

A blue-toned background image of a water fountain with water spraying upwards and creating ripples on the surface below. The text is overlaid in the center.

**WATER STORAGE
TANKS
CHAPTER 11**

WATER STORAGE

217

- A WATER STORAGE TANK
- TO SUPPLY LARGE QUANTITIES OF WATER TO A COMMUNITY DURING A FIRE OR IN THE EVENT OF A WATER SOURCE FAILURE.

WATER STORAGE REQUIREMENTS

217

TYPE AND CAPACITY OF STORAGE TANK AND OTHER CONSIDERATIONS

1. HYDROPNEUMATIC TANKS

2. GROUND LEVEL TANKS

3. BURIED TANKS

4. ELEVATED TANKS



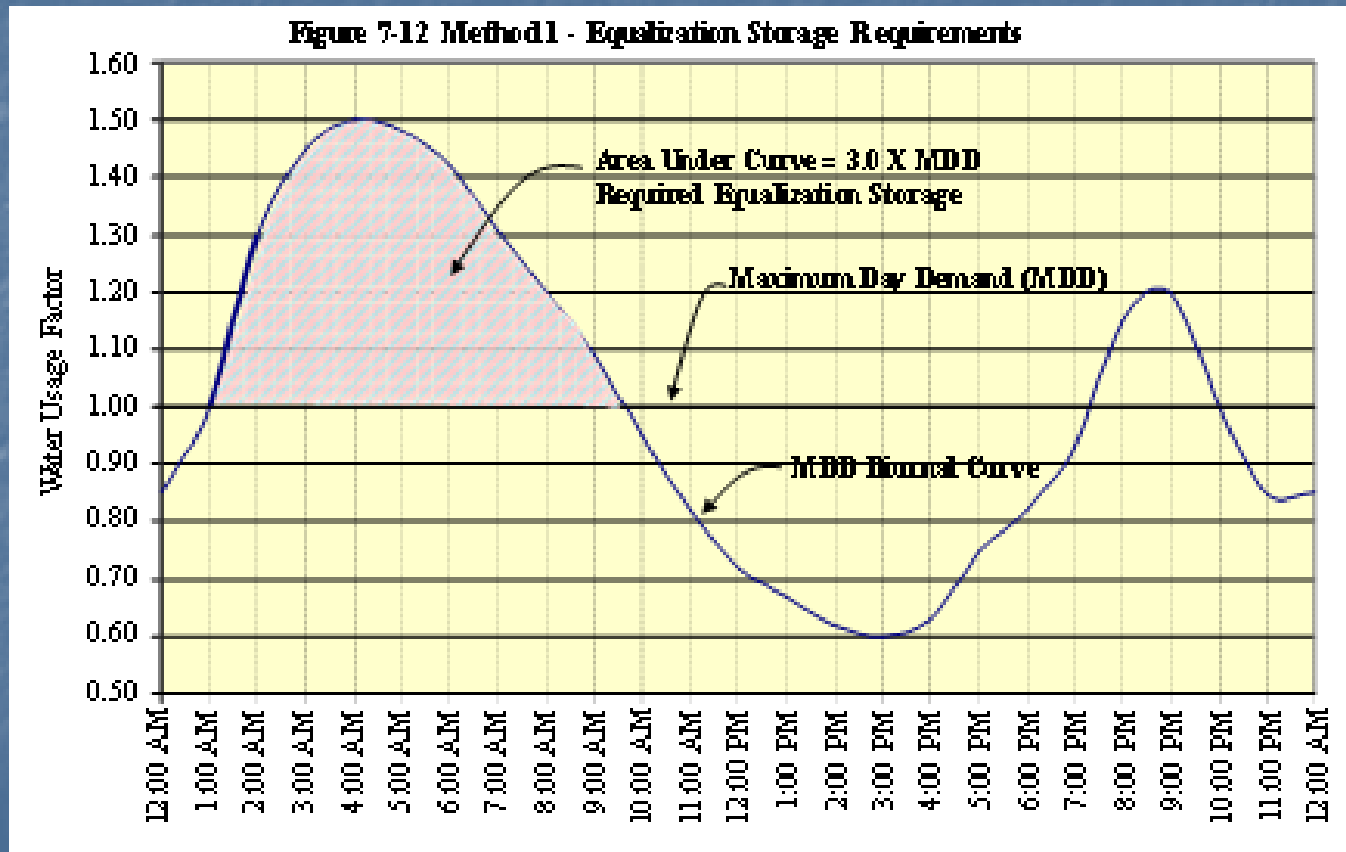
WATER STORAGE FUNCTIONS

217

- **EQUALIZING SUPPLY AND DEMAND**
- **INCREASED OPERATING CONVENIENCE**
- **BALANCING PUMPING REQUIREMENTS**
- **DECREASING POWER COSTS**
- **EMERGENCY FIRE REQUIREMENTS**
- **SURGE RELIEF**
- **INCREASING CHLORINE DETENTION TIME**
- **BLENDING WATER SOURCES**

