or similar materials. Drainage tile lines installed at the time of construction to lower the groundwater may remain in place as long as they are outside of the proposed toe of berm.

c. The applicant for a construction permit for a formed manure storage structure shall investigate for tile lines during excavation for the structure. Drainage tile lines discovered upgrade from the structure shall be rerouted around the formed manure storage structure to continue the flow of drainage. All other drainage tile lines discovered shall be rerouted, capped, or plugged with concrete, Portland cement concrete grout or similar materials. Drainage tile lines installed at the time of construction to lower a groundwater table may remain where located even if located under the floor; however, the tile lines must be tied into the perimeter drain tile.

d. Other proven methods approved by the department may be utilized to discover drainage tile lines.

e. The requirements of this subrule do not apply if sufficient information is provided that allows the department to conclude that the location does not have a history of drainage tile.

65.108(2) Drainage tile removal around an existing manure storage structure. The owner of an aerobic structure, anaerobic lagoon or earthen manure storage basin or earthen waste slurry storage basin, other than an egg washwater storage structure, that is part of a confinement feeding operation with a construction permit granted before March 20, 1996, but after December 31, 1992, shall inspect for drainage tile lines as provided in this subrule, and all applicable records of known drainage tiles shall be examined. The owner of an aerobic structure, anaerobic lagoon, earthen manure storage basin or earthen waste slurry storage basin, other than an egg washwater storage structure, that is part of a confinement feeding operation with a construction permit granted before January 1, 1993, but after May 31, 1985, shall inspect for drainage tiles as provided in this subrule, and all applicable records of known drainage tiles shall be examined. Drainage tile lines shall not be installed within the separation distance provided in paragraph 65.108(1)“b” once the basin has been constructed.

a. Inspection shall be by digging an inspection trench of at least ten inches wide around the structure to a depth of at least 6 feet from the original grade and within 25 feet from the outside edge of the berm. The owner first shall inspect the area where trenching is to occur and manure management records to determine if there is any evidence of leakage and, if so, shall contact the department for further instructions as to proper inspection procedures. The owner of a confinement feeding operation shall either obtain permission from an adjoining property owner or trench up to the boundary line of the property if the distance of 25 feet would require the inspection trench to go onto the adjoining property.

b. The owner of the confinement feeding operation may utilize other proven methods approved by the department to discover drainage tile lines.

c. The drainage tile lines discovered near an aerobic structure, anaerobic lagoon, earthen manure storage basin or earthen waste slurry storage basin, other than an egg washwater storage structure, shall be removed within 25 feet of the outside edge of the berm. Drainage tile lines discovered upgrade from the aerobic structure, anaerobic lagoon or earthen manure storage basin shall be rerouted within 25 feet from the berm to continue the flow of drainage. All other drainage tile lines discovered shall be rerouted, capped, plugged with concrete, or Portland cement concrete grout or similar materials, or reconnected to upgrade tile lines. Drainage tile lines that were installed at the time of construction to lower a groundwater table may either be avoided if the location is known or may remain at the location if discovered.

d. The owner of an aerobic structure, anaerobic lagoon, earthen manure storage structure or an earthen waste slurry storage basin with a tile drainage system to artificially lower the groundwater table shall have a device to allow monitoring of the water in the drainage tile lines that lower the groundwater table and to allow shutoff of the drainage tile lines if the drainage tile lines do not have a surface outlet accessible on the property where the aerobic structure, anaerobic lagoon, earthen manure storage basin or earthen waste slurry storage basin is located.

e. If the owner of the confinement feeding operation discovers drainage tile that projects underneath the berm, the owner shall follow one of the following options:

(1) Contact the department to obtain permission to remove the drainage tile under the berm. The manure in the structure must be lowered to a point below the depth of the tile prior to removing the drainage tile from under the berm. Prior to using the structure, a new percolation test must be submitted to the department and approval received from the department.

(2) Grout the length of the tile under the berm to the extent possible. The material used to grout shall include concrete, Portland cement concrete grout or similar materials.

f. A waiver to this subrule may be granted by the director if sufficient information is provided that the location does not have a history of drainage tile.

g. A written record describing the actions taken to determine the existence of tile lines, the findings, and actions taken to comply with this subrule shall be prepared and maintained as part of the MMP records.

65.108(3) *Earthen waste slurry storage basins.* An earthen waste slurry storage basin shall have accumulated manure removed at least twice each year, unless there is sufficient basin capacity to allow removal of manure once each year and maintain freeboard as determined pursuant to paragraph 65.100(1) "b."

