Precast Concrete Septic Tanks

Rock Solid Tanks, Rock Solid Treatment

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Background

- **Nearly 85 million Americans – more than 25% of the country - are being served by the onsite industry and that number is growing.**
- **Centralized treatment systems are often at capacity and there is minimal to no funding to expand or repair these systems**
- **Bottom Line…<u>CUSTOMERS NEED BIG BANG FOR THEIR BUCK</u>**

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Septic Tank is the Heart of the System

A well manufactured and maintained precast concrete septic tank can exceed the life of the home.

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Topics

- Background
- Applicable Standards
- Septic Tank Design
  - Forces
  - Manufacturing
  - Connections
- Septic Tank Installation
  - Excavation Considerations
  - Bedding
  - Backfill
- Post Installation
- Case Studies

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Applicable Standards

Tanks are built to strict standards and specifications. Some common standards include:

- ASTM C1227
- ASTM C890
- ASTM C913
- CSA B66
- IAPMO/ANSI
- Municipal, County and State Regulations
- NPCA Best Practices Manual

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Applicable ASTM Standards

Tanks should be specified to meet the requirements of:

ASTM C 890

- Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures

ASTM C 1227

- Standard Specification for Precast Concrete Septic Tanks

ASTM C 913

- Standard Specification for Precast Concrete Water and Wastewater Structures

ASTM INTERNATIONAL
Standards Worldwide

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Other ASTM Standards

ASTM C 1719

- Standard Test Method for Installed Precast Concrete Tanks and Accessories by the Negative Air Pressure (Vacuum) Test Prior to Backfill

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Other Standards

CSA B66

- Prefabricated Septic Tanks and Sewage Holding Tanks - Plumbing Products and Materials

IAPMO/ANSI Z1000-2013

- Prefabricated Septic Tanks

Municipal, County and State Regulations

- Various State Regulations May Govern Design of Tanks

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Use NPCA as a resource!

- Web site tools at www.precast.org
- NPCA Best Practices Manual Universally Recognized Amongst Precast Companies
- Can act as dictating code amongst varying local codes
- Strictly adheres to ASTM codes

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SEPTIC TANK DESIGN

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Forces to Consider

- Live Loads
  - Traffic
  - Water Table
  - Contents of Tank
- Dead Loads
  - Soil Loads
  - Weight of Structure

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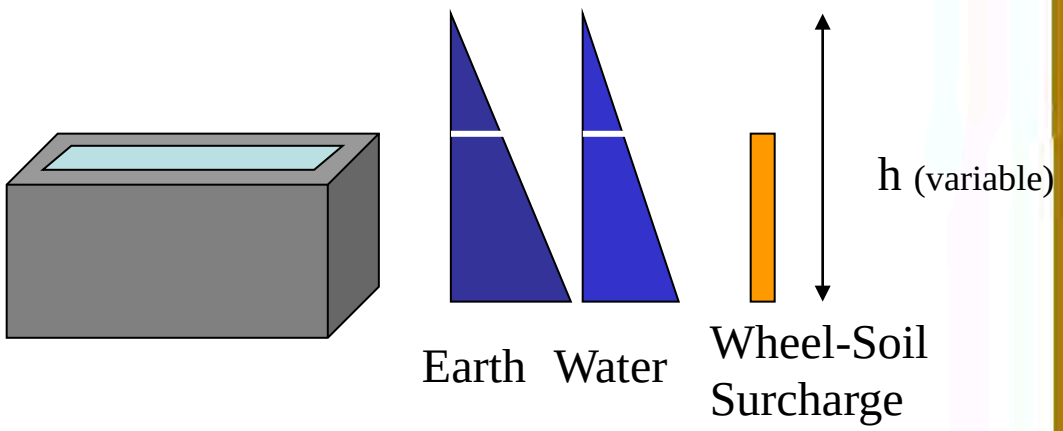
Lateral Forces

- Soil Loads
- Water Loads
- Wheel and Surcharge Loads
- All Dependent on Depth

- Precast concrete can withstand these forces.
- Tank is designed for certain depth.
- Manufacturer can design for deeper depths



ASTM C 890

•Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures

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Buoyancy

- In high water table sites, this must be considered in the design.
- Precast concrete has a higher specific gravity that other alternative materials. Higher resistance to buoyant forces.

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Live Loads

- Normal Live Loads (Lawn Tractor)
- Driveway Loads
- HS20 Loading
- Water Table
- Contents of Tank

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Dead Loads

- Soil
- Weight of Tank

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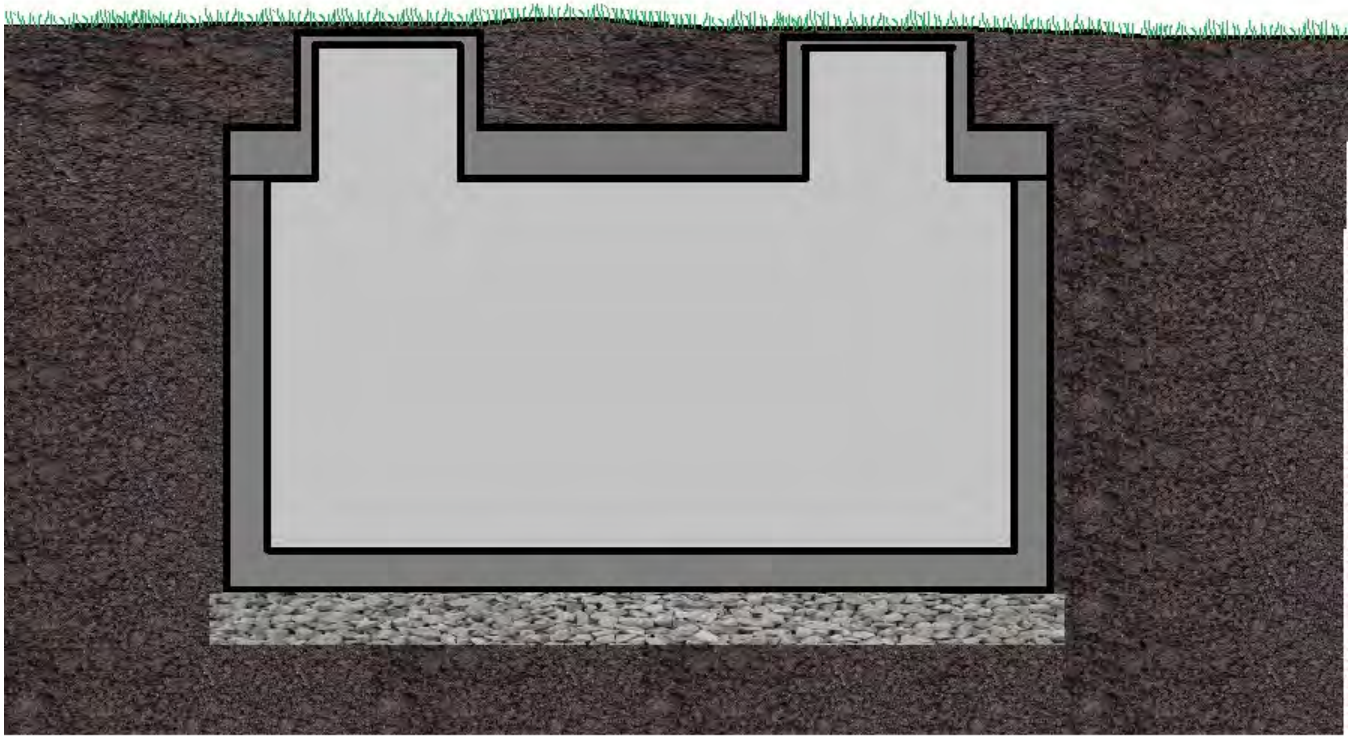
Forces on an underground structure



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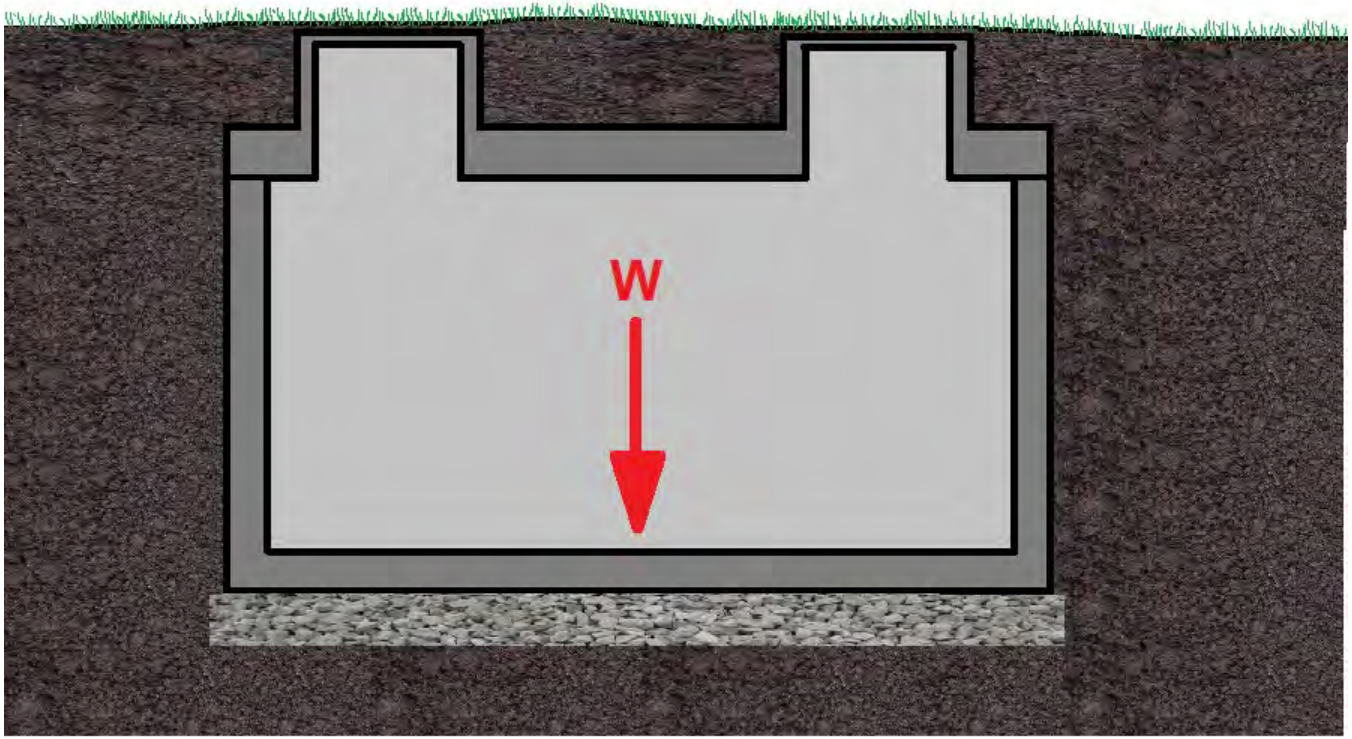
Forces on an underground structure



