THE PLANNING AND DESIGN
OF
MENTAL HEALTH TREATMENT CENTRES

Vol. 1

JOSEPH MacNEAL CREWS

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Abstract

This research thesis was developed as a planning and design reference for mental health treatment centres. This text is intended to assist planners, designers, and health practitioners to optimize patient health and comfort by providing suitable environments to facilitate care and treatment. This thesis examines and provides guidance on security issues, environmental design, the cognitive environment, and site development. Sample facility plans are also provided to demonstrate the design principles advocated.

The foreword examines the historical background of mental health treatment facilities in relation to the context of care. The continuing problem of the alienating and dehumanizing effects of psychiatric hospitals on patients is also addressed.

Security requirements are investigated in relation to patients' rights and personal needs. This text also examines related fire safety requirements and design measures to minimize the risks of suicides, self injuries, and assaults. Environmental design issues, including lighting, color, acoustics, construction materials, air quality, and spatial relationships, are examined in relation to mental and physical health.

Cognitive issues such as wayfinding, mental maps, symbolism, and perceptions of physical environments and architectural design are explored in relation to mental health treatment facilities. Earlier research suggests that patients have difficulty making the cognitive adjustment to typical mental health treatment facilities, and this can negatively effect their therapy and potential recovery. An illustrated questionnaire was developed to help determine the types of facilities patients can relate to and experience relative comfort. This questionnaire was used to examine perceptions of buildings and designs in relation to the provision of comfortable and healthy environments.

The survey revealed that patients, health care providers, and students shared similar perceptions of the built environment, and that buildings possessing features generally associated with domestic buildings (houses) were considered more comfortable than other building types. In particular, buildings with pitched roofs and brick exteriors were considered most suggestive of comfort. Horizontal windows were preferred to more common vertically oriented windows. This effect was more pronounced when windows framed a pleasant natural view. Curved interior forms were also found to be suggestive of comfort.

Past, current, and emerging patterns of site and facility development are reviewed in association with their environmental context. The role of nature in the healing process, from ancient Greece to recent discoveries, is also examined.

The final chapter of this thesis is a demonstration of design principles with annotated drawings of a hypothetical inpatient unit and outpatient clinic. These drawings are provided to demonstrate an integration of thesis findings and design principles. These drawings are not a definitive design or prototype, because every site and building program are different and require their own design solution.

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Introduction

This research thesis culminated in the development of a planning and design reference for medium security, mental health treatment facilities for members of the armed forces and veterans. This text was developed in cooperation with the United States Air Force Medical Service with assistance from other health agencies including the U.S. Veteran's Administration and the Royal Army Medical Corps. This guide was developed to assist planners, designers, and health practitioners to optimize the health and comfort of patients by providing suitable environments to facilitate care and treatment. Although this guide was developed in consideration of the needs of patients in the armed forces and veterans, it also contains information that may be applied to the development of mental health treatment facilities by other health care organizations.

This thesis examines and provides guidance on security requirements, environmental design, the cognitive environment, and site development. This thesis will demonstrate how these disparate requirements may be harmonized to develop secure and therapeutic facilities.

The foreword examines the historical background of mental health treatment facilities in relation to the context of care. The continuing problem of the alienating and dehumanizing effects of psychiatric hospitals on patients is also addressed.

The chapter on security issues focuses on the proper design of facilities to balance security requirements with patients' personal needs and rights. The security chapter also investigates related fire safety requirements and facility design measures to minimize the risks of suicides, self injuries, and assaults. The environmental design chapter focuses on lighting, color, acoustics, construction materials, air quality, and spatial relationships in the context of mental and physical health.

The cognitive environment chapter focuses on issues such as wayfinding, mental maps, symbolism, and perceptions of suitable physical environments and architectural design as they apply to mental health treatment facilities. Earlier research has suggested that patients have difficulty making the cognitive adjustment to typical mental health treatment facilities, and that this can negatively effect their therapy and potential recovery. An illustrated questionnaire was developed to help determine what types of facilities patients can relate to and experience relative comfort. This questionnaire was used to examine patient and staff perceptions of building types and architectural design as they relate to providing comfortable and healthy environments. This questionnaire was fielded to 25 psychiatric patients, 25 health care providers, and a control group of 25 university students in the United Kingdom. An equivalent sample of 75 was surveyed in the United States. A second survey, without illustrations, was fielded in both countries to verify findings from the first survey.

These surveys revealed that patients, health care providers, and students shared similar perceptions of the built environment, and that buildings possessing features generally associated with domestic buildings (houses) were considered more comfortable than other building types. In particular, buildings with pitched roofs and brick exteriors were considered most suggestive of comfort. Horizontal windows were preferred to the more common vertically oriented windows. This effect was more pronounced when the windows framed a pleasant natural view. Curved interior forms were also found to be suggestive of comfort.

The site development chapter focuses on past, current, and emerging patterns of site and facility development in relation to treatment methods. The role of nature in the healing process, from ancient Greece to recent discoveries, is also examined.

The final chapter of this thesis is a demonstration of design principles with a set of annotated drawings of a hypothetical inpatient unit and outpatient clinic. These drawings are provided to demonstrate an integration of thesis findings and design principles. These drawings are not a definitive design or prototype, because every site and building program are different and require their own design solution.

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Foreword

At best, even a short hospital stay can be a disconcerting experience; at worst, it can be a nightmare. The philosopher Foucault believed that most hospitals were woefully inadequate.

> ...the hospital appears in many respects as an obsolete structure. A fragment of space closed in on itself, a place of internment of men and diseases, its ceremonious but inept architecture multiplying the ills in its interior without preventing their outward diffusion, the hospital is more the seat of death for cities where it is sited than a therapeutic agent for the population as a whole. (Foucault, 1980, p177)

In order to understand and correct problems in mental health treatment facility planning and design, it is necessary to briefly examine the historical development of psychiatric hospitals. The historical background of these facilities in Europe and North America is examined and related to the context of care. The continuing problem of the alienating and dehumanizing effects of psychiatric hospitals on patients is also addressed.

Early European Development

In ancient Greece, after the golden age, the city states experienced a time of great civil conflict and plague known as the Peloponnesian War. The war went on for decades and although there is no accurate count for the war dead, it is known that the accompanying plague killed a quarter of the population of Athens, and was devastating to other cities as well. After the war the Greek people remained in a lingering state of despair. (Center, p6) We might now call this Post Traumatic Syndrome. Many Greeks made the pilgrimage to Epidaurus to be healed and relieved of their despair.

Although healing temples had existed in Greece and Egypt prior to the construction of the temple of Aesclepius in Epidaurus in the third century B.C., the Epidaurus site was the first to specialize in the healing of the mind. The temple was a place of great beauty, of both its architectural design and the surrounding aesthetics. C.D. Leakey believed that the psychological effect of convalescing in such surroundings was considered a major factor in the curative process. (Leakey, p94-97) Epidaurus was a city of the arts filled with sculpture, gardens, paintings, music, and dance. Pilgrims were treated with herbs, mud, and mineral baths, and attended the theater. The largest theater in Epidaurus could seat about 10,000 spectators. The theater consisted of many dramas, comedies and tragedies played one after another. After this long and intense variety of feelings, many spectators experienced a catharsis and believed themselves to be healed. (Center, p7)

The importance of the relationship between institutional design and therapeutic goals was also recognized by classical Roman architects. For example, Vitruvius suggested that environmental variables such as noise, climate, prevailing winds, and spatial surroundings should be taken into account in the construction of health temples. Roman health temples were generally quite spacious with large open areas, gardens and courtyards, and set in restful areas with a good climate. (McClure, p135)

After the fall of the Roman Empire, medieval hospitals were still somewhat ordered along the Roman model. Indeed, most of these hospitals were operated by the Roman Catholic Church. Although architectural form naturally reflected changing cultural influences and building techniques, these hospitals still featured large open spaces, with gardens, cloisters, and access to nature. (McClure, p135) Health was always a consideration in the siting of medieval buildings, especially their proximity to water. Medieval hospitals were usually connected with an abbey or monastery and built with the same methods and materials - as a result many of these hospitals were quite beautiful.

When monks cared for the mentally ill, they prayed over them and touched them with relics, or they concocted fantastic potions for patients to drink in the waning phase of the moon. The families of the mentally disordered might also take them to shrines in hopes of a miracle. Often the families of the mentally ill disavowed them out of fear and superstition. (Davison, p11-12)

During the thirteenth and the next few centuries, a populace already suffering from social unrest and recurrent famine and plague became obsessed with the devil. Witchcraft, viewed as instigated by the powerful Satan of the heretics, was itself considered a heresy and a denial of God. Faced with inexplicable and frightening occurrences, people tended to seize upon easy explanations. Enormous blame was heaped on those regarded as witches, and they were persecuted with zeal. In 1484 Pope Innocent VIII exhorted through a papal bull that no stone should remain unturned in the search for witches. The mentally ill were especially vulnerable to the witch hunts that followed. The Catholic church issued a comprehensive manual, the Malleus Maleficarum (the Witch Hammer), to guide these hunts. The manual specified that a person's sudden loss of reason was a symptom of demonic possession and that burning was the usual method of driving out the supposed demon. Insensitivity to pain, common among people in dissociative states, was also considered a mark of Satan. As a result of the witch hunts, thousands of the mentally ill were tortured and killed across Europe. (Davison, p12-13)

As the cities of Europe grew larger, hospitals began to come under secular control. Municipal authorities, as they grew more powerful, tended to supplement or take over some activities of the church, including the care of the ill. Municipal leaders also became concerned by the religious persecution of the mentally ill. When the Holy Trinity Hospital in Salisbury was established in the mid-fourteenth century, that the "mad are kept safe until they are restored of reason" was specified in its charter. (Allderidge, p321-324)

Contrary to contemporary notions, many medieval towns, in their remedial and preventative measures for health, were quite advanced. Holy orders founded hospitals in nearly every town: there would be at least two in most German towns, one for lepers, and one for other types of disease. Preventative measures, such as the quarantine of persons suspected of harboring illness and isolation of infected persons, were instituted in the more enlightened communities even prior to the onset of the Black Death. (Mumford, p295-296)

Until the end of the Crusades in the fifteenth-century, there were very few mental hospitals in Europe. However, there had been thousands of hospitals for lepers. As the incidence of leprosy gradually waned, attention turned to the problem of mental illness. Confinement of the mentally ill to asylums began in earnest in the fifteenth and sixteenth-centuries. The leprosariums were converted to asylums, refuges established for the confinement and care of the mentally ill. (Davison, p14)

Many of the asylums took in a mixed lot of disturbed persons and beggars. Beggars were regarded as enormous social problem at the time. In fact, in the sixteenth century, Paris had 30,000 beggars in its population of fewer than 100,000 persons. (Foucault, 1965, p30-60) Apparently there was no effective discrimination between these inmates because asylums usually had no specific regimen for their inmates other than to get them to work. (Davison, p14)

There was no effective treatment offered in these asylums, and the only benefit was protection of the mentally ill from the general populace. Even the effect of this limited benefit declined over time. Conditions in Bethlem Hospital, established as a humane institution in 1243, declined substantially until the nineteenth-century, by which time its contracted name, Bedlam, had become synonymous with insanity and disorder. The public was invited in, at a fee, to mock the inmates. As late as 1815, if a report presented in the House of Commons is to be believed, Bethlem hospital exhibited lunatics for a penny, every Sunday. (Foucault, 1965, p 68) This example of decline was characteristic of society's treatment of the mentally ill. Over time, society's view of these asylums shifted from protection of the patient to protection of the community.