65.108(4) *Earthen manure storage basins.* An earthen manure storage basin shall have accumulated manure removed at least once each year. An earthen manure storage basin constructed after June 19, 2024, must have enough manure storage capacity for eight months. An earthen manure storage basin may have enough manure storage capacity to contain the manure from the confinement feeding operation for up to 14 months and maintain freeboard as determined pursuant to paragraph 65.100(1) "b."

65.108(5) *Soil testing for earthen structures.* Applicants for construction permits for earthen manure storage structures shall submit soils information according to this subrule for the site of the proposed structure. All subsurface soil classification shall be based on American Society for Testing and Materials Designations D 2487-06, effective May 1, 2006, or D 2488-06, effective November 1, 2006. Soil corings shall be taken to determine subsurface soil characteristics and groundwater elevation and direction of flow of the proposed site for an anaerobic lagoon, aerobic structure, earthen egg washwater storage structure, or earthen manure storage basin. Soil corings shall be conducted by a qualified person normally engaged in soil testing activities. Data from the soil corings shall be submitted with a construction permit application and shall include a description of the geologic units encountered; a discussion of the effects of the soil and groundwater elevation and direction of flow on the construction and operation of the anaerobic lagoon, aerobic structure, earthen egg washwater storage structure, or earthen manure storage basin and a discussion that addresses the suitability of the proposed structure at the site. All soil corings shall be taken by a method that identifies the continuous soil profile and does not result in the mixing of soil layers. The number and location of the soil corings will vary on a case-by-case basis as determined by the designing engineer and accepted by the department. The following are minimum requirements:

a. A minimum of four soil corings reflecting the continuous soil profile is required for each anaerobic lagoon, aerobic structure, earthen egg washwater storage structure, or earthen manure storage basin. Corings which are intended to represent soil conditions at the corner of the structure must be located within 50 feet of the bottom edge of the structure and spaced so that one coring is as close as possible to each corner. Should there be no bottom corners, corings shall be equally spaced around the structure to obtain representative soil information for the site. An additional coring will be required if necessary to ensure that one coring is at the deepest point of excavation. For an anaerobic lagoon, aerobic structure, earthen egg washwater storage structure, or earthen manure storage basin larger than four acres water surface area, one additional coring per acre is required for each acre above four acres surface area.

b. All corings shall be taken to a minimum depth of ten feet below the bottom elevation of the anaerobic lagoon, aerobic structure, earthen egg washwater storage structure, or earthen manure storage basin.

c. At least one coring shall be taken to a minimum depth of 25 feet below the bottom elevation of the anaerobic lagoon, aerobic structure, earthen egg washwater storage structure, or earthen manure storage basin or into bedrock, whichever is shallower.

d. Upon abandonment of the soil core holes, all soil core holes including those developed as temporary water level monitoring wells shall be plugged with concrete, Portland cement concrete grout, bentonite, or similar materials.

65.108(6) Hydrology.

a. *Groundwater table.* A minimum separation of four feet between the top of the liner for any unformed manure storage structure or earthen egg washwater storage structure and the groundwater table is recommended; however, in no case shall the top of the liner for an unformed manure storage structure or earthen egg washwater storage structure be below the groundwater table. If the groundwater table is less than two feet below the top of the liner for an unformed manure storage structure or earthen egg washwater storage structure, the unformed manure storage structure or earthen egg washwater storage structure shall be provided with a synthetic liner as described in paragraph 65.108(8) "f."

b. *Permanent artificial lowering of groundwater table.*

(1) Unformed manure storage structures. The groundwater table around an unformed manure storage structure or earthen egg washwater storage structure may be artificially lowered to levels required in paragraph 65.108(6) "a" by using a gravity flow tile drainage system or other permanent nonmechanical system for artificial lowering of the groundwater table. Detailed engineering and soil drainage information shall be provided with a construction permit application for an unformed manure storage structure or earthen egg washwater storage structure if a drainage system for artificially lowering the groundwater table will be installed. The level to which the groundwater table will be lowered will be considered to represent the seasonal high-water table. If a drainage tile around the perimeter of the basin is installed a minimum of two feet below the top of the basin liner to artificially lower the seasonal high-water table, the top of the basin's liner may be a maximum of four feet below the seasonal high-water table which existed prior to installation of the perimeter tile system. Drainage tile lines shall be installed between the outside of the proposed toe of the berm and within 25 feet of the outside of the toe of the berm. Drainage tile lines shall be placed in a vertical trench and encased in granular material which extends upward to the level of the seasonal high-water table which existed prior to installation of the perimeter tile system. A device to allow monitoring of the water in the drainage tile lines installed to lower the groundwater table and a device to allow shutoff of the drainage tile lines shall be installed if the drainage tile lines do not have a surface outlet accessible on the property where the unformed manure storage structure is located.