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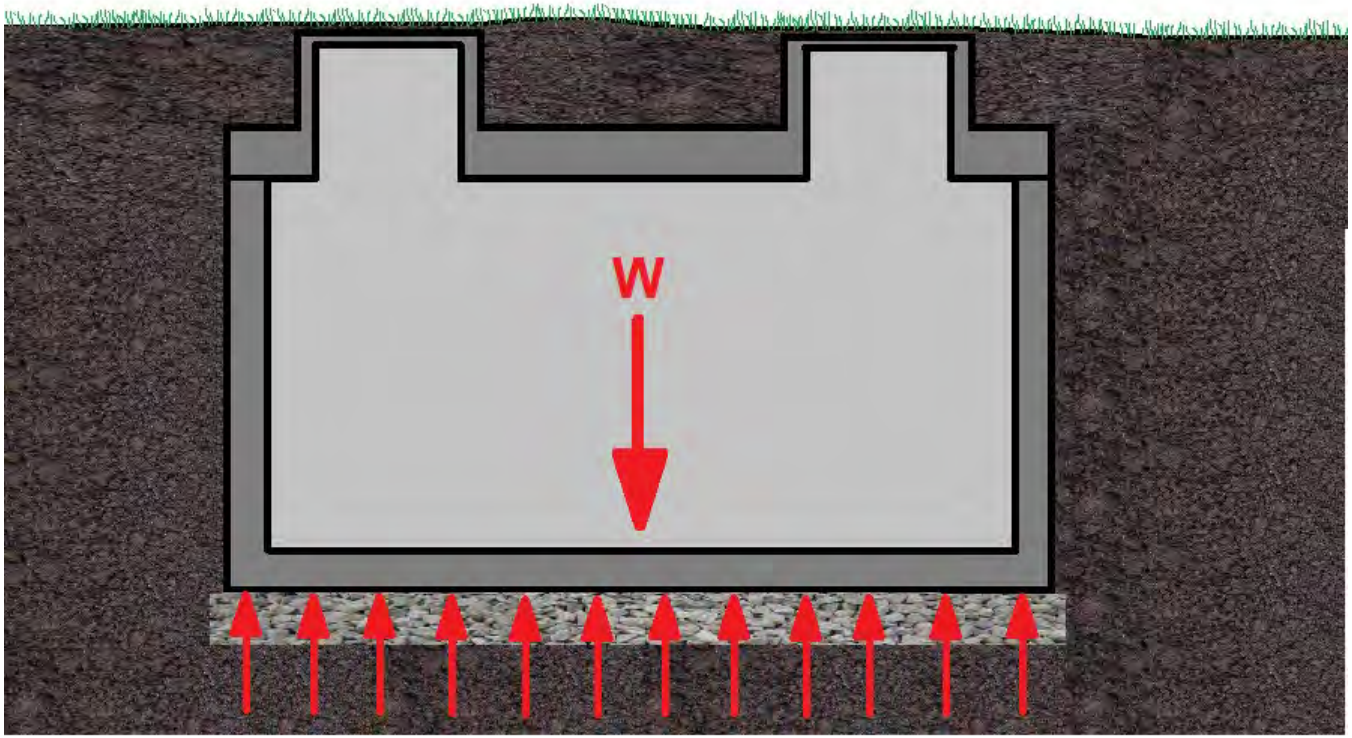

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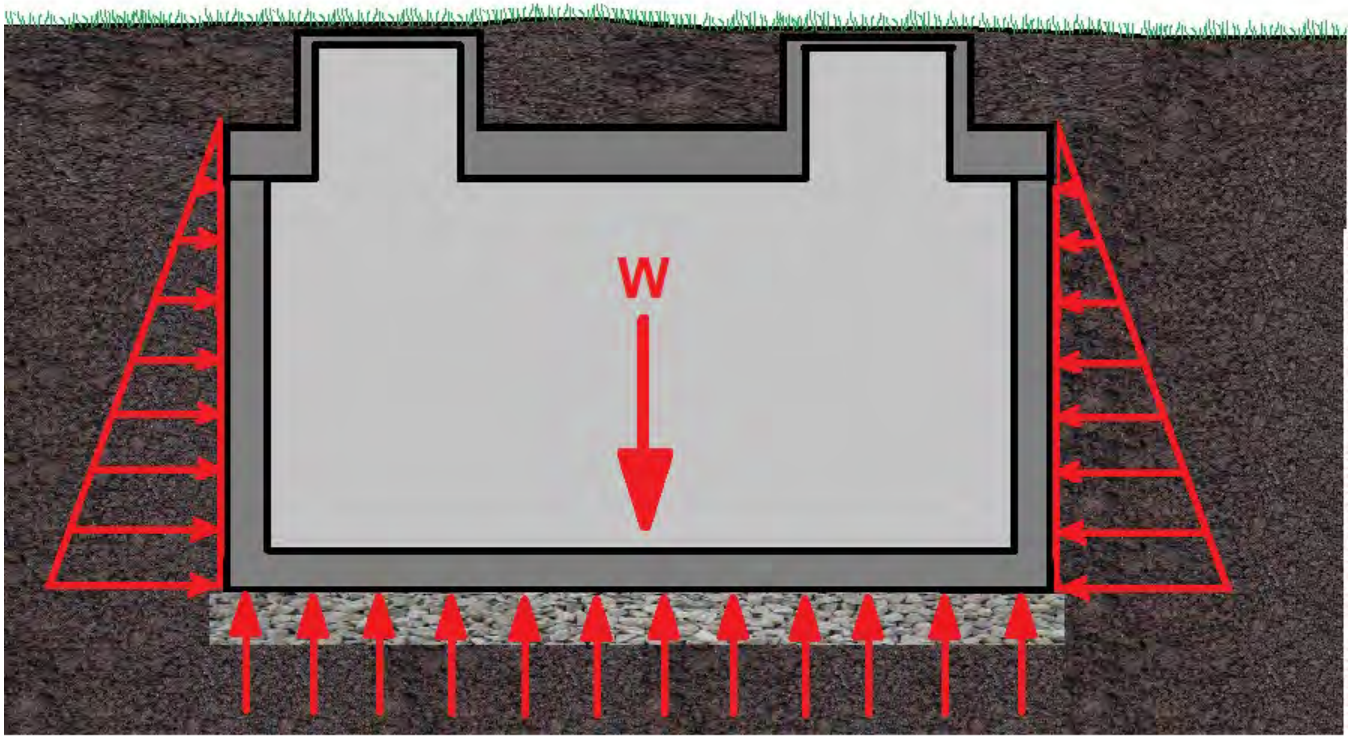