Even worse than the humiliation of patients at Bethlem were the horrific conditions at a large Paris asylum known as La Bicêtre. At the time of the revolution, the following conditions were recorded by a contemporary historian -

> (The patients were) shackled to the walls of cells, by iron collars which held them flat against the wall and permitted little movement ...They could not lie down at night, as a rule ... Oftentimes there was a hoop of iron around the waist of the patient and in addition ... chains on both the hands and the feet ... These chains (were) sufficiently long so that the patient could feed himself out of a bowl, the food usually being a mushy gruel - bread soaked in a weak soup. Since little was known about dietetics, (no attention) was paid to the type of diet given the patients. They were presumed to be animals ... and not to care whether the food was good or bad. (Selling, p54)

One of the most horrific ideas in institutional design for the mentally ill was never fully realized. In the late eighteenth-century, Jeremy Bentham developed a radical design for prisons and constantly pressed the British parliament for funds to construct them. Bentham's panopticon penitentiary was intended to be a six floor building of circular or polygonal shape with the cells around the circumference. At the core was to be a central inspection area of galleries and lodges, disjoined from the main building, linked to the outer perimeter only by stairways, with none of the floors or ceilings coinciding. From this dark core, authorities could exercise constant surveillance while remaining undetected. (Semple, p115) This arrangement allowed prisoners to be held in solitary confinement while at the same time having no privacy whatsoever, and no respite from the constant view of scores of fellow prisoners. Foucault described the panopticon as "a cruel ingenious cage, a pitiless contraption, designed for control and subjugation." (Foucault, 1972, p205)

Bentham advocated this design to house both criminal inmates and the mentally ill, with the idea that constantly being under the eye of the unseen authorities could reform character and mind. "The powers of the insane, as well as those of the wicked, are capable of being directed either against their fellow creatures or against themselves. If in the latter case nothing less than perpetual chains should be availing, yet in all instances where only the former danger is to be apprehended, separate cells, exposed, as in the case of prisons, to inspection would render the use of chains and other modes of corporal sufferance as unnecessary in this case as in any. And with regard to the conduct of the keepers, and the need which the patients have to be kept, the natural, and not discommendable jealousy of abuse would, in this instance as in former ones, find a much readier satisfaction than it could anywhere at present." (Bozovic, p81)

Bentham believed he was performing a great public service, and his vision was of a beautiful building, a stately pleasure dome comparable to the rotundas at Ranelagh and Dublin, or the circus at Bath. There was he insisted, no reason why the panopticon should not be a cheerful place; a sketch of it in this notebooks depicts a fairy palace tinted in muted shades of pink and gray. (Semple, p115-116)

This extreme form of punishment never gained the support of parliament, and no funding was offered. Bentham's plans shocked the conscience of the British people and only one such structure was built during his lifetime - on the banks of the Neva river in Saint Petersburg. (Semple, p256-259) Although Bentham was unsuccessful in having his model of the panopticon built during his lifetime, the design was influential and numerous circular and semicircular prisons with central observation areas were developed. Bentham's design continued to influence prison design well into the twentieth-century; for example - a panopticon rotunda prison was constructed in Cuba in 1932. (Evans,1982, p235)

Although panopticon plans never caught on for mental hospital design, radial plans were widely used for prison and mental hospital designs in the nineteenth-century. These radial facilities were constructed with intersecting wings and central observation areas. Radial prisons had as few as three, and as many as 16 radial arms, with most resembling a wagon wheel or octopus. Radial mental hospitals were usually cross shaped with four arms, or designed as a combination of interconnected radial crosses, and less often in spoked wheel configurations typical of radial penitentiaries. (Evans, 1982, p96-103) As the number of radial arms increased, so did the suggestion of the appearance of a penal facility.

Although radial plan facilities were usually better lit and ventilated than the facilities that preceded them, they still possessed flaws. Facilities with more than four arms had poor views, with cell blocks facing each other at acute angles. Outdoor space was usually limited to triangle shaped exercise yards between cell blocks.

Many social, political, and economic factors played significant roles in accounting for the deplorable institutional conditions which had developed by the late eighteenth and early nineteenth centuries. Two are especially important to the development of institutions. Firstly, organized religion influenced society to believe that the mentally ill were receiving their just punishment for their sins. Therefore, it became much easier to ignore the plight of the mentally ill. The second major factor was the increasing urbanization of growing populations, crowding existing institutions into squalid conditions, and preventing the construction of new institutions. People sought to earn more money in cities than was possible in rural areas, but this heightened standard of living was at the expense of their health. Eighteenth-century London is a good example of a city with an increasing population and limited resources. This trend continued until the Victorian period, wherein the crown and government took greater responsibility for the welfare of others, and a large number of suburban and country hospitals were erected to relieve overcrowding and unsanitary conditions.

Early American Development

The mentally ill in America were usually cared for by their families in their own homes during the colonial era. This was consistent with the treatment of the physically ill, with family members providing nursing care with occasional visits from a physician. Prior to the mid-eighteenth-century, hospitals were rare in America because of the small population and low rates of urbanization. As urban areas developed along the eastern seaboard, the mentally ill without benefit of family care were housed in almshouses along with the destitute, the blind, the orphaned, the aged, and the crippled. (McClure, p137)

The first general hospital established in America also provided care for the mentally ill; albeit very poor care. The Pennsylvania Hospital in Philadelphia was established around 1750 as a combined effort of the colony's legislature and private donations. Unfortunately, the benevolence of the supporters of this hospital did not influence the standard of care for the mentally ill. Within the general hospital, those patients considered insane were forced to live in basement cells approximately three meters square (10 feet square). These cells were devoid of sunlight, cold, dark, and uncomfortable - clearly inappropriate for the advancement of physical or mental health. However, this environment was touted as the most humane and benevolent care available. (McClure, p 138)

The first institution established exclusively for the care of the mentally ill was Virginia's Williamsburg Hospital in 1770. This institution was supported with public money from the colonial and later state government. This hospital provided patients with two floors of above ground rooms with window views and access to a large rear garden. The facility was well ventilated and considered comfortable by contemporary standards. Unfortunately, the Pennsylvania model was the most emulated by the other states, with the mentally ill typically warehoused in the casemates or attics of general hospitals where they would be out of sight.

The available treatment was also deplorable. The American physician most influential in the care of the mentally ill in the eighteenth and nineteenth-centuries was Benjamin Rush. Rush began practicing medicine in Philadelphia in 1769 and believed that mental disorders were caused by an excess of blood in the brain. Consequently, the favored treatment was to draw as much blood from the insane as possible, as much as six quarts over a period of a few months. Not surprisingly, patients treated in this manner became less agitated, as would anyone weak from loss of blood. Another of Rush's ideas was that the insane could be cured by frightening them. One of his recommended procedures was to convince patients of their impending death. (Davison, p14)

Moral Treatment

The two leading figures in the reform movement known as "moral treatment" developed independently of each other; namely Phillipe Pinel in France and William Tuke in England. Pinel removed the chains of the people imprisoned at Bicêtre to treat them as sick human beings rather than as beasts. Many who had been completely unmanageable in chains became calm and easier to handle. Patients once considered dangerous strolled through the hospital and grounds with no inclination to create disturbances or to harm anyone. Light and airy rooms replaced their dungeons. Some patients who had been incarcerated for years were soon restored to health and eventually discharged from the hospital. Freeing patients of restraints was not the only humanitarian reform advocated by Pinel. Consistent with the egalitarianism of the new French Republic, he believed the mental patients in his care were essentially normal people who should be approached with compassion and understanding, and treated with dignity as individual human beings. Pinel believed their reason had left them because of severe personal and social problems, and it might be restored to them through comforting counseling and purposeful activity. (Davison, p15-16) While many are familiar with Pinel's removal of the chains confining patients at Bicêtre, the theoretical foundations of his reforms are less widely known.

> ...he delved deeply into the available literature on insanity, particularly the long-forgotten works by and about the ancient Apostles of mild and kindly treatment - Asclepiades, Aretaens, Soranus, Caelium Aurelianus, and the rest. The conviction grew upon him that their precepts were sounder therapeutically...than the brutal methods everywhere prevalent in his day. (Deutsch, p89)

Whereas Pinel was a physician, Tuke was not, rather a layman and devout Quaker. The source of Tuke's treatment philosophy was the humanitarian influences from his religion. Following the mysterious death of a Quaker woman at the York Asylum in 1791, Tuke established a "retreat" for mentally ill Quakers. The name "retreat" was key because it avoided the stigma of "madhouse or asylum." (Jones, p20)

This retreat was seen by Tuke as a refuge for the troubled, and sought to provide a family like atmosphere for the patient, as manifested by the non-institutional appearance of the buildings and grounds. (Deutsch, p93) Patients were considered guests rather than inmates and the use of chains and coercive methods were not allowed. Heavy reliance was placed on human interaction between staff and patients, exercise, and a variety of productive activities designed to occupy patients' time in a meaningful and therapeutic manner. These activities included gardening, sewing, writing, knitting, and religious activities. (Jones, p21)

A large number of hospitals on both sides of the Atlantic were influenced by the sympathetic and attentive treatment provided by Pinel and Tuke. Generally these hospitals were built on country or suburban sites with large gardens. In accordance with Pinel and Tuke's treatment approach, which became known as *moral treatment,* patients had close contact with attendants, who talked and read to them and encouraged them to purposeful activity. Residents were to lead as normal lives as possible and generally take responsibility for themselves within the constraints of their disorders. (Davison, p18)

However, hospitals embracing moral treatment were not the only methods society employed to deal with the mentally ill; many mentally ill persons continued to be inappropriately housed in jails, penitentiaries, and poor houses. Unfortunately, moral treatment was largely abandoned in the second half of the nineteenth-century. The staffs of the large, public mental hospitals (being built to take in the many patients who could not be accommodated by private hospitals) could not provide such individual attention. Moreover, these hospitals came to be administered by physicians, who were more interested in the biological aspects of illness and in the physical health of patients. The money that once paid the salaries of personal attendants was devoted to equipment, medication, and laboratories. (Davison, p18)

Twentieth-Century Development

Massive government intervention in North America, and to a lesser degree in Europe, resulted in the construction of enormous city hospitals, many caring for over 10,000 of the mentally ill. These large sizes in urban locations resulted from the perceived need for economies of scale, and the necessity of attracting large numbers of qualified staff. As a result, these facilities were often constructed as tall, multi-floor buildings with little or no access to parks and gardens, and offered little other than views of a crowded city from available windows. (McClure, p163) Most psychiatric hospitals are publicly funded, and are often old and grim in appearance.

Private psychiatric hospitals tend to be superior to those of public hospitals for one reason: the private hospitals have more money. The daily costs to patients in these private institutions can exceed a thousand dollars per day and may still not include individual therapy sessions with a member of the professional staff.

Deinstitutionalization sweeps in the 1970s and 1980s greatly reduced the number of patients in mental hospitals, but the problems of chronic patients continue. Even in the best hospitals, patients usually have little contact with psychiatrists or clinical psychologists. Most of a patient's days and evenings are spent either alone, or in the company of other patients, or with aides or orderlies. These aides typically have little professional education or skills, and correspondingly low salaries. (Paul, 1987, p61-84)

As with imprisonment, the overwhelming feelings are of helplessness and depersonalization. Patients may sit for hours in hallways waiting for dining halls to open, for medication to be dispensed, and for consultations with psychologists, social workers, and vocational therapists to begin.