(2) Formed manure storage structures. For a formed manure storage structure or a formed egg washwater storage structure, partially or completely constructed below the normal soil surface, a perimeter tile drainage system or other permanent system for artificial lowering of groundwater levels shall be installed around the structure if the groundwater table is above the bottom of the structure. The perimeter tile shall include a sample port to allow monitoring of the water in the drainage tile lines and a device to allow shutoff of the drainage tile lines if the drainage tile lines do not have a surface outlet accessible on the property where the formed manure storage structure is located or if the perimeter tile is connected to an existing tile. The perimeter tile may be tied into the monitoring port or a sump; however, there shall be a permanent automatic pump installed.

c. *Determination of groundwater table.* For purposes of this rule, groundwater table is the seasonal high-water table determined by a licensed PE, a groundwater professional certified pursuant to 567—Chapter 134, or qualified staff from the department or NRCS. If a construction permit is required, the department must approve the groundwater table determination.

(1) Current groundwater levels shall be measured using at least one of the following for either formed or unformed manure storage structures:

1. Temporary monitoring wells. A minimum of three temporary monitoring wells shall be installed. The top of the well screen shall be within five feet of the ground surface. Each well shall be extended to at

least two feet below the bottom of the liner of an unformed manure storage structure or to at least two feet below the footings of a formed manure storage structure.

- Unformed manure storage structures. For an unformed manure storage structure, each monitoring well may be installed in the existing core holes resulting from the corings required in subrule 65.108(5).

- Formed manure storage structures. For a formed manure storage structure, at least three temporary monitoring wells shall be installed as close as possible to three corners of the structure, with one of the wells close to the corner of deepest excavation. If the formed manure storage structure is circular, the three monitoring wells shall be equally spaced and one well shall be placed at the point of deepest excavation.

2. Test pits. The department may allow use of test pits in lieu of temporary monitoring wells if seasonal variation in climatic patterns, soil and geologic conditions prevent accurate determination of the seasonal high-water table or prior to the construction of an unformed manure storage structure liner to ensure that the required separation distance to the groundwater table is being met. The bottom of each test pit shall be at least two feet below the floor of the manure storage structure or egg washwater storage structure. Each pit shall be allowed to remain open and unaltered for a minimum of seven days for viewing by the department or NRCS-qualified staff person for the determination of soil characteristics and related groundwater influence. Adequate protection (temporary berms and covers) shall be provided to prevent surface runoff from entering the test pits. One test pit shall be located in each corner and one in the center of the proposed manure control structure, unless otherwise specified by the department. Test pits shall be backfilled and compacted to achieve the seepage loss as outlined in subrule 65.108(7). A description of the materials present in the test pit shall be documented by all of the following:

- Digital photos;
- Description of soils including mottling;
- Construction specifications; and
- Weather conditions both prior to and during the period in which test pits are open.

(2) The seasonal high-water table shall be determined by measuring the groundwater level in the temporary monitoring wells not earlier than seven days following installation and shall include consideration of NRCS soil survey information, soil characteristics such as color and mottling, other existing water table data, and other pertinent information. If a drainage system for artificially lowering the groundwater table will be installed in accordance with the requirements of paragraph 65.108(6) "b," the level to which the groundwater table will be lowered will be considered to represent the seasonal high-water table.

65.108(7) *Seals for unformed manure storage structures and unformed egg washwater storage structures.* An unformed manure storage structure or egg washwater storage structure shall be sealed such that seepage loss through the seal shall not exceed 1/16 inch per day at the design depth of the structure. Following construction of the structure, the results of a testing program that indicates the adequacy of the seal shall be provided to that department in writing prior to start-up of a permitted operation.

