

**User Driven New Product Development:
Bathing and the Older Adult**

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Abstract

By understanding the bathing needs, preferences and experiences of older adults, it becomes apparent that these are not being satisfied by the majority of bathing products & environments currently interfaced with by this population.

This Master's Degree Project considers the needs of older adults, and then proposes a more inclusive bathing environment that other populations may also benefit from. It further challenges the conventions, which we have come to accept as standard, in our bathing environments.

The first sections of this document identify the issues that could potentially impact the design of a bathing product intended for older users. These include an identification of the changes which accompany human aging, a review of the various bathtub & shower products currently available, as well as of the approaches which are typically applied to the design of products intended for people with unique requirements. The next sections seek to understand what parts of the bathing process (if any), cause difficulty for older users and what these problems stem from. Utilized in this user research component are the methods of focus group sessions, user observation & personal interviews with bathers, and questionnaires distributed to the care-providers of dependent bathers. The final sections outline the target user group, the type of product to be developed and the environment within which the product is to be implemented, concluding with the design of the proposed bathing unit.

Key Words

Aging

Bathing

Design

Environment

Fixtures

Human Factors

Inclusive

Older Adult

Product

User

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1 Introduction

"The aging of North America will change the nature of demand for everyday products and services to meet the physical requirements of older consumers such as design changes in cars, chairs, automatic teller machines, telephones, etc. Comfort, security and convenience will be key characteristics of products and services for this group" (Ernst & Young, 1990).

North America's demographics are changing rapidly and will continue to do so well into the 21st century. The number of adults aged 65 and older is the largest in history and growing. Life expectancy is increasing, and with improvements in health and medical care, older people are living longer and healthier lives. Resulting from these changes will be a demand for everyday products and services that meet the requirements of older consumers. It will further be the ability for such products and services to meet the requirements of this large and growing market segment that will determine their success. Products that have in the past been the source of user inefficiency among older users will receive greater criticism and will demand modifications.

1.1 Background

No room in the home poses more threats to safety than the bathroom (Mullick, 1993), and perhaps the greatest danger in the bathroom is slipping and falling when entering or exiting the bathtub or shower (Koncelik, 1982).

A review of currently available bathtub and shower products suggests that there is an opportunity for greater *safety*, *convenience* and *aesthetics* to be implemented into their designs. While all users are susceptible to bathing-related injuries (on average 370 persons of all ages sustain injuries from the bathtub/shower daily in the United States), the most vulnerable have been found to be those people closer to the upper age limit (Mullick, 1993). According to data reported by the Consumer Product Safety Commission, there were 117,230 bathtub/shower injuries in 1989, 136,616 in 1990, and 139,434 in 1991. While those between the ages of 25-64 accounted for 37% of all bathtub/shower injuries, the elderly accounted for 17% of such injuries in 1989, 22% in 1990, and 20% in 1991 and 1994 (Mullick, 1993; Ahmadi, 1996). As the population ages, more and more people will rely on improvements in the safety and accessibility of bathing equipment to maintain their independence.

While safety is an obvious factor associated with the bathing process for people

of all ages, inconvenience and compensated personal well being are other factors that often directly affect older users. Psychologically, the inability to care for one's self can sometimes be just as much of a hazard as the physical injuries that can result from a fall. According to one survey of 1,500 non-institutionalized people over the age of 55 in 1983, "using the shower or tub" was one of the sixteen problem areas identified for maintaining activities of daily living (Mullick, 1993). "For many elderly people, the point when assistance is needed in the bathroom is critical and often represents a turning point and challenge in terms of the person's outlook. It serves as the last reminder that one has regressed to a helpless level, can no longer cope or function by oneself and therefore must depend on some form of assistance" (Ahmadi, 1996).

1.2 Objectives

The objectives of this MDP will be to show that:

- a) human factors user research is an effective and necessary element in the design process;
- b) designing for a specific population's requirements results in 'good design' which other populations may also benefit from; and
- c) unlike the institutional appearance of many assistive and accessible products currently on the market, high aesthetic qualities may be present in products intended for users with unique physical requirements.

1.3 Methodology

1.3.1 Background Research

An initial familiarization with the topic of human aging was acquired prior to commencing this project, assisting by having outlined potential literature resources which proved to be useful during this stage of the research. The objectives of the background research were to acquire an understanding of the physiological, social and psychological changes accompanying the aging process, the population characteristics of adults 60+ years old, to review recently developed and historical bathing-related products, and to evaluate the different design approaches currently being applied to the design of products for elderly and special needs populations. The following methods were employed:

- Literature search.
- Attendance of "Designing for the 21st Century: An International Conference

on Universal Design", Hempstead, New York, June 17-21, 1998; correspondence with Conference Presenter Abir Mullick from The University at Buffalo IDEA Center.

- Tour of the FIAT manufacturing facility in Winnipeg, Manitoba; discussions with the Company's Marketing Director and Marketing Assistant.

- Tour of Ten Ten Sinclair's ProductABILITY functional assessment suite in Winnipeg, Manitoba including discussions with the Consulting Service's Manager regarding accessibility, product sourcing, universal design and barrier-free design.

1.3.2 User Research

While the resources used to acquire the background research provided valuable information regarding where in the home accidents occur and the number of people annually injured while bathing, information was lacking in regards to, for example, which part of the bathing process causes the most difficulty for older users. Being aware that safety problems exist within currently available bathing products is one thing, however, it is even more important to know where these problems stem from. Due to budget and time constraints, three methods of data collection were therefore employed to provide this type of information, and helped to obtain essential qualitative data on the bathing needs, preferences and experiences of older adults and their care providers:

- Focus group sessions with bathers.
- Simulated observation and personal interviews with bathers.
- Questionnaires & personal interview with the care-providers of dependent bathers.

1.3.3 Key Expert Interviews

Information regarding the opportunities for dependent bathers to receive assistance and the conditions which typically prevent older adults from bathing independently was acquired by interviewing two nurses working with older adults requiring bathing assistance. Speaking with individuals who work directly with older adults requiring bathing assistance helped to provide a more personal interpretation of the factors that contribute to bathing dependence.

2 Background Research

2.1 Consumers

"Products customized for older consumers - but not advertised as such - will find a loyal, affluent audience" (Ernst & Young, 1990).

The U.S. Bureau of the Census projected in 1991 that "by the year 2000, the world population of those 65 and above will be over 419 million people - a number larger than today's combined populations of Japan (123,642,000), Brazil (152,505,000), France (56,358,000), and Germany (78,475,000)" (Pirkl, 1994). Now that the year 2000 is just around the corner, and many of the demographic projections of the past few decades are beginning to be realized, product development for aging consumers is no longer a matter of adding a few selective products to existing product lines as an effort of springboarding oneself ahead of the competition, but it is necessary to merely keep up with those who have already recognized the shortcomings of many of the products interfaced with by this population. It is furthermore in the understanding and subsequent accommodation of the needs and services demanded by today's elderly and aging (baby boomers) consumers (see Figure 2-1) that will determine the successful development of new products and services.

Ernst & Young (1990) indicated that "Canada and the U.S. have much in common: similar consumer demographics, such as median population ages, aging consumers, increasingly self-reliant seniors, changing ethnic make-up driven by new waves of immigration, and a broadly based advance of wealth". While demographic differences also exist, both countries will be referenced for the purposes of identifying significant trends within North American elderly and aging populations (Ernst & Young, 1990).

According to the U.S. Conference Board, the older baby boomers (born 1946-54) will control 40% of spending power by 2000 (Ernst & Young, 1990). This group is said to allocate more available income to housing (31% of expenditures) than does any other age group, but will still be affluent enough to be major purchasers of discretionary products and services (Ernst & Young, 1990). Other trends to note are that while 85% of today's adults aged 65 and over do not work, 80% are financially independent and therefore "have more money, leisure time and needs yet to be addressed than other age segments" (Ernst & Young, 1990).

The aging consumer of tomorrow will not consent to 'grow old gracefully', but will instead "expect science and business to provide them with products and services to fight the aging process on every front" (Ernst & Young, 1990). It is further anticipated that unlike previous generations, "people will take more responsibility

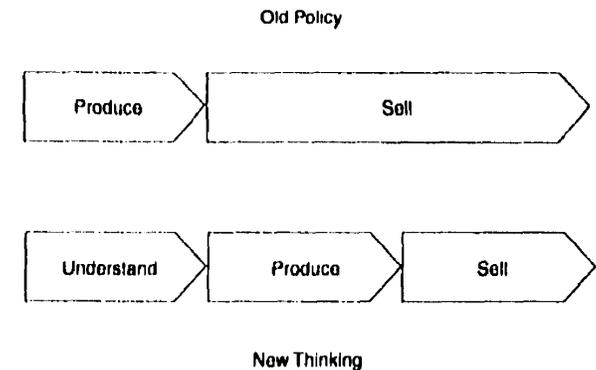


Figure 2-1

Product choice and accommodation are both part of the new marketing equation.

for their health and well-being and will expect industry to remain at the leading edge in bringing new medical developments to the market as quickly as possible" (Ernst & Young, 1990).

2.1.1 Demographics

The Senior Population

"It is widely believed that from 1980 to the year 2020 the number of elderly persons throughout the world will have doubled" (Pirkl, 1994).

In 1995, people aged 65 and over represented 12% of the total population in Canada, a number of people estimated at 3.6 million. In the same year in the U.S., the share of the population made up of seniors was 13% (Statistics Canada, 1997). Although seniors currently make up a smaller share of the Canadian population than that in the United States, people aged 65 and over are projected to make up 18% of the Canadian population in 2021, whereas they are expected to represent 'only' 16% of the Americans in 2020 (Statistics Canada, 1997). As this is being said, however, one must not forget what this means in terms of numbers since "there are more people age 65 and older living in the United States today than the combined populations of Canada (24,070,000) and Ireland (3,401,000)" (Pirkl, 1994).

Within this growing elderly population, it is the 'old-old' subgroup (those over 85) that is the fastest growing segment of the population (Ernst & Young, 1990). The number of people in the oldest age categories has risen substantially in recent decades and is expected to increase rapidly in the decades to come (Statistics Canada, 1997). Statistics Canada has projected that there will be almost 1.6 million Canadians aged 85 and over in 2041, more than four times greater than the figure in 1995 (Statistics Canada, 1997). In the U.S., this group is projected to more than quadruple as well, from 3.25 million in 1991 to 15.3 million in 2050 (Pirkl, 1994).

Life Expectancy

Older adults are not only increasing in number, but they are also healthier and living longer. While a person born in 1900 could only expect to live 47.3 years, in 1930 59.7 years, and in 1960 69.7 years, an infant born today (1994) has a life expectancy of 75.6 years and one born in the year 2000 can expect to live 77.0 years (projected) (Pirkl, 1994). This increase over the past century may be attributed to improvements in medicine and infrastructure - advancements which we haven't seen the last of (Pirkl, 1994).

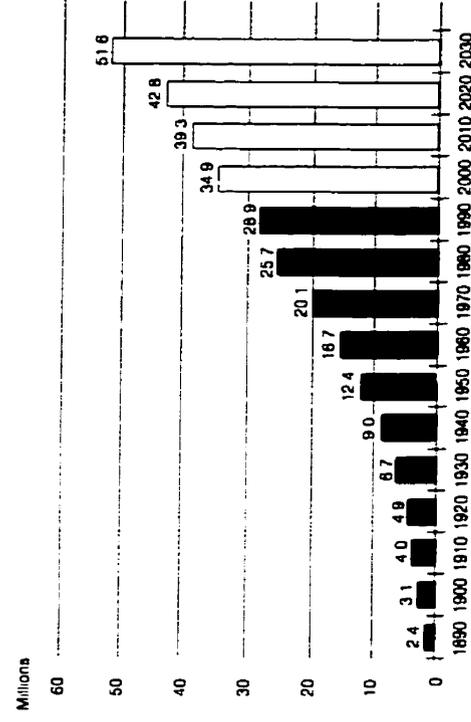


Figure 2-2
Population age 65 and older.

The life expectancy of senior women is longer than that of senior men. In 1991, a woman aged 65 could on average expect to live another 20 years, four years longer than the figure for a man aged 65 (Statistics Canada, 1997). This has been attributed to the fact that since the early 1920's the life expectancy of women has increased much faster than that of men.

Gender

Older female adults tend to live longer, on average, than their male counterparts. In 1995, 58% of all people aged 65 and over, 51% of those aged 55 to 64 and less than half of those under age 55 were female (Statistics Canada, 1997). This outnumbering of men by women increases even more in the older age groups. In 1995, 70% of all people aged 85 and older were women, as compared to 60% of those aged 75 to 84 and 54% of those aged 65 to 74 (Statistics Canada, 1997). Women are further projected to continue to make up a relatively large share of the senior population well into the next century.

2.1.2 Population characteristics

The "Cohort Effect"

This is the term used by gerontologists to describe the effects of time and place as they relate to generations of people going through life at different times. "Common values shared by individuals born of common experiences follow each cohort group through their lifespan and color their views as they pass from one age to the next" (Pirkl, 1994).

As stated by Pirkl (1994), fifty million baby boomers are approaching retirement and are helping to "tilt society's traditional views of aging with a more transgenerational perception". This group has been bombarded with (and has been at the forefront of implementing into mainstream culture) images of youth and activity, and does not intend to submit to the stereotypes of its parent generation (yesterday's and today's defining senior population). As such, the "arbitrary line once separating youth from age becomes blurred and faded, (and) 65 no longer remains a relevant passage marker" (Pirkl, 1994). It is further suggested that a new set of aging designations replace the old in which 40 to 60 becomes known as middle age, 60 to 80 as late adult and 80 and above as old age (Pirkl, 1994).

Such "transgenerational overlapping" begins to re-interpret the lifespan in which today's "linear progression of education-work-retirement (leisure)" (see Figure 2-4) becomes replaced by a "series of cyclical activities spread throughout our lives and extending

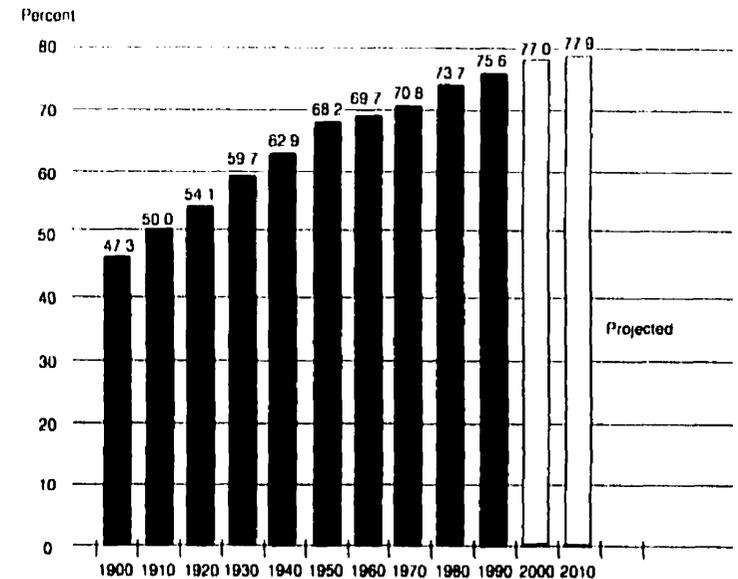


Figure 2-3
Life expectancy at birth.

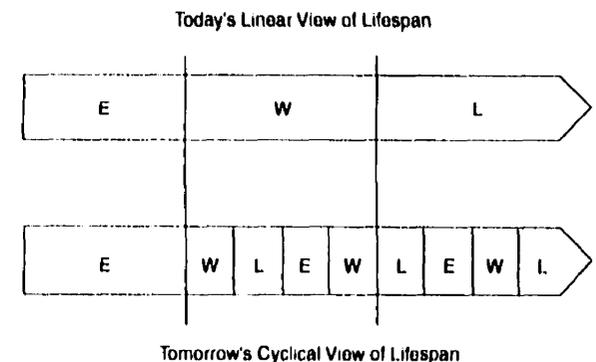


Figure 2-4
Changing views of the lifespan.

well into old age" (Pirkl, 1994). As these life experiences are permitted to extend into older age and as people begin to experience declines in their physical capabilities, "they will demand products that help them maintain their active lifestyle and activities" (Pirkl, 1994).

Living Arrangements

While more adults over the age of 65 live in institutions when compared to those in age groups between 15 and 64, the myth that most older adults live in institutions simply isn't true. In fact, in 1991, 92% of all people aged 65 and over lived in a private household (Statistics Canada, 1997). The number of older adults living in institutions is, however rising. In 1991, 256,000 people aged 65 and over, or 8% of all seniors in Canada, lived in an institution (Statistics Canada, 1997), an increase from 143,000 in 1971 (Statistics Canada, Summer 1990).

The proportion of seniors living in a private household also declines with age. In 1991, 97% of those aged 65 to 74 lived in a private household while 90% of those aged 75 to 84 and only 63% of those aged 85 and over lived in a private household (Statistics Canada, 1997). The likelihood of living in a private household also varies according to gender. Senior men are more likely than senior women to live in a private household, with senior women in the oldest age range being the least likely (Statistics Canada, 1997).

Since it is those seniors in the oldest age range, in particular women, who are least likely to live in a private household, and the fastest growing segment of the senior population is the over 85s (Ernst & Young, 1990), such trends have implications for current and future housing requirements. This population may, for example, require "special purpose or custom-built housing or perhaps continue to utilize large family homes" (Statistics Canada, Summer 1990). Nevertheless, there will still most likely be a need for more specialized institutional and private accommodation for such a diverse and growing population.

Statistics Canada (1997) reported that of those older adults living in private households, over half live with their immediate family. Immediate family includes spouses, either married or common-law, lone parents, and never married children living at home. A substantial number live with members of their extended family such as the family of their children. In 1991, 61% of all people aged 65 and over lived with their immediate family (56% of whom lived with their spouse), while 8% lived with extended family and 2% lived with non-relatives (Statistics Canada, 1997).

Senior women are less likely than senior men to be living with their spouse, primarily because women generally tend to outlive their spouses. The share of

women living with a spouse declines even more with age. While in 1991, 42% of women aged 65 and over were living with their spouse, only 10% of those aged 85 and over were living with their spouse (Statistics Canada, 1997).

For those over the age of 75, living with someone else can prove to be the difference between living in the community or moving into an institution, especially considering that in 1991, 67% of those aged 75 and over stated that they received 'help' (i.e. with housework, yardwork, meal preparation, grocery shopping, transportation, babysitting, money management, personal care or emotional support) regularly (Statistics Canada, Autumn 1993). Spouses were found to be an especially important source of help, of which 82% of married men and 75% of married women provided help to their spouse, and 81% of married men and 72% of married women received help from their spouse (Statistics Canada, Autumn 1993).

While most older adults live with someone else, a substantial proportion of the senior population lives alone. In 1991, 28% of all people aged 65 and over (800,000 seniors), lived alone (Statistics Canada, 1997). Senior women are particularly likely to live alone. In 1991, while only 8% of people aged 15 to 64 lived alone, 38% in the female population and 15% of men aged 65 and over lived alone (Statistics Canada, 1997). This was an increase from 26% for women and 13% for men in 1971. This growing number of seniors living alone is anticipated to result in an "increased demand for goods and services that enable older seniors to maintain an independent lifestyle" (Statistics Canada, Autumn 1993).

Housing & Household Facilities

In 1991, 56% of seniors aged 75 and over lived in a dwelling they owned and of those, 96% said they were mortgage free (Statistics Canada, Autumn 1993). Those who own their own homes include seniors who are both married as well as unattached, however those who are married tend to be more likely than others to be homeowners (Statistics Canada, Autumn 1993).

While many unattached seniors own their own homes, a considerable number still rent their dwellings (Statistics Canada, 1997). In 1995, just over half (51%) of unattached people aged 65 and over were renters, compared to only 17% of families headed by someone 65 and over (Statistics Canada, 1997).

On average, the homes of seniors generally have more living space than those of younger people, a difference in 1995 of 2.7 rooms per person in the homes of families 65 and over to 2.0 rooms per person in the homes of families 15 to 64 (Statistics Canada, 1997). It was further discovered that close to 100% of the homes of families headed by seniors and unattached individuals had household facilities including baths, flush toilets, refrigerators and telephones.

Income and expenditures

While the incomes of both senior women and men have risen since the early 1980's, seniors have lower incomes on average than people in most age groups under the age of 65 (Statistics Canada, 1997). In terms of expenditures, seniors tend to devote somewhat greater shares of their overall spending to basics such as food and shelter than do people under the age of 65, however the actual dollar amounts are considerably lower than those expended by younger people (Statistics Canada, 1997). Seniors also tend to devote smaller shares of their overall spending to clothing, education and security items such as insurance than do younger people (Statistics Canada, 1997). Seniors also pay less in taxes than younger people and since pensions have been improved and couples are retiring with not one but two pensions, the statement that "evidence points to a new affluence among the elderly" (Statistics Canada, Summer 1990) appears to have some merit.

Homeowners focus of spending appears to change at different ages. In 1988, additions accounted for 32% of the repair and renovation budget by owners under the age of 35 as compared to 19% by those aged 65 and over (Statistics Canada, Summer 1990). On the other hand, elderly homeowners spent 30% of their expenditures on repairs and maintenance as compared to 18% for those under the age of 35 (Statistics Canada, Summer 1990). The likelihood of making repairs and renovations also varies by the value of the home, more so even than by the age of the homeowners. However, while homes of greater value tend to receive larger renovations in terms of dollars spent, this likelihood doesn't vary by much (Statistics Canada, Summer 1990).

Life styles

Seniors tend to spend a considerable amount of time per day, more so than younger adults, performing personal care activities such as sleeping, eating, and washing and dressing. In 1992, adults aged 65 and over averaged about an hour and a half more per day on these activities than those aged 15 to 64 (Statistics Canada, 1997). While sleeping and eating accounted for part of this extra time spent on personal care activities, washing and dressing accounted for half of the extra time spent, almost 45 minutes more than younger adults. This could suggest that older adults have certain difficulties interacting with the products involved in these processes.

Health

The increase in life expectancy among seniors reflects long-term declines in mortality rates among people in this age group, with much of the decline in

mortality rates resulting from a decline of the heart disease death rate (Statistics Canada, 1997). There has been a similar decline in the death rate as a result of strokes in the last decade and half, contrasting the death rates for cancer and respiratory diseases which have risen (Statistics Canada, 1997). While the heart disease death rate has fallen among seniors, heart disease is still the leading cause of death among seniors. In 1994, heart disease accounted for 31% of all deaths among Canadian seniors, while 26% were due to cancer, 11% the result of respiratory diseases and 9% the result of strokes (Statistics Canada, 1997).

In terms of the perceived health of seniors, most describe their health in positive terms, especially those living in private households (Statistics Canada, 1997). In 1995, 73% of the non-institutionalized population aged 65 and over said their health was either good (34%), very good (27%), or excellent (12%) (Statistics Canada, 1997). 21% reported their health was only fair and 6% described it as poor. Despite the statements by most seniors that their overall health is relatively good, many have a chronic health condition as diagnosed by a health professional (Statistics Canada, 1997). In 1995, 81% of all people aged 65 and over living in a private household reported they had at least one chronic health condition. Of those living in a private household, 39% said they experienced some level of activity restriction because of a chronic health condition (Statistics Canada, 1997).

Arthritis and rheumatism are the most common chronic health problems reported by seniors. In 1995, 40% of the non-institutionalized population aged 65 and over had been diagnosed by a health professional with one of these problems, while 29% had high blood pressure, 18% had back problems, 17% had chronic heart problems, 16% had food or other allergies, 14% had cataracts and 11% had diabetes (Statistics Canada, 1997). While only a small proportion of seniors have Alzheimer's disease or other dementia (8% in 1991), a substantial proportion have some problems with cognition in which they are forgetful or they have difficulty thinking. In 1995, 33% of all people living in a private household reported they had these kinds of problems (Statistics Canada, 1997).

Statistics Canada (1997) indicated that in 1995, approximately one in ten seniors suffered an injury. Seniors, however, were found to be generally less likely than younger people to be injured. For example, among those living in a private household, 9% of people aged 65 and over, compared to 11% of those aged 55 to 64, 14% of those aged 45 to 54 and 19% of those aged 25 to 44, suffered an injury (Statistics Canada, 1997). Where these injuries occurred and what type of injuries were suffered were not indicated, however most seniors who suffer injuries are hurt in falls. In 1995, 5% of the non-institutionalized population aged 65 and over were injured in falls (Statistics Canada, 1997).

2.1.3 Seniors with Disabilities

An often-misconceived belief in regards to elderly populations is that the majority of older adults have some type of *severe* disability. While a substantial number of seniors do have some type of minor, moderate or major disability, this group accounts for less than half of the population of adults over the age of 65. In fact, most older adults who have some form of disability live in the community and lead relatively similar lives to those without disabilities, however there are a significant number who are severely limited because of economic or environmental barriers (Statistics Canada, 1997).

In 1991, nearly half (46%) of all people over the age of 65 had disabilities, compared with 27% of people aged 55 to 64, 14% of those aged 35 to 54, 8% of those aged 15 to 34 and 7% of children under age 15 (Statistics Canada, 1997). The proportion of seniors with disabilities also increases with age. In 1991, 84% of people aged 85 and over had disabilities, compared with 57% of those aged 75 to 84 and 37% of those aged 65 to 74 (Statistics Canada, 1997).

Of those with disabilities, over half have either a mild or moderate disability. In 1991, 35% of all people aged 65 and over with disabilities were considered to have a mild disability and 32% to have a moderate disability. 32% were considered to have a severe disability (Statistics Canada, 1997).

Disability Type

Problems with mobility/agility are the most common types of disabilities reported by the elderly. In 1986, 81% of all seniors with a disability had a mobility/agility problem (Statistics Canada, Spring 1991). Vision and hearing impairments that are not corrected by corrective lenses or hearing aids are also common among the elderly. In 1995, 8% of people aged 65 and over living in a private household reported that they could not see well enough to read, even with corrective lenses, compared with 2% of those aged 15 to 64 (Statistics Canada, 1997). In the same year, 6% of people aged 65 and over living in a private household could not follow a conversation, even with a hearing aid, compared with 1% of those aged 15 to 64.

Seniors living in an institution are even more likely to have vision or hearing problems. In 1995, 28% of all people aged 75 and over living in an institution could not see well enough to read, even with corrective lenses (Statistics Canada, 1997). Approximately a quarter of those living in institutions experienced hearing problems, even with the presence of a hearing aid. The prevalence of these problems increases even more with older age (Statistics Canada, 1997).

Housing & Household Facilities

The majority of seniors with disabilities live in the community, most in a private household (Statistics Canada, 1997). While most are able to handle basic daily tasks without assistance, several experience difficulty using some of the basic facilities in their homes. In 1991, 17% of seniors with disabilities living in a private household encountered some difficulty using their bathtub or shower while only 10% had made modifications to these facilities. This compared with 9% of people aged 15 to 64 with disabilities who experienced difficulties using these facilities while only 4% had made modifications. 6% of seniors with disabilities reported difficulty using laundry equipment and approximately 5% experienced difficulty accessing the kitchen cabinets, the stove and the toilet facilities (Statistics Canada, 1997).

2.2 Human factors and the Older Adult

"The basic premise connecting human factors with information on aging is that much of the world designed for people to function in (i.e., to live, work, play, get around) was created with little systematic regard for the older user. Therefore as people age, they are exposed to an increasing array of threats to their health, safety, performance, and quality of life, many of which could be avoided or minimized through improved design" (Howell, 1997).

Human Factors has been defined by the Human Factors and Ergonomics Society (HFES) as "the knowledge concerning the characteristics of human beings that are applicable to the design of systems and devices of all kinds...and the use of such knowledge to achieve compatibility in the design of interactive systems of people, machines, and environments to ensure their effectiveness, safety, and ease of performance" (Rogers, 1997). To achieve an understanding of human factors within the context of the aging process, the terms *aging* and *older adults* will first be specified. For the purposes of the following review, older adults are to be understood as being those individuals aged 60 and over. Chronological age is to be used only as an index for biological, psychological, and sociological changes that occur, with the understanding that older adults are not a homogeneous population (Rogers, 1997).

2.2.1 Biomedical Aspects of Aging

The Aging Skin

As a buffer zone between humans and their environment, the skin undergoes

frequent and cumulative injury. As one ages, the margin between the outermost epidermis and an underlying area of vacuolated connective tissue known as the dermis becomes flattened, resulting in a reduction of surface contact and therefore of nutrient transfer and waste clearance via diffusion from underlying dermis capillary beds. There is also a decrease in the epidermal turnover rate and a reduction in the barrier function of the epidermis, resulting in older skin becoming more susceptible to chemical irritants and allergens at the same time that the rate of skin repair declines. As the dermis becomes thinner, the skin is given a transparent, loose and inelastic quality (Kart, Metress & Metress, 1988).

Other changes in older skin include changes in sweat production, decreased dermal vascularity, reduced dilation and constriction of dermal vessels, and a loss of subcutaneous fat, all contributing to a weakening of the older adult's *thermoregulation*. As a result, the older adult becomes more susceptible to heat exhaustion and excessive chilling (Kart, Metress & Metress, 1988).

Older skin also has a tendency to become dry and scaly due to a less well hydrated epidermis resulting from decreased perspiration. The degree of dryness present also varies according to the time of year, generally being most prevalent and severe during the winter months when low humidity, central heating and drying winds hasten the evaporation of moisture from the skin. While the itching accompanying dry skin can be relieved by the application of creams, oils and lotions, these alone may not do the trick. Fewer tub baths and more sponge baths are often recommended for the elderly as an attempt to reduce the frequency that the skin is exposed to drying conditions. Those who enjoy bath oils are often advised to apply them after a bath, as they tend to form a slippery coating on the surface of the tub (Kart, Metress & Metress, 1988).

The Aging Skeletal System

The skeletal system helps to protect vital organs, give stability to the body, preserve its shape and allow for the freedom of movement and locomotion. It also acts as a metabolic reservoir through the continuing process of bone remodeling as calcium enters and leaves the bones. As the body ages, joint changes and reduced bone and muscle mass can lead to increased fractures and falls, stooped posture and shortened stature, loss of muscle power, misshapen joints, pain, stiffness and limited mobility. Such changes are significant as they can greatly alter an individual's lifestyle by making activities of daily living more difficult, however most older adults are not severely limited, nor is their lifespan shortened directly (Kart, Metress & Metress, 1988).

Arthritis (a generic term which basically means joint inflammation) and certain

bone and muscular conditions are among the most common of all disorders affecting people over 65 years old. There are several types of arthritis, including osteoarthritis, rheumatoid arthritis and gout. Osteoarthritis is a defect of articular cartilage and is accompanied by pain, stiffness, and joint enlargement. Rheumatoid arthritis is a systemic disease not merely confined to the joints, and it attacks connective tissue throughout the body. Gout is a metabolic disease that causes an acutely painful form of arthritis (Kart, Metress & Metress, 1988).

Osteoporosis is the major cause of skeletal fractures in post-menopausal women and older adults in general, characterized by a loss of bone density. Although all bones lose mass with age, some may become more critically involved than others. This condition is characterized as either Type I or II, depending on where a fracture is most likely to occur. The vertebrae, wrist and hip are the most common fracture sites, however hip fractures are the most serious hazard related to osteoporosis because of their deadly indirect side effects (Kart, Metress & Metress, 1988).

Sensorimotor Development

Psychologists refer to the acquisition of information by our sensory receptors (ears, skin, tongue, nostrils, and eyes) as sensation, and the interpretation of what is sensed as perception. The ways in which physical movements and actions change throughout the lifecycle is known as motor development, and the growth and coordination of sensory and motor processes as sensorimotor development (Rybash, Roodin & Santrock, 1991).

Vision

During the course of adult development, there are a number of changes in the eye's ability to transmit sensory information to the brain. While visual abilities seem to show little change during the early adult years, in the middle adult years, difficulties in vision become a problem for many people. The ability of the lens to focus and maintain an image on the retina experiences its sharpest decline between the ages of 40 and 59. Middle age also marks the time when many adults experience difficulty viewing objects at very close range as the lens gradually loses its capacity to accommodate to near and far objects. Another problem associated with the middle-aged years is an increased sensitivity to glare, largely due to changes in the lenses that seem to become progressively thicker, less flexible, and more opaque with age. Evidence also suggests that middle-aged adults begin to experience problems adjusting to changes in illumination (i.e. when going from a brightly lit to a dimly lit environment). As one moves from middle adulthood through late adulthood, these declines in vision become even more pronounced and problematic (Rybash, Roodin & Santrock, 1991).

Visual declines in late adulthood have been traced to reductions in the quality or intensity of light reaching the retina. This is due to several factors, including the progressive yellowing of the lens, an increased irregularity of the cornea, and a reduction in the diameter of the pupil. In fact, it has been determined that the retina of a 60-year-old receives only approximately one third of the light received by the retina of a 20-year-old (Rybash, Roodin & Santrock, 1991).

The incidence of blindness being positively associated with age has also been well documented. While legal blindness has been found to occur in less than 100 out of every 100,000 people under the age of 21, in adults over the age of 69, it occurs in more than 1,400 cases per 100,000. Two of the most common pathologies of the aging eye that lead to blindness or severe visual impairment are cataracts and glaucoma. A person with cataracts has a lens that is completely opaque, preventing light from travelling through the lens to project onto the retina. They can be surgically removed and replaced by a special contact lens. Glaucoma, on the other hand, is an irreparable condition, resulting from increasing pressure inside the eye, damaging the retina and optic nerve (Rybash, Roodin & Santrock, 1991).

One final change to acknowledge which occurs in late adulthood is that of *contrast sensitivity*. Contrast sensitivity refers to an individual's ability to perceive visual stimuli that differ in both contrast and spatial frequency. *Contrast* refers to the difference in brightness between adjacent areas of a visual stimulus, while *spatial frequency* refers to the number of cycles of bars of light imaged within a specific area on the retina. It has been found that under conditions of reduced contrast (i.e. driving at dusk or reading in a dimly lit room), older adults may experience a pronounced difficulty in seeing. However, when high levels of contrast are available, they experience little difficulty in seeing (Rybash, Roodin & Santrock, 1991).

Hearing

Hearing usually reaches its peak in adolescence and remains relatively stable during early adulthood, however in middle adulthood it may begin to decline. While less than 20 percent of individuals between 45 and 54 years of age have been found to have a hearing problem, the figure rises to 75 percent for those between 75 and 79. We also become less sensitive to taste, smell, and pain as we age (Rybash, Roodin & Santrock, 1991).

Motor Development

Motor skills generally tend to peak during young adulthood, however have been found to decrease in later adulthood. One of the major reasons for a decrease in, for example, athletic performance during adulthood is a reduction in strength and



Figure 2-5

Approximation of non-impaired eyesight.



Figure 2-6

Approximation of age-changed older eyesight.

muscularity. Muscular strength and the ability to maintain maximum muscular effort have both been found to decline steadily during middle adulthood, having been linked to such physiological changes as the thickening of the walls of the air sacs in the lungs (which hinders breathing), and the hardening of connective sheaths that surround muscles (which is linked with decreases in both oxygen and blood supply). Exercise and physical activity (especially lifelong patterns of physical activity), however, rather than age, are better predictors of one's levels of physical performance (Rybash, Roodin & Santrock, 1991).

Among those over the age of 65, falling has been found to be the leading cause of accidental injury (Rybash, Roodin & Santrock, 1991). In fact, the rate of mortality from falling increases directly with increased age and represents the sixth leading cause of death in those over 70 (Rovner, 1994). Falls can be caused by intrinsic and extrinsic factors: intrinsic factors being those related to the individual; extrinsic factors being causes external to the person such as the physical environment (Government of Canada, 1997). However, more than half of all falls involving the elderly have been found to be caused by environmental hazards (60 percent occur in the living room, while 14 percent occur in the bathroom) (Rovner, 1994). It has further been suggested that an unsupportive environment (i.e. a slippery tub bottom) may actually increase the likelihood of falling, and conversely, that a supportive environment (i.e. designed with sufficient support to potentially offset a fall) may reduce this likelihood (see Figure 2-7) (Pirkl, 1994).

Some of the physical conditions that contribute to falling are arthritis, loss of balance and equilibrium, weakness in the muscles that control coordination of the knees and ankles, impaired vision, impaired hearing (hearing provides critical feedback for walking), and diabetes (leading to reduced sensation in the legs) (Rybash, Roodin & Santrock, 1991). Other contributors are certain neurological disorders such as Parkinson's disease, stroke and Alzheimer's disease, drugs such as tranquilizers, antihistamines and antidepressants, and common prescription drugs used to lower blood pressure. Even large doses of aspirin (i.e. used for arthritis) can affect the inner ear and cause disturbance in balance (Rybash, Roodin & Santrock, 1991).

The reason why falls often lead to such severe injury in older as compared to younger adults has been suggested by two theories. The first is because older people may not be as able as younger people to prepare themselves to break a fall (a result of generalized age-related slowing of behavior). The second results from the condition of osteoporosis, in which the thinning or weakening of the bones may spontaneously shatter, and actually cause a fall. Thus, falls can cause broken bones, and brittle or broken bones can cause falls (Rybash, Roodin & Santrock, 1991).

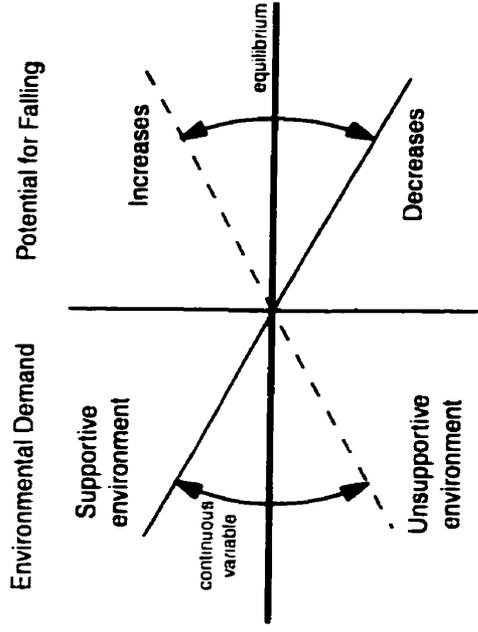


Figure 2-7

Falling as Influenced by Environmental Demand.

Illness and Impairment

Two of the most common causes of death in elderly populations are heart disease and cancer. These chronic diseases lead to long-term illness, both psychological and physical discomfort, and impairment (Rybash, Roodin & Santrock, 1991). Other chronic conditions common in elderly populations include arthritis and hypertension, and while neither of these directly cause death, they usually leave the afflicted person with some kind of physical impairment such as limited mobility (Rybash, Roodin & Santrock, 1991). Almost two out of every five people between the ages of 65 and 75 have some impairment of physical functioning (see Figure 2-8). After age 75, the rate increases to three out of five (Rybash, Roodin & Santrock, 1991). The most common chronic conditions that impair the health of the elderly include arthritis (38%), hearing impairment (29%), vision impairment (20%), and heart condition (20%) (Rybash, Roodin & Santrock, 1991).

Mental Health Problems

The term *mental health* is used to describe "one's ability to deal with the issues of life in an effective if not pleasurable or satisfying manner" (Rybash, Roodin & Santrock, 1991). The purpose of identifying some of the mental health problems which may impact older populations is twofold: (1) to recognize that older, like younger, adults may come to experience numerous impairments, not merely physical, that impact their ability to interface successfully with their environments, and (2) to recognize that it should not necessarily be assumed that growing old increases the risk of mental illness. In fact, studies have found no support for the hypothesis that the symptoms of mental illness increase with age (Rybash, Roodin & Santrock, 1991).

"Perhaps the most controversial, confounding, and debilitating set of mental disturbances afflicts individuals who have been classified as having some type of dementia" (Rybash, Roodin & Santrock, 1991). Dementia is mental disorder that is characterized by a gradual deterioration of intelligence and cognitive ability, often with associative behavioral changes in the ability to care for one's self. It is estimated to affect 5% of adults over the age of 65 and more than 20% of those over the age of 80 (Rybash, Roodin & Santrock, 1991). This disorder has often erroneously been referred to as *senility*, which is an overused and imprecise layperson's term that is used to summarize all of the debilitating personality and cognitive changes that may be observed in elderly populations (Rybash, Roodin & Santrock, 1991).

Dementia, which is not part of normal aging, is also often confused with *senescence*, which is a part of the natural aging process and refers to the point at which degenerative processes overwhelm the biological ability to recover from

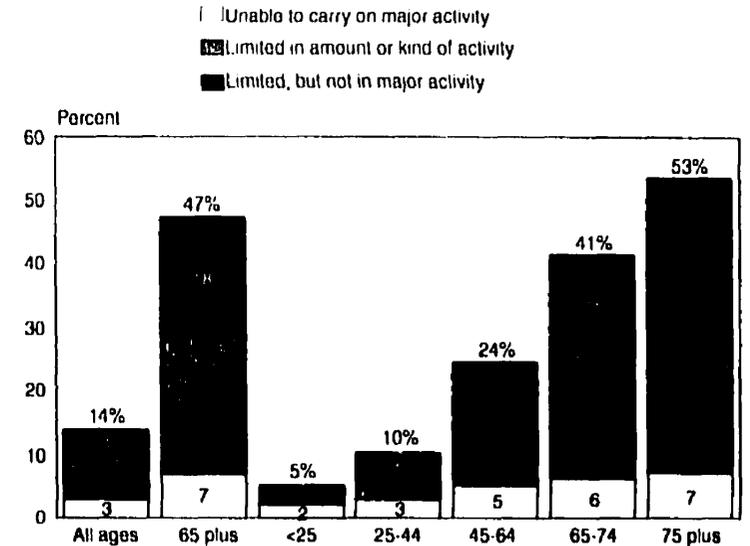


Figure 2-8

Limitations of activity due to chronic conditions by type of limitations and age.

those losses (Rybash, Roodin & Santrock, 1991). Alzheimer's disease is one form of dementia and accounts for the largest proportion (60%) of dementia types among people aged 65 and over (Rybash, Roodin & Santrock, 1991). It is diagnosed by the presence of progressive cognitive and memory impairments.

One of the most common and most overlooked mental health problems among older adults is depression, in which an estimated 4 - 7% of the elderly experience depression seriously enough to require intervention (Rybash, Roodin & Santrock, 1991). If left untreated, depression in older adults may lead to suicide. Schizophrenia, a chronic condition which rarely begins in old age, is another condition which afflicts older adults and is characterized by the presence of hallucinations, delusions, inappropriate affect, disturbances in speech, and alterations in logical thought processes. Parkinson's disease is another health problem that generally causes such symptoms as tremors in the small muscle groups appearing as jerky motions. The risk of falling increases among older adults with this condition (Rybash, Roodin & Santrock, 1991).

2.2.2 Information Processing and Cognition

An ability has been defined as a "behavioral repertoire that is a determiner of performance in the various tasks that require the ability. A person has a number of abilities, and tasks require them in different combinations" (Rogers, 1997). The relationship between individual differences in abilities and learning has been investigated since the early 1900s, and has generally been found to change as a function of task practice. Some research has also suggested that ability-performance relationships may differ for young and older adults, with such age differences possibly being the result of older individuals compensating for ability deficits through the reliance on intact abilities (Rogers, 1997).

Intelligence

It has further been suggested that it is important to be aware of those cognitive abilities that do and do not change as we grow older. The distinction between *fluid intelligence* and *crystallized intelligence* has often been used to identify such differences. Fluid intelligence represents on-line reasoning and the ability to solve problems. Crystallized intelligence refers to the acquired knowledge that an individual possesses. Typical patterns of age-related differences indicate that fluid intelligence abilities such as inductive reasoning and problem solving begin to decline as early as age 25 or 30. On the contrary, older adults tend to maintain their crystallized abilities such as vocabulary and general knowledge, well into their 60s and 70s (Rogers, 1997). Understanding these general patterns of age-related changes in cognitive ability can help researchers and developers to

maximize the performance of older adults by relying more on their acquired knowledge base and less on their ability to perform fluid operations (Rogers, 1997).

Attention

The vast majority of the research on attention has focussed on two different ways in which attention may fail as one ages, the first being failures of selective attention and the second of divided attention. Failures of selective attention occur when one has difficulty *ignoring* material that is irrelevant to their interests or goals (i.e. attempting to read while ignoring a loud television). Failures of divided attention occur when one has problems *processing* all of the information in a situation that is of importance (i.e. trying to listen to two or more important conversations simultaneously). Overall, the research seems to suggest that divided attention may be more negatively affected by aging than selective attention (Rybash, Roodin & Santrock, 1991).

The topic of age-related differences in attention is quite controversial, however a growing body of research argues that there does exist an age-related decrement in attention capacity (that is, a decrease in the amount of psychological energy available to perform mental work) (Rybash, Roodin & Santrock, 1991). Several investigators have found little, if any, age-related changes in attention (or perception) for highly automatic tasks. As a general rule, older adults seem to perform most poorly when confronted with highly unfamiliar tasks that demand a great deal of effortful processing (Rybash, Roodin & Santrock, 1991).

Memory and Learning

Learning capacity appears to be relatively unaffected by the aging process (changes in learning ability appear to be small), however one's attitude towards learning may change more significantly with age. Older individuals may be less ready to learn than in their youth, and as a result may be more likely to attempt to solve problems on the basis of what they already know, rather than learning new solutions. Those who do exhibit learning impairments often do so as a result of some prior incapacity or a debilitating change in their health rather than as a result of normal aging (Kart, Metress & Metress, 1988).

The aging process does appear, however, to involve a greater loss in recent memory than old memory. Also, as age increases, the retention of things heard becomes increasingly superior to the retention of things seen (Kart, Metress & Metress, 1988). Age-related differences in memory appear to be greater when (1) the memory task taps long- rather than short-term memory, (2) effective processing strategies are not employed during the learning of new material, (3) retention tasks demand

a great deal of effortful search or retrieval, (4) the materials are unfamiliar, and (5) the memory task does not draw upon previously acquired knowledge and skills (Rybash, Roodin & Santrock, 1991). Some have suggested that new learning actually interferes with the ability to recall old material, however there appears to be little support for this proposition (Kart, Metress & Metress, 1988).

2.2.3 Anthropometry

Anthropometry measures and shows the size and mobility of the human body (Kroemer, 1997). While a considerable amount of anthropometric information is currently available for able-bodied and disabled populations, specific data for elderly populations is virtually non-existent. Even when such data attempted to include elderly populations, it is often lumped in with that established for disabled populations. Human factors data for elderly populations must therefore be generated for individual applications by assimilating often contradicting sources, and as a result, has the potential of being expressed misleadingly.

Limitations of Anthropometric Data

Most of our built environment has been constructed for the "average" adult, who is presumed to have "normal" anthropometry (i.e. body dimensions such as stature, hand reach, or body weight) and "normal" biomechanic functions (i.e. regarding muscular, metabolic, circulatory, and respiratory capacities and nervous control with fully functional sensory capabilities and intelligence) (Kroemer, 1997). While much of the work done in the past few decades in the area of human measurement did manage to bring the consideration of anthropometric "standards" into the design process, many designers have been using schemes that have assumed that body segments are all of the same percentile value, thereby misleadingly expressing body heights, body breadths, and segment lengths within their designs. Not only the 50th percentile phantom (the "average person") has been used as a design template, but other "ghostly figures" have been created that have, for example, all 5th or 95th percentile values (see Figure 2-9) (Kroemer, 1997). Another problem with current anthropometric information is that it has been done, as a rule, in a cross-sectional approach in which measurements are collected on all available people, and then grouped together usually within certain age brackets (Kroemer, 1997) While this apparently does not create a problem in describing the "young adult" population (because attributes do not change very much in its age span), it is a major problem in the description of elderly populations for the following reasons:

- Among the aging, some persons change dimensions rapidly within a few years, and others in contrast, show little change over long periods of time.

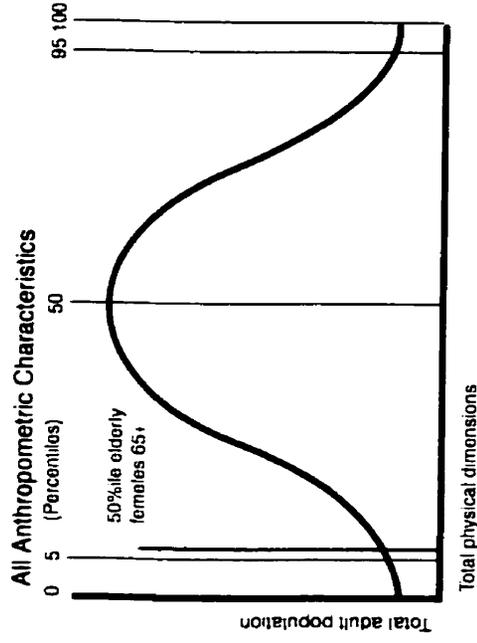


Figure 2-9

- The age brackets used for surveys are rather wide, usually encompassing decades or even longer time spans, as opposed to the common five years in younger cohorts. Thus, people with very different dimensions are contained in each observation sample (Kroemer, 1997).

Age-Related Anthropometric Changes

Although specific data on anthropometric age-related changes *within* elderly populations is not necessary for the purposes of this project, general changes that accompany the aging process are of importance. In particular, general body dimensions and strength abilities of adults over the age of 60 that may influence the design of bathing environments are of interest. Unfortunately, not even documented information of this type has been found to be reliable enough to draw any specific conclusions from. Data tends to either be inconsistent (see Appendix A), or a skewed at best half-century-old sampling of past populations (such as in the case of the *Humanscale* reference guides which don't, for example, reflect such secular changes as the general increasing size of the population which have occurred since having been published). Since no reliable sources have therefore been found which will provide the precise measurements needed, information has been assimilated from a few sources in an attempt to at least loosely outline some of the documented general anthropometric characteristics that may accompany older age.

Strength

There usually tends to be gradual decreases but occasionally sharp declines in strength and work capabilities with increasing age, with the losses becoming more pronounced in the years of old age (Kroemer, 1997).

The following statements have been summarized from data presented in *Humanscale 1,2,3, & 4* in which "human strength" abilities are indicated regardless of age but categorized according to "weak woman", strong woman", weak man", and "strong man", as shown in the chart below. (Diffrient, Tilley & Bardagjy, 1974).

| Standing Height | Woman | Man |
|------------------------|--------------|------------|
| 58.7" | Weak | |
| 68.5 - 68.8" | Average | Weak |
| 63.6" | Strong | Average |
| 74" | | Strong |

Since the true test of a product's usability is its ability to accommodate individuals with reduced abilities, and since the strength capabilities of elderly individuals tend to decrease with advanced age, only the "weak woman" data has been used for the following comparisons.

Arm strength while sitting (feet braced):

- arm straight, facing forward, horizontal
 - pushing down strength > pushing up strength
 - pulling towards body strength > pushing away strength
- arm bent 90°, elbow at side, forearm horizontal
 - pushing down strength > pushing up strength
 - pulling towards body strength < pushing away strength
- arm straight, vertical at side of body, hand below waist
 - Pushing down strength < pulling up strength

Arm strength while standing (feet 12" (30.5cm) apart):

- arm straight, facing forward, horizontal
 - pushing down strength > pushing up strength
 - pulling towards body strength < pushing away strength
- arm bent 90°, elbow at side, horizontal
 - pushing down strength > pushing up strength
 - pulling towards body strength < pushing away strength

Body Dimensions

In the majority of people, their body dimensions change slowly at first with aging, and then become more and more apparent with progressing age (Kroemer, 1997). The measurements shown in the following chart (page 23) indicate some body dimensions for the "handicapped and Elderly", as summarized from data presented in *Humanscale 1,2,3, & 4* (Diffrient, Tilley & Bardagjy, 1974).

Body Dimensions (inches)

| | Small Female | Avg Female, Small Male | Avg Adult | Avg Male, Large Female | Large Male | Average |
|--------------------------------|--------------|------------------------|-----------|------------------------|------------|---------|
| Standing | | | | | | |
| Stature (height): | 57.4 | 62 | 64.5 | 66.8 | 71.5 | 64.4 |
| Eye height (to floor): | 53.4 | 58 | 60.4 | 62.6 | 66.9 | 60.3 |
| Shoulder height (to floor): | 46.4 | 50.6 | 52.8 | 54.7 | 58.7 | 52.6 |
| Elbow height (to floor): | 34.5 | 37.5 | 39.1 | 40.6 | 43.4 | 39.0 |
| High reach (to floor): | 63 | 67.3 | 70 | 72.7 | 77.9 | 70.2 |
| Low reach (to floor): | 21.7 | 22.8 | 24 | 25.1 | 27.3 | 24.2 |
| Sitting | | | | | | |
| Height (to seat): | 27.8 | 30.6 | 32 | 33.4 | 35.6 | 31.9 |
| Eye height (to seat): | 23.6 | 26.4 | 27.8 | 29 | 30.9 | 27.5 |
| Shoulder height (to seat): | 17.1 | 19.2 | 20.3 | 21.3 | 22.8 | 20.1 |
| Thigh height (to seat): | 4 | 5.3 | 5.4 | 6.8 | 6.8 | 5.7 |
| Buttock to knee (depth): | 19.8 | 22.2/20.6 | 22.6 | 23/25.3 | 24.4 | 22.6 |
| Forward reach (depth): | 17 | 18.7 | 19.9 | 20.2 | 21.2 | 19.4 |
| Wheelchair Users | | | | | | |
| Head height (to floor): | 46.8 | 50.3 | 51.8 | 53 | 55.8 | 51.5 |
| Eye height (to floor): | 42.8 | 46.3 | 47.7 | 48.6 | 51.1 | 47.3 |
| Shoulder height (to floor): | 35.8 | 38.6 | 39.8 | 40.4 | 42.8 | 39.5 |
| Side high reach (to floor): | 53 | 59.3 | 62 | 64.6 | 71.2 | 62.0 |
| Side low reach (to floor): | 18.7 | 17.3 | 15.3 | 13.3 | 10 | 12.1 |
| Max. forward reach: | 31.3 | 34.2 | 35.3 | 36.3 | 38.3 | 35.1 |
| Easy forward reach: | 18.5 | 20.2 | 20.8 | 21.3 | 22.3 | 20.6 |
| Forward high reach (to floor): | 45.5 | 51.5 | 53.5 | 55.5 | 59.2 | 53.0 |

2.3 Bathing

2.3.1 Perceptions of Body Cleansing

Perceptions of cleanliness, and the means by which it is to be attained, have varied between cultures, countries, social classes and ultimately between individuals for centuries, and have been accompanied by numerous philosophical and psychological interpretations. Our current value system places an overwhelming premium on grooming and personal hygiene, which on the one hand has a positive effect on health, but on the other is "essentially cosmetic and superficial [and] is a result of social pressures to appear young, thin and beautiful" (Kira, 1966).

Dirt and bodily filth are condemned in principle, whereas the ideals of purity and goodness are equated with the state of being clean. These associations have permeated many facets of our language, having the ability to ascribe not only physical attributes, but also character identifiers to an individual, independent from their actual cleanliness. When a person is described as being "clean cut", for example, more than merely their physical appearance is being referred to, but a certain moral integrity is being ascribed. Similarly, when a criminal suspect is called "clean", it denotes innocence (Kira, 1966).

The idea of cleanliness is not only limited to our personal state of hygiene, but it also extends into our environment. The historical absence of color in bathroom fixtures, for example, was directly linked to society's instinctual belief that white, the absence of color, or the absence of anything impure, implied clean. Colored fixtures were rejected in principle until the mid 1900's, after which time they were 'sold' to popular culture as being just as clean as their white predecessors, but able to make bathrooms more 'livable'. Today, with the widespread availability of both whites and colors, the objections are with the colored fixtures, not as much because of their previous connotations with impurity, but because they tend to show dirt more readily. Society has learned to deal with dirt by maintaining an image of cleanliness. Be it with patterned or textured surfaces to camouflage the dirt, it becomes apparent that "our primary concern is with visual rather than actual cleanliness" (Kira, 1966)

Regardless of this, however, there are some fundamental bases which body cleansing has been derived from (Kira, 1966). The first is the maintenance of health, whereby vermin are not to be harbored, irritations and rashes are not to be allowed to develop into infectious lesions, the accumulation of waste materials are not to be allowed to interfere with the respiratory and secretor functions of the skin, and the delicate bactericidal balance of the skin is not to be disrupted. The second is the maintenance of a socially acceptable level of aesthetic presence,

in both visual and olfactory senses. The third is in the use of water and the washing process as a device for refreshing, reviving, relaxing, cooling, warming, and for simply obtaining sensual pleasure. Following a normal cultural pattern, once we have achieved the minimum practical hygiene necessary to avoid vermin and skin disorders, any further attention to the body is merely a matter of refinement (Kira, 1966). The motivations of aesthetics and refreshment thereby appear to be the primary factors currently governing our current attitudes and practices (Kira, 1966).

The Tub Bath

The tub bath has been said to be generally more relaxing, more luxurious, and more 'feminine' than the shower. While the shower is generally described as 'refreshing' and 'revitalizing', the tub bath tends to call forth such terms as 'soothing' and 'calming' (Kira, 1966). This may be attributed to several factors that differentiate each bathing experience. For one, the tub bath allows the user to sit or recline in a semi-recumbent position whereas most showers don't provide the user with an area to sit even to perform a few washing activities. The tub bath also, because it requires time on the part of the user to fill and release the water, doesn't allow the bathing activity to be rushed and therefore attracts those who wish to relax (Kira, 1966). Once one is in the state of mind to relax, it becomes that much more possible to relax.

The connotation of the tub bath being luxurious stems from a history, not so long ago, when tub baths were limited in their use to the wealthy because of their cost. The elaborately decorated tubs themselves reflected the luxuriousness of the experience that would be enjoyed in the tub. Although years have past, and a tub bath is now affordable to all, the same connotations of luxury and indulgence remain.

The so-called 'feminine' nature of the tub bath is an interesting notion, and as Kira (1966) describes, is clearly revealed in advertising, where, for example, "men are generally shown in showers - rarely in tubs. Advertising directed at women, on the other hand, tends to divide clearly into two images: the tub image, which suggests luxury and eroticism, and the shower image, which is more neutral" (Kira, 1966). Thinking about it, this is true. The only time men are seen in tub baths are either when they are enjoying it with a woman, or with their small children.

Water therapy has long been recognized for its many medical benefits in treating such conditions as arthritis, muscular pains, and poor circulation. The tub bath helps to make these therapies available to anyone, while in the comfort of their own home. Whether used for relaxation, luxury, eroticism or medical purposes,

"the tub emerges ultimately as a source of 'relaxation' in a variety of ways, some purely physical and direct, some purely psychological" (Kira, 1966).

The Shower

The shower bath represents "a series of attitudes and images that are almost directly opposite to those of the tub" (Kira, 1966). It is no wonder, then, that many people, when asked which type of experience they prefer (see results from bather personal interviews), are quite adamant about either the tub bath or the shower, expressing an extreme dislike for one or the other. Those who dislike the shower tend to do so because of more of a perceived than a real problem of not being able to get "as clean" as in the tub where you are able to soak. Those who dislike the tub bath do so also for hygienic reasons, many because they don't want to lie in their own dirt - a hygienically more legitimate claim.

The shower evokes 'refreshing' and 'efficient' terminology when the experience is described, and as a result, appears sometimes to be 'sexless' in the sense that "it does not seem to be as overtly erotic either in its use or in its image" (Kira, 1966). It has been given a distinctly masculine image, with its "speed and efficiency, its invigorating quality, and its generally businesslike, no-nonsense character" (Kira, 1966).

It has only been recently that the shower has begun to assume some of the 'luxury' images, previously only associated with the tub bath, in the form of up-scale steam and multiple water jet showers. Advertisements for such products appear to have attempted to replace the previously marketed 'neutral' woman in the 'man's world' with a more seductive, typically young and nude female (or in some cases female and male), cleverly shielded by vast quantities of steam.

2.3.2 The Bathroom: A Brief History

"The bathroom, more than any room of the American home, has been the least understood and appreciated in its contribution to the design and history of our everyday environment" (Fisher, 1989).

Overview

Bathrooms emerged as a commonplace feature as a result of post-Civil War industrialization, of improved sanitation in both the home and urban areas, and, ultimately, of the convenience they represented. (Fisher, 1989) As the challenges of sewage systems and running water were being met, portable bathing and toilet facilities gave way to permanent installations (Fisher, 1989).

In the late 1800s, the earliest private bathrooms were affordable only by the wealthy, who, as fixtures were being introduced for indoor use, began retrofitting their homes. Typically, bedrooms - called "chambers" - were sectioned off to include a bathroom. These new bathrooms were generally massive spaces with a freestanding lavatory, bathtub and pull-chain toilet placed around the perimeter of the space (National Kitchen & Bath Association, 1997).

For the general public, private indoor bathrooms only became a standard inclusion for new homes in the early 1920's, when, for the first time, it was required by law for new residential construction to include a minimum of one private bath for each dwelling unit (Kira, 1966) At this time, the priority was primarily to 'include' the three most important plumbing fixtures - bathtub, toilet and lavatory - into the smallest space possible. The quality of the space was not a priority for architects or builders, and as a result, the cramped 5' x 7' (152.4cm x 213.36cm) area became the standard space reserved for the bathroom. (National Kitchen & Bath Association, 1997)

Bathroom fixtures have changed little from the beginning of the century to the present, the essential components of the modern bathroom having been established, for the most part, by 1914. With the onset of the Depression, followed by a period of wars and frantic building booms, bathrooms remained essentially at fixed minimal levels. Even during the sixties, when there was a trend to provide multiple bathrooms within the average household, the fixtures and spaces still followed the same minimal pattern (Kira, 1966). It has only been in recent years that bathroom fixtures, in particular the whirlpool tub and steam shower, have elevated the bathroom to receive similar attention as other rooms, demanding the allocation of larger spaces from architects and builders. For the most part, though, it was with the popularization in the mid 1930's of the built-in or recessed combination bath and shower, that today's bathroom was largely defined (Fisher, 1989).

The Least-Studied Room

Our understanding of the history of the bathroom in the North American home is limited, as it is the one room in the home that was rarely photographed. As a result, one of the only sources of achieving an understanding of 20th century fixture construction and installation details becomes the illustrated catalogs of the product manufacturers of the period. These, in themselves, may not be entirely accurate, as most advertising isn't, however they do provide visual representation of the fixtures within the context of the entire bathroom as well as providing insight into the manner in which products were marketed and popularized.

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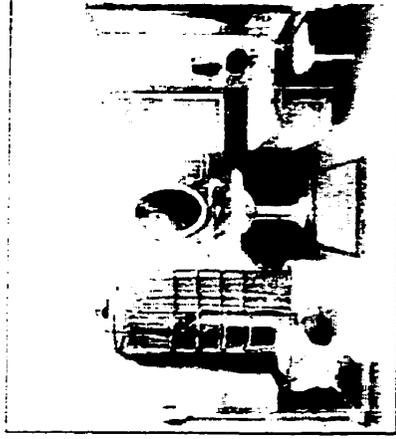


Photo from "A Bathroom Remodel"

(Caption taken from the back cover of all J.L. Standard Sanitary Company catalogs)

Figure 2-10

J.L. Mott Iron Works catalog page.

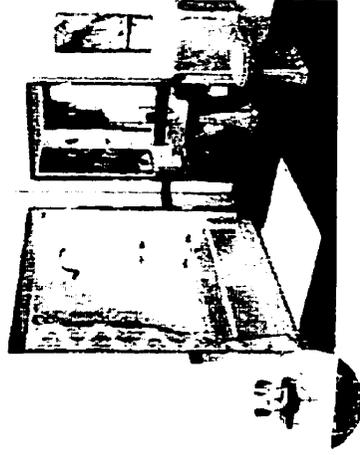


Figure 2-11

J.L. Standard Sanitary Company catalog page.

The prevalence of certain fixtures in today's environments can be traced back to the manner in which they were initially developed, advertised and then accepted by the public. The catalogs of two major fixtures manufacturers during the early and mid 1900s, J.L. Mott Iron Works and Standard Sanitary Company (later American Standard) illustrate the types of products which were being developed at the time as well as the manner in which they were 'sold' to the public. Both companies challenged the architect, builder and homeowner of their time to thoughtfully design and purchase fixtures that would make the bathroom "cheerful, comfortable and elegant" (Fisher, 1989).

The Technology Variable

The tubs developed during the 18th and early 19th centuries were made of sheet metal including copper or sheet iron coated with tin or zinc and painted. Many of these were small, basically for the reason that they were filled and emptied by hand. It wasn't until hot and cold running water eliminated these tasks that the form of the larger plunge tub of today came into effect (Fisher, 1989). These tubs were still made of sheet metal, and were typically encased in wood wainscoting to match the walls of the room, a similar treatment that wash basin and water closets received (Fisher, 1989).

The need for frequent repainting and difficulty in cleaning were the most obvious defects with sheet metal tubs, leading manufacturers to experiment with cast iron (Fisher, 1989). While some of the earliest of these were encased in wood, it was with the development of enameled, as opposed to painted, finishes that made these tubs in great demand (Fisher, 1989). This finish, however, was only applied to the interiors of tubs and not to the outsides which were still being painted. As an effort to develop a new approach to the problem, J.L. Mott Iron Works began purchasing porcelain bathtubs from the Trenton Fire Clay and Porcelain Company, the first firm in America to produce such tubs. The advances in enamel and porcelain ware dramatically altered the appearance of American bathrooms (Fisher, 1989).

The fixture that received the most criticism was the footed bathtub. By the last decade of the 19th century to the early 1900s, the footed bathtub was criticized as posing serious housekeeping problems. Since inadequate sanitary conditions had been receiving a significant amount of attention, this was enough to put an end to this once regarded desirable tub. The Standard Sanitary Manufacturing Company further compared it unfavorably to its newer models stating that "a built-in tub eliminates that accumulation of water and dirt under the back of the tub, which is so difficult to keep clean where the old pattern tub on feet is installed" (Fisher, 1989).

While footed bathtubs continued to be sold well into the 20th century, molded one-piece tubs were rapidly gaining popularity. By 1914, the J.L. Mott catalog was printed and the deemed most fashionable designs were the double shell bathtubs without feet (part of the "Pan American" bathroom collection), which were conveniently also the most expensive. Cast-iron tubs without feet (part of the "Everett" bathroom collection), enameled on the inside but painted on the outside, were the next best thing and were priced for less. The "old fashioned" footed bathtub and tubular shower (part of the "Economic" bathroom collection) were available for the lowest price and were considered to be the least stylish of them all. Similarly, only one footed bathtub appeared in the c. 1935 Standard sales brochure, and it was available with a base to give it a look of modernity. A caption described the bathroom containing the footed tub as "Old fashioned - unsightly - an irritation to the family". The same room outfitted with a "Neo-Angle bath" was declared "Beautiful - modern - clean - inviting - easy to keep spick and span" (Fisher, 1989).

The Introduction of Color

An interesting development of the early 20th century was the introduction of color into bathroom fixtures, instigated in 1926 by the Universal Sanitary Manufacturing Company in New Castle, Pa. Prior to the 1920's, sanitary ware had generally been white, with occasional marbling or hand-painted decoration, because of its sanitary connotations (Fisher, 1989). The Kohler Company followed in 1927, announcing a line of six colors, and then Crane Plumbing of Chicago introduced a line of 18 colors in 1928. By the 1930's, Standard fixtures were available in 10 colors, with the statement "The all-white bathroom is no longer favored as the perfect ideal of sanitation" appearing in their c. 1935 publication (Fisher, 1989). The J.L. Mott Iron Works apparently did not explore color, as it had gone into receivership in 1924, then merged with two other firms in 1927, went into receivership again in 1931 and then closed the following year (Fisher, 1989).

2.3.3 Bathing Fixtures Materials & Processes

Enameled Steel: Used in the manufacture of bathtubs and lavatories, this material is fabricated by forming steel in a cold state, then applying a coating of enamel, then firing the finished piece in an oven. In the fabrication of an enameled steel fixture, a metal sheet is pressed into a die to form the desired shape, a process called drawing. The sheet is also subject to stamping and cutting mechanical operations to form the fixture or individual parts of the fixture. Some enameled steel fixtures also require sections to be welded together. After the form and shape have been finalized, an enamel coating is sprayed onto the fixture and the

piece is then fired. While enameled steel fixtures closely resemble cast iron fixtures, enameled steel is more susceptible to damage. If an object is dropped on the fixture, the smooth formed steel will flex on impact, and since the smooth enameled finish does not follow the movement of the steel, the surface may chip. Enameled steel bathtubs are also noisy and good heat conductors, causing the bath water to cool quickly. On the other hand, they are the least expensive to purchase and easy to handle because of their lightweight (National Kitchen & Bath Association, 1997).

Proprietary Materials: In an effort to maintain the weight benefits and the cost savings of enameled steel fixtures, yet overcome the material's susceptibility to damage, manufacturers have introduced proprietary fixture materials over the last several years (National Kitchen & Bath Association, 1997).

Cast Iron: A method used for more than a century to produce bathtubs, this process involves the molding of the metal when it is in a hot liquid state. Recycled sand is used to create the shape of the mold into which molten iron, at 2,700°F (1482°C) is poured into a channel, filling the cavity. After the iron has cooled and the sand-cast removed, the exterior finish must be smoothed to a uniform finish. After this has been done, the final enamel finish coat is applied, which is a combination of clay, frit, color oxides and opacifiers. It is applied in powder form, and then fired at 1,250°F (695°C) which melts the powder uniformly and fuses it to the cast iron material. The enamel coating on iron is much thicker and the cast iron more resistant to movement than in the case of an enameled steel fixture, making the product more chip-resistant. Because cast iron fixtures are also good heat conductors, the bath water will cool more rapidly than it will in one constructed of a plastic material, which has better insulating properties. Cast iron bathtubs are heavy, and therefore generally limited to sizes up to 72" x 36" (182.88cm x 91.44cm) and 60" x 42" (152.4cm x 106.68cm) (National Kitchen & Bath Association, 1997).

