

ENVIRONMENTAL PROTECTION COMMISSION[567]

Adopted and Filed

Pursuant to the authority of Iowa Code section 459.103, the Environmental Protection Commission hereby amends Chapter 65, "Animal Feeding Operations," Iowa Administrative Code.

The amendments modify the construction design standards for formed manure storage structures as prescribed by 2002 Iowa Acts, chapter 1137. The standards include upgraded requirements for formed manure storage structures in karst areas and separate construction design standards for formed manure storage structures that store manure exclusively in a dry form.

Notice of Intended Action was published in the Iowa Administrative Bulletin on August 20, 2003, as **ARC 2716B**.

Written comments were received by the Department. In addition, oral comments were received by the Department at a public hearing held on September 11, 2003.

As a result of the written and oral comments, the following changes have been made to the Notice of Intended Action:

1. The introductory paragraph of subrule 65.15(14) has been modified to address the Iowa Engineering Society's concerns. As a result, a definition has been added for a professional engineer licensed in the state of Iowa (PE) and for an engineer working for the USDA Natural Resources Conservation Service (NRCS engineer).

2. Adopted subrule 65.15(14) now provides alternative design methods, other than the DNR minimum standards initially proposed in the Notice. These alternative design methods include a design prepared and sealed by a PE or an NRCS engineer. When a PE or an NRCS engineer is not involved, the design shall be in accordance with MidWest Plan Service (MWPS) or in accordance with DNR minimum standards. This will allow for a more flexible, site-specific design and industry-based standards. If the design is prepared and sealed by a PE or an NRCS engineer, it shall be in conformance with the American Concrete Institute (ACI) Building Code ACI 318, ACI 360, or ACI 350; or MWPS-36 or MWPS TR-9; or Portland Cement Association (PCA) publication EB075, EB001, or IS072; or a combination. These technical documents meet or exceed the proposed minimum concrete standards set forth in the Notice.

3. Furthermore, subrule 65.15(14) requires that additional minimum concrete standards be met if the design of a formed manure storage structure is not prepared and sealed by a PE or an NRCS engineer.

4. For the subgrade preparation required in 65.15(14)"a"(2), numbered paragraph "1," a definition of the term "uniform" has been added for clarification purposes. Adopted subrule 65.15(14) requires that if the subgrade is nonuniform, it shall be made uniform. This specification, however, is only for a formed manure storage structure that is not designed and sealed by a PE or an NRCS engineer, due to the reasons explained in "2" above.

5. In 65.15(14)"a"(2), numbered paragraph "2," the requirement to install a drain tile at 2 feet below the footing elevation required has been modified. Several comments indicated this requirement might compromise the structural stability due to the need to place fill material underneath the

footings. Comments recommended that the drain tile be installed right at the footing elevation, instead of at 2 feet below the footing, as initially proposed. A new Figure D-1 has been added at the end of Chapter 65 to illustrate the ideal location of the drain tile. In addition, the option to install fabric around the drain tile or a combination of fabric and granular material has been added. This specification, however, is only for a formed manure storage structure with a design not sealed by a PE or an NRCS engineer, due to the reasons explained in "2" above.

6. The requirements for concrete have been expanded in 65.15(14)"a"(2), numbered paragraph "4," to include blended cements. This specification, however, is only for a formed manure storage structure with a design not sealed by a PE or an NRCS engineer, due to the reasons explained in "2" above.

7. The minimum floor design requirements have been modified as follows in 65.15(14)"a"(1), numbered paragraphs "1" and "2," 65.15(14)"a"(2), numbered paragraph "8," and 65.15(14)"b"(2) and (3). The requirement that the floor be a minimum of 5 inches thick is for a nondry manure storage structure regardless of who designs the structure and for a dry manure storage structure that is not designed and sealed by a PE or an NRCS engineer. Wire mesh is not accepted as primary reinforcement for a formed manure storage structure with a depth of 4 feet or more regardless of who designs the structure. However, wire mesh can be used as shrinkage reinforcement in floor slabs of a formed manure storage structure with a depth of less than 4 feet. Fiber is not accepted as reinforcement, except for a dry manure storage structure designed and sealed by a PE or an NRCS engineer. In addition, clarification on the placement of the steel reinforcement has been added. Furthermore, in response to comments, the adopted subrule allows for floor thickness tolerances in accordance with industry standards. Finally, if a formed manure storage structure is not designed and sealed by a PE or an NRCS engineer, floor thickness verification will be limited to nondestructive methods.