65.108(8) *Unformed manure storage structure and unformed egg washwater storage structure liner design and construction standards.* An unformed manure storage structure or unformed egg washwater storage structure that receives a construction permit after January 21, 1998, shall comply with the following minimum standards in addition to subrule 65.108(7).

a. If the location of the proposed unformed manure storage structure or unformed egg washwater storage structure contains suitable materials as determined by the soil corings taken pursuant to subrule 65.108(5), those materials shall be compacted to establish a minimum of a 12-inch liner. A minimum initial overexcavation of six inches of material shall be required. The underlying material shall be scarified, reworked and compacted to a depth of six inches. The overexcavated materials shall be replaced and compacted.

b. If the location of the proposed unformed manure storage structure or unformed egg washwater storage structure does not contain suitable materials as determined by the soil corings taken pursuant to subrule 65.108(5), suitable materials shall be obtained from another location approved by the department and shall be compacted to establish a minimum of a 24-inch liner.

c. Where sand seams, gravel seams, organic soils or other materials that are not suitable are encountered during excavation, the area where they are discovered shall be overexcavated a minimum of 24 inches and replaced with suitable materials and compacted.

d. All loose lift material must be placed in lifts of nine inches or less and compacted. The material shall be compacted at or above optimum moisture content and meet a minimum of 95 percent of the maximum density as determined by the Standard Proctor test after compaction.

e. For purposes of this rule, suitable materials means soil, soil combinations or other similar material that is capable of meeting the permeability and compaction requirements. Sand seams, gravel seams, organic soils or other materials generally not suitable for unformed manure storage structure or unformed egg washwater storage structure construction are not considered suitable liner materials.

f. As an alternative to the above standards, a synthetic liner may be used. If the use of a synthetic liner is planned for an unformed manure storage structure or unformed egg washwater storage structure, the permit application shall outline how the site will be prepared for placement of the liner, the physical, chemical, and other pertinent properties of the proposed liner, and information on the procedures to be used in liner installation and maintenance. In reviewing permit applications that involve use of synthetic liners, the department will consider relevant synthetic liner standards adopted by industry, governmental agencies, and professional organizations as well as technical information provided by liner manufacturers and others.

g. For berm erosion control, the following requirements apply to unformed manure storage structures and unformed egg washwater storage structures constructed after May 12, 1999:

(1) Concrete, riprap, synthetic liners or similar erosion control materials or measures shall be used on the berm surface below pipes where manure will enter the structure.

(2) Concrete, riprap, synthetic liners or similar erosion control materials or measures of sufficient thickness and area to accommodate manure removal equipment and to protect the integrity of the liner shall be placed at all locations on the berm, side slopes, and base of the structure where agitation or pumping may cause damage to the liner.

(3) Erosion control materials or measures shall be used at the corners of the structure.

(4) To control erosion, perennial (grass) vegetation must be maintained on the outer, top and inner dikes up to the two-foot freeboard level of the unformed storage structure or earthen egg washwater storage structure, unless covered by concrete, riprap, synthetic liners or similar erosion control materials or measures.

(5) The owner of a confinement feeding operation with an unformed manure storage structure or an unformed egg washwater storage structure shall inspect the structure berms at least semiannually for evidence of erosion. Erosion problems found that may impact either structural stability or liner integrity shall be corrected in a timely manner.

h. After May 29, 1997, a person shall not construct a new or expand an existing unformed manure storage structure or an unformed egg washwater storage structure within an agricultural drainage well area.

i. The top width of any dike shall be a minimum of ten feet wide. The interior and exterior dike slopes shall not be steeper than three feet horizontal to one foot vertical.

65.108(9) Anaerobic lagoon design standards. An anaerobic lagoon shall meet the requirements of this subrule.

a. *General.*

(1) Depth. Liquid depth shall be at least 8 feet, but 15 to 20 feet is preferred if soil and other site conditions allow.

(2) Inlet. One subsurface inlet at the center of the lagoon or dual (subsurface and surface) inlets are preferred to increase dispersion. If a center inlet is not provided, the inlet structure shall be located at the center of the longest side of the anaerobic lagoon.

(3) Shape. Long, narrow anaerobic lagoon shapes decrease manure dispersion and should be avoided. Anaerobic lagoons with a length-to-width ratio of greater than 3:1 shall not be allowed.

(4) Aeration. Aeration shall be treatment as an "add-on process" and shall not eliminate the need for compliance with all anaerobic lagoon criteria contained in these rules.

(5) Manure loading frequency. The anaerobic lagoon shall be loaded with manure and dilution water at least once per week.