Stainless Steel: These fixtures are generally formed using the same process as enameled steel fixtures, however no surface coating is applied. The quality of SS is generally judged by the steel gauge, the nickel content and the finishing technique used on the fixture. The higher the gauge number, the thinner the steel. 18-gauge steel is considered the best product for an upscale residential product. 20-gauge steel may also be appropriate. 22-gauge steel is generally reserved for very low budget projects. The nickel in the steel increases the corrosion and stain resistant qualities of the fixture. European products typically have a higher nickel content than U.S. stainless steel products. A brushed finish is easier to care for than a mirror-like surface (National Kitchen & Bath Association, 1997).

Cast Polymers: Cultured marble, cultured onyx, cultured granite and solid-colored polymer-based materials are all used for cast mineral filled polymer fixtures. Cast polymer surfaces are created by pouring a mixture of ground marble and polyester resin into a treated mold, where the curing process takes place at room temperature or in a curing oven.

Gel Coat Application The process begins by spraying a gel coat onto a mold. Because most residential fixtures are sprayed by hand, the gel coat thickness typically ranges from 12 to 20 mil (1 mil = 1/1000th of an inch). Research by the Cultured Marble Institute has proven that a 12-mil gel coat is the minimum acceptable gel coat thickness. A 20-mil gel coat is more durable, however, gel coats thicker than 20 mil do not add wearability. Actually a negative effect occurs in thicker gel coats applied unevenly in which a common problem associated with cast polymer fixtures called "crazing" occurs. This is the presence of tiny fractures within the gel coat resulting from the thermal shock caused by repeated exposure of the material to alternating hot and cold water. The molding process for the gel coat involves first allowing the gel coat to cure. A semi-liquid material which consists of polymer resins, a catalyst to promote curing, and highly filled, inorganic particulates of pulverized calcium carbonate, hydrated alumina and, in some cases, glass bubbles is then poured into the mold. If the cast polymer is to have a solid color, no further steps are taken. If the material will have a marbled pattern throughout, the second color is swirled into the mixture. The mixture is then allowed to cure, after which it is removed from the mold, inspected, finished, boxed and shipped. Because cast polymer fixtures are fabricated with a gel coat finish, the benefits of machining in the field are not present. The polyester gel coat finish is also not as durable as other surfacing materials (National Kitchen & Bath Association, 1997).

Solid Surfacing Materials: These are excellent products for bathroom wall panels and countertops, as well as fixtures. These are manufactured from acrylic, polyester or a combination of acrylic and polyester base materials. They are homogeneous materials (color all the way through) and can be machined by a skilled fabricator and are repairable if damaged. The surfaces are hard and non-porous and are stain and burn resistant (National Kitchen & Bath Association, 1997).

Wood: Wood bathtubs were offered a few years ago, however are no longer available from major manufacturers because of their poor market acceptance. Wood fixtures are generally constructed from solid strips of teak or oak. Once constructed, the fixtures are finished with a marine varnish to protect and enhance the beauty of the wood (National Kitchen & Bath Association, 1997).

Man-madePlastics:

Fiberglass Fixtures referred to as "fiberglass" refers to the backing material used to reinforce a polyester gel coat-finishing surface. A mold receives a layer of gel coat and then fiberglass strands immersed in a polyester resin is sprayed on or placed on top of the mold in mat form. Additional reinforcing, in the form of wood or metal strips or braces, is attached at this stage of the manufacturing process. The polyester gel coat is not as durable as other finish surface layering materials in use today, however, it is generally the least expensive.

Acrylic This method uses a 1/8" - 1/10" (.32 - .25cm) sheet of acrylic or acrylonitrile-butadiene styrene (ABS) to form the fixture. The temperature of a thermoplastic material, such as acrylic or ABS, is elevated to a level that makes it pliable and workable, and then it is vacuum formed into a mold, creating the desired shape. All fixtures requiring structural support are then sprayed with resin and chopped strands of glass in much the same manner as the fiberglass spray-up method of construction. The application of reinforcement boards or braces is also the same as for both materials. An advantage of acrylic or ABS thermal plastics is that they are harder materials than polyester gel coat and the color goes all the way through the material. They also offer deeper color tones and are more resistant to abrasion, high heat scarring and sun fading. Although acrylic can be scratched, it is repairable. Acrylic fixtures are also more expensive than gel coat finished fixtures. Acrylic bathtubs are reinforced on the underside, usually with fiberglass (National Kitchen & Bath Association, 1997).

Injection Molding This is the third method of manufacturing plastic fixtures. With this method, the plastic material is heated until it reaches a liquid state, at which time it is injected into the cavity of a mold for the fixture. With this process, the color on the surface goes all the way through the material. All plastic fixtures are warm to the touch and therefore are comfortable for the bather to lean against. These fixtures act as insulators so that the water in the bathtub does not cool too rapidly. Noise may also be reduced if a sound-deadening undercoating is included (National Kitchen & Bath Association, 1997).

2.3.4 Current Products Review

Bathtub Fixtures

Standard bathtubs: These are ideally suited for relaxing in warm, soothing water. They are not ideal shower receptors because of the fixture's high sides, curved bottom and narrow width. "Even a bathtub that is solely reserved for bathing is a dangerous fixture for users because of the likelihood of falling or slipping while

entering or exiting the bathtub, or while changing from a seated to a standing position (National Kitchen & Bath Association, 1997). Generally a person will stay in the bathtub for about 20 minutes, in water temperatures that range from 95°F (52.8°C) for children and elderly adults, to 103/104°F (52.7/57.8°C) for others (National Kitchen & Bath Association, 1997). There are a wide variety of bathtub types in many different shapes and sizes, with varying installation methods. The National Kitchen & Bath Association (1997) have categorized these as follows:

Recessed This type of bathtub comes without finished ends and with one finished side, typically called the "apron". The bathtub is designed to slip between two end walls and against a back wall. These tubs are manufactured with the drain at the right or left end of the tub, a relationship established when a person stands in front of the bathtub about to enter. If the drain is on the left, it is considered a left-hand tub. Typical sizes are 30" (76.2cm) to 34" (86.36cm) wide, 14" (35.56cm) to 20" (50.8cm) deep, and 60" (152.4cm) long. Bathtubs are constructed of enameled cast iron, enameled steel and proprietary materials, as well as fiberglass and acrylics. These bathtubs usually have an integral tile flanges on the two sidewalls and the back so that when the wet wall material is installed, water will not be able to "wick" up behind the surround material and damage the drywall or wood studs. Many manufacturers also offer a tile bead kit that allows the installer to transform a bathtub without flanges into a recessed unit.

Corner There are generally two types of corner units. One type is available in a configuration similar to the standard recessed bathtub, but instead of only the front being finished, one end also has a finished panel. Another type is designed to fill a corner, with three angled or curved finished sides and are available in a variety of sculpted shapes for a wide range of configurations. This type generally requires from 4' (121.92cm) to 5' (152.4cm) along the back two walls, and extends from 5' (152.4cm) to 6' (182.88cm) out from the back corner into the room. Corner installations are an efficient way of incorporating a whirlpool bath if the available back wall space is limited.

Free-Standing These types of bathtubs are designed to literally stand in the middle of a room, and include such designs as recreated claw foot tubs to pre-formed concrete. Some of these bathtubs are available with a whirlpool system. These are extremely dangerous if used as showering facilities, and are recommended to be avoided for such installations.

Platform These bathtubs have no finished sides and are designed to drop into a platform made of another material. They are available in the same range of materials as recessed bathtubs, however there are some limitations on sizes fixtures fabricated with cast iron. These bathtubs lend themselves well to installations

where the platform material may be extended over the bathtub creating an under-mounted condition, however, this may make lounging uncomfortable for the user to rest their head. It also makes it more costly to replace the fixture if ever necessary.

Whirlpool Bathtubs: An estimated 20% of all bathtubs sold today feature a hydromassage, or jetted system (National Kitchen & Bath Association, 1997). Introduced in 1968, the system was originally designed for therapeutic use in hospitals. The whirling motion of thousands of bubbles bouncing and bursting against the skin increases blood circulation along the surface of the skin and acts as a massage on tired or painful muscles and joints (National Kitchen & Bath Association, 1997). The capacity of whirlpool bathtubs ranges from 50 to 140 gallons (190 to 530 L) of water. A jetted bathtub does not replace the function of body cleansing as in traditional American bath or shower fixtures. Washing and rinsing must be done before and after the experience intended for rejuvenating the body. Jetted tubs are available in a variety of sizes, shapes and colors. Standard 5' (152.4cm) long units that look like conventional tubs as well as larger more luxurious models, which are contoured to fit the body, are available.

Shower Fixtures

Shower stalls: Showering is a quick and efficient method of cleaning the body (Kira, 1966). Stall showers are available in a variety of materials, sizes, and configurations.

Materials Masonry and stone, solid surface, plastic, and cast polymer materials are used in the fabrication of shower stalls. Masonry pans are of a cement construction with chips of ground stone used as filler, much like terrazzo. The mixture is poured into a mold and then subjected to high temperatures and pressure for curing. When removed from the mold, the pan has a smooth finish with a homogeneous wall structure. Solid surface shower pans are offered in popular sizes, and can also be customized by skilled fabricators. Fiberglass reinforced gel coat, acrylic and ABS plastic as well as cast polymer shower pans are also available. Solid surface, plastic and cast polymer pan materials have an advantage in that the walls of the surrounding enclosure can be made of the same or similar material (National Kitchen & Bath Association, 1997).

Sizes The minimum size of a stall shower is established by building codes. The minimum shower enclosure must be at least 1,024 square inches (6,606.44 sq.cm) (National Kitchen & Bath Association, 1997). Using these guidelines, a 32" x 32" square (81.28cm x 81.28cm) is the smallest shape possible. National Kitchen & Bath Association (1997) recommends an interior minimum of 34" x 34" (86.36cm x 86.36cm). Regardless of the minimum code size, it is further suggested that

the enclosure be large enough to allow the user to step out of the stream of water to adjust the temperature or flow of water. For a typical adult, an enclosure that is 42" x 36" (106.68cm x 91.44cm) in size is necessary to provide that flexibility (National Kitchen & Bath Association, 1997).

Showers without doors: These are generally designed and fabricated on site. The recommended space requirement for this type of installation is that it be at least 60" (152.4cm) deep to handle the water spray. A shower with no door should include wall, floor and cabinet surfaces outside the shower enclosure that feature the same attention to waterproofing as the wet walls inside. Water vapor in the form of steam spreading throughout the adjacent bathroom space also occurs. A shower door system that extends to the ceiling will contain all the steam in the enclosure. When the door is opened, the colder air will rush into the enclosure causing the steam to condense on the shower walls before it escapes into the general bathroom area (National Kitchen & Bath Association, 1997).

Steam showers: For centuries, people from other cultures have used steam to cleanse the body and relax the mind. Until recently, however, N. Americans have associated steam rooms with health clubs. The new generation of smaller, lighter and more economical steam generators makes it easier to incorporate one of these fixtures into a 'normal' bathroom. A steam bath component can be added to a standard stall shower. Steam baths are also energy and water efficient. A standard 15-minute steam bath consumes only about 1 1/2 quarts (1.42 liters) of water and 1.8 kilowatts of electricity. A normal steam bath lasts about 10 to 20 minutes in an enclosed environment where the humidity level reaches nearly 100%. A lukewarm shower then follows the steam bath to aid in relaxation, or a cold shower to stimulate the body. Ergonomic concerns for a safe and comfortable steam room are the same as those for stall showers (National Kitchen & Bath Association, 1997).

Bathtub/Shower Combination Fixtures

"A bathtub that also doubles as a shower is inherently a dangerous fixture to use and offers limited comfort to the consumer" (National Kitchen & Bath Association, 1997). These units typically do not provide a comfortable bath, nor a safe showering experience, however, because of space constraints, they are a common installation (National Kitchen & Bath Association, 1997). These combinations units are typically either bathtub fixtures with separate surrounding wall materials (i.e. tile), or one-piece units. The one-piece units are the easiest to clean, the least susceptible to water damage, and the most flexible in their overall design (National Kitchen & Bath Association, 1997). Incorporated in such units are sometimes benches and seats, fold-down seating areas, built-in grab bars, and storage shelves.

Saunas

The sauna bath is a 2,000 year-old custom that has been enjoyed by the ancient Greeks and N. American Indians, along with the Finnish version (a country where there are more saunas than automobiles) (National Kitchen & Bath Association, 1997). Sauna procedures are as varied as the those who use them, however most enthusiasts recommend briefly showering, then entering the sauna for five to fifteen minutes. The sauna enthusiast would particularly appreciate a shower with body sprays because it will provide as full-body stimulating shower experience. The individual may sit or lie in the insulated wooden room, of which the lower bench is always cooler than the higher one. Next, a cool shower, a swim in a pool, or a roll in the snow invigorates the body's system. A short ten to fifteen minute rest follows. Finally, a second visit to the sauna for about twenty minutes is enjoyed. A second twenty-minute rest is suggested, followed by a final shower and light snack (National Kitchen & Bath Association, 1997).

Bathtub & Shower Enclosures:

Shower Rod and Curtain: A shower rod and curtain is often used to add a decorative color accent to a stall or bathtub/shower combination, however they are not the safest type of enclosure. They can unexpectedly wrap around a bather as they move during the shower, and they can make it more difficult for the user to enter and exit the shower (National Kitchen & Bath Association, 1997). This type of enclosure may typically have a valence across the top to conceal the bar or have a tieback decorative fabric that conceals a clear or utilitarian curtain behind (this installation requires double bars and hooks). Shower rods are held in place with brackets that are secured to studs or by tension rods. They are available finished in a chrome, brass, or covered with a colored sleeve to match other accessories. The hooks may be plastic or wire. Shower rods may be straight or curved for corner installations.

Glass or Plastic Enclosures: These are typically more water tight and generally easier to clean than shower curtain enclosures (National Kitchen & Bath Association, 1997). These include sliding, swinging, pivot or accordion folding doors.

Sliding doors These doors (usually two) hang and roll on parallel tracks and are typically seen in stall showers and on bathtub/shower combinations. An advantage of these enclosures is that the sliding operation keeps the door from protruding into the space. A disadvantage is that the track that the door typically slides on is difficult to clean. Also, in the tub/shower combination, the doors block one side of the bathtub making it difficult for a care provider to assist a dependent bather with bathing (Mullick, 1993).

Swinging doors These are doors which swing open on a hinge, and are traditionally reserved for stall showers (with or without fixed side panels completing the enclosure) (National Kitchen & Bath Association, 1997). Some poorly designed units drip water on the floor when opened. The door should comfortably swing without interfering with other fixtures and should not block access to the valves inside the shower enclosure. The water spray from the showerhead should also not be directed towards the door (National Kitchen & Bath Association, 1997).

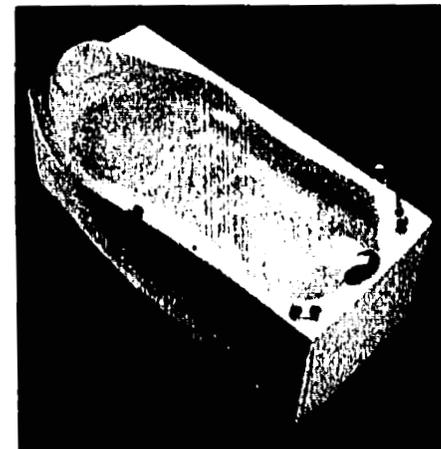
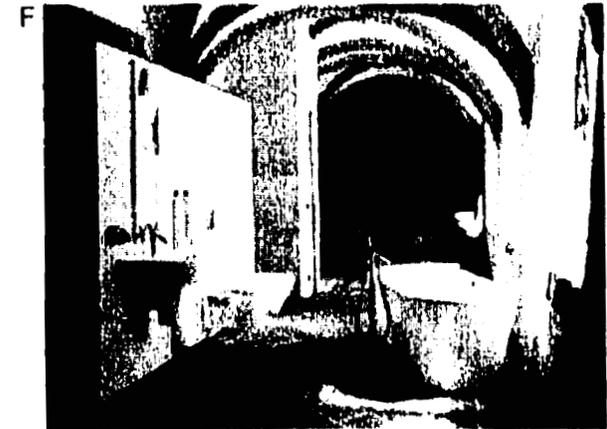
Pivot doors These are doors that pivot on a pin to open and close. The advantage of these is that while they protect the room from being splattered with water, they do not imprison the bather. Some doors, however, pivot into the enclosure and therefore do not meet the safety standards recommended by the National Kitchen & Bath Association (1997) because an injured or ill bather could be trapped in the enclosure with the door blocking assistance from the rescue team. These installations sometimes require special wall preparation to carry their weight (National Kitchen & Bath Association, 1997).

Accordion folding doors These doors consist of a series of panels which fold against one another in an open position. These are available for both shower and bathtub/shower combination units. Extra care is required regarding maintenance and the prevention of mildew on the track. A disadvantage of these doors is that they are not as watertight as other enclosures (National Kitchen & Bath Association, 1997).

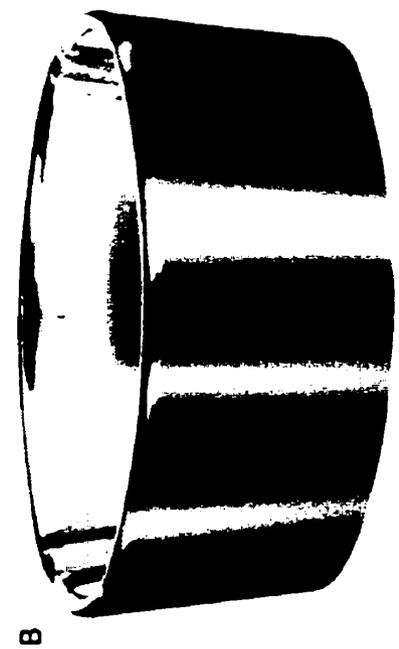
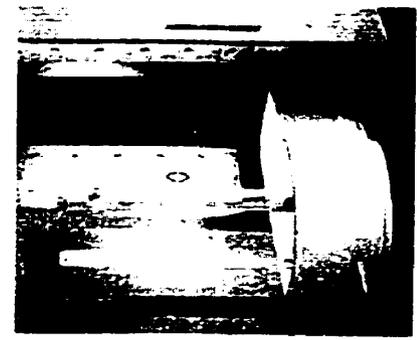
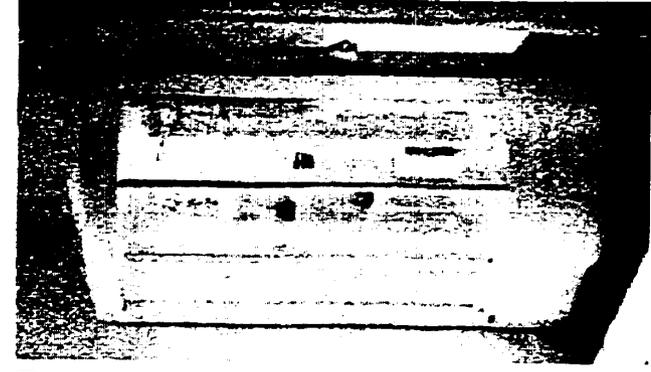
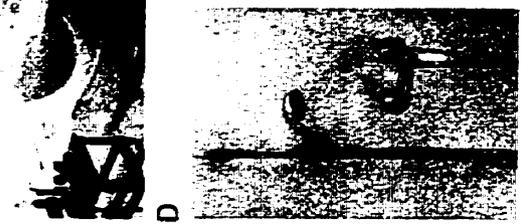
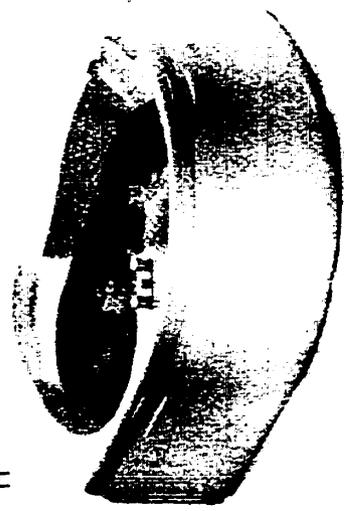
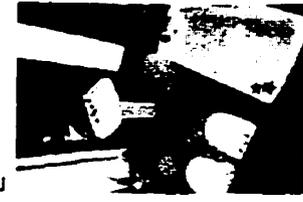
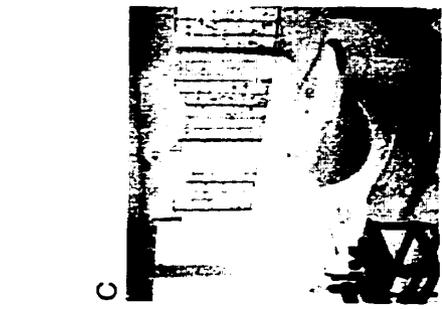
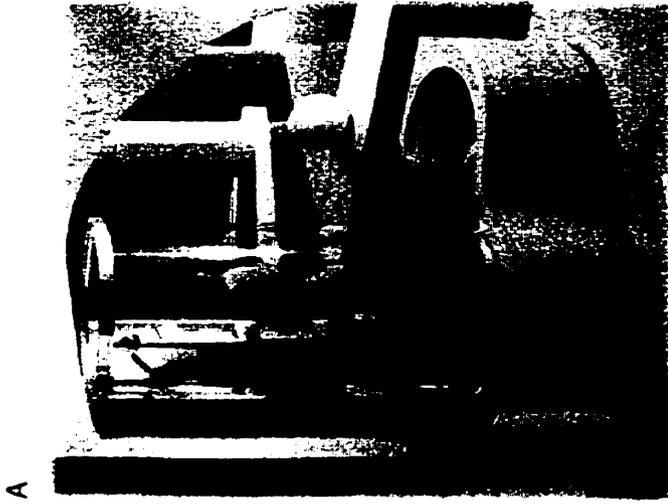
The doors of tub/shower enclosures are typically framed in anodized aluminum or brass trim or left frameless. Epoxy-coated, colored enclosure frames are also available. Tempered safety glass or plastic is usually used for safety reasons as compared to normal glass, however it cannot be drilled or altered after the tempering process because it will break. Clear, translucent and mirrored panels are available. Clear panels require that the surface be wiped down after each use, treating the glass with a water-sheeting product, or using a squeegee to prevent water mineral deposits from gathering on the surface and discoloring the clear glass over years of use (National Kitchen & Bath Association, 1997).

Sampling of Fixture Types
Bathtub, Shower & Bathtub/Shower Combination Fixtures
Figure 2-12 (A-F)

- A Bathtub/Shower Combination Fixture*
- B Shower stall & Platform Bathtub*
- C Floor-Recessed Bathtub*
- D Platform Corner Bathtub*
- E Whirlpool Bathtub*
- F Free-Standing Bathtub*



**Recent Product Developments
Innovative Design - Bathing Fixtures
Figure 2-13 (A-J)**



2.4 Design Approach

Levitt (1986) introduced the idea that "corporate survival depends on doing everything necessary to satisfy the needs and wants of the customer" (Pirkl, 1994). Recent research has also shown that future 'success' in market share will be determined through a better understanding of customer values and requirements" (Muddell & Sale, 1998). While industrial design has, historically, had a strong social agenda of designing for human needs (Mullick & Steinfeld, 1997), manufacturers, on the other hand, have generally tended to "keep benchmarking off their competitors rather than their customers", and as a result have been "benchmarking off mistakes that have been made for years and years" (Smart Business Supersite, 1995). User driven new product development, as outlined in the following approaches, seeks to provide a better match between products and users through a better understanding of customer values and requirements.

2.4.1 Universal design

The term "universal design" has been defined and interpreted numerous times by numerous individuals, and as a result, is a highly misunderstood concept. Recently, however, advocates of universal design, including architects, product designers, engineers and environmental design researchers, collaborated to establish a working definition of the concept as well as seven principles intended to guide a wide range of design disciplines including environments, products and communications. Universal design was defined as "The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (The Center for Universal Design, 1997). The seven principles were established so that they may be applied to evaluate existing designs, guide the design process, and educate both designers and consumers about the characteristics of more usable products and environments. The principles are as follows:

1. *Equitable Use.* The design is useful and marketable to people with diverse abilities.
2. *Flexibility in Use.* The design accommodates a wide range of individual preferences and abilities.
3. *Simple and Intuitive Use.* Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4. *Perceptible Information.* The design communicates necessary information

effectively to the user, regardless of ambient conditions or the user's sensory abilities.

5. *Tolerance for Error.* The design minimizes hazards and the adverse consequences of accidental or unintended actions.

6. *Low Physical Effort.* The design can be used efficiently and comfortably and with minimum fatigue.

7. *Size and Space for Approach and Use.* Appropriate size and space is provided for approach, reach, manipulation, and use regardless of users' body size, posture, or mobility.

Some of the proponents of Universal Design have suggested that one of the ways the ideal may be accomplished is by the adoption of a "systems" approach to the design of products, stating that "Universal design does not necessarily mean that the product or environment is designed to be usable by all people from the beginning" (Steinfeld, 1994). By adopting a systems approach to provide an adaptive environment, it is suggested that interchangeable parts may be used to allow for a substitution of features to accommodate different levels of ability, or the approach of adaptability by the use of add-on features may be used. For example, a consumer might purchase a basic bathtub to begin with, but as they got older, could buy additional options that easily attach to the tub. Although this approach may have the benefit of creating a system of uniform aesthetics, it does not alleviate the user's responsibility of having to continuously update the product. Since users generally do not want to be made aware of their functional deterioration by a product (see results from personal interviews with bathers), this does not seem to be much of an improvement from what commonly exists already.

While the concept of universal design is to offer "the same level of access, assistance and enablement to all users" (Mullick & Steinfield, 1997), true universal design has often been criticized as being an unattainable ideal. Even advocates of the concept recognize that its "high social objectives are almost unattainable" (Mullick & Steinfield, 1997). It is, in fact, impossible to design all things, for all people, all of the time. Since its principles have also been developed to span all of the design disciplines, it seems to be even more questionable as to whether it can ever be achieved, at least when applied to product design.

2.4.2 Assistive design

Assistive design is almost the exact opposite of universal design. This approach creates "specialized products used to increase, maintain or improve the functional

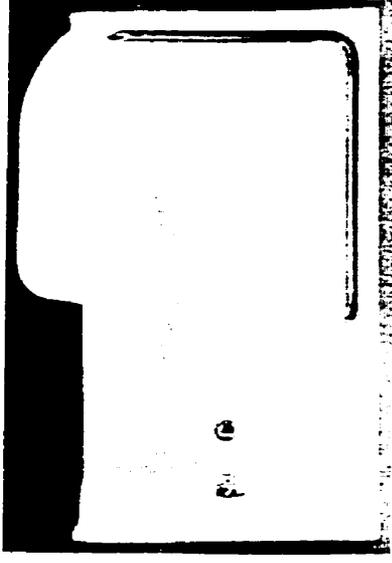


Figure 2-14
Universal design example?

capabilities of individuals with disabilities" (Mullick & Steinfeld, 1997). While these may be considered 'Band-Aid' solutions to already inappropriately designed products, they are indispensable for helping many individuals with more specialized disabilities achieve independence. "Assistive devices include mobility aids such as wheelchairs, walking sticks, crutches and walkers and toileting aids such as raised seats and grab bars" (Mullick & Steinfeld, 1997).

These products are typically expensive due to the small size of their intended market, and are typically sold primarily through catalogs and specialized stores. This makes them difficult to obtain, repair and have serviced. They generally also have a clinical and sterile appearance, often dissuading those who may benefit from their use from even considering trying them.

Unfortunately, even individuals who do attempt to use these products may be annoyed or even turned off completely from ever using them again, regardless of their need for such products. This is because, for the most part, assistive products haven't been designed to interface effectively with other general-purpose products or the built environment (Mullick & Steinfeld, 1997). In some cases, the use of these products may even increase the likelihood of accidents (Mullick & Steinfeld, 1997). If a plastic raised toilet seat, for example, shifts only slightly from its intended position on the top of the 'regular' toilet seat, the user may fall. The potential for accidents results not only from the often poor interfaces existing between assistive and 'standard' products, but also from the weak materials and joining processes often used to fabricate such products and from a false sense of security they can portray to their users.

2.4.3 Adaptive devices

Adaptive devices are common products that are made usable by modifying them in some way or another by people with disabilities. The common feature of these products is that they all have add-on features that are capable of transforming otherwise unusable products into usable products. Adaptation "personalizes designs, provides social empowerment and offers personal independence" to their users, however this two-stream approach of "adaptive" products and "general" products also generally hampers social interaction (Mullick & Steinfeld, 1997).

These devices are also often good indicators of a "general" product's shortcomings. Products that require modification so that they may be used by people with specific needs demonstrate a weakness in the overall design of the product. For example, slip-on lever handles suggest that round doorknobs are too slippery and difficult to grip for some people (Mullick & Steinfeld, 1997). It is further the methods in which certain products are modified which may be some of the best

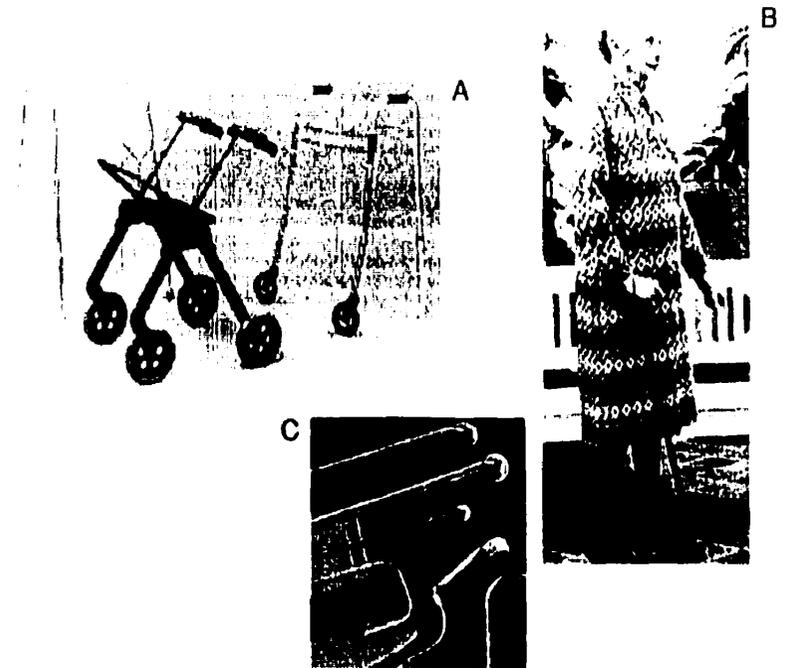


Figure 2-15
Examples of assistive devices.

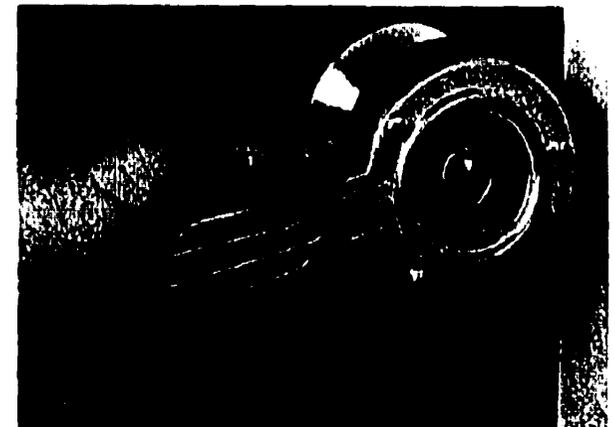


Figure 2-16
Adaptive device example, lever door handle.

indicators of how "general" product designs may be improved.

While adaptive devices are able to provide independence to many users with unique needs, they have been criticized, appropriately, for their lack of aesthetic appeal. Most appear to be pieced-together homemade solutions, often drawing attention to users' *disabilities* instead of to the inability for the products to accommodate users' *abilities*.

2.4.4 Accessible design

Accessible design is similar to assistive design in that it produces specialized devices that meet the unique needs of people with disabilities (Mullick & Steinfield, 1997). Examples of accessible design includes wider door widths, larger floor space clearance, higher toilets, lower drinking fountains and pay phones, and ramps beside stairways.

While the concept of accessible design has evolved as an effort to eliminate the environmental barriers that may otherwise prevent access to buildings and products, it has been accompanied by the negative side effect of segregating users. While the concept of accessibility is a needed one (still often neglected despite standards and regulation), it has become an add-on feature in many cases, applied only after 'standard' products and environments have been developed. At a recent architectural defence, for example, a student was asked how she had incorporated issues of accessible design into her building. Her response was that with everything else she had to consider, it wasn't really a major 'focus' in the design development. The most surprising thing wasn't even that she had neglected the issues, but in the fact that the jury found her response completely acceptable.

The provision of *accessible* design for people with disabilities and *normal*/design for able-bodied users contributes to the stigma of disability, duplicates resources and adds to the cost of design (Mullick & Steinfield, 1997). Side-by-side drinking fountain set-ups, for example, in which a low one is intended for wheelchair users and those of short stature and a raised one is for 'everybody else', not only segregate users by drawing attention to varying abilities (more so to disabilities), but they unnecessarily require products and materials to be duplicated.

2.4.5 Transgenerational design.

Pirkil (1994) has defined transgenerational design as being "the practice of making products and environments compatible with those physical and sensory



Figure 2-17

Accessible design example - ramp beside stairs.

impairments associated with human aging, which limit major life activities". This design approach further attempts to reject the discriminatory specialized "elderly" products or devices targeted directly at older consumers and offers instead products that are attractive and accommodating.

While the roots of transgenerational design stem from the limitations associated with human aging which tend to limit various life activities, this approach may also benefit younger people who may be experiencing impairments similar to those associated with the aging process. "It recognizes that many disabilities, normally associated with the elderly, frequently occur much earlier in life due to sickness or accident" (Pirkki, 1994). Many impairments, such as those associated with vision or hearing, for example, require the use of eyeglasses or hearing aids, limiting the activities of anyone afflicted with them, regardless of age. Transgenerational products are therefore designed with the intent that individuals of any age and ability may benefit from their non-stigmatized and appealing character.

Similar to the other design methods, transgenerational design has been criticized as being too narrow in focus by its concentration on age as a design determinant rather than other issues of "human diversity" (Mullick & Steinfield, 1997). Such criticism, however, doesn't recognize that this approach does, in fact, recognize such issues, but as they are contained under the umbrella of human aging. "Age" itself isn't used as a design determinant, as the critics suggest, but is instead used to identify many of the activity limitations that could strike the human body at any time.

2.4.6 Summary

While there are advantages and disadvantages of each approach described above, by no means is there one method which should be applied to the design of all products or environments. Each method may be an appropriate and effective response depending on the situation to which it is applied. While universal design strives for products and environments which can be used by everyone, they obviously can't. A design intervention that would help one person to use a product may be the very intervention that prevents another person from using that same product (Designing Universal/Accessible Consumer Products).

Prior to attending "Designing for the 21st Century: An International Conference on Universal Design" in Hempstead, New York, June 1998, a universal design approach was to be applied to the design of a bathing environment for the older adult. As the conference progressed, however, many of the inconsistencies with the objectives of the method became apparent, especially as they were translated

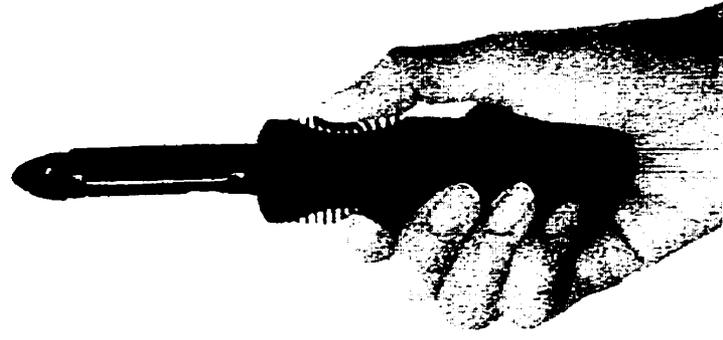


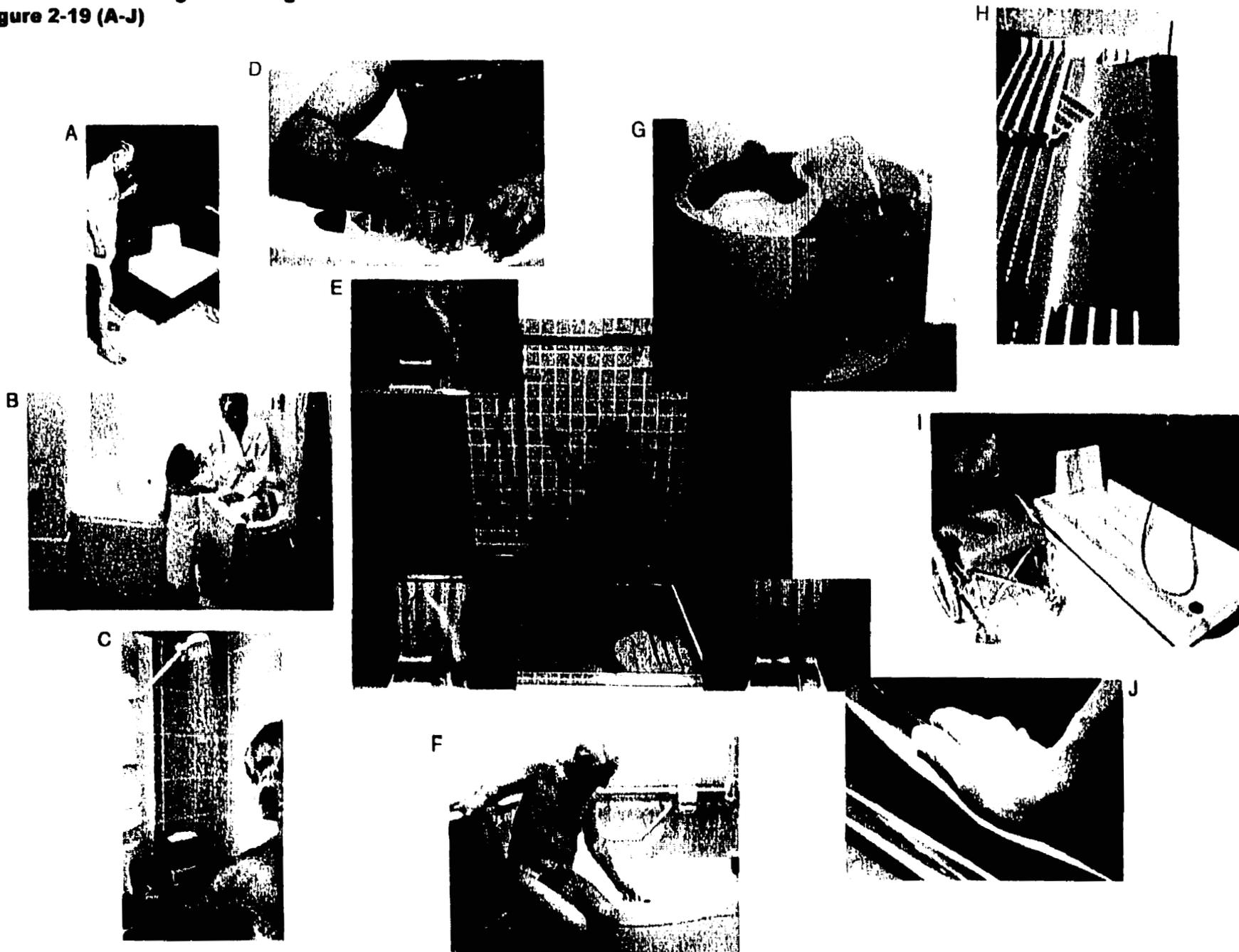
Figure 2-18

Examples of transgenerational design.

between design disciplines. During a conversation with one of the advocates of the method who had collaborated to establish the seven principles, even he suggested that the approach is flawed, and shouldn't necessarily be adopted "universally", that is to say in all circumstances without proper evaluation.

Approaching design by considering the relevance of the different methods is, on the other hand, a step in the right direction. Regardless of which approach is adopted for a given design problem, the objectives should generally be to consider the requirements of a specific group of people, and then to create a design which other populations may also be able to benefit from. While more specialized products are still needed to fulfill the needs of many individuals, approaching design in a more inclusive manner basically results in 'good design', capable of reducing dependence for many more.

Recent Product Developments
User Inclusive Design - Bathing Fixtures
Figure 2-19 (A-J)



3 User Research

The following study was designed to obtain qualitative data on the bathing needs, preferences and experiences of older adults and their care providers. This research was conducted using three methods of data collection:

- 1 - Focus group sessions with bathers.
- 2 - Simulated observation and personal interviews with bathers.
- 3 - Questionnaires & personal interview with the care-providers of dependent bathers.

3.1 Focus Group sessions

Prior to commencing any personal interviews with bathers, three focus group sessions were conducted with older adults with the intent of outlining some of the bathing related issues that impact this population. The sessions were scheduled in Calgary at a retirement residence and at a community center, and in Winnipeg at an apartment complex.

A loose set of pre-formatted bathing-related questions was used to introduce the topic and to encourage dialogue among participants. Discussions were then allowed to develop around the issues voiced by the participants promoting a wide range of perceived needs, preferences, experiences and environmental conditions to be outlined independent from any biases I might have brought into the conversations. Notes were taken during the discussions to record the information from the sessions.

3.1.1 Session 1

Setting: A Calgary retirement residence for older adults who may require mild to moderate assistance with different aspects of daily living. Home care services are stationed on the premises. Individuals live independently with the exception of meal preparation and individually required services (i.e. bathing).

Attendance: 4 female participants.

Issues which arose during the discussion:

- The curb around tub should be shorter for stepping over.
- There should be a softer kind of material for around the edges of the tub.
- Temperature control shouldn't be so low.
- A heat lamp in the tub would be nice.

3.1.2 Session 2

Setting: A Calgary community center with recreation facilities for individuals of all ages. An adult day program is in place.

Attendance: 3 female participants, 1 male participant. The program manager supervised.

Issues which arose during the discussion:

- One participant needed to know how to wash his feet and wanted to install grab bar but not a *permanent* one.
- The same participant was "terrified" during an experience at a new hotel because it was so slippery and the water temperature was not constant.
- There should be more storage space around sinks.
- Tub is "too deep".
- Have a non-slip surface in the tub so it's still comfortable to lie on.
- The ledge on the outside of the tub could be lower because she doesn't fill the tub so it doesn't have to be that high.
- Something to grab onto around the edge of the tub.
- Have a sloped backrest at the end of the tub for leaning against.
- Have a sloped backrest that could be adjustable for different angles.

3.1.3 Session 3

Setting: A Winnipeg apartment complex for people of all ages, however a large number of the tenants are 60+ years old.

Attendance: 10 female participants.

Issues which arose during the discussion:

- One woman found it difficult to be on her knees when she was on the floor cleaning her tub.
- Three women told her that they used a mop on a pole to clean their tile.
- One woman got stuck in the bathtub one time.
- One woman stated that she just got a bar put in on the back wall of her tub and that it has saved her - "It's just great".
- One woman complained that her tub surface was slippery.

- One woman suggested that a good tub would be one that had a door that you could walk through to get in. I informed her that one exists.

3.2 Simulated user observation & personal interviews with bathers

While conducting background research for this project, it was discovered that a number of studies had been recently conducted to better understand older adults in their bathing environments. One study entitled *A Bathroom for the Elderly: A Case Study of Human Factors Research in Industrial Design* (Singer & Graeff, 1989), proposed a procedure to integrate HF knowledge in design projects, and presented a case-study of the design and development of a bathroom for the elderly as an application of this approach. In this study, a full-size mock-up of a 'typical' bathroom facility was constructed and used as the environment in which to study participants interacting with the equipment. Another more recent study entitled *Bathing for Older People with Disabilities* (Mullick, 1993), was conducted to assess the bathing needs and preferences of older persons living at home and their care providers to be used in designing a bathing facility capable of providing greater safety and access to all. In this study, participants were interviewed individually and in focus group settings. The bathroom environments of those being interviewed were videotaped and then studied.

While each study was able to collect useful data to better understand the unique needs of older adults and their bathing environments, it is believed that an even better understanding could be achieved by combining some of the methods used in each study. By combining the method of user observation during the performance of a particular task with that of observing individual environmental conditions, bathers may be studied not in a controlled or 'typical' environment but in the one which is most likely to impact them the most: their own.

3.2.1 Objectives

- To identify the types of difficulties, if any, that users of bathing products experience while interacting with their equipment.
- To identify and interpret various methods of conscious or unconscious means of adapting to bathing environments as developed by the users and project these findings to suggest that other users may employ similar methods.
- To draw a set of design criteria from the data to form a basis for the conceptual design phase of the project.

3.2.2 Sample

Voluntary interviews with bathers were scheduled with 25 participants aged 60 and over from both Calgary and Winnipeg. Participants were recruited using four methods:

- 1 - During the focus group sessions held in Calgary (11 participants).
- 2 - Posters (no responses).
- 3 - Advertisement for participants placed in the Kerby News (Kerby Center, Calgary) (4 participants).
- 4 - Word of mouth (10 participants).

Although a sample size of 30 participants was intended for the study, saturation was achieved after interviewing 25 participants. Since the study was designed to produce qualitative data, the sample size was determined to be sufficient and the interviews were ceased.

Due to the unusual type of subject matter being researched along with the method in which data needed to be collected, difficulty was experienced in finding older adults who were not only willing to discuss bathing openly, but be willing to demonstrate their bathing ritual, be physically able to perform the demonstration and consent to be video-recorded. The sample size of 25 indicates the number of people who were interviewed. After that, 22 were willing to demonstrate their bathing ritual (19 were physically able to demonstrate), and 21 were willing to be video-recorded. Several individuals who were initially willing to be interviewed later declined entirely when they were informed about the demonstration and video-recording portion of the study.

3.2.3 Methodology

The personal interviews were conducted in the homes of the participants using a pre-designed set of questions (Appendix A) as a base from which to begin discussion. Depending on the responsiveness of the participants, some questions were left out while others were added. All interviews were audiotaped.

Participants who were willing to physically demonstrate their bathing ritual were observed in their personal bathing environments. Participants remained fully clothed for duration of the simulation. The demonstration and personal bathing environments of the participants were videotaped.

Participants who were willing to physically demonstrate their bathing ritual as well as be interviewed were asked to perform the demonstration prior to being

interviewed. This allowed participants to be observed as 'naturally' as possible. The interview then proceeded either away from or in the bathing environment, depending on the preference of the participant.

3.2.4 Results - Personal Interviews

The audiotaped interviews were transcribed verbatim, and numbered sequentially according to when they were conducted. The transcripts were then analyzed to extract the following information:

- What type of bathing people prefer and why.
- What types of activities are performed while bathing, when and where they are performed.
- What types of problems, fears or injuries can accompany the bathing process.

Participant Profile - Current Method of Bathing

| | Shower | | | Tub Bathe | | | Sponge Bathe | | |
|------------------------------|--------------|----------|-----------|-----------|----------|-----------|--------------|----------|-----------|
| | Only | Usually | Sometimes | Only | Usually | Sometimes | Only | Usually | Sometimes |
| Age | Total | | | | | | | | |
| 60 - 69 | 4 | - | 1 | 2 | 1 | - | - | - | - |
| 70 - 79 | 4 | 2 | 2 | 2 | 3 | 1 | - | - | 2 |
| 80+ | - | 2 | - | 3 | - | 2 | 2 | - | - |
| Gender | | | | | | | | | |
| Male | 4 | 1 | - | 1 | - | 1 | - | - | - |
| Female | 4 | 3 | 3 | 6 | 4 | 2 | 2 | - | 2 |
| Bather_Type | | | | | | | | | |
| Independent | 7 | 4 | - | 7 | 4 | 3 | 1 | - | 2 |
| Partially Dependent | 1 | - | 3 | - | - | - | - | - | - |
| Totally Dependent | - | - | - | - | - | - | 1 | - | - |
| Residence_Type | | | | | | | | | |
| Apartment (independent) | 2 | 4 | 1 | 4 | 2 | 3 | 1 | - | 2 |
| Apartment (seniors building) | - | - | - | 1 | - | - | 1 | - | - |
| House | 5 | - | 1 | 1 | 1 | - | - | - | - |
| Condominium | - | - | - | 1 | - | - | - | - | - |
| Townhouse | 1 | - | 1 | - | 1 | - | - | - | - |
| Living_Status | | | | | | | | | |
| Alone | 3 | 3 | 1 | 6 | 2 | 2 | 2 | - | 2 |
| With Spouse | 5 | 1 | 2 | 1 | 2 | 1 | - | - | - |
| TOTAL | 25 | 4 | 3 | 7 | 4 | 3 | 2 | - | 2 |

Current Method of Bathing

Shower

- 15 total.
- 8 shower only.
- 3 shower usually, tub sometimes.
- 1 showers usually, sponges sometimes.
- (3 tub usually, shower sometimes)

Tub Bath

- 14 total.
- 7 tub only.
- 3 tub usually, shower sometimes.
- 1 tubs usually, sponges sometimes.
- (3 shower usually, tub sometimes)

Sponge bath

- 4 total.
- 2 sponge only.
- (1 showers usually, sponges sometimes)
- (1 tubs usually, sponges sometimes)

Reasons for using this method

Shower Bathers

- 4 can't take bath (1 has difficulty getting out of the bath, 1 can't get out of the bath, 1 is unable to take a bath, 1 because it is the only way he can bathe with little difficulty).
- 2 dislike the tub (1 has no patience to sit in the tub, 1 doesn't like to lay in the stuff used to wash himself with).
- 2 as an issue of time (1 stated it's more utilitarian to wash her hair, 1 wants her hair to dry so she showers in the morning).

- 1 for various personal benefits (if it's hot or when she can't take a bath).
- 1 experienced a problem with tub bathing (got stuck in the tub so she doesn't take baths).

Tub Bathers

- 6 find the tub relaxing (6 stated relaxation as the reason for using this method).
- 5 for various personal benefits (1 likes to soak legs and feet, 1 likes the suds, 1 likes to get all drenched, 1 likes to warm up in the evening if she's cold, 1 likes it to cool down).
- 3 out of habit (2 grew up without showers, 1 has "been doing it for years").
- 3 dislike the shower (1 stated that with a shower "parts just don't get clean", 1 doesn't want to clean the shower every time, 1 is cautious of her hairdo and therefore dislikes showering).
- 2 for various medical benefits (1 stated that it helps her arthritis, 1 stated that a cool bath helps her muscles).
- 1 experienced a problem with showering (fell in the shower so she doesn't take a chance).

Sponge Bathers

- 2 as an alternative (1 as an alternative to showering, 1 as an alternative to tub bathing).
- 1 has no other option (only method available since she's a dependent bather).
- 1 fears other methods (is afraid of slipping in tub/shower).

Is this your 1st choice?

20 participants said that the way they are bathing is their 1st choice in the way they would bathe (currently 7 tub bathe only, 3 tub bathe usually and shower sometimes, 1 tub bathes usually and sponge bathes sometimes, 6 shower only, 3 shower usually and tub bathe sometimes).

5 participants said they would prefer another method of bathing. Of those, 4 would prefer to tub bathe (currently 2 shower only, 1 showers usually and sponge bathes sometimes, 1 sponge bathes only) and 1 would prefer to shower (currently

this person sponge bathes only). The reasons why these participants don't bathe according to their 1st choice are:

- 1 is a dependent bather and has no choice but to sponge bathe.
- 1 stopped taking a bath 20 years ago when she couldn't get out.
- 1 can't get out of the tub.
- 1 is afraid of slipping in the tub/shower so she takes no chances.
- 1 finds it too hard to get up from the tub.

Bathing Process

Method of Washing Hair

- 8 wash their hair in the shower (5 shower only, 1 showers usually and tub bathes sometimes, 1 showers usually and sponge bathes sometimes, 1 tub bathes usually and showers sometimes).
- 3 wash their hair in the sink (1 tub bathes and showers sometimes, 1 tub bathes only, 1 sponge bathes only).
- 1 goes to the hairdresser (sponge bathes only).
- 13 didn't indicate.

Shower/Sponge Bathers: Whether they Sit or Stand

- 11 stand (1 would sit if bench/seat was present, 3 would never sit).
- 2 sit.
- 2 didn't indicate.

Tub Bathers: When They Empty the Tub

- 4 before getting out.
- 4 pull the plug while in tub but step out before it empties.
- 1 after getting out.
- 5 didn't indicate.

Method of Drying Body

- 2 while in the tub/shower.

- 6 partially in the tub/shower, the rest after stepping out.
- 6 after stepping out.
- 11 didn't indicate.

Method of Drying Feet

- 3 stand and lift feet onto front ledge of tub (1 always, 2 sit on toilet seat also).
- 4 sit on toilet seat (2 always, 2 stand and lift feet onto front ledge also).
- 1 stands and lifts feet on toilet seat.
- 17 didn't indicate.

Other Things Done in the Bathing Area

- 12 hang clothes.
- 2 hand wash clothes.
- 1 soaks feet.
- 1 shaves legs (18 didn't indicate).
- 1 stores bucket and mop.

Method of Cleaning the Bathing Area

- 10 on hands and knees and wipe with cloth (2 'swish' with their hands while in the tub).
- 9 have it done by someone else or a cleaning person.
- 4 use a mop to wipe the area down.
- 3 didn't indicate.

Problems Experienced (as stated by the participant)

- 8 getting down/up from the tub.
- 7 getting over the front ledge of the tub.
- 3 bending.
- 3 cleaning the tub.

- 2 reaching the curtain rod (1 gets dizzy reaching up for the curtain rod).
- 1 washing feet.
- 1 reaching his back during showering.
- 1 lack of energy after bathing.

Bathing Safety

Injuries / Accidents

- 2 broke their ribs after slipping in the tub (1 stepping out of the tub after showering, 1 stepping out after tub bathing). Both accidents occurred while bathing in a tub other than their own.
- 1 fell when her bath seat broke while she was bathing.
- 1 got stuck in the tub for 6 hours unable to get out.
- 1 hurt her back getting up from the tub.
- 3 mentioned accidents which had happened to someone else (1 only sponge bathes now after her friend slipped in the tub and broke her leg, 1 spoke of a neighbor who couldn't get out of the tub, caught pneumonia from the water turning cold and died, 1 spoke of the comedian George Burns who fell in the tub).

Fears

2 participants expressed that they are fearful during the bathing process. One is so fearful that she avoids any type of bathing that involves the tub/shower stating "I'm afraid. I'm alone you know, and the accidents happen so darn quick, so I sponge bathe." The other stated that she is "so afraid of slipping", however she doesn't change the way in which she bathes as a result of that fear.

10 participants described that they are careful of slipping and/or falling or that they are aware during the bathing process. Some of their statements are as follows:

- "I'm aware of balance also when I'm taking a shower... At a certain point in life I became aware not to fall, as most people of my age are aware, whether walking or whatever... It's just a matter of being aware."
- "I like to get in but I'm always glad when I get out and I'm, safely, without falling... I'm so careful."

- "I've got to be very careful 'cause I'm alone...You can fall any time."
- "I'm afraid of falling in the bathtub, just like I'm afraid of falling anywhere I guess...I'm very careful with my balance."
- While describing the reason why she empties the tub before getting out, one participant stated "If I'm going to fall, at least I won't drown!"
- "I'm very careful. I'm aware that I live alone and it could be a long time before someone could get over."
- "But I'm very careful."
- "I'm pretty careful".
- "It's easy to slip on but I'm always hanging onto something...But otherwise I think very safely."
- "Sometimes I lose my balance a little bit when I am standing up...If I am not very careful."

Suggestions Made for Improving the Bathing Environment

Front Ledge of the Tub

- 1 suggested having something like a curb on the street as the outside ledge of the tub to contain the water instead of the high ledge that's there now.
- 1 wanted a spot to put the cellular phone and suggested that maybe it could be incorporated with the handle over the front ledge of the tub.
- 1 suggested having something to lean on over the front ledge of the tub but not a pole stating that "poles are no good for people with arthritic hands".
- 1 wanted a bar along the front ledge of the tub that "you could really grasp" and stated that "your arms are your best help to get in and out".
- 1 doesn't want tile or anything like that over the front ledge making it higher to get her leg over.

Getting In and Out

- 1 suggested a tub with a door so "I don't have to balance on a foot that's standing on a slippery surface".

- 1 suggested a bar across the width of the tub near the taps for "the in and out" and stated that this would be better than a pole because you would use less strength.

- 1 suggested having a step along the outside edge of the tub and incorporating a handle with the step.

- 1 stated that a step wouldn't be good because you'd likely lose your balance more.

- 1 doesn't want a tub she has to walk up steps to get in because she can't get up there.

- 2 referred to bath lifts but stated that they are too expensive.

Support

- 1 stated that horizontal grab bars are better than the diagonal ones because they are better for leaning on.

- 1 suggested incorporating a rail system in the shower stall stating "I can see me using them later".

Shower Cubicles versus Tubs

- 1 suggested having a double shower cubicle - one side for showering and the other for drying off.

- 2 wanted a shower cubicle as well as a tub rather than having to shower in the tub.

- 1 wanted a walk-in shower (with a stool inside).

- 1 would like a shower stall and stated that if she had one she would take showers.

- 1 prefers to shower in the tub instead of his shower stall because he states that the tub has more elbow room.

Seating

- 1 wanted a stool to sit on outside the tub except her bathroom is too small.

- 1 suggested having a built-in stool inside the shower (1 woman used to have a portable one with suction cups but got rid of it because "it was

always in the way", "you've always got to move it here and there", and the suction cups were hard to get off).

- 1 stated that he would like something to sit on in the shower so he can wash his feet without assistance from his wife.

Non-Slip

- 1 stated that the long non-slip bathmats are better than the short ones because the short ones are uncomfortable across your back when you are lying in the tub.
- 1 stated that the non-slip mat (short one) is good while you are standing but not if you are taking a bath.
- 1 thinks a non-slip mat would be good but she doesn't want to sit on it.

Various

- 1 stated "Well, you'd have to start from scratch really".
- 1 suggested that the curtain rod be lowered.
- 1 stated how he detests North American "cheap stuff" with no variety.
- 1 stated he wouldn't have sliding doors again because they are never square against the wall and therefore water leaks out.
- 1 wanted more storage space around the tub.
- 1 suggested having something to lean back against while sitting in the bathtub.
- 1 prefers the water in the tub to be not too deep.

Miscellaneous Statements Made During the Interviews

Getting In and Out

- While speaking of the front ledge of the tub, one participant stated "But in this one you have to climb over the mountain, to get into where the water is... And (it is) ridiculous for people of our age bracket. You just don't ask them to climb a mountain before they (can get into the tub)."
- "I'm getting to a point where getting down and up is getting difficult for me... So I might have to resort to showering."

Support

- "The good thing of a small apartment is there's lots of stuff to grab onto."
- "I hang onto everything everywhere".
- "I know a lot of people they do have a handrail on the wall. I don't, I'm used to it."

Various

- "But the bathtub I think is the biggest hazard, and then of course cooking is hard too."
- "All the years I couldn't afford to have them (baths) and now, why not!"
- "As long as I can still give my own showers and everything, I don't think I'm bad, you know?"
- While speaking of front ledge removable bars, one participant stated "I don't like that...I find that hard to clean around that stuff. It gets crappy looking you know...I don't like all that stuff."
- While speaking of how she would like a removable front ledge bar, one participant stated "But I haven't seen any...Well they don't have much of a choice."

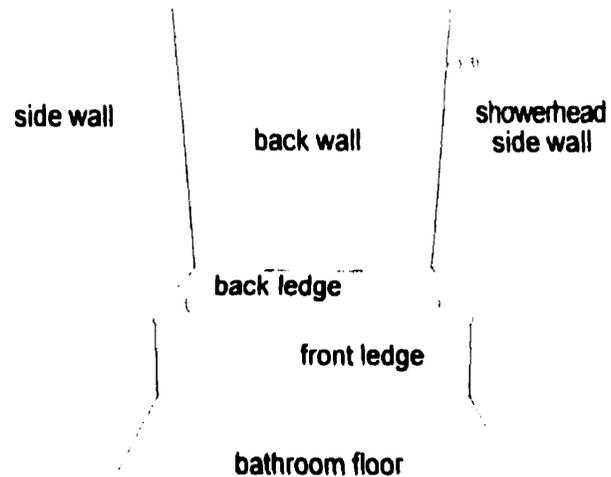
3.2.5 Results - Simulated User Observation

The videotaped demonstrations were reviewed to identify similarities and differences between participants' bathing rituals and environmental characteristics. As they were viewed, observations were made according to:

- What types of equipment people use for bathing, the other uses of this equipment, and the storage of products.
- How people perform various aspects of bathing including stepping in and out of tub/shower and getting down and up in the tub.
- Body positions and methods of support during different activities.

Bathing Environment

For the purposes of this discussion, the anatomy of the tub/shower is to be understood as follows:



Type of Bathing Facility

- 22 had a tub/shower with 2 sidewalls & 1 back wall (1 used bathroom sink only).
- 1 had a tub/shower with 1 sidewall & 1 back wall.
- 1 had a shower cubicle.

Equipment Present Inside the Tub/Shower (Appendix B)

Back Wall

- 10 had a wall-mounted grab bar (8 diagonal, 2 horizontal).
- 15 had a wall-mounted soap holder (13 with a handle, 2 without a handle).
- 3 had a window ledge.

Ledges

- 6 had a removable front ledge bar.

Side Walls

- 16 had a stationary showerhead, 8 had a hand-held showerhead.
- 4 had a wall-mounted grab bar (2 diagonal, 2 vertical).

Various

- 1 had a removable shower seat.
- 5 had a rod for hanging clothes (other than the curtain rod).
- 3 had a removable drying rack.
- 12 had non-slip items (8 had a mat, 4 had a non-slip surface or stickers)
- 8 had body scrub brushes (7 on a long handle, 1 with suction cups for his feet)

Equipment Present Outside the Tub/Shower (Appendix B)

Enclosure

- 20 had a shower curtain, 2 had sliding glass doors, 2 had a sliding accordion.

Bathroom Wall

- 1 had a wall-mounted grab bar (vertical).
- 12 had a wall-mounted towel rod.
- 1 had a heater.

Bathroom Built-Ins

- 16 had a counter beside the tub/shower.
- 3 had a towel pole.

Various

- 17 had a non-slip mat/carpet.
- 3 had a chair/seat (1 to be used in the shower but isn't used).

Storage of Products (Appendix B)

Towels, face clothes, bathmats etc.

- 5 on the grab bars.
- 2 on the taps.
- 10 on the front ledge.
- 5 on the curtain rod.

Bottles, etc.

- 14 on the ledges of the tub/shower (2 on high ledges of the shower).
- 5 in various plastic hanging storage holders inside the tub/shower.
- 4 on storage poles with mini shelves in the corner of the tub/shower.
- 1 used a wall-mounted dispenser for shampoo and conditioner.
- 5 on the counter outside the tub/shower.
- 2 on the toilet box outside the tub/shower.
- 1 in a plastic storage cabinet.

Reasons for Making Modifications

- 5 acquired a removable front ledge bar (1 to assist her with getting on and off the toilet, 1 for getting down into and up from the tub, 1 because she thought it would be handy getting in and out of the tub, 1 based on an assessment made by aids to daily living, 1 for leverage getting up from the tub).
- 4 put in at least one permanent grab bar (1 for balance, 1 for leaning on stepping in and out of the tub, 1 because she always needs to hold something with one arm, 1 based on an assessment made by aids to daily living).
- 5 installed an additional rod for hanging clothes.
- 8 added holders for additional storage (4 added a storage pole, 5 added holders hung from either the shower head or curtain rod).
- 2 purchased a seat for inside the tub/shower (only 1 uses it stating that it is too hard to clean and that it is bothersome).

- 3 installed a new tub/shower (1 because she didn't like the color of her old one, 1 because it was the only one available which had support bars incorporated in the wall, 1 because she wanted a tub with handles).

- 1 purchased a foot scrub device so that he could stand and wash his feet but doesn't use it because he's too ticklish.

Reasons for Considering Making Modifications

- 2 are considering getting a removable front ledge bar (1 for getting out of the tub, 1 for additional support).

- 4 are considering putting in at least one permanent grab bar (1 so she has something to hang onto while showering and to help her lift up more readily while getting up in the tub, 1 for support but her soap dish is in the way, 1 for her balance, 1 for getting out of the tub).

- 1 is considering having an opening cut in the front ledge of her tub so she can step in to shower without having to step over high ledge since it hurts her so much to step over.

Reasons for Not Having Made or Not Considering Making Modifications

- 2 considered getting a bath lift but decided against them because they are too expensive.

- 9 haven't made modifications and aren't considering any (2 because they live in a seniors building so the modifications had already been done, 1 because he lives in an apartment which doesn't allow modifications to be done, 4 because they "don't need it" or "don't need it yet", 2 because they are "just used to it")

Bathing Ritual

It became apparent early on in the analysis that although the bathing environments of the participants remained similar, each person had developed a unique method of interacting with their equipment. For the purposes of this discussion, 'inside foot' is to be understood as being the one closest to the tub/shower and 'outside foot' as being the one closest to the bathroom area.

Stepping Into the Tub/Shower

Body Position

- 14 faced the showerhead wall (all stepped in with their inside foot first).

- 3 faced the back wall.
- 16 stood upright.
- 2 bent over.

Methods of Support (Appendix D)

Of the 18 who demonstrated stepping in, all 18 held onto something. 10 held something inside the tub/shower, 2 held something outside the tub/shower, and 6 held something both inside & outside the tub/shower.

- 5 held onto one thing (3 on something inside the tub/shower, 2 on something outside the tub/shower).
- 13 held onto two things (7 on something inside the tub/shower, 6 on something inside & outside the tub/shower).

In total, 16 held something **INSIDE** the tub/shower.

- 15 held something on the back wall.

7 held onto a bar (6 with their inside hand, 1 with their outside hand).

5 held onto the wall tile (4 with their inside hand, 1 with their inside & outside hand).

1 held onto the window ledge (with their inside hand).

2 held onto the soap holder (both with their inside hand).

- 5 held something on the ledges.

3 held onto the front ledge bar (all 3 with their outside hand).

2 held onto the front ledge (1 with both hands, 1 with their outside hand).

1 held onto the back ledge (with their inside hand).

- 2 held onto a sidewall.

1 held onto the side wall bar (with their inside hand).

1 held onto the showerhead wall bar (with their outside hand).

In total, 8 held something OUTSIDE the tub/shower.

- 2 held onto the enclosure.
 - 2 onto the shower curtain (with both hands).
 - 1 onto the sliding doors (with both hands simultaneously).
- 1 held onto the bathroom sidewall.
 - onto the wall surface (with their outside hand).
- 5 held onto a bathroom built-in.
 - 1 held onto the towel pole (with their outside hand).
 - 4 held onto the counter (all 4 with their outside hand).

Stepping Out of the Tub/Shower

Body Position

- 11 faced forwards.
- 4 faced the showerhead wall (all stepped out with their outside foot first).
- 2 faced a side wall (both stepped out with their outside foot first).
- 16 stood upright.
- 1 bent over.

Methods of Support (Appendix D)

Of the 18 who demonstrated stepping out, 16 held onto something. 4 held something inside the tub/shower, 6 held something outside the tub/shower, and 6 held something both inside & outside the tub/shower.

- 2 held onto nothing
- 8 held onto one thing (3 on something inside the tub/shower, 5 on something outside the tub/shower).
- 6 held onto two things (1 on something inside the tub/shower, 1 on something outside the tub/shower, 4 on something inside & outside the tub/shower).
- 2 held three things (both on something inside & outside the tub/shower).

In total, 10 held something INSIDE the tub/shower.

- 6 held something on the back wall.

3 held onto a bar (all 3 with their inside hand).

1 held onto the wall tile (with their inside hand).

1 held onto the window ledge (with their inside hand).

1 held onto the soap holder (with their inside hand).

- 4 held something on the ledges.

3 held onto the front ledge bar (2 with their inside hand, 1 with their outside hand).

1 held onto the front ledge (with their inside hand).

- 1 held onto a sidewall.

onto the side wall bar (with their inside hand).

In total, 12 held something OUTSIDE the tub/shower.

- 1 held onto the enclosure.

onto the sliding doors (with their inside hand).

- 4 held onto the bathroom sidewall.

3 held onto the towel rod (all 3 with their outside hand).

2 held onto the wall surface (1 with their inside hand, 1 with their outside hand).

- 8 held onto a bathroom built-in.

2 held onto the towel pole (both with both hands).

7 held onto the counter (1 with their inside hand, 2 with their outside hand, 3 with both hands simultaneously).

Getting Down and Up - Tub Bathers

Body Position

- 7 stepped in facing the showerhead wall and sat down and up in the tub

facing the same direction (1 participant only partially demonstrated).

-1 stepped in facing the showerhead wall, turned 180° CW while standing, lowered onto her knees, then turned another 180° CW to end up sitting on the bottom of the tub facing the showerhead wall. She got up by doing just the reverse - she rolled 180° CCW onto her knees to face the sidewall, then stood up facing the same direction.

