SEPTIC TANK DESIGN REVIEW AND INSPECTIONS

Protecting the Consumer

Protecting the Environment

Protecting Public Health & Safety

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NOWRA 2021 Mega Conference

Disclaimer

- *The materials being presented represent the speaker's own opinions and do NOT reflect the opinions of NOWRA.*

Tank design specifications

NMAC 20. 7. 3	IAPMO	ASTM
Sections 501 & 502 (Precast concrete)	IAPMO ANSI Z1000-2013 (Plastic, fiberglass) (precast concrete)	ASTM C-1227 2012 (precast concrete)

OTHER REFERENCES

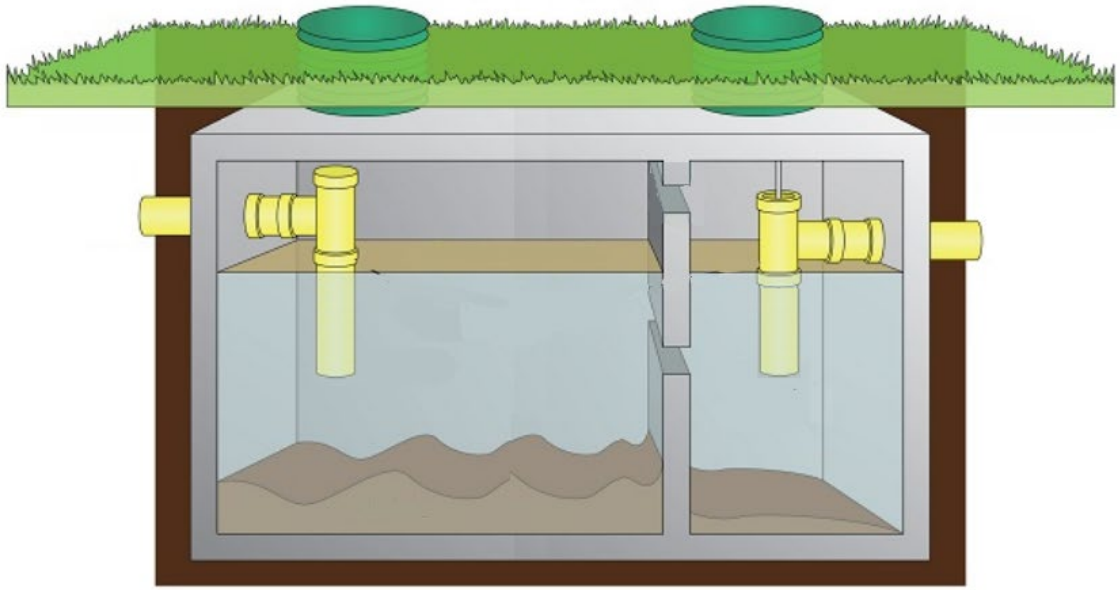
UPC 1970 TO PRESENT

MANUAL ON SEPTIC TANK PRACTICES (1957)

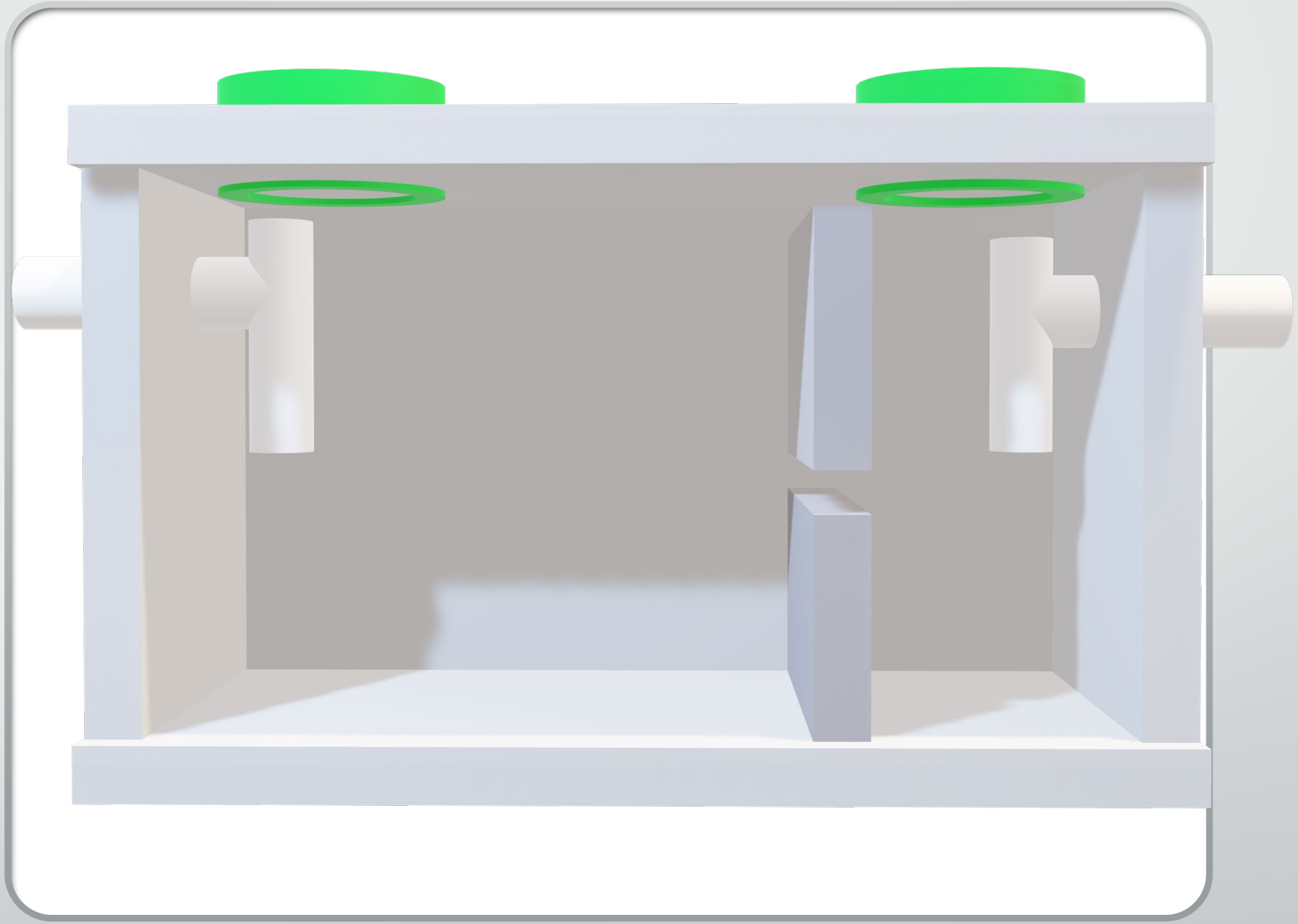
Septic Tanks

- Purpose: to Remove solids, TSS
- Provide treatment retention time, size, dimensions
- Safe, structural standard, dimensions