8. The minimum dimensions required for footings have been modified slightly in 65.15(14)"a"(2), numbered paragraph "9," and 65.15(14)"b"(3). This specification, however, is only for a formed manure storage structure with a design not sealed by a PE or an NRCS engineer, due to the reasons explained in "2" above.

9. The minimum wall design has also been modified. Several comments indicated the initially proposed standards were "one size fits all" and did not allow for site-specific design considerations and that they restricted the design prepared and sealed by a PE or an NRCS engineer. Therefore, the standards in 65.15(14)"a"(1) and 65.15(14)"b"(1) accept a wall design prepared and sealed by a PE or an NRCS engineer, due to the reasons explained in "2" above.

For cases in which a PE or an NRCS engineer is not involved, 65.15(14)"a"(2) and 65.15(14)"b"(3) refer to tables with varying minimum wall thickness and steel reinforcement requirements according to depth of the formed structure, vehicle traffic and type of backfill material used. Comments from the Iowa Farm Bureau Federation and Iowa Pork Producers Association suggested that DNR work with MidWest Plan Service (MWPS) to develop design specifications and tables based on depth of the formed manure storage structure and other factors. These new tables are in a new Appendix D at the end of the chapter.

10. In 65.15(14)"a"(1), numbered paragraph "4," 65.15(14)"a"(2), numbered paragraph "10," and 65.15(14)"b"(2) and (3), the requirements for vertical steel

or dowels have been modified to provide an alternative to the 90° bent dowel requirement and to provide an alternative for interior walls.

11. The term "load bearing wall" used in the Notice at 65.15(14)"a"(10) and 65.15(14)"b"(10) has been deleted.

12. The concrete curing requirements have been modified in 65.15(14)"a"(2), numbered paragraph "12," to provide a description of alternative methods for concrete curing. This specification, however, is only for a formed manure storage structure with a design not sealed by a PE or an NRCS engineer, due to the reasons explained in "2" above.

13. The waterstop and keyway requirements have been modified as follows. The keyway requirement has been eliminated. The waterstop requirements in 65.15(14)"a"(1), numbered paragraph "3," and 65.15(14)"a"(2), numbered paragraph "13," have been expanded to allow rolled bentonite and to include a reference to Appendix D, Figures D-1 and D-2, at the end of Chapter 65 to better illustrate installation.

14. The requirement that contraction joints be not more than 100 feet apart, proposed in the Notice at 65.15(14)"a"(15) and 65.15(14)"b"(14), has been removed because it is not an industry standard.

15. The concrete standards required for a structure storing manure exclusively in a dry form have also been modified. Several comments recommended that these standards be tailored to the characteristics of dry manure and current industry practices (mainly poultry), thereby eliminating unnecessary expenses without causing environmental damage. In addition, several comments suggested that the standards allow for alternative designs that are submitted by a PE or an NRCS engineer. In response to this suggestion and because of the explanation in "2" above, the adopted subrule allows for a design prepared and sealed by a PE or an NRCS engineer for a dry manure storage structure in lieu of the DNR minimum concrete standards. Most facilities store dry manure in formed structures aboveground. If a formed manure storage structure is not designed and sealed by a PE or an NRCS engineer and is above the ground, the adopted subrule requires that only certain concrete standards for nondry manure be met, but if a formed manure storage structure for the storage of manure exclusively in a dry form is to be constructed below or partially below the ground and is not designed and sealed by a PE or an NRCS engineer, all of the concrete standards for nondry manure must be met.

