

# ***Heat Stress Abatement in Naturally Ventilated 4-Row Freestall Barns (Head to Head Stalls) Using TeeJet® Turbo Jet Nozzles***

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## ***Facts on Heat Generation***

- Cows produce about 4,500-6,000 BTU's per hour depending on the level of milk production
- A cow's heat production is similar to a 1,500 W hair dryer during a one-hour period
- The heat produced by a cow in one day is equivalent to the heat produced when 1.2 gallons of propane is burned

## ***Management strategies to reduce heat stress in freestalls***

- Open sidewalls and ridge row to maximize natural ventilation.
- Use a soaker over the feed line.
- Increase soaking frequency with temperature.
- Adding fans has little benefit unless a good soaker system is installed first.
- Place single row of fans over feed line and freestalls with head to head stall arrangements (Figure 1).
- Maintain a minimum of 150 ft open space between buildings with 4-row freestalls.

## ***Enhancing Natural Ventilation***

- 14 sidewalls (measured above concrete stem wall or curb) with at least 80 percent opening
- 4/12 roof slope
- Ridge row should be open a minimum of 2 inches per 10 feet of building width

## ***Fans Specifications***

- Post Spacing 24 ft to 30 ft: One 36-inch fan per post spacing
- Post Spacing less than 20 ft: One 48-inch fan every other post
- Ideal distance between rows-20-24 feet for 36-inch fans and 30-36 feet for 48-inch fans
- Fan Location: (See Figure 1)
  - Head to head freestalls: one row of fans
  - Feed Line – one row of fans
- Mounting Height – bottom of the fan as low as possible allowing adequate head space to operate equipment (7 to 8 feet from the ground to the bottom of the fan is ideal)
- Mount fans such that air flow is with prevailing winds
- Thermostat turns fans on when barn temperature reaches 70°F

## ***Soaker System***

- Approximate system capacity = .33 gallons per cow per cycle
- Thermostat turns soakers on when pen temperature reaches 70°F
- Soaking Frequency
  - 70-80 °F Every 15 minutes
  - 81-90 °F Every 10 minutes
  - > 90 °F Every 5 minutes
- On time per cycle will depend on the nozzle size and will generally be 1 to 2 minutes
- Mounting height – 6 to 12 inches above top of the headlocks or 5-6 ft above floor
- Pressure in distribution line should be 15 to 20 psi.
- Spacing between nozzles, 6-8 feet
- The size of the water source line and the distribution line will be dependent on the nozzle size, spacing between nozzles and the length of the distribution line (Table 1 and 2).

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- Different examples of plumbing the distribution lines are in Figures 3,4 and 5.
- Pictures of plastic and brass TeeJet® nozzles can be viewed in Figure 6.
- Nozzles need to have check valves to prevent the distribution line from draining after each cycle.

### ***Utilities Required***

- Electrical service for additional fans – ¾ kVA per fan horsepower
- Water supply – 1 gallon per 10 cows per cooling cycle

