

## **DESIGN GUIDE MD #7**

### **PREQUALIFIED WASTE STORAGE FACILITY DESIGNS**

(Index of Standard Detail Drawings by Private Vendors)



*January 2004*  
*Revised - May 2010*

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# **SECTION I**

## **GENERAL**

Prequalified engineering designs are to be used as part of a site-specific design; the site-specific design must be reviewed and approved by someone with the appropriate engineering approval authority. The vendor must supply to the field office all appropriate construction drawings, notes, details, and construction specifications prior to approval of the site design. In situations where a different prequalified design is being substituted into an already approved site design, all documentation must be provided by the vendor and the design reviewed and reapproved prior to start of any construction.

Each prequalified design has a unique set of plans and specifications. Construction must be in accordance with these plans and specifications. It is important that inspectors familiarize themselves with the prequalified design and inspect accordingly. In particular on prequalified circular concrete storage facilities vendors have different approved requirements for installing kicker walls, pushoff pads, adjacent concrete barnyards or have different minimum requirements for soil bearing capacities. These requirements must be met. Any design changes in these requirements must be approved by an NRCS engineer, prior to construction.

## **DESIGN**

### **Geotechnical Investigations**

Criteria for allowable soil bearing capacity, based on foundation description, are contained in the Waste Storage Facility conservation practice standard (code 313) Table 2-Presumptive Allowable Bearing Stress Values. Site soil investigations are to include a soil foundation description that corresponds to Table 2. The actual soil bearing (allowable stress) capacity for the site must meet or exceed the soil bearing capacity required by the design. When the actual soil bearing capacity (based on foundation description) is less than that required by the design the design cannot be used unless site specific testing, for soil bearing capacity is performed and the site soil bearing capacity is found to meet or exceed the required soil bearing capacity for the planned design. Testing is to be performed by a qualified geotechnical engineering representative. A copy of the test report must be kept on file with the engineering plans. The testing must be complete, prior to start of construction.

### **Floor Designs for Prequalified Concrete Manure Storage Facilities**

The NRCS, Maryland Conservation Practice Standard, code 313, Waste Storage Facility requires a different slab design procedure for tank floors than many of the prequalified designs were design and approved under. All companies with standard detail drawings for concrete manure storage tanks, concurred in by NRCS, have been notified of this change. The NRCS in Maryland is not requiring a re-submittal of the designs. However all floor design must comply with the criteria shown below:

A standard floor design table, shown below has been developed that will apply to all new tank installations effective October 1, 2003.

<b>CONCRETE STORAGE FACILITIES</b>		
<i>MAXIMUM FLOOR DIMENSION</i>	<i>REQUIRED STEEL FOR 5" THICK FLOOR W/ GRAVEL SUBGRADE</i>	
	<i>A<sub>s</sub></i>	<i>EXAMPLE</i>
$\leq 60'$	0.058	6x6-#6 gage, or 6x6-W2.9xW2.9, or #3 bar @ 18 inch
$>60 \leq 100'$	0.126	4x4-#4 gage, 4x4-W4xW4, or #4 @ 18"
$>100' \leq 160'$	0.190	#4 @ 12"
$>160' \leq 200'$	0.230	#4 @ 10" or #5 bar @ 16"

### **Welding of Steel Reinforcement**

The welding of reinforcement steel for use in cast-in-place is no longer accepted. Manufactured materials that contain the welding of reinforcement steel that is inherent within their design, such as welded wire fabric are acceptable products. Precast concrete will continue to be manufactured to their specific specifications.

### **Wall Thickness**

Wall ties used in the forming of cast-in-place concrete walls are made in nominal or full dimensions. An 8-inch nominal wall tie does not measure a full 8 inches in width and therefore, when used, will not result in an 8-inch thick concrete wall. An 8-inch full wall tie, as the name implies, does measure a full 8 inches and will result in an 8-inch thick concrete wall. Therefore, nominal size wall ties are not acceptable, full dimension wall ties are required.

In addition concrete wall ties must be broken off and patched with a concrete epoxy, or a polymer modified cement. Patching of wall ties is required on both the inside and outside of concrete structures.

### **Concrete Mix**

Concrete mix tickets are required for all concrete projects. Mix tickets are to include the mix strength, type of cement, type of admixtures, time loaded, time load arrived at job site, and time unloading is complete.

## **Curing Concrete**

Proper curing of concrete is required. Curing must be accomplished by protecting the concrete from drying during the curing period by leaving forms in place, spraying or sprinkling the concrete with water, covering with wet burlap or plastic sheeting, or by use of a curing compound. The protection must be applied immediately after the initial set of the concrete. A minimum curing period of 3 days is required when atmospheric temperatures are at or above 55° F or 7 days when the atmospheric temperature is below 55° F. Concrete must be kept from freezing during the curing period.

## **SECTION II**

### **Index of Standard Detail Drawings (Prequalified Designs) by Non-NRCS Engineers Receiving Maryland Concurrence**

<b>VENDOR</b>	<b>DESCRIPTION</b>	<b>DATE APPROVED</b>	<b>DESIGN DATA</b>
Keystone Concrete Inc.	#E056-06 Pages 1-6, Manure Storage 60' Span utilizing pre cast concrete wall panels.	Maryland 12/8/08	Attached
Coverall Building Systems	#126773 Pages 1-9, 40' wide model LBS Legend Building 14 foot Frame Spacing	Maryland 2/25/08	Attached
Prepared by EA Engineering, Science and Technology for NRCS Maryland	Pages #A-1, #S-1 and #S-2, Concrete wall, footing and slab design for Coverall LBS Legend Building with 14' frame spacing	Maryland 2/25/08	Attached
Sollenberger Silo Corporation/Nitterhouse Concrete Products	#0773 Precast concrete wall panels 8'7" high by 7'6" wide and precast concrete corner panels	Maryland 10/21/02	Attached
Coverall Building Systems	#05402201 Pages 1-5 40' wide model 220 TAS #S-1 Footing, slab and Wall Design	Maryland 2/11/99	Attached
Sam Yoder and Son, Inc.	#109926 Roof truss for use with NRCS drawing MD-84-02	Maryland 1/28/97	None
Aline Supply	#5206169 pages 1-3, A wooden single stage open-air composting crib	National 9/22/94	Attached
Abetong	Circular, Post Tensioned, Precast Concrete	National 7/25/88	Attached
Abetong (Sol)	Circular, Post Tensioned, Precast Concrete	National 1/31/91	Attached
Brad Beaver	Circular, Site Cast Concrete	National 7/1/93	Attached
Chase	Rectangular, Precast Concrete	National 1/84	None
Energy-Pak	Circular, Site Cast Concrete	National 4/9/86	Attached
Groffdale (89)	Circular, Site Cast Concrete	National 4/30/90	Attached
Groffdale (89UN)	Circular, Site Cast Concrete, w/ Unequal Backfill	National 4/30/90	Attached

<b>VENDOR</b>	<b>DESCRIPTION</b>	<b>DATE APPROVED</b>	<b>DESIGN DATA</b>
Groffdale (90)	Circular, Site Cast Concrete	National 4/30/90	Attached
Groffdale (91)	Circular, Site Cast Concrete	National 7/1/93	Attached
Groffdale (91CMT)	Circular, Site Cast Concrete	National 7/1/93	Attached
Groffdale (92KW)	Circular, Site Cast Concrete	National 5/10/94	Attached
Keystone Concrete Products	Precast Concrete Members	National 7/1/93	Attached
Lancaster	Circular, Site Cast Concrete	National 9/1/95	Attached
Lanco	Circular, Site Cast Concrete	National 9/1/95	Attached
Lanco	Circular, Uneven Backfill	National 7/12/95	Attached
Midwest Plan Service (TR-9)	Circular, Site Cast Concrete	National 9/5/89	Attached
Midwest Plan Service (74303)	Rectangular, Site Cast Concrete	National 1/84	None
Northern Star Silo	Circular, Site Cast Concrete	National 1/84	None
Patz	Circular, Site Cast Concrete	National 9/1/95	Attached
Precise Concrete Walls	Circular, Site Cast Concrete	National 7/1/93	Attached
Precise Concrete Walls	Circular, Site Cast Concrete	National 8/25/94	Attached
Ribcast	Circular, Precast Concrete	National 10/12/84	Attached
Slurrystore Systems - Series (90)	Circular, Glass Fused Steel	National 7/1/93, 12/8/93	Attached
Sollenberger Silos (MT)	Circular, Site Cast Concrete	National 7/1/93	Attached