- 1 stepped in facing the showerhead wall, and lowered into the tub facing the same wall. She got up by rolling 180° CCW on the bottom of the tub to face the sidewall and then stood up facing the same wall.

Methods of Support (Appendix D)

Of the 8 who demonstrated getting down into the tub, all 8 held onto something inside the tub/shower. Nobody held anything outside the tub/shower. All 8 held onto 2 things.

- 3 held something on the back wall.

2 held onto a bar (both with their inside hand).

1 held onto the soap holder (with their inside hand).

- All 8 held something on the ledges.

3 held onto the front ledge bar (all 3 with their outside hand).

5 held onto the front ledge (all 5 with their outside hand).

5 held onto the back ledge (all 5 with their inside hand).

Of the 7 who demonstrated getting up from the tub, all 7 held onto something inside the tub/shower. Nobody held anything outside the tub/shower. 1 held onto one thing while 6 held onto 2 things.

- 2 held something on the back wall.

both held onto a bar (both with their inside hand).

- 6 held something on the ledges.

3 held onto the front ledge bar (all 3 with their outside hand).

3 held onto the front ledge (2 with their outside hand, 1 with both hands simultaneously).

4 held onto the back ledge (all 4 with their inside hand).

Observed Difficulties / Dangers (Appendix D)

- 7 had no difficulties.
- 8 had difficulty stepping over the front ledge of the tub (3 stepping in, 2 stepping out, 3 stepping both in and out).
- 1 had difficulty getting down into the tub.
- 6 had difficulty getting up from the tub.
- 3 had difficulty removing the hand-held showerhead from its holder.

3.3 Care-Providers of Dependent Bathers - Questionnaire & Interview

3.3.1 Objectives

- To gain an understanding of the types of assistance given to dependent bathers by their care providers during the bathing process.
- To identify the different types of equipment used by dependent bathers and their care providers during the bathing process.
- To identify the types of difficulties, if any, that care providers of dependent bathers experience while interacting with their equipment.

3.3.2 Sample

Two Calgary personal care agencies were chosen to receive the distribution of a total of 65 questionnaires. One agency operates out of the Renoir retirement residence and the other, Universal Rehabilitation Service Agency, manages the personal care needs of four residential complexes in the city. A personal interview was also conducted with a care provider presently employed by the Home Health Care Center in Winnipeg.

3.3.3 Methodology

25 questionnaires were distributed to the Renoir personal care agency and 40 to the Universal Rehabilitation Service Agency. The first set of 25 questionnaires was given to a manager at the Renoir agency who was instructed to distribute them to "as many individuals who assist bathers as possible". It was decided between the two of us that the questionnaires be collected at her end in a drop box and that I would then collect them at a later date. Of the 25 that were distributed, only 1 was returned. Based on the poor response rate, the manner in which questionnaires were distributed and collected was re-evaluated and the 1 returned questionnaire was reviewed to insure that the questions were responded to in the manner in which they were

designed. After a few revisions were made to the format (Appendix E), the second set of questionnaires was given to a manager at the Universal Rehabilitation Service Agency, however this time pre-posted envelopes were attached to the questionnaires. 9 of the 40 were returned.

The personal interview was conducted with the care-provider of dependent bathers in the home of one of her clients. The intent of the personal interview was to discuss the bathing-related issues which impact dependent bathers as well as the care provider in a less structured and more open-ended format than a questionnaire would allow. The interview lasted approximately 15 minutes and it was audiotaped.

3.3.4 Results

The personal interview was transcribed verbatim and analyzed along with the responses from the questionnaires. The following information has been extracted from the analysis:

Questionnaires

- Respondents' clients' ages ranged from 15 to 90. While only one client was stated to be over the age of 60 (with the majority of clients being in their 20's to 40's), it was determined that for the purposes of this portion of the study, the experience of assisting dependent bathers would be similar enough regardless of age.

- The types of medical conditions which affect the clients of the respondents while they bathe include seizures, mental and physical handicaps, hypersensitivity and low motor functioning.

- 7 of the respondents stated that they provide all of their clients with full bathing assistance (including transferring the clients into and out of the tub, washing their body and hair, drying them off). 2 respondents provide their clients with partial assistance (1 provides transferring assistance to one client onto the bath lift, 1 helps a client to step into the tub and assists her with washing her back).

- 7 respondents assist their clients in a shared or common bathing area. 1 assists her clients in a shared bathing area or on their personal bathrooms. 1 assists her clients in their personal bathrooms only.

- 6 respondents assist clients in more than one type of bathing structure (3 in a shower cubicle, bathtub or C-tub, 2 in a bathtub or C-tub, 1 in either a shower cubicle or C-tub). 3 respondents only assist in one type of structure (1 in a shower cubicle, 1 in a shower/tub, 1 in a C-tub). 4 respondents indicated the presence of a non-slip floor mat in the area in which they assist their clients. The structures were described as containing the following:

- shower stall: curtain, removable seat, hand-held showerhead. One stall

also has a sling.

- bathtub: 2 grab bars, removable showerhead.

- century tub (C-tub): bath lift, removable showerhead.

- shower/tub: curtain, grab bar, removable seat, stationary showerhead.

- 4 respondents indicated that at least one of their clients had injured or nearly injured themselves while bathing (1 stated that "the possibility of falling or slipping is great", 1 client nearly slipped out of the bath chair as a result of too much oil in the water, 1 client slipped and fell while being transferred, 1 client slipped while in the shower chair).

- 3 respondents indicated that the part of the bathing experience which causes the least problems for themselves or the client is when the client is sitting and relaxing in the water. 2 indicated that it is when the client is independent and can transfer independently. 1 indicated that it is when the client is sitting in the C-tub chair.

- 4 respondents indicated that the part of the bathing experience which causes the most problems for themselves or the client is when they are transferring the client into or out of the bath area (1 from a wheelchair into and out of the C-tub chair, 2 into the shower, 1 out of the tub/shower). 2 indicated that it is the lack of space in the bath area (1stated that it is because of the wheelchair lift etc., 1 because the toilet is too close to the shower). 1 indicated that it is when the clients have been taken out of the water and he can't seem to dry them quickly enough. 1 indicated that it is when she has to bend over the clients in the shower to clean them while trying not to get too wet.

- 5 respondents indicated that in terms of safety, accessibility and ease of use that the bathing environments in which they assist their clients is good, very good or excellent. 2 stated that it is adequate or average.

- Respondents suggested that the following would help themselves or their clients during the bathing process:

- A better way to dry clients, possibly heat lamps.

- Toiletries within arms reach on a shelf.

- A way to keep the room warm, especially when transferring clients from the bathroom to the bedroom.

- All bathing products closer to the bathtub.

- More open space and non-slip mats.

Interview

- Her clients appreciate the assistance because "they're afraid to fall or to slip... It's a big help for them... They're scared of falling".
- Sometimes the bathtubs she assists in are unsafe because they lack bars for the client to hold. She also stated that there should be a chair in the bathtub "so they could sit, they could just sit".
- Sometimes she uses the grab bars while helping the client.
- When helping the client, she has to help them get right in the tub by holding them. This is difficult because sometimes they are so frail that they can't walk without a walker or cane, and these items can't be brought in the tub. It's also hard when the bathrooms are so small.
- Clients will often grab onto anything when they don't have bars such as the towel rod or the walls. When the clients don't have bars, it's often the care worker who has the responsibility of reporting it to the office.
- Flexible showerheads are much better than stationary heads because she always has control over where the water goes.
- She has to be very careful with slipping even when using a rubber mat especially when some clients are so big.
- The biggest problem she has is when she's assisting clients who are disabled or when they can't walk. With those clients, assistance is also given by occupational therapists.
- She never really fills the tub but just puts a little bit of water in the bottom so the client can be warm.
- She suggested "Do you think you could possibly design a tub that can be opened?" because her clients are finding it hard to lift their legs.

3.4 Conclusions / Recommendations

3.4.1 Personal Interviews with Bathers & Simulated User Observation

Summary

Method of Bathing

- Participants' method of bathing varies according to their beliefs about cleanliness, the personal benefits they acquire from using the method, or their fear or inability to use another method.

- Approximately the same numbers of participants take tub baths as showers. However, of those who take showers, a few would prefer to take a tub bath. All of those who tub bathe stated that it's their preferred method.

- In terms of preference, more participants stated that they would prefer to take a tub bath than to shower. The majority of those who would prefer to take a tub bath were 70-79 and 80+. The majority of those who would prefer to shower were 60-69 and 70-79. Male participants seem to prefer to take a shower. Female participants seem to prefer to take a tub bath.

- The reasons why participants take showers are because it's the only way they can bathe with little difficulty, because they dislike the tub bath, as an issue of time or for various personal benefits. The reasons why participants take tub baths are because they find it relaxing, for various personal or medical benefits, out of habit or because they dislike the shower. The sponge bath only tends to be used by participants if they have no other option or as an alternative to another method.

Problems, Injuries & Accidents

- The predominate problems experienced by participants include getting up from the tub after tub bathing and getting over the front ledge of the tub while stepping in or out.

- Most participants had never had an accident or injury while bathing. However, of those that had one (or know of someone who had one), the primary types were slipping-related or getting stuck in the tub unable to get out.

- Half of the participants stated that they are careful of slipping and/or falling or that they are aware during the bathing process. A couple expressed that they are extremely fearful.

Participant Suggestions

- Suggestions for improving the bathing environment focussed primarily around the act of stepping in and out of the tub/shower. These included lowering or removing the front ledge of the tub, provisions for support (i.e. something to lean on) along the front ledge, and incorporating or not incorporating a step along the outside edge of the tub. Also suggested was the addition of a walk-in shower into the bathing environment, in some cases as a substitute for the tub and in others in addition to the tub.

- Other suggestions included provisions for seating (primarily inside the bathing area but outside as well), non-slip surfaces which don't interfere with tub bathing, and more storage space around the tub for toiletries.

Bathing Environment

- The tub/shower built-in unit was present in the residences of all participants. A few also had walk-in showers located in their basements.

- A little over half of the participants had made some type of modification to their bathing environment. The most common modifications included the addition of support bars (stationary and removable), holders for additional storage, and rods for hanging clothes. Others included a new tub/shower, and removable bath seats.

Bathing Ritual

- Participants who demonstrated stepping into the tub/shower tended to hold onto things inside the tub/shower for support more than onto things outside the tub/shower. All participants held onto something.

- Participants who demonstrated stepping out of the tub/shower tended to hold onto things outside the tub/shower for support more than onto things inside the tub/shower. All participants but one held onto something.

- All participants who demonstrated getting down and most who demonstrated getting up in the tub held onto things on the ledges for support. A few held onto something on the back wall getting down and up.

Recommendations

- Accommodate individuals who prefer to shower as well as those who prefer to tub bathe. Whether or not these functions can be facilitated within the same bathing unit will need to be determined.

- Lower the height of the front ledge of the tub/shower allowing users to step into and out of the bathing area with ease.

- Incorporate provisions for support inside and outside the bathing area to assist the user during the various stages of the bathing process.
- Incorporate provisions for seating inside and outside the bathing area.
- Ensure non-slip surfaces throughout.
- Allow for adequate storage of toiletries around the bathing area.

3.4.2 Care-Providers of Dependent Bathers

Summary

- Half of the respondents stated that at least one of their clients had injured or nearly injured themselves while bathing. These injuries had occurred while the client was being transferred into or out of the bath area or while the client was sitting in the bath chair.
- Transferring the client into or out of the bath area is the part of the bathing experience which causes the most problems for both the care-provider and the bather. Other problems include having insufficient space in and around the bath area, being unable to keep the client warm as they are being dried off, and bending over clients in the shower while trying not to get too wet.
- Suggestions included that there should be heat lamps or other methods of keeping the room warm incorporated outside the bathing area, more open space around the bathing area, and a door incorporated into the front ledge of the tub.

Recommendations

- Ensure that there is adequate access space in and around the bathing unit for up to two users.
- Accommodate the potential for some assistive devices to be retrofitted into the bathing unit by users who require assistance.

4 Key Expert Interviews

The purpose of the interviews was to obtain information regarding the types of medical conditions which prevent older adults from bathing independently and the types of injuries that can result from bathing-related accidents (Appendix E).

4.1 The Experts

Two registered nurses were interviewed from the Kerby Center's Adult Day Program. One was the previous manager of the program and the other was previously working in a hospital and was just beginning her employment at Kerby as the new manager of the program. The Kerby Center Adult Day Program offers nursing care including personal care, monitoring of health problems, treatments, health teaching and physiotherapy, recreation and socialization for adults over the age of 60 who are physically or emotionally challenged. A bathing service is also offered on the premises which includes foot and nail care.

4.2 Interview Results

The interview was conducted at the Kerby Center Adult Day Program Manager's office. The interview was audio-recorded and was conducted using a predetermined set of questions (Appendix F) to encourage dialogue between the two nurses and myself. The following points represent most of the information that came out of the interview:

4.2.1 General

- Clients generally respond positively towards bathing. It is something that is an enjoyable experience for everybody who's in the Kerby Center's Adult Day program and it's something that's really important to them.
- The type of bathing that most older adults prefer is the tub bath. That is probably because it's what they have grown up with and been used to and because in the earlier days it was a considered a luxury to have baths. Psychologically, most older people find a bath more comforting and relaxing. Physiologically, the whirlpool also helps promote circulation. Also, if they have an area of their body that's not working too well or is weak they can exercise it in the water. In terms of cleanliness, both nurses believe the shower is better but admit that the bath still gets them clean.
- Patients who have a medical condition (i.e. if they are short of breath) believe that by going under the shower they will develop some severe shortness of breath. Cardiacs as well tend to be nervous that under the shower they might develop some chest pain. This may result from having to stand or by being

startled when temperature controls don't work. The nurses believe that sitting may alleviate some of these problems, but also that if you're sitting in the shower, you're not getting your dirtiest parts clean especially if you're not very agile.

- The most demanding tasks for people who are living in the community can be just getting into the bathtub and getting out again. That can be it for the day as far as their exercise tolerance goes. For people who have difficulty transferring onto lifts that can also be a big job. They recommend sponge bathing for people who are short of breath during the bathing process either getting in and out or washing their body.

- **Sponge bathing is recommended for people with medical-related problems, especially if they have severe angina and their medications are in the process of being altered. They don't want these people to overtax themselves so they never allow them to shower or take a bath.**

- The most difficult aspect of sponge bathing is getting to the backs of the legs, especially if the person has angina or shortness of breath. For some people angina is a way of life, they have it for most of their lives before they actually have a massive MI (heart attack).

4.2.2 Dependence

- "If people fall it's easier to place them somewhere or it's easier to do something for them than allow them to independently do it for themselves."

- Bathing dependence is the result of both medical and environmental conditions. Most people have had some type of fall and they live alone and they're just afraid of getting into the tub or shower for fear that they may injure themselves and not be found.

- Arthritis is the number one medical condition that typically prevents older adults from bathing independently. The joints become stiff making it difficult for people to stand on one foot, something that you have to be able to do to get into the tub. Eyesight can be another limiting factor. They either have to take their glasses off or if they keep them on the glasses can fog up causing them to make misjudgments. Since many bathrooms tend to be beige or white with little contrast, this problem is magnified because many people find it difficult to distinguish where the edges of things are unless they're completely different colors. Patients taking medication prior to going into the tub are also more at risk (i.e. drops for glaucoma). If they take them at a certain time prior to doing some type of activity they are more at risk for falling because their eyes aren't focused. A similar thing occurs if they have to take a diuretic, otherwise referred to as a water pill. Sometimes they can lose their balance or feel dizzy getting up or bending over. Cardiac conditions can also limit people from bathing independently. Sometimes the least exertion gives them chest pain,

and with chest pain you get the shortness of breath. Stroke resulting in weakness or paralysis on one whole side of the body also limits people since it's difficult to put weight all on one side of the body to transfer into the tub. Devices such as sliding boards eliminate a lot of these people if they only have one hand to hang on. Parkinson's patients can also have a difficult time both getting into the tub independently and adjusting the water controls because they are quite tremulous.

- Hip injuries are probably the most serious mobility-related conditions that can inhibit older adults while they bathe. Also, the older you get the more calcium you lose so you're more at risk if you fall or if you knock yourself against the tub. People with osteoporosis are more at risk if they fall that they'll break something.

4.2.3 Risk of Injury

- The area that is the highest risk of falls for seniors is the bathroom - getting in and out of the tub and getting on the toilet. If people do fall in the bathroom, they're more likely to be injured than if they fall in their living room on the carpet.

- The most severe type of injury that can occur in the bathroom is the head injury. Everything in the bathroom is hard - the tub, sink, toilet - a simple bang of the head on one of those things and you can be in a lot of trouble. Others are hip and wrist injuries. Hips tend to break easily and the wrists are usually injured trying to break a fall. With the hip injury, it isn't the injury itself that causes the most damage but it's the immobility afterwards. A lot of people after breaking their hip end up in bed for extended periods of time, get pneumonia and die. Older adults are also more prone to burns because their sensitivity to heat and cold is less. Temperature controls that can't go above certain temperatures are therefore important.

- The healing process in older people is generally slower, especially if they have circulatory problems on top of just general aging or if they're diabetic.

4.2.4 Gender

- Women live longer than men do, so men usually have a caregiver because they have their wife. But by the time the wife is getting to the point where she needs help, she's alone. Combine that with the fact that women are more at risk for osteoporosis and they are more likely to have to go into a care facility where they can receive assistance because they have not got anybody to provide that care.

4.3 Conclusions / Recommendations

Summary

- Most older adults prefer the tub bath. Psychologically it is comforting and relaxing. Physiologically, a whirlpool bath helps promote circulation. In terms of cleanliness, the shower is believed to be better than the tub bath.
- Showers may cause shortness of breath or promote chest pain in cardiacs especially if they have to stand. While sitting may alleviate some problems, it's more difficult to clean the dirtiest parts of the body. In terms of exertion, getting in and out of the tub and even transferring onto lifts can be hard. Sponge bathing is often recommended as the alternative for such problems.
- Arthritis, poor eyesight, cardiac conditions or the taking of medications are the conditions that often prevent older adults from bathing independently. Hip injuries are the most serious mobility-related conditions that can inhibit older adults while they bathe.
- The healing process in older adults is generally slower than in younger adults worsening the effects of head, hip and wrist injuries which can occur in the bathroom.

Recommendations

- A tub bath with whirlpool qualities would be an appropriate consideration in the bathing unit.
- Hard corners and edges should be avoided and replaced by smooth and soft materials.

5 Design Development

A number of early concepts for the bathing unit were sketched prior to and while the user research was being conducted. These ranged from freestanding pole assistive devices mounted outside the standard tub/shower unit to inflatable platforms inside the tub/shower area to shower curtain adaptations for providing support at the front threshold area of the tub/shower. While these were initially ideas intended for potential future exploration, they were not conceptualized using any of the information gathered from the future users of the products. Interestingly enough, they also had something in common: they were all *assistive devices* intended to help the user in overcoming many of the accessibility-related problems associated with their current bathing environment. They were also very similar in nature to many of the clutter-type assistive products already available. While their forms were conceived as offering an exciting alternative to the sterile appearing products currently plaguing the market of products intended for older adults, that was all they had to offer. They did nothing to challenge the problems that exist in today's bathing environments; they only masked the problems by offering a pleasant appearing 'solution'.

5.1 Problem Definition

After the research was analyzed and documented to establish recommendations for the development of the bathing unit, the following criteria were constructed to guide the design development.

5.1.1 User Profile

Having studied the requirements of ambulatory male and female adults aged 60+ without major mental or physical limitations, this population is to be the primary user target group for the design phase of this project.

5.1.2 Product Type

The design of a bathing unit that facilitates showering as well as tub bathing within one unit was determined to be something to strive for. Not only is this the type of unit that the majority of users interviewed bathed in, but it is capable of accommodating users who prefer to shower as well as tub bathe within one environment, thus eliminating the need for duplicate plumbing, fixtures and side wall materials. This type of unit also presents the unique design challenge of maintaining an aesthetic as well as functional separateness of the different bathing activities while allowing them to complement each other.

5.1.3 Description of Activities

The Tub Bath

The American College Dictionary (1963) defines a bath as a washing of the body in, or an exposure of it to the action of, water or other liquid, or vapor, etc., as for cleansing, refreshment, medical treatment, etc. and a bathtub as a vessel for containing this. The activities related to tub bathing are to be understood as consisting of several components, including getting into and out of the tub, relaxing, and cleansing (encompassing such aspects as wetting, soaping, massaging, and rinsing the body).

Generally speaking, getting into a tub involves lowering the body from a standing (or sitting) position to a squat, by using mainly the body's own restraint mechanisms, and then shifting each leg into an outstretched position and lowering that side of the buttocks onto the tub bottom while simultaneously shifting much of the body weight to it (Kira, 1966). Getting out involves shifting the weight of the body from the buttocks onto the feet, which must become positioned underneath the major weight of the body, and then pulling or pushing the body into an upright position (Kira, 1966).

Relaxing in the tub involves assuming a passive and static position in which the body is relieved of all muscular tension and strain, resulting when stable positions are assumed by achieving the lowest center of gravity and providing support for every body segment (Kira, 1966). The relaxation component in this project will also be extended to encompass such activities as utilizing the water for therapeutic purposes (i.e. arthritis relief, cooling the body, etc.), and therefore it must be understood that the body may merely achieve a state of partial relief. It must also be considered that the entire body may not require full immersion into the tub cavity to achieve this relief (i.e. foot soaking).

The cleansing process will be understood to involve the actions of wetting, soaping, massaging, and rinsing the body, and may also include such actions as hair removal, and nail clipping. While wetting may be accomplished by either immersing or partially immersing the body into the water, the other actions require the body to be partially out of the water to be effective. Rinsing requires the use of a clean water source, and is therefore only properly accomplished once the body is removed from the tub water.

The Shower

The activities involved in showering may be regarded as simpler, faster, and safer than in tub bathing, primarily because it basically only involves the cleansing

function, which is most comfortably and conveniently performed while one is standing or sitting upright - both inherently simple and stable postures (Kira, 1966). In stall shower installations, the process of getting into and out of the bathing area is an inherently simpler task, as one does not have to climb over a high ledge and into a pool to initiate the cleansing process. In typical tub/shower combination units, however, the user does not benefit from this simpler access, as stepping over a high ledge is unavoidable.

The cleansing procedures of wetting, soaping, massaging and rinsing the body, are similar to those described for the tub bathing method, and are performed most effectively while in a standing or upright sitting position (the legs and feet are reached most comfortably from a seated position) (Kira, 1966). Similarly, the actions of soaping and massaging are best performed while the body is wet but out of the direct stream of water, accomplished by temporarily shutting the water on and off during the washing process or moving the body in and out of the stream - a simpler and more natural action (Kira, 1966).

5.1.4 Environment

The proposed bathing unit is to be incorporated within new commercial and residential construction projects including retirement residences, apartment complexes, condominiums, townhouses, hotels and single detached residences. It may also find applications in some retrofit or renovation projects. Why new construction versus retrofit applications? While both require attention, the advantages of new construction applications definitely outweigh those of retrofit. The main advantage of designing a product intended for retrofit installations is that the product could potentially help more people, especially those living in apartments or town houses who really are not able to make major modifications to their environments. On the other hand, however, this approach does not really address the problems existing in these environments, it only offers a method of coping with them. Designing for retrofit applications requires that the dimensions of bathing environments already existing dictate the dimensions of any new product to be implemented into that space regardless of whether or not these dimensions are appropriate. In the case of bathtub dimensions, for example, designing a product intended for retrofit applications demands that the product fit within the typical 5' long dimension between side walls. Adopting this approach to the design of a new product does not even begin to address the issue of whether or not the dimension is even appropriate for such an application.

A product designed for new construction applications may abandon any preconceived notions of how bathing-related products of the past have been

installed and the dimensions they have been allocated to fit into. Adopting this approach seeks a more long-term solution to the problems existing today so that present as well as future users may benefit.

5.1.5 Spatial Requirements

Since the bathing unit is to be incorporated primarily within new construction projects, typical dimensions (i.e. the typical 5' bath alcove) as they currently exist in bathing environments, will have little influence on the overall dimensions of the bathing unit. The dimensions of the bathing unit will instead be driven by user proportions, accessibility and comfort issues.

5.2 Conceptual Design

5.2.1 Phase 1: Preliminary Concepts

The conceptual design for the bathing unit began by focussing on the accessibility problems associated with stepping over the front ledge of the tub. This had been determined the most significant limiting feature present in the bathing environments of those individuals interviewed during the User Research phase of this project. A number of possibilities were explored and included concepts which treated the entire front ledge as a blind, moving up and down according to whether the user would be tub bathing or showering, as well as concepts in which the front ledge opened like a door whereby the user could step in and out over an approximate 5" threshold versus the traditional 12"-16" threshold. Both concepts were inspired from recommendations expressed by bathers and the care-providers of dependent bathers during the personal interviews as well as from recent product developments by manufacturers currently utilizing removable front ledge technology.

The primary advantage of incorporating removable front ledge technology into the design of a tub-shower bathing unit is that the user may enter and exit the unit by only having to step over a curb-like threshold thus eliminating many of the potential accessibility related dangers present in conventional combination units with higher front ledges. However these solutions also present some disadvantages. The first disadvantage is that if the user wishes to use the unit for tub bathing, he/she must step into the unit and close the 'door' prior to commencing filling the tub with water. After bathing, the same sequence must be followed only in reverse. The user must release all water from the tub prior to opening the door and stepping out. In both cases, the user is susceptible to feeling chilled while waiting for the water to fill and empty. This sequence is also contrary to the method described by bathers during the personal interviews in which a little over half of those who responded to the question of when they empty the tub indicated that they step out of the tub before the

water empties or let the water out after stepping out. A second disadvantage of this type of solution is with the high-tech method of containing the water. While an inflatable gasket system creates a seal between the permanent tub walls and the removable wall section, it is a relatively complicated and technical system being used to replace the traditionally basic function of containing water. It could therefore be projected that the target user group may have difficulty accepting that the sealing mechanism would work, especially without leaks.

While the reduction in height (or removal) of the front ledge of the tub is one method of offering users improved and safer access to showering and tub bathing functions within the bathing unit, it still implies that the basic configuration of the tub-shower remain unchanged. It was at this point that other solutions were investigated, and the possibility of developing a floor-recessed tub emerged. See Appendix G concept sketches.

5.2.2 Phase 2: Floor-Recessed Concepts

By using the floor cavity to contain the water for the tub bath, the threshold between the bathing unit and the bathroom floor that typically is required to contain the water may be eliminated. Also eliminated is a complicated sealing mechanism required by removable front ledge solutions. These benefits stimulated the decision to thoroughly investigate a number of possible solutions utilizing the floor to recess a cavity to be used as a tub.

The accessibility challenge for this type of configuration became facilitating the simplest transfer of the user from one elevation to another. Other challenges included incorporating the unit within conventional building construction techniques and maintaining aesthetic separateness of the functions of showering and tub bathing within the unit. A variety of methods to potentially fulfill these challenges were explored and included concepts in which the user could descend into the cavity using steps, platforms, and even air pressured devices. Those which utilized air pressured devices, however, were eventually ruled out for their complexity and higher cost that the inclusion of steps or platforms did not demand.

Early concepts for this type of bathing unit were inspired by the numerous floor-recessed jacuzzi-type tubs already on the market, but with the significant difference of including steps within the recessed cavity. This would allow the user to descend with greater ease than in the typically deep (with no steps) tubs currently available, and would also help to reduce the risk of falls which, according to the National Kitchen & Bath Association (1997), tend to result from the abnormally high stepping distance which exists in typical recessed tubs. After a number of concepts were explored, the design focus expanded to concentrate on how the showering function within the bathing unit would be

incorporated. It was at this point that several concepts were developed in which the user would descend on a step into the bathing cavity to tub bathe or to shower.

While these were potential solutions because of their interesting forms and accessibility benefits for tub bathers, they were also problematic. By requiring bathers who intended to shower to descend down a step, the units were not as accessible as walk-in shower stalls - a feature that was being considered to be more and more important as the design process progressed. The new bathing unit, which was intended to alleviate the front ledge accessibility problems existing in conventional tub/showers, was all of a sudden appearing to present a whole new set of problems for the user who only wished (or was only able) to shower. The decision was therefore made to maintain in all future designs a floor-level walk-in shower, as this arrangement would accommodate both the physically strong as well as the frailer shower users. See Appendix G concept sketches.

5.2.3 Phase 3: Floor-Recessed and Flush-Floor Concepts

Once the decision was made to maintain a floor-level walk-in shower in all future designs, the design focus somewhat shifted from thinking of the functions of showering and bathing as existing within the same physical space to being physically separated. A variety of concepts were developed which explored different configurations of the two functions, including solutions which used a floor-recessed tub and others which explored the possibilities of platform-recessed or raised-ledge tubs. In each of the scenarios, the type of tub did not really matter, as the bathing functions were quite separate and therefore only some of the other elements (i.e. the fixtures, storage, support devices, etc.) could have any dualistic functional capabilities. This was not exactly good. While some of the designs which arose from this type of configuration were exciting because of their interesting play of forms and their ability to satisfy the accessibility and usability challenges of this project, the bathing functions were to be completely separate from each other. There was really no functional difference between the proposed bathing unit (or more appropriately units) and currently available separate bathtubs and shower stalls. Now, this would not have been a big deal if the intent of the product was to compete with other separate tub and shower stall units - actually, it could be an interesting product to be developed. However, the product type which was outlined during the Problem Definition phase of this project to be developed was to be a bathing unit which facilitates both showering as well as tub bathing within one unit, to potentially replace some of the typical tub/shower combination units currently plaguing the market. Since the showering and tub bathing elements in the concepts had such functional as well as aesthetic

separateness, other solutions needed to be developed. See Appendix G concept sketches.

5.2.4 Phase 4: Floor-Recessed Concepts with Removable Platform

The idea of incorporating a removable platform or 'floor' upon which the user would shower and then somehow remove for tub bathing had initially been planted while viewing an exhibit at the International Conference on Universal Design in June, 1998. It was there that rough images of this concept had been displayed to demonstrate the possibilities of universal design when applied to a bathing environment (see Figure 2-22E). While at the time the idea seemed interesting, the User Research phase of the project had only just begun, and it was therefore filed away as a design precedent. However, during a brainstorming session, the idea was once again triggered, and the possibility of incorporating a removable platform above a recessed floor cavity was revisited. A removable 'floor' could potentially solve the primary problem that arose during phase 3 in that both the showering and tub bathing functions could take place within the same physical space while still maintaining a high degree of individuality. Also, the flush-floor threshold would provide users (both ambulatory and wheelchair users) with the highest level of accessibility for showering, and tub bathers would benefit from a simpler descent into the bathing cavity. Numerous methods of dealing with a removable floor were explored, and included options in which a platform would be hoisted on a wall, slid under the floor, folded, and even retracted. Eventually, after being inspired by garage door track systems and roll-top desks, an interesting and economical method of retracting the platform was conceived in which a series of slats would retract on channels and travel underneath the tub, thereby utilizing the plenum space beneath the tub cavity. Once the logistics of the mechanism were figured out, and several concepts focussing on the comfort and usability aspects of the bathing unit were developed, a configuration which appeared to have satisfied the preliminary design criteria established during the previous conceptualization phases was used as the basis for a more detailed design exploration. This process included investigations in regards to the sizes and configurations of the bathing unit, methods of support, methods of enclosure, seating, storage and the placement of fixtures. See Appendix G concept sketches.

5.3 Design Refinement

5.3.1 Design Considerations

Sizes and Configurations

Since the proposed bathing unit is intended to facilitate both the bathing methods of showering as well as tub bathing, the overall size of the unit should be derived from a consideration of the optimum sizes recommended for each method.

Tub

The activities associated with tub bathing have been identified as consisting of getting into and out of the tub, relaxing, and cleansing and rinsing the body. As such, the size and configuration of the type of vessel that could potentially facilitate these functions becomes critical. Firstly, it will be accepted that a reclined posture in which the lower part of the body may be immersed in water is appropriate for either relaxing or wetting the body, and an upright posture is effective for cleansing the body. The user must therefore be able to comfortably lie back and stretch out during part of the bathing process (an ability which is restricted in the majority of conventional tub units), as well as bring the body to a stable upright sitting position at other times. It will also be accepted that the surfaces upon which the user shifts their weight between standing, seated, upright and reclined positions are flat.

Since there are no actual code-related requirements for tub sizes and configurations, these will be based on recommendations from Kira (1966) who tested various backrest angles and configurations as well as dimensions for the length, depth, and width of tubs, and Pheasant (1996) who evaluated some of Kira's results. The angle of the backrest that Kira found to be the most comfortable when users sat with their buttocks to the back of the tub and when they slumped away from the back was in the range from 25-40°. While Kira further recommended a rake of 50-65° from the vertical and contouring to conform to the shape of the back, Pheasant argued that this may be excessive and that a rake of 30° and a suitable radius where the base meets the end would be adequate. Since the overall length of the tub is a function of the angle of the back of the tub (assuming that a fully reclined posture is to be accommodated), it therefore follows that the more the length of the horizontal base is increased, the greater the chance for total submersion (Kira, 1966; Pheasant, 1996).

Is total submersion really necessary though? Indications from the User Research phase of this project suggest that some older adults who tub bathe do not actually fill their tubs to a level in which total submersion is ever achieved (the reasons for this stemmed primarily from the participants' desire to not waste water). Total

submersion does, however, seem to be the more commonly desired approach (Kira, 1966; Pheasant, 1997). Since both the aspects of water conservation and user comfort are important considerations, and since neither appear to have been successfully integrated into the designs of the majority of tub/shower installations, it was decided that they should be significant considerations in the design of the proposed bathing unit.

In order to achieve greater submersion while simultaneously keeping the volume of water needed to reach that state at a minimum, the body would need to be able to recline as low as possible into the water, but not be so low as to not be able to return to an upright sitting position with ease. As indicated by Kira (1966) and Pheasant (1997), the possibility for greater submersion increases as a result of the angle of the backrest of the tub reducing and the length of the horizontal base increasing.

The recommended length of the flat portion of the bottom of the tub is derived from the dimension taken from the back of the buttocks to the feet in a sitting position plus 127mm (5 inches). Kira (1966) recommends a tub bottom length of approximately 1,145mm (45 inches), as it is the compromise of lengths appropriate for the shortest (1,065mm or 42 inches) and largest segments of the adult population (1,220mm or 48 inches).

The recommended depth dimension is determined largely by its relationship to the angle and contour of the back and the length. If, for example, the slope of the backrest conforms to the suggested 25-40° range, the depth of water needed to cover the shoulders of large adults while fully reclining would be 305-405mm (12-16 inches respectively) (Kira, 1966). It is further suggested, however, that an additional 100mm (4 inches) be added to the total inside depth so as to prevent water from splashing out while the user is moving around in the tub.

Combining the above figures with the recommended angles for the backrest, the overall length of the tub would therefore range between 1629mm (64 inches) ($406/\tan 40^\circ + 1,145$) and 2016mm (79 inches) ($406/\tan 25^\circ + 1,145$).

The inside width of the tub at a minimum must accommodate the seat breadth of the largest members of the population with at least 50mm (2 inches) of clearance on either side, implying a width of approximately 535mm (21 inches) (Kira, 1966). Optimum width, however, must allow sufficient room for the movements commonly involved with washing, as well as recognize that the population has generally become larger (speculating) during the decades since Kira's figures were documented. As such, Kira's the optimum width recommendations of 610-685mm (24 to 27 inches) may be slightly small.

Shower

Building codes for stall showers state that the minimum size of an enclosure must be at least 6,606.44 square cm (1,024 square inches). Therefore, an 81.28cm x 81.28cm square (32" x 32") is the smallest shape that can be specified under any circumstance (National Kitchen & Bath Association, 1997). Kira (1966), however, recommends that this size should really be larger, citing experiments that have been conducted with various sizes and arrangements of enclosures. Such experiments indicate that the total space actually used in a standing position (in a virtually unlimited enclosure) range from 915 to 965mm (36 to 38 inches) along the axis of the stream and from 840 to 865mm (33 to 34 inches) in the transverse direction. It is further suggested that an actual enclosure would need to allow for an additional 100 to 150mm (4 to 6 inches) in both directions, making the minimum comfortable enclosure size for washing 1,065 x 915mm (42" x 36").

Methods of Support

While there are somewhat varying opinions about the optimal types of support which should be provided in and around bathing areas, support of some kind is always recommended. Early attempts at incorporating support within the bathing unit concepts generally took the form of bars, as these have tended to be the conventional types of support used in environments requiring higher levels of safety (i.e. bathrooms). However, even though these were initially believed to be the most appropriate solution, after more consideration, they did not seem to be the best. Recalling that only a little over a third of older adults interviewed had a grab bar support device in their bathing environment, and more importantly the reasons why they did not have them (stemming from the fact that they are believed to be unattractive and from their perceived associations with frailty and dependence), it seemed odd to incorporate a feature primarily because it is the most frequently recommended method of support by safety agencies.

After reviewing the results from the User Research phase of the project, it was realized that the most common method of support used by those interviewed was to *lean* on horizontal surfaces (i.e. window ledge, counter tops, grab bar, etc.) while stepping in and out of the tub/shower, and to *pull* (i.e. on diagonal or vertical grab bars, tub ledges, etc.) while getting down and up in the tub. While most people had never had an accident while using objects other than grab bars for support, they easily could have, as none of the objects being used had been designed to support the body weight of an adult, especially with slippery wet hands. Most people were simply unable to distinguish which objects they should or should not hold onto for support, and would therefore grab onto anything when stabilization was needed. It was with this understanding that it was decided that anything which could possibly be interpreted by the users of the bathing unit as

a support device (i.e. storage shelves, seat surfaces, etc.) would be designed to be used as such. Other support elements would then be designed to complement these, and integrate discretely within the bathing unit, while corresponding with recommendations made by Kira (1966) and the National Kitchen & Bath Association (1997).

Kira (1966) identified two types of support which appear necessary as one is getting in and out of and operating within a tub. The first is for use while the user is getting into and out of the tub in an erect position, and the second is for use in raising and lowering the body from a sitting/reclining position. Even though the recommendations were made for applications within typical tub units, they will still be considered for the recessed tub unit since many similarities still remain. It is suggested that for the first type, a vertical bar be located at the outer edge of the tub, acting as a support as well as a pivot point. For the second area of support in which the user must raise and lower the body from a standing to a sitting or reclining position, two critical points arise in which support is needed. The first critical point is when the body is in a squat position, and the weight must be transferred to a sitting position. During that transition, balance is completely lost (at least in typical tub units) unless the arms are used to provide a temporary second support, typically on the tub floor. While the step platform in the bathing unit being conceptualized would somewhat alleviate this temporary loss in balance as the user could squat and shift their buttocks weight gradually down using the floor, step and then tub floor, support would also be needed for the user to lean on with their arms for the duration of this new process. The second critical point occurs when the user shifts their body weight from a balanced vertical sitting position to a reclining one. Horizontal support on both sides (i.e. outer tub rim, horizontal bar, etc.) is recommended at this point, allowing the user to ease the body down gradually and pull the body up to a sitting position after bathing.

For shower users, it has been recommended (Kira, 1966; National Kitchen & Bath Association, 1997) that support devices be provided for entering and leaving the shower enclosure, using a seat or footrest, and standing under the stream. For entering and leaving and for operating controls, a vertical bar at the entrance is considered to be most desirable (if located at the entrance of the unit). The most effective support elements are further suggested to be no lower than 865mm (34 inches) or higher than 1,270mm (50 inches), and ideal at 1,000mm (40 inches).

Methods of Enclosure

Some of methods of enclosure which were considered throughout the various conceptual design phases included the incorporation of a shower curtain, a roll-up partition, straight and curved sliding doors, accordion and pivot doors. The shower curtain, if somehow re-designed to reduce it's sterile appearance, was

considered a strong possibility, being the most common and least expensive of the different options. Unfortunately, though, this method was flawed in too many ways (too noisy when in contact of the water spray, dirty and difficult to clean, difficult to control) to make it a viable option for inclusion within the bathing unit. Sliding and pivot doors were considered for their ability to bring an interesting element of transparency into the bathing environment, for their sturdiness, and simple maintenance. Pivot doors, however, were eventually ruled out in favor of sliding doors because of their greater physical intrusion into the bathing space.

Seating

One of the key features which was considered to be a mandatory inclusion in the bathing unit was a provision for seating for shower bathers. The type of seating was based on recommendations acquired from Kira (1966) and the National Kitchen & Bath Association (1997), in which recommendations were cited for seating sizes and heights in shower areas. A seat is suggested to have a minimum width of 405mm (16 inches) and a minimum depth of 255mm (10 inches) and should be arranged to allow for adequate elbowroom. The most comfortable height has been found to be approximately 380mm (15 inches), a height which would make the seat compatible as a footrest and as a transfer seat from a wheelchair. After meeting the minimum requirements derived from these sources, some additional goals were established for the design of the shower seat. Firstly, it was to facilitate the transfer of a user out of and back into a wheelchair, and secondly, to double as a ledge that could be used for support by users either getting into or out of the tub. It would also have to aesthetically integrate with the other elements in the bathing unit, be comfortable and easy to clean.

Storage

One significant complaint expressed by individuals during the Personal Interviews phase of this project was that there was not a sufficient amount of storage in their bathing area. Even those who did not comment on whether they were unsatisfied with their storage areas demonstrated some degree of a shortage of space, apparent because of the presence of numerous types of miscellaneous storage gadgets and cluttered surfaces in their bathing environments.

The storage of bathing products in the majority of bathing environments has, for the most part, been a neglected feature. Even if provisions have been included, they rarely appear to have been designed to take into consideration the ways in which products are retrieved or placed upon their surfaces. For example, many of the 1-piece molded tub/shower units being distributed today have been designed with storage of products in mind, however, their typical wall-molded shelves are contoured in such a way that when wet and slippery products are set upon them

(usually with eyes closed), the chances of them staying put are minimal. Another aspect of storage provision that is also rarely considered in the design of bathing environments is the aesthetics of the products themselves when they are set in their allocated places. In most instances, the shower curtain becomes the only visual barrier blocking the otherwise product-filled cluttered appearing bathing environment.

Storage concepts for the bathing unit were therefore generated with the intent of avoiding many of these problems. It was decided that flat shelf-type surfaces, possibly even adjustable, would be integrated into the vertical walls and even into the seating element. Integrating the shelves aesthetically was not much of a difficult task, however, when the clutter factor was taken into consideration, their placement became much more challenging. If the bathing unit was to be seen without a visual barrier (i.e. a shower curtain), clutter seemed almost unavoidable. It was at this point that several concepts were generated which would somehow mask the clutter, and included concepts whereby storage shelves were built into the sidewalls of the tub, into the recessed floor cavity, and into the sidewalls of the shower. In each scenario, storage for products needed to be located at a height appropriate to the bathing functions of showering and tub bathing.

Fixtures

The placement of fixtures and water controls became a challenging task, as tub bathers and shower users each require very specific placements. For tub bathers, it has been recommended (Kira, 1966) that the water source fitting (and the controls) be located where it can be reached for testing the temperature of the water from both inside and outside the tub, and the controls be located in a similar manner such that they are accessible from a sitting position inside the tub and from a standing position outside the tub. It is further recommended that the controls be placed at a height of 760 to 865mm (30 to 34 inches) for a person standing outside or sitting on a seat while still allowing them to be reached from a sitting position in the bottom of the tub if necessary. For shower users, the placement of controls as well as the location and type of showerhead becomes especially important. The National Kitchen & Bath Association (1997) has recommended that controls be located so that users may access them without having to lean into or under the stream of water, thereby reducing the risk of being scalded while adjusting the water temperature. Kira (1966) made a similar recommendation, suggesting that it should also be possible to control the water supply from both inside and outside the shower, and from both in and out of the water. Placing the controls directly below the showerhead therefore becomes undesirable. Instead, it is recommended that an ideal location is at the side of the entrance to the shower, closest to the stream of water, and at a height of 96 to

122cm (38 to 48 inches) (National Kitchen & Bath Association, 1997) or 1,000 to 1,300mm (40 to 50 inches) (Kira, 1966) from the floor. It should be understood, however, that PirkI recommended a height based on the operation of the controls from the 'basic' standing position, and therefore will not be appropriate for a seated user. It has further been suggested that the showerhead be located so that it directs the spray towards the body and away from the face and hair (Kira, 1966; National Kitchen & Bath Association, 1997). If a fixed showerhead is to be installed, the water supply should be adjustable both to angle and coarseness of spray, and roughed in at a height of 182.88 to 198.12cm (72 to 78 inches) from the floor (Kira, 1966; National Kitchen & Bath Association, 1997). A hand-held shower is also a necessary inclusion for a seated person in the shower or in the tub and for those bathers who may require assistance.

5.3.2 Detailing & Form Resolution

Having established a precise set of design criteria, the bathing unit configuration generated in phase 4 of the conceptual design phases needed a significant amount of refinement. During a brainstorming session, it was realized that assimilating some of the features developed in phase 3 with those developed in phase 4 could allow for an interesting interplay of curvilinear and rectilinear forms, while facilitating the activities of tub bathing and showering in a functionally effective manner.

The configuration which was developed would allow users (both ambulatory and wheelchair users) to shower on a flush-floor removable platform, which would completely cover the tub bathing cavity, and only be removed when such activities took place. For safety reasons, retraction of the platform would be activated by the user from outside the bathing unit's immediate area. The platform would retract on channels and be stored underneath the useable tub cavity while the tub bathing activities were performed, after which time, the platform would be returned to its resting position of covering the tub cavity. Within the tub cavity itself, a single step (2 risers) would allow the user to descend into the tub with greater ease than in conventional tubs. The user could potentially ease their body weight down gradually, using the step as a key element in the transition from the one elevation to the other. Auxiliary support would be provided in the form of the ledges (i.e. top of the shower seat) which the user could lean on during their descent into the bottom of the tub, as well as hand holds on the back of the bathing unit and along the sides of the tub. A wide ledge slightly lower than the floor would provide a large enough area that could be used by the user to lean on while getting up from the tub, as well as act as a seat which could be used during certain tub bathing cleansing activities. The backrest would be sloped between the recommended 25-40°

range (Kira, 1966), but closer to the upper end of the range, thereby making it easier for the user to sit up after being in a reclined position. The width of the tub would be wider than that which is recommended by Kira (610-685mm, 24-27 inches) around the area where the user's buttocks would sit (so that a larger adult could sit comfortably without potentially becoming stuck in the tub), however not wider than the recommended maximum width of 915mm (36 inches). The depth and length dimensions of the tub would also correspond with those recommended in Design Considerations. Adjustable storage shelves would be located at a height easily reached by the user while lying in the tub, and would only be visible from inside the bathing unit area. The typical clutter commonly associated with bathing environments will therefore not be visible from outside the bathing area, even though no visual barrier (i.e. shower curtain) is present. Prior to leaving the tub, a hand held shower would be available to the user for rinsing off or for rinsing out the tub cavity for cleaning purposes. This would be integrated into the vertical surface of a shower bench located at the end of the tub. Once the tub has been drained, the user would activate the mechanism of the retracted floor and it would close to cover the cavity.

The walk-in shower would be able to accommodate 1 to 2 ambulatory adults or 1 wheelchair user with 1 ambulatory adult. A cylindrical glass sliding door enclosure could be pulled out from its resting position against the side wall of the bathing unit (where it would not interfere with tub bathing) to prevent the spray of water outside the immediate shower area. Its design would ensure that the closed position correspond with the placement of the water controls, thereby allowing the user to adjust the water temperature either from outside the enclosure (by opening it just a bit and reaching inside) or from inside. The rail upon which the doors would slide, would be located at a height of approximately 1828mm (72 inches), and would be supported by a bulkhead and sidewall of the shower. The space between the bulkhead and side wall would be left open, allowing for the steam from the shower to escape, while the rail could act as a rod for hanging clothes (an activity which was identified as being quite common during the User Research phase of this project). The bulkhead serves two other functions; the first of which is to supply the water for and support the showerhead, the second being to visually compress the vertical space (from the perspective of the tub user) which is otherwise increased from having recessed the tub into the floor. A shower bench would be located inside the enclosure, capable of facilitating the transfer from a wheelchair when the sliding doors are fully open (in their resting position), and would give the user the option of sitting while performing either some or all of their bathing activities. The bench would also act as a visual barrier from the mechanical elements of the retracting floor. Storage shelves would be located

at a height easily reached by the user from either a standing or seated position. Similar to those intended for tub bathers, these shelves would also not be visible from outside the bathing unit. See Appendix H design refinement sketches.

5.4 Testing & Revisions

Prior to advancing the design of the proposed bathing unit any further, it was believed to be critical to the process that input from bathers and from care-providers who are currently assisting dependent bathers be acquired. As such, two focus group sessions were organized to provide feedback on the design. The first session was conducted with older adults at a Calgary community center, and the second, with care-providers of dependent bathers at a Personal Care Agency operating out of a Calgary Retirement Residence. Several perspective renderings illustrating different views and details of the proposed bathing unit (see Appendix H) were used in the sessions to describe the design, and were thoroughly explained to the participants. Some of the background and user research findings, as well as the design intent were also described prior to the commencement of feedback.

5.4.1 Focus Group Session with Bathers

Setting: A Calgary community center with recreation facilities for individuals of all ages. An adult day program is in place.

Attendance: 11 female participants, 1 male participant. The program manager supervised.

The feedback was as follows:

- As a whole, the feedback was extremely positive.
- People really liked the fact that you could walk into the shower and retract the floor to expose a tub. One woman who takes baths and whose husband showers especially liked the idea.
- One woman stated that she would prefer it if bars looked like bars stating "what's wrong with the bars they've already got?" She went on to say that it is because then you would know what to hold onto.
- While stepping down into the tub, one woman thought that it would be better to have support on both sides, rather than on just the one side.
- One woman stated that her perfect tub would include a step on the outside to get in and out (referring to typical above-floor tubs). Others disagreed with her, stating that it would even be more dangerous than stepping over

the ledge as they do presently. She later went on to say that the proposed bathing unit still allowed for a step, which she liked.

- The issue of cost of the bathing unit came up, in which one person asked "how much would something like this cost in comparison to other tubs?" One woman responded for me, stating that 25 years ago, the molded tubs were extremely expensive but that now they are commonplace.

- All of the participants liked the idea of a molded seat integrated right into the shower area. One woman indicated, though, that she thinks her tub is perfect the way it is with her portable chair.

- One woman, who has bad shoulders, stated that she cannot get out of the tub. She said that the step in the proposed design would allow her more flexibility in the way she would get out. I then asked her if she would transfer her weight by shifting from one step to the other. She indicated that perhaps that would be the way she would do it.

- Participants also liked the lower hand-held showerhead that could be used in the tub, not just in the shower. One woman who tub bathes stated that a higher showerhead is not as good as a lower one for rinsing off.

- One woman liked the fact that you do not have to add anything yourself, that everything had already been incorporated.

5.4.2 Focus Group Session with Care-Providers of Dependent Bathers

Setting: A Calgary retirement residence for older adults who may require mild to moderate assistance with different aspects of daily living. Home care services are stationed on the premises. Individuals live independently with the exception of meal preparation and individually required services (i.e. bathing).

Attendance: 2 female care-providers.

The feedback was as follows:

- As in the focus group session with older adults, the feedback was very positive.

- Both indicated that they assist their clients mostly in typical front ledge tubs that have been fitted with a flexible showerhead. The most difficult part for them is getting the client up from the tub and out. One stated that if the proposed bathing unit was installed in the bathrooms of her clients, some of them could bathe themselves nearly without assistance, because they would not have to get up from the tub.

- They both really liked the fact that a walk-in shower would be easier to assist their clients with getting into the area to be bathed.
- One was skeptical about whether the removable floor would be able to hold 2 people safely and without shifting around. I told her that it had been designed to withstand the weight of 2 people, and that this was one of its features.
- One pointed out that after helping her client onto the seat and closing the door, she would prefer if the hand-held shower was "right there" and on the back wall instead of under the bench.
- The same woman stated that if she was helping her client into the bathtub, she would want to go down the step with her, but she would not be able to take her shoes off. I suggested that she could use the shower instead of the tub, or else she could assist the person from the floor level. She agreed with the first point, but was not quite as sure about how she would manage the person from above. She later stated that she would probably be able to work something out, and that it would just be a matter of getting used to something new.

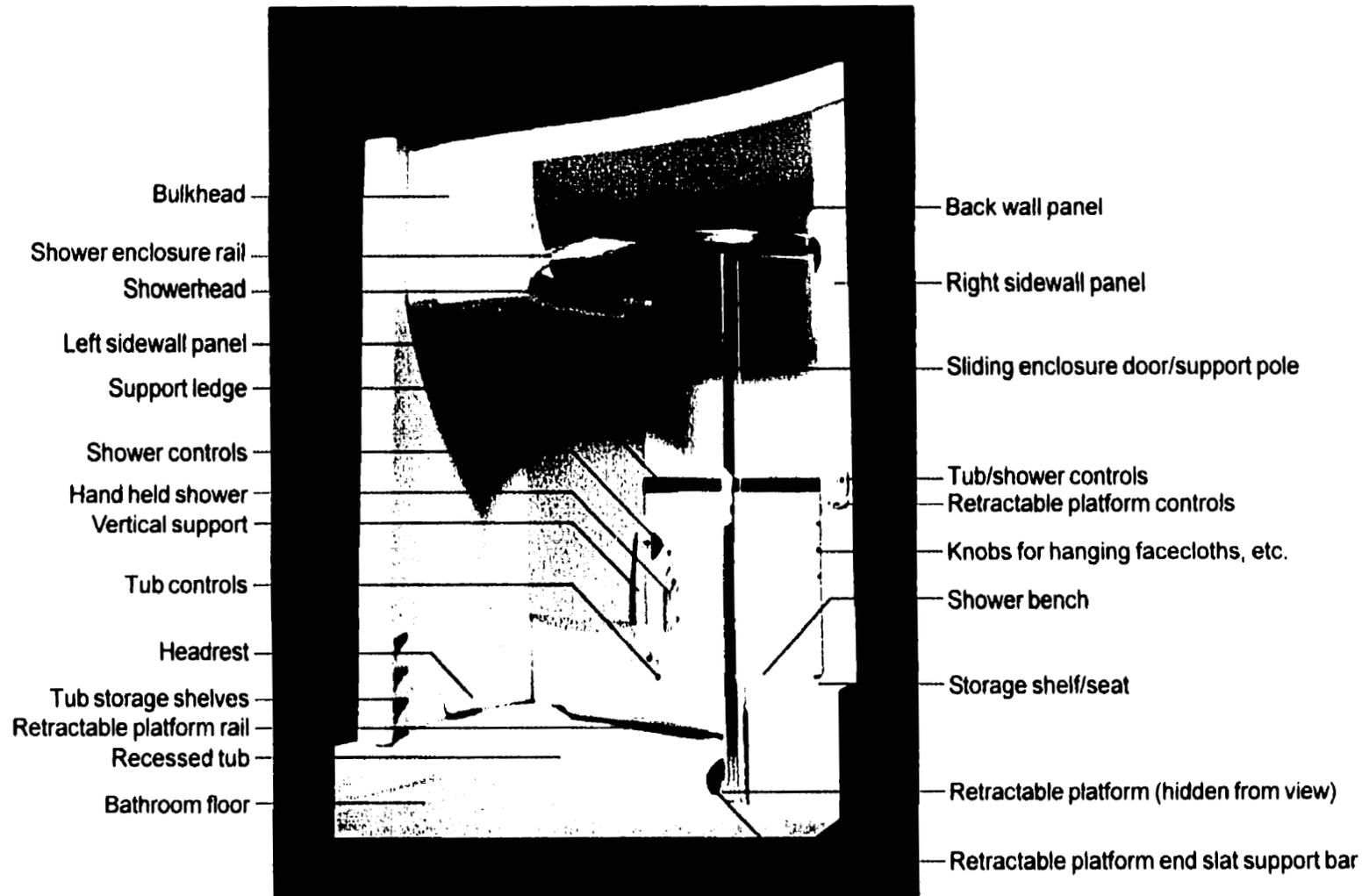
5.4.3 Summary

Overall, the feedback from older adults who would be the potential bathers in the proposed bathing unit, as well as that from the care-providers of dependent bathers who might also be users of the product, was extremely positive. Generally speaking, the feedback from the older adults was less inquisitive in terms of how the floor mechanism and other features of the design would actually work, than the care-providers. They were more accepting of the whole concept without needing an explanation. This perhaps stems from the fact that they have a more personal attachment to the potential product, and are therefore able to evaluate the ability of the product to meet their needs more readily than the care-provider who interacts with the product in a much different way. They were also all able to bathe independently.

The feedback that was offered from both groups was evaluated, and certain issues singled out as considerations for implementation in the final refinement of the design. The desire expressed by one woman, for example, to have the bars look like bars, although a valid point, was considered to be more of an issue of not wanting something new, regardless of how effective it could be. It therefore would have little impact on the final design. The comment made by one of the care-providers to change the location of the hand-held showerhead, however, should impact the final configuration of the fixtures, since it identifies the existence of a potential flaw in the design.

6 Proposed Bathing Unit

6.1 Components Identification



6.2 User Engagement
6.2.1 Entering Tub



Adjusting temperature



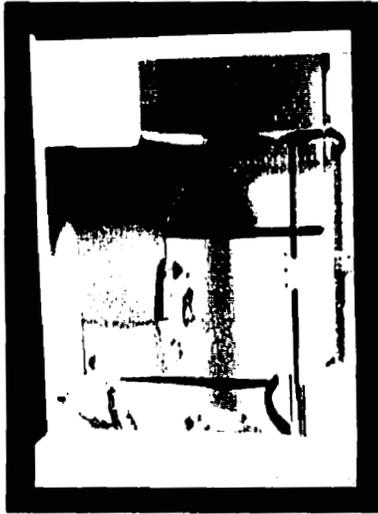
Preparing to enter tub



Getting down into tub

6.2 User Engagement

6.2.2 Activities Performed While in Tub



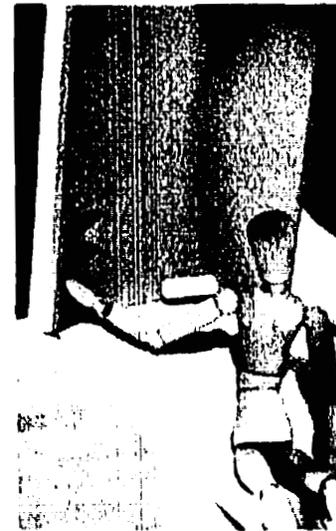
Preparing to relax



Relaxing



Adjusting temperature



Reaching for shelves



Preparing to get up

6.2 User Engagement

6.2.3 Exiting Tub



Utilizing vertical support



Rinsing prior to exiting tub



Stepping out of tub

6.2 User Engagement
6.2.4 Operation of Retractable Platform



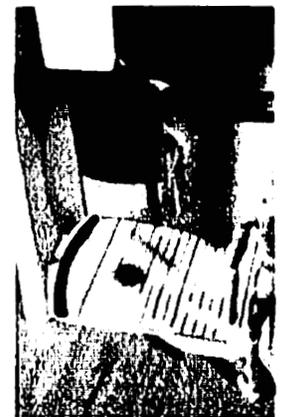
Initiating platform controls



Fully open

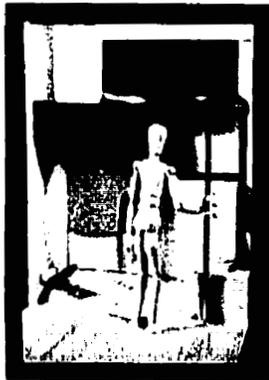


Partially closed



Fully closed

6.2 User Engagement
6.2.5 Entering Shower



Pulling enclosure closed



Adjusting temperature



Reaching for hand held shower

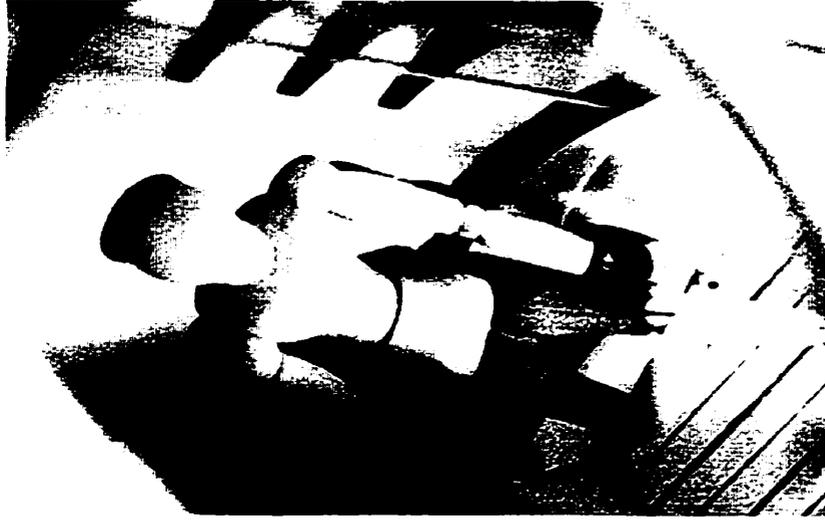
6.2 User Engagement
6.2.6 Activities Performed While in Shower



Washing body



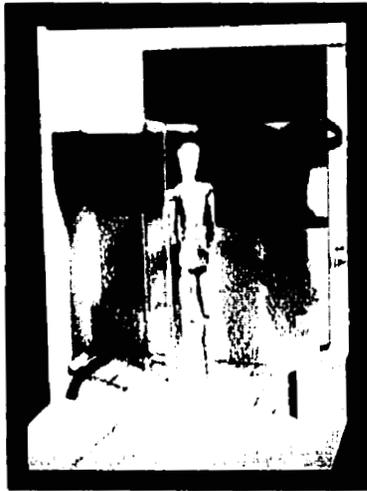
Reaching for shelves



Washing feet

6.2 User Engagement

6.2.7 Exiting Shower/Multiple Users



Pushing enclosure open



Assistant with dependent bather

6.3 Materials

6.3.1 General Notes

- All materials and parts are to be understood as existing within a typical bathing environment. As such, they will be required to withstand the following conditions:

- Water and/or water vapor.

- Cleansing substances including those used for body cleansing (i.e. soap, shampoo, foams and gels, etc.) and environmental maintenance (i.e. abrasives, bleaches, etc.).

- Sharp and/or hard objects (i.e. razors, etc.) if dropped/struck upon surfaces.

- Miscellaneous substances including such items as bath oils, candle flames, etc.

- Installation of the bathing unit is to be performed only by highly experienced trades' people.

- It is to be understood that parts could be specified from a wide range of colors, and are not limited to those specified below.

6.3.2 Description by Part (See Appendix I Exploded Isometric)

(1) Leftwall Panel

Material: Opaque plastic with good scratch resistance, chemical resistance, weathering resistance and durability. Compatible with bulkhead, back and rightwall panels.

Finish: Medium gloss, opaque apple green.

Process: Thermoformed.

(1A) Leftwall Shelves

Material: Transparent plastic with moderate strength, scratch resistance, chemical resistance, weathering resistance and durability.

Finish: Semi-transparent cranberry color.

Process: Blow molded.

(2) Bulkhead

Material: Opaque plastic with high strength, good weathering resistance and durability. Compatible with left, back, and rightwall panels.

Finish: Medium gloss, opaque white.

Process: Thermoformed.

(3) Enclosure Rail

Material: Aluminum.

Finish: Chrome plated.

Process: Aluminum extruded, then shape rolled.

(4) Removable Platform Slats

Material: Plastic coated aluminum. Opaque plastic with excellent dent and scratch resistance, chemical resistance, weathering resistance and durability.

Finish: Medium texture (non-slip), low gloss, opaque white.

Process: Aluminum extruded, punched (where specified), then plastic coated.

(5) Backwall Panel

Material: Opaque plastic with good scratch resistance, chemical resistance, weathering resistance and durability. Compatible with bulkhead, left and rightwall panels.

Finish: Medium gloss, opaque white.

Process: Thermoformed.

(5A) Backwall Horizontal Bar

Material: Transparent plastic with high strength, scratch resistance, chemical resistance, weathering resistance and durability.

Finish: Semi-transparent cranberry color. Medium surface texture.

Process: Extruded then curved.

(5B) Backwall Vertical Bar

Material: Transparent plastic with high strength, scratch resistance, chemical resistance, weathering resistance and durability.

Finish: Semi-transparent clear color. Medium surface texture.

Process: Extruded then curved.

(6) Rightwall Panel

Material: Opaque plastic with good scratch resistance, chemical resistance, weathering resistance and durability. Compatible with bulkhead, back and leftwall panels.

Finish: Medium gloss, opaque apple green.

Process: Thermoformed.

(6A) Rightwall Shelves

Material: Transparent plastic with moderate strength, scratch resistance, chemical resistance and durability.

Finish: Semi-transparent cranberry color. Smooth surface finish.

Process: Blow molded.

(7) Shower Bench

Material: Opaque plastic with good scratch resistance, chemical resistance, weathering resistance and durability. Compatible with bulkhead and backwall panels. Non-slip, medium density foam rubber seat.

Finish: Medium gloss, opaque white.

Process: Thermoformed.

(8) Enclosure Doors

Material: Curved, tempered glass treated to resist hard water and mineral deposits.

Finish: Clear or semi-transparent (depending on user preference).

Process: Drawn and rolled.

(8A) Enclosure Door Edge/Grab Pole

Material: Aluminum. Hand grip high density foam rubber.

Finish: Chrome plated. Hand grip opaque white.

Process: Extruded.

(9) Tub

Material: Opaque plastic with excellent scratch resistance, chemical resistance, weathering resistance and durability. Compatible with bulkhead and backwall panels.

Finish: Medium gloss, opaque white. Medium texture (non-slip) on tub bottom.

Process: Thermoformed.

(10) Removable Platform Rail

Material: Aluminum.

Finish: Treated to withstand wet environmental conditions as outlined in section 6.3.1.

Process: Extruded then rolled.

6.3.3 Water Controls Fixtures

It is to be understood that fixtures would be specified according to personal preference, however, the following notes represent a suggested set of guidelines which should be followed in order to achieve maximum comfort and safety.

Fixed Showerhead

Location: Bulkhead.

Features: Adjustable spray patterns, anti-lime self-cleaning system, water saving head.

Suggested Model: Grohe Relaxa and Relaxa Plus 28 272 Champagne Spray Showerhead.

Finish: Chrome.

Hand Held Shower

Location: Backwall.

Features: Adjustable spray patterns, anti-lime self-cleaning system.

Suggested Model: Grohe Relaxa and Relaxa Plus 28 175 Champagne Hand Shower.

Finish: Chrome.

Shower Water Controls

Location: Backwall; rightwall panel (bathroom face).

Features: Touch-sensitive LCD panel with built-in memory allowing for settings to be saved. Thermostatic temperature control with a safety stop at 100° Fahrenheit for added protection.

Suggested Model: Custom. Alternate by Trevi (model unknown).

Finish: White.

Tub Water Controls

Location: Rightwall panel (bathroom face); backwall.

Features: Touch-sensitive LCD panel with built-in memory allowing for settings to be saved.

Suggested Model: Custom. Alternate by Trevi (model unknown).

Finish: White.

Tub Water Supply

Location: Tub end (above step).

Features: Function of a bath tap and overflow combined in one fitting. High speed aerators to inject air into the water to produce a forceful flow using the minimum amount of water. Minimal intrusion of fitting into tub cavity.

Suggested Model: Hansgrohe Exafill.

Finish: Chrome.

Removable Platform Controls

Location: Tub end.

Suggested Model: Custom.

Finish: White.

6.4 Implications

Basically what this project has done is challenge the conventions - which we have all come to accept as standard - in our bathing environments. By using the changes which accompany the aging process to not only identify the shortcomings of existing bathing products, but to also derive a new set of criteria upon which the designs of these environments should be based upon, what results is simply 'good design'. As a result, other populations such as wheelchair users may benefit from the design intent, even though they were not initially identified as the primary users of the product.

So where does this project go from here? The next phase would be to develop a full-scale prototype of the bathing unit, and then to study older adults, as well as users from other populations, interacting with the product as they might in 'real life' situations. Following this, perhaps other products may be developed using similar methods of user driven new product development.

In any case, this project has prompted an investigation into the overall *quality* of the bathing experience, and if further investigated, could likely inspire a new generation of bathing product environments.

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Figure 2-12F (October 1998). *World Architecture* (p. 22), no. 70.

Figure 2-13A (1998). Jacuzzi Advertisement.

Figure 2-13B (September/October 1998). *I.D.* (p. 38).

Figure 2-13C (July/August 1998). *World Architecture* (p. 122), no. 68.

Figure 2-13D (July/August 1998). *World Architecture* (p. 121), no. 68.

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Figure 2-13F (July/August 1998). *World Architecture* (p. 25), no. 68.

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Figure 2-13I (July/August 1998). *World Architecture* (p. 119), no. 68.

Figure 2-13J (July/August 1998). *World Architecture* (p. 119), no. 68.

Figure 2-14 Fernie, G. (1997). Assistive Devices. In A. Fisk & W. Rogers (Eds.), *Handbook of Human Factors and the Older Adult* (p. 304). San Diego, CA: Academic Press, Inc.

Figure 2-15A Fernie, G. (1997). Assistive Devices. In A. Fisk & W. Rogers (Eds.), *Handbook of Human Factors and the Older Adult* (p. 295). San Diego, CA: Academic Press, Inc.