Most hospitals require patients to attend group therapy, where at least two, usually more, patients are supposed to relate to each other and to a group leader in a room for a specific period of time. For some patients there are a few sessions alone with a professional therapist. For the most part however, traditional hospital treatment over the last forty years has been biologically oriented. Other activities are used primarily to occupy patients' time until drugs have taken effect. The institutional setting itself is used as a way to provide supportive care and to protect and care for patients whose conditions make it virtually impossible for them to look after themselves or render them an unreasonable burden or threat to others. (Davison, p20)

Sedatives are often used to reduce the tension associated with anxiety disorders. Antipsychotic drugs such as thorazine were once in widespread use for disorders such as schizophrenia, with side effects such as drooling and muscle spasms associated with the stereotypical image of a mental patient. These old antipsychotic drugs have been largely replaced by new drugs such as Clorazil with fewer side effects. Lithium is frequently used in the treatment of bipolar disorder, also known as manic-depressive disorder. Numerous drugs are in use which alter neurotransmitter levels for the treatment of depression. Controversial electroconvulsive shock therapy (ECT) is sometime used to treat patients with cases of severe depression who do not respond to conventional therapies. Neither the drugs nor ECT are cures for mental disorders, but are regarded as biological treatments. (Davison, p33)

A recent development in treatment methods seems promising. A treatment known as *milieu therapy*, in which the entire hospital becomes a therapeutic community has been increasingly used since the 1960s. All the hospital's ongoing activities and all its personnel become part of the treatment program. Milieu therapy appears to be a partial return to the practices of nineteenth-century moral treatment. Social interaction and group activities are encouraged so that group pressure may be directed toward normal functioning. Patients in milieu therapy programs are treated as responsible human beings rather than custodial cases. They are expected to participate in their own readjustment as well as that of fellow patients. (Davison, p20-21)

The Alienating and Dehumanizing Effects of Institutions

According to Marx, there are three kinds of alienation - from self, others and nature. (Tucker, p12-20) (Some might argue that a fourth type of alienation, alienation from God, also exists - but Marx would disagree.) All three types of alienation cited by Marx can be found in a psychiatric hospital.

The most notorious example of alienation and dehumanization is perhaps the treatment of the mentally ill in eighteenth-century France. The mentally ill were chained in dungeons and referred to as beasts. Often inmates were kept naked and unprotected from the elements. Even Pinel commented that many of the mentally ill had lost the human ability to feel pain or cold. There was also an associated belief that the mentally ill possessed inhuman strength. (Foucault, 1965, p 221-243) The general perception by French society was that the mentally ill were somehow less than human, and this allowed the "sane" to treat them without humanity.

Modern institutions have improved greatly since Bicêtre, but alienation and dehumanization are still problems. According to sociologist Erving Goffman, institutionalization often leads to an alienated state where the patient feels he has been rejected by society, his colleagues, and even by those closest to him. Upon entering the hospital, a patient may strongly feel the desire not to be known to anyone as a person who could possibly be reduced to his present circumstances, or as a person who conducted himself in the way he did prior to commitment. Consequently, he may avoid speaking to anyone, may stay by himself as much as possible, and/or his behavior may be "out of control" or "manic" to avoid participating in any interaction that presses a polite reciprocal role upon him. Through these means he may avoid opening up and seeing what he fears he has become in the eyes of others. (Goffman, p146)

Usually patients come to give up these taxing efforts at anonymity and detachment, and begin to present themselves for conventional social interaction in the hospital community. Thereafter, patients may withdraw only in less overt ways - by always using a nickname, by signing with initials only, and avoiding discussion of their previous lives. (Goffman, p147)

Inpatients find themselves cleanly stripped of accustomed affirmations and satisfactions, and are typically subjected to a rather full set of mortifying experiences: restriction of free movement, forced communal living, and subjugation to the authority of a whole echelon of people. An inpatient must come to grips with the limited extent to which a conception of himself can be sustained when the usual setting of supports is removed. (Goffman, p148)

> In the mental hospital, the setting and the house rules press home to the patient that he is, after all, a mental case who has suffered some kind of social collapse on the outside, having failed in some over-all way, and that here he is of little social weight, being hardly capable of acting like a full-fledged person at all. (Goffman, p151)

Often these torn-down patients attempt to reassemble themselves out of their imaginations because they perceive their true selves as worthless. In the context of helping the patient, hospital staff may attempt to deconstruct this new affectation or identity, further alienating the patient. (Goffman, p157)

Goffman has ably described alienation from self and others, but alienation from nature is also a problem in most institutions. Patients have reduced freedom of movement and are typically exposed only to grim hospital environments. It is not uncommon for mental health treatment facilities to be devoid of natural light, views of natural settings, and gardens for patient use.

To avoid alienation and dehumanization, institutions should allow patients to maintain their humanity, dignity, and self image. While these allowances are dependent on the treatment program, the design of the facility should follow the first directive of Hippocrates and do no harm.

Chapter 1 - Security

Renewed interest in security planning for Department of Defense mental health care facilities was generated by the following incident. On June 20th 1994, a recently discharged airman in civilian clothes hired a taxi from Spokane, Washington to nearby Fairchild Air Force Base. He had been discharged because of developmental autism and severe antisocial behavior including threatening barracks-mates, coworkers, and medical staff. He also exhibited several forms of inappropriate behavior including chronic masturbation in the presence of barracks-mates. (Camden, pA1)

Fairchild Incident Apparently, Dean Mellberg, 20, of Lansing, Michigan, still held a military identification card and had no problem clearing the base security gate. While Mellberg had returned his military identification card upon his discharge (as required) he apparently possessed a duplicate. (It is relatively easy to obtain a duplicate - one merely claims to have lost the original. This practice is now being corrected by a bar coding system.) The taxi driver dropped Mellberg at the base hospital along with his gear - a military duffel bag and a rifle case. Mellberg then entered a men's toilet in the nearby hospital annex where he began assembly of his AK-47 automatic rifle with 75 round magazine. (Hansen, pB1) This toilet was next to the mental health clinic and the office of Captain Alan London, the psychologist who had recommended Mellberg's discharge from the service. Mellberg finished assembly of his rifle, went next door and murdered Dr. London, and proceeded down the hall to shoot Major Thomas Brigham. Dr. Brigham was the psychiatrist who concurred with Dr. London's findings. (Camden, pA1)

After murdering Brigham, Mellberg went to the main hospital building and began shooting indiscriminately, wounding 23 people, killing an eight-year old girl, a 39-year old woman, and another woman's unborn fetus. A nearby off-duty security policeman, on bicycle, heard an emergency radio call and was first on the scene. Mellberg, then outside in the parking lot, was instructed to drop his weapon by the security policeman - instead Mellberg raised his weapon and the security policeman used his sidearm to shoot Mellberg in the head. (Bird, p16)

After this incident the Air Force Health Facilities Office in Dallas, Texas received numerous telephone calls from several bases seeking advice on how to make their mental health clinics more secure. At that time, a variety of facility security measures were discussed, but no definitive guidance was developed. This piqued my curiosity and I began to search for design guidance for both outpatient and inpatient mental health care facilities. I found very little guidance available, and the available guidance was of little value.

Torbay Incident An unrelated incident in Great Britain also focused new attention on the design of mental health care facilities. The Edith Morgan centre at Torbay hospital in Devon had been controversial since it opened in 1986. It was opened as part of the National Health Service's new approach to care for the mentally ill in decentralized community based arrangements, as opposed to the old method of institutionalized care in asylums. Andrew Robinson, 36, had been sent to Broadmoor hospital in 1978 after threatening to shoot a girlfriend. After his discharge, he had been admitted to the Edith Morgan centre seven times. (Brindle, 19Apr94, p6)

Robinson was a severe paranoid schizophrenic with a history of violent behavior, prone to going off his medication, and being readmitted for inpatient care. Robinson was one of the few patients at the Edith Morgan centre that nurses were genuinely afraid of. The Edith Morgan centre, having only a minimum security ward for patients requiring inpatient treatment allowed their patients a great deal of freedom of movement and Robinson made many trips to nearby

Torquay. On one visit to Torquay, he tried to persuade a print shop to publish his "autobiography," which was a manifesto of violence which included justifications of mass murder and his dreams of assassinating the Prime Minister, John Major. (Davies, p6)

On another visit to Torquay, Robinson purchased a five-inch knife and was able to sneak it into the centre undetected. On 28 August 1994, he set out for London on an unauthorized leave but was confounded to find that Mr. Major and the rest of parliament were on summer recess. Robinson then returned to the Edith Morgan centre with the idea of killing a doctor. On the first of September he wandered through the building with his knife in search of Dr. Montera, the man responsible for admitting him two months previously. Unable to find Montera, Andrew Robinson decided to kill any doctor he could find, but instead found Georgina Robinson (no relation) talking to another patient in her room. Georgina Robinson, a 27 year old occupational therapist, had long had reservations about her safety at the centre. (Davies, p6)

Andrew Robinson entered undetected and stabbed Georgina Robinson repeatedly; she died several days later in intensive care. When the police came to take him away he said "She got between me and the system." (Davies, p6) In addition to Georgina Robinson's death, the Edith Morgan centre had experienced 30 suicides in its first eight years of operation. (Brindle, 17Jan95, p2)

An inquiry by the Mental Health Act Commission reviewed this incident and found the design of the facility was partially to blame for this and other tragedies. The commission described the centre as having a "sense of desolation more reminiscent of a disused bus station." The commission determined there were too many entrances for people to feel safe and strangers went unchallenged. (Brindle, 19 Apr 94, p6) Patients and staff also had strong opinions about the design of the building. Patients considered it a big, soulless place that felt empty and cold. Staff considered the building an observational nightmare because of recent patient suicides by hanging and drowning in the maze of upper floor rooms. (Davies, p6)

Both of these incidents demonstrate that the design of mental health care facilities can have a significant impact on the security of patients and staff. In both cases a lack of adequate patient observation and access control led to tragedy. The Fairchild incident also demonstrates that outpatient facilities are not immune to security problems.

Security Issues The planning and design of security for mental health facilities must encompass three related issues: control of access and observation for staff and patient safety, fire safety, and suicide prevention. Fire safety relates to access and observation because fire can be used to override security measures and effect escapes. Fire can also be used as a means of suicide, self injury, and as a means to harm others. A lack of access control and observation relates directly to patient suicide and self injury. The same design features that limit patient access to the means of suicide and self injury can also limit their ability to harm others.

Several other aspects of security should also figure into the planning and design of mental health care facilities. Mental hospitals were originally established to protect the patients from the public; the design of mental health facilities should not only limit unauthorized departures but unauthorized entries as well. Security is also a two way street, while patients are capable of harming each other and staff members; in some cases staff members are capable of harming patients.

Increasing violence in health care facilities is emerging as a disturbing trend. A 1998 survey of 1,000 nurses for the Royal College of Nursing found that 47 percent of those polled had been slapped, punched or spat at in the past year. 88 percent of this number needed medical attention. Half of all nurses said they had considered quitting because of violence and the majority indicated they did not feel safe at work. (Ellis & Taylor, p5)

The U.S. Labor Department has recently identified homicide as now being the second-leading cause of death on the job, and workers at nursing homes, hospitals and other residential or psychiatric programs are especially vulnerable. The following factors, associated with treatment of the mentally ill, contributed to this problem: (Moore,J., p29)

1. Too many handguns in circulation among patients and their associates.

2. The use of hospitals by police and the justice system to hold criminals and disturbed violent persons.

3. Chronically mentally ill persons released from hospitals without follow-up care, who don't take their medication and can refuse hospitalization.

