DEVELOPMENT OF A CAMPUS WIDE DISTRICT CHILLED WATER SYSTEM

SAMFORD UNIVERSITY

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ABSTRACT

Samford University is a private, liberal arts university located in Birmingham, Alabama, with enrollment of approximately 4,500 students. In 1994, Samford embarked on an innovative program to construct a central chilled water plant and distribution system to replace over twenty-four chillers located in twenty major buildings on the campus. The program also involved replacing a thirty-eight year old electrical distribution system with a new high voltage system. The project utilized a design-build approach including a 2,000 ton chiller plant and was completed in approximately eighteen months. Benefits of the project include annual electric energy savings, retirement of aging refrigeration equipment, elimination of twenty-two cooling towers, elimination of CFC problems throughout the campus, and reductions of maintenance and operating expenditures. This paper discusses the concept, the University's decision process, construction program, and performance after approximately two years of operations.

CAMPUS HISTORY

Samford University is the largest privately supported and fully accredited institution for higher learning in Alabama. Founded by a group of educational, economic, and religious leaders, the school was chartered in 1841. In 1887, it was relocated in Birmingham, and in 1957 the institution was moved to its present campus in Homewood, South of Birmingham.

The University now consists of the Howard College of Arts and Sciences, School of Business, Orlean Bullard Beeson School of Education, School of Music, Ida V. Moffett School of Nursing, School of Pharmacy, Beeson School of Divinity, and Cumberland School of Law.

In the thirty-five years since the development of the campus at Homewood, over twenty-five major buildings were constructed in the Georgian-Colonial style of architecture on the beautifully landscaped grounds. In 1994, an ambitious construction program was undertaken to add to the Divinity School and the Library facilities.

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NEED FOR CAMPUS RENOVATIONS

During 1993-1994 the Samford administration realized that continuing problems with the 4 KV primary electrical distribution system serving the campus needed to be addressed through replacement or major repairs. The original underground system was constructed with the initiation of the new central campus and had served reliably for thirty-five years. Increasing failures brought the system's reliability and remaining life into question. The Alabama Power Company, which serves the campus with electricity, offered to assist Samford by assessing the situation and offering its expertise in proposing solutions. Alabama Power, a subsidiary of the Southern Company, worked with another Southern subsidiary, the Southern Development and Investment Group, to propose a design and construction program for new underground electrical distribution facilities, transformers and building service entrances.

At the same time upgrading of electrical systems was being considered, a review of air conditioning systems at major buildings revealed over 3,000 tons of cooling capacity allocated between twenty-four chillers ranging from five to thirty-five years in age. Almost one-third of the existing air conditioning units used R11 or R12 refrigerant. An independent engineer's study identified $750,000 of immediate equipment replacement needs and an additional $1.8 million of projected maintenance and replacement requirements over the next twenty years.

School administrators were also concerned with the operation of twenty-two cooling towers associated with the existing chiller equipment. Newly implemented stormwater discharge and pollution discharge regulations protecting the Cahaba River Basin were likely to affect the University due to direct piping of cooling tower discharges into the storm sewer system.

DESIGN/BUILD PROPOSAL

With the cooperation of the University, the Southern Development and Investment Group proposed a design/build project which would combine construction of a new 13.2 KV underground electrical distribution system with installation of a new central chilled water plant and piping distribution network. The utility subsidiary offered to design and build the system, and then sell or lease the facilities to the college. Benefits for Samford University included:

Electrical

- Improved reliability
- Potential for expansion
- Central metering (lower cost per KWH)
- Reduced maintenance over expected forty year life.