16. The upgraded concrete standards for karst areas in 65.15(14)"c" have been modified. The phrase "sinkholes within one-half mile" has been eliminated because several comments received mentioned that it was not compatible with the language provided in the statute. Adopted paragraph "c" maintains the language prescribed in Iowa Code section 459.307 and requires upgraded concrete standards in "an area that exhibits karst terrain or an area that drains into a known sinkhole." DNR will provide contact information by which the location of these karst areas and known sinkholes can be identified.

17. The language in 65.15(14)"c"(1) has been modified as a result of further technical review. The adopted subparagraph requires a vertical separation of at least 5 feet between the bottom of a formed structure and limestone, dolomite or other soluble rock unless the structure is designed by a PE or an NRCS engineer.

18. Subparagraph 65.15(14)"c"(2) has been modified to require a compacted liner below the floor of the formed structure if the vertical separation between the bottom of the formed structure and the limestone, dolomite or other solu-

ble rock is less than 5 feet. Also, as a result of public comments, the Department is recommending that in those cases an aboveground structure should be constructed (instead of a belowground structure).

19. Subparagraph 65.15(14)"c"(3) has also been modified to require that the soil borings or test pits for a soil investigation be performed by a PE, an NRCS engineer or a qualified organization. In addition, in response to several comments, a requirement that these soil borings or test pits be properly plugged, using similar language contained in other sections of the chapter, has been added.

20. New subparagraphs 65.15(14)"c"(4) and (5) have been added for structures constructed in areas that exhibit karst terrain or that drain into known sinkholes. Groundwater monitoring must be performed as specified by DNR, and backfill requirements are provided.

21. Comments received from the regulated community, through Iowa Farm Bureau Federation and Iowa Pork Producers Association, suggested that the Department work with MidWest Plan Service (MWPS) to develop design specification tables. Accordingly, a new Appendix D has been added to the end of Chapter 65. This new appendix includes five tables with design specifications for formed manure storage structures and two figures to illustrate requirements pertaining to waterstops and footing drain tile. Appendix D applies to a formed manure storage structure that is not required to be designed and sealed by a PE or an NRCS engineer.

These amendments are intended to implement Iowa Code section 459.307.

These amendments will become effective on March 24, 2004.

The following amendments are adopted.

ITEM 1. Rescind subrule 65.15(14) and adopt in lieu thereof the following **new** subrule:

65.15(14) Concrete standards. A formed manure storage structure which is constructed of concrete on or after March 24, 2004, that is part of a confinement feeding operation other than a small animal feeding operation shall meet the following minimum standards. For the purpose of this subrule, a "PE" is a professional engineer licensed in the state of Iowa and an "NRCS engineer" is an engineer working for the USDA Natural Resources Conservation Service (NRCS). (CAVEAT: These standards are not intended to address other site-related engineering and construction considerations beyond the department's jurisdiction.)

a. Nondry manure storage. The following minimum concrete standards are required for a formed manure storage structure other than that used for the storage of manure exclusively in a dry form. A formed manure storage structure must be designed in accordance with one of the following design methods:

(1) Engineering report, plans and specifications prepared and sealed by a PE or an NRCS engineer. Design considerations shall be in conformance with the American Concrete Institute (ACI) Building Code ACI 318, ACI 360 or ACI 350; or Portland Cement Association (PCA) publication EB075, EB001 or IS072; or MidWest Plan Service (MWPS) publication MWPS-36 or MWPS TR-9, and shall include all of the following:

1. The floors shall be a minimum of 5 inches thick. Non-destructive 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 4½ inches.

2. Wire mesh shall not be used as primary reinforcement for a formed manure storage structure with a depth of 4 feet or more. Fiber shall not be used as reinforcement.

3. 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.

4. 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 an alternate 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. In lieu of dowels, mechanical means or alternate methods may be used as anchorage of interior walls to footings.