4. Low staffing levels during meal times, visiting hours and when staff transports patients.

5. The presence of drugs and money at pharmacies, clinics, and hospitals.

6. Isolated work with patients during examinations or treatments.

Additionally, military mental health facilities require extra protection because military members usually possess greater physical strength and prowess than the general populace, greater martial skills and access to firearms, and less fear of violence and injury. Many military members are also trained to be secretive and to improvise weapons from available materials. Unfortunately, most mental health practitioners (military and civilian) working in these facilities are not prepared to deal with this level of risk. It is necessary to design the facilities to minimize risk. For these reasons, most military mental health facilities should be designed as medium-security facilities.

Low-security facilities usually equate with minimal risk of suicide or physical harm and little or no need for patient restraint, while high-security facilities, also known as forensic units, usually serve known, high risk, violent patients. This type of high risk patient is typically transferred to a suitable Veterans Administration facility. Medium-security facilities are intended for those patients with the recognized potential for suicide or physical harm, but without a proven record of such behavior. With adequate planning, medium-security facilities can be stepped down to low-security or up to high-security, with minor alterations. While this text is not intended as a guide for the design of civilian facilities, there may also be some suitable applications to mental health treatment facilities outside the military.

Civil Rights Security requirements must also be balanced with the patient's civil rights. The Joint Commission for the Accreditation of Healthcare Organizations requires that the following guidelines are met. (American Society for Healthcare Engineering, p168-171)

The hospital establishes a social environment that supports its basic mission and services.

Appropriate space to support services is provided.

Articles for grooming and personal hygiene that are appropriate to the patient's age, developmental level, and clinical status are readily available.

Closet and drawer space are provided for storing personal property and those items provided for use by the patients.

An environment that fosters a positive self-image for the patient and preserves his or her human dignity is provided.

Door locks and other structural restraints used are consistent with the hospital's mission and program goals.

Hospital patients wear clothing suitable to their clinical condition.

Adequate privacy to reflect sensitivity and respect for patient privacy is provided.

A telephone is available to all patients for private conversations.

Sleeping rooms have doors for privacy, unless clinically contra-indicated.

The number of patients in a room is appropriate to the hospital's goals and to patient's ages, developmental levels and clinical needs.

Activities to support the development and maintenance of the patient's interests, skills and opportunities for personal growth are provided.

Furnishings and equipment suitable to the population served are available.

As appropriate to the length of stay, the hospital accommodates the needs of patients to be outdoors unless contra-indicated for therapeutic reasons.

The intent of these standards is to provide an environment appropriate to the hospital's setting and the population it serves while providing appropriate space and preserving the dignity of patients. As such, the following interpretations of the Joint Commission's standards are provided by the American Hospital Association. (American Society for Healthcare Engineering, p171-172)

Locking a patient in a room is considered seclusion and is subject to (applicable) seclusion standards.

The designated space allows for recreational interchange, accommodates necessary equipment (such as wheelchairs), has appropriate lighting, temperature and ventilation, assures auditory and visual privacy, and provides telephones for physically challenged as well as non-challenged patients.

Furnishings and equipment are selected to "normalize" the patient's environment, are in good repair, attractively decorated and suitable to the age of the patients.

No more than eight patients may sleep in a single room. In other than single rooms, privacy may be provided by curtains, partitions, or furniture placement.

The hospital permits patients to wear their own clothing or provides a suitable alternative. Personal grooming items are permitted to be kept close to the patient and suitable lockers, drawers or closet space is provided.

Arrangements for leisure time activities are provided and during long stays, access to the outdoors is available.

Section 1.1 -Fire Safety

The planning and design of fire safety for health care facilities is a strong determinant of the size and shape of the facility, its corridors, and its exits. These three features also have a great influence on the ability of staff to observe patients and control access throughout the facility. For this reason fire safety and the control of observation and access should be laid out first as the spine or backbone of the facility. In laying down this backbone, we should review the fundamentals of the Life Safety Code as it applies to mental health treatment facilities. Other requirements based on the size of patient and staff populations may also apply; so a qualified architect or engineer, experienced in fire protection, should be retained to assist in planning any facility.

Travel Distance Limit The Life Safety Code, as established by the National Fire Protection Association, stipulates the travel distance limit in a new health care occupancy at 150 feet (45 meters). This travel distance limit rises to 200 feet (60 meters) in a completely sprinklered health care occupancy. (NFPA 101, p248) "Travel distance" refers to the distance from any point in a building to a protected exit. This exit may be a protected corridor, stair, or door to an area of safety. Special care should be taken when developing mental health treatment facilities in overseas locations; they not only have to meet the Life Safety Code (U.S. standard) but also the codes of the nation in which they are built. Regional and local codes may also apply both in the United States and in overseas locations. For example, the British code sets a maximum travel distance of 64 meters (210 feet) to a protected exit, and a maximum travel distance of 32 meters (105 feet) from one fire compartment to another. (DHSS, 1987, p16-17) One should also note that the British code allows no additional travel distance for sprinklering.

The Dead End Limit stipulated by the Life Safety Code is set at 30 feet (9.1 meters) for both unsprinklered and completely sprinklered health care occupancies. This means that the travel path from a door exiting a room along a dead end corridor may not exceed this distance. In contrast, the British code sets the dead end limit for any point within a room to the beginning of the corridor at 15 meters (50 feet). (DHSS, 1987, p39)

Common Path of Travel The Life Safety Code has set no specific limits for common path of travel in new health care occupancies but in the case of mental health treatment facilities it is prudent to seek and set a limit for the design to avoid future litigation or other challenges. The only other occupancy comparable to a mental health treatment facility is the detention and correctional occupancy. The common path of travel limit for this occupancy is set at 50 feet (15 meters), and 100 feet (30 meters) for a completely sprinkered facility. (NFPA 101, p249) The common path of travel is the distance from any isolated point in a facility to a point where one has a choice of two exit paths. One might conceptualize this as a dead end within a suite instead of a corridor. The British standards for common path of travel limits are the same as the dead end limits described in the paragraph above. Again, the British code allows no additional travel distance for sprinklering.

Minimum Corridor Width set by the Life Safety Code is six feet (1.8 meters) for patient areas in mental health treatment facilities. The code sets 44 inches (112 centimeters) as the minimum corridor width in adjunct areas not intended for the housing, treatment, or use of inpatients. (NFPA 101, p119) This is the clear measurement not inclusive of railings, equipment, or other obstructions. The British code standard is lower, allowing a minimum corridor width of 1.1 meters (43.3 inches) for inpatient, outpatient, and non-patient use. (Firecode, p36) However, the

British National Health Service recommends a minimum corridor width of 1.5 meters (59 inches) for minor corridors, and 1.8 meters (six feet) for major corridors. (NHS Estates, p10)

Maximum Corridor Length The Life Safety Code sets no limits on the length of corridors as long as they conform to the above criteria for travel distance, dead end corridors, and common path of travel. If a corridor were able to meet those criteria, it is conceivable that a corridor could be nearly 300 feet (90 meters) long in an unsprinklered facility or 400 feet (120 meters) in a sprinklered facility. However, it is rare to find a corridor in any health care facility in excess of 150 feet (45 meters) in unsprinklered facilities and 200 feet (60 meters) in sprinklered facilities because of more conservative interpretations of maximum travel distance. Similarly, the British standard sets no maximum corridor length, but for the same reasons, corridors over 64 meters (210 feet) are extremely rare.

Stairways and Other Exits should be designed to empty outside into a secure area that offers safety from spreading flames and smoke. A large fenced area which allows about 30 meters (100 feet) separation between the building and the fence should be adequate. Courtyards are not safe unless they are exceptionally large, perhaps 45 meters (150 feet) in diameter. Stairs and other exits should also be constructed to provide a one hour barrier to the resistance of fire and smoke. Areas beneath the bottom flights of stairs should be sealed and never used for storage because a fire originating in such an area would make the stairs an unusable exit. Additional guidance for the design of stairs and other exits are covered in the sections concerning control of access and observation for staff and patient safety, and suicide and injury prevention.

Compartmentalization The Life Safety Code requires that any sleeping room, or suite that includes sleeping rooms, of more than 1,000 square feet (93 square meters) have at least two exit access doors remotely located from each other. The area of suites of sleeping rooms shall also not exceed 5,000 square feet (460 square meters). Any suite of rooms, other than patient sleeping rooms, of more than 2,500 square feet (230 square meters) shall have at least two exit doors located remotely from each other The size of suites of rooms, other than patient sleeping rooms, shall also not exceed 10,000 square feet (930 square meters). (NFPA 101. p120)

Additionally, smoke barriers are required on every story of a new health care facility to divide each floor into at least two smoke compartments. Additionally, no more than 50 patients may occupy any smoke compartment. Each smoke compartment must also have two exit access doors remotely located from each other (NFPA 101, p123) A study by Britain's Fire Research Station suggests that greater compartmentalization of facilities results in fewer fire related injuries and fatalities. (Williams & Hopkinson, p2-3)

The Life Safety Code requirement for existing health care facilities differs; smoke barriers must be provided to divide every story used for sleeping rooms for more than 30 patients into at least two smoke compartments. (NFPA 101, p136) The British fire code requirements for the subdivision of each story of a health care facility are nearly identical to the US requirements for existing health care facilities. (DHSS, 1987, p12) However, the requirement for the compartmentalization of suites of sleeping rooms is different. According to the British standard, each compartment on every story should be divided into at least two connected sub-compartments if there are more than 30 patients in a ward, or when the compartment is shared with a non-ward function. Additionally, each sub-compartment should measure no more than

750 square meters (8,073 square feet) and must have two exit access doors remotely located from each other. (DHSS, 1987, p16)

Patients per Ward Neither the Life Safety Code nor the British fire code for new construction stipulates the maximum number of patients per ward. Although the British standard limits sleeping compartments to 30 patients each, a sleeping compartment does not necessarily equate to a ward. The accepted standard for the maximum number of patients per mental health ward is set at 30 patients. (Neufert, p164) Numbers greater than 30 would conceivably overwhelm the ability of staff to effectively care for, monitor, and egress patients in case of fire or other emergency. While 30 is seen as the limit, the National Health Service suggests 14 patients per ward in a mental health treatment facility is the optimal size. (NHS estates, p12) However, NHS rarely builds small 14 bed wards, probably because of cost concerns, and wards of 20 - 24 patients are more the norm. This subject is covered in greater depth under the chapter describing therapeutic design features.

Minimum Width of Doors The Life Safety Code sets the minimum clear width of doors in health care facilities at 32 inches (81 centimeters). The greater clear width of 41.5 inches (105 centimeters) is advisable in any areas of a mental health care facility where patients would receive medical treatment such as procedure rooms or electro-convulsive therapy (ECT) suites. (NFPA 101, p119) The British code only requires a 75 centimeter (29.5 inch) minimum clear width. (DHSS, 1984, p9) Clear width differs from the size of the door or the door frame; clear width refers to the unobstructed opening exclusive of the door butt edge, hinges, hardware, jamb edges etc. For example, a 34 inch (86 centimeter) door and frame might be required to provide a 32 inch (81 centimeter) clear opening.