Chilled Water System

- Approximately $200,000 in annual operating savings
- Retirement of old air conditioning equipment

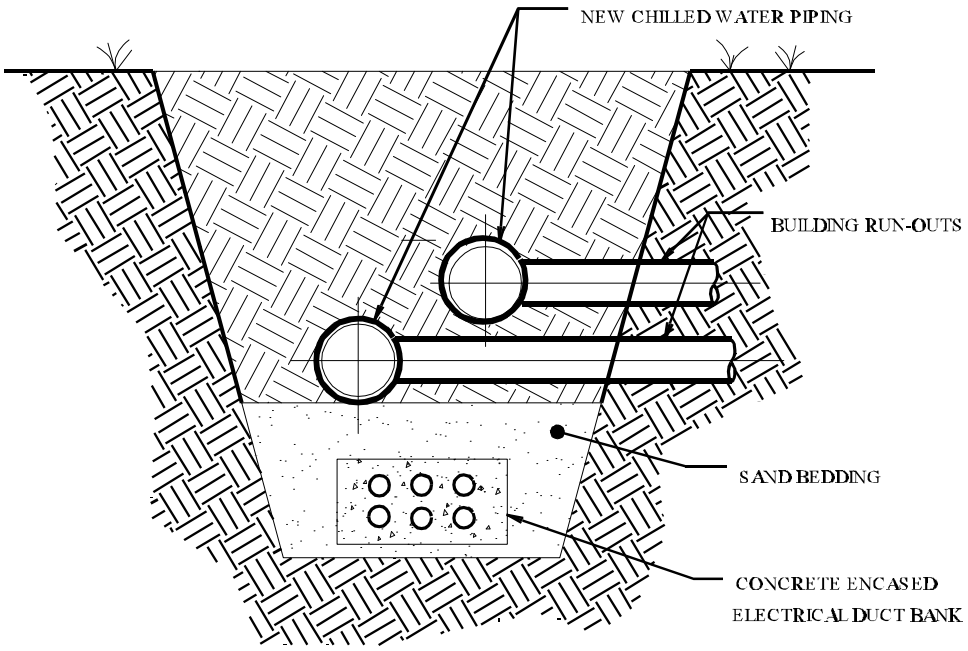
Elimination of CFC and stormwater discharge issues

Increased quality of the learning environment due to better humidity control

Centralization of refrigeration systems

Potential for expansion with additional chillers or thermal storage.

Proposed development costs were approximately $4.5 million and included construction of a central plant at the Northwest corner of the main campus and joint occupancy of direct buried electrical and chilled water distribution systems in utility trenches throughout the campus. (*Figure 1)*



COMMON TRENCH ARRANGEMENT

SCALE: 1/2"= 1'-0"

Figure 1

PROJECT DEVELOPMENT TEAM

The Southern Development and Investment Group teamed with the contracting firm Stanley Jones Corporation to prepare a design/build proposal for Samford's consideration. I. C. Thomason & Associates was retained by the contractor as the design engineer, and RDA Engineering, Inc. assisted the owner by evaluating the design, reviewed costs and provided construction review over the twelve

month construction period. Samford's Director of Planning and Development, Mr. Rick Stephens, was Project Manager for the University.

As consideration of the project progressed during the first half of 1994, Southern Development and Investment Group withdrew from the project due to uncertainties related to financing, ownership, etc. This withdrawal was due primarily to regulatory issues surrounding the Southern Company, which could not be resolved in time to meet the University's needs. As a result, the project was undertaken directly by the Stanley Jones Corporation under a design/build contract with Samford.