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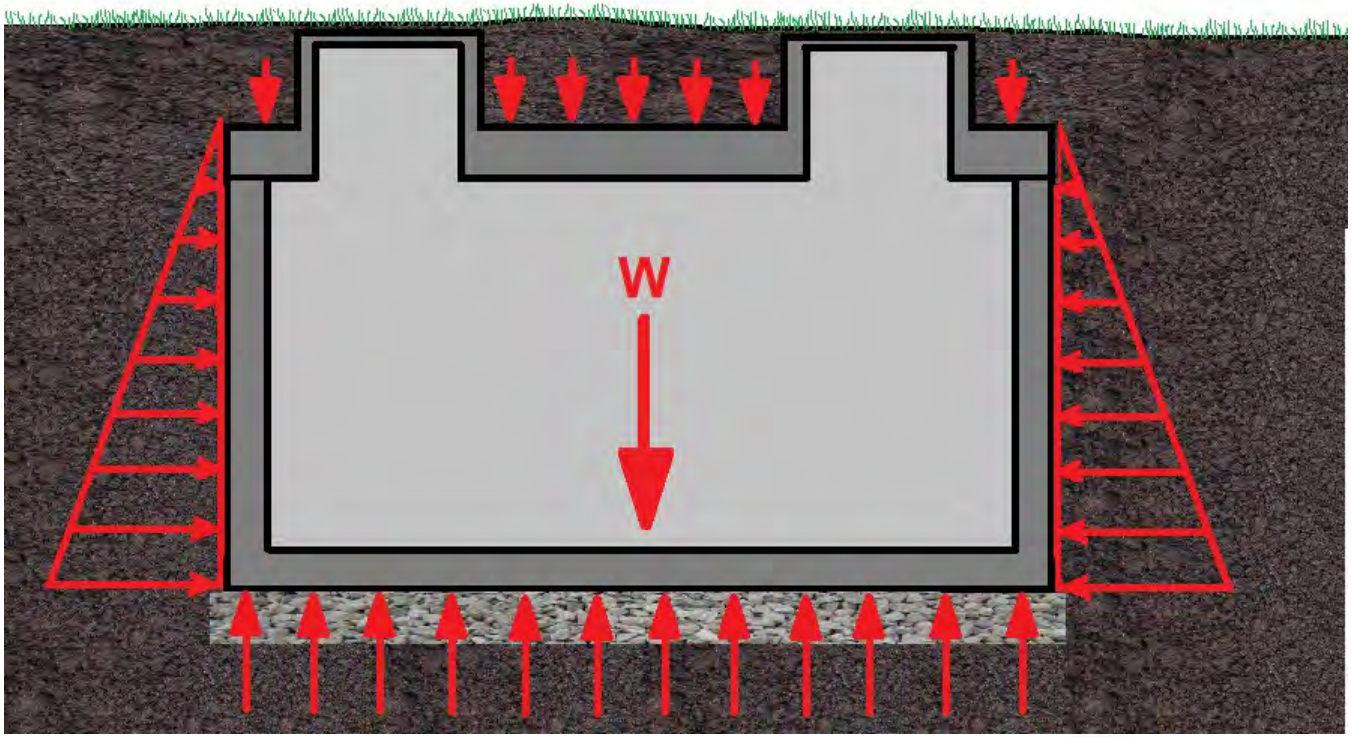

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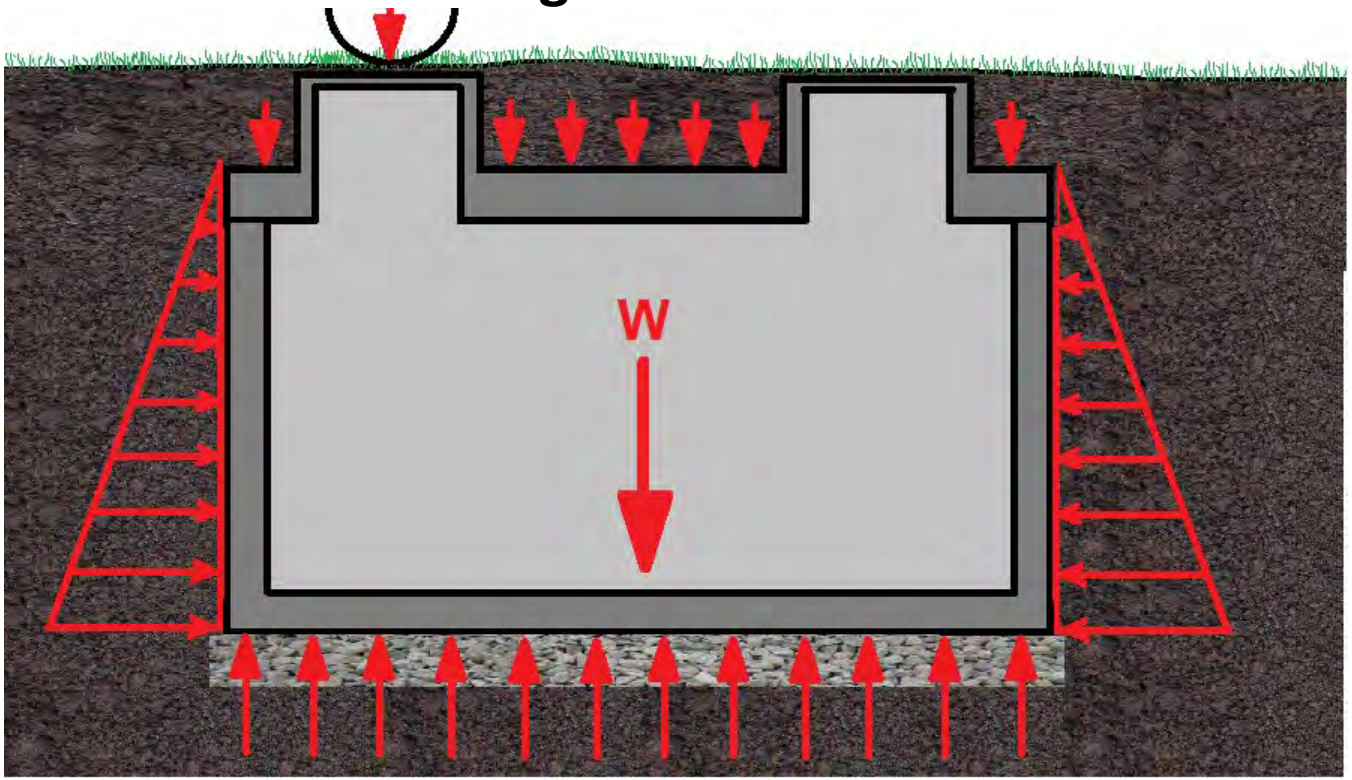

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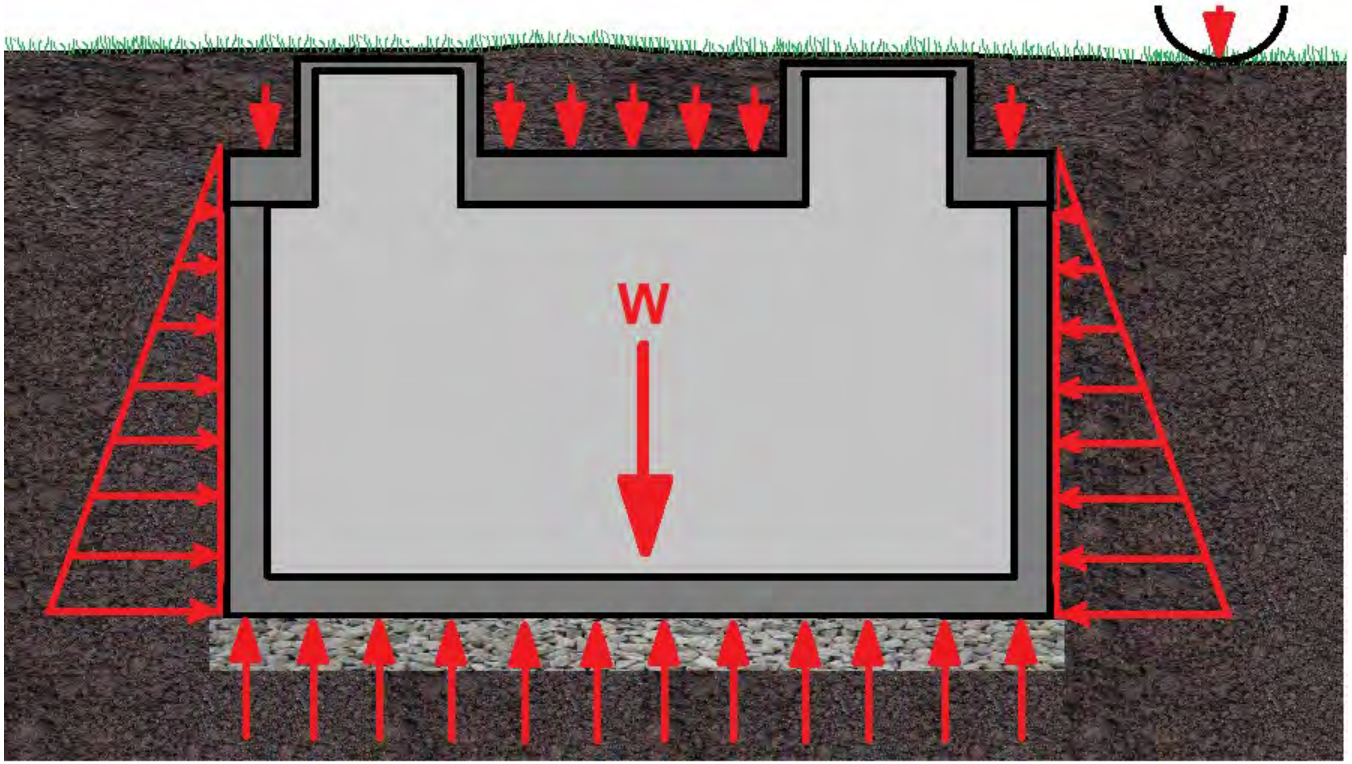