(6) Design procedure. Total anaerobic lagoon volume shall be determined by summation of minimum stabilization volume; minimum dilution volume (not less than 50 percent of minimum stabilization volume); manure storage between periods of disposal; and storage for eight inches of precipitation.

(7) Manure storage period. Annual or more frequent manure removal from the anaerobic lagoon, preferably prior to May 1 or after September 15 of the given year, shall be practiced to minimize odor production. Design manure storage volume between disposal periods shall not exceed the volume required to store 14 months' manure production. Manure storage volume shall be calculated based on the manure production values found in Table 5 located at iowadnr.gov/afo/rules.

b. Minimum stabilization volume and loading rate.

(1) For all animal species other than beef cattle, there shall be 1,000 cubic feet minimum design volume for each 5 pounds of volatile solids produced per day if the volatile solids produced per day are 6,000 pounds or fewer and for each 4 pounds if the volatile solids produced per day are more than 6,000 pounds. For beef cattle, there shall be 1,000 cubic feet minimum design volume for each 10 pounds of volatile solids produced per day.

(2) In Lyon, Sioux, Plymouth, Woodbury, Osceola, Dickinson, Emmet, Kossuth, O'Brien, Clay, Palo Alto, Cherokee, Buena Vista, Pocahontas, Humboldt, Ida, Sac, Calhoun, and Webster Counties for all animal species other than beef there shall be 1,000 cubic feet minimum design volume for each 4.5 pounds of volatile solids per day if the volatile solids produced per day are 6,000 pounds or fewer. However, if a water analysis as required in subparagraph 65.108(9)"c"(2) below indicates that the sulfate level is below 500 milligrams per liter, then the rate is 1,000 cubic feet for each 5.0 pounds of volatile solids per day.

(3) Credit shall be given for removal of volatile solids from the manure stream prior to discharge to the lagoon. The credit shall be in the form of an adjustment to the volatile solids produced per day. The adjustments shall be at the rate of 0.5 pound for each pound of volatile solids removed. For example, if a swine facility produces 7,000 pounds of volatile solids per day, and if 2,000 pounds of volatile solids per day are removed, the volatile solids produced per day would be reduced by 1,000 pounds, leaving an adjusted pounds of volatile solids produced per day of 6,000 pounds (for which the loading rate would be 5 pounds according to subparagraph 65.108(9)"b"(1) above).

(4) Credit shall be given for mechanical aeration if the upper one-third of the lagoon volume is mixed by the aeration equipment and if at least 50 percent of the oxygen requirement of the manure is supplied by the aeration equipment. The credit shall be in the form of an increase in the maximum loading rate (which is the equivalent of a decrease in the minimum design volume) in accordance with Table 8 located at iowadnr.gov/afo/rules.

(5) If a credit for solids removal is given in accordance with subparagraph 65.108(9)"b"(3) above, the credit for qualified aeration shall still be given. The applicant shall submit evidence of the five-day biochemical oxygen demand (BOD5) of the manure after the solids removal so that the aeration credit can be calculated based on an adjustment rate of 0.5 pound for each pound of solids removed.

(6) American Society of Agricultural and Biological Engineers standards, "Manure Production and Characteristics," D384.2, effective March 2005, or Midwest Plan Service-18, Table 2-1, effective January 2004, shall be used in determining the BOD5 production and volatile solid production of various animal species.

c. Water supply.

(1) The source of the dilution water discharged to the anaerobic lagoon shall be identified.

(2) The sulfate concentration of the dilution water to be discharged to the anaerobic lagoon shall be identified. The sulfate concentration shall be determined by standard methods as defined in rule 567—60.2(455B).

(3) A description of available water supplies shall be provided to prove that adequate water is available for dilution. It is recommended that, if the sulfate concentration exceeds 250 mg/l, then an alternate supply of water for dilution should be sought.

d. Initial lagoon loading. Prior to the discharge of any manure to the anaerobic lagoon, the lagoon shall be filled to a minimum of 50 percent of its minimum stabilization volume with fresh water.

e. Lagoon manure and water management during operation. Following initial loading, the manure and water content of the anaerobic lagoon shall be managed according to either of the following:

(1) For single-cell lagoons or multicell lagoons without a site-specific lagoon operation plan. The total volume of fresh water for dilution added to the lagoon annually shall equal one-half the minimum stabilization volume. At all times, the amount of fresh water added to the lagoon shall equal or exceed the amount of manure discharged to the lagoon.