EQUALIZING SUPPLY AND DEMAND 218

Calculated Diurnal Equalization Storage



INCREASED OPERATING CONVENIENCE

218

- OPERATING A PLANT MORE SHIFTS ARE REQUIRED- WATER STORAGE HELPS SYSTEMS COAST THROUGH THE NIGHT



LEVELING PUMPING REQUIREMENTS ²¹⁸

- WATER USE IS CONTINUALLY CHANGING
- TIME OF DAY
- DAY OF WEEK
- WEATHER CONDITIONS
- SUPER BOWL SUNDAY
- STORAGE TANKS CAN MINIMIZE THE CYCLING OF THE PUMPS AND ELECTRICAL COSTS



DECEASING POWER COSTS ²¹⁹

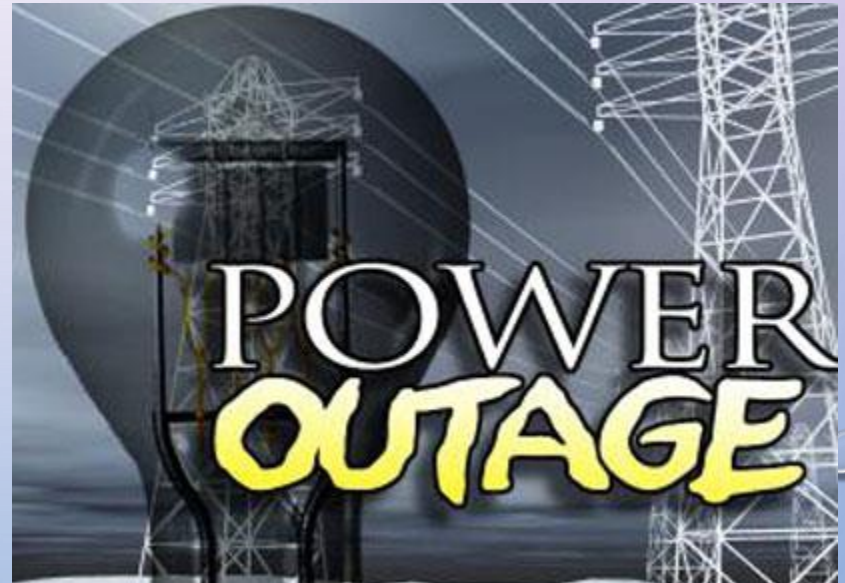
- LOCAL ELECTRIC COMPANIES HAVE SPECIAL POWER RATES FOR OFF PEAK HOURS.
- STORAGE TANKS ALLOW FOR THE PUMPS TO STAY INACTIVE DURING THOSE PEAK USAGE HOURS.
- GROUND LEVEL TANKS BEST...



PROVIDE WATER DURING SOURCE AND PUMP FAILURES

219

- POWER FAILURES
- MECHANICAL BREAKDOWNS
- MAINTENANCE WORK
- TREATMENT PLANT DOWN
- TRANSMISSION LINE DOWN



EMERGENCY AND FIRE REQUIREMENTS

- FIRE DEMAND CAN ACCOUNT FOR 50% OF WATER STORAGE
- LARGE MAIN BREAKS
- TEMPORARY LOSS OF POWER
- WATER SOURCE DISRUPTIONS
- MAXIMUM DAY DEMAND CAN LAST SEVERAL DAYS



