TECHNICAL PUBLICATION NO. 89

SINGLE STACK PLUMBING DRAINAGE SYSTEM

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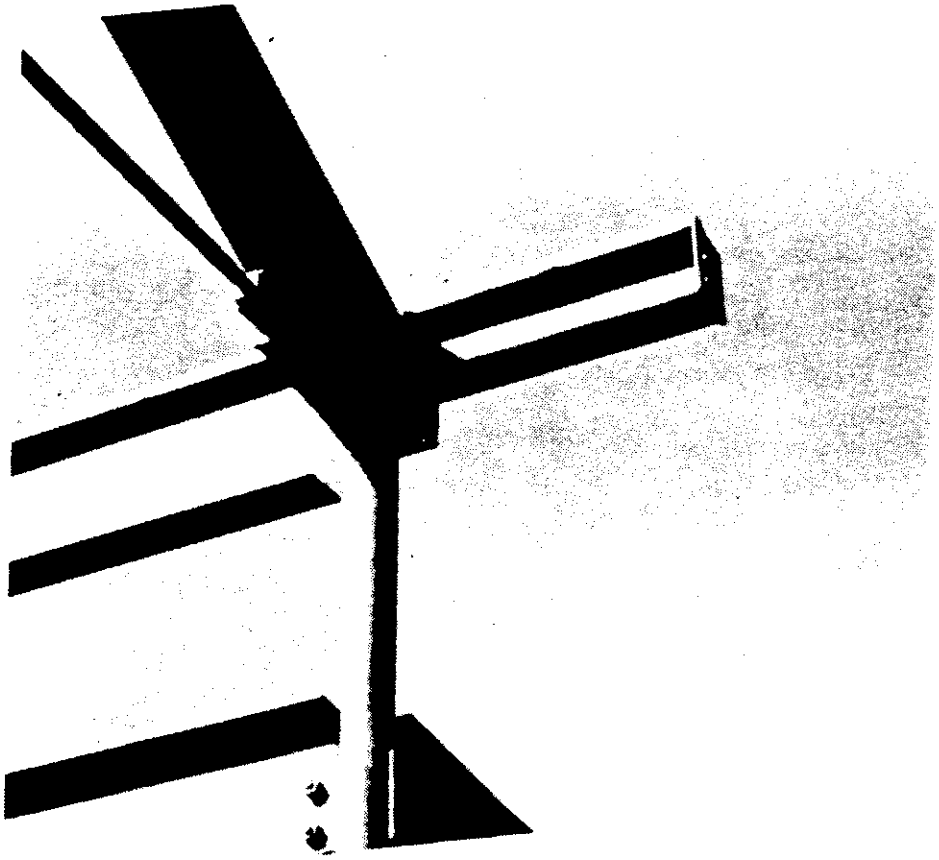


By: Dr. Richard Coble
Dr. Fwu-shiun Liou

School of Building Construction
University of Florida
1993

R 91-14

SINGLE STACK PLUMBING DRAINAGE SYSTEM

BCIAC Coordinator:

Clifford I. Storm, Director
The Broward County Board of Rules and Appeals
955 S. Federal Highway
Suite 401
Ft. Lauderdale, Florida 33316

Principal Investigator:

Fwu-shiun Liou, Associate Professor

Co-Principal Investigator:

Richard Coble, Assistant Professor

M.E. Rinker, Sr. School of Building Construction

University of Florida

Gainesville, Florida 32611

(904)392-5965

March 1, 1993

This research project was sponsored by the Building Construction Industry Advisory Committee under a grant from the State of Florida Department of Education.

TABLE OF CONTENTS

TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS

PAGE

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

The plumbing industry is undergoing changes both in the methods of construction and development of new systems, in attempts to reduce the material, and labor costs of construction. By studying plumbing systems used abroad, valuable historical data has been obtained. In European countries, the single stack DWV system, and in particular Sovent, has been used in high-rise buildings, and accordingly, has shown to be both effective in cutting material and labor costs. This single stack system, that is most commonly used in the United States, is also known as "Sovent", which is derived from the words "soil" and "vent".

The Sovent system is a simple system, and with this simplicity comes easier installation, less material, with maintenance being highly dependent on proper installation. The ability of the Sovent system to interface with other components within a building, to include less structural interference, is excellent. Since installation of Sovent requires less materials and substantially less labor, significant cost savings can be realized. Because the Sovent system is simpler and requires less space, when maintenance is necessary, structural access requires fewer and smaller wall penetrations.

The disadvantages of Sovent are typical of any system that reduces sizing of components, that being, correct installation is critical to correct system operation. Alleged failures in the Sovent system are reported to be: backwash from detergent sudsing, grease build-up, and more sensitivity to installation. It is alleged that the above stated problems may cause obstruction in the venting and clogging of the system, which in turn may lead to both objectionable noise, pressure build-ups, and odors. After review of the allegations, there appears to be no quantifiable evidence that supports these the stated problems.

Additional empirical research is necessary to thoroughly analyze the Sovent system, with particular focus on mid-rise and high-rise condominium or apartment structures. Seasonal usage can allow trap seals to be lost, which may account for objectionable odors or gases entering the units. These types of occupancies are prone to the sudsing and grease buildups in certain applications, but at this juncture, no empirical testing indicates Sovent is more prone to problems in this regard than the two-pipe systems.

The use of the Sovent system in office, hotel, or dormitory usage has been very successful, both on an international level and also in the United States. Sovent is currently being used and is in the planning to be used in this type of occupancy on a continual basis. The European community's use of Sovent reports no malfunctions or problems with the Sovent system in any regard.

Copies of this report can be obtained by contacting:

Executive Secretary
Building Construction Industry Advisory Committee
FAC 101
University of Florida
Gainesville, Florida 32611
(904) 392-5965

ACKNOWLEDGEMENTS

This report is a compilation of the experience, testing, and knowledge of many people that have come in contact with the Sovent system. To the extent that this report assists the construction industry in evaluating the Sovent system, much of the credit goes to the many anonymous contributors, without whom this report would not have been possible.

We owe a special thanks to Dan Whiteman, John T. Moore, Suzanne Ormand, and Peter Remstedt for their dedication in research, assistance in analyzing the documents and material that has become available, and working toward the work product that is contained within this text.

Our thanks also includes the manufacturers of the Sovent fittings, the engineers who have designed Sovent systems, the engineers who have evaluated the Sovent system, the plumbing contractors who have installed the systems, and the building officials who have approved and in some cases inspected its installation.

Thanks also goes to the C.I.B. and the Belgium Building Research Institute for the extensive review of their information, with regard to this text.

CHAPTER I

INTRODUCTION

This report is a feasibility study relating to the versatility of the Sovent system, which is a single stack drainage system. In attempts to reduce the costs of construction, by proposing a system relatively new to the United States plumbing industry, the Sovent system is a topic of much debate. This system continues to be an extensively tested drain, waste, and vent system. Some Plumbing codes have not accepted or have conditionally accepted this system. In some areas, its use has been prevented.

In the European Community, Sovent is a well accepted system. The single stack system has become so widely accepted in Europe, that to use the two stack system, one must refer to the appendix of the proposed new code.

In order to prove feasibility, this report has delved into several crucial areas that should be evaluated when considering the use of the Sovent system. The predominant concerns in evaluating the Sovent system are: system operation, cost effectiveness, necessary building code compliance, simplicity of installation, and engineering-design considerations. This data was compiled from: engineers having experience with Sovent, plumbing contractors, material

suppliers, code enforcement officials, testing laboratories, general contractors, owners of buildings containing Sovent, and research studies.

This report also includes the basic operation of the Sovent system. An understanding of this basic system is imperative to the analysis of its performance.

The European plumbing standards have readily accepted the single stack sanitary system, which includes the use of the Sovent system. In Europe, the Sovent system is distributed by Geberit, whose home office is in Switzerland. They have conducted extensive research and possess extensive technical support resources within their company. They are also distributors for hundreds or other water and sanitary supplies.

Presently, the Sovent system is successfully being used on a world-wide basis, with future use of the system in the planning stages. The following pages of this text will attempt to enlighten the reader about the Sovent system, and in particular its use in Florida. The objectives section of this report further identifies this report's mission statement.

OBJECTIVES

This report has the mission to investigate Sovent from many aspects to include:

1.) The cost efficiency of the system

2.) Code requirements and compliance in using Sovent

3.) The latitude that can be gained using Sovent

4.) The simplicity of installation

5.) Engineering and design considerations

6.) Sovent vs. Two-pipe system

7.) Cast iron pipe vs. PVC pipe in conjunction to the Sovent system

8.) The use of Sovent in mid-rise and high-rise commercial buildings

9.) The use of Sovent in mid-rise and high-rise condominiums

10.) How long Sovent has been used in the United States

The history of past and present usage of Sovent, and the benefits or problems associated with this usage is also contained within this text. The report contains a record of findings, developed conclusions, and recommendations as to the viability and versatility of the Sovent system in the United States. This text also examines the Sovent system's use in Europe.

HISTORY OF SOVENT

The Sovent, single stack drainage plumbing system is an engineered system developed in 1959 by Friz Sommers, a Swiss vocational school director. His work came in response to demands for a more modern, less costly drainage system for high-rise buildings.(Conine, Media File No. 307, 1983) The name Sovent is derived from the words, "soil" and "vent", thus a combination soil and vent stack.(Schultz, 1991) The system substantially reduces the number of stacks, the linear feet of tube, the number of fittings, and the size of the pipe chases.

After Sovent's initial development, the system was subjected to more testing than any other drainage system in the history of plumbing.(Conine, Design Manual No. 802) In the United States, this system has been researched, tested, and evaluated by both public and private organizations.

The Sovent system was first tested in a laboratory setting that utilized a well instrumented testing tower located in Burne, Switzerland. It was later utilized in multistory residential dwellings. Both laboratory and field testing provided positive results, confirming that in Sovent, the single stack system worked well and proved to be not only cost effective, but also very efficient. It was then offered on a royalty basis to other industrialized countries, including the United States, Germany, Canada, Italy, Australia, France, Venezuela,

Belgium, and Japan.(Conine, "Sovent Plumbing Systems for Multi-Story Buildings", 1991)

The Sovent system has been proven to be a very cost effective DWV system in hundreds of buildings containing thousands of living units and also in commercial facilities. The single stack system lends itself to well-established, accepted plumbing standards, with the installation of single stack plumbing systems being very logical and uncomplicated. Opposition to this viewpoint has not, as of this date, provided documentation that would include an empirical analysis that counters this position.

Twenty-two industrialized countries, including the United States, presently use the single stack system. The system, however, is not a universally accepted concept. The controversial aspects of Sovent continue as of the writing of this report. Empirical methods have repeatedly failed to validate the problems that the opponents of Sovent have alleged.

The system must be designed and constructed properly. Many of these alleged problems with the system come from errors made in these areas. Maintenance is critical in either the two-stack system or Sovent system in particular installations prone to grease build-up or seasonal use, where the trap seal may be lost.

The use of Sovent has gained wide acceptance in the European community, with virtually no recorded problems associated with the system. Along with the use of an oversized pipe to provide a single stack drain, waste, and vent system, Sovent also has also gained high acceptance in the European community. **TABLE D** in **APPENDIX 11** is the standard that is in use in Europe at this time.

The new plumbing code in Europe has evolved to the point that the two stack system is so uneconomical, in conjunction with the highly successful use of the single stack systems, that the two pipe system is now contained in the appendix of that code.

LENGTH OF USE IN THE UNITED STATES

Although, the system was invented by Friz Sommers in Switzerland in the late 1950's, the system's patent was not offered in North America until the early 60's, after it had been thoroughly tested in Europe.(Schultz, 1991) The first North American project was Habitat at the 1967 Olympic Village in Montreal.(Conine, Report No. 892-CSK, 1992)

The Sovent system was introduced in the United States in 1968 in a FHA/HUD project in Unimet-Richmond, California, where it was reported that it "performed better than the adjacent building that was plumbed with Uniform Plumbing Code criteria", which included a two-stack system.(Schultz, 1991) The single stack system is currently used in 43 states, and 275 cities across the United States.(Conine, Report No. 79115)

Sovent is currently specified by over 200 U.S. Consulting Engineers and installed by over 300 U.S. Plumbing/Mechanical Contractors.(Conine, Cast Iron Sovent DWV Systems...) The Sovent system has been currently installed in over 1,000 projects in the United States, including providing service for over 250,000 hotel rooms.(Conine, Report No. 79115)

The research on the Sovent system has been extensive in the United States. Both government and private organizations participated in these studies. On the

public level, the U.S. Department of Commerce, National Bureau of Standards conducted research which included testing that was published in Building Science No. 41.(Wyche, 1972) On the private level, Stevens Institute of Technology has been a primary contributor. The Stevens Institute also has done Sovent research on behalf of the United States Department of Housing and Urban Development (HUD).(Konen, 1974)

The original approval of the Sovent fittings was for the use of copper in the manufacturing process. The American National Standards Institute (ANSI) granted the approval for cast copper alloy solder joint fittings for Sovent drainage systems in 1973, which is ANSI B 16.32-1973. In 1982, ANSI approved the use of wrought copper and copper alloy solder joint fittings under ANSI B 16.43-1982. The use of cast iron for Sovent received its approval by ANSI in 1987, which is ASME/ANSI B 16.45.(American Society of Mechanical Engineers, 1987)

Because of the rise in the cost of copper materials, the cast iron fittings, in conjunction with poly vinyl chloride (PVC) pipe are the most economical installation. Variations, with respect to system operation, in using cast iron versus copper have shown to be insignificant.