VENDOR	DESCRIPTION	DATE APPROVED	DESIGN DATA
Sollenberger Silos (MT-UB)	Circular, Site Cast Concrete	National 7/1/93	Attached
Weaver	Rectangular, Precast Concrete	National 1/84	None



## **SECTION III**

### **Data Sheets for Standard Detail Drawings (Prequalified Designs) Receiving Concurrence for Use in Maryland**

**Keystone Concrete, Inc. (E056-06) 60' storage span utilizing pre cast concrete wall panels with post frame walls and trusses.**

- Designer: Timothy Royer, PE.  
Timber Tech Engineering  
22 Denver Road  
Denver, PA 17517  
717-335-2750
- Fabricators: Keystone Concrete, Inc.  
477 E. Farmville Road  
New Holland, PA 17557  
717-335-2750
- Drawings: Product Number E056-06 cover plus sheets 1 thru 5 dated 3/29/06
- Location: Plans have been reviewed by the USDA, Natural Resources Conservation Service in Maryland for compliance with the structural aspects of Maryland Conservation Practice standard for Waste Storage Facility, code 313. Drawings are on file at the Natural Resources Conservation Service State Office in Annapolis, Maryland. Reviews were completed in December 2008.
- Materials: Precast concrete wall panels 8' high with a 4' concrete footing with 5,000 psi concrete. Post frame walls and trusses are mounted on top of the pre cast wall panels.
- Sizes: Building spans are 60' wide and less. Interior clearance is 16' or less.
- Applications: Maryland Conservation Practice Standard for Waste Storage Facility, code 313 with equivalent fluid pressure of 45 pcf.
- Assumptions: Minimum required soil bearing capacity is 3,000 psf. Backfill can vary from 2.5 feet to 6 feet. Roof designed as per IBC 2003 with 10 psf dead load and 30 psf roof live load, 30 psf ground snow load, and 90 mph wind speed.
- Concurrence: The State Conservation Engineer concurs in the use of these precast concrete panels.

## **COVERALL Building Systems**

- Designer: Mason Dixon Cover All Inc. 888-289-4213  
Danielle Evans  
325 Rentzel Road  
Gettysburg, PA 17325
- Support Structure  
Prepared by  
EA Engineering, Science and Technology  
For NRCS Maryland  
15 Loveton Circle  
Sparks, MD 21152
- Fabricators: COVERALL Building Systems - Roof  
Support Structures - Others
- Drawings: #05402201 40' wide model 220 TAS Page 1 - 5, issued 6/22/98, revised 6/24/98  
approved 6/25/98
- Support Structure  
Footing, slab, and wall design #A-1, S-1, S-2  
Approved 2/25/08
- Location: Plans have been reviewed by USDA, Natural Resources Conservation Service in Maryland for compliance with the structural aspects of Conservation Standard 313. Drawings are on file at the Maryland Natural Resources Conservation Service State Office in Annapolis. Reviews were completed in February 2008.
- Material: The roof structure consists of a truss arch fabric covered steel frame. The support structure consists of site cast concrete. All reinforcing steel is Grade 60.
- Sizes: Wall height is 4 feet with a 40' span and varying lengths in 14' increments.
- Application: National Conservation Practice 313-95
- Assumptions: Walls are designed for 0 to 3' back fill with no surcharge. Maximum roof snow load is 30 psf with a basic wind speed = 90 M.P.H. exposed to the wind. Foundation design based on allowable soil bearing pressure of 2000 psf.
- Concurrence: The State Conservation Engineer concurs in the use of this structure.

**Sollenberger Silos Corp. 8'6" high by 7'6" wide precast concrete containment panels for manure storage**

Designer: Sollenberger Silos Corp. Nitterhouse Concrete Products  
2294 Molly Pitcher Highway South 2655 Molly Pitcher Highway South  
Chambersburg, PA 17201-9202 Chambersburg, PA 17201  
717-264-9588 717-264-6154

Fabricators: Sollenberger Silos Corp.  
2294 Molly Pitcher Highway South  
Chambersburg, PA 17201  
717-264-9588

Drawings: Product Number 0773, pages 1-5 issued 2/11/98

Location: Plans have been reviewed by the USDA, Natural Resources Conservation Service in Maryland for compliance with the structural aspects of Maryland Conservation Practice standard for Waste Storage Facility, code 313. Drawings are on file at the Natural Resources Conservation Service State Office in Annapolis, Maryland. Reviews were completed in August of 2002.

Materials: Precast concrete wall panels.

Sizes: Precast concrete wall panels are 8'6" high by 7'6" wide.  
Precast concrete corner panels are 8'6" high by 4' wide.

Applications: Maryland Conservation Practice Standard for Waste Storage Facility, code 313.

Assumptions: Minimum 4-inch cast-in-place concrete floor at base of panel

Minimum soil bearing capacity of 2000 psf

Maximum Backfill 6'6" with maximum 250 psf surcharge on wall. 7'3" with maximum 100 psf surcharge on wall.

Minimum Backfill 4'6" (Liquid Manure)

2'6" (Stackable manure with bedding, must be protected from saturation and manure will not be stacked higher than top of precast wall).

Backfill Material Backfill material consists of a granular material with a unit weight of 120 pct.

**Equipment Access Areas**

Maximum Backfill Backfill height may be increased to the top of wall with maximum 100 psf surcharge on wall. Wall must be used in conjunction with the cast-in-place concrete bridge slab for equipment access drawing #SSC-92-MT-UB-7.

Backfill Material Wall requires backfill of clean well-graded gravel. (MSHA #57)

Concurrence: The State Conservation Engineer concurs in the use of these precast concrete panels.

## COVERALL Building Systems

Designer: COVERALL Building Systems 800-877-2208  
J.D. Sauer Corporation  
166 Lone Pine Road  
Edinburg, VA 22824

Support Structure  
CAD-CON Consulting, Inc. 703-392-5141  
10706 Vandor Lane  
Manassas, VA 20109

Fabricators: COVERALL Building Systems - Cover  
Support Structures - Others

Drawing: #05402201 40' wide model 220 TAS  
Page 1 - 5, issued 6/22/98, revised 6/24/98 approved 6/25/98

Support Structure  
Footing, slab, and wall design #S-1  
Page 1, issued 9/1/98, last revision 2/4/99  
Approved 2/4/99

Location: Plans have been reviewed by USDA, Natural Resources Conservation Service in Maryland for compliance with the structural aspects of Conservation Standard 313. Drawings are on file at the Maryland Natural Resources Conservation Service State Office in Annapolis. Reviews were completed in February 1999.

Material: The roof structure consists of a truss arch fabric covered steel frame. The support structure consists of site cast Class 3500 concrete. All reinforcing steel is Grade 60.

Sizes: Wall height is 4 feet with a 40' span and lengths varying from 40' to 120' in 10' increments.

Application: National Conservation Practice 313-95

Assumptions: Walls are designed for 0 to 3' back fill with no surcharge. Maximum roof snow load is 30 psf with a basic wind speed = 90 M.P.H. exposed to the wind. Foundation design based on allowable soil bearing pressure of 2000 psf.

Concurrence: The State Conservation Engineer concurs in the use of this structure.