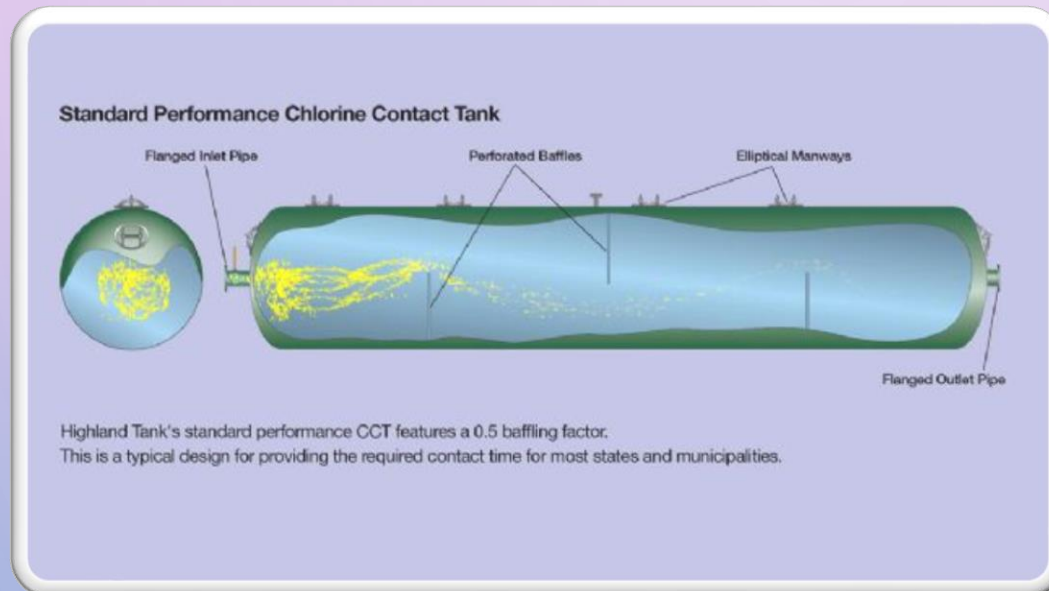
SURGE RELIEF

219

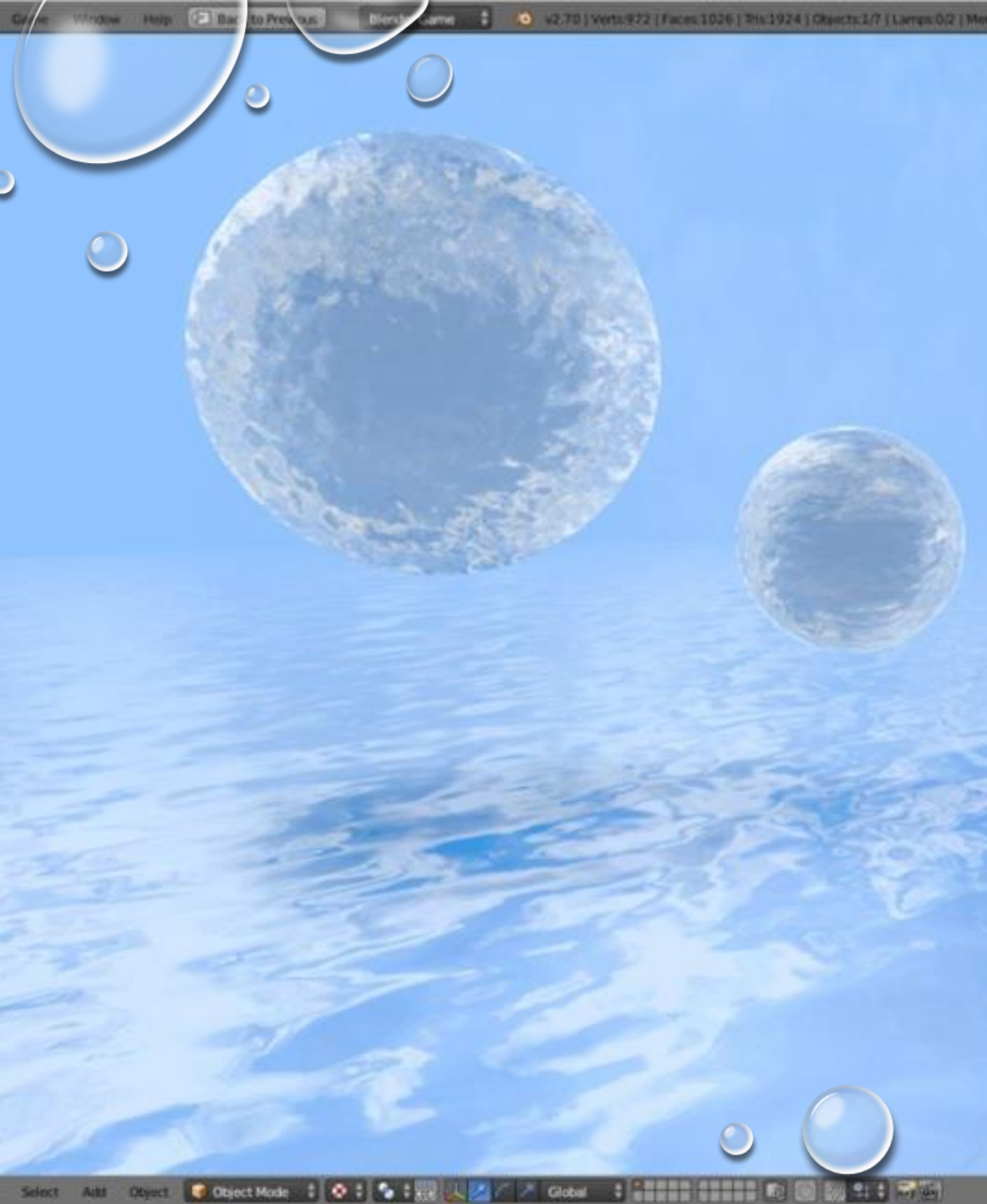
- WATER HAMMER – OPENING AND CLOSING VALVES QUICKLY CAUSING HYDRAULIC SURGE.
- ELEVATED TANKS CAN HELP ABSORB THE
- SHOCK WAVE CREATED BY WATER HAMMER.