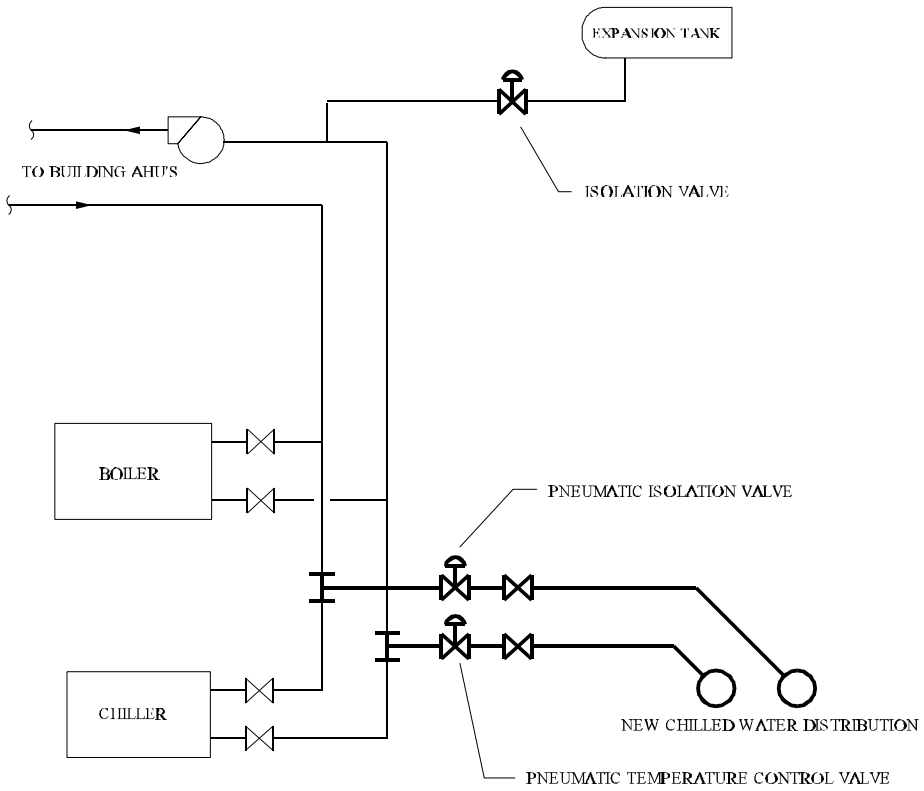
CHILLED WATER SYSTEM DESIGN

The original Southern Development and Investment Group project proposed a central chiller plant consisting of two electric drive water chillers and a 275,000 gallon thermal storage tank. Chilled water would be pumped from the central plant to each building where a connection to the building system would allow removal or retirement of existing chillers. Design chilled water sendout temperature was 42°F.

As the project development progressed, the thermal storage tank was eliminated due to relatively low potential for off peak electric cost savings. Other adjustments to the project scope included construction of a Georgian/Colonial facade on the chiller plant building. Two 1,000 ton electric drive chillers were installed, and provision was made to add a third unit in the future. (*Figure 2)* Relatively new chillers in the Law School Library, Divinity School, and the Library addition were incorporated into the system with the ability to serve as back-up or peaking units.