CHAPTER II

SYSTEM OPERATION

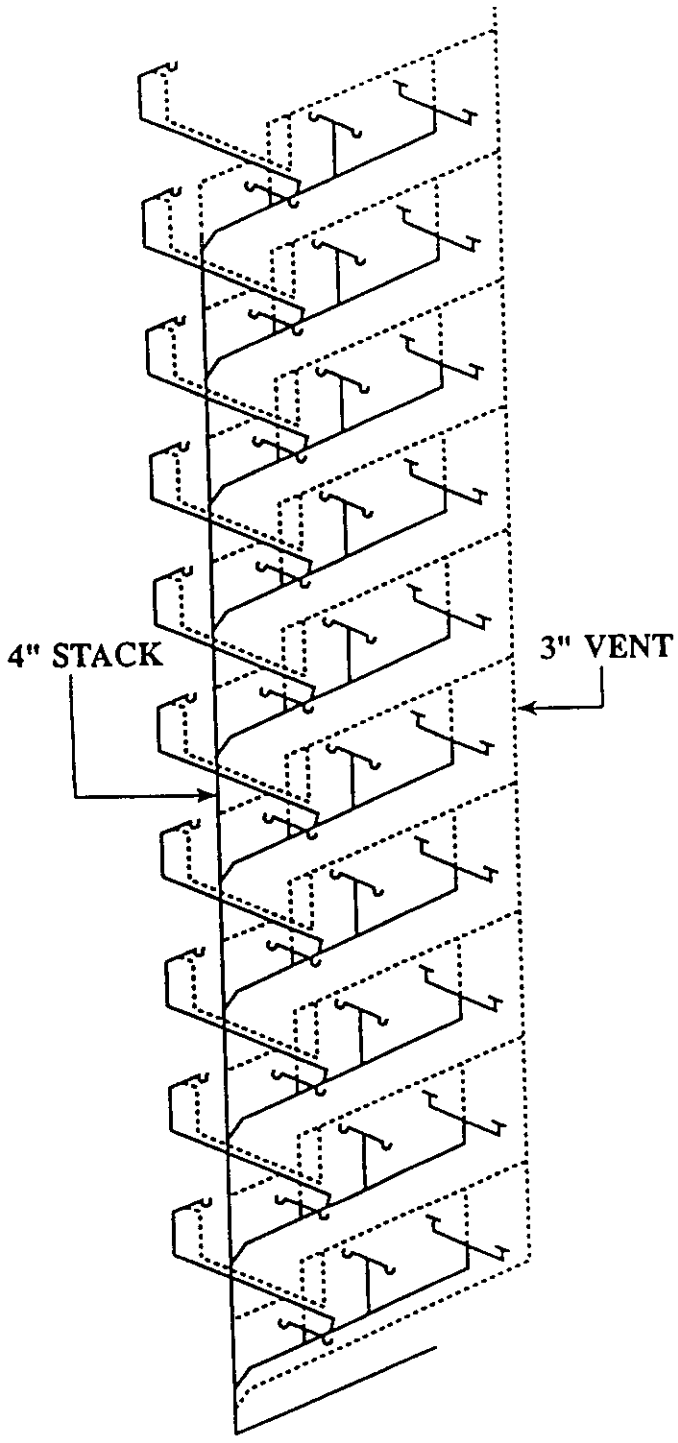
BASIC OPERATION

In any properly designed sanitary drainage system, traps are required to prevent sewer gas from entering a building. The seal in a water filled trap is quite fragile, therefore the design of all drainage systems must ensure that pressure within the system is balanced with atmospheric pressure. Pressure excursions must not exceed plus or minus one inch of water column or the trap seal is susceptible to failure. In conventional two-pipe systems, balance is maintained by separate systems for the movement of air and waste. The Sovent drainage system, however, accomplishes this by using only one stack in a self-venting system. FIGURE 1 and FIGURE 7 depict how the system functions.

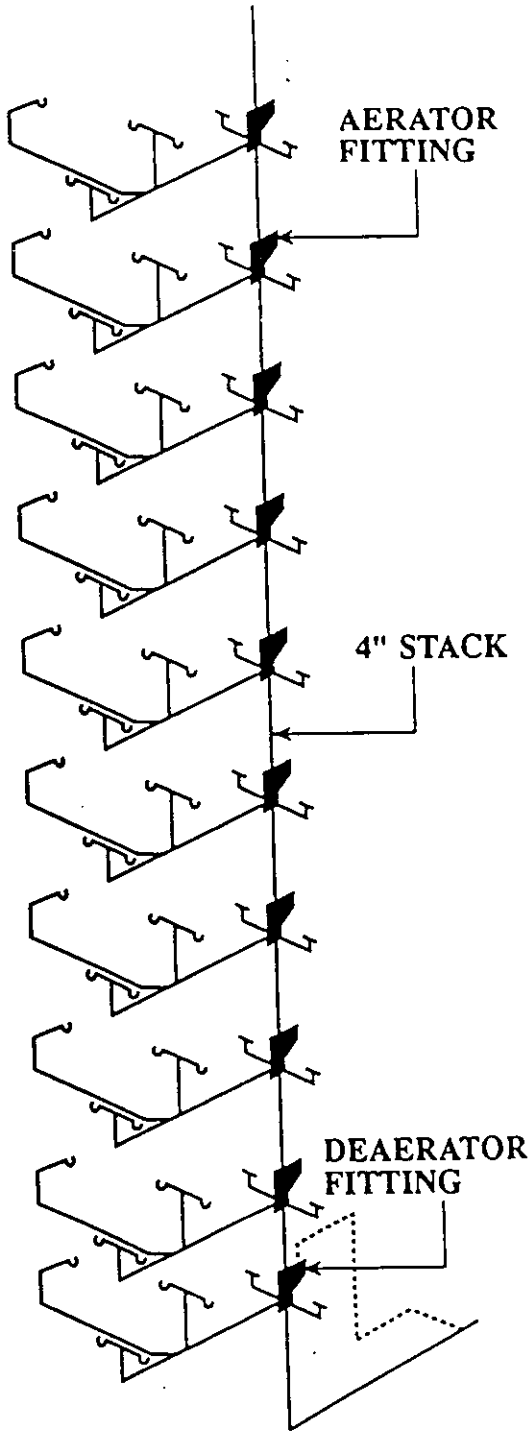
A venting system is a pipe or pipes installed in a sanitary drainage system to serve the following three functions: 1) to provide a flow of air to and from a drainage system so as to ventilate it; 2) to provide a circulation of air within such a system to eliminate trap siphonage and reduce back pressure and vacuum surge; and 3) to ensure the rapid and silent flow of waste. The Sovent system accomplishes this by means of a single stack with a special aerator fitting at each floor level and a de-aerator at the bottom of the stack.

FIGURE 1

COMPARISON OF TWO-PIPE SYSTEM AND SOVENT SYSTEM



CONVENTIONAL TWO-PIPE SYSTEM



SOVENT SYSTEM

SYSTEM COMPONENTS

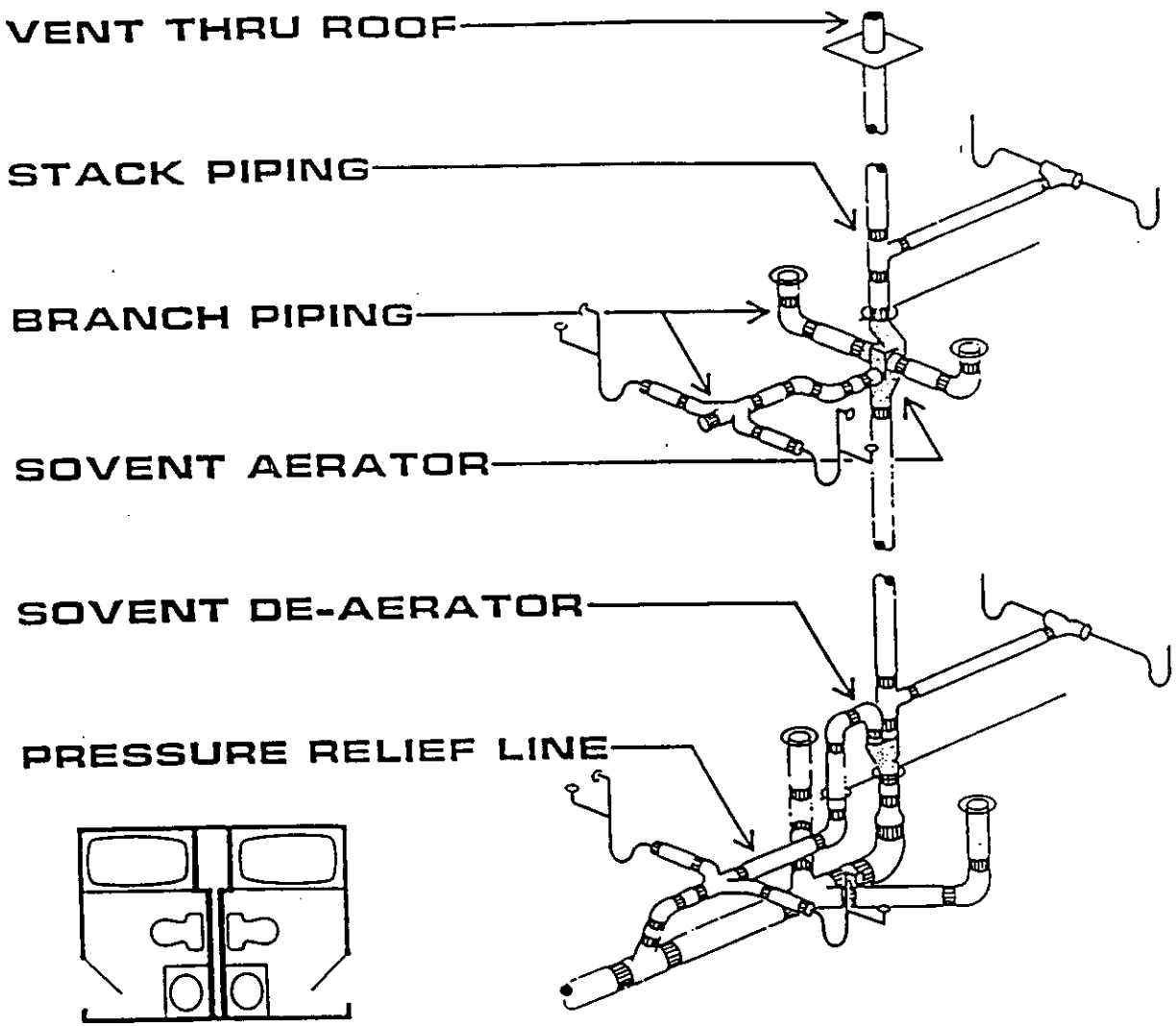
The Sovent system is designed to simplify drainage, waste, and vent piping in multistory buildings. It uses one pipe and specialized fittings to prevent the stack from becoming completely filled at any given time. The Sovent design utilizes two unique fittings as the basis for the self-venting features: the aerator and the de-aerator. (see **FIGURE 2**) Opponents contend that the Sovent system reduces the ability of the drainage piping to self-scour, because the system uses the aerator fittings which results in reduced flow in the branch lines, relative to the conventional system. This conclusion is inconsistent with the findings of the empirical research at this point in time.

To date, the efficiency of the Sovent system has shown to be directly related to the quality of installation. Proper sloping of lines is critical to functioning and maintenance of the system. The sloping of the drain lines is not limited to the branch Sovent lines; it also includes the other lines the Sovent system discharges into on site. **TABLE C** shows how the sloping of the lines effects the load carrying qualities.

Proper installation of the aerator fittings is also essential for the proper functioning of the system. The Sovent system will not function properly if the aerator fitting is installed upside down, which has been a problem in some installations.

FIGURE 2

Sovent System Components



Typical Back-to-Back Hotel Installation

THE AERATOR

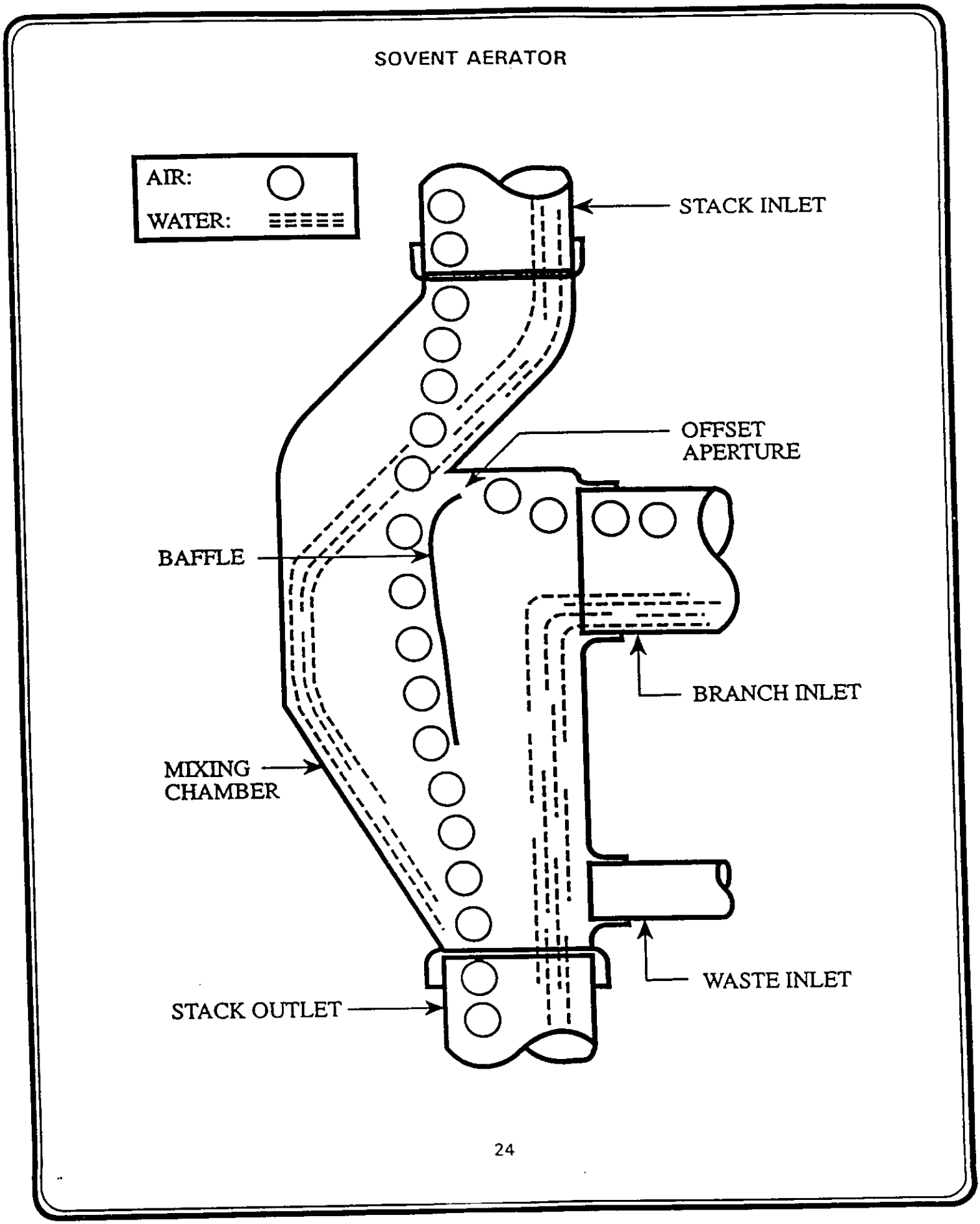
There are four primary components to the aerator: the mixing chamber, the offset chamber, and two internal baffles.(Conine, Sovent Plumbing Systems for Multi-Story Buildings, 1991) These components are cast into one piece. Once the casting is made, there is no access to the fitting without cutting or breaking the casting.