(2) If a formed manure storage structure is not designed and sealed by a PE or an NRCS engineer, the design and specifications shall be in conformance with MWPS-36 (for a belowground rectangular tank) or MWPS TR-9 (for a circular tank); or in accordance with Appendix D at the end of this chapter (for a belowground, laterally braced rectangular tank). In addition, all of the following concrete standards shall apply:

1. 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.

2. When the groundwater table, as determined in 65.15(7)"c," is above the bottom of the formed structure, a drain tile shall be installed along the footings to artificially lower the groundwater table pursuant to 65.15(7)"b." The drain tile shall be placed within 3 feet of the footings as indicated in Appendix D, Figure D-1, at the end of this chapter and shall be covered with a minimum of 2 inches of gravel, granular material, fabric or a combination of these materials to prevent plugging the drain tile.

3. 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:

- 4,000 pounds per square inch (psi) for walls, floors, beams, columns and pumpouts;
- 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.

4. Cementitious materials shall consist of portland cement conforming to ASTM C 150. Aggregates shall conform to ASTM C 33. Blended cements in conformance with ASTM C 595 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.

5. All concrete placed for walls shall be consolidated or vibrated, by manual or mechanical means, or a combination, in a manner which meets ACI 309.

6. All 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.

7. All wall reinforcement shall be placed so as to have a rebar cover of 2 inches from the inside face of the wall for a belowground manure storage structure. Vertical wall rein-

forcement should be placed closest to the inside face. Rebar placement shall not exceed tolerances specified in ACI 318.

8. The floor slab shall be a minimum of 5 inches thick. The floor slab of any formed manure storage structure with a depth of 4 feet or more shall have primary reinforcement consisting of a minimum of #4 rebar placed a maximum of 18 inches on center in each direction placed in a single mat. The floor slab of any formed manure storage structure with a depth less than 4 feet shall have shrinkage reinforcement consisting of a minimum of 6 × 6-W1.4 × W1.4 welded wire fabric. Floor slab reinforcement shall be located in the middle of the thickness of the floor slab. 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 4½ 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 8 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 -½ 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 D, Figure D-1, at the end of this chapter. 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 walls shall be formed with rigid forming systems and shall not be earth-formed.

12. All concrete shall be cured for at least seven days after placing, in a manner which meets ACI 308, by maintaining adequate moisture or preventing evaporation. Proper curing shall be done by ponding, spraying or fogging water; or by using a curing compound that meets ASTM C 309; or by using wet burlap, plastic sheets or similar materials.

13. All construction joints in exterior walls shall be constructed to prevent discontinuity of steel and have properly spliced rebar placed through the joint. Waterstops shall be installed in all areas where fresh concrete will meet hardened concrete as indicated in Appendix D, Figures D-1 and D-2, at the end of this chapter. The waterstops shall be made of plastic, rolled bentonite or similar materials approved by the department.

14. Backfilling of the walls shall not start until the floor slats or permanent bracing have been installed. Backfilling shall be performed with material free of vegetation, large rocks or debris.

15. A formed manure storage structure with a depth greater than 12 feet shall be designed by a PE or an NRCS engineer.

b. Dry manure storage. A formed structure for the storage of manure exclusively in a dry form shall be designed and constructed in accordance with one of the following:

(1) Engineering report, plans and specifications prepared and sealed by a PE or an NRCS engineer. Design considerations shall be in conformance with the American Con-

crete Institute (ACI) Building Code ACI 318 or ACI 360; or Portland Cement Association (PCA) publication EB075, EB001 or IS072; or MidWest Plan Service (MWPS) publication MWPS-36.

(2) If a formed manure storage structure that stores manure exclusively in a dry form is to be constructed aboveground and the design is not prepared and sealed by a PE or an NRCS engineer, the requirements set forth in 65.15(14)“a”(2), numbered paragraphs “1,” “3,” “4,” “5,” “6,” “8” and “12,” shall apply. Consideration shall be given to internal and external loads including, but not limited to, wind loads, building load, manure pile and equipment vehicle loads.

