**Section 370.410 Design**

The following items should be given consideration in the design of sewage pumping stations:

a) Type

 Sewage pumping stations in general use fall into three types: wet well/dry well, submersible, and suction lift.

b) Structures

1) Separation

 Dry wells, including their superstructure, shall be completely separated from the wet well. Common walls must be gastight.

2) Pump Removal

 Provision shall be made to facilitate removing pumps and motors.

3) Access

A) Suitable and safe means of access shall be provided to dry wells and to wet wells. Access to wet wells containing either bar screens or mechanical equipment requiring inspection or maintenance shall conform to Section 370.600(a)(2)(C).

B) For built-in-place pump stations, a stairway to the dry well with rest landings shall be provided at vertical intervals not to exceed 12 feet. For factory-built pump stations over 15 feet deep, a rigidly fixed landing shall be provided at vertical intervals not to exceed 10 feet. Where a landing is used, a suitable and rigidly fixed barrier shall be provided to prevent an individual from falling past the intermediate landing to a lower level. A manlift or elevator may be used in lieu of landings in a factory-built station, provided emergency access is included in the design.

4) Buoyancy

 Where high ground water conditions are anticipated, buoyancy of the sewage pumping station structures shall be considered and, if necessary, adequate provisions shall be made for protection.

c) Pumps and Pneumatic Ejectors

1) Multiple Units

 Multiple pumps or ejector units shall be provided. Where only two units are provided, they shall be of the same size. Units shall have capacity such that, with any unit out of service, the remaining units will have capacity to handle the design peak flows. A single pump equipped with an audio-visual alarm system to warn of failure may be used when serving only one single-family dwelling.

2) Protection Against Clogging

A) Pumps handling combined sewage shall be preceded by readily accessible bar racks to protect the pumps from clogging or damage. Bar racks should have clear openings not exceeding 1 inch. Where a bar rack is provided, a mechanical hoist shall also be provided. Where the size of the installation warrants, mechanically cleaned and/or duplicate bar racks shall be provided.

B) Pumps handling separate sanitary sewage from 30 inch or larger diameter sewers shall be protected by bar racks meeting the above requirements. Appropriate protection from clogging shall also be considered for small pumping stations.

3) Pump Openings

 Pumps handling raw sewage shall be capable of passing spheres of at least 3 inches in diameter. Pump suction and discharge openings shall be at least 4 inches in diameter. Grinder pumps that do not meet these requirements may be used solely for lift stations with a capacity of 70 gpm or less with the largest unit out of service.

4) Priming

 The pump shall be so placed that under normal operating conditions it will operate under a positive suction head, except as specified in Section 370.133.

5) Electrical Equipment

 Electrical systems and components (e.g., motors, lights, cables, conduits, switchboxes, control circuits, etc.) in raw sewage wet wells, or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, shall comply with the National Electrical Code requirements for Class 1 Group D, Division 1 locations. In addition, equipment located in the wet well shall be suitable for use under corrosive conditions. Each flexible cable shall be provided with water-tight seal and separate strain relief. A fused disconnect switch located above ground shall be provided for all pumping stations. When such equipment is exposed to weather, it shall meet the requirements of weatherproof equipment (National Electric Manufacturers Association (NEMA) 3R or 4).

6) Intake

 Each pump shall have an individual intake. Wet well and intake design should be such as to avoid turbulence near the intake and to prevent vortex formation.

7) Dry Well Dewatering

 Duplicate sump pumps equipped with dual check valves for each pump shall be provided in the dry well to remove leakage or drainage with discharge above the maximum high water level of the wet well. Water ejectors connected to a potable water supply will not be approved. All floor and walkway surfaces should have an adequate slope to a point of drainage. Pump seal leakage shall be piped or channeled directly to the sump. The sump pumps shall be sized to remove the maximum pump seal water discharge which would occur in the event of a pump seal failure.