The mixing chamber allows waste flow from horizontal branches to enter the stack without interrupting vertical flow. This is the area where the liquids and solids drop down the drain line and the gases are vented to the roof through the Sovent system.

The function of the offset chamber is to reduce the velocity of falling waste and plugs of waste water that cause trap seal failures.(see FIGURE 7) One internal baffle separates the mixing and off-set chambers, and contains an aperture to ensure atmospheric balance of air pressure. The second internal baffle prevents cross flow from opposing branch inlets.

The aerator provides a chamber where the flow of soil and waste from the horizontal branches can unite smoothly with the air and liquid already flowing in the stack. These fittings are placed in the stack at every floor where there is a substantial branch. (see FIGURE 3)

FIGURE 3


SOVENT AERATOR
AIR:
WATER:
STACK INLET
OFFSET APERTURE
BAFFLE
BRANCH INLET
MIXING CHAMBER
WASTE INLET
STACK OUTLET

THE DE-AERATOR

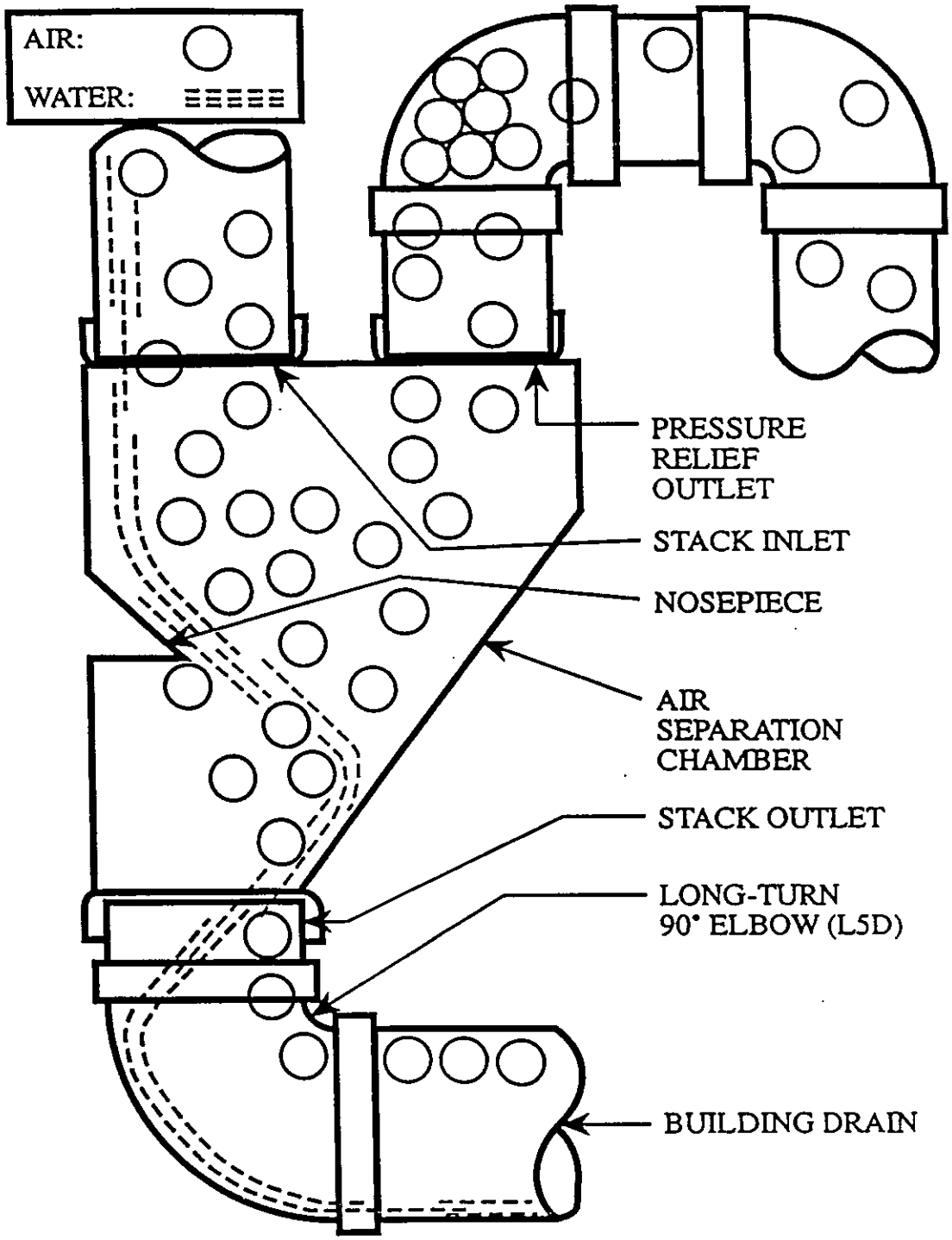
The de-aerator is placed at the base of the Sovent stack and at the horizontal stack off-sets. There are four primary components, as shown in **FIGURE 4**, which include: an internal nosepiece, a stack inlet and outlet and a pressure relief line outlet.(Conine, Sovent Plumbing Systems for Multi-Story Buildings, 1991) The internal nosepiece slows down the velocity of the waste entering the de-aerator, and allows the waste to continue down the horizontal drain, yet it still maintains air circulation in the stack and the pressure relief line. The inlet and outlet allow waste to flow through the de-aerator, while not permitting air to flow. The pressure relief line prevents pressure excursions that occur due to hydraulic jump.

The de-aerator is designed to essentially remove pressure fluctuations that occur when the combination of the water and the solid wastes stops falling vertically and makes a sudden change of direction to the horizontal plane, which allows their exit from the building.

This sudden change of direction causes a backup in the Sovent system which will result in a wave action. This tendency of the waste to jump to the horizontal pipe causes a hydraulic jump. The amount of hydraulic jump is dependant on the velocities and the amount of flow. Sovent has lower velocities and less hydraulic jump is experienced, than two-pipe systems.

FIGURE 4

SOVENT DE-AERATOR



BRANCH LINES

Unlike the conventional system, the Sovent design does not require back venting until the horizontal run exceeds 27 feet for 4 inch and larger lines. Smaller lines can be run 15 feet until venting is required.(Conine, Paper No. SAT-5001) The long horizontal distances without a separate vent permitted by the Sovent design are achieved by over sizing the branches.

The branch lines consist of standard piping and fittings that are the same type used on the two-stack systems. This standard piping and fittings are required to meet the standards as outlined by their manufacturers and the applicable codes.

The sizing of branch lines is based on basic criteria which allocates approximately 75% of the cross-sectional area of the DWV pipe for venting. With this much air space available for venting, designers are afforded considerable flexibility in their designs.

Sovent does not operate on a wet venting concept, because under this concept a separate vent stack would still be required. This concept is often misunderstood, and could lead to very expensive cost consideration, if owners, designers, and contractors are not on the same level of understanding.

SOVENT TESTING

Testing of the Sovent System was originally done under a grant for the Federal Government when the system was first introduced in to the United States. Under this testing the system was found to work in a satisfactory manner, which led to its use on a Federal Housing Authority Project in California.

The recent laboratory testing has been done in Hoboken, New Jersey at the Stevens Institute of Technology in the department of Mechanical Engineering. The principle researcher for this testing has been and currently is Professor Thomas P. Konen, P.E.

The testing apparatus as shown in **FIGURE 5** is designed to simulate actual conditions that would be encountered in the field. The Stevens Institute also has a building on campus that they use as an experimental building that is piped with the Sovent system.

The testing device shown in **FIGURE 5** contains a plastic tank which is filled with water and vented to the atmosphere, so as not to create any back pressure when the water is discharged from the tank. The flow of water from the tank is then controlled by two valves. One valve is a calibrated valve, so as to allow various amounts of water into the system. The second valve is a quick-opening valve, which will simulate a fixture that quickly discharges into a trap, which in

turn would go into the Sovent system.

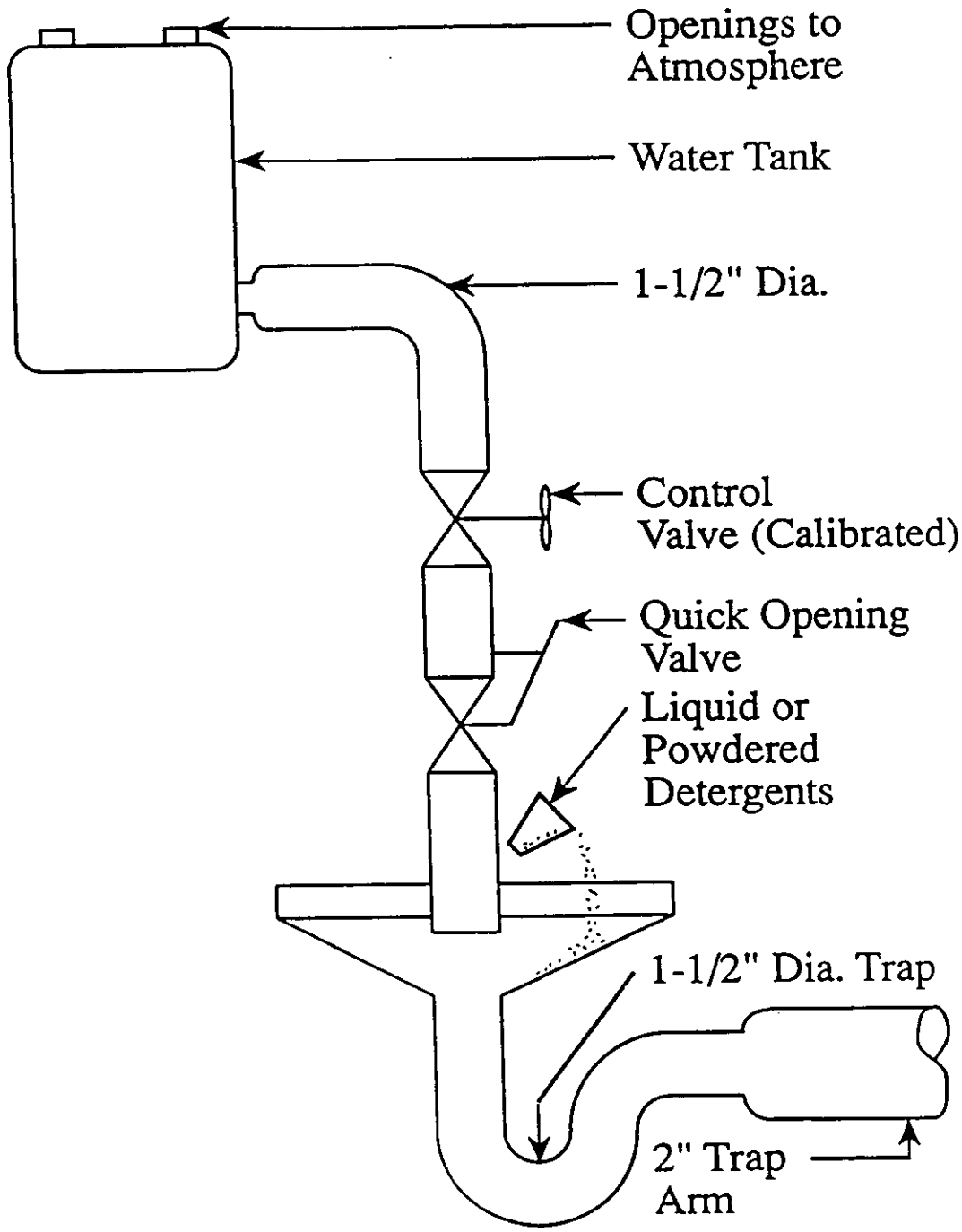
With suds being a problem with either the two-pipe or the Sovent system, the device in **FIGURE 5** also allows for detergents to be added to the testing apparatus to simulate not only the discharge of a bathtub or lavatory, but also that which would be encountered by the discharge from a washing machine or dishwasher.

Field tests have also been done by other engineers by filling up bathtubs, lavatories, and flushing water closets in a simultaneous manner on several floors of a building. The coordination of this effort was accomplished by the use of two-way radios with multiple test assistants in each test area. The intent of this type of field testing is to try to simulate alleged gas or waste backup in a Sovent system.

Computer technology has also been installed into the testing of the Sovent system. Computers are excellent for monitoring and recording data created when different variables are introduced into the testing process.

FIGURE 5

SIMULATION TESTING APPARATUS



CHAPTER III

METHODOLOGY OF RESEARCH

TELEPHONE INTERVIEWS

Four different types of telephone survey interviews were conducted. The reason for conducting each is outlined below.

