

® 建筑给排水 ®

广州市芳村花园住宅小区生活给水系统设计

王 峰 陈欣燕

提要 芳村花园工程为一片 40 万 m^2 的大型住宅小区,设置了集中泵房竖向分区供水系统,配置全流量高效变频调速给水设备,使该系统一次性投资节省 2 208 万元,能耗与传统的变频给水设备相比节约 30 % 左右。

关键词 住宅小区 给水系统 全流量高效变频调速给水设备 经济效益

1 工程概况

广州市直属机关安居工程芳村花园是广州市政府为解决市直属机关职工住房建造的住宅小区。占地 100 760 m^2 ,总建筑面积 401 016 m^2 ,包括 21 栋住宅楼及小区配套工程(水泵房、变配电房、会所、中小学、幼儿园、停车场及地下车库、游泳池、网球场等),表 1 为住宅楼层数及小区分区一览表。小区设计居住人口 12 602 人。该工程施工图于 1999 年 6 月底完成,2001 年 7 月竣工并交付使用。

表 1 住宅楼层数及分区一览表

分区编号	层数	栋数	每层户数	总户数	建筑高度/m	备 注
A	18	3	8	408	57	一层为支柱层
B	18	3	4	204	57	一层为支柱层
C	32	2	8	496	99	一层为支柱层
	18	2	8	272	57	
D	30	1	8	224	93	一、二层为商场或其他用房
	32	2	8	480	99	
E	32	2	8	480	99	一、二层为商场或其他用房
	30	1	8	224	93	
	28	1	8	208	87	
F	30	2	6	348	93	一层为支柱层
	18	2	6	204	57	
A~F				3 548		上述各栋均有一层地下室,层高 4.25 m,架空层总高 6 m,住宅层高 3 m

2 系统设置及竖向分区

广州市自来水公司提供的资料为:市政给水管 $DN800$ 可供本工程用水,干管水压为 0.40 MPa;商业用水、住宅用水及中小学用水因水费不同应分别计费。

根据上述条件,由市政给水干管接出 3 条计量管道:第一条为商业用水管(直供);第二条为中小学、幼儿园等用水(直供);第三条至小区水泵房贮水池,经加压后供住宅用水。

水泵房贮水池按 2 倍最大小时用水量设置为 1 200 m^3 。

住宅用水集中为一个泵房供水。竖向分为 3 个区:2~10 层为 1 区,11~20 层为 2 区,21~32 层为 3 区。每个区设 1 套变频调速给水设备加压供水,给水系统示意图 1。

需要说明的是,在本工程给水系统实施之前,广州市供水部门从来没有批准过诸如 40 万 m^2 的住宅小区采用一个集中泵房的供水方案。按对一般房地产开发商的要求,本工程至少要按 6 个住宅区(A~F)建 6 个泵房,这样一次性投资要比建一个泵房多出 1 200 万元。由于该工程得到有关领导的重视,使设计的给水方案得以实施。

3 用水量计算

根据《广州市住宅设计试行规范》第 6.2.3 条规定,整栋住宅综合用水总量按平均 450 L/(人·d)计。该规范没有提到住宅区的综合用水总量标准,但广州市多年来城市人均综合用水量实际为 500~515 L/(人·d),本工程据此确定的小区日用水量为 6 301 m^3 ,最大小时用量为 603.8 m^3 ($K=2.3$)。

住宅部分设计秒流量按 $q_g = 0.2 \sqrt{N_g} + kN_g$ 计算,和 k 值按《建筑给水排水设计规范》(GBJ15-88 1997 年版)表 2.6.4 确定为 1.02 和 0.004 5。