Figure 2-15B Mullick, A., & Steinfeld, E. (Spring 1997). Universal Design: What it is and Isn't. *Innovation* (p. 16).

Figure 2-15C Safety Guard. (1997). Bathroom Safety Devices. <http://www.safety-guard.com>.

Figure 2-16 Mullick, A., & Steinfeld, E. (Spring 1997). Universal Design: What it is and Isn't. *Innovation* (p. 17).

Figure 2-17 Story, M.F. (Spring 1997). Is it Universal?. *Innovation* (p. 29).

Figure 2-18A Mueller, J., & Mace, R. (Spring 1997). Silver & Gold. *Innovation* (p. 40).

Figure 2-18B Mueller, J., & Mace, R. (Spring 1997). Silver & Gold. *Innovation* (p. 41).

Figure 2-18C PirkI, J.J. (1994). *Transgenerational Design: Products for an Aging Population* (p. 148). New York: Van Nostrand Reinhold.

Figure 2-19A PirkI, J.J. (1994). *Transgenerational Design: Products for an Aging Population* (p. 183). New York: Van Nostrand Reinhold.

Figure 2-19B PirkI, J.J. (1994). *Transgenerational Design: Products for an Aging Population* (p. 179). New York: Van Nostrand Reinhold.

Figure 2-19C PirkI, J.J. (1994). *Transgenerational Design: Products for an Aging Population* (p. 189). New York: Van Nostrand Reinhold.

Figure 2-19D PirkI, J.J. (1994). *Transgenerational Design: Products for an Aging Population* (p. 189). New York: Van Nostrand Reinhold.

Figure 2-19E The Center for Universal Design. (Spring 1998). *Quarterly Newsletter*, vol. 1, no. 3.

Figure 2-19F PirkI, J.J. (1994). *Transgenerational Design: Products for an Aging Population* (p. 188). New York: Van Nostrand Reinhold.

Figure 2-19G PirkI, J.J. (1994). *Transgenerational Design: Products for an Aging Population* (p. 177). New York: Van Nostrand Reinhold.

Figure 2-19H PirkI, J.J. (1994). *Transgenerational Design: Products for an Aging Population* (p. 190). New York: Van Nostrand Reinhold.

Figure 2-19I PirkI, J.J. (1994). *Transgenerational Design: Products for an Aging Population* (p. 182). New York: Van Nostrand Reinhold.

Figure 2-19J PirkI, J.J. (1994). *Transgenerational Design: Products for an Aging Population* (p. 23). New York: Van Nostrand Reinhold.

Anthropometric Data on the Elderly: Means and Standard Deviations

| Age range Sample Size | 50-100 ^a 822 | 60-69 ^b 43 | 60-69 ^c 72 | 65-69 ^d 24 | 65-74 ^e 72 | 65-90 ^f 184 | 66-70 ^a 169 | 70+ ^b 12 | 70+ ^d 20 | 70+ ^c 28 | 72-91 ^o 130 | 75-94 ^o 40 |
|-------------------------------|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|---------------------------|---------------------------|------------------------|------------------------|------------------------|---------------------------|--------------------------|
| Stature, against wall | | 172.8 (6.6) | | 171.9 (6.6) | | | | 171.5 (9.0) | 170.4 (7.5) | | | |
| Stature, free standing | 175.1 (8.9) | | 172.6 (6.4) | 171.2 (6.6) | | 169.0 | | | 169.6 (7.8) | 171.9 (8.4) | 168.4 (5.3) | |
| Sitting height | 79.9 (5.3) | 90.8 (3.0) | 90.8 (2.9) | 90.0 (2.9) | | | | 89.5 (3.5) | 89.0 (3.4) | 89.8 (3.9) | 88.3 (3.1) | |
| Knee height | | 53.9 (2.5) | 53.6 (2.5) | | | | | 53.5 (3.4) | 53.2 (2.9) | 53.7 (3.2) | 53.8 (2.1) | |
| Popliteal height | 42.1 (3.5) | | 42.1 (2.3) | | | | | | | 42.1 (3.0) | 44.0 (2.1) | |
| Thigh clearance height | | | 19.7 (1.4) | | | | | | | 14.8 (1.2) | | |
| Hip breadth | 37.4 (3.9) | | | 38.0 (2.3) | | | | | 35.8 (1.7) | 37.8 (2.4) | | |
| Bideltoid breadth | | | 45.3 (2.4) | 45.1 (2.1) | | | | | 44.7 (1.8) | 45.0 (1.7) | 43.4 (2.3) | |
| Biacromial breadth | | | 38.9 (1.7) | | | | | | | 39.2 (1.8) | 37.8 (1.6) | |
| Hand breadth | 7.7 (0.6) | | 8.5 (0.4) | 8.5 (0.4) | | | | | 8.5 (0.4) | 8.6 (0.4) | 8.4 (0.4) | |
| Head breadth | | | 15.5 (0.5) | 15.5 (0.5) | | | | | 15.5 (0.5) | 15.5 (0.4) | 15.4 (0.5) | |
| Foot breadth | | | 9.8 (0.6) | | | | | | | 9.9 (0.5) | 10.0 (0.5) | |
| Head circumference | | | 57.1 (1.4) | 57.1 (1.3) | | | | | 58.0 (1.4) | 57.4 (1.8) | 56.9 (1.8) | |
| Calf circumference | | | 35.9 (2.5) | 36.0 (2.9) | | | | | 34.7 (2.1) | 34.3 (2.2) | 34.3 (2.7) | |
| Chest circ., resting | | | 99.6 (7.1) | 99.9 (6.3) | | | | | 99.6 (5.5) | 99.7 (5.9) | 98.2 (7.6) | |
| Chest circ., maximum | | | 101.8 (6.9) | 101.7 (6.1) | | | | | 101.5 (5.4) | 101.7 (5.7) | 98.7 (7.4) | |
| Chest circ., minimum | | | 97.6 (7.2) | 97.5 (6.5) | | | | | 97.8 (5.6) | 97.9 (6.0) | 94.5 (7.6) | |
| Upper arm circumference | | | 30.9 (2.7) | 30.5 (2.8) | | | | | 30.0 (2.4) | 28.7 (2.8) | | |
| Waist circumference | | | 95.5 (9.3) | 97.4 (8.9) | | | | | 97.1 (8.0) | 97.0 (7.6) | | |
| Head length | | | 19.6 (0.6) | 19.6 (0.6) | | | | | 19.5 (0.6) | 19.7 (0.7) | 19.7 (0.6) | |
| Hand length | 175.5 (1.2) | | 18.9 (0.9) | 18.9 (0.9) | | | | | 18.8 (0.9) | 19.0 (1.0) | 18.8 (0.8) | |
| Buttock-knee length | | | 58.6 (3.0) | | | | | | | 58.4 (3.2) | 59.1 (2.4) | |
| Buttock-popliteal length | 46.3 (3.6) | | 48.2 (2.8) | | | | | | | 48.1 (3.1) | 47.2 (2.5) | |
| Elbow to middle finger length | 44.2 (2.8) | | 46.8 (2.0) | 46.8 (1.9) | | | | | 46.4 (2.5) | 46.9 (2.8) | 46.4 (1.8) | |
| Shoulder to elbow length | | | 37.3 (1.8) | 37.4 (1.7) | | | | | 37.0 (2.1) | 37.4 (2.2) | 36.9 (1.7) | |
| Forward reach | | | 84.2 (3.7) | | | | | | | 85.9 (5.4) | 86.9 (3.8) | |
| Span | | | 178.7 (7.5) | 178.6 (7.5) | | | | | 177.6 (9.0) | 179.2 (9.9) | 174.0 (7.0) | |
| Skinfold (triceps)(right) | | | | 1.1 (0.4) | | 1.2 (0.3) | | | | 0.9 (0.4) | 1.1 (0.4) | |
| Skinfold (subcap)(right) | | | | 1.7 (0.8) | | | | | | 1.5 (0.7) | 1.6 (0.7) | |
| Foot height | | | | 26.3 (1.7) | 26.4 (1.2) | | | | 26.5 (1.3) | 26.8 (1.4) | 26.0 (1.0) | |
| Weight (kg) | 63.7 | | 76.6 (1.1) | 76.4 (1.0) | 65.8 (11.8) | 63.7 | | | 74.3 (9.9) | 75.3 (9.0) | 69.0 (10.5) | 83.7 (11.7) |
| Grip strength (left)(N) | | | 432 (88) | | | | 323 (58) | | | 352 (88) | 282 (80) | |
| Grip strength (right)(N) | | | 461 (88) | | | | 370 (68) | | | 412 (88) | 283 (78) | |

Personal Interview Questions Bathers

Background

1. What age group do you belong to? (60-69 yrs/ 70-79 yrs/ 80+yrs)
2. Do you like to bathe?
(if no) give reasons
3. What type of bath do you generally take? (shower, tub bath, sponge bath)
give reasons
4. Is this your 1st choice in the way you would bathe?
(if no) what type of bath would you prefer? (shower, tub bath, sponge bath) give reasons
5. Do you receive any assistance with bathing?
(if yes) what type of assistance do you receive? describe
6. Do you have any medical conditions that affect you while you bathe?
(arthritis, cardio, etc.)
(if yes) describe

Bathing Environment

(Video-record or photograph participant's bathing environment, note whether participant lives in a house, apartment, condo, etc.)

1. Is this where you *always* bathe?
(if no) where else do you bathe? describe
2. Has your bathing environment ever been modified?
(if yes) what modifications were made and why?
(if no) have you ever considered modifying your bathing environment?
(if yes) what types of modifications have you considered?

3. Do you use your bath area for any other purpose than for bathing?
(hanging clothes, etc.)

(if yes) describe

Bathing Ritual

(ask participant to demonstrate and/or describe their bathing ritual, video-record)

1. Do you bathe while standing, sitting, lying or a combination of these?
describe

Is this your 1st choice in the way you could bathe?

(if no) how would you prefer to bathe? (standing, sitting, lying)

2. Besides soaping and rinsing your body, list some of your other bath related activities. (i.e. nail cutting, etc.)

3. Where do you dress and undress yourself for bathing? (in the bath area, outside the bath area) describe

4. Where do you dry yourself? (in the bath area/ outside the bath area) describe

5. (if participant takes a bath) Do you empty the water from the tub before or after you get out? describe

Problems Experienced

1. Have you ever experienced any difficulties at any time during your bathing process? (getting in or out of the tub/sower, soaping, etc.) describe

2. While getting in and out of the tub/shower, how balanced do you feel? describe

3. While in the tub/shower, how balanced do you feel? describe

4. Have you ever lost your balance or nearly lost you balance while bathing?

(if yes) what happened? (how, what were you doing, where were you, etc.)

5. How is your tub/shower floor in terms of traction or slipperiness? describe

6. Have you ever slipped or nearly slipped while bathing?

(if yes) what happened or nearly happened? (how, what were you doing, etc.)

7. Have you ever injured or nearly injured yourself while bathing?

(if yes) what type of injury or what nearly happened?

8. While you are bathing, is there anything that is awkward to do? describe

9. What parts of your body are the most and least difficult to reach while soaping, rinsing and drying? describe

10. Do you ever experience difficulty using any part of your bathing equipment?

(if yes) what kinds of difficulties?

11. At what point during your bathing process do you feel the most secure?

12. At what point during your bathing process do you feel the most unstable?

13. If any part of your bathing process could be improved, what would that be? describe

14. Overall, on a scale of 1-10 (10 being the best score possible), how would you rate your bathing environment in terms of ease of use, accessibility, etc.?

15. Do you clean your own bathing area?

(if yes) While you are cleaning, is there anything that is awkward or difficult to do? describe

(if yes) what would assist you?

Bathing Environments

Storage of Bathing Accessories

Towels & face clothes are hung or stuffed over grab bars.



***Area of the Tub/Shower:
Back wall & side walls
(inside the tub/shower).***

Face clothes & body sponges are hung around taps.



***Area of the Tub/Shower:
Showerhead side wall
(inside the tub/shower).***

Towels & bathmats are draped over front ledge of tub.



***Area of the Tub/Shower:
Front ledge of tub (inside
the tub/shower).***

Towels are hung over shower curtain rod or sliding doors.



***Area of the Tub/Shower:
Top of shower enclosure.***

Bottles, soap, etc. are stored on tub ledges.



***Area of the Tub/Shower:
Front, back and side ledges
(inside the tub/shower).***

Storage poles hold bottles, soap, etc. on mini-shelves.



***Area of the Tub/Shower:
Corner between back & side
walls (inside the tub/
shower).***

Plastic hanging holders store face clothes, soap, etc.



***Area of the Tub/Shower:
Showerhead; curtain rod.***

Bottles, soap, etc. are stored on top of counters.



***Area of the Tub/Shower:
Sink vanity counter (outside
the tub/shower).***

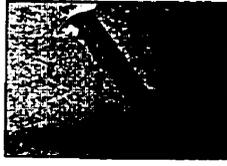
Bottles, soap, etc. are stored on top of the toilet box.



***Area of the Tub/Shower:
Toilet (outside the tub/
shower).***

**Bathing Environments
Equipment Present Inside the Tub/Shower**

Wall mounted horizontal or diagonal grab bar.



Area of the Tub/Shower:
Back wall.

Horizontal grab bar (incorporated in wall profile).



Area of the Tub/Shower:
Back wall.

Wall mounted soap holder with handle.



Area of the Tub/Shower:
Back wall.

Wall mounted soap holder without handle.



Area of the Tub/Shower:
Back wall.

Window ledge.



Area of the Tub/Shower:
Back wall.

Removable front ledge grab bar (mounted parallel to ledge).



Area of the Tub/Shower:
Front ledge of tub.

Removable front ledge grab bar (mounted perpendicular to ledge).



Area of the Tub/Shower:
Front ledge of tub.

Wall mounted diagonal or vertical grab bar.



Area of the Tub/Shower:
Side walls.

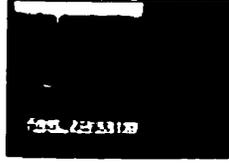
Stationary showerhead.



Area of the Tub/Shower:
Showerhead side wall.

**Bathing Environments
Equipment Present Inside the Tub/Shower Contd.**

Removable showerhead.



Area of the Tub/Shower:
Showerhead side wall.

Removable shower seat.



Area of the Tub/Shower:
Floor of the tub/shower.

Rod for hanging clothes mounted parallel to the shower curtain rod.



Area of the Tub/Shower:
Spans between the side walls.

Rod for hanging clothes mounted parallel to the shower curtain rod.



Area of the Tub/Shower:
Spans between the back wall and shower curtain rod.

Removable clothes drying rack.



Area of the Tub/Shower:
Floor of the tub/shower.

Portable non-slip rubber mat.



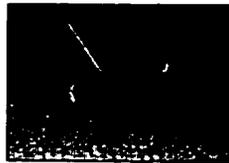
Area of the Tub/Shower:
Floor of the tub/shower.

Permanently fixed non-slip surface/stickers.



Area of the Tub/Shower:
Floor of the tub/shower.

Portable long-handled body scrub brush.



Area of the Tub/Shower:
Hung or sit in various places around the tub/shower.

Portable foot scrub brush with suction cups.



Area of the Tub/Shower:
Floor of the tub/shower (stored by suction on back wall).

**Bathing Environments
Equipment Present Outside the Tub/Shower**

Non-slip mat/carpet



Area of the Tub/Shower:
Bathroom floor.

Chair/seat.



Area of the Tub/Shower:
Bathroom floor.

Shower curtain.



Area of the Tub/Shower:
Enclosure.

Sliding shower doors.



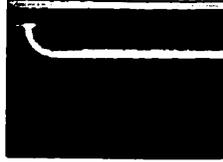
Area of the Tub/Shower:
Enclosure.

Accordion shower door.



Area of the Tub/Shower:
Enclosure.

Wall mounted vertical grab bar.



Area of the Tub/Shower:
Bathroom wall.

Wall mounted towel rod.



Area of the Tub/Shower:
Bathroom wall.

Sink vanity counter.



Area of the Tub/Shower:
Adjacent to the tub/shower.

Floor-ceiling mounted towel pole.



Area of the Tub/Shower:
Adjacent to the tub/shower.

**Simulated User Observation
Stepping Into the Tub/Shower - Methods of Support**

| # | Inside Tub/Shower | | | | | | | | | | Outside Tub/Shower | | | | | |
|----|-------------------|-----------|--------------|-------------|----------------|-------------|------------|---------------|--------------------------|----------------|--------------------|--------------------|-----------|-------------------|------------|---------|
| | Back Wall | | | | Ledges | | | Side Walls | | | Enclosure | Bathroom Side Wall | | Bathroom Built-in | | |
| | bars | wall tile | window ledge | soap holder | front ledgebar | front ledge | back ledge | side wall bar | side wall shower wallbar | shower curtain | | sliding doors | towel rod | wall surface | towel pole | counter |
| 4 | 1 | | | | 0 | | | | | | | | | | | |
| 5 | | 1 | | | 0 | | | | | | | | | | | |
| 7 | | 1 | | | | | | | | | | | | | | |
| 8 | 1 | | | | | | | | | | | | | | 0 | |
| 9 | | 10* | | | | | | | | | | | | | 0 | |
| 10 | | | | | | 10* | 1 | | | | | | | | | 0 |
| 11 | | | 1 | | | | | | 1 | | | | | | | |
| 12 | 0 | | | | | | | | | | | | | | | |
| 13 | | 1 | | | | | | | | | 10 | | | | | |
| 14 | 1 | | | | | | | | | | | | | | | 0 |
| 16 | | | | 1 | | | | | | | | | | | | |
| 17 | | 1 | | | | | | | | | | | | | | |
| 18 | | | | 1 | | | | | | | | | | | | 0 |
| 19 | 1 | | | | 0 | | | | | | | | | | | |
| 20 | 1 | | | | | | | 0 | | | | | | | | |
| 22 | 1 | | | | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | | | 10* | | |
| 24 | | | | | | | | | | | | | | | 0 | |

* Both hands simultaneously.

1 - Participant used their inside hand.

0 - Participant used their outside hand.

Simulated User Observation Video Stills

Stepping Into the Tub/Shower - Methods of Support

1 thing is used for support (inside the tub/shower).



2 things are used for support (inside the tub/shower).



1 thing is used for support (outside the tub/shower).



2 things are used for support (inside the tub/shower).
* Both hands simultaneously.



1 thing is used for support (outside the tub/shower).
* Both hands simultaneously.



2 things are used for support (inside & outside the tub/shower).



Simulated User Observation Stepping Out of the Tub/Shower - Methods of Support

| # | Inside Tub/Shower | | | | | | | | | | Outside Tub/Shower | | | | |
|----|-------------------|-----------|--------------|-------------|----------------|-------------|------------|---------------|----------------|---------------|--------------------|--------------|-------------------|---------|--|
| | Back Wall | | | Ledges | | | Side Walls | | Enclosure | | Bathroom Side Wall | | Bathroom Built-in | | |
| | bars | wall tile | window ledge | soap holder | front ledgebar | front ledge | back ledge | side wall bar | shower curtain | sliding doors | towel rod | wall surface | towel pole | counter | |
| 4 | 1 | | | | | | | | | | 0 | 1 | | | |
| 5 | | | | | 1 | | | | | | | | | | |
| 7 | | | | | | | | | | | | | 1 0 | | |
| 8 | | | | | | | | | | | | | | 1 0* | |
| 9 | | 1 | | | | | | | | | | | | 1 0* | |
| 10 | | | | | | | | | | | | | | 1 | |
| 11 | | | 1 | | | | | | | | | | | 1 | |
| 12 | 1 | | | | | | | | | | 0 | | | | |
| 13 | | | | | | | | | | | 0 | | | | |
| 14 | | | | | | | | 1 | | | | | | | |
| 16 | | | | 1 | | | | | | | | | | 1 0* | |
| 17 | | | | | | | | | | | | | | | |
| 18 | | | | | 1 | | | | | | | | 1 0 0 | | |
| 19 | 1 | | | | 0 | | | | | | | | | | |
| 20 | | | | | | 1 | | | | | | | | | |
| 21 | | | | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | | 1 | | |
| 24 | | | | | | | | | | | | 0 | | | |

* Both hands simultaneously.

1 - Participant used their inside hand.
0 - Participant used their outside hand.

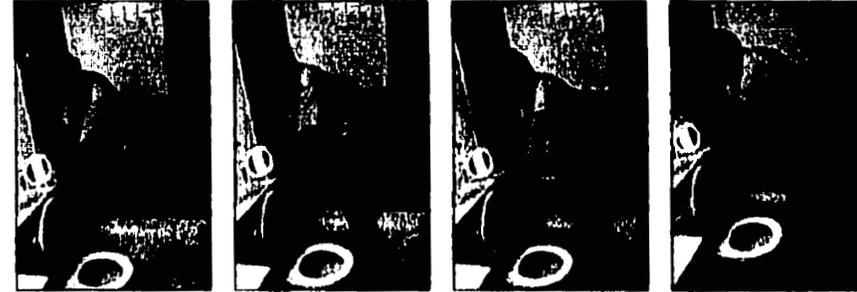
Simulated User Observation Video Stills

Stepping Out of the Tub/Shower - Methods of Support

Nothing is used for support.



1 thing is used for support (outside the tub/shower).
* Both hands simultaneously.



1 thing is used for support (inside the tub/shower).



2 things are used for support (inside the tub/shower).



1 thing is used for support (outside the tub/shower).



2 things are used for support (outside the tub/shower).



Simulated User Observation Video Stills

Stepping Out of the Tub/Shower - Methods of Support

2 things are used for support (inside & outside the tub/shower).



2 things are used for support (inside & outside the tub/shower).
* Both hands simultaneously.



3 things are used for support (inside & outside the tub/shower).



Simulated User Observation Getting Down and Up in the Tub - Methods of Support

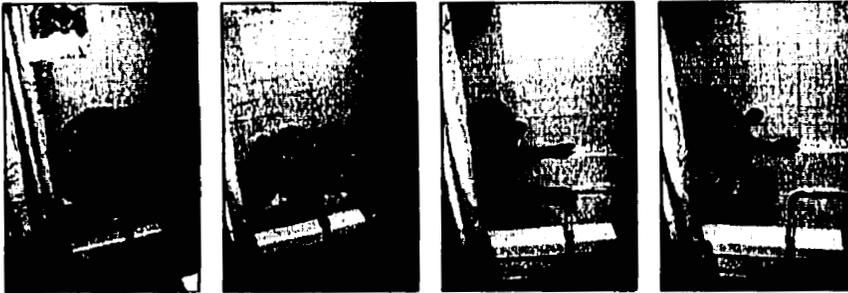
| # | Getting Down | | | | | | Getting Up | | | | | | | |
|----|--------------|-------------|----------------|-------------|------------|------|-------------|----------------|-------------|------------|--|---|----|---|
| | Back Wall | | | Ledges | | | Back Wall | | | Ledges | | | | |
| | bars | soap holder | front ledgebar | front ledge | back ledge | bars | soap holder | front ledgebar | front ledge | back ledge | | | | |
| 4 | | | | | | | | | | | | | | |
| 5 | | | 0 | | 1 | | | | | | | | | |
| 7 | | | | 0 | 1 | | | | 0 | | | | | 1 |
| 8 | | | | | | | | | | | | 0 | | 1 |
| 9 | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | |
| 11 | | | | | 0 | 1 | | | | | | 1 | 0* | |
| 12 | | | | | | | | | | | | | | |
| 13 | | | | | 0 | 1 | | | | | | | | |
| 14 | 1 | | | | 0 | | | | | | | | 0 | 1 |
| 16 | | 1 | | | 0 | | | | | | | | | |
| 17 | | | | | 0 | | | | | | | | | |
| 18 | | | | | | | | | | | | | 0 | 1 |
| 19 | 1 | | 0 | | | | | | | | | | 0 | |
| 20 | | | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | | | |

* Both hands simultaneously.

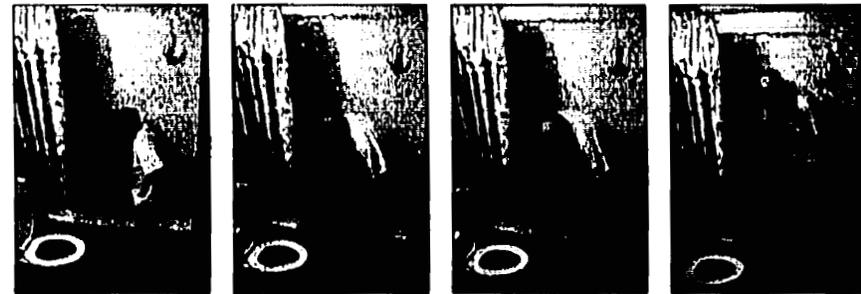
- 1 - Participant used their inside hand.
- 0 - Participant used their outside hand.

Simulated User Observation Video Stills
Getting Down and Up in the Tub - Methods of Support

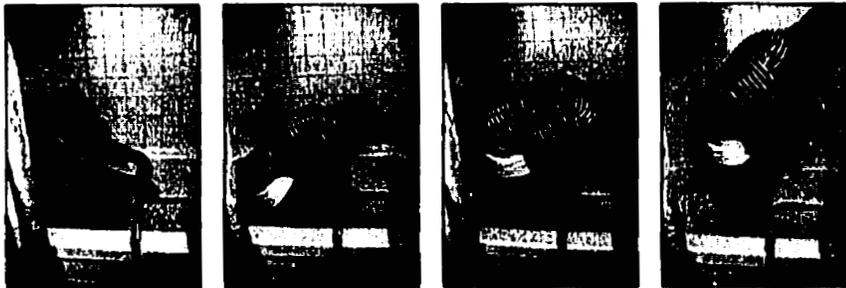
Support on the front ledge bar & back ledge (getting down).



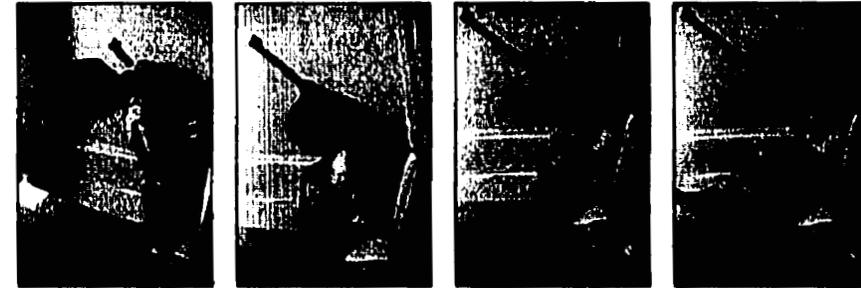
Support on the front & back ledges (getting up).



Support on the front ledge bar & back ledge (getting up).



Support on the front ledge & back wall bar (getting down).



Support on the front & back ledges (getting down).



Roll on the bottom of tub, support on the front ledge & back wall bar (getting up).



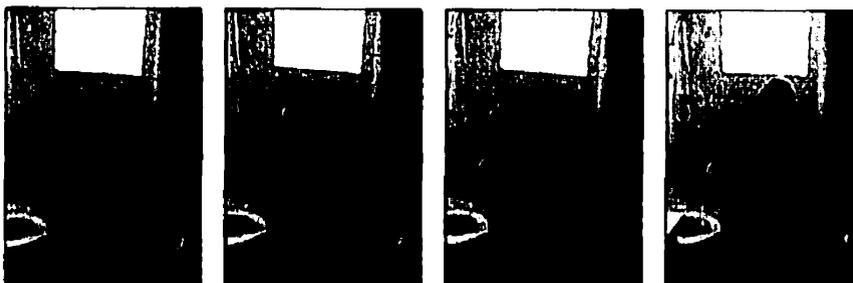
Simulated User Observation Video Stills

Getting Down and Up in the Tub - Methods of Support

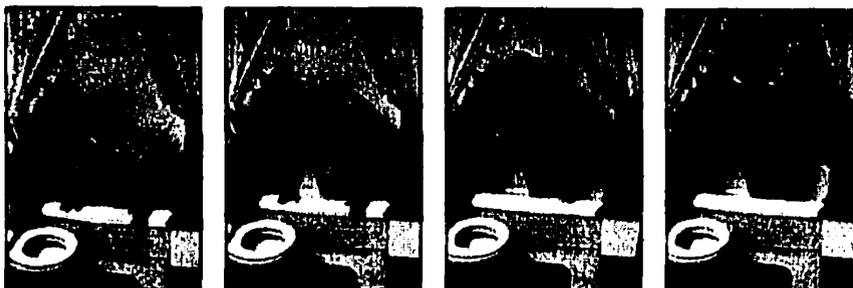
Support on the front ledge bar & back wall bar, roll on the bottom of tub (getting down).



Roll on the bottom of tub, support on the front ledge bar and back wall bar (getting up).

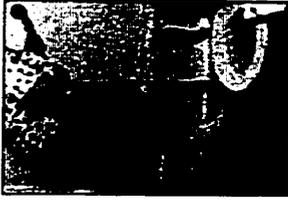


Support on the front ledge with both hands (getting up).



**Simulated User Observation Video Stills
Observed Difficulties / Dangers**

Difficulty stepping over front ledge of tub/shower.



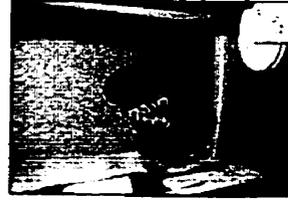
Potential danger - participant leans on soap holder.



Reduced balance while avoiding the shower curtain stepping out.



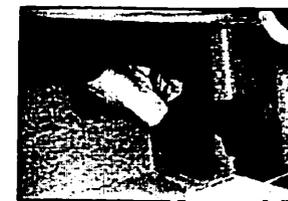
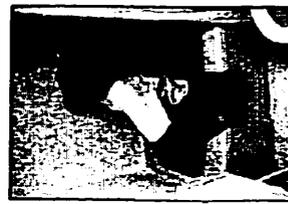
Potential danger - participant lets go with hands while getting up from the tub.



Difficulty removing the showerhead from the wall mounted holder.



Nearly an accident - a facecloth used to improve traction slips while participant demonstrates getting up from the tub.



Questionnaire
Care-Providers of Dependent Bathers

Background

1. How many clients are you currently assisting with bathing?

2. What are the ages of your clients who receive bathing assistance?

3. How many of your clients are male? _____ female? _____

4. Do your clients have any medical conditions which affect them while they bathe? Please describe:

5. What type of bathing assistance do your clients require?

Bathing Environment

1. Where do you assist your clients with bathing? (e.g. in their personal bathroom, in a bathing area shared by more than one client, etc.)

2. Please circle the type of bathing structure present in this area:

shower cubicle

bathtub

shower/bathtub

2a. Please draw in the space below roughly what the structure looks like:

3. Which of the following are present in the environment in which you assist your client:

- | | |
|--|--|
| <input type="checkbox"/> stationary shower head | <input type="checkbox"/> bath lift |
| <input type="checkbox"/> hand-held shower head | <input type="checkbox"/> shower curtain |
| <input type="checkbox"/> grab bars (how many? _____) | <input type="checkbox"/> sliding shower doors |
| <input type="checkbox"/> removable bath seat/bench | <input type="checkbox"/> pivoting shower doors |
| <input type="checkbox"/> built-in bath seat/bench | <input type="checkbox"/> non-slip floor mat |
| <input type="checkbox"/> other (please describe) _____ | |

3a. Please describe how the above products are used by your clients?

3b. Please describe how you use them while you assist your clients?

4. Please describe how your clients get in and out of the tub/shower (i.e. client sits on edge and pivots legs, steps into while holding your hand and bar, etc.)

5. Do your clients sit or stand during the bathing process? sit _____ stand _____
please describe the process:

6. Have your clients ever injured or nearly injured themselves while bathing?
yes _____ no _____ If yes, what type of injury or what nearly happened?

7. Which part of your clients' bathing environment causes the least problems
for you or your clients during the bathing process?

8. Which part of your clients' bathing environment causes the most problems
for you or your clients during the bathing process?

9. Overall, how would you describe your clients' bathing environment for you
and your clients in terms of safety, accessibility, ease of use, etc.

10. If you could think of anything which could help you or your clients during
the bathing process, what would it be?

Key Expert Interview Questions

Care Provider/Nurse

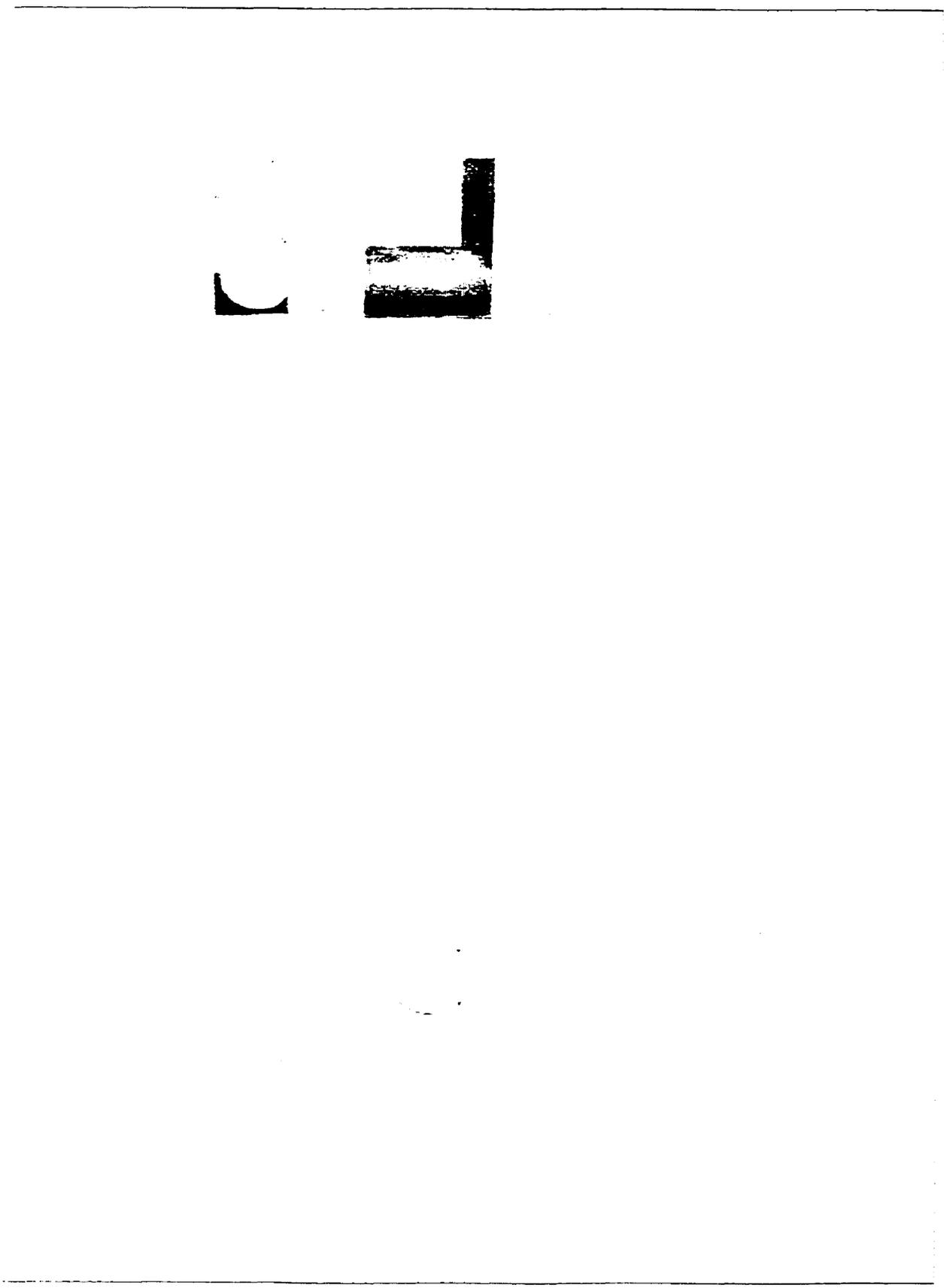
1. Please tell me a little bit about what you do? (Do you work directly with elderly bathers, have you in the past, etc.)
2. How many years have you been working in this field?
3. Do you find that your clients respond positively towards bathing?
(if no) why
4. Do you find that your clients fear bathing?
(if yes) describe why
5. What type of bathing have you found most older adults to prefer?
6. What type of bathing do most older adults engage in? (tub bath, shower, sponge)
7. What type of bathing is best for older adults? (physiologically, psychologically, in terms of cleansing, in terms of time, etc.)
8. Are there any particular tasks you find are more demanding for older adults as they bathe (physiologically, psychologically, etc.)
9. How could the demands of any of these tasks be reduced?
10. What is the range of capabilities of some of your clients?
11. What types of medical conditions typically prevent older adults from bathing independently (dizziness, arthritis, etc.) list as many as possible
12. Why do these people generally require *personal* assistance? (\$ can't afford lift devices, etc. on the market, aren't aware of assistive devices on the market, devices on the market don't meet their needs, feel more comfortable having personal assistance, etc.)
13. What are some typical problems you have encountered while bathing dependent older adults?
14. Does gender seem to affect any of what we've been discussing?
15. How many older adults have you known of that have been injured while bathing?

16. What types of injuries have occurred?

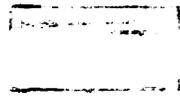
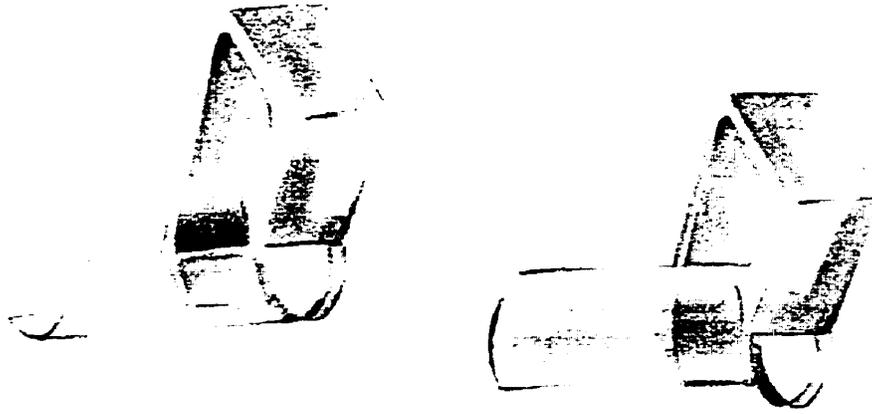
17. What types of injuries have been the most serious? (short term and long term effects)

18. Why are these injuries so serious?

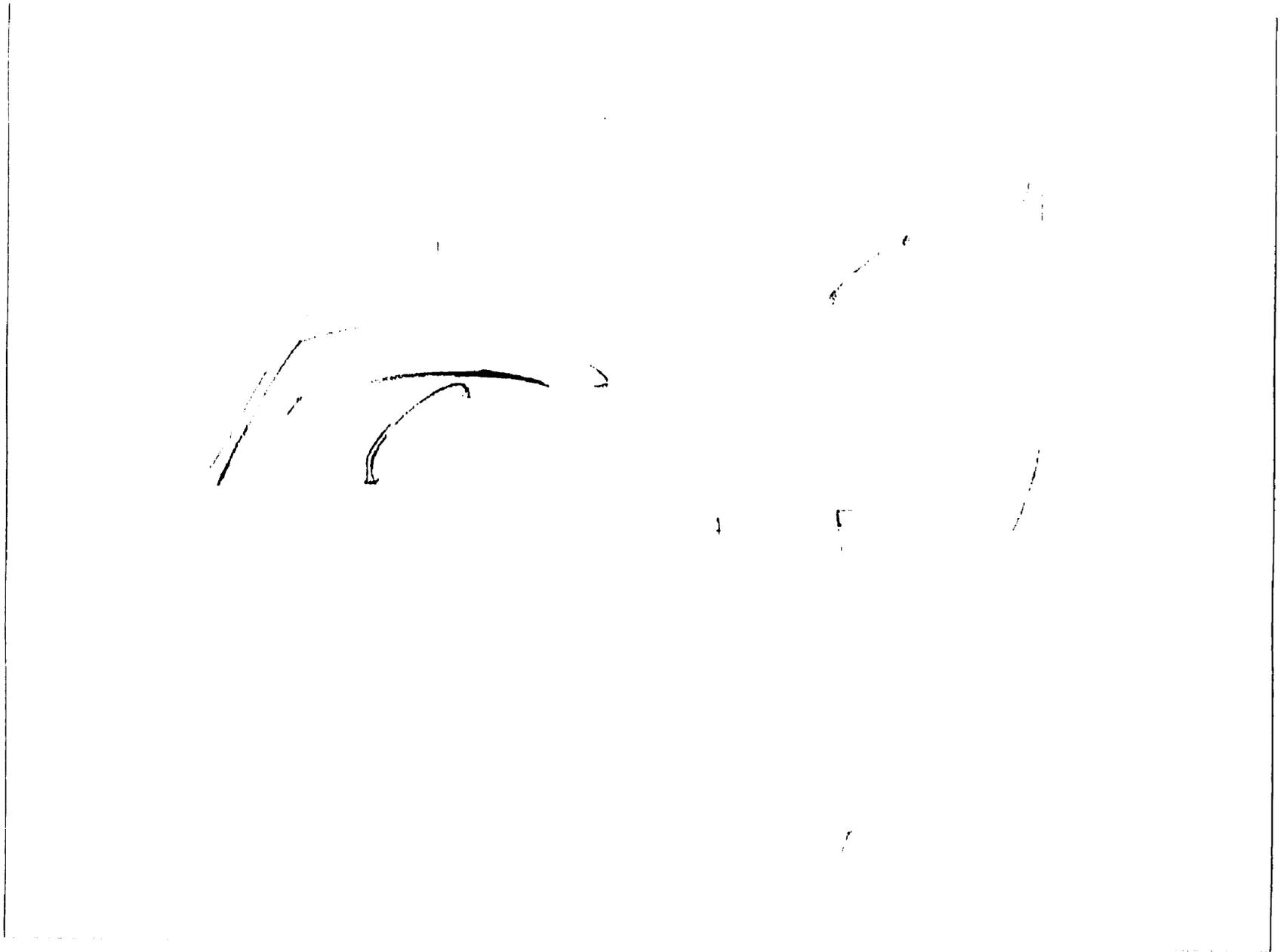
Conceptual Design
Phase 1: Preliminary Concepts
Removable Front Ledge



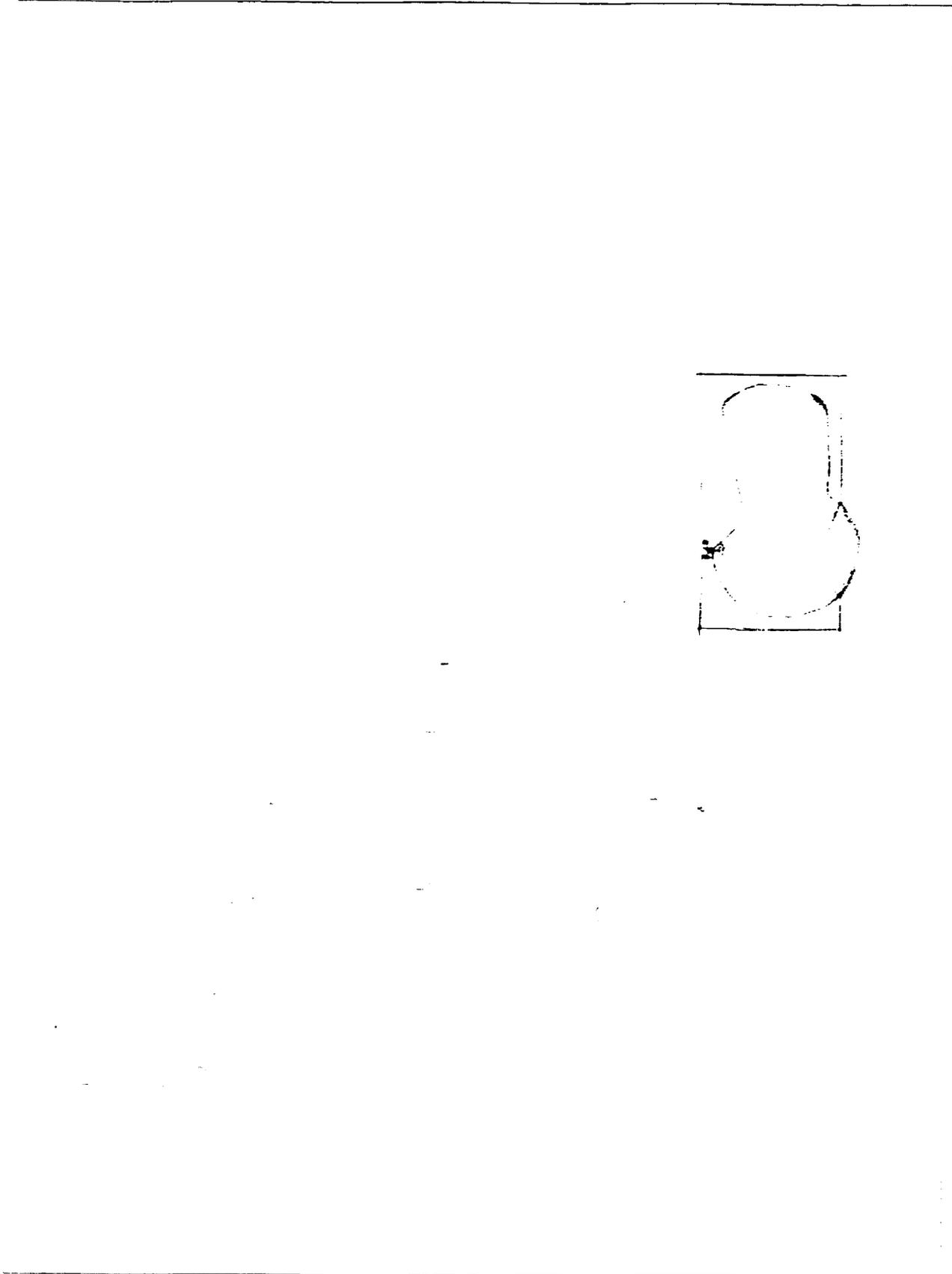
**Conceptual Design
Phase 1: Preliminary Concepts
Removable Front Ledge**



Conceptual Design
Phase 2: Floor-Recessed Concepts
Initial Ideas



Conceptual Design
Phase 2: Floor-Recessed Concepts
User Steps Down to Tub Bathe & Shower



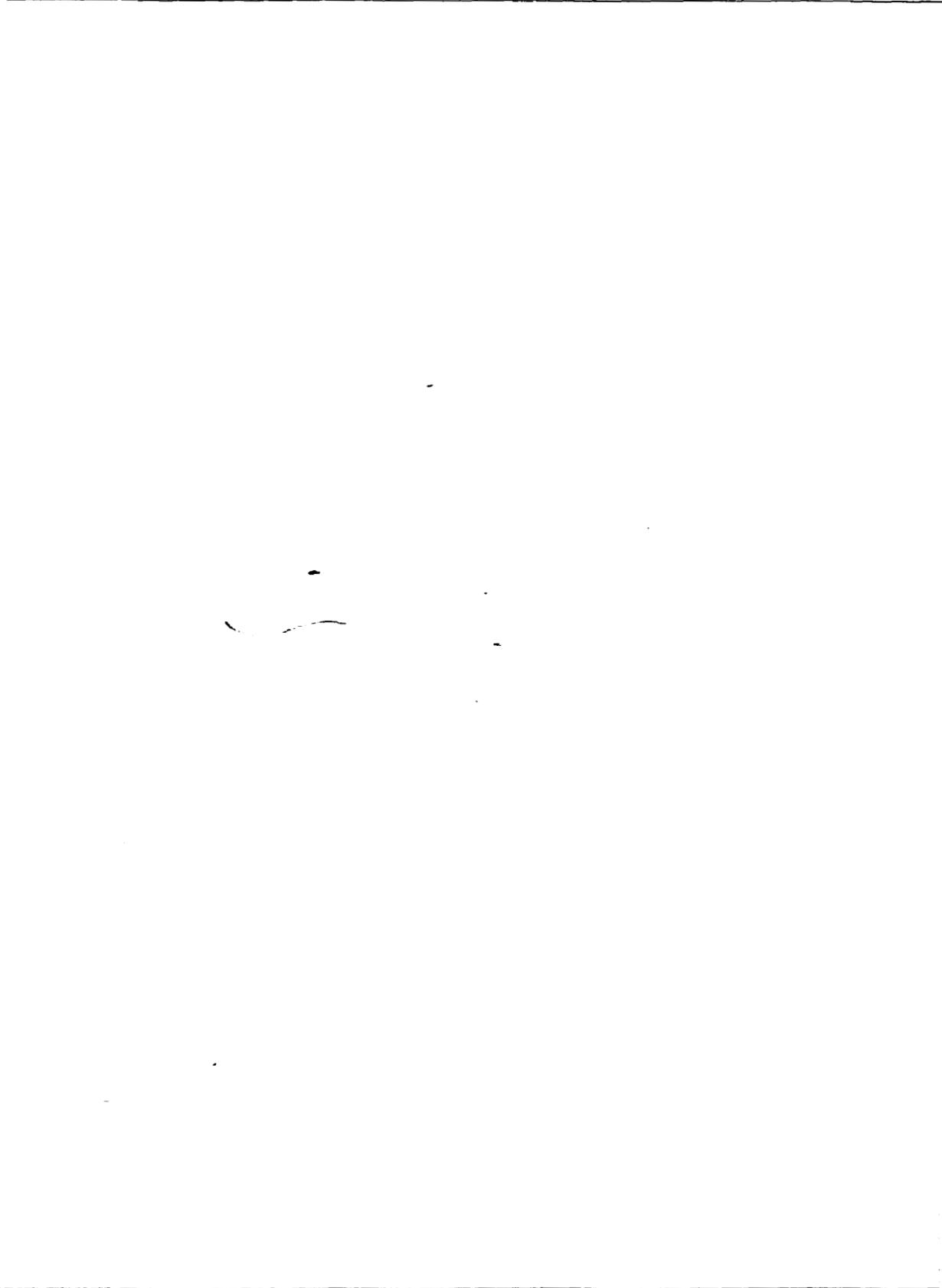
Conceptual Design
Phase 2: Floor-Recessed Concepts
User Steps Down to Tub Bathe & Shower



Conceptual Design
Phase 3: Floor-Recessed & Flush-Floor Concepts
User Steps Down to Tub Bathe, Floor Level Walk-In Shower



Conceptual Design
Phase 3: Floor-Recessed & Flush-Floor Concepts
User Steps Down to Tub Bathe, Floor Level Walk-In Shower



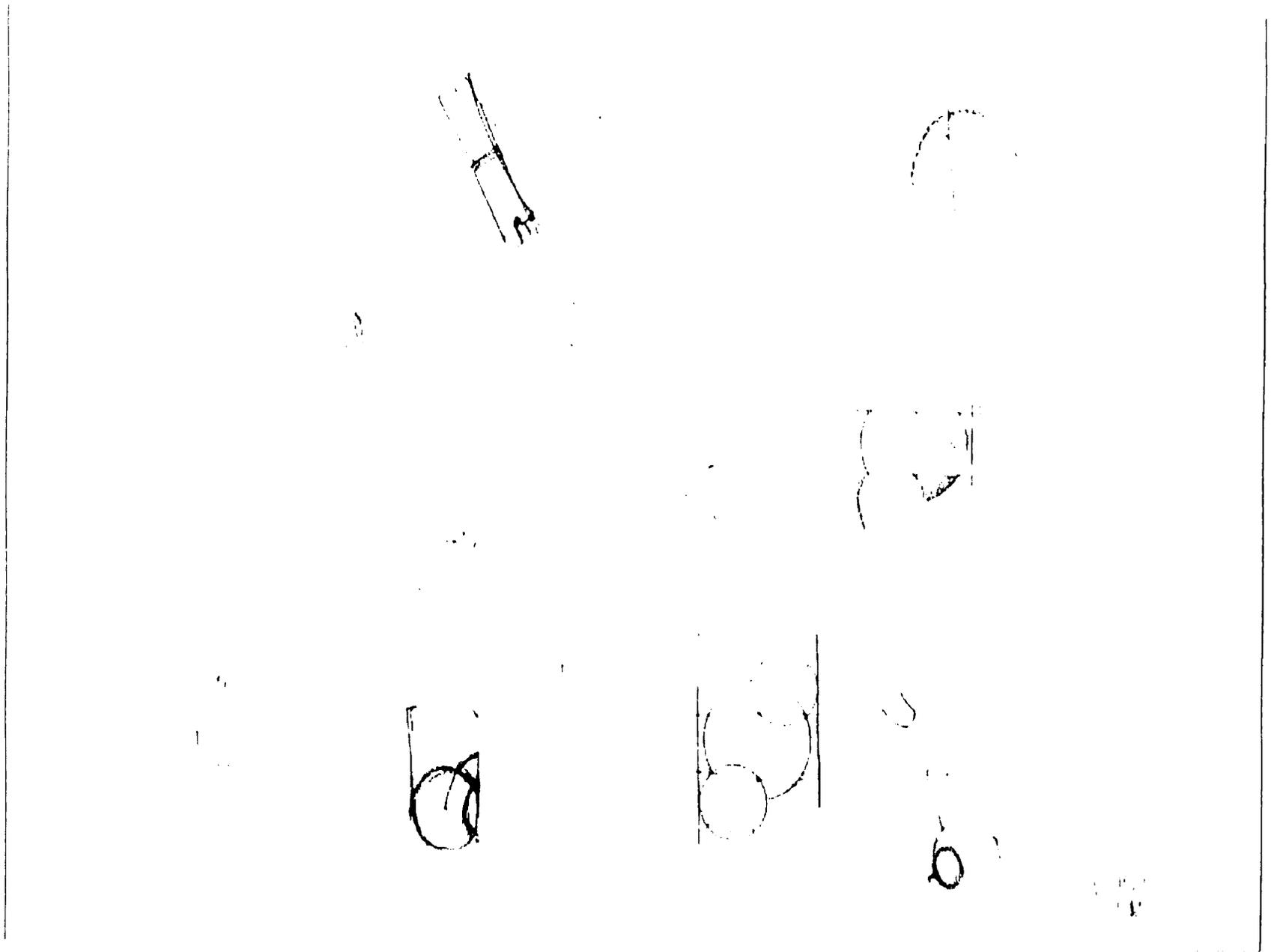
Conceptual Design
Phase 3: Floor-Recessed & Flush-Floor Concepts
User Steps Down to Tub Bathe, Floor Level Walk-In Shower



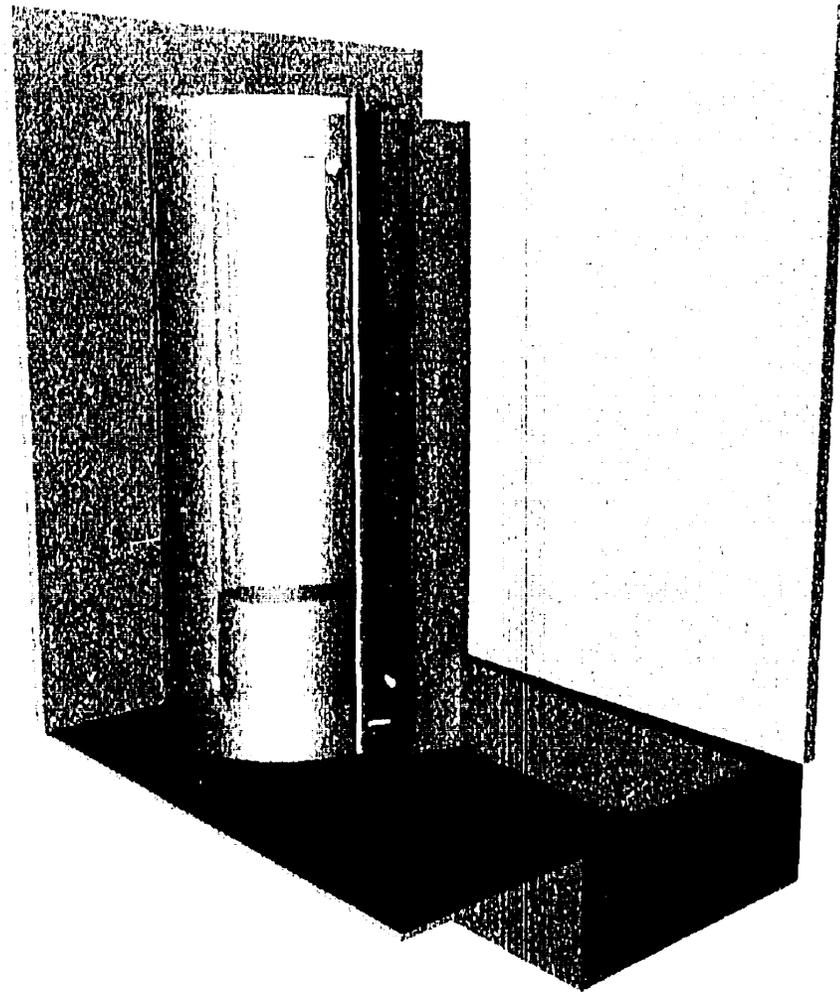
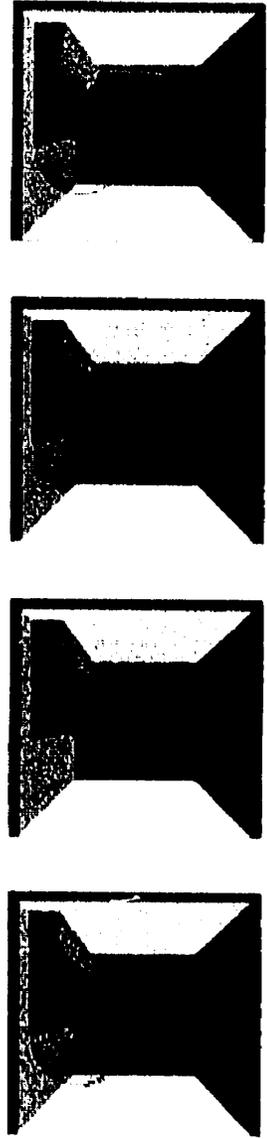
Conceptual Design

Phase 3: Floor-Recessed & Flush-Floor Concepts

User Steps Down to Tub Bathe, Floor Level Walk-In Shower



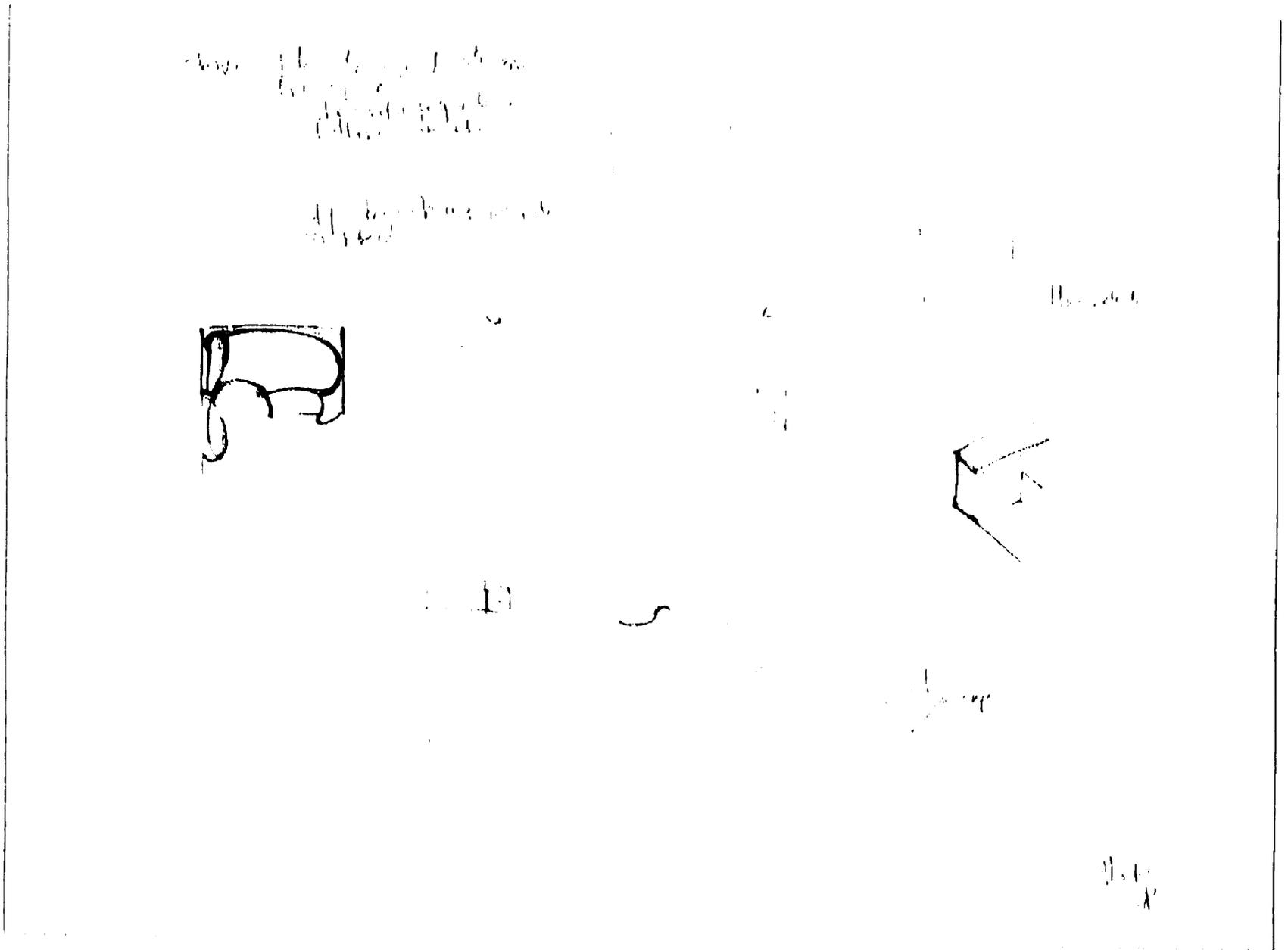
Conceptual Design
Phase 3: Floor-Recessed & Flush-Floor Concepts
User Steps Down to Tub Bathe, Floor Level Walk-In Shower



Conceptual Design

Phase 4: Floor-Recessed Concepts with Removable Platform

Initial Ideas & Brainstorming



Conceptual Design
Phase 4: Floor-Recessed Concepts with Removable Platform
Initial Ideas & Brainstorming



Conceptual Design

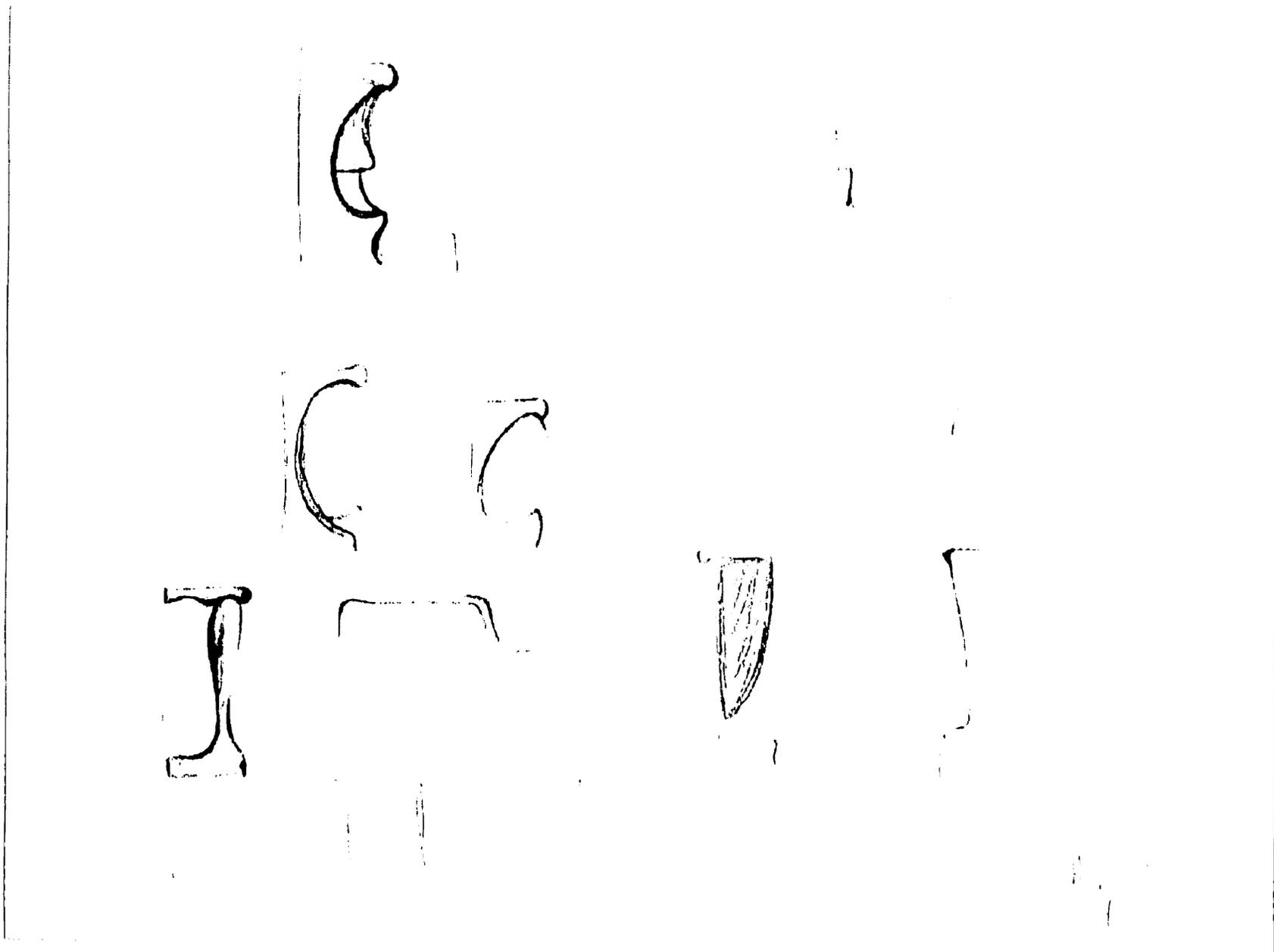
Phase 4: Floor-Recessed Concepts with Removable Platform
User Steps Down to Tub Bathe, Removable Floor-Level Walk-In Shower



Conceptual Design

Phase 4: Floor-Recessed Concepts with Removable Platform

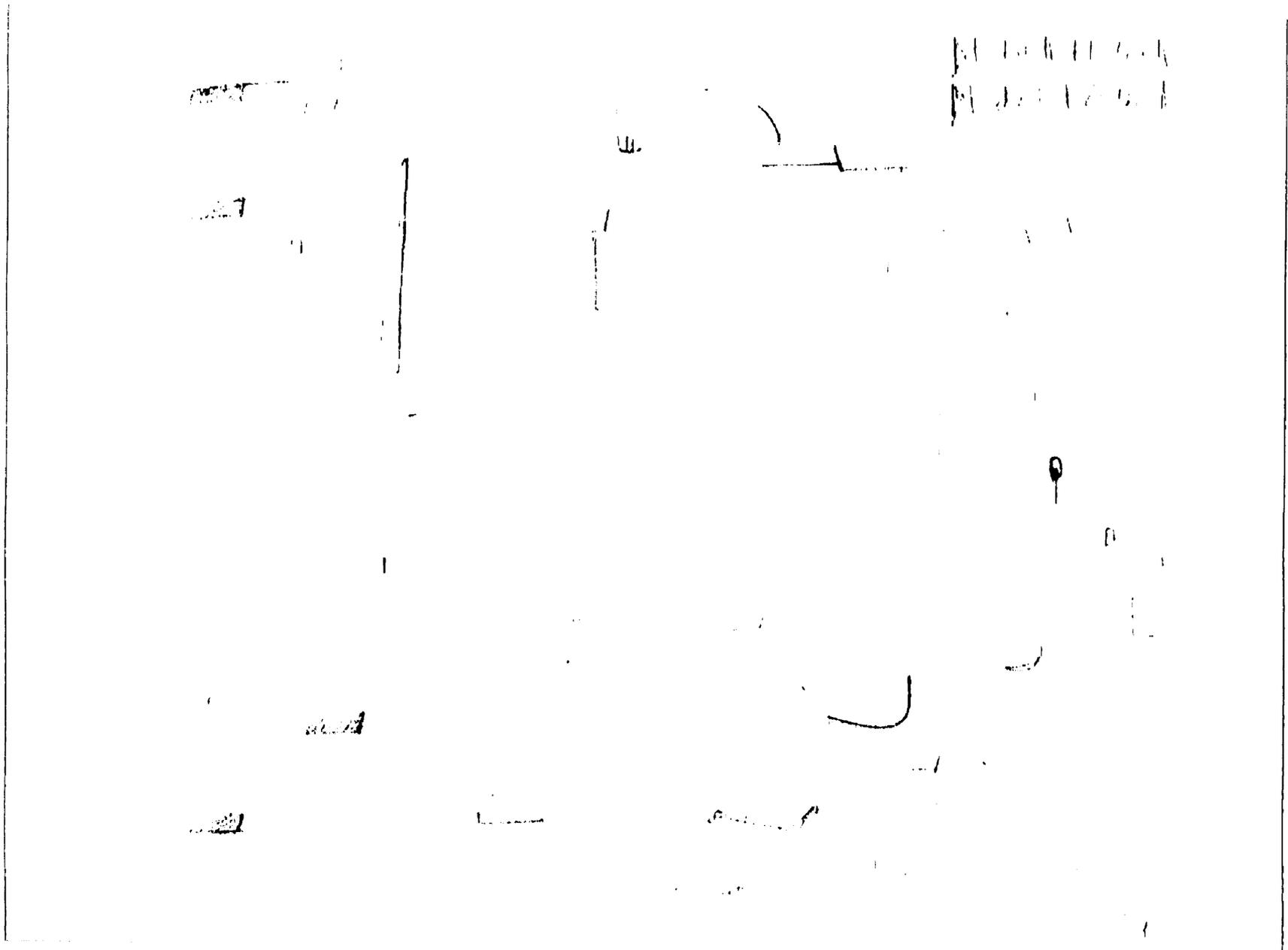
User Steps Down to Tub Bathe, Removable Floor-Level Walk-In Shower