8) Pumping Rates

 The pumps and controls of main pumping stations, and especially pumping stations operated as part of treatment works, should be selected to operate at varying delivery rates. The stations shall be designed to deliver as uniform flow as practicable in order to minimize hydraulic surges. The peak design flow of the station shall be determined in accordance with Sections 370.300(c), 370.310(b) and 370.520(c) and should be adequate to maintain a minimum velocity of 2 feet per second in the force main. Refer to Section 370.470(f).

d) Controls

 Control float tubes and bubbler lines should be so located as not to be unduly affected by turbulent flows entering the well or by the turbulent suction of the pumps. Provision shall be made to automatically alternate the pumps in use.

e) Valves

 Shutoff valves shall be placed on suction and discharge lines of each pump. A check valve shall be placed on each discharge line, between the shutoff valve and the pump. Check valves shall not be located on a vertical rise unless they are specifically designed for such usage.

f) Wet Wells

1) Divided Wells

 Where continuity of pumping station operation is critical, consideration should be given to dividing the wet well into two sections, properly interconnected, to facilitate repairs and cleaning.

2) Size

 The design fill time and minimum pump cycle time shall be taken into account in sizing the wet well. The effective volume of the wet well shall be based on design average flow and a filling time not to exceed 30 minutes unless the facility is designed to provide flow equalization. The pump manufacturer's duty cycle recommendations shall be used in selecting the minimum cycle time. When the anticipated initial flow tributary to the pumping station is less than the ultimate average design flow, provisions should be made so that the holding time indicated is not exceeded for initial flows. When the wet well is designed for flow equalization as part of a treatment plant, provisions should be made to prevent septicity.

3) Floor Slope

 The wet well floor shall have a minimum slope of 1 to 1 to the hopper bottom. The horizontal area of the hopper bottom shall be no greater than necessary for proper installation and function of the inlet.

4) Air Displacement

 Covered wet walls shall provide for air displacement open to the atmosphere, such as by an inverted "j" tube or similar means.

g) Ventilation

1) General

 Adequate ventilation shall be provided for all pump stations. Where the dry well is below the ground surface, mechanical ventilation is required. If screens or mechanical equipment requiring maintenance or inspection is located in the wet well, permanently installed ventiliation is required. There shall be no interconnection between the wet well and dry well ventilation systems.

2) Air Inlets and Outlets

 In dry wells over 15 feet deep, multiple inlets and outlets should be used. Dampers should not be used on exhaust or fresh air ducts and fine screens or other obstructions in air ducts should be avoided to prevent clogging.

3) Electrical Controls

 Switches for operation of ventilation equipment should be marked and located conveniently. All intermittently operated ventilation equipment shall be interconnected with the respective pit lighting system. Consideration should be given also to automatic controls where intermittent operation is used. The manual lighting ventilation switch shall override the automatic controls.

4) Fans, Heating and Dehumidification

 The fan wheel shall be fabricated from non-sparking material. Automatic heating and dehumidification equipment shall be provided in all dry wells. The electrical equipment and components shall meet the requirements of subsection (c)(5) above.

5) Wet Wells

 Wet well ventilation may be either continuous or intermittent. Ventilation, if continuous, should provide at least 12 complete air changes per hour; if intermittent, at least 30 complete air changes per hour. Air shall be forced into the wet well by mechanical means rather than exhausted from the wet well. Portable ventilation equipment shall be provided for use at submersible pump stations and at wet wells with no permanently installed ventilation equipment.

6) Dry Wells

 Dry well ventilation may be either continuous or intermittent. Ventilation, if continuous, should provide at least 6 complete air changes per hour; if intermittent, at least 30 complete air changes per hour. A system of two-speed ventilation with an initial ventilation rate of 30 changes per hour for 10 minutes and an automatic switch-over to 6 changes per hour may be used to conserve heat.

h) Flow Measurement

 Suitable devices for measuring sewage flow shall be provided at all pumping stations. Indicating, totalizing and recording flow measurement shall be provided at pumping stations with a 1200 gpm or greater design peak flow. Elapsed time meters used in conjunction with pumping rate tests may be used for pump stations with a design peak flow of up to 1200 gpm.

i) Water Supply

 There shall be no physical connection between any potable water supply and a sewage pumping station which under any conditions might cause contamination of the potable water supply. If a potable water supply is brought to the station, it should comply with conditions stipulated under Section 370.146(b)(3). In-line backflow preventors shall not be used.

(Source: Amended at 21 Ill. Reg. 12444, effective August 28, 1997)