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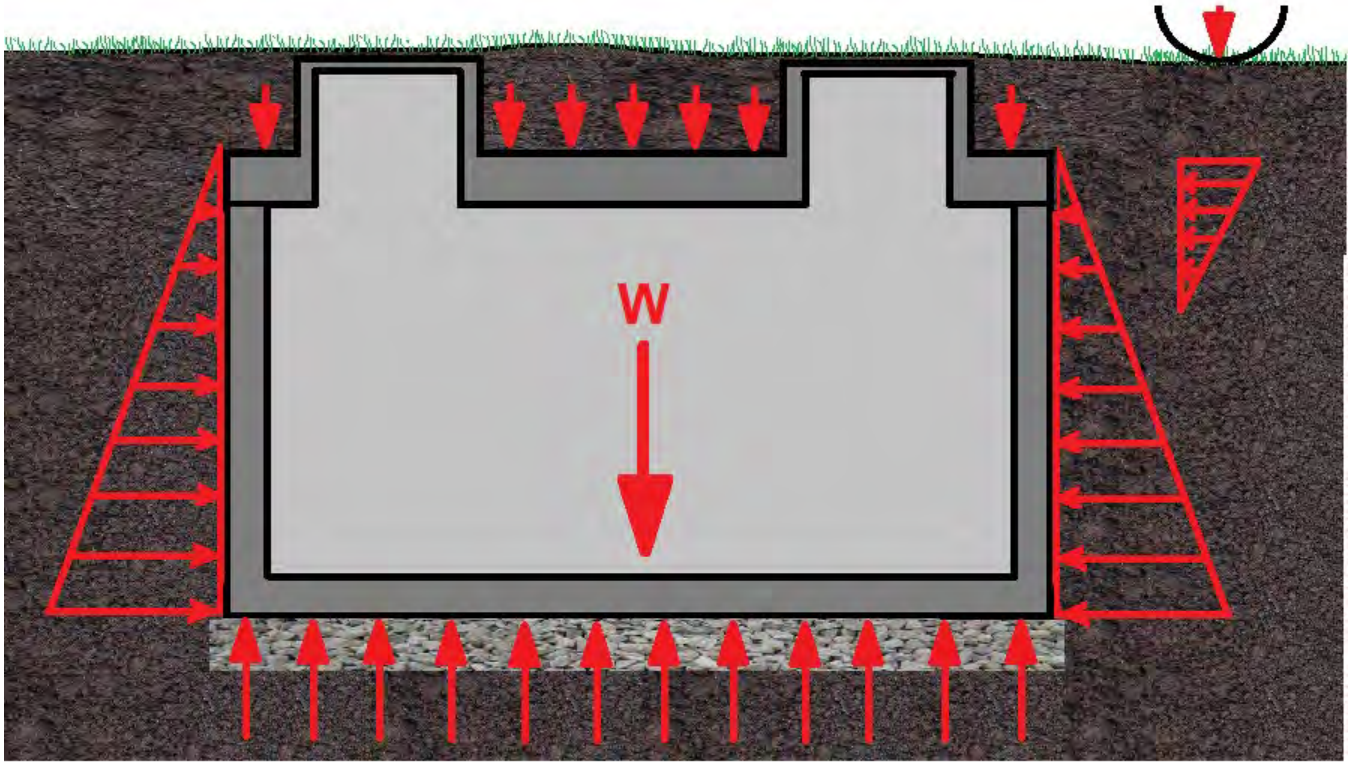

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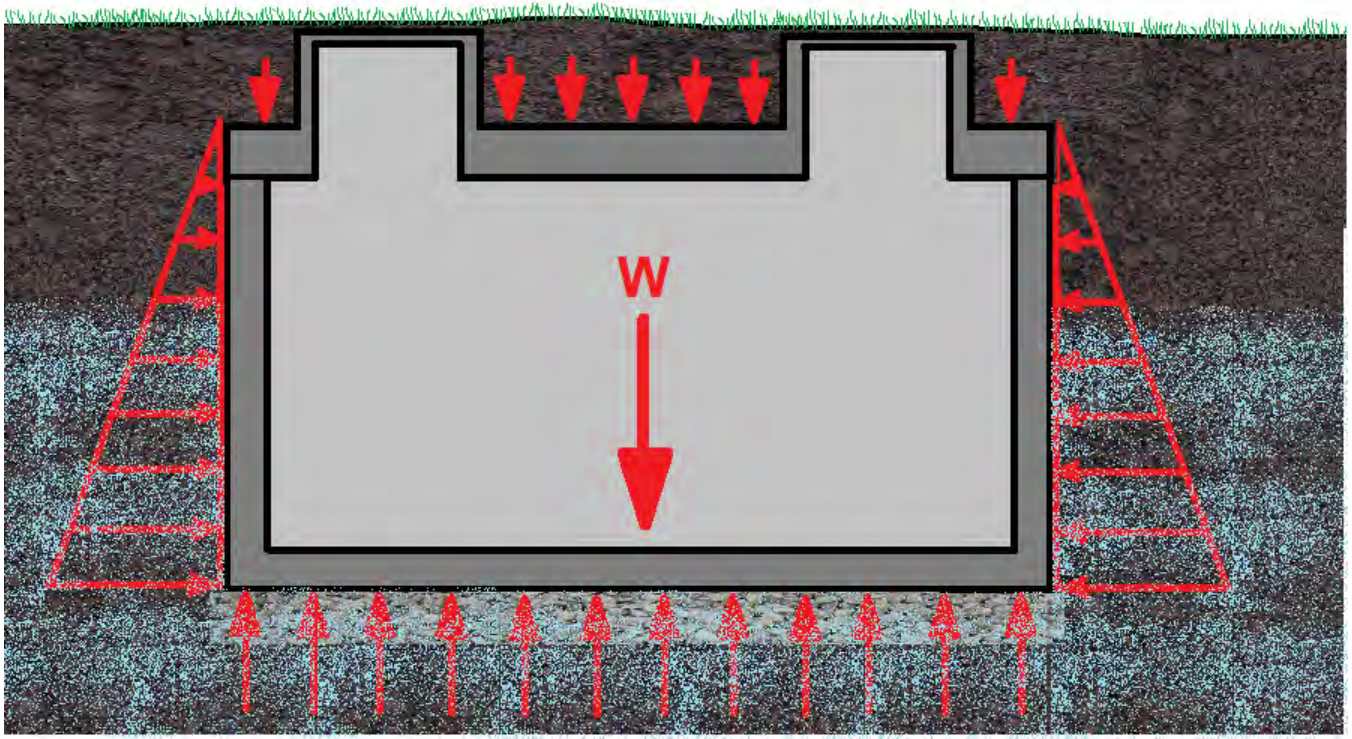

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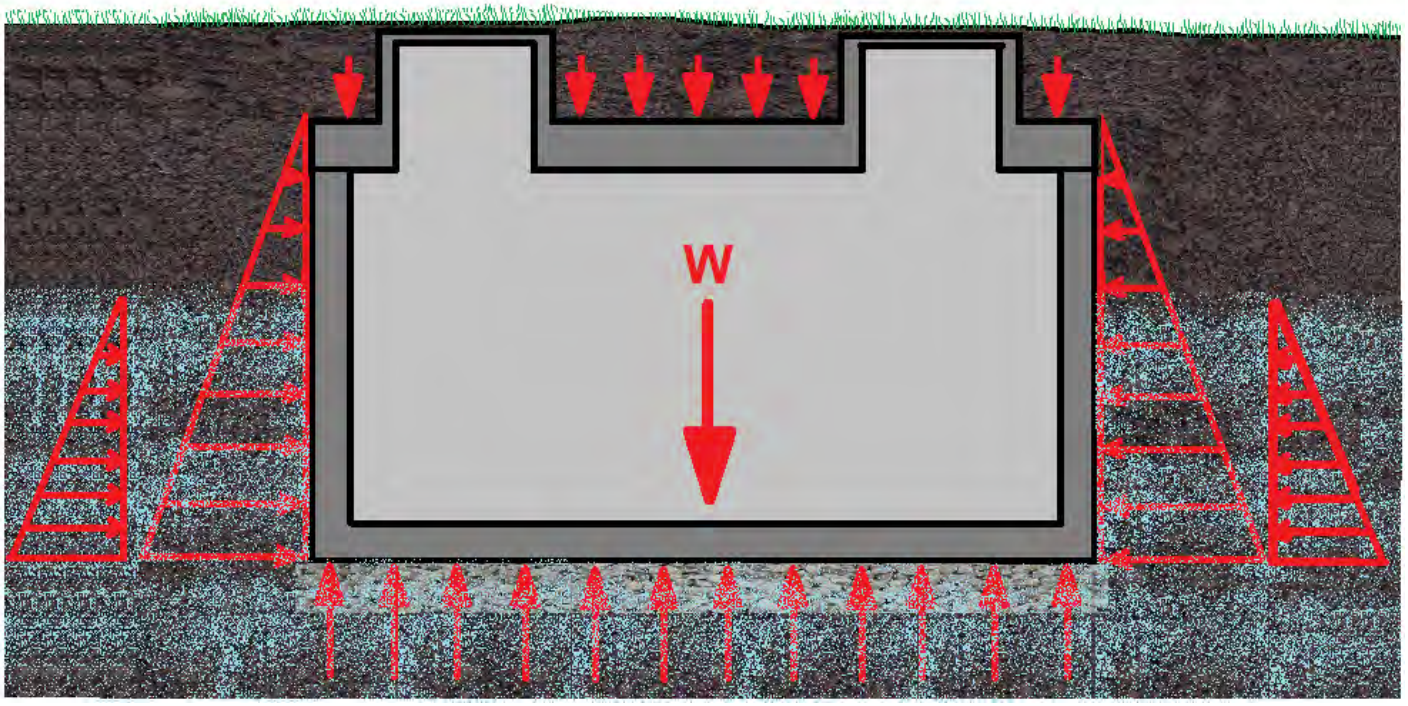