### ***List of Suppliers***

Nozzles

<http://www.teejet.com/products/nozzles.htm>

### ***Plastic TeeJet® Adapter and Cap (Nozzle)***

**QJ8360-NYB** – Quick TeeJet system (Adapter)

**25600-4-NYR** – Quick TeeJet cap for above adapter

### ***Brass TeeJet® Parts (Nozzle)***

**CP1322**- Body

**CP1325** - Cap

**4193A-10-24SS** - Check Valve

### ***Plastic TeeJet® Tips for both the plastic and brass nozzles (Turbo FlodJet Tips)***

**TF-VP-5** (.6 gal/min at 15 PSI)

**TF-VP-7.5** (.85 gal/min at 15 PSI)

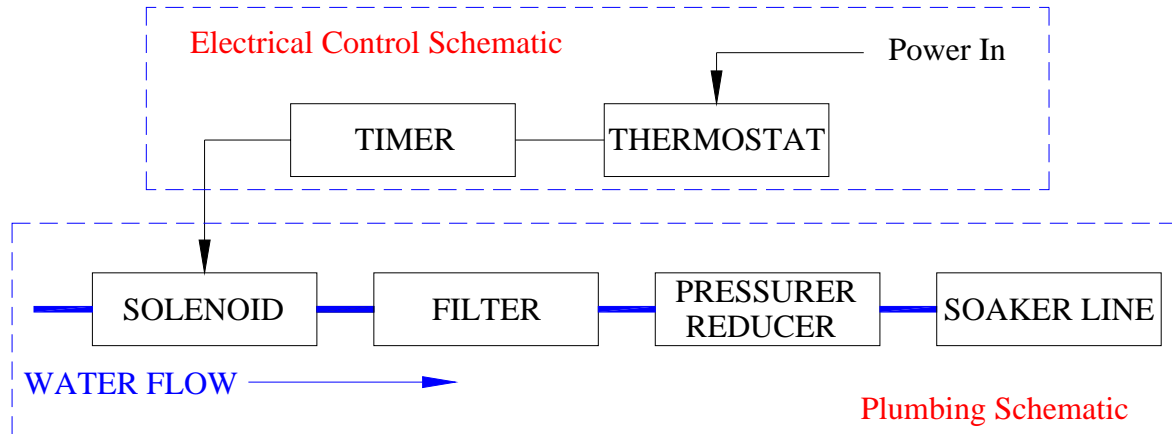
Controllers

[http://www.agselect.com/ED/showprod.cfm?&DID=11&CATID=2&ObjectGroup\\_ID=4](http://www.agselect.com/ED/showprod.cfm?&DID=11&CATID=2&ObjectGroup_ID=4)

<http://www.meter-man.com/agprods.html>

<http://www.farmtek.com/>

## Schematic of Electrical Control and Plumbing



## References

- Brouk, M.J., J.F. Smith, and J.P. Harner, III. 2003. Effect of sprinkling frequency and airflow on respiration rate, body surface temperature and body temperature of heat stressed dairy cattle. *Proc of Fifth International Dairy Housing Conference*, Fort Worth, TX, pp 263-368.
- Brouk, M.J., J.F. Smith, J.P. Harner III, and S.E. DeFrain. 2001. Effect of Fan Placement on Milk Production and Dry Matter Intake of Lactating Dairy Cows Housed in a 4-Row Freestall Barn. *KSU Dairy Day Report of Progress* 881:4-10.
- Brouk, M.J., J.F. Smith, J.P. Harner III, B.J. Pulkrabek, D.T. McCarty, and J.E. Shirley. 1999. Performance of Lactating Dairy Cattle Housed in a Four-Row Freestall Building Equipped with Three Different Cooling Systems. *KSU Dairy Day, Report of Progress* 842:23-27.

Table 1. Recommended pipe diameter for different nozzle capacities based on feed line length. The nozzle capacity influences the time required to apply 0.05 inches of water per on-cycle.

	<b>NOZZLE CAPACITY (gallons per minute)</b>						
<b>Pipe Diameter (inches)</b>	<b>0.5 gpm</b>		<b>0.75 gpm</b>		<b>1.0 gpm</b>		<b>Inlet Water Demand (gpm)**</b>
	Feedline Length (feet)	Number of Nozzles*	Feedline Length (feet)	Number of Nozzles*	Feedline Length (feet)	Number of Nozzles*	
1.00	200	25	140	18	100	12	12
1.25	320	40	210	25	160	20	20
1.50	480	60	320	40	240	30	30
2.0	800	100	530	70	400	50	50
2.5	1600	200	1000	125	800	100	100
On Cycle for 0.05 in	2.5 minutes (150 seconds)		1.7 minutes (100 seconds)		1.25 minutes (80 seconds)		

\* Assume nozzle spacing is 8 feet on center using the agricultural spray nozzles with a minimum of 20 psi pressure at the outlet of the nozzle.