(2) For a two- or three-cell anaerobic lagoon. The manure and water content of the anaerobic lagoon may be managed in accordance with a site-specific lagoon operation plan approved by the department. The lagoon operation plan must describe in detail the operational procedures and monitoring program to be followed to ensure proper operation of the lagoon. Operational procedures shall include identifying the amounts and frequencies of planned additions of manure, fresh water and recycle water, and amount and frequencies of planned removal of solids and liquids. Monitoring information shall include locations and intervals of sampling, specific tests to be performed, and test parameter values used to indicate proper lagoon operation. As a minimum, annual sampling and testing of the first lagoon cell for electrical conductivity and either chemical oxygen demand (COD) or total ammonia (NH₃ + NH₄) shall be required.

f. Manure removal. If the anaerobic lagoon is to be dewatered once a year, manure should be removed to approximate the annual manure volume generated plus the dilution water used. If the anaerobic lagoon is to be dewatered more frequently, the anaerobic lagoon liquid level should be managed to maintain adequate freeboard.

65.108(10) Concrete standards.

a. A formed manure storage structure that is constructed of concrete on or after March 24, 2004, and that is part of a confinement feeding operation other than a SAFO shall meet the following minimum design and concrete standards and be designed by either of the two methods listed below:

(1) Design of a formed manure storage structure prepared and sealed by a PE or an NRCS engineer shall be in accordance with the American Concrete Institute (ACI) Building Code ACI 318-19, effective May 3, 2019, ACI 360R-10, effective April 2010, or ACI 350-20, effective November 6, 2020; Portland Cement Association (PCA) publication EB075, effective April 19, 2021, or PCA EB001.16, effective September 2016; or Midwest Plan Service (MWPS) publication MWPS-36 2nd Edition, effective 2005, or MWPS TR-9, effective 1999, and shall also meet the minimum design and concrete standards in paragraph 65.108(10) "b."

(2) If a formed manure storage structure is not designed by a PE or NRCS engineer, the design and specifications shall be in conformance with MWPS-36 2nd Edition (for a belowground rectangular tank), with MWPS TR-9 (for a circular tank) or in accordance with Appendix C located at iowadnr.gov/af0/rules (for a belowground, laterally braced rectangular tank). A formed manure storage structure with a depth greater than 12 feet shall be designed by a PE or NRCS engineer.

b. Formed manure storage structures used to store liquid manure, dry manure or dry bedded manure shall meet all of the following minimum requirements:

(1) All concrete shall have the following minimum as-placed compressive strengths and shall meet American Society for Testing and Materials (ASTM) standard ASTM C 94-18, effective December 15, 2018:

1. 4,000 pounds per square inch (psi) for walls, floors, beams, columns and pumpouts;
2. 3,000 psi for the footings.

The average concrete strength by testing shall not be below design strength. No single test result shall be more than 500 psi less than the minimum compressive strength.

(2) Cementitious materials shall consist of Portland cement conforming to ASTM C 150, effective July 1, 2022. Aggregates shall conform to ASTM C 33-18, effective March 15, 2018. Blended cements in conformance with ASTM C 595, effective December 15, 2008, are allowed only for concrete placed between March 15 and October 15. Portland-pozzolan cement or Portland blast furnace slag blended cements shall contain at least 75 percent, by mass, of Portland cement.

(3) All concrete placed for walls shall be consolidated or vibrated, by manual or mechanical means, or a combination, in a manner that meets ACI 309R, effective January 2005.

(4) All steel rebar used shall be a minimum of grade 40 steel. All rebar, with the exception of rebar dowels connecting the walls to the floor or footings, shall be secured and tied in place prior to the placing of concrete.

(5) Waterstops shall be installed in all areas where fresh concrete meets hardened concrete. Waterstops shall be made of plastic, rolled bentonite or similar materials approved by the department. Only embedded waterstops are allowed in vertical joints. Adhesive or self-sticking waterstops shall not be used on vertical joints.

(6) The finished subgrade of a formed manure storage structure shall be graded and compacted to provide a uniform and level base and shall be free of vegetation, manure and debris. For the purpose of this subrule, “uniform” means a finished subgrade with similar soils.

(7) When the groundwater table, as determined in paragraph 65.108(6) “c” is above the bottom of the formed manure storage structure, a drain tile shall be installed along the footings to artificially lower the groundwater table pursuant to paragraph 65.108(6) “b.” The drain tile shall be placed within three feet of the footings as indicated in Appendix C, Figure C-1, located at iowadnr.gov/afo/rules, and shall be covered with a minimum of two inches of gravel, granular material, fabric or a combination of these materials to prevent plugging the drain tile.