(3) If the formed structure that stores manure exclusively in a dry form is to be constructed below or partially below the ground and the design is not prepared and sealed by a PE or an NRCS engineer, the requirements set forth in 65.15(14)“a”(2), numbered paragraphs “1” through “15,” shall apply. Wall design shall be in accordance with Appendix D at the end of this chapter or in accordance with MWPS-36. Consideration shall be given to internal and external loads including, but not limited to, lateral earth pressures, hydrostatic pressures, wind loads, manure pile and equipment vehicle loads.

c. Karst terrain—upgraded standards. If the site of the proposed formed manure storage structure is located in an area that exhibits karst terrain or an area that drains into a known sinkhole, the minimum concrete standards set forth in 65.15(14)“a” or “b” shall apply. In addition, the following requirements apply to all formed manure storage structures that store nondry or dry manure:

(1) A minimum 5-foot vertical separation distance between the bottom of a formed manure storage structure and

limestone, dolomite, or other soluble rock is required if the formed manure storage structure is not designed by a PE or an NRCS engineer.

(2) If the vertical separation distance between the bottom of the proposed formed manure storage structure and limestone, dolomite, or other soluble rock is less than 5 feet, the structure shall be designed and sealed by a PE or an NRCS engineer who certifies the structural integrity of the structure. A 2-foot-thick layer of compacted clay liner material shall be constructed underneath the floor of the formed manure storage structure. However, it is recommended that any formed manure storage structure be constructed aboveground if the vertical separation distance between the bottom of the structure and the limestone, dolomite, or other soluble rock is less than 5 feet.

(3) In addition, in an area that exhibits karst terrain or an area that drains into a known sinkhole, a PE, an NRCS engineer or a qualified organization shall submit a soil exploration study based on the results from soil borings or test pits to determine the vertical separation between the bottom of the formed structure and limestone, dolomite, or other soluble rock. A minimum of two soil borings or two test pits, equally spaced within each formed structure, are required. After soil exploration is completed, each soil boring and pit shall be properly plugged with concrete grout, bentonite, or similar materials.

(4) Groundwater monitoring shall be performed as specified by the department.

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

ITEM 2. Amend 567—Chapter 65 by adopting the following **new** appendix:

APPENDIX D
DESIGN SPECIFICATIONS—FORMED MANURE
STORAGE STRUCTURES

The following design specifications apply to a formed manure storage structure that is constructed belowground, is laterally braced and is not designed using MWPS-36 or by a PE or an NRCS engineer:

(1) The walls of a rectangular formed structure with a depth up to 12 feet shall be designed in accordance with the tables provided in this appendix.

(2) Consideration shall be given to internal and external loads including, but not limited to, lateral earth pressures, hydrostatic pressures, wind loads, and floor or cover, building and equipment loads.

(3) Each wall shall be braced laterally at the top of the wall.

(4) The walls shall be constructed above the groundwater table, or a drain tile shall be installed to artificially lower the groundwater table.

(5) Each wall that includes a pumpout port shall be constructed under the design consideration that vehicles will be operating within 5 feet of the wall as provided in Tables D-2 and D-4.

(6) Minimum wall thickness and minimum vertical steel reinforcement shall be in accordance with one of the following:

(a) Table D-1, if **all** of the following conditions are met:

1. There will be NO VEHICLES operating within 5 feet of the wall.

2. Backfilling is performed with gravel, sand, silt, and clay mixtures (less than 50 percent fines), with coarse sand with silt or clay (less than 50 percent fines), or cleaner granular material (see NRCS Conservation Practice Standard, “Waste Storage Facility,” Code 313, Table 2, for description and unified classification or ASTM D 2488 and D 653).