Fire Egress Doors The Life Safety Code allows door locking arrangements in health care occupancies or portions of health care occupancies where the clinical needs of the patients require specialized security measures for their safety, provided keys are carried by staff at all times. The Life Safety Code also allows delayed egress locks that can be operated by a staff key. (NFPA 101, p118) These delayed egress locks sound an alarm when the panic bar is depressed and release after a maximum period of 20 seconds. The nursing staff then has 20 seconds to intercede if necessary. The British Mental Health Act of 1983 provides no clear guidance on these issues but gives broad powers to mental health practitioners to restrain patients. Lock down wards in Britain and the United States were once common, but due to greater concern for patient rights, reasonable alternatives to ordinary locks such as delayed egress are more appropriate. Some hospitals tie the egress locks to the smoke detection system, but this can become a nuisance due to false alarms. An alternate solution may be to use fencing to provide a secure perimeter and to activate delayed egress locks only during sleeping hours.

Additionally, the National Fire Protection Association allows fire egress doors in one hour protected walls to have glass vision panels up to 1,296 square inches (0.84 square meters) in size. The vertical dimension of these panels may not exceed 54 inches (1.37 meters) unless otherwise tested. These panels should be constructed of wired glass and held in place by fire resistant metal frames. (NFPA 80, p15)

Fire Protection Strategy and Sprinklers When planning your mental health care facility one must decide whether to employ a wet pipe or dry pipe system. A wet pipe system, as its name suggests, is a sprinkler system always filled with water. The wet pipe system is activated on a sprinkler head by sprinkler head basis as the fusible link in each sprinkler head melts. The fusing temperature for these links can be set at approximately 57°C (135°F), 74°C (165°F), or 100°C (212°F). A dry pipe system can be activated by an automatic smoke or fire detection system, or by a manual pull station. Water is then pumped through the pipes to the various zones activated by the automatic system or pull station.

Each system has its own pros and cons. A wet pipe system offers good protection for the facility with very little associated water damage in areas not threatened by fire, but will not activate until the temperature in a particular room rises to a minimum of 57°C (135°F). By this time, the room occupant would probably already have expired. A smoke detection system with alarm klaxons should be used as an adjunct to rouse patients before the fire and smoke concentration becomes lethal. A dry pipe system provides good protection for the patients but is prone to false alarms and associated unwanted discharges and water damage. A wet pipe system with an adjunct automatic smoke detection system is usually a better choice.

Source of Fire A study conducted by Britain's Fire Research Station examined 89 fires producing fatalities in health care and residential care facilities, occurring between 1978 and 1982. 48 of these fires (54%) originated in an occupied sleeping room and resulted in the deaths of 56 people. 14 of these fires (16%) originated in occupied nursing ward space other than sleeping rooms and produced 31 fatalities. Seven fires (8%) originated in occupied lounges, day rooms, or recreation rooms and resulted in a single death each. Seven fires (8%) originated in occupied circulation spaces (corridors and stairs) or utility rooms, and resulted in eight deaths. 13 of these fires (14%) originated in other unoccupied rooms or spaces and resulted in 29 deaths. (Williams & Hopkinson, p2)

Fires originating in occupied sleeping rooms produced single deaths 73% percent of the time, multiple deaths 27% of the time, and clothes or bedding were the first items ignited 67% of the time. Smoking materials were also implicated in 65% of these incidents. (Williams & Hopkinson, p3)

Fires originating in occupied nursing ward space produced single deaths 71% percent of the time, multiple deaths 29% of the time, and smoking materials were implicated in 86% of these incidents. (Williams& Hopkinson, p4)

Fires originating in occupied lounges, day rooms, or recreation rooms produced single deaths 100% of the time, and smoking materials were implicated in all of these incidents. (Williams & Hopkinson, p5)

Fires originating in unoccupied circulation spaces produced single deaths 86% of the time, multiple deaths 14% of the time, and mental illness was considered a contributing factor in 63% of these fires. The Fire Research Station characterized the root cause of these fires as "A person at risk becomes involved personally with fire because of mental imbalance, suicidal motives, non-ambulance or recklessness. (Williams & Hopkinson, p5-6)

Fires originating in other unoccupied rooms and spaces also produced single deaths 69% of the time, and multiple deaths 31% of the time. The Fire Research Station characterized these fires as a result of carelessness, unlawful intent, or "latent defect," and the fire is allowed to develop in its early stages without the knowledge of the occupants. The Fire Research Station noted that fires originating in unoccupied rooms, are typically discovered later, and as a result the products of combustion are more likely to spread than in fires developed in occupied rooms. In cases where buildings lacked adequate fire protection, this type of fire commonly forced people to egress through windows (even on upper floors) to avoid fire injury. (Williams & Hopkinson, p6)

Smoking From a review of the Fire Research Station study it is easy to conclude that good patient observation and limiting patient access to smoking materials would greatly decrease fire deaths and injuries in health care facilities. Human nature being what it is, an outright ban on smoking would probably be ineffective and might lead to clandestine patient smoking in unobserved sections of facilities. (Staff members might also be vulnerable.) Visiting relatives and friends of patients are known to sometimes smuggle contraband items in to patients, despite official bans. Clandestine smoking in secret places could potentially lead to greater deaths and injuries. It would seem more prudent to allow inpatients to retain their tobacco (but not their matches and lighters) and to provide both indoor and outdoor smoking areas that may be easily observed from the nursing station. (Most U.S. psychiatric hospitals limit possession of lighters and matches to staff to control patient smoking.) Lighters in these smoking areas can be secured to walls or fixed tables and operated by a switch in the nurses station. The indoor smoking area should be available 24 hours a day to prevent unobserved smoking in the middle of the night.

It might also be prudent to provide an additional sprinkler system in these smoking areas that can be activated from the nursing station. Automatic sprinkler systems which are actuated by smoke detectors would be ineffective in such areas. Heat actuated automatic sprinkler systems would also be ineffective because by the time enough heat was generated by a fire in the smoking area to actuate the system, the patient would probably already be mortally wounded. Manually operated sprinkler systems in the smoking areas would also be ineffective in situations where one patient was smoking alone. Although many hospitals maintain portable fire extinguishers and/or hose reels in the nursing station, the Fire Research Station Study suggests they are rarely effective when used by staff or patients to fight fire. (Williams & Hopkinson, p24)

Section 1.2 - Access and Observation

After fire safety, the requirements for access and observation must be considered. Access and observation are also integral components of the spine or backbone of the facility.

Access Zones Access to the facility can be considered as a matter of zones. The model of these zones for inpatient facilities typically runs in a progression from public, semi-public, semi-private, and private zones. (AHA, 1996) The *public zone* includes the parking areas, main entries, lobbies, outpatient pharmacy service areas, and reception areas. The *semi-public* zone includes outpatient diagnostic and treatment areas, (* including day hospital), pharmacy departments, outpatient group rooms, outpatient dining areas, outpatient toilets, and provider offices. The *semi-private* zone includes ward support spaces such as nursing stations, nursing supply rooms, dayrooms, visitation rooms, inpatient dining areas, inpatient diagnostic and treatment areas, and seclusion rooms. The *private zone* includes patient gardens, bed rooms, toilets and shower rooms, and secured linen closets/utility centers. A hospital with residential care would contain all of these zones, while an outpatient clinic would only contain the public and semi-public zones. Ideally, each zone acts as a buffer to the next zone. An additional private zone may also be required if *electro-convulsive therapy* is used to treat patients.

*Day hospital or day care areas are intended for outpatients not requiring residential care but requiring supervision and support during the day while their families or guardians are working. Day hospital areas often share space with the semi-private functions listed above, but also require a daytime residential area where patients may relax or nap. These daytime residential areas are sometimes arranged like open-bay wards where patients may relax or nap on mats or in reclining chairs. Day hospital areas should be arranged to prevent unauthorized departure of their charges. These areas are not generally provided in military mental health facilities but may be required in facilities operated by the Veterans Administration.

Access Control The control of access between these zones is critical to the operation of an orderly, safe, and therapeutic clinic or hospital. The "buffers" between these zones come in the form of physical barriers and management practices.

Public Zone Control of access to the public zone can be accomplished by maintaining well lit parking areas, walkways, and entries. Personnel at reception desks should be able to visually survey these areas and be ready to contact security services if trouble erupts. Visual surveillance is also helpful in determining which arriving patients and visitors require assistance entering the facility.

Semi-Public Zone Control of access to and from the semi-public zone can also be accomplished by maintaining visual surveillance of lobbies from reception areas. Patients and visitors may be signed-in and issued appropriate passes (if necessary) from staff at these reception areas. Staff at these reception areas may control access to doors in the semi-public zone by manual or electric means. Visual surveillance of the public zone and semi-public zone could have prevented or mitigated the tragedy of the Fairchild incident.

Semi-Public Zone Hardening The Fairchild incident could also have been greatly mitigated by hardening the buffer between the public zone and the semi-public zone. This hardening can be accomplished in new facilities by constructing the lower half of lobby and reception walls with concrete impregnated wall board instead of the usual gypsum or plaster based wall board. This product is usually used in the construction of bathrooms and other wet areas because of the concrete's resistance to water damage. Concrete impregnated wall board can be erected to the height of 1.2 meters (4 feet) on both sides of the framed walls and then the voids can be filled with a mixture of plaster grout and gravel. These voids should be filled in a series of 30 centimeter (1 foot) lifts to avoid rupturing the walls during installation. The grout should be plaster based instead of cement based to allow future alteration of walls and rewiring. The combination of concrete impregnated wall board and grouted voids will either stop or greatly reduce the velocity of small arms fire. With this hardening of the lower half of these walls, staff members are able to duck and cover with less risk of injury. Installation of 1.6 centimeters (5/8 inch) thick, laminated, bullet resistant glass may also be advisable for large areas of interior glass adjacent to lobbies and reception areas.

Hardening can be accomplished in existing facilities by cutting holes above the lower half of lobby and reception walls and then filling the voids. To avoid water damage, the voids should be filled only with gravel or pellets of lightweight expanded concrete without the liquid grout. Some existing walls may require installation of reinforcing tension bolts to prevent the walls from rupturing.

Semi-Private Zone Control of access to and from the semi-private zones (ward support areas) can be exercised by nursing staff from the nursing station by means of visual surveillance or closed-circuit television and manual or electric doors. The necessity of locking the wards must be assessed by administration and nursing staff. The transition to the semi-private zone is also an appropriate place to provide a fixed weapons locker outside the wards. In the event that security services must be summoned to the facility, it is prudent that security personnel (if armed) check their weapons in a secure locker before entering the wards. (Colling, p267) This type of locker is not operated by the nurse key system, but rather by a common security duty key such as a standard handcuff key.

It is also prudent to maintain equipment in the nursing station to screen patients returning from leave, suspicious looking visitors, gifts, and packages. A hand held metal detector can be purchased for as little as 350 dollars or 200 pounds. Nursing staff can become proficient in the operation of these devices after a few minutes of training. Use of such a detector could have averted the Torbay incident.