小区内 10 层及以下共计 1 276 户,11~20 层共计 1 352 户,21 层及以上共计 920 户。

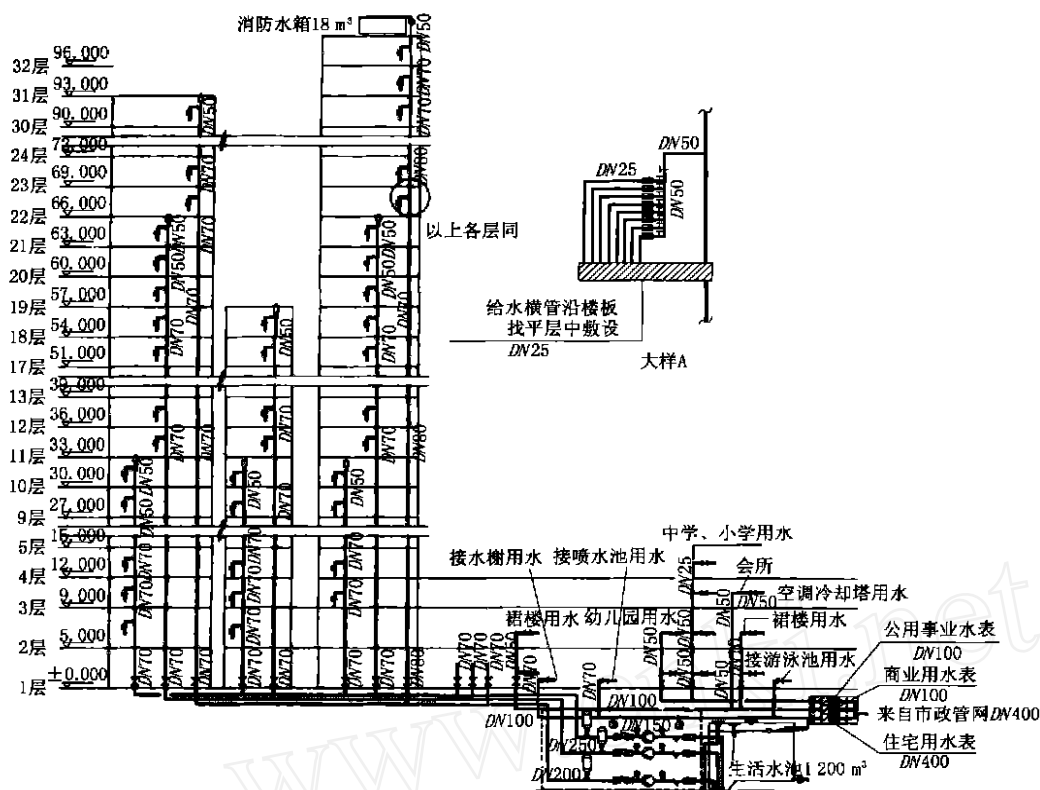


图1 生活给水系统示意

每户设置两个卫生间,当量统计见表2。

表2 每户的当量统计

卫生器具	数量	当量数
洗菜盆	1	1
大便器	2	0.5 ×2
洗脸盆	2	1 ×2
洗衣机	1	1.2
浴盆水龙头	2	1.5 ×2
总计		8.2

由此计算出住宅竖向3个分区的设计秒流量作为变频调速给水设备的设计参数:1区 67.95 L/s,2区 71.38 L/s,3区 51.67 L/s。

4 设备配置

住宅竖向3个区加压给水采用全流量高效变频调速给水设备^[1]。该设备是基于下述原理提出的:对于一个供水系统而言,全天24h的用水量不同,使最不利点自由水头满足要求所需的总扬程也不同。传统的变频调速供水设备是按设计秒流量及此时所需的扬程选用水泵的。在系统用水量减少时,水泵转速降低以适应系统工况变化,当频率降到某

一临界值时,水泵不在高效段工作。由于全天24h出现设计秒流量的时段不多,故水泵大部分时间处于低效段工作,使系统不能达到节能高效运行。为改变这种现象,通过划分设计秒流量的不同流量段,计算出各流量段所需的扬程,根据实际需要配置水泵,利用PLC编程控制及变频调速控制,实现各流量供水过程中水泵均在高效工况段工作,以此达到高效节能供水之目的。

因本工程水泵房距最不利点近800

m,最不利点最大供水和最小供水时所需扬程差异较大,为保证高效节能供水,需对系统水泵作精确配置。

本工程采用的配泵公式如下:

$$Q_g = (N_L - 1) \cdot Q_L \quad (1)$$

$$Q_L = A N_s Q_s \quad (2)$$

式中 Q_L, Q_s ——大、小泵流量, L/s;