Figure 2

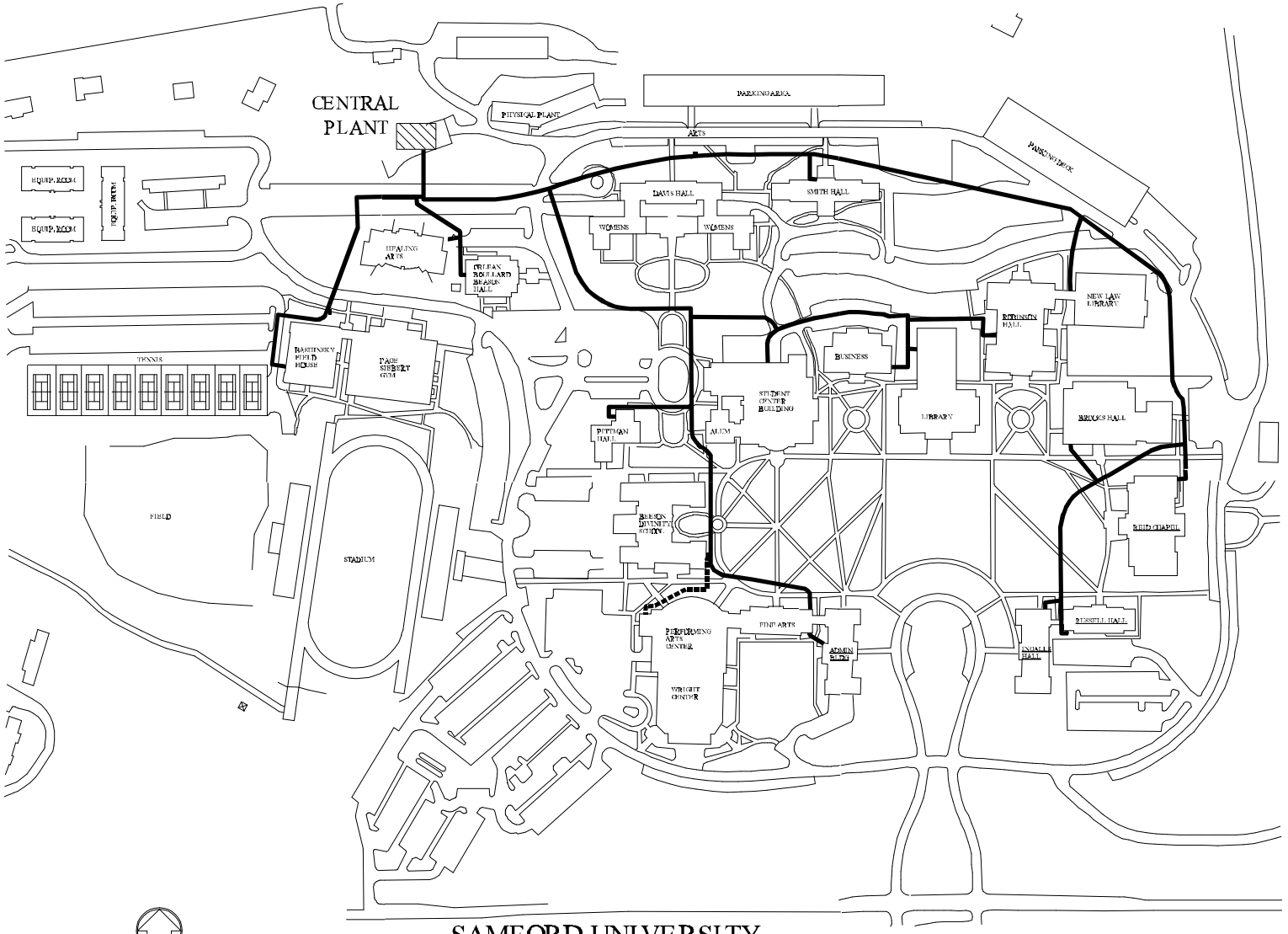
The system initially provided chilled water service to nineteen major buildings ranging in size from 132,000 square feet to 26,000 square feet. Total square footage of buildings connected was 1,039,760. An additional 150,000 square feet of buildings were slated for connection in the near future pending renovations to interior HVAC systems. Connections to each building were made simply by tying into existing mains within building mechanical rooms. In many cases existing buildings were two-pipe changeover systems which required double shut-off valves and control interlocks to prevent cross-connection during heating and cooling operations. It was anticipated that a 12° temperature differential would be achieved in existing buildings. *(Figure 3)*



TYPICAL BUILDING CONNECTION
NTS

Figure 3

The project incorporated the unique application of high density polyethylene (HDP) piping for chilled water distribution. The direct buried circulating chilled water piping was placed in the same trench as the 12 KV electrical distribution system. Approximately 6,000 linear feet of trench containing the supply and return piping was installed. The system was laid out radially from the central plant with pipe sizes ranging from eighteen inches in diameter to four inches in diameter. (*Figure 4)*



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CHILLED WATER DISTRIBUTION SYSTEM

Figure 4

SYSTEM EXPANSION

Since start-up in 1995, additional load has been added to the system through renovation of the main library from an older DX system to chilled water, air conditioning of a major dormitory complex, and air conditioning of the field house. In 1998, a third electric drive centrifugal water chiller was added, along with a plate and frame heat exchanger which is used to provide free cooling during winter months. Future plans call for additional dormitory renovation and construction of a new basketball arena.