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AWMFH Change Notice 2

February 1999

**CHIC-ALL-GO**  
**Compost Crib**

Designers: Foresees, Inc.  
1525 Airport Road  
Hot Springs, AR 71913

Distributor: Aline Supply  
R.D. 2, Box 289 (Rt. 35)  
Mt. Pleasant Mills, PA 17853

Drawings: 5206169-1 thru -3

All drawings are dated 9-94

Location: Drawings on file at the Maryland State Office

Materials: A wooden single-stage, layered, open-air composting crib with plastic mesh side walls. Roof is a fiberglass-reinforced greenhouse plastic with UV inhibitor. All lumber is 40-year ground contact pressure-treated and all hardware is zinc and hot-dipped galvanized.

Size: All concrete is 3000 psi. and shall be 4" thick with 6"x 6", 10 gage x 10 gage. welded wire fabric reinforcement. All concrete shall have an underlayment of polyethylene sheeting of at least 4 mil thickness.

Application: National Conservation Practice Standard 313-80 for 15-year service life.

Assumptions: Solar roof is to be pitch-oriented to the south. Recommend placement of composters as close as possible to poultry house doors.

Concurrence: The State Conservation Engineer concurs in the use of this composter.

**ABETONG Circular Precast Post-Tensioned Concrete**  
**Waste Storage Structures**

- Designers: Michael Malsom, P.E.  
The Consulting Engineers Group, Inc.  
1701 E. Lake Avenue  
Glenview, IL 60025 (312) 729-0646
- Owners: Abetong America Incorporated  
P.O. Box 1943  
North Brunswick, NJ 08902 (201) 294-8943
- Fabricator: Sollenberger Silos Corporation  
2294 Molly Pitcher Highway South  
Chambersburg, PA 17201 (717) 264-9588
- Drawings: SK1 General Tank and Fndn Requirements 6/8/88  
SK2 Tank Fndn and Fndn Curb 6/8/88  
SK3 Tank Approach Slab 6/8/88  
SK4 Fndn Pit Details at Large Pipes  
SK5 Post-Tensioning Details  
SK6 Backfill and Drainage Details  
SK7 Interior Pump Pit Details
- Sizes: The structures are multiples of nominal metric size panels. Resulting structures sizes include:  
13 ft. 1.5 in. or 12 ft. high - 24.3 ft. thru 74.1 ft. diameters  
12 ft. high only - 76.5 ft. thru 90.8 ft. diameters  
8 ft. high - 24.3 ft. thru 90.8 ft. diameters
- Location: Plans have been reviewed by the NNTC for compliance with the structural aspects of National Conservation Practice Standard 313-80. Design folders are on file at the NNTC. Initial reviews were completed in July 1988.
- Materials: Wall panels are precast ribbed panels with Class 5000 concrete and Grade 60 steel. Floor slab is site cast, Class 3000 concrete with Grade 60 reinforcing. All wall panel joints are grouted with cement mortar before post tensioning. The post-tensioning strands are low relaxation, seven wire strands with an fPU of 270 ksi, and are covered with cement mortar after post tensioning.
- Application: National Conservation Practice Standard 313-80. The Standard does not list a service life for prestressed concrete, but we would estimate a Long (50 year) service life since the concrete will be in compression at service loads.
- Assumptions: Walls are designed for a full backfill, tank empty condition, and a tank full, no backfill condition as shown on the plans. Lateral earth pressure of 60 pcf and lateral wheel surcharge loads of 100 psf are assumed. A maximum allowable backfill height differential of 3 ft. is noted on the plans.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of this detail drawing.

**ABETONG (SOL) Circular Concrete, Post-Tensioned, Precast  
Waste Storage Structures**

- Designers: Michael Malsom, P.E. John Jones, P.E.  
The Consulting Engr. Group Sollenberger Silos  
1701 E. Lake Avenue P.O. Box N  
Glenview, IL 60025 Chambersburg, PA  
(312) 729-0646 (717) 264-9588
- Owners: Abetong American Incorporated  
P.O. Box 1943  
North Brunswick, NJ 08902 (201) 294-8943
- Fabricator: Sollenberger Silos Corporation  
2294 Molly Pitcher Highway South  
Chambersburg, PA 17201 (717) 264-9588
- Drawings: SK1 General Tank and Fndn Requirements 6/8/88  
SK2A Tank Fndn and Fndn Curb rev. 11/2/90  
SK3 Tank Approach Slab 6/8/88  
SK4 Fndn Pit Details at Large Pipes  
SK5 Post-Tensioning Details rev. 12/13/90  
SK6 Backfill and Drainage Details  
SK7 Interior Pump Pit Details  
Specifications rev. 12/13/90
- Sizes: The structures are multiples of nominal metric size panels. Resulting structures sizes include:  
13 ft. 1.5 in. high - 24.3 ft. thru 74.1 ft. diameters  
12 ft. high - 76.5 ft. thru 90.8 ft. diameters  
8 ft. high - 24.3 ft. thru 90.8 ft. diameters
- Location: Plans have been reviewed by the NNTC for compliance with the structural aspects of National Conservation Practice Standard 313-80. Design folders on file at the NNT were originally reviewed in July 1988. Revisions reviewed in January 1991.
- Materials: Wall panels are precast ribbed panels with Class 5000 concrete and Grade 60 steel. Floor slab is site cast, Class 3000 concrete with Grade 60 reinforcing. All wall panel joints are grouted with cement mortar before post tensioning. The post-tensioning strands are low relaxation, seven wire strands with an fPU of 270 ksi.
- Application: National Conservation Practice Standard 313-80. The Standard does not list a service life for prestressed concrete, but we would estimate a Long (50 year) service life since the concrete will be in compression at service loads.
- Assumptions: Walls are designed for a full backfill, tank empty condition, and a tank full, no backfill condition as shown on the plans. Lateral earth pressure of 60 pcf and lateral wheel surcharge loads of 100 psf are assumed. A maximum allowable backfill height differential of 3 ft. is noted on the plans.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of this detail drawing.



## **BRAD BEAVER, Circular, Site Cast Concrete, Waste Storage Structures**

- Designer: Norton & Schmidt, Consulting Engineers  
1100 Main St., Suite 419  
City Center Square  
Kansas City, MO 64105 (816) 421-4232
- Fabricator: Brad Beaver Poured Concrete Walls  
5022 Burkholder Road  
Chambersburg, PA 17201 (717) 264-9186
- Drawings: Sheets BE8CT1 thru BE8CT9, BE10CT1 thru BE10CT9 and BE12CT1 thru BE12CT9 for tanks with walls 8, 10 & 12 feet high with tank diameters for each wall height ranging from 40 to 100 feet in 20-foot increments.
- Location: Calculations and drawings have been reviewed by the NNTC and the PA state office for compliance with SCS Practice Standard 313. Design folders are on file at both reviewing locations. The reviews were completed in September 1992.
- Materials: Reinforced concrete footings, floor, walls and access pads contain Class 4000 concrete and Grade 60 steel.
- Sizes: 40 to 100 ft. diameters. in 20-ft. increments. 8, 10 & 12 ft. high walls. 7 in. thick walls for 8 ft. walls, 8 in. thick walls for 10 ft. walls and 9 in. thick walls for 12 ft. walls.
- Application: SCS Practice Standard 313 for med. (20 yr.) service life.
- Assumptions: Allowable soil bearing capacity for footings. 1500 psf. Walls designed according to PCA "Circular Concrete. Tanks Without Prestressing" for hinged base connection and tank full, no backfill condition. Walls are also adequate for full backfill, tank empty condition. Height of backfill against tank walls shall not vary more than 4 ft. Minimum backfill of 4 ft. is provided to assure frost protection for footing. A drainage system under and around structure base with a pipe outlet is provided. Allowable equipment for the walls and access pad are given in the General Notes.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these Standard Detailed Drawings.