APPENDIX D, TABLE D-1
Minimum Wall Thickness and Vertical Steel Reinforcement

Wall height (feet)	Wall thickness (inches)	Steel Grade			
		Grade 40		Grade 60	
		Bar	Space o.c. (inches)	Bar	Space o.c. (inches)
4 or less	6	#4	16.5	#4	18.0
		#5	18.0	#5	18.0

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4 or less	8	#4	12.0	#4	13.5
		#5	18.0	#5	18.0
6	6	#4	14.5	#4	18.0
		#5	18.0	#5	18.0
6	8	#4	12.0	#4	13.5
		#5	18.0	#5	18.0
8	8	#4	9.5	#4	13.5
		#5	14.5	#5	18.0
8	10	#4	9.5	#4	11.0
		#5	15.0	#5	17.0
10	8	#4	6.5	#4	9.5
		#5	10.0	#5	13.5
10	10	#4	6.5	#4	9.5
		#5	10.0	#5	15.0
12	10	#4	5.0	#4	7.5
		#5	7.5	#5	11.5

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(b) Table D-2, if **all** of the following conditions are met:

1. There will be VEHICLES operating within 5 feet of the wall.
2. Backfilling is performed with gravel, sand, silt, and clay mixtures (less than 50 percent fines), with coarse sand with silt or clay (less than 50 percent fines), or cleaner granular material (see NRCS Conservation Practice Standard, "Waste Storage Facility," Code 313, Table 2, for description and unified classification or ASTM D 2488 and D 653).

APPENDIX D, TABLE D-2
Minimum Wall Thickness and Vertical Steel Reinforcement

Wall height (feet)	Wall thickness (inches)	Steel Grade			
		Grade 40		Grade 60	
		Bar	Space o.c. (inches)	Bar	Space o.c. (inches)
4 or less	6	#4	16.5	#4	18.0
		#5	18.0	#5	18.0
4 or less	8	#4	12.0	#4	13.5
		#5	18.0	#5	18.0
6	6	#4	10.5	#4	15.5
		#5	16.5	#5	18.0
6	8	#4	12.0	#4	13.5
		#5	18.0	#5	18.0
8	8	#4	6.5	#4	10.0
		#5	10.5	#5	16.0
8	10	#4	8.5	#4	11.0
		#5	13.5	#5	17.0
10	8	#4	4.5	#4	6.5
		#5	7.0	#5	10.5
10	10	#4	5.0	#4	7.5
		#5	8.0	#5	12.0
12	10	#4	3.5	#4	5.5
		#5	5.5	#5	8.5

(c) Table D-3, if **all** of the following conditions are met:

1. There will be NO VEHICLES operating within 5 feet of the wall.
2. Backfilling is performed with low plasticity silts and clays with some sand or gravel (50 percent or more fines); or fine sands with silt or clay (less than 50 percent fines); or low to medium plasticity silts and clays with little sand or gravel (50 percent or more fines); or high plasticity silts and clays (see NRCS Conservation Practice Standard, "Waste Storage Facility," Code 313, Table 2, for description and unified classification or ASTM D 2488 and D 653).

APPENDIX D, TABLE D-3
Minimum Wall Thickness and Vertical Steel Reinforcement

Wall height (feet)	Wall thickness (inches)	Steel Grade			
		Grade 40		Grade 60	
		Bar	Space o.c. (inches)	Bar	Space o.c. (inches)
4 or less	6	#4	16.5	#4	18.0
		#5	18.0	#5	18.0
4 or less	8	#4	12.0	#4	13.5
		#5	18.0	#5	18.0
6	6	#4	10.5	#4	15.5
		#5	16.5	#5	18.0
6	8	#4	12.0	#4	13.5
		#5	18.0	#5	18.0
8	8	#4	6.5	#4	10.0
		#5	10.5	#5	16.0
8	10	#4	9.0	#4	11.0
		#5	14.0	#5	17.0
10	8	#4	4.5	#4	6.5
		#5	7.0	#5	10.0
10	10	#4	5.0	#4	7.5
		#5	8.0	#5	12.0
12	10	#4	3.5	#4	5.0
		#5	5.5	#5	8.0

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(d) Table D-4, if **all** of the following conditions are met:

1. There will be VEHICLES operating within 5 feet of the wall.
2. Backfilling is performed with low plasticity silts and clays with some sand or gravel (50 percent or more fines); or fine sands with silt or clay (less than 50 percent fines); or low to medium plasticity silts and clays with little sand or gravel (50 percent or more fines); or high plasticity silts and clays (see NRCS Conservation Practice Standard, "Waste Storage Facility," Code 313, Table 2, for description and unified classification or ASTM D 2488 and D 653).