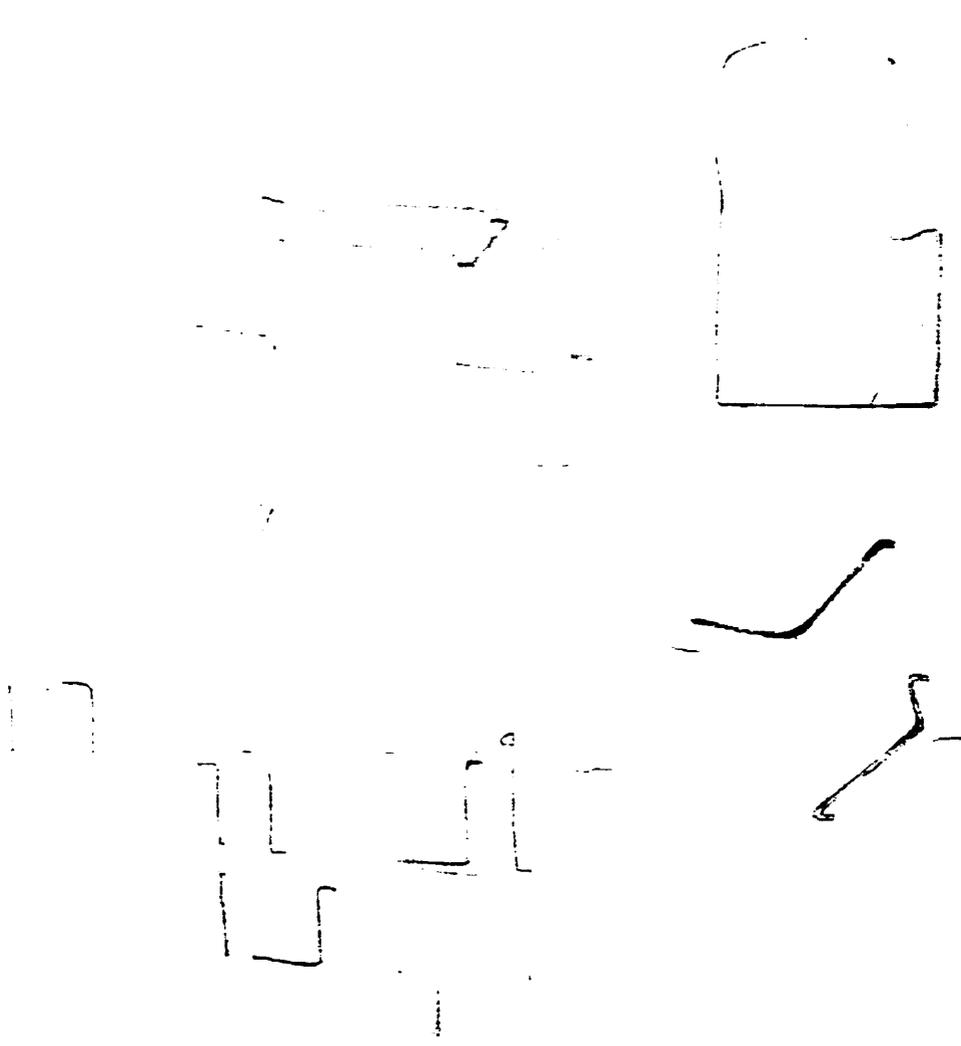
Conceptual Design

Phase 4: Floor-Recessed Concepts with Removable Platform

User Steps Down to Tub Bathe, Removable Floor Level Walk-In Shower



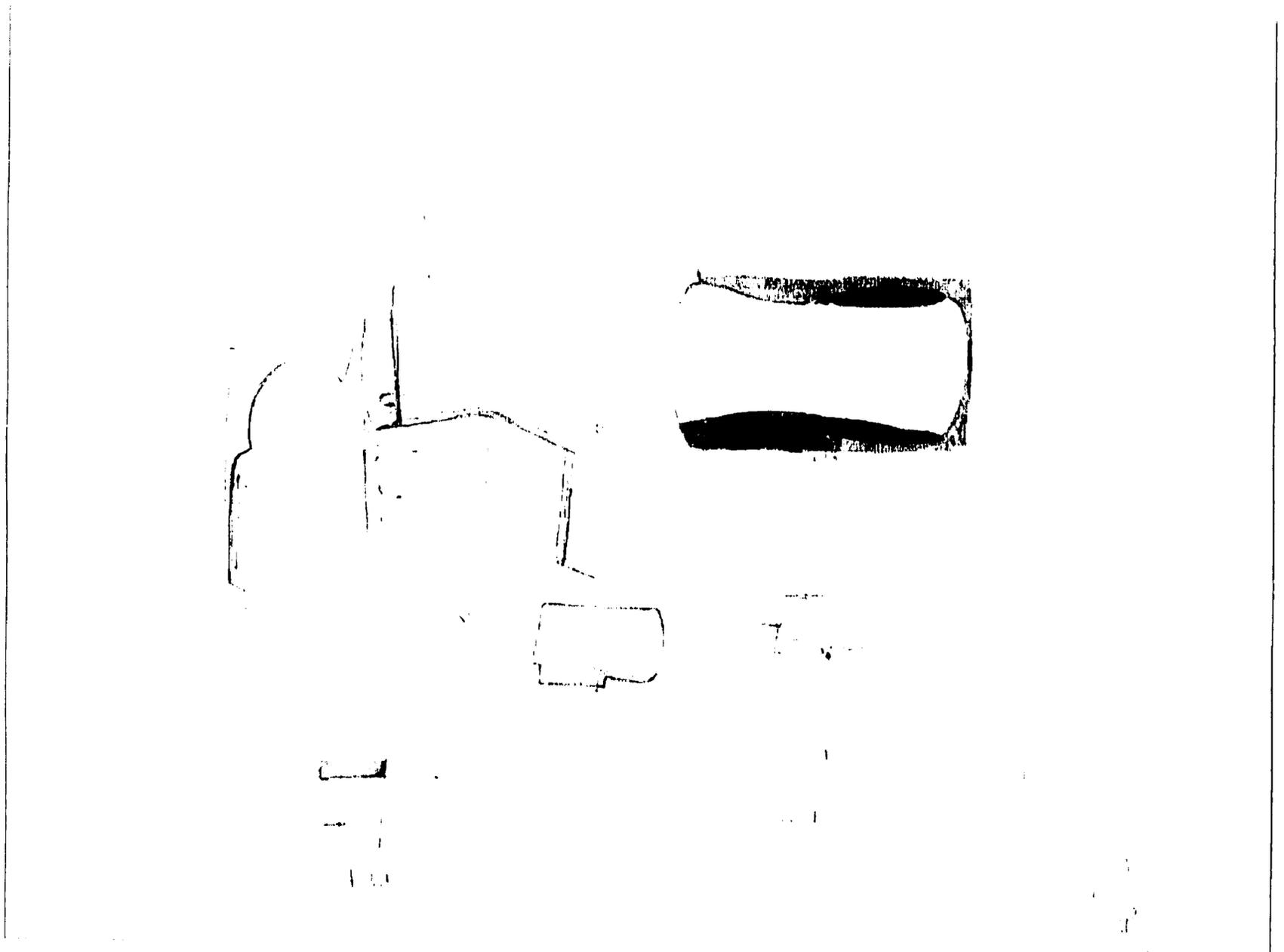
Conceptual Design
Phase 4: Floor-Recessed Concepts with Removable Platform
User Steps Down to Tub Bathe, Removable Floor Level Walk-In Shower



Conceptual Design

Phase 4: Floor-Recessed Concepts with Removable Platform

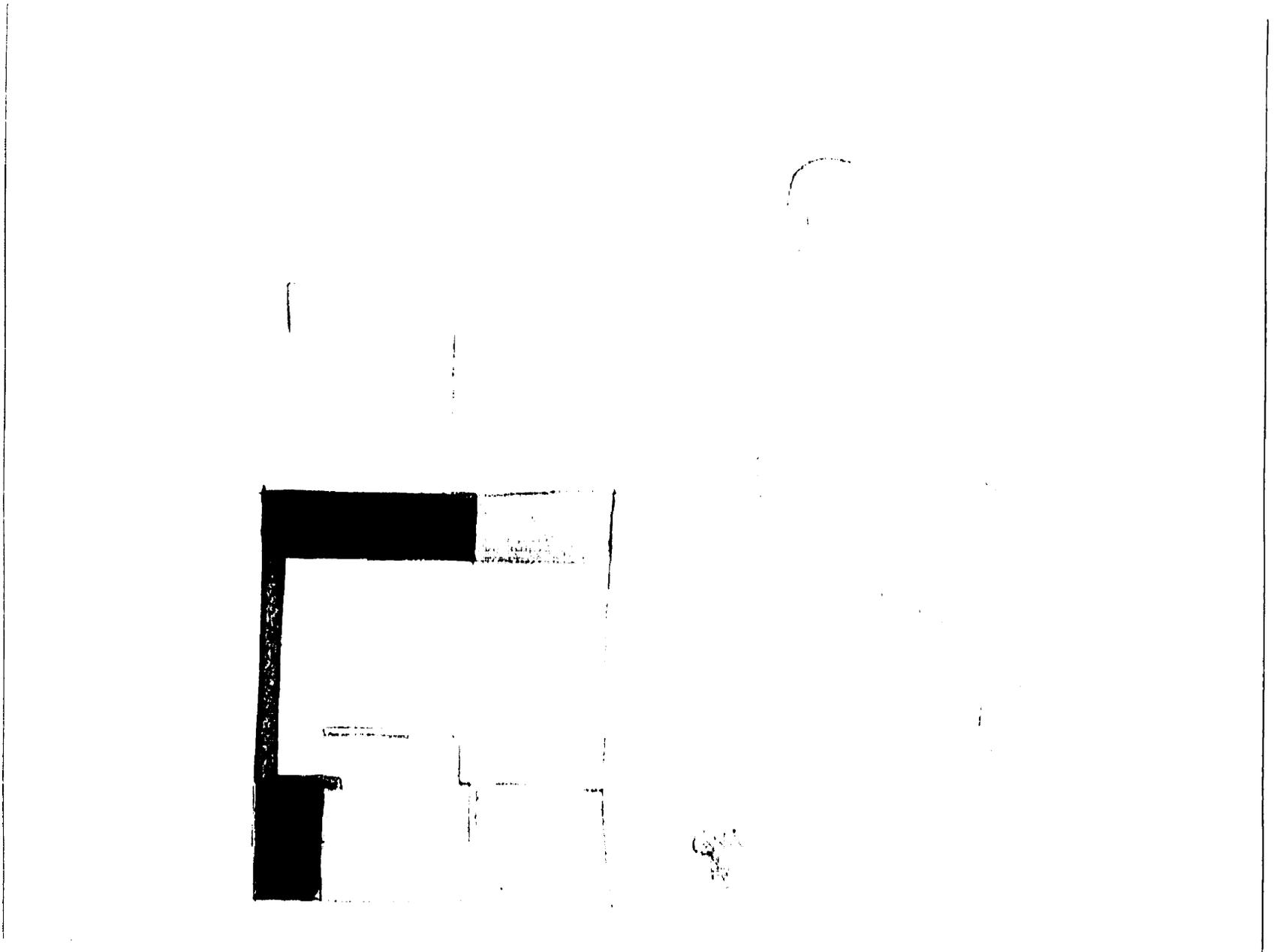
User Steps Down to Tub Bathe, Removable Floor Level Walk-In Shower



Conceptual Design

Phase 4: Floor-Recessed Concepts with Removable Platform

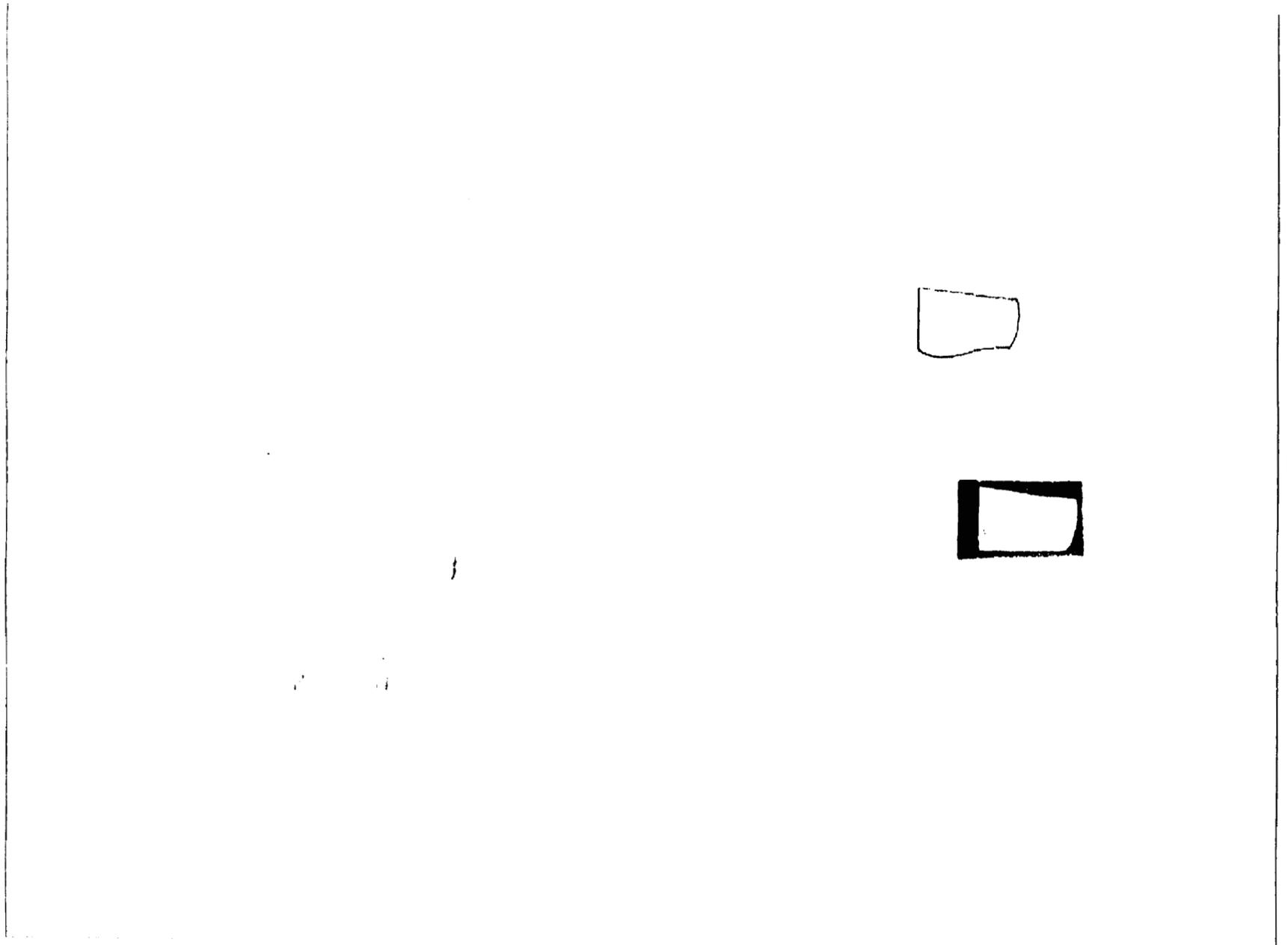
User Steps Down to Tub Bathe, Removable Floor Level Walk-In Shower



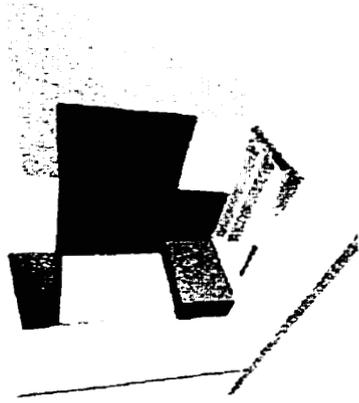
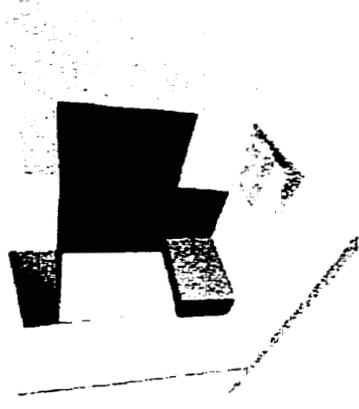
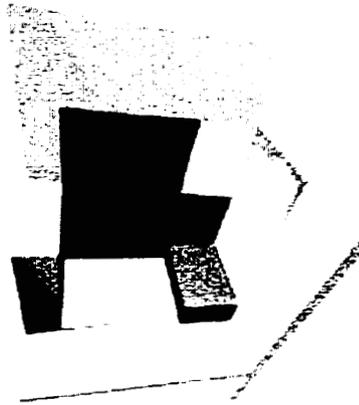
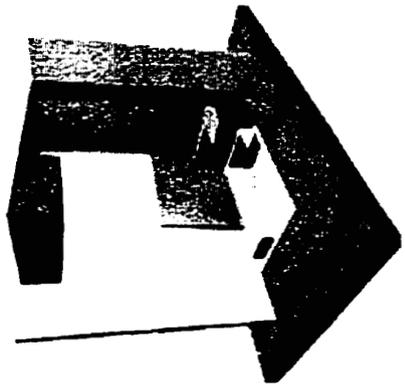
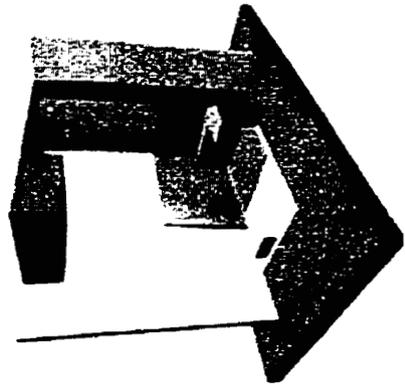
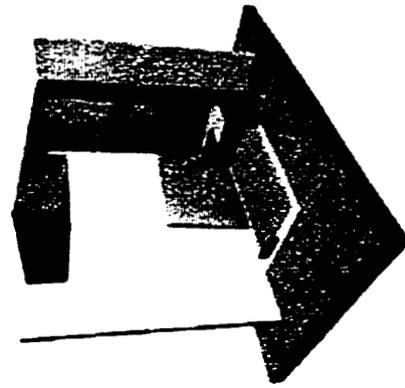
Conceptual Design

Phase 4: Floor-Recessed Concepts with Removable Platform

User Steps Down to Tub Bathe, Removable Floor Level Walk-In Shower

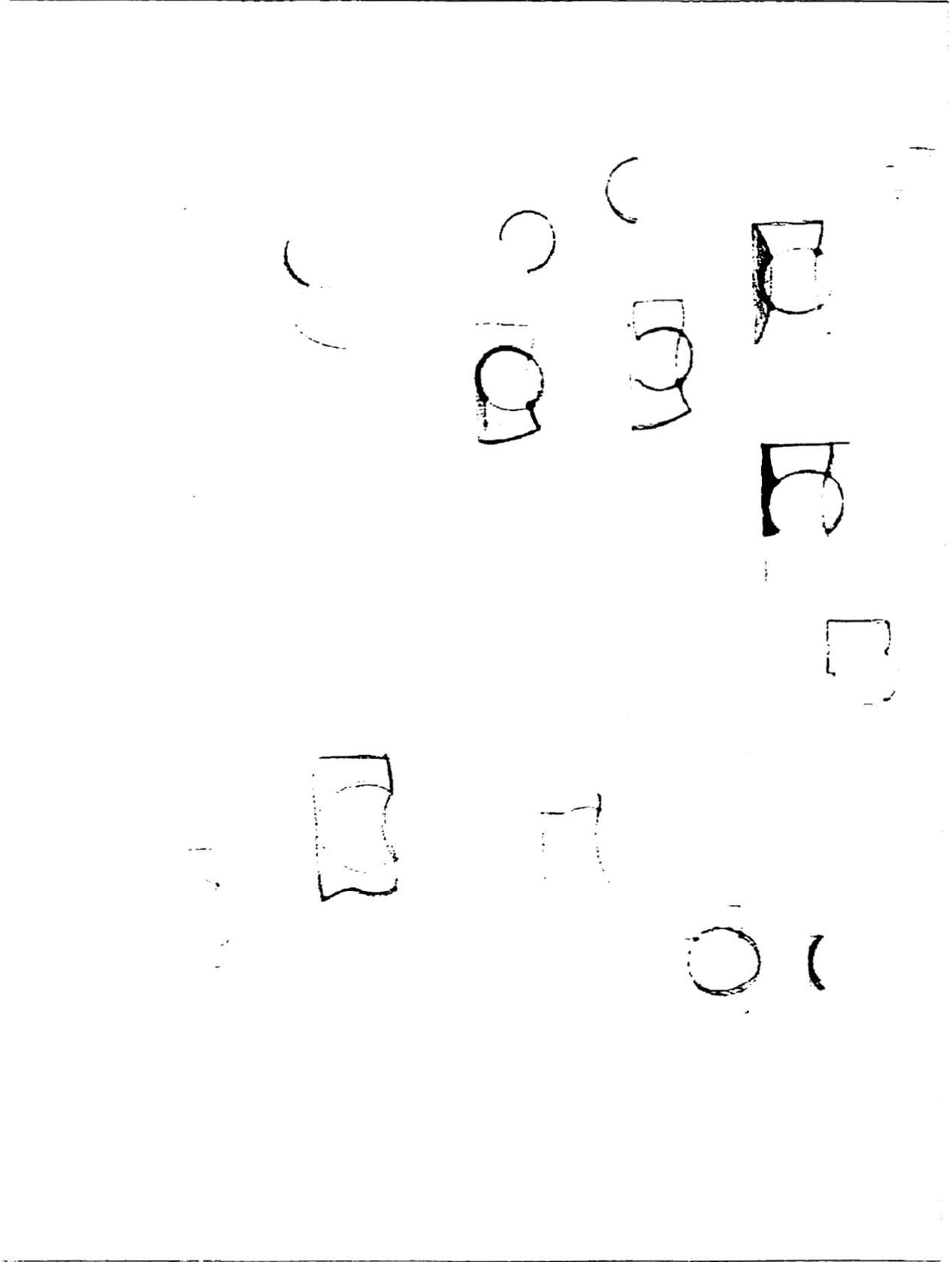


Conceptual Design
Phase 4: Floor-Recessed Concepts with Removable Platform
User Steps Down to Tub Bathe, Removable Floor Level Walk-In Shower



Design Refinement

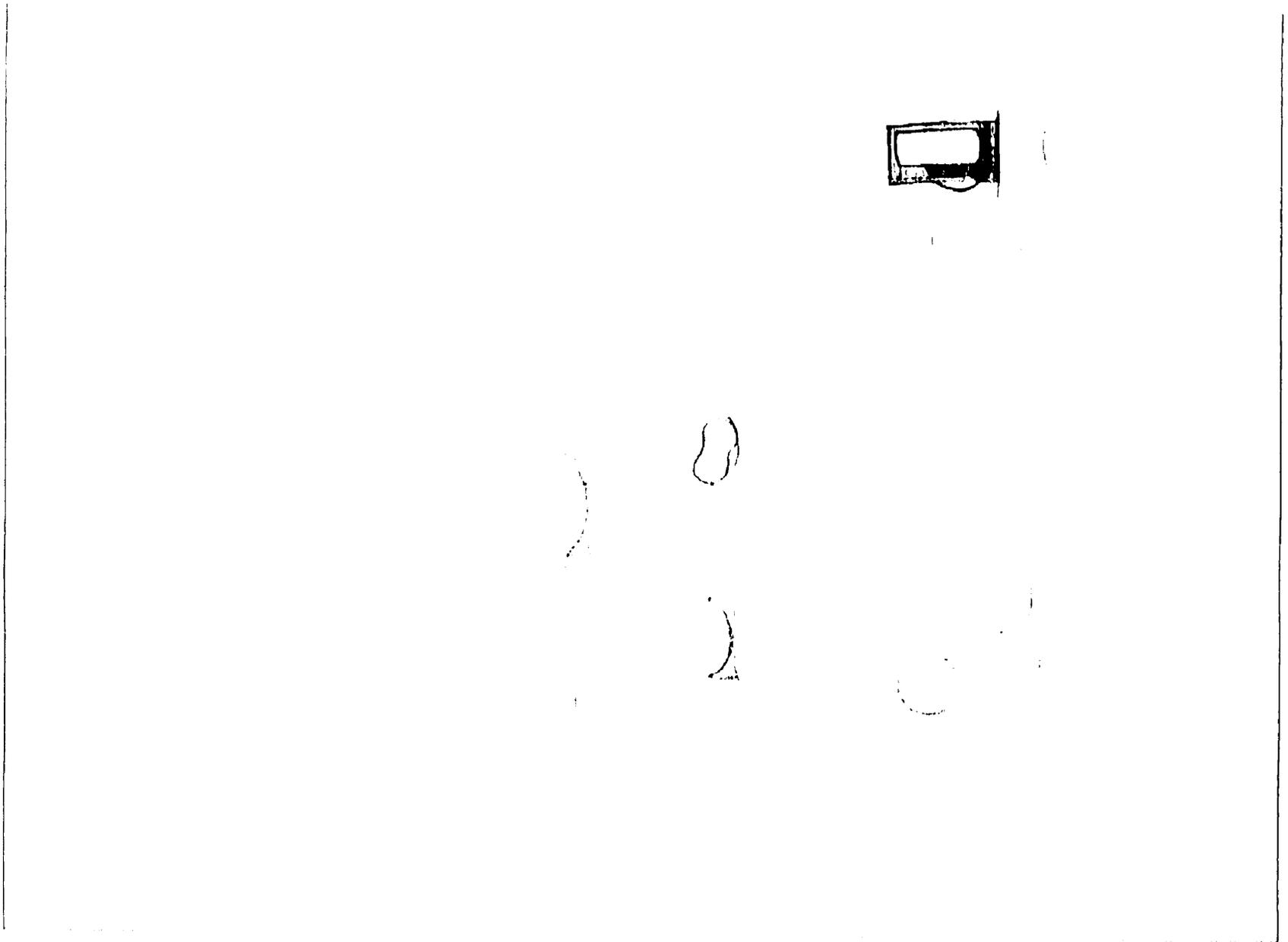
**Combination of Elements from Conceptual Design Phases 3 & 4
Initial Ideas & Brainstorming**



Design Refinement

Floor-Recessed Concept with Removable Platform

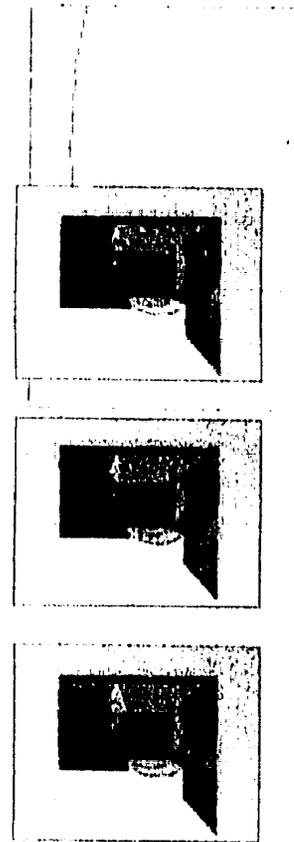
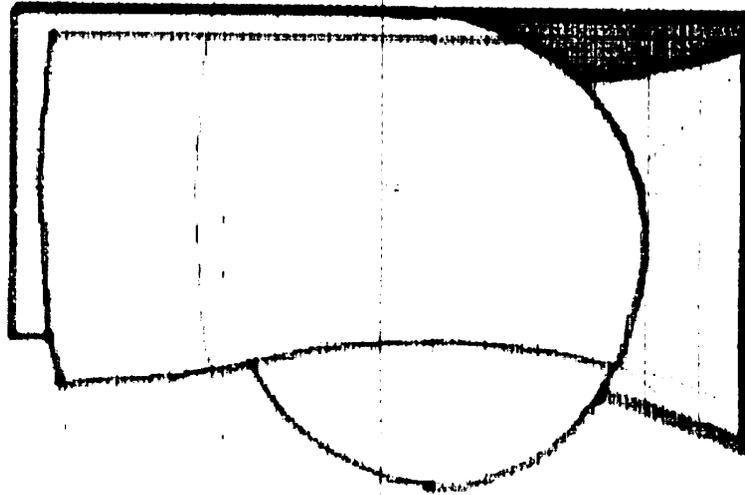
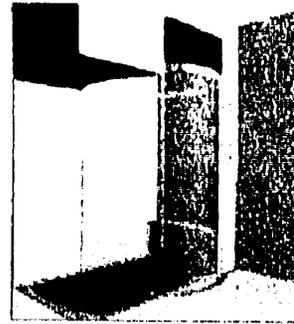
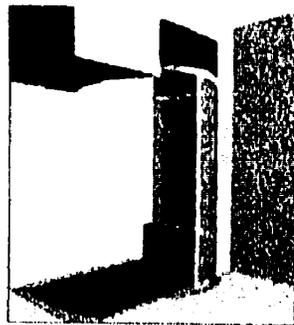
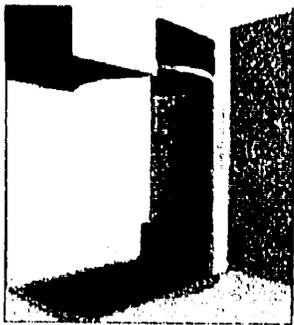
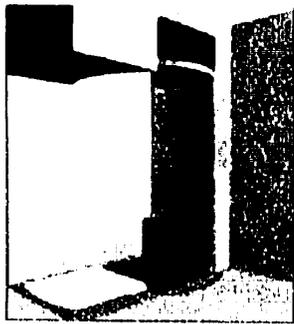
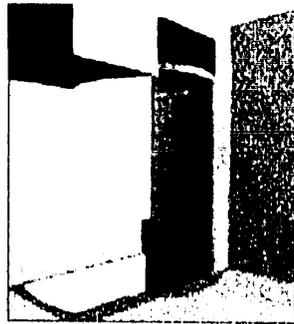
User Steps Down to Tub Bathe, Removable Floor Level Walk-In Shower



Design Refinement

Floor-Recessed Concept with Removable Platform

User Steps Down to Tub Bathe, Removable Floor Level Walk-In Shower



* Drawings used to acquire user feedback in section 5.4.

Design Refinement

Floor-Recessed Concept with Removable Platform

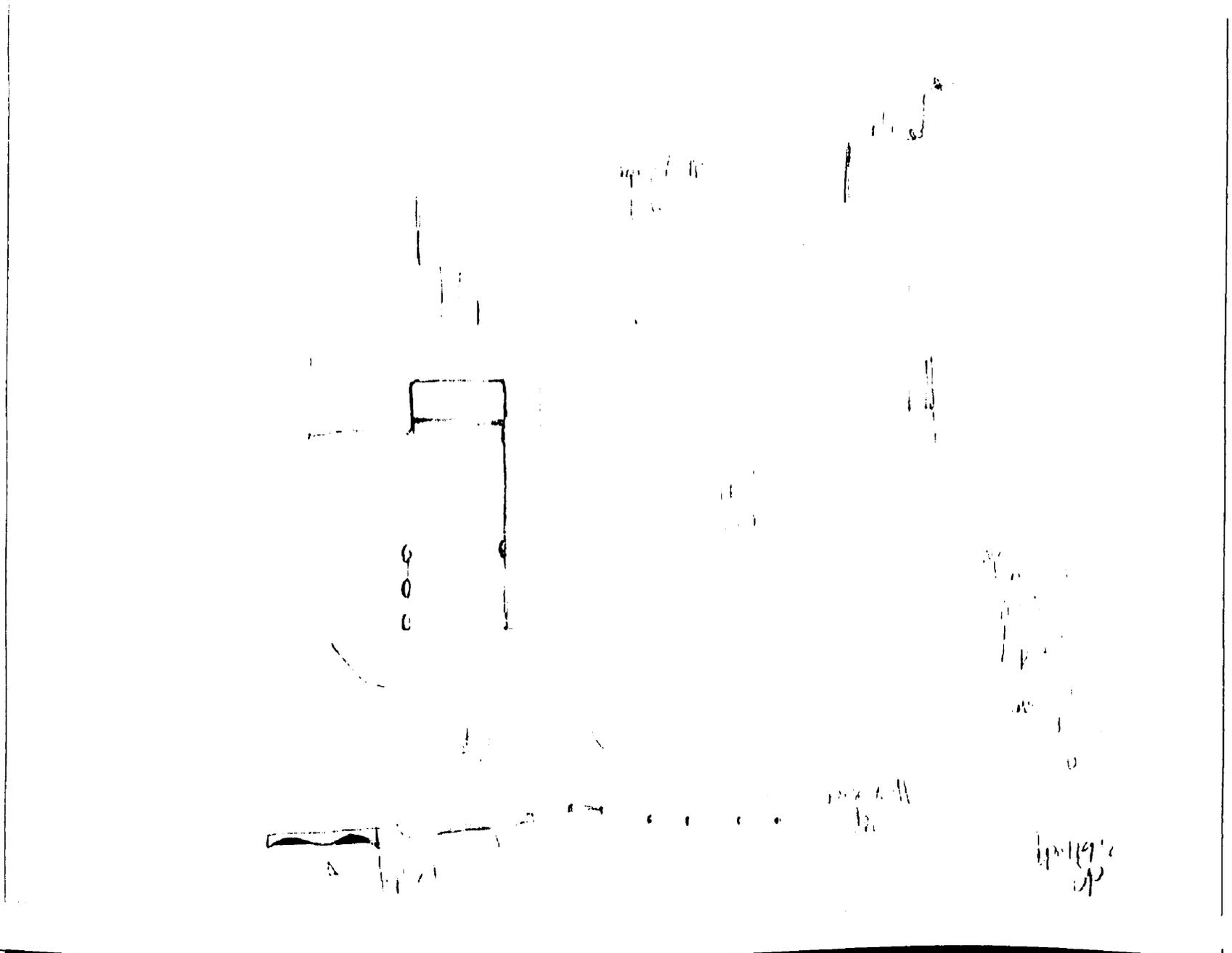
User Steps Down to Tub Bathe, Removable Floor Level Walk-In Shower



Design Refinement

Floor-Recessed Concept with Removable Platform

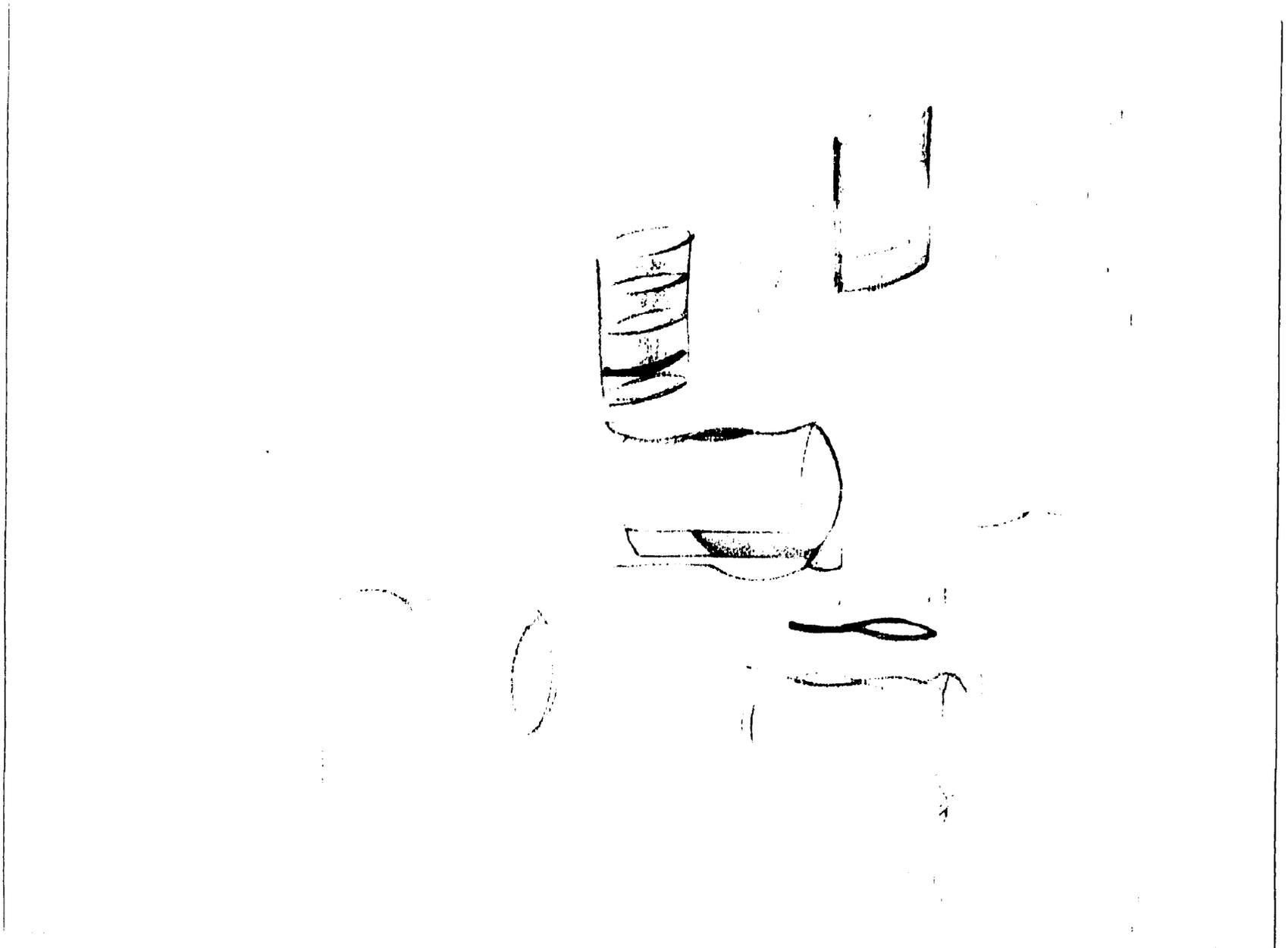
User Steps Down to Tub Bathe, Removable Floor Level Walk-In Shower



Design Refinement

Floor-Recessed Concept with Removable Platform

User Steps Down to Tub Bathe, Removable Floor Level Walk-in Shower



Design Refinement

Floor-Recessed Concept with Removable Platform

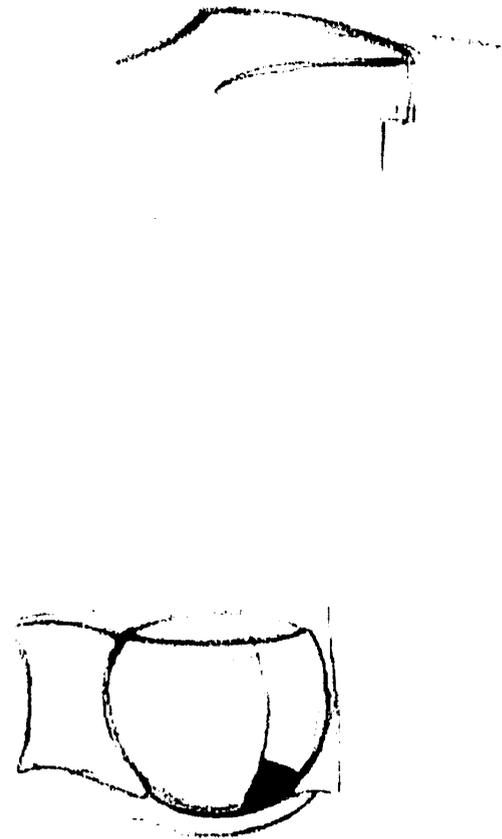
User Steps Down to Tub Bathe, Removable Floor Level Walk-In Shower



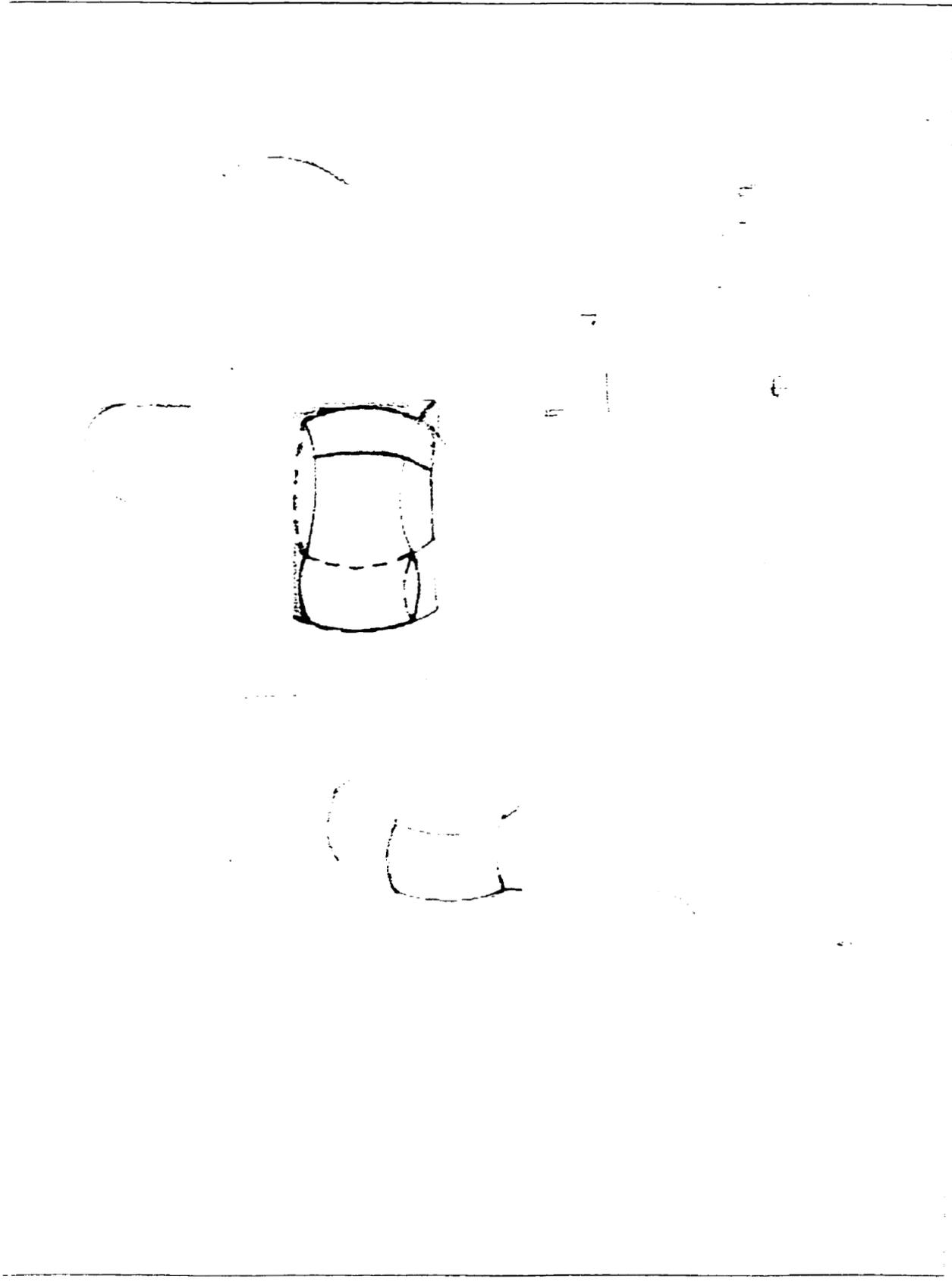
Design Refinement

Floor-Recessed Concept with Removable Platform

User Steps Down to Tub Bathe, Removable Floor Level Walk-In Shower



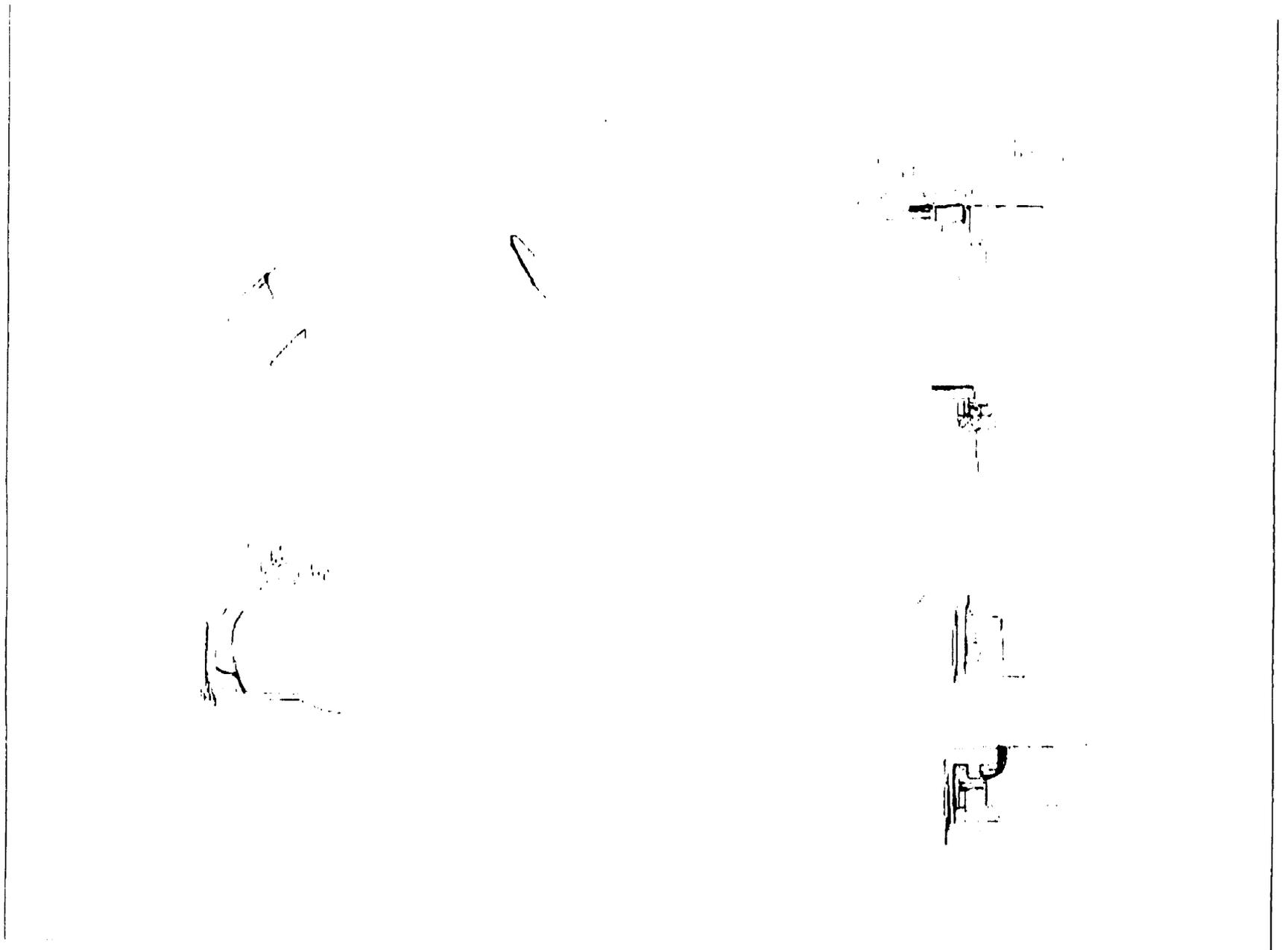
Design Refinement
Floor-Recessed Concept with Removable Platform
User Steps Down to Tub Bathe, Removable Floor Level Walk-In Shower

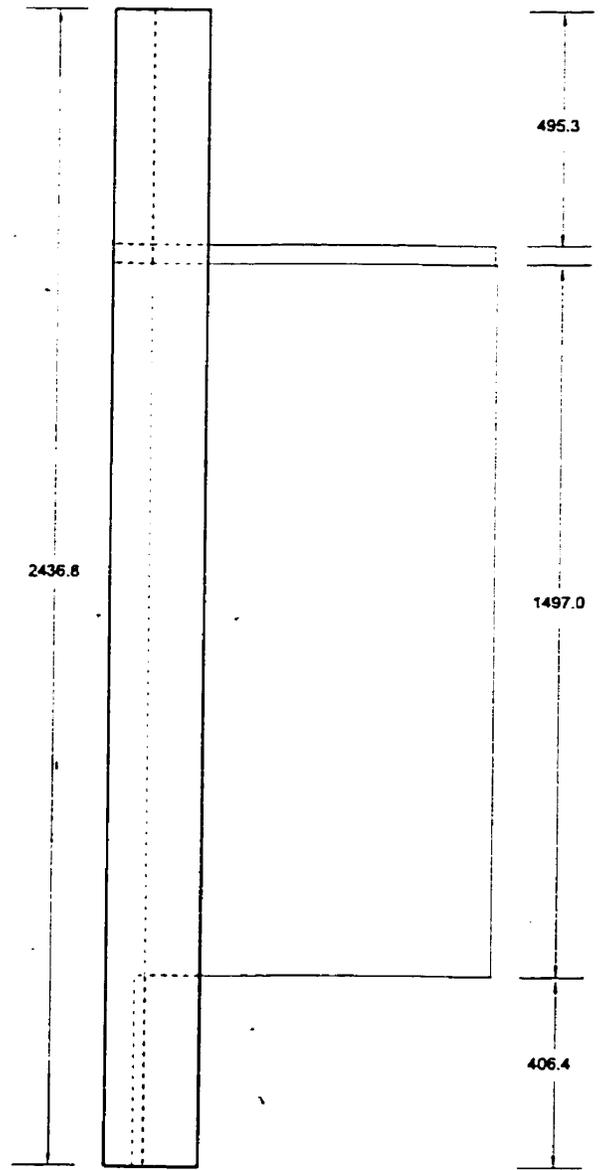
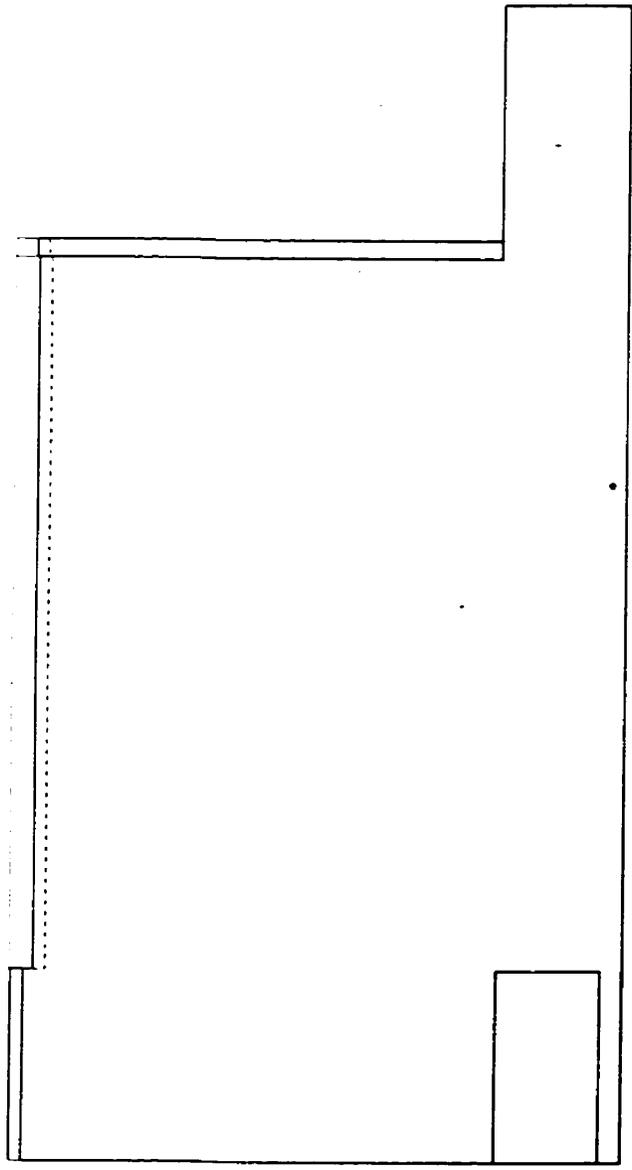
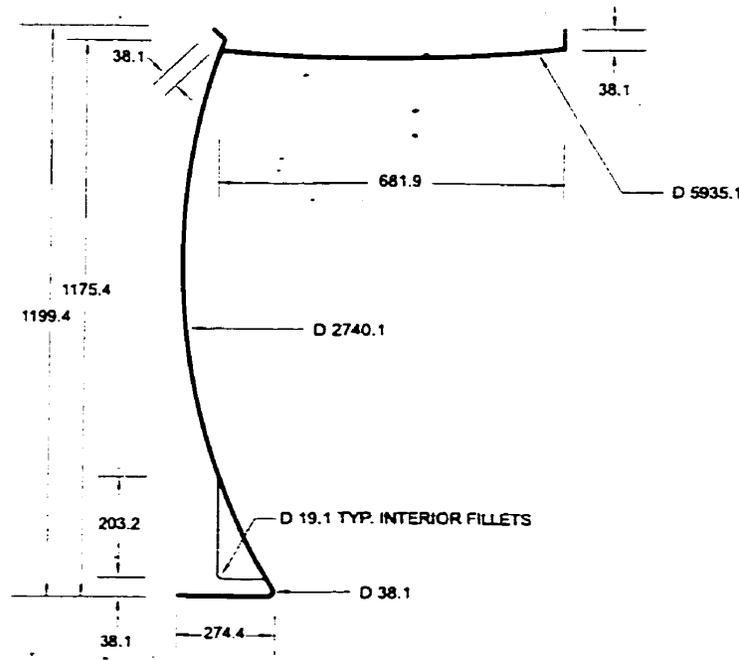


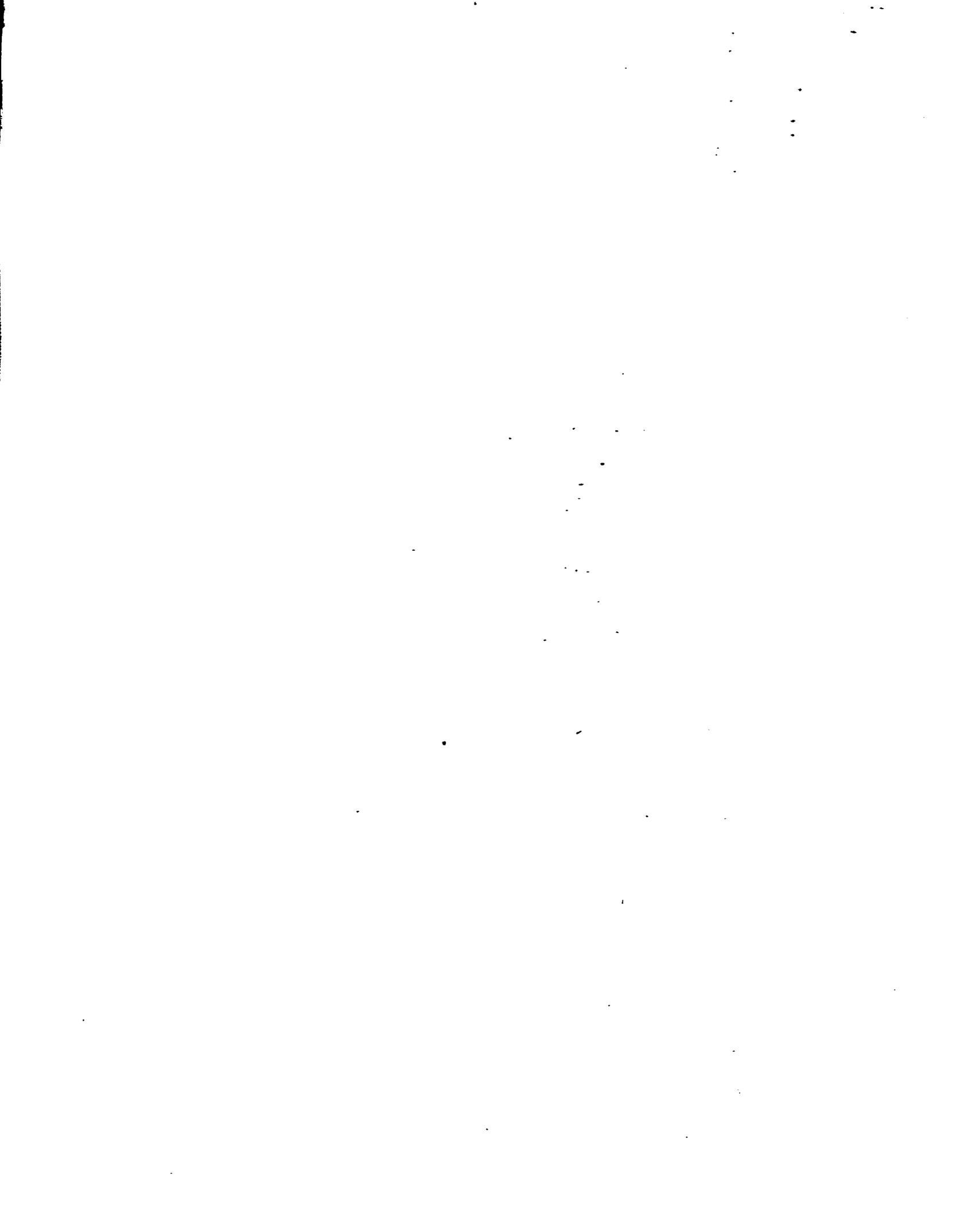
Design Refinement

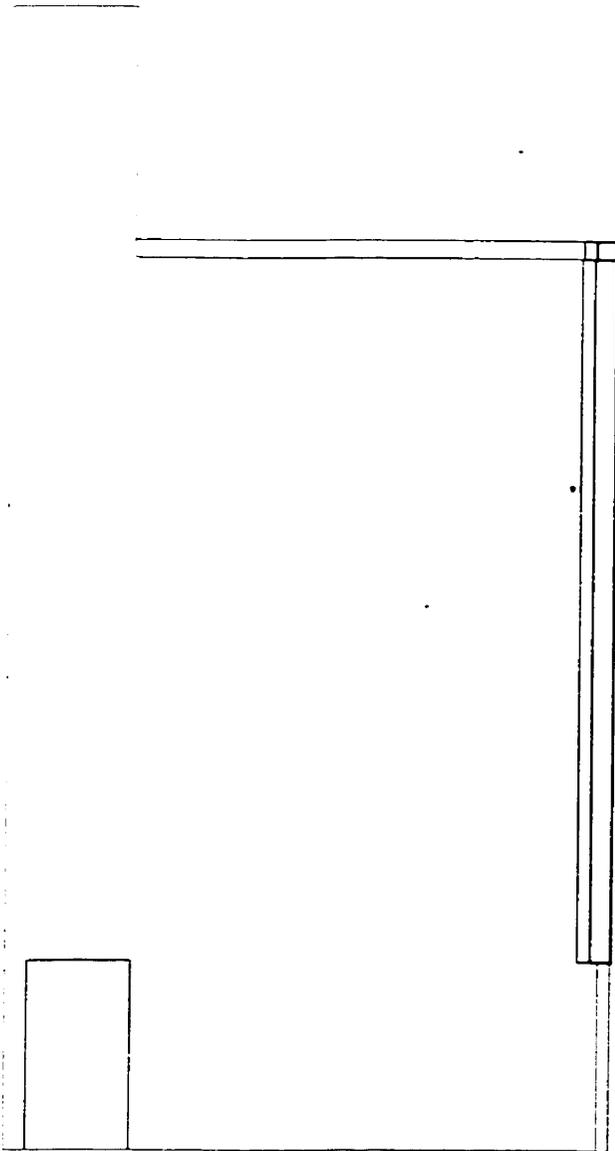
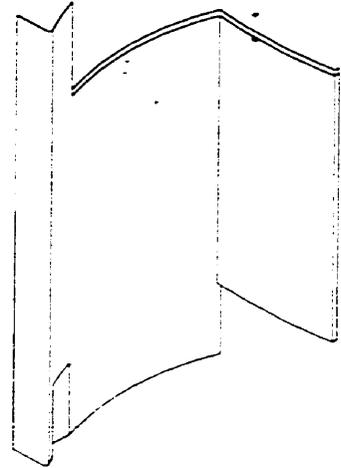
Floor-Recessed Concept with Removable Platform

User Steps Down to Tub Bathe, Removable Floor Level Walk-In Shower









BATHING UNIT - LEFT WALL PANEL

SCALE: 1:18

DATE: 08/25/99

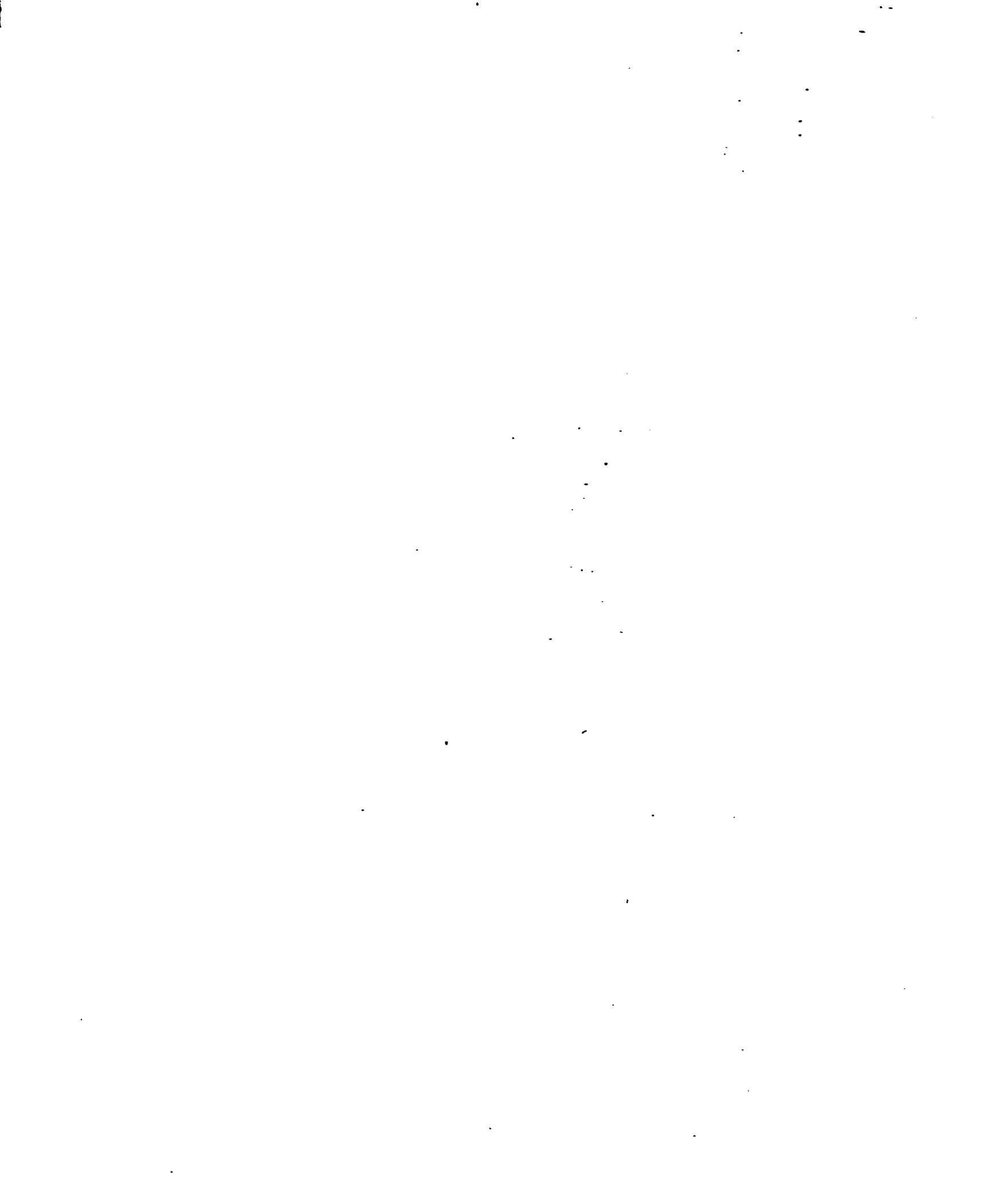
DRAWN BY: AP

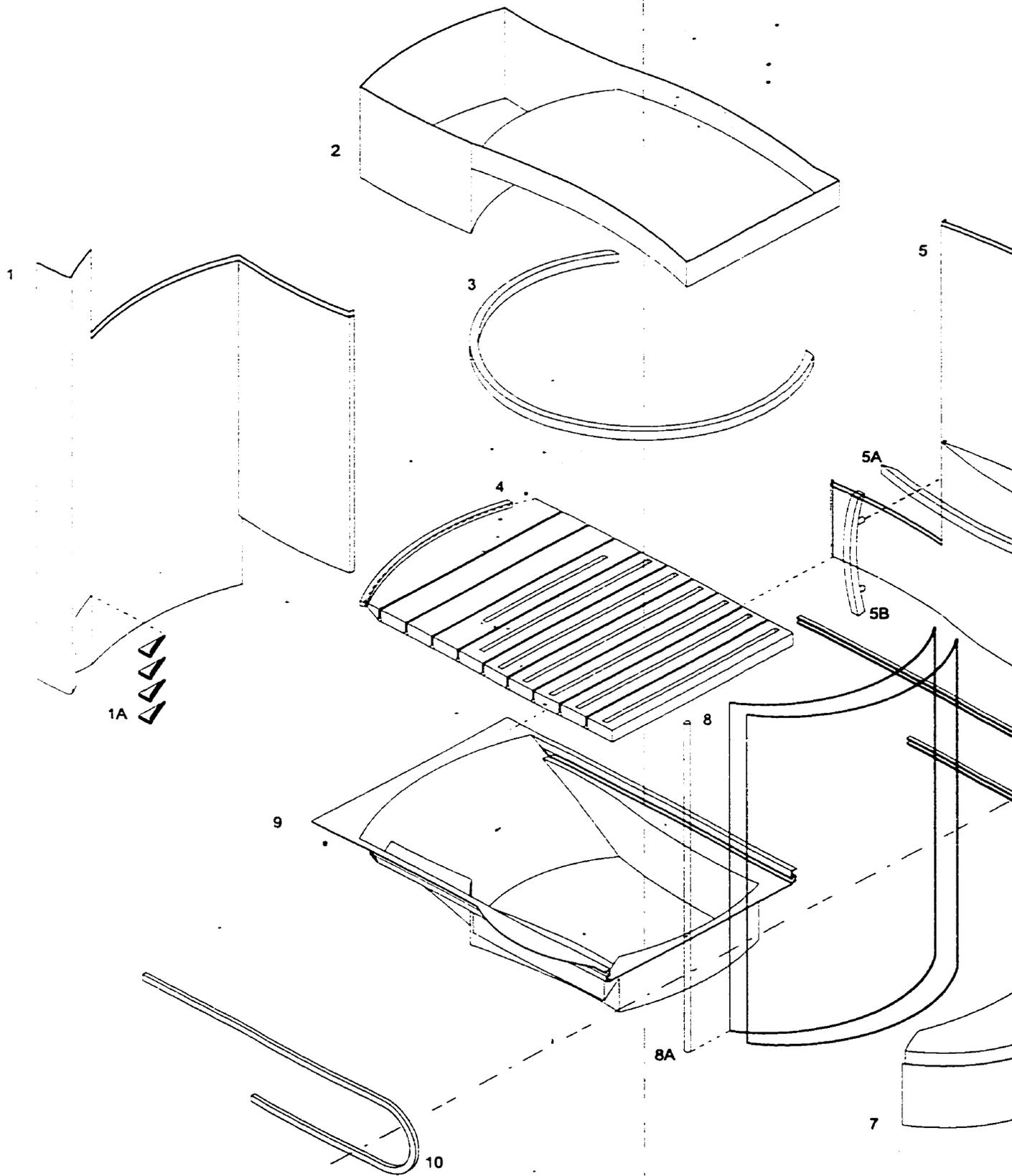
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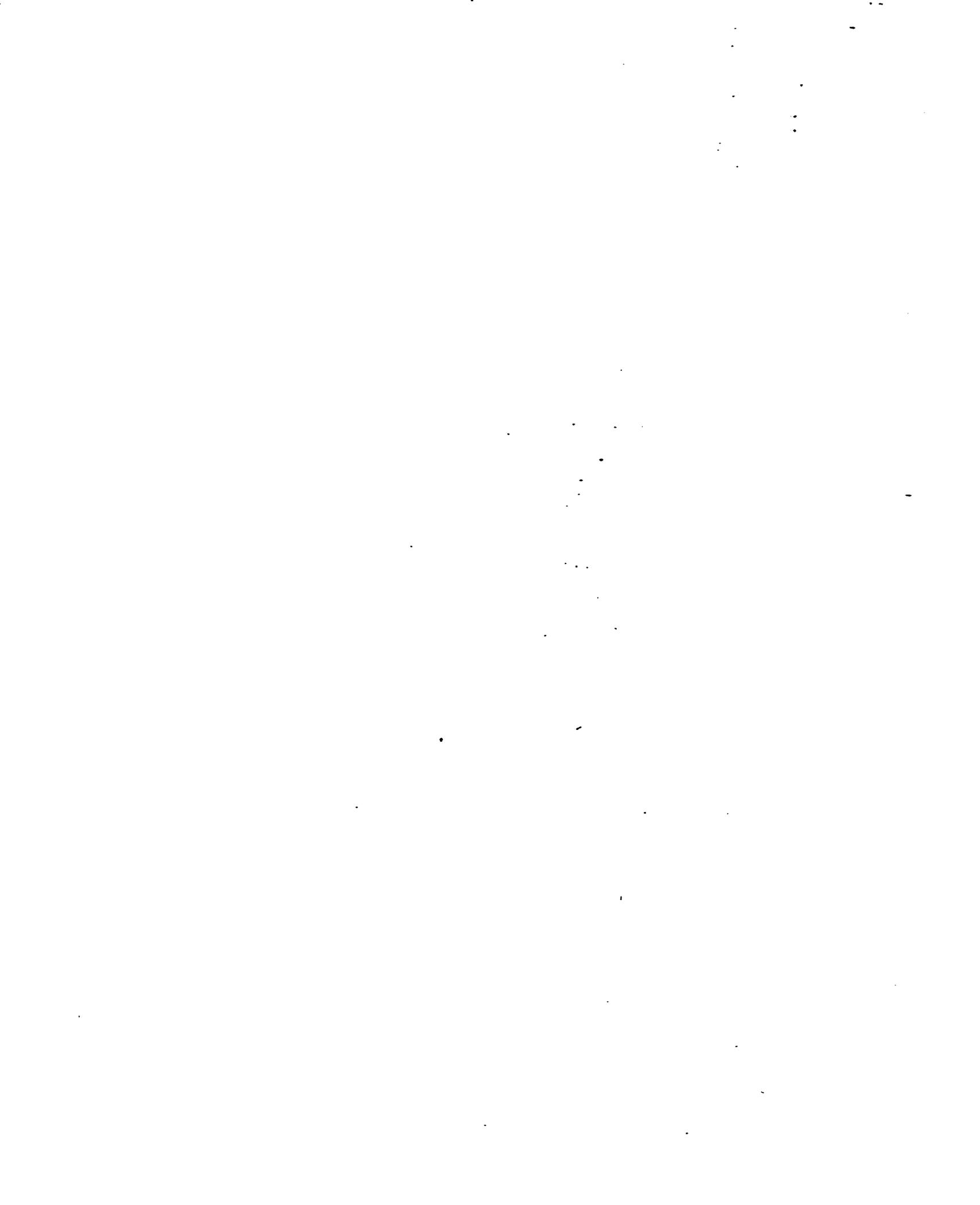