## **ENERGY-PAK Circular, Site Cast Concrete, Waste Storage Structures**

- Designers: Stephen B. Clarke and Associates  
Rd #2 Baden  
Ontario, Canada  
(519) 634-8453
- Fabricators: Sollenberger Silos  
2294 Molly Pitcher Highway South  
Chambersburg, PA 17201 (717) 264-9588
- Drawings: C1025-1A,1B Revision 3 dated 2-1-86 (specs)  
C1025-2 Revision 1 dated 8-10-85 (footing)  
C1025-3,4 Revision 1 dated 3-27-84  
C1025-6,7,8 Revised 2-82  
C1025-9,10,11,12 dated 2-10-82  
C1025-13,17,21 Revision 2 dated 3-27-84  
C1025-14,15,16,18,19,20 dated 2-82  
C1025-22,23-24,25,26 dated 12-84  
C1025-28 Revision 1 dated 2-21-86 (ramp)  
C1025-29 dated 3-86 (sump pit)
- Location: Plans have been reviewed in detail by NNTC for compliance with structural aspects of National Conservation Practice Standard 313-80. Design data is on file at the NNTC. Reviews of revisions were completed in April 1986.
- Material: The circular structure consists of site cast Class 4000 psi concrete with Grade 60 steel.
- Sizes: Heights of 6, 8, 12, 16, 20, 24 ft. and 30 thru 140 ft. diameters. Walls thicknesses vary from 6 to 8 inches.
- Application: National Conservation Practice Standard 313-80 for chart (10 year) service life.
- Assumptions: Footings are designed for an allowable soil bearing capacity of 3000 psf. Walls are designed according to PCA "Circular Concrete Tanks Without Prestressing" for a hinged base connection and tank full, no backfill condition. Walls are also adequate for full backfill, tank empty condition. Backfill is assumed to be uniform depth plus or minus 2 ft. around the perimeter of the tank. Placement of the tank above the seasonal high water table is also assumed.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detailed drawings.

## **GROFFDALE (89) Circular, Site Cast Concrete, Waste Storage Structures**

- Designers: Norton & Schmidt Consulting Engineers, Inc.  
1009 Baltimore 8<sup>th</sup> Fl  
Kansas City, MO 64105 (816) 421-4232
- Fabricators: Groffdale Concrete Walls, Inc.  
430 Concrete Avenue  
Leola, PA 17540 (717) 656-2016
- Drawings: GCW-NS-89 shts 1-3 dated 8-31-89 (dimensions)  
GCW-NS-89 shts 4-5 dated 11-30-89 (chimney)  
GCW-NS-89 sht 6 dated 8-31-89 (pipe opening)  
GCW-NS-89 sht 7 dated 11-30-89 (access pad)  
GCW-NS-89 sht 8 dated 8-31-89 (general notes)  
GCW-NS-89 shts 9-20 dated 8-21-89 (wall steel)
- Location: Plans were reviewed in April 1990 by NNTC for compliance with structural aspects of National Conservation Practice Standard 313-80. Design data is on file at the NNTC.
- Material: The structure contains site cast Class 3000 concrete in the floor slab and Class 3500 in the walls. All reinforcing steel is Grade 60.
- Sizes: Heights of 8, 10, 12 ft. and 50 thru 100 ft. diameters. Walls are 7 in. thick for the 8 ft. high walls and 9 in. thick for the other walls.
- Application: National Conservation Practice Standard 313-80 for medium (20 year) service life.
- Assumptions: Footings assume an allowable soil bearing capacity of 1500 psf. Walls are designed according to PCA "Circular Concrete Tanks Without Prestressing" for a hinged base connection and tank full, no backfill condition. Walls are also adequate for full backfill, tank empty condition. Backfill is assumed to be uniform depth plus or minus 2 ft. around the perimeter of the tank. Minimum backfill to assure frost protection of the footing should be provided. A drainage system behind the walls and under the floor with a tile outlet is provided on the drawings. Walls are adequate for an adjacent wheel load of 15 kips when structural modifications are made as detailed in the General Notes. Walls are adequate for larger adjacent wheel loads when an access pad is constructed as detailed in the Drawings.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detailed drawings.

## **GROFFDALE (89UN) Circular, Site Cast Concrete, Waste Storage Structures**

- Designers: Norton & Schmidt Consulting Engineers, Inc.  
1009 Baltimore 8<sup>th</sup> Fl  
Kansas City, MO 64105 (816) 421-4232
- Fabricators: Groffdale Concrete Walls, Inc.  
430 Concrete Avenue  
Leola, PA 17540 (717) 656-2016
- Drawings: GCW-NS-89UN shts 1-5 dated 12-5-89 (dimensions)  
GCW-NS-89UN sht 6 dated 12-5-89 (pipe opening)  
GCW-NS-89UN sht 7 dated 12-5-89 (access pad)  
GCW-NS-89UN sht 8 dated 12-5-89 (general notes)  
GCW-NS-89UN shts 9-20 dated 12-5-89 (wall steel)
- Location: Plans were reviewed in April 1990 by NNTC for compliance with structural aspects of National Conservation Practice Standard 313-80. Design data is on file at the NNTC.
- Material: The structure contains site cast Class 3000 concrete in the floor slab and Class 3500 in the walls. All reinforcing steel is Grade 60.
- Sizes: Heights of 8, 10, 12 ft. and 50 thru 100 ft. diameters. Walls are 7 in. thick for the 8 ft. high walls and 9 in. thick for the other walls.
- Application: National Conservation Practice Standard 313-80 for medium (20 year) service life.
- Assumptions: Footings assume an allowable soil bearing capacity of 1500 psf. Walls are designed according to PCA "Circular Concrete Tanks Without Prestressing" for a hinged base connection and tank full, no backfill condition. Walls are also designed with Finite Element Methods for a tank empty, backfill sloping from full wall height uphill to 4 ft. minimum height downhill condition. Walls are also adequate for all uniformly level or sloping backfill conditions between these limits. A drainage system behind the walls and under the floor with a tile outlet is provided on the drawings. Walls are adequate for a wheel load of 15 kips adjacent to the tank when structural modifications are made as detailed in the General Notes. Walls are adequate for larger wheel loads when an access pad is constructed as detailed in the Drawings.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detailed drawings.

## **GROFFDALE (90) Circular, Site Cast Concrete, Waste Storage Structures**

- Designers: Norton & Schmidt Consulting Engineers, Inc.  
1009 Baltimore 8<sup>th</sup> Fl  
Kansas City, MO 64105 (816) 421-4232
- Fabricators: Groffdale Concrete Walls, Inc.  
430 Concrete Avenue  
Leola, PA 17540 (717) 656-2016
- Drawings: GCW-NS-90 sht 1 dated 1-29-90 (plan view)  
GCW-NS-90 sht 2 revised 3-19-89 (wall section)  
GCW-NS-90 shts 3-4 dated 1-29-90 (chimney)  
GCW-NS-90 sht 5 revised 3-19-90 (pipe opening)  
GCW-NS-90 sht 6 dated 1-29-91 (access pad)  
GCW-NS-90 sht 7 revised 3-19-90 (general notes)  
GCW-NS-90 shts 8-13 dated 1-29-90 (wall steel)
- Location: Plans were reviewed in April 1990 by NNTC for compliance with structural aspects of National Conservation Practice Standard 313-80. Design data is on file at the NNTC.
- Material: The structure contains site cast Class 3000 concrete in the floor slab and Class 3500 in the walls. All reinforcing steel is Grade 60.
- Sizes: Wall height of 16 ft. and thickness of 9 in. for 70 thru 120 ft. diameters.
- Application: National Conservation Practice Standard 313-80 for medium (20 year) service life.
- Assumptions: Footings assume an allowable soil bearing capacity of 2000 psf. Walls are designed according to PCA "Circular Concrete Tanks Without Prestressing" for a hinged base connection and tank full, no backfill condition. Walls are also adequate for full backfill, structure empty condition. Backfill is assumed to be uniform depth plus or minus 2 ft. around the perimeter of the structure. Minimum backfill of 4 ft. is provided to assure frost protection of the footing. A drainage system behind the walls and under the floor with a tile outlet is provided on the drawings. Walls are adequate for an adjacent wheel load of 15 kips when structural modifications are made as detailed in the General Notes. Walls are adequate for larger adjacent wheel loads when an access pad is provided as shown on the Drawings.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detailed drawings.