(8) All floor slabs shall be a minimum of five inches thick and have minimum primary reinforcement using one of the following methods:

1. Grade 40 #4 steel rebar, placed at a maximum of 18 inches on center each way in a single mat. Floor slab reinforcement shall be located in the middle of the thickness of the floor slab.

2. Glass fiber-reinforced polymer (GFRP) rebar, fiber-reinforced polymer (FRP) rebar or composite rebar may be used in floor slabs only and shall conform to ACI 440.11.22, effective September 2, 2022, and Table 3 of ASTM 7957, effective February 1, 2022. Supporting documentation shall be submitted for nonsteel rebar demonstrating the equivalency to #4 steel rebar at 18 inches on center each way. GFRP rebar shall not be manufactured using a polyester-based resin system per ASTM D7957 and shall meet the additional following ASTM D7957 parameters:

- Mean Tensile Modulus of Elasticity.....>6,500,000 psi (44,800 MPa)
- Guaranteed Bond Strength.....>1,100 psi (7.6 MPa)

3. Fiber-reinforced concrete (FRC) may be used in floor slabs only and shall conform to the requirements of ASTM C1116/C1116M Type I (steel FRC) and Type III (synthetic FRC), effective September 1, 2023. FRC shall provide a minimum average equivalent strength ratio (Re3) of 30 percent when tested in accordance with ASTM C1812/1812M, effective December 15, 2022.

4. Fiber mesh shall not be substituted for primary reinforcement.

5. Nondestructive methods to verify the floor slab thickness may be required by the department. The results shall indicate that at least 95 percent of the floor slab area meets the minimum required thickness. In no case shall the floor slab thickness be less than four and one-half inches.

(9) The footing or the area where the floor comes in contact with the walls and columns shall have a thickness equal to the wall thickness, but in no case be less than eight inches, and the width shall be at least twice the thickness of the footing. All exterior walls shall have footings below the frostline. Tolerances shall not exceed negative one-half inch of the minimum footing dimensions.

(10) The vertical steel of all walls shall be extended into the footing and be bent at 90° or a separate dowel shall be installed as a #4 rebar that is bent at 90° with at least 20 inches of rebar in the wall and extended into the footing within 3 inches of the bottom of the footing and extended at least 3 inches horizontally, as indicated in Appendix C, Figure C-1, located at iowadnr.gov/afo/rules. As an alternative to the 90° bend, the dowel may be extended at least 12 inches into the footing, with a minimum concrete cover of 3 inches at the bottom. Dowel spacing (bend or extended) shall be the same as the spacing for the vertical rebar. In lieu of dowels, mechanical means or alternate methods may be used as anchorage of interior walls to footings.

(11) All footings, slabs, and walls shall be formed with rigid forming systems and shall not be earth-formed. Form ties shall be nonremovable to provide a liquid-tight structure. No conduits or pipes shall be installed through an outside wall below the maximum liquid level of the structure.

(12) All wall reinforcement shall be placed so as to have a rebar cover of two inches from the inside face of the wall for a belowground manure storage structure. Vertical wall reinforcement should be placed closest to the inside face. Rebar placement shall not exceed tolerances specified in ACI 318-19.

(13) All construction joints in exterior walls shall be constructed to prevent discontinuity of steel and have properly spliced rebar placed through the joint.

(14) All concrete shall be cured for at least seven days after placing, in a manner which meets ACI 308R-16, effective May 2016, by maintaining adequate moisture or preventing evaporation. Proper curing shall be done by ponding, spraying or fogging water; by using a curing compound that meets ASTM C 309, effective August 22, 2019; or by using wet burlap, plastic sheets or similar materials.

(15) Backfilling of the walls shall not start until the floor slats or permanent bracing has been installed and grouted. Backfilling shall be performed with material free of vegetation, large rocks or debris.

(16) If air temperature is below 40 degrees Fahrenheit, the ACI Standard 306R-16, "Recommended Practice for Cold Weather Concreting," effective September 2016, should be followed. If ready-mix concrete temperature is above 90 degrees Fahrenheit, the ACI Standard 305R-20, "Recommended Practice for Hot Weather Concreting," effective date September 2020, should be followed.

c. Formed manure storage structures constructed of steel or pre-cast concrete shall be designed by a PE and certified by the PE and the manufacturer's representative that the structure was built in accordance with the manufacturer's requirements.