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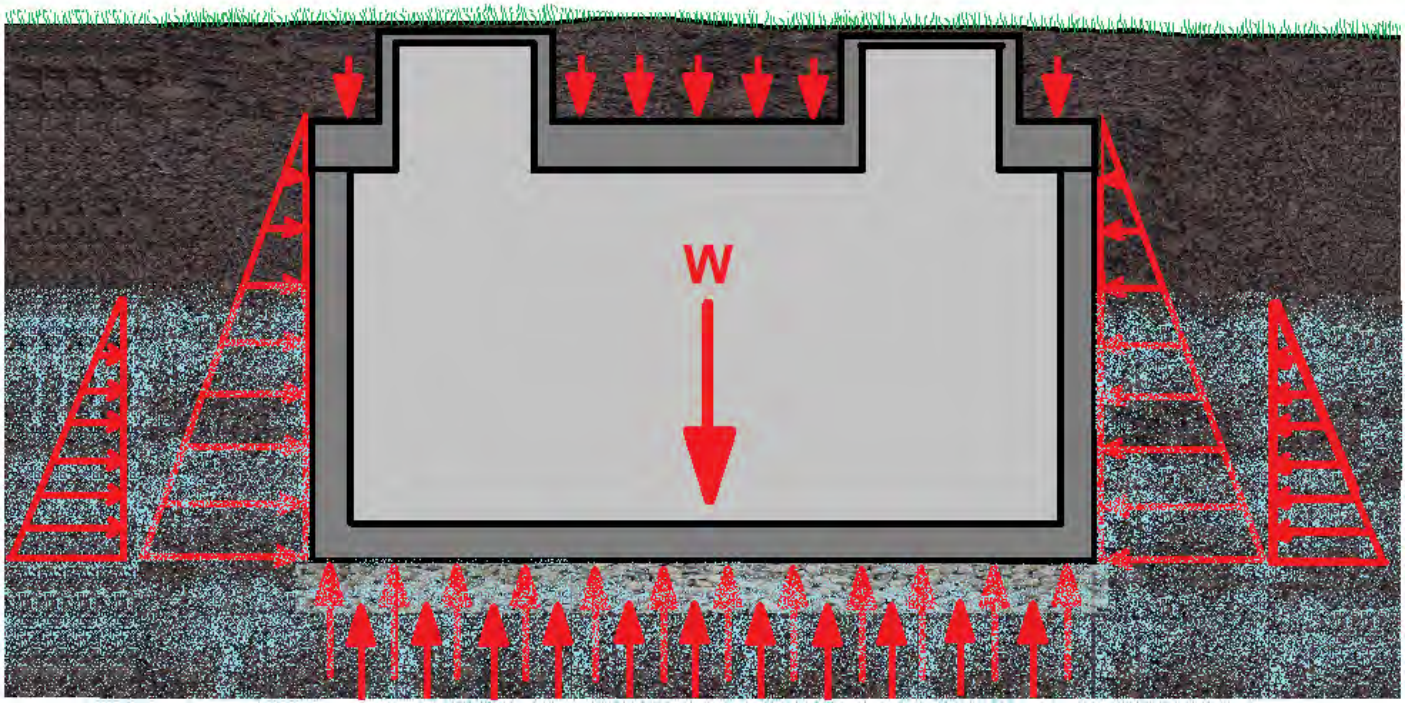

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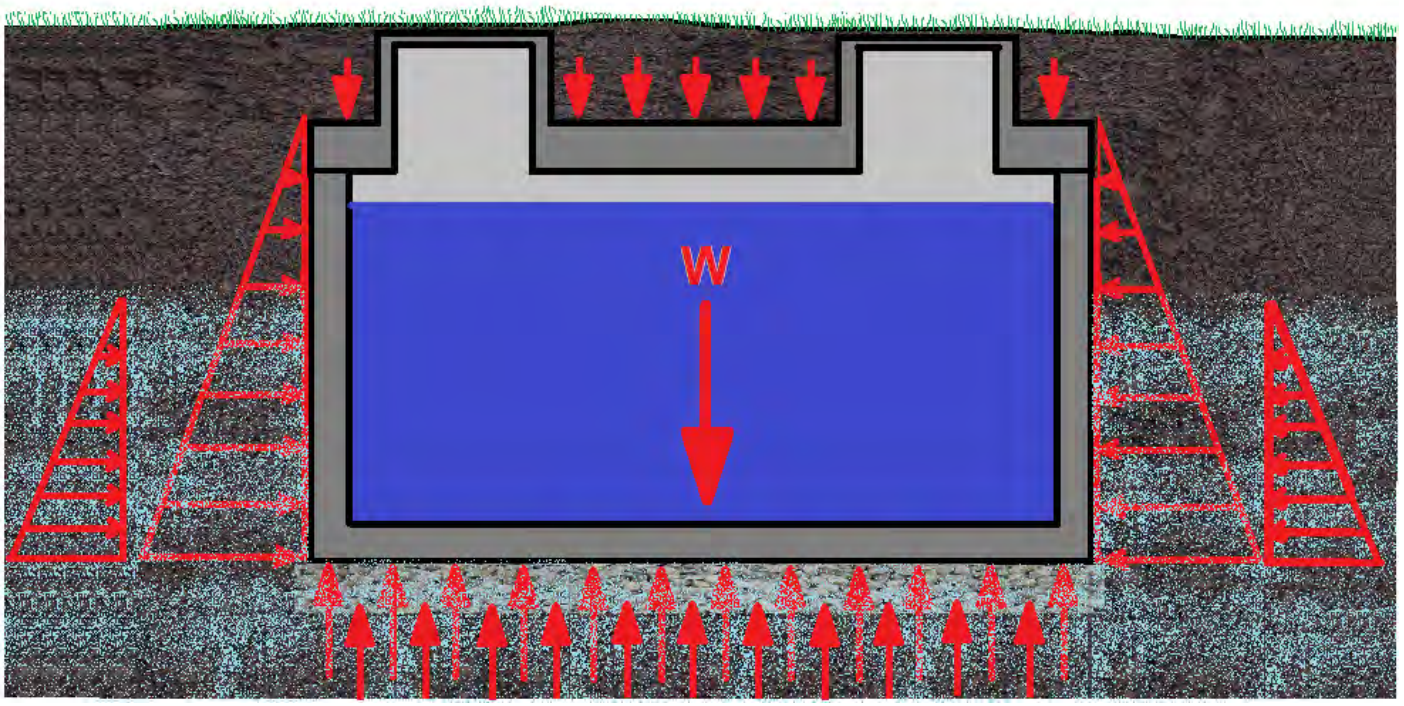

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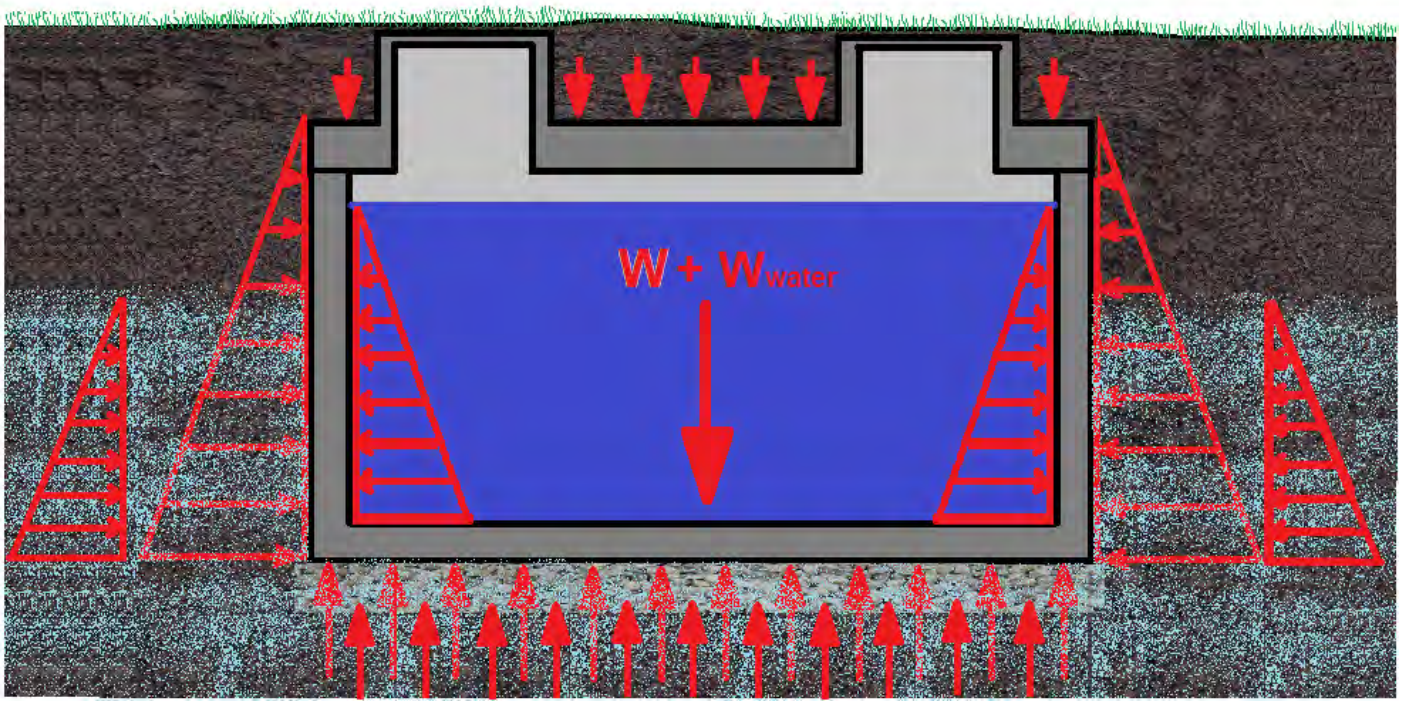

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Manufacturing a Quality Septic Tank

- Mix Design
- Wall Thicknesses
- Reinforcing
- Handling
- Quality Control/Quality Assurance

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Mix Design – Start with a Good Recipe

- Major Components
  - Cement
  - Aggregates
  - Water
  - Admixtures

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Cement

Cement

The majority of cement used in the manufactured concrete products industry is governed by ASTM C 150, “Standard Specification for Portland Cement.”