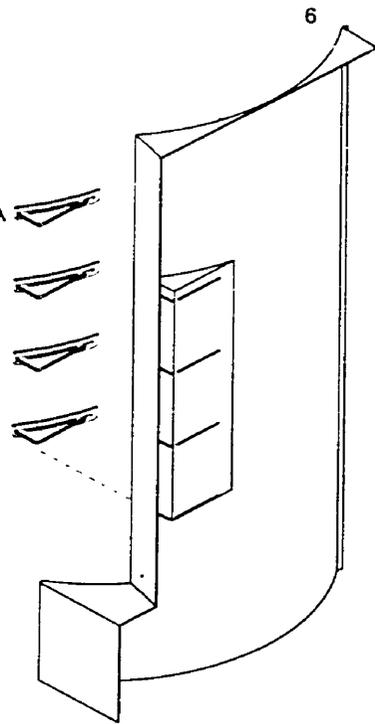
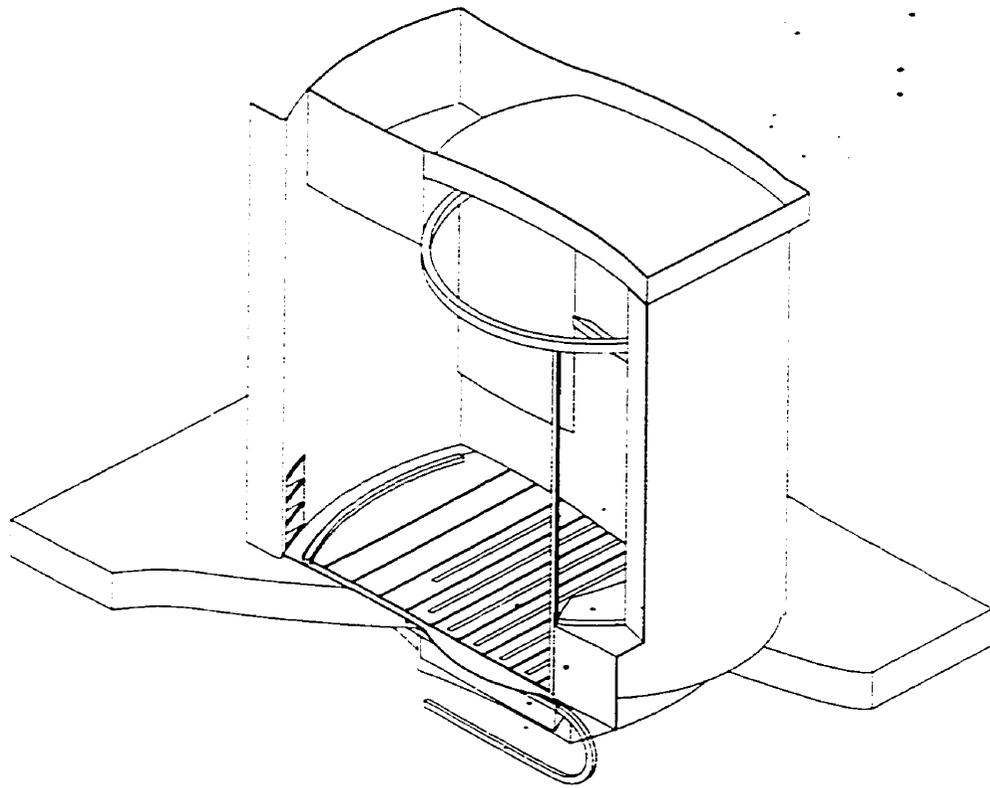
PAGE: 1 OF 1

APPENDIX I









| 10 | REMOVABLE PLATFORM RAIL | 2 |
|----------|---------------------------|----------|
| 9 | TUB | 1 |
| 4A | ENCLOSURE DOORS GRAB POLE | 1 |
| 8 | ENCLOSURE DOORS | 2 |
| 7 | BENCH | 1 |
| 6A | RIGHT WALL SHELVES | 1 |
| 6 | RIGHT WALL PANEL | 4 |
| 5B | BACK WALL VERTICAL BAR | 1 |
| 5A | BACK WALL HORIZONTAL BAR | 1 |
| 5 | BACK WALL PANEL | 1 |
| 4 | REMOVABLE PLATFORM | 1 |
| 3 | ENCLOSURE RAIL | 1 |
| 2 | BULKHEAD | 1 |
| 1A | LEFT WALL SHELVES | 4 |
| 1 | LEFT WALL PANEL | 1 |
| ITEM NO. | DESCRIPTION | QUANTITY |

BATHING UNIT - EXPLODED ISOMETRIC

SCALE: NTS

DATE: 08/25/99

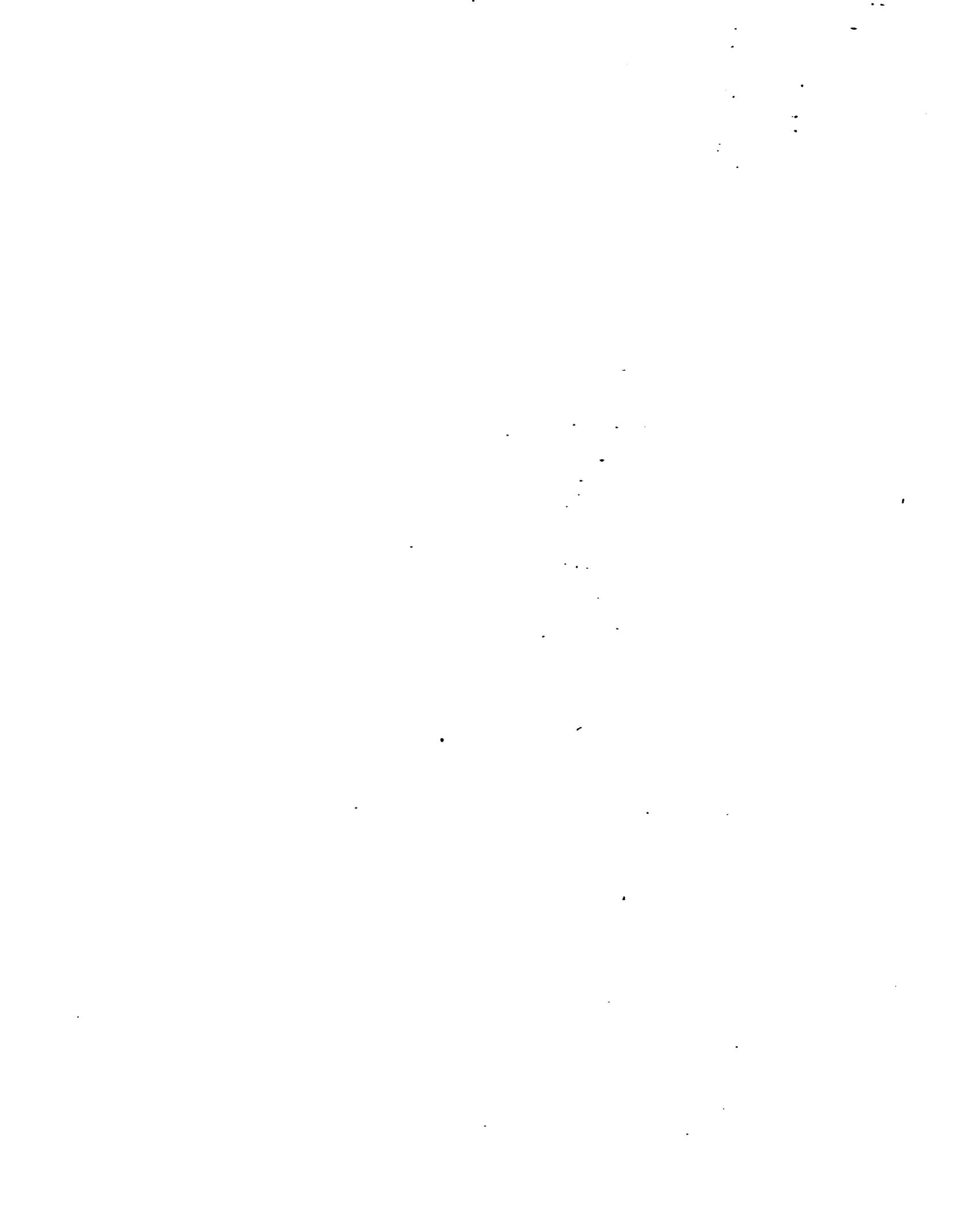


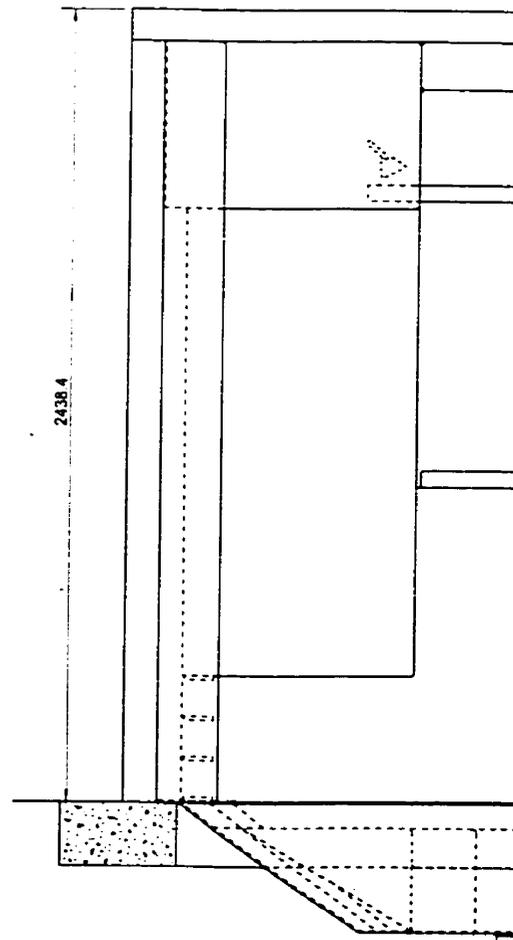
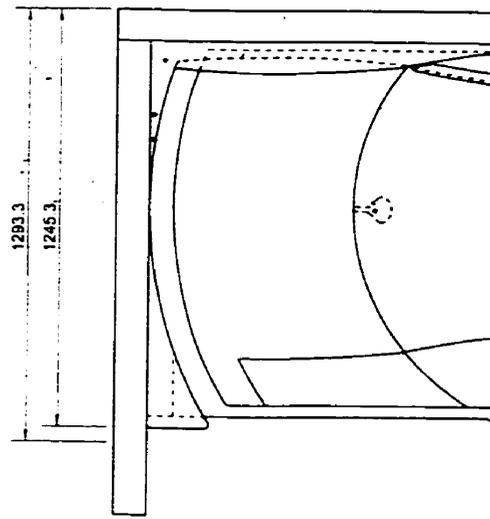
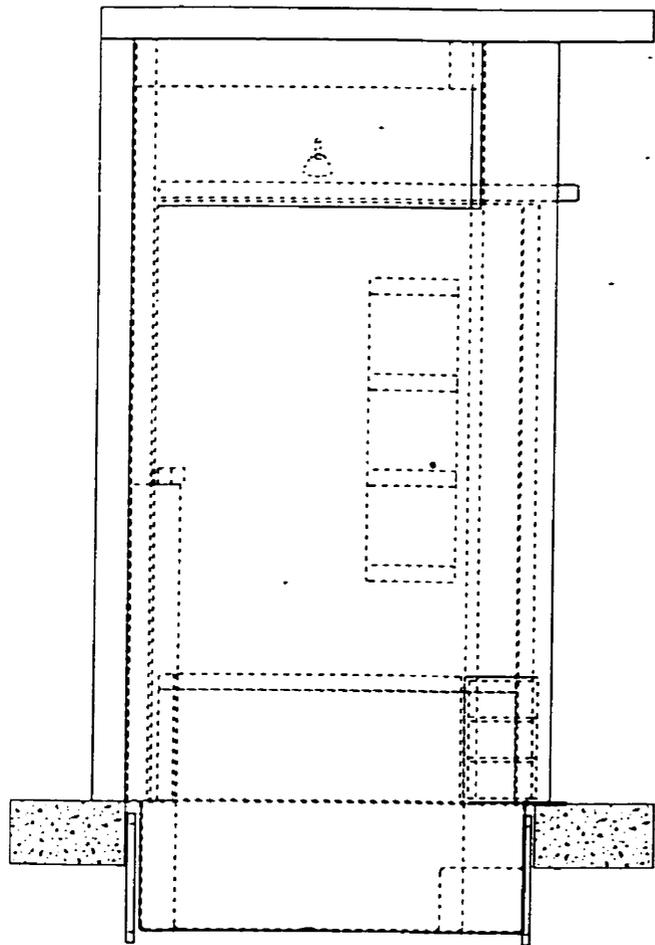
PAGE: 1 OF 1

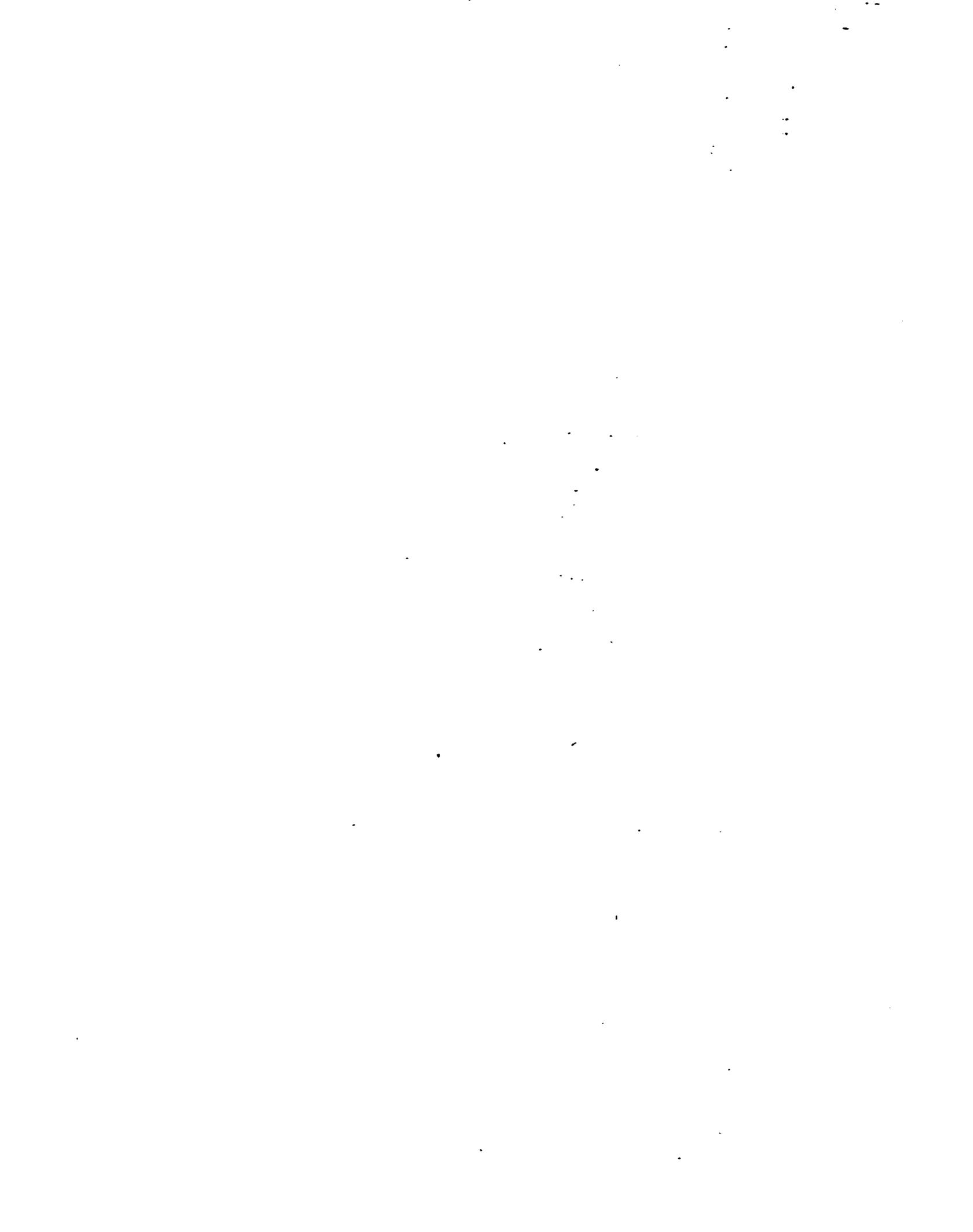
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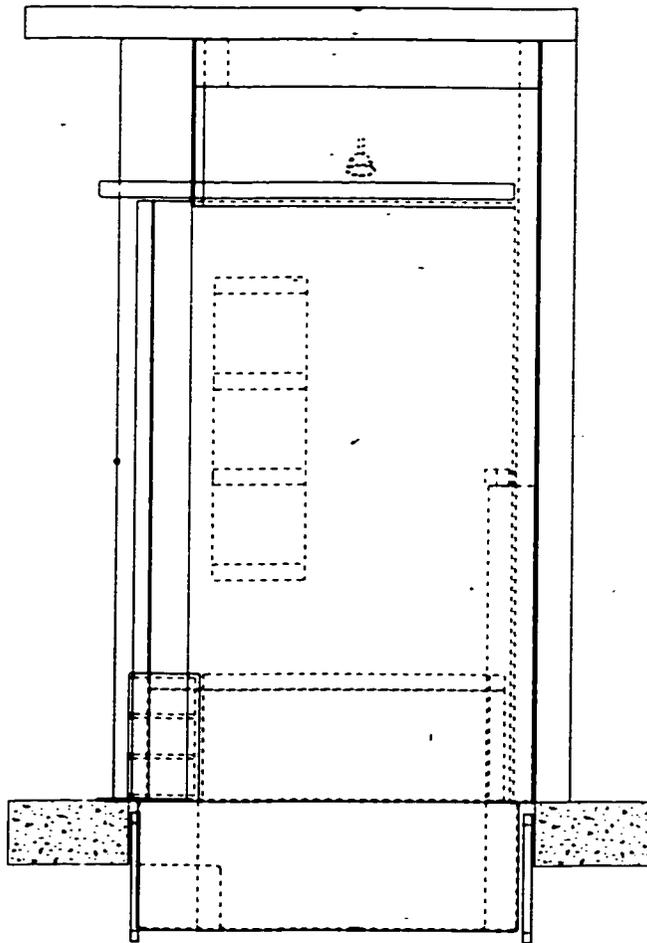
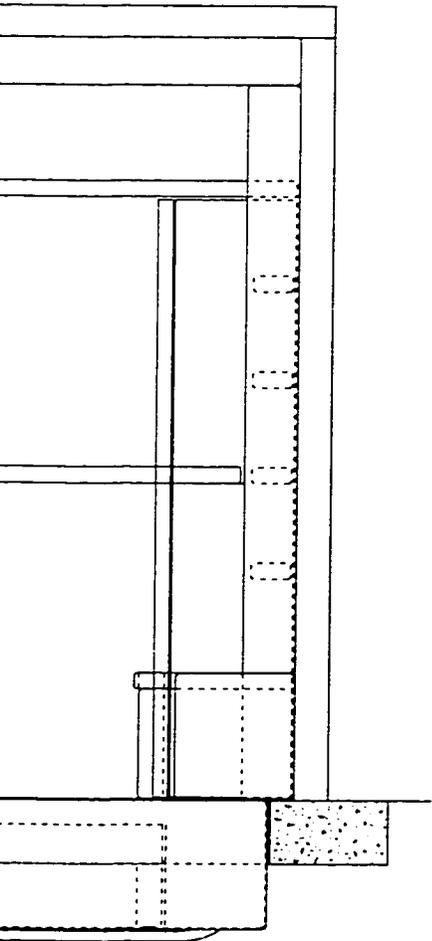
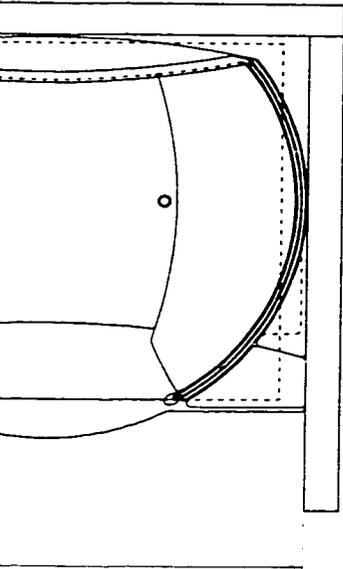
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APPENDIX I









BATHING UNIT - GENERAL ASSEMBLY

SCALE: 1:24

DATE: 08/25/99

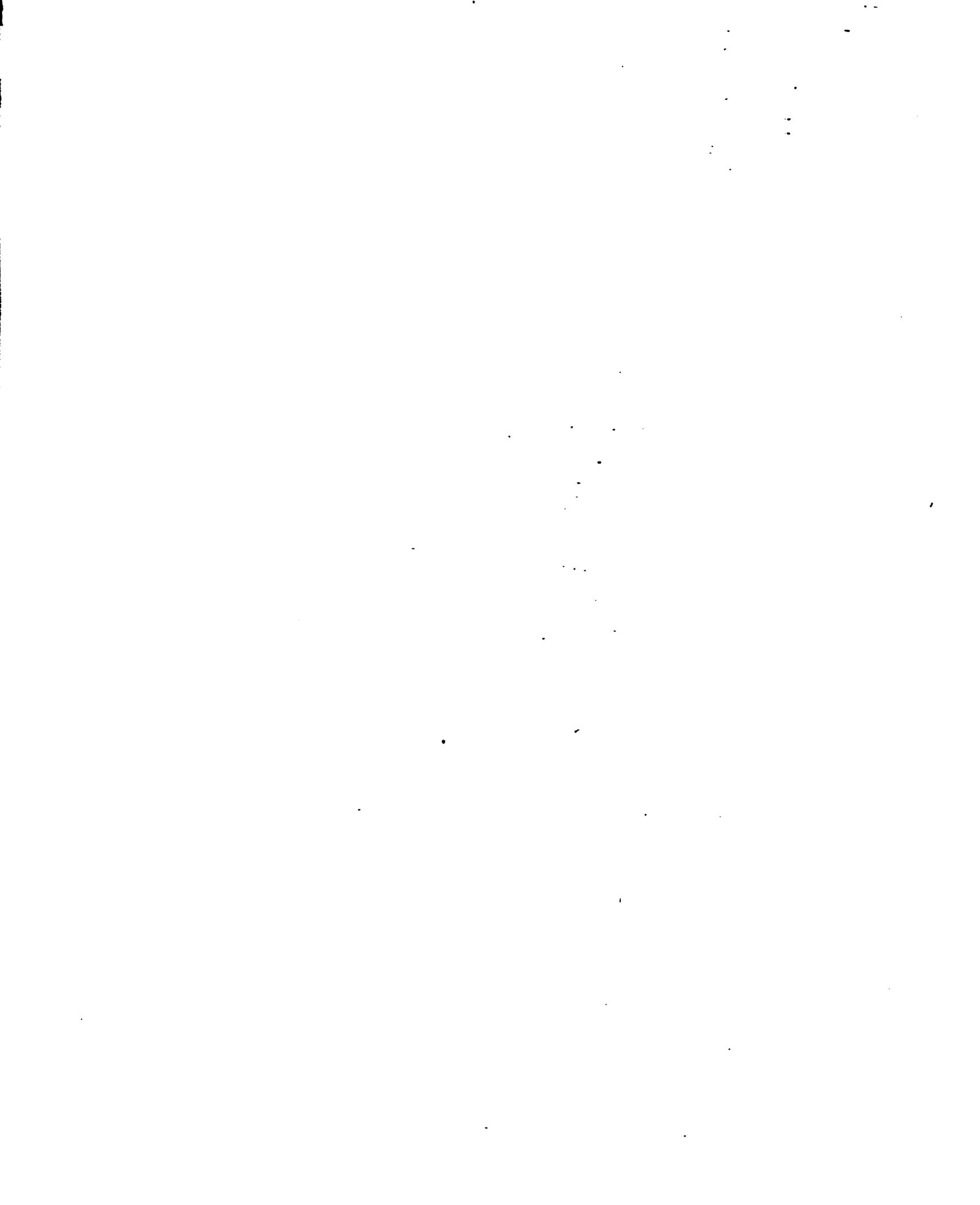
DRAWN BY: AP

CLIENT: EVDS

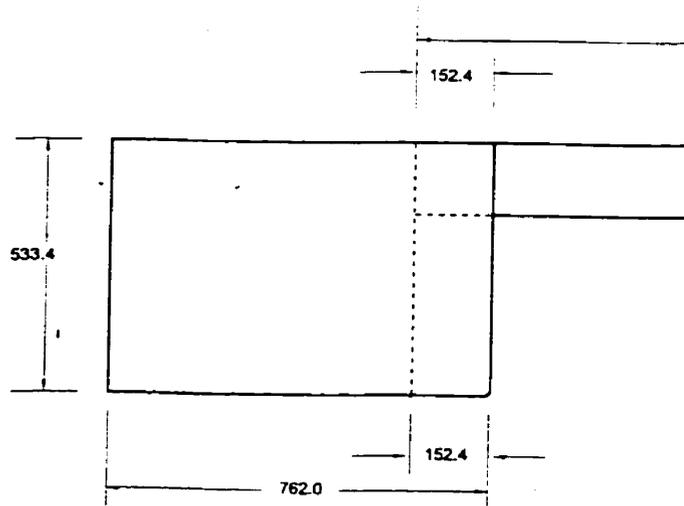
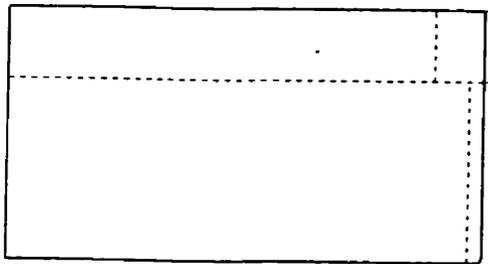
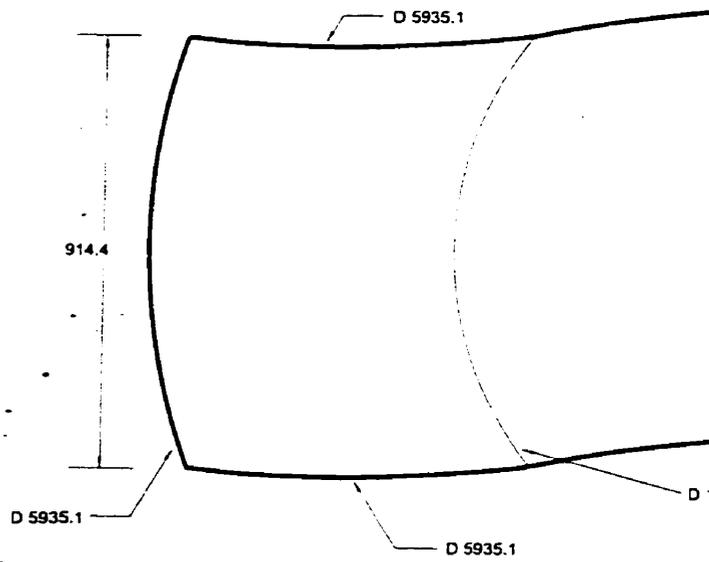


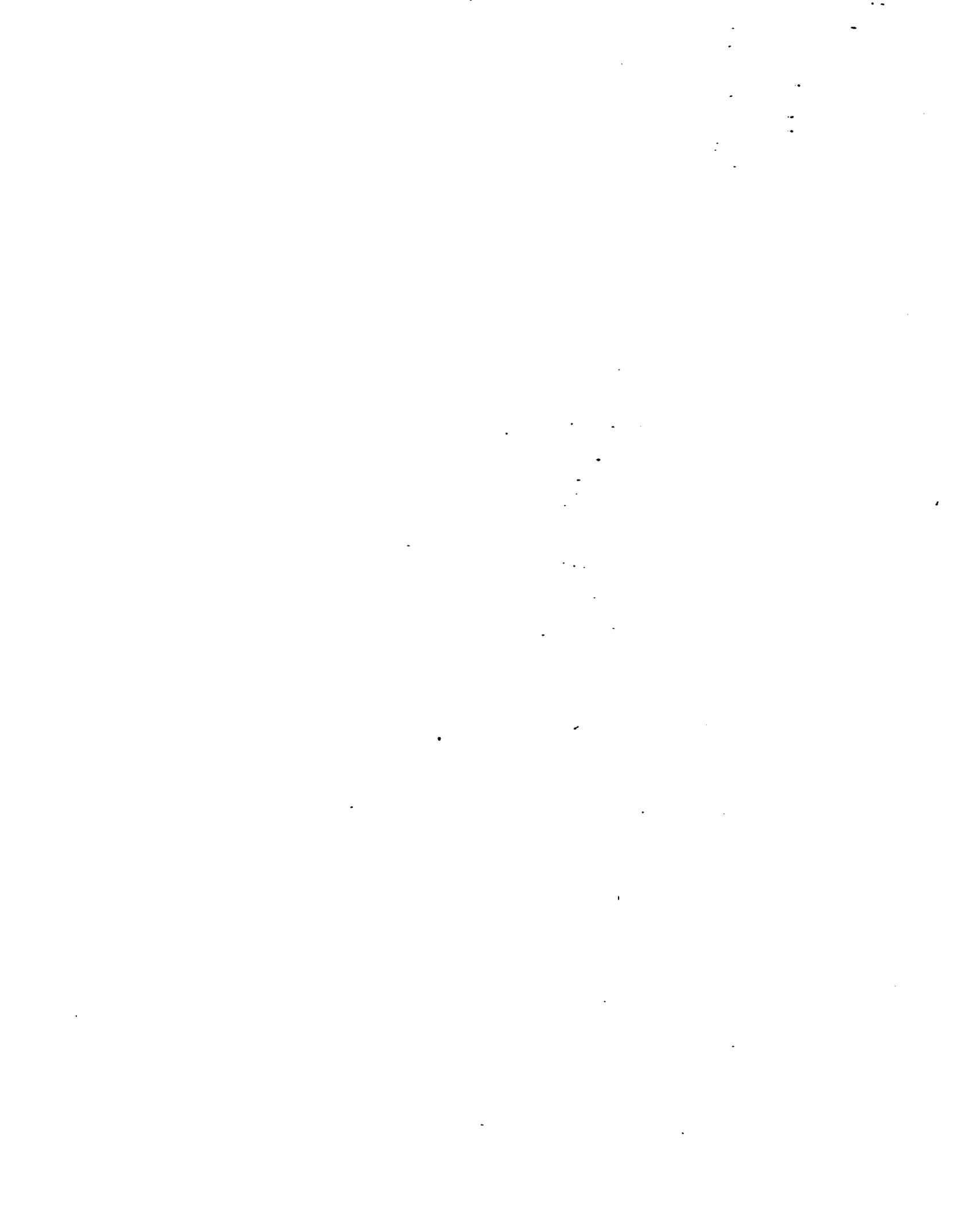
PAGE: 1 OF 1

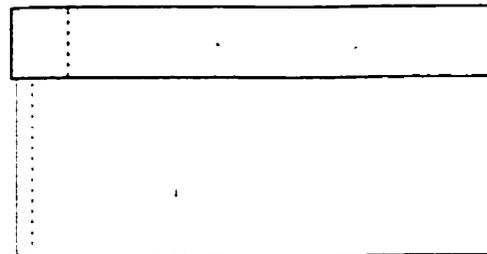
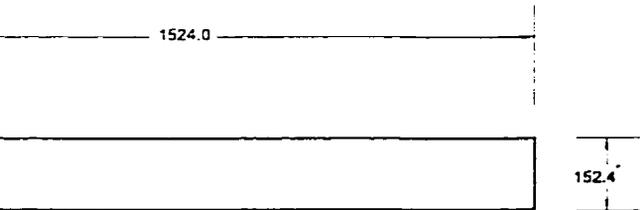
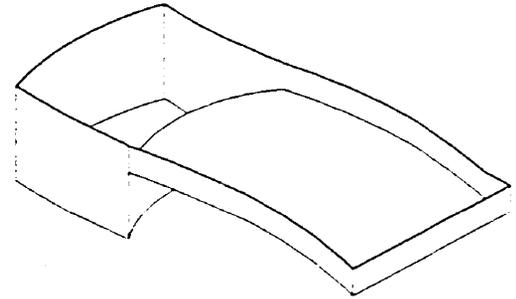
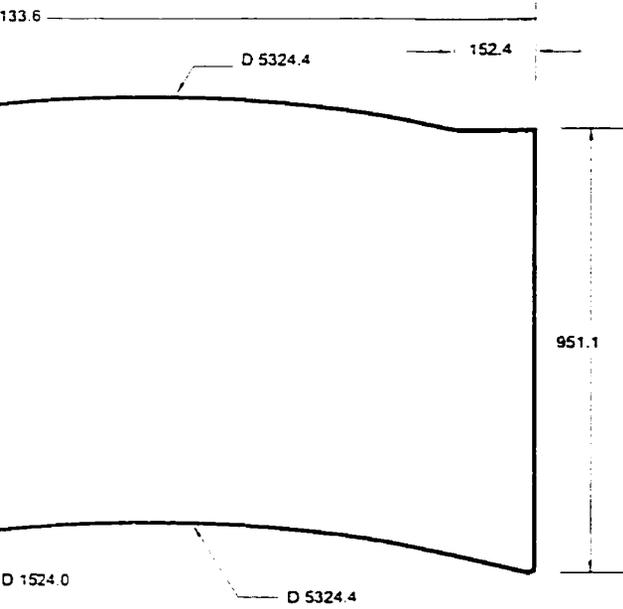
APPENDIX I



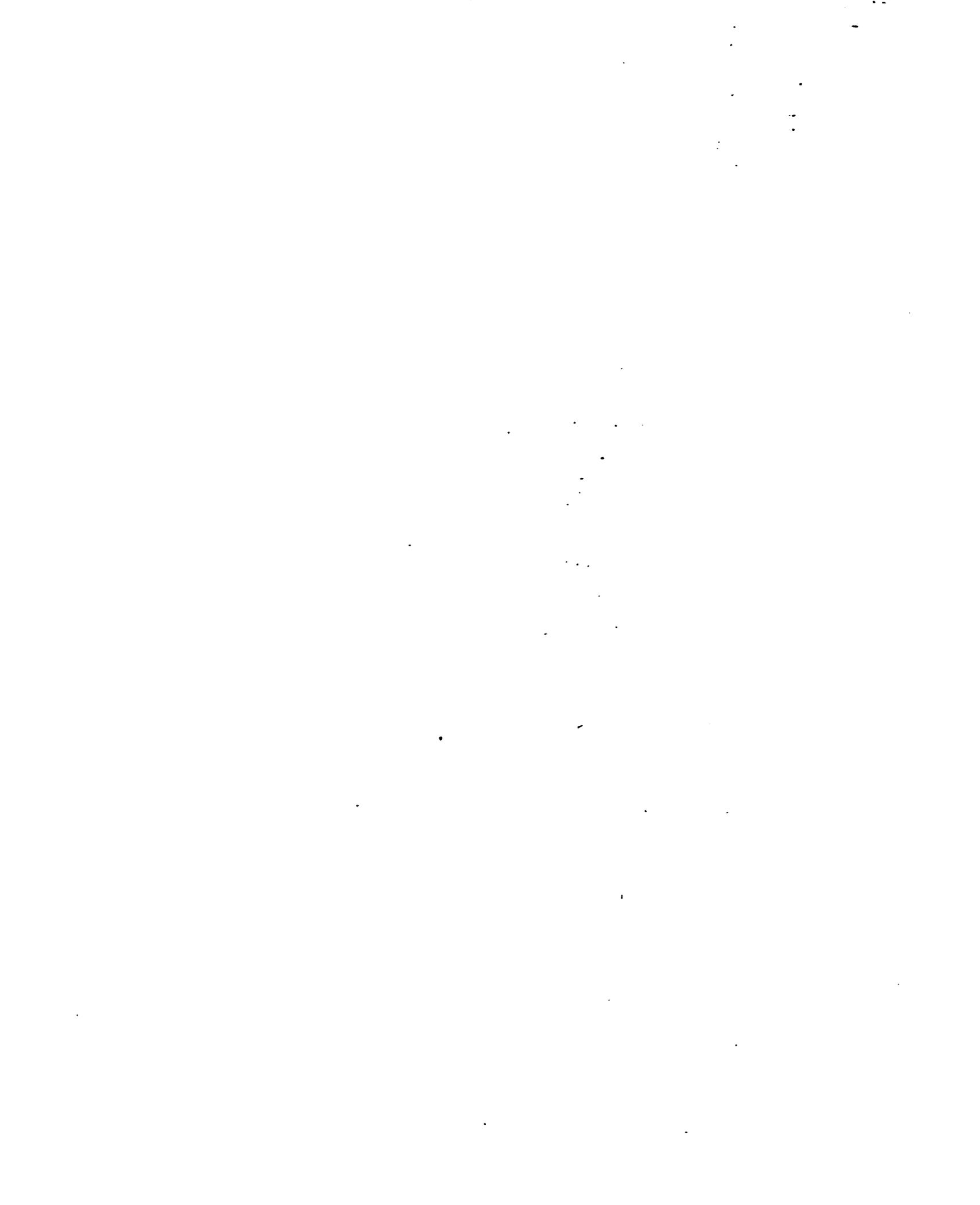
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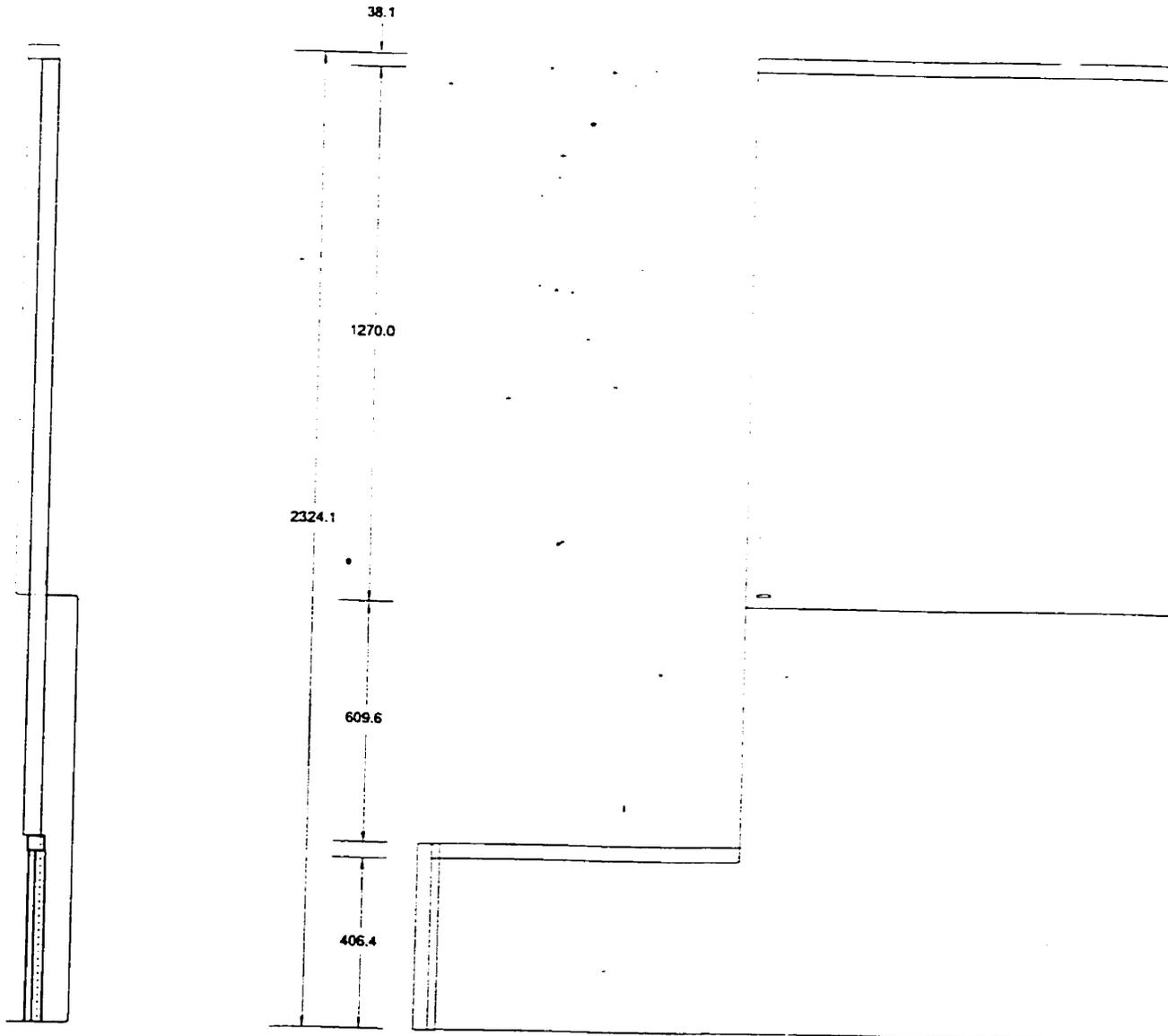
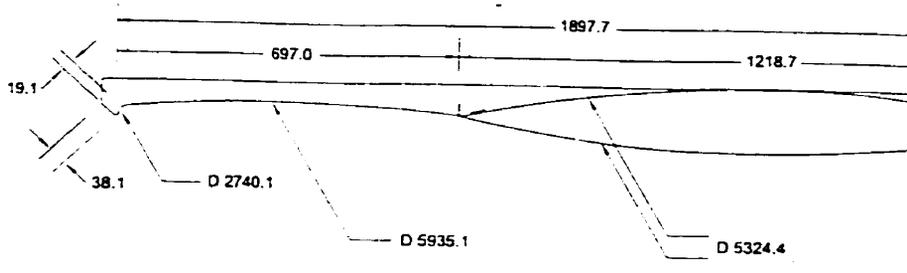


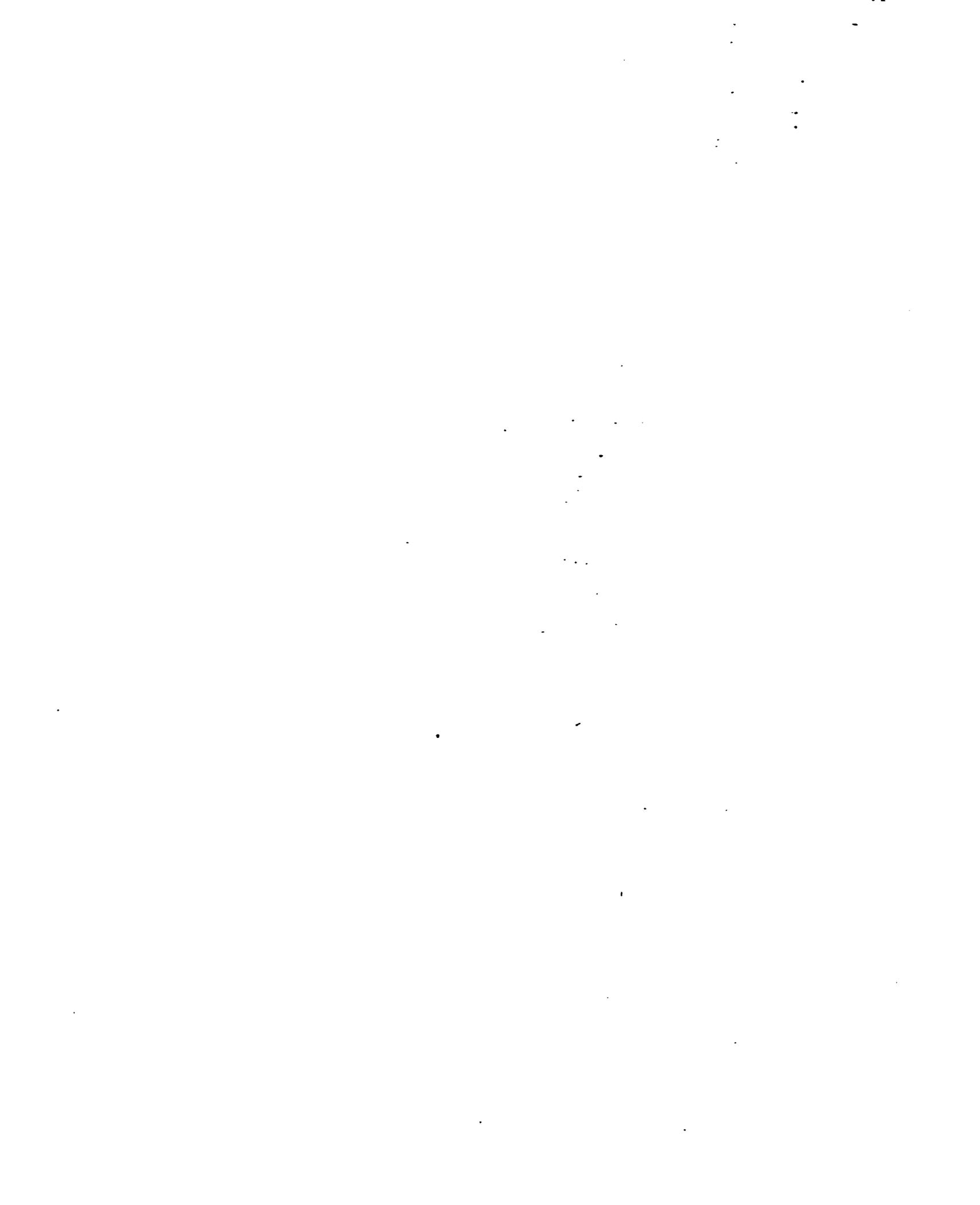




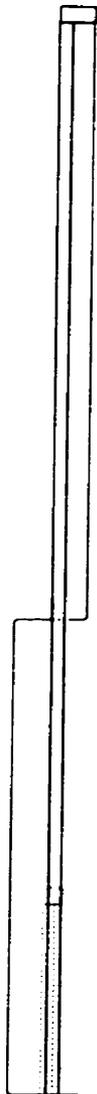
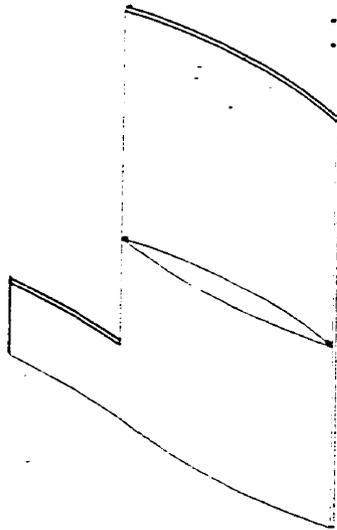
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|--------------------------------|----------------|---|--------------|
| BATHING UNIT - BULKHEAD | | | |
| SCALE: 1:18 | DATE: 08/25/99 |  | PAGE: 1 OF 1 |
| DRAWN BY: AP | CLIENT: EVDS | | APPENDIX I |







38.1



BATHING UNIT - BACK WALL PANEL

SCALE: 1:18

DATE: 08/25/99

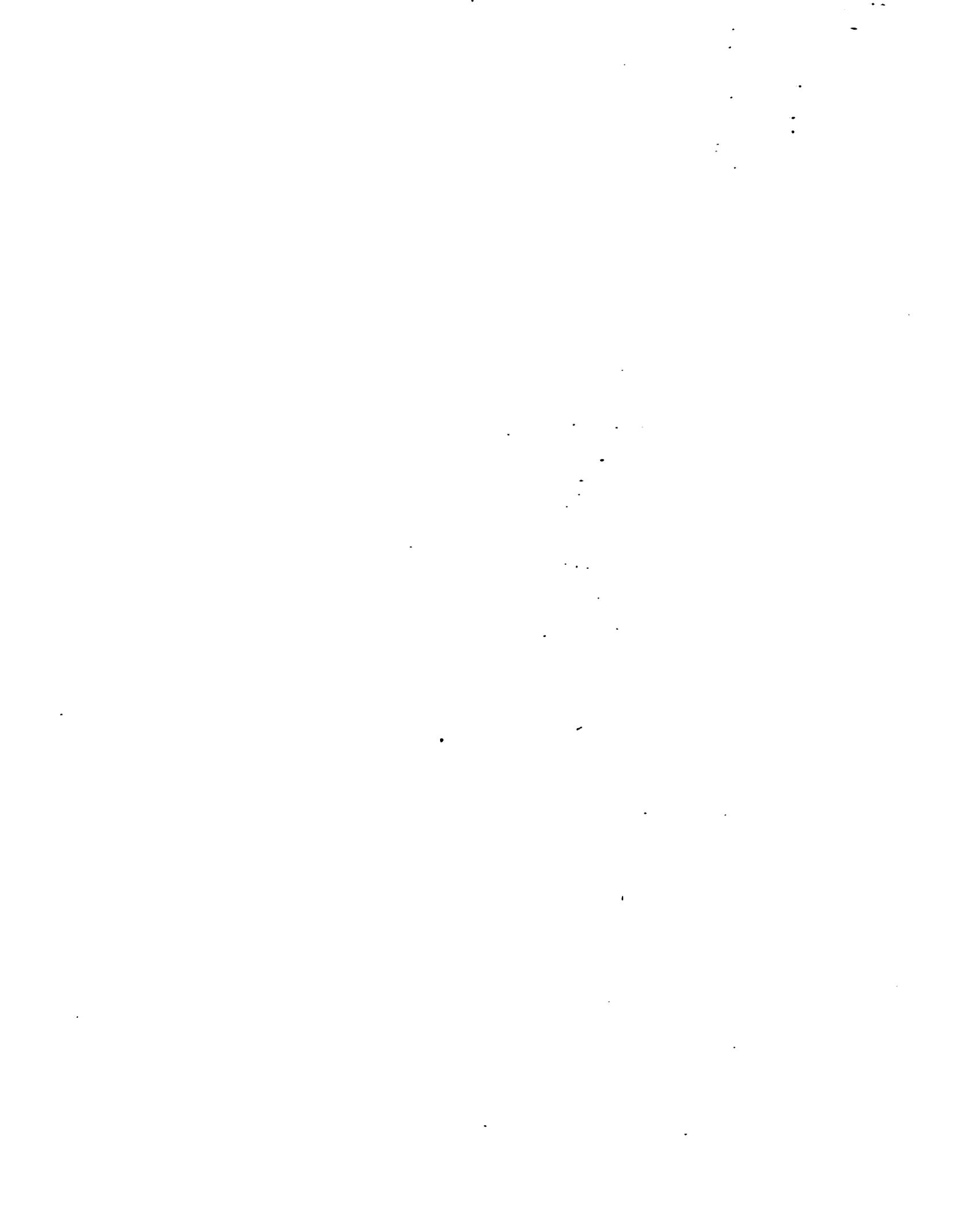


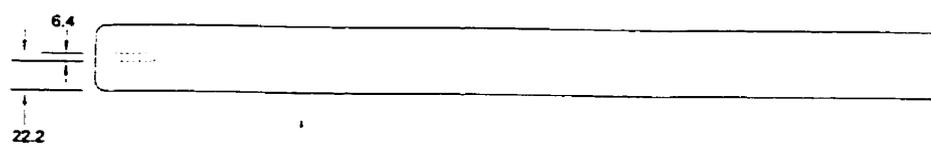
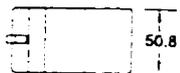
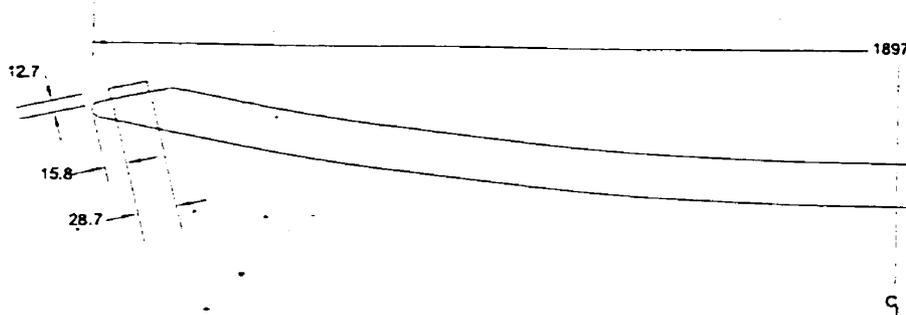
PAGE: 1 OF 1

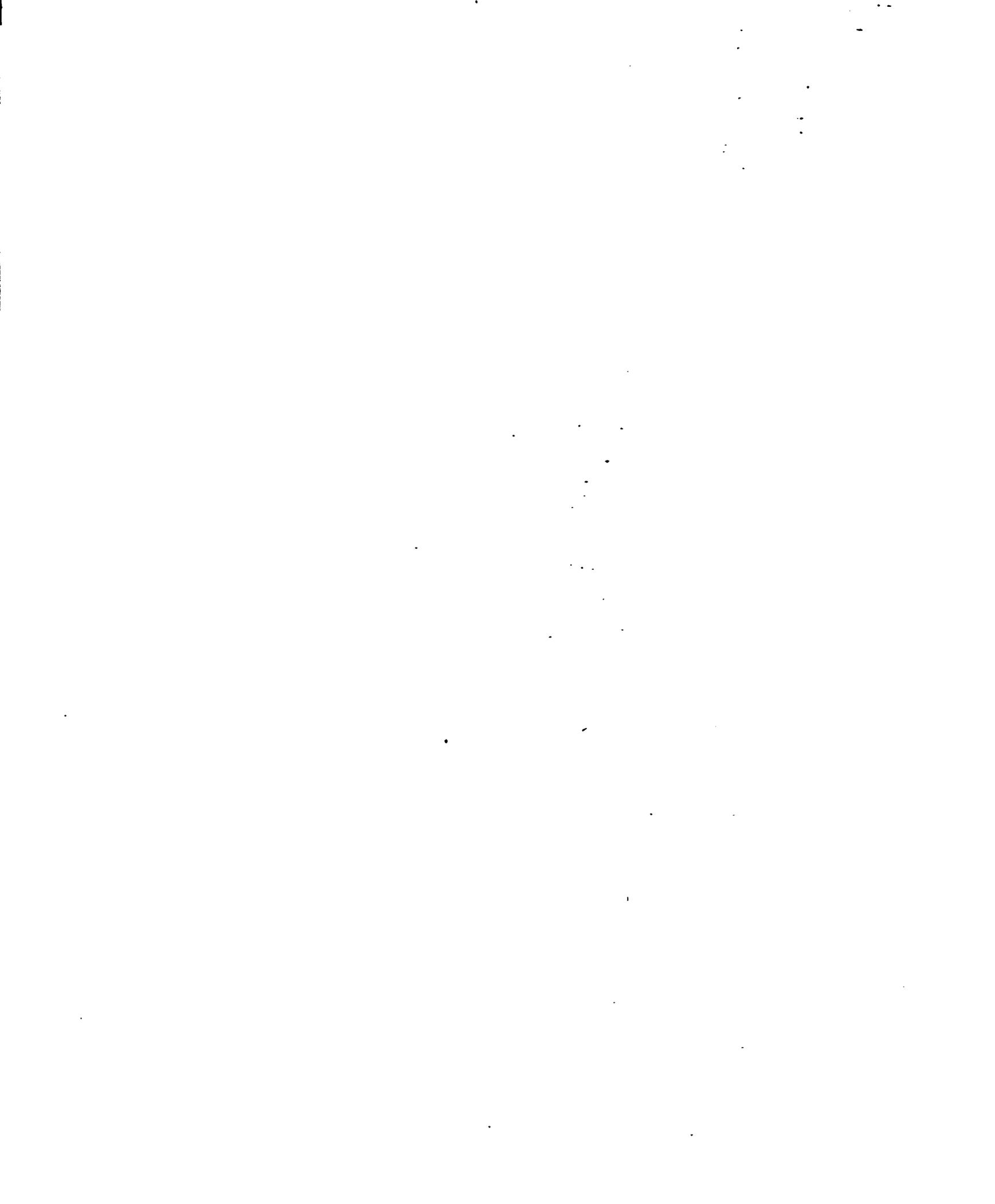
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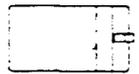
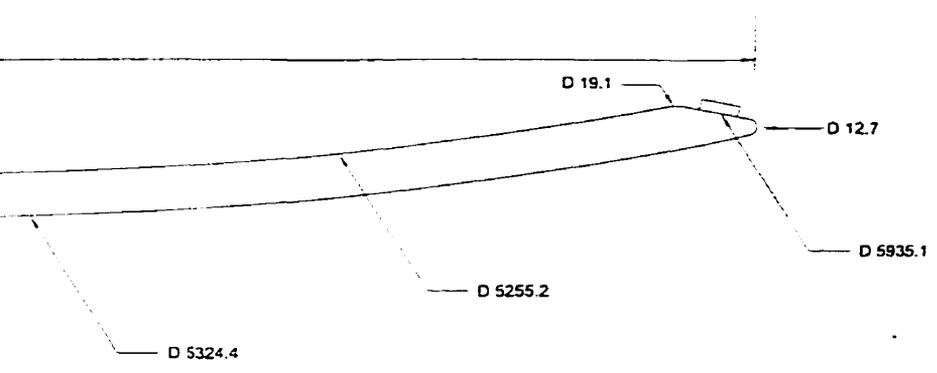
CLIENT: EVDS

APPENDIX I

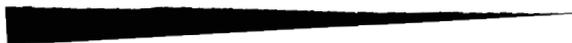


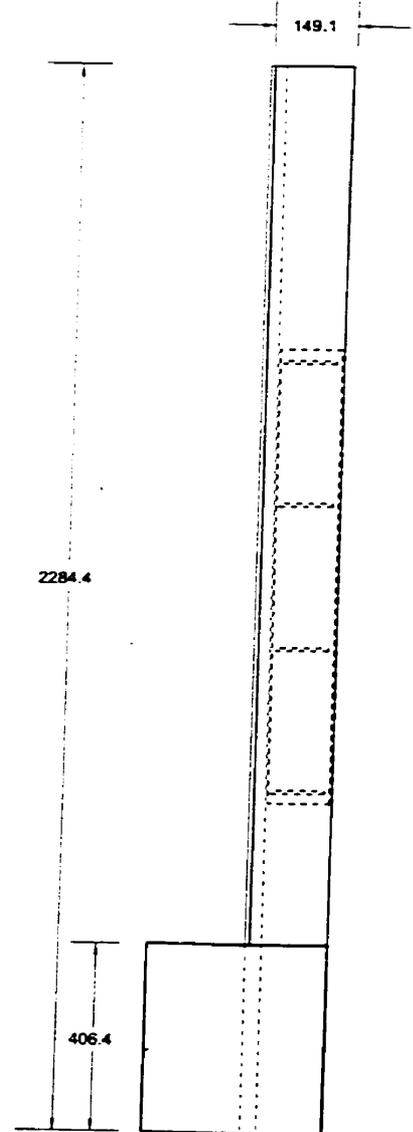
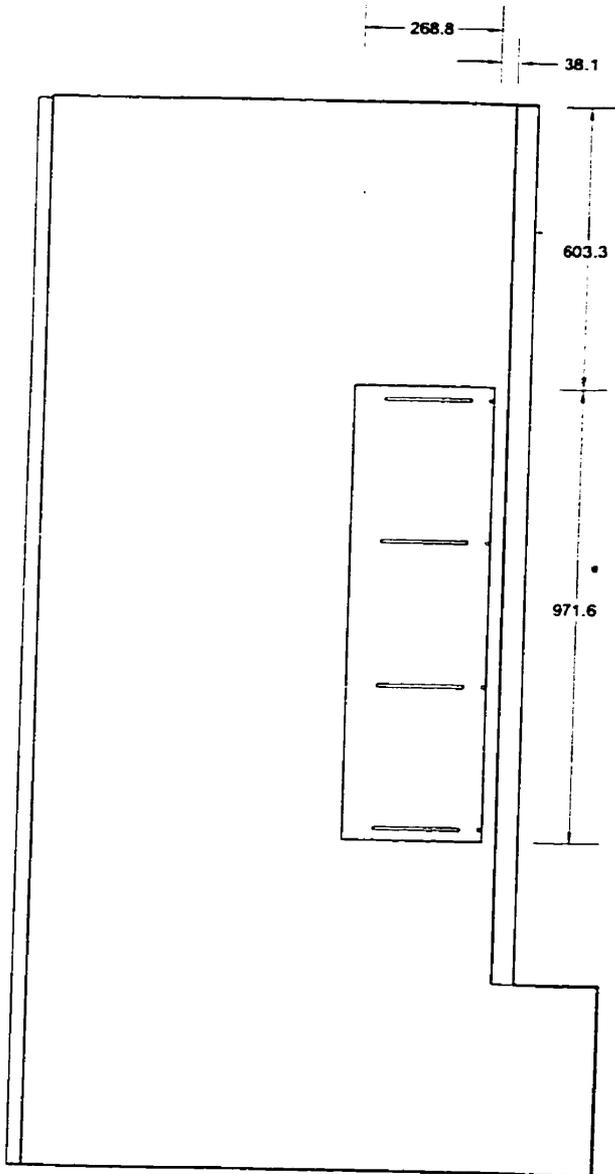
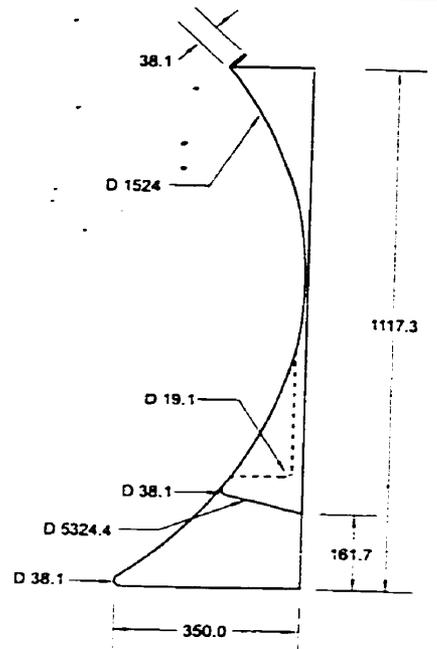


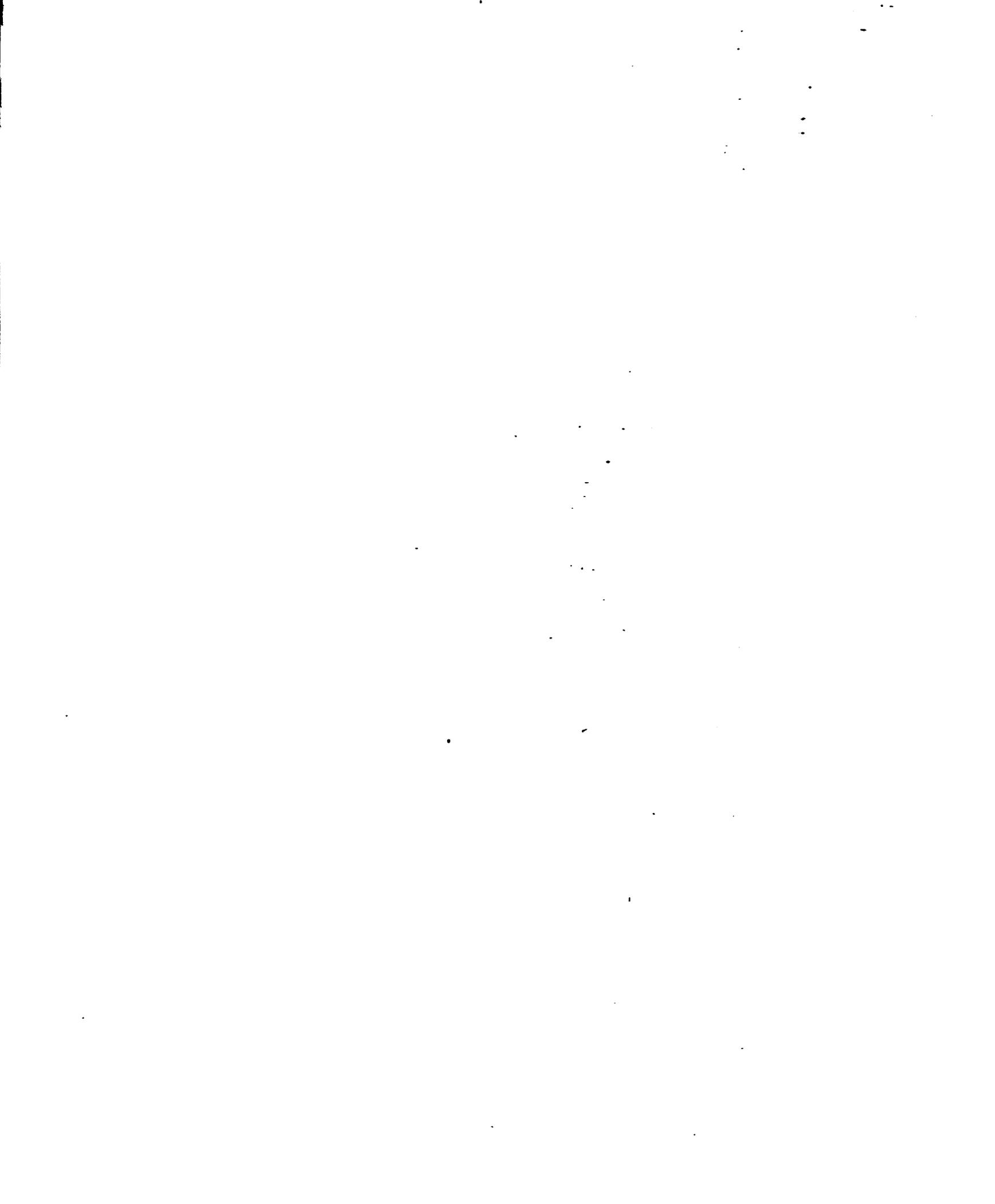


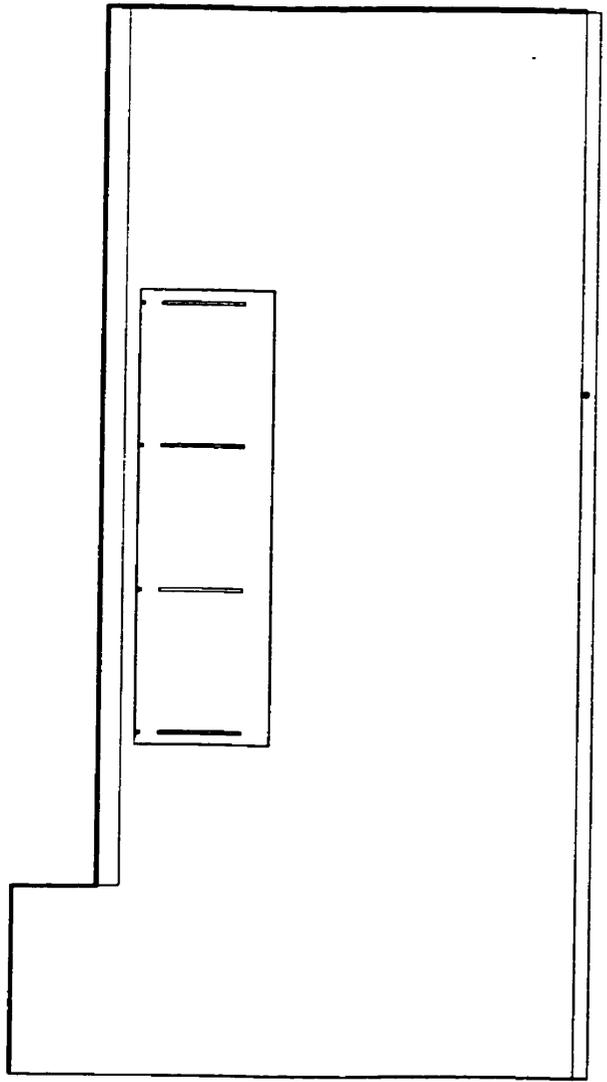
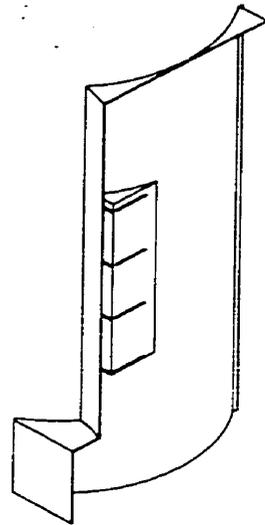


| | | | |
|--|----------------|---|--------------|
| BATHING UNIT - BACK WALL HORIZONTAL BAR | | | |
| SCALE: 1:6 | DATE: 08/25/99 |  | PAGE: 1 OF 1 |
| DRAWN BY: AP | CLIENT: EVDS | | APPENDIX I |