The first interviews were to determine which counties in the state of Florida have used the Sovent system, and further, what the success or problems associated with Sovent have been. The questions that were used in these interviews are listed in APPENDIX 1 of this text. APPENDIX 2 contains the personal comments of the people that were contacted from the counties. All names were agreed, in advance of the interview, to be kept confidential, so this report would hopefully reflect their true experience or beliefs about the Sovent system.

The second telephone interviews asked questions as outlined in APPENDIX 3. These interviews targeted plumbing contractors in Florida who have installed Sovent. The nature of this interview was to determine reliability, desirability, cost effectiveness, code compliance and ease of installation of the Sovent system.

In the third telephone interview, engineers who have designed Sovent or who had knowledge of the system were contacted to establish ease of design, cost effectiveness, and problems associated with the system. The results of these interviews are contained in **APPENDIX 4**.

The fourth interviews were to have been with organized with labor who have had their members install the Sovent system. Organized labor was unavailable to discuss the Sovent system, and accordingly no comments are contained in this report as to their experience or opinion in this regard.

The questionnaire that was used for the plumbing contractors and the designers is in **APPENDIX 5**. The intent of this questionnaire was to give the person being interviewed adequate time to express their views on some of the critical issues regarding the use of the Sovent system. It has been found in other research that mail-out questionnaires have a low response rate, which led to these questionnaires being conducted over the telephone and through personal interviews.

The results of the questionnaires is believed to have provided both information that is accurate and candid. This information was obtained with the expected understanding, to those requesting to be kept anonymous, that we would honor this request.

CHAPTER IV

COST EFFECTIVENESS

Single stack plumbing systems have been in use for more than two decades in European countries. They have numerous cost advantages which focus around less material, and decreased labor. Savings are reported to be from 20 to 50%.

No one denies that savings can clearly be accomplished during the installation by using the Sovent system, but there are those that argue that the cost to the users is long term. They allege that the Sovent system tends to allow for back-up conditions which may cause objectionable odors and gases that create a health problem.

The manufacturers of Sovent fittings can point to numerous "no problem" installations in some very prestigious building across the United States and throughout the world. Sovent has shown to be an excellent cost effective measure that can and has been used in the mid to high-rise building process. The Sovent system will work in low-rise construction, but the cost effectiveness of usage in this type of installation does not justify having a new system introduced to the building process.

CHAPTER V

BUILDING CODE REQUIREMENTS AND COMPLIANCE

Code requirements and compliance are issues that are argued on many of the proposed installations of Sovent; the most argued points of code compliance are: the allowance of vent piping to run horizontally, the minimum distance to a vented line, and the mode in which the code is written. It is preferable to vent the loop to atmosphere rather than looping it into the sewer line. In the United States, due to the higher level of conventional plumbing standards over those of Europe, plumbing codes are more stringent. It is always possible to vent to atmosphere by running a vent pipe horizontally through the nearest outside wall. This practice, which is commonly accepted in Europe, is forbidden in the United States, where vent pipes must be run vertically through the roof of the building. If the second vertical pipe to the roof were installed, much of the economy of the Sovent system would be lost.

The Sovent system's lines can go up to twenty-seven feet un-revented, but most codes enforce a much smaller maximum distance. Codes are not written in the performance mode, which is a disadvantage to Sovent. If the codes were written more towards a specified end result, it would be much easier to employ the system. To be universally accepted throughout the United States, the Sovent

system would require its own, unique set of rules because it is radically different from the conventional system, upon which plumbing codes are based.

When asked about codes that allow Sovent installations, several engineers referred to the Philadelphia Code, but the system in Philadelphia is based on oversized pipe, not using Sovent fittings. This code would be an excellent reference for any code governing body to examine if they desire to consider a single pipe drain, waste, and vent system.

Code acceptance for the Sovent system has been slow and vague in the United States, but agencies such as: the Building Officials and Code Administrators, International BOCA, and the Southern Building Code Congress International (SBCCI) have endorsed its direct adaptation to their codes. The SBCC has approved the use of the Copper Development Association's Sovent System. In most cases the approval of the copper Sovent system will allow the use of the cast iron Sovent system. The only difference in copper versus cast iron are in the aerator and de-aerator, which ANSI has approved for copper and cast iron.

CHAPTER VI

SOVENT SYSTEM VS. CONVENTIONAL SYSTEM

The Sovent system is much more versatile and cost effective than the conventional, two-pipe system. There are three major areas that are attractive about the Sovent system.

The first area, as mentioned earlier, is that the branch lines can go twenty-five feet un-revented. The conventional system requires a much smaller distance, which requires considerably more piping. Next, because of this further venting distance, there is less restriction in the horizontal lines. This minimal restrictiveness of this system allows for more flexibility when deciding on fixtures. The third area where Sovent is advantageous over the conventional system is Sovent allows for more flexibility, because in the two-pipe system fixtures have to be placed on the line in a particular order.

The Sovent system also requires less: structural reinforcing, fire sealing, and sleeving. All of the above characteristics contribute to simplicity of installation, which requires less cross-over space.

Opponents of the Sovent system report that, due to its use of baffles and

offsets, Sovent creates a turbulent flow of water within the system, which is more susceptible to the production of suds. With more sudsing comes more potential back-up which in turn creates the possibility for odor and gas buildup. This gas buildup can not only create odors, but also pressures that may cause damage to fixtures or cause solids to be forced in the reverse direction of their intended flow.

Proponents argue that no more suds are created with the single stack system than the conventional, two-stack system. The key problem with the Sovent system is that, as explained further in the next chapter, it has a reduced margin for error relative to the conventional system.

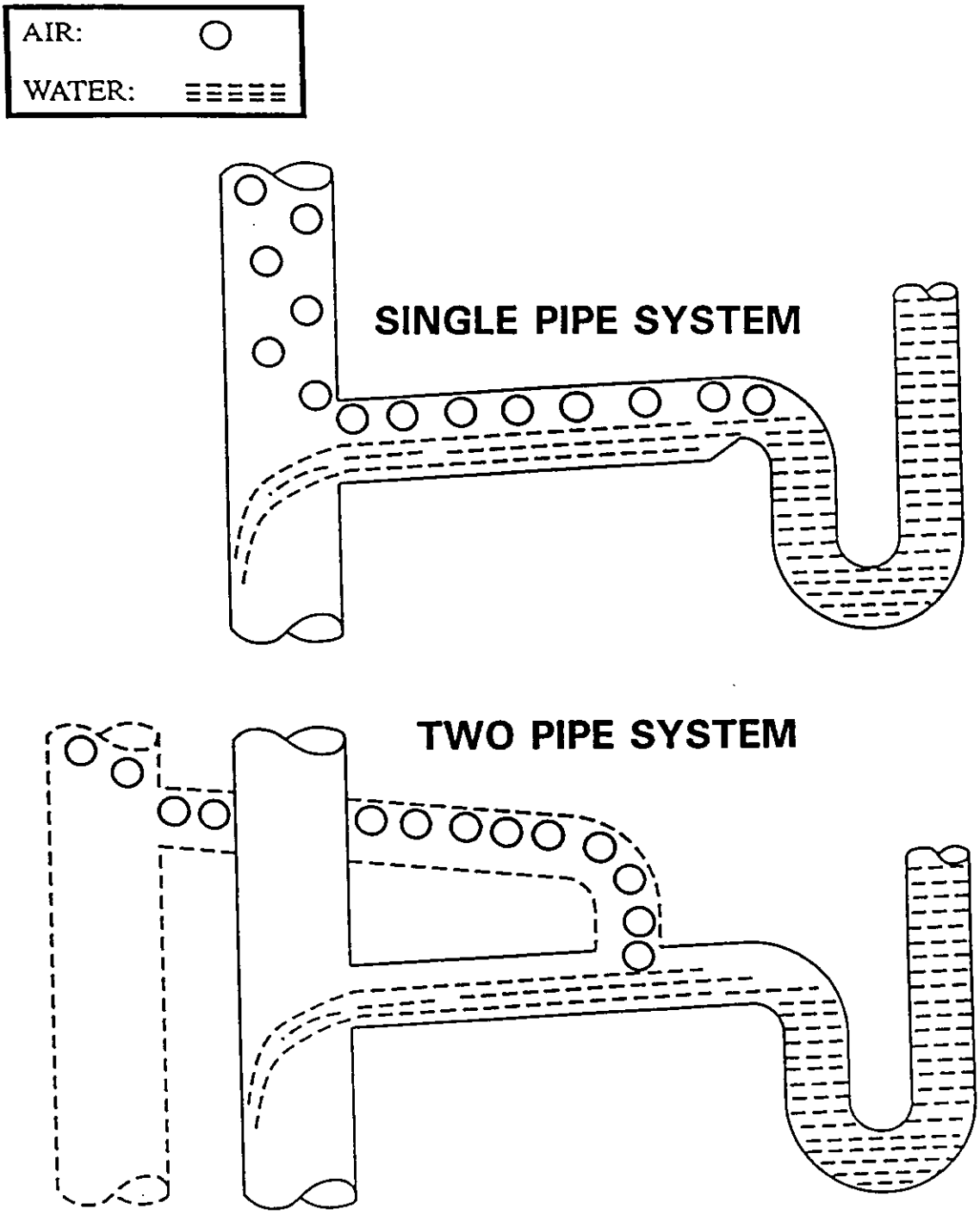
Extensive testing has been done on the Sovent system, which to this point, has indicated that the Sovent system does not have design deficiencies, but rather may have limitations in use.

One of the best ways to better understand how the two-pipe system compares to the single pipe system is to refer to **FIGURE 6**, which is a comparison of the two-pipe vented system and the single pipe system.

In **FIGURE 6**, it can readily be seen that if the trap seal in the Sovent system is ever lost, any gases that have accumulated in the high point of the line may be released through the trap. Testing to this point is still not conclusive.

FIGURE 6

COMPARISON OF SINGLE PIPE SYSTEM VS. TWO PIPE SYSTEM



CHAPTER VII

SIMPLICITY OF INSTALLATION

Installation is an area where the opponents of the system take issue. Organized labor has stated that their mechanics are not trained how to install Sovent, because it is not taught in their apprentice training programs. If Sovent's guidelines are not followed stringently, Sovent, as in any plumbing system, is prone to malfunction, with problems such as: fixture stoppages, backflow, sewer odors, loss of trap seals, sudsing, and noise. Some of these problems will occur regardless of the system installed, because conditions and materials, other than that of the Sovent fittings, will cause the problems.

The proponents of the system state the use of Sovent in the single stack system is easy to install, if the Sovent Installation Manual is followed thoroughly. The system uses universally accepted piping materials, which allows plumbers to use materials that are common to their training and licensing requirements.

The two stack system is commonly referred to as being "idiot proof," whereas the Sovent system requires more attention to the details of installation. The details that are most critical include: installing the fitting in the correct direction, sloping the lines properly, and removing all in-line obstructions from

system prior to putting the system to full-time use. If done correctly, the Sovent system can be installed in half the time it takes to install the traditional two-pipe systems. Correct installation is a primary concern, but prior to installation it must be designed properly. Pipe sizing is the critical aspect of the design process.

An experienced professional engineer, who understands the Sovent system, is required for design. Design help is available from the manufacturer and the consultants they have available. These consultants include researchers who have tested the system in actual field and laboratory conditions.

Design engineers and installers who have worked with the Sovent system have been complimentary regarding the availability of design assistance from Sovent manufacturers and their consultants. This assistance has been available not only in the United States, but also throughout other parts of the world.

CHAPTER VIII

ENGINEERING DESIGN CONSIDERATIONS

The Sovent system does have very important design considerations which are laid out in more detail in APPENDIX 7 of this text. This chapter will highlight some of the more important design considerations of the Sovent system. First, a minimum of eighteen to twenty-two inches of space is required between floors to accommodate the system. This minimum space is required to allow enough room for the proper pitch of the piping, which is essential for the system to operate effectively.

To create uniformity of flow, it is essential that the size of pipe used and the length of the branches be designed in accordance with Cast Iron Sovent Design Manual No. 802. Proper anchorage and support are also very important to assure system alignment.

It is essential that all connections be watertight, which must be verified by testing to assure design criteria will be met. Leaks in the system is a condition that could lead to gases being discharged in places other than where they were intended.