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Aggregate

Aggregates

Well-graded, sound, nonporous aggregate conforming to ASTM C 33, “Standard Specification for Concrete Aggregates,” is essential in the production of high-quality precast concrete.

Makes up 60-75% of volume and 70-85% of

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Water

Water

Water for mixing high-quality precast concrete shall meet ASTM C1602, “Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.”

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Admixtures

- Admixtures are used to reduce the cost of concrete construction, achieve certain properties in concrete, maintain certain qualities of concrete while placing, curing in adverse weather conditions.
- ASTM C494 - “Specification for Chemical Admixtures for Concrete”

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Start with Strong Mix – Compressive Strength

- **Design is based on 28-day f'_c**
- **Performance is based on actual f'_c**
- **All standards based on f'_c not mix designs**
- **Water-cement ratio will dictate compressive strength as well as porosity, permeability and durability.**

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Minimum f'_c Requirements

- NPCA
- ASTM C 1227
- PCA
- ACI 318

- 4,000 psi
- 4,000 psi
- None
- None

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Pre- f'_c

- **Movement can Cause Micro-Cracks**
- **Designs are not Valid**
- **Concrete may be Very Weak**
- **Lifting may be Hazardous**

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Minimum Wall Thickness

- NPCA
- ASTM C 1227
- PCA
- ACI 350

- 3-inches
- None
- None
- 4 inches

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How Thin is Thick Enough?

- **NCPA & ASTM C 1227 Require 1-inch Minimum Concrete Cover (2-inch (+))**
- **ACI 318 Requires 3/4-inch Minimum Concrete Cover (1.5-inch (+))**
- **Concrete Must be Watertight**
- **Lift System Requirements**
- **Maintaining Minimum Thickness with Tapers**
- **Lid and base thickness designed based on conditions and applicable specifications.**

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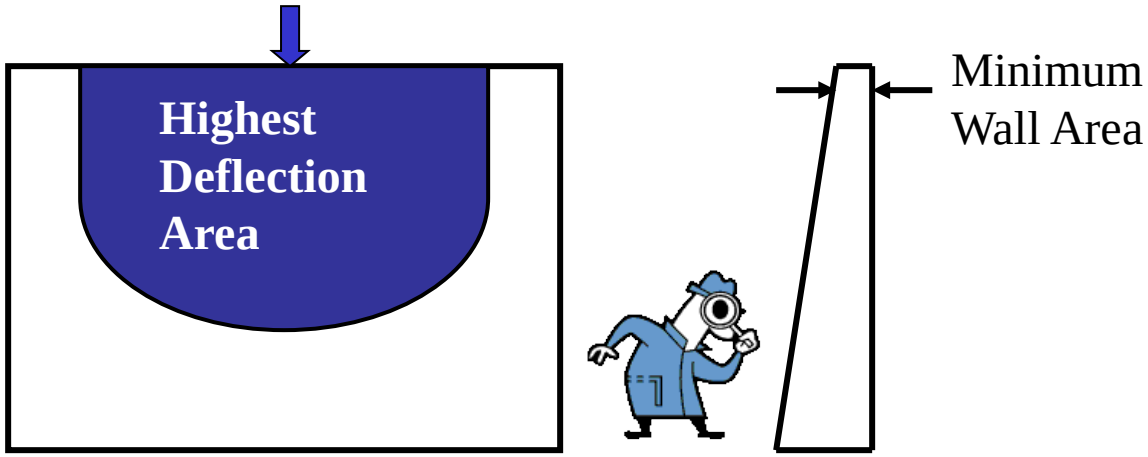
Wall Tapers



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Connections

Joint Sealant

Pipe to Tank Connections

Concrete to Concrete

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Connectors

Pipe to Tank Connections

Basic Function – Prevent Infiltration and Exfiltration

- Provide a permanent flexible connection between pipe and tank.
- Provide for angular deflection of pipe.
- Provide for shear deflection of pipe.
- Provide sure, simple connection for installer.

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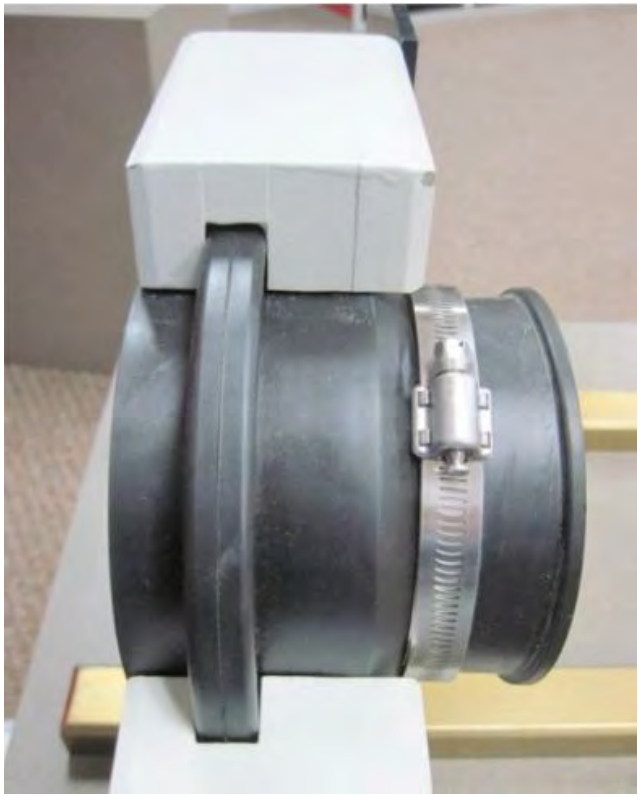
Connectors

Must conform to:

ASTM C1644 – Specification for Resilient Connectors Between Reinforced Concrete On-Site Wastewater Tanks and Pipes.

Required by ASTM C1227



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Connectors

Why do connectors leak?

- Insufficient Compression of Rubber….

Quality Installation is Key to Success!

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Leaks – Between Rubber and Pipe

- **Clamp not tightened correctly –**
- **Recommend using a T –Handle Torque Wrench to install clamps instead of a screwdriver or power tools.**
- **Clamps must be tight but not over-tightened**
- **Follow manufacturers requirements**

Leaks – Between Rubber and Pipe

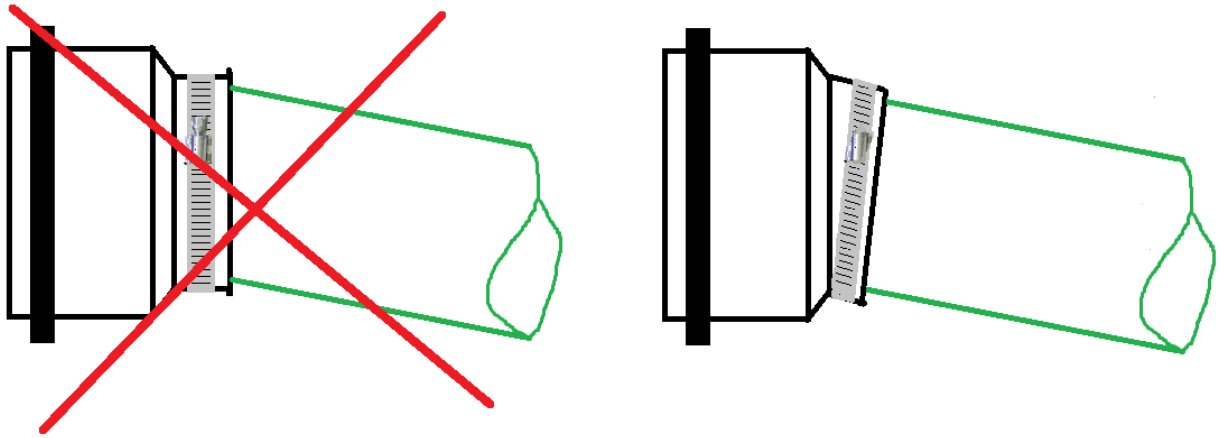
- **Mud on pipe**
- **Mud, Concrete, Debris between rubber and clamp**
- **Rubber/Throat Clamp not square to pipe – Either tighten clamp on pipe first before defecting pipe or align boot square to the pipe before tightening clamp.**

Leaks – Between Concrete & Rubber

- **Poor consolidation**
- **Poor mix design**
- **Insufficient concrete strength**

Connectors

Rubber/Throat Clamp not square to pipe – Either tighten clamp on pipe first before defecting pipe or align boot square to the pipe before tightening clamp.