CHLORINE DETENTION TIME ²²⁰



- SURFACE WATER TREATMENT RULE / GROUNDWATER RULE
- CHLORINE CONTACT TIME WITH WATER BEFORE FIRST CUSTOMER



BLENDING WATER

- WHY BLEND???
- DIFFERENT WATER QUALITIES
- INADEQUATE WATER SOURCE
- WATER TEMPERATURES
- EXCEEDING MCL

CAPACITY REQUIREMENTS 220

DISTRIBUTION STORAGE CAPACITY IS BASED ON THE MAXIMUM WATER DEMANDS IN THE DIFFERENT PARTS OF THE SYSTEM

STORAGE CAPACITY FOR FIRE PROTECTION IS BASED ON THE RECOMMENDATIONS OF THE ISO AND QUALIFIED ENGINEERS

EMERGENCY STORAGE IS BASED ON THE RELIABILITY OF THE BACK UP SOURCE AND EQUIPMENT

BACK UP POWER SUPPLY – GENERATORS

REDUNDANT PUMPING AND WATER SUPPLY





Access hatch with air vent

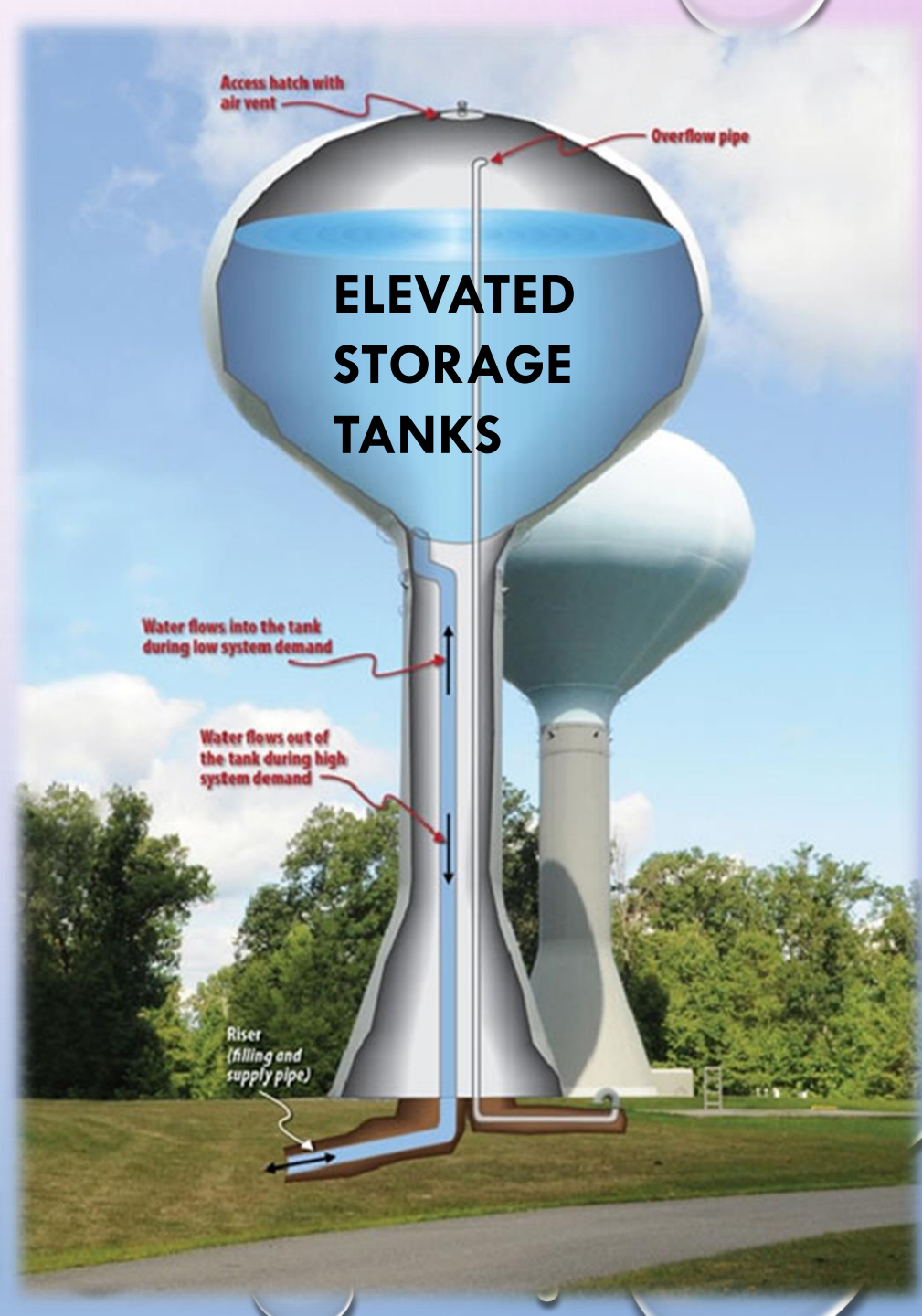
Overflow pipe

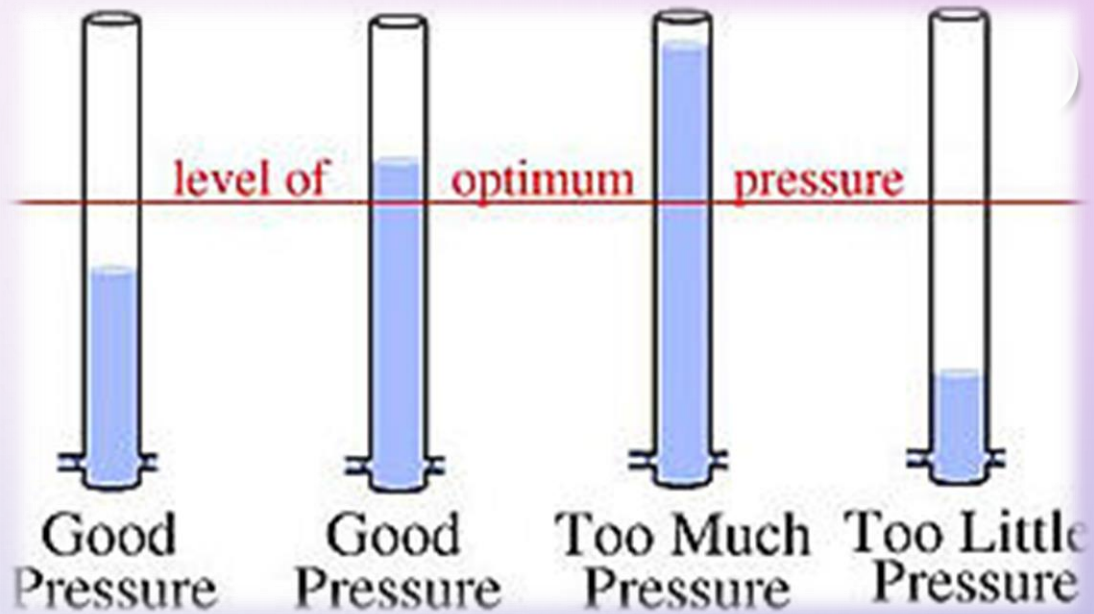
ELEVATED STORAGE TANKS

Water flows into the tank during low system demand

Water flows out of the tank during high system demand

Riser (filling and supply pipe)





STANDPIPE STORAGE TANKS

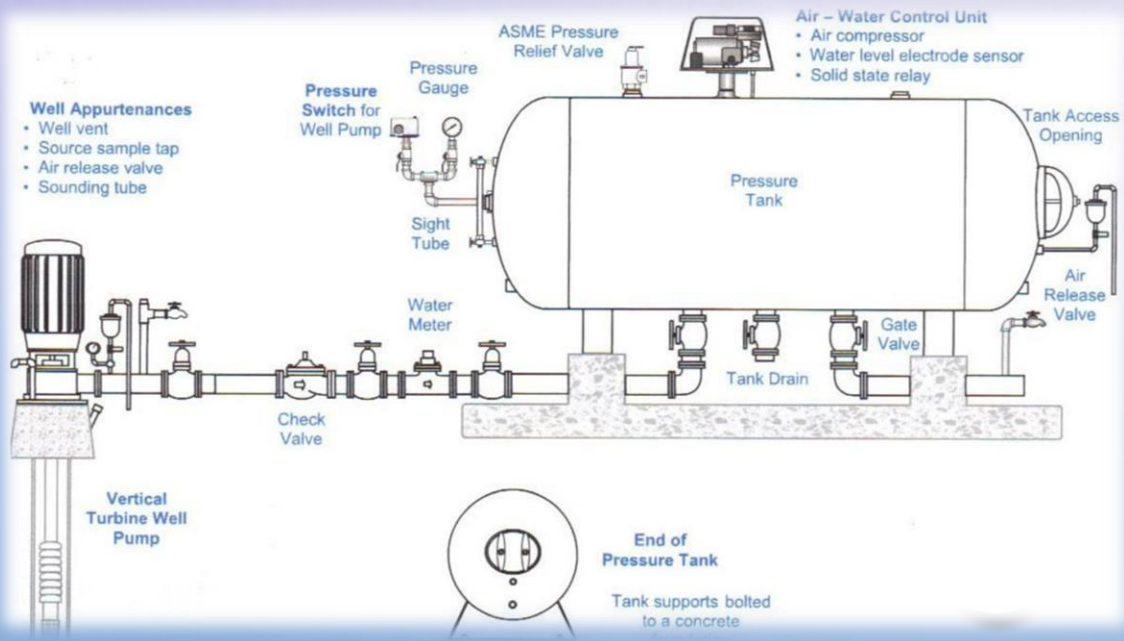
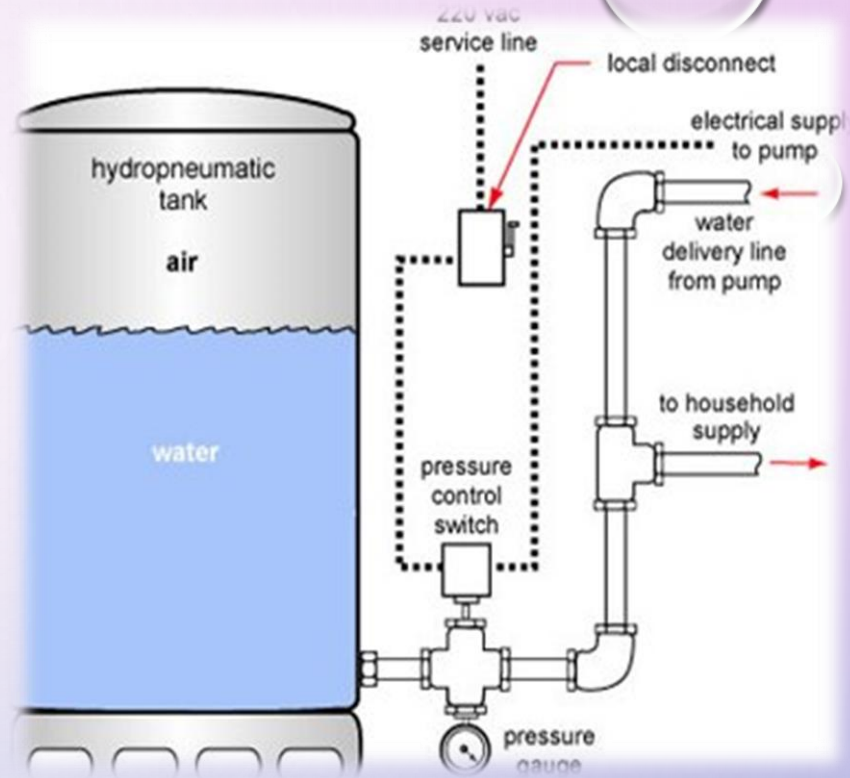
221