Private Zone Control of access to the private zones can also be exercised by nursing staff from the nursing station by means of visual surveillance. Spaces and corridors should be arranged to provide a clear unobstructed view. These spaces and corridors should be designed to provide a clear line of sight without the use of security mirrors. If mirrors must be used, parabolic, globe, and angle mirrors should be avoided. While parabolic and globe mirrors provide an outstanding wide-angle view of hidden areas, they produce a great deal of distortion. These distortions can be especially disturbing to some patients and may trigger hallucinations or other psychotic episodes. (Prohansky, p561) Angle mirrors (see figure 1.2.1), which can be installed directly in front of a nursing station to provide views of each end of a perpendicular corridor, create twin divergent views of any person or object directly in front of the mirror. This can also trigger hallucinations or other psychotic episodes, especially among patients suffering from schizophrenia and other multiple personality disorders. The use of these mirrors in other parts of the facility is also discouraged. This problem can be eliminated by providing a nonreflective area between the two mirrors to prevent possible reflection of double images.

Electro-Convulsive Therapy is a controversial procedure wherein an electric current is passed through the patients brain under controlled conditions. This procedure is often very effective in moderating extreme patient behavior. This procedure, commonly known as ECT, also has a large number of detractors who believe it is inhumane. If this treatment is employed in a facility, it should be segregated into its own private zone complete with recovery area. It can be very disturbing to patients to see one of their peers who has not fully recovered from a session of ECT.

Access and Perimeter Security The transition between the private zone and the public zone can be protected by developing and maintaining some form of perimeter. This perimeter should not only contain patients, but also keep unauthorized visitors and contraband items out. Compliance with fire regulations usually prevents using the building itself as the final barrier between the private and public zones.

Walls At some of the oldest hospitals in the United States there are extensive brick, stone, and concrete walls enclosing the entire facility. These barriers, generally patterned after European hospitals, were probably built to provide privacy rather than protection. Low walls can be effective at diverting pedestrian and vehicular traffic away from facilities, but they are not effective at preventing patients from absconding. The cost of construction today has practically eliminated walls as a primary form of perimeter protection. (Colling, p346)

Fencing Protection of the perimeter is sometimes accomplished by using the exterior structural walls of the facility in combination with fencing of garden areas. The use of garden areas is often limited because of anxiety associated with patients absconding over fences. The National Health Service in the United Kingdom recommends fences be constructed of close-welded steel mesh, with 12 millimeter (1/2 inch) reinforcing bars. Mesh is necessary to prevent patients from gaining finger and toe holds on the fencing. The NHS also recommends that fencing should possess a height of 5.8 meter (19.5 feet) to provide a reliable deterrent to absconding. (NHS Estates, p11) This height seems excessive, as a height of four to five meters (12 to 15 feet) seems to be the norm (even within the NHS). The fencing should also extend well into the ground, approximately 1.8 meters (six feet), to prevent digging under fences.

The presence of these tall fences can result in a hospital taking on the appearance of a fortified camp. This appearance can be somewhat mitigated by the use of "ha-ha"s and berms. The ha-ha is a type of concealing ditch in which fencing is set. They were originally developed to provide landholders an unobstructed view of their property while keeping livestock and the paean masses from approaching the main house. A berm can be used in conjunction with a ha-ha to further reduce the apparent height of a fence, and provides a convenient use for the soil removed when digging the ditch. (See figure 1.2.2)

Courtyards are sometimes used to provide patients with necessary outdoor space. The NHS suggests that two-storey buildings have the advantage of being harder to abscond from. (NHS Estates, p7) The use of courtyards in medium security facilities seems inappropriate, because unless these courtyards are of an exceptionally large size, they have the appearance of a large outdoor room open only to the sky above. A two-storey courtyard eliminates the opportunity for pleasant views, observation of changing weather on the horizon, and limits the amount of daylight that can enter the facility.

A primary concern with courtyards, or the combination of fencing with the exterior structural walls of one-storey facilities, is the prevention of inpatients from absconding over the roof. The elimination of gutters and drainpipes can help deny a patient access to the roof. The roof and landscaping below would then be designed to allow water to shed naturally from the roof. The roof slope, eave height, and roof finish should work together to prevent patients from absconding over the roof. Therefore, tactile, easily graspable materials such as clay and concrete roofing tiles should be avoided. Eave heights of around twelve feet or nearly four meters, with an eave width of a yard or meter will help to keep patients off the roof. No method of construction can permanently prevent patients from gaining access to the roof; however, this act can be made fruitless by providing adequate perimeter fencing.

<u>Interior Observation</u> is determined by three elements: the shape of the floor plan, the transparency of the walls therein, and available apertures.

Floor Plans of "racetrack" design or of great complexity are much more difficult to monitor than plans with simple 90° corridor crossings. The term "racetrack" corridor derives its name from the typical floor plans present in most wards and clinics where loops of corridors serve rooms in a center section and perimeter rooms. In this type of floor plan, patients can hide from staff indefinitely, especially if there are multiple loops. "Racetrack" floor plans make it nearly impossible for staff to monitor the behavior of patients, prevent unauthorized visitations, and provide orderly evacuation of the facility during emergencies. This type of floor plan was implicated as contributory to the security problems at the Edith Morgan centre. (Brindle, 19 Apr 94, p6) Simple floor plans with right angle crossings, especially those with manned staff desks or nursing stations at the crossings, are much easier to monitor. (See figure 1.2.3.)

Transparent walls around nursing stations and other manned staff areas greatly increase the ability of staff to monitor patient behavior. These walls are typically constructed of wired or laminated glass in wood or steel frames. Laminated glass in a wood frame is usually sufficient to provide a smoke resistant wall. Walls that serve as fire barriers must be constructed of wired glass in a steel frame and conform with the requirements of the National Fire Protection Association as described in their Standard for Fire Doors and Fire Windows. (NFPA 80, p32) This standard also limits fire windows to the following dimensions.

1. Single window, other than casement: 5' by 5' (1.52 m by 1.52 m).
2. Multiple window, other than casement: 7' by 10' (2.13 m by 3.05 m).
3. Single casement window: 3.5' by 10' (1.07 m by 3.05 m).
4. Multiple casement window: 7' by 10' (2.13 m by 3.05 m).

Apertures in patient doors are sometimes required to monitor the status of patients. To prevent unauthorized use of these apertures by other patients, it may be advisable to control these apertures via means of a staff key. Apertures for monitoring seclusion rooms are essential, especially when patients are being transferred between the seclusion room and adjacent toilet facilities, or when secluded patients are being transferred to other parts of the facility. The design of apertures for seclusion rooms (and the seclusion rooms themselves) should ensure there are no "blind spots" where patients cannot be observed.

<u>Exterior Observation</u> of outdoor areas, especially patient gardens, is facilitated by the provision of adequate views, proper arrangement and maintenance of landscape materials, and adequate exterior lighting. Landscaping, especially trees, should be selected and maintained to prevent patients from using it for hanging themselves or for other forms of self injury.

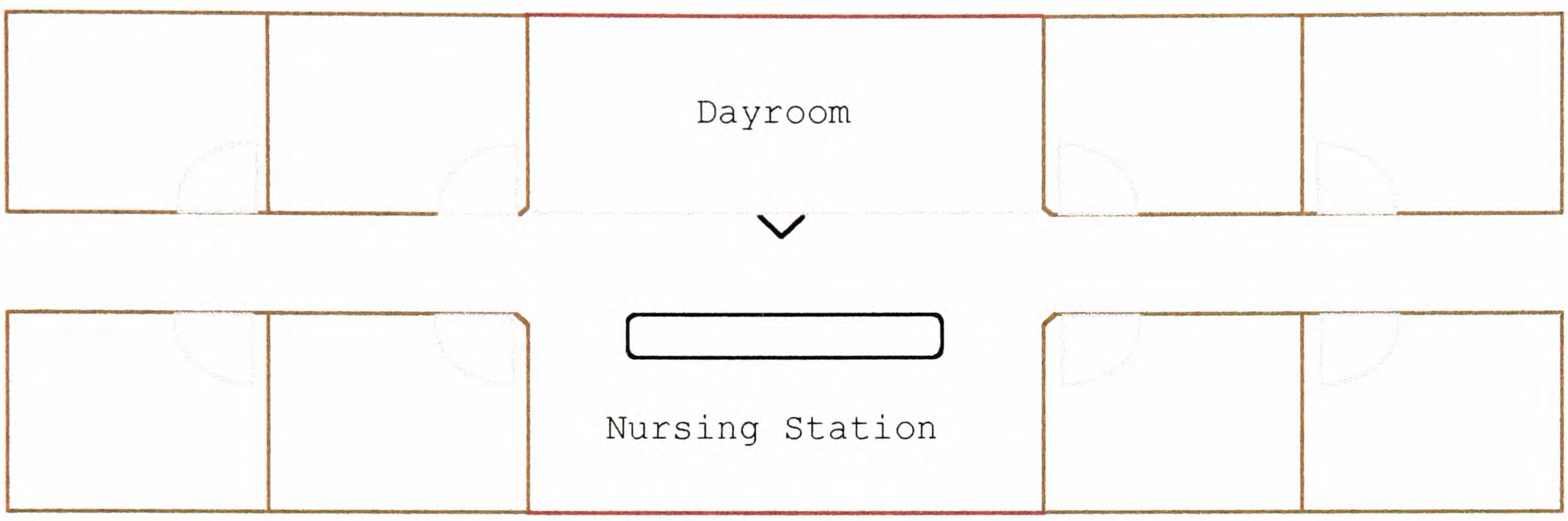
Communications Systems and Duress Alarms are essential to maintaining effective treatment within a mental health treatment facility. These systems allow staff to monitor patient health where direct observation is not always possible.

Communications Systems include ordinary telephones, paging systems, and nurse call systems. Ordinary telephones are necessary for the everyday chores of running any health care facility but should be protected by location or by codes to prevent unauthorized use by patients, visitors, and even certain staff members (who might abuse telephone privileges). Telephones are also required for patient use. Patient phones should allow patients to initiate and receive private calls. (American Society for Healthcare Engineering, p169) However, in inpatient facilities, these phones may be switched from nursing stations to prevent patients from making harassing or nuisance calls. Paging systems may also be required based on the size of the facility in question.