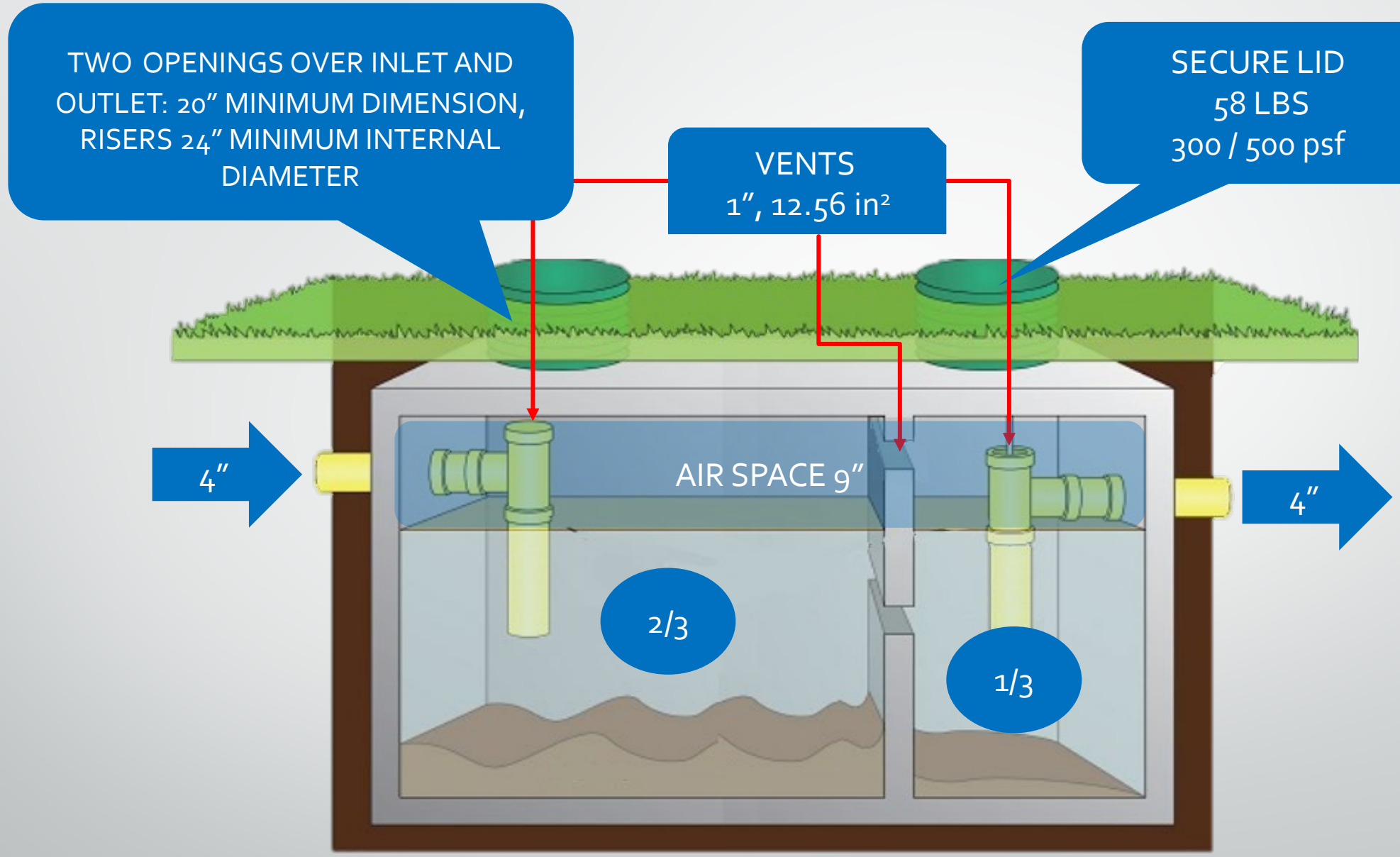
COMPLIANT SEPTIC TANK New Mexico



COMPLIANT SEPTIC TANK 3-D VIEW



PARTITION WALL OTHER DESIGNS



Tank Features

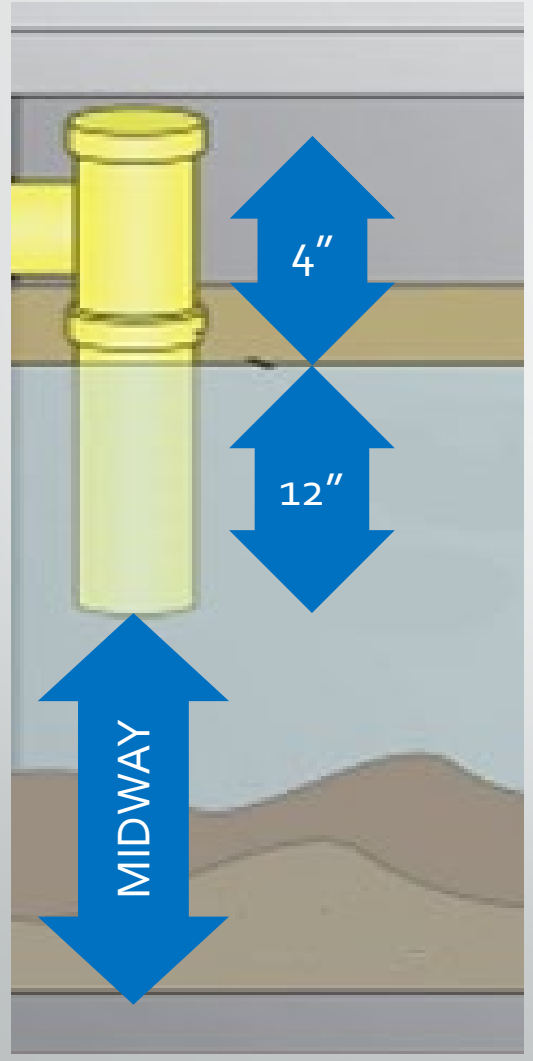
KEY VENTING FEATURES
BACK VENT OPENINGS & PARTITION VENT

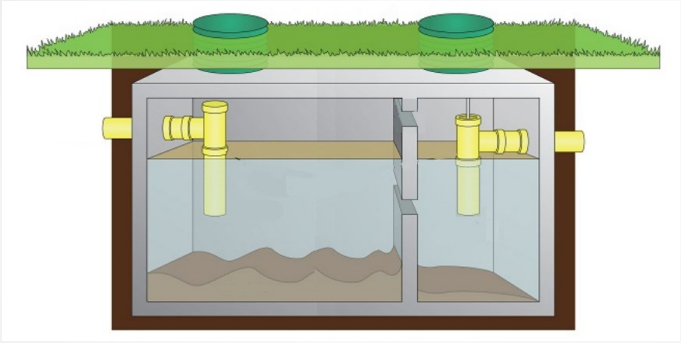
IMPROPER SPACING, MIN 1 INCH REQUIRED

1″
12.56 sq inches

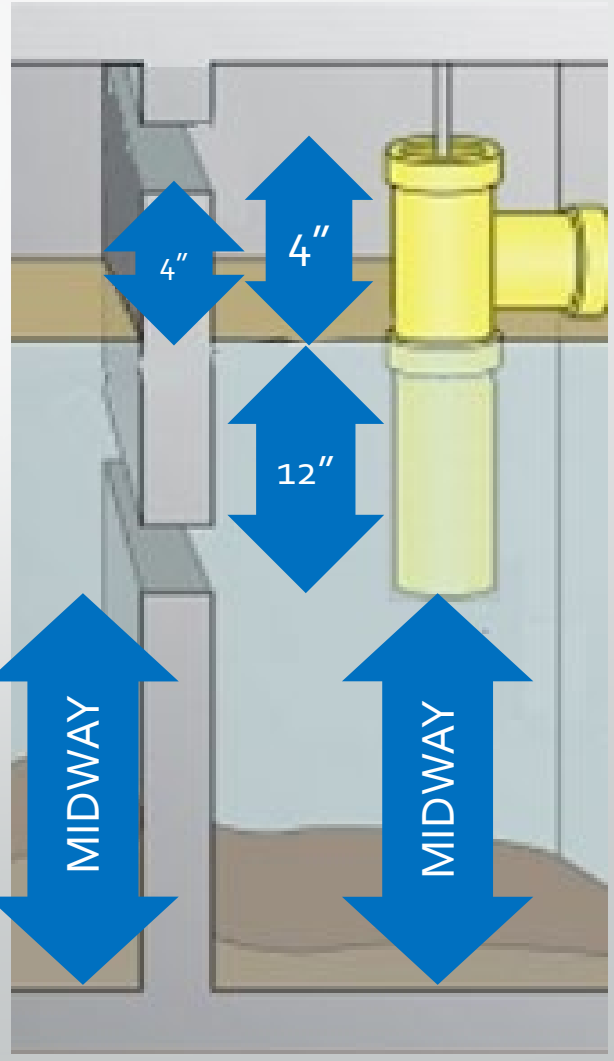
PRECAST BAFFLE FLASHING

INLET - OUTLET BAFFLE DISTANCES & PARTITION OPENING HEIGHT

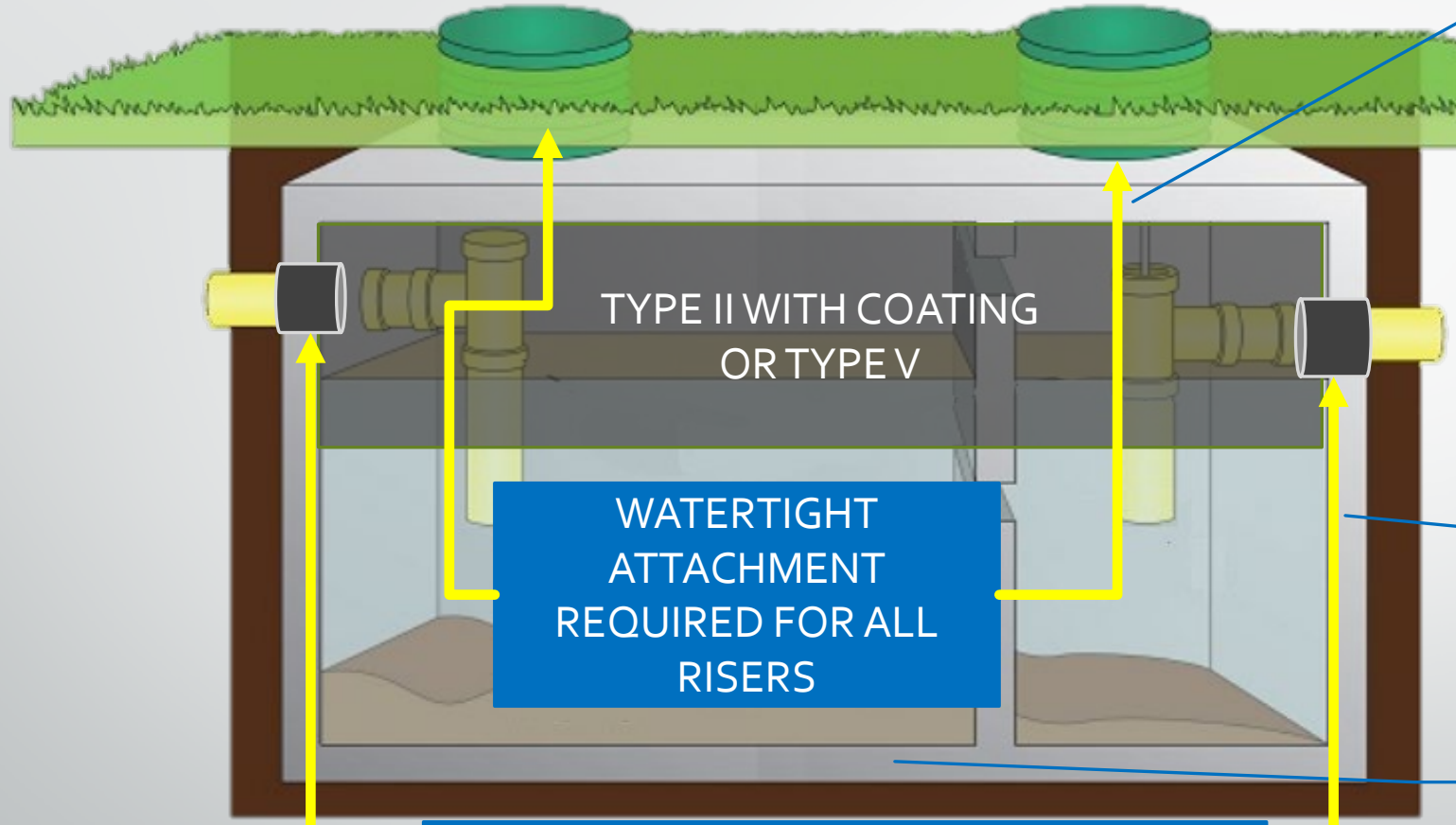




COMPLETE DIMENSIONING



Tank Walls and Slab Dimensions

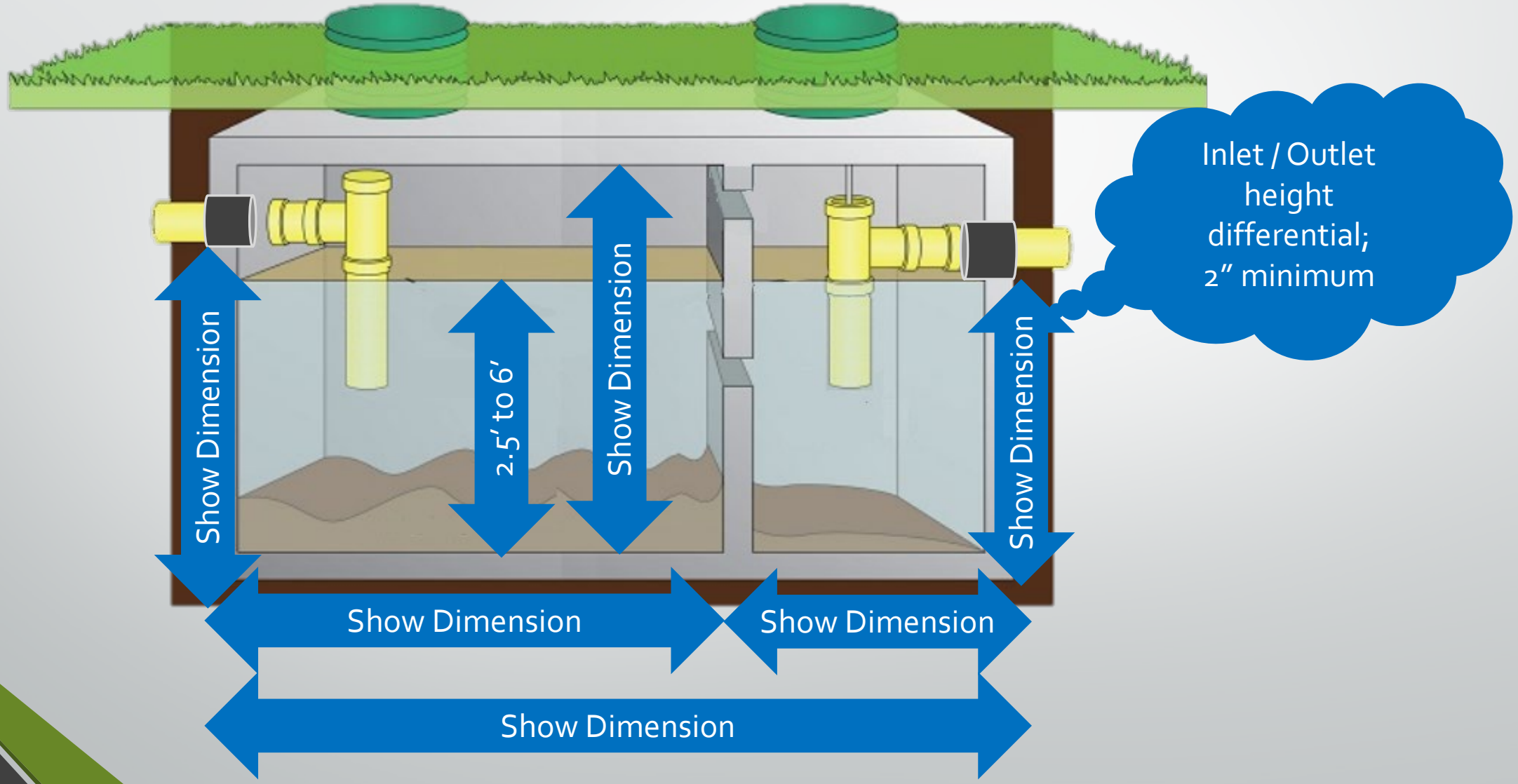


COVER
TOP SLAB
3" MIN

WALLS
2.5" MIN

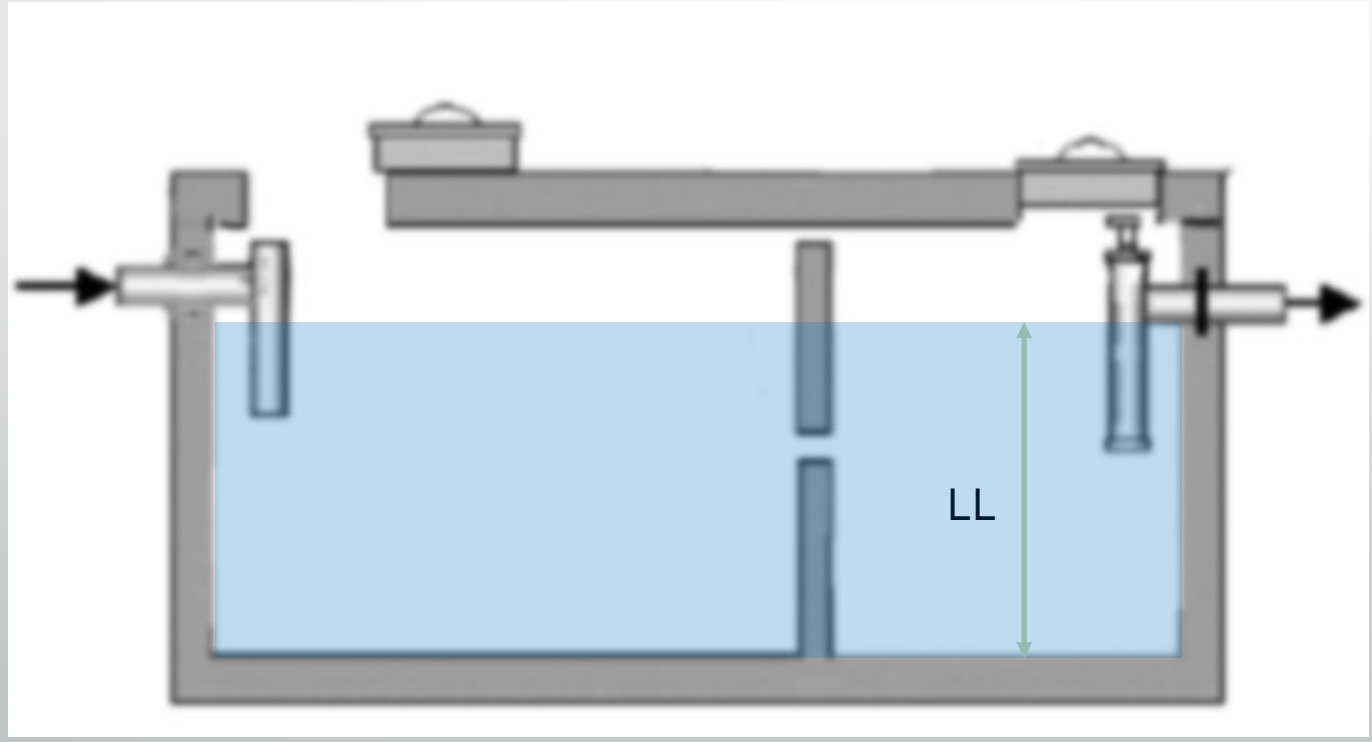
FLOOR
BOTTOM SLAB
3" MIN
MUST BE INTEGRAL
TO WALLS

Tank Internal Dimensions



Tank Liquid Volume

- Liquid Capacity, internal L x W x LL
  note: baffle does not reduce volume calculated, nominal value.

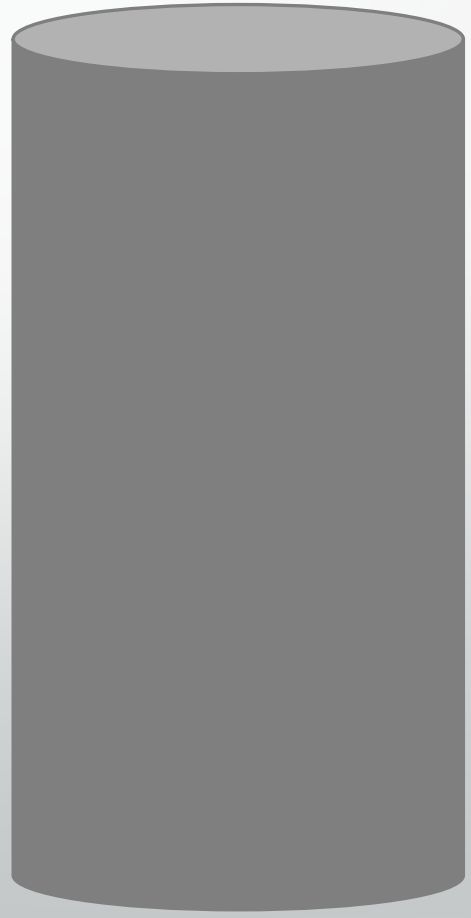


PERFORMANCE TESTING

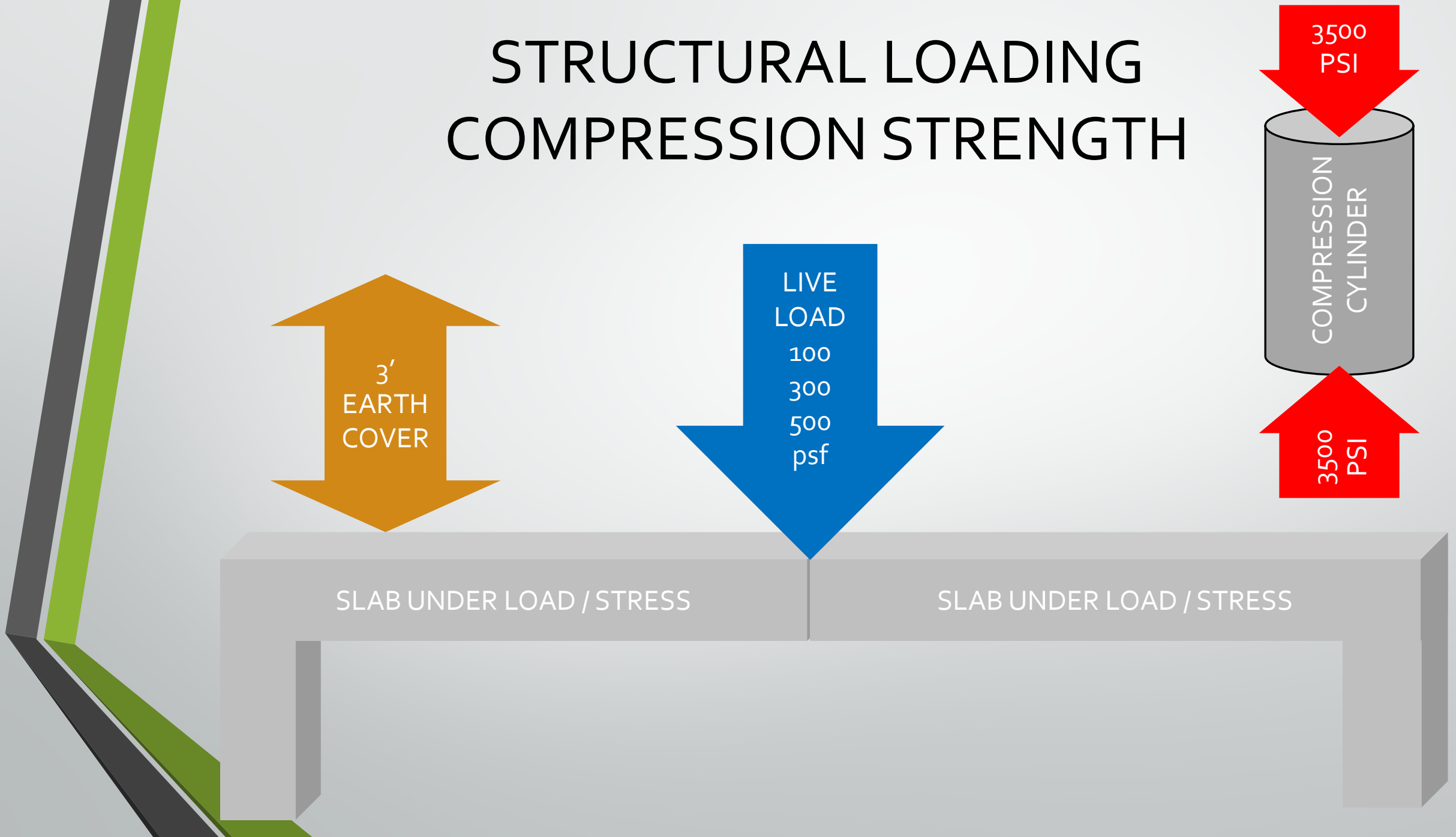
- CYLINDER TEST, MEASURES COMPRESSION STRENGTH

3,500/ 4,000 psi minimum

At what pressure does the cylinder break?



STRUCTURAL LOADING COMPRESSION STRENGTH



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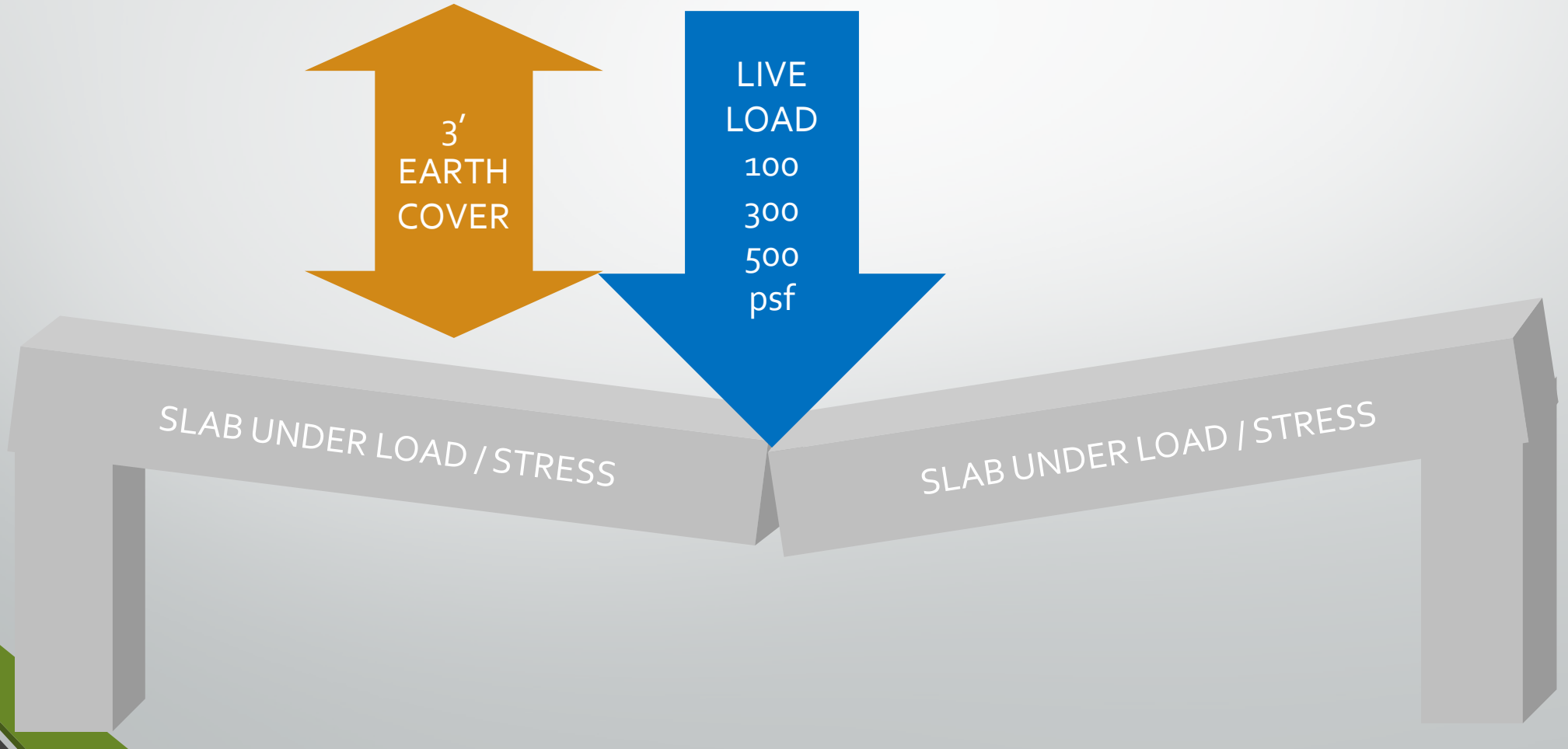
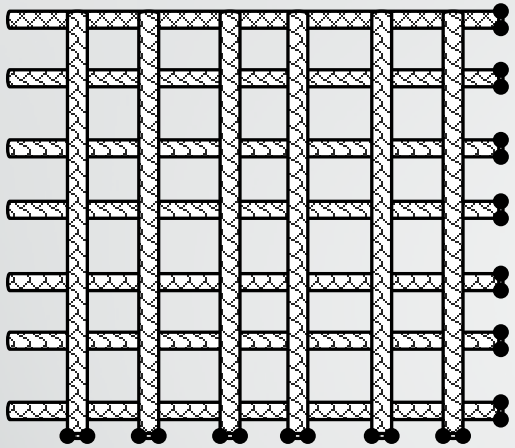


STRUCTURAL LOADING REINFORCEMENT



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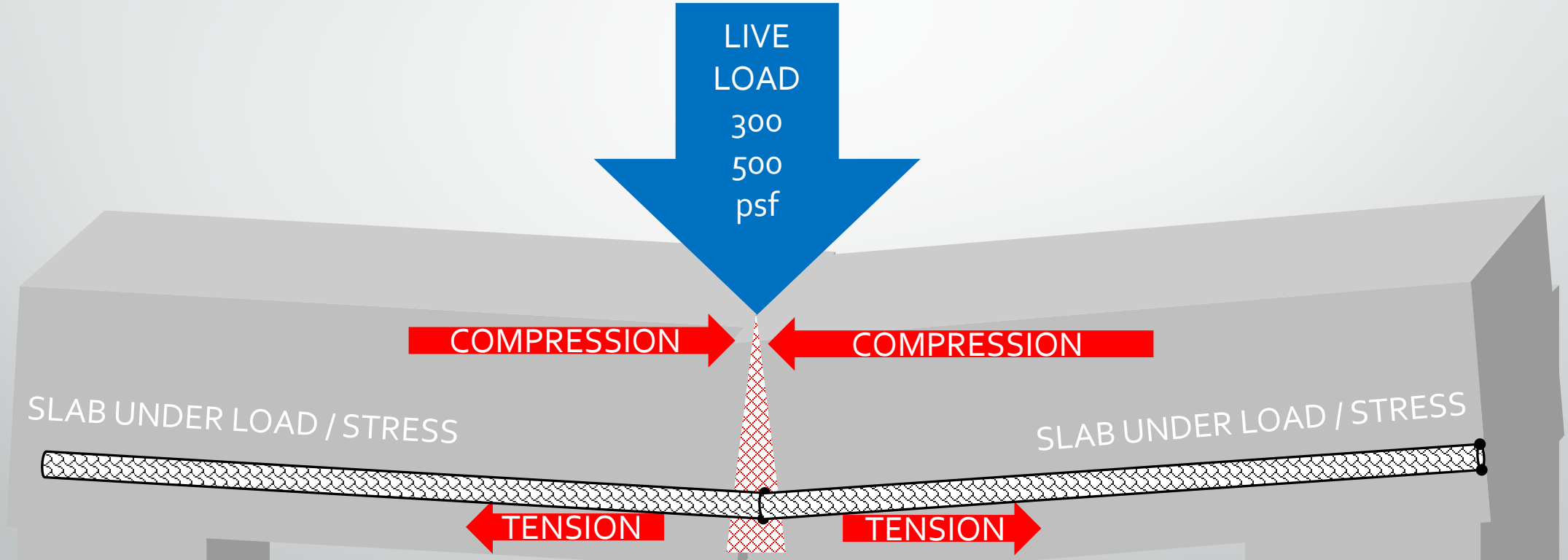
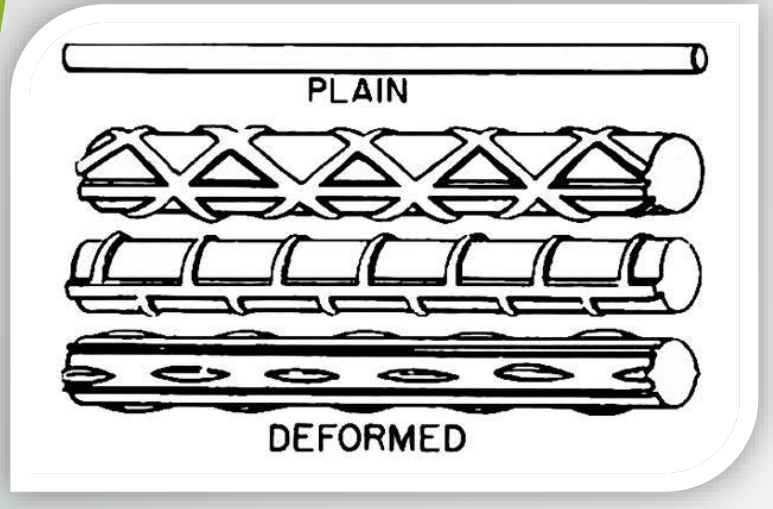


Reinforcement - Deformed Steel Bars



Point of Origin
Letter(s) or symbol(s) of producing mill

Size Designation
3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 18
[10, 13, 16, 19, 22, 25, 29, 32, 36, 42, 57]

Type of Steel
S = Carbon-Steel (A615/A615M)
W = Low-Alloy Steel (A706/A706M)
SS = Stainless-Steel (A955/A955M)
R = Rail-Steel (A996/A996M)
= Rail-Steel (A996/A996M)
A = Axle-Steel (A996/A996M)
CS = Low-Carbon Chromium (A1035/A1035M)

Minimum Yield Designation (Grade Mark or Grade Line)

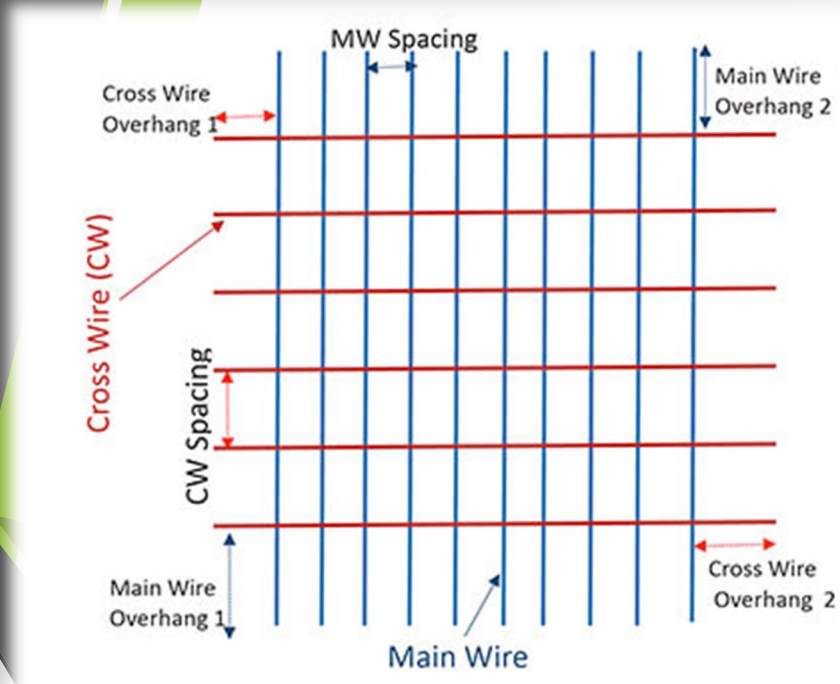
Inch-Pound Markings		Metric Markings	
60	Grade 60*	4	Grade 420*
75	Grade 75**	5	Grade 520**
80	Grade 80***	6	Grade 550***
100	Grade 100***	6	Grade 690***
120	Grade 120****	8	Grade 830****
None	Grade 40 or 50	None	Grade 280 or 350

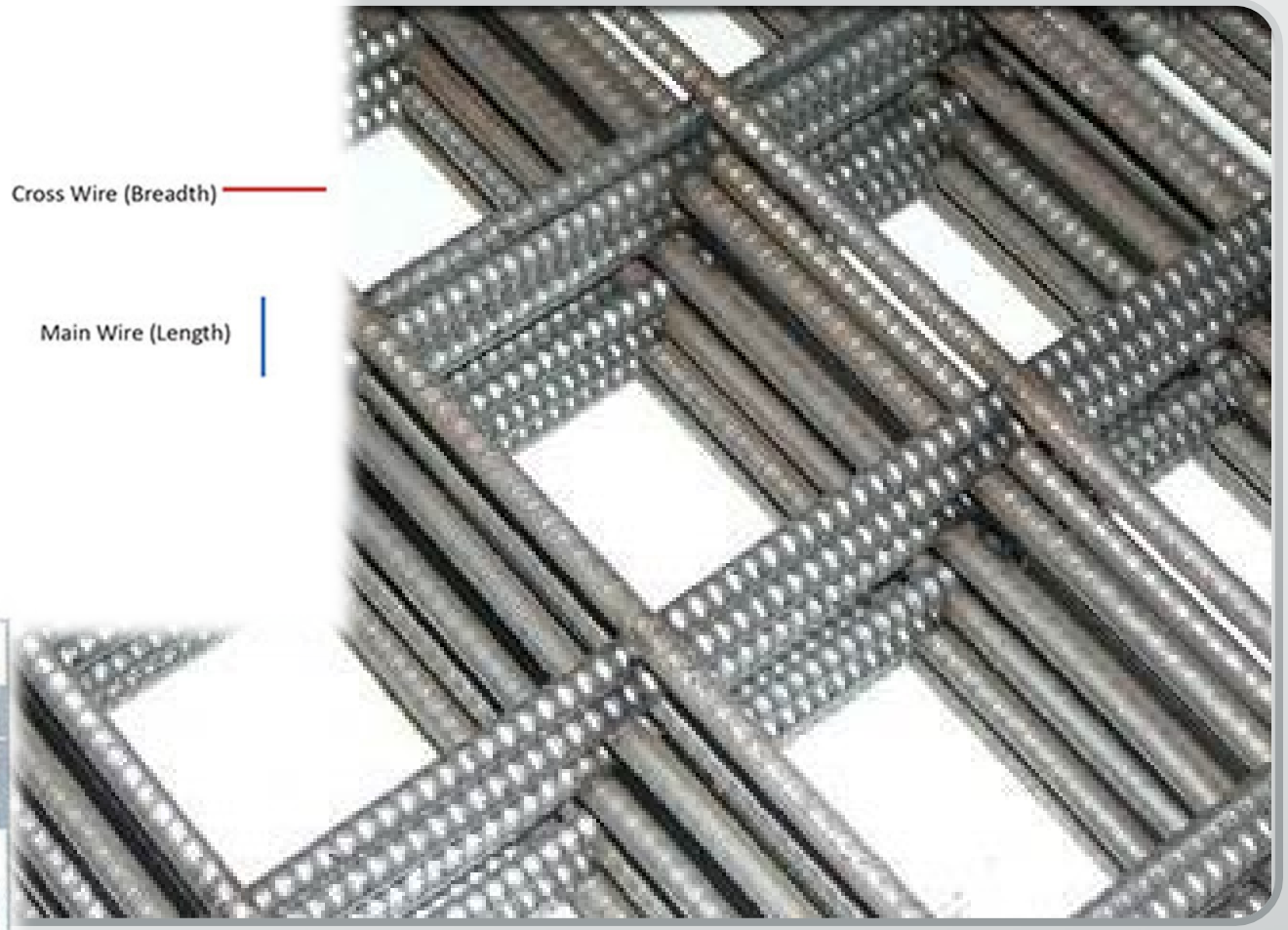
*Or 1 Grade Line / **Or 2 Grade Lines / ***Or 3 Grade Lines / ****Or 4 Grade Lines

For stainless-steel (ASTM A955/A955M) reinforcing bars:
"•" for Grade 60 [420], "••" for Grade 75 [520]

Reinforcement Grade – Yield Strength (bending and deforming under load)

		A615				Non ASTM		
		Gr 40	Gr 60	Gr 75	Gr 80	Gr 90	Gr 100 Standard	Gr 100 ductile
Physical Properties	Yield Strength (min) psi	40,000	60,000	75,000	80,000	90,000	100,000	100,000
	Yield Strength (max) psi	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Tensile Strength (min) psi	60,000	90,000	100,000	105,000	120,000	120,000	120,000
	CE							
	TS / YS Ratio							>1.20
Grade Code and Markings on Bar XX= Bar Size 3,4,5,6,7,8,9,10,11,14,18								





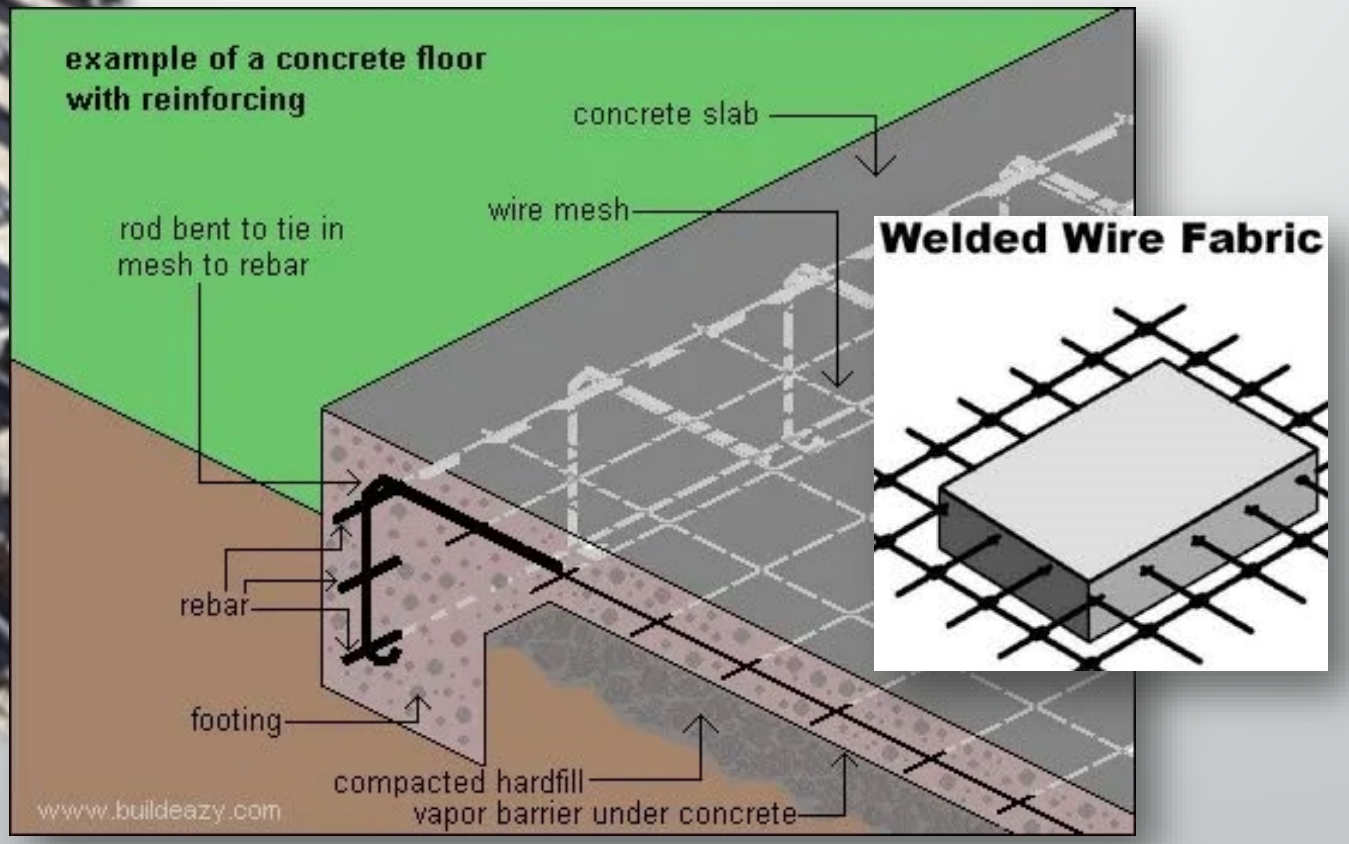
Common Styles of Welded Wire Reinforcement

Style Designation	New Designation	Old Designation (By Steel Wire Gauge)	Approx. Weight/ 100 ft.²
Sheets	6 x 6 - (D/W) 1.4 x (D/W) 1.4	6 x 6 - 10 x 10	21 lb.
	6 x 6 - (D/W) 2.1 x (D/W) 2.1	6 x 6 - 8 x 8	30 lb.
	6 x 6 - (D/W) 2.9 x (D/W) 2.9	6 x 6 - 6 x 6	42 lb.
	6 x 6 - (D/W) 4 x (D/W) 4	6 x 6 - 4 x 4	58 lb.
	4 x 4 - (D/W) 2.9 x (D/W) 2.9	4 x 4 - 6 x 6	62 lb.
	4 x 4 - (D/W) 4 x (D/W) 4	4 x 4 - 4 x 4	85 lb.
Rolls	6 x 6 - (D/W) 1.4 x (D/W) 1.4	6 x 6 - 10 x 10	21 lb.
	6 x 6 - (D/W) 2.9 x (D/W) 2.9	6 x 6 - 6 x 6	42 lb.

WELDED WIRE REINFORCEMENT DEFORMED

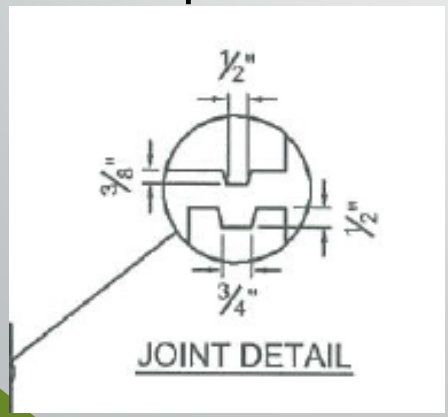
WELDED WIRE REINFORCEMENT

FLOOR AND WALL MUST BE INTERGRAL



Seams: dimensional requirements joints

- Key annular space, Greater than 50% compression



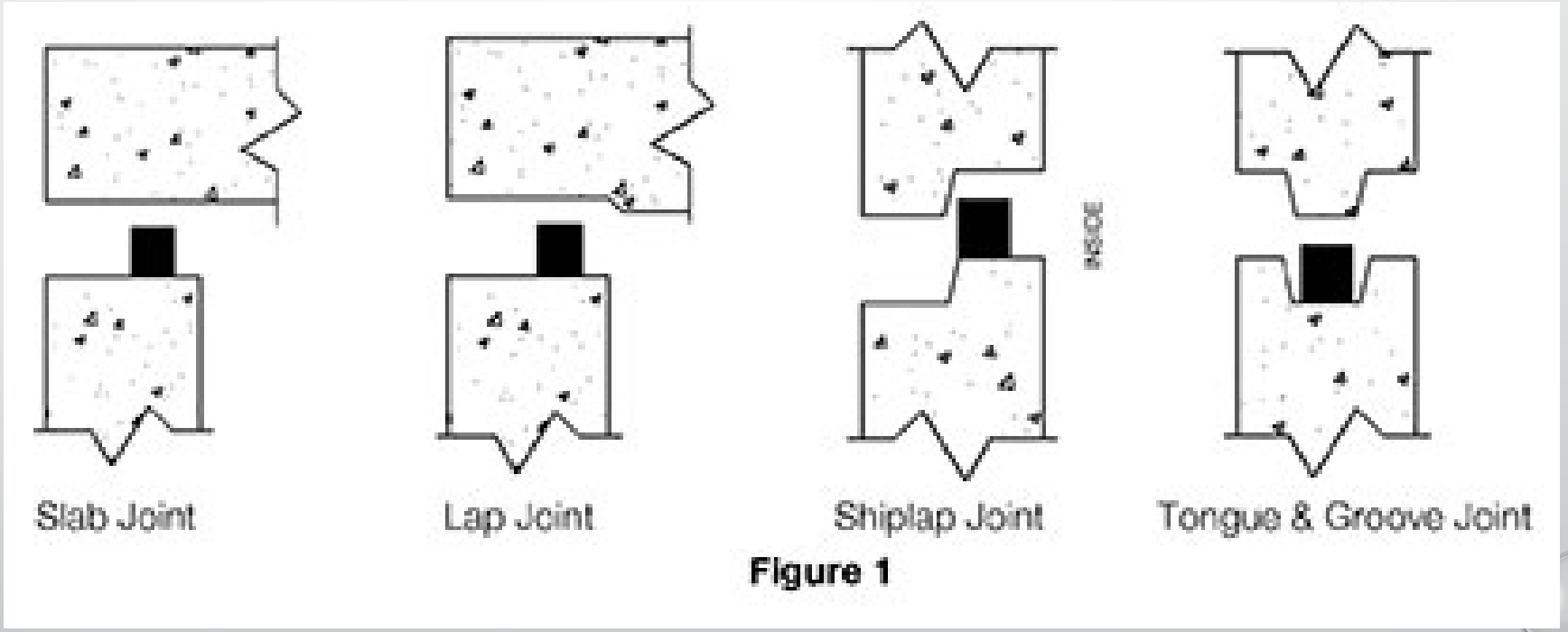
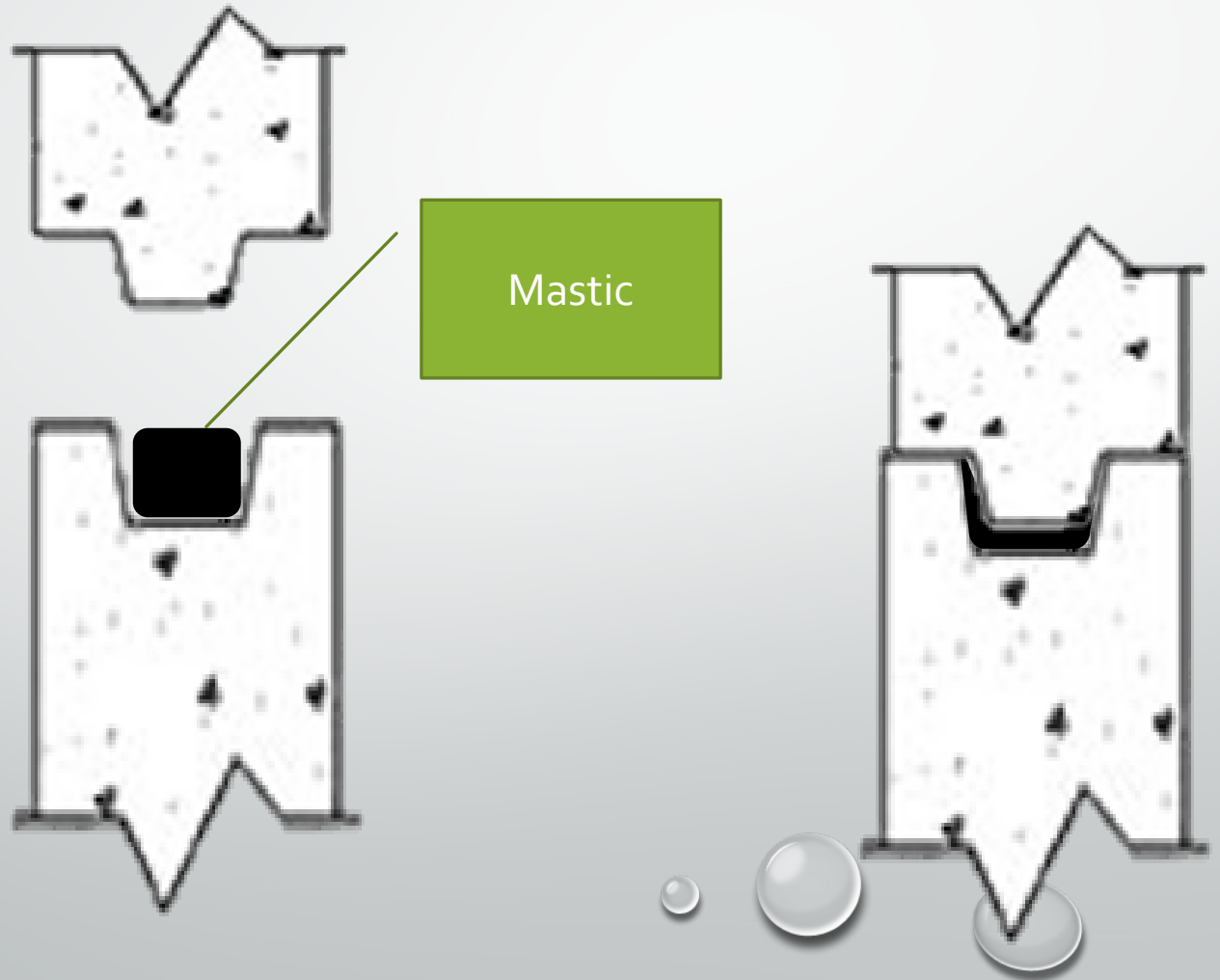
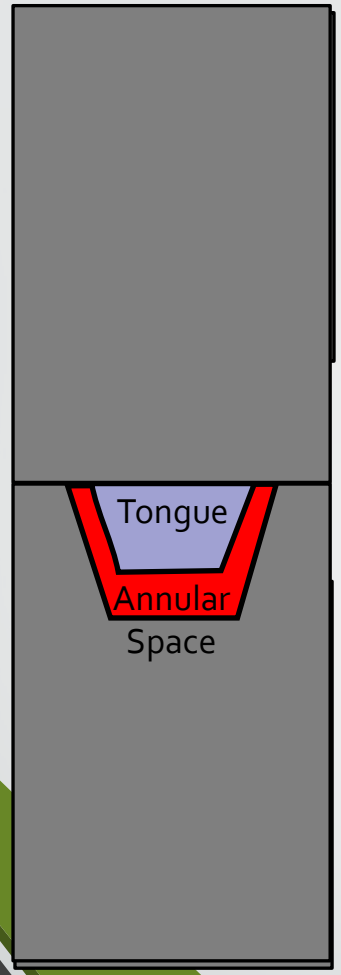


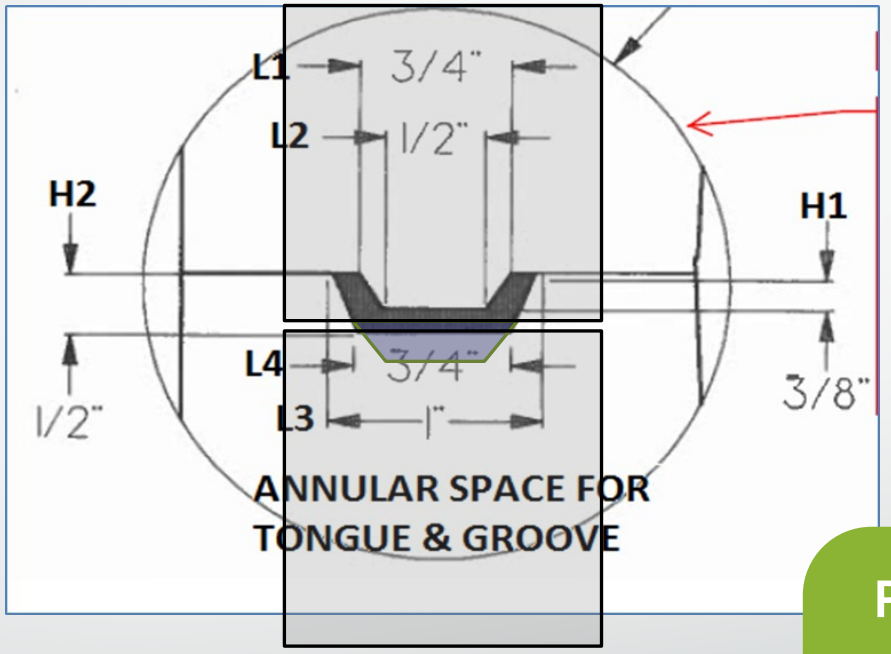
Figure 1

Seams: dimensional requirements for keyway joints and sealant



JOINT DETAIL
SEALANT PROPER SELECTION

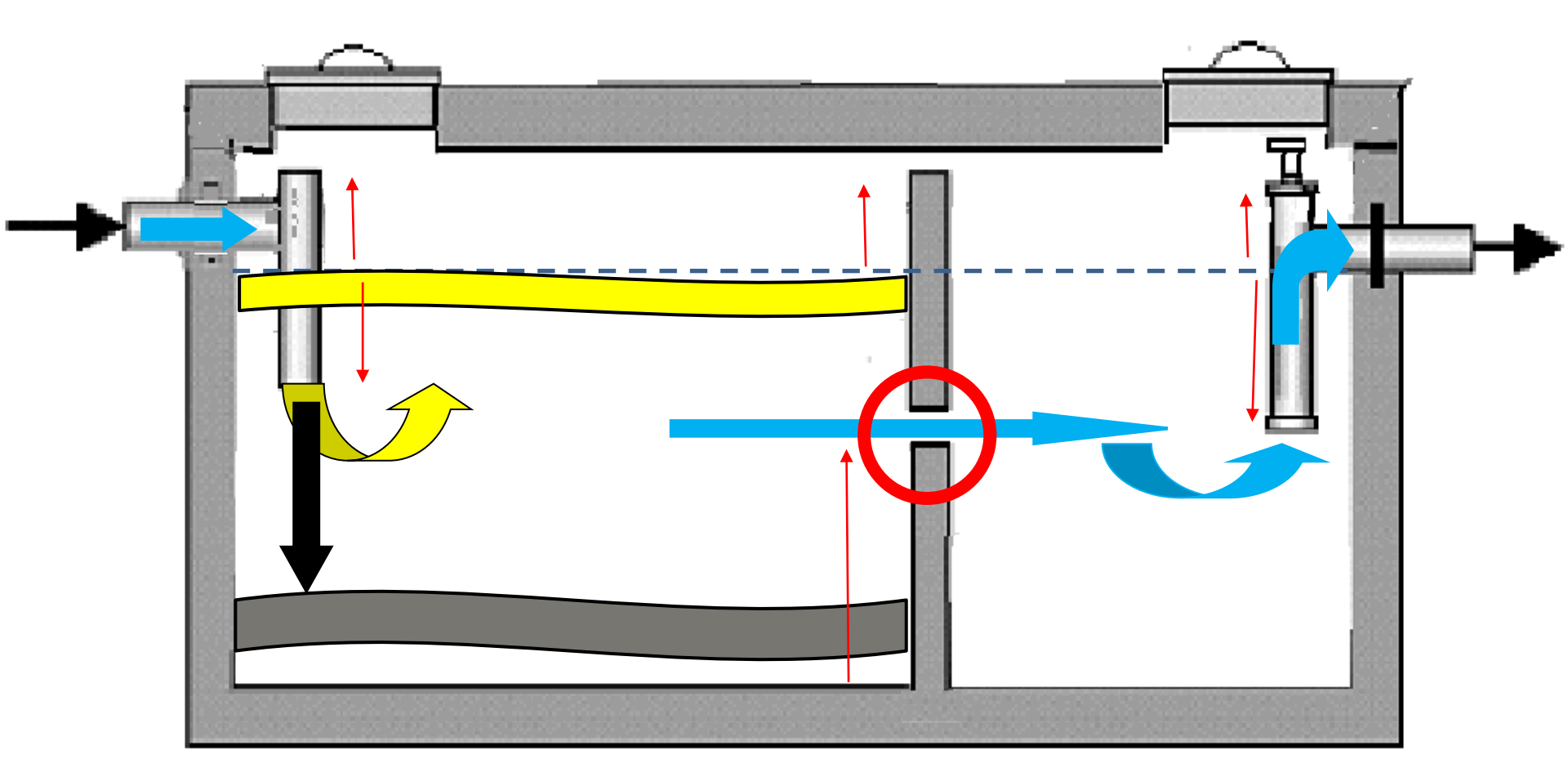




Precast Concrete Tank
Tongue and Groove Proper Seal for Water tightness

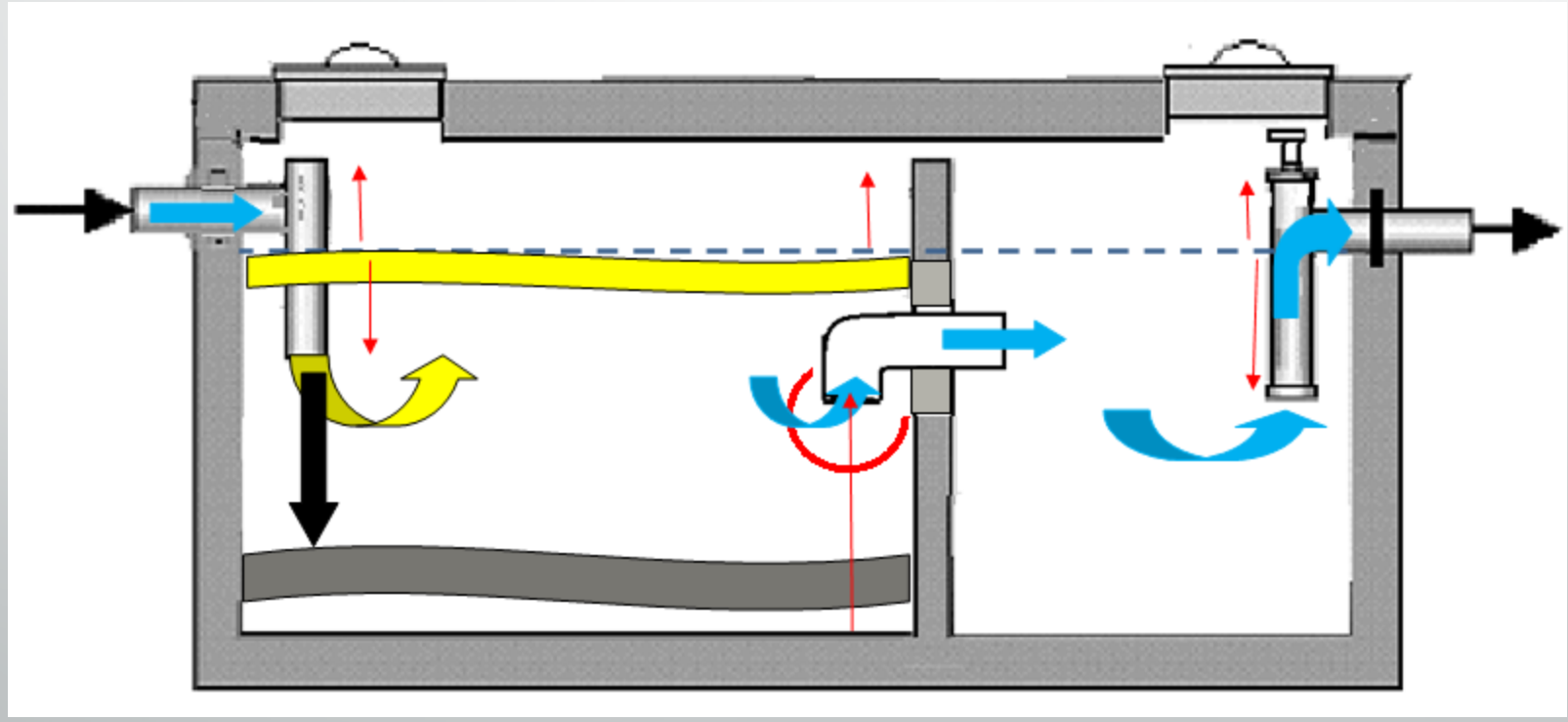
501J-3

LIQUID WASTE MOVING THRHOUGH THE TANK



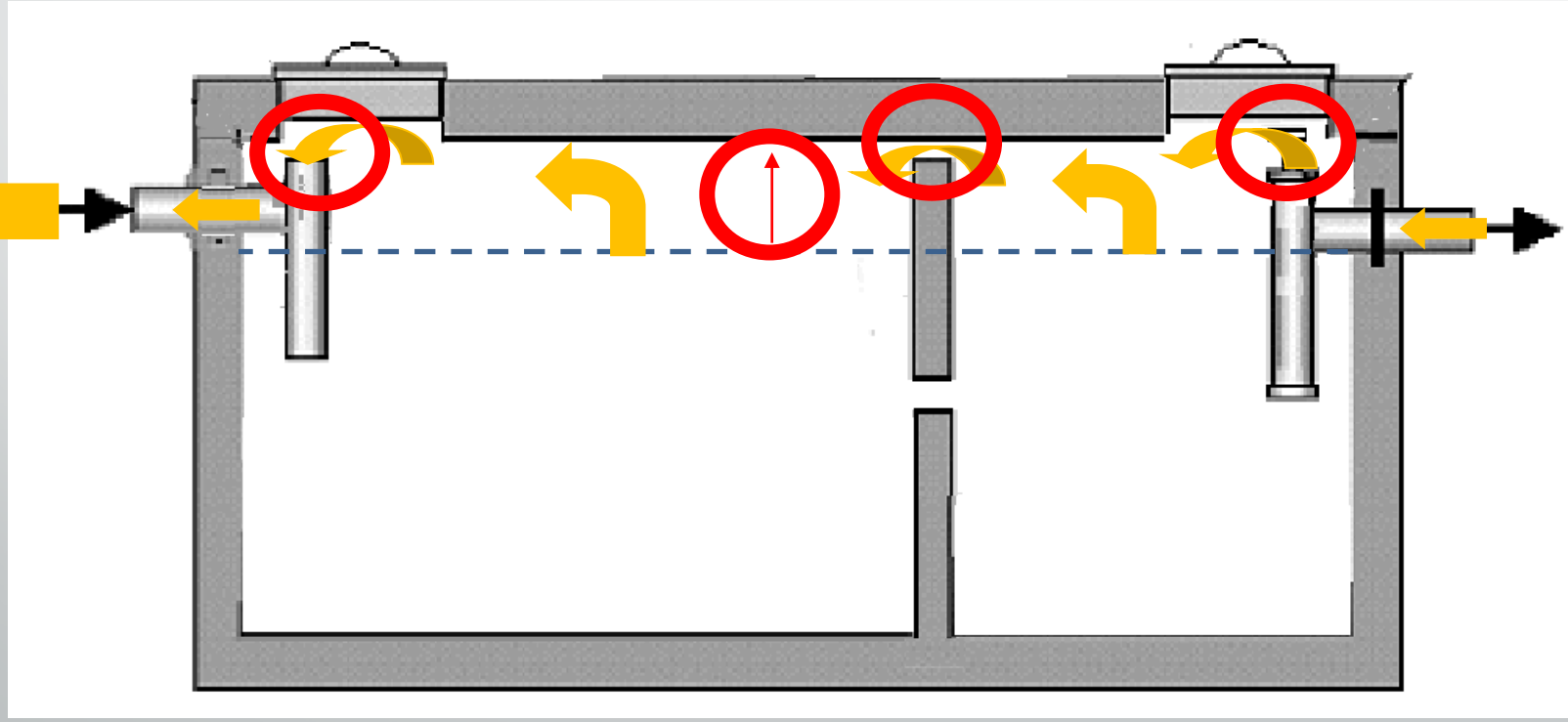
Liquid Waste Flow w/ inverted fitting!

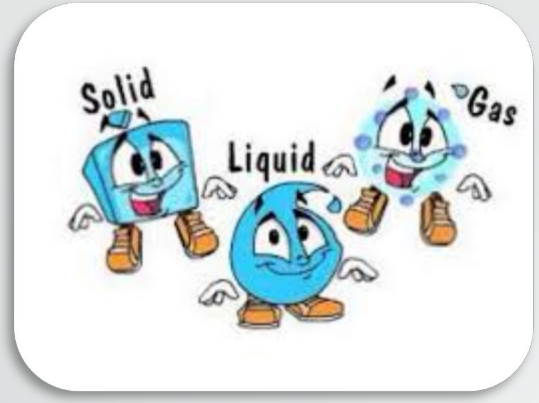
- **Remove Solids**, 1 day retention, 2.5 times Q,
- 1st Compartment 2/3, 2nd Compartment 1/3



GASSES DIFFUSING THROUGH THE TANK
Ventilation

- Diffusion of gases, passive ventilation minimum, leachfield
- Corrosion Prevention Type II or V (Coatings & Ad-Mixtures)





Three states “that matter”, for material & function

- Solids
- Liquids
- Gases, air entrainment

How do we understand septic tank construction?

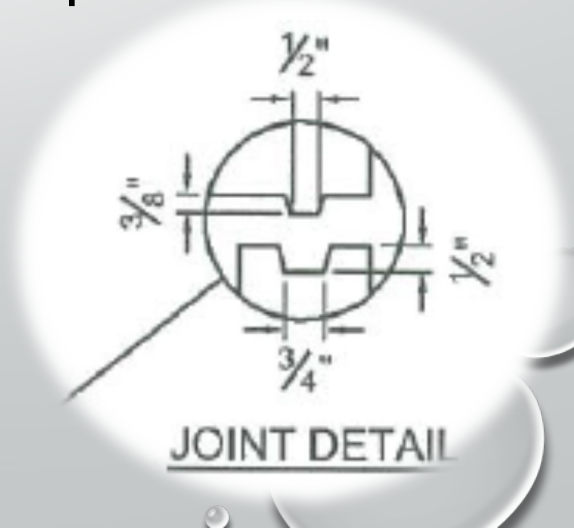
- Solids; what solids are used?
- Liquids; what liquids are used?
- Gasses; what gasses are used?

How do we understand septic tank design?

- Solids; how does the tank handle solids?
- Liquids; how does the liquids move through?
- Gasses; what does the gasses do and where do they go?

Liquids: dimensional requirements to move water through tank

- Size, how tank is sized, rated volume, liquid volume
  - Depth
- Walls, floor, cover, openings
- Two compartments 2/3 and 1/3
  - Min / Max length, width, air space
- Inlet / outlet
  - Size
  - Differential height
  - Above / below
- Partition
  - Vent
  - Transfer opening
  - Above
- Key annular space, Greater than 50% compression per sealant manufacturer



CONSTRUCTION

- CONCRETE
  - PRE-CAST
  - POURED IN PLACE, PE Design
- PLASTIC / FIBERGLASS
- METAL TANKS PROHIBITED IN NM
- HOME MADE TANKS ALLOWED UNITL 2005
  - CINDERBLOCK
  - PLASTER

Solids:
Construction materials

- Portland cement,
  - Type II (moderate sulfate resistance) or
  - Type V (high sulfate resistance)
- Sand
- Aggregate
- Reinforcement; rebar grade 40 / 60 & WWR (welded wire reinforcement)
- Joint sealant
- Pipe to pre-cast concrete seal

Solids
Basic Ingredients

- Solids

Type II **Type V**

ASTM C-33

Grade 40/60 min

Solids

Solids, pre and post casting
Seals, Boots, Coatings & Ad-mixtures

ASTM

ASTM C-990

Bituminous

Liquids; Basic Ingredients

- Liquids
  - Clean water
  - Additives, approved
  - Form Release

ADMIXTURE

Form Release: liquid

- ASTM Standard
  - Not transmission fluid
  - Not other oils
  - Must meet specification

Gasses: dimensional requirements to move gasses through tank

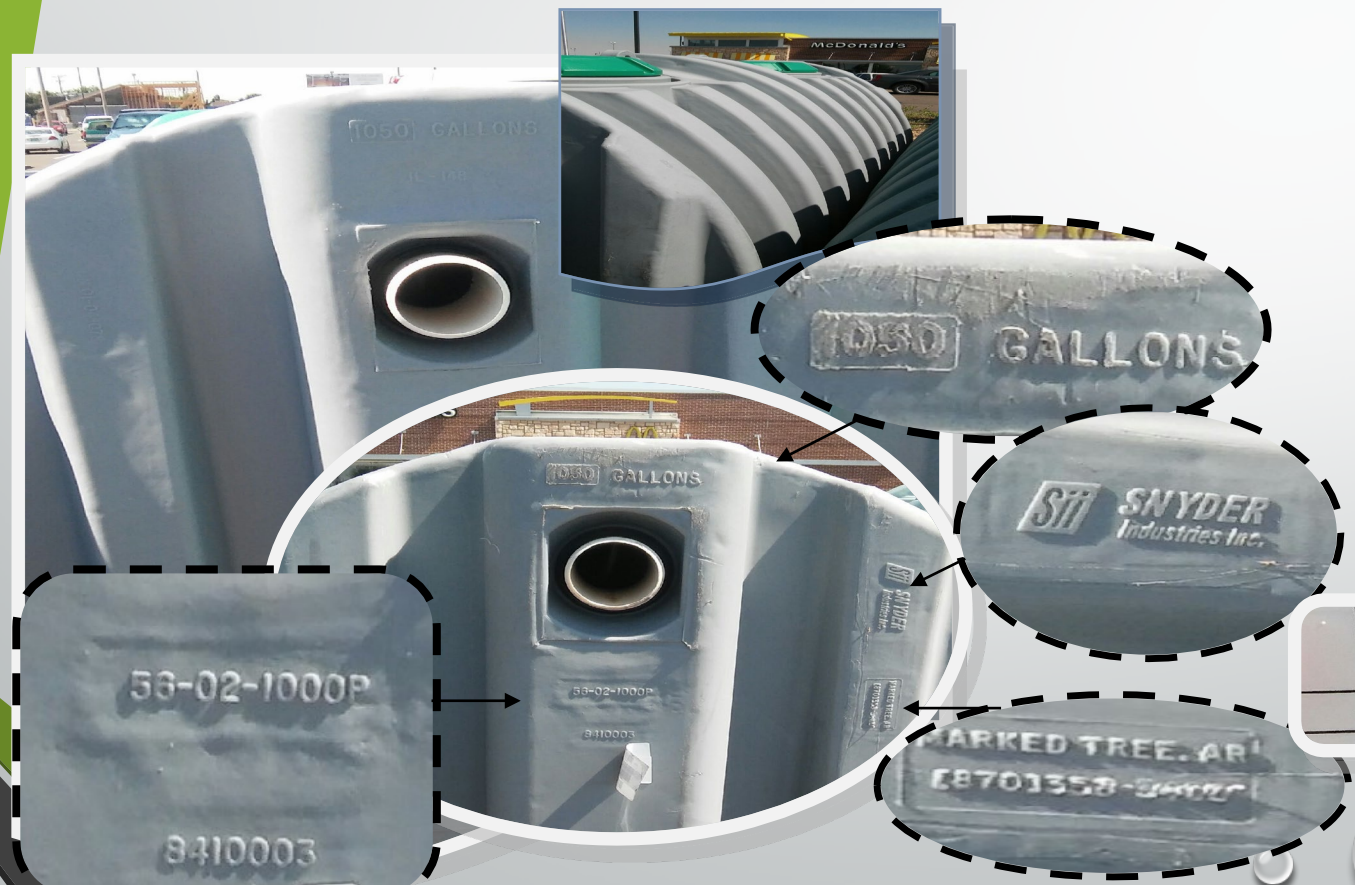
Gasses: diffusion	
Headspace, air space: 9” min	
Back vent opening inlet/ outlet	• 1”, cross sectional area
Cover, openings	• 20” min dimension, Corrosion signs
Two compartments 2/3 and 1/3	• Min / Max length, width, air space
Inlet / outlet	• Size, Above / below: 4” / 12”
Partition	• Vent, none, concrete flashing, too small

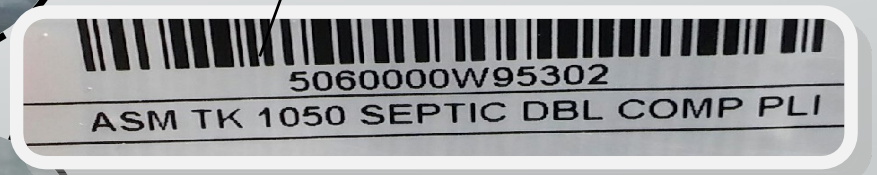
Material Specifications
Letters of Certification

- Manufacturer certifies that product meets or exceeds specific ASTM, ANSI, IAPMO, standards
- Beware of letters that only say a product was tested and passed one specific test, spec may call for additional testing to meet specification.

MARKINGS: IAPMO Approved tank

Good morning,
I spoke to you about the problem we are having to get our septic tank approved by NMED because we bought it at Lowes. I have attached all the info. Can you please let me know as soon as possible if this type of tank is allowed?





MARKINGS

- NMAC
- IAPMO
- ASTM

Septic tank Inspections

- Design Review
- File Audit
- Production Facility
- Installation Inspection

Septic tank …..
…Design Review issues

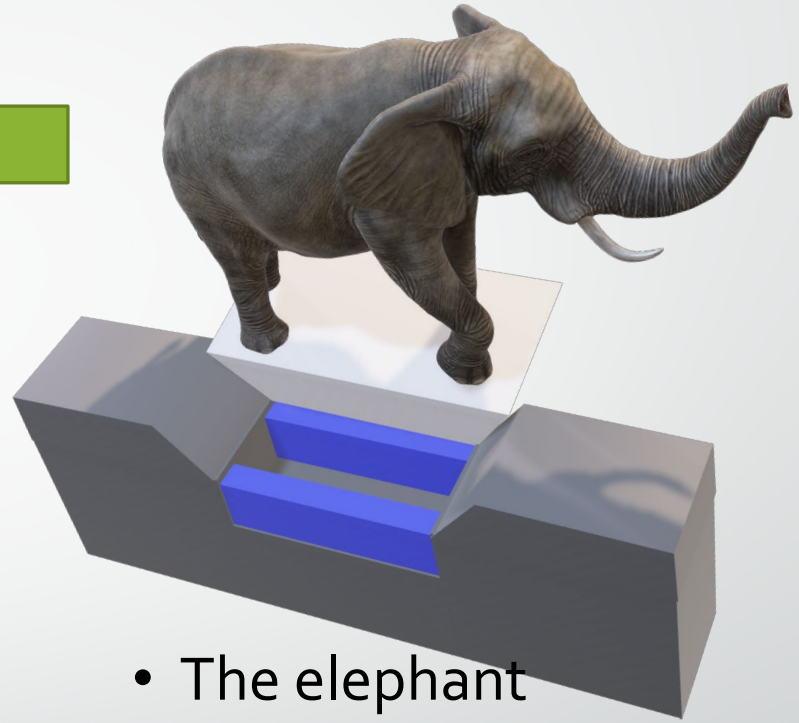
1. Incomplete dimensioned or no reinforcement plan
2. Cover depth not specified
3. Traffic rating, H10, H20
4. Product Specs from manufacturer
5. Supplier list, who supplies certified material?

Case Study #1

Venting is the most common problem,

- A tank manufacturer that also installs and evaluates systems for property transfers.
- Fails systems installed 3 years earlier because tank is deteriorating.
- Replaces their own 3-year-old precast tank with the same model precast tank.
- Facility inspection revealed no vent present in partition wall.
- Manufacturer pointed to partition transfer opening and stated, “there is the vent!”
- The plan had no dimension for the partition vent

Case Study #2, Partition Venting



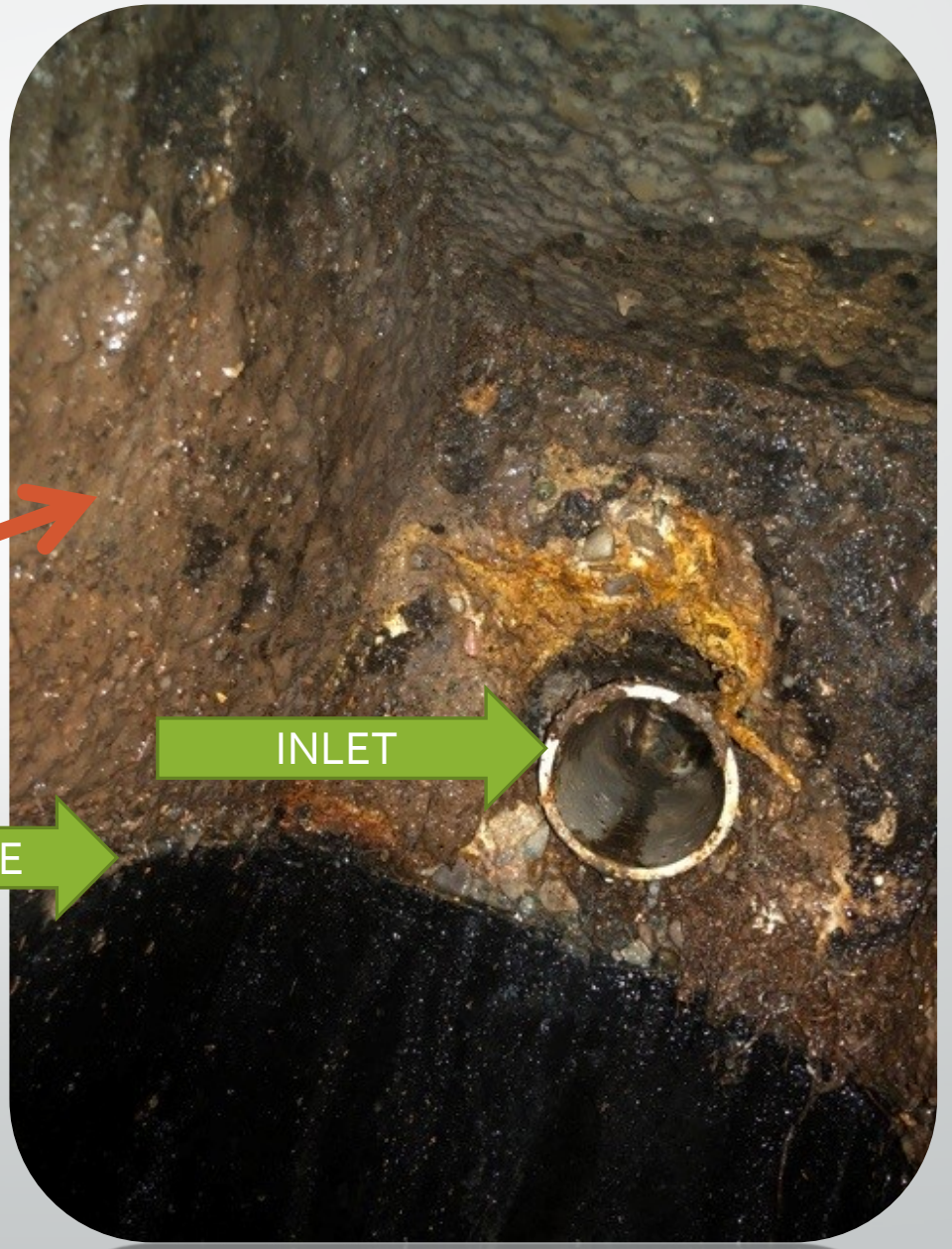
- The elephant in the vent!

concrete flashing that blocks the vent. Any reduction to the minimum required square inches of opening decreases venting. A minimum of 12.56 square inches is required, or a 2" x 6 3/8" dimensioned opening.

Case Study #3

Flashing & Coating

- Vents blocked by flashing
- Department found many older system with excessive corrosion
- Outlet cover deteriorating
- Type II Portland cement tanks not coated
- Manufacturer "the Department must inform us when the rules are changed!"



Case Studies #4 & 5

Certified Material

- A pour in place tank, design review
- Manufacturer did not want to provide supplier list.
- Manufactured refused to provide material specifications.
- Specs for Portland cement, compression testing, reinforcement material
- Manufacturer argued that the Department would never know if specified material was used.
- Two 5,000 gallon tanks poured in place.
- Both tanks leaked, owner crushed and abandoned use of system within 6 months of install

Reinforcement

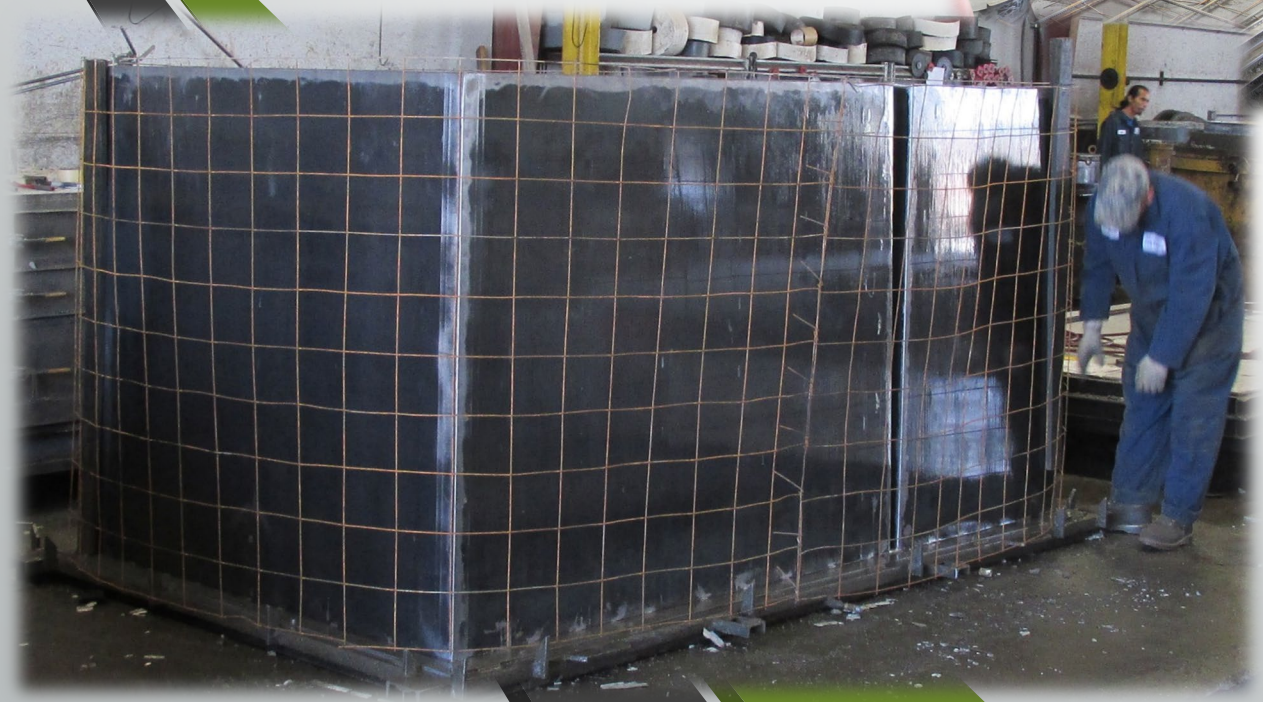
- Tank manufacture replaced all reinforcement with fiber.
- Ready mix truck driver told him he did not need any wire or metal because the fiber provides a 5000 psi mix.
- Manufacturer "the psi is higher!"

NM Design Review File Audit (71 files audited)

- 57 manufacturers, 180 approved plans
- 86% (61/71) had a PE stamped plan
- 42% (30/71) had a PE stamped calculation sheet, 58% had no calculation sheet
- 72% (19/71) had a structural reinforcement plan stated on the drawing
- 27% (19/71) had cover depth stated on plan drawing.

Operational Inspection
Installation Inspection

Operational Inspection



Questions?