WATER RESERVOIRS



HYDROPNEUMATIC SYSTEMS 222

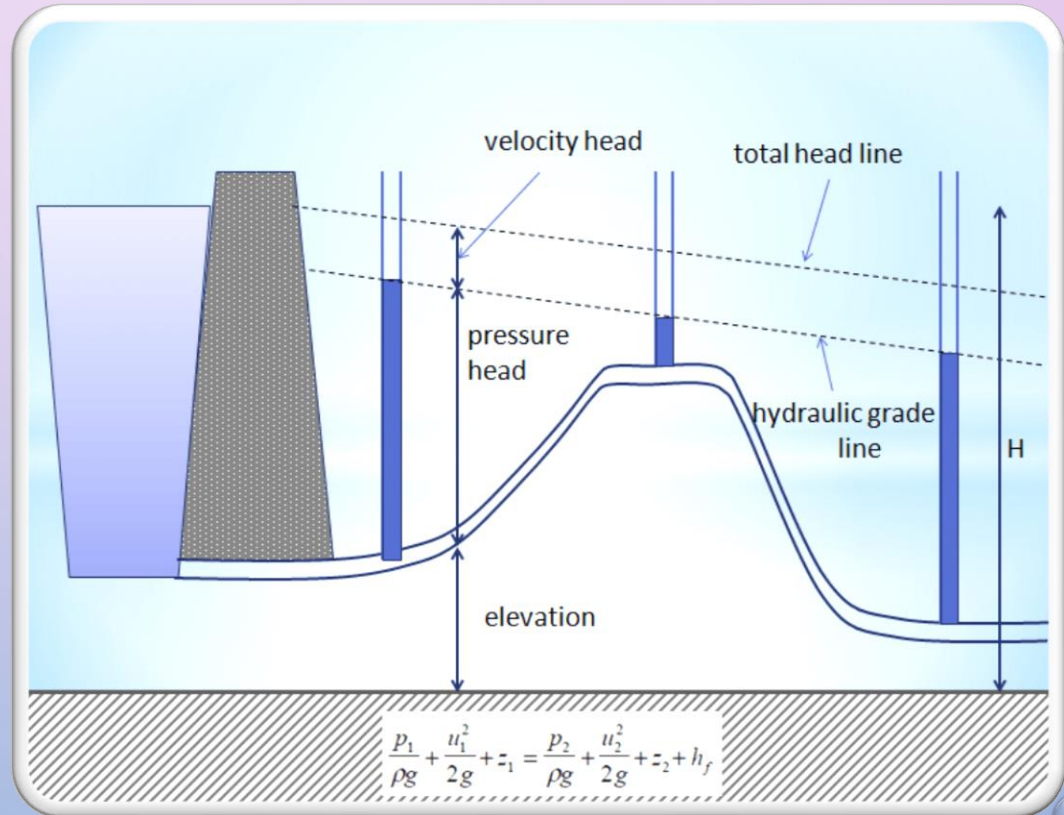


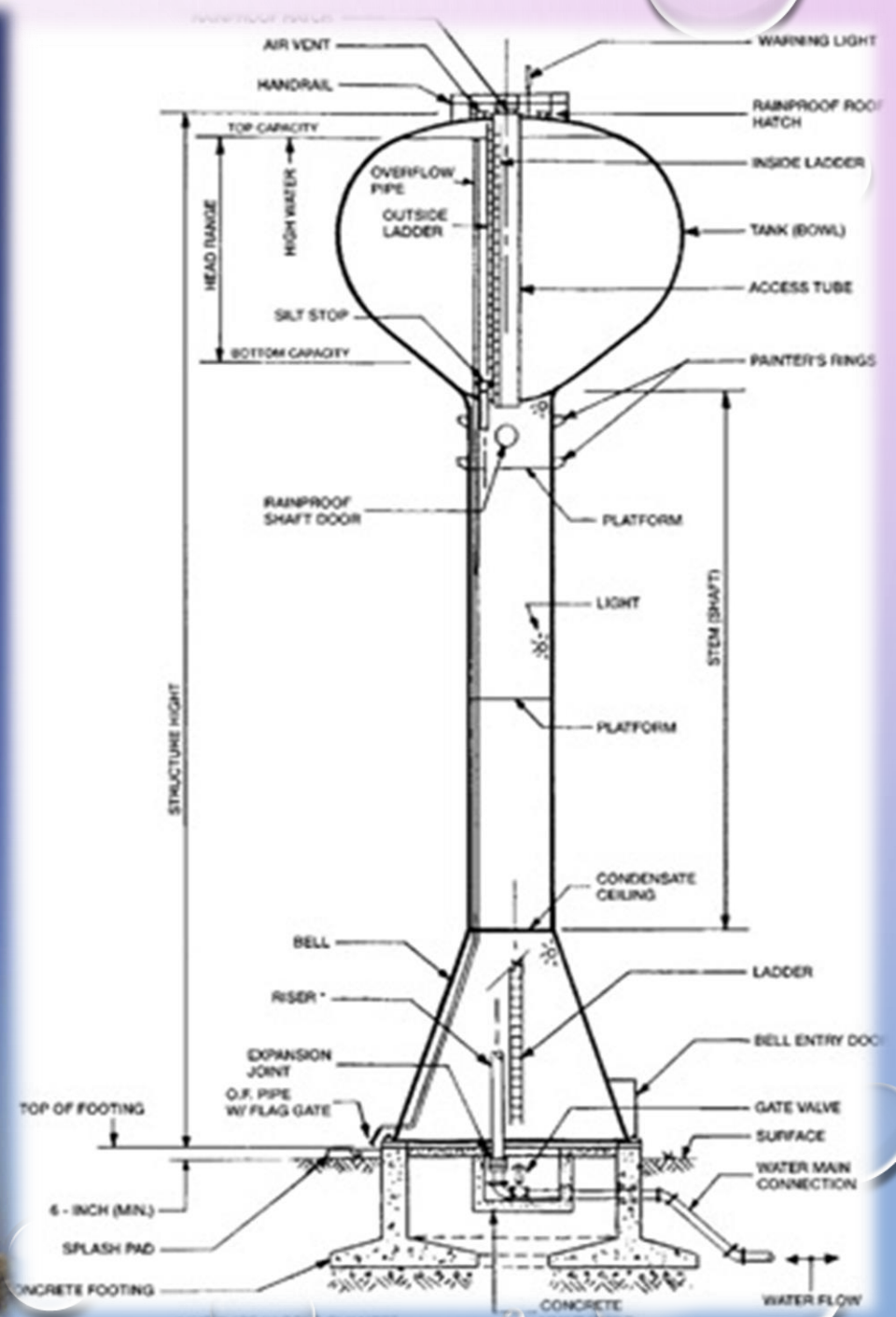


SYSTEM HYDRAULICS

225

- HYDRAULIC GRADIENT LINE
- HEAD LOSS AT THE FURTHEST POINT
- FIGURE 11-7A
- FIGURE 11-7B
- FIGURE 11-7C





WATER STORAGE FACILITY EQUIPMENT²²⁷

- INLET AND OUTLET PIPES – RISER
- OVERFLOW PIPE
- DRAIN CONNECTION
- MONITORING DEVICES
- VALVING
- AIR VENTS
- ACCESS HATCHES
- LADDERS
- COATINGS
- CATHODIC PROTECTION
- OBSTRUCTION LIGHTING

WATER STORAGE TANK



CATHODIC PROTECTION SYSTEMS

COLD WATER OPERATIONS

233

- FREEZING WATER IN TANKS IS A VERY SERIOUS PROBLEM
- SURFACE WATER IN TANK IS MOST LIKELY
- ICE CAN DAMAGE PAINT, CATHODIC PROTECTION, LADDERS, OVERFLOW PIPES, TARGETS, FLOATS AND CABLES
- CIRCULATING WATER USUALLY PREVENTS RISER FROM FREEZING
- CHANGE THE OPERATING LEVEL OF THE WATER
- STEAM GENERATOR AND/OR ELECTRIC HEATERS - COSTLY



DISINFECTION

234

- AWWA STANDARD C652
- METHOD 1 – FILL ENTIRE TANK 10 PPM (6HRS DETENTION TIME) 24 HOURS BEFORE WATER CAN BE USED
- METHOD 2 – SPRAY WALLS AT 200 PPM
- METHOD 3 – 6% OF THE TANK TO 50 PPM FOR 6 HRS – FILL COMPLETELY HOLD FOR 24 HOURS.