## **GROFFDALE (91) Circular, Site Cast Concrete, Waste Storage Structures**

- Designers: Norton & Schmidt Consulting Engineers, Inc.  
1009 Baltimore 8<sup>th</sup> Fl  
Kansas City, MO 64105 (816) 421-4232
- Fabricators: Groffdale Concrete Walls, Inc.  
430 Concrete Avenue  
Leola, PA 17540 (717) 656-2016
- Drawings: GCW-NS-91 sht 1 dated 2-11-91 (tank plan view)  
GCW-NS-91 sht 2 dated 2-11-91 (wall section)  
GCW-NS-91 shts 3-4 dated 2-11-91 (chimney)  
GCW-NS-91 sht 5 dated 2-11-91 (pipe opening)  
GCW-NS-91 sht 6 dated 2-11-91 (access pad)  
GCW-NS-91 sht 7 dated 2-11-91 (general notes)  
GCW-NS-91 shts 8-9 dated 2-11-91 (wall steel)
- Location: Plans were reviewed in March 1991 by NNTC for compliance with structural aspects of National Conservation Practice Standard 313-80. Design data is on file at the NNTC.
- Material: The structure contains site cast Class 3000 concrete in the floor slab and Class 3500 in the walls. All reinforcing steel is Grade 60.
- Sizes: Wall height of 16 ft. and thickness of 9 in. for 130 and 140 ft. diameters.
- Application: National Conservation Practice Standard 313-80 for medium (20 year) service life.
- Assumptions: Footings assume an allowable soil bearing capacity of 2000 psf. Walls are designed according to PCA "Circular Concrete Tanks Without Prestressing" for a hinged base connection and tank full, no backfill condition. Walls are also adequate for full backfill, tank empty condition. Backfill is assumed to be uniform depth plus or minus 2 ft. around the perimeter of the tank. Minimum backfill of 4 ft. is provided to assure frost protection of the footing. A drainage system behind the walls and under the floor with a tile outlet is provided on the drawings. Walls are adequate for an adjacent wheel load of 15 kips when structural modifications are made as detailed in the General Notes. Walls are adequate for larger adjacent wheel loads when an access pad is provided as shown on the Drawings.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detailed drawings.

## **GROFFDALE (91CMT) Circular, Site Cast Concrete, Waste Storage Structures**

- Designers: Norton & Schmidt Consulting Engineers, Inc.  
1100 Main, Suite 419  
City Center Square  
Kansas City, MO 64105 (816) 421-4232
- Fabricators: Groffdale Concrete Walls, Inc.  
430 Concrete Avenue  
Leola, PA 17540 (717) 656-2016
- Drawings: GCW-NS-91CMT8 Sheets 1 thru 12, 8 foot high walls  
GCW-NS-91CMT10 Sheets 1 thru 14, 10 ft. high walls  
GCW-NS-91CMT12 Sheets 1 thru 17, 12 ft. high walls  
All drawings revised 6/92.
- Location: Calculations and drawings have been reviewed by the NNTC and the PA State Office for compliance with the structural aspects of National Conservation Practice Standard 313-80. Design folders are on file at both reviewing locations. The reviews were completed in September 1992.
- Materials: All site cast concrete is Class 4000. All reinforcing steel is Grade 60. All structural steel is A36.
- Sizes (ft.): Diameters range from 50 to 140 feet in 10-foot increments. Heights range from 8 to 12 feet.
- Application: National Conservation Practice Standard 313-80 for medium (20 year) service life.
- Assumptions: The allowable soil bearing capacity for the footings is 1500 psi. Walls are designed according to PCA "Circular Concrete Tanks Without Prestressing" for a hinged base connection and tank full, no backfill condition. Walls are also adequate for full backfill, tank empty condition. Backfill is assumed to be uniform depth plus or minus two feet around the perimeter of the tank. Minimum backfill of four feet is provided to assure frost protection of the footing. A drainage system behind the walls and under the floor with a pipe outlet is provided. Walls are adequate for an adjacent wheel load of 15 kips when structural modifications are made as explained in the General Notes. Walls are adequate for larger adjacent wheel loads when an access pad is provided.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detail drawings.

## **GROFFDALE (92KW) Circular, Site Cast Concrete, Waste Storage Structures**

- Designers: Norton & Schmidt Consulting Engineers, Inc.  
1100 Main, Suite 419  
City Center Square  
Kansas City, MO 64105 (816) 421-4232
- Fabricators: Groffdale Concrete Walls, Inc.  
430 Concrete Avenue  
Leola, PA 17540 (717) 656-2016
- Drawings: GCW-NS-92KW (8,10&12) Sh.1 Tank Plan View  
GCW-NS-92KW (8,10&12) Sh. 2 Typ. Tank Wall Sec.  
GCW-NS-92KW (8,10&12) Sh. 3 Interior Chimney  
GCW-NS-92KW (8,10&12) Sh.4 Exterior Chimney  
GCW-NS-92KW (8,10&12) Sh.5 Pipe Opening Detail  
GCW-NS-92KW (8,10&12) Sh.6 Equip. Access Pad & Curb  
GCW-NS-92KW (8,10&12) Sh.7 Kicker Wall Section  
GCW-NS-92KW (8,10&12) Sh.8&9 Tank Plan & Elev. Views  
GCW-NS-92KW (8,10&12) Sh.10 General Notes  
GCW-NS-92KW8 Sh.11 thru 15 Reinforcing Tables  
GCW-NS-92KW10 Sh.11 thru 17 Reinforcing Tables  
GCW-NS-92KW12 Sh.11 thru 20 Reinforcing Tables
- Location: Calculations and drawings have been reviewed by the NNTC and the PA state office for compliance with National Conservation Practice Standard 313. Design folders are on file at both reviewing locations. Reviews were completed in November 1993.
- Materials: All site cast concrete is Class 4000. All reinforcing steel is Grade 60.
- Sizes: Diameters range from 50 to 140 ft. in 10-ft. increments. Heights range from 8 to 12 ft.
- Application: National Conservation Practice Standard 313 for medium (20 year) service life.
- Assumptions: The allowable soil bearing capacity for the footing is 1500 psi. Walls are designed according to PCA "Circular Concrete Tanks Without Prestressing" for a hinged base connection and tank full, no backfill condition. Walls are also adequate for full backfill, tank empty condition. Backfill is assumed to be of uniform depth +/-2' around the perimeter of the tank. Min. backfill of 4' is provided to assure frost protection of the footing. A drainage system behind the walls and under the floor with a pipe outlet is provided. Walls are adequate for an adjacent wheel load of 15K when structural modifications are made as explained in the General Notes. Walls are adequate for larger adjacent wheel loads when an access pad is provided.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detailed drawings.