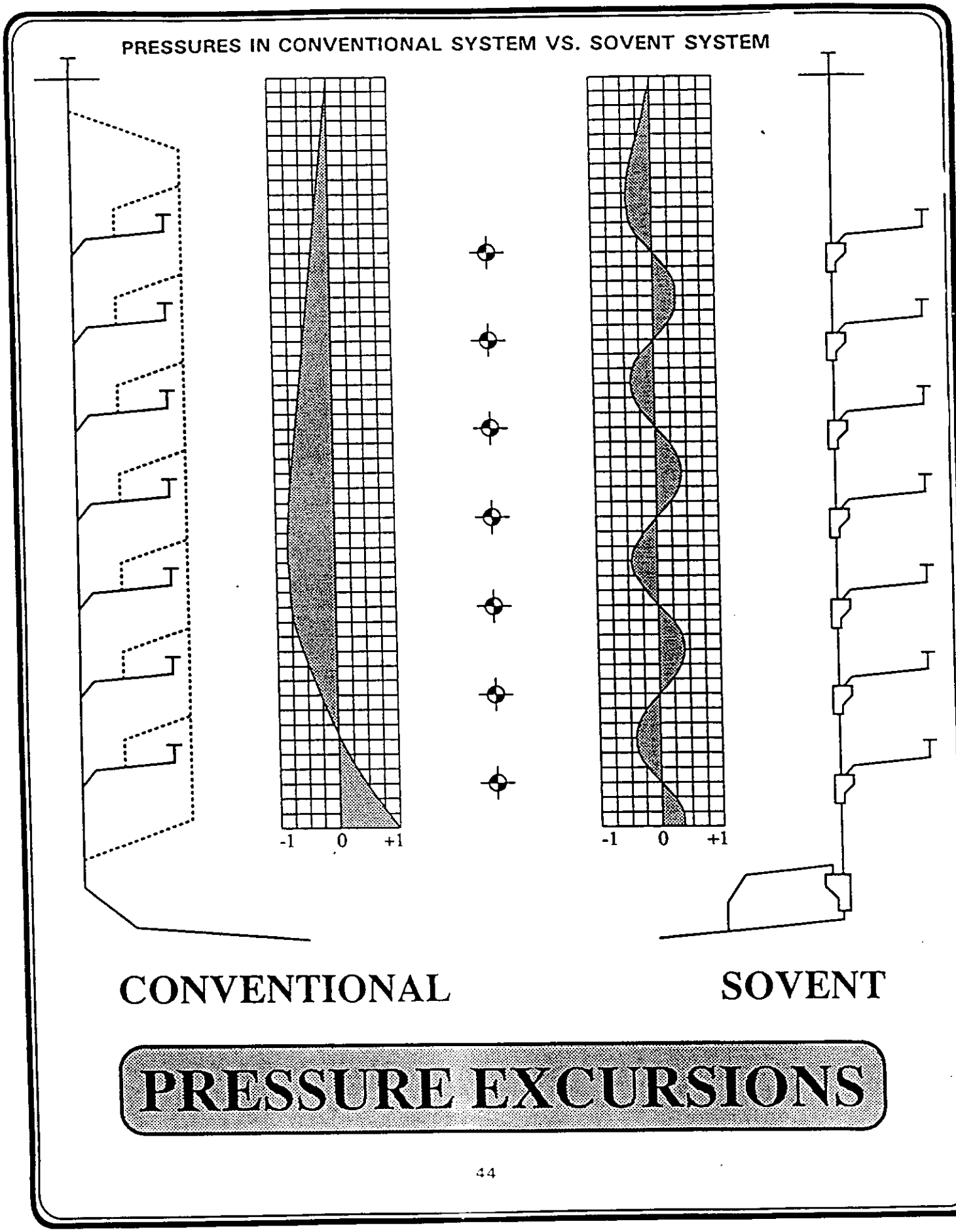
It is very important that pumped discharge fittings not be tied into the system. The Sovent system is very delicate in that it relies on a state of equilibrium, and if a pumped discharge fittings were used, it would disrupt that balance. The single stack Sovent system is designed for gravity fixtures; any other usage would require testing beyond what has been done at this time. It should also be noted that self-venting drainage systems, such as Sovent, are not suitable where flooded sewer conditions exist or where there is the potential for flooding.

The inventor and subsequent developers of Sovent have provided the plumbing industry with design criteria and installation techniques, as outlined in Appendix 6 of this text, that offer a plumbing designer data enabling him to design DWV systems using Sovent. All plans that involve the use of the Sovent system must be reviewed by the manufacturer to help eliminate design problems. This form of quality control helps to ensure that a constant, good quality system can be achieved using the Sovent system.

Pressure within any drain, waste, and vent system is a very important concern. To protect trap seals it is essential that neither a negative or a positive pressure excursion be created that exceeds the affect of one inch of water column. The term excursions in this usage is a deviation from a zero pressure ideal condition.

The pressure excursions in **FIGURE 7** give a good comparison of how the Sovent system functions in relationship to the conventional system. This type of graphical representation allows designers to have a visual understanding of how the two systems function in different manners.

FIGURE 7


PRESSURES IN CONVENTIONAL SYSTEM VS. SOVENT SYSTEM
-1
0
+1
-1
0
+1
CONVENTIONAL
SOVENT
PRESSURE EXCURSIONS

CHAPTER IX

CAST IRON PIPE VS. PLASTIC PIPE VS. COPPER PIPE

The type of pipe used is another highly debated issue. Engineers differ as to their own personal preference. Cast iron pipe is the more universally accepted material for the Sovent system, where material uniformity is required. It's attributes include a reduction in noise, ease of assembly, and it's less costly than copper.

Plastic pipe, PVC, has been introduced in more recent system design due to its ease of handling and cost saving features. PVC has had limited use, because of plumbing codes that restrict such usage. There are no PVC Sovent fittings (aerator, de-aerator), therefore if plastic pipe is used, cast iron or copper adapters must be provided. Use of multiple materials in the installation of the Sovent system has become common practice.

When Sovent was originally introduced, the systems were usually uniform as to the material utilized. As previously stated, the two materials used for uniformity are copper and cast iron.

Cast iron stacks are still required in some installations. In most recent installations, PVC branches have become widely accepted. The use of PVC branches are often dependant on the approval of the governing authority.

The use of copper Sovent fittings and then using copper pipe would allow for material uniformity, but with today's prices of materials, this uniformity would not be cost effective. Copper does allow for better flow, but through testing, it has been shown that the degree of smoothness does not materially affect the system's functions.

At one time, the Copper Development Association did the marketing for the Copper Sovent. Today, copper is still an excellent material for the Sovent fitting and also the drain pipe, but the cost of these materials has virtually eliminated the use of the Copper Sovent system.

CHAPTER X

USE OF SOVENT IN MID-RISE AND HIGH-RISE INSTALLATIONS

CONDOMINIUMS

The Sovent system has been used in numerous condominium projects throughout the world. This type of construction allows for repetative systems to be employed, which lends itself very well to use of the Sovent system. Cost savings are considerable with the use of Sovent in this type of construction, but these installations in condominiums and apartments are not without controversy.

Alleged problems with the Sovent system have been primarily in condominiums or other residential units, which included: 1.) Excess noise on upper floors that is transferred to the lower floors 2.) Soap suds caused by laundry systems have, at times, caused system blockage 3.) Installation problems have caused system malfunctions, which were correctable after the problems were identified 4.) Seasonal usage may have caused traps to become dry, thus allowing odors to be discharged, which have been noticeable within adjacent units.

As of the writing of this report, the alleged problems, as described above, can not be recreated by generally accepted empirical methods.

HOTEL AND DORMITORY BUILDINGS

Installation of Sovent in hotels and dormitory buildings has yielded problem free installations. Because of the lack of grease and high sudsing detergents, the waste system is allowed to flow as it was designed in Europe and originally tested under the guidelines of HUD/FHA.

So far, the further field testing of the Sovent system by the Department of Mechanical Engineering at the Stevens Institute of Technology has focused on Hotels/Dormitory type of buildings. Their primary testing facility being a residence center on their campus called Technology Hall which contains a Sovent system.

The testing in the above references has shown the system to perform very well. Both laboratory and field testing have been positive with respect to the Sovent system, in the hotel and dormitory application.

OFFICE BUILDINGS

Buildings that are used as offices create high peak demands, but do not, except for a few cases, have the problem of sudsing or excessive grease being injected into the system. Exceptions would include buildings with a restaurant on an upper floor or office buildings with mixed use of office spaces and apartments.

The Sovent system has shown to function very well in office buildings, with maintenance costs at a minimum. Sovent has also shown to be a very cost effective method of handling the discharge from drainage, waste, and vent systems, in office type buildings.

CHAPTER XI

RESULTS OF PLUMBING SUBCONTRACTOR INTERVIEWS

These interviews were conducted by phone with plumbing subcontractors, on a random basis, throughout the State of Florida. The purpose of these interviews was to determine the length of use, the frequency of use, the success of installation, the durability, the type of material used, and the savings realized with the use of the Sovent system. The interviews showed that the plumbing contractors, who had successfully installed the Sovent system, had no reservations about installing the system again on another project; they all emphasized the care that was necessary for successful installation.

The plumbing contractors, who were required to certify that their installation was correctly accomplished, were willing to do so. Without reservation they emphasized the simplicity of installation. The plumbing contractors, who had experience with the Sovent system on more than one installation, indicated that the only problems they were aware of dealt with incorrect installation, which after corrected eliminated the problems completely. The systems that were installed in Florida have been those of cast iron fittings in conjunction with PVC pipe, and no plumber reported any problem with the installations.

CHAPTER XII

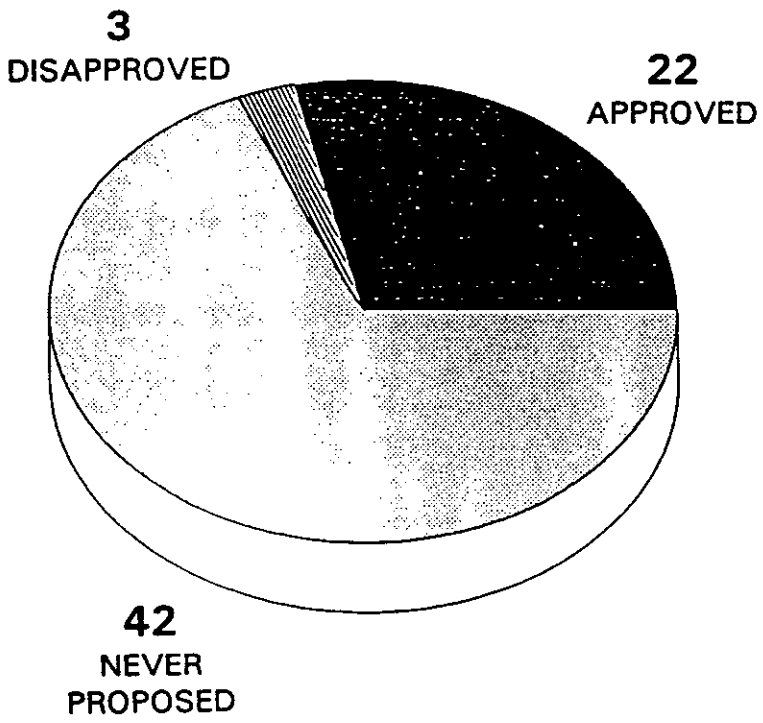
RESULTS OF FLORIDA COUNTY INTERVIEWS

All Florida counties were contacted. Most often, the plumbing inspector was interviewed. When unavailable, other responsible personnel, such as the building inspector, plan reviewer, or building official, were interviewed. The results of these questions were catalogued on TABLE 1, and significant comments made by interviewees are contained in APPENDIX 2. After analyzing this data, what conclusions may be made?

After contacting the counties, it was found that those who have used Sovent have a high population within their counties, and are dense with commercial and residential multi-story buildings. Counties that are mainly agricultural had never used Sovent, although they had mid-rise structures. Since the plumbing codes do not specifically refer to acceptance of Sovent, a professional engineer is required to seal the plans. Even with the seal, some Florida counties have been reluctant and have refused to give approval to the Sovent system. (see FIGURE 8) There concern is in the area of public welfare, but the basis for their denial of the Sovent system lacks technical support.

FIGURE 8

SOVENT SYSTEM
Approval in Florida Counties



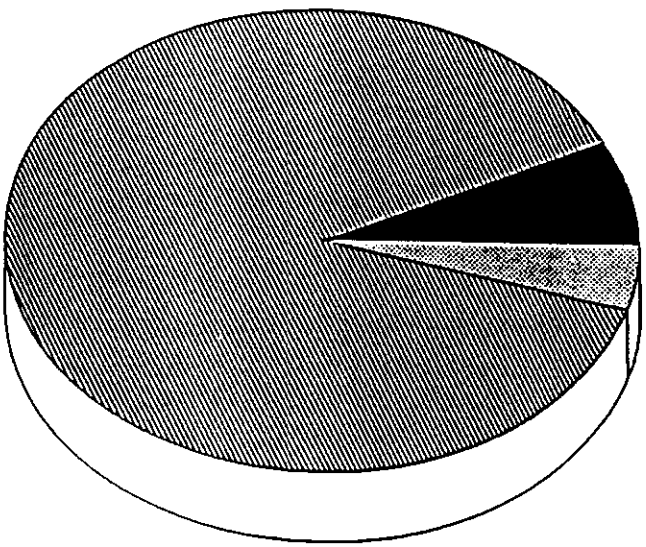
As the interviews of the officials were conducted, it was found that a great number of them had never heard of the Sovent system. Review of FIGURE 10 gives a good indication as to the scattered use of the Sovent system. With the Sovent system being used in the new Dolphin Motel at Walt Disney World, an acceptance of the system has reached a new high for hotel usage. Larger populated areas such as Tallahassee and Jacksonville have had very limited use of the system which is evidenced in FIGURE 9.

The interviews with the building officials throughout the state indicated a lack of understanding of how the system is designed to function. The building officials also showed a concern for the training of their inspectors relative to inspecting the system's installation.

In the majority of interviews it was found that the inspectors that understood the Sovent system, and were trained in its installation were not concerned with its usage in their county. In some cases, these inspectors indicated that, because of the Sovent system requires less piping than the two pipe system, inspections could be accomplished more expediently.

FIGURE 9

SOVENT SYSTEM
Results of Performance in Florida Counties



47
NOT USED,
OR NO RECORD
OF USE

18
GOOD RECORD
OF USE

2
MIXED RESPONSES,
POSITIVE AND
NEGATIVE RECORD
OF USE

CHAPTER XIII

RESULTS OF ENGINEER INTERVIEWS

The design engineers that were contacted that had actually designed Sovent systems, repeatedly had positive comments about the system. The negative comments came from engineers that either were called in to review an existing system or those who were asked to make additions onto existing systems.

The engineers that refused to use the Sovent system, based their reluctance on negative publicity. Neither negative qualitative or quantitative test data was ever specified as a reason for not being willing to design a sanitary system using Sovent.

Without exception, the design engineers make it very clear, that if tests conclusively proved the Sovent system would not function properly, or that if it created health problems, they would not use the system. None of the engineers could reference any such data.

Engineers did explain their concern in the area of potential lawsuits, focused against their errors and ommisions policies. They stated that the fees they would recieve for the design services would not justify the potential exposure of a

lawsuit. These statements are not without basis cosidering the extensive class action lawsuits filed by condominium associations against entire development teams, including designers, owners, and constructors.

The engineers that had previously designed plumbing systems utilizing Sovent were very clear in their understanding of the advantages of the system. The comments from the designers are listed in **APPENDIX 5** of this text. Where there was repetition in their comments, they were listed only on one occasion.