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Joint Sealant

Must conform to ASTM C990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

Required by ASTM C1227

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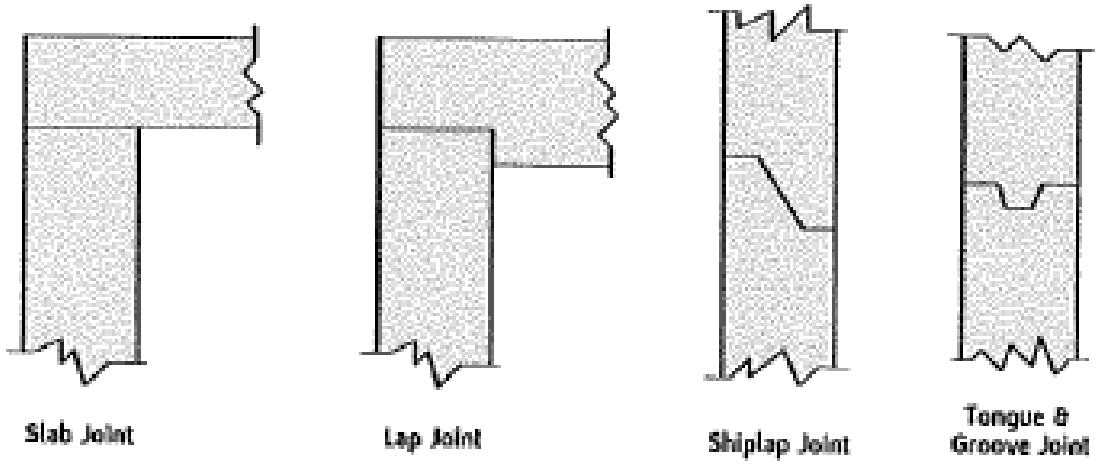
What Makes Precast Concrete Structures Watertight?

Joint Configurations



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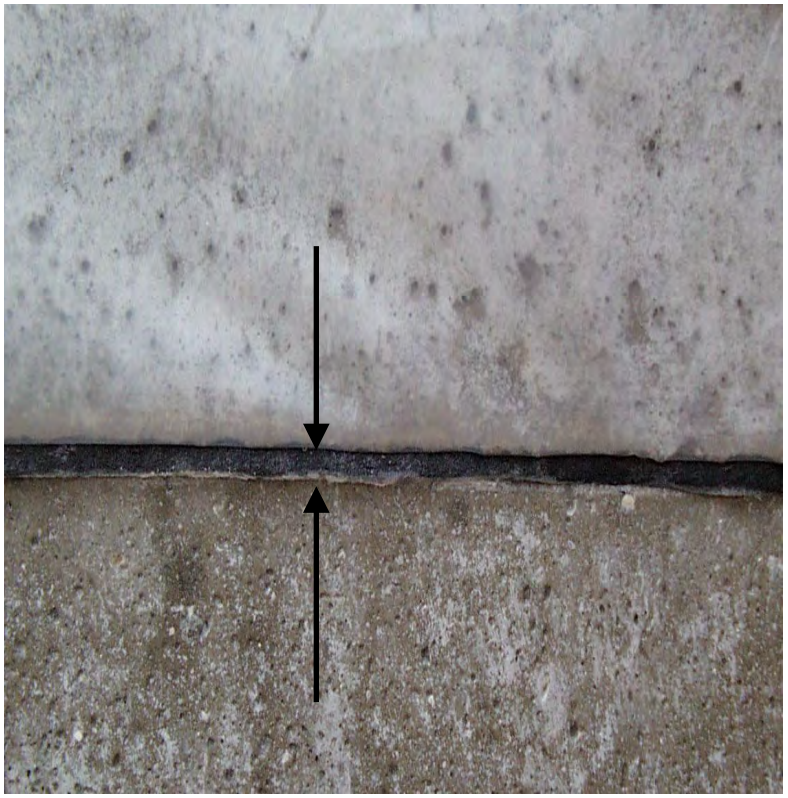
A Good Quality Joint (watertight tank)



3/8” maximum gap between two mating joint surfaces BEFORE sealant is applied.

ASTM C 1227-05 Section 10.3

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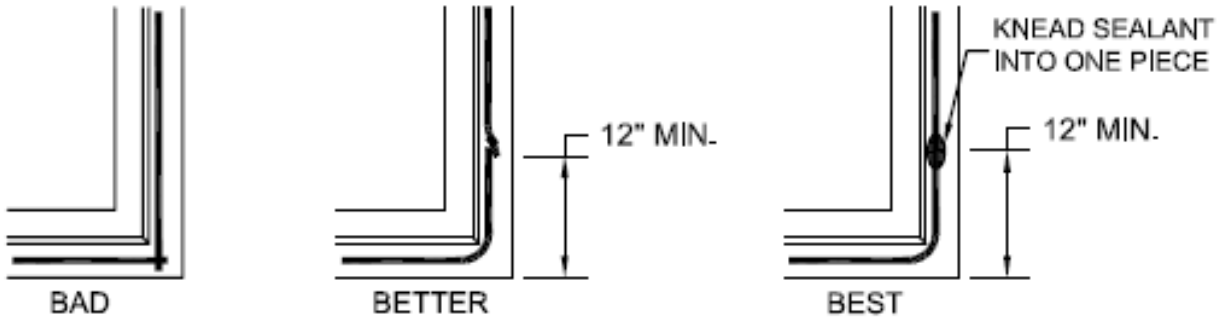
What Makes Precast Concrete Structures Watertight?

Recommended Practice



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What Makes Precast Concrete Structures Watertight?

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SEPTIC TANK INSTALLATION

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Site Truck Considerations

- **The installation site must be accessible to large, heavy trucks weighing up to 80,000 lbs. (36,000 kg) .**

- Most trucks will need to get within 3 to 8 feet (1 to 2.5 m) of the excavation to be unloaded.

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Site Considerations

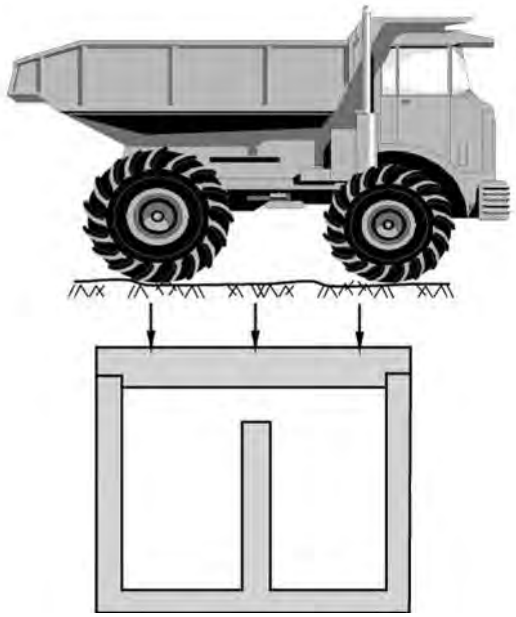
- The construction area should be free of trees, branches, overhead wires or parts of buildings that could interfere with the delivery and installation of the on-site wastewater tank.

- Construction equipment traffic should be minimized while precast delivery truck is onsite

- Site should consider both movement of the truck and movement of the crane. Both need to be considered.

Depth Considerations

- Most residential grade septic tanks are limited in depth of bury and traffic loading



- Other tanks can be buried deeper, consult with manufacturer before specifying tank

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Bedding and Backfill

- The tank must be placed on 4” of granular material leveled in all directions over a firm and suitable sub base.
- It is important to make sure the bedding is level to distribute the load over the entire tank.
- The sub base must be capable of bearing the weight of the tank and its contents.

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Excavate Safe Hole

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Bedding

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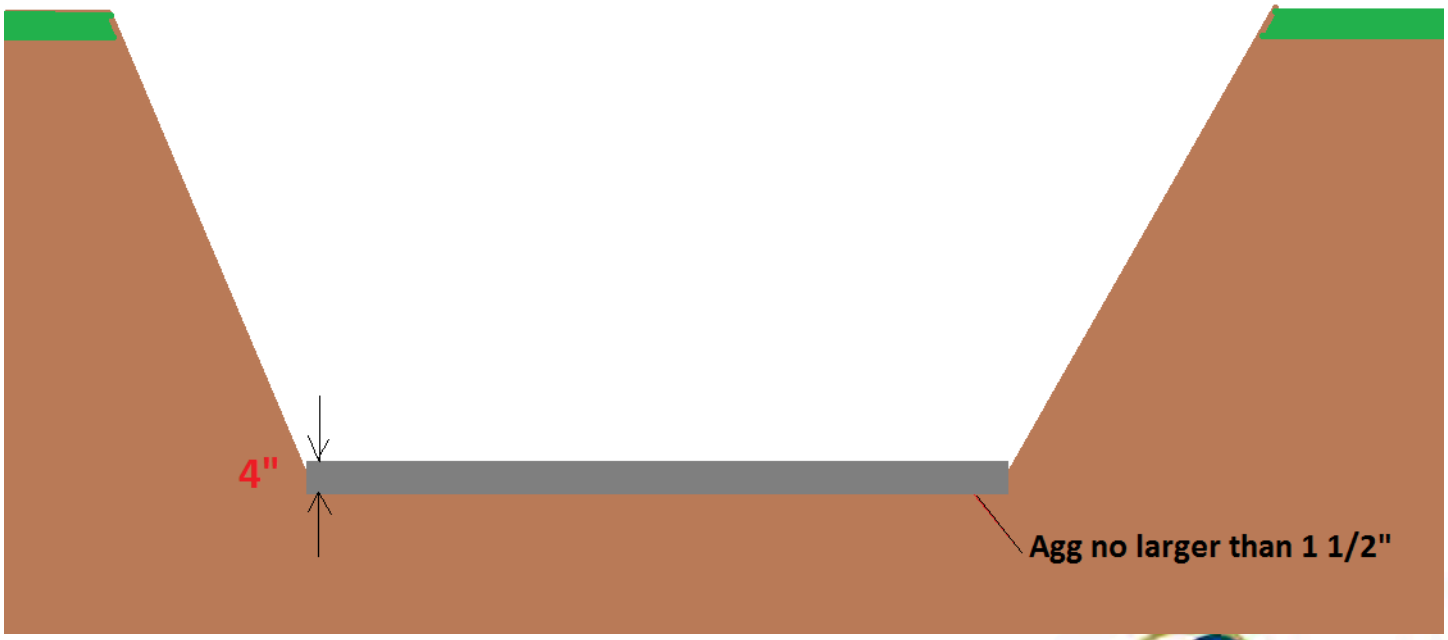
Bedding