INSPECTION 236

- STORAGE TANKS MUST BE INSPECTED PERIODICALLY
- STRUCTURAL PROBLEMS
- CORROSION
- CRACKS OR HOLES
- CATHODIC PROTECTION
- OVERFLOW VENTS
- ALTITUDE VALVES
- CONTROLS – LEVEL SENSORS, PRESSURE GAUGES
- SECURITY – VANDALISM
- AVIATION WARNING LIGHTS



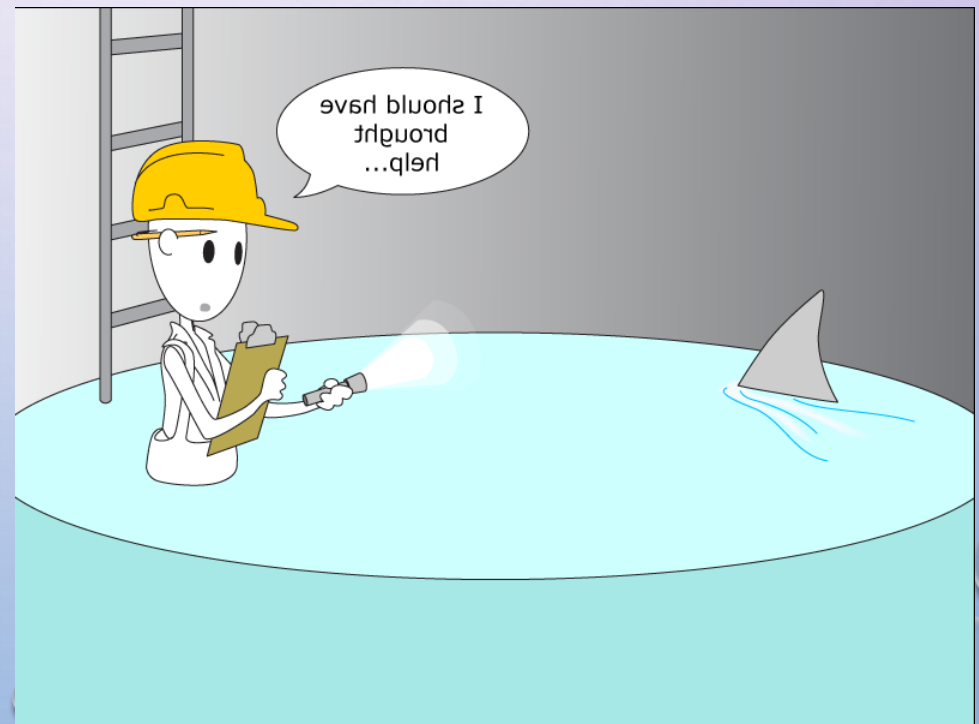
RECORDS

- TANK LOCATION
- DATES OF INSPECTION
- CONDITIONS NOTED DURING INSPECTION
- MAINTENANCE PERFORMED
- EQUIPMENT SUPPLIERS INFORMATION
- CONTRACTORS INFORMATION FOR EMERGENCY REPAIRS

WATER STORAGE SAFETY

236-237

- ONLY TRAINED AND EXPERIENCED OPERATORS SHOULD BE ALLOWED TO WORK ON AN ELEVATED STORAGE TANK
- SPECIAL PRECAUTIONS SHOULD BE OBSERVED
 - CONFINED SPACE
 - SLIPPING
 - FALL PROTECTION
- CHECK LADDERS
- PPE
- VENTILATION
- ADEQUATE LIGHTING



STUDY QUESTION 45 237

THE HEIGHT OF WATER IN (3) DIFFERENT SHAPED TANKS IS 22.4 FT. WHICH TANK WILL HAVE THE HIGHEST PSI AT THE BOTTOM?

- a. THE SQUARE TANK
- b. THE RECTANGULAR TANK
- c. THE CYLINDRICAL TANK
- d. IT WILL BE THE SAME IN ALL 3 TANKS

STUDY QUESTION 46

WHICH ONE OF THE FOLLOWING IS THE PROPER DETENTION TIME FOR DISINFECTING A WATER STORAGE TANK THAT IS FILLED WITH ALREADY CHLORINATED WATER SUCH THAT THE FREE CHLORINE RESIDUAL IS 10 MG/L AFTER THE PROPER DETENTION TIME IS COMPLETED?

- a. 4 HOURS
- b. 6 HOURS
- c. 8 HOURS
- d. 24 HOURS

FLINT WATER PLANT



STUDY QUESTION 47

WHICH ONE OF THE FOLLOWING IS THE PROPER DETENTION TIME FOR DISINFECTING A WATER THAT HAS BEEN MIXED WITH HYPOCHLORITE ALREADY CHLORINATED WATER SUCH THAT THE FREE CHLORINE RESIDUAL IS 10 MG/L AFTER THE PROPER DETENTION TIME IS COMPLETED?

- a. 6 HOURS
- b. 8 HOURS
- c. 12 HOURS
- d. 24 HOURS

STUDY QUESTION 48

IN WHAT TYPE OF WATER STORAGE SYSTEM DOES WATER GENERALLY “FLOAT” ON THE SYSTEM?

- a. ELEVATED STORAGE
- b. DEMAND STORAGE
- c. EMERGENCY STORAGE
- d. OPERATING STORAGE

STUDY QUESTION 49

THE _____ MAY REQUIRE THE INSTALLATION OF OBSTRUCTION LIGHTS OR STROBE LIGHTS ON AN ELEVATED TANK, DEPENDING ON ITS HEIGHT AND LOCATION, TO WARN AIRCRAFT IN THE VICINITY

- a. OSHA
- b. AWWA
- c. FAA
- d. FCC