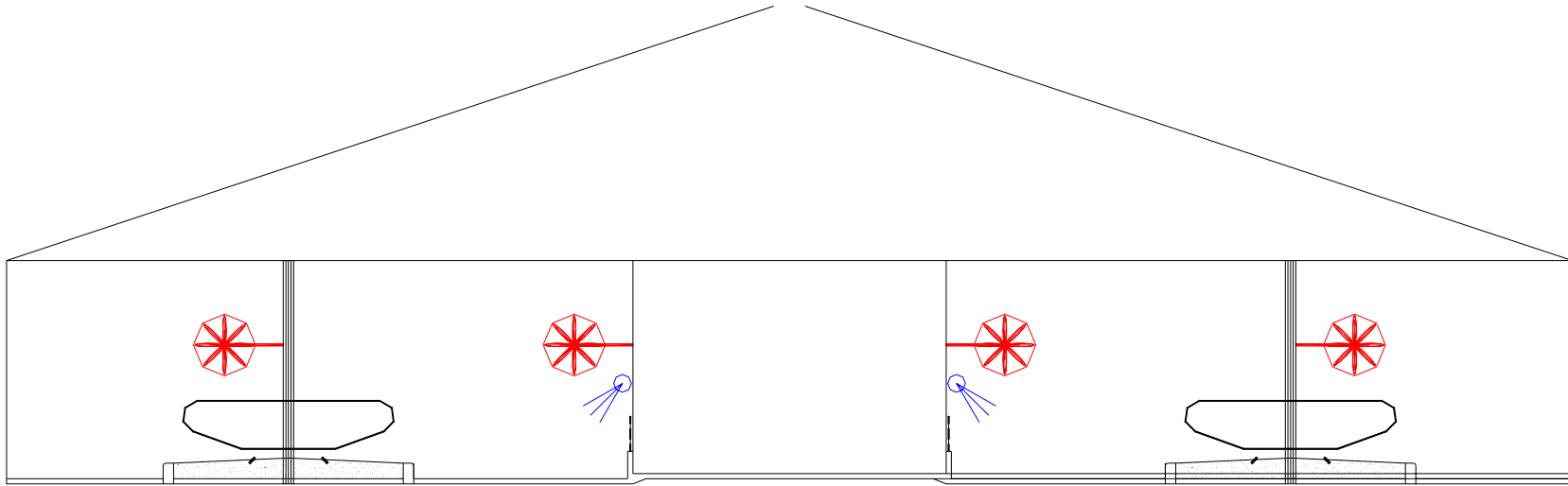
\*\* Water demand based on a maximum of 5 feet per second flow velocity in the pipe.

Table 2. Impact of spacing between nozzles on inlet water demand (gallons).\*

	<b>Spacing Between Nozzles</b>			
<b>Feedline Length (feet)</b>	<b>8 feet</b>	<b>7 feet</b>	<b>6 feet</b>	<b>5 feet</b>
100	12	14	17	20
160	20	23	27	32
240	30	34	40	48
400	50	57	67	80
800	100	114	113	160

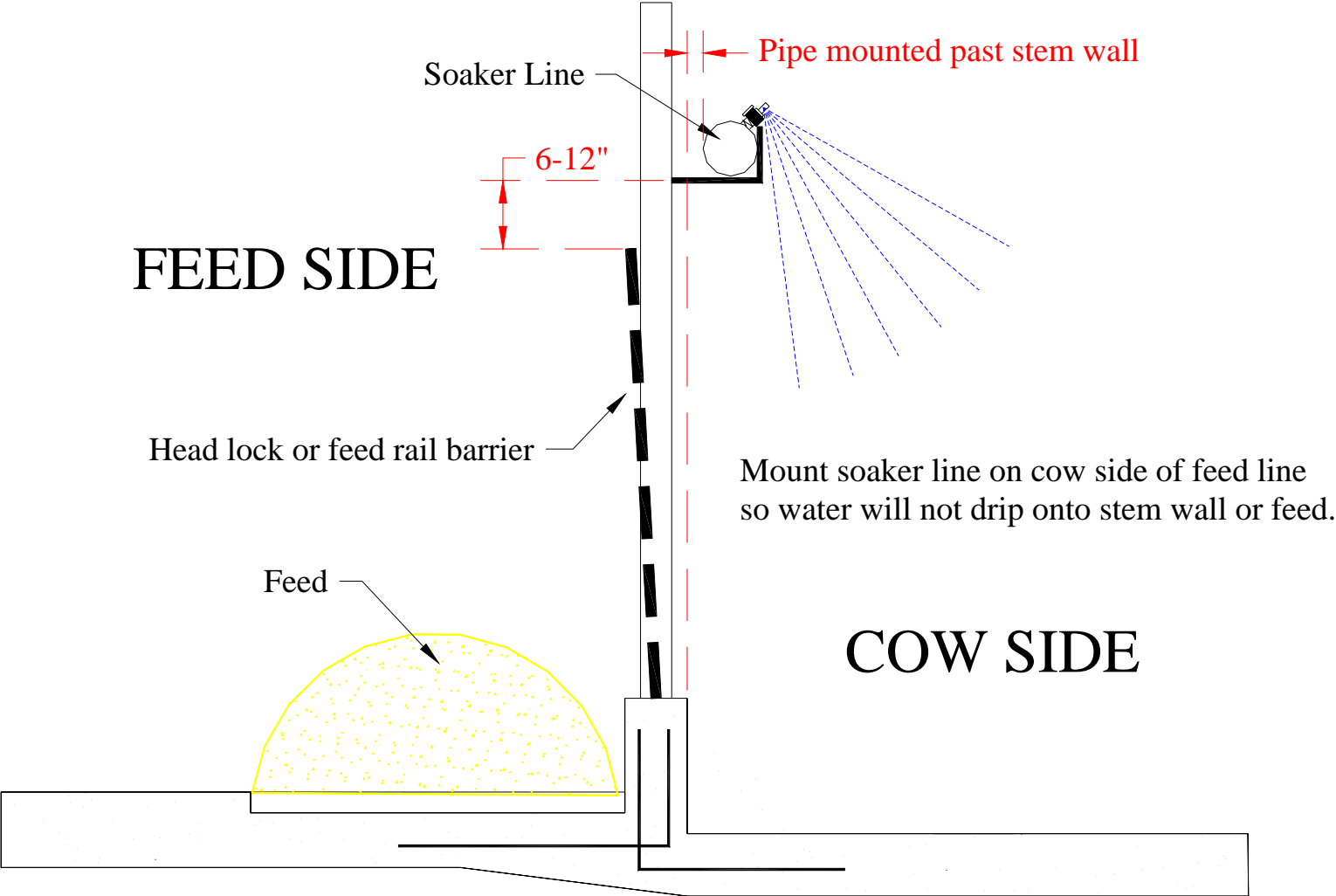
\*Calculated using a nozzle that will deliver 1 gallon of water per minute.