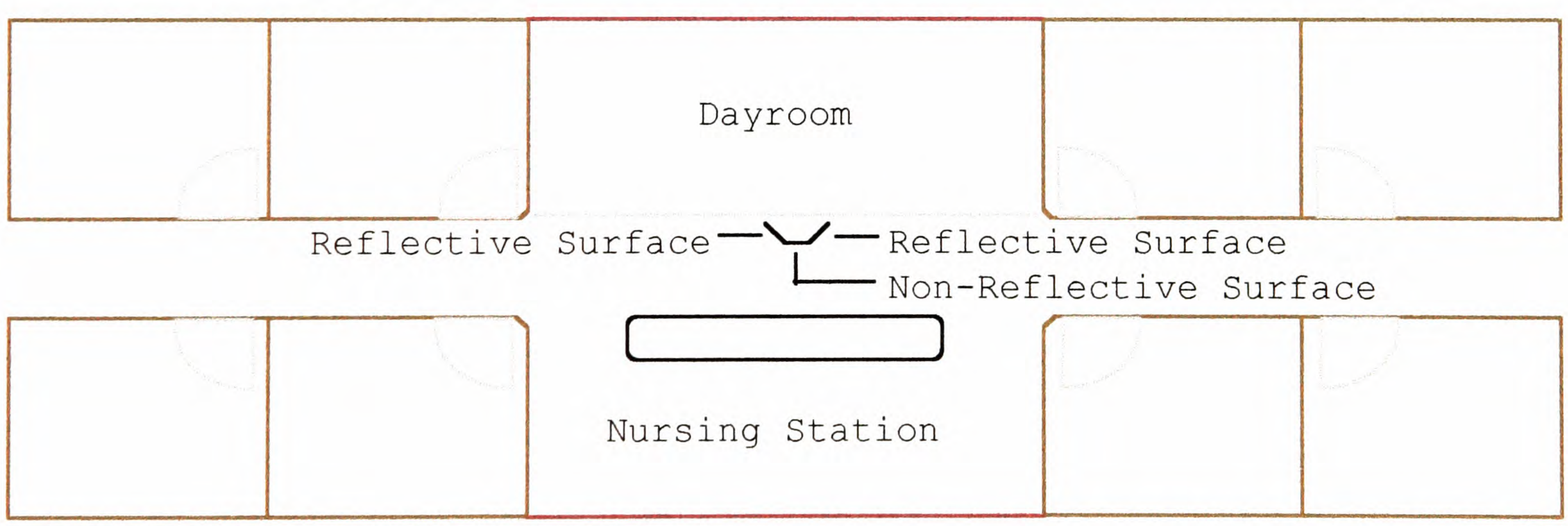
Nurse call systems allow patients in distress to notify staff of their situation. Nurse call circuits are required in sleeping rooms, toilets, and other rooms where patients cannot be easily observed. These circuits should be wired into an annunciator panel in the nursing station where staff can easily determine the location of the patient in distress. (NFPA 99, p21) These circuits also typically illuminate a colored fixture over the door of the room in question.

Duress Alarms have experienced growing acceptance in mental health treatment facilities in recent years. These alarms allow mental health professionals and other therapists to discretely and silently summon assistance if they or their patients are physically threatened. They are typically activated by a set of buttons under the therapist's desk in offices and similar treatment rooms. Despite growth in their use, there is still no consistent policy on duress alarms from any national governing body. This may be because of the possibility of perceived breaches in patient confidentiality. C.D. Stromberg, a legal expert in mental health, offers the following advice: "Ethically, the therapist may be bound to disclose information concerning a patient in an emergency, when disclosure would obviously be best for the patient."(Stromberg, p14)

In the absence of any definitive guidance, the author suggests that a two-tiered duress alarm system be installed in therapists offices and similar spaces. A first tier alarm would illuminate a diode in an annunciator panel in the nursing station or reception area similar to the nurse call system. (These two systems may be integrated into the same panel to save space and simplify operations.) This alarm may be accompanied by an tone or signal that is only audible in the nursing station or reception area. This first tier alarm would be used to summon additional staff when a therapist believes they or a patient are being physically threatened. The second tier alarm would perform all the functions of the first tier alarm but would also notify security personnel and open an intercom circuit between the room and the nursing station or reception area. Once this circuit is open, outside personnel may monitor conversations within the room or engage in two way communication with the occupants of the room as appropriate. This second tier alarm should only be used under the most grave threat of physical harm.

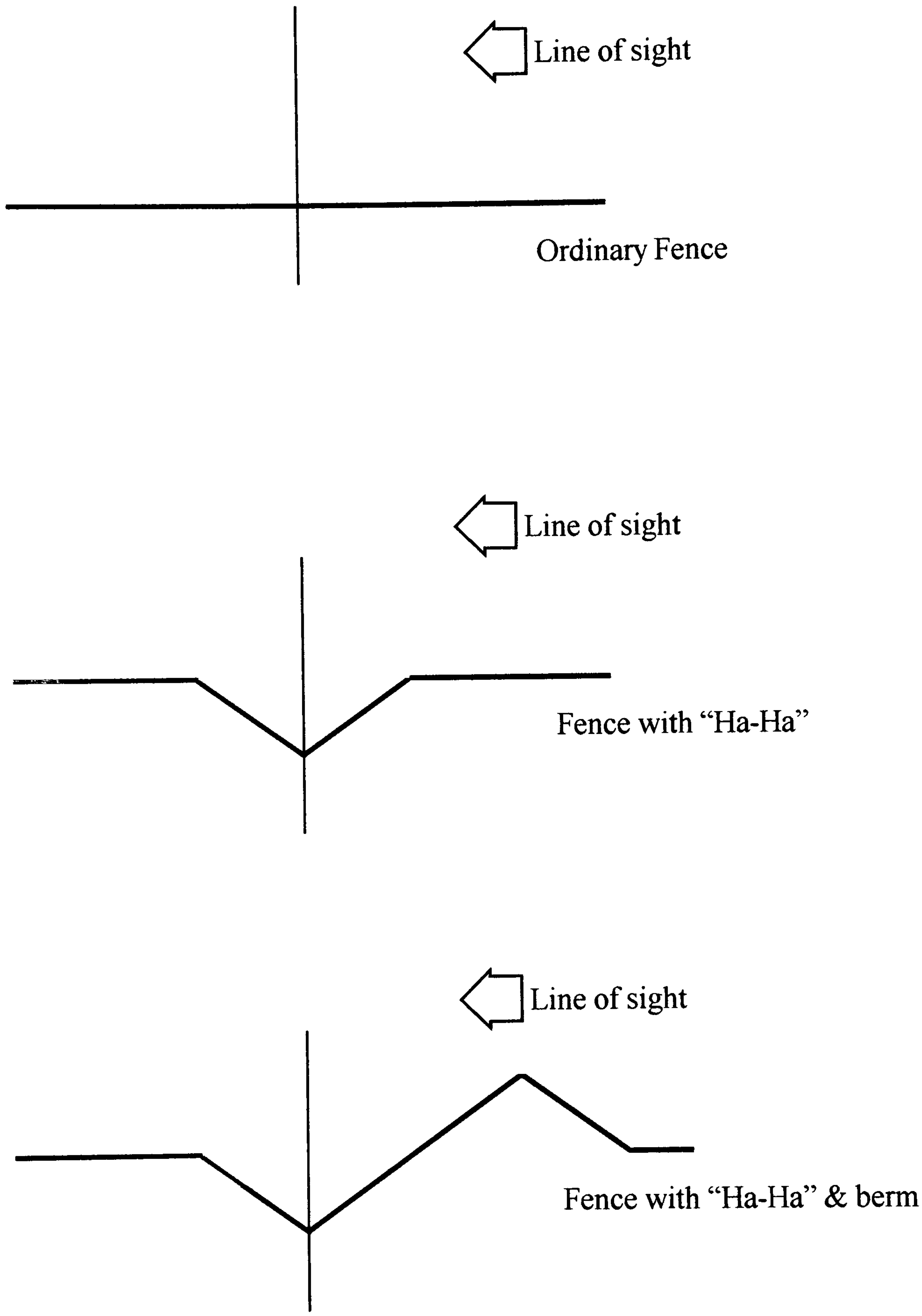


Improperly Installed Angle Mirrors

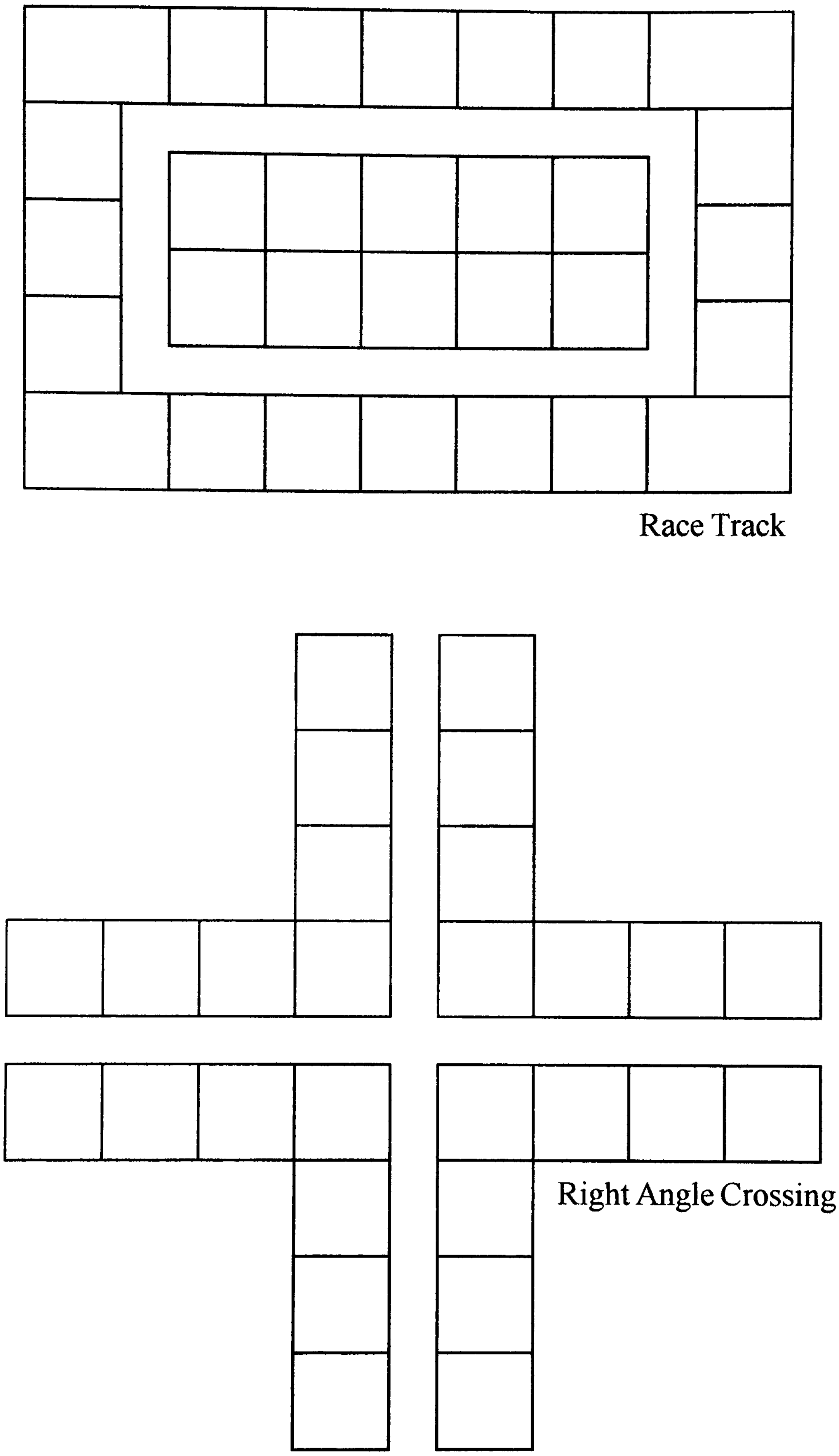


Properly Installed Pair of Mirrors

Angle Mirrors - Figure 1.2.1



Fencing, “Ha-Ha’s” & Berms
Figure 1.2.2



Floor Plan Types

Figure 1.2.3

Section 1.3 - Prevention of Suicide and Injury

Risk of Suicide Among Americans aged 15 through 34, suicide was the third most common cause of death after accidents and illnesses. Among Americans aged 35 through 44, it is the fourth most common cause of death after cancer, heart disease, and accidents. (Evans, 1988, p317) Since military members tend to range between the ages of 18 and 44, it seems they and the other members of the general population in this age range are under great risk of suicide. Members of the armed forces are under additional risk because they are predominantly male, and males have a rate of completed suicide, which is three times the rate for females. However, among psychiatric patients, completed male suicides are only 50% more common than completed female suicides. (Bongar, p85)