65.108(11) *Secondary containment barriers for manure storage structures.* Secondary containment barriers used to qualify any confinement feeding operation for the exemption provision in subrule 65.107(7) shall be filed with the department according to subrule 65.104(5) and shall meet the following design standards:

a. A secondary containment barrier shall consist of a structure surrounding or downslope of a manure storage structure and shall be designed according to either of the following:

(1) If the manure storage structure is used to store liquid or semiliquid manure, the secondary containment barrier shall be designed to contain 120 percent of the volume of manure stored above the manure storage structure's final grade or 50 percent of the volume of manure stored belowground or partially belowground, whichever is greater. Engineering drawings prepared by a PE licensed in Iowa or an NRCS-qualified staff person must be submitted according to procedures set forth in subrule 65.104(5) and must show compliance with subrule 65.108(11). If the containment barrier does not surround the manure storage structure, upland drainage must be diverted. For purposes of this subrule only, semiliquid manure means manure that contains a percentage of dry matter that results in manure too solid for pumping but too liquid for stacking.

(2) If the manure storage structure is used for the storage of only dry manure or dry bedded manure, the secondary containment barrier shall be designed to contain at least 10 percent of the volume of manure stored. Detailed drawings prepared by the owner or a representative must be submitted according to procedures set forth in subrule 65.104(5) and must show compliance with subrule 65.108(1). If the containment barrier does not surround the manure storage structure, upland drainage must be diverted. Any dry manure retained by the secondary containment barrier shall be removed and properly disposed of within 14 days.

b. The barrier may be constructed of earth, concrete, or a combination of both. If a relief outlet or valve is installed, the relief outlet or valve shall remain closed. Any accumulated liquid due to an overflow shall be land-applied as stated in the operation's MMP.

c. The base shall slope to a collecting area where storm water can be pumped out. If storm water is contaminated with manure, it shall be land-applied at normal fertilizer application rates in compliance with rule 567—65.101(455B,459,459B).

d. Secondary containment barriers constructed entirely or partially of earth shall comply with the following requirements:

(1) The soil surface, including dike, shall be constructed to prevent downward water movement at rates greater than 1×10^{-6} cm/sec and shall be maintained to prevent downward water movement at rates greater than 1×10^{-5} cm/sec.

(2) Dikes shall not be steeper than 45 degrees and shall be protected against erosion. If the slope is 19 degrees or less, grass can be sufficient protection, provided it does not interfere with the required soil seal.

(3) The top width of the dike shall be no less than three feet.

e. Secondary containment barriers constructed of concrete shall be watertight and comply with the following requirements:

(1) The base of the containment structure shall be designed to support the manure storage structure and its contents.

(2) The concrete shall be routinely inspected for cracks, which shall be repaired with a suitable sealant.

f. Nothing shall be stored within a secondary containment barrier, including but not limited to machinery or feedstock.

65.108(12) *Human sanitary waste.* Human sanitary waste shall not be discharged to a manure storage structure or egg washwater storage structure.

65.108(13) *Requirements for qualified operations.* A confinement feeding operation that meets the definition of a qualified operation shall only use an aerobic structure for manure storage and treatment. This requirement does not apply to the following types of confinement feeding operations: (1) one that only handles dry manure; (2) an egg washwater storage structure; (3) a confinement feeding operation that was constructed before May 31, 1995, and does not expand; or (4) a confinement feeding operation that processes manure using an anaerobic digester system.

65.108(14) *Aboveground formed manure storage structures with external outlet or inlet below the liquid level.* A formed manure storage structure that is constructed to allow the storage of manure wholly or partially above ground and that has an external outlet or inlet below the liquid level shall have all of the following:

a. Two or more shutoff valves on any external outlet or inlet below the liquid level. At least one shutoff valve shall be located inside the structure and be operable if the external valve becomes inoperable or broken off. Alternative options may be considered by the department.

b. All external outlets or inlets below the liquid level shall be barricaded, encased in concrete, or otherwise protected to minimize accidental destruction.

c. Construction shall comply with the manufacturer's requirements.

d. An emergency response plan for retaining manure at the site and cleanup if the manure storage structure fails or there is any other type of accidental discharge. The plan shall consist of telephone numbers to comply with subrule 65.2(1) and a list of contractors, equipment, equipment technical support, and alternative manure storage or land application sites that can be used during inclement weather.

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