**KEYSTONE CONCRETE PRODUCTS Precast Concrete Members for Waste Storage Structures**

- Designer: Christopher T. Haffner, PE  
Norton & Schmidt, Consulting Engineers  
1009 Baltimore, 8<sup>th</sup> Floor  
Kansas City, MO 64105 (816) 421-4232
- Fabricator: Keystone Concrete Products  
477 East Farmersville Road  
New Holland, PA 17557
- Drawings: Job #900013 (March 3, 1992)
- Location: Calculations and drawings have been reviewed by the NNTC for compliance with the structural aspects of Nat. Cons. Practice Standard 313-80. Design folders are on file at the NNTC. The reviews were completed in April 1992.
- Materials: Precast reinforced. conc. members including gang slat panels, beams, columns, and lintels. Panels contain Class 8000 concrete. Beams, columns, and lintels contain Class 5000 concrete. Steel is Grade 60 steel except Grade 40 for stirrups and ties. Includes coil bolts and neoprene pads.
- Sizes (ft.): 4' wide panels 8', 10', and 12' long. 10" x 15-5/8" beams up to 24' long. 10" x 15-1/2" and 6" x 6" columns up to 11' long. 8" x 10" lintels up to 13' long.
- Application: National Conservation Practice Standard 313-80 for Medium (20 year) service life except 10 year life for lintels.
- Assumptions: 150 psf live load for the gang slat panels. 3 klf total load for the beams. 1 klf total load for the lintels. 23.4 k axial load for the 10" x 15-1/2" columns. 39 k axial load for the 6" x 6" columns. The design assumes self-supporting walls by others. Column footings capable of supporting 39 k are required.
- In addition to the multiple spans shown by the drawings, structures may also be constructed using single span gang slats with the end so the gang slats supported by compatible structure sidewalls. For such structures, 1) the axial load on the gang slat panels is limited to 9 klf, 2) the required restraint (if any) at the top of the sidewalls is not to exceed 9 klf, and 3) structure endwalls are designed so that restraint from the gang slat panels is not required at the endwalls.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these standard detail drawings when the components are used with multiple span structures whose drawings have NNTC concurrence and that a) have self-supporting walls as shown drawing sheet 2 of 8 and b) have footings adequate for the loading shown. Concurrence is also provided when components are used in single gang slat structures meeting the conditions outlined above.

**LANCASTER Concrete Walls, Site Cast, Circular,  
Waste Storage Structures**

- Designer: Robert D. Hyland, PE  
Norton & Schmidt, Consulting Engineers  
1100 Main Street, Suite 419  
Kansas City, MO 64105 (816) 421-4232
- Fabricator: LANCASTER Concrete Walls  
2008 Horseshoe Road  
Lancaster, PA 17601  
(717) 299-3721
- Drawings: LR8CT1 through LR8CT11 For eight-foot walls.  
LR10CT1 through LR10CT11 For ten-foot walls.  
LR12CT1 through LR12CT11 For twelve-foot walls.  
LR16CT1 through LR16CT11 For sixteen-foot walls.
- Location: Calculations and drawings have been reviewed for compliance with National Conservation Practice Standard 313-80. Design folders are on file at the PA state office and the NNTC. The review was completed in May 1995.
- Materials: Reinforced concrete footings, floor slabs, walls and access pads require Grade 60 steel with Class 4000 air entrained concrete.
- Sizes: Diameters: 50 to 100 feet in 10-foot increments.  
Walls: Wall height varies from 8 feet to 16 feet.
- Application: National Conservation Practice Standard 313-80 for medium (20 year) service life.
- Assumptions: Walls are designed for full backfill with a maximum 4-foot variation in backfill height with the structure empty and structure full and for no backfill conditions. Lateral earth pressure of 45 psf with a 100 psf surcharge is assumed. The access pads, proportioned to eliminate lateral surcharge loads on the walls, are designed for 2 wheel loads of 7.5 kips each. Minimum required soil bearing capacities are 1.0 ksf for floor slabs and 2.0 ksf plus 110 psf multiplied by the depth below grade in feet for the footings. Backfill for frost protection of the footings is required. Design assumes a foundation drain as shown on the drawings. Structure diameters between those shown may be used provided the reinforcing steel for the next larger diameter is used.
- Concurrence: The Acting Head of the NNTC Engineering Staff concurs in the use of these detail drawings.

**LANCO Concrete Walls, Site Cast, Uneven Backfill Circular,  
Waste Storage Structures**

- Designer: Robert D. Hyland, PE  
Norton & Schmidt, Consulting Engineers  
1100 Main Street, Suite 419  
Kansas City, MO 64105 (816) 421-4232
- Fabricator: LANCO Concrete Walls  
346 Beechdale Road  
Bird-in-Hand, PA 17505 (717) 291-4585
- Drawings: LA12UN1 through LA12UN10 (Dated 4/4/95) for 12-ft. walls.
- Location: Calculations and drawings have been reviewed for compliance with National Conservation Practice Standard 313-80. Design folders are on file at the PA state office and the NNTC. The review was originally completed in July 1995.
- Materials: Reinforced concrete footings, floor slabs, walls and access pads require Grade 60 steel with Class 4000 air entrained concrete.
- Sizes: Diameters: 50 to 100 feet in 10-foot increments.  
Walls: 12 ft. high by 9 in. thick.
- Application: National Conservation Practice Standard 313-80 for medium (20 yr.) service life.
- Assumptions: Walls are designed for full backfill, structure empty and structure full, no backfill conditions. Lateral earth pressure of 45 psf with a 100 psf surcharge is assumed. The access pads, proportioned to eliminate lateral surcharge loads on the walls, are designed for 2 wheels of 7.5 k each. The access pads can be eliminated for certain equipment loads if additional wall reinforcement is provided. Minimum required soil bearing capacities are 1.0 ksf, floor slabs and 2.0 ksf plus 110 psf multiplied by the depth below grade in feet for the footings. Backfill for frost protection of the footings is required. Design assumes a foundation drain as shown on the drawings. Height of backfill against the structure walls shall not vary more than 10 ft. Structure diameters between those shown may be used provided the reinforcing steel for the next larger diameter is used.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detail drawings.

**LANCO Concrete Walls, Site Cast, Circular,  
Waste Storage Structures**

- Designer: Robert D. Hyland, PE  
Norton & Schmidt, Consulting Engineers  
1100 Main Street, Suite 419  
Kansas City, MO 64105 (816) 421-4232
- Fabricator: LANCO Concrete Walls  
346 Beechdale Road  
Bird-in-Hand, PA 17505 (717) 291-4585
- Drawings: LA8CT1 through LA8CT11 (Dated 6/12/94) for 8-ft. walls.  
LA10CT1 through LA10CT11 (Dated 6/12/94) for 10-ft. walls.  
LA12CT1 through LA12CT12 (Dated 6/12/94) for 12-ft. walls.  
LA16CT1 through LA16CT11 (Dated 6/12/94) for 16-ft. walls.
- Location: Calculations and drawings have been reviewed for compliance with National Conservation Practice Standard 313-80. Design folders are on file at the PA state office and the NNTC. The review was originally completed in July 1994.
- Materials: Reinforced concrete footings, floor slabs, walls and access pads require Grade 60 steel with Class 4000 air entrained concrete.
- Sizes: Diameters: 50 to 100 feet in 10-foot increments plus the 12-ft. walls have a 130-ft. diameter.
- Walls: 8 ft. high by 7 in. thick.  
10 ft. high by 8 in. thick.  
12 ft. high by 9 in. thick.  
16 ft. high by 10 in. thick.
- Application: National Conservation Practice Standard 313-80 for medium (20 yr.) service life.
- Assumptions: Walls are designed for full backfill, structure empty and structure full, no backfill conditions. Lateral earth pressure of 45 psf with a 100 psf surcharge is assumed. The access pads, proportioned to eliminate lateral surcharge loads on the walls, are designed for 2 wheels of 7.5 k each. The access pads can be eliminated for certain equipment loads if additional wall reinforcement is provided. Minimum required soil bearing capacities are 1.0 ksf, floor slabs and 2.0 ksf plus 110 psf multiplied by the depth below grade in feet for the footings. Backfill for frost protection of the footings is required. Design assumes a foundation drain as shown on the drawings. Height of backfill against the structure walls shall not vary more than 4 ft. Structure diameters between those shown may be used provided the reinforcing steel for the next larger diameter is used.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detail drawings.