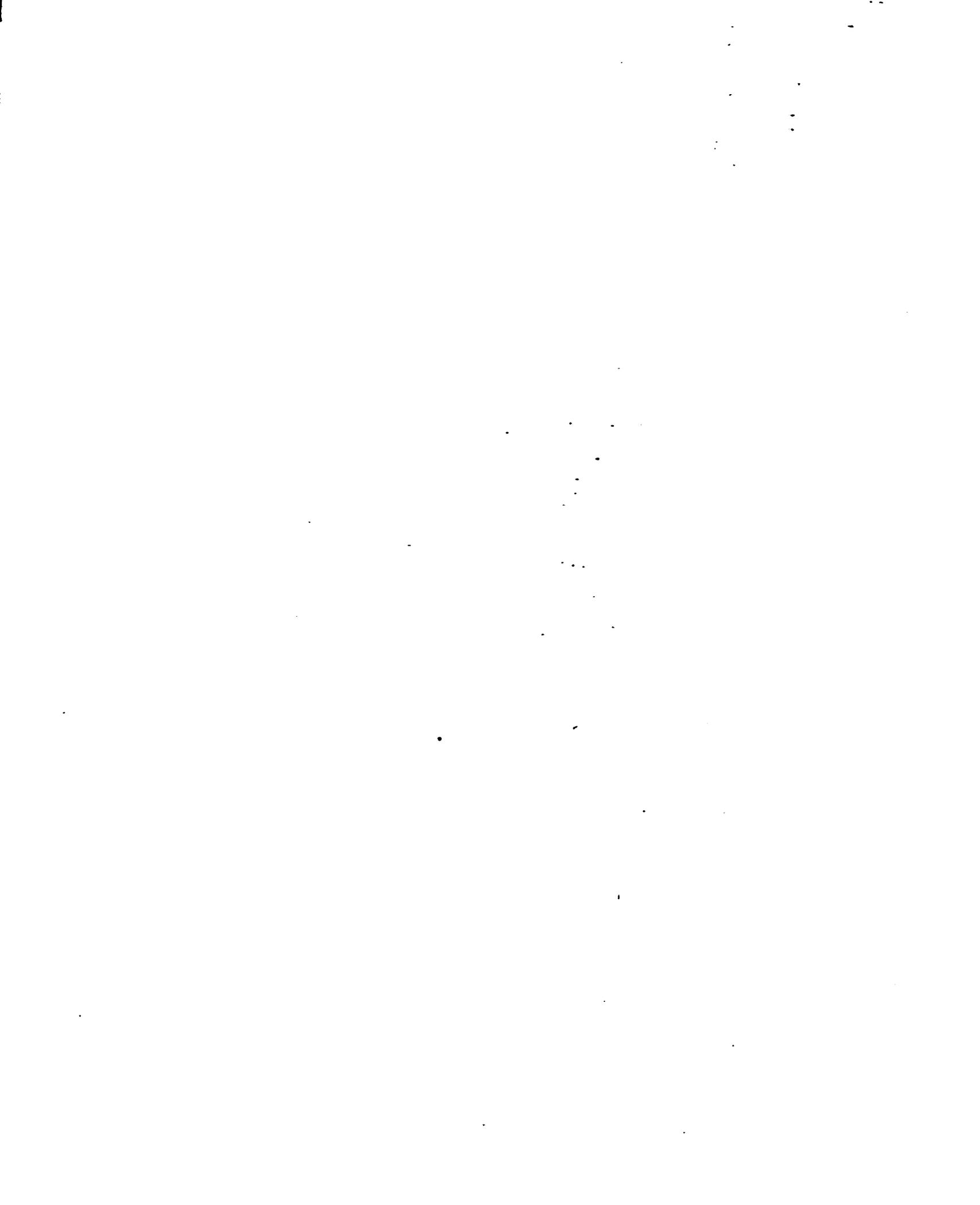


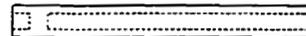
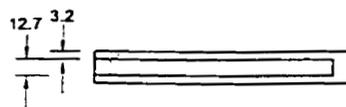
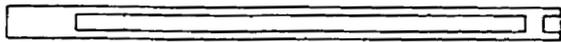
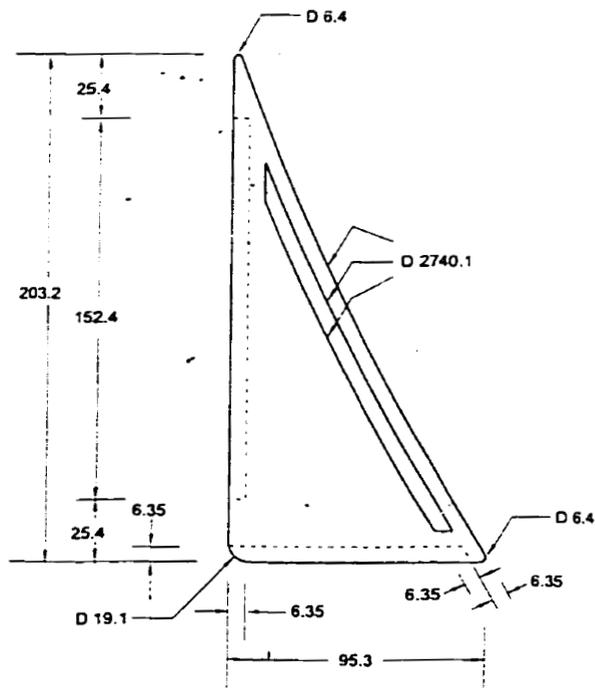




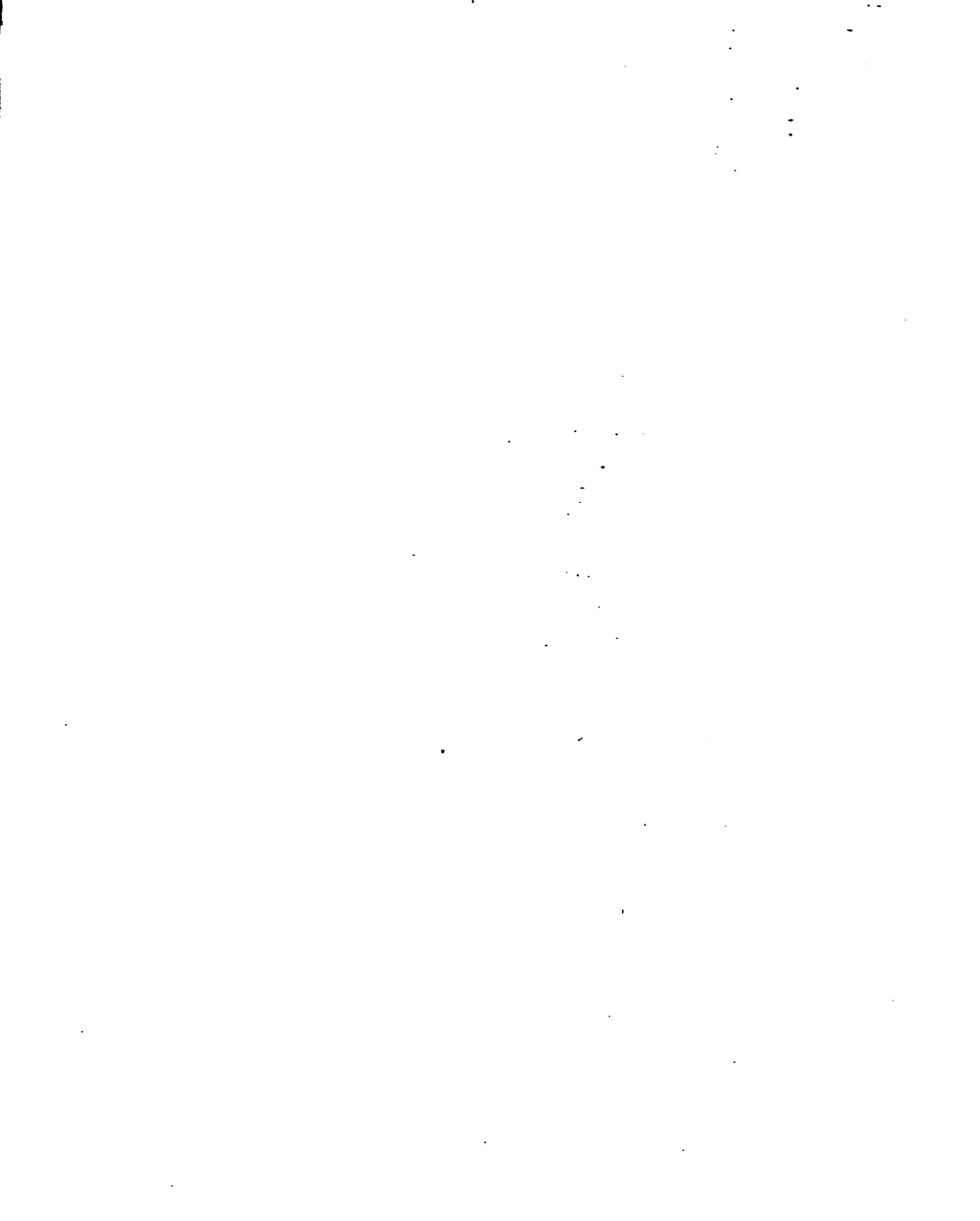


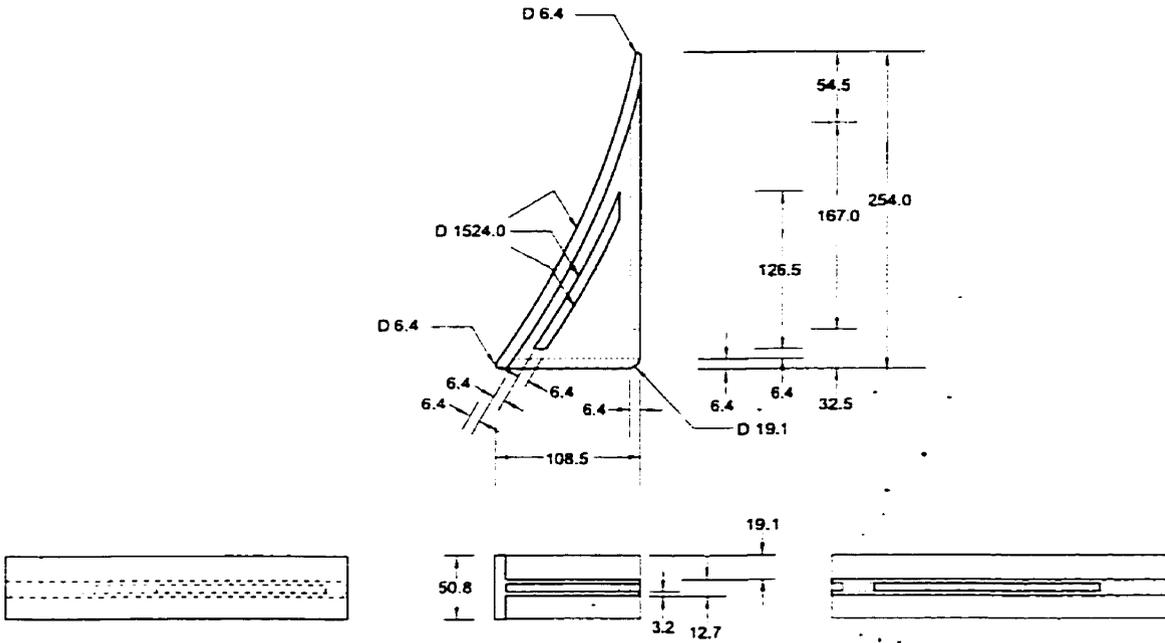
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| BATHING UNIT - RIGHT WALL PANEL | | | |
| SCALE: 1:18 | DATE: 08/25/99 |  | PAGE: 1 OF 1 |
| DRAWN BY: AP | CLIENT: EVDS | | APPENDIX I |





LEFT WALL SHELVES (x4)





RIGHT WALL SHELVES (x4)
SCALE 1:6

BATHING UNIT - SHELVES

SCALE: 1:3

DATE: 08/25/99

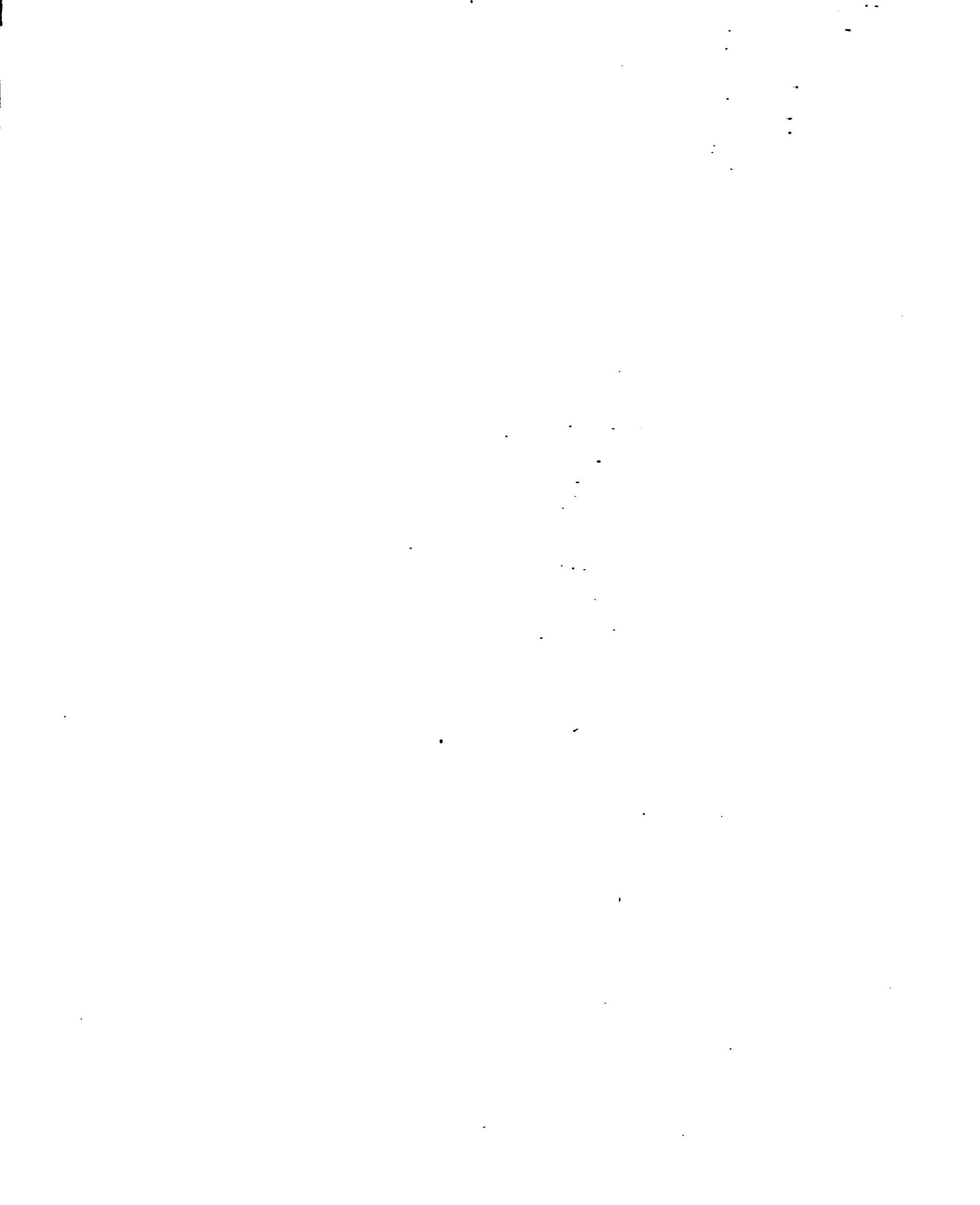
DRAWN BY: AP

CLIENT: EVDS

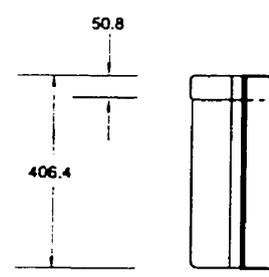
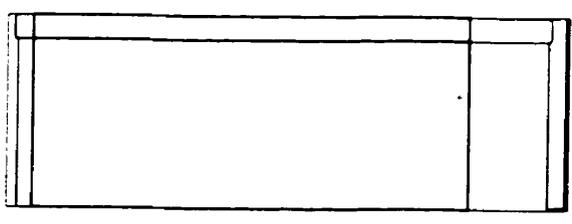
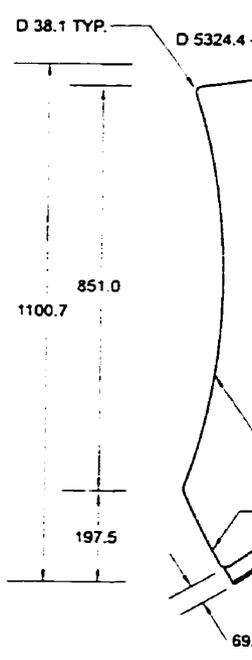


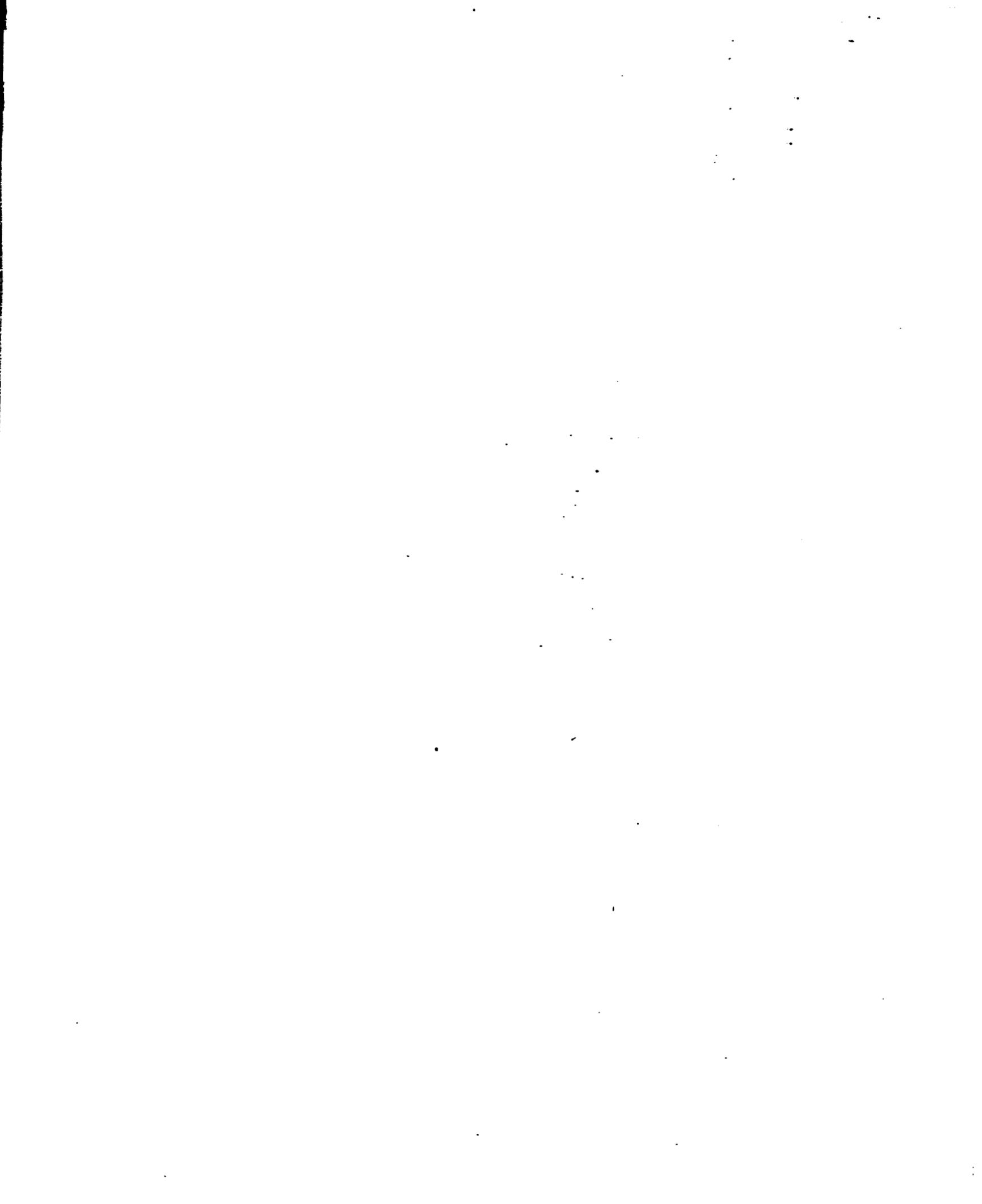
PAGE: 1 OF 1

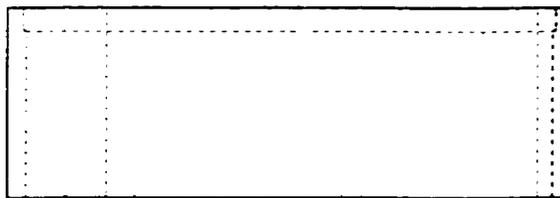
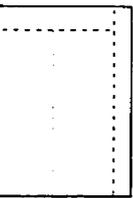
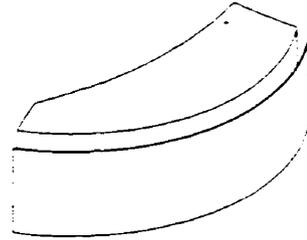
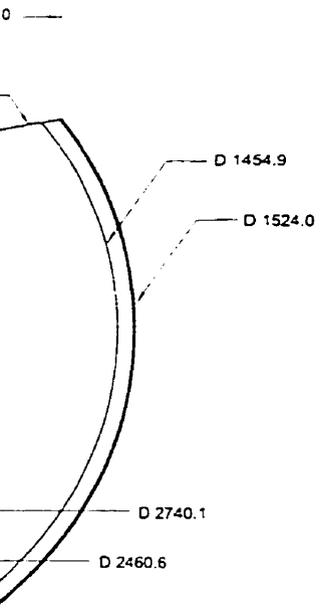
APPENDIX I



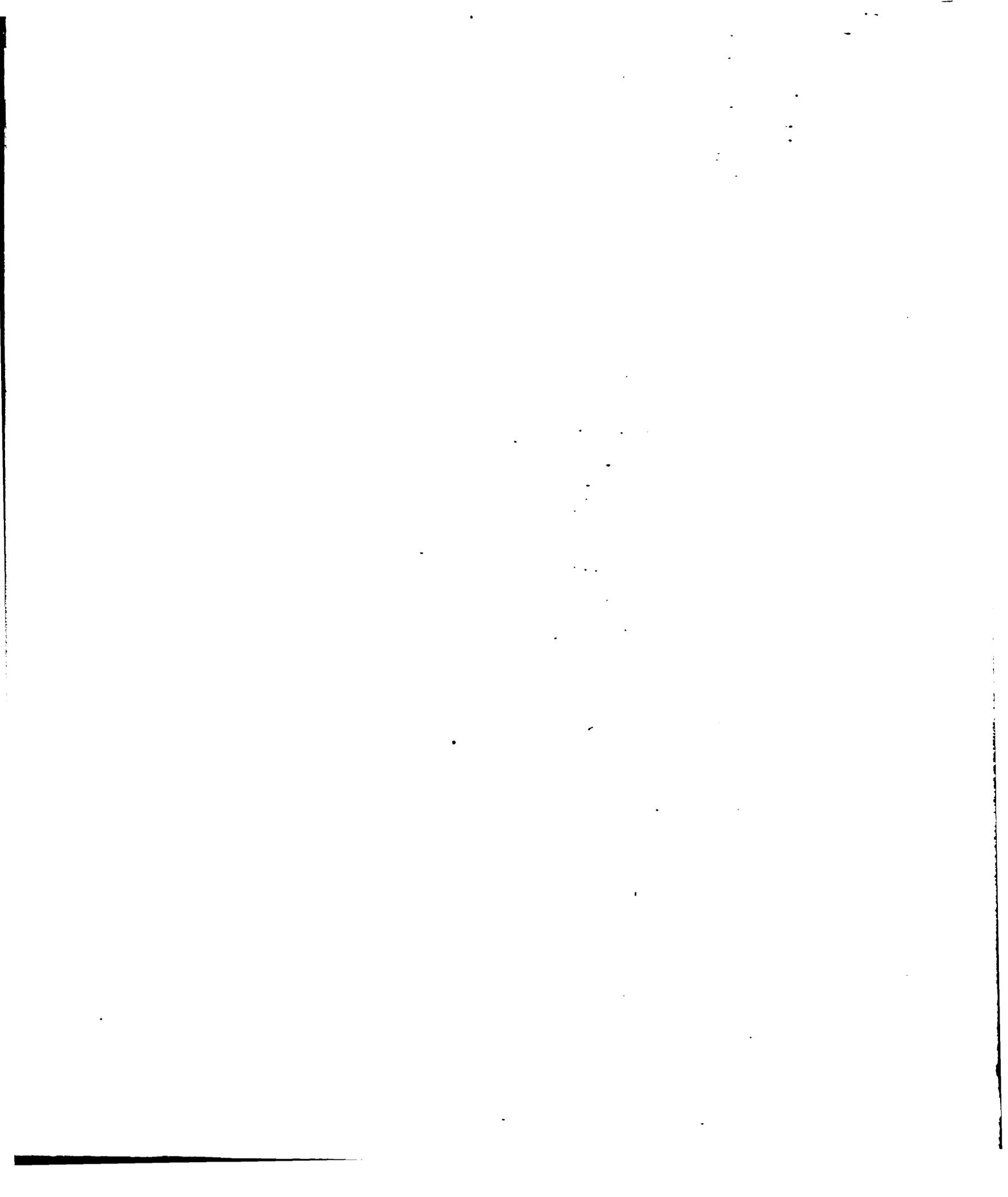
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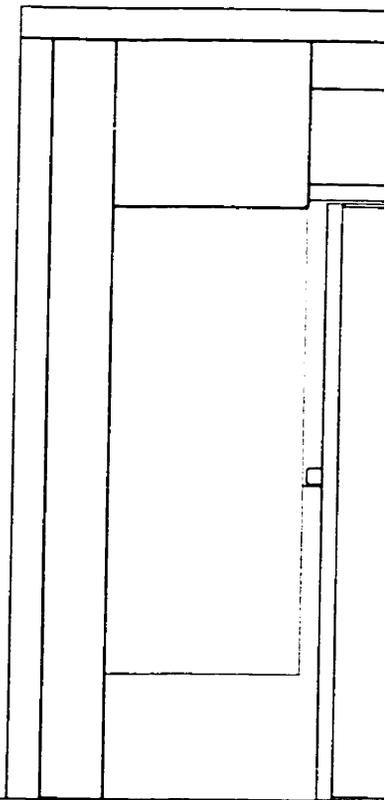
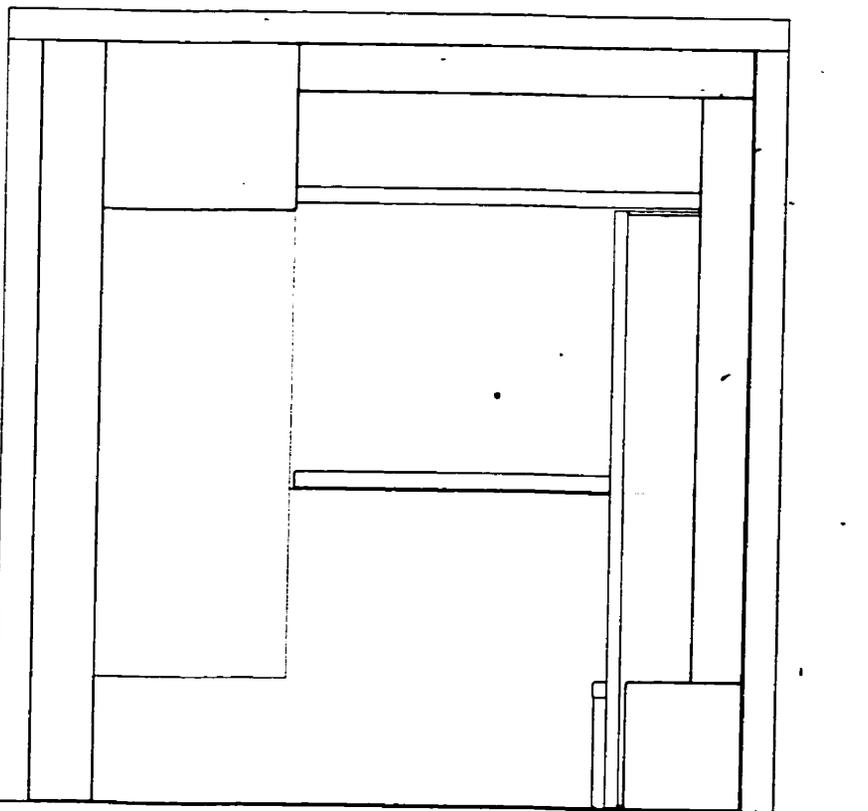
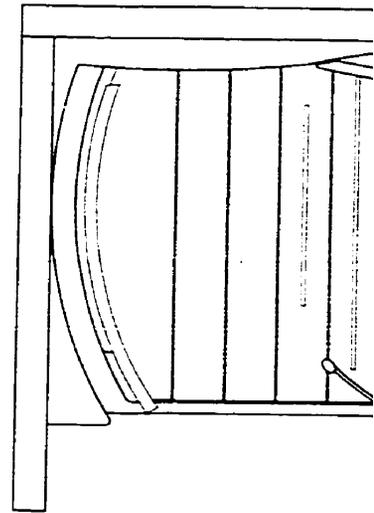
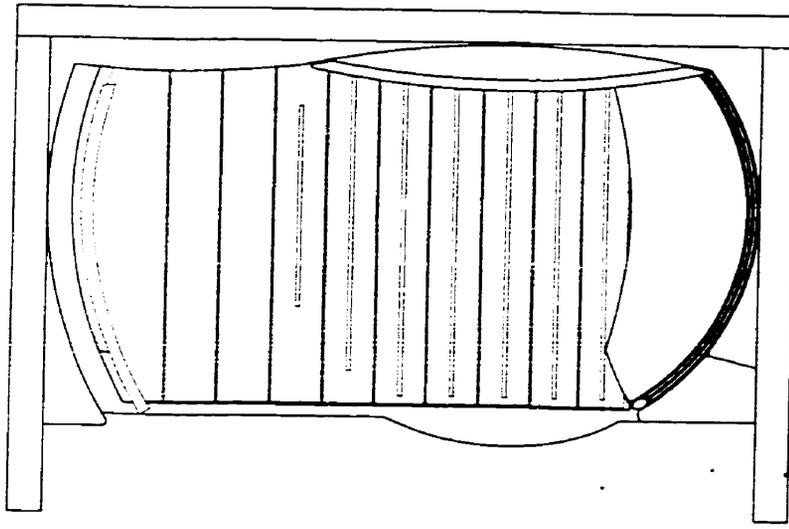






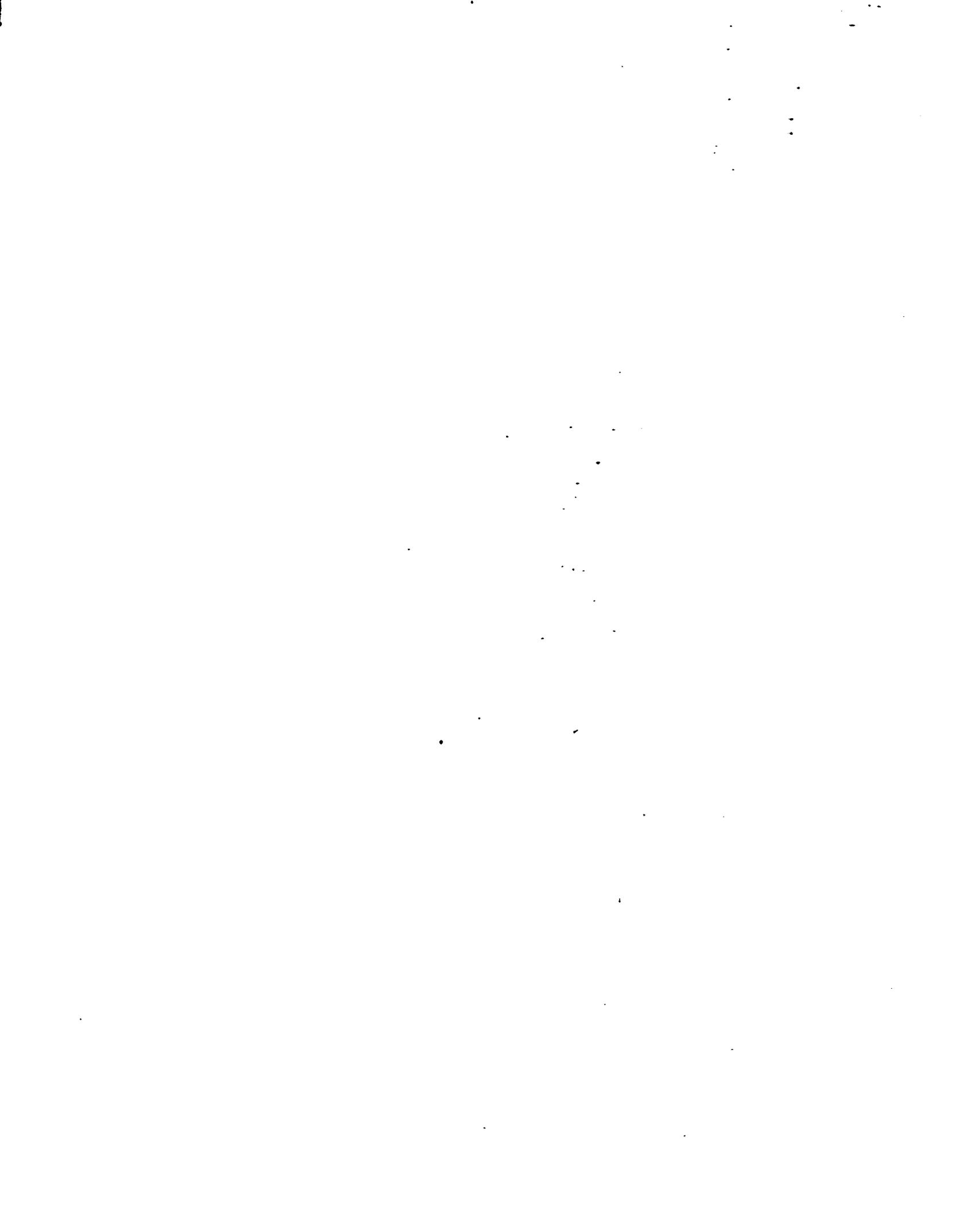
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|-----------------------------|----------------|---|--------------|
| BATHING UNIT - BENCH | | | |
| SCALE: 1:18 | DATE: 08/25/99 |  | PAGE: 1 OF 1 |
| DRAWN BY: AP | CLIENT: EVDS | | APPENDIX I |

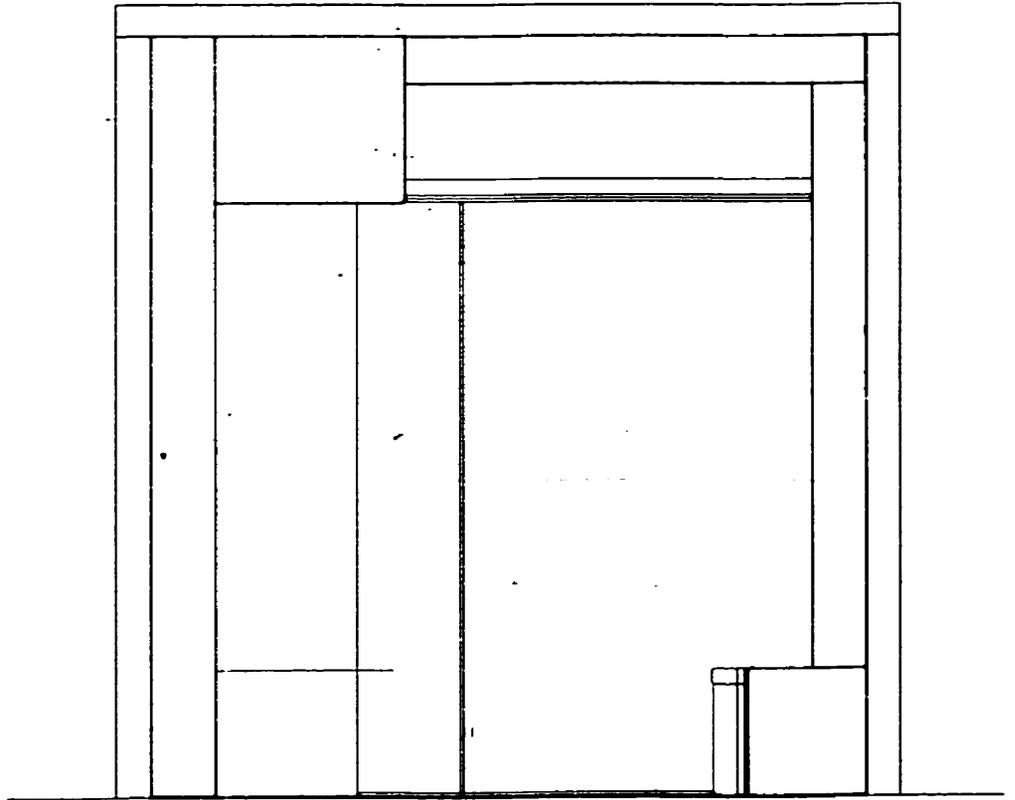
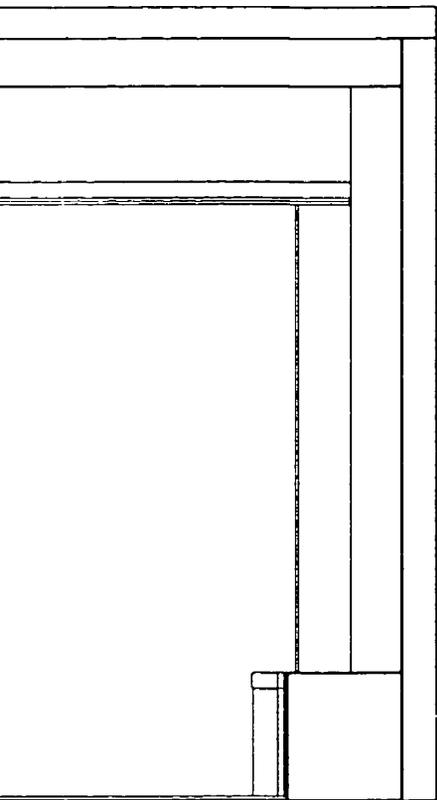
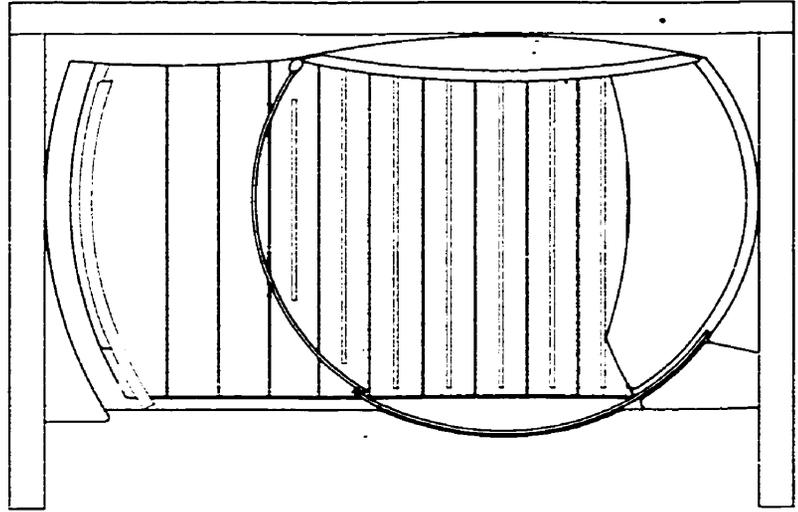
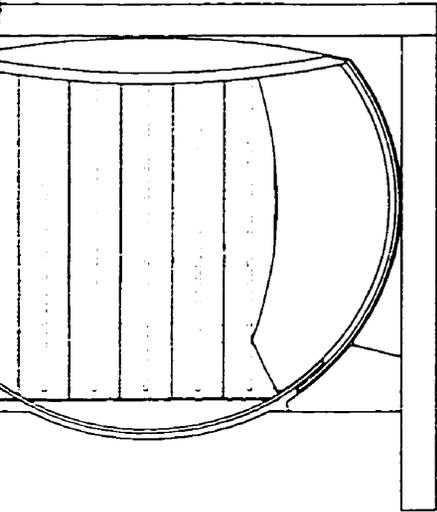




FULLY OPEN

PARTIAL





LLY CLOSED

FULLY CLOSED

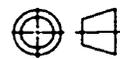
BATHING UNIT - ENCLOSURE POSITIONS

SCALE: 1:12

DATE: 08/25/99

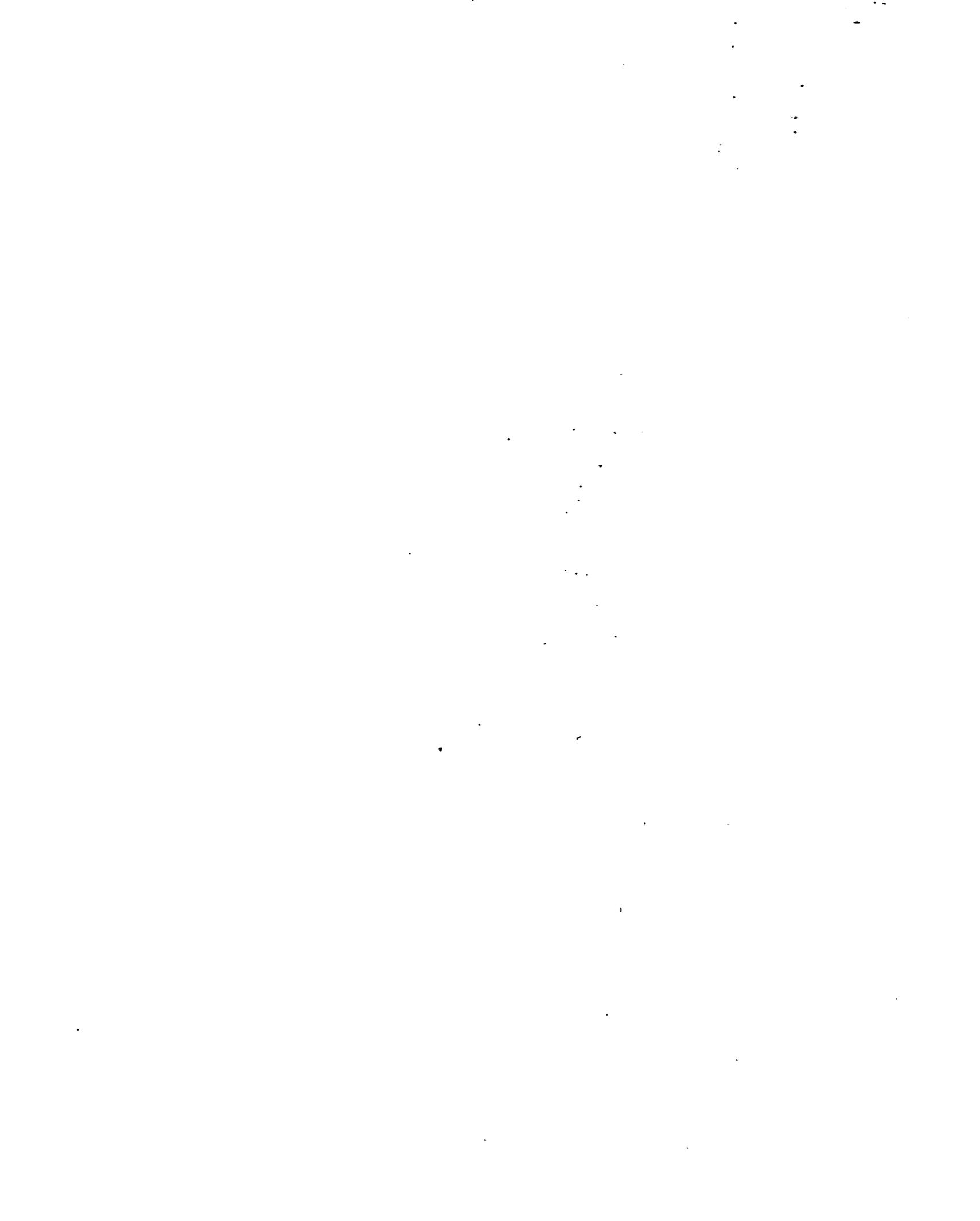
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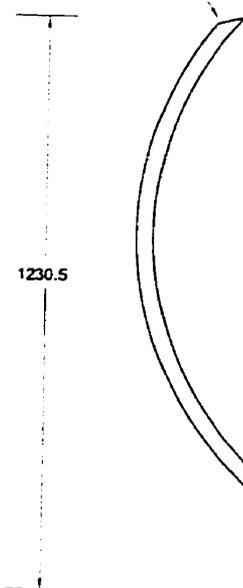


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APPENDIX I



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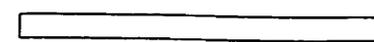
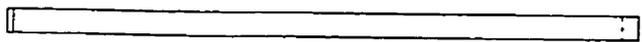


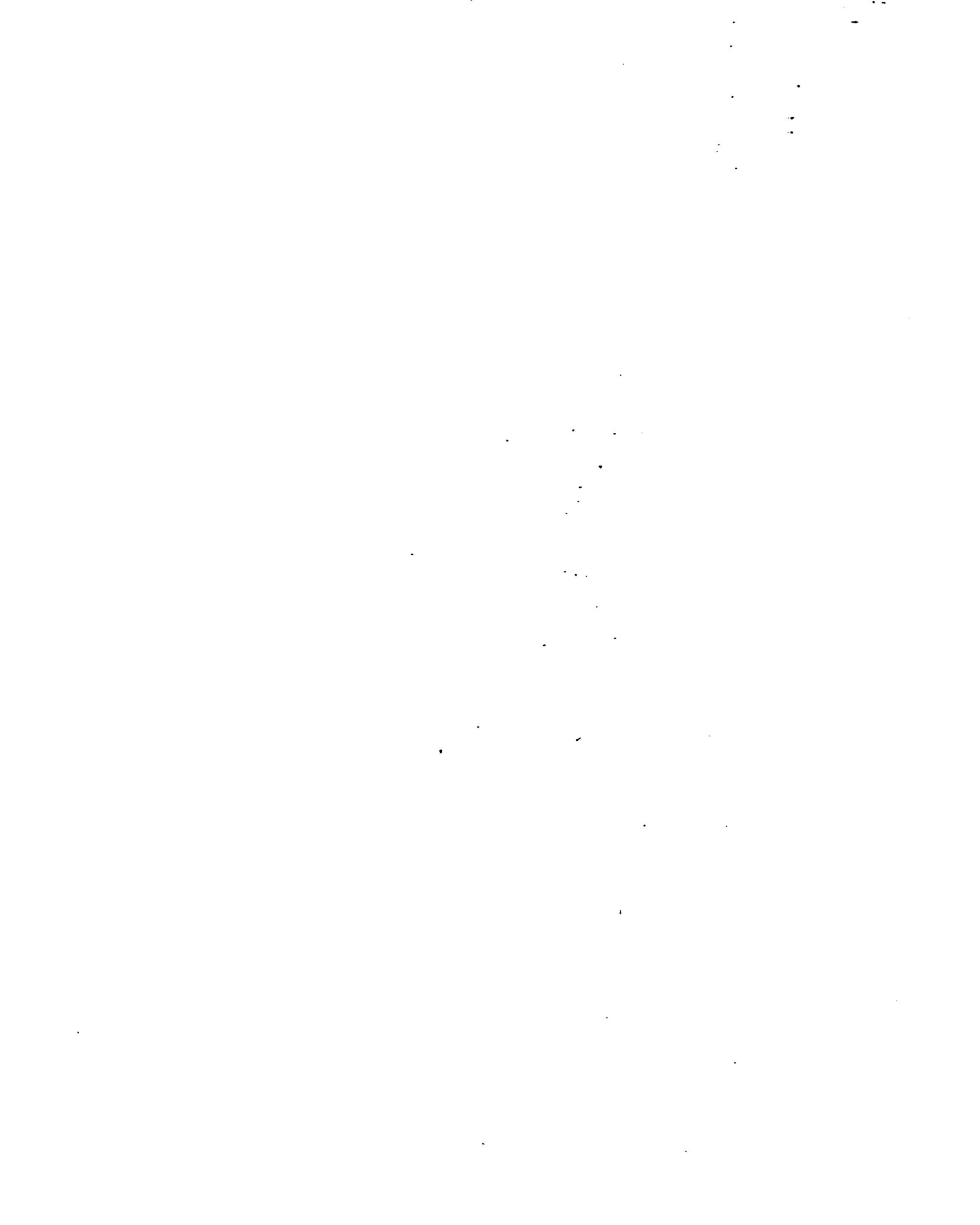
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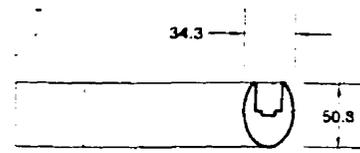
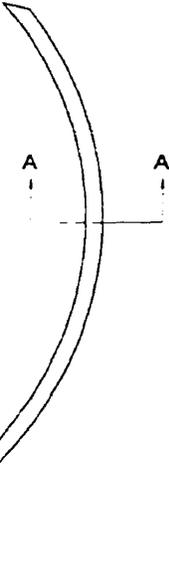
D 1454.9

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1524.0



SECTION AA
SCALE 1:6

BATHING UNIT - ENCLOSURE RAIL

SCALE: 1:18

DATE: 08/25/99

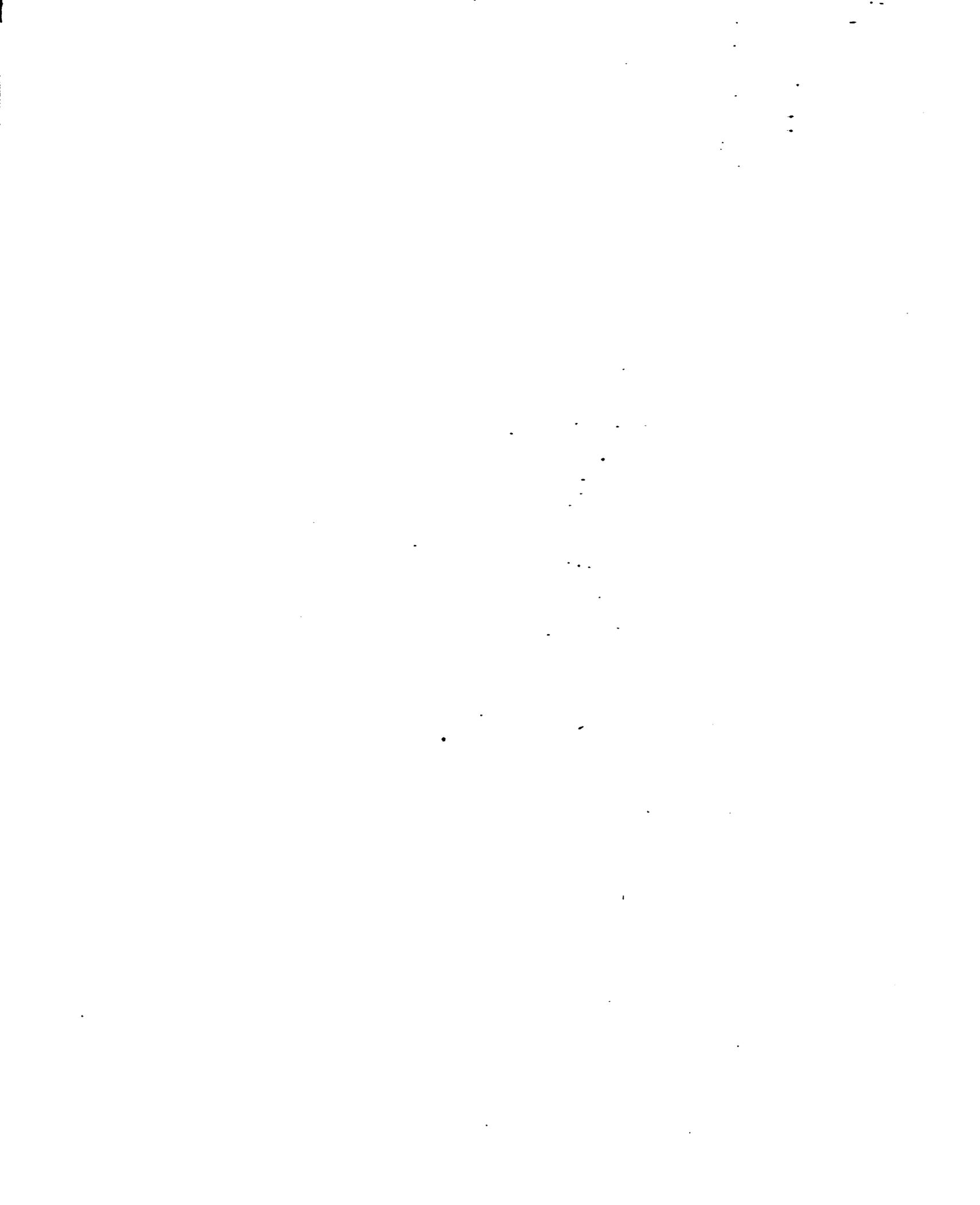
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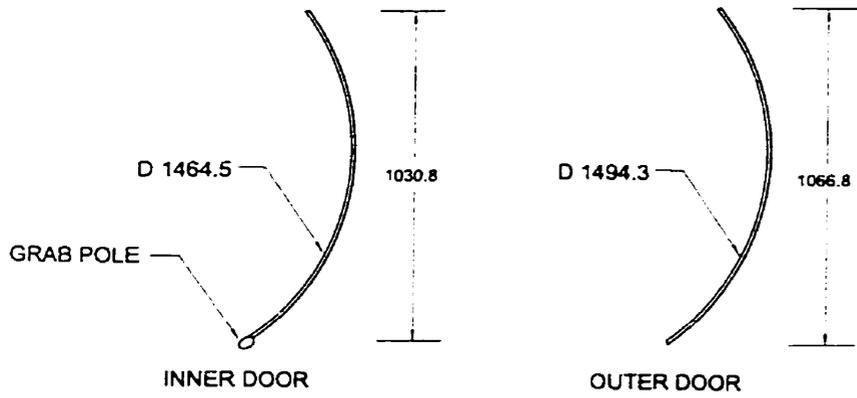
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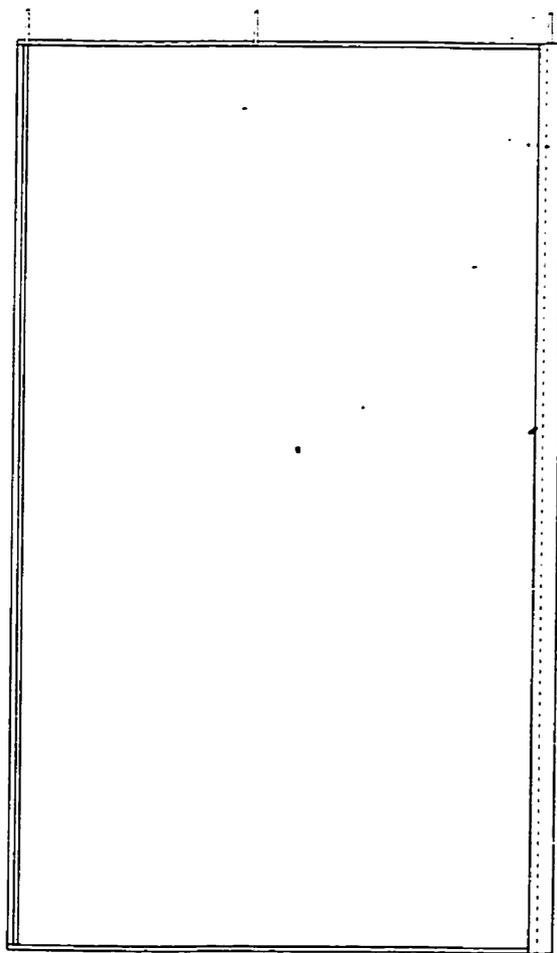
PAGE: 2 OF 3

APPENDIX I

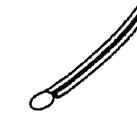




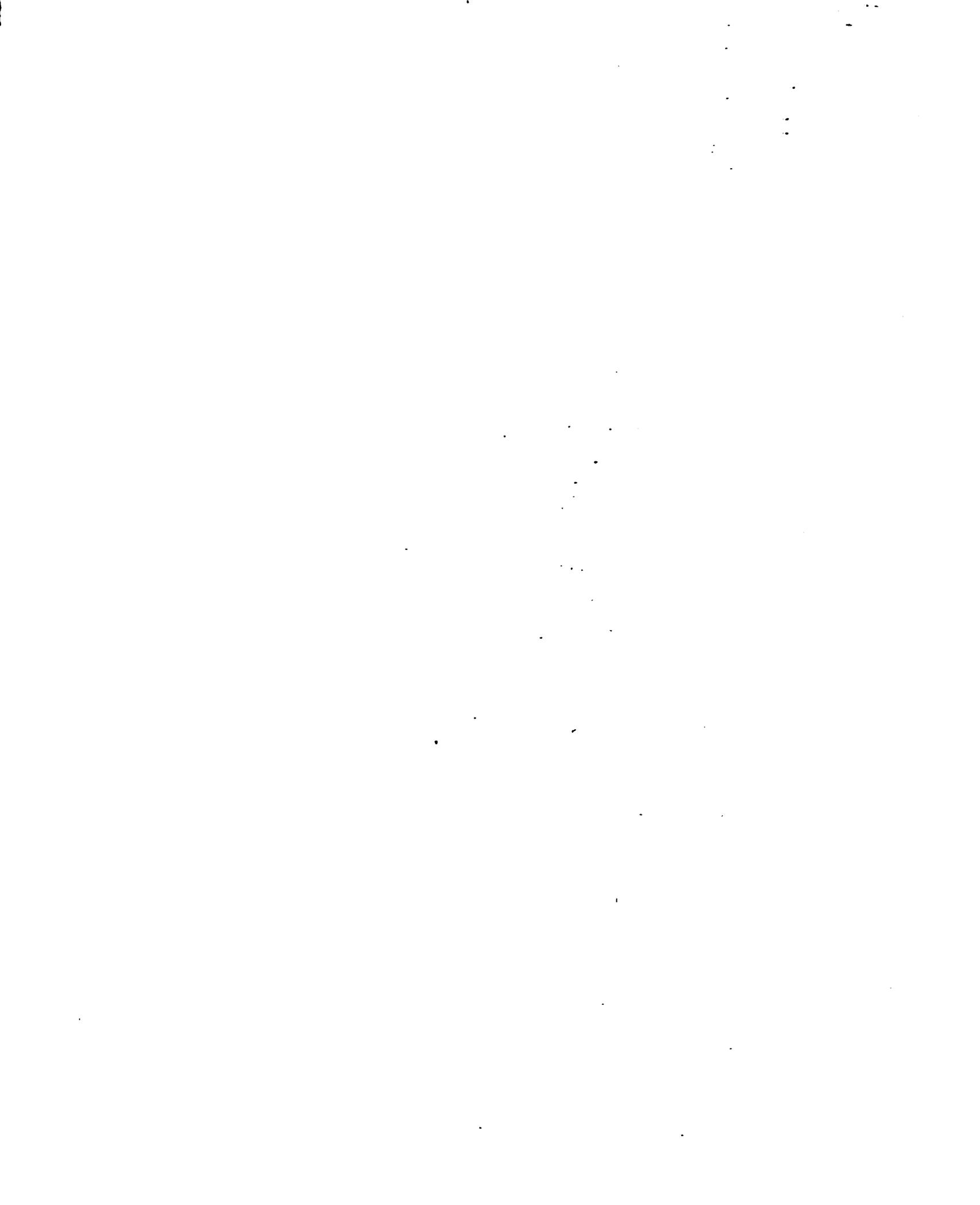
DOORS
SCALE 1:24

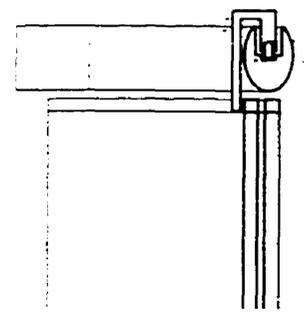
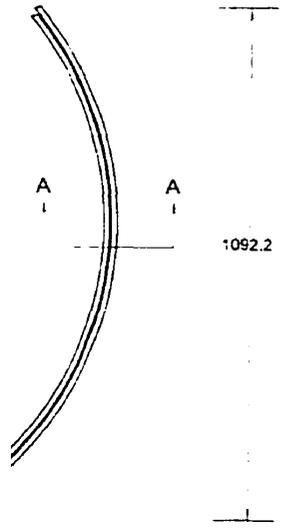


DOORS HUNG FROM ABOVE RAIL

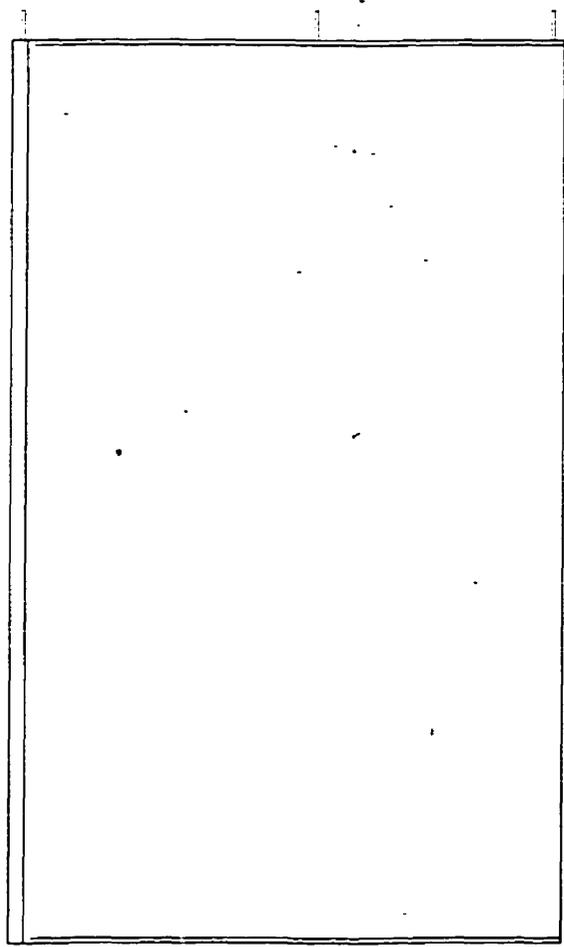
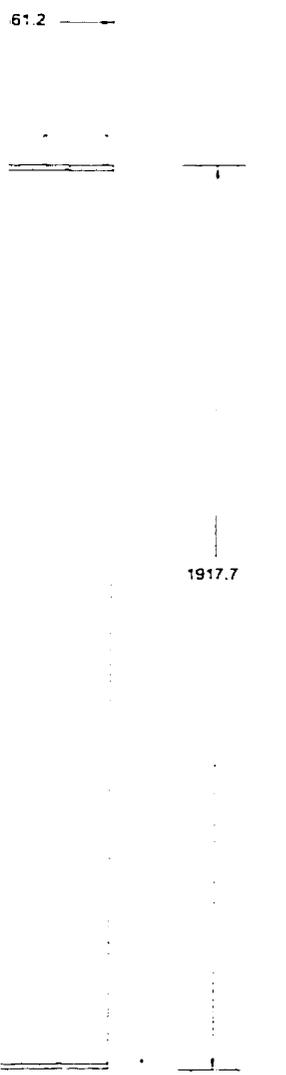


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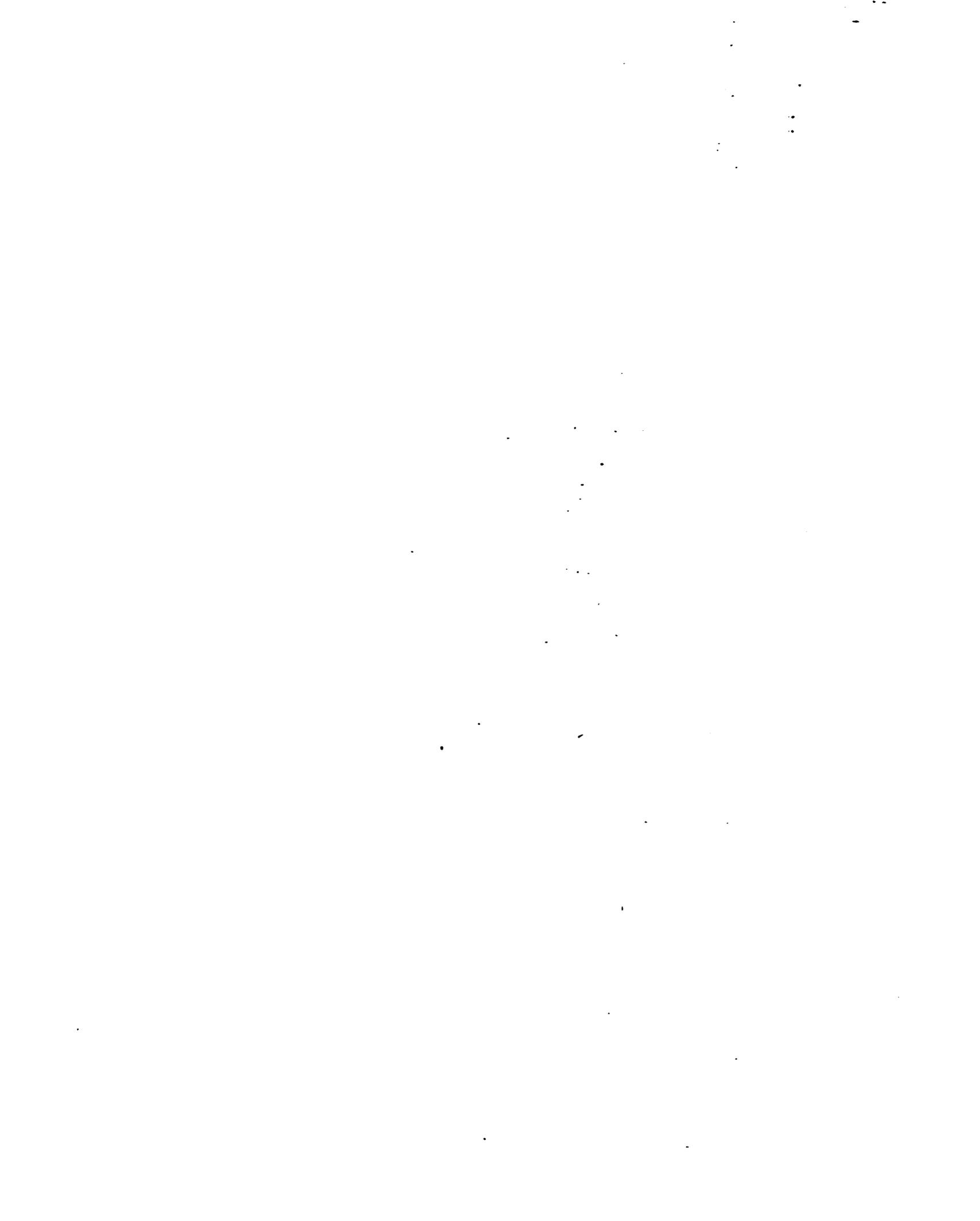