N_L, N_s ——大、小泵数量,台;

Q_g ——设计秒流量, L/s;

A ——由高效频率下限值确定的系数。

式(1)和式(2)中没有扬程参数,各流量段扬程据实计算。考虑到零流量运行,各系统配置设1000隔膜式气压罐。设备配置见表3。

从表3可以看出,本工程小流量时,为保证最不利点自由水头所需水泵扬程与设计秒流量时的扬程相差0.2 MPa以上。由此可以直观地看出全流量高效变频调速给水设备的节能效果。

5 设计总结

从水费谈供水管理体制问题

文 烨 孙 钢

提要 现行供水管理体制存在着收费不合理,生活消防供水安全可靠性和较差的弊端。提出将小区室外给水管网交由自来水公司施工管理维护,及只设分户水表的改进建议。

关键词 供水管理体制 水价 消防给水

随着改革开放,城市建设大跨步地向前发展,特别是住宅建筑的大规模兴建,使得人民的住房水平得到了很大的改善。在各大中城市中,各种形式的住宅小区、高层住宅等是目前住宅产业的主要开发品种,但不管住宅的形式与组成怎样变化,其与城市供水的关系却并没有作相应的调整。目前,绝大多数住宅小区,包括学校等其他建筑,与城市给水管网的关系都是采用一个住宅小区设一只供水总表的方式。也就是说,一个住宅小区一般都是从城市给水管网上引入一条总供水管,设置一只总水表;进入小区后,再进行管道分支供水,一栋楼一表或一单元一表,且对各住户设分户水表。目前,这种供水方式已

经暴露出了许多问题,下面就几个方面的问题谈谈笔者的看法。

1 用水价格

一般来说,在修建住宅小区供水管网的时候,从城市管网至小区总水表前的管道及其产权属自来水公司所有和负责维修管理。小区总水表后至小区内各住户的管道及其产权则属房地产开发公司所有,并由房地产开发公司或负责小区物业管理的部门进行维修管理。自来水公司在收取水费时只按小区总水表上显示的用水量和自来水公司正式公布的价格对小区物业管理部门进行收费。而小区物业管理部门则对各住户按每户的分户水表显示的用水量和小

表 3 设备配置一览

竖向 分区	水泵 型号	水泵 数量	水泵参数			气压罐 参数
			$Q/L/s$	H/m	N/kW	
1 区	65DL $\times 3$	1	8.33	48	7.5	畝 1 000
	80DL $\times 4$	6	15	77	22	$P=1.0\text{ MPa}$
2 区	65DL $\times 5$	1	8.33	80	15	畝 1 000
	80DL $\times 5$	7	14	100	30	$P=1.0\text{ MPa}$
3 区	65DL $\times 7$	1	8.33	112	18.5	畝 1 000
	80DL $\times 7$	5	14	140	37	$P=1.6\text{ MPa}$

本次设计的经济效益是十分可观的。由于同时采用了区域消防给水系统,整个小区的泵房仅在 F 区地下室设置一处水泵房。与整个小区根据 A ~ F 区各设一个水泵房(共设 6 个水泵房)的设计方案相比,仅泵房设备及水池的工程造价就节省 1 200 万元。同时节省泵房面积 3 600 m^2 ,本工程结算造价为 2 800 元/ m^2 ,此项共节省投资 1 008 万元。上述两项共节省造价 2 208 万元。

按每个泵房 3 人值班,管理员月工资 1 200 元/人

计,年管理费节省 21.6 万元。给水系统与传统的变频给水系统相比节能 30 % 左右。广州市一般住宅小区户均给水加压电费 15 ~ 55 元/月,取中间数 35 元/月计,小区此项全年可节省电费 44.7 万元。

除经济效益外,因只设一个泵房,物业管理十分方便,因此该工程给水系统设计的综合效益是显而易见的。

鉴于小区集中供水系统显著的技术经济效益,在住宅小区给水系统设计中应大力推广集中供水的全流量高效变频调速给水设备。

参考文献

- 1 王峰. 广东奥林匹克体育场给排水设计介绍及总结. 给水排水, 2000, 26(7): 47 ~ 53

▽作者通讯处: 510641 广州市五山华南理工大学
建筑设计研究院

电话: (020) 85516734

收稿日期: 2002-7-15

ter of wool treat scouring and dyeing. The design parameters are presented in this paper. The observed operating data shows that the process operates effectively and stably. All the measured parameters of the effluent are good enough to meet the requirement of class II guided in the national wastewater discharge standard (GB8978 - 1996). It has been confirmed that this process might be a high effective one with advantages of low investment and consumption.