**MIDWEST PLAN SERVICE Circular, Site Cast Concrete,  
Waste Storage Structures**

- Designers: Midwest Plan Service  
Agricultural Engineering Department  
Iowa State University  
Ames, IA 50011  
(515) 294-4337
- Drawings: TR-9 'Circular Concrete Manure Tanks' dated 11-83, Revised 1999.
- Location: Plans have been reviewed in detail by NNTC for compliance with structural aspects of National Conservation Practice Standard 313-80. Design data is on file at the NNTC. Reviews were completed in June 1989.
- Material: The circular structure consists of site cast Class 4000 psi concrete with Grade 60 steel.
- Sizes: Heights of 8, 10, 12, 14 ft. and 30, 60, 90, 120 ft. diameters. Walls thicknesses vary from 6 inches on the smaller tanks to 12 inches on the larger.
- Application: National Conservation Practice Standard 313-80 for medium (20 year) service life.
- Assumptions: The drawings state an allowable bearing capacity of 1 ksf for footings on the 8 and 10 ft. deep tanks, and 1.5 ksf for the 12 and 14 ft. deep tanks. The NNTC review analyzed the designs utilizing the stiffness methods published in PCA's "Circular Concrete Tanks Without Prestressing" for a hinged base connection and tank full, no backfill condition. The tanks are structurally adequate for this assumed condition, and are also adequate for a full non-uniform backfill, tank empty condition.
- Limitations: The drawings do not show any minimum backfill which would be necessary in cold areas to provide adequate frost depth to the bottom of the footings. The drawings do not show any drainage which would be necessary in areas below the seasonal groundwater table to relieve uplift pressures under the non-structural floor slab.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detailed drawings.

## **Patz Sales, Inc., Reinforced Concrete Ag Waste Storage Structures**

Owners: Patz Sales, Inc.  
917 Hwy 141 N.  
P.O. Box 7  
Pound, WI 54161-0007  
Telephone: (920) 897-2251

Designer: Milton A. Nero, P.E.  
DePere, WI

Drawings: Patz Solid Manure Storage Plans and Specifications for Construction of Concrete Holding Areas for Above-Ground Storage and Manure dated (as revised) May 1983 (document PA-2052 1.5M Rev. 5/83) consisting of 15 numbered sheets plus cover sheet.

1. Facilities for Storage and Handling of Manure
2. Planning Considerations
3. Manure Storage Area for Patz Model 400 44' Manure Stacker
4. Plan View
5. Wall Footing and Reinforcing Detail
6. Specifications
7. Manure Storage Area for Patz Model 400 54' Manure Stacker
8. Plan View
9. Wall Footing and Reinforcing Detail
10. Specifications
11. Manure Storage Area for Patz Model 400 60' Manure Stacker
12. Plan View
13. Wall Footing and Reinforcing Detail
14. Specifications
15. Alternate Wall Footing and Reinforcing Detail

Sizes: Torus section or "arc" shaped (in plan) above ground reinforced concrete storage facilities (for use with pivoting manure stacker) varying from 90' centerline length and 42' in width (44' Manure Stacker). Walls are 8" and 12" thick (12" where manure stacker shuttles on wall top) and vary in height from 3' to 8', and typically are backfilled to half-height.

Location: Design notes and plans have been reviewed by the MNTC for compliance with the structural aspects of Conservation Practice Standard 313-80. Design folders are on file at the MNTC.

Materials: Walls, footings and floors are site cast with Class 3000 concrete and Grade 60 steel.

**PRECISE CONCRETE WALLS (PCCT) Circular, Site Cast Concrete**  
**Waste Storage Structures**

- Designer: Robert D. Hyland, PE  
Norton & Schmidt, Consulting Engineers  
1100 Main Street, Suite 419  
Kansas City, MO 64105 (816) 421-4232
- Fabricator: Precise Concrete Walls  
601 Overly Grove Road  
New Holland, PA 17557 (717) 354-2780
- Drawings: PC8CT1 through PC8CT11 (Dated 4/19/91, revised 9/25/91 and 1/8/92) for 8 ft. wall.  
PC10CT1 through PC10CT11 (Dated 4/19/91, revised 9/25/91 and 1/8/92) for 10 ft. wall.  
PC12CT1 through PC12CT11 (Dated 10/24/90, revised 2/11/91 and 1/8/92) for 12 ft. wall.  
PC16CT1 through PC16CT11 (Dated 12/28/92) for 16 ft. wall.
- Location: Calculations and drawings have been reviewed for compliance with National Conservation Practice Standard 313-80. Design folders are on file at PA state office and NNTC. The most recent review was completed March 1993.
- Materials: Reinforced concrete footings, floor slabs, walls, and access pads require Grade 60 steel with Class 3000 air entrained concrete (12 ft. walls), Class 3500 air entrained concrete (8 & 10 ft. walls), and Class 4000 air entrained concrete (16 ft. walls).
- Sizes: Diameters: 50 to 100 ft. diameters in 10-foot increments.  
Walls: 8 ft. high by 7 in. thick;  
10 ft. high by 8 in. thick;  
12 ft. high by 9 in. thick;  
16 ft. high by 10 in. thick.
- Application: National Conservation Practice Standard 313-80 for Medium (20 year) service life.
- Assumptions: Walls are designed for a full backfill, structure empty and structure full, no backfill condition. Lateral earth pressure of 45 psf and 100 psf surcharge are assumed. The access pads, proportioned to eliminate lateral surcharge loads on the walls, are designed for 2 wheels of 7.5 k each. Minimum required soil bearing capacities are 1.0 ksf, floor slabs and 2.0 ksf plus 110 psf multiplied by the depth below grade in feet for the footings. Backfill for frost protection of the footings is required. Design assumes a foundation drain as shown on drawings. Height of backfill against the structure walls shall not vary more than 4 feet. Structure diameters between those shown may be used provided the reinforcing steel for the next larger diameter is used.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detail drawings.

**PRECISE Concrete Walls, Site Cast, Circular  
Waste Storage Structures**

- Designer: Robert D. Hyland, PE  
Norton & Schmidt, Consulting Engineers  
1100 Main Street, Suite 419  
Kansas City, MO 64105 (816) 421-4232
- Fabricator: PRECISE Concrete Walls  
601 Overly Road  
New Holland, PA 17557 (717) 354-2780
- Drawings: PC12UE1 Dated 3/24/94) Typical Wall Section & Plan View  
PC12UE2 (Rev. 8/25/94) Exterior Chimney and Access Pad  
PC12UE3 (Rev. 8/25/94) Reinforcement at Pipe Openings  
PC12UE4 (Rev. 8/25/94) General Notes  
PC12UE5 through PC12UE10 (Rev. 8/25/94) Reinforcing Tables
- Location: Calculations and drawings have been reviewed for compliance with National Conservation Practice Standard 313-80. Design folders are on file at the PA state office and the NNTC. The review was completed in August 1994.
- Materials: Reinforced concrete footings, floor slabs, walls and access pads require Grade 60 steel with Class 4000 air entrained concrete.
- Sizes: Diameters: 50 to 100 feet in 10-foot increments.  
Walls: Wall height for all diameters is 12 feet.
- Application: National Conservation Practice Standard 313-80 for medium (20 year) service life.
- Assumptions: Walls are designed for full and uneven backfill with a maximum 10-foot variation in backfill height with the structure empty and structure full and for no backfill conditions. Lateral earth pressure of 45 psf with a 100 psf surcharge is assumed. The access pads, proportioned to eliminate lateral surcharge loads on the walls, are designed for 2 wheel loads of 7.5 kips each. Minimum required soil bearing capacities are 1.0 ksf for floor slabs and 2.0 ksf plus 110 psf multiplied by the depth below grade in feet for the footings. Backfill for frost protection of the footings is required. Design assumes a foundation drain as shown on the drawings. Structure diameters between those shown may be used provided the reinforcing steel for the next larger diameter is used.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detail drawings.