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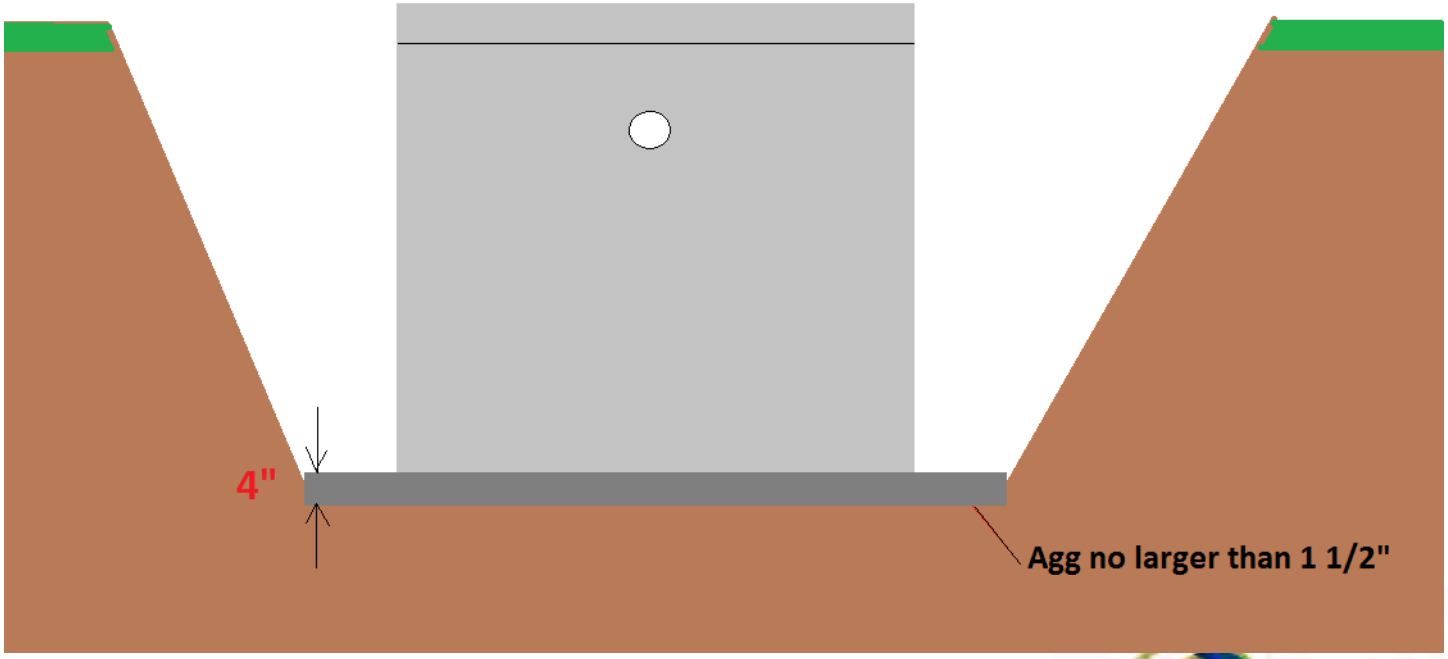
Tank Installation



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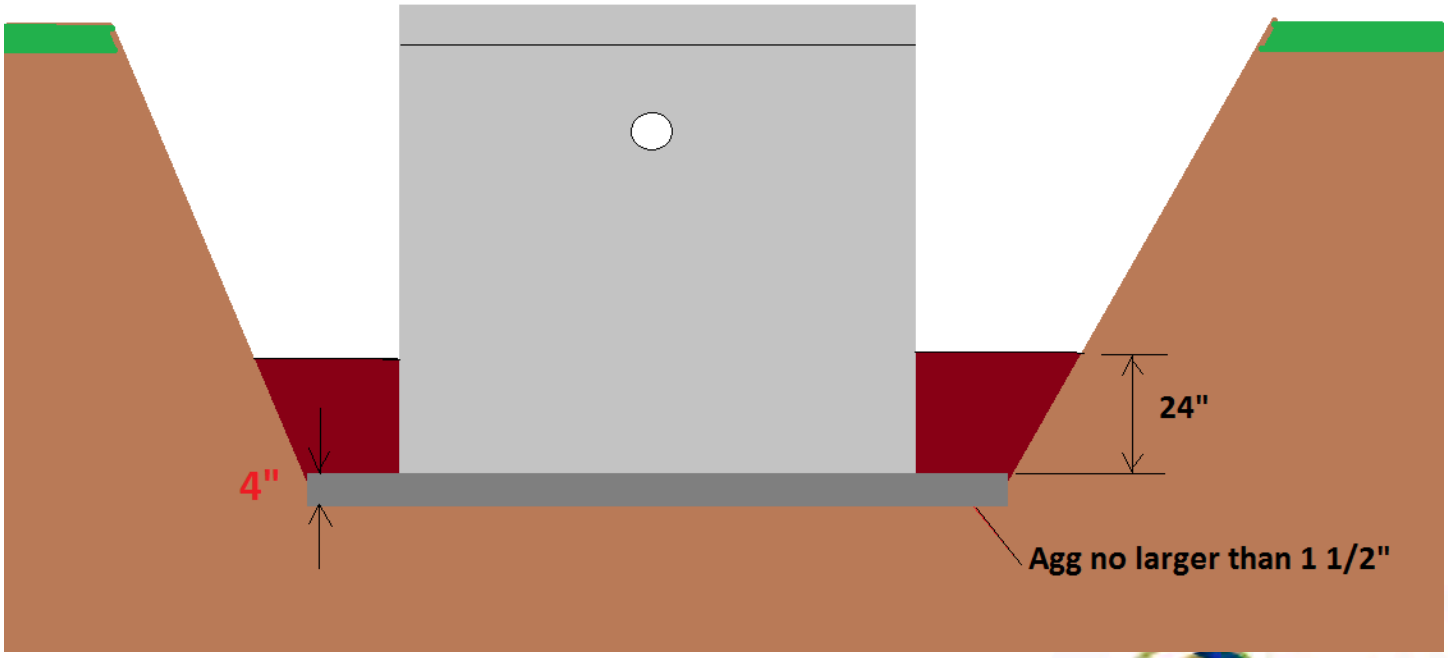
Backfill



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AFTER THE INSTALL

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PROOF TESTING

ASTM C 1227-10a

- 9.1 Proof testing is used to demonstrate the strength of the tank to resist anticipated external and internal loads.

- 9.1.1 Proof testing, when required by the purchaser, shall be performed in such a way as to simulate the actual anticipated loads.

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Testing in Action

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Testing in Action

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Performance Testing For Watertightness

- **Vacuum Testing**
  - ASTM C 1227-13
    - Seal the empty tank and apply a vacuum to 4” of mercury.
    - The tank is approved if 100% of vacuum is held for 2 minutes.
  - NPCA Best Practices Manual
    - Seal tank, apply a minimum vacuum of 4” mercury
    - It may take some time to stabilize the vacuum due to various factors (it is permissible to continue vacuum until stable at 4”)
    - Shut off vacuum pump. Tank is approved if there is no pressure drop for 5 minutes
    - If the tank fails the test, it may be repaired and retested.

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Performance Testing For Watertightness

- **ASTM C 1227 Test Method**
  - Seal the tank, fill with water
  - Let stand for 24 hours
  - Refill the tank
  - Monitor tank for 1 hour
    - if there is no water loss tank is approved
- **NPCA Recommended Water Testing**
  - Fill tank to 2” above the top of the cover inside riser
  - Allow it to stand for 24 hours
  - Absorption may explain water loss
  - If visibly leaking, repair tank, refill, allow to stand 1 hour
  - No visible leakage is allowed

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Watertight Testing: In-Plant

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Watertight Testing: In Field

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Watertight Testing: In Field

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Manhole Access Ways

- Manholes Should be Accessible for Servicing Easily
- Should be Above Ground
- Should be Locked

- SAFETY

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Homeowner Consideration

- Septic Knowledge
  - What
  - Where
  - Why
  - How
- Service

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CASE STUDIES

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