APPENDIX D, TABLE D-4
Minimum Wall Thickness and Vertical Steel Reinforcement

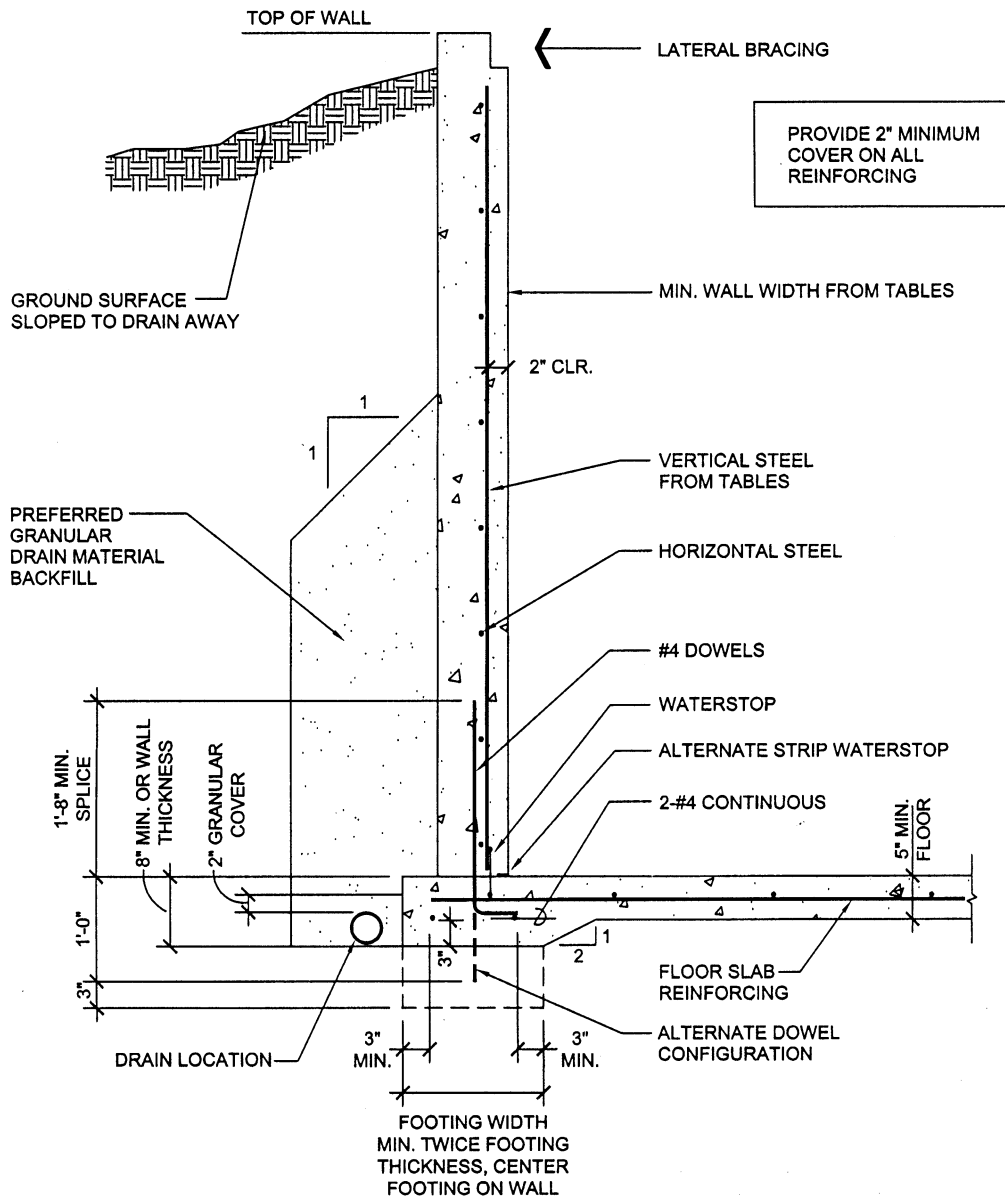
Wall height (feet)	Wall thickness (inches)	Steel Grade			
		Grade 40		Grade 60	
		Bar	Space o.c. (inches)	Bar	Space o.c. (inches)
4 or less	6	#4	16.5	#4	18.0
		#5	18.0	#5	18.0
4 or less	8	#4	12.0	#4	13.5
		#5	18.0	#5	18.0
6	6	#4	8.0	#4	12.0
		#5	12.5	#5	16.5
6	8	#4	9.5	#4	13.5
		#5	15.0	#5	18.0
8	8	#4	6.0	#4	9.0
		#5	9.0	#5	11.5
8	10	#4	6.0	#4	9.0
		#5	9.5	#5	14.0
10	8	#4	3.0	#4	4.5
		#5	4.5	#5	7.0
10	10	#4	4.5	#4	6.5
		#5	6.5	#5	10.0
12	10	#4	2.5	#4	4.0
		#5	4.0	#5	6.0