The suicide rate among the U.S. population hovers around 12.5 per 100,000 per annum. The suicide rate for members of the U.S. armed forces tends to mirror the general population. For example, the Air Force now has a suicide rate of 13 per 100,000 per annum, up from 11 per 100,000 per annum in 1992. However, certain locations such as Offutt Air Force Base, the headquarters of U.S. Strategic Command near Omaha, Nebraska, have suicide rates as high as 6 per 10,000 per annum. (Gertzen, p3) In contrast, the suicide rate among the British population is only about 8.2 per 100,000 per annum. (Eldrid, p128)

If a risk of 12.5 per 100,000 is spread over twenty years, the composite risk is about 250 per 100,000 (or about one quarter of a percent). These figures pale in comparison to estimates by Dr. D.C. Clark, who estimates that ten to fifteen percent of psychiatric patients commit suicide over a treatment period of fifteen to twenty years. (Clark, p923) This figure seems to be in line with other estimates. Dorwart and Chartok estimate that depression, recognized or unrecognized, is the most important risk for suicide and that fifteen percent of depressed individuals die by suicide. (Jacobs, p31-55) Alcoholism, which often accompanies depression, is also a strong predictor for suicide; according to Dr. D.G. Jacobs about fifteen percent of alcoholics commit suicide. (Jacobs& Brown, p372)

Although schizophrenia is a completely different form of mental illness, the rate of suicides among schizophrenic patients is similar to that of depressed patients. Dorwart and Chartok estimate that schizophrenic patients have a ten percent lifetime risk for completed suicide, and twenty percent of all schizophrenic patients make a suicide attempt. (Jacobs& Brown, p31-55) Surprisingly, the greatest risk may lie among those in poor physical health as opposed to those in poor mental health. For example, Wise and Rundell report that the completed suicide rate for renal dialysis patients is 400 times higher than the general population. (Wise, p154)

The high rate of suicide among psychiatric patients is not unique; it has a parallel among another group of isolated individuals. Similarly, incarcerated adults have suicide rates (132 per 100,000) that are ten times higher than those of the general population. (Fremouw, p50)

Risk of Self Injury Apart from suicide, there is also the risk of deliberate self injury among some individuals. This deliberate self injury is also known as parasuicide. This often takes the form of non-lethal drug overdoses. According to John Eldrid, there are six primary things that parasuicide may communicate: (Eldrid, p40)

1. A bid for sleep, rest from risk, or temporary oblivion

2. An adolescent expression of anger, frustration, great letdown, or confusion about coping with emotions

3. The onset of mental illness, psychotic illness, a bid for help

4. Reaction to loss of a significant other (spouse/lover/companion/etc.) or social status, loss from crime, loss of job

5. Feelings of inadequacy, constant trouble with relationships, work, money, police, alcohol, drugs

6. The intention of future suicide attempts

As indicated by Eldrid, these "parasuicide" overdoses are a strong indicator for future completed suicide. According to Dr. R.W. Maris, nonfatal suicide attempts occur approximately six to eight times more often than completed suicide, and the risk of eventual completed suicide among attempters is roughly 15%. (Maris, p37) There is also another form of self injury among psychiatric patients - self mutilation. According to Dr. G.E. Murphy, "some patients appear to engage in low-lethality self-mutilation or self harming acts to ward off feelings of numbness or unreality. These are usually either dissociative states or represent an underlying psychotic process." (Murphy, p146)

Methods of Suicide The most common method of inpatient suicide among psychiatric patients is self-poisoning by pill ingestion. According to Dr. Bruce Bongar - "Most self-poisonings are impulsive acts in which patients ingest what is available - often more than one substance or drug at a time." (Bongar, p145) The second most common method for inpatient suicide attempts is wrist cutting. Dr. G.E. Murphy estimates that this method figures in ten percent of attempts, with 60% of attempters being female. (Murphy, p145) Benonsohn and Resnik, American psychotherapists, considered hanging, jumping, cutting, and lethal drugs to be the most common methods of inpatient suicide. (Bongar, p152) In contrast to psychiatric inpatients, the majority of suicidal prisoners in jails and prisons simply hang themselves. (Evans, 1988, p228)

Availability of the means of suicide would seem to be a strongest indicator of the eventual method selected among individuals. Consider the most prevalent methods of suicides among Americans and Britons:

Rank	American Methods (Evans,1988 , p311)	Total	Male	Female
1.	Firearms & Explosives	56.8%	60.0%	43.9%
2.	Hanging, Strangulation, & Suffocation	14.6%	16.1%	8.9%
3.	Poisoning by Solid or Liquid Substances	13.1%	8.6%	30.7%
4.	Poisoning by Gases	7.5%	7.8%	6.3%
5.	Other Means (jumping from heights, train strikes, intentional auto accidents, drownings, etc)	6.2%	5.6%	8.7%

Rank	British Methods (Eldrid, p129)	Male	Female
1.	Poisoning by Solid or Liquid Substances	24.8%	54.3%
2.	Hanging, Strangulation, & Suffocation	29.3%	17.2%
3.	Poisoning by Gases	17.0%	2.7%
4.	Drowning	5.4%	12.1%
5.	Firearms	8.1%	0.4%
6.	Jumping from Heights	4.3%	4.9%
7.	Cutting & Piercing Instruments	2.7%	1.8%

It appears the most significant difference between the methods of suicides in these two cultures is the availability of handguns. The motivated, suicidal individual will simply use whatever means are available.

Routine Precautions Benensohn and Resnik, presented the following common sense guidelines for preventing suicides in psychiatric wards in 1973. (Bongar, p152-153)

1. Count silverware and all other sharp objects before and after use by the patients.

2. Do not allow patients to spend much time alone in their rooms and abolish private rooms altogether.

3. Jump and hang-proof the bathrooms by installing breakaway shower rods and recessed shower nozzles, and by removing exposed pipes and locating ventilation ducts at floor level.

4. Keep electrical cords to a minimum length.

5. Install windows of unbreakable glass with either tamper-proof screens or partitions too small to pass through. Keep all windows locked.

6. Keep all storage and utility rooms and adjacent stairwells, offices, and kitchens in sight. Security precautions need to be impressed on all non-clinical staff, including housekeepers and maintenance personnel.

7. Have visitors clear all gifts with staff, and search patients (for drugs, sharp objects, cords, and other such items) after they return from passes. Being able to receive a pass may signify that the patient is getting better and now has enough energy to carry out a suicide plan that the inertia of depression had previously made impossible.

While these precautions will not totally eliminate hospital suicide, they can reduce liability in most hospitals because reasonable care has been provided by the hospital. (Bongar, p153) Some mental health practitioners may take exception with Benensohn and Resnik's second recommendation. There are essentially two competing philosophies on patient privacy. The first asserts that patients should not occupy individual bedrooms because patients are self-policing and can keep an eye on each other to prevent suicide and other destructive behavior. The second asserts that patients need privacy to help effect their recovery and as a refuge from other patients - especially for facilities serving both sexes.

Facility Design Measures While Benensohn and Resnik's recommendations are certainly valid, they are probably insufficient for psychiatric hospitals operated for military members. Military members require additional protection because they usually possess greater physical prowess than the general populace, have less fear of violence and injury, are trained to be secretive and to improvise weapons from available materials. Additionally, members of elite Special Forces groups are conditioned by constant combat training to respond to conflict in an almost instinctual manner. The following facility design guidelines are therefore recommended. These recommendations are the synthesis of numerous interviews with staff members at several mental health treatment facilities in North America and Great Britain.

Bedroom Ceilings, and ceilings in other rooms such as bathrooms where patients cannot be constantly monitored, should be seamless and monolithic in construction. This should also apply to rooms in outpatient areas such as toilets. Plaster on lath, plasterboard, and gypsum board, 1.6 centimeter (5/8 inch) thick, with light wire mesh reinforcement should be adequate to prevent patients from gaining access to overhead ductwork, plumbing, electrical systems, and interstitial spaces. While a patient might eventually breach this type of ceiling, he would make so much noise doing it that staff would become aware of his activities.

Acoustic grid ceilings are inappropriate for such rooms because they make it too easy to access overhead space. It is necessary to prevent patients from accessing plumbing and mechanical systems to prevent hanging from overhead pipes and ducts. Patients must be prevented from accessing electrical systems to prevent both electrocution and gathering of wiring for nooses or garrotes. It is also necessary to prevent patients from accessing interstitial spaces and ductwork to prevent abscondence and unauthorized access to other parts of the facility. Patients must also be prevented from using this interstitial space to hide contraband items.

Sprinkler Heads in all patient rooms, and in other rooms where patients cannot be constantly monitored should be of institutional design. Institutional sprinkler heads are typically low-profile, streamlined models with no exposed parts or gaps that can be used to suspend a rope, wire, or other fiber to facilitate hanging. Any exposed screws or bolts should likewise be flush and tamper-proof.

Light Fixtures in all patient rooms, and in other rooms where patients cannot be monitored constantly should be flush mounted with shatterproof polycarbonate lenses to prevent access to the wiring. The frame should likewise have no exposed parts or gaps that can be used to suspend a rope, wire, or other fiber. Again, any exposed screws or bolts should be flush and tamper- proof.

Ceiling Mounted Air Grilles in all patient rooms, and other rooms not constantly monitored should be the flush mounted, perforated metal (not louvered) type, mounted with flush, tamper-proof screws or bolts. This is the most difficult ceiling component to protect from use by hanging. Since a looped wire can be run through one perforation and returned through another, it would be prudent to tie ceiling mounted air grilles to an audible alarm and an enunciator panel in the nursing station to indicate any tension on the units. Benensohn and Resnik recommend installing these grilles at floor level, but this is not always possible.

Switches and Electrical Outlets in patient bedrooms, and other rooms not constantly monitored should have shatterproof coverplates with tamper-proof hardware to prevent patients from accessing wiring inside. The tamper-proof hardware is also effective in preventing patients from using these switch and electrical outlets boxes as places to hide contraband items such as drugs and small knives. Electrical outlets throughout the facility should be ground fault protected to prevent patients from using them as a means of electrocution (by inserting a conductor, urinating on an outlet, etc.).

Tamper-Proof Hardware is available in two main types. The first type of tamper-proof screw or bolt features heads with two small round divots on top. A screwdriver with two small pins instead of a blade is used to install or remove the screws or bolts. This type of hardware is very easy to adjust and simplifies repairs on equipment. Unfortunately, it is very easy for a patient to construct his own special screwdriver from a bent metal fork. If this type of hardware is used, the institution in question must exercise great control over silverware.

The second type of tamper-proof screw or bolt features heads with two raised ridges on opposite sides of the top. This type of hardware can easily be installed with a regular screwdriver, but is impossible to remove with a regular screwdriver. This hardware is very difficult to adjust and complicates repairs on equipment. This type of bolt can only be removed with a set of vise-gripped pliers and with great effort. A screw of this type can only be removed by shearing the head off with a chisel. Therefore, only the bolts of this type are recommended.

Door Latches Although designed for the physically handicapped, push/pull toggle latches on patient bedroom doors are very effective at preventing self injury and suicide. These latches are typically encased in a rounded seamless metal housing and are operated by toggle levers that always point down. This design prevents patients from attaching any wire or fiber to the latch. Ordinary door knobs and levers are vulnerable to use in hangings and autoