Dean Powers

DESIGN PACKAGE

Waste Storage Facility and Supporting Practices

April 2023

Prepared By: Pamela Smith

NRCS
Natural Resources
Conservation Service

USDA United States Department of Agriculture

Pamela Smith
Signature of Design Engineer

5/30/23
Date

Robert G. Dahlgren
Signature of Engineer for Approval

7-6-23
Date

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Dean Powers – Susquehanna County, PA

OPERATION AND MAINTENANCE PLAN

This project was designed specifically for your farm operation. As with any other aspect of your farm, a certain level of maintenance is required to keep the system operating properly. Your project has several practices proposed, some with inherently greater risks should they fail. The success of this system is dependent on the proper construction, operation, and maintenance of each and every one of these practices. Your facility is intended to prevent nutrient laden runoff from leaving the animal concentration areas and manure storage areas and flowing directly into watercourses or causing any other environmental impacts.

Heavy Use Area and/or Manure Stacking Facility

This Heavy Use Area (HUA) and Manure Stacking Structure (Storage) is intended to eliminate a problem area that was causing unacceptable environmental impacts on your farm. It may only be used as a feeding, loafing, or exercise area. It may not be converted into animal housing (by adding tie stalls, freestalls, or more pen divisions then what NRCS allows). Equipment and/or hay may not be stored in this facility at times when the facility is needed for animal or manure storage use. Adding sidewalls and curtains are only allowed for those sides shown as "enclosed" in the original design. Permanent sidewalls and/or curtains may not be installed at a later date unless the design shown that those sides can be "enclosed".

Use the HUA to confine animals over the winter, early spring, late fall or during any periods when pasture is too wet or is becoming overgrazed (less than 3" of vegetation). A good indication of pastures being too wet is if the animals are "punching up" or leaving hoof indentations in the soil. Feeding animals on the HUA is required during the confinement periods. There shall be a water source provided on the HUA as well. Animals are prohibited from being fed or watered outside of the HUA structure during the confinement period.

The HUA shall be cleaned as needed with manure being pushed to the stacking structure or hauled and field applied. During extended periods of animal confinement additional organic material is allowed on the pad to provide safer animal footing or to improve manure "stackability" in the stacking structure. The height of the manure and bedding shall never reach the top of curb or wall elevations. During frigid conditions it may be necessary to scrape more often, as it may be hard to clean the facility if the manure and organic material becomes frozen and stuck to the floor. This may be a "trial and error" approach to figure out what works for your management style.

Animals that need exercise in the winter should only have access to pastures when the ground is completely frozen. The animals should not be fed or watered outside of the HUA structure during this timeframe. The animals should only spend a few hours a day outside of the planned HUA, during this timeframe, to avoid damaging vegetation in the pastures. Rotate animals to different pastures to avoid concentrating manure and destroying vegetation. The use of the area around the facility is the most undesirable, and shall be avoided.

Many impacts are related to the movement of animals between areas. Allowing free access from the HUA structure to pasture or paddock is not desired. Frequent use of the animal walkway can result in

deterioration of the walkway and the walkway becoming a loafing area. Animals should be moved thru the walkway to the desired paddock and gated out at that point. This will require water in those paddock locations. Animals should not have access to water or minerals on the walkway. The walkway is only intended for moving animals. Allowing the animals to "free range" from pasture to HUA structure also causes accumulations of manure on the walkway and allows nutrient laden runoff to leave the walkway; this would defeat the purpose of the project in most cases. One alternative is to gate the animals in the Heavy Use Area. During the grazing season; management styles that suggest feeding grain or other supplemental feed in the planned HUA structure then allowing the cattle to use the walkway to access pasture, as a come and go at will, is again not suggested or desired but can be allowed in situations where the following criteria are met:

- The walkway is constructed as narrow as possible (10' or less),
- The walkway is constructed on the contour,
- There is at least 200 feet of grass (filter) between the walkway and any sensitive areas like streams, drainage-ways, or other water courses,
- The operator must agree to periodically scrape the walkway and spread all accumulated solids,
- The operator must provide water in the pasture to limit the traffic on the walkway.

After constructing the designed structure; there shall not be any "brown" areas around the structure or any new animal concentration areas (ACAs) in any other locations. A prescribed grazing system is required as part of this overall "system" of practices and will provide a detailed program for managing the pastures, walkway, and HUA structure properly.

The manure storage portion of the structure is dedicated to the storage of manure and bedding and should be managed accordingly. Animals can have access to the storage area until it is needed for manure storage. Another option is to allow the animals on the manure stack, as the manure stack may provide added area for bed-down and exercise. The stack will also provide heat as it decomposes, which may enhance animal comfort during the winter months. It is sometimes necessary to have a fence or other barrier between the storage and animals to prevent their access to the storage. If the animals are allowed on the stack, it may be necessary to install a fence along the structure walls, to prohibit animals from jumping out of the structure or from damaging the posts or side walls. The storage area is planned to have a stack height no greater than to the top of wall elevation around the perimeter of the structure. The stack can "heap" in the center. If waste feeding material does not supply sufficient solids to make the manure stackable to that height, additional bedding material may be required to achieve this design height. Manure sloughing, oozing, or running indicates lack of sufficient solids. Manure and liquids shall not be allowed to run out of the facilities entrance locations.

Inspect all roofed structures for damage or member failure. Replace or repair needed members with equal to or better and with the required type and amount of fasteners. Inspect fasteners for failure or pullout and replace or redrive when necessary. Inspect steel roofing and sidewall panels for damage or deterioration; replace or repair as needed.

Check concrete curbs, walls, & floors often for cracks or separations and repair immediately.
Most cracks can be ground-out or sawcut then have a primer and sealant applied.

Future Expansion Requirements

Operational expansion is not restricted however, this facility must be expanded at the owner's expense. The landowner/farmer is responsible for preventing the development of new animal concentration areas (brown areas) or pathways located outside of the improved Heavy Use Area.

Check concrete curbs, walls, and pad for cracks or separations and repair immediately. Refer to the concrete patch manufacturer's recommendation for repair of the cracks or consult your local NRCS office. All structural components- posts, girders, trusses, and their connections should be inspected yearly to make sure they are structurally sound and repaired or replaced if damaged.

Fence, Pasture and/or along Animal Trail

Inspect fence on a regular basis. Replace all broken fencing material (posts included) and hardware. Check all fence systems for proper functionality and maintain tension to design specifications. Follow an approved Grazing Plan for required fence locations.

Access Road & Animal Trail

The animal trail is intended as a walkway from your headquarters out to various pastures. To minimize manure deposits, it should not be used as a loafing area. Animals shall not have access to water or minerals on the walkway. If manure builds up, scrape and haul away as needed. Access roads and animal trails should be inspected, at a minimum, once per year and after major storm events. Repair and maintain wearing surface as needed. Provide positive grading away from heavy use area and manure stacking structures, if applicable. Maintain the water-bars to work properly, clean out built-up sediment and re-build as needed when not working properly. The discharge should go into a stable vegetated area.

Roof Gutters and/or Dripline drains

Maintain the roof gutters by cleaning accumulated debris from the gutter.

Maintain all drainage devices and underground outlets by keeping the outlets free of debris and maintaining all animal guards.

SAFETY

During the operation and maintenance of the components in this system, safety shall be given a high priority at all times. See the "SAFETY" section of the design package for more in-depth safety information.

Never walk on the surface of manure in any type of storage structure. The surface is not solid.

Perform all visual checks from on top/outside of the structures (manure storage tank, manhole, settling tank, and pump tank); never enter the structures without taking the proper precautions, see the safety section of the design for guidance. Concentrations of animal wastes can cause accumulations of hazardous gasses. Do not enter confined spaces where these gasses can accumulate. Provide ventilation when checking or working on waste storage components.

When excavating a trench to install or repair any underground pipes and outlets, dig with sloping sides to prevent cave-ins. Cave-ins can entrap people, which can be fatal. The Natural Resources Conservation Service can assist on the proper slope of trench sides.

Be careful when working around underground and overhead utilities. Before digging occurs, the landowner or excavator should call the Pennsylvania One Call System, Inc. (1-800-242-1776) to assist in the prevention of accidental damage to underground public utilities.

DISCLAIMER

This plan is not a substitute for any local, state or federal permits that might be required and any laws or regulations that may apply. It is the landowner's responsibility to comply with any and all such laws and regulations. This plan was prepared upon the landowner's request. All work is expected to be designed and to be implemented in compliance with the applicable standards and specifications of the "Pennsylvania Soil & Water Conservation Technical Guide".

Operation and Maintenance Summary

1. Follow your Grazing Plan.
2. Follow the guidelines above for managing and maintaining the "system" of practices
3. See the "SAFETY" section of the design package for more detailed guidance on safety.

Questions or concerns should be directed to the local NRCS Field Office

Landowner's Signature: _____ Date:_____

NRCS Representative: _____ Date: _____

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AGREED-TO MANAGEMENT OF THE PROPOSED STRUCTURES

The planned Heavy Use Area (HUA) and Manure Stacking Structure (Storage) is intended to eliminate a problem area, on your farm, that is causing unacceptable environmental impacts. The success of this "system" of planned conservation practices is dependent on the proper management of each and every one of these practices. The main purpose of the planned facilities is to prevent nutrient laden runoff from leaving the animal concentration areas and manure stacking areas and flowing directly into watercourses or causing any other environmental impacts. To make sure that participants are fully aware of these conditions, we are asking you to carefully read and sign this document. By signing you indicate that you thoroughly understand and agree to the conditions.

The cost-shared portion of the planned HUA may only be used as a feeding, loafing, or exercise area. Adding tie stalls, freestalls, or more pen divisions than what NRCS allows in the table below, is not permissible. Equipment and/or hay may not be stored in this facility at times when the facility is needed for animal or manure storage use. Adding sidewalls and curtains are only allowed for those sides shown as "enclosed" in the original design. Permanent sidewalls and/or curtains may not be installed at a later date unless the design shows that those sides can be "enclosed".

Divisions for pens may not exceed the following guidelines:

Building Length	Pen Divisions
≤ 40′	2 – 3
41′ – 60′	3 – 4
61′ – 80′	4 – 6
> 80′	6 – 8

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The manure storage portion of the structure is dedicated to the storage of manure and bedding and should be managed accordingly. Animals can have access to the storage area until it is needed for manure storage. It is sometimes necessary to have a fence or other barrier between the storage and animals to prevent their access to the storage. The storage area is planned to have a stack height no greater than to the top of wall elevation around the perimeter of the structure. The stack can "heap" in the center. If waste feeding material does not supply sufficient solids to make the manure stackable to that height, additional bedding material may be required to achieve this design height. Manure sloughing, oozing, or running indicates lack of sufficient solids. Manure and liquids shall not be allowed to run out of the facilities entrance locations.

Future Expansion Requirements

Operational expansion is not restricted, however; this facility must be expanded at the owner's expense. The landowner/farmer is responsible for preventing the development of new animal concentration areas (brown areas) or pathways located outside of the improved Heavy Use Area.

Acceptance of Terms by Landowner/Operator

I have read over and fully understand the conditions and terms in this document. I agree to manage the planned facility according to these parameters. I realize that if I do not manage the planned facility accordingly then NRCS can ask to be paid back for any financial compensation that was received to construct the facility. With the signature below; I am agreeing to manage the structures, as discussed and planned in the Inventory & Evaluation (I&E) report.

Once a signature is obtained; survey and design discussions will begin.

LANDOWNER'S SIGNATURE OF MANAGEMENT ACCEPTANCE	1/10/19 **DATE**
AGENCY REPRESENTATIVE	1/10/19 DATE

USDA

United States Department of Agriculture

Fact Sheet #8

Febuary 2016

Manure Storage Maintenance and Safety

This fact sheet provides a checklist of common maintenance and safety issues found around existing manure storage facilities and promotes developing and reviewing a written safety plan focused on your manure waste management system.

The owner or farm operator is responsible for maintaining a safe environment for their family and all those working near their waste storage facility(s). Each year farm families suffer the loss of life, whether animals or, more tragically, humans that could be avoided with proper maintenance and safety training. Each farm operation should develop a written safety plan (Contact your local extension Agent for information or do an internet search). Review this plan with everyone working near the waste storage facility. Discuss potential hazards and the need to maintain safety devices and follow proper safety protocol. Consider upgrading older facilities with current safety signs and devices. Make repairs in a timely manner. Someone's life may depend upon it. Listed below are the more common safety issues and areas to check.

- Check to see if your safety fence is being properly maintained at the manure storage and loading hoppers.
  - o Replace fence/posts that have been damaged.
  - o Check the gates to verify they close properly and can be latched and locked.
  - o Tighten loose fence and repair damaged sections.
  - o The minimum height of fence should be 4.5 feet. Higher fence may be appropriate for some sites.
- Check to see if your warning signs are still in place and add as needed.
  - o One or more of the following signs should be posted at all appropriate locations. Examples include "DROWNING HAZARD," "DURING AGITATION, DEADLY GASES POSSIBLE," "NO DUMPING OVER FENCE," "DEADLY MANURE GASES POSSIBLE, DEATH MAY BE IMMEDIATE." See NRCS Fact Sheet #4 for additional information and sources.
  - o Appropriate locations include all manure storage access points and on each side or several spaced around the perimeter.
- Check your manure push-off/loading access areas for safety concerns.
  - o Verify that the safety bar or cage installed to keep equipment from falling in is still solid and properly anchored. If not, replace or repair. If none exists, install a safety device.
    - When not in use, there must be a separate gate that is in front of the equipment barrier that limits human and animal access. If there is none, install a gate.

o Verify that the gate can close and be latched when not in use. If it broken, or jammed, have it fixed and properly cleaned. Make sure that the maximum square opening does not exceed 6 inches by 6 inches or 4 inches between vertical members. Adjust gate and/or add coverings to reduce opening size or gap as needed.

o Verify that no one is using a skid loader or other equipment to dump manure directly over the safety fence around the storage. Typical safety fencing will not keep equipment out of the storage.

- Loading is only to be done at the designated push-off locations.
- Consider installing a new curb (at least 24-inches high) and top with a fence higher than the equipment can reach, or install a curb located 30-inches from the tank wall to eliminate the possibility of lifting manure over the fence. These measures will reduce the possibility of improper loading; however, they may not completely prevent access by moving equipment or animals.

- Discuss your emergency manure loading plan for materials (waste feed, snowpack, or frozen manure) that can't be loaded or pushed in at your normal access points with all equipment operators.
  - Consider additional push-off structures that can accommodate these materials.
  - Add a safe access location(s) designed for lifting manure over the manure storage tank wall that is strong enough to hold a tipping loader. A chain link fence is not adequate.
  - Provide short-term storage location(s) elsewhere. Do not store in a watercourse or water flow path.
  - If you plan to load at the agitation or pumpout location, keep the load low going over the wall. Add an extra wheel barrier or swinging bar across opening to keep equipment from entering. Make sure animals are not in the area and the gate is closed and locked after the operation has been completed.

- Review your safety plan prior to agitating, transferring, and pumping manure out of a manure storage. This is especially critical when you have inexperienced personnel involved in the process.
  - Make sure all animals are out of the area when the unloading access gates are opened or the lids are removed from an access hole.
  - After placing the pump, secure gates or plates around equipment to minimize access to storage.
  - If you use gypsum as a bedding additive or as an antiskid on cattle walkways, be aware that during agitation, extremely high levels of deadly Hydrogen Sulfide (H_2S) gas may be emitted. Keep everyone away from the area prior to start-up. Operator should be aware of setting and wind direction. Access points surrounded by buildings and/or no wind or wind blowing from agitation area can carry toxic H_2S. Wait for better conditions. Ventilate area with clean air. Consider using a self-contained breathing apparatus or having a meter to warn the operator that dangerous levels of manure gases are present. Always watch from a safe distance.
  - If your pump controls require standing next to pump and/or behind the power unit, consider extending the controls to move them and the operator a safe distance away from the manure storage or access point.
  - Fully remove the pump and move it away from the storage to make repairs or unclog the intake. Working on the pump while it is in the pit is extremely dangerous. Remember to close the gate or replace grates during this process.
  - Replace grates over agitation openings if they become damaged. If grates are not practical, add safety fence and gates around the opening(s).
  - Remind all manure haulers that your manure has gypsum and that excessive H_2S gas hazards must be considered.
- Review your safety plan prior to going inside the fence adjacent to an earthen or High Density Polyethylene (HDPE)-lined facility to do maintenance.
  - HDPE-lined slopes are slippery and fallen individuals will require help getting out.
  - Have someone outside the fence to get help. Have a rope and floatation device ready to toss over the fence to the fallen individual. The rescue person must stay outside of the fence to avoid the same situation.
- Review your safety plan before entering a plugged loading hopper or going down inside a covered underground storage or reception pit. These are "Confined Spaces" and entry without taking precautions has resulted in deaths.
  - Never enter these spaces without prior ventilation and use of a self-contained breathing apparatus.
  - Even with prior ventilation the air needs to be checked with a calibrated meter.
  - Vertical access will require a harness, rope, and hoisting system to pull out a fallen person.
  - Require a second person stationed outside to get help if a properly planned entry goes bad.
  - Do not enter a storage to rescue a co-worker as this often results in multiple fatalities.
  - Have a system to contact your local emergency response personal.

USDA
United States Department of Agriculture

Fact Sheet #10

January 2016

Safety and Emergency Response for Manure Management Systems

This Fact Sheet is an NRCS update to the Safety Section of the Manure Management for Environmental Protection, Document MM2, dated 11/2001.

Storing animal manure on farms is very common in Pennsylvania. Many dairy, beef, veal, swine, and poultry operations are installing manure storage systems with the potential, under certain circumstances, for safety risks. Experience indicates that when an accident does occur, it sometimes involves two or three fatalities. Large numbers of livestock may also perish.

Some manure storage systems are more hazardous than others. Below-ground storages, or pits, are more hazardous than above-ground storages. Systems that are covered by lids, caps, or slotted floors are more hazardous than uncovered systems. The most dangerous storages are pits within buildings or directly beneath livestock. Pump-out access pits with lids or caps can also be very hazardous.

Safety Hazards

Under certain circumstances, manure storage hazards include gases that are toxic (hydrogen sulfide), asphyxiant (carbon dioxide), corrosive (ammonia), and explosive (methane), and may include an atmosphere that contains insufficient oxygen to sustain life. Drowning is also a possibility. With solid covered or slatted covered pit storages, the danger from gases is most severe when manure is being agitated or pumped out. At other times, little gas is produced, and natural air movements or ventilation from fans can at times prevent hazardous gas buildup and oxygen levels from becoming dangerously low. With open storages and above-ground tanks, oxygen depletion and toxic and explosive gas buildup are less likely (with the exception of sulfur-containing additives such as gypsum), so the major potential hazard normally associated with such systems is drowning. The use of gypsum as an animal bedding or for non-slip alley footing dramatically increases the amount of hydrogen sulfide produced by the manure. In some cases the presence of gypsum has increased the hydrogen sulfide gas content by a factor of 100 fold (this applies to both covered storages and open-top storages).

Maximum safe gas concentrations, or threshold limit values (TLV), have been established for an 8-hour exposure for humans by the American Conference of Government Industrial Hygienists. TLVs are expressed in parts per million (ppm). Safe gas levels for animals have not been established, but animal responses to gases are known to be similar to human responses. Animals, however, suffer more continuous exposure and may be adversely affected over time by a lower level of gas than affects humans. This is of particular concern with small or lightweight animals, such as newborn pigs.

The concentrations of gases in manure storages can be measured with special instruments, but such instruments are reliable only if they are carefully maintained, stored, calibrated, and operated by trained personnel. Some instruments cost only a few hundred dollars. Using gas detection instruments is the best way to monitor a hazardous environment. Never enter a confined space without proper testing and safety equipment. Emergency procedures are outlined at the end of this document.

Hydrogen sulfide (H_2S), the most hazardous manure gas, is associated with most fatalities in manure storages. H_2S can cause death within seconds at high concentrations. The TLV is 10 ppm. It is colorless and heavier than air, accumulating near the bottom of the storage (this gas can flow out of a storage and continue to hug the ground and adjacent low areas). Though some concentrations (100 to 150 ppm) can be identified by a rotten-egg odor, hydrogen sulfide deadens one's sense of smell and its odor is often masked by other smells common to livestock facilities. Lethal concentrations of 500 to 600 ppm are thus difficult to detect. Gas amounts can increase a thousand fold during agitation and emptying of a manure facility. The presence of gypsum additives increases H_2S production to extremely high levels.

Carbon Dioxide (CO_2), while a nontoxic gas itself, displaces oxygen and therefore can asphyxiate humans and animals. The TLV is 25 ppm. Being both colorless and odorless, carbon dioxide is impossible to detect without gas detection equipment.

Ammonia (NH_3) can severely damage the eyes, throat, and lungs. It combines with moisture in the eyes and respiratory tract to form an alkaline solution that causes severe burns. Its TLV is 25 ppm. NH_3 is lighter than air and has a strong bleach-like odor. Because of its irritating nature, people usually leave a contaminated area. Therefore, it is not suspected to have caused any human deaths. Constant, low-level exposure to ammonia has a discomforting effect on humans and livestock.

Methane (CH_4) is a highly-flammable and explosive gas. The TLV for methane is 1000 ppm. Like carbon dioxide, it is odorless, colorless, asphyxiating, and impossible to detect without gas detection instruments. Methane is lighter than air and rises out of storage areas to collect under hoods, roof ridges, and corners. It is most likely to accumulate during hot weather, especially if ventilation is poor. Methane explosions have resulted from someone lighting a torch or from short circuits in electrical system.

Oxygen (O_2) deficient atmosphere occurs when oxygen is displaced by another gas to less than 19.5% by volume of the total air. Normally, oxygen in air is 20.8% by volume. When oxygen is at 16% by volume of the air, a person becomes disorientated and has impaired judgement. At 14% by volume of the air, a person has rapid fatigue and faulty judgement. At 6% by volume of air, a person can have difficulty in breathing and death will occur within minutes. The oxygen percent should be measured at all levels of a manure storage to ensure that there is no oxygen deficiency.

Design and Construction Recommendations

Many safety hazards can be minimized by properly designing and constructing a manure storage facility. Several recommendations to consider when building a storage are listed below. Many of the recommendations should also be incorporated into existing storages.

- Keep in-barn pits for liquid manure to a minimum.
- Install fences to restrict access for people and animals. Keep fence gates and access locations locked.
- Gypsum for bedding or creating non-slip surfaces should never be loaded into storages located within buildings (and covered storages). Extreme caution and continuous use of gas monitoring equipment shall be used when agitating open, outdoor storages with gypsum.
- Locate pump-out openings for manure pits outside of buildings. Use heavy covers or grates for pit access points and keep them in place.
- Equip ventilation systems with an alarm to indicate power failure, and provide a backup ventilation system.
- Walls of open storages adjacent to barnyards should extend two feet above barnyard elevation.
- If the manure storage is outdoors, provide a gas trap or other device in pipes running to the storage to prevent gases in the storage structure from reentering the building, especially during pit agitation.
- Install a fence around open storages, ponds, treatment basins, and lagoons. The fence should be tight enough to keep out small children.
- Warning signs should be placed near storages and above-ground tanks, and a rescue pole and rope should be located conspicuously in the area.

Operating Recommendations

Manure storage hazards can be further reduced by consistently following recommended operating procedures. You should adopt all of the following practices that apply to your operation.

- Test the pit atmosphere for toxic gases and oxygen levels.
- Never enter a pit without proper ventilation. When going in, wear an air-supplied respirator or a self-contained breathing apparatus (SCBA), as well as a safety harness attached to a rope attended by at least two people at the entrance to the pit. Any person utilizing this equipment must be trained in advance. Attaching the safety rope to a winch or hoist is also recommended. Cartridge-type masks are not safe.
- Keep people and animals out of any building where manure is being agitated or emptied. Provide strong mechanical ventilation during agitation and pumping, and for a few hours after pumping has stopped. If an animal collapses during pit agitation, do not try to rescue it immediately. Turn the pump off and ventilate the building until the gases have had a chance to escape.

- Never fill a manure pit completely, but allow 1- to 2-feet of air space to accommodate concentrations of gas. Lower the level of liquid manure in a storage facility before starting agitation to reduce the possibility of gas being forced above floor level.
- Keep the agitator below the liquid surface because gas is released in greater volumes with vigorous surface agitation.
- Forbid smoking, open flames, or spark-producing operations in the immediate vicinity of the storage area. Keep all guards and safety shields in place on pumps, pump hoppers, tank wagons, and power units, and maintain electrical motors, fixtures, and wiring in good condition.
- Do not leave temporary access ladders leaning against above-ground tanks. Permanent ladders on the outside of above-ground tanks should terminate above the reach of people or should have locked entry guards.
- Do not walk, ride, or allow animals on the crust surface of open-air storages. Like ice, the crust is not uniformly solid and can break through suddenly.
- Warn visitors and guests of manure storage hazards. Owners are legally responsible for their safety while they are on their property.
- Only dump or scrape manure into storages at locations designed for that purpose. Install safe access locations for lifting manure over tank walls, or install safety guard push-in structures for safely loading manure into storages.
- Never dump manure over the top of chain link or other fences.
- Become familiar with and follow the Occupational Safety and Health Administration (OSHA) regulations and recommended practices for confined spaces (OSHA 1910.146). While production agriculture was excluded from these regulations, any farmer with an employee could be cited for a violation under the General Duty Clause of the OSHA Act, Public Law 91-596. The General Duty Clause requires employers to provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm. A confined space, such as a manure storage, may fit this clause. A confined space is defined by OSHA as a space that (1) is large enough for an employee to enter fully and perform assigned work; (2) is not designed for continuous occupancy by the employee; and (3) has a limited or restricted means of entry or exit.

Emergency Procedure

Emergencies result from ignoring or not knowing the hazards of manure storages and the recommended safety practices. Generally, someone enters a pit without a self-contained breathing apparatus (or is not properly trained in its use) and passes out almost immediately from toxic gases or oxygen deficiency. The tragedy can be compounded when would-be rescuers, family, coworkers, emergency personnel, panic and follow the first victim into the pit.

When someone collapses in a pit, gases are so concentrated that it is extremely dangerous for anyone else to enter without a self-contained breathing apparatus and proper training. The only reasonable immediate action is to ventilate the storage area and notify rescue personnel who can bring the proper equipment. Barn fans and silo blowers may be activated to provide ventilation, but do not lower fans into the pit because of the possibility of a methane explosion.

Before entering a confined space manure storage, gas detection equipment must be used to determine hazardous gas concentrations and oxygen levels. This should be done prior to and during entry because extremely toxic gases often accumulate from decomposing manure and safe oxygen levels are often depleted. A gas monitor with remote sampling enables measurements to be taken by workers located safely outside the storage facility. These measurements can also be used to establish ventilation times and rates before workers enter the manure storage. The gas and oxygen measurement results would be used with ANSI/ASABE S607, Ventilating Manure Storages to Reduce Entry Risk, to establish ventilation times before entry for a specific manure storage facility. Once a worker has entered the facility, gas sensors allow for constant monitoring of the atmosphere while the person is in the storage. Additional information is presented in Fact Sheet E 52 titled "Confined Space Manure Gas Monitoring" written by Penn State Cooperative Extension.

In any rescue attempt, the rescuer should have a self-contained breathing apparatus, proper training, and a safety harness with a lifeline. The lifeline should be attended by at least two people outside the storage unit. Rescuers should never place their own masks on a victim or remove their own lifelines. Ropes, carriers, and oxygen for victims can be lowered into the pit if necessary. Victims should be brought out as quickly as possible, administered to by emergency services personnel, and transported to an emergency room.

Subject: Inventory & Evaluation **Date:** 11/02/2021

Dean Powers; Susquehanna County

To: Ain Welmon

On October 18, 2021 Andy Wodehouse, Ain Welmon, Deb Basalyga and I met with Dean Powers on his farming operation to discuss and correct the resource concerns at his farm. The farm is located at 1254 Powers Road, Susquehanna, PA 18847 in Susquehanna County. There was an original I&E done in 2015 by Corey Grove with Team Ag; due to the age of this report and more updated animal numbers, the 2015 report shall not be used. The attached I&E report shall be used instead. The resource concerns consisted of lack of manure storage and a place to confine animals during the winter. Mr. Powers understands the importance to confine all animals during non-grazing times and the need to not create any ACA's (Animal Concentration Areas/ Mud lots) on the farm.

We discussed a roofed heavy use area (HUA) with an attached manure storage, an animal walkway, and an access road. The positioning of the structure was affected by the steepness of the site location.

There are a vast number of animals that exist on this farm or he hopes to bring back to the farm with the construction of these practices to fix the resource concerns. There are 31 cows, 20 calves, 4 heifers, 5 bulls and 10 finishers. The animal numbers that we talked about are very close to what Mr. Powers wants the building sized for, except for a change in the number of bulls (3) and (8) heifers.

Some items to point out; Mr. Powers stated that he wanted a scrape lane that would be divided from the heavy use area by a 4" curb. At first, Mr. Powers did not want the cows to have access to the proposed manure stack then on a later phone call said he would be ok with giving the one pen group access for extra room.

Heavy Use Area & Manure Storage

As of now all of the cows are in pasture year-round with concentrated feeding locations that have caused areas of resource concern as they have little to no vegetation. The solution to the resource concerns on the farm is a structure that is 50 feet wide by 164 feet long. The structure will have the HUA on the south side with a 10-foot-wide feed table running on the north side with a scrape lane between. With this structure the manure will get pushed East into a manure storage area. In order for Mr. Powers to be able to haul out the manure from the storage area there is a true 16-foot entrance on the North side of the structure. There is a scrape lane dividing the feed table from the heavy use area and has a 4-inch curb that runs the length of the structure. There can be breaks or entrances in this curb to allow easier access to the Heavy Use Area (bed-down area). The scrape lane can be entered into from an entrance on the West end. The heavy use area can be divided into four different sections, a pen for the 3 bulls, an area for 8 heifers, an area for the 10 feeders, and a fourth area for the 31 cows and 20 calves. Having a divider curb between the scrape lane and the bed-down area is very doable, however this is more for a dairy operation. I say this because whenever there is a divider curb, then this generally produces two

different types of consistency of waste product in the structure: very sloppy in the scrape lane but dry in the bed-down area. Mr. Powers stated this because he wants to scrape by the feed table once a day and not have to use more and more bedding each day. Generally, for beef operations, there is not a division between the scrape lane and bed-down area; one big open floor plan is most often desired. With no divider, animals tend to drag some bedding into the scrape lane, and this is generally good, as it makes the scrape lane less sloppy and doesn't require as much mixing of that product with the bedded product to get a true stack. Generally speaking; if you have a bucket of manure and bedding, then it is required that about 1/3 of the bucket consist of the bedding material to get a mixture that is truly stackable. The divider curb was drawn in the floor plan, attached, but we discourage it for beef operations when a stackable product (manure + bedding) is desired. However, Mr. Powers did understand this concept and with the curb only being 4" inches some bedding will work its way down into the scrape lane.

The building is as large as it is, because Mr. Powers would like to have all the cows have the capability to eat all at the same time. So, to accommodate this, for each cow there was a 2-foot shoulder (body width) taken into account for sizing the pens. This is common within beef operations, however if there is ever a reason for decreasing the size, the length could be cut down by decreasing the feeding length. The cows would create a pecking order of when they would eat.

The size of the stacking structure is for 5 months of manure and bedding generated by the beef herd. A 6' stack height was planned for the structure along with the use of 6' walls. This allowed for a smaller structure. He also can approximately get another 1+ month of storage volume in the bed-down area as a bedded pack. Giving Mr. Powers a total storage time of 6 months which is recommended for beef operations up in the northern counties since they have colder and longer winters.

We normally allow (2) sides of the building to be enclosed; (curtains, permanent steel, or wood). However, based on this site I received approval from Bob Deecki the Area Engineer to have (3) sides enclosed. The reason being that there was evidence of wind damage on the existing feeding area, and how strong the wind was coming from the west. Also, the use of curtains helped Mr. Powers out with obtaining this request. The South and North of the structure will enclosed by curtains, and the West wall will be closed with steel. Since curtains are going to be used on the feed table side, they will be raised up partially for the cattle to be able to feed allowing for ventilation to occur. These curtains will not be fully closed.

Water must be provided on the pad, as this is an NRCS policy. NRCS will only provide an incentive payment towards (1) waterer on the pad and the pipeline to supply the water. The cost of the remainder of the waterers on the pad, will need be to out of pocket.

I have included an "engineer's estimate" which is an estimate of what I believe it will cost to construct the proposed buildings and associated practices. You are allowed to do as much as you would like yourself, as long as it meets the design that we would put together if funding is received. It is very tough to provide an accurate estimate of material with the current COVID-19 situation; material prices are really high right now. I inflated my estimates for the roof and pipe costs, but again, I am not sure how accurate this is. They should consult with a building

contractor for more accurate costs prior to making a decision. I have also attached the possible EQIP incentive payment spreadsheet for the practices being proposed. This will give Mr. Powers an idea of the out-of-pocket cost that he may have if he decided to proceed with the project. If the Conservation District is interested in applying for Growing Greener (State Funding) for this project, then often they need to include an estimate that takes prevailing wage rates into account. Please go over my sketches and estimates with Mr. Powers, as I have not sent him a copy of the "final" report as I am relying on you to hand deliver a copy.

I also did not account for Storm Water Management Practices; some Counties, Townships, or Municipalities require that PA ACT 167 be followed for such projects. The roofed structure that I am proposing is over 5000 sq. ft. in size which is a typical value that triggers these practices. Neither NRCS nor PACD (State Agency that works closely with us for Growing Greener funded projects) will develop a Storm Water Management Plan or design such practices. You should consult with your local County office, Township, or Municipality to determine if this project applies to PA ACT 167. Explain to them what we are doing on your farm and the environmental benefit that these "practices" offer. If ACT 167 does apply; you will need to hire a consulting engineering firm to design such practices and develop the plan. The cost for the engineering services and the installation of these stormwater practices, could reach $20,000 and this shall then be added to my cost estimate. This can also be added into the growing greener grant. You should point this out to the Conservation District when speaking to them about funding possibilities.

Filter Area vs. Roof Payment: The need to cap a roof payment if a filter area is available is currently being reviewed by the state office and hopefully this comparison will not be required in the future. The soils that are within 500' pumping distance, would not support a sprinkler dosed filter area. Plus, the existing steep slope of the project and the depth to water table in the soils would not be adequate to support a filter area. So, for these reasons I did not cap the roof payment, as I truly believe a roof is needed. Plus, the belief that the requirement for least cost alternative will end very soon.

The soils in the project area include: VcC2 (Volusia channery silt loam) and BfC2 (Bath flaggy loam). BfC2 soil has a depth to water table of 21-36 inches and is in Hydrologic soil group C. VcC2 soil has a depth to water table of only 6-18 inches and is in the Hydrologic soil group D. Also, within this soil there does contain a minor component that consists of 4% of this soil that has a hydric soil rating.

If you have any questions as to what I have sketched and/or proposed, please don't hesitate to call me. Please check my work for inconsistency or errors.

Justin Groshek (EIT)

USDA-NRCS Civil Engineer

Approved by: Andrew Wodehouse 11/2021

Dean Powers I+E	Sizing Calcs	11/01/21 JEG	ACW

Contact Information

Address: 1254 Powers Road
Susquehanna, PA 18847

Cell: 570-665-4266

Current Animal Numbers

		AEU
Bulls:	(5) @ 1200 #s =	6
Cows:	(31) @ 1000 #s =	31
Heifers:	(4) @ 800 #s =	3.2
Calves:	(20) @ 400 #s =	8
Feeders:	(10) @ 800 #s =	8
		56.2 AU's

USE: 57 AU's b/c bull weights may be a little low

Expected Animal Numbers

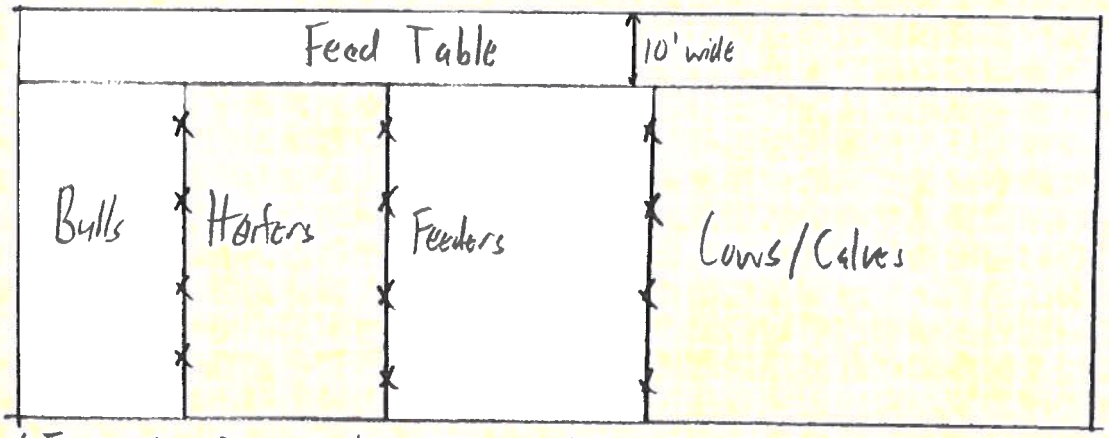
		AEU
Bulls:	(3) @ 1200 #s =	3.6
Cows:	(31) @ 1000 #s =	31
Heifers:	(8) @ 800 #s =	6.4
Calves:	(20) @ 400 #s =	8
Feeders:	(10) @ 800 #s =	8
		57 AU's

Heavy Use Sizing

3	Bulls x	140 ft² =	420 ft²	} 4470 ft²
31	Cows x	70 ft² =	2170 ft²	
8	Heifers x	60 ft² =	480 ft²	
20	Calves x	40 ft² =	800 ft²	
10	Feeders x	60 ft² =	600 ft²	

Allow animals access to manure storage which can reduce the HUA by 50%, for one pen grouping.

Calves/Cows = 2970 ft² x 0.5 = 1485 ft²



* Extra Area for calves burn during winter confinement

Bed-down (Loafing) Area Available: Bulls: 622 ft² ∴ OK Heifers: 640 ∴ OK
Feeders: 960 ft² ∴ OK
Cows/Calves: 2463 ∴ OK

AW

Stacking Structure Sizing

57 AU's × 1.2 ft^3/AU-day = 68.4 ft^3/day Manure Only

I talked to Mr. Powers on 11/02/21 and he said approx. 3 calves could be born in confinement in the early spring.

3 Calves @ 200#s = 0.6 AU's × 1.2 ft^3/AU-day = 0.72 ft^3/day Manure Only

Total Manure Per Day = 69.12 ft^3/day

Need 6 total months of storage; 5 months in actual storage stacking structure and 1 month bed-pack in HUA.

68.4 ft^3/day × 150 days (5 months) = 10,260 ft^3 Manure Only

0.72 ft^3/day × 30 days (1 month) = 21.6 ft^3 Manure Only

10,282 ft^3 Manure Only

Bedding: Chopped Hay

From Stackability Sheet to get 30%: **2950 ft^3 of Chopped Hay Req'd**

Reduction to Bedding: 2950 ft^3 × 0.5 (Reduction Factor) = 1475 ft^3

* The Reduction factor is only taken into account for the storage sizing. The recommended amount of bedding to allow a stackable product is 2950 ft^3

Total Storage Sizing: 10,282 + 1475 = 11,757 ft^3

Storage: 50' wide × 44' long

Useable Storage: 48.67' wide × 43.33' long

AW

EQIP Eligible Quantities

Practice	Location / Description	Quantity
561	- 57 AU's x 60 sf/AU = 3420 ft² - 8' x 120' = 960 ft² (Silage Lane that is seperated from HUA by a curb) - Concrete in Front of Entrances: [1] 16' x 16' = 256 ft² [1] 15' x 24' = 360 ft²	
313	50' x 44' = 2200 ft² (outside of walls)	
367	Roof over HUA = 3420 ft² Roof over Silage Lane = 960 ft² } 4380 ft² Roof over Storage = 2200 ft²	2190 ft² Timber Roof 2190 ft² Concrete Foundation 2200 Timber Roof

AW

Estimated Quantities + Costs

Practice Code	Estimated Quantities	Estimated Cost
313	Excavation: 6370 ft² × 2' ÷ 27 = 472 yd³ × $20	$ 9,440
&	Fill: 4900 ft² × 2' ÷ 27 = 363 yd³	
561	Backfill: 164 × (3/4)	
	(164 × ½ [3 × 4]) ÷ 27 = 37 yd³	
	TOTAL FILL = 400 yd³ × $20	$ 8,000
	6' Wall: 268' × 6' Tall × [8"/12" wide] ÷ 27 = 40 yd³ × $350	$ 14,000
	6' Wall Footer: 268 × 3.583 × 1' ÷ 27 = 36 yd³ × $325	$ 11,700
	4' Buried Wall: 120' × 4' Tall × [8"/12" wide] ÷ 27 = 12 yd³ × $350	$ 4,200
	4' Wall Footer: 120' × 3.83 × [9/12] ÷ 27 = 13 yd³ × $325	$ 4,225
	4" Curb: 110' × [4"/12"] × [8"/12"] ÷ 27 = 1 yd³ × $350	$ 350
	Flatwork: (164' × 50') − (268' × 1.25') = 7,865 ft²	
	7,865 ft² × [5"/12"] ÷ 27 = 122 yd³ × $275	$ 33,550
	Concrete @ Entrances: (16' × 16') + (15' × 24') = 616 ft²	
	616 ft² × [6"/12"] ÷ 27 = 12 yd³ × $275	$ 3,300
	Raised Feed Table: (10' × 120') = 1200 ft²	
	1200 ft² × [6"/12"] ÷ 27 = 23 yd³ × $275	$ 6,325
	STONE Under all concrete = 10,016 ft²	
	10,016 ft² × [3"/12"] ÷ 27 × 1.7 = 158 tons × $30	$ 4,740
367	Rout to outside of walls: 50' × 164' = 8200 ft² × $16	$ 131,200
382	Safety Fence: 50' × $4	$ 200
	(1) 16' Gate × $425	$ 425
	(2) 12' Gates × $300	$ 600
	Slant Bars: 120' × $36/ft	$ 4,320
	Interior Fencing for Pens, etc estimated	$ 4,000
606	Perimeter Drain = 4" drain 406' × $10	$ 4,060
558	164' × 2 = 328 × $10	$ 3,280
	8 downs × 12' = 96' × $10	$ 960
620	Rout Runoff Outlets: (6") 428' × $10	$ 4,280
	Perimeter Drain Outlet: (4") 80' × $8	$ 640
587	Culvert Pipe: 24" Diameter 25' long	$ 900
468	Rock Apron for Outlets 40 ft² × 1.5' deep = 60 ft³	
	60 ÷ 27 × 1.8 = 4 tons × $30	$ 120
	Rock for Culvert [End wall, etc]: 40 ft² × 1' = 40 ft³	
	40 ÷ 27 × 1.8 = 3 tons × $30	$ 90

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Practice Code	Estimated Quantities	Estimated Cost
614	Waterline ≈ 400' × $10/LF	$4,000
	Double Bowl Troughs (4) × $1600	$6,400
560	2185 ft²	
	geo: 2185 ft² ÷ 9 = 243 × $3.50	$850.50
	AASHTO #2: 2185 × (8"/12") ÷ 27 × 1.5 = 81 tons × $30	$2,430
	2A MOD: 2185 × (4"/12") ÷ 27 × 1.8 = 49 tons × $30	$1,470
575	830 ft²	
	geo: 830 ft² ÷ 9 = 93 × $3.50	$325.50
	AASHTO #2: 830 ft² × (6/12) ÷ 27 × 1.5 = 23 tons × $30	$690
	2A MOD: 830 ft² × (2/12) ÷ 27 × 1.8 = 10 tons × $30	$300
	AASHTO #10: 830 ft² × (2/12) ÷ 27 × 1.8 = 10 tons × $30	$300
342	All Dist. Acres 0.5 Acres 0.5 Ac/$1200/Ac	$600
382	204' × $3.50/LF for Fencing along Walkway	$714

Total Engineering Estimate
$272,985

AW

RGD-9/2021

IS THE PRODUCT STACKABLE?

STACKABLE =	GREATER THAN	30.00%	SOLDS CONTENT
NOT STACKABLE =	LESS THAN	30.00%	SOLIDS CONTENT

MOISTURE CONTENT OF MANURE %		SOLIDS CONTENT %
Dairy =	88	12
Veal =	96	4
Beef =	86	14

MOISTURE CONTENT OF BEDDING %		SOLIDS CONTENT %
Corn Tops (Shredded) =	16	84
Ground Limestone =		
Hay (Chopped) =	14	86
Hay (Loose) =	14	86
Hay (Bailed) =	14	86
Sand =		
Sawdust =	39	61
Newspaper =	8	92
Straw (Chopped) =	10	90
Straw (Loose) =	10	90
Straw (Bailed) =	10	90

MANURE VOLUME (Cu.Ft.)
10282

* BEDDING VOLUME (Cu.Ft.)
2950

ANIMAL TYPE
Beef

BEDDING TYPE
Hay (Chopped)

MANURE SOLIDS CONTENT (%)
14

BEDDING SOLIDS CONTENT (%)
86

* NO REDUCTION FACTOR SHALL BE APPLIED TO BEDDING VOLUME, THIS IS THE TOTAL VOLUME OF BEDDING BEING USED .

SOLIDS CONTENT = $\frac{\text{(Volume of Manure Solids) + (Volume of Bedding Solids)}}{\text{Total Volume of Manure + Bedding}}$

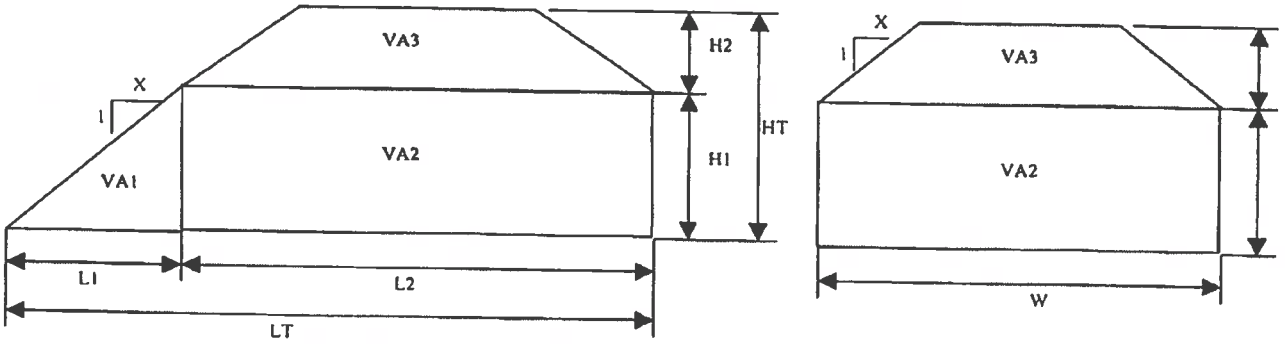
= 30.05%

= STACKABLE

AW

STACKING STRUCTURE CALCULATION SHEET
STRUCTURE WITH ONE END OPEN

COUNTY _____ DATE _____
OWNER _____ ADDRESS _____
PREPARER _____ TITLE _____ DATE _____
CHECKED _____ TITLE _____ DATE _____



SIDE VIEW FRONT VIEW

Storage Volume Required	11,757	cu. ft.
Storage Duration	150	days

STRUCTURE DIMENSIONS

X - Angle of repose for manure	1	:1 ratio, (1:1 suggested)
HT - Total Manure Height	6	ft.
H1 - Structure Wall Height -4 Ft. max.	6	ft.
H2 - Stackable Height above wall	0	ft.
LT - Total Structure Length	43.33	ft. (Recommend making length divisible by 8')
L1 - Length for VA1	6	ft.
L2 - Length for VA2	37.33	ft.
W - Structure Width	48.67	ft.

CALCULATED VOLUMES

VA1 =	876.1	cu. ft.	(V=.5*L1*W*H1)
VA2 =	10,901.1	cu. ft.	(V=L2*W*H1)
VA3 =	0.0	cu. ft.	(V=(L2*W*H2)-(X*L2*H2^2)-(X*W*H2^2)+(1.33*X^2*H2^3))
TOTAL VOLUME =	11,777.2	cu. ft.	11757 cu. Ft. = Required volume

CONCLUSION

Structure Length:	43.33 ft.
Structure Width:	48.67 ft.
Height of Manure Pile:	6 ft.
Storage Volume:	11,777 cu. ft.

AW

11/10/2021

SPEC.	ENGINEERS ESTIMATE: DEAN POWERS				
	ITEM	UNIT	QUANTITY	COST / UNIT	COST($)
561 & 313 STRUCTURES	**Excavation:**	cu.yd.	472	$20.00	$9,440.00
	Fill:	cu.yd.	363	$20.00	$7,260.00
	Backfill / Grading:	cu.yd.	37	$20.00	$740.00
	Stone:				
	Bedding Stone (AASHTO #57)	ton	158	$30.00	$4,740.00
	Concrete:				
	6' WALL	cu.yd.	40	$350.00	$14,000.00
	6' WALL FOOTING	cu.yd.	36	$325.00	$11,700.00
	4' BURIED WALL	cu.yd.	12	$350.00	$4,200.00
	4' BURIED WALL FOOTING	cu.yd.	13	$325.00	$4,225.00
	4" CURB	cu.yd.	1	$350.00	$350.00
	FLAT WORK	cu.yd.	122	$275.00	$33,550.00
	CONCRETE @ ENTRANCES	cu.yd.	12	$275.00	$3,300.00
	RAISED FEED TABLE	cu.yd.	23	$275.00	$6,325.00
	TOTAL FOR PRACTICE 561/313:				$99,830.00
367	ROOF OVER BEEF PAD + STORAGE	SQ.FT.	8200	$16.00	$131,200.00
	TOTAL FOR PRACTICE 367:				$131,200.00
606 (Subsurface Drains)	Drain Around Entire Structure	LF	406	$10.00	$4,060.00
	TOTAL FOR PRACTICE 606:				$4,060.00
558 (Roof Runoff)	**Gutters:**				
	6" Box Ogee Alumn.	LF	328	$10.00	$3,280.00
	Downspouts:				
	3"x4" Downs	LF	96	$10.00	$960.00
	TOTAL FOR PRACTICE 558:				$4,240.00
620 (Outlets)	4" PVC SCH 40 Pipe	LF	80	$8.00	$640.00
	6" PVC SCH 40 Pipe	LF	428	$10.00	$4,280.00
	TOTAL FOR PRACTICE 620:				$4,920.00
587 (Water Control)	24" Diameter HDPE Culvert Pipe	each	1	$900.00	$900.00
	TOTAL FOR PRACTICE 620:				$900.00
468 (Lined Outlet)	R4 Riprap	ton	7	$30.00	$210.00
	TOTAL FOR PRACTICE 468:				$210.00
516 (Waterline)	Pipeline for waterers	LF	400	$10.00	$4,000.00
	TOTAL FOR PRACTICE 516:				$4,000.00
614 (Waterers)	Water Troughs on Beef Pad	Each	4	$1,600.00	$6,400.00
	TOTAL FOR PRACTICE 614:				$6,400.00

AW

11/10/2021

382 (Fence)	**Fence**				
	4 strand High Tensile	LF	204	$3.50	$714.00
	12' Gate	Each	2	$300.00	$600.00
	16' Gate	Each	1	$425.00	$425.00
	SLANT BARS	LF	120	$36.00	$4,320.00
	INTERIOR FENCING INSIDE BEEF STRUCTU	Job	1	$4,000.00	$4,000.00
	SAFTEY FENCE ON TOP OF 6' EAST WALL	LF	50	$4.00	$200.00
	TOTAL FOR PRACTICE 382:				$10,259.00
575 (Walkway)	**Stone:**				
	AASHTO #1 (BASE)	Ton	23	$30.00	$690.00
	2A Mod. (Top)	Ton	10	$30.00	$300.00
	AASHTO #10	Ton	10	$30.00	$300.00
	Geotextile	sq.yd.	93	$3.50	$325.50
	TOTAL FOR PRACTICE 575:				$1,615.50
560 (Access Rd)	**Stone:**				
	AASHTO #1 (BASE)	Ton	81	$30.00	$2,430.00
	2A Mod. (Top)	Ton	49	$30.00	$1,470.00
	Geotextile	sq.yd.	243	$3.50	$850.50
	TOTAL FOR PRACTICE 560:				$4,750.50
342 (Seeding)	**Seeding:**				
	All disturbed areas	acre	0.5	$1,200.00	$600.00
	TOTAL FOR PRACTICE 342:				$600.00
	TOTAL FOR ALL PRACTICES:				**$272,985.00**

EQIP Practice Check List

v. 11132020

Press Ctrl r to reset

Name: County:

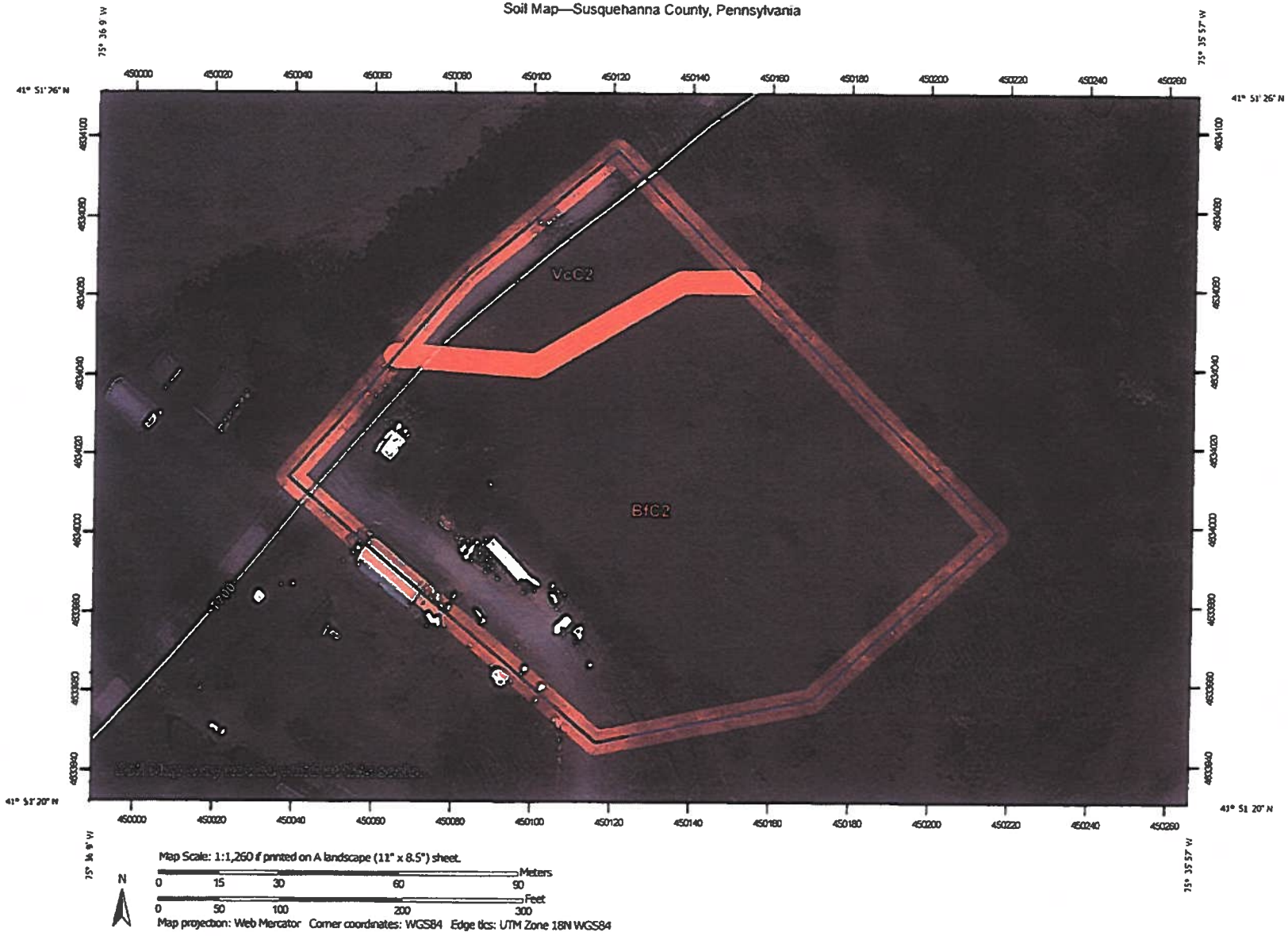
Completed By: Date: 11/10/2021

Code	Practice	Componet Name	Quantity	Units	Payment per Unit	Incentive Payment		ENGINEERS ESTIMATE Quantity	Units	Unit Cost	Estimated Total Cost
313	Waste Storage Facility					$30,712.00	Total				$0.00
313		Dry Stack, <2K Concrete Fl walls	2200	SF	$13.96	$30,712.00					
342	Critical Area Planting					$121.06	Total				$0.00
342		Native or Introduced Vegetation - Normal Tillage (Organic and Non-Organic)	0.5	AC	$242.12	$121.06					
367	Roofs and Covers					$60,446.50	Total				$0.00
367		Timber Frame Roof	4390	SF	$9.01	$39,553.90					
367		Timber Frame Roof, complex foundation	2190	SF	$9.54	$20,892.60					
382	Fence					$559.40	Total				$0.00
382		Electric - 4 or more strands	204	LF	$2.10	$428.40					
382		Woven Wire	50	LF	$2.62	$131.00					
468	Lined Waterway or Outlet					$495.60	Total				$0.00
468		Rock Lined - 12 inch	120	SF	$4.13	$495.60					
516	Livestock Pipeline					$836.00	Total				$0.00
516		2 inches or less buried by LF	400	LF	$2.09	$836.00					
558	Roof Runoff Structure					$2,335.36	Total				$0.00
558		Roof Gutter	328	LF	$7.12	$2,335.36					
560	Access Road					$4,245.36	Total				$0.00
560		Constructed road with Heavy Stone Base and Geotextile	196	LF	$21.66	$4,245.36					
561	Heavy Use Area Protection					$40,533.80	Total				$0.00
561		Concrete Slab with Curbs, Reinforced	4380	SF	$8.53	$37,361.40					
561		Concrete Slab, reinforced with gravel foundation	616	SF	$5.15	$3,172.40					
575	Animal Trails and Walkways					$1,361.20	Total				$0.00
575		Walkway with Gravel and Geotextile	830	SF	$1.64	$1,361.20					
587	Structure for Water Control					$63.75	Total				$0.00
587		Culvert <30 inches CMP	25	InFt	$2.55	$63.75					
606	Subsurface Drain					$1,408.82	Total				$0.00
606		Corrugated Plastic Pipe, Single Wall, Less than or equal to 6 inches	406	LF	$3.47	$1,408.82					
614	Watering Facility					$1,010.72	Total				$0.00
614		Frost Proof Trough (2 Ball)	1	EA	$1,010.72	$1,010.72					
620	Underground Outlet					$2,707.64	Total				$0.00
620		UO 6 inch or less	508	LF	$5.33	$2,707.64					
Totals					Estimated Payment	$146,837.21				Estimated Installation Cost	$272,985.00

AW

AW

Soil Map—Susquehanna County, Pennsylvania



USDA **Natural Resources Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

AW

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Susquehanna County, Pennsylvania
Survey Area Data: Version 18, Sep 1, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 14, 2012—May 8, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

AW

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BfC2	Bath flaggy loam, 12 to 20 percent slopes, moderately eroded	3.1	85.3%
VcC2	Volusia channery silt loam, 8 to 15 percent slopes, eroded	0.5	14.7%
Totals for Area of Interest		**3.6**	**100.0%**

AW

Susquehanna County, Pennsylvania

BfC2—Bath flaggy loam, 12 to 20 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: 9z2g
Elevation: 800 to 1,800 feet
Mean annual precipitation: 30 to 40 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 140 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Bath and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bath

Setting

Landform: Mountains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Upper third of mountainflank, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy till derived mainly from gray and brown siltstone, sandstone, and shale

Typical profile

H1 - 0 to 8 inches: flaggy loam
H2 - 8 to 27 inches: channery silt loam
H3 - 27 to 60 inches: very flaggy sandy loam
H4 - 60 to 64 inches: very channery loam

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: 21 to 38 inches to fragipan
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 21 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C

AW

Ecological site: F140XY030NY - Well Drained Dense Till
Hydric soil rating: No

Data Source Information

Soil Survey Area: Susquehanna County, Pennsylvania
Survey Area Data: Version 18, Sep 1, 2021

AW

Susquehanna County, Pennsylvania

VcC2—Volusia channery silt loam, 8 to 15 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2srg0
Elevation: 330 to 2,460 feet
Mean annual precipitation: 31 to 70 inches
Mean annual air temperature: 39 to 52 degrees F
Frost-free period: 105 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Volusia, eroded, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Volusia, Eroded

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy till derived from interbedded sedimentary rock

Typical profile

Ap - 0 to 9 inches: channery silt loam
Eg - 9 to 13 inches: loam
Bx1 - 13 to 21 inches: channery loam
Bx2 - 21 to 31 inches: channery loam
Bx3 - 31 to 43 inches: channery loam
Bx4 - 43 to 60 inches: channery silt loam

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: 10 to 22 inches to fragipan
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified

AW

Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: F140XY024NY - Moist Dense Till
Hydric soil rating: No

Minor Components

Mardin, eroded

Percent of map unit: 6 percent
Landform: Mountains, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Chippewa

Percent of map unit: 4 percent
Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Susquehanna County, Pennsylvania
Survey Area Data: Version 18, Sep 1, 2021

SHEET OF

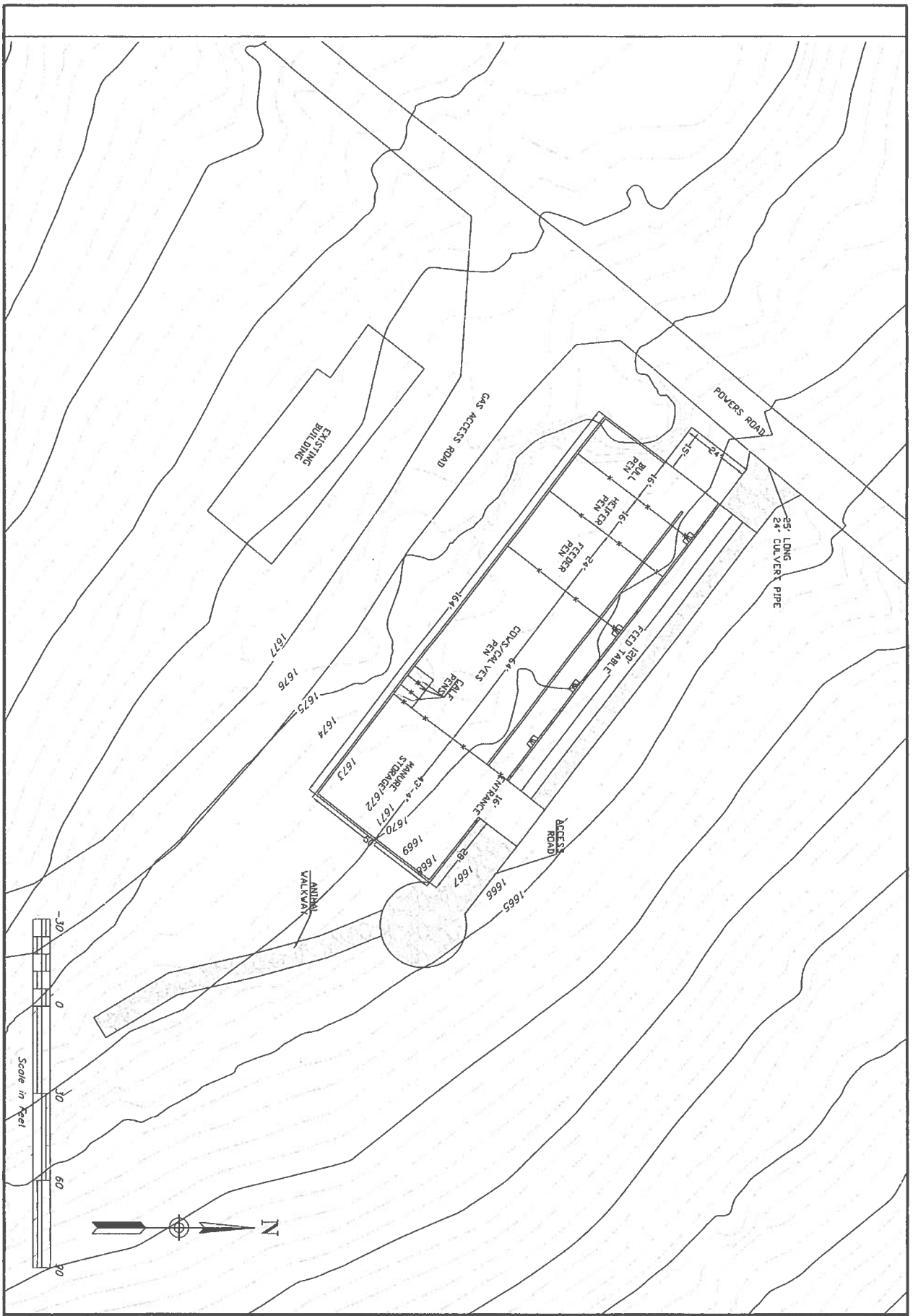
DRAWING NO.

FILE NO. POWERS MAP.DWG

USDA United States Department of Agriculture
Natural Resources Conservation Service

30 SCALE PLANVIEW
DEAN POWERS
SUSQUEHANNA COUNTY

		DATE
DESIGNED	JEG	/
DRAWN	JEG	/
CHECKED	Andrew Wodehouse	11/2021
APPROVED	Andrew Wodehouse	11/2021

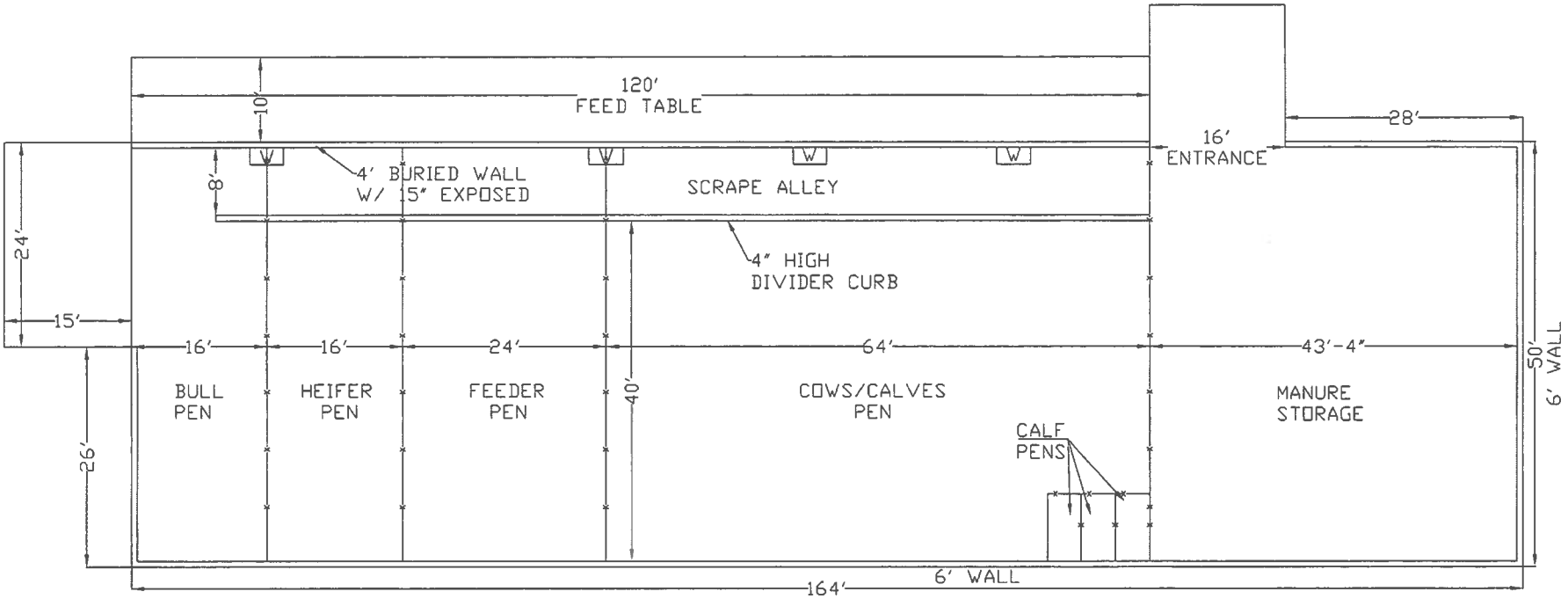


SHEET OF | DRAWING NO. | FILE NO. FARMS WAT OWC

USDA United States Department of Agriculture
Natural Resources Conservation Service

30 SCALE PLANVIEW
DEAN POWERS
SUSQUEHANNA COUNTY

		DATE
DESIGNED	JEG	#
DRAWN	JEG	#
CHECKED	Andrew Wodehouse	11/2021
APPROVED	Andrew Wodehouse	11/2021



NO SCALE NOT A FINAL DESIGN

DESIGNED JEG DATE 11/2021
DRAWN JEG
CHECKED Andrew Wedebrune 11/2021
APPROVED Andrew Wedebrune 11/2021

BUILDING LAYOUT
DEAN POWERS
SUSQUEHANNA COUNTY

USDA United States Department of Agriculture
Natural Resources Conservation Service

FILE NO. POWERS L&E.DWG
DRAWING NO.
SHEET OF

BOLTS

Table 12F BOLTS: Reference Lateral Design Values, Z, for Double Shear (three member) Connections[1,2]

for sawn lumber or SCL with all members of identical specific gravity

Thickness			G=0.67			G=0.55			G=0.50			G=0.49			G=0.46		
Main Member	Side Member	Bolt Diameter	Red Oak			Mixed Maple Southern Pine			Douglas Fir-Larch			Douglas Fir-Larch(N)			Douglas Fir(S) Hem-Fir(N)		
t_m in.	t_s in.	D in.	$Z_{\parallel}$ lbs.	$Z_{s\perp}$ lbs.	$Z_{m\perp}$ lbs.	$Z_{\parallel}$ lbs.	$Z_{s\perp}$ lbs.	$Z_{m\perp}$ lbs.	$Z_{\parallel}$ lbs.	$Z_{s\perp}$ lbs.	$Z_{m\perp}$ lbs.	$Z_{\parallel}$ lbs.	$Z_{s\perp}$ lbs.	$Z_{m\perp}$ lbs.	$Z_{\parallel}$ lbs.	$Z_{s\perp}$ lbs.	$Z_{m\perp}$ lbs.
1-1/2	1-1/2	1/2	1410	960	730	1150	800	550	1050	730	470	1030	720	460	970	680	420
		5/8	1760	1310	810	1440	1130	610	1310	1040	530	1290	1030	520	1210	940	470
		3/4	2110	1690	890	1730	1330	660	1580	1170	590	1550	1130	560	1450	1040	520
		7/8	2460	1920	960	2020	1440	720	1840	1260	630	1800	1210	600	1690	1100	550
		1	2810	2040	1020	2310	1530	770	2100	1350	680	2060	1290	650	1930	1200	600
1-3/4	1-3/4	1/2	1640	1030	850	1350	850	640	1230	770	550	1200	750	530	1130	710	490
		5/8	2050	1370	940	1680	1160	710	1530	1070	610	1500	1060	600	1410	1000	550
		3/4	2460	1810	1040	2020	1550	770	1840	1370	680	1800	1310	660	1690	1210	600
		7/8	2870	2240	1120	2350	1680	840	2140	1470	740	2110	1410	700	1970	1290	640
		1	3280	2380	1190	2690	1790	890	2450	1580	790	2410	1510	750	2250	1400	700
2-1/2	1-1/2	1/2	1530	960	1120	1320	800	910	1230	730	790	1210	720	760	1160	680	700
		5/8	2150	1310	1340	1870	1130	1020	1760	1040	880	1740	1030	860	1660	940	780
		3/4	2890	1770	1480	2550	1330	1110	2400	1170	980	2380	1130	940	2280	1040	860
		7/8	3780	1920	1600	3360	1440	1200	3080	1260	1050	3010	1210	1010	2820	1100	920
		1	4690	2040	1700	3840	1530	1280	3500	1350	1130	3440	1290	1080	3220	1200	1000
	1-1/2	1/2	1530	960	1120	1320	800	940	1230	730	860	1210	720	850	1160	680	810
		5/8	2150	1310	1510	1870	1130	1290	1760	1040	1190	1740	1030	1170	1660	940	1090
		3/4	2890	1770	1980	2550	1330	1550	2400	1170	1370	2380	1130	1310	2280	1040	1210
		7/8	3780	1920	2240	3360	1440	1680	3180	1260	1470	3150	1210	1410	3030	1100	1290
		1	4820	2040	2380	4310	1530	1790	4090	1350	1580	4050	1290	1510	3860	1200	1400
3-1/2	1-3/4	1/2	1660	1030	1180	1430	850	1030	1330	770	940	1310	750	920	1250	710	870
		5/8	2310	1370	1630	1990	1160	1380	1860	1070	1230	1840	1060	1200	1760	1000	1090
		3/4	3060	1810	2070	2670	1550	1550	2510	1370	1370	2480	1310	1310	2370	1210	1210
		7/8	3940	2240	2240	3470	1680	1680	3270	1470	1470	3240	1410	1410	3110	1280	1290
		1	4960	2380	2380	4400	1790	1790	4170	1580	1580	4120	1510	1510	3970	1400	1400
	3-1/2	1/2	1660	1180	1180	1500	1040	1040	1430	970	970	1420	960	960	1370	920	920
		5/8	2590	1770	1770	2340	1560	1420	2240	1410	1230	2220	1390	1200	2150	1290	1090
		3/4	3730	2380	2070	3380	1910	1550	3220	1750	1370	3190	1700	1310	3090	1610	1210
		7/8	5080	2820	2240	4600	2330	1680	4290	2130	1470	4210	2070	1410	3940	1960	1290
		1	6560	3340	2380	5380	2780	1790	4900	2580	1580	4810	2520	1510	4510	2410	1400
5-1/4	1-1/2	5/8	2150	1310	1510	1870	1130	1290	1760	1040	1190	1740	1030	1170	1660	940	1110
		3/4	2890	1770	1980	2550	1330	1690	2400	1170	1580	2380	1130	1550	2280	1040	1480
		7/8	3780	1920	2520	3360	1440	2170	3180	1260	2030	3150	1210	1990	3030	1100	1900
		1	4820	2040	3120	4310	1530	2680	4090	1350	2360	4050	1290	2260	3860	1200	2100
	1-3/4	5/8	2310	1370	1630	1990	1160	1380	1860	1070	1270	1840	1060	1250	1760	1000	1180
		3/4	3060	1810	2110	2670	1550	1790	2510	1370	1660	2480	1310	1630	2370	1210	1550
		7/8	3940	2240	2640	3470	1680	2260	3270	1470	2100	3240	1410	2060	3110	1290	1930
		1	4960	2380	3240	4400	1790	2680	4170	1580	2360	4120	1510	2260	3970	1400	2100
	3-1/2	5/8	2590	1770	1770	2340	1560	1560	2240	1410	1460	2220	1390	1450	2150	1290	1390
		3/4	3730	2380	2480	3380	1910	2180	3220	1750	2050	3190	1700	1970	3090	1610	1810
		7/8	5080	2820	3290	4600	2330	2530	4390	2130	2210	4350	2070	2110	4130	1960	1930
		1	6630	3340	3570	5740	2780	2680	5330	2580	2360	5250	2520	2260	4990	2410	2100
5-1/2	1-1/2	5/8	2150	1310	1510	1870	1130	1290	1760	1040	1190	1740	1030	1170	1660	940	1110
		3/4	2890	1770	1980	2550	1330	1690	2400	1170	1580	2380	1130	1550	2280	1040	1480
		7/8	3780	1920	2520	3360	1440	2170	3180	1260	2030	3150	1210	1990	3030	1100	1900
		1	4820	2040	3120	4310	1530	2700	4090	1350	2480	4050	1290	2370	3860	1200	2200
	3-1/2	5/8	2590	1770	1770	2340	1560	1560	2240	1410	1460	2220	1390	1450	2150	1290	1390
		3/4	3730	2380	2480	3380	1910	2180	3220	1750	2050	3190	1700	2020	3090	1610	1900
		7/8	5080	2820	3290	4600	2330	2650	4390	2130	2310	4350	2070	2210	4130	1960	2020
		1	6630	3340	3740	5740	2780	2810	5330	2580	2480	5250	2520	2370	4990	2410	2200
7-1/2	1-1/2	5/8	2150	1310	1510	1870	1130	1290	1760	1040	1190	1740	1030	1170	1660	940	1110
		3/4	2890	1770	1980	2550	1330	1690	2400	1170	1580	2380	1130	1550	2280	1040	1480
		7/8	3780	1920	2520	3360	1440	2170	3180	1260	2030	3150	1210	1990	3030	1100	1900
		1	4820	2040	3120	4310	1530	2700	4090	1350	2630	4050	1290	2480	3860	1200	2390
	3-1/2	5/8	2590	1770	1770	2340	1560	1560	2240	1410	1460	2220	1390	1450	2150	1290	1390
		3/4	3730	2380	2480	3380	1910	2180	3220	1750	2050	3190	1700	2020	3090	1610	1940
		7/8	5080	2820	3290	4600	2330	2690	4390	2130	2720	4350	2070	2670	4130	1960	2560
		1	6630	3340	4190	5740	2780	3680	5330	2580	3380	5250	2520	3230	4990	2410	3000

1. Tabulated lateral design values, Z, for bolted connections shall be multiplied by all applicable adjustment factors (see Table 11.3.1).
2. Tabulated lateral design values, Z, are for "full-body diameter" bolts (see Appendix Table L1) with bolt bending yield strength, F_{yb}, of 45,000 psi.

Landowner:		Preparer:	RGD	Version 1.2.1
County:		Date:	10-Feb-23	6/21/20102
Component Description:				By: ASH

LATERAL DESIGN VALUE OF SPECIALITY NAILS

Reference 11.3.1, NDS 2001 Edition.

NAILS Bearing Block to post (GRAVITY)

Nail Length =		3.25	In.	
Nail Diameter =		0.131	In.	
Main Member Thickness	t(m) =	7.000	In	post
Side Member Thickness	t(s) =	1.500	In	Block
Dowel Bearing Strength Main Member	F(em) =	5550	psi	(See Table 11.3.2)
Dowel Bearing Strength Side Member	F(es) =	5550	psi	(See Table 11.3.2)

Nail Length	L=	3.25	In		
Bending Yield Strength of Nail	F(yb) =	100000	psi		
Nail Diameter	D =	0.131	In		
	K(D) =	2.2			
Penetration of nail in main member	p=	1.75	in	=	13.4 D

Lateral Design Value Z = 107 lbs/Nail
Based on Yield Mode, Not Adjusted for Main Member Penetration

Lateral Design Value Z = 107 lbs/Nail
Adjusted for Main Member Penetration, See Footnote 2, Table 11N, NDS

ADJUSTED LATERAL DESIGN VALUE OF SPECIALITY NAILS

$Z' = Z \cdot C_D \cdot C_M \cdot C_t \cdot C_{eg} \cdot C_{di} \cdot C_{tn}$

Load Duration Factor (Table 2.3.2)	C_D =	1.15	Snow Load	
Wet Service Factor	C_m =	1		(See Table 10.3.3)
Temperature Factor	C_t =	1		(See Table 10.3.4)
End Grain Factor	C_{eg} =	1		(0.67 if applies)
Diaphragm Factor	C_{di} =	1		(1.1 if applies)
Toe-Nail Factor	C_{tn} =	1		(0.83 if applies)

Adjusted Lateral Design Value Z' = 123.05 lbs/Nail

REQUIRED NUMBER OF NAILS

$$\#\ \text{Nails} = \frac{P}{Z'}$$

Required Lateral Load	P =		lbs
Required Number of Nails	# =	0.0	Nails

CONCLUSION

Use 0 3.25 In. Long x 0.131 In. Diameter Nails

Landowner:		Preparer:	RGD
County:		Date:	10-Feb-23
Component Description:			

Version 1.2.1
6/21/20102
By: ASH

LATERAL DESIGN VALUE OF SPECIALITY NAILS

NAILS LVL to POST (GRAVITY)

Reference 11.3.1, NDS 2001 Edition.

Nail Length =		3.25	In.	
Nail Diameter =		0.131	In.	
Main Member Thickness	t(m) =	7.000	In	POST
Side Member Thickness	t(s) =	1.750	In	LVL
Dowel Bearing Strength Main Member	F(em) =	5550	psi	(See Table 11.3.2)
Dowel Bearing Strength Side Member	F(es) =	3650	psi	(See Table 11.3.2)

Nail Length	L=	3.25	In		
Bending Yield Strength of Nail	F(yb) =	100000	psi		
Nail Diameter	D =	0.131	In		
	K(D) =	2.2			
Penetration of nail in main member	p=	1.5	in	=	11.5 D

Lateral Design Value Z = 95 lbs/Nail
Based on Yield Mode, Not Adjusted for Main Member Penetration

Lateral Design Value Z = 95 lbs/Nail
Adjusted for Main Member Penetration, See Footnote 2, Table 11N, NDS

ADJUSTED LATERAL DESIGN VALUE OF SPECIALITY NAILS

$Z' = Z \cdot C_D \cdot C_M \cdot C_t \cdot C_{eg} \cdot C_{di} \cdot C_{tn}$

Load Duration Factor (Table 2.3.2)	C_D =	1.15	Snow Load – GRAVITY	
Wet Service Factor	C_m =	1		(See Table 10.3.3)
Temperature Factor	C_t =	1		(See Table 10.3.4)
End Grain Factor	C_{eg} =	1		(0.67 if applies)
Diaphragm Factor	C_{di} =	1		(1.1 if applies)
Toe-Nail Factor	C_{tn} =	1		(0.83 if applies)

Adjusted Lateral Design Value Z' = 109.25 lbs/Nail

REQUIRED NUMBER OF NAILS

$$\text{\# Nails} = \frac{P}{Z'}$$

Required Lateral Load	P =		lbs
Required Number of Nails	# =	0.0	Nails

CONCLUSION

Landowner:		Preparer:	RGD
County:		Date:	10-Feb-23
Component Description:			

Version 1.2.1
6/21/20102
By: ASH

LATERAL DESIGN VALUE OF SPECIALITY NAILS

Reference 11.3.1, NDS 2001 Edition.

* NAILS LVL to POST CONNECTION (UPLIFT)

Nail Length =		3.25	In.	
Nail Diameter =		0.131	In.	
Main Member Thickness	t(m) =	7.000	In	POST
Side Member Thickness	t(s) =	1.750	In	KERTO BOUGHTOUT MASTER PLANK MASTER PLANK SAYS S.G = .44
Dowel Bearing Strength Main Member	F(em) =	5550	psi	(See Table 11.3.2)
Dowel Bearing Strength Side Member	F(es) =	3650	psi	(See Table 11.3.2)

Nail Length	L=	3.25	In	
Bending Yield Strength of Nail	F(yb) =	100000	psi	
Nail Diameter	D =	0.131	In	
	K(D) =	2.2		
Penetration of nail in main member	p=	1.5	in	= 11.5 D

Lateral Design Value Z = 95 lbs/Nail
Based on Yield Mode, Not Adjusted for Main Member Penetration

Lateral Design Value Z = 95 lbs/Nail
Adjusted for Main Member Penetration, See Footnote 2, Table 11N, NDS

ADJUSTED LATERAL DESIGN VALUE OF SPECIALITY NAILS

$Z' = Z \cdot C_D \cdot C_M \cdot C_t \cdot C_{eg} \cdot C_{di} \cdot C_{tn}$

Load Duration Factor (Table 2.3.2)	C_D =	1.6	Wind/Earthquake Load UPLIFT
Wet Service Factor	C_m =	1	(See Table 10.3.3)
Temperature Factor	C_t =	1	(See Table 10.3.4)
End Grain Factor	C_{eg} =	1	(0.67 if applies)
Diaphragm Factor	C_{di} =	1	(1.1 if applies)
Toe-Nail Factor	C_{tn} =	1	(0.83 if applies)

Adjusted Lateral Design Value Z' = 152 lbs/Nail

REQUIRED NUMBER OF NAILS

$$\text{\# Nails} = \frac{P}{Z'}$$

Required Lateral Load	P =		lbs
Required Number of Nails	# =	0.0	Nails

CONCLUSION

SCENARIO #2: 50' SPAN W/ 8' OVERHANG
20' HEADER SPAN
(16' TRUE ENTRANCE)

TRUSS LOAD "P": $\left(\frac{50}{2} + 8'\text{O.H}\right) \times 40\text{psf} \times 4'\text{ TRUSS SPACING} = 5280\#$

* TRY 7"X16" PSL BY "TRUSJOIST"

A) MOMENT CHECK:
$M_{REQ} = 59400$ FT-LBS (BEAM ANALYSIS) PASS
$M_{AVAIL} = 69905$ FT-LBS

B) BENDING CHECK:
$f_{b\,ACTUAL} = \frac{M}{S} = \frac{59400\,(12/1)}{298.7}$

$= 2386.3$ psi

$S = \frac{bd^2}{6} = \frac{7(16)^2}{6}$

$= 298.7\ in^3$

$Fb_{AVAIL} = 2900 \times 1.15 \times \left[\frac{12}{16}\right]^{.111}$ PASS

$= 3230$ psi

.969

C) SHEAR CHECK:
$f_{v\,ACTUAL} = \frac{1.5(V)}{A} = \frac{1.5(11130)}{112}$

$= 149$ psi PASS

$A = 7" \times 16" = 112\ in^2$

$V = 11130\#$
(FROM BEAM ANALYSIS)

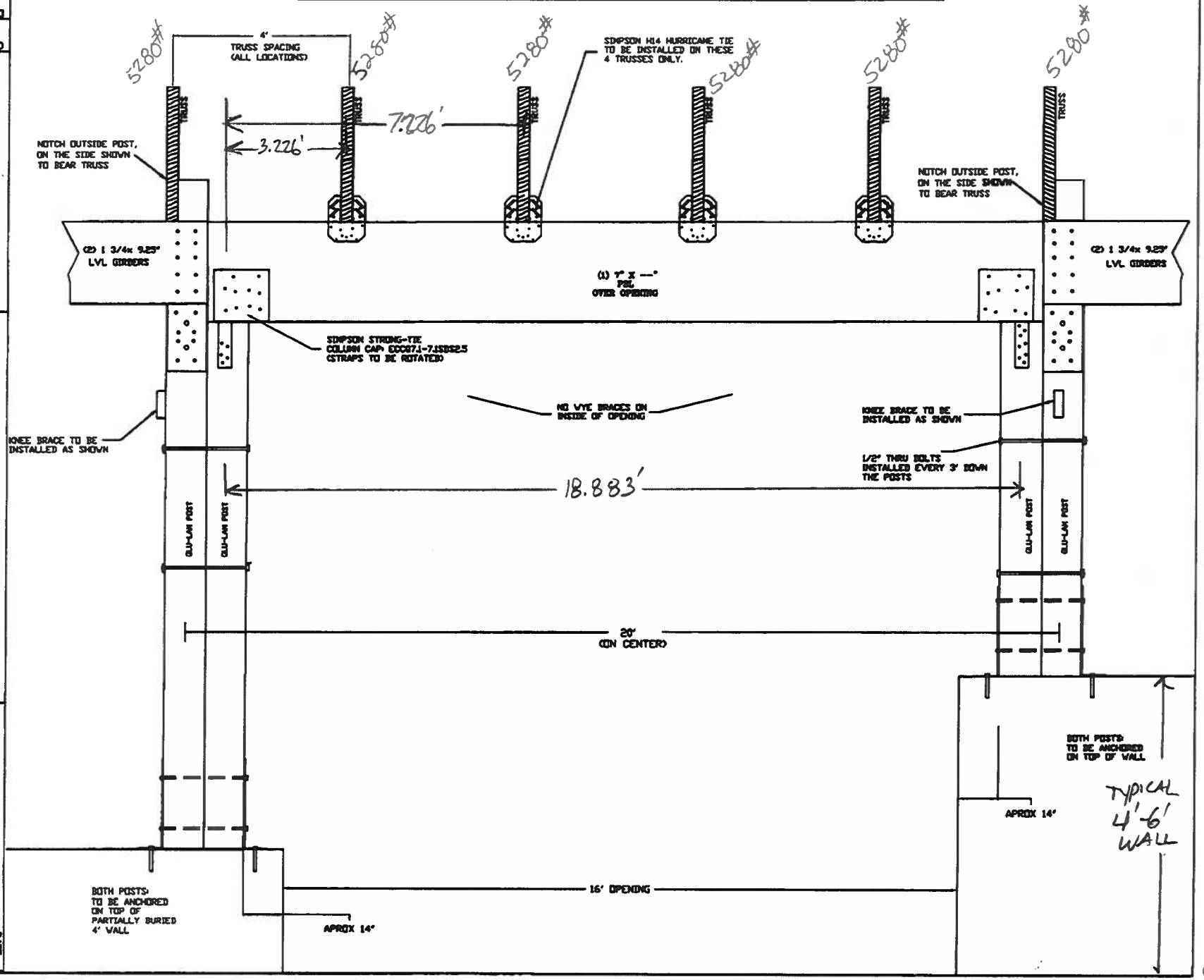
$F_{v\,AVAIL} = 290 \times 1.15 = 333.5$ psi

D) DEFLECTION CHECK:
$\Delta_{ACTUAL} = .803"$ PASS

$\Delta_{ALLOWED} = \frac{L}{180} = \frac{18.883\,(12/1)}{180} = 1.259"$

USE 7" X16" PSL

FASTENER REQUIREMENTS AT SIDE ENTRANCE LOCATION



"BEAMANAL.xls" Program
Version 2.3

SINGLE-SPAN BEAM ANALYSIS

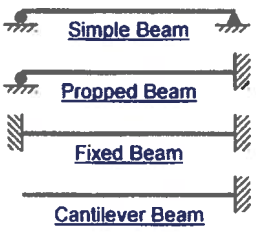
For Simple, Propped, Fixed, or Cantilever Beams

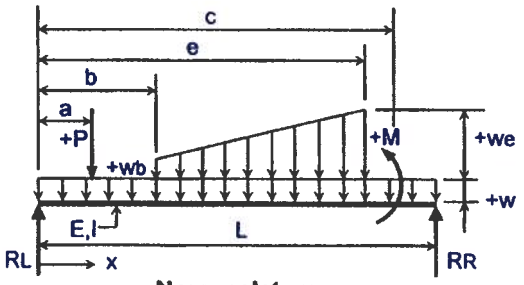
Job Name:		Subject:			
Job Number:	50' SPAN W/ 8' O.H	Originator:		Checker:	

Input Data:

Beam Data:

Span Type?	Simple	
Span, L =	18.8830	ft.
Modulus, E =	2000	ksi
Inertia, I =	2389.00	in.^4





Nomenclature

Beam Loadings:

Full Uniform:

w = 0.0350 kips/ft.

Distributed:	Start b (ft.)	Start Wb (kips/ft.)	End e (ft.)	End We (kips/ft.)
#1:				
#2:				
#3:				
#4:				
#5:				
#6:				
#7:				
#8:				

Point Loads:	a (ft.)	P (kips)
#1:	0.0000	0.00
#2:	3.2260	5.28
#3:	7.2260	5.28
#4:	11.2260	5.28
#5:	15.2260	5.28
#6:	18.8830	0.00
#7:		
#8:		
#9:		
#10:		
#11:		
#12:		
#13:		
#14:		
#15:		

Moments:	c (ft.)	M (ft-kips)
#1:		
#2:		
#3:		
#4:		

Results:

Reactions:

RL =	11.13 k	RR =	10.65 k
ML =	N.A.	MR =	N.A.

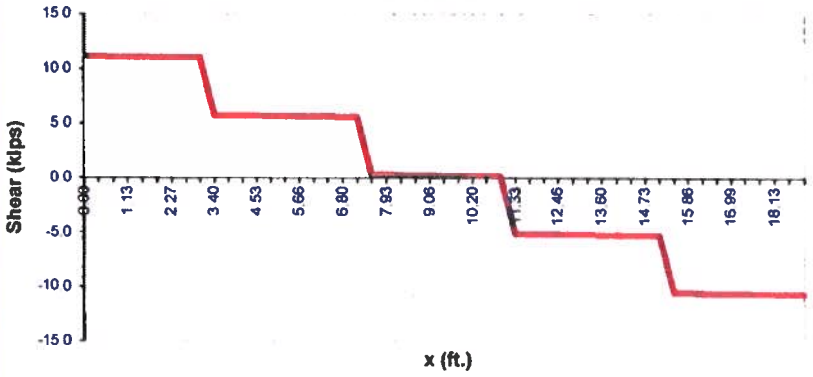
Maximum Moments:

+M(max) =	59.40 ft-k	@ x =	11.23 ft.
-M(max) =	0.00 ft-k	@ x =	0.00 ft.

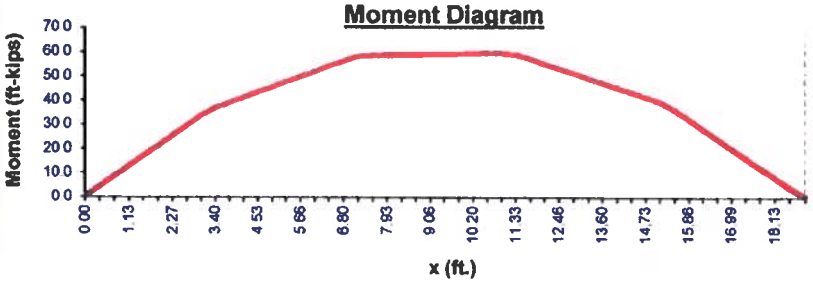
Maximum Deflections:

-Δ(max) =	-0.803 in.	@ x =	9.43 ft.
+Δ(max) =	0.000 in.	@ x =	0.00 ft.
Δ(ratio) =	L/282		

Shear Diagram



Moment Diagram



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50' SPAN W/

"BEAMANAL.xls" Program
Version 2.3

Tabulation of Single-Span Beam Shear, Moment, Slope, and Deflection for 50 Equal Segments					
Point #	x (ft.)	Shear (k)	Moment (ft-k)	Slope or Rotation (deg.)	Deflection (in.)
1	0.0000	11.13	0.00	-0.6489	0.0000
2	0.3777	11.12	4.20	-0.6476	-0.0513
3	0.7553	11.11	8.40	-0.6435	-0.1024
4	1.1330	11.09	12.59	-0.6366	-0.1530
5	1.5106	11.08	16.78	-0.6271	-0.2030
6	1.8883	11.07	20.96	-0.6147	-0.2521
7	2.2660	11.05	25.13	-0.5997	-0.3002
8	2.6436	11.04	29.31	-0.5820	-0.3469
9	3.0213	11.03	33.47	-0.5615	-0.3922
10	3.3989	5.73	36.72	-0.5384	-0.4357
11	3.7766	5.72	38.88	-0.5138	-0.4773
12	4.1543	5.71	41.04	-0.4877	-0.5169
13	4.5319	5.69	43.19	-0.4603	-0.5544
14	4.9096	5.68	45.34	-0.4314	-0.5897
15	5.2872	5.67	47.48	-0.4011	-0.6226
16	5.6649	5.65	49.62	-0.3695	-0.6531
17	6.0426	5.64	51.75	-0.3364	-0.6811
18	6.4202	5.63	53.88	-0.3020	-0.7063
19	6.7979	5.61	56.00	-0.2661	-0.7288
20	7.1755	5.60	58.12	-0.2289	-0.7484
21	7.5532	0.31	58.50	-0.1908	-0.7650
22	7.9309	0.29	58.62	-0.1526	-0.7786
23	8.3085	0.28	58.73	-0.1144	-0.7891
24	8.6862	0.27	58.83	-0.0760	-0.7967
25	9.0638	0.25	58.93	-0.0376	-0.8012
26	9.4415	0.24	59.02	0.0008	-0.8026
27	9.8192	0.23	59.11	0.0393	-0.8010
28	10.1968	0.21	59.19	0.0779	-0.7964
29	10.5745	0.20	59.27	0.1165	-0.7887
30	10.9521	0.19	59.35	0.1552	-0.7779
31	11.3298	-5.11	58.87	0.1939	-0.7641
32	11.7075	-5.12	56.94	0.2317	-0.7473
33	12.0851	-5.13	55.00	0.2682	-0.7275
34	12.4628	-5.14	53.06	0.3034	-0.7049
35	12.8404	-5.16	51.12	0.3374	-0.6796
36	13.2181	-5.17	49.16	0.3701	-0.6516
37	13.5958	-5.18	47.21	0.4015	-0.6211
38	13.9734	-5.20	45.25	0.4316	-0.5881
39	14.3511	-5.21	43.28	0.4605	-0.5528
40	14.7287	-5.22	41.31	0.4881	-0.5153
41	15.1064	-5.24	39.34	0.5144	-0.4756
42	15.4841	-10.53	35.99	0.5391	-0.4340
43	15.8617	-10.54	32.02	0.5613	-0.3904
44	16.2394	-10.56	28.03	0.5808	-0.3452
45	16.6170	-10.57	24.04	0.5978	-0.2986
46	16.9947	-10.58	20.05	0.6122	-0.2507
47	17.3724	-10.60	16.05	0.6240	-0.2018
48	17.7500	-10.61	12.04	0.6331	-0.1521
49	18.1277	-10.62	8.03	0.6397	-0.1017
50	18.5053	-10.64	4.02	0.6436	-0.0510
51	18.8830	-10.65	0.00	0.6449	0.0000

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DESIGN PROPERTIES

Design Stresses

Grade	Orientation	G Shear Modulus of Elasticity (psi)	E Modulus of Elasticity (psi)	E_{adj} Adjusted Modulus of Elasticity[1] (psi)	F_b Flexural Stress[2] (psi)	F_t Tension Stress[3] (psi)	$F_{c\perp}$ Compression Perpendicular to Grain[4] (psi)	$F_{c\parallel}$ Compression Parallel to Grain (psi)	F_v Horizontal Shear Parallel to Grain (psi)	SG Equivalent Specific Gravity[5]
TimberStrand® LSL										
1.3E	Beam/Column	81,250	1.3×10^6	660,750	1,700	1,075	680	1,400	400	0.50[6]
	Plank	81,250	1.3×10^6	660,750	1,900[7]	1,075	435	1,400	150	0.50[6]
1.55E	Beam	96,875	1.55×10^6	787,815	2,325	1,070[8]	800	2,050	310[8]	0.50[6]
Microllam® LVL										
1.9E	Beam	118,750	1.9×10^6	965,710	2,600	1,555	750	2,510	285	0.50
Parallam® PSL										
1.8E	Column	112,500	1.8×10^6	914,880	2,400[9]	1,755	425[9]	2,500	190[9]	0.50
2.0E	Beam	125,000	2.0×10^6	1,016,535	2,900	2,025	750	2,900[10]	290	0.50

(1) Reference modulus of elasticity for beam stability and column stability calculations, per NDS® 2005.

(2) For 12" depth. For other depths, multiply F_b by the appropriate factor as follows:
- For TimberStrand® LSL, multiply by $\left[\frac{12}{d}\right]^{0.092}$
- For Microllam® LVL, multiply by $\left[\frac{12}{d}\right]^{0.136}$
- For Parallam® PSL, multiply by $\left[\frac{12}{d}\right]^{0.111}$

(3) F_t has been adjusted to reflect the volume effects for most standard applications.

(4) $F_{c\perp}$ may not be increased for duration of load.

(5) For lateral connection design only.

(6) Specific gravity of 0.58 may be used for bolts installed perpendicular to face and loaded perpendicular to grain.

(7) Values are for thickness up to 3½".

(8) Values account for large hole capabilities. See Allowable Holes on page 36.

(9) Values are for plank orientation.

(10) For column applications, use $F_{c\parallel}$ of 500 psi.

General Assumptions for Trus Joist® Beams

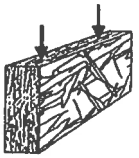
- Lateral support is required at bearing and along the span at 24" on-center, maximum.
- Bearing lengths are based on each product's bearing stress for applicable grade and orientation.
- All members 7¼" and less in depth are restricted to a maximum deflection of 1/16".
- Beams that are 1¾" x 16" and deeper require multiple plies.
- No camber.
- Beams and columns must remain straight to within $^{5L}/_{4608}$ (in.) of true alignment. L is the unrestrained length of the member in feet.
- Tables on pages 8–15 include load reductions applied in accordance with code.

For applications not covered in this brochure, contact your Weyerhaeuser representative.

See pages 38 and 39 for multiple-member beam connections.

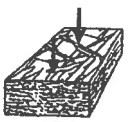
TimberStrand® LSL, Microllam® LVL, and untreated Parallam® PSL are intended for dry-use applications

Beam Orientation



Column Orientation

Plank Orientation



DESIGN PROPERTIES

Allowable Design Properties[1] (100% Load Duration)

Grade	Width	Design Property	Depth 4⅛"	5½"	5½" Plank orientation	7¼"	8¾"	9¼"	9½"	11⅞"	11⅞"	14"	16"	18"	20"
TimberStrand® LSL															
1.3E	3½"	Moment (ft-lbs)	1,735	2,685	1,780	4,550	6,335	7,240		10,520					
		Shear (lbs)	4,085	5,135	1,925	6,765	8,050	8,635		10,500					
		Moment of Inertia (in.⁴)	24	49	20	111	187	231		415					
		Weight (plf)	4.5	5.6	5.6	7.4	8.8	9.4		11.5					
1.55E	1¼"	Moment (ft-lbs)						4,950	5,210	7,195	7,975	10,920	14,090		
		Shear (lbs)						3,345	3,435	4,070	4,295	5,065	5,785		
		Moment of Inertia (in.⁴)						115	125	208	244	400	597		
		Weight (plf)						5.1	5.2	6.2	6.5	7.7	8.8		
	3½"	Moment (ft-lbs)						9,905	10,420	14,390	15,955	21,840	28,180		
		Shear (lbs)						6,690	6,870	8,140	8,590	10,125	11,575		
		Moment of Inertia (in.⁴)						231	250	415	488	800	1,195		
		Weight (plf)						10.1	10.4	12.3	13	15.3	17.5		
Microllam® LVL															
1.9E	1¼"	Moment (ft-lbs)		2,125		3,555		5,600	5,885	8,070	8,925	12,130	15,555	19,375	23,580
		Shear (lbs)		1,830		2,410		3,075	3,160	3,740	3,950	4,655	5,320	5,985	6,650
		Moment of Inertia (in.⁴)		24		56		115	125	208	244	400	597	851	1,167
		Weight (plf)		2.8		3.7		4.7	4.8	5.7	6.1	7.1	8.2	9.2	10.2
Parallam® PSL															
2.0E	3½"	Moment (ft-lbs)						12,415	13,055	17,970	19,900	27,160	34,955	43,665	
		Shear (lbs)						6,260	6,430	7,615	8,035	9,475	10,825	12,180	
		Moment of Inertia (in.⁴)						231	250	415	488	800	1,195	1,701	
		Weight (plf)						10.1	10.4	12.3	13.0	15.3	17.5	19.7	
	5¼"	Moment (ft-lbs)						18,625	19,585	26,955	29,855	40,740	52,430	65,495	
		Shear (lbs)						9,390	9,645	11,420	12,055	14,210	16,240	18,270	
		Moment of Inertia (in.⁴)						346	375	623	733	1,201	1,792	2,552	
		Weight (plf)						15.2	15.6	18.5	19.5	23.0	26.3	29.5	
	7"	Moment (ft-lbs)						24,830	26,115	35,940	39,805	54,325	69,905	87,325	
		Shear (lbs)						12,520	12,855	15,225	16,070	18,945	21,655	24,360	
		Moment of Inertia (in.⁴)						462	500	831	977	1,601	2,389	3,402	
		Weight (plf)						20.2	20.8	24.6	26.0	30.6	35.0	39.4	

(1) For product in beam orientation, unless otherwise noted.

Some sizes may not be available in your region.

PRODUCT STORAGE

Protect product from sun and water

CAUTION:
Wrap is slippery when wet or icy

Use support blocks at 10' on-center to keep bundles out of mud and water

2-17-23

HURRICANE STRAP REQUIREMENTS

1) 40' SPAN W/ 8' O.H. :

UPLIFT PER TRUSS = $\left(\frac{40}{2}+8\right) \times 4' \times (16psf\uparrow - 5psf\downarrow)$ ← TRUSS SPACING

$= 1232^{\#}\uparrow$ ACTUAL

SIMPSON STRONG TIE HURRICANE TIE OPTIONS:

OPTION #1 : (2) H10A TIES — $U_{AVAIL} = 1040 \times 2 = 2080^{\#}$

OPTION #2 : (1) H14 TIES — $U_{AVAIL} = 1275^{\#}$

★ 2) 50' SPAN W/ 8' O.H. :

UPLIFT PER TRUSS = $\left(\frac{50}{2}+8\right) \times 4'_{\text{TRUSS SPACING}} \times (16psf\uparrow - 7psf\downarrow)$

$= 1188^{\#}\uparrow$ ACTUAL

SIMPSON STRONG TIE HURRICANE TIE OPTIONS:

OPTION #1 : (2) H10A TIES — $U_{AVAIL} = 2080^{\#}$

→ OPTION #2 : (1) H14 TIE — $U_{AVAIL} = 1275^{\#}$

3) 60' SPAN W/ 8' O.H. :

UPLIFT PER TRUSS = $\left(\frac{60}{2}+8\right) \times 4'_{\text{TRUSS SPACING}} \times (16psf\uparrow - 7psf\downarrow)$

$= 1368^{\#}\uparrow$ ACTUAL

SIMPSON STRONG TIE HURRICANE TIE OPTIONS:

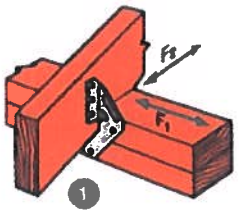
OPTION #1 : (2) H10A TIES — $U_{AVAIL} = 2080^{\#}$

OPTION #2 : (1) H10A + (1) H14 — $U_{AVAIL} = 1040 + 1275 = 2315^{\#}$

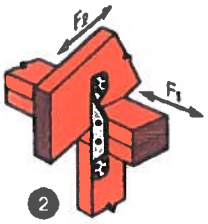
OPTION #3 : (1) H16 TIE — $U_{AVAIL} = 1370^{\#}$

H/TSP

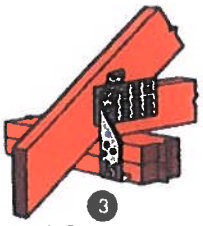
Seismic and Hurricane Ties (cont.)



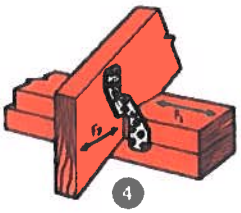
1 **H1 Installation**
(H1.81Z similar)



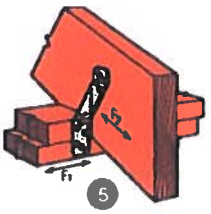
2 **H2A Installation**



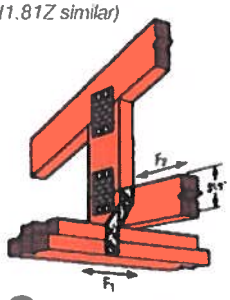
3 **TSP Installation**



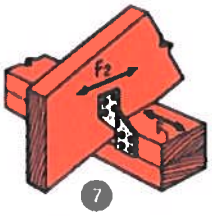
4 **H2.5A Installation**
(nails into both top plates)



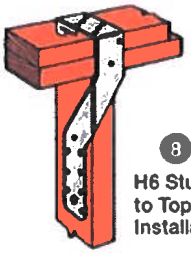
5 **H2.5T Installation**
(nails into both top plates)



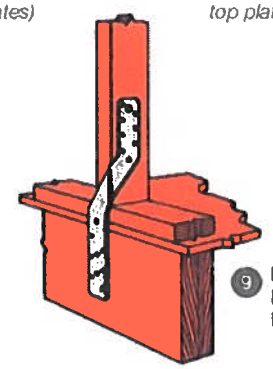
6 **H2.5T Installation**



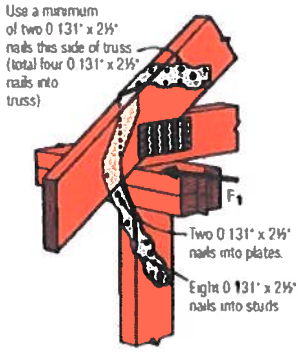
7 **H3 Installation**
(nails into upper top plate)



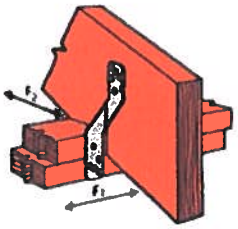
8 **H6 Stud to Top Plate Installation**



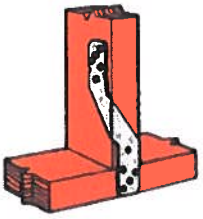
9 **H6 Stud to Rim Board Installation**



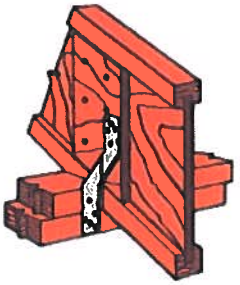
10 **H7Z Installation**



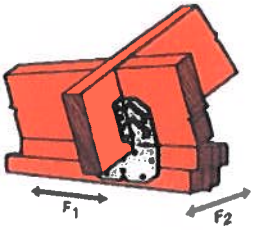
11 **H8 Attaching Rafter to Double Top Plates**



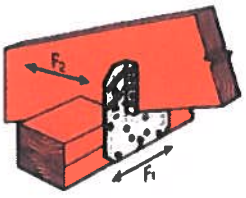
12 **H8 attaching Stud to Sill**
((4) 0.131" x 2½" nails into plate, (5) 0.131" x 2½" nails into stud, refer to footnote 3 for loads)



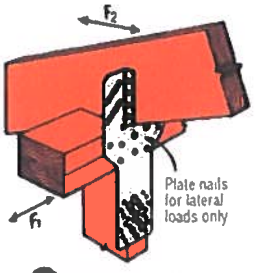
13 **H8 attaching I-Joist to Double Top Plates**



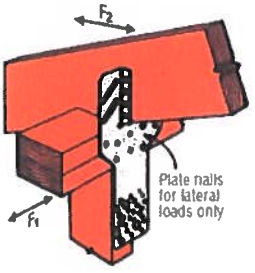
14 **H10A Field-Bent Installation**



15 **H10A Installation**



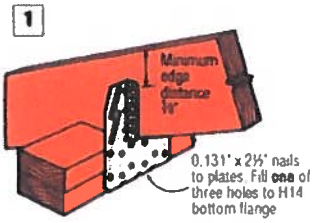
16 **H10S Installation**



17 **H10S Installation with Stud Offset**

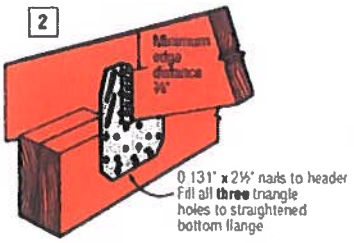
H10A optional nailing connects shear blocking to rafter. Use 0.131" x 2½" nails. Slot allows maximum field-bending up to a pitch of 6/12, bend one time only.

1



18 **H14 Installation to Double Top Plates**

2



19 **H14 Installation to Double 2x Header**

H/TSP

Seismic and Hurricane Ties

Simpson Strong-Tie hurricane ties provide a positive connection between truss/rafter and the wall of the structure to resist wind and seismic forces.

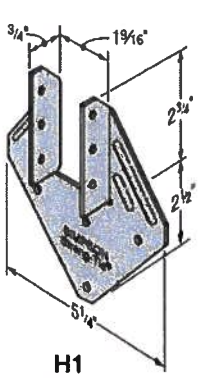
Material: See table

Finish: Galvanized. H1.81Z, H7Z and H11Z — ZMAX® coating. Some models available in stainless steel or ZMAX; see Corrosion Information, pp. 12–15 or visit **strongtie.com**.

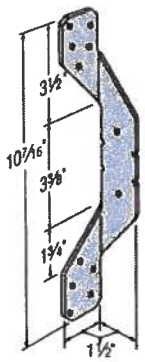
Installation:

- Use all specified fasteners; see General Notes.
- Hurricane ties can be installed with flanges facing inward or outward.
- H2.5T, H3 and H6 ties are shipped in equal quantities of right and left versions (right versions shown).
- Hurricane ties do not replace solid blocking.
- When installing ties on plated trusses (on the side opposite the truss plate) do not fasten through the truss plate from behind. This can force the truss plate off of the truss and compromise truss performance.
- H10A optional nailing to connect shear blocking, use 0.131" x 2½" nails. Slots allow maximum field bending up to a pitch of 6:12, use H10A sloped loads for field-bent installation.

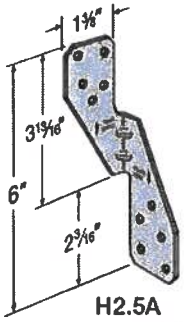
Codes: See p. 11 for Code Reference Key Chart



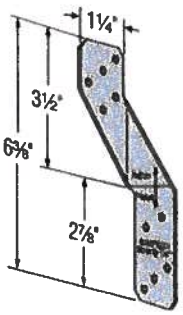
H1
(H1.81Z similar)



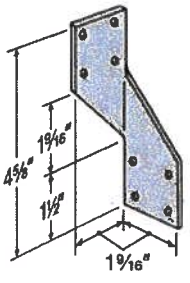
H2A
(H2ASS similar)



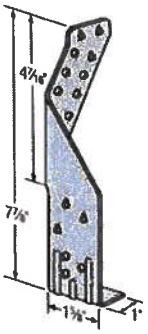
H2.5A
(H2.5ASS similar)



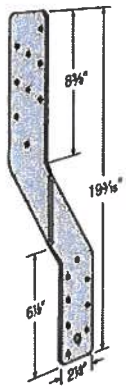
H2.5T



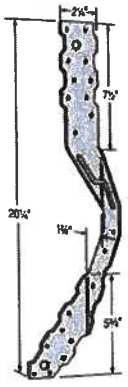
H3
(H3SS similar)



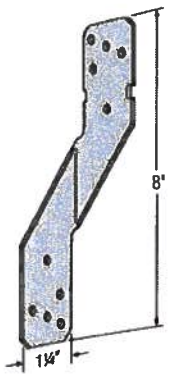
TSP



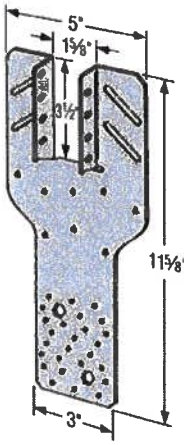
H6



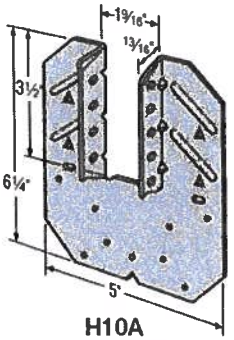
H7Z



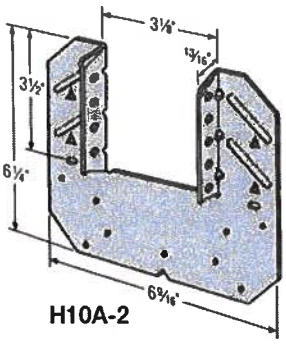
H8
(H8SS similar)



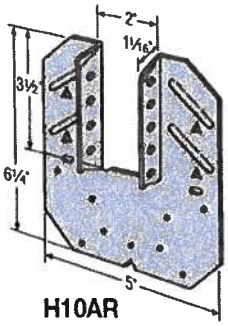
H10S



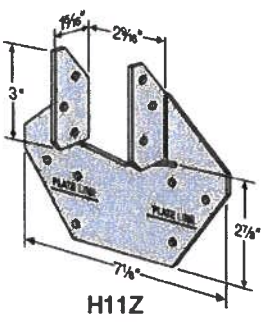
H10A
(H10ASS similar)



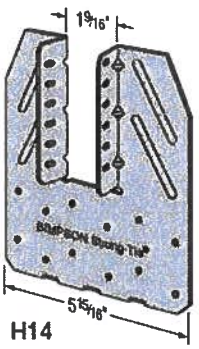
H10A-2



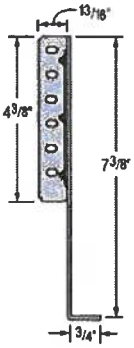
H10AR



H11Z



H14



H14 Profile

Straps and Ties

H/TSP

Seismic and Hurricane Ties (cont.)

These products are available with additional corrosion protection. For more information, see p. 14.

SS For stainless-steel fasteners, see p. 21.

SD Many of these products are approved for installation with Strong-Drive® SD Connector screws. See pp. 348–352 for more information.

	Model No.	Ga.	Fasteners (in.)			DF/SP Allowable Loads			Uplift with 0.131" x 1½" Nails (160)	SPF/HF Allowable Loads			Uplift with 0.131" x 1½" Nails (160)	Code Ref.
			To Rafters/Truss	To Plates	To Studs	Uplift (160)	Lateral (160) F_1	Lateral (160) F_2		Uplift (160)	Lateral (160) F_1	Lateral (160) F_2		
	H1	18	(6) 0.131 x 1½	(4) 0.131 x 2½	—	480	510	190	455	425	440	165	370	IBC, FL, LA
	H1.81Z	18	(6) 0.131 x 1½	(4) 0.131 x 2½	—	540	440	170	460	465	380	130	395	—
	H2A	18	(5) 0.131 x 1½	(2) 0.131 x 1½	(5) 0.131 x 1½	525	130	55	—	495	130	55	—	IBC, FL, LA
SS	H2ASS	18	(5) 0.131 x 1½	(2) 0.131 x 1½	(5) 0.131 x 1½	400	130	55	400	345	130	55	345	—
	H2.5A	18	(5) 0.131 x 2½	(5) 0.131 x 2½	—	700	110	110	625	615	110	110	540	IBC, FL, LA
SS	H2.5ASS	18	(5) 0.131 x 2½	(5) 0.131 x 2½	—	440	75	70	365	380	75	70	310	—
	H2.5T	18	(5) 0.131 x 2½	(5) 0.131 x 2½	—	590	135	145	480	565	135	145	475	IBC, FL, LA
	H3	18	(4) 0.131 x 2½	(4) 0.131 x 2½	—	400	210	170	400	365	180	145	290	
SS	H3SS	18	(4) 0.131 x 2½	(4) 0.131 x 2½	—	280	145	120	275	225	100	85	210	—
	H6 (to Plates)	16	—	(8) 0.131 x 2½	(8) 0.131 x 2½	930	—	—	—	800	—	—	—	IBC, FL, LA
	H6 (to Rim)	16	(8) 0.131 x 2½	—	(8) 0.131 x 2½	1,230	—	—	—	1,065	—	—	—	
	H7Z	16	(4) 0.131 x 2½	(2) 0.131 x 1½	(8) 0.131 x 2½	830	410	—	—	715	355	—	—	
	H8	18	(5) 0.148 x 1½	(5) 0.148 x 1½	—	780	95	90	630	710	95	90	510	
SS	H8SS	18	(5) 0.148 x 1½	(5) 0.148 x 1½	—	610	90	120	440	370	90	55	335	—
	H10A Field Bent	18	(9) 0.148 x 1½	(9) 0.148 x 1½	—	780	565	285	—	760	485	285	—	IBC, FL, LA
	H10A	18	(9) 0.148 x 1½	(9) 0.148 x 1½	—	1,040	565	285	—	1,015	485	285	—	
SS	H10ASS	18	(9) 0.148 x 1½	(9) 0.148 x 1½	—	970	565	170	—	835	485	170	—	—
	H10AR	18	(9) 0.148 x 1½	(9) 0.148 x 1½	—	1,050	490	285	—	905	420	285	—	
	H10S	18	(8) 0.131 x 1½	(8) 0.131 x 1½	(8) 0.131 x 2½	910	660	215	550	785	570	185	475	IBC, FL, LA
	H10A-2	18	(9) 0.148 x 1½	(9) 0.148 x 1½	—	1,080	680	260	—	930	585	225	—	
	H11Z	18	(6) 0.162 x 2½	(6) 0.162 x 2½	—	830	525	760	—	715	450	655	—	—
	H14	18	(12) 0.131 x 1½	(13) 0.131 x 2½	—	1,275	725	285	—	1,050	480	245	—	IBC, FL, LA
			(12) 0.131 x 1½	(15) 0.131 x 2½	—	1,340	670	230	—	1,050	480	245	—	
	TSP	16	(9) 0.148 x 1½	(6) 0.148 x 1½	—	755	310	190	—	650	265	160	—	
			(9) 0.148 x 1½	(6) 0.148 x 3	—	1,015	310	190	—	875	265	160	—	

1. See pp. 266–267 for Straps and Ties General Notes.
2. Allowable loads are for one anchor. A minimum rafter thickness of 2½" must be used when framing anchors are used on each side of the joist and on the same side of the plate (exception: connectors installed such that nails on opposite side don't interfere).
3. Allowable DF/SP uplift load for stud-to-bottom plate installation (see detail 12) is 390 lb. (H2.5A); 265 lb. (H2.5ASS); and 310 lb. (H8). For SPF/HF values, multiply these values by 0.86.
4. Allowable loads in the F_1 direction are not intended to replace diaphragm boundary members and do not account for possible cross-grain bending of the truss or rafter members.
5. When cross-grain bending or cross-grain tension cannot be avoided in the members, mechanical reinforcement to resist such forces shall be considered by the designer.
6. Hurricane ties are shown installed on the outside of the wall for clarity and assume a minimum overhang of 3½". Installation on the inside of the wall is acceptable. For uplift Continuous Load Path, connections in the same area (i.e., truss-to-plate connector and plate-to-stud connector) must be on same side of the wall.
7. Southern pine allowable uplift loads for H10A = 1,105 lb. (160), H2.5A with 0.131" x 1½" nails = 635 lb. (160) and H2.5A with 0.131" x 2½" nails = 730 lb. (160).
8. Refer to Simpson Strong-Tie® technical bulletin T-C-HTIEBEAR at **strongtie.com** for allowable bearing enhancement loads.
9. H10S can have the stud offset a maximum of 1" from the rafter (center to center) for a reduced uplift of 890 lb. (DF/SP) and 765 lb. (SPF).
10. H10S nails to plates are optional for uplift but required for lateral loads.
11. Some load values for the stainless-steel connectors shown here are lower than those for the carbon-steel versions. Ongoing test programs have shown this also to be the case with other stainless-steel connectors in the product line that are installed with nails. Visit **strongtie.com/corrosion** for updated information.
12. The allowable loads of stainless-steel connectors match carbon-steel connectors when installed with stainless-steel Strong-Drive® SCNR Ring-Shank Connector nails. For more information, refer to engineering letter L-F-SSNAILS at **strongtie.com**.
13. Simpson Strong-Tie offers stainless-steel Strong-Drive SCNR Ring-Shank Connector nails. For bulk SCNR nails, see p. 345; for collated SCNR nails, see p. 346. For general fastener information, see pp. 21–22.
14. Allowable DF/SP/SPF uplift load for the H2.5A fastened to a 2x4 truss bottom chord and double top plates using five 0.131" x 1½" nails in the top plates and three 0.131" x 1½" nails in the lowest three flange holes into the truss bottom chord is 260 lb. (160).
15. For TSP installed stud to single plate see pp. 280–281.
16. For simultaneous loads in more than one direction, the connector must be evaluated using either the Unity Equation or the 75% Rule, as described in Straps and Ties General Notes on p. 267.
17. **Fasteners:** Nail dimensions are listed diameter by length. See pp. 21–22 for fastener information.

SIMPSON Strong-Tie

H

Seismic and Hurricane Ties

The hurricane tie series features various configurations of wind and seismic ties for trusses and rafters. The H16 series has a presloped seat of 5/12 for double trusses.

The presloped 5/12 seat of the H16 provides for a tight fit and reduced deflection. The strap length provides for various truss heel heights ranging from 13½" maximum to 4" minimum

The HGA10 attaches to gable trusses and provides good lateral wind resistance. The HS24 attaches the bottom chord of a truss or rafter at pitches from 0/12 to 4/12 to double 2x4 top plates. Double-shear nailing allows for higher lateral resistance.

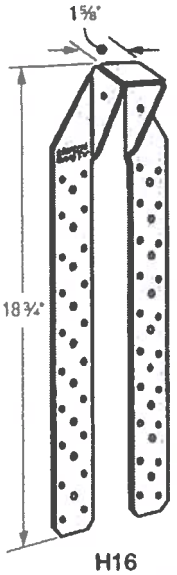
Material: See table

Finish: Galvanized; HGA also available in HDG; see Corrosion Information, pp. 12–15

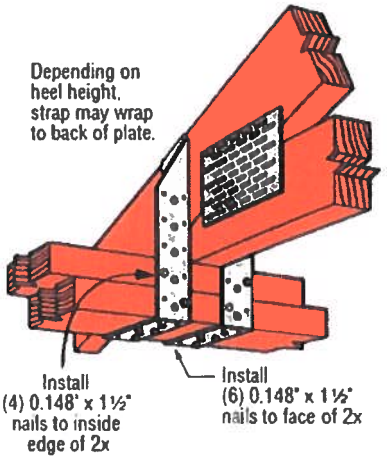
Installation:

- Use all specified fasteners; see General Notes.
- HGA10KT: sold as a kit with (10) HGA10 connectors and (40) ¼" x 1½" Strong-Drive® SDS Heavy-Duty Connector screws and (40) ¼" x 3" SDS screws. Additional screws sold separately to install with all ¼" x 1½" SDS screws (SDS25112)
- HS24 requires slant nailing only when bottom chord of truss or rafter has no slope.

Codes: See p. 11 for Code Reference Key Chart



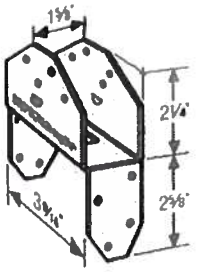
H16
Presloped at 5/12.
Pitch of 3/12 to 7/12 is acceptable.



H16 Installation

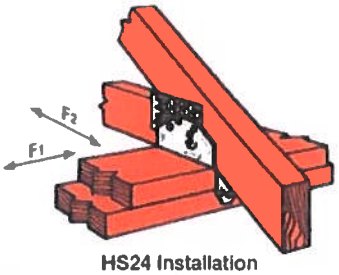
These products are available with additional corrosion protection. For more information, see p. 14.

Model No.	Ga.	Fasteners (in.) To Rafters/Truss	Fasteners (in.) To Plates	DF/SP Allowable Loads Uplift (160)	DF/SP Allowable Loads Lateral (160) F_1	DF/SP Allowable Loads Lateral (160) F_2	DF/SP Allowable Loads Lateral (160) F_3	SPF/HF Allowable Loads Uplift (160)	SPF/HF Allowable Loads Lateral (160) F_1	SPF/HF Allowable Loads Lateral (160) F_2	SPF/HF Allowable Loads Lateral (160) F_3	Code Ref.
HGA10KT	14	(4) ¼ x 1½ SDS	(4) ¼ x 3 SDS	650	1,165	940	815	500	840	675	495	IBC, FL, LA
			(4) ¼ x 1½ SDS	605	500	720	—	435	360	520	—	
HS24	**18**	**(8) 0.131 x 1½ and (2) 0.131 x 2½ slant**	**(8) 0.131 x 2½**	605	645	1,100	—	**520**	**555**	**945**	—	
H16	18	(2) 0.148 x 1½	(10) 0.148 x 1½	1,370	—	—	—	1,180	—	—	—	

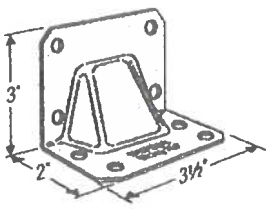


HS24

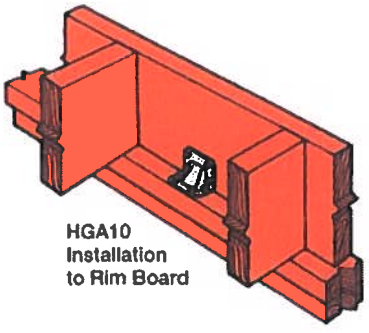
1. See pp. 266–267 for Straps and Ties General Notes.
2. When cross-grain bending or cross-grain tension cannot be avoided in the members, mechanical reinforcement to resist such forces shall be considered by the Designer.
3. HS24 DF/SP allowable loads without slant nailing are 605 lb. (uplift), 590 lb. (F_1), 640 lb. (F_2). For SPF/HF loads multiply these values by 0.86.
4. Allowable loads in the F_1 direction are not intended to replace diaphragm boundary members or prevent cross-grain bending of the truss or rafter members. Additional shear transfer elements shall be considered where there may be effects of cross-grain bending or tension.
5. Fasteners: Nail dimensions in the table are diameter by length. SDS screws are Simpson Strong-Tie® Strong-Drive® SDS Heavy-Duty Connector screws. See pp. 21–22 for fastener information.



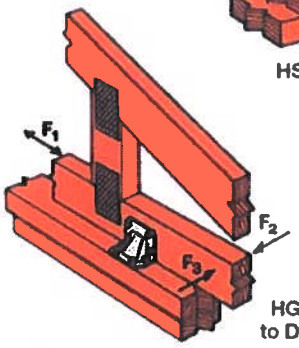
HS24 Installation



HGA10



HGA10 Installation to Rim Board



HGA10 Installation to Double Top Plates

CCQ/ECCQ

Column Caps

This product is preferable to similar connectors because of (a) easier installation, (b) higher loads, (c) lower installed cost, or a combination of these features.

Column caps provide a strong connection for column-beam combinations. This design uses Strong-Drive® SDS Heavy-Duty Connector screws to provide faster installation and provides a greater net section area of the column compared to bolts. The SDS screws provide for a lower profile compared to standard through bolts.

Material: CCQ3, ECCQ3, CCQ4, CCQ4.62, ECCQ4, ECCQ4.62, CCQ6, ECCQ6 — 7 gauge; all others — 3 gauge

Finish: Simpson Strong-Tie gray paint; available in HDG and stainless steel; CCQQ and ECCQQ — no coating

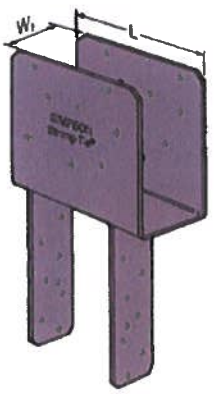
Installation:

- Install ¼" x 2½" Strong-Drive SDS Heavy-Duty Connector screws, which are provided with the column cap. (Lag screws will not achieve the same load.) Install stainless-steel Strong-Drive screws with stainless-steel connectors.
- CCQQ and ECCQQ column caps only (no straps) may be ordered for field-welding to pipe or other columns. Dimensions are same as CCQ and ECCQ. Weld by designer.
- For rough-cut lumber sizes, provide dimensions. An optional W_2 dimension may be specified with any column size given. (Note that the W_2 dimension on straps rotated 90° is limited by the W_1 dimension.)

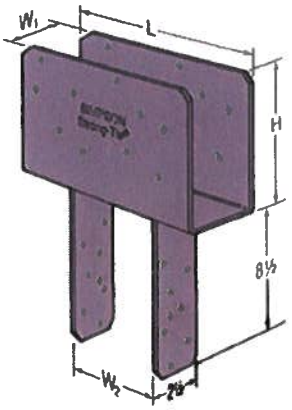
Options:

- For end conditions, specify ECCQ.
- Straps may be rotated 90° where $W_1 \geq W_2$ and for CCQ5-6.
- Other custom column caps are available. Contact Simpson Strong-Tie.

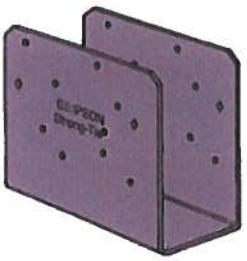
Codes: See p. 11 for Code Reference Key Chart



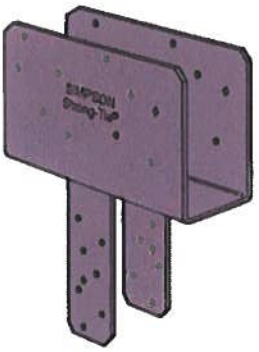
ECCQ46SDS2.5



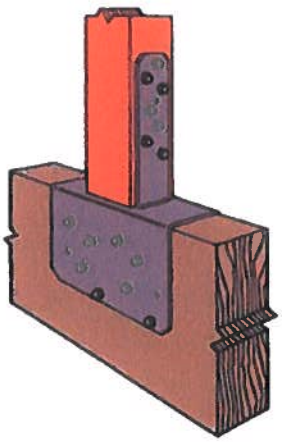
CCQ46SDS2.5



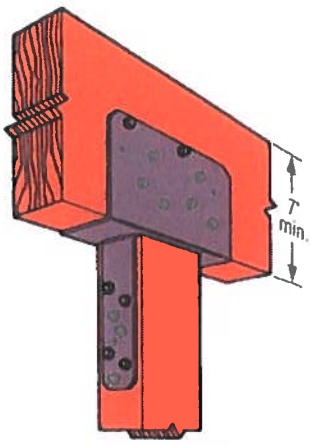
CCQQ4-SDS2.5
(no coating)



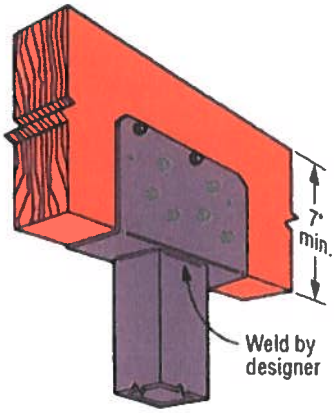
Optional CCQ with Straps Rotated 90°



Inverted CCQ44SDS2.5 Post-to-Beam Installation



Typical CCQ46SDS2.5 Installation



CCQQ Installation on Steel Column

Specify post-to-beam connections

CCQ/ECCQ

Column Caps (cont.)

These products are available with additional corrosion protection. For more information, see p. 14. SS For stainless-steel fasteners, see p. 21.

Model No.	Beam Width (in.)	Dimensions (in.) W1	W2	L CCQ	L ECCQ	H	No. of ¼" x 2½" SDS Screws Beam CCQ	Beam ECCQ	Post	Allowable Loads (DF/SP) CCQ Uplift (160)	CCQ Down (100)	ECCQ Uplift (160)	ECCQ Down (100)	Code Ref.	CCQ/ECCQ Model No. (No Legs)
CCQ3-4SDS2.5	3½	3¼	3⅜	11	8½	7	16	14	14	5,370	16,980	3,465	6,125	IBC, FL, LA	CCQ03-SDS2.5 ECCQ03-SDS2.5
CCQ3-6SDS2.5	3½	3¼	5½	11	8½	7	16	14	14	5,370	21,485	3,465	10,740		
CCQ44SDS2.5	3½	3⅜	3⅜	11	8½	7	16	14	14	5,370	19,020	3,785	7,655		CCQ04-SDS2.5 ECCQ04-SDS2.5
CCQ46SDS2.5	3½	3⅜	5½	11	8½	7	16	14	14	6,785	24,065	3,785	12,030		
CCQ48SDS2.5	3½	3⅜	7½	11	8½	7	16	14	14	6,785	24,065	3,785	16,405		
CCQ4.62-3.62SDS	4½	4⅜	3⅜	11	8½	7	16	14	14	5,370	23,390	3,785	9,845		CCQ04.62-SDS2.5 ECCQ04.62-SDS2.5
CCQ4.62-4.62SDS	4½	4⅜	4⅜	11	8½	7	16	14	14	5,370	30,070	3,785	12,655		
CCQ4.62-5.50SDS	4½	4⅜	5½	11	8½	7	16	14	14	6,785	30,940	3,785	15,470		
CCQ5-4SDS2.5	5⅛	5¼	3⅜	11	8½	7	16	14	14	5,370	26,635	4,040	11,210		CCQ05-SDS2.5 ECCQ05-SDS2.5
CCQ5-6SDS2.5	5⅛	5¼	5½	11	8½	7	16	14	14	6,785	28,190	5,355	17,615		
CCQ5-8SDS2.5	5⅛	5¼	7½	11	8½	7	16	14	14	6,785	35,235	5,355	24,025		
CCQ64SDS2.5	5¼, 5½	5½	3⅜	11	8½	7	16	14	14	5,370	28,585	3,785	12,030		CCQ06-SDS2.5 ECCQ06-SDS2.5
CCQ66SDS2.5	5¼, 5½	5½	5½	11	8½	7	16	14	14	6,785	30,250	3,785	18,905		
CCQ68SDS2.5	5¼, 5½	5½	7½	11	8½	7	16	14	14	6,785	37,815	3,785	25,780		
CCQ6-7.13SDS2.5	5¼, 5½	5½	7⅛	11	8½	7	16	14	14	6,785	37,815	3,785	24,490		
CCQ74SDS2.5	6¾	6⅞	3⅜	11	8½	7	16	14	14	5,370	33,490	4,040	15,355		CCQ07-SDS2.5 ECCQ07-SDS2.5
CCQ76SDS2.5	6¾	6⅞	5½	11	8½	7	16	14	14	6,785	37,125	5,355	24,130		
CCQ77SDS2.5	6¾	6⅞	6⅞	11	8½	7	16	14	14	6,785	48,265	5,355	29,615		
CCQ78SDS2.5	6¾	6⅞	7½	11	8½	7	16	14	14	6,785	48,265	5,355	32,905		
CCQ7.1-4SDS2.5	7	7⅛	3⅜	11	8½	7	16	14	14	5,370	34,730	4,040	18,375		CCQ07.12-SDS2.5 ECCQ07.12-SDS2.5
CCQ7.1-6SDS2.5	7	7⅛	5½	11	8½	7	16	14	14	6,785	38,500	5,355	28,875		
CCQ7.1-7.1SDS2.5	7	7⅛	7⅛	11	8½	7	16	14	14	6,785	57,750	5,355	36,750		
CCQ7.1-8SDS2.5	7	7⅛	7½	11	8½	7	16	14	14	6,785	52,500	5,355	39,375		
CCQ84SDS2.5	7½	7½	3⅜	11	8½	7	16	14	14	6,785	37,210	5,355	16,405		CCQ08-SDS2.5 ECCQ08-SDS2.5
CCQ86SDS2.5	7½	7½	5½	11	8½	7	16	14	14	6,785	41,250	5,355	25,780		
CCQ88SDS2.5	7½	7½	7½	11	8½	7	16	14	14	6,785	51,565	5,355	35,155		
CCQ94SDS2.5	8¾	8⅞	3⅜	11	8½	7	16	14	14	6,785	47,545	5,355	19,905		CCQ09-SDS2.5 ECCQ09-SDS2.5
CCQ96SDS2.5	8¾	8⅞	5½	11	8½	7	16	14	14	6,785	48,125	5,355	31,280		
CCQ98SDS2.5	8¾	8⅞	7½	11	8½	7	16	14	14	6,785	62,565	5,355	42,655		
CCQ106SDS2.5	9¼	9½	5½	11	8½	7	16	14	14	6,785	52,250	5,355	32,655		CCQ10-SDS2.5 ECCQ10-SDS2.5

1. Uplift loads have been increased for earthquake or wind loading with no further increase allowed. Reduce where other loads govern.
2. Downloads shall be reduced where limited by capacity of the post.
3. Uplift loads do not apply to spliced conditions. Spliced conditions must be detailed by the designer to transfer tension loads between spliced members by means other than the post cap.
4. Spliced conditions must be detailed by the designer to transfer tension loads between spliced members by means other than the column cap.
5. Column sides are assumed to be aligned in the same vertical plane as the beam sides. CCQ4.62 models assume a minimum 3½"-wide post.
6. Structural composite lumber columns have sides that show either the wide face or the edges of the lumber strands/veneers known as the narrow face. Values in the tables reflect installation into the wide face. See technical bulletin T-C-SCLCLM at **strongtie.com** for load reductions resulting from narrow-face installations.
7. Beam depth must be a minimum of 7".
8. For 5¼" engineered lumber, use 5½" models.
9. CCQQ and ECCQQ welded to a steel column will achieve maximum load listed for the beam and the post cap as CCQ and ECCQ. The steel column width shall match the beam width. Weld by designer.

CHAPTER 6
Tabulated Designs

6.1 General

The tabulated designs in this *Design Guide* give complete dimensions and reinforcement details for cantilevered retaining walls varying from 3 to 22 feet in height above the top of footing, for two backfill conditions: level backfill and no surcharge,[1] and backfill sloping upward (backfill angle $\beta = \phi$).

The tabulated designs were proportioned to obtain the most economical design. Three different wall configurations were investigated:

1. Length of base was varied from $0.40h_w$ to $1.0h_w$ while the stem and base thicknesses were varied up to 24 inches with no key.
2. Length of base was varied from $0.67h_w$ to $1.0h_w$ while key depth was varied from 16 to 60 inches and the stem and base thicknesses were varied up to 50 inches.
3. Key depth was varied from 16 to 60 inches while the base length was varied from $1.0h_w$ to $1.5h_w$ and the base and stem thicknesses were varied up to 60 inches.

In the case where, for a specific wall height, any of the design requirements (i.e., factor of safety against sliding or overturning, deflection at the top of the wall) could not be met regardless what dimensions were tried, the computer program used to prepare the tabulated designs skipped this wall height. For example, on page T-13 for a sloping backfill with $\gamma = 115$ pcf, $\phi = 30°$, and $\mu = 0.45$, the tabulated designs stop at 18 feet. The design table stopped at 18 feet because, for any wall height greater than 18 feet with these soil properties, no dimensions for wall, base, and key could be found to satisfy all design requirements.

The tabulated designs present the following data:

- Concrete Dimensions & Volume. Dimensions of the stem, base and key (if needed), and concrete quantity.
- Service Load Analysis. Base soil pressures at the toe and heel, safety factors against sliding and overturning, and calculated deflection at the top of the wall.
- Stem Reinforcement. Bar size and spacing for the "O", "M" and "L_w" bars.
- Base Reinforcement. Bar size and spacing for the "P", "L_b" and "K" (if needed) bars.
- Total steel weight.

The critical starting dimension is the height of the wall from the top to the base (h_w). The tabulated designs were prepared for a 12 in. minimum depth of soil above the base at the toe (frontfill). Note that for Sloping Backfill, the tabulated designs are based upon a minimum frontfill of $0.10h_w \geq 12$ in. Frost conditions may require greater frontfill in some areas. Consideration should be given whether to use a small camber to offset tilt and deflection or to use a tapered wall to save concrete or both.

[1] *Instead of a fixed surcharge, AASHTO recommends 2 feet of added depth of fill for walls as the equivalent loading for a normal highway surcharge, provided that the wall backface is at least one foot from the edge of traffic (Article 3.11.6.4). It should usually be satisfactory to select a design tabulated for 2 feet added to actual height, and to reduce reinforcement and concrete quantities for the amounts that would have been required in the top 2 feet.*

CANTILEVERED RETAINING WALLS

SOIL PROPERTIES: $\gamma = 130$ pcf, $\phi = 30°$, $\mu = 0.45$ $f'_c = 3{,}000$ psi

BACKFILL SLOPE: LEVEL $f_y = 60{,}000$ psi

CONCRETE DIMENSIONS & VOLUME							SERVICE LOAD ANALYSIS					STEM REINFORCEMENT				BASE REINFORCEMENT			
Height Above Base (h_w)	Stem Thickness (A_{stem})	Heel ©	Width of Base (W)	Base Depth (A_{base})	Key ($t \times k$)	(1) Concrete Quantity	Base Soil Pressures		Safety Factors		Deflection at Top	(2) (4) "O" Bars	Dowels into Stem	(3) (4) "M" Bars	(5) "L_w" Bars	(2) "P" Bars	"L_b" Bars	(6) "K" Bars	(7) Total Steel Weight
							Toe	Heel	Sliding	Overturning									
ft	in.	ft-in.	ft-in.	in.	in. x in.	cy/lf	psf	psf			in.	Size @ in.	ft-in.	Size @ in.	Size @ in.	Size @ in.	No. Size	Size @ in.	lb/lf
3	8	1-0	2-8	12	None	0.17	525	293	3.10	3.85	0.001	Hk# 4@ 9	None	None	# 4@12	# 4@ 9Hk	5 # 4	None	11.36
4	8	1-0	2-8	12	None	0.20	891	99	2.18	2.43	0.005	Hk# 4@ 9	None	None	# 4@12	# 4@ 9Hk	5 # 4	None	12.91
5	8	1-6	3-2	12	None	0.24	1138	94	1.88	2.42	0.015	Hk# 4@ 9	None	None	# 4@12	# 4@ 9	5 # 4	None	14.92
6	8	1-8	3-7	12	None	0.28	1314	46	1.58	2.22	0.038	Hk# 4@ 9	None	None	# 4@12	# 4@ 9	5 # 4	None	16.85
7	8	2-4	4-5	12	None	0.34	1345	234	1.55	2.59	0.082	# 4@ 9	None	None	# 4@12	# 4@ 9	6 # 4	None	19.82
8	8	3-0	5-4	12	None	0.40	1340	430	1.54	2.98	0.160	# 4@ 9	None	None	# 4@12	# 4@ 9	7 # 4	None	22.86
9	8	3-8	6-2	12	None	0.45	1415	568	1.54	3.24	0.288	# 6@15	None	None	# 4@12	# 6@15	8 # 4	None	31.58
10	8	4-2	6-10	12	None	0.50	1535	643	1.50	3.28	0.488	# 8@18	None	None	# 4@12	# 6@18	9 # 4	None	41.14
11	10	4-8	7-9	12	None	0.63	1577	799	1.51	3.53	0.402	# 6@ 9	2-2	# 6@18	# 5@12	# 5@ 9	7 # 5	None	52.38
12	11	5-2	8-6	12	None	0.72	1689	892	1.50	3.62	0.467	# 6@ 9	2-2	# 6@18	# 5@12	# 6@ 9	5 # 6	None	60.76
13	12	5-8	9-4	12	None	0.83	1736	1037	1.51	3.81	0.536	# 5@ 6	1-10	# 5@12	# 5@12	# 5@ 6	8 # 5	None	66.91
14	13	6-2	10-1	14	None	1.00	1924	1105	1.53	3.79	0.611	# 7@ 9	2-5	# 6@18	# 6@12	# 7@ 9	7 # 6	None	93.39
15	14	6-8	10-10	14	None	1.12	2039	1196	1.52	3.84	0.691	# 7@ 9	3-2	# 7@18	# 6@12	# 7@ 9	17 # 4	None	105.77
16	15	7-1	11-7	16	None	1.31	2190	1270	1.52	3.80	0.775	# 8@ 9	3-2	# 7@18	# 6@11	# 7@ 9	20 # 4	None	126.29
17	17	7-4	12-2	18	None	1.57	2413	1292	1.50	3.68	0.721	# 8@ 9	3-2	# 7@18	# 7@14	# 7@ 9	6 # 8	None	138.74
18	18	7-10	13-0	18	None	1.72	2460	1436	1.51	3.82	0.809	# 8@ 9	3-2	# 7@18	# 8@17	# 8@ 9	26 # 4	None	159.75
19	19	8-4	13-9	20	None	1.96	2648	1503	1.52	3.80	0.901	# 7@ 6	2-5	# 6@12	# 8@16	# 7@ 6	10 # 7	None	183.31
20	20	8-10	14-6	20	None	2.13	2763	1595	1.51	3.84	0.998	# 9@ 9	3-7	# 8@18	# 8@15	# 9@ 9	8 # 8	None	219.94
21	22	7-6	13-7	22	12x18	2.41	3321	1131	1.51	2.99	0.957	# 9@ 9	3-7	# 8@18	# 8@14	# 8@ 9	21 # 5	# 4@ 9	214.80
22	23	7-8	14-0	24	12x20	2.67	3609	1065	1.50	2.87	1.057	# 8@ 6	3-2	# 7@12	# 9@17	# 7@ 6	24 # 5	# 4@ 6	252.03

Typical 6' wall (no vehicle loading)

(1) Calculated for uniform thickness base and stem. Deduct for tapered stem or base. Nominal dimensions used for calculations. Actual quantities for concrete cast against earth, especially with keys, are larger.

User should allow additional concrete based upon job conditions.

(2) 'Hk' designates a 90° or 180° hook. If flag is before 'O' bar or 'P' Bar then hook to be in toe of base. If after 'P' Bar then hook to be in heel of base. Alternatively, designer to resize or use headed bars.

(3) If optional splice is used (Fig. 1) for $h_w \leq 10'\text{-}0"$, provide 'M' Bars at same size and spacing as 'O' Bars with length = (h_w – 3"). See Fig. 1 for Class B lap length to establish cut-off height for 'O' Bars.

(4) Lengths alternate for both 'O' Bars and 'M' Bars. See Fig. 2.

(5) 'L_w' bars are based on 0.0025 A_g (0.002 A_g for #5 bars and smaller).

(6) 'K' Bars are to have 90° hook in bottom of key. When 'Hk' appears by 'K' Bar, use 180° hook. Add longitudinal bars in keys: 2-#4 where 'K' Bars are shown.

(7) Does not include lap allowance for horizontal bars, which varies with joint spacing, stagger, etc.

CHAPTER 1
Introduction

1.1 General

Cantilevered retaining walls have been classified in this *Design Guide* as "low" (h_w no taller than 10 ft) and "high" (h_w greater than 10 ft) with different arrangements of vertical reinforcing steel. In low walls, lap splices of vertical reinforcement can be avoided entirely. The vertical bars are L-shaped and serve as vertical, dowel, and footing reinforcement. Temporary bracing must be provided for all dowels to ensure proper position (plumb) and location. For high walls, only 50 percent of the main flexural reinforcing steel is lap spliced at the base, using Class "B" lap splices to the short dowels.

Dimensions of the wall, base, and key (if required), as shown in Figs. 1, 2 and 3, are included in the tabulated designs. Note that the minimum wall thickness is 8 inches. Sometimes, the front (exposed) face of the wall is cambered for expected lateral deflection-plus-tilt at the top. A variable thickness wall may be used, tapered from the top (8 inches) to the base, with the slope located on either face. Camber on the front face is desirable, even if a sloping back face is used.

When keys are not feasible or where the sliding circle analysis requires additional precautions for soil-loading combinations outside the scope of the tabulated designs, some alternate wall geometries are suggested. See Fig. 4.

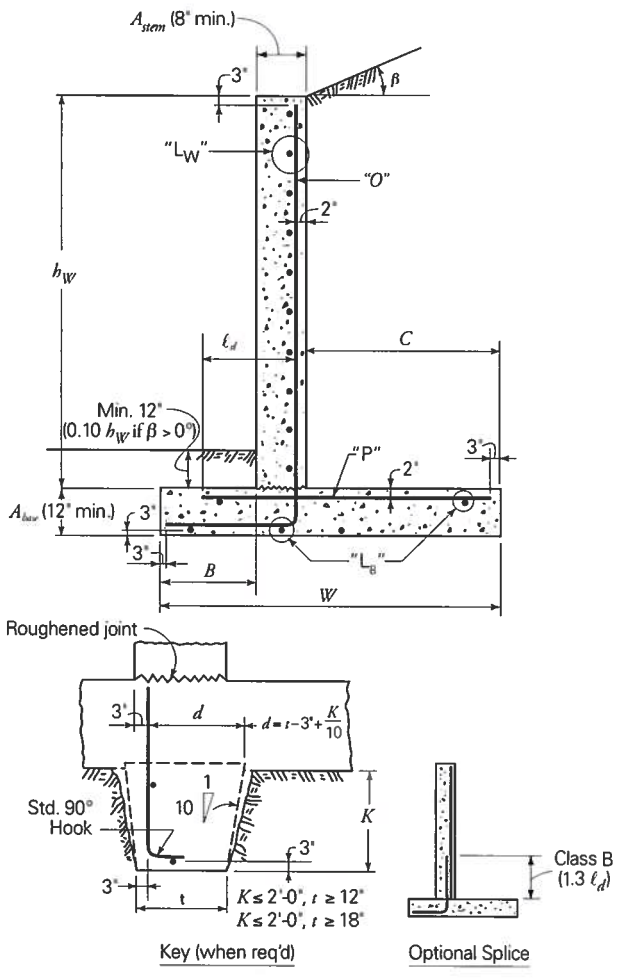


Fig. 1 Notation for Dimensions and Reinforcement for Wall Heights ≤ 10'.

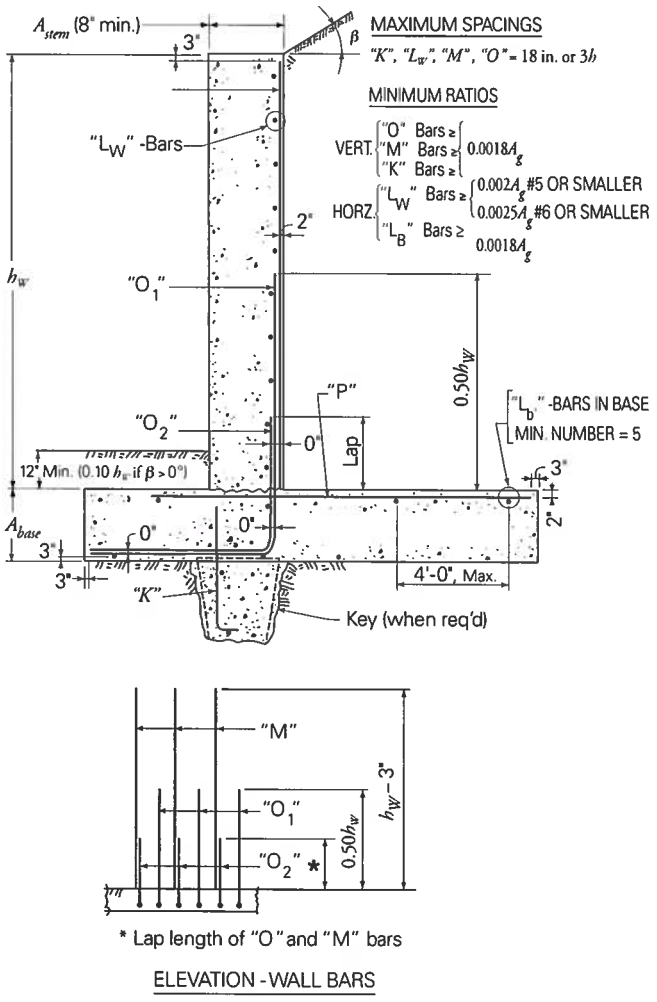


Fig. 2 Notation for Dimensions and Reinforcement for Wall Heights > 10'.

CANTILEVERED RETAINING WALLS

SOIL PROPERTIES: $\gamma = 130$ pcf, $\phi = 30°$, $\mu = 0.45$ $f'_c = 3{,}000$ psi

BACKFILL SLOPE: LEVEL $f_y = 60{,}000$ psi

CONCRETE DIMENSIONS & VOLUME							SERVICE LOAD ANALYSIS					STEM REINFORCEMENT				BASE REINFORCEMENT			
Height Above Base (h_w)	Stem Thickness (A_{stem})	Heel ©	Width of Base (W)	Base Depth (A_{base})	Key ($t \times k$)	(1) Concrete Quantity	Base Soil Pressures		Safety Factors		Deflection at Top	(2) (4) "O" Bars	Dowels into Stem	(3) (4) "M" Bars	(5) "L_w" Bars	(2) "P" Bars	"L_b" Bars	(6) "K" Bars	(7) Total Steel Weight
							Toe	Heel	Sliding	Overturning									
ft	in.	ft-in.	ft-in.	in.	in. x in.	cy/lf	psf	psf			in.	Size @ in.	ft-in.	Size @ in.	Size @ in.	Size @ in.	No. Size	Size @ in.	lb/lf
3	8	1-0	2-8	12	None	0.17	525	293	3.10	3.85	0.001	Hk# 4@9	None	None	#4@12	#4@9Hk	5#4	None	11.36
4	8	1-0	2-8	12	None	0.20	891	99	2.18	2.43	0.005	Hk# 4@9	None	None	#4@12	#4@9Hk	5#4	None	12.91
5	8	1-6	3-2	12	None	0.24	1138	94	1.88	2.42	0.015	Hk# 4@9	None	None	#4@12	#4@9	5#4	None	14.92
6	8	1-8	3-7	12	None	0.28	1314	46	1.58	2.22	0.038	Hk# 4@9	None	None	#4@12	#4@9	5#4	None	16.85
7	8	2-4	4-5	12	None	0.34	1345	234	1.55	2.59	0.082	#4@9	None	None	#4@12	#4@9	6#4	None	19.82
8	8	3-0	5-4	12	None	0.40	1340	430	1.54	2.98	0.160	#4@9	None	None	#4@12	#4@9	7#4	None	22.86
9	8	3-8	6-2	12	None	0.45	1415	568	1.54	3.24	0.288	#6@15	None	None	#4@12	#6@15	8#4	None	31.58
10	8	4-2	6-10	12	None	0.50	1535	643	1.50	3.28	0.488	#8@18	None	None	#4@12	#6@18	9#4	None	41.14
11	10	4-8	7-9	12	None	0.63	1577	799	1.51	3.53	0.402	#6@9	2-2	#6@18	#5@12	#5@9	7#5	None	52.38
12	11	5-2	8-6	12	None	0.72	1689	892	1.50	3.62	0.467	#6@9	2-2	#6@18	#5@12	#6@9	5#6	None	60.76
13	12	5-8	9-4	12	None	0.83	1736	1037	1.51	3.81	0.536	#5@6	1-10	#5@12	#5@12	#5@6	8#5	None	66.91
14	13	6-2	10-1	14	None	1.00	1924	1105	1.53	3.79	0.611	#7@9	2-5	#6@18	#6@12	#7@9	7#6	None	93.39
15	14	6-8	10-10	14	None	1.12	2039	1196	1.52	3.84	0.691	#7@9	3-2	#7@18	#6@12	#7@9	17#4	None	105.77
16	15	7-1	11-7	16	None	1.31	2190	1270	1.52	3.80	0.775	#8@9	3-2	#7@18	#6@11	#7@9	20#4	None	126.29
17	17	7-4	12-2	18	None	1.57	2413	1292	1.50	3.68	0.721	#8@9	3-2	#7@18	#7@14	#7@9	6#8	None	138.74
18	18	7-10	13-0	18	None	1.72	2460	1436	1.51	3.82	0.809	#8@9	3-2	#7@18	#8@17	#8@9	26#4	None	159.75
19	19	8-4	13-9	20	None	1.96	2648	1503	1.52	3.80	0.901	#7@6	2-5	#6@12	#8@16	#7@6	10#7	None	183.31
20	20	8-10	14-6	20	None	2.13	2763	1595	1.51	3.84	0.998	#9@9	3-7	#8@18	#8@15	#9@9	8#8	None	219.94
21	22	7-6	13-7	22	12x18	2.41	3321	1131	1.51	2.99	0.957	#9@9	3-7	#8@18	#8@14	#8@9	21#5	#4@9	214.80
22	23	7-8	14-0	24	12x20	2.67	3609	1065	1.50	2.87	1.057	#8@6	3-2	#7@12	#9@17	#7@6	24#5	#4@6	252.03

6' high wall → use 8' row for vehicle loading

(1) Calculated for uniform thickness base and stem. Deduct for tapered stem or base. Nominal dimensions used for calculations. Actual quantities for concrete cast against earth, especially with keys, are larger.

User should allow additional concrete based upon job conditions.

(2) 'Hk' designates a 90° or 180° hook. If flag is before 'O' bar or 'P' Bar then hook to be in toe of base. If after 'P' Bar then hook to be in heel of base. Alternatively, designer to resize or use headed bars.

(3) If optional splice is used (Fig. 1) for $h_w \leq 10'\text{-}0"$, provide 'M' Bars at same size and spacing as 'O' Bars with length = $(h_w - 3")$. See Fig. 1 for Class B lap length to establish cut-off height for 'O' Bars.

(4) Lengths alternate for both 'O' Bars and 'M' Bars. See Fig. 2.

(5) 'L_w' bars are based on 0.0025 A_g (0.002 A_g for #5 bars and smaller).

(6) 'K' Bars are to have 90° hook in bottom of key. When 'Hk' appears by 'K' Bar, use 180° hook. Add longitudinal bars in keys: 2-#4 where 'K' Bars are shown.

(7) Does not include lap allowance for horizontal bars, which varies with joint spacing, stagger, etc.

Computation Sheet

NRCS–ENG-523A Rev. 6-2002

U.S. Department of Agriculture
Natural Resources Conservation Service

AW

State	Project			
PA · SUSQUEHANNA	POWERS, DEAN			
By: PAS	Date: 4/14/23	Checked by:	Date:	Job No.:
Subject: VENTILATION + ROOF RUNOFF				Sheet ____ of ____

Ventilation: 2" of opening per 10' of building width

60' width (including overhangs)

(2"/10')(60') = 12"

12" required

Roof Runoff: 164' x 60' (w/ OH's)

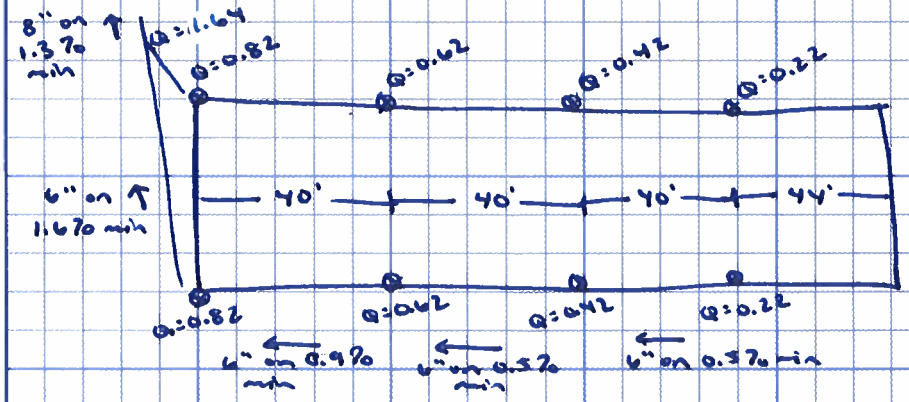
(164)(60)(0.6)/3600 = 1.64 cfs to outlet

downspouts every 48':

48'(30')(0.6)/3600 = 0.24 cfs/ea

Q_{av} = 0.26 cfs (for 3" x 4" ea) ∴ ok

max. downspout spacing = 48'



6" gutter capacity Q_{av} = 0.30 cfs (1/16 in/ft)

Rock Apron Sizing:

8" pipe flow 1.64 cfs

A_8 = 0.35 SF

1.64 cfs / 0.35 SF = 4.7 fps

use R-3 rock at outlet (V_{R-3} = 5.0 fps available)

AW

Pipe Capacity

Qav=(0.000614/0.011)*((Pipe Size)^2.67)*(SQRT(Slope))

Pipe Size	Slope	Qav
6	0.004	0.422
6	0.005	0.472
6	0.006	0.517
6	0.007	0.558
6	0.008	0.597
6	0.009	0.633
6	0.01	0.667
6	0.011	0.700
6	0.012	0.731
6	0.013	0.761
6	0.014	0.790
6	0.015	0.817
6	0.016	0.844
6	0.017	0.870
6	0.018	0.896
6	0.019	0.920
6	0.02	0.944
6	0.021	0.967
6	0.022	0.990
6	0.023	1.012
6	0.024	1.034
8	0.002	0.643
8	0.003	0.788
8	0.004	0.910
8	0.005	1.017
8	0.006	1.115
8	0.007	1.204
8	0.008	1.287
8	0.009	1.365
8	0.01	1.439
8	0.011	1.509
8	0.012	1.576
8	0.013	1.641
8	0.014	1.703
8	0.015	1.762
8	0.016	1.820
8	0.017	1.876
8	0.018	1.930
8	0.019	1.983
8	0.02	2.035
8	0.021	2.085
8	0.022	2.134

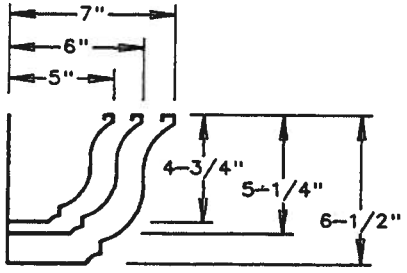
Pipe Size	Slope	Qav
8	0.03	2.492
8	0.031	2.533
8	0.032	2.574
8	0.033	2.614
8	0.034	2.653
8	0.035	2.692
8	0.036	2.730
8	0.037	2.768
8	0.038	2.805
8	0.039	2.842
8	0.04	2.878
8	0.041	2.914
8	0.042	2.949
8	0.043	2.984
8	0.044	3.018
8	0.045	3.052
8	0.046	3.086
8	0.047	3.119
8	0.048	3.152
8	0.049	3.185
8	0.05	3.217
8	0.051	3.249
8	0.052	3.281
8	0.053	3.313
8	0.054	3.344
8	0.055	3.374
8	0.056	3.405
8	0.057	3.435
8	0.058	3.465

DESIGN GUIDE NO. PA-1: ROOF GUTTERS & DOWNSPOUTS

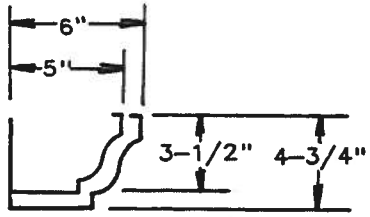
Gutter Style	Gutter Size (inches)	Gutter Slope (in/ft)	Max Roof Areas for [1] P = 0.5" [2]	Max Roof Areas for [1] P = 0.6" [3]	Max Gutter Capacity (CFS) [4]	Compatible Downspouts - size / cfs [5]									
						Plain Rectangular		Corrugated Round		Octagonal		Corrugated Square		Plain Rectangular	
BOX OGEE GALVANIZED	5	1/16	1580	1320	0.22	3" 0.15		3" 0.13		3" 0.13		3" 0.17		2"x3" 0.13	3"x4" 0.26
		1/8	2230	1860	0.31										
		1/4	3170	2640	0.44										
	6	1/16	2450	2040	0.34	3" 0.16	4" 0.29	3" 0.14	4" 0.25	3" 0.14	4" 0.26	3" 0.18	4" 0.27	3"x4" 0.27	4"x5" 0.46
		1/8	3460	2880	0.48										
		1/4	4900	4080	0.68										
	7	1/16	4250	3540	0.59	4" 0.32	5" 0.5	4" 0.28	5" 0.45	4" 0.28	5" 0.45	4" 0.3	5" 0.48	4"x5" 0.51	5"x6" 0.74
		1/8	5980	4980	0.83										
		1/4	8420	7020	1.17										
BOX OGEE ALUMINUM	5 [6]	*1/64*	*633*	*528*	*0.09*	3" 0.13		3" 0.11		3" 0.13		3" 0.14		2"x3" 0.11	3"x4" 0.22
		1/32	*892*	*744*	*0.13*										
		1/16	*1260*	*1050*	*0.18*										
		1/8	*1785*	*1488*	*0.25*										
		1/4	*2527*	*2106*	*0.35*										
	6 [6]	*1/64*	*1094*	*912*	*0.15*	3" 0.15	4" 0.28	3" 0.13	4" 0.24	3" 0.13	4" 0.23	3" 0.17	4" 0.26	2"x3" 0.13	3"x4" 0.26
		1/32	*1548*	*1290*	*0.21*										
		1/16	*2188*	*1824*	*0.30*										
		1/8	*3096*	*2580*	*0.43*										
		1/4	*4377*	*3648*	*0.61*										
SEMI-CIRCLE	6	1/16	1150	960	0.16	3" 0.12	4" 0.21	3" 0.10	4" 0.18	3" 0.11	4" 0.19	3" 0.13	4" 0.19	3"x4" 0.20	4"x5" 0.33
		1/8	1660	1380	0.23										
		1/4	2300	1920	0.32										

[1] Square feet (max gutter capacity controls)
[2] 10-year, 5-minute rainfall
[3] 25-year, 5-minute rainfall
[4] with 1/2" freeboard. For roof area less than maximum, actual gutter discharge is this value times (actual roof area/maximum roof area)
[5] Sizes that fit the gutter bottom width and their respective orifice discharge. Select size and number of downspouts that provide discharge equal to or greater than gutter capacity.
[6] Designers should use caution when planning 1/32 and 1/64 in/ft slopes. Flatter slopes can present additional installation challenges.

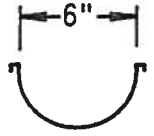
Box Ogee Galvanized



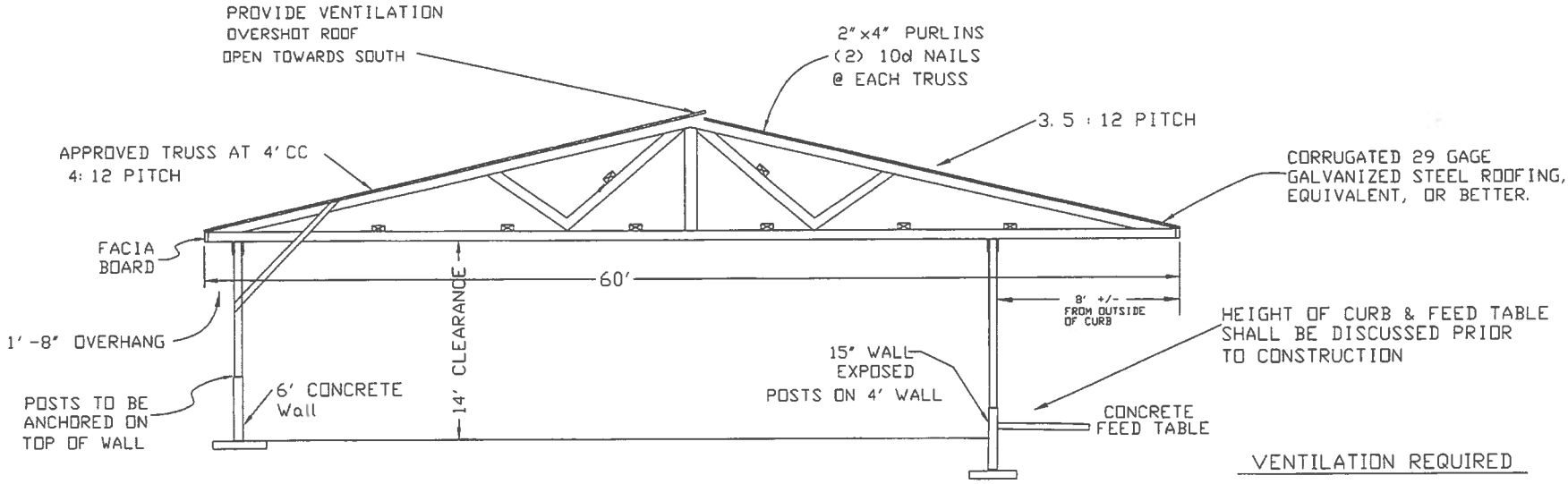
Box Ogee Aluminum



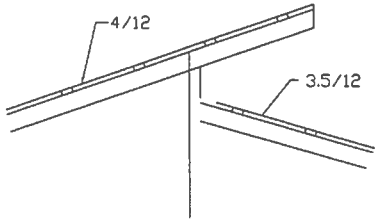
SEMI-CIRCLE



HEAVY USE AREA ROOF SECTION



VENTILATION REQUIRED



CONCRETE SLAB & BEDDING STONE
NOT SHOWN FOR CLARITY

WALL/CURB FOOTINGS TYPICALLY
PLACED THE SAME TIME AS THE
FLOOR SLAB.

ROOF GUTTERS REQUIRED ON ALL ROOFS

NO SCALE NOT A FINAL DESIGN

DESIGNED JEG DATE //
DRAWN JEG //
CHECKED Andrew Wedebrun 11/2021
APPROVED Andrew Wedebrun 11/2021

ROOF LAYOUT
DEAN POWERS
SUSQUEHANNA COUNTY

United States Department of Agriculture
USDA Natural Resources Conservation Service

FILE NO. POWERS WE.DWG
DRAWING NO.
SHEET OF

Computation Sheet

NRCS–ENG-523A Rev. 6-2002

U.S. Department of Agriculture
Natural Resources Conservation Service

State	Project			
PA · SUSQUEHANNA	POWERS, DEAN			
By: PAS	Date: 4/4/23	Checked by:	Date:	Job No.:
Subject: DESIGN				Sheet ____ of ____

Landowner discussion + survey on March 29, 2023

* Remove 4" divider curb in structure
* overshot direction towards south
  → Animal numbers to remain the same as I+E ; no other changes
* requested an opening in the gable end storage wall

POST SIZING

(40 PSF COMBINED LOAD-NO DRIFT LOADS)
(POSTS & TRUSSES ON 8' CENTERS)
REVISED 2/2023

SPAN (FT)	OVERHANG (FT)	ENCLOSED OR OPEN	CLEARANCE (FT)	WALL HT ABOVE GROUND (FT)	RESULTANT POST HT (FT)	MOMENT ON POST DUE TO KNEE BRACE AGAINST POST (FT-LBS)	.6 WIND REDUCTION (FT-LBS)	POST LOAD	COMBINED VALUE "C"	KE VALUE	POST SIZE	
40	8	OPEN	12	1.25	10.75	6770	4062	8960	0.845	2.4	4-PLY 2X8	
40	8	OPEN	14	1.25	12.75	6050	3630	8960	0.559	2.4	5-PLY 2X8	
40	8	OPEN	16	1.25	14.75	5140	3084	8960	0.872	2.4	5-PLY 2X8	
40	8	OPEN	12	6	6	6440	3864	8960	0.593	2.4	4-Ply 2x6	
40	8	OPEN	12	4	8	7130	4278	8960	0.428	2.4	4-PLY 2X8	
40	8	OPEN	14	4	10	6950	4170	8960	0.674	2.4	4-PLY 2X8	
40	8	OPEN	16	4	12	6350	3810	8960	0.763	2.0	4-PLY 2X8	
40	2	OPEN	12	4	8	5930	3558	7040	0.696	2.4	4-Ply 2x6	USE 4-PLY 2X8 PER TT
40	2	OPEN	14	4	10	5635	3381	7040	0.463	2.4	4-PLY 2X8	
40	2	OPEN	16	4	12	5340	3204	7040	0.8	2.4	4-PLY 2X8	
40	2	CLOSED	12	4	8	4740	2844	7040	0.397	1.0	4-PLY 2X6	
40	2	CLOSED	14	4	10	6580	3948	7040	0.575	1.0	4-PLY 2X6	
40	2	CLOSED	16	4	12	8420	5052	7040	0.793	1.0	4-PLY 2X6	USE 4-PLY 2X8 PER TT
50	8	OPEN	12	1.25	10.75	8240	4944	10560	0.784	2.0	4-PLY 2X8	
50	8	OPEN	14	1.25	12.75	7330	4398	10560	0.779	2.4	5-PLY 2X8	
50	8	OPEN	16	1.25	14.75	6170	3702	10560	0.71	2.0	5-PLY 2X8	
50	8	OPEN	12	6	6	7900	4740	10560	0.749	2.4	4-Ply 2x6	
50	8	OPEN	12	4	8	8730	5238	10560	0.552	2.4	4-PLY 2X8	
50	8	OPEN	14	4	10	8480	5088	10560	0.667	2.0	4-PLY 2X8	
50	8	OPEN	16	4	12	7710	4626	10560	0.665	2.4	5-PLY 2X8	
50	2	OPEN	12	4	8	6870	4122	8640	0.895	2.4	4-Ply 2x6	USE 4-PLY 2X8 PER TT
50	2	OPEN	14	4	10	6500	3900	8640	0.619	2.4	4-PLY 2X8	
50	2	OPEN	16	4	12	6130	3678	8640	0.712	2.0	4-PLY 2X8	
50	2	CLOSED	12	4	8	5960	3576	8640	0.507	1.0	4-Ply 2x6	
50	2	CLOSED	14	4	10	7525	4515	8640	0.678	1.0	4-PLY 2X6	
50	2	CLOSED	16	4	12	9090	5454	8640	0.901	1.0	4-PLY 2X6	USE 4-PLY 2X8 PER TT
60	8	OPEN	12	1.25	10.75	9480	5688	12160	0.667	2.4	5-PLY 2X8	
60	8	OPEN	14	1.25	12.75	8430	5058	12160	0.666	2.0	5-PLY 2X8	
60	8	OPEN	16	1.25	14.75	7090	4254	12160	0.736	2.0	5-PLY 2X8	15' clearance max.
60	8	OPEN	12	6	6	9100	5460	12160	0.89	2.4	4-Ply 2x6	
60	8	OPEN	12	4	8	10050	6030	12160	0.672	2.4	4-PLY 2X8	
60	8	OPEN	14	4	10	9760	5856	12160	0.839	2.0	4-PLY 2X8	
60	8	OPEN	16	4	12	8870	5322	12160	0.868	2.4	5-PLY 2X8	
60	2	OPEN	12	4	8	8470	5082	10240	0.529	2.4	4-PLY 2X8	
60	2	OPEN	14	4	10	7975	4785	10240	0.861	2.4	4-PLY 2X8	
60	2	OPEN	16	4	12	7480	4488	10240	0.755	2.0	4-PLY 2X8	15' clearance max.
60	2	CLOSED	12	4	8	6990	4194	10240	0.605	1.0	4-PLY 2X6	
60	2	CLOSED	14	4	10	7140	4284	10240	0.668	1.0	4-PLY 2X6	USE 4-PLY 2X8 PER BOB
60	2	CLOSED	16	4	12	7290	4374	10240	0.777	1.0	4-PLY 2X6	USE 4-PLY 2X8 PER BOB

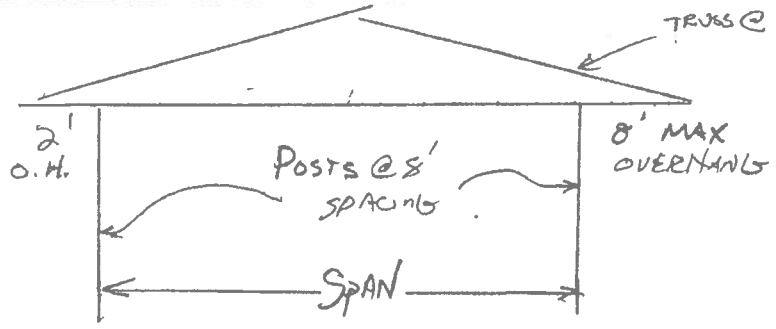
* CLOSED SIDES MUST BE STEEL OR WOOD SIDING TO BE CONSIDERED CLOSED FOR POST DESIGN
IF CURTAINS ARE USED; THEN CHOOSE THE "OPEN" POST DESIGN ROWS

* use 5-ply 2"x8" posts on front of structure

GIRDER CALCULATIONS

KLD
2-8-2023

AM 2



SPAN = 50'

GIRDER SIZING FOR 8' OVERHANG SIDE

SPAN = 50' TRY (2) 1.75" X 9.25" LVL's

TRUSS LOAD = $\left(\frac{50}{2} + 8' \text{ O.H.}\right) \times 40 \text{ psf} \times 4' \text{ SPACING} = 5280\# = P$

(A) MOMENT CHECK: (BEAM FORMULA 4/2-4/ (MULTI-SPAN)):

$M = -\frac{3PL}{16} = -\frac{3(5280)(8)}{16} = -7920$ FT-LBS ACTUAL

PASS

$M_{AVAIL\ (KERTO)} = 6271 \times 2 \text{ LVL's} = 12542$ FT-LBS

$M_{AVAIL\ (ROSEBURG)} = 6660 \times 2 \text{ LVL's} = 13320$ FT-LBS

(B) BENDING CHECK:

$f_{b\ ACTUAL} = \frac{M}{S} = \frac{7920(12/1)}{49.91} = 1904.2$ psi

$S = \frac{bd^2}{6} = \frac{1.75(9.25)^2}{6} = 24.96 \times 2 \text{ LVL's} = 49.91 \text{ in}^3$ REQUIRED

$F_{B\ AVAIL\ (KERTO)} = 2900 \times 1.15 \times \left(\frac{12}{9.25}\right)^{1.5} = 3469.8$ psi

$F_{B\ AVAIL\ (ROSEBURG)\ DOUGLAS\ FIR} = 3100 \times 1.15 \times \left(\frac{12}{9.25}\right)^{1.8} = 3682.9$ psi

PASS

$F_{B\ AVAIL\ (ROSEBURG)\ SYP} = 3100 \times 1.15 \times \left(\frac{12}{9.25}\right)^{1.5} = 3755.5$ psi

(C) SHEAR CHECK:

$f_v = \frac{1.5(V)}{A} = \frac{1.5(3630)}{32.38} = 168.16$ psi ACTUAL

PASS

$F_{V\ AVAIL\ (KERTO)} = 320 \times 1.15 = 368$ psi

$F_{V\ AVAIL\ (ROSEBURG)} = 290 \times 1.15 = 333.5$ psi

$V = \frac{11(P)}{16}$ (BEAM FORMULA 4/2-4/)

$= \frac{11(5280)}{16} = 3630\#$

$A = 1.75(9.25) \times 2 \text{ LVL's} = 32.38 \text{ in}^2$

$I = \frac{bd^3}{12} = \frac{1.75(9.25)^3}{12} = 115.42 \text{ in}^4$

$E = 2{,}000{,}000$ psi (KERTO)

$E = 2{,}100{,}000$ psi (ROSEBURG)

(D) DEFLECTION CHECK:

$\Delta_{ACTUAL} = \frac{PL^3}{48EI}$ (BEAM FORMULA 4/2-8) ← CONVERSION FACTOR

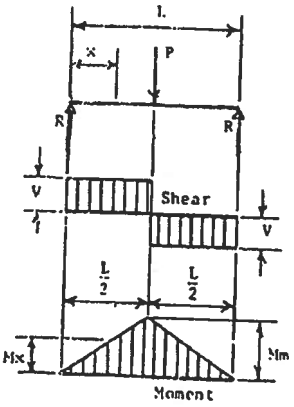
$= \frac{5280(8)^3(1728)}{48(2{,}000{,}000)(115.42 \times 2)} = .21"$ (KERTO)

$\Delta_{ACTUAL} = \frac{5280(8)^3(1728)}{48(2{,}100{,}000)(230.84)} = .2"$ (ROSEBURG)

PASS

$\Delta_{ALLOWED} = \frac{L}{180} = \frac{8(12/1)}{180} = .53"$

★ USE (2) 1.75" X 9.25" LVL's



Eq 412-8

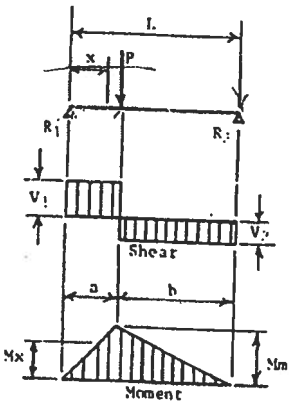
R = V . . . . . = P/2

Mm [@ load] . . . . . = PL/4

Mx [@ x < L/2] . . . . . = Px/2

Dm [@ load] . . . . . = $\frac{PL^3}{48EI}$

Dx [@ x < L/2] . . . . . = $\frac{Px}{48EI}(3L^2 - 4x^2)$



Eq 412-9

$R_1 = V_1$ [max. @ a < b] . . . . . = Pb/L

$R_2 = V_2$ [max. @ a > b] . . . . . = Pa/L

Mm [@ load] . . . . . = Pab/L

Mx [@ x < a] . . . . . = Pbx/L

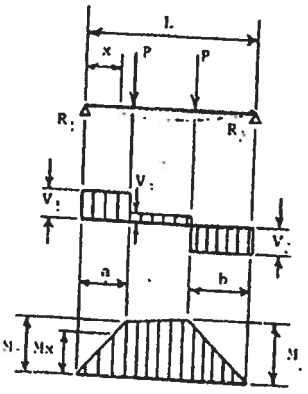
Mx [@ a < x < L] . . . . . = $\frac{Pa}{L}(L - x)$

Dm [@ $x = \sqrt{\frac{a(a+2b)}{3}}$ @ a > b] . . = $\frac{Pab(a+2b)\sqrt{3a(a+2b)}}{27EIL}$

Da [@ load] . . . . . = $\frac{Pa^2b^2}{3EIL}$

Dx [@ x < a] . . . . . = $\frac{Pbx}{6EIL}(L^2 - b^2 - x^2)$

Dx [@ a < x < L] . . . . . = $\frac{Pa(L-x)}{6EIL}(-a^2 + 2xL - x^2)$



2 Equal loads

Eq 412-10 a = b = c = L/3

R = V . . . . . = P

Mm [between loads] . . . . . = PL/3

Mx [@ x < L/3] . . . . . = Px

Dm [@ center] . . . . . = $\frac{23PL^3}{648EI}$

Dx [@ x < a] . . . . . = $\frac{Px}{6EI}(\frac{2L^2}{3} - x^2)$

Dx [@ a < x < (L - a)] . . . = $\frac{PL}{18EI}(3Lx - 3x^2 - L^2/9)$

Eq 412-11 a = b ≠ c

R = V . . . . . = P

Mm [between loads] . . . . . = Pa

Mx [@ x < a] . . . . . = Px

Dm [@ center] . . . . . = $\frac{Pa}{24EI}(3L^2 - 4a^2)$

Dx [@ x < a] . . . . . = $\frac{Px}{6EI}(3La - 3a^2 - x^2)$

Dx [@ a < x < (L - a)] . . . . . = $\frac{Pa}{6EI}(3Lx - 3x^2 - a^2)$

Eq 412-12 a ≠ b ≠ c

$R_1 = V_1$ [max. @ a < b] . . . . = $\frac{P}{L}(L - a + b)$

$R_2 = V_2$ [max. @ a > b] . . . . = $\frac{P}{L}(L - b + a)$

V_3 . . . . . = $\frac{P}{L}(b - a)$

M_1 [max. @ a > b] . . . . . = $R_1 a$

M_2 [max. @ a < b] . . . . . = $R_2 b$

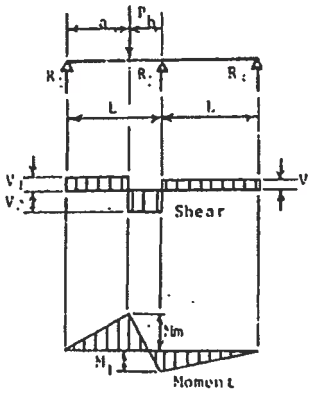
Mx [@ x < a] . . . . . = $R_1 x$

Mx [@ a < x < (L - b)] . . . . = $R_1 x - P(x - a)$

Mx [@ (L - b) < x < L] . . . . = $R_2(L - x)$

NOTE: For deflections use superposition of 2 single concentrated loads.

412.13



Eq 412-40

$R_1 = V_1 \ldots = \frac{Pb}{4L^3}(4L^2 - a(L + a))$

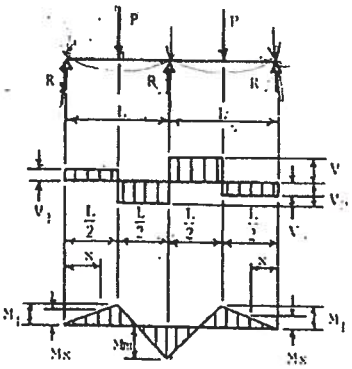
$R_2 = V_2 + V_3 \ldots = \frac{Pa}{2L^3}(2L^2 + b(L + a))$

$R_3 = V_3 \ldots = -\frac{Pab}{4L^3}(L + a)$

$V_2 \ldots = \frac{Pa}{4L^3}(4L^2 + b(L + a))$

$Mm \text{ [@ load]} \ldots = \frac{Pab}{4L^3}(4L^2 - a(L + a))$

$M_1 \text{ [@ } R_2\text{]} \ldots = -\frac{Pab}{4L^2}(L + a)$



Eq 412-41

$R_1 = V_1 = R_3 = V_3 \ldots \ldots = \frac{5P}{16}$

$R_2 = 2V_2 \ldots = \frac{11P}{8}$

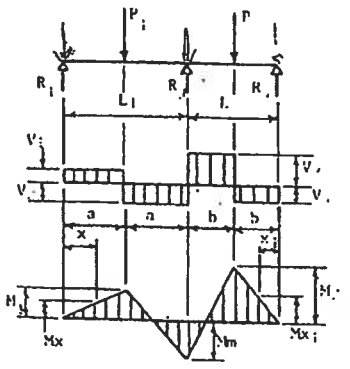
$V_2 = P - R_1 \ldots = \frac{11P}{16}$

$Mm \ldots = -\frac{3PL}{16}$

$M_1 \ldots = \frac{5PL}{32}$

$Mx \text{ [@ } x < a\text{]} \ldots = R_1x$

$Mx \text{ [@ } a < x < L\text{]} \ldots = R_1x - P(x - L/2)$



Eq 412-42

$R_1 = V_1 \ldots = \frac{M_3}{L_1} + \frac{P_1}{2}$

$R_2 \ldots = P_1 + P_2 - R_1 - R_3$

$R_3 = V_4 \ldots = \frac{M_3}{L_2} + \frac{P_2}{2}$

$V_2 \ldots = P_1 - R_1$

$V_3 \ldots = P_2 - R_3$

$M_1 \ldots = R_1a$

$M_2 \ldots = R_2b$

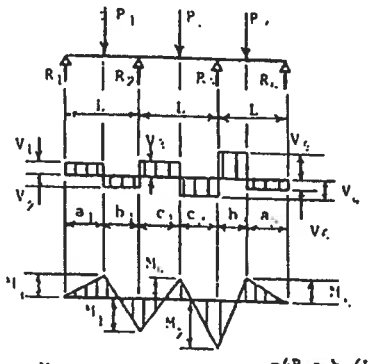
$M_3 \ldots = -\frac{3}{16}\left(\frac{P_1L_1^2 + P_2L_2^2}{L_1 + L_2}\right)$

$Mx \text{ [@ } x < a\text{]} \ldots = R_1x$

$Mx \text{ [@ } a < x < L\text{]} \ldots = R_1x - P(x - a)$

$Mx_1 \text{ [@ } x_1 < b\text{]} \ldots = R_3x_1$

$Mx_1 \text{ [@ } b < x_1 < L\text{]} \ldots = R_3x_1 - P(x_1 - b)$



Eq 412-43

$R_1 = V_1 \ldots = \frac{M_1 + P_1b_1}{L}$

$R_2 \ldots = \frac{M_2 - 2R_1L + P_2c_2 + P_1(L + b_1)}{L}$

$R_3 \ldots = \frac{M_1 - 2R_4L + P_2c_1 + P_3(L + b_2)}{L}$

$R_4 = V_6 \ldots = \frac{M_2 + P_3b_2}{L}$

$V_2 \ldots = R_1 - P_1$

$V_3 \ldots = R_2 - V_2$

$V_4 \ldots = R_3 - V_5$

$V_5 \ldots = R_4 - P_3$

$M_1 \ldots = \frac{-4P_1a_1b_1(L + a_1) - P_2c_1c_2(7L - 5c_1) + P_3b_2a_2(L + a_2)}{15L^2}$

$M_2 \ldots = \frac{-4P_3a_2b_2(L + a_2) - P_2c_1c_2(7L - 5c_2) - 4P_1b_1a_1(L + a_1)}{15L^2}$

KERTO® LAMINATED VENEER LUMBER

TABLE OF CONTENTS

KERTO-S MAIN APPLICATIONS

- Beams
- Headers
- Floor joists
- Roof rafters
- Columns
- Studs
- Truss Chords
- Tall wall and long length framing
- Components for modular construction
- Industrial and commercial applications
- Components for manufactured housing
- Stair stringers
- Concrete formwork
- Scaffold boards

KERTO-S LVL DESIGN PROPERTIES

Flexural Stress (Beam)	Flexural Stress (Plank)	Tension Parallel to Grain	Compression Parallel to Grain	Compression Perpendicular to Grain $F_{c\perp}$ [3] (psi)		Horizontal Shear F_v (psi)		True MOE[6] (psi)	
F_b [2,4] (psi)	F_b (psi)	F_t [5] (psi)	F_c (psi)	Directions:		Directions:		Directions:	
				Beam	Plank	Beam	Plank	Beam	Plank
2900	3200	2300	2700	870	435	320	200	2.0×10^6	2.0×10^6

NOTES

1 Allowable design stresses are based on covered dry conditions of use

2 The tabulated flexural stresses are based on loads of a normal duration and a referenced depth of 12 inches. For other depths, the tabulated flexural stress must be adjusted by a depth factor adjustment of $(12/d)^{1/9}$. For depths less than 3½ inches, use the value for 3½ inches.

3 The tabulated design stresses provided in this table are based on a normal duration. Loads of longer or shorter duration must be adjusted in accordance with the 2012, 2009, 2006 International Building Code, the 2012, 2009, 2006 International Residential Building Code, as applicable. Duration of load factors must not be applied to Fc⊥ and E.

4 The allowable bending stress increase for repetitive members must not exceed 4 percent.

5 The tabulated tension stress is based on a length of 55 inches (1397 mm). For lengths longer than 55 inches, tabulated tension stress must be adjusted by a factor of $(55/L)^{1/9}$. The tabulated values for lengths shorter than 55 inches must not be increased.

6 The values in this column reflect the true MOE which is the shear-free modulus of elasticity. When calculating deflection, both bending and shear deformations must be included. Equations for various span and load conditions are available in engineering references. For example, the equation for a simple supported beam under uniform load is:

$$\Delta = 270wL^4/Ebd^3 + 28.8wL^2/Ebd$$

where: Δ = Deflection in inches (in), w = Uniform load in pounds per lineal foot (plf), L = Design span in feet (ft), b = Beam width in inches (in), d = Beam depth in inches (in), and E = Shear free modulus of elasticity in pounds per square inch (psi).

Refer to ICC-ES Evaluation Report ESR-3633 For additional information regarding Kerto-S Laminated Veneer Lumber (LVL).

HANDLING, STORAGE AND INSTALLATION GUIDELINES:

- **Warning:** Failure to apply good building practices regarding application, handling, storage and installation of this product can result in poor performance and/or unsafe structures
- Kerto-S LVL must be properly installed and braced before any loads are applied to the structure
- Kerto-S LVL is to be used in a dry, well ventilated environment
- Kerto-S LVL is not to be used for unintended purposes such as ramps or planks
- Handle Kerto-S LVL carefully to avoid damage. Store the product on stickers on a clean, level surface and keep it dry
- Use appropriate personal protection equipment for handling and working with wood products; including but not limited to eye protection and gloves

ALLOWABLE UNIFORM LOAD TABLE NOTES

KERTO-S LVL DESIGN PROPERTIES FOR WIDTH AND DEPTHS USED IN THIS PRODUCT GUIDE

Width	Design Property	Depth									
		7¼"	9¼"	9½"	11¼"	11⅞"	14"	16"	18"	20"	24"
1¾"	Moment (ft-lbs)	3996	6271	6588	9008	9955	13499	17282	21490	26115	36591
	Shear (lbs)	2707	3453	3547	4200	4433	5227	5973	6720	7467	8960
	Moment of Inertia (in4)	56	115	125	208	244	400	597	851	1167	2016
	Weight (plf)	2.8	3.6	3.7	4.4	4.6	5.4	6.2	7.0	7.8	9.3

GENERAL NOTES

FOR USING THIS PRODUCT GUIDE AND UNIFORM LOAD (PLF) TABLES

1. Tables are for simple span beams (with a support at each end) and uniformly distributed loads.
2. Continuous lateral restraint must be provided at the top (compression) edge of the beam to prevent buckling.
3. For other span, load or restraint conditions, design the beam using Finnwood software, iStruct™ software or other competent analysis.
4. Lateral restraint is required at supports to prevent rotation of the beam.

LOADS:

5. There are three sets of Load Tables: 100% for Floor Loads, 115% for Roof Loads (Snow), 125% for Roof Construction Loads (Non Snow). Refer to the NDS (National Design Specification for Wood Construction) Section 2.3.2 for more information about load duration.
6. In order to satisfy both deflection and strength requirements for beam design, live load for floors, live or snow load for roofs as well as total load (live or snow + dead load) must be considered.
7. Uniform load tables in this product guide have values for Live (or Snow) load as well as Total load. The user must calculate both uniform load values in pounds per linear foot (PLF).
   Additionally, two deflection limits are listed for Live (or Snow) loads: the value typically required by the building code and a more stringent or higher "performance" value. The user must verify the requirements for the application and decide the appropriate deflection value to use.
9. The self weight of the beam is allowed for in the loads shown. It is not necessary to add the self weight of the beam to the calculated total load.

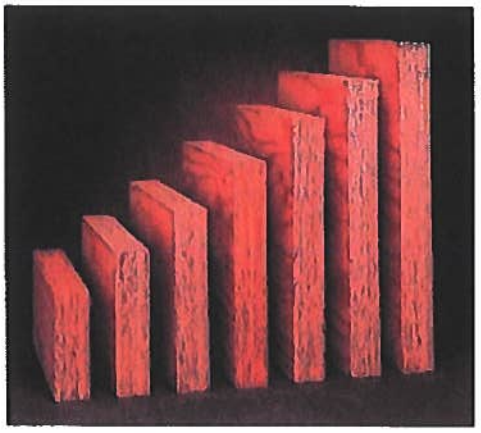
MULTIPLE PLIES:

10. Loads are for one ply (member) 1-3/4" thick.
    Multiply the loads: x 2 for 2 - ply beams, x 3 for 3 – ply beams, x 4 for 4 - ply beams
11. Beam plies (members) must be adequately connected by nails, screws or bolts as specified in this product guide or by competent analysis.
12. Two (2) or more 1-3/4" plies are recommended for depths greater than 14 inches. If a single 1-3/4" member deeper than 14" is used; pay particular attention to stability, lateral restraint and connections. Make sure these structural details are provided and properly installed.
13. 4 – ply beams require bolts or long screws which are specifically manufactured to connect all the plies of a multiple ply beam. 4 - ply beams must be top loaded or loaded equally from both faces.
14. Refer to the multiple ply connection information in this product guide for specific fastener information for connecting the plies. Note: Connection requirements depend on whether loads are applied equally to each ply (Typically when beam is top loaded). Or if loads are applied to one face of the multiple ply beam. For loads applied to one face; additional connections and lateral restraint may be required to avoid torsional loads/stresses in the beam.

BEARINGS:

15. Make sure bearings are structurally adequate to carry the loads and are in compliance with building codes and regulations.
16. Bearing widths shown are required to support the maximum PLF loads shown.
    If less than maximum PLF load is applied to the beam, tabulated bearing widths may be reduced proportionally as follows:
    Total Load applied/Total Load from table. Refer to examples on PLF tables.
17. This value may be conservative, specific analysis may produce a better result.

RigidLam® LVL Product Line



You've probably been building with traditional solid sawn lumber beams, headers, columns and studs for as long as you've been building. Now through advances in technology and design, there is a better choice – RigidLam LVL (Laminated Veneer Lumber) beams, headers, columns and studs. They are simply a better alternative than traditional solid sawn lumber pieces. Work with a stronger, stiffer, more consistent and more predictable building material. Compared with similar sized sections, our RigidLam LVL products can support heavier loads and allow greater spans than conventional lumber.

MOISTURE REPELLENT SEALER

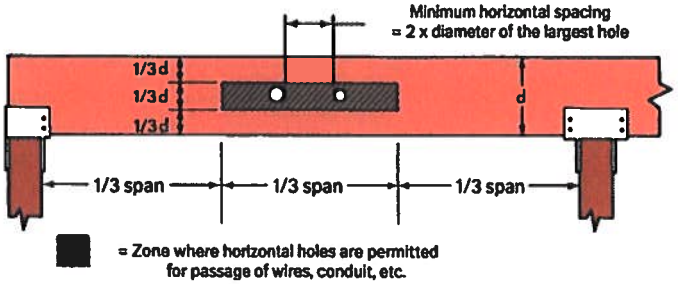
RigidLam LVL is coated with a wax-based moisture repellent sealer that is formulated specifically for LVL to provide temporary protection against moisture issues during normal storage and construction schedules. It is applied to all six sides of the LVL during the manufacturing process.

STORAGE, HANDLING & INSTALLATION

- Do not drop RigidLam LVL off the delivery truck. Best practice is use of a forklift or boom.
- RigidLam LVL should be stored lying flat and protected from the weather.
- Keep the material a minimum of 6" above ground to minimize the absorption of ground moisture and allow circulation of air.
- Bundles should be supported every 10' or less.
- RigidLam LVL is for use in covered, dry conditions only. Protect from the weather on the jobsite both before and after installation.
- 1-1/2" x 14" and deeper and 1-3/4" x 16" and deeper must be a minimum of two plies unless designed by a design professional for a specific application.
- RigidLam LVL headers and beams shall not be cut, notched or drilled except as shown below. Heel cuts may be possible. Contact your Roseburg Forest Products representative.
- It is permissible to rip RigidLam LVL to a non-standard depth provided it is structurally adequate for the applied loads. Use appropriate software (e.g. Simpson Strong-Tie® Component Solutions™) or engineering analysis to analyze non-standard depths.
- Protect RigidLam LVL from direct contact with concrete or masonry.
- Ends of RigidLam LVL bearing in concrete or masonry pockets must have a minimum of 1/2" airspace on top, sides and end.
- RigidLam LVL is manufactured without camber and therefore may be installed with either edge up or down.
- Do not install damaged RigidLam LVL.
- Do not walk on beams until they are fully braced, or serious injuries may result.

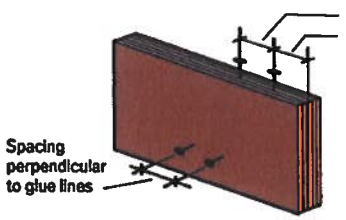
See additional notes on page 3

PERMISSIBLE HORIZONTAL ROUND HOLE LOCATION FOR RIGIDLAM® LVL BEAMS



- For beam depths (d) of 4-3/8, 5-1/2, and 7-1/4 inches, the maximum hole diameter is 1, 1-1/8, and 1-1/2 inches, respectively.
- For deeper beams, the maximum hole diameter is 2 inches.
- Diagram applies for simple and multi-span applications with uniform loading.
- No more than 3 holes per span are permitted.
- Holes should not be cut in cantilevers.
- Note: Larger holes, more holes and/or holes that are located outside of the shaded area shown may be permissible as verified by appropriate software (e.g. Simpson Strong-Tie® Component Solutions™) or engineering analysis.

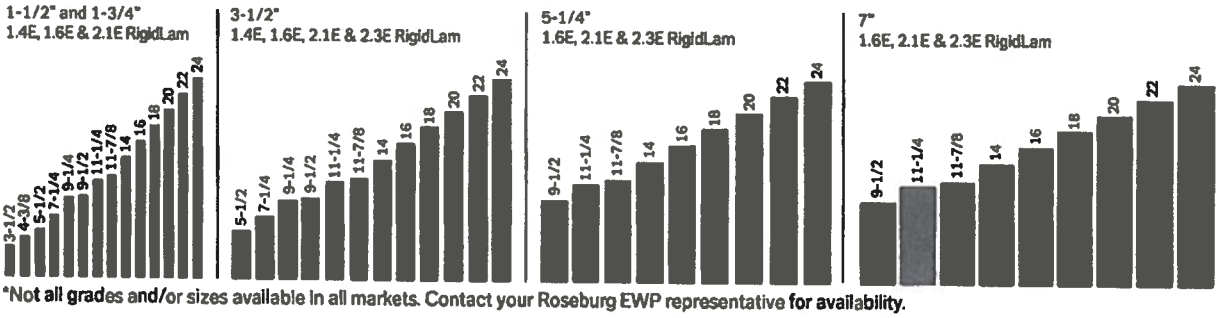
MINIMUM NAIL SPACING FOR RIGIDLAM LVL BEAMS



If more than one row of parallel nails is required for edge nailing, the rows must be offset at least 1/2" and staggered.

Nail Size	Minimum Parallel Spacing	Minimum Parallel End Distance	Minimum Perpendicular Spacing
8d Box	2"	1-1/2"	2"
8d Common	3"	2"	2"
10d & 12d Box	3"	2"	2"
10d & 12d Common	4"	3"	3"
16d Sinker	4"	3"	3"
16d Common	6"	4"	3"

Available RigidLam® LVL Sizes and Grades*



*Not all grades and/or sizes available in all markets. Contact your Roseburg EWP representative for availability.

RigidLam® LVL Allowable Design Stresses[1]

		1.4E LVL	1.6E LVL	2.1E LVL	2.3E LVL
True Modulus of Elasticity (MOE)[2] – Edgewise or Flatwise	E (psi) =	1,400,000	1,600,000	2,100,000	2,300,000
Apparent Modulus of Elasticity (MOE)[2] – Edgewise or Flatwise	E (psi) =	1,300,000	1,500,000	2,000,000	2,200,000
Bending – Edgewise[3,4]	F_b edge (psi) =	2,250	2,250	3,100	3,100
Bending – Flatwise[5]	F_b flat (psi) =	2,250	2,250	3,100	3,100
Horizontal Shear - Edgewise	F_v edge (psi) =	200	220	290	290
Horizontal Shear - Flatwise	F_v flat (psi) =	130	130	130	130
Compression Perp. To Grain[2] - Edgewise	$F_{c\ perp}$ edge (psi) =	560	575	750	750
Compression Perp. To Grain[2] - Flatwise	$F_{c\ perp}$ flat (psi) =	650	650	650	650
Compression Parallel to Grain	$F_{c\ para}$ (psi) =	1,950	1,950	3,000	3,000
Tension Parallel to Grain[6]	F_t (psi) =	1,500	1,500	2,100	2,100
MOE for stability calculations[2]	E_{min} (psi) =	704,639	805,301	1,056,958	1,157,620

1. These allowable design stresses apply to dry service conditions.
2. No increase is allowed for duration of load.
3. The tabulated values are based on a reference depth of 12 inches. For other depths, when loaded edgewise, the allowable bending stress (F_b) shall be modified by a depth factor, $K_d = (12/d)^{1/9}$ for Douglas fir LVL (Mill #1055) or $K_d = (12/d)^{1/8}$ for Southern Pine LVL (Mill #1125), where d is the LVL depth in inches. For depths less than 3-1/2 inches, multiply the tabulated value by 1.17 for DF LVL or 1.28 for SP LVL.
4. A factor of 1.04 may be applied for repetitive members as defined in the National Design Specification for Wood Construction.
5. Tabulated F_b flat values are based on a thickness of 1-3/4". For other thicknesses, when loaded flatwise, multiply F_b flat by $(1.75/t)^{1/9}$, where t is the LVL thickness in inches. For thicknesses less than 1-3/4", use the tabulated value.
6. Tensile stress is based on a 4-foot gage length. For greater lengths, multiply F_t by $(4/L)^{1/9}$ where L = length in feet. For lengths less than 4 feet, use the tabulated value.

RigidLam® LVL Design Values (1-Ply 1-3/4" Edgewise)

	1.6E Douglas-fir RigidLam LVL				2.1E Douglas-fir RigidLam LVL				2.3E Douglas-fir RigidLam LVL				2.1E Southern Pine RigidLam LVL			
Depth (in)	Max. Vert. Shear (lbs)	Max. Moment (ft-lbs)	EI x10[6] (lbs-in[2])	Approx. Weight (lbs/ft)	Max. Vert. Shear (lbs)	Max. Moment (ft-lbs)	EI x10[6] (lbs-in[2])	Approx. Weight (lbs/ft)	Max. Vert. Shear (lbs)	Max. Moment (ft-lbs)	EI x10[6] (lbs-in[2])	Approx. Weight (lbs/ft)	Max. Vert. Shear (lbs)	Max. Moment (ft-lbs)	EI x10[6] (lbs-in[2])	Approx. Weight (lbs/ft)
3-1/2	898	781	10	1.53	1,184	1,077	13	1.62	1,184	1,077	14	1.62	1,184	1,181	13	1.79
4-3/8	1,123	1,187	20	1.91	1,480	1,636	26	2.02	1,480	1,636	28	2.02	1,480	1,765	26	2.23
5-1/4	1,348	1,671	34	2.30	1,776	2,303	44	2.42	1,776	2,303	49	2.42	1,776	2,450	44	2.68
5-1/2	1,412	1,824	39	2.41	1,861	2,513	51	2.54	1,861	2,513	56	2.54	1,861	2,664	51	2.81
7	1,797	2,866	80	3.06	2,368	3,949	105	3.23	2,368	3,949	115	3.23	2,368	4,112	105	3.57
7-1/4	1,861	3,061	89	3.17	2,453	4,218	117	3.35	2,453	4,218	128	3.35	2,453	4,380	117	3.70
9-1/4	2,374	4,834	185	4.05	3,130	6,660	242	4.27	3,130	6,660	265	4.27	3,130	6,791	242	4.72
9-1/2	2,438	5,082	200	4.16	3,214	7,002	263	4.39	3,214	7,002	288	4.39	3,214	7,125	263	4.85
11-1/4	2,888	6,977	332	4.92	3,806	9,613	436	5.20	3,806	9,613	478	5.20	3,806	9,660	436	5.74
11-7/8	3,048	7,722	391	5.20	4,018	10,639	513	5.48	4,018	10,639	562	5.48	4,018	10,647	513	6.06
14	3,593	10,514	640	6.13	4,737	14,486	840	6.47	4,737	14,486	920	6.47	4,737	14,320	840	7.15
16	4,107	13,506	956	7.00	5,413	18,608	1,254	7.39	5,413	18,608	1,374	7.39	5,413	18,210	1,254	8.17
18	4,620	16,843	1,361	7.88	6,090	23,206	1,786	8.31	6,090	23,206	1,956	8.31	6,090	22,511	1,786	9.19
20	5,133	20,522	1,867	8.75	6,767	28,275	2,450	9.24	6,767	28,275	2,683	9.24	6,767	27,212	2,450	10.21
22	5,647	24,537	2,485	9.63	7,443	33,807	3,261	10.16	7,443	33,807	3,572	10.16	7,443	32,305	3,261	11.23
24	6,160	28,886	3,226	10.50	8,120	39,798	4,234	11.08	8,120	39,798	4,637	11.08	8,120	37,782	4,234	12.25

1. Allowable shear and moment values are for 100% Duration of Load and may be adjusted for other durations of load. EI shall not be adjusted for duration of load.
2. For 2-Ply, 3-Ply and 4-Ply LVL members, the values in the tables may be multiplied by 2, 3 and 4 respectively.
3. For 1-1/2" thick LVL members, allowable design values may be obtained by multiplying the table values by 0.857.
4. 1-1/2" thick members 14" and deeper must be a minimum of two plies unless designed by a design professional for a specific application.
5. 1-3/4" thick members 16" and deeper must be a minimum of two plies unless designed by a design professional for a specific application.
6. Single ply 1-1/2" thick members are assumed to be laterally braced at 16" o.c. or less.
7. Single ply 1-3/4" thick members are assumed to be laterally braced at 24" o.c. or less.

SCENARIO #4 : 50' SPAN W/ 8' OVERHANG

P = TRUSS LOAD = $\left(\frac{50}{2} + 8'\text{OH}\right) \times 40\text{PSF} \times 4'$ TRUSS SPACING

$= 5280^{\#}$

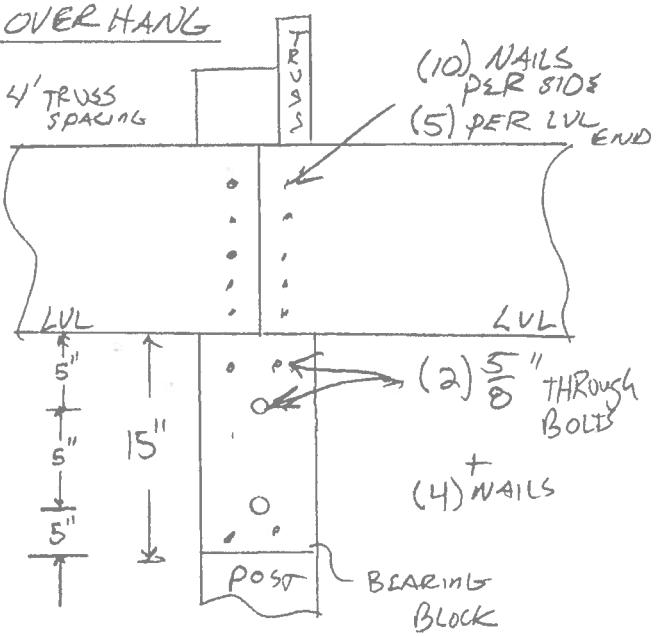
UPLIFT = $33 \times (16-7) \times 8'$ POST SPACING

$= 2376^{\#} \uparrow$

GRAVITY = $1.33(P)$

$= 1.33(5280)$

$= 7022.4^{\#} \downarrow$



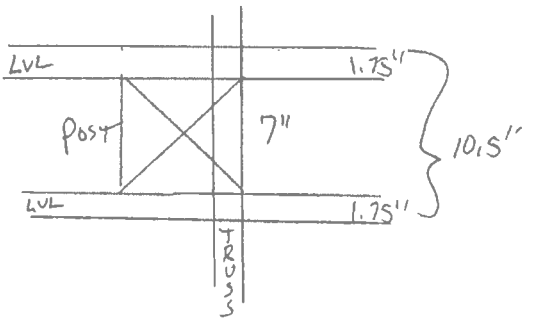
UPLIFT

$2376^{\#}$

$\div 152^{\#}$/NAIL

15.6

USE (20) TOTAL
(10) PER SIDE
OR
(5) PER GIRDER END



$\frac{3.5}{10.5} = .33 \leftarrow 33\%$ OF LOAD ON LVL's (4 ply & 5 ply posts)

GRAVITY

$7022.4^{\#}$

$-(20) \times 109.25^{\#}$/NAIL IN LVL $= 2185^{\#}$

$4837.4^{\#}$

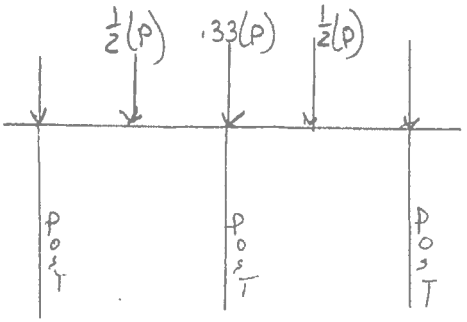
$- 2150.5^{\#}$ ($5/8$" BOLT)

$2687^{\#}$

$\div 123.05^{\#}$ PER NAIL IN BLOCK

21.8 (11 NAILS PER SIDE)

OR



7022.4

$- 2185$

$4837.4^{\#}$

$- 4301^{\#} \leftarrow$ (2) 5/8" BOLTS

$536.4^{\#}$

$\div 123.05$

4.4 NAILS

USE THIS OPTION

USE (8) TOTAL
(4) PER SIDE OF BLOCK TO HOLD BLOCK IN PLACE ADEQUATELY WHILE DRILLING 5/8" BOLT HOLES

* ALL NAILS = .131" x 3.25" POWER DRIVEN

SPECIFIC GRAVITY LVL = .44

SPECIFIC GRAVITY POST/BLOCK = .55

$\frac{5}{8}$" BOLT = $1870^{\#} \times 1.15 = 2150.5^{\#}$

↳ NDS TABLE 11F

Table 12.3.3A Assigned Specific Gravities

Species Combination	Specific[1] Gravity, G
Alaska Cedar	0.47
Alaska Hemlock	0.46
Alaska Spruce	0.41
Alaska Yellow Cedar	0.46
Aspen	0.39
Balsam Fir	0.36
Beech-Birch-Hickory	0.71
Coast Sitka Spruce	0.39
Cottonwood	0.41
Douglas Fir-Larch	0.50
Douglas Fir-Larch (North)	0.49
Douglas Fir-South	0.46
Eastern Hemlock	0.41
Eastern Hemlock-Balsam Fir	0.36
Eastern Hemlock-Tamarack	0.41
Eastern Hemlock-Tamarack (North)	0.47
Eastern Softwoods	0.36
Eastern Spruce	0.41
Eastern White Pine	0.36
Engelmann Spruce-Lodgepole Pine	0.38
Hem-Fir	0.43
Hem-Fir (North)	0.46
Mixed Maple	0.55
Mixed Oak	0.68
Mixed Southern Pine	0.51
Mountain Hemlock	0.47
Northern Pine	0.42
Northern Red Oak	0.68
Northern Species	0.35
Northern White Cedar	0.31
Ponderosa Pine	0.43
Red Maple	0.58
Red Oak	0.67
Red Pine	0.44
Redwood, close grain	0.44
Redwood, open grain	0.37
Sitka Spruce	0.43
Southern Pine	0.55
Spruce-Pine-Fir	0.42
Spruce-Pine-Fir (South)	0.36
Western Cedars	0.36
Western Cedars (North)	0.35
Western Hemlock	0.47
Western Hemlock (North)	0.46
Western White Pine	0.40
Western Woods	0.36
White Oak	0.73
Yellow Poplar	0.43

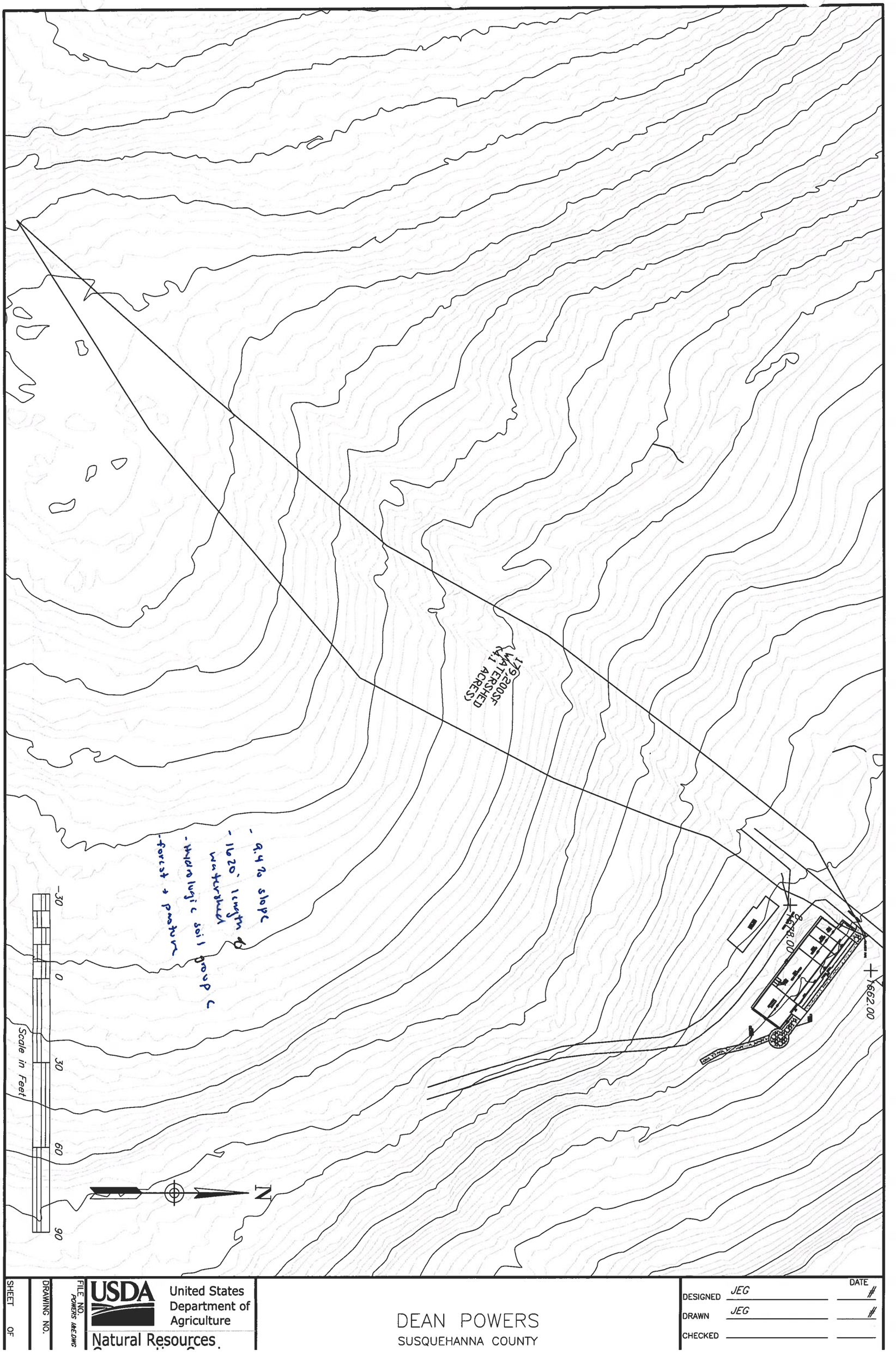
Species Combinations of MSR and MEL Lumber	Specific[1] Gravity, G
Douglas Fir-Larch	
E=1,900,000 psi and lower grades of MSR	0.50
E=2,000,000 psi grades of MSR	0.51
E=2,100,000 psi grades of MSR	0.52
E=2,200,000 psi grades of MSR	0.53
E=2,300,000 psi grades of MSR	0.54
E=2,400,000 psi grades of MSR	0.55
Douglas Fir-Larch (North)	
E=1,900,000 psi and lower grades of MSR and MEL	0.49
E=2,000,000 psi to 2,200,000 psi grades of MSR and MEL	0.53
E=2,300,000 psi and higher grades of MSR and MEL	0.57
Douglas Fir-Larch (South)	
E=1,000,000 psi and higher grades of MSR	0.46
Engelmann Spruce-Lodgepole Pine	
E=1,400,000 psi and lower grades of MSR	0.38
E=1,500,000 psi and higher grades of MSR	0.46
Hem-Fir	
E=1,500,000 psi and lower grades of MSR	0.43
E=1,600,000 psi grades of MSR	0.44
E=1,700,000 psi grades of MSR	0.45
E=1,800,000 psi grades of MSR	0.46
E=1,900,000 psi grades of MSR	0.47
E=2,000,000 psi grades of MSR	0.48
E=2,100,000 psi grades of MSR	0.49
E=2,200,000 psi grades of MSR	0.50
E=2,300,000 psi grades of MSR	0.51
E=2,400,000 psi grades of MSR	0.52
Hem-Fir (North)	
E=1,000,000 psi and higher grades of MSR and MEL	0.46
Southern Pine	
E=1,700,000 psi and lower grades of MSR and MEL	0.55
E=1,800,000 psi and higher grades of MSR and MEL	0.57
Spruce-Pine-Fir	
E=1,700,000 psi and lower grades of MSR and MEL	0.42
E=1,800,000 psi and 1,900,000 grades of MSR and MEL	0.46
E=2,000,000 psi and higher grades of MSR and MEL	0.50
Spruce-Pine-Fir (South)	
E=1,100,000 psi and lower grades of MSR	0.36
E=1,200,000 psi to1,900,000 psi grades of MSR	0.42
E=2,000,000 psi and higher grades of MSR	0.50
Western Cedars	
E=1,000,000 psi and higher grades of MSR	0.36
Western Woods	
E=1,000,000 psi and higher grades of MSR	0.36

1. Specific gravity, G, based on weight and volume when oven-dry. Different specific gravities, G, are possible for different grades of MSR and MEL lumber (see Table 4C, Footnote 2).

Table 12.3.3 Dowel Bearing Strengths, F_e, for Dowel-Type Fasteners in Wood Members

Specific[1] Gravity, G	Dowel bearing strength in pounds per square inch (psi)[2]										
	F_e	$F_{e\|\|}$	$F_{e\perp}$								
	D<1/4"	1/4" ≤ D ≤ 1"	D=1/4"	D=5/16"	D=3/8"	D=7/16"	D=1/2"	D=5/8"	D=3/4"	D=7/8"	D=1"
0.73	9300	8200	7750	6900	6300	5850	5450	4900	4450	4150	3850
0.72	9050	8050	7600	6800	6200	5750	5350	4800	4350	4050	3800
0.71	8850	7950	7400	6650	6050	5600	5250	4700	4300	3950	3700
0.70	8600	7850	7250	6500	5950	5500	5150	4600	4200	3900	3650
0.69	8400	7750	7100	6350	5800	5400	5050	4500	4100	3800	3550
0.68	8150	7600	6950	6250	5700	5250	4950	4400	4050	3750	3500
0.67	7950	7500	6850	6100	5550	5150	4850	4300	3950	3650	3400
0.66	7750	7400	6700	5950	5450	5050	4700	4200	3850	3550	3350
0.65	7500	7300	6550	5850	5350	4950	4600	4150	3750	3500	3250
0.64	7300	7150	6400	5700	5200	4850	4500	4050	3700	3400	3200
0.63	7100	7050	6250	5600	5100	4700	4400	3950	3600	3350	3100
0.62	6900	6950	6100	5450	5000	4600	4300	3850	3500	3250	3050
0.61	6700	6850	5950	5350	4850	4500	4200	3750	3450	3200	3000
0.60	6500	6700	5800	5200	4750	4400	4100	3700	3350	3100	2900
0.59	6300	6600	5700	5100	4650	4300	4000	3600	3300	3050	2850
0.58	6100	6500	5550	4950	4500	4200	3900	3500	3200	2950	2750
0.57	5900	6400	5400	4850	4400	4100	3800	3400	3100	2900	2700
0.56	5700	6250	5250	4700	4300	4000	3700	3350	3050	2800	2650
0.55	5550	6150	5150	4600	4200	3900	3650	3250	2950	2750	2550
0.54	5350	6050	5000	4450	4100	3750	3550	3150	2900	2650	2500
0.53	5150	5950	4850	4350	3950	3650	3450	3050	2800	2600	2450
0.52	5000	5800	4750	4250	3850	3550	3350	3000	2750	2550	2350
0.51	4800	5700	4600	4100	3750	3450	3250	2900	2650	2450	2300
0.50	4650	5600	4450	4000	3650	3400	3150	2800	2600	2400	2250
0.49	4450	5500	4350	3900	3550	3300	3050	2750	2500	2300	2150
0.48	4300	5400	4200	3750	3450	3200	3000	2650	2450	2250	2100
0.47	4150	5250	4100	3650	3350	3100	2900	2600	2350	2200	2050
0.46	4000	5150	3950	3550	3250	3000	2800	2500	2300	2100	2000
0.45	3800	5050	3850	3450	3150	2900	2700	2400	2200	2050	1900
0.44	3650	4950	3700	3300	3050	2800	2600	2350	2150	2000	1850
0.43	3500	4800	3600	3200	2950	2700	2550	2250	2050	1900	1800
0.42	3350	4700	3450	3100	2850	2600	2450	2200	2000	1850	1750
0.41	3200	4600	3350	3000	2750	2550	2350	2100	1950	1800	1650
0.40	3100	4500	3250	2900	2650	2450	2300	2050	1850	1750	1600
0.39	2950	4350	3100	2800	2550	2350	2200	1950	1800	1650	1550
0.38	2800	4250	3000	2700	2450	2250	2100	1900	1750	1600	1500
0.37	2650	4150	2900	2600	2350	2200	2050	1850	1650	1550	1450
0.36	2550	4050	2750	2500	2250	2100	1950	1750	1600	1500	1400
0.35	2400	3900	2650	2400	2150	2000	1900	1700	1550	1400	1350
0.34	2300	3800	2550	2300	2100	1950	1800	1600	1450	1350	1300
0.33	2150	3700	2450	2200	2000	1850	1750	1550	1400	1300	1200
0.32	2050	3600	2350	2100	1900	1750	1650	1500	1350	1250	1150
0.31	1900	3450	2250	2000	1800	1700	1600	1400	1300	1200	1100

1. Specific gravity, G, shall be determined in accordance with Table 12.3.3A.
2. $F_{e\|\|} = 11200G$; $F_{e\perp} = 6100G^{1.45}/\sqrt{D}$; F_e for D < 1/4" = $16600\,G^{1.84}$; Tabulated values are rounded to the nearest 50 psi.



SHEET OF	DRAWING NO.	FILE NO. POWERS ABE:DWG	USDA United States Department of Agriculture Natural Resources

DEAN POWERS
SUSQUEHANNA COUNTY

		DATE
DESIGNED	JEG	#
DRAWN	JEG	#
CHECKED		

AW

EFH-2 ESTIMATING RUNOFF VOLUME AND PEAK DISCHARGE Version 2.0.1

Client: Powers
County: SUSQUEHANNA-C State: PA
Practice: Culvert
Calculated By: PAS Date: 7/6/2023
Checked By: _____ Date: _____

Drainage Area:	4	Acres (provided from RCN Calculator)
Curve Number:	75	(provided from RCN Calculator)
Watershed Length:	1620	Feet
Watershed Slope:	9.4	Percent
Time of Concentration:	0.30	Hours (calculated value)
Rainfall Type:	NOAA_C	

Storm Number	1	2	3	4	5	6	7
Frequency (yrs)	1	2	5	10	25		
24-Hr rainfall (in)	2.50	3.00	3.70	4.30	5.30		
Ia/P Ratio	0.27	0.22	0.18	0.16	0.13	0.00	0.00
Runoff (in)	.29	.52	.89	1.28	1.98		
(ac-ft)	0.10	0.17	0.30	0.43	0.66	0.00	0.00
Peak Discharge (cfs)	2.17	3.36	5.21	6.91	9.89		

Warning: - RCN data inconsistant or different from Basic data.

↳ 4.1 acres : program rounded down to 4 acres

AW

EFH-2 ESTIMATING RUNOFF VOLUME AND PEAK DISCHARGE Version 2.0.1

Curve number Computation

Client: Powers
County: SUSQUEHANNA-C State: PA
Practice: Culvert
Calculated By: PAS Date: 7/6/2023
Checked By: _____ Date: _____

COVER DESCRIPTION		Acres (CN) Hydrologic Soil Group A	B	C	D
OTHER AGRICULTURAL LANDS					
Pasture, grassland or range	good	-	-	2.1(74)	-
Woods - grass combination	fair	-	-	2(76)	-
Total Area (by Hydrologic Soil Group)				4.1	
TOTAL DRAINAGE AREA: 4.1 Acres				WEIGHTED CURVE NUMBER: 75	

AW

Computation Sheet

NRCS–ENG-523A Rev. 6-2002

U.S. Department of Agriculture
Natural Resources Conservation Service

State	Project			
PA - SUSQUEHANNA	POWERS, DEAN			
By: PAS	Date: 7/6/23	Checked by:	Date:	Job No.:
Subject: CULVERT DESIGN				Sheet ____ of ____

Need 12" cover on pipe

Slope of culvert = $\frac{1566.89 - 1565.11}{27.14'}$ = 13.9% slope of existing ELD

Q to culvert (EFH2)

2 yr storm = 3.4 cfs
10 yr storm = 6.9 cfs

Install 12" culvert pipe on existing grade

Qallowable = 3.4 cfs → passes 2 yr storm

Additional flow to flow over culvert pipe

Rock @ outlet:

12" pipe for 3.4 cfs
A_{12} = 0.79 SF

3.4 cfs / 0.79 SF = 4.3 fps
use R-3 rock at outlet (Vav = 5.0 fps)

AV

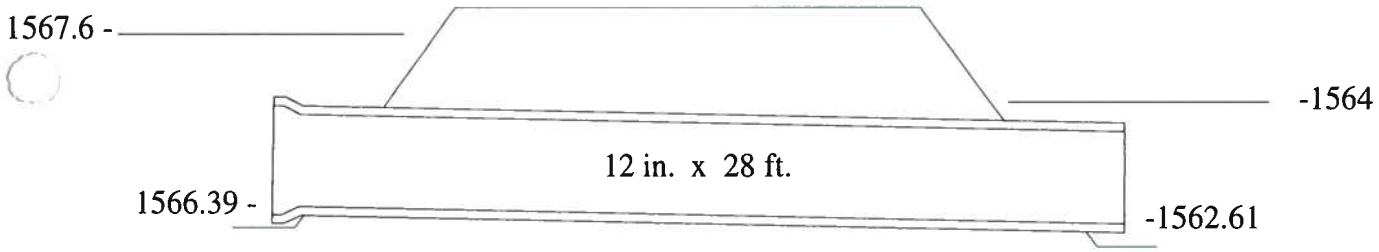
Natural Resources Conservation Service
United States Department of Agriculture

Culvert Evaluation

Participant: Powers
Location: Susquehanna
County: County, PA
Designer: PAS
Date: 07/06/2023
Checker: _____
Date: _____

Hydraulics Formula, Version 2.2.1

proposed culvert



'n' value: .011
Length: 28 ft.
Diameter: 12 in.
Projecting - groove edge ; Ke = .25

Capacity = 3.4 cfs

Inlet Controls Flow

$Q_{24hr} = 3.4$ cfs

Elevation of Headwater: 1567.6
Elevation of Inlet: 1566.39
Elevation of Tailwater: 1564
Elevation of Outlet: 1562.61

AW

Natural Resources Conservation Service
United States Department of Agriculture

Culvert Evaluation

Participant: Powers

Location:

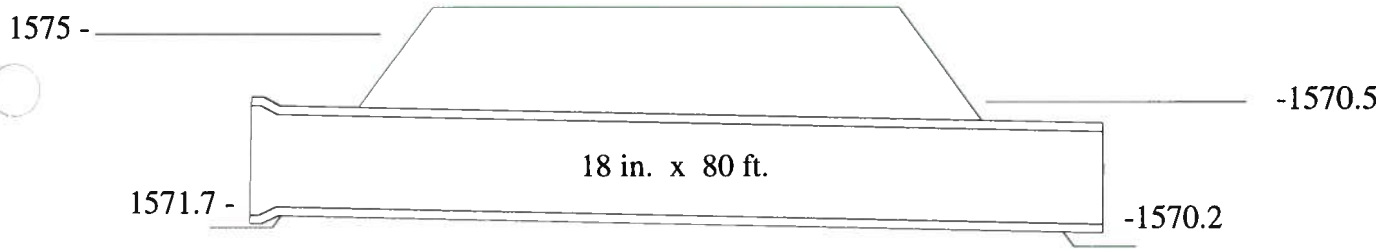
County: County, PA - Susquehanna

Designer: PAS
Date: 05/15/2023

Checker: _____
Date: _____

Hydraulics Formula, Version 2.2.1

Existing culvert pipe
(under Gas Access Road)



'n' value: 0.015
Length: 80 ft.
Diameter: 18 in.
Projecting - groove edge ; Ke = .25

Capacity = 14.9 cfs

Inlet Controls Flow

Elevation of Headwater: 1575
Elevation of Inlet: 1571.7
Elevation of Tailwater: 1570.5
Elevation of Outlet: 1570.2

* watershed to proposed ~~existing~~ culvert allows for 6.9 cfs from 10 yr storm

1	622887.8	2553711	1577.995	bm1
2	623085.9	2553799	1554.157	bm2
10	623088.5	2553798	1553.591	topo
11	623097.7	2553806	1552.258	topo
12	623099.5	2553805	1551.771	topo
13	623107.3	2553814	1550.676	topo
14	623104.7	2553818	1550.39	f
15	623145.7	2553862	1544.032	f
16	623148.9	2553859	1544.522	er
17	623165.4	2553847	1544.568	er
18	623128.9	2553805	1550.495	er
19	623111.8	2553817	1550.524	er
20	623092.1	2553794	1554.155	er
21	623104.7	2553780	1554.261	er
22	623066.2	2553741	1560.753	er
23	623052.5	2553754	1561.004	er
24	623047.8	2553755	1561.097	topo
25	623044.8	2553758	1561.284	f
26	623040	2553747	1561.448	cld
27	623041.9	2553745	1562.483	er
28	623036.6	2553740	1563.445	er
29	623033.2	2553741	1562.679	cld
30	623026.4	2553734	1563.108	cld
31	623028.2	2553731	1564.815	er
32	623040.4	2553718	1565.175	er
33	623018.3	2553701	1568.16	er
34	623007.1	2553713	1568.188	er
35	623006.7	2553716	1566.886	cld
36	623004.6	2553716	1567.405	topo
37	623021.7	2553702	1567.693	er
38	623003.6	2553688	1570.173	er
39	622993.2	2553702	1570.174	er
40	622991.7	2553704	1568.777	cld
41	622984.6	2553698	1570.099	cld
42	622980.1	2553693	1571.947	er
43	622972.9	2553687	1572.961	er
44	622970.7	2553688	1570.063	d
45	622967.7	2553687	1569.928	cld
46	622966.6	2553688	1571.702	t pipi
47	622966.6	2553685	1573.084	topo
48	622964	2553683	1573.759	er
49	622961.9	2553688	1574.133	topo
50	622963.5	2553691	1574.085	topo
51	622967.1	2553694	1573.943	topo
52	622971.4	2553697	1574.579	topo
53	622964.7	2553706	1574.202	topo
54	622953.5	2553703	1573.769	ex c

55	622969.1	2553716	1573.608	ex
56	622972.2	2553711	1574.367	topo
57	622945	2553692	1574.652	drive
58	622906.4	2553656	1578.259	drive
59	622905	2553638	1580.724	er
60	622917.3	2553621	1580.874	er
61	622903.1	2553703	1575.249	drive
62	622883	2553736	1575.454	gate
63	622902.2	2553747	1575.093	gate
64	622893	2553757	1574.957	drive
65	622876.3	2553781	1575.307	drive
66	622859.3	2553768	1575.816	drive bldg off
67	622838.9	2553825	1575.334	drive
68	622821.9	2553812	1575.353	drive
69	622809	2553819	1572.288	culv
70	622809.4	2553819	1573.982	culv
71	622812.6	2553824	1575.526	drive
72	622802.9	2553825	1574.951	topo
73	622777.9	2553836	1577.702	topo
74	622782.7	2553843	1575.762	topo
75	622786.7	2553849	1576.053	drive
76	622799.7	2553865	1575.796	drive
77	622824.9	2553877	1575.003	topo
78	622840.5	2553842	1574.866	corn
79	622836.2	2553865	1574.958	topo
80	622854.9	2553855	1570.594	culv
81	622857.8	2553859	1570.663	topo
82	622858.2	2553860	1572.184	wall
83	622863	2553854	1571.888	wall
84	622863.4	2553856	1569.206	topo
85	622842.7	2553901	1565.512	topo
86	622829.1	2553894	1568.533	topo
87	622836.4	2553921	1564.102	tree
88	622846.3	2553910	1564.948	topo
89	622853.1	2553913	1563.384	topo
90	622883.2	2553940	1558.895	topo
91	622874.7	2553983	1554.139	topo
92	622932.1	2553941	1554.887	topo
93	622903.7	2553910	1560.565	topo
94	622890.3	2553895	1563.476	topo
95	622880.1	2553885	1564.5	topo
96	622875.7	2553881	1565.737	topo corn
97	622866.7	2553873	1566.866	topo
98	622855.2	2553864	1569.105	topo
99	622855.2	2553864	1572.311	wall
100	622882.1	2553838	1568.723	wall topo
101	622903.2	2553853	1566.036	topo

102	622906.8	2553856	1564.839	topo
103	622923.1	2553867	1563.542	topo
104	622939.5	2553880	1560.951	topo
105	622963.3	2553895	1556.703	topo
106	623001.8	2553866	1554.59	topo
107	622976.8	2553845	1560.437	topo
108	622946.2	2553821	1564.727	topo
109	622927.9	2553827	1565.92	topo
110	622912.7	2553815	1567.108	topo
111	622907.4	2553809	1569.282	wall corn
112	622906.3	2553810	1571.194	wall
113	622908	2553796	1568.458	topo
114	622895.4	2553795	1570.319	topo tree
115	622888.5	2553793	1572.653	wall
116	622888.1	2553792	1574.859	wall
117	622887.2	2553781	1573.595	topo
118	622901	2553765	1573.029	topo
119	622912.8	2553764	1571.203	topo
120	622923.5	2553769	1569.391	topo
121	622933	2553775	1567.797	topo
122	622935.6	2553769	1567.518	topo
123	622929.6	2553763	1567.842	wall
124	622917.6	2553753	1568.657	wall
125	622913.2	2553752	1572.109	wall
126	622942.6	2553755	1567.943	topo
127	622924.9	2553746	1568.408	topo
128	622948	2553750	1568.453	cc
129	622960.6	2553760	1568.309	cc
130	622960.2	2553764	1567.177	opo
131	622970.7	2553764	1567.038	tree
132	622976.5	2553774	1565.414	topo
133	623005.3	2553799	1560.582	topo
134	623055	2553771	1559.169	topo
135	623039.6	2553754	1562.388	topo
136	623019.1	2553737	1565.288	topo
137	623013.4	2553743	1565.528	topo
138	623000.4	2553739	1566.042	topo
139	623010.2	2553732	1566.919	tree off 5
140	622987.1	2553738	1567.075	topo
141	622987.3	2553729	1568.452	topo
142	622987.7	2553753	1565.691	topo
143	622977.8	2553750	1566.625	topo
144	622974.5	2553746	1568.081	topo
145	622973.8	2553753	1567.145	topo
146	622971.2	2553753	1568.065	topo
147	622962	2553741	1568.16	topo
148	622934.8	2553731	1568.389	wall

149	622946.6	2553732	1568.619	cc
150	622955.5	2553739	1568.027	cc
151	622953.7	2553727	1568.469	topo
152	622975.6	2553723	1568.631	wall corn
153	622953.5	2553707	1568.544	topo
154	622953.6	2553707	1568.547	topo
155	622932.6	2553730	1573.45	wall
156	622906	2553766	1572.321	topo
157	622887.6	2553711	1578.043	bm close
158	622942	2553694	1574.723	topo
159	622930	2553724	1574.725	topo

Smith, Pamela - FPAC-NRCS, PA

om: Welmon, Ain - FPAC-NRCS, PA
Sent: Monday, May 15, 2023 9:11 AM
To: Smith, Pamela - FPAC-NRCS, PA
Subject: FW: [External Email]POCS 05/15/23 09:03:47 20231350746-000 WR# 119320230515 New Excavation Preliminary Design

Pam,
Here is the PA One Call for Powers.
Thanks
Ain

-----Original Message-----
From: POCS Web Ticket Confirmation <Delivery@pa1call.net>
Sent: Monday, May 15, 2023 9:04 AM
To: Welmon, Ain - FPAC-NRCS, PA <ain.welmon@usda.gov>
Subject: [External Email]POCS 05/15/23 09:03:47 20231350746-000 WR# 119320230515 New Excavation Preliminary Design

[External Email]
If this message comes from an unexpected sender or references a vague/unexpected topic; Use caution before clicking links or opening attachments.
ease send any concerns or suspicious messages to: Spam.Abuse@usda.gov

WEBCFM 00000 POCS 05/15/23 09:03:47 20231350746-000 WR# 119320230515 NEW XCAV DSGN

==========PENNSYLVANIA UNDERGROUND UTILITY LINE PROTECTION REQUEST========== Serial Number--[20231350746]-[000] Channel#--[0732AWEB][5323][2019-08]
Message Type--[NEW][EXCAVATION][PRELIMINARY DESIGN]

County--[SUSQUEHANNA] Municipality--[JACKSON TWP]
Work Site--[1254 POWERS RD]
Nearest Intersection--[MARVINS RD]
Second Intersection--[STATE ROUTE 92]
At Intersection--[N] Between Intersections--[N]
Subdivision--[]
Location Information--
[SITE IS ON FIELD NEXT TO ROAD ACROSS FROM HOOP BUILDING]
Caller Lat/Lon--[]
Mapped Type--[P] Mapped Lat/Lon--
[41.856611/-75.601494,41.856657/-75.601381,41.856241/-75.600729,
41.856081/-75.600901,41.856487/-75.601571]
Attachments--
[https://gcc02.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwww.pa811.org%2Fattachments%2F20231350746
data=05%7C01%7C%7Cb503141fd6a74f9f2c1b08db5545c8f9%7Ced5b36e701ee4ebc867ee03cfa0d4697%7C0%7C0%7
638197530435029947%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJ
XVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=4JNVndu6d8oKgwhcuSE63S0zfdfkpk9YqLJptyOMuiA%3D&reserved=0]
Type of Work--[INSTALL STORAGE FACILITY AND BARN YARD] Depth--[]

Extent of Excavation--[164FT X 50FT] Method of Excavation--[DIGGING]
Equip Type--[EXCAVATOR]
Street--[ ] Sidewalk--[ ] Pub Prop--[ ] Pvt Prop--[ ] Other--[ON FIELD] Private Front--[ ] Rear--[ ] Left--[ ] Right--[ ]

Project Dates--[ ] thru [ ] Response Due Date--[30-May-23]
Scheduled Excavation Date--[DESIGN]

Caller--[AIN WELMON]
Caller Phone--[570-278-1197]
Excavator--[PENNSYLVANIA U S D A N R C S]
Address--[359 E PARK DR SUITE 2]
City--[HARRISBURG] State--[PA] Zip--[17111]
FAX--[855-836-9214] Caller Type--[B]
Email--[AIN.WELMON@USDA.GOV]
Work For--[DEAN POWERS]
Project Contact--[AIN WELMON]
Project Contact Phone--[570-278-1197]
Best Time to Call--[0730-1600 M-F]
Project Contact Email--[AIN.WELMON@USDA.GOV]

Prepared--[15-May-23] at [0901] by [WELMON101]
Remarks--
[***=== APPROVED ANINGRAM WR#119320230515--SUBMITTED 5/15/2023 0732 ===***]

AF 0 AF =ADAMS CATV LV 0 LV =PENELEC NT10 NT1=NE PA TEL

rial Number--[20231350746]-[000]

Smith, Pamela - FPAC-NRCS, PA

From: Welmon, Ain - FPAC-NRCS, PA
Sent: Wednesday, May 31, 2023 9:45 AM
To: Smith, Pamela - FPAC-NRCS, PA
Subject: FW: [External Email]POCS 05/31/23 02:09:07 20231350746-000 KARL Automated Response Service

Follow Up Flag: Follow up
Flag Status: Flagged

FYI

-----Original Message-----
From: POCS KARL Responses <Delivery@pa1call.net>
Sent: Wednesday, May 31, 2023 2:09 AM
To: Welmon, Ain - FPAC-NRCS, PA <ain.welmon@usda.gov>
Subject: [External Email]POCS 05/31/23 02:09:07 20231350746-000 KARL Automated Response Service

[External Email]
If this message comes from an unexpected sender or references a vague/unexpected topic; Use caution before clicking links or opening attachments.
Please send any concerns or suspicious messages to: Spam.Abuse@usda.gov

PENNSYLVANIA ONE CALL SYSTEM, INC.
KARL AUTOMATED RESPONSE SERVICE

Excavator: PENNSYLVANIA U S D A N R C S
Telephone #: 570-278-1197
Caller: AIN WELMON
Fax #: 855-836-9214
E-Mail: AIN.WELMON@USDA.GOV

Serial Number 20231350746 at the following location:

County: SUSQUEHANNA
Municipality: JACKSON TWP
Address: 1254 POWERS RD
Nearest Intersection: MARVINS RD
Second Intersection: STATE ROUTE 92
Location Information: SITE IS ON FIELD NEXT TO ROAD ACROSS
FROM HOOP BUILDING

has been responded to through Pennsylvania One Call System by these facility owners in the following manner:

UTILITY
RESPONSE
Facility Owner Note:
==========

ADAMS CABLE TV (AF)
001- CLEAR. NO FACILITIES OR FACILITIES NOT INVOLVED BASED ON TICKET INFORMATION.
NORTHEASTERN PENNSYLVANIA TELEPHONE CO (NT1)
001- CLEAR. NO FACILITIES OR FACILITIES NOT INVOLVED BASED ON TICKET INFORMATION.
PENNSYLVANIA ELEC CO (LV)
083- ENGINEERING COMPLETED. A PDF FILE OR MARKED UP PLANS WERE SENT TO THE REQUESTOR.

Please take this document to the work site and compare the utility responses for 003-FIELD MARKED to temporary facility marks on the ground. Missing or incorrect marks at the site and/or utilities who DID NOT RESPOND THROUGH PA ONE CALL on this document may warrant further investigation to determine underground utility location(s).

Name or Office Name Montrose Field Office, USDA_NRCS
Office Address 17089 SR 706, Montrose, PA 18801
Phone Number (570)278-1197
Email ain.welmon@usda.gov

United States Department of Agriculture

PA Cultural Resources Review Worksheet

Landowner: Dean Powers
Operator: Dean Powers
Site Address: 1254 Powers Road
41.85505, -75.599867

County: Susquehanna
Tract Number: 3990
Township: Jackson
Program: EQIP

Undertakings that have the Potential to Affect Cultural Resources

No.	Undertaking (Practice number and Size Included in the Undertaking) (acres, feet, ft², ft³, no., etc.)	Max. Depth of Anticipated Disturbance[1]	APE, Acres of Undertakings For Review	Has area been previously disturbed?[2]
1	313(2200SF)/561(4390SF)/560(196LF)		0.20	☑
	2-558(328LF)/620(508LF)/ 500 (60LF)			☐
				☐
				☐
				☐
				☐
	Total Number of Undertakings Reviewed = 1	**Total Acres =**	0.20	

[1] Please use **Additional Notes to the Reviewer** on Page 2, if needed, to clarify depth of disturbance.
[2] If checked, please describe disturbance in **Previous Disturbance** on Page 2.

ARCHAEOLOGICAL RESOURCES

Areas Investigated - Provide information for each Investigation Conducted. Each Investigation must be its own column.

Which undertaking(s)?	All					
Size of Investigation (acres)	5.00					
Type of ground cover	grass					
Percent of ground visible	0					
Primarily hydric soil (Y/N)?	N					
Percent slope	6					
Feet to perennial water	1000					

Does the landowner/operator know of or suspect any historic or prehistoric cultural resources within the APE? If yes, check which resource and describe below.

Presence of within APE:
☐ Ruins or foundation(s)? ☑ Old stone wall? ☐ Hand dug well?
☐ Unusual depression? ☐ Mound of soil or stone? ☐ Cistern(s)?
☐ Privies/Latrines? ☐ Other cultural features? ☐ None
☐ Rock outcrops that could have been used for tools (flint or chert) or shelter?
☐ Tools ☐ Shelter

Describe: Some of the old stone wall is in the APE. Partially damaged by owner prior to NRCS involvement.

Have artifacts been found on the property? If so, check material type and describe below.

☐ Flint/Chert Flakes ☐ Projectile Points
☐ Pottery Sherds ☐ Other ☑ None

Describe:

ABOVE GROUND RESOURCES

Describe all above ground resources (buildings, structures, objects, or landscape sites) and their estimated ages on the farm that may be affected by the proposed undertakings. Also describe the potential effect. (Direct effect examples - demolition, physical modification, and repair; Indirect effect examples - introduction of buildings, alteration of land use, visual impacts, foreseeable development)

NOTE: If buildings 50 years old or older may be directly or indirectly affected, send photos of buildings, area of planned undertaking, and wide view of area.

Remains of stack field stone wall will be removed to facilitate installation of practices.
Adjacent trees will be removed under practice 500.
There are no buildings within the APE that are greater than 50 years old.

Is this site located in a historical district? ☑ No ☐ Yes, Name

OTHER INFORMATION

Previous Disturbance

If you checked the Previous Disturbance box for any of the Undertakings on Page 1, please describe the type, depth, and extents of previous disturbance (beyond normal tillage) that has occurred in the undertaking's APE.

Years ago a portion of the rock wall was disturbed.
Normal farming and construction activities, to an average depth of 18"

Additional Notes to the Reviewer

Please include any additional information about the site or planned practices that may be helpful to the person reviewing this form.

How did you acquire this information? Check all that apply

- ☑ National Register of Historic Places using Priority Resource Map or CRGIS - ***Required*** (https://www.dot7.state.pa.us/crgis/)
- ☑ Recollections from landowner(s) - ***Required, if practicable***
- ☑ Historic Documents (old maps, plats, aerial photos) Penn Pilot - http://www.pennpilot.psu.edu/
- ☑ Visual clues - ***Required***

Field survey conducted by (mark one):
(Must have completed NRCS Cultural Resources Training Mods 1-8)

NRCS	District	RC&D	TSP	Other
☑	☐	☐	☐	☐

Signature AIN WELMON Digitally signed by AIN WELMON Date: 2023.05.17 11:53:42 -04'00' Date:

A complete cultural resources review submission includes:

- ☑ *CRRW form*
- ☑ *Practice Map (identifying the location and extents of the planned undertakings)*
- ☑ *Pictures (as appropriate)*

CRC/CRS Use Only Below this Line

Number of Investigations Conducted	Acres of Investigation Conducted	Number of Potential Sites Identified in APE	Acres of Potential Sites Identified in APE
1	5.00	0	0.00

SHPO Consultation? ☑ No ☐ Yes

ER: _____

Additional Work: ☐ Phase I ☐ HRSF ☐ Phase II ☐ None

Contractor: _____

Treatment Type

- ☐ Not Applicable
- ☐ Avoidance
- ☐ No Treatment
- ☑ None
- ☐ Data Recovery/Interpretation
- ☐ Other:

NRCS CRC/CRS Review

Reviewed By: CHRISTOPHER PLOUNT Digitally signed by CHRISTOPHER PLOUNT Date: 2023.05.23 08:13:26 -04'00' Date:

Comments: Per phonecon with Hanson at SHPO, stone wall is not a viable resource for review.
Undertaking approve provided it occurs in the manner and location provided.

Montrose Field Office, USDA_NRCS
17089 SR 706, Montrose, PA 18801
(570)278-1197
ain.welmon@usda.gov

United States Department of Agriculture

PA Cultural Resources Review Worksheet

Landowner: Dean Powers
Operator: Dean Powers
Site Address: 1254 Powers Road
41.85505, -75.599867

County: Susquehanna
Tract Number: 3990
Township: Jackson
Program: EQIP

Undertakings that have the Potential to Affect Cultural Resources

No.	Undertaking (Practice number and Size Included in the Undertaking) (acres, feet, ft², ft³, no., etc.)	Max. Depth of Anticipated Disturbance[1]	APE, Acres of Undertakings Reviewed	Has area been previously disturbed?[2]
				☐
				☐
				☐
				☐
				☐
				☐
				☐
				☐
Total Number of Undertakings Reviewed =	See Page 1	**Total Acres =**	See Page 1	

[1] Please use **Additional Notes to the Reviewer** on Page 2, if needed, to clarify depth of disturbance.
[2] If checked, please describe disturbance in **Previous Disturbance** on Page 2.

ARCHAEOLOGICAL RESOURCES

Areas Investigated - Provide information for each Investigation Conducted. Each Investigation must be its own column.

Which undertakings?						
Size of Investigation (acres)						
Type of ground cover						
Percent of ground visible						
Primarily hydric soil (Y/N)?						
Percent slope						
Feet to perennial water						

Clear Form

Dean Powers
Roofed Heavy Use Area & Manure Stacking Structure & Supporting Practices
Quality Assurance Plan

Location: Susquehanna County, Pa

Estimated Performance Time: 28 work days (5.6 Weeks @ 5 Days/Week)

Critical Items of Work and Timing of Inspection	Work Days	Inspection Req'd
Pre-construction meeting	0.5	**full time**
E&S measures installation	0.5	daily as needed
Obstruction removal (concrete and rock wall)	3	daily as needed
Excavation	2	daily as needed
Perimeter drains	1	daily as needed
Compacted fill and stone to reach subgrade elevations	2	daily as needed
Concrete flatwork placement	2	**full time**
Concrete prep-walls/curbing	4	**full time**
Concrete wall/curbing placement	2	**full time**
Construct roof	6	daily as needed
Access road installation	1	daily as needed
Roof Runoff Items	1	daily as needed
All Outlet Pipes	1	daily as needed
Complete Final Grading	1	daily as needed
Seed all disturbed areas	1	once when done

General Items

1. The site will be checked at least once a day during the construction period when the contractor is working, expected to work, or could work. These visits should be unannounced and at random times.
2. Materials should match the specifications or values referenced within the construction package. A substitution should not be made without prior approval by the design engineer. If the contractor expects that a different product will be used, they will need to provide pertinent material information in order to provide adequate comparison.
3. All visits must be documented on SCS-CPA-6 or job diary. It is required that a continuous record of construction assistance be kept from the pre-construction conference to the final inspection. OSHA standards for trenches and other excavation must be followed. If safety violations are observed, notify the contractor and contact the NRCS supervisor or engineer assigned to the job.
4. **If the primary inspector can't meet the inspection responsibilities day to day or otherwise, they should contact the backup inspector and be sure the site is adequately inspected. It is the responsibility of the primary inspector to be sure there is adequate and continuous inspection throughout the project.** If a backup inspector agrees to inspect a project during a period of time when the primary inspector will be absent, it is then the backup's responsibility to find an inspector if they can't inspect the site.

Specific Items to be Checked:

1) Preliminary Information
   a) Document contractor names and associated work items
   b) Ensure that a PA-One Call Construction request has been submitted and that all lines are marked prior to beginning excavation

2) Erosion and Sedimentation Controls
   a) Document these practices

3) Excavation
   a) Check for seep locations during excavation and ensure all sub-bases are free of seeps or unstable soils

4) Timber Structures
   a) Document post size, material, and brackets. Report inadequate materials to the design engineer.
   b) Materials to be checked – lumber quality and dimensions, post spacing, required bracing, nail and bolt sizes and patterns
   c) Trusses should be PE approved and should be approved by the design engineer prior to ordering.

5) Footer Drain and Outlet
   a) Document diameter, ASTM, elevations and length
   b) Verify animal guard is installed

6) Reinforced Gravel Placement
   a) Verify dimensions and grades of reinforced gravel areas
   b) Document material types and amounts for each area
   c) Verify surface water controls if needed

7) Concrete Placement
   a) Document foundation.
   b) Obtain concrete design mix prior to contractor ordering concrete and placement; send the mix design to the design engineer for acceptance and approval well in advance of placing the concrete; work with the contractor/concrete supplier to make sure revisions are made to the concrete design, if found not adequate, and forward any revised concrete designs to the design engineer for final acceptance and approval.
   c) Verify subgrade, steel, and forms before concrete arrives.
   d) Obtain batch tickets with pertinent information for concrete delivered.
   e) Document any on-site testing of concrete materials.
   f) Ensure that weather precautions and curing procedures are followed.
   g) Make sure contractor has enough waterstop on-site prior to concrete placement
   h) If cold or hot weather concreting is necessary; consult with the design engineer.

8) Seeding
   a) Document materials and locations

9) Final Documentation
   a) Make daily inspection documentation.
   b) Sufficient information should be taken to document against the original construction drawings.

c) Final documentation of the completed project must be shown in red on the construction drawings.
d) Take photos and include in the as-built plans, as needed, to show installation procedures or materials used.
e) Make notes of verifications and/or any changes in red as well.

This inspection plan was developed to ensure the designer's objectives are met and quality workmanship is performed. This plan sets forth the minimum, but not necessarily all the inspection items and time needed. If additional inspection is needed, the assigned inspector shall inform the supervisor and note it on the SCS-CPA-6.

CERTIFICATION OF CONFORMANCE

The undersigned primary manufacturer/supplier/contractor has furnished to:

Farmer's Name: Dean Powers
Address: _____
City/State/Zip: _____
Type of Storage: Concrete Works

And hereby states that the quality of work and materials meets the requirements as set forth on the design Drawings and/or Specifications.

Name of Manufacturer/Supplier/contractor: _____

Signature/Title/Date: _____

Description of Items Completed: _____
_____
_____

In addition, the landowner and/or the following subcontractors were also involved in the installation and they hereby certify their work meets the requirements of the drawings and/or specifications as stated previously.

Landowner Signature/Date: _____

Description of Items Completed: _____
_____
_____

Subcontractor Signature/Date: _____

Description of Items Completed _____
_____

Subcontractor Signature/Date: _____

Description of Items Completed: _____
_____

Received By: _____
SIGNATURE TITLE DATE

Note: It is the primary manufacturer/supplier's/contractor's responsibility to obtain and furnish all required signatures.

CERTIFICATION OF CONFORMANCE

The undersigned primary manufacturer/supplier/contractor has furnished to:

Farmer's Name: Dean Powers
Address: _____
City/State/Zip: _____
Type of Storage: Timber Works

And hereby states that the quality of work and materials meets the requirements as set forth on the design Drawings and/or Specifications.

Name of Manufacturer/Supplier/contractor: _____

Signature/Title/Date: _____

Description of Items Completed: _____
_____
_____

In addition, the landowner and/or the following subcontractors were also involved in the installation and they hereby certify their work meets the requirements of the drawings and/or specifications as stated previously.

Landowner Signature/Date: _____

Description of Items Completed: _____
_____
_____

Subcontractor Signature/Date: _____

Description of Items Completed _____
_____

Subcontractor Signature/Date: _____

Description of Items Completed: _____
_____

Received By: _____
SIGNATURE TITLE DATE

Note: It is the primary manufacturer/supplier's/contractor's responsibility to obtain and furnish all required signatures.

USDA

United States Department of Agriculture

Fact Sheet #9

January 2016

Agriculture Construction Safety

Compliance with safety regulations on agricultural projects is required by OSHA and by all construction insurance/ liability companies. The contractor is to maintain a safe working environment for themselves, their employees, subcontractors, and others who must have access to the site. Detailed knowledge and implementation of safety regulations is their responsibility. Those with more than ten employees must have written safety procedures and document implementation.

Imminent danger situations (hazards that could cause death or serious physical harm) require immediate action, including work stoppage. When NRCS and/or partner personnel observe or become aware of an imminent danger on the work site they will alert the contractor and landowner. They will also advise the landowner that funding and/or technical assistance will be withdrawn if the situation is not corrected. Work may continue after the imminent danger is resolved.

Effective January 1, 2015, all employers must report work-related fatalities, hospitalizations, amputations, and losses of an eye. They can contact the 24-hour OSHA hotline at 1-800-321-OSHA (6742) or their regional OSHA office. See OSHA standards 29 CFR 1904.39 for more information.

Soil Cave-In Protection

- Applies to all excavation over five feet in depth.
- OSHA has regulations set forth in Standards 29 CFR 1926 -Subpart P.
- Options include: sloping, shoring, or working from a safe distance.
- See "Fact Sheet" – SOIL CAVE IN – A FATAL SLIP for general information.

Fall Protection

- This applies to all areas where an individual could fall six feet or more.
- OSHA regulations in 29 CFR Parts 1910 for General Industry and 1926 for the Construction Industry apply to agricultural construction.
- OSHA 29 CFR 1926 subpart L deals with scaffolds and 29 CFR 1926 Subpart M deals with overall fall protection, including but not limited to cast-in-place concrete work, leading edge work, pre-cast concrete erection, tying reinforcement steel, truss installation, and roof construction.
- Options include: warning line system, safety monitors, mechanical equipment, controlled access area, covers, safety nets, scaffolding, guardrail system, and personal fall arrest.
- Selected method(s) shall be implemented at the start of construction.

Underground and Overhead Utility Protection

- Contractor is required to do their own utility check via PA-ONE Call system (811).
- Landowner and/or contractor shall contact any overhead utilities and prepare a procedure to avoid contact and/or schedule work with utility oversight.
- Landowner is to mark and locate any known private buried utilities within the work area.

NOTE: Critical safety measures may be highlighted in the Project Drawings and Specifications.

Fact Sheet

SOIL CAVE IN-A FATAL SLIP

United States Department of Agriculture

Natural Resources Conservation Service

Cause of Cave Ins

Cave ins in pits and ditches cause the death of construction workers every year. Most deaths have occurred in trenches dug for utility lines. However, soil slippage can occur anywhere soil is excavated. Landslides in clay soils kill more people each year than those in sandy soils.

Most workers are careful around sand because they know it moves easily. However, many believe a thick, tough clay soil will not slip. Yet, most clay soils shrink and crack open when dry and swell when wet. This shrinkage and swelling cause slick areas to develop beneath the surface.

Some clay soils contain water-tight layers called fragipans. Water accumulating on the impervious layer lubricates the soil, increasing the probability of slippage. When a ditch or pit is dug in a soil with a fragipan or in a soil with a high shrink-swell potential, the soil will often slip, resulting in a dangerous cave in. This becomes even more likely WHEN THE SOIL IS WET.

Prevention

Occupational Safety and Health Administration (OSHA) regulations require protective action on all worker-occupied excavations unless the cut is made in stable rock, or the cut is less than five feet deep and there is no potential for a cave in to occur. Protection can be accomplished with sloping and benching, support systems, or shield systems which conform to OSHA regulations.

Sloping the sides of the excavation is the simplest protection against a cave in. If soil properties in the excavation are unknown, the excavation slopes should be no steeper than 1-1/2 horizontal to 1 vertical. If the soil can be classified as a Type A or Type B material according to the OSHA classification system (see back side), you can use a steeper slope, as shown in Figures 1 through 5.

Consult OSHA regulations when more than one soil type is exposed in an excavated slope, or when benched slopes are used. The regulations also provide details on support and shield requirements. Complete requirements are found in OSHA's safety and health standards (29 CFR 1926, Subpart P).

Soils Information

Soil survey publications are available for most counties. This information is useful to engineers, builders, contractors and others interested in construction hazards. The publication identifies soils with fragipans and high shrink-swell potential. Other potential construction problems, such as water table, bedrock and corrosiveness, are also contained in the reports as well as information on engineering properties of soils.

Copies of soil survey reports and other soils information are available from the local office of the USDA, Natural Resources Conservation Service, or write Soils, USDA, Natural Resources Conservation Service, Suite 340, One Credit Union Place, Harrisburg, PA 17110-2993.

OSHA Soils Classification for Excavated Slopes

Type A means cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as hardpan are also considered Type A. However, no soil is Type A if:

(i) The soil is fissured; or
(ii) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
(iii) The soil has been previously disturbed; or
(iv) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of 4H:1V or greater; or
(v) The material is subject to other factors that would require it to be classified as a less stable material.

Type B means:

(i) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf; or
(ii) Granular, cohesionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam; or
(iii) Previously disturbed soils except those which would otherwise be classed as Type C soil; or
(iv) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or
(v) Dry rock that is not stable; or
(vi) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than 4H:1V, but only if the material would otherwise be classified as Type B.

Type C means:

(i) Cohesive soil with an unconfined compressive strength of 0.5 tsf or less; or
(ii) Granular soils including gravel, sand, and loamy sand; or
(iii) Submerged soil or soil from which water is freely seeping; or
(iv) Submerged rock that is not stable; or
(v) Material in a sloped, layered system where the layers dip into the excavation ona slope of four 4H:1V or steeper.

MAXIMUM ALLOWABLE SLOPES

Figure 1. Type A Soil
Simple Slope, General

Figure 2. Type A Soil
Simple Slope, Short Term

Figure 3. Type A Soil
Unsupported, Vertically Sided Lower Portion, Maximum 8 Feet in Depth

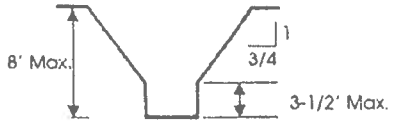
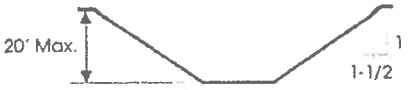


Figure 4. Type A Soil
Unsupported, Vertically Sided Lower Portion, Maximum 12 Feet

Figure 5. Type B Soil
Simple Slope

Figure 6. Type C Soil
Simple Slope



Fact Sheet

COLD WEATHER CONCRETING
(ACI-306R-88 Summary)

USDA
Natural Resources
Conservation Service

Definition of Cold Weather (1.1)

As per ACI-306R report, cold weather is defined as: a period for more than 3 consecutive days the average daily air temperature is less than 40^0 F, and the air temperature is not greater the 50^0 F for more than half (12hrs.) of any of the 3 days. *"The average daily air temperature is the average of the highest and the lowest temperatures occurring during the period from midnight to midnight."*

-Objectives (1.3)

The objectives for cold weather concreting are to;

- prevent damage to concrete from early stage freezing. As concrete gains maturity the mixing water combines with the cement during hydration decreasing the degree of saturation below the critical level. The critical level is the degree of saturation where a single cycle of freezing could cause damage to the concrete.
- assure that the concrete develops essential strength for safe removal of forms and safe loading of the structure during construction and after.
- limit rapid changes of temperature before the concrete has obtained sufficient strength to withstand induced thermal stresses.
- provide protection that warrant normal strength development and the intended serviceability of the structure.

"Short-term construction economy should not be obtained at the expense of long-term durability."

-Principles (1.4)

Concrete that has attained a compressive strength of at least 500-psi will not be damaged by exposure to a single freezing cycle. Concrete that is protected will obtain its potential strength despite subsequent exposure to cold weather. Except within heated enclosures little or no external supply of moisture is required. Calcium chloride should not be used to accelerate setting because of increased chances of corrosion to re-enforcing metal.

-Economy (1.5)

The owner must decide whether the extra costs in cold weather concreting are more profitable or cost effective than waiting for milder weather. Neglect of protection against freezing in the early stages can cause immediate destruction or weakening of the concrete.

-Planning (2.1)

Plans to prevent early freezing of fresh concrete and maintaining temperatures above the recommended minimums should be made well before freezing temperatures are expected to occur. The necessary equipment and materials should be at the work site before cold weather is likely to occur, not after the fresh concrete begins to approach the freezing point.

-Protection during fall and spring (2.2)

During Fall and Spring when temperatures are not defined as cold weather, all concrete surfaces should be protected from freezing, for at least the first 24-hours after placement, when heavy frost or freezing is forecast at the job site.

-Concrete temperature (2.3)

The concrete temperature at the time of placement should not be lower than the values given in Table 3.1, also the concrete temperature should be maintained at the recommended placement temperature for the required protection period.

Air Temperature	Concrete Temperature
Minimum concrete temperature as placed and maintained	
ALL	**55 F**
Minimum concrete temperature as mixed for indicated air temperature	
Above 30F	60F
0-30F	65F

Table 3.1- Recommended concrete temperatures

-Preparation before concreting (4.1, 4.3, 4.4)

Preparation for concreting primarily consists of insuring that all surfaces that will be in contact with the freshly poured concrete are at temperatures that will not cause freezing or prolonged setting. All snow, ice and frost must be removed prior to placement of the concrete. Concrete will not be placed on frozen subgrade. The subgrade can be thawed, sometimes, by covering it with insulating material for a few days prior to concrete placement.

-Protection to prevent early-age freezing (5.1)

Prevention of early-age freezing must be provided immediately after concrete placement. Arrangements for covering, housing or heating of newly placed concrete should be made before placement. Protective materials must be on-site ready for installation to prevent corners and edges from freezing. In cold weather, the temperature of newly placed concrete should be kept as close to the values given in Table 3.1 and the corners and edges are more vulnerable to freezing and are more difficult to maintain at the optimal temperature.

-Length of protection period (5.3)

The length of the required protection period depends on the type and amount of cement used and whether an accelerator is used. The length of protection may be reduced by: (1) using Type III cement; (2) using an accelerating admixture **(non-chloride)**; or (3) using 100 lb/yd^3 of cement in excess of the design cement content. Table 5.3 gives the minimum length of protection, in days at the temperatures given in Line 1 of Table 3.1.

Fact Sheet

USDA
Natural Resources
Conservation Service

Line	Service category	Type I or II cement	Type III or 100lb/yd^3 of additional cement
1	No load not exposed	2	1
2	No load, exposed	3	2
3	Partial load, exposed	6	4

Table 5.3- Length of protection period for concrete placed during cold weather (Days)

-Stripping forms (5.4)
The protection afforded by forms may require that the forms remain in-place for the full length of the protection period recommended in Table 5.3. The minimum time before stripping the forms is best determined by past experiences and current job conditions. If the newly placed concrete is in a heated enclosure, form removal and exposure to low daily temperatures may cause damage to corners and edges. Also, in the case of structures subjected to hydrostatic pressure, hasty removal of forms may dislodge the form ties creating water channels.

-Temperature drop after removal of protection (5.5)
Concrete should be cooled gradually to reduce differential strains between the interior and exterior of the structure. This can be accomplished by slowly reducing the applied heat or by leaving the insulation materials until the concrete has reached equilibrium with ambient temperatures.

-Form removal requirements (6.10)
Recommendations made are based on job conditions that meet the following requirements:

- Concrete internal temperature is at least 50 F after placement.
- Facilities are available to maintain the concrete temperature at 50 F throughout the structure.
- Reshores are left in place as long as necessary to safeguard all members of the structure.
- The concrete is made of Type I or II Portland cement.
- Proper curing is used to avoid drying in heated enclosures.

-Materials and methods of protection (7.2)
In some cases the use of natural heat of hydration may only require the use of insulating material. In extreme cases, it may be necessary to us enclosure and heating units to maintain the required temperature.

The heat of hydration is mostly generated during the first 3 days. The heat may be retained on unformed surfaces using insulating blankets and by using insulated forms. The insulation must be kept in close contact with the concrete or the form surface. Suitable protection from wind, moisture and heat loss are required. Corners and edges are particularly vulnerable, therefore the thickness of the insulation should be about three times the thickness used for walls or slabs. Commonly used insulating materials follow, definitions are listed in Chapter 7 ACI-306R:

- Polystyrene foam sheets
- Urethane foam
- Foamed vinyl blankets
- Mineral wool or cellulose fibers
- Straw
- Blanket or batt insulation

The heat of hydration will gradually decrease with age. It may be necessary to use enclosures and heating units to maintain the required temperature for the required protection period. Enclosures conserve heat, keep out cold air, and if secured properly block the wind. They can be made with any suitable material such as wood, canvas or plastic sheet. Enclosures must capable of withstanding wind and snow loads and be reasonably air tight. Sufficient space between the concrete and the enclosure to allow circulation of warmed air. If combustion heaters are used, venting is required to prevent reactions between exhaust gasses and exposed concrete surfaces that will result in a weak concrete surface. Also, heaters and vents should be placed so as not to cause overheating or drying of concrete. The operation of combustion heaters should be supervised continuously and fire fighting equipment should be available at the job site at all times. **Warning, exhaust gasses poses a serious health threat in an enclosed structure. Never enter without properly venting before hand.**

-NOTE:
This fact sheet does not include all information set forth in the ACI-306. Consult the latest edition for further details. A complete catalog of all ACI publications is available from:

American Concrete Institute
Box 19150, Redford Station
Detroit, Michigan 48219

RGD
Revised 9/19

GUIDELINES FOR COLD WEATHER CONCRETING

This document is to be used as a supplement to the current PA Fact Sheet #2—Cold Weather Concreting—ACI 306R-16. This document is intended to provide additional guidance, for cold weather concreting procedures, in the Northeast Counties that receive engineering guidance from the NRCS Bloomsburg Technical Office. This document is only to be used for Heavy Use Area and Stacking Structure type of construction. This document does not apply to "liquid" storage structures (Tanks or Paint Tray Style Storages). Cold weather concreting on "liquid" structures is discouraged and shall be discussed with the NRCS engineering staff in Bloomsburg in detail prior to planning construction.

Cold Weather Concreting shall be discussed at the preconstruction meeting, no matter what time of year the meeting is held and discussed again 2 weeks prior to concrete placement. The landowner shall be involved in these conversations to help make a decision if it is worth the extra expense and effort to provide the added level of protection during cold weather concrete procedures or wait until milder weather.

Roles & Responsibilities:

It is the contractor's responsibility to submit a "Cold Weather Concrete Plan" to the assigned primary inspector for the given project. This plan shall be provided to the inspector at least 2 weeks prior to the concrete placement. The concrete mix design shall also be submitted to the inspector at this time. The primary inspector shall review the submitted Cold Weather Concrete Plan and also the Concrete Design Mix. If revisions to the Cold Weather Plan are required, then the contractor will do so. If changes to the design mix are required, the contractor shall work with the concrete plant to make the needed changes. The revised documents shall be resubmitted to the inspector for further review. Concrete cannot be ordered and construction cannot begin until the inspector approves all submitted documents.

Design Mix:

Concrete with a slump lower than normal (less than 4") is particularly desirable in cold weather for flatwork; bleeding of water is minimized and set occurs earlier. Bleed water, during cold weather, could affect the concrete surface strength. It is assumed that concrete with at least 600 #/cu.yd of cement content is being used for cold weather placement.

Conditions of Subgrade & Reinforcement:

Concrete shall not be placed on "frosty" or frozen subgrade material or reinforcement. The subgrade and reinforcement shall be covered with insulating material for a few days before the concrete placement. In some cases, external heat must be applied. Steel forms for walls, especially, shall be heated by some means prior to concrete placement. There shall not be any snow or ice on the forms prior to placement of concrete. Tops of wall forms shall be covered to prohibit snow and ice from occupying space intended for concrete. Snow and ice at the bottom of the forms will also expose the freshly placed concrete to low temperatures.

Protecting Concrete During Cold Weather:

TABLE 1 shall be used to determine if the Contractor's Cold Weather Concrete Plan is sufficient for the forecasted weather conditions. The table shows what thermal resistance value (R-Value) is required at expected low air temperatures, for any of the first 3 days of the curing period; However, Concrete shall be protected for a minimum of 7 days. It is assumed that the ground (subgrade) temperature is well above freezing.

TABLE 1A -5" SLAB THICKNESS

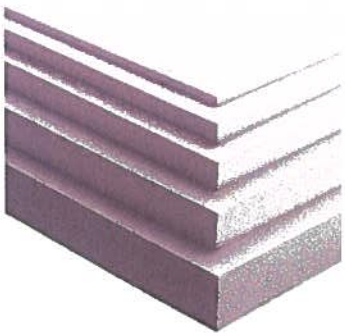
EXPECTED LOW TEMP FOR 1ST 3 DAYS OF CURING (DEGREES)	REQUIRED R-VALUE (hr-sqft-F/Btu)	REQUIRED SAWDUST (INCHES)	REQUIRED STRAW (INCHES)
40	4	2	3
35	7	3	4.5
30	8	4	5.5
25	9	4.5	6.5
20	11	5	7
<20	ADDITIONAL HEAT REQUIRED ENCLOSURE REQUIRED CONSULT WITH DESIGN ENGINEER		

TABLE 1B -8" WALL THICKNESS

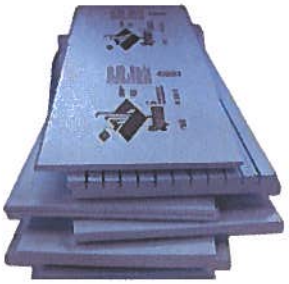
EXPECTED LOW TEMP FOR 1ST 3 DAYS OF CURING (DEGREES)	REQUIRED R-VALUE (hr-sqft-F/Btu)
40	3
35	4
30	5
25	6
20	7
<20	ADDITIONAL HEAT REQUIRED ENCLOSURE REQUIRED CONSULT WITH DESIGN ENGINEER

Insulating Materials:

A. Blankets: Concrete "Blankets" typically have an R-Value between 2 & 8; R value of blankets need confirmed prior to use.
B. Polystyrene foam or Polyurethane sheets; R value needs verified according to manufacturer data sheets.



EXPANDED POLYSTYRENE FOAM (EPS)
(Similar to the foam used for
for packing "peanuts")
R=3.6 to 4.0 per inch of thickness



EXTRUDED POLYSTYRENE FOAM (XPS)
(Blue board or pink board)
R=4.5-5.0 per inch of thickness

POLYISOCYANURATE /
POLYURETHANE BOARD
(Foil Faced)
R=7.0-8.0 per inch of thickness

C. Sawdust: Typical R-Value is 2.22 per 1" thickness
D. Straw or Hay: Typical R-Value is 1.5 per 1" thickness.

Straw, Hay, and Sawdust (Materials) need to be dry. Any moisture in the materials beyond normal may result in it freezing and providing a lesser degree of protection. If using these materials for flatwork protection; a layer of plastic shall be installed on the concrete surface prior to the material. After the required thickness of the material is placed, it needs covered with another layer of plastic or a tarp and weighted down to prevent it from blowing off. Do not install the initial layer of plastic until the concrete has set enough; otherwise the plastic will stick to the concrete.

Corners and edges are particularly vulnerable during cold weather. Therefore, the thickness of insulation for these parts shall be about 3X the thickness that is required for slabs or walls. It is recommended to extend the protection a minimum of 2' beyond the edges of footing and slabs.

Concrete placed for footings or slabs shall be covered, with the needed protection, as soon as the concrete can be walked on. Concrete placed in wall forms shall be covered, with the needed protection, immediately after concrete placement. Insulation shall be kept in close contact with the concrete form surface to be effective.

Protection Period:

All concrete (Footings, Slabs, and Walls) shall be protected for no less than 7 days for proper curing purposes. Wall forms shall remain in place for a minimum of 7 days as well. Curing compound does not need to be used during cold weather concreting, due to the insulating material being left on for a minimum of 7 days. Many curing compound manufacturers do not recommend that this product be used at cold temperatures. The use of non-chloride "accelerators" are welcome as an added measure of early set and strength gain. The use of accelerators will not decrease the protection period; 7 days is still the minimum protection period.

At the end of the protection period, concrete should be cooled gradually to reduce the risk of "thermal shock". Gradual cooling reduces the risk of cracking. This can be accomplished by allowing the insulating material to remain in place until the concrete has essentially reached equilibrium with the outside air temperature.

Consult with the design engineer for the allowable time of "loading" the concrete structures. Depending on the weather conditions; the curing time before backfilling, driving on slabs with skid steers, or allowing animal traffic may vary.

RGD
3/21

GUIDELINES FOR HOT WEATHER CONCRETING
(FOR ALL CONCRETE)

This document is intended to provide general information and guidance, for hot weather concreting procedures, in the Northeast Counties that receive engineering direction from the NRCS Bloomsburg Technical Office. Thoroughly discuss hot weather concreting during site showings so accurate bid prices can be achieved for the project. Hot weather concreting is discouraged and shall be discussed with the NRCS engineering staff in Bloomsburg in detail prior to planning construction.

If there is a chance of encountering hot weather conditions during construction; Hot Weather Concreting shall be discussed at the preconstruction meeting and discussed again 2 weeks prior to concrete placement. The landowner shall be involved in these conversations to help make a decision if it is worth the extra expense and effort to provide the added level of protection during hot weather concrete procedures or wait until more favorable weather. Proper measures need to be in place for the placement and curing of the concrete.

Definition & Concerns:

As per ACI 305R; Hot weather is any combination of the following conditions that tends to impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and rate of cement hydration, or otherwise causing detrimental results:

- High ambient temperature
- High concrete temperature
- Low relative humidity
- Wind speed
- Solar radiation

Hot weather concreting is any period of high temperature in which special precautions need to be taken to ensure proper handling, placing, finishing, and curing of concrete. The exact temperature where special precautions should be taken varies. Advanced planning is required for concrete placed in ambient conditions that are at or above 75°F (Portland Concrete Association). This is generally the temperature that starts to affect the efficiency of the cementitious system. Evaporation rate is a more accurate indicator of hot weather conditions for concrete.

Hot weather can cause an increased water demand, an increased rate of slump loss and tendency to add water at the job site, faster set-up time, difficulty in maintaining air entrainment, and more shrinkage cracking. All of these can reduce long term strength, reduce durability, and increase permeability.

Roles & Responsibilities:

If there is a chance of encountering hot weather conditions during construction; It is the contractor's responsibility to submit a "Hot Weather Concrete Plan" to the assigned primary inspector for the given project. This plan shall be provided to the inspector at least 2 weeks prior to the concrete placement. The concrete mix design shall also be submitted to the inspector at this time. The primary inspector shall review the submitted Hot Weather Concrete Plan and the concrete mix design. If revisions to the Hot Weather Plan are required, then the contractor will do so. If changes to the mix design are required, the contractor shall work with the concrete plant to make the needed changes. The revised documents shall be resubmitted to the inspector for further review. Concrete cannot be ordered, and construction cannot begin until the inspector approves all submitted documents. The inspector shall work with the design engineer in making these decisions. The design engineer shall approve all concrete mix designs that have portland cement replacements, as described later in this document.

The inspection staff shall provide timely inspections. Inspect steel, forms, and foundation the day before the actual placement, so the contractor has time to remedy any oversights well in advance of concrete placement. Avoid work delays caused by untimely inspections. The inspector shall get proper approval for working during early or late concrete placements. If the assigned inspector cannot be available for a concrete placement, they are responsible for finding a qualified back-up inspector. Allowing early or late starts without inspection shall not be allowed.

The inspection staff shall have a concrete thermometer and slump equipment ready in case any issues develop. The inspector shall check the delivery tickets and compare the ticket information with the mix design that has already been approved. The batch ticket shall indicate how much free water can be added; if this is not shown on the batch ticket then no water can be added on-site.

Possibilities for Avoiding or Preventing Issues:

The contractors have a lot of flexibility on how they plan to address concerns about hot weather and its effect on the final product. Some typical options include:

- Delay placement to a cooler day, especially when high winds and low relative humidity are anticipated
- Move placement start time to early morning or late evening
- Pre-wet sub-base, to reduce moisture loss
- Wet forms and steel to cool materials
- Make sure excess water drains away; concrete shall not be placed on standing water
- Have extra crew members to reduce placement time
- Schedule more equipment; have multiple pump trucks to accelerate delivery schedule
- Erect sunshades and wind barriers to protect the fresh concrete

Precautionary measures required on a windy, sunny day will be stricter than those required on a calm, humid day, even if the air temperatures are identical.

Mix Design & Placement:

Aggregates are the greatest part of the concrete mixture. Keeping the aggregates shaded and moist when being stored can be an effective means to achieving lower concrete temperature. The temperature of the water used in the concrete mixture will also play a major part in the overall concrete temperature; store water in tanks away from the sun or cool the water with ice or liquid nitrogen. If ice is used; the ice must be completely melted by the time mixing is complete.

Using slower hydrating cements will help with controlling heat development in the concrete and should result in lower peak temperatures; there will be less thermal expansion, and the risk of thermal cracking will be reduced. Concrete mixtures that obtain high strength at an early age will develop high concrete temperature during initial curing. These concrete mixtures should be provided thermal protection to ensure gradual cooling at a rate that will not cause them to crack.

Using partial replacements for the portland cement like fly ash and other pozzolans, and ground granulated blast-furnace slag is allowed. These portland cement substitutes are known for having both a slower setting rate and early strength gain to the concrete, which is desirable in hot weather concreting. Concrete containing the slower setting cements will be less likely to have plastic-shrinkage cracking. The design engineer must approve any concrete designs having portland cement replacements.

Various types of chemical admixtures have been found beneficial in offsetting some of the undesirable characteristics of concrete placed during periods of high ambient temperatures. The benefits may include lower mixing water demand or extended periods of use. Admixture effectiveness depends on the chemical reactions of the cement being used. Set retardation and water reducing admixtures can be used to reduce set time or increase slump and workability. Shrinkage reducing admixtures are also allowed. Consider adding the air entrainment admixture at the site and holding back some water to aid in the mixing of the air entrainment once in the truck. All admixtures shall be included in the mix design and have been approved by the inspector prior to placement. The concrete company shall provide a history report showing satisfactory performance, at the expected hot weather conditions, before a certain admixture can be used.

Adding water and remixing of concrete which has lost enough workability to become unplaceable, known as "retempering" is prohibited. Water additions, in excess of the mix design water cement ratio, to compensate for loss of workability is prohibited.

Discharge the concrete as soon as the concrete truck arrives at the job site. Prolonged mixing in hot weather increases the temperature of the concrete, which makes it set faster and shortens the placing and finishing time. Concrete shall also be conveyed from the mixer to the forms as rapidly as practical by methods that will prevent segregation of the aggregates or loss of mortar. In hot weather or under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 85°F or above as delivered at the job site; the time between the introduction of the cement to the aggregates and completion of truck discharge shall not exceed 45 minutes. If these conditions are encountered, the concrete plant shall be notified to take the necessary precautions.

The supplier shall maintain the temperature of concrete below 90°F during transportation, mixing, and conveying. Concrete with a temperature above 90°F at the job site shall not be placed. The inspector shall have an immediate conversation with the contractor and landowner about not accepting a load of concrete and the ramifications that can take place if the concrete is placed and later found to not be acceptable for the intended purpose. The contractor and landowner need to be involved in the final decision before the load of concrete is rejected.

In hot weather, it is usually necessary to place formed concrete in shallower layers than usual, to assure vibration well into the layer below and that the elapsed time between layers be minimized to avoid cold joints.

Curing and Protection:

Proper curing of concrete, during hot weather, is critical. Early curing is critical and lack of it is increasingly detrimental as temperatures rise.

All concrete (Footings, Slabs, and Walls) shall be protected for no less than 7-days for proper curing purposes. This 7-day curing time is the same for concrete with and without pozzolans and chemical admixtures. A 7-day minimum duration of curing will often be sufficient to attain approximately 70% of the specified compressive strength. If a change in curing method is made during this period, it should be done only after the concrete is 3 days old. (ACI 305R & ACI 308R-18). At the end of the curing period (7 days), any covering that is used should be left in place without wetting for several days (4 days is suggested) so that the concrete surface will dry slowly and be less subject to surface shrinkage cracking. The effects of drying can also be minimized by applying a sprayable curing compound at the end of the moist-curing period. Strategies for achieving this shall be discussed with the contractor prior to placement.

Some options for curing include:

- Spray with curing compound as soon as possible upon final finish. Consider applying a second coat of curing compound if it is windy. Curing compounds shall contain a heat reflecting white pigmented compound. Curing compound shall be applied heavier than manufacture's recommendations to ensure uniform coverage and proper curing.
- Wet curing is the most preferred method for curing concrete during hot weather.
- Exposed surfaces shall be continuously moistened by means of fog spray or otherwise protected from drying immediately prior to placement and during curing.

Curing of flatwork concrete; Of the different curing procedures, wet-curing is the best method for developing the strength of concrete and minimizing early drying shrinkage. This can be provided by ponding, covering with clean sand kept continuously wet, or continuous sprinkling. A more practical method of wet-curing is covering the prewetted concrete with impervious sheeting or absorptive mats or fabric kept continuously wet with a soaker hose or similar means. These materials shall be kept in contact with the concrete surface at all times. The temperature of water used for curing must be as close as possible to that of the concrete to avoid thermal shock.

Curing of concrete in forms; ACI 305R suggests that forms should be covered and kept continuously moist during the early curing period (first 3-days). If this idea is found to be impractical by the contractor; the contractor can cure with curing compound or shall come up with another acceptable means of curing concrete in forms. Ideas shall be discussed with the inspector.

If the curing compound option is chosen for formed concrete, the form tie holes shall be parged and curing compound applied, within 1 hour of stripping forms. Sufficient staff need to be available to be able to achieve this timeframe or strip forms in the early morning or late day, so the concrete is not exposed to the sun and hot temperatures; then parge tie holes and apply the curing compound as soon as possible.

Leaving forms on for 7-days, as a means of curing, may not be a good idea during hot weather, as forms may generate an excessive amount of heat and negatively affect the curing process. It is best to strip the forms after 24-hrs of placement and provide curing by other means.

The concrete shall also be protected against thermal shrinkage-cracking from rapid temperature drops, particularly during the first 24 hours. Early cracking due to the thermal shrinkage is generally more severe in the spring and fall. This is because the temperature differential for each 24-hour period is greater during these times of year. This is a concern when there is a wide day and night temperature difference. The contractor shall come up with a means of protecting the concrete in these circumstances.

No equipment shall be allowed on concrete slabs or floors until the concrete has cured for a minimum of 7 days. This includes any motorized material handling equipment, pallets of forms, etc. Skid loaders used for transporting concrete into forms shall not be allowed on slabs or floors for a minimum of 14 days.

Practice Specification
Waste Storage Facility (Code 313)
Structure

1. SCOPE

The work shall consist of furnishing materials and installing all components of the waste storage structure as outlined in this specification and the drawings.

Construction work covered by this specification shall not be performed between December 1 and the following March 15 unless the site conditions and/or the construction methods to be used have been reviewed and approved by the Engineer or his/her designated Representative.

2. MATERIALS

All materials used shall conform to the quality and grade noted on the drawings, set forth in Section 9, or as otherwise listed below:

PORTLAND CEMENT shall be Type I, IA, II or IIA and conform to ASTM-C150, unless otherwise set forth in Section 9. If Type I or II is used, an air-entrainment agent shall be used.

CONCRETE AGGREGATE shall meet the requirements and gradation specified in ASTM-C33. Coarse aggregate shall meet the gradation for size numbers 57 or 67.

WATER used in mixing or curing concrete shall be clean and free from injurious amounts of oil, acid, salt, organic matter or other deleterious substances.

REINFORCEMENT BARS shall be grade 40 or higher, and shall conform to ASTM- A615, A616, or A617. Welded wire fabric reinforcement shall conform to ASTM-A185 or A497. Reinforcement shall be free from loose rust, oil, grease, curing compound, paint or other deleterious coatings.

CONCRETE ADMIXTURES shall conform to ASTM-C260 for air-entrainment, and ASTM- C494, type A, D, F or G, for water- reduction and set-retardation, and type C or E for non- corrosive accelerators.

POZZOLAN shall conform to ASTM-C618, Class F, except loss of ignition shall not exceed 3.0 percent.

CURING COMPOUND shall meet the requirements of ASTM-C309, Type 2, Class A or B or as otherwise required in Section 9.

MASONRY COMPONENTS shall meet the requirements of ASTM-C90 & C270 and placed in accordance with ACI-530.

PRECAST CONCRETE units shall comply with ACI-525 and 533.

PREFORMED EXPANSION JOINT FILLER shall conform to the requirements of ASTM- D1752, Type I, II, or III, unless bituminous type is specified, in which case it shall conform to ASTM-D994 or D1751.

JOINT SEALERS shall conform to the requirements for ASTM-C920, Federal Specification SS-S-210A, or Federal Specification TT-S-227, as appropriate for the specific application. WATERSTOPS. Vinyl-chloride polymer types shall be tested in accordance with Federal Test Method Standard No. 601 and shall show no sign of web failure due to brittleness at a temperature of -35 degrees Fahrenheit. Colloidal (bentonite) waterstops shall be at least 75 percent bentonite in accordance with Federal Specification SS- S-210A. Non-colloidal waterstops shall only be used if approved by the Engineer.

METALS shall conform to the following standards:

Structural steel - ASTM-A36

Carbon steel - ASTM-A283, grade C or D; or A611, grade D; or A570, grade C or D

Aluminum alloy - ASTM-B308, B429, B221, B210, B211, or B209

Bolts - ASTM-A307; zinc coating shall conform to ASTM-A153, B633 (cond. SC3), A165 (type TS).

Screws - wrought iron or medium steel Split or tooth-ring connectors - hot-rolled, low carbon steel conforming to ASTM- A711, grade 1015

WOOD shall be graded and stamped by an agency accredited by the American Lumber Standards Committee as meeting the required species, grade, and moisture content. In the absence of such a stamp, the Contractor or material supplier shall provide written certification that the wood products meet the designated quality criteria.

MANUFACTURED TRUSSES shall be certified as having been designed and built to Truss Plate Institute standards.

PRESSURE TREATED WOOD PRODUCTS shall be Douglas Fir, Southern Yellow Pine, or as otherwise specified on the drawings or in Section 9. They shall be treated with preservatives in accordance with the American Wood Preservers Association (AWPA) Standard C16, "Wood Used on Farms, Pressure Treatment." Each piece shall bear the AWPA stamp of quality. In the absence of such a stamp, the Contractor or material supplier shall provide written certification that the pressure treated wood meets the designated quality criteria.

FASTENERS for wood structures shall be stainless steel, galvanized, or otherwise protected from corrosion due to contact with moisture, manure and associated gasses.

3. FOUNDATION PREPARATION AND CONDITIONS

All trees, brush, fences, and rubbish shall be cleared within the area of the structure, including any appurtenances, and borrow areas. All material removed by clearing and excavation operations shall be disposed of as directed by the Owner or his/her Representative. Sufficient topsoil shall be stockpiled in a convenient location for spreading on disturbed areas. All structures shall be set on undisturbed soil or non-yielding compacted material. Over excavation must be corrected as noted on the drawings or as directed by the Engineer or his/her designated Representative.

In addition to uniformity, the existing subgrade material must have sufficient strength to support the structure and its associated loads. Organic soils shall be removed. A base course (a layer of granular material placed on the subgrade prior to placement of concrete) may be used to improve the stability of the foundation. In addition, geosynthetics may be used, if approved by the Engineer, to further separate and/or stabilize the foundation.

Surface and subsurface drainage systems shall be installed and operating adequately to remove water from the foundation to allow for proper structure placement.

Drainfill upon which concrete is to be placed shall be covered with a geosynthetic that has an AOS between 20 and 100, inclusive.

Concrete shall not be placed until the subgrade, forms and steel reinforcements have been inspected and approved by the Engineer or his/her designated Representative. Notification shall be given far enough in advance to provide time for the inspection.

Prior to placement of concrete, the forms and subgrade shall be free of chips, sawdust, debris, standing water, ice, snow, extraneous oil, mortar or other harmful substances or coatings.

Earth surfaces against which concrete is to be placed shall be firm and damp. Placement of concrete on mud, dried earth or uncompacted fill or frozen subgrade will not be permitted.

4. CAST-IN-PLACE CONCRETE STRUCTURES

a. Concrete Forms

Forms shall be of wood, plywood, steel, or other approved material and shall be mortar tight. The forms and associated falsework shall be substantial and unyielding and shall be constructed so that the finished concrete will conform to the specified dimensions and contours.

Form surfaces shall be smooth and essentially free of holes, dents, sags, or other irregularities. Forms shall be coated with form oil before being set into place.

Care shall be taken to prevent form oil from coming in contact with steel reinforcement.

b. Concrete Mix

Concrete for structures shall have a 28-day compressive strength of at least 4000 psi, unless otherwise specified on the drawings or in Section 9. The Contractor shall be responsible for the design of the mix and certification of the necessary compressive strength. Current certification of the design mix by Penn DOT may be accepted in lieu of additional testing.

The slump shall be 3 to 6 inches (without superplasticizers, if any); the air content by volume shall be five to seven percent of the volume of the concrete. Admixtures such as superplasticizers, water-reducers and set-retarders may be used provided they are approved by the Engineer prior to concrete placement and are used in accordance with the manufacturer's recommendations. Superplasticizers (ASTM C494, Type F or G) may be added to concrete that has a 2 to 4-inch slump before the addition, and that is not warmer than 95° F. The slump shall not exceed 7½ inches with the addition of superplasticizer.

c. Mixing and Handling Concrete

In general, concrete shall be transported, placed, and consolidated in accordance with ACI- 304, of which some specific interpretations are set forth below.

The supplier shall provide a batch ticket to the Owner or Technician with each load of concrete delivered to the site. The batch ticket shall state the class of concrete, any admixtures used, time out, and the amount of water that can be added at the site and still be within the design mix limits.

Concrete shall be uniform and thoroughly mixed when delivered to the job site. The Contractor shall test slump and air entrainment as necessary to insure that the concrete meets the requirements of this specification. Variations in slump of more than one inch within a batch will be considered evidence of inadequate mixing and shall be corrected or rejected. No water in excess of the amount called for by the job design mix shall be added to the concrete.

For concrete mixed at the site, the mixing time after all cement, aggregates and water are in the mixer drum shall be at least 1-1/2 minutes.

Concrete shall be conveyed from the mixer to the forms as rapidly as practical by methods that will prevent segregation of the aggregates or loss of mortar. Concrete shall be placed in the forms within 1-1/2 hours after the introduction of cement to the aggregate unless an approved set-retarding admixture is used in the mix. In hot weather or under conditions contributing to quick stiffening of the concrete, or when temperatures of the concrete is 85oF or above, the time between the introduction of the cement to the aggregates and completion of truck discharge shall not exceed 45 minutes.

Concrete shall not be dropped more than 5 feet vertically unless special equipment is used to prevent segregation.

Superplasticized concrete shall not be dropped more than 12 feet unless special equipment is used to prevent segregation.

Slab concrete shall be placed at the design thickness in one layer. Formed walls shall be placed in layers not more than 24-inches high, unless superplasticizer is used, in which case the maximum layer shall be 5 feet. Each layer shall be consolidated to insure a good bond with the preceding layer.

Immediately after placement, concrete shall be consolidated by spading and vibrating, or by spading and hand tamping. It shall be worked into corners and angles of the forms and around all reinforcement and embedded items in a manner that prevents segregation or in the formation of "honeycomb." Excessive vibration that results in segregation of materials will not be allowed. Vibration must not be used to make concrete flow in forms, slabs, or conveying equipment.

If the surface of a layer in place will develop its initial set, i.e., will not flow and merge with the succeeding layer when vibrated, a construction joint shall be made. Construction joints shall be made by cleaning the hardened concrete surface to exposed aggregate by sandblasting, air/water jetting, or hand scrubbing with wire brush, and keeping the concrete surface moist for at least one hour prior to placement of new concrete.

Concrete surfaces do not require extensive finishing work; however, the surface shall be smooth and even with concrete paste worked to the surface to fill all voids. The concrete surface must be watertight. Careful screeding (striking-off) and/or wood float finishing shall be required, unless otherwise shown on the drawings. Exposed edges shall be chamfered, either with form molding or molding tools.

The addition of dry cement or water to the surface of screeded concrete to expedite finishing is not allowed.

d. Reinforcing Steel Placement

Reinforcement shall be accurately placed and secured in position in a manner that will prevent its displacement during the placement of concrete. In forms, this shall be accomplished by tying temperature and shrinkage steel or special tie bars (not stress steel) to the form "snap ties" or by other methods of tying. In slabs, steel or wire shall be supported by precast concrete bricks (not clay bricks), or metal or plastic chairs. Concrete bricks supporting steel and wire must be full and not broken (unless bricks are manufactured with creases or indentations meant to be broken). Except for dowel rods, placing steel reinforcement into concrete already in place shall not be permitted.

The following tolerances will be allowed in the placement of reinforcing bars shown on the drawings:

1. Maximum reduction in cover: from formed and exposed surfaces – ¼ inch from earth surfaces - ½ inch
2. Maximum variation from indicated spacing: 1/12th of indicated spacing

Splices of reinforcing bars shall be made only at the locations shown on the drawings, unless otherwise approved by the Engineer. Unless otherwise required, welded wire fabric shall be spliced by overlapping sections at least one full mesh dimension plus two inches. All reinforcement splices shall be in accordance with ACI 318.

Reinforcing steel shall not be welded, unless approved by the Designer. The ends of all reinforcing steel shall be covered with at least 1-1/2 inches of concrete.

e. Curing

Concrete shall be prevented from drying for at least seven days after it is placed. Exposed surfaces shall be kept continuously moist during this period by covering with moistened canvas, burlap, straw, sand or other approved material unless they are sprayed with a curing compound. Wooden forms left in place during the curing period shall be kept wet.

Concrete, except at construction joints, may be coated with a curing compound in lieu of continuous application of moisture. The compound shall be sprayed on moist concrete surfaces as soon as free water has disappeared but shall not be applied to any surface until patching, repairs and finishing of that surface are completed. Concrete shall be wet cured or remain in forms until immediately before patching, repairs, or finishing is performed. Curing compound shall not be allowed on any rebars.

Curing compound shall be applied in a uniform layer over all surfaces requiring protection at a rate of not less than one gallon per 150 square feet of surface. Surfaces subjected to heavy rainfall or running water within three hours after the curing compound has been applied, or otherwise damaged, shall be resprayed.

Any construction activity which disturbs the curing material shall be avoided during the curing period. If the curing material is subsequently disturbed, it shall be reapplied immediately.

Steel tying or form construction adjacent to new concrete shall not be started until the concrete has cured at least 24 hours.

Vehicles, overlying structures, or other heavy loads shall not be placed on new concrete slabs for at least three days, unless the concrete strength can be shown to be adequate to support such loads.

f. Form Removal and Concrete Repair

Forms for walls and columns shall not be removed for at least 24 hours after placing the concrete. When forms are removed in less than seven days, the exposed concrete shall be sprayed with a curing compound or be kept wet continuously for the remainder of the curing period. Forms which support beams or covers shall not be removed for at least seven days, or 14 days if they are to support forms or shoring.

Forms shall be removed in such a way as to prevent damage to the concrete. Forms shall be removed before walls are backfilled. Columns shall be at least seven days old before any structural loads are applied.

Where minor areas of the concrete surface are "honeycombed," damaged or otherwise defective, the area shall be cleaned, wetted and then filled with a dry-pack mortar. Dry-pack mortar shall consist of one-part Portland cement and three parts sand with just enough water to produce a workable paste.

g. Concreting in Cold Weather Concreting in cold weather shall be performed in accordance with ACI-306R-16. In addition, the contractor shall provide a written plan at least 24 hours in advance of placing concrete in cold weather and shall have the necessary equipment and materials on the job site before the placement begins.

h. Concreting in Hot Weather

Concreting in hot weather shall be performed in accordance with ACI 305, of which some specific interpretations are set forth below.

The supplier shall apply effective means to maintain the temperature of concrete below 90 degrees Fahrenheit during mixing and conveying. Exposed surfaces shall be continuously moistened by means of fog spray or otherwise protected from drying during the time between placement and finishing and during curing. Concrete with a temperature above 90 degrees Fahrenheit shall not be placed.

i. Backfilling New Concrete Walls

Backfilling and compaction of fill adjacent to new concrete walls shall not begin in less than 14 days after placement of the concrete, except that walls that can be backfilled on both sides simultaneously may be done so within seven days.

Heavy equipment shall not be allowed within three feet of a new concrete wall. Provide compaction near the wall by means of hand tamping or small, manually-directed equipment.

5. WOOD STRUCTURES

All framing shall be true and exact. Timber and lumber shall be accurately cut and assembled to a close fit and shall have even bearing over the entire contact surfaces.

Nails and spikes shall be driven with just sufficient force to set the heads flush with the wood surface. Deep hammer marks in the wood shall be considered evidence of poor workmanship and may be sufficient cause for rejection of the work.

Holes for lag screws shall be bored with a bit not larger than the body of the screw at the base of the thread. Holes for bolts shall be bored with a bit no more than 1/16" larger than the bolt diameter to achieve a snug fit without forcibly driving the bolt.

Washers shall be used in contact with all bolt heads and nuts that would otherwise be in contact with wood.

All joints shall be fastened with the number, type, and size of fasteners specified, at the locations or spacing specified.

If field cuts of pressure-treated wood expose untreated interior wood, the untreated surfaces shall be covered with two coats of a liquid preservative, as approved by the Engineer.

Roof trusses shall be handled, installed and braced according to the Truss Plate Institute's BCSI-B1-06, "Handling, Installing and Bracing MPC Wood Trusses."

Wood structures shall be backfilled within the limits shown on the drawings by placing material in uniform lifts not to exceed nine inches. Compaction within three feet of walls shall be accomplished by means of hand tamping or small manually-directed equipment.

6. STRUCTURES INSTALLED ACCORDING TO STANDARD DETAIL DRAWINGS PREPARED BY OTHERS

Commercially available structures shall be installed as shown on the drawings provided to and concurred in by NRCS. All materials furnished and installed shall conform to the quality and grade noted on the drawings. A site-specific set of construction drawings shall be at the site during construction.

Modification of the structure outside limits shown on the drawings shall not be made without prior review and approval by the Engineer with appropriate approval authority. The Supplier or Contractor who submitted the original standard detail drawings shall be responsible for making any changes. Sufficient design documentation to allow an adequate review of the proposed modification shall accompany any request for a change.

Within thirty (30) days of the completion of construction of the structure, the Contractor or Supplier shall furnish written certification to the Engineer that all aspects of the installation are in conformance with the requirements of the drawings and specifications.

7. BURIED TANKS

a. Tank Condition

Tanks, whether steel or fiberglass/plastic, shall have sufficient strength to withstand design loads, be watertight, and be protected from corrosion. New tanks shall have a manufacturer's certification to this effect.

Used tanks must be inspected for pitting, corrosion, and cracks that could impair the strength or water tightness. Tanks which originally stored leaded fuels may have tetraethyl lead deposits and scale on the inside. This material should be detached from the tank's interior, pumped out, and disposed of in a manner which will not pollute ground or surface waters. Also, if welding, handling, etc. is done, safety precautions should be taken to avoid ingesting or inhaling the lead or its fumes. (These tanks may have gasoline fumes or vapors in them and may explode from a spark, welding arc or torch.)

A tank that has been bent or dented will not be accepted unless adequate repairs have been made to restore the strength, water tightness, and corrosion protection. When inlet or outlet pipes or other type of openings are to be cut into one of these tanks, the reduced strength must be considered when the tank is put into use. The Steel Tank Institute's sti- P3 certification procedure shall be used to evaluate the structural integrity and assure the corrosion protection of steel tanks which have been repaired or modified.

b. Installation

Underground tanks shall be handled and installed according to the manufacturer's recommended procedures.

At a minimum, all tanks shall be set on a firm earth foundation or a full-length concrete slab covered with six inches of clean sand. The tank shall be surrounded by clean sand or well- tamped earth, free from stones and other debris. The use of saddles or "chock blocks" of any sort interferes with the proper distribution of the backfill loads and shall not be permitted.

The excavation shall be dewatered during installation and backfill operations. The backfill shall be well compacted, particularly under the tank, to provide adequate support.

Tanks shall be covered with a minimum of two feet of earth, or with not less than one foot of earth on which is placed a reinforced concrete slab not less than four inches thick.

Tank installations, which will be subjected to traffic, shall have adequate strength to withstand the anticipated overload. Tanks shall be protected against damage from vehicles passing over them by at least three feet of earth cover or by 18 inches of well- tamped earth plus either eight inches of asphaltic paving or six inches of reinforced concrete. The paving or concrete shall be placed to extend at least one foot horizontally in all directions beyond the outline of the tank.

Tanks shall not be filled or even partially filled during their installation and backfilling.

Unless high ground water levels are not expected, the site shall have a drain system to prevent ground water from flooding around the tank. Where a tank may become buoyant due to a rise in the level of the water table or due to location in an area subjected to flooding, applicable precautions shall be taken to anchor the tank in place or dewater the site.

Openings on all underground tanks must be properly located and maintained in place during backfilling.

8. PIPES

Excavation for pipes shall be made to the grades and lines shown on the drawings or as indicated by construction stakes. Care should be taken not to excavate below the depths specified. Excavation below grade shall be corrected by placing firmly compacted layers of moist earth to provide a good foundation. If rock or boulders are exposed in the bottom of the excavation, they shall be removed to a minimum depth of eight inches below the invert grade of the pipe and any appurtenances and replaced with firmly compacted earth to the specified grade.

Pipes shall be backfilled with horizontal lifts of moist earth not to exceed four inches in thickness, or with other material as specified in Section 9 or in the drawings.

Each lift shall be compacted by hand tampers or other compaction equipment, however at no time shall driven equipment tires or tracks be within two feet of pipes or appurtenances.

All connections between pipes and structure walls and floors shall be water tight and capable of withstanding the expected operating pressures.

9. ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE:

Specific Site Requirements

Practice Specification
Roofs and Covers (Code 367)

1. SCOPE

The work shall consist of furnishing materials and installing all components of the roof or cover, as outlined in this specification and the drawings.

Construction work covered by this specification shall not be performed between December 1 and the following March 15 unless the site conditions and/or the construction methods to be used have been reviewed and approved by the Engineer or his/her designated Representative.

2. MATERIALS

All materials used shall conform to the quality and grade noted on the drawings, set forth in Section 8, or as otherwise listed below:

PORTLAND CEMENT shall be Type I, IA, II or IIA and conform to ASTM-C150, unless otherwise set forth in Section 8. If Type I or II is used, an air-entrainment agent shall be used.

CONCRETE AGGREGATE shall meet the requirements and gradation specified in ASTM-C33. Coarse aggregate shall meet the gradation for size numbers 57 or 67.

WATER used in mixing or curing concrete shall be clean and free from injurious amounts of oil, acid, salt, organic matter or other deleterious substances.

REINFORCEMENT BARS shall be grade 40 or higher, and shall conform to ASTM- A615, A616, or A617. Welded wire fabric reinforcement shall conform to ASTM-A185 or A497. Reinforcement shall be free from loose rust, oil, grease, curing compound, paint or other deleterious coatings.

CONCRETE ADMIXTURES shall conform to ASTM-C260 for air-entrainment, and ASTM-C494, type A, D, F or G, for water- reduction and set-retardation, and type C or E for non-corrosive accelerators.

POZZOLAN shall conform to ASTM-C618, Class F, except loss of ignition shall not exceed 3.0 percent.

CURING COMPOUND shall meet the requirements of ASTM-C309, Type 2, Class A or B or as otherwise required in Section 8.

MASONRY COMPONENTS shall meet the requirements of ASTM-C90 & C270, and placed in accordance with ACI-530.

PRECAST CONCRETE units shall comply with ACI-525 and 533.

PREFORMED EXPANSION JOINT FILLER shall conform to the requirements of ASTM- D1752, Type I, II, or III, unless bituminous type is specified, in which case it shall conform to ASTM-D994 or D1751.

JOINT SEALERS shall conform to the requirements for ASTM-C920, Federal Specification SS-S-210A, or Federal Specification TT-S-227, as appropriate for the specific application.

WATERSTOPS. Vinyl-chloride polymer types shall be tested in accordance with Federal Test Method Standard No. 601, and shall show no sign of web failure due to brittleness at a temperature of -35 degrees Fahrenheit. Colloidal (bentonite) waterstops shall be at least 75 percent bentonite in accordance with Federal Specification SS- S-210A. Non-colloidal waterstops shall only be used if approved by the Engineer.

METALS shall conform to the following standards:

Structural steel - ASTM-A36

Carbon steel - ASTM-A283, grade C or D; or A611, grade D; or A570, grade C or D

Aluminum alloy - ASTM-B308, B429, B221, B210, B211, or B209

Bolts - ASTM-A307; zinc coating shall conform to ASTM-A153, B633 (cond. SC3), A165 (type TS).

Screws - wrought iron or medium steel Split or tooth-ring connectors - hot-rolled, low carbon steel conforming to ASTM- A711, grade 1015

WOOD shall be graded and stamped by an agency accredited by the American Lumber Standards Committee as meeting the required species, grade, and moisture content. In the absence of such a stamp, the Contractor or material supplier shall provide written certification that the wood products meet the designated quality criteria.

MANUFACTURED TRUSSES shall be certified as having been designed and built to Truss Plate Institute standards.

PRESSURE TREATED WOOD PRODUCTS shall be Douglas Fir, Southern Yellow Pine, or as otherwise specified on the drawings or in Section 8. They shall be treated with preservatives in accordance with the American Wood Preservers Association (AWPA) Standard C16, "Wood Used on Farms, Pressure Treatment." Each piece shall bear the AWPA stamp of quality. In the absence of such a stamp, the Contractor or material supplier shall provide written certification that the pressure treated wood meets the designated quality criteria.

FASTENERS for roofs and covers shall be stainless steel and/or galvanized in accordance with ASTM A153, and/or A653 Class G185, and Type 304 or 316, or otherwise protected from corrosion due to contact with moisture, manure and associated gasses. All fasteners, connectors, and any other metal contacting ACZA, ACQ or CA treated wood shall be stainless steel, in accordance with Supplement A below.

GEOMEMBRANES shall comply with the requirements of Construction Specification PA521A-PE/PP, as applicable.

3. FOUNDATION PREPARATION AND CONDITIONS

All trees, brush, fences, and rubbish shall be cleared within the area of the structure, including any appurtenances, and borrow areas. All material removed by clearing and excavation operations shall be disposed of as directed by the Owner or his/her Representative. Sufficient topsoil shall be stockpiled in a convenient location for spreading on disturbed areas. All structures shall be set on undisturbed soil or non-yielding compacted material. Over excavation must be corrected as noted on the drawings or as directed by the Engineer or his/her designated Representative.

In addition to uniformity, the existing subgrade material must have sufficient strength to support the structure and its associated loads. Organic soil or soils with high percentages of clays and silts shall be removed. A base course (a layer of granular material placed on the subgrade prior to placement of concrete) may be used to improve the stability of the foundation. In addition, geosynthetics may be used, if approved by the Engineer, to further separate and/or stabilize the foundation.

Surface and subsurface drainage systems shall be installed and operating adequately to remove water from the foundation to allow for proper structure placement.

Drainfill upon which concrete is to be placed shall be covered with a geosynthetic that has an AOS between 20 and 100, inclusive.

Concrete shall not be placed until the subgrade, forms and steel reinforcements have been inspected and approved by the Engineer or his/her designated Representative. Notification shall be given far enough in advance to provide time for the inspection.

Prior to placement of concrete, the forms and subgrade shall be free of chips, sawdust, debris, standing water, ice, snow, extraneous oil, mortar or other harmful substances or coatings.

Earth surfaces against which concrete is to be placed shall be firm and damp. Placement of concrete on mud, dried earth or uncompacted fill or frozen subgrade will not be permitted.

4. CAST-IN-PLACE CONCRETE STRUCTURES

a. Concrete Forms

Forms shall be of wood, plywood, steel, or other approved material and shall be mortar tight. The forms and associated falsework shall be substantial and unyielding and shall be constructed so that the finished concrete will conform to the specified dimensions and contours.

Form surfaces shall be smooth and essentially free of holes, dents, sags, or other irregularities. Forms shall be coated with form oil before being set into place. Care shall be taken to prevent form oil from coming in contact with steel reinforcement.

b. Concrete Mix

Concrete for structures shall have a 28-day compressive strength of at least 4000 psi, unless otherwise specified on the drawings or in Section 8. The Contractor shall be responsible for the design of the mix and certification of the necessary compressive strength. Current certification of the design mix by Penn DOT may be accepted in lieu of additional testing.

The slump shall be 3 to 6 inches (without superplasticizers, if any); the air content by volume shall be five to seven percent of the volume of the concrete. Admixtures such as superplasticizers, water-reducers and set-retarders may be used provided they are approved by the Engineer prior to concrete placement and are used in accordance with the manufacturer's recommendations. Superplasticizers (ASTM C494, Type F or G) may be added to concrete that has a 2 to 4 inch slump before the addition, and that is not warmer than 95°F. The slump shall not exceed 7½ inches with the addition of superplasticizer.

c. Mixing and Handling Concrete

In general, concrete shall be transported, placed, and consolidated in accordance with ACI-304, of which some specific interpretations are set forth below.

The supplier shall provide a batch ticket to the Owner or Technician with each load of concrete delivered to the site. The batch ticket shall state the class of concrete, any admixtures used, time out, and the amount of water that can be added at the site and still be within the design mix limits. Concrete shall be uniform and thoroughly mixed when delivered to the job site. The Contractor shall test slump and air entrainment as necessary to insure that the concrete meets the requirements of this specification. Variations in slump of more than one inch within a batch will be considered evidence of inadequate mixing and shall be corrected or rejected. No water in excess of the amount called for by the job design mix shall be added to the concrete.

For concrete mixed at the site, the mixing time after all cement, aggregates and water are in the mixer drum shall be at least 1-1/2 minutes.

Concrete shall be conveyed from the mixer to the forms as rapidly as practical by methods that will prevent segregation of the aggregates or loss of mortar. Concrete shall be placed in the forms within 1-1/2 hours after the introduction of cement to the aggregate unless an approved set-retarding admixture is used in the mix. During periods of hot weather, it may be necessary to reduce this time.

Concrete shall not be dropped more than 5 feet vertically unless special equipment is used to prevent segregation.

Superplasticized concrete shall not be dropped more than 12 feet unless special equipment is used to prevent segregation.

Slab concrete shall be placed at the design thickness in one layer. Formed walls shall be placed in layers not more than 24-inches high, unless superplasticizer is used, in which case the maximum layer shall be 5 feet. Each layer shall be consolidated to insure a good bond with the preceding layer.

Immediately after placement, concrete shall be consolidated by spading and vibrating, or by spading and hand tamping. It shall be worked into corners and angles of the forms and around all reinforcement and embedded items in a manner that prevents segregation or in the formation of "honeycomb." Excessive vibration that results in segregation of materials will not be allowed. Vibration must not be used to make concrete flow in forms, slabs, or conveying equipment.

If the surface of a layer in place will develop its initial set, i.e., will not flow and merge with the succeeding layer when vibrated, a construction joint shall be made. Construction joints shall be made by cleaning the hardened concrete surface to exposed aggregate by sandblasting, air/water jetting, or hand scrubbing with wire brush, and keeping the concrete surface moist for at least one hour prior to placement of new concrete. Concrete surfaces do not require extensive finishing work; however, the surface shall be smooth and even with concrete paste worked to the surface to fill all voids. The concrete surface must be watertight. Careful screeding (striking-off) and/or wood float finishing shall be required, unless otherwise shown on the drawings. Exposed edges shall be chamfered, either with form molding or molding tools.

The addition of dry cement or water to the surface of screeded concrete to expedite finishing is not allowed.

d. Reinforcing Steel Placement

Reinforcement shall be accurately placed and secured in position in a manner that will prevent its displacement during the placement of concrete. In forms, this shall be accomplished by tying temperature and shrinkage steel or special tie bars (not stress steel) to the form "snap ties" or by other methods of tying. In slabs, steel shall be supported by precast concrete bricks (not clay bricks), or metal or plastic chairs. Except for dowel rods, placing steel reinforcement into concrete already in place shall not be permitted.

The following tolerances will be allowed in the placement of reinforcing bars shown on the drawings:

1. Maximum reduction in cover:
    - from formed and exposed surfaces - 1/4 inch
    - from earth surfaces - 1/2 inch
2. Maximum variation from indicated spacing - 1/12th of indicated spacing

Splices of reinforcing bars shall be made only at the locations shown on the drawings, unless otherwise approved by the Engineer. Unless otherwise required, welded wire fabric shall be spliced by overlapping sections at least one full mesh dimension plus two inches. All reinforcement splices shall be in accordance with ACI 318.

Reinforcing steel shall not be welded, unless approved by the Designer. The ends of all reinforcing steel shall be covered with at least 1-1/2 inches of concrete.

e. Curing

Concrete shall be prevented from drying for at least seven days after it is placed. Exposed surfaces shall be kept continuously moist during this period by covering with moistened canvas, burlap, straw, sand or other approved material unless they are sprayed with a curing compound. Wooden forms left in place during the curing period shall be kept wet.

Concrete, except at construction joints, may be coated with a curing compound in lieu of continuous application of moisture. The compound shall be sprayed on moist concrete surfaces as soon as free water has disappeared but shall not be applied to any surface until patching, repairs and finishing of that surface are completed. Concrete shall be wet cured or remain in forms until immediately before patching, repairs, or finishing is performed. Curing compound shall not be allowed on any rebars.

Curing compound shall be applied in a uniform layer over all surfaces requiring protection at a rate of not less than one gallon per 150 square feet of surface. Surfaces subjected to heavy rainfall or running water within three hours after the curing compound has been applied, or otherwise damaged, shall be resprayed.

Any construction activity which disturbs the curing material shall be avoided during the curing period. If the curing material is subsequently disturbed, it shall be reapplied immediately.

Steel tying or form construction adjacent to new concrete shall not be started until the concrete has cured at least 24 hours. Vehicles, overlying structures, or other heavy loads shall not be placed on new concrete

slabs for at least three days, unless the concrete strength can be shown to be adequate to support such loads.

f. Form Removal and Concrete Repair

Forms for walls and columns shall not be removed for at least 24 hours after placing the concrete. When forms are removed in less than seven days, the exposed concrete shall be sprayed with a curing compound or be kept wet continuously for the remainder of the curing period. Forms which support beams or covers shall not be removed for at least seven days, or 14 days if they are to support forms or shoring.

Forms shall be removed in such a way as to prevent damage to the concrete. Forms shall be removed before walls are backfilled. Columns shall be at least seven days old before any structural loads are applied.

Where minor areas of the concrete surface are "honeycombed," damaged or otherwise defective, the area shall be cleaned, wetted and then filled with a dry-pack mortar. Dry- pack mortar shall consist of one part Portland cement and three parts sand with just enough water to produce a workable paste.

g. Concreting in Cold Weather

Concreting in cold weather shall be performed in accordance with ACI-306R-88. In addition, the contractor shall provide a written plan at least 24 hours in advance of placing concrete in cold weather, and shall have the necessary equipment and materials on the job site before the placement begins.

h. Concreting in Hot Weather

Concreting in hot weather shall be performed in accordance with ACI 305, of which some specific interpretations are set forth below. The supplier shall applyeffective means to maintain the temperature of concrete below 90 degrees Fahrenheit during mixing and conveying. Exposed surfaces shall be continuously moistened by means of fog spray or otherwise protected from drying during the time between placement and finishing and during curing. Concrete with a temperature above 90 degrees Fahrenheit shall not be placed.

i. Backfilling New Concrete Walls

Backfilling and compaction of fill adjacent to new concrete walls shall not begin in less than 14 days after placement of the concrete, except that walls that can be backfilled on both sides simultaneously may be done so within seven days.

Heavy equipment shall not be allowed within three feet of a new concrete wall. Provide compaction near the wall by means of hand tamping or small, manually-directed equipment.

5. WOOD STRUCTURES

All framing shall be true and exact. Timber and lumber shall be accurately cut and assembled to a close fit and shall have even bearing over the entire contact surfaces. Nails and spikes shall be driven with just sufficient force to set the heads flush with the wood surface. Deep hammer marks in the wood shall be considered evidence of poor workmanship and may be sufficient cause for rejection of the work.

Holes for lag screws shall be bored with a bit not larger than the body of the screw at the base of the thread. Holes for bolts shall be bored with a bit no more than 1/16" larger than the bolt diameter to achieve a snug fit without forcibly driving the bolt.

Washers shall be used in contact with all bolt heads and nuts that would otherwise be in contact with wood.

All joints shall be fastened with the number, type, and size of fasteners specified, at the locations or spacing specified.

If field cuts of pressure-treated wood expose untreated interior wood, the untreated surfaces shall be covered with two coats of a liquid preservative, as approved by the Engineer.

Roof trusses shall be handled, installed and braced according to the Truss Plate Institute's HIB-91, "Handling, Installing and Bracing MPC Wood Trusses."

Wood structures shall be backfilled within the limits shown on the drawings by placing material in uniform lifts not to exceed nine inches. Compaction within three feet of walls shall be accomplished by means of hand tamping or small manually-directed equipment.

6. GEOMEMBRANE STRUCTURES

Semi-rigid and flexible covers which utilize geomembranes shall be installed as required by the manufacturer, and as otherwise set forth in Section 8 and Construction Specification PA521A-PE/PP.

7. STRUCTURES INSTALLED ACCORDING TO STANDARD DETAIL DRAWINGS PREPARED BY OTHERS

Commercially available structures shall be installed as shown on the drawings provided to and concurred in by NRCS. All materials furnished and installed shall conform to the quality and grade noted on the drawings. A site specific set of construction drawings shall be at the site during construction.

Modification of the structure outside limits shown on the drawings shall not be made without prior review and approval by the Engineer with appropriate approval authority. The Supplier or Contractor who submitted the original standard detail drawings shall be responsible for making any changes. Sufficient design documentation to allow an adequate review of the proposed modification shall accompany any request for a change.

Within thirty (30) days of the completion of construction of the structure, the Contractor or Supplier shall furnish written certification to the Engineer that all aspects of the installation are in conformance with the requirements of the drawings and specifications.

8. ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE:

Supplement A – "Guidelines for Selecting Corrosion-Resistant Fasteners for Use with Preservative-Treated Wood"

Based on a review of technical information posted by the major U. S. preservative manufacturers and selected fastener and connector manufacturers, the following guidelines summarize the current state-of-practice regarding the selection of metal fasteners and connectors for use with ACQ and copper azole (CA) preservative-treated wood:

AWPA Use Category and Description	**Appropriate Fastener/Connector Types**
UC 3A or B – Exterior Construction, Above Ground UC 4A – Ground Contact or Fresh Water, Non-critical components	Fasteners Hot-Dipped (HD) Galvanized per ASTM A153 or Stainless Steel (SS), Type 304 or 316 Connectors HD Galvanized per ASTM A653, Class G185 or Stainless steel, Type 304 or 316
UC 4B - Ground Contact or Fresh Water, Critical components or difficult to replace	Stainless steel, Type 304 or 316

Other Preservatives:

1. For CCA-treated wood, HD galvanized fasteners and connectors as specified above are recommended. CCA is less corrosive than ACQ and CA.
2. For ACZA-treated wood, SS fasteners and connectors as specified above are recommended. ACZA contains ammonia and is significantly more corrosive than ACQ and CA.
3. For other preservatives, the more stringent of the preservative manufacturer's recommendations and the fastener/connector manufacturer's recommendations should be followed.

Notes regarding NRCS-type structures:

1. Use Category UC 3A and B include railings, decking, bracing, and slats on composter bins.
2. Use Category UC 4A includes posts such as those used in composter bins.
3. Use Category UC 4B includes structural building poles and permanent wood foundations.

Specific Site Requirements

Practice Specification
Underground Outlet (Code 620)

1. SCOPE

The specification covers the fabrication, installation, and construction of underground outlets.

2. MATERIALS

The materials required for the underground outlet shall be as shown on the drawings or as otherwise required in Section 9.

a. DRAINFILL AGGREGATE shall meet the requirements of Penn DOT, Publication 408, Section 703, fine and coarse aggregate. The size and gradation shall be as specified in the additional conditions of this specification or on the drawings.

Table 1 – Drain pipe requirements

Type	Specification
Clay drain tile, solid	ASTM-C-4
Clay pipe, standard and extra strength	ASTM-C-700
Clay pipe testing	ASTM-C-301
Concrete drain tile	ASTM-C-412
Concrete pipe for irrigation or drainage	ASTM-C-118
Concrete pipe or tile, determining physical properties of	ASTM-C-497
Concrete sewer, storm drain and culvert pipe	ASTM-C-14
Reinforced concrete culvert, storm drain and sewer pipe	ASTM-C-76
Perforated concrete pipe	ASTM-C-444
Portland cement	ASTM-C-150
Pipe, bituminized fiber & fitting	Fed Spec SS-P-1540
Styrene rubber (SR) plastic drain pipe & fitting	ASTM-D-2852
Polyvinyl chloride (PVC), Sch'd. 40, 80, 120	ASTM-D-1785
Polyvinyl chloride (PVC) sewer pipe & fitting	ASTM-D-2729
Polyvinyl chloride (PVC) pipe	ASTM-D-3034
	type PSM
Corrugated polyethylene tubing & fitting (3-6 inch)	ASTM-F-405
Corrugated polyethylene tubing & fitting (8-24 inch)	ASTM-F-667
Pipe, corrugated (steel, polymer coated)	ASTM-A-762
Pipe, corrugated (steel, zinc coated)	ASTM-A-760

b. PIPE shall meet the requirements of Table 1, and as set forth in Section 9 and/or on the drawings. All pipes shall be clearly marked with the appropriate specification designation. If plastic pipe is stored on site for a length of time, it should be protected from sunlight. At the time of installation, it should be kept as cool as possible to minimize elongation of the pipe during installation.

c. GEOTEXTILE shall meet the requirements as outlined in PennDOT Publication 408, Section 735, Class 1, Subsurface Drainage.

d. CONCRETE and related materials shall meet the requirements set forth in Construction Specification PA313S, Waste Storage Facility (Structure), and/or as set forth in Section 9.

All materials shall be carefully inspected prior to installation. Clay and concrete tile shall be checked for damage by freezing. Plastic pipe and tubing shall be protected from hazards causing deformation. Any damaged or imperfect pipe or tubing shall not be installed. Any pipe or tubing which is damaged during installation shall be removed and replaced.

3. SITE PREPERATION

All trees, brush, fences and rubbish shall be cleared within the area that the subsurface drain will be installed. All material removed by the clearing and grubbing operation shall be disposed of as directed by the Owner or his/her Representative.

4. INSPECTION AND MATERIAL HANDLING

Material for underground outlets shall be carefully inspected before the drains are installed. If applicable, clay and concrete tile shall be checked for damage from freezing and thawing before it is installed. Bituminized fiber and plastic pipe and tubing shall be protected from hazard causing deformation or warping.

Plastic pipe and tubing with physical imperfections shall not be installed. Any damaged section shall be removed and replaced. All material shall be satisfactory for its intended use and shall meet applicable specifications and requirements.

5. SAFETY

All positive "design" responses from the Pennsylvania One Call System are noted on the plans. It is the Contractor's or Landowner's responsibility to notify One Call of pending construction and to contact the affected utility for marking at the time of construction.

The Contractor must comply with OSHA requirements Part 1926, subpart P, for protection of workers entering trench.

6. EXCAVATION

Construction operations shall be done in such a manner that soil and water pollution are a minimum and all state and local erosion regulations are followed.

Unless otherwise specified, excavation for each underground outlet shall begin at the outlet end and progress upstream. The trench shall be excavated to the grades and cross sections shown on the drawings. The trench width above the conduit may increase as necessary for safe installation or for the convenience of the Contractor. Trench shields, shoring, or bracing are required whenever workers will be in a trench deeper than four feet, or as otherwise required be OSHA Regulations.

7. INSTALLATION

BEDDING. In stable soils, the conduit shall be firmly and uniformly bedded throughout its entire length as required on the drawings or Section 9. Where the underground outlet foundation is in unstable soils, the bedding shall be as shown on the drawings or as otherwise required by the Engineer. Where the conduit is to be laid in rock, or rock is exposed at the trench bottom, the rock shall be removed at least two inches below the invert grade to allow for compacted bedding under the conduit.

PLACEMENT. Debris inside of pipes and tubing shall be removed prior to installation. The conduit ends shall be protected during placement. Similarly, all appurtenances, including trash guards and animal guards, shall be protected during installation to avoid damage. All underground outlets shall be laid to line and grade, and immediately covered with an approved blinding, envelope, or the required depth of filter material. No reversals in grade of the conduit are permitted, no more than five percent stretch is allowed. Special precautions must be taken in hot weather to observe this stretch limit.

Flexible conduits, such as plastic pipe or tubing and bituminized fiber pipe, shall be installed, according to the requirements in ASTM-F-449, "Standard Recommended Practice for Subsurface Installation of Corrugated Thermoplastic Tubing for Agricultural Drainage or Water Table Control."

Earth backfill material shall be placed in the trench in a manner to ensure that the conduit does not become displaced and so that the filter and bedding material, after backfilling, meet the requirements of the plans and specifications.

8. BACKFILL

Initial backfill shall be of selected material that is free of rocks or other sharp-edged material that could damage the pipe. Earth backfill shall be placed in the trench in such a manner that the conduit is not displaced, and that the filter and bedding materials are not contaminated or displaced. Unless otherwise specified, where the underground outlet is laid under roads or at other designated locations, the backfill shall be placed in successive layers of not more than six inches, and each lift compacted before the subsequent layer. Backfill shall extend above the adjacent ground to allow for settlement, and be well rounded over the trench.

Work areas shall be restored to their pre- construction condition or as otherwise required in the plans or Section 9.

9. ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE:

Specific Site Requirements