Some engineers indicated that they felt they had a responsibility to owners to design the best plumbing system for the money. All engineers agreed that Sovent systems are more economical, anywhere from 20% to 50% reduced installation costs, than what is referred to at the conventional two pipe system.

CHAPTER XIV

SOVENT USAGE THROUGHOUT FLORIDA

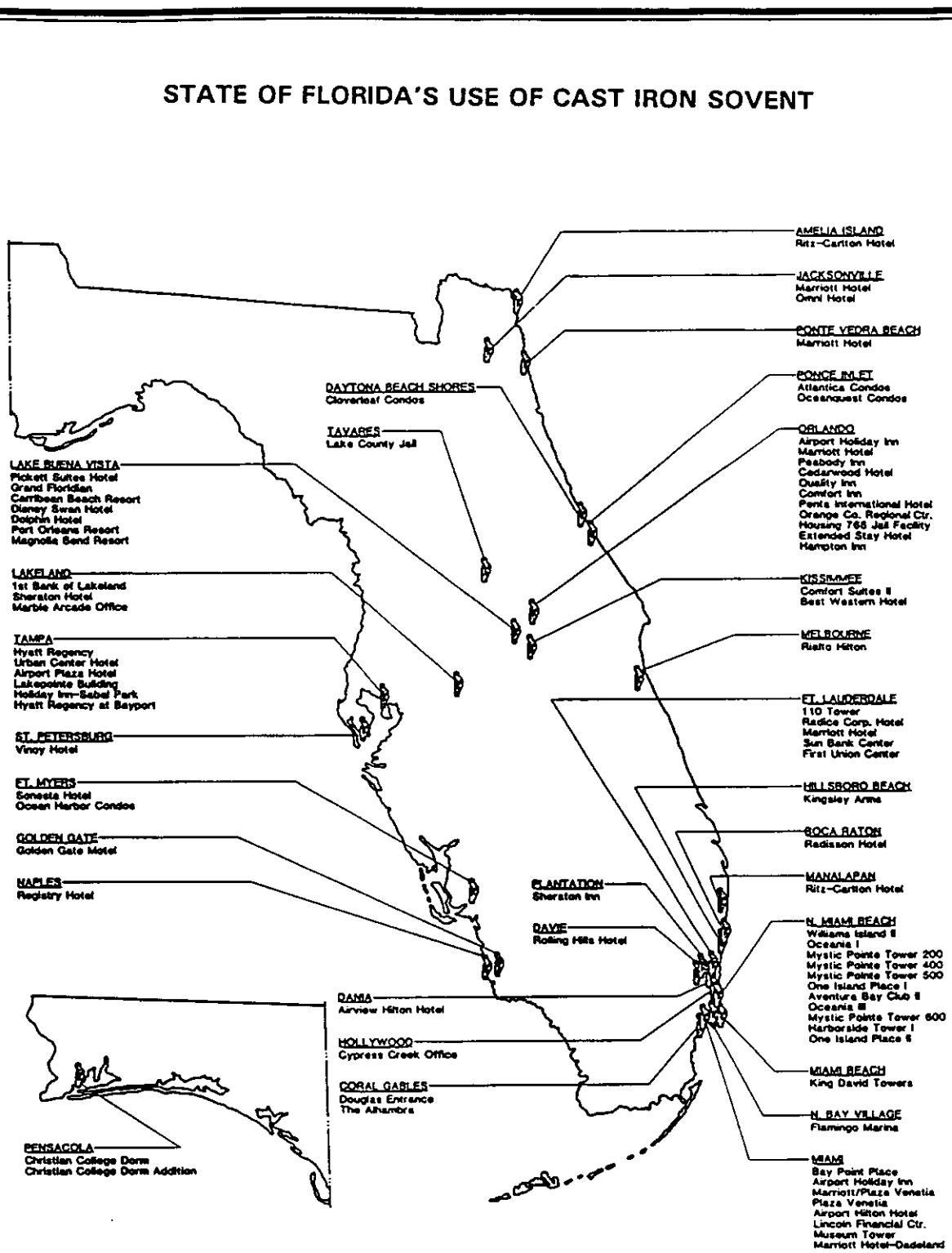
The cast iron Sovent system has had extensive use throughout the state of Florida, as **FIGURE 10** depicts. The titles of the projects, in most cases, detail the types of projects that have been constructed within Florida using the Sovent system.

As can be seen in **FIGURE 10**, the greater concentration of the Sovent system usage is in the central and southern part of Florida, with strictly hotel usage in the northern part of the state. There have not been reported problems in hotels. Those using the Sovent system in the northern part of the state have not indicated any problems associated with the system.

The central part of the state has used the Sovent system primarily for hotel, dormitory, and office buildings. There have been no reported problems with the system in these types of usage. Future designs incorporating the Sovent system are continuing for these usages, in these areas.

Since the southern part of the state has a much higher concentration of condominiums, usage is now being questioned in Dade county.

FIGURE 10


STATE OF FLORIDA'S USE OF CAST IRON SOVENT
AMELIA ISLAND
Ritz-Carlton Hotel
JACKSONVILLE
Marriott Hotel
Omni Hotel
PONTE VEDRA BEACH
Marriott Hotel
PONCE INLET
Atlantica Condos
Oceansquest Condos
DAYTONA BEACH SHORES
Cloverleaf Condos
TAVARES
Lake County Jail
ORLANDO
Airport Holiday Inn
Marriott Hotel
Peabody Inn
Cedarwood Hotel
Quality Inn
Comfort Inn
Penta International Hotel
Orange Co. Regional Ctr.
Housing 768 Jail Facility
Extended Stay Hotel
Hampton Inn
LAKE BUENA VISTA
Pickett Suites Hotel
Grand Floridian
Carribean Beach Resort
Disney Swan Hotel
Dolphin Hotel
Port Orleans Resort
Magnolia Bend Resort
KISSIMMEE
Comfort Suites II
Best Western Hotel
LAKELAND
1st Bank of Lakeland
Sheraton Hotel
Marble Arcade Office
MELBOURNE
Radio Hilton
TAMPA
Hyatt Regency
Urban Center Hotel
Airport Plaza Hotel
Lakepointe Building
Holiday Inn-Sabal Park
Hyatt Regency at Bayport
FT. LAUDERDALE
110 Tower
Radice Corp. Hotel
Marriott Hotel
Sun Bank Center
First Union Center
ST. PETERSBURG
Vinoy Hotel
HILLSBORO BEACH
Kingsley Arms
FT. MYERS
Sonesta Hotel
Ocean Harbor Condos
BOCA RATON
Radisson Hotel
GOLDEN GATE
Golden Gate Motel
MANALAPAN
Ritz-Carlton Hotel
NAPLES
Registry Hotel
PLANTATION
Sheraton Inn
N. MIAMI BEACH
Williams Island II
Oceania I
Mystic Pointe Tower 200
Mystic Pointe Tower 400
Mystic Pointe Tower 500
One Island Place I
Aventura Bay Club II
Oceania III
Mystic Pointe Tower 600
Harborside Tower I
One Island Place II
DAVIE
Rolling Hills Hotel
DANIA
Airview Hilton Hotel
HOLLYWOOD
Cypress Creek Office
MIAMI BEACH
King David Towers
CORAL GABLES
Douglas Entrance
The Alhambra
N. BAY VILLAGE
Flamingo Marina
MIAMI
Bay Point Place
Airport Holiday Inn
Marriott/Plaza Venetia
Plaza Venetia
Airport Hilton Hotel
Lincoln Financial Ctr.
Museum Tower
Marriott Hotel-Dadeland
PENSACOLA
Christian College Dorm
Christian College Dorm Addition

CHAPTER XV

CONCLUSION

The Sovent system has gained international acceptance, but has run into problems in the United States. Installation problems have shown to be the system's main adversary. Opponents of the Sovent system have spent considerable effort in identifying building projects, where Sovent was installed, that had plumbing related problems. After reviewing hundreds of such allegations, and conducting hundreds of interviews, this report finds that these statements are not supported by empirical data.

Objectionable noise, odors, and in some cases sewage backwash have caused concern to building officials, owners, engineers, and contractors. Some engineers refuse to accept the system as an alternative to the two-pipe system. Allegations of problems as described above need a more thorough investigation, but this investigating needs to be done by qualified and unbiased people.

With the extensive testing done by Stevens Institute and with the successful installations in Europe and the United States, the results clearly indicate that Sovent has had good success for hotels, dormitories, and offices. When the system is designed and installed properly, the alleged problems that have been

attributed to the Sovent system can not be recreated by field testing.

It is essential that building officials be trained as to installation requirements, or engineers with professional registration must supervise and give written approval of installations. Plumbing installations, whether Sovent or the traditional two-pipe system, without inspection will always allow for workmanship shortcomings.

The problems that have been encountered with the Sovent system in South Florida may have a relationship with the amount of grease produced and discharged into the system from cooking, or the seasonal use of the dwelling units where traps lose their seal.

As stated previously, the use of the Sovent system has had its best success in hotels, dormitories, and commercial buildings. This report has found no reason why the Sovent system should not be used in these types of installations. The record of success in these types of installation now has the longevity in Europe and the United States that should satisfy potential installers, designers, users, or building officials.

The problems of health concern, which include the potential of solids backing up in the system, gases, grease accumulation, noise, and odors, can not

be disregarded. At the same time, these issues do not necessarily make an indictment against the Sovent system. Studies that were designed to evaluate whether the Sovent system was the cause of the problems have not been successful in providing data that justifies such an indictiment against Sovent.

The interview comments as listed in **APPENDICES 2-5** are typical of the proponents and opponents of Sovent, only further unbiased testing will resolve the entrenched positions of those having opinions about Sovent. Even with such testing, different buildings have many variables that would create unique features, and accordingly cause specific design considerations.

With engineers willing to put their reputations in jeopardy, by using a controversial system like Sovent, it clearly indicates their support of the Sovent system is strong. Without test data to support the alleged problems of Sovent, this report can only conclude that there is no reason why the system should not be used. With the cost of construction continually on the rise, the Sovent system is clearly a way to reduce costs.

CHAPTER XVI

RECOMMENDATIONS

1.) Sovent manufacturers need to qualify installers, so that all who install the system are qualified by strictly regulated forms of certification. If manufacturers do qualify their installers,then it would follow that failure to provide proper installations would necessitate revoking certification. This method of certification would signal building departments to not allow permits to be issued to installers that were not certified in the installation of the Sovent system.

2.) System installation needs to be inspected prior to any part of the system being enclosed in a wall. Slopes of drain lines, pressure testing of the Sovent system, and adherence to manufacturers recommendations need to be verified, while the system is available to visual inspection.

3.) Inspectors need to be trained regardless of whether they represent a government agency or an engineer. Manufacturer certification may be appropriate in this regard. Since the system is simple, the training should also be simple. A VCR training film would be appropriate for use in this type of training. The first time the VCR is used to communicate Sovent intallation, it should be introduced by the Sovent manufacturer's representatives. After the initial presentation, the Sovent videotape should be kept on file with the building department or engineer.

4.) Provisions need to be made, that guarantees for continuation of the Sovent fittings to protect owners and occupants of buildings that now contain the system. One suggestion in this regard may be for the manufacturers to keep an inventory of fittings of a certain quantity at all times. Another way to accomplish this gaurantee would be for some form of backup agreement with another entity that would take over manufacturing and distribution, if the present manufacturer is unable or unwilling to continue.

5.) Data needs to be accumulated, recorded, and analyzed as to alleged malfunctioning with respect to Sovent. To date, research indicates the problems that occur in plumbing systems where Sovent is involved, can not be attributed back to the Sovent system. This investigation needs to be done through an engineering based analysis.

6.) Further research would be appropriate as to how the Sovent system functions in various conditions where, as an example: cooking is done with heavy greases, or the affect of seasonal usage of the dwelling units, where the trap seals may be lost. The same research should be done on the two-pipe system to provide a comparison. The results of this research needs to be done by an unbiased engineering based investigator. If findings show that trap seals are lost quicker in the two pipe system, because of the more air exposed to the trap, then these results need to be noted, as a positive aspect of Sovent.

7.) Differentiation of usage of Sovent needs to be determined in some applications. The system is clearly more desirable in certain uses than in others. Usage needs to be evaluated before the system, as a whole, is banned. An example of this would be in hotel vs. condominium usage. Hotels do not have the sudsing or grease problems that are inherent with condominiums.

8.) Manufacturers of the Sovent fittings need to cast some indication, as to the direction of flow externally on to the aerator fitting. Until some form of certification is utilized regarding installers, the fitting can be installed upside down by inexperienced installers. This type of added safegaurd is very important to system installation and maintenance.

9.) To eliminate the affect of sudsing in the Sovent system, a separate drain line should be considered for clothes washers. This drain line would be tied into the sanitary system on the downflow side of the Sovent system. Some engineers have indicated reservations in this regard, because of the possible backup of this new line, from excessive sudsing, because there would not be enough waste to wash the suds out of the drain line.

CHAPTER XVII

SOURCES OF ASSISTANCE

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APPENDIX 1

TABLE A

INTERVIEW OF COUNTY INSPECTORS

KEY

REP = REPRESENTATIVE WHO WAS INTERVIEWED
- BI = BUILDING INSPECTOR
- BO = BUILDING OFFICIAL
- PI = PLUMBING INSPECTOR
- CL = CLERK
- PA = PLANS APPROVAL

CON = CONTRACTOR PROPOSED
- YES = YES
- NO = NO

APP = APPROVAL OF THE SOVENT SYSTEM INTO A COUNTY
- NP = NEVER PROPOSED
- YES = YES
- NO = NO

REJ = REJECTION OF THE PROPOSED SOVENT SYSTEM
- YES = YES
- NO = NO

RES = RESULTS OF THE SOVENT SYSTEM IN THE COUNTY
- GOOD = GOOD
- NONE = NOT USED OR NO RECORD OF USE
- MIXED = MIXED RESPONSES

APPENDIX 1

TABLE A

INTERVIEW OF COUNTY INSPECTORS

COUNTY	REP	APP	CON	REJ	RES
Alachua	BI	NP	NO	NO	NONE
Baker	BI	NP	NO	NO	NONE
Bay	PI	NP	YES	NO	NONE
Bradford	BI	NP	NO	NO	NONE
Brevard	PI	YES	YES	NO	GOOD
Broward	PI	YES	NO	NO	MIXED
Calhoun	PI	YES	YES	NO	GOOD
Charlette	PI	NP	NO	NO	NONE
Citrus	PI	NP	NO	NO	NONE
Clay	PI	YES	NO	NO	GOOD
Collier	PI	YES	YES	NO	GOOD
Columbia	PI	NP	YES	NO	NONE
Dade	PI	NO	YES	YES	MIXED
DeSota	BO	YES	YES	NO	NONE
Dixie	BI	NP	NO	NO	NONE
Duval	PI	YES	NO	NO	GOOD
Escambia	PI	YES	YES	NO	GOOD
Flagler	PI	NP	NO	NO	NONE
Franklin	PI	NP	NO	NO	NONE
Gadsden	PI	NP	NO	NO	NONE

APPENDIX 1

TABLE A

INTERVIEW OF COUNTY INSPECTORS

COUNTY	REP	APP	CON	REJ	RES
Gilchrist	PI	NP	NO	NO	NONE
Glades	PI	NP	NO	NO	NONE
Gulf	PI	NP	NO	NO	NONE
Hamilton	PI	NP	NO	NO	NONE
Hardee	BI	NP	YES	NO	NONE
Henry	PI	YES	NO	NO	NONE
Hernando	PI	YES	NO	NO	GOOD
Highlands	PI	NP	NO	NO	NONE
Hillsborough	PI	YES	YES	NO	GOOD
Holmes	SE	NP	NO	NO	NONE
Indian River	PI	YES	NO	NO	NONE
Jackson	SE	NP	NO	NO	NONE
Jefferson	PI	NP	NO	NO	NONE
Lafayette	BI	NP	NO	NO	NONE
Lake	BI	YES	YES	NO	GOOD
Lee	BI	YES	YES	NO	GOOD
Leon	BI	YES	YES	NO	GOOD
Levy	SE	NP	NO	NO	NONE
Liberty	CL	NP	NO	NO	NONE
Madison	SE	NP	NO	NO	NONE

APPENDIX 1

TABLE A

INTERVIEW OF COUNTY INSPECTORS

COUNTY	REP	APP	CON	REJ	RES
Manetee	PA	NP	NO	NO	NONE
Marion	PI	NP	NO	NO	NONE
Martin	PI	NP	NO	NO	NONE
Monroe	PI	NO	NO	YES	NONE
Nassau	PI	YES	NO	NO	GOOD
Okaloosa	BO	NP	YES	NO	NONE
Okeechobee	BI	NP	NO	NO	NONE
Orange	PI	YES	YES	NO	GOOD
Osceola	PA	YES	YES	NO	GOOD
Palm Beach	PI	YES	YES	NO	GOOD
Pascoe	PI	NP	NO	NO	NONE
Pinellas	PI	YES	YES	NO	GOOD
Polk	PI	YES	YES	NO	GOOD
Putnam	SE	NP	NO	NO	NONE
Santa Rosa	BI	NP	YES	NO	NONE
Sarasota	BO	NP	YES	NO	NONE
Seminole	PI	YES	YES	NO	GOOD
St. Johns	BI	NP	NO	NO	NONE
St. Lucie	SE	NP	NO	NO	NONE
Sumter	BI	NP	NO	NO	NONE

APPENDIX 1

TABLE A

INTERVIEW OF COUNTY INSPECTORS

COUNTY	REP	APP	CON	REJ	RES
Suwanee	BI	NP	YES	NO	NONE
Tayler	PI	NP	NO	NO	NONE
Union	PI	NP	NO	NO	NONE
Volusia	BO	NP	NO	NO	NONE
Wakulla	BI	NP	NO	NO	NONE
Walton	BI	NP	NO	NO	NONE
Washington	PI	NP	NO	NO	NONE

APPENDIX 2

COUNTY PERSONNEL INTERVIEW COMMENTS

"We call that a wet vent, never heard of Sovent."

"This Sovent system has given us nothing but problems, and I cannot comment on it anymore than that."

Sovent is common in this area and almost all the subs install it."

"Sovent would only be approved in this county if the SBCCI were to approve it in the manual."

"No buildings in this county have ever used Sovent, but Sovent is mainly for high rise construction, and we have no tall buildings here in Indian River."

"Not used here at all."

"It has never been considered, we are mostly single story construction, not very much development going on here."

"We are only a county of about 6000 people, and we have no use for something like that. I would know because I am the only inspector for the entire county."

"Air omittance valves must be accepted by SBCCI before we will accept the Sovent system, and no other way otherwise."

"Nothing like that in Liberty, mostly trailer homes and residential."

"There is no approved compliance code for Sovent in the SBCCI, the only way to approve would be with a engineer's design."

"Never heard of it and I am a master plumber."

"Black Book and Board of County Commissions governs everything here, and it would not be approved until included in the Standard Building Code."

"Our county is limited to four stories in height, so we have no need for such a system."

"We would go with a seal on engineer's plan on this."

"Sovent is as good a system as you can get, we have no problem inspecting it in Orange County."

"I haven't heard anything bad, just that it tends to gurgle a little bit more when the tubs drain. One reason I think we have seen more of the Sovent system lately is because it requires less penetrations which saves money. The fire codes are so strict, that each penetration is costly."

"I haven't seen a Sovent system in probably fifteen years, but it would be approved."

"I've been down here for twenty two years and I've never seen Sovent in this county, but I saw it in New York."

"I haven't seen it in over four years, but it is approved in this county."

"Never heard of it."

"We require a 3" main vent-only, restriction. Sovent is not being considered because we are mostly single family dwellings."

"We would accept (Sovent) with a stamped set of engineer's plans."

APPENDIX 3

PLUMBING CONTRACTOR INTERVIEW COMMENTS

POSITIVE COMMENTS

- Savings vary from 30-40%
- The system uses conventional material
- Less penetrations through floor slab
- More flexible than conventional two-pipe system
- Have used cast iron vertical lines and PVC branch lines
- No bad experiences with the system
- Good support from manufacturers on questions that come up on the job
- Problems usually a result of poor installation
- Save a lot of money
- Easy to work with a real good material

NEGATIVE COMMENTS

- Unions do not train for Sovent during apprenticeship program
- Does not meet the code
- Too many problems
- It needs to be outlawed
- It creates problems for people that live in the units that have Sovent

APPENDIX 4

BUILDING OFFICIALS INTERVIEW COMMENTS

POSITIVE COMMENTS

- Approximate 20% total savings
- Much more simple to install
- Requires less floor and roof penetrations
- The minor faults in the system do not justify outlawing the system
- Research supports use of the system
- Too many people use the system without trouble
- It is the system of the future
- It is a good system
- Installers, as on any system, need to be checked
- It has become a political issue
- It has withstood negative publicity

NEGATIVE COMMENTS

- Does not meet code
- Future of the system is as limited as the manufacturers
- Manufacturer not available to train our inspectors
- Too many complaints about the system

APPENDIX 5

DESIGNER INTERVIEW COMMENTS

POSITIVE COMMENTS

- Save approximately 50% on labor and material costs
- 50-60% material savings
- Broward County is more relaxed and easy to use Sovent and their is no problem with SBC
- No gain in latitude
- Have used the Sovent system in a 40 story building with no problems whatsoever
- Less expensive since it only has 1 stack
- Easy to install as long as you follow guidelines
- Sovent saves floor area
- Requires less steel in floor reinforcing because of less penetrations
- Testing has not shown problems exist
- Problem allegations can not be recreated in simulated system tests
- Can have 20 -30 % savings in installation
- Very versatile
- Can go 25 feet un-revented
- Some codes have decided to accept Sovent system

- Philadelphia Code - has made code allowances for Sovent system
- Order of fixtures doesn't matter
- Simple to install, rules must be followed
- Problems with plumber, installing improperly
- Problems, more sensitive to pitch
- Properly pitching line is a must
- De-aerator must be properly installed
- Don't tie-in pumped discharge fittings
- Suitable for gravity fixtures
- Cast-iron is better than copper due to density
- No problems with a high-rise office building
- Used it in Manhattan with great success
- Plans must be reviewed by Sovent manufacturers before installation
- We wouldn't use it if it had documented problems
- When space available the system is very cost effective
- No deviation in code under section 16
- Horizontal restraints - much less restrictive
- Works fine in commercial buildings
- Younger installers are very enthused about Sovent
- No problem with fire sealing
- Works well with back to back toilet configuration
- Needs less cross over space

- Needs less cross over space
- Can use coupling to connect cast iron aerator with PVC piping
- France uses Sovent big-time
- Sovent system is the wave of the future
- Save on labor and material
- Sovent installation manual is a good resource
- Distance from vented line can be further using Sovent
- Save pipe space when 3 fixtures not in same area
- Simple to install if willing to follow rules
- Used extensively on the west coast

NEGATIVE COMMENTS

- Dade county has lots of bureaucracy
- Installer must be more conscientious
- Rules put on system are too restrictive due to lobbying by cast iron people
- Must be willing to pay for time it takes to fight the political system
- PVC used in the Sovent system causes too much noise
- Residential application creates problems with sudsing
- Requires separate system for laundry
- If codes are relaxed, it will be used more
- System has a bad reputation
- Possibility of lawsuit too great to get involved

- Code has not approved the system
- PVC is a problem with code governing bodies
- Traditional system idiot proof, whereas Sovent is sensitive to installation
- Need better quality plumber & engineering to use the system
- Older contractors don't like the system
- Size of pipe is important consideration in using Sovent
- Must have space to work with in
- Washing machines cause problems, that being sudsing
- Too many complaints about the system
- Not worth the risk of using
- The public needs to be protected from potential health
- Using Sovent does not justify the cost saving
- The exposure is too great for a contractor to install
- The code does not specifically allow for its use
- Must have 18-22 inches between floors
- No one wants to learn new rules

APPENDIX 6

SOVENT CODE SPECIFICATIONS

1.) Building Officials and Code Administrators International (BOCA)

Article 18
Title under which Sovent systems are installed:
"Alternative Engineered Design"

2.) Southern Building Code Congress International (SBCCI)

Chapter 16
Title under which Sovent systems are installed:
16.03 Single Stack Plumbing Systems
16.031 Sovent Single Stack Plumbing Systems

3.) National Standards Plumbing Code (NSPC)

Appendix E
Title under which Sovent systems are installed:
"Special Design Plumbing Systems"

4.) Uniform Plumbing Code (UPC)

Section 201
Title under which Sovent systems are installed:
"Alternative Materials and Methods"

APPENDIX 7

INTERVIEW QUESTIONNAIRE

1.) YRS = How many years have you used the Sovent system?

This question served to determine how long the interviewee has been familiar with Sovent and to determine how long Sovent has been present in the State of Florida.

2.) TYP = Please explain what type of projects you have used/seen the Sovent system with:

The answer to this question indicates which types Sovent has been used with in the state of Florida. Answers included high-rise (HR), condominium high-rise (CH), hotel high-rise (HH), commercial high-rise (MH).

___HR ___CH ___HH ___MH

3.) CDS = Under what building codes were these buildings built?

The building code that allows Sovent is extremely important to the acceptance of Sovent as a viable plumbing system in the construction industry. At times the contractor did not know the building code guideline used to install Sovent (DK).

_____ ___DK

4.) LTH = How long has the Sovent system been approved by these codes?

The answer to this question was generally not approved yet (NY), but accepted under special codes, otherwise this question was answered in a year amount.

___NY ___years

5.) CHG= What major aspect of the code needs to be changed to make installation of the Sovent system easier?

Acceptance of Sovent in the code book as an identified, approved plumbing practice instead of a special condition was the most popular answer to this question (AC).Another answer was simply acceptance in the county of practice (AX).

___AC ___AX

6.) **PBS = Are you aware of any installation problems with the Sovent system?**
The only problem encountered included installation when the engineer's plans were not followed correctly (EP). The key to making a Sovent system work is correct installation.

___NO ___EP

7.) **FUC = Are you aware of any functional problems with the Sovent system?**
While some said no to this question (NO), others noticed that Sovent did not function properly when washing machines were drained into the stack; sudsing occurred (WM).

___NO ___WM

8.) **MAT = What piping materials have you used with the Sovent system?**
Cast Iron (CI), Copper (CU) or PVC (PV) were the answers to this question.

___CI ___CU ___PV

9.) **PER = How have these materials performed?**
No matter which material the contractor used for Sovent, they all commented that the material worked well (GD). The other comments included the use of copper to be expensive (CE), and the use of PVC to be loud when a tub was draining (LD).

___GD ___CE ___LD

10.) **COM = What do you feel can be gained from using a Sovent system over a conventional system?**
The answers to this question were very broad.

11.) **NUM = Does number of stories have an effect on savings?**

___NO ___YS

12.) **COS = How cost effective have you found the Sovent system to be?**
This question was answered in terms of percent savings.

13.) **General comments.**

APPENDIX 8

SOVENT DESIGN CRITERIA

Basic Rules for the Cast Iron Sovent are:

1.) The stack size must be computed according to fixture load using Table B.

2.) The stack must continue full-size through the roof.

3.) An aerator fitting is required at each floor level where the following horizontal branches enter the stack:

    1.) A soil branch

    2.) A waste branch the same size as the stack

    3.) A waste branch one pipe size smaller than the stack

4.) At any level where an aerator is not required, a double in-line offset may be used. Vertical distance between an aerator or in-line offset shall not exceed twenty feet. No more than two consecutive in-line offsets may be used.

5.) Waste branches two pipe sizes smaller than the stack may be connected directly to the stack through a sanitary fitting.

6.) The maximum developed length of a 3 inch soil branch may not exceed 12 feet, and the maximum developed length of a 4 inch soil branch may not exceed 27 feet.

7.) The maximum developed length of a waste branch may not exceed 15 feet.

8.) The slope of the horizontal branches is recommended to be 1/4 inch per foot.

9.) Offsets in the stack of more than sixty degrees require a de-aerator fitting and pressure relief line. Soil or waste branches may be connected into the horizontal offset in between the vertical stack and termination of the Pressure Relief Line. The horizontal piping at a stack offset of more than sixty degrees shall be sized per Table C. This type of installation may require resizing of stack. Refer to Table B for stack loading.

10.) Stacks may be combined before entering the horizontal building or "common house" drain. The size of the horizontal drain or common house drain is determined by the total fixture load of the combined stacks.

11.) Stacks may be combined above the highest fixture with the one combined vertical stack extending through the roof. The one combined vertical stack must be one pipe diameter larger than the largest of the combined stacks. If the distance between the two stacks is greater than twenty feet, the horizontal must also be one pipe diameter larger than the downstream stack.

12.) The de-aerator shall be installed at the base of the stack and be equipped with a pressure relief line.

APPENDIX 9

TABLE B

MAXIMUM STACK LOADING

STACK SIZE	MAXIMUM FIXTURE UNITS
+ 3"	64
+ 3"	102
4"	504
5"	1,010
6"	2,200
8"	3,900

+ No more than six (6) water closets permitted on a 3" stack. 3" stacks will use a 4" de-aerator at the base of the stack.

APPENDIX 10

TABLE C

BUILDING DRAIN LOADING

DRAIN	SLOPE	
SIZE	1/4"/FT (2%) F.U.	1/8'/FT (1%) F.U.
4"	120	96
5"	350	280
6"	850	680
8"	2,700	2,160
10"	3,900	3,120
12"	5,800	4,640

APPENDIX 11

TABLE D

EUROPEAN SANITARY DRAINAGE SIZING CHART

Chart for Capacity of Stacks

The chart below is valid for primary vented stacks, when the pipe diameter of the vent is equal to the pipe diameter of the stack.

ID	MIN. ID (mm)	Q_1 (l/s)	Q_2 (l/s)	Q_3 (l/s)
60	56	0.5	0.7	0.9
70	68	1.5	2.0	2.6
80	80	2.5	3.3	4.3
90	93	3.5	4.5	6.0
100	96	4.0	5.2	6.8
125	115	5.5	7.2	9.4
125	147	10.0	13.0	17.0

Q_1 is the maximum capacity of stacks:
- with normal entries

Q_2 is the maximum capacity of stacks:
- with swept entries
- stacks in secondary vented systems, indirect
- stacks in secondary vented systems, direct

Q_3 is the maximum capacity of:
- stacks with Sovent system
- stacks in secondary vented systems with branch vents

APPENDIX 12

BCIAC MAILING LIST

Mr. William Conway
BCIAC Chairman
110 Orchard Lane
Ormand Beach, Florida 32176

Mr. Mel A. Bryan, President
DEVCON GROUP
6837 Phillips Parkway Drive North
Jacksonville, Florida 32256

Mr. Donald R. Dolan, Executive Vice-President
MECHANICAL CONSTRUCTORS ASSOCIATION
OF SOUTH FLORIDA
99 N.W. 183rd Street, Suite 102
Miami, Florida 33169

Mr. Deane Ellis
FLA. AIR CONDITIONING CONTR. ASSOC.
802 N.W. First Avenue
Delray Beach, Florida 33444

Mr. Joseph Holland, III
CONSULTANT
1225 N. Halifax Avenue
Daytona Beach, Florida 32118

Mr. Harold Johnson
P.O. Box 770771
Winter Garden, Florida 34777-0771

Mr. Thomas Mack, State Director
FLA. HOME BUILDERS ASSOCIATION
135 Young Place
Lakeland, Florida 33803

Mr. John C. Pistorino,President
PISTORINO & ALAM CONSULTING ENGINEERING, INC.
7701 S.W. 62nd Ave., 2nd Floor
South Miami, Florida 33143

Mr. Bruce Simpson
CROM CORPORATION
250 S.W. 36th Terrace
Gainesville, Florida 32607

Mr. Russel P. Smith
THE PLUMBING EXPERTS, INC.
303 Northwest First Avenue
Boca Raton, Florida 33421

Mr. Clifford I. Storm, Director
THE BROWARD CO. BOARD OF RULES AND APPEALS
955 S. Federal Highway, Suite 401
Ft. Lauderdale, Florida 33316

APPENDIX 12

BCIAC MAILING LIST

Mrs. Celeste K. Valdez, Vice-President
KALEMERIS CONSTRUCTION, INC.
P.O. Box 15422
Tampa, Florida 33684

Dr. Brisbane H. Brown, Jr.
Executive Secretary - BCIAC
School of Building Construction
FAC 101 - University of Florida
Gainesville, Florida 32611

The Honorable Wm. Cecil Golden
Deputy Commisioner
Department of Education
Florida Education Center
Tallahassee, Florida 32399

Mr. Daniel O'Brien, Executive Director
Construction Industry Licensing Board
111 Coast Line Drive, East
Suite 516
Jacksonville, Florida 32202

Mr. Carlos Lopez-Cantera, Chairman
Construction Industry LIcensing Board
7401 N.W. Seventh Street
Mlami, Florida 33126

Mr. Warren M. Sutton
UNIVERSAL DIVERSIFIED ENT., INC.
1050 East 24th Street
Hialeah, Florida 33013

Mr. J.R. Crockett
Construction Complaints Study
Committee
2157 Coral Gardens Drive
Wilton Manors, Florida 33306

Mr. Hoyt G. Lowder
FAILS MANAGEMENT INST.
5301 West Cypress Street
Tampa, Florida 33622

Mr. Clark Jennings
Department of Legal Affairs
Tallahassee, Florida 32399-1050

BROWARD COMMUNITY COLLEGE
FIU/Broward Construction
Management
3501 S.W. Davie Road
Ft Lauderdale, Florida 33314

CENTRAL FLA. COMMUNITY
COLLEGE
Building Construction
P.O. Box 1388
Ocala, Florida 32678

APPENDIX 12

BCIAC MAILING LIST

DAYTONA BEACH COM. COLLEGE
Building Construction
P.O. Box 1111
Daytona Beach, Florida 32015

EDISON COMMUNITY COLLEGE
Construction Department
8099 College Parkway, S.W.
Fort Myers, Florida 33919

FLORIDA JUNIOR COLLEGE
Building Construction Technology
101 W. State Street
Jacksonville, Florida 32202

GULF COAST COMMUNITY COLLEGE
Building Construction
5230 West Highway, 98
Panama City, Florida 32401

HILLSBOROUGH COM. COLLEGE
Architectural and Construction
P.O. Box 30030
Tampa, Florida 33630-3030

INDIAN RIVER COM. COLLEGE
Building Construction
3209 Virginia Avenue
Ft Pierce, Florida 33498

MANATEE JUNIOR COLLEGE
Technology
5840 26th Street, West
Bradenton, Florida 34207

MIAMI DADE COMMUNITY COLLEGE
Building Construction Technology
11011 S.W. 104th Street
Miami, Florida 33176

OKALOOSA-WALTON COM. COLLEGE
Technical Ed. & Economical Devel.
100 College Blvd.
Niceville, Florida 32578

PALM BEACH JUNIOR COLLEGE
Construction Engineering
4200 Congress Avenue
Lake Worth, Florida 33641

PASCO HERNANDO COM. COLLEGE
Vocational and Technical Programs
2401 State Highway 41, North
Dade City, Florida 33525

PENSACOLA JUNIOR COLLEGE
Engineering and Construction
1000 College Blvd.
Pensacola, Florida 32504

APPENDIX 12

BCIAC MAILING LIST

POLK COMMUNITY COLLEGE
Station 61 - Lakeland
Business and Technology
999 Avenue H. NE
Winter Haven, Florida 33881

SANTA FE COMMUNITY COLLEGE
Building Construction I-50
3000 N.W. 83rd Street
Gainesville, Florida 32602

SEMINOLE COMMUNITY COLLEGE
Construction Engineering Technology
100 Weldon Blvd.
Sanford, Florida 32771-6199

SOUTH FLORIDA JUNIOR COLLEGE
Technical and Industrial
600 West College Drive
Avon Park, Florida 33825

ST. PETERSBURG JUNIOR COLLEGE
Building Arts Program
2465 Drew Street
Clearwater, Florida 33575

VALENCIA COMMUNITY COLLEGE
Construction Technology Program
P.O. Box 3028 MC 4-23
Orlando, Florida 32802

FLORIDA A&M UNIVERSITY
Dept. of Construction Technology
P.O. Box 164
Tallahassee, Florida 32307

FLORIDA INTERNATIONAL UNIVERSITY
Construction Mgmt. Dept. V H 230
University Park - Tamiami Trail
Miami, Florida 33199

UNIVERSITY OF FLORIDA
School of Building Construction
FAC 101
Gainesville, Florida 32611

UNIVERSITY OF CENTRAL FLORIDA
College of Engineering
Dept. of Civil and Environmental Engineering
P.O. Box 2500
Orlando, Florida 32817

UNIVERSITY OF NORTH FLORIDA
Division of Technology & Vocational Ed.
4567 St. Johns Bluff Road, South
Jacksonville, Florida 32216

APPENDIX 12

BCIAC MAILING LIST

UNIVERSITY OF WEST FLORIDA
Building Construction
Building 70
Pensacola, Florida 32504

ABC Central Florida Chapter
1260 Palmetto Avenue
Winter Park, Florida 32789

ABC Florida Gold Coast Chapter
4700 N.W. 2nd Avenue
Boca Raton, Florida 33431

ABC Florida Space Coast Chapter
P.O. Box 2296
Melbourne, Florida 32902-2296

Florida AGC Council
1363 A.E. Lafayette Street
P.O. Box 10569
Tallahassee, Florida 32302

AGC Florida East Coast Chapter
2617 Australian Avenue
West Palm Beach, Florida 33407

AGC Mid-Florida, Inc.
P.O. Box 22646
Tampa, Florida 33622

AGC Northeastern Florida Chapter
P.O. Box 2519
Jacksonville, Florida 32204
AGC Northwest Florida Chapter
P.O. Box 17108
Pensacola, Florida 32522

BA of Manatee County
4835 27th Street, West, #220
Bradenton, Florida 34207

Charlette County BCA
630 Woodbury Drive, #A
Port Charlette, Florida 33954

HBA of Lake County
1102 N. Joanna Avenue
Taveres, Florida 32778

Mid-Florida HBA
544 Mayo Avenue
Maitland, Florida 32751

Okaloosa/Walton HBA
1980 Lewis Turner Blvd.
Ft. Walton Beach, Florida 32548

Palm Beach County HBCA
5713 Corporate Way
West Palm Beach, Florida 33407

APPENDIX 12

BCIAC MAILING LIST

Hernando BA
7391 Sunshine Grove Road
Brooksville, Florida 34613

Highlands County BA
2005 U.S. 27 South
Sebring, Florida 33870

CITRUS COUNTY BA
1196 S. LeCanto Hwy, 491
LeCanto, Florida 32661

East Florida BIA
2435 S. Ridgewood Avenue
South Daytona, Florida 32119

MARION COUNTY HBA
409 N.E. 36th Avenue
Ocala, Florida 32670

OKEECHOBEE BLDRS CHAPTER
1980 Lewis Turner Dlvd.
Ft. Walton Beach, Florida 32548

Mr. Jay Daggner
Lake City Division of PLanning &
Development Building Department
315 N. Main Street, Bldg. B
Tavares, Florida 32778

Mr. Lionel Lesperanze
J.L.W. Vo-Tech Center
3702 Estay Avenue
Naples, Florida 33942

LEE BIA
4571 Colonial Blvd.
Ft. Meyers, Florida
33912NORTHEAST

FLORIDA BA
P.O. Box 17339
Jacksonville, Florida 32245

AGC South Florida Chapter
15225 N.W. 77th Avenue
Miami Lakes, Florida 33014

HBA of Panama City
P.O. Box 979
Panama City, Florida 32402

Pascoe BA
5852 Main Street
New Port Richey, Florida 34652

CBA of Pinellas County
7600 66th Street N.
Suite200
Pinellas Park, Florida 34665

APPENDIX 12

BCIAC MAILING LIST

Polk County BA
2940 Winter Lake Road
Lakeland, Florida 33801

Tampa BA
6925 N. 56th Street
Suite 201
Pempie Terrace, Florida 33617

Washington/Holmes Counties HBA
P.O. Box 84
Chipley, Florida 32428

East Florida BIA
2435 S. Ridgewood Avenue
South Daytona, Florida 32119

CA of Sarasota County
3844 Bee Ridge Road
Suite 201
Sarasota, Florida 34233

Tallahassee BA
2522 Capital Circle, N.E. #3
Tallahassee, Florida 32308

Treasure Coast BA
6560 South Federal Highway
Port St. Lucie, Florida 34952

West Florida HBA
4400 Bayou Blvd., #45
Pensacola, Florida 32503

Chipola HBA
603 N. Main Street
Blounstown, Florida 32424

Florida Home Builders Association
201 East Park Avenue
Tallahassee, Florida 32301

Flagler-Palm Coasr BA
One Florida Park Drive #330
Palm Coast, Florida 32137

Florida Atlantic BA
3200 N. Military Trail #400
Boca Raton, Florida 33431

Gainesville HBA
2217 N.W. 66th Court
Gainesville, Florida 32606

HBCA Brevard
1500 W. Eau Gallie Blvd.
Melbourne, Florida 32935

APPENDIX 12

BCIAC MAILING LIST

Mr. Bob Usefof
Vocational Technology Education
600 S.E. 3rd Avenue, 4th Floor
Ft. Lauderdale, Florida 33301

Mr. R. Bruce Kershner
Underground Utility Contractors of
Florida, Inc.
150 S. East Lake Street
Suite 311
Longwood, Florida 32750