## **RIBCAST Circular, Precast Concrete, Waste Storage Structures**

- Designer: Gerald L. Kilheffer, PA P.E. 31602E  
P.O. Box 152  
Brownstown, PA 17508
- Fabricators: Ribcast Systems Co.  
49 Wolf Road  
Akron, PA 17501  
(717) 859-3324
- Drawings: B-1000, B-2000, B-3000 dated 12-15-83
- Location: Plans have been reviewed in detail by NNTC for compliance with structural aspects of National Conservation Practice Standard 313-80. Design folders are on file at the NNTC. Reviews were completed in February 1984.
- Material: The circular structure consists of 8 ft. wide, 12 ft. high precast waffle panels with Class 5000 concrete and Grade 40 steel. Minimum concrete cover on principal steel is 3/4 inch. The panels are held together with galvanized Grade 60 silo hoops. The ring footing and articulated slab are site cast Class 3500 concrete. All joints contain a butyl seal.
- Sizes: 12 ft. high and 60 ft. diameter.
- Application: National Conservation Practice Standard 313-80 for Medium (20 year) service life.
- Assumptions: Design assumes a sliding base connection and considers a tank full, no backfill condition and a tank empty, 4 ft. high backfill condition. Backfill assumed is sandy silts and clays with 70 pcf EFP. A perimeter footing drain is also assumed. No wall surcharge loading is considered.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detail drawings.

**SLURRYSTORE SYSTEM (90 Series) Circular, Glass-Fused Steel,  
Waste Storage Structures**

Designer & Fabricator: Engineered Storage Products, Co.  
345 Harvestore Drive  
De Kalb, IL 60115 (815) 756-1551

Drawings & Sizes: Drawing numbers and nominal structure sizes are as follows:

Shell Assembly Drawing No.	Diameter (ft.)	Height (ft.)
2-261283	42	14, 19, 23 & 28
2-261284	62	14, 19, 23 & 28
2-261285	81	14, 19, 23 & 28
2-261286	101	14, 19, 23 & 28
2-262358	120	14, 19, 23 & 28
2-261282	Foundation Assembly, all sizes	
2-261289	Foundation Construction Details, all sizes	
2-257014	Cathodic Protection System, all sizes	

Structures can be identified by the Model No. shown on their nameplate. The first two numbers indicate the series (90 Series). The second set of 2 or 3 numbers indicate the nominal diameter. The last two numbers indicate the nominal height. The 90 Series replaced the 50A and 50B Series that were originally concurred in by the NNTC in 1979.

Materials: The structure shell consists of glass fused to steel sheets that are bolted together. Footing walls and floor are reinforced concrete. Cathodic protection is provided by zinc anodes electrically connected to the shell sheets and the floor and footing reinforcement.

Application: SCS Practice Standard 313 for med. (20 yr.) service life.

Assumptions: The shell design assumes above ground application only. Footing sizes are designed for a maximum allowable bearing capacity of 2000 psf. Footing strength design is based on a minimum 3000 psi concrete strength. Wind design considerations are based on a wind speed of 70 mph.

Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these Standard Detailed Drawings, July 1, 1993. The Head of the MWNTC reviewed and concurs in the use of model 2-262358 December 8, 1993.

**SOLLENBERGER SILOS (MT) Circular, Site Cast Concrete,  
Waste Storage Structures**

- Designers: Stephen B. Clarke and Associates Ltd.  
Rd #2 Baden  
Ontario, Canada (519) 634-8453
- Fabricators: Sollenberger Silos  
2294 Molly Pitcher Highway South  
Chambersburg, PA 17201 (717) 264-9588
- Drawings: SSC-92-MT-1 General Specifications  
SSC-92-MT-2 Typical Wall to Footing Details  
SSC-92-MT-3 Floor Sump and Pipe Details  
SSC-92-MT-4 Wall Opening Details  
SSC-92-MT-5 6' Wall Reinforcing Schedule  
SSC-92-MT-6 8' Wall Reinforcing Schedule  
SSC-92-MT-7 12' Wall Reinforcing Schedule  
SSC-92-MT-8 16' Wall Reinforcing Schedule  
SSC-92-MT-9 Kicker Wall Schematics  
SSC-92-MT-10 Equipment Access Bridge Slab  
SSC-92-MT-11 Wall Reinforcing for Equipment Access Beside Wall
- Location: Calculations and drawings have been reviewed by the NNTC and the PA state office for compliance with National Conservation Practice Standard 313-80. Design folders are on file at both reviewing locations. The reviews were completed in February 1993.
- Materials: Reinforced concrete footings, floors, walls and access pads contain Class 4000 concrete and Grade 60 steel.
- Sizes: 6', 8', 12' walls with diameters. from 30' through 140'.  
16' walls with diameters. from 30' through 90'.  
Walls 8" thick (9" thick alternate).
- Application: National Conservation Practice Standard 313-80 for medium (20 year) service life.
- Assumptions: The allowable soil bearing capacity for the footings is 1500 psf. Walls are designed according to PCA "Circular Concrete Tanks Without Prestressing" for a hinged base connection and tank full, no backfill condition. Walls are also adequate for full backfill, tank empty condition. Backfill is assumed to be uniform depth (+/- 2') around the perimeter of the tank. Minimum backfill of 4' is provided to assure frost protection of the footing. A drainage system behind the walls and under the floor with a pipe outlet is provided. Heavy equipment is not to be operated within 10' of the walls, except in areas specifically constructed with an access bridge or additional wall reinforcement for equipment access as shown on the drawings.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detailed drawings.

**SOLLENBERGER SILOS (MT-UB) Circular, Site Cast Concrete,  
Waste Storage Structures**

- Designers: Stephen B. Clarke and Associates Ltd.  
Rd #2 Baden  
Ontario, Canada (519) 634-8453
- Fabricators: Sollenberger Silos  
2294 Molly Pitcher Highway South  
Chambersburg, PA 17201 (717) 264-9588
- Drawings: SSC-92-MT-UB-1 General Specifications  
SSC-92-MT-UB-2 Typical Wall to Footing Details  
SSC-92-MT-UB-3 Floor Sump and Pipe Details  
SSC-92-MT-UB-4 Wall Opening Details  
SSC-92-MT-UB-5 12' Wall Reinforcing Details  
SSC-92-MT-UB-6 16' Wall Reinforcing Details  
SSC-92-MT-UB-7 Equipment Access Bridge Slab
- Location: Calculations and drawings have been reviewed by the NNTC and the PA state office for compliance with National Conservation Practice Standard 313-80. Design folders are on file at both reviewing locations. The reviews were completed in February 1993.
- Materials: Reinforced concrete footings, floors, walls and access pads contain Class 4000 concrete and Grade 60 steel.
- Sizes: 12' walls with diameters from 30' through 140'.  
16' walls with diameters from 30' through 90'.  
Walls 8" thick (9" thick alternate).
- Application: National Conservation Practice Standard 313-80 for medium (20 year) service life.
- Assumptions: The allowable soil bearing capacity for the footings is 1500 psf. Walls are designed according to PCA "Circular Concrete Tanks Without Prestressing" for a hinged base connection and tank full, no backfill condition. Walls are also adequate for full backfill, tank empty condition. Additionally, the walls are adequate for varying backfill, tank empty condition with backfill depth differing up to 75% of the wall height around the perimeter of the tank. A finite element analysis was used for this condition. Minimum backfill of 4' is provided to assure frost protection of the footing. A drainage system behind the walls and under the floor with a pipe outlet is provided. Heavy equipment is not to be operated within 10' of the walls, except in areas specifically constructed with an access bridge slab or additional wall reinforcement for equipment access as shown on the drawings.
- Concurrence: The Head of the NNTC Engineering Staff concurs in the use of these detailed drawings.