Figure 1. Recommended fan placement in a 4-row freestall barn with head-to-head stalls.



Repeated field trials at Kansas State University have shown that optimum performance was obtained by placing a single row of fans over the feed line and the freestalls arranged in a head to head configuration. Milk production is increased 5-6 pounds per cow per day when fans are located on both the feedline and the freestalls versus only locating fans on the feedline or over the stalls.

Figure 2. Soaker line location on the feedline.



Adequately sized supply and distribution lines are essential in the design of a soaker system. Enough water must be supplied in a 1 to 2 minute interval to wet cows along the entire feed line. If either pipe is undersized, nozzles at one end of the feed line may not be on as long as those near the main water line. This causes cows to bunch towards the end where adequate water is supplied. Shown below are three diagrams of the same barn but with the main supply line connecting to the soaker line (distribution line) at different locations (8 feet between nozzles and .75 gallons per minute per nozzle).

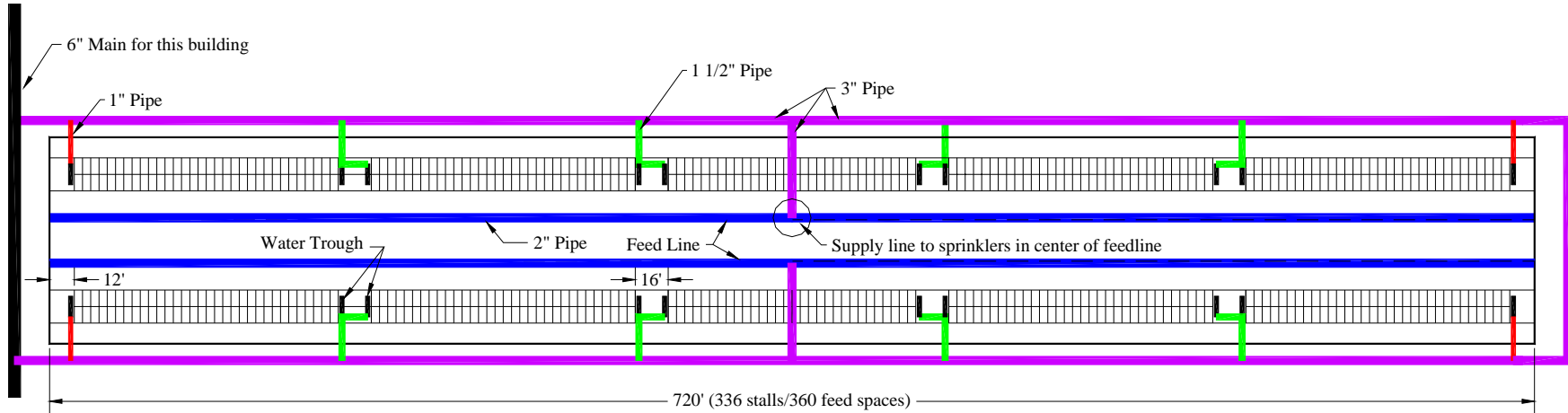


Figure 3. Diagram showing recommended pipe sizes for a soaker system that has the main supply line in the center of the feed line.