(7) Minimum horizontal steel for a rectangular tank shall be selected and placed according to Table D-5, regardless of wall height, and shall be tied to the soil side of vertical steel:

APPENDIX D, TABLE D-5
Minimum Wall Horizontal Steel Reinforcement

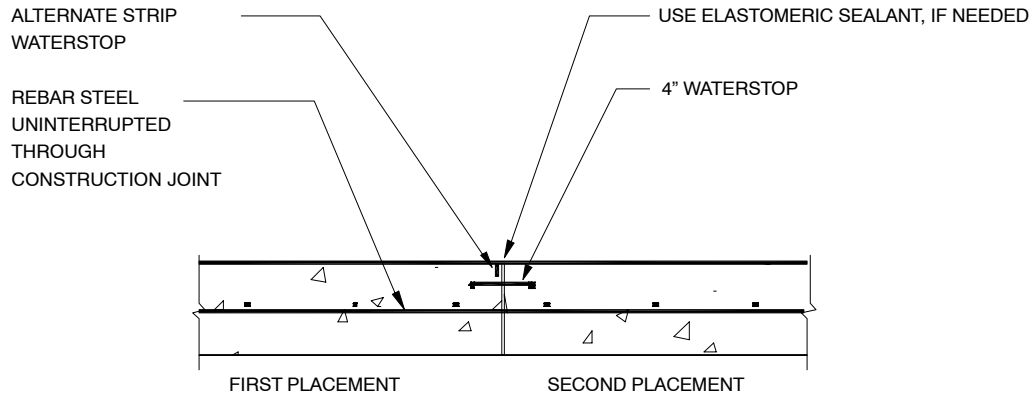
Wall thickness (inches)	Steel Grade			
	Grade 40		Grade 60	
	Bar	Space o.c. (inches)	Bar	Space o.c. (inches)
6	#4	16.5	#4	18.0
	#5	18.0	#5	18.0
8	#4	12.0	#4	13.5
	#5	18.0	#5	18.0
10	#4	9.5	#4	11.0
	#5	15.0	#5	17.0

APPENDIX D, FIGURE D-1
MONOLITHIC FOOTING FLOOR DETAIL*



*For a more detailed version of this figure, contact the department, animal feeding operations.

APPENDIX D, FIGURE D-2
WALL AND FLOOR CONSTRUCTION JOINT*



*For a more detailed version of this figure, contact the department, animal feeding operations.

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