Water System Design for Fangcun Garden Residential Quarter in Guangzhou Wang Feng et al (43)

Abstract : This is a residential quarter with structure area of 400 thousand square meter and its water system includes central pumping station and vertical partitioned water supply system with full flow high performance frequency controlled pumping devices. By this design 22.08 million RMB of investment was saved and 30 % of power consumption was reduced as compared with that of conventional frequency control system.

Consideration on Water Fee and Water Supply Management System Wen Ye et al (45)

Abstract : The recent status water supply management nowadays the inhabitants in residential quarters are disturbed by some deficiencies in water supply management such as illogical charge and poor reliability of drinking and fire water supply. It is recommended that the outdoor water line in residential quarter could be managed and maintained by water enterprise, and the water consumption might be metered only by water meter inside the door of each user.

Hot Water System Design for Building of the Bo - Ai Hospital in Zhongshan City Chen Xianhua (51)

Abstract : The hot water system design for clinic building of the Bo - Ai (Philanthropy) Hospital in Zhongshan City, Guangdong Province was worried by problems of insufficient water head caused by architectural layout and high requirements on water supply. Measures to keep the balance of hot water system and to control the water head were done in design stage and results of economical, rational and reliable system for hospital application were obtained.

Experimental Research on Biological Filtering Ditch for Scenery Water Body Treatment Lang Jian et al (54)

Abstract : Experimental research on biological filtering ditch (BFD), a combined process of traditional brick filtration and wetland pounds was conducted to treat urban scenery water body under normal temperature. The results show that BFD aerated by multi-stage waterfalls is effective to reduce water smell and to remove ammonia nitrogen, and also the removal of organic substances improved.

Engineering Practice of Polluted Scenery Water Body Treatment Gan Shuying et al (56)

Abstract : The scenery water treatment facility of Pudong international airport in Shanghai is presented in this paper. The origin of eutrophication is also discussed and various alternatives for water body treatment are compared. Finally a system composed of external circulating, internal circulating, air aeration and water supplement systems, is proposed to treat the scenery water body.

Proper Application of Red Copper Pipe in Building Water System Xiao Ruishu et al (59)

Abstract : Copper pipe will be promoted conditionally in residential houses in this country. The tables for hydraulic calculation and maximum allowable working pressure of red copper pipes have been established by the authors. Main specification and prices of five pipe materials including red copper have been also listed and compared, and these might be useful as scientific base for application of red copper pipe in building construction.

Application and Preference of Copper Pipe Jiang Wenyuan (67)

Abstract : The price and applicable allocation of copper pipe are presented and the problems in adoption of copper pipe indicated. All attentions in compile of Technical Instruction on Application of Copper Pipe in Building Engineering are described.

Development and Application of LS Automatic Control Device for Waterworks Zhang Aimin et al (81)

Abstract : A home developed systematic software LS and an in-site bus-based device FCS is introduced for automatic monitoring and control of waterworks. It is also indicated that best operating results of reliable, stable and safe operation have been obtained in practical application in small and medium-size waterworks.

Development of An Automatic Control System for a Lab - Scale CAST Process Zhang Benlong et al (85)

Abstract : In this paper, an Automatic Control System for a lab-scale CAST reactor was developed independently. During continuous operation at the foregoing four months, the CAST reactor treating municipal wastewater was automatically controlled by this system successfully. The sequential control for all of the process equipment of the CAST reactor could be achieved by the software in a computer, and furthermore, the feedback control for the CAST reactor could be achieved if there were some on-line sensors for such as liquid level, DO and OPR levels. The operation interface of his system was very friendly, and its flexibility and transferability were also very good.