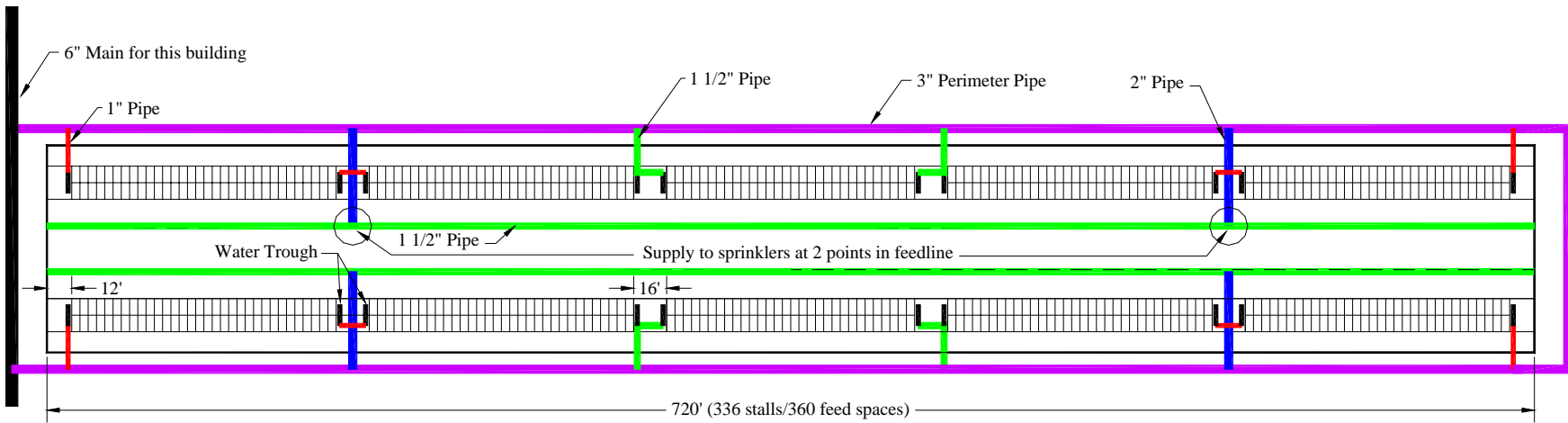


Figure 4. Diagram showing recommended pipe sizes for a soaker system that has the main supply line at two locations along the feed line.

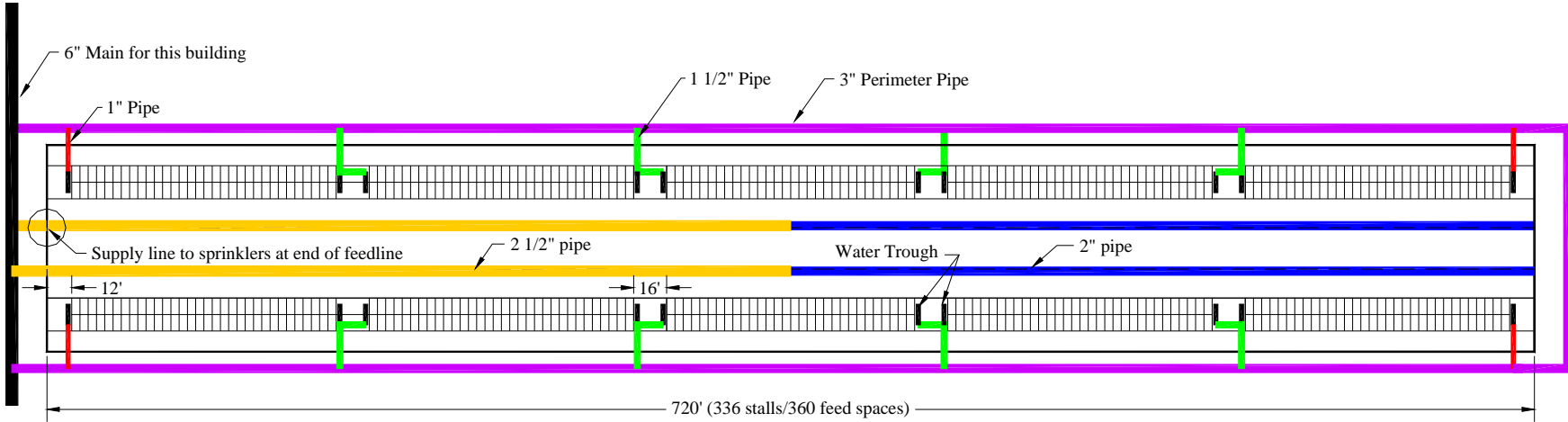


Figure 5. Diagram showing recommended pipe sizes for a soaker system that has the main supply line at one end of the feed line.

Figure 6. Examples of the brass and plastic TeeJet® nozzles.