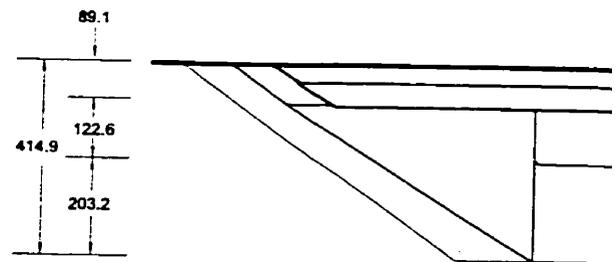
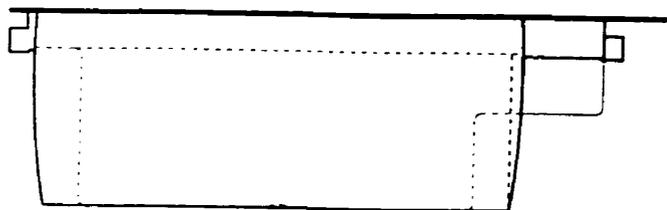
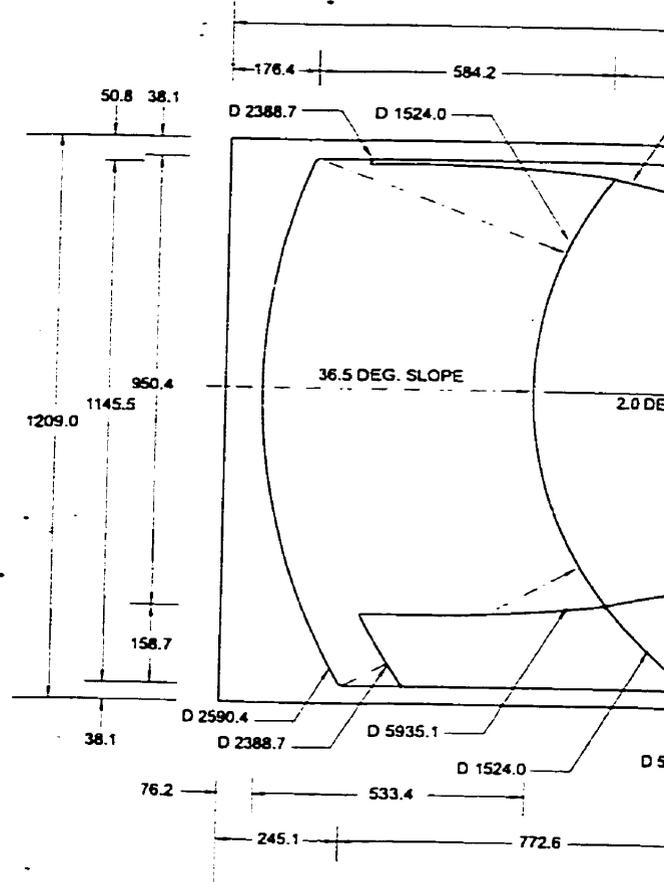


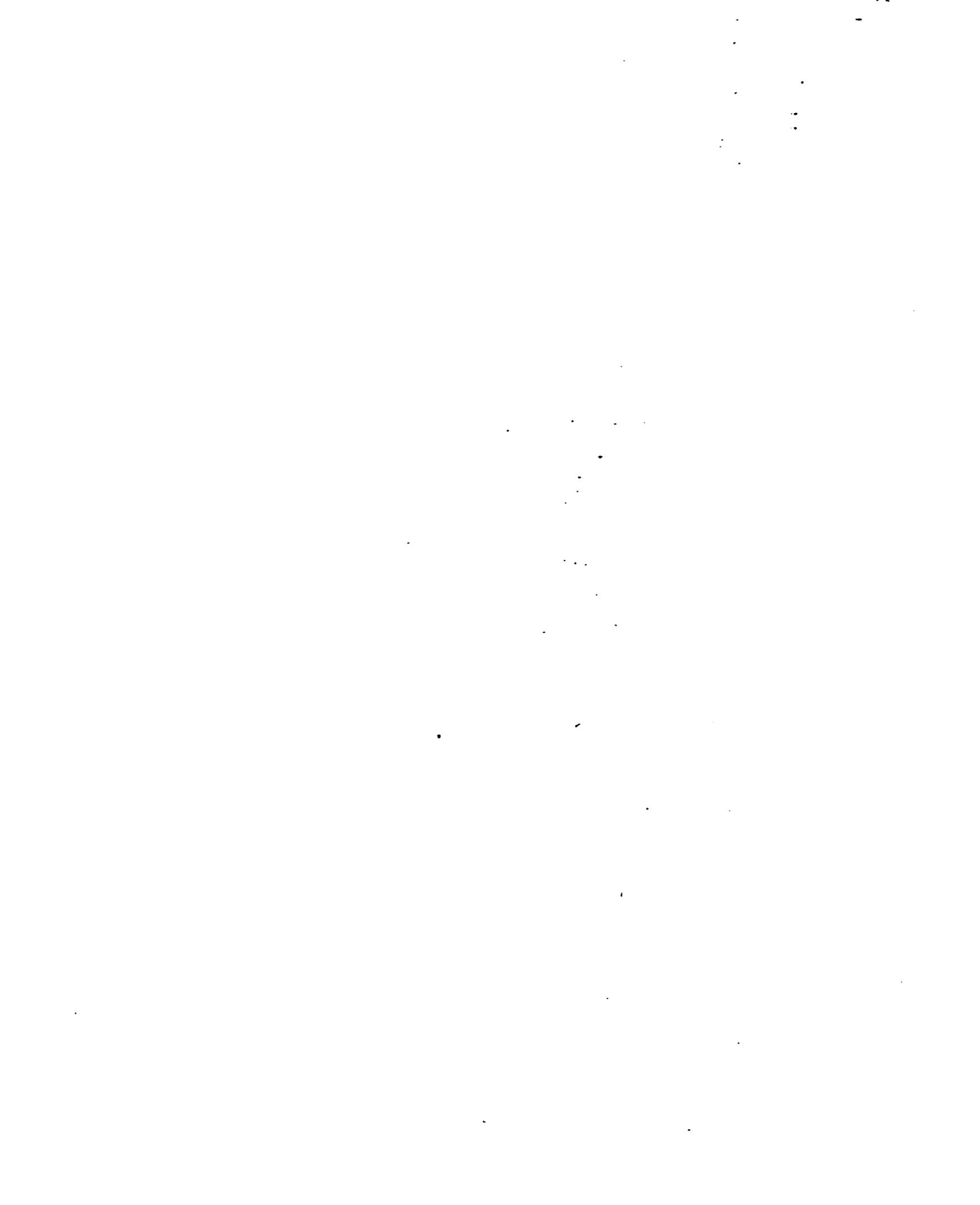
SECTION AA
DOORS WITH RAIL
 SCALE 1:6

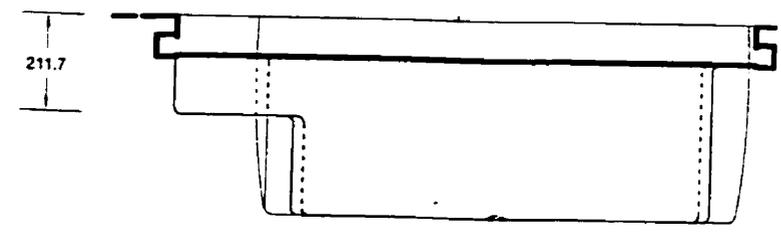
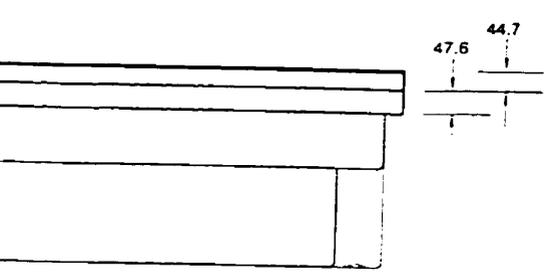
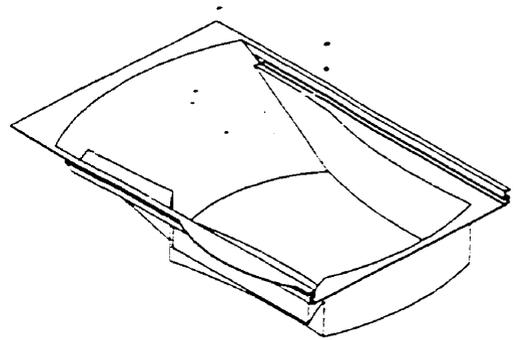
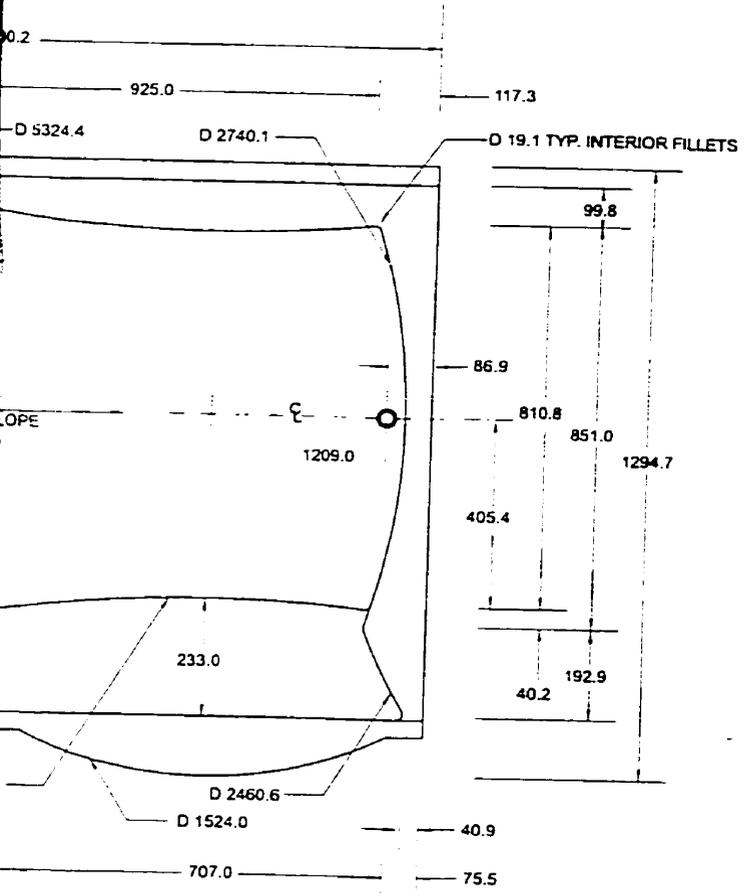


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|---------------------------------------|----------------|---|--------------|
| BATHING UNIT - ENCLOSURE DOORS | | | |
| SCALE: 1:18 | DATE: 08/25/99 |  | PAGE: 3 OF 3 |
| DRAWN BY: AP | CLIENT: EVDS | | APPENDIX I |

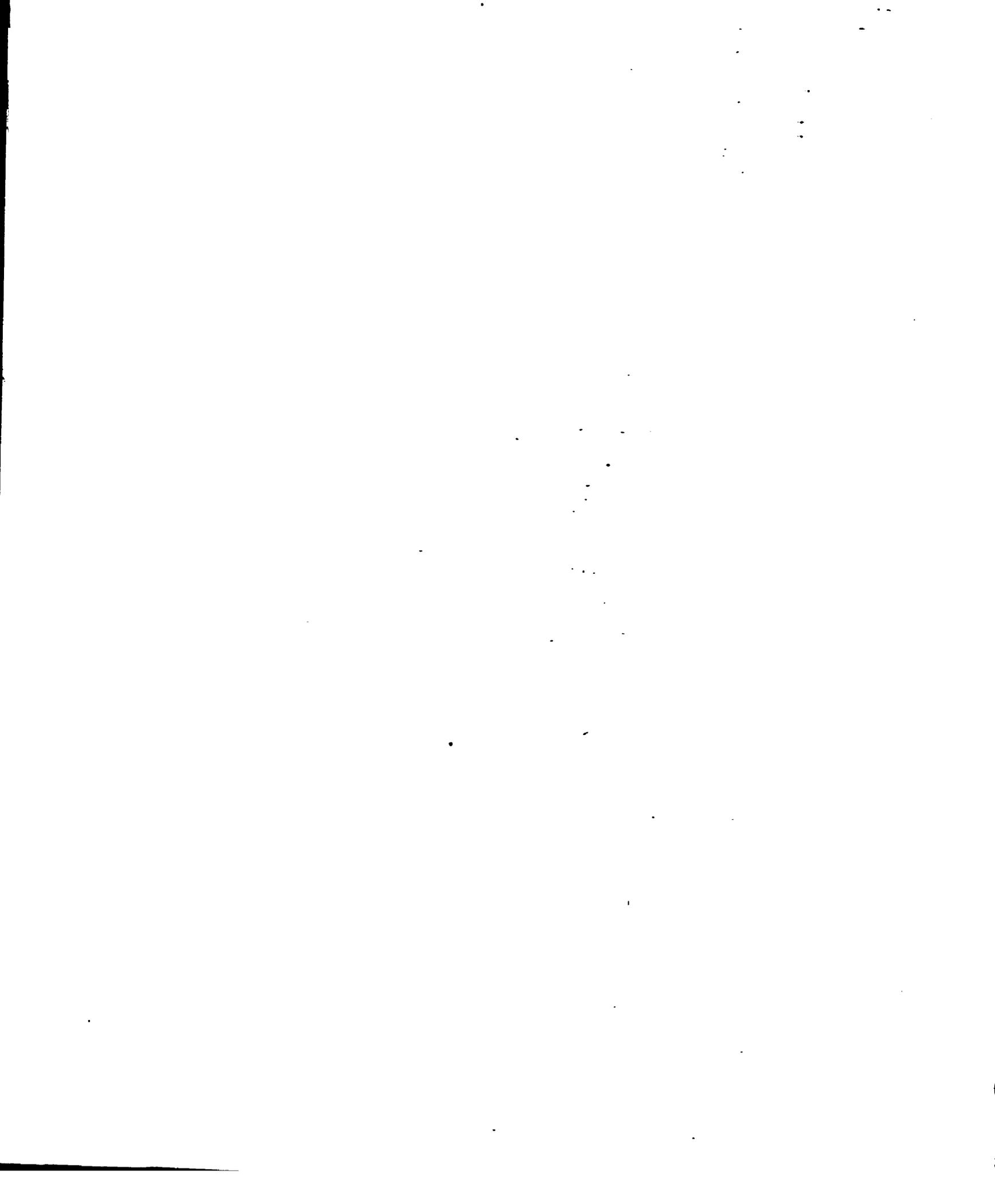


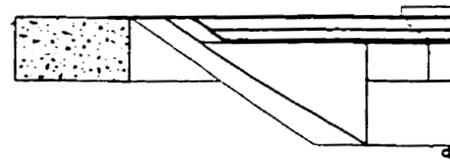
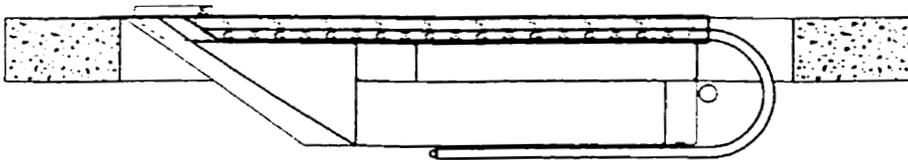
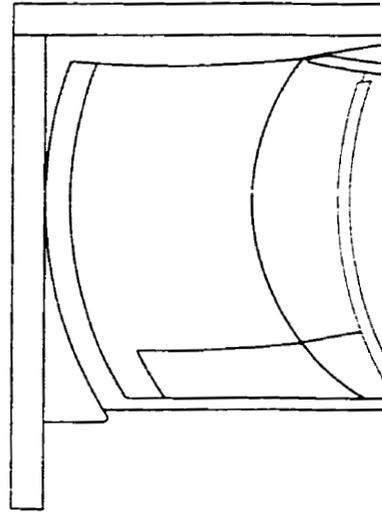
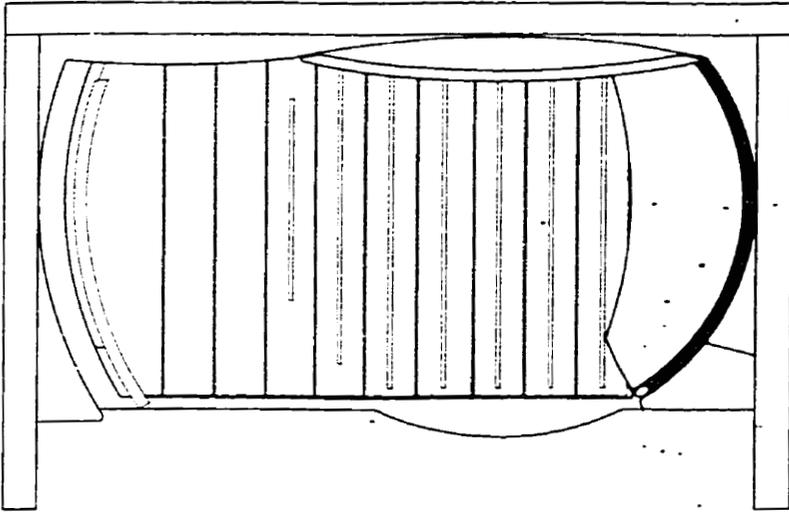






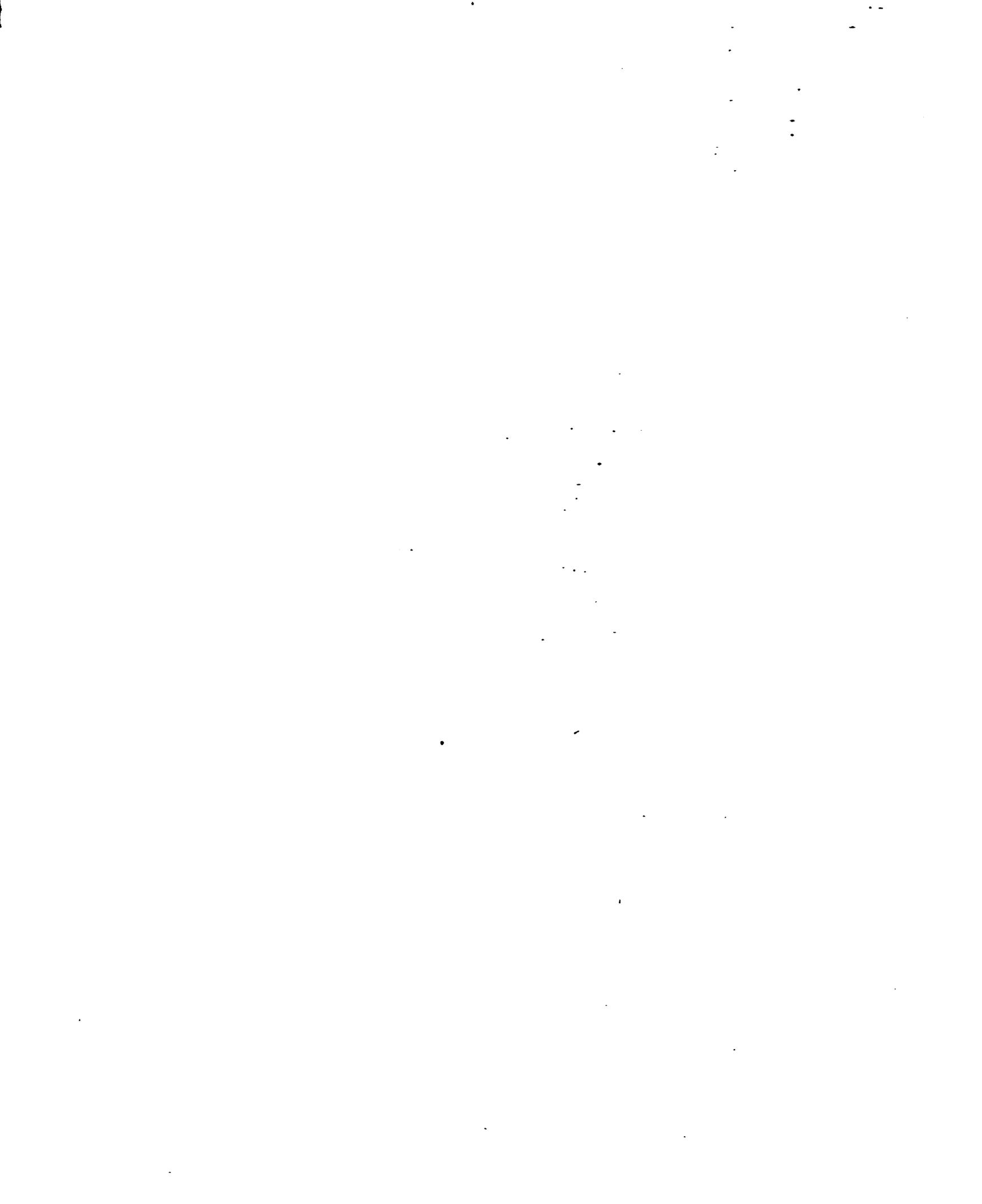
| | | | |
|---------------------------|----------------|---|--------------|
| BATHING UNIT - TUB | | | |
| SCALE: 1:18 | DATE: 08/25/99 |  | PAGE: 1 OF 1 |
| DRAWN BY: AP | CLIENT: EVDS | | APPENDIX I |

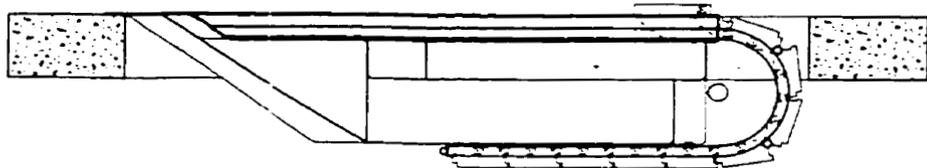
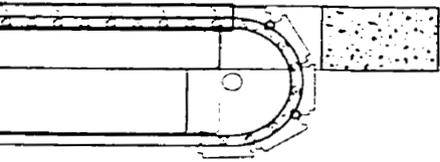
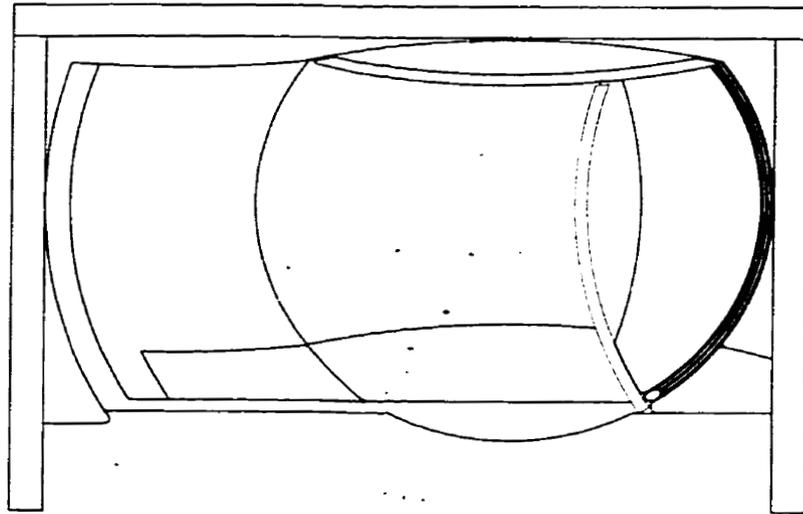
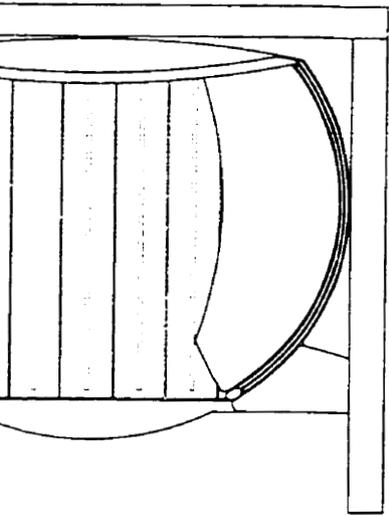




FULLY CLOSED

PARTIAL





OPEN

FULLY OPEN

BATHING UNIT - RETRACTABLE PLATFORM POSITIONS

SCALE: 1:12

DATE: 08/25/99

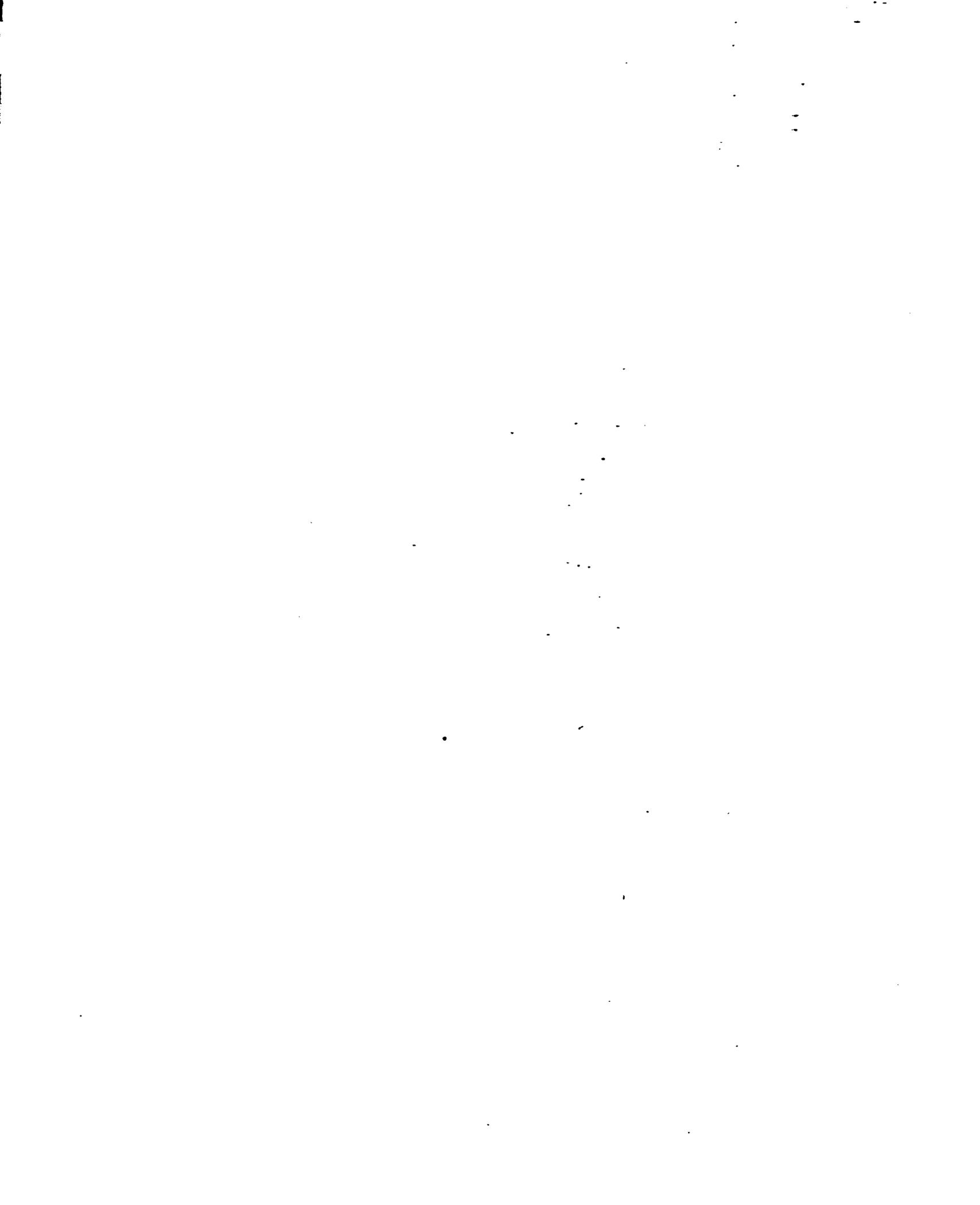
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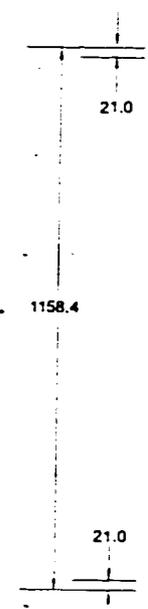
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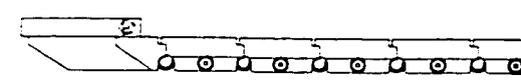
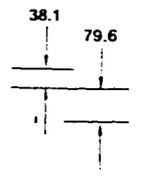
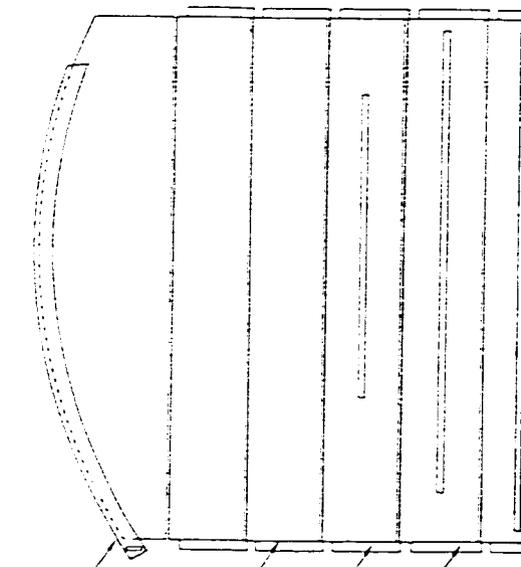
PAGE: 1 OF 5

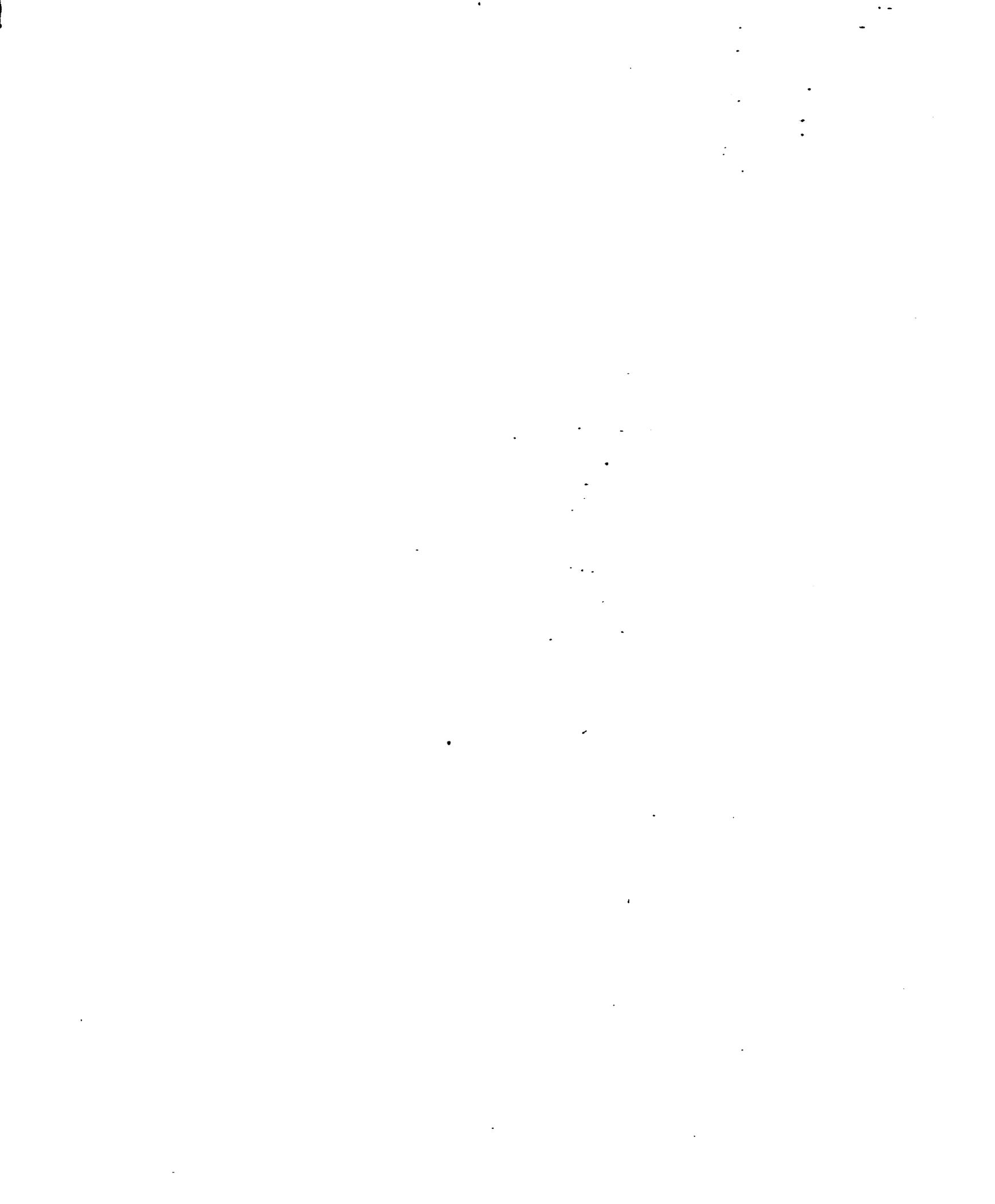
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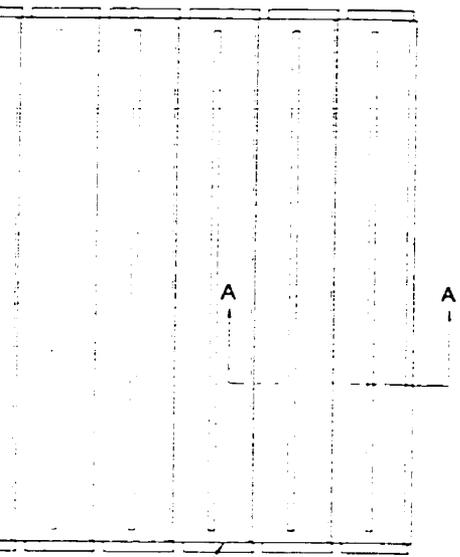


SLAT A5
(END SLAT)

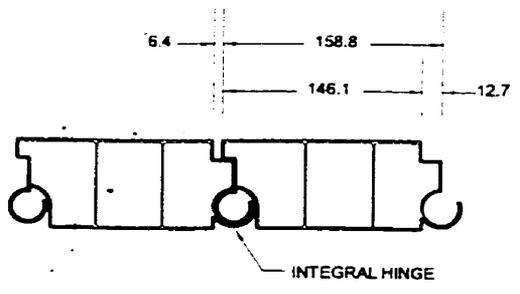




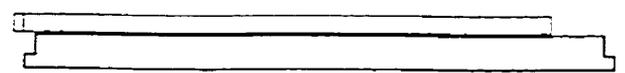
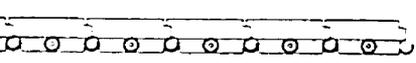
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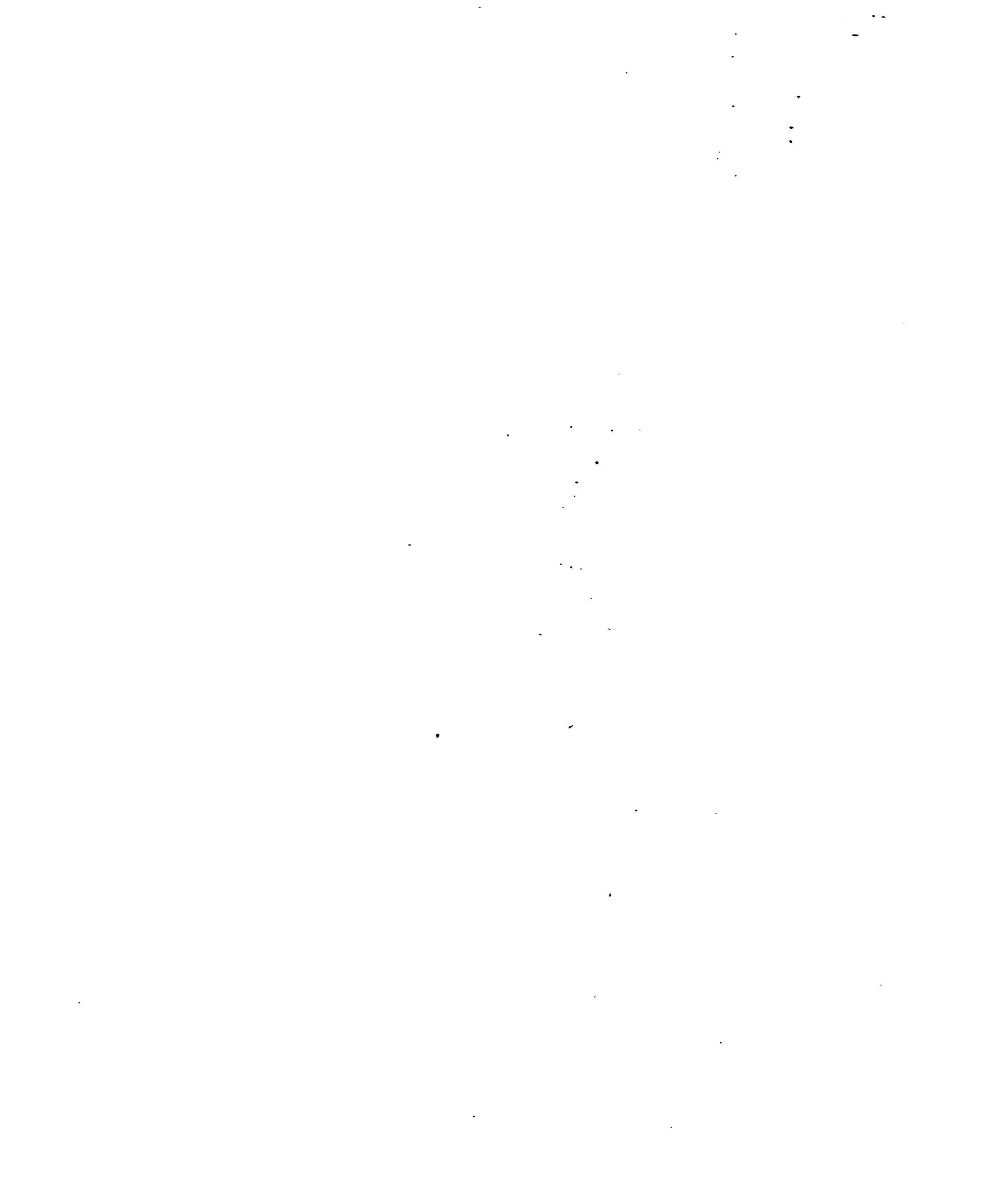
SLAT A4

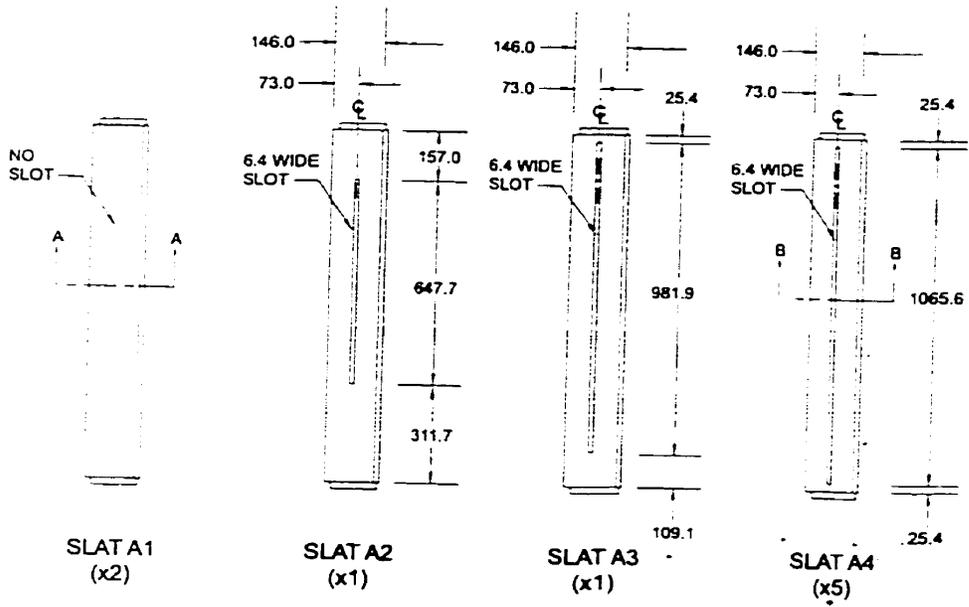


SECTION AA
TYPICAL SLAT ASSEMBLY
 SCALE 1:6

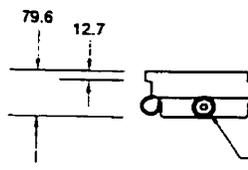
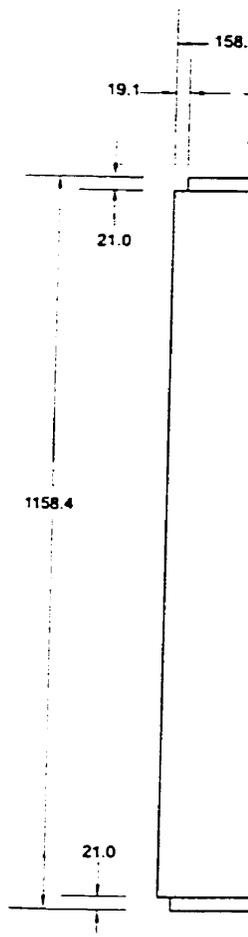


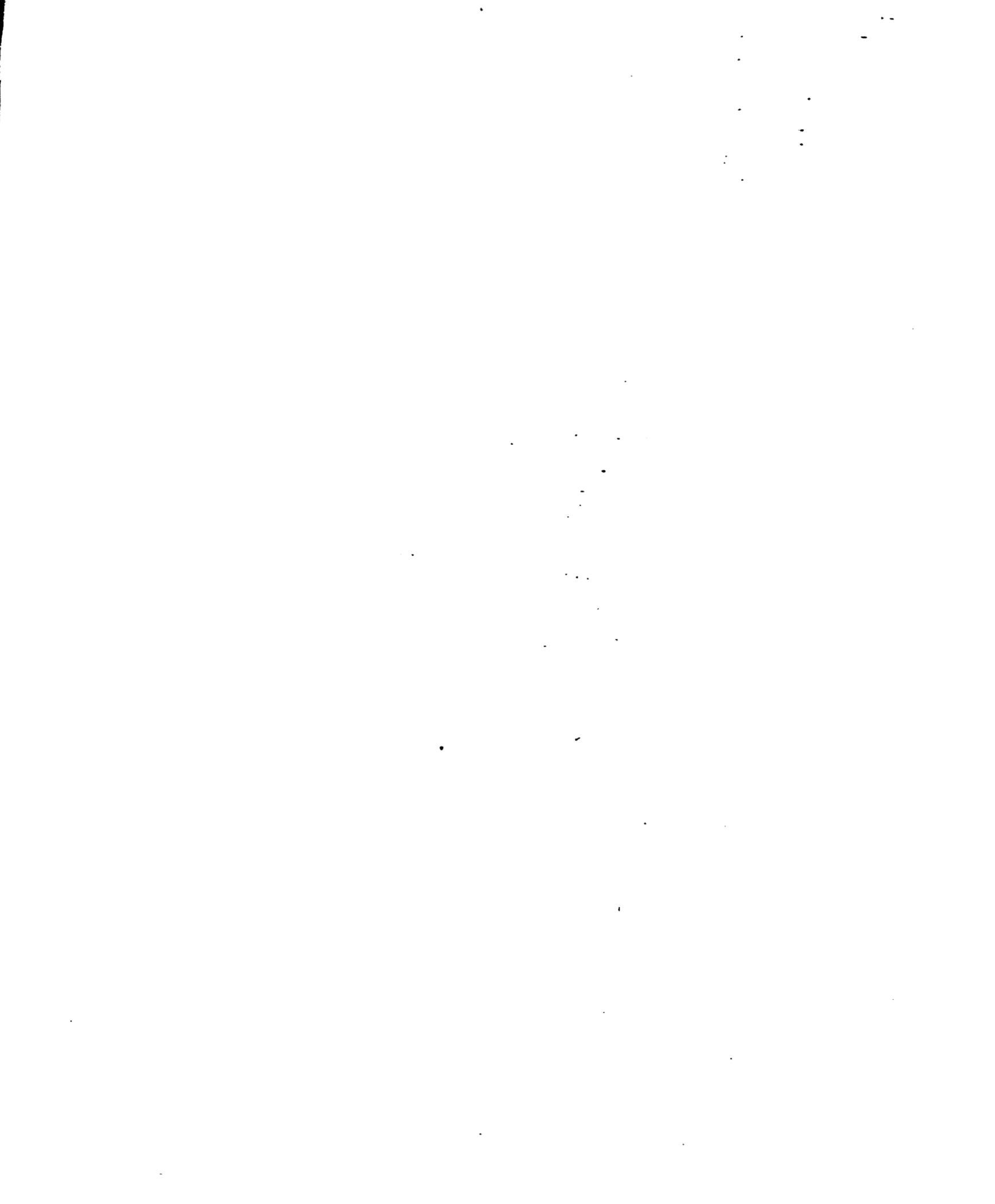
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| BATHING UNIT - RETRACTABLE PLATFORM ASSEMBLY | | | |
| SCALE: 1:18 | DATE: 08/25/99 | | PAGE: 2 OF 5 |
| DRAWN BY: AP | CLIENT: EVDS | | APPENDIX I |



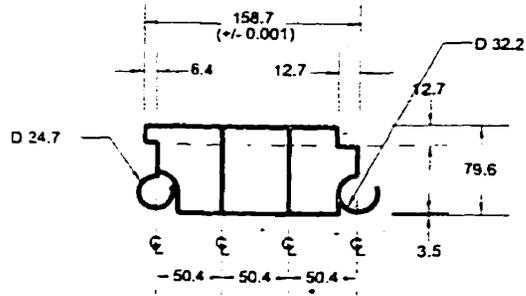


SLOT PLACEMENTS
SCALE 1:24

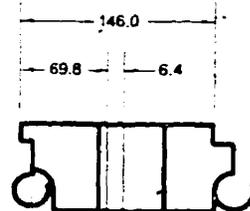




12.7
6.4



SECTION AA
SCALE 1:6

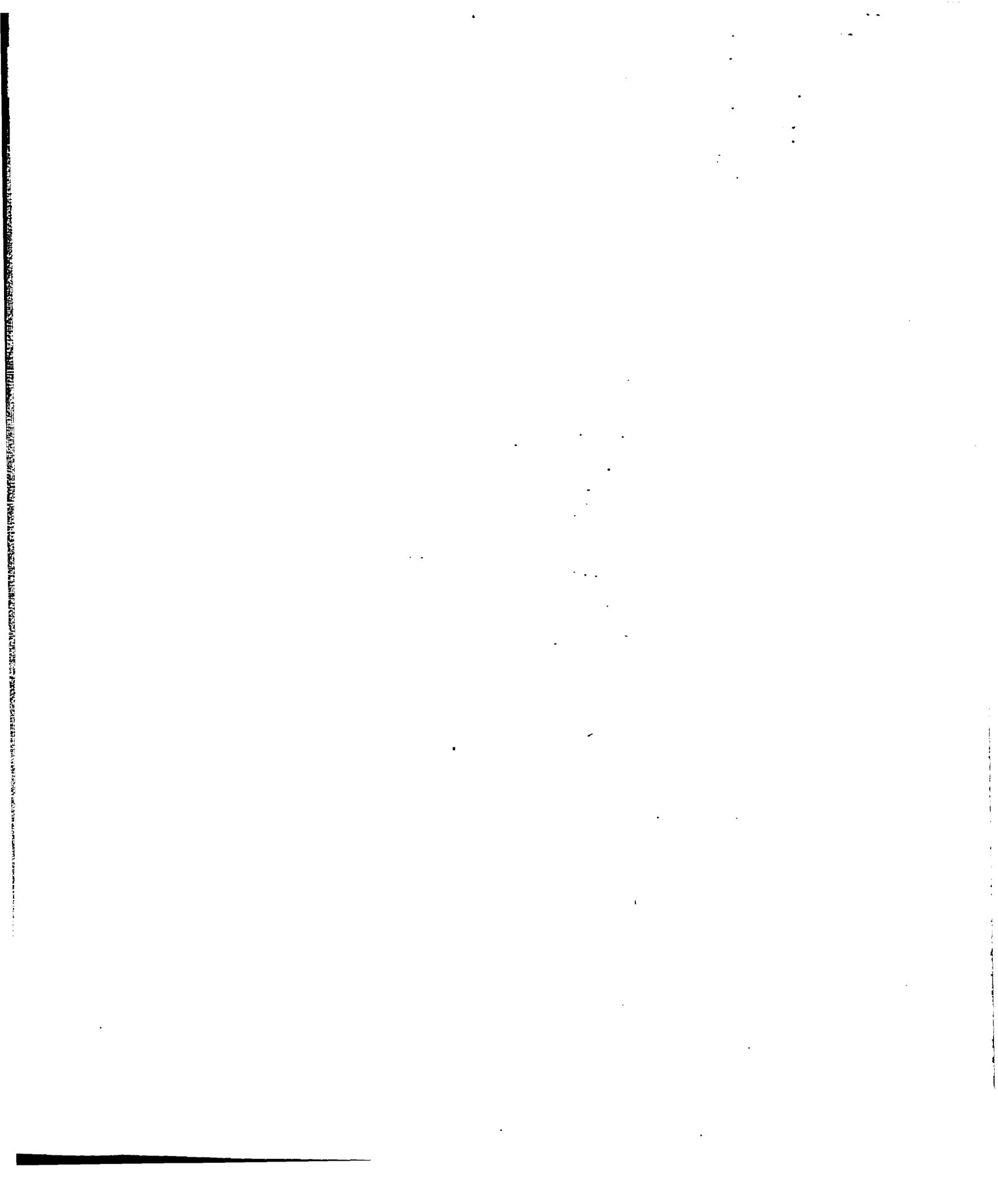


SECTION BB
SCALE 1:6



HEEL - D 31.8

| | | | |
|--|----------------|--|--------------|
| BATHING UNIT - RETRACTABLE PLATFORM SLATS A1-A4 | | | |
| SCALE: 1:12 | DATE: 08/25/99 | | PAGE: 3 OF 5 |
| DRAWN BY: AP | CLIENT: EVDS | | APPENDIX I |



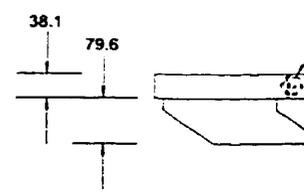
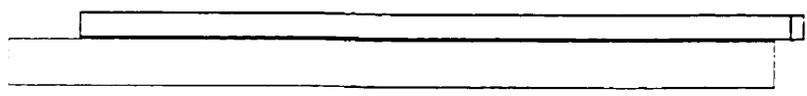
12.7 272.6 152.4

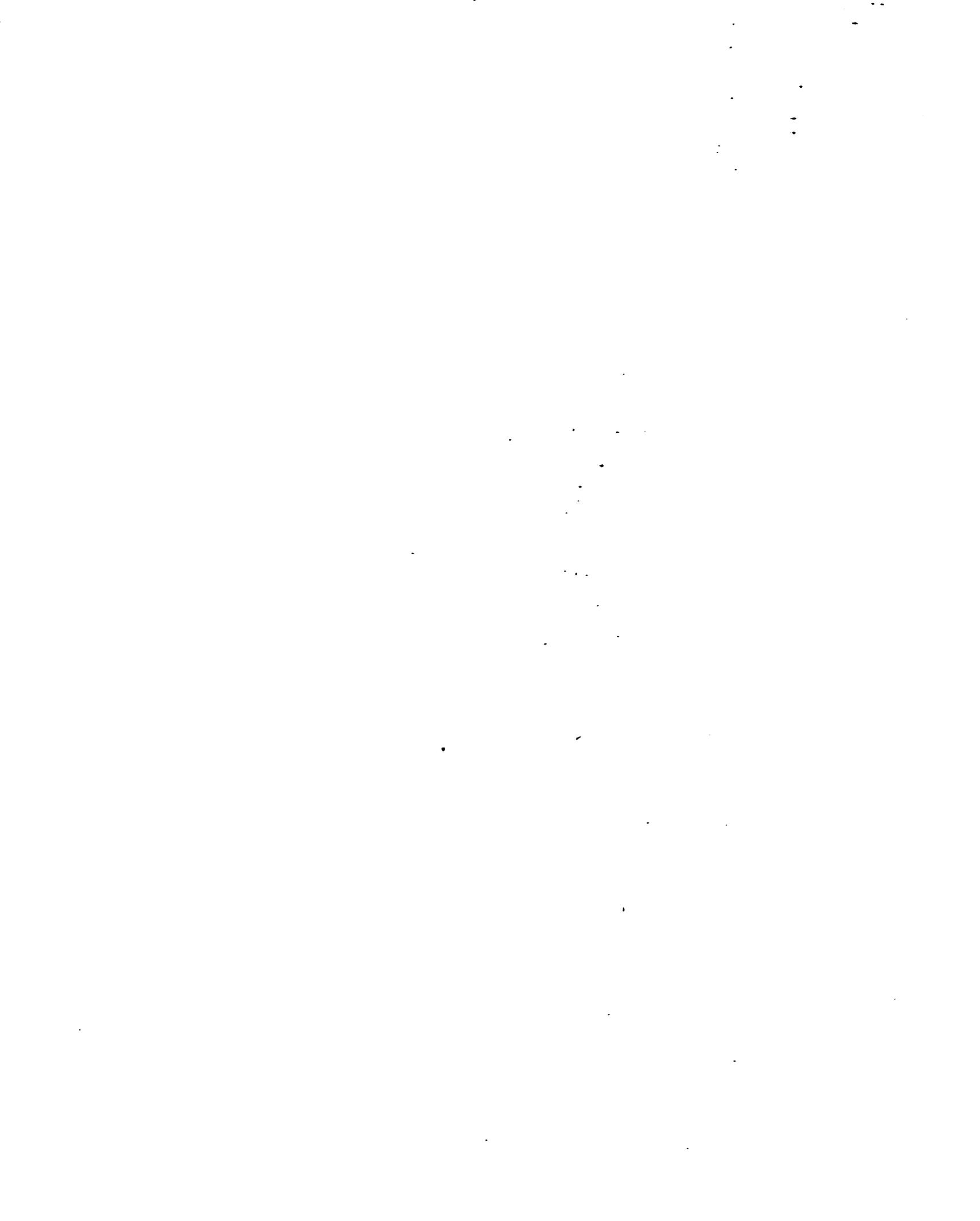
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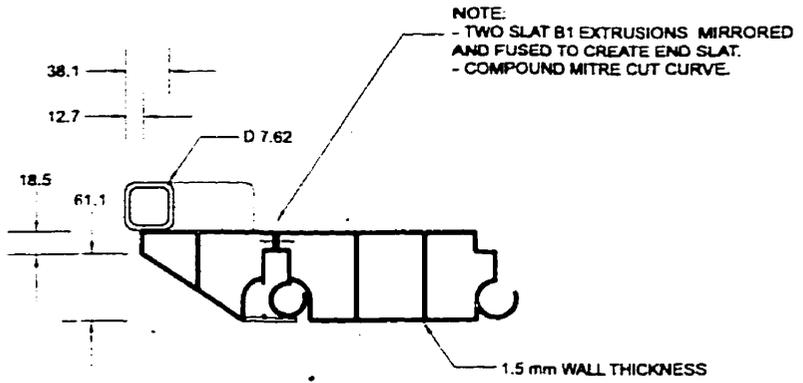
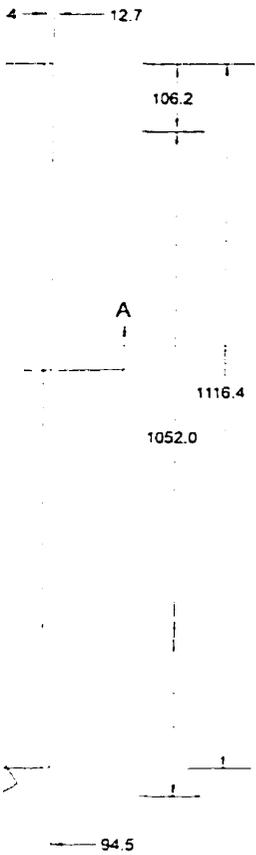
A

D 2460.6

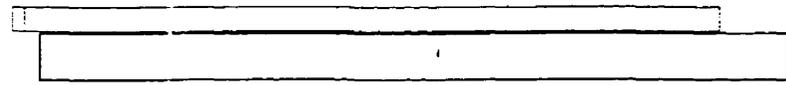
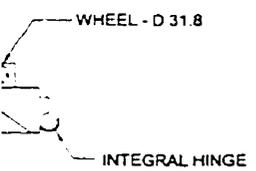
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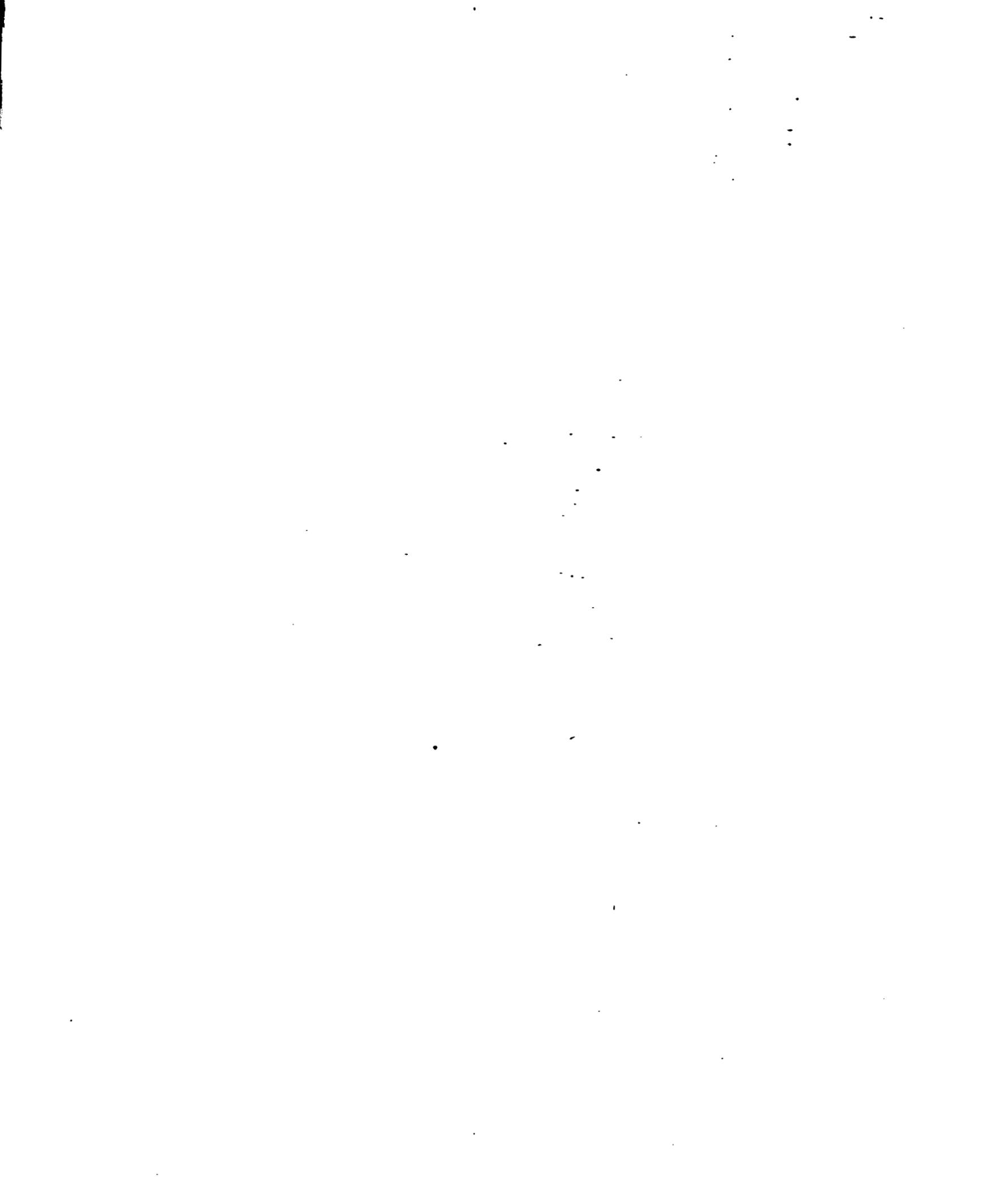


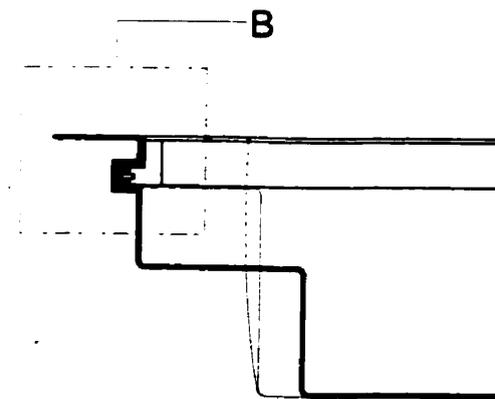
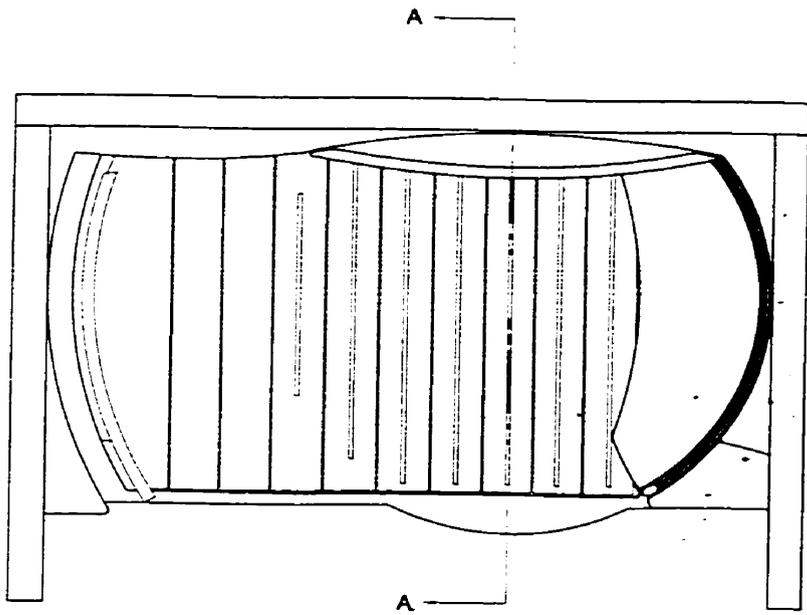


SECTION AA
SCALE 1:6

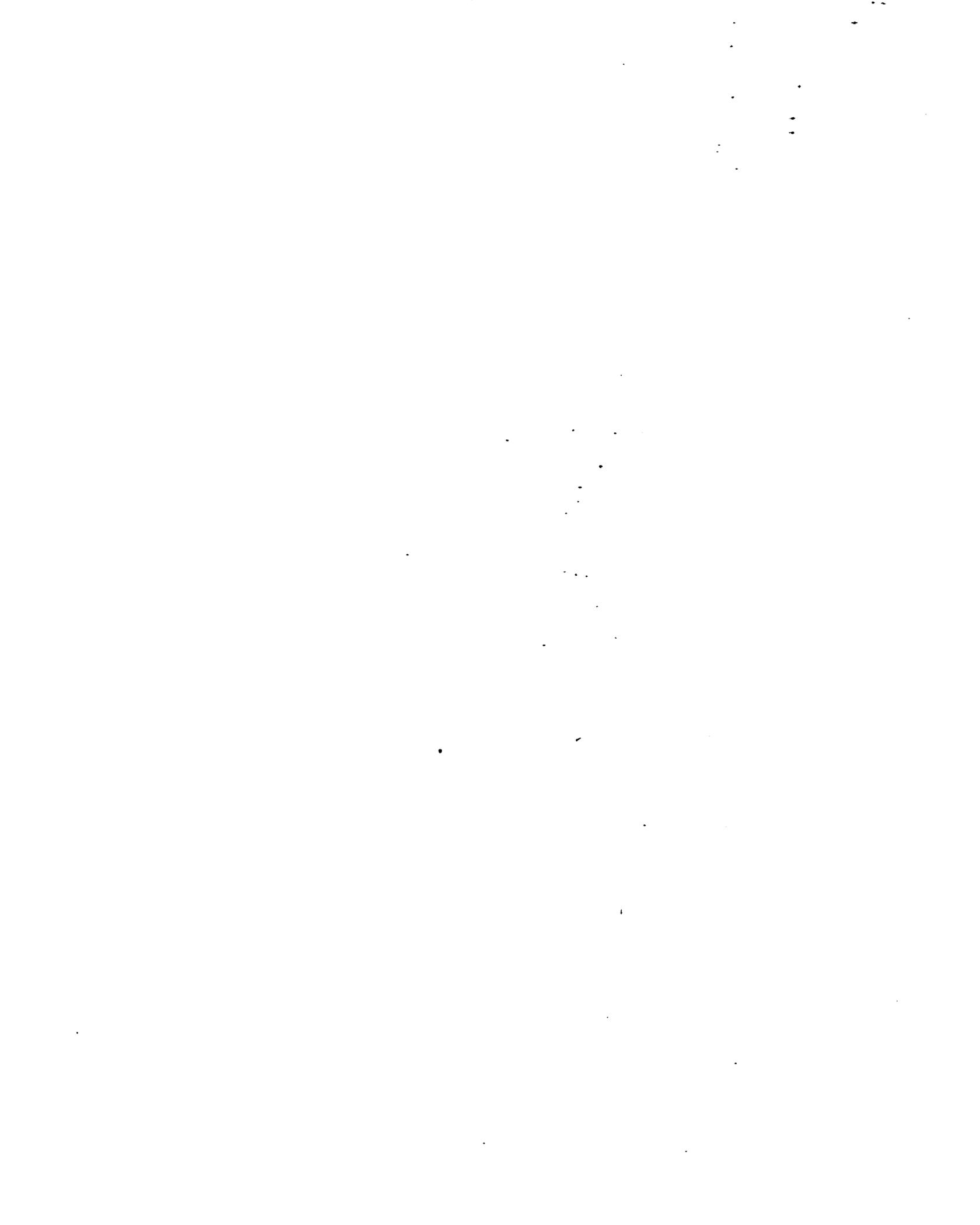


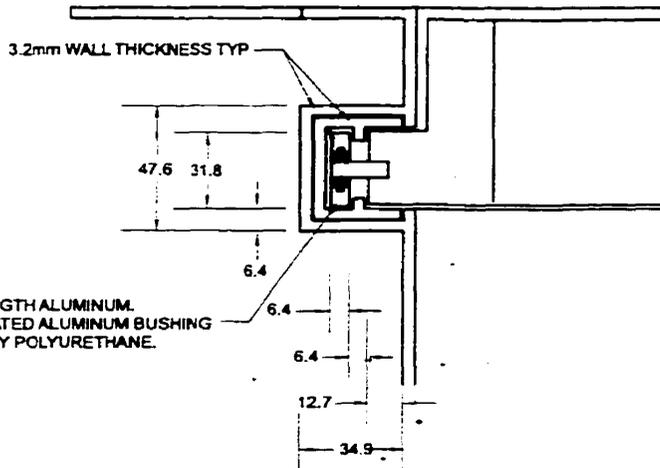
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|--|----------------|---|--------------|
| BATHING UNIT - RETRACTABLE PLATFORM A5 END SLAT | | | |
| SCALE: 1:12 | DATE: 08/25/99 |  | PAGE: 4 OF 5 |
| DRAWN BY: AP | CLIENT: EVDS | | APPENDIX I |





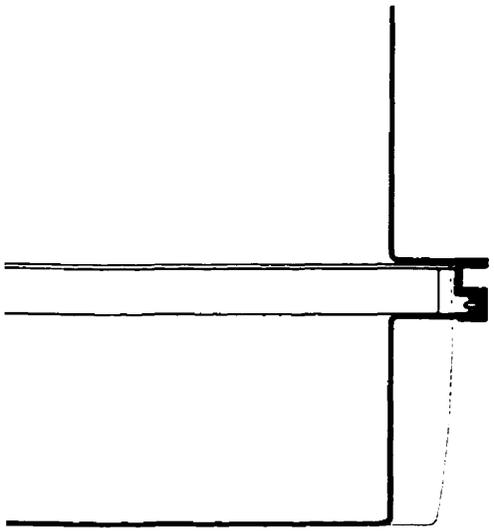
SECTION AA
SCALE 1:12

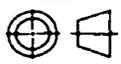




NOTE:
 - PIN - HIGH STRENGTH ALUMINUM.
 - WHEEL - INTEGRATED ALUMINUM BUSHING
 WITH HIGH DENSITY POLYURETHANE.

DETAIL B
 SCALE 1:3



| | | | |
|---|----------------|---|--------------|
| BATHING UNIT - RETRACTABLE PLATFORM SECTIONS | | | |
| SCALE: 1:12 | DATE: 08/25/99 |  | PAGE: 5 OF 5 |
| DRAWN BY: AP | CLIENT: EVDS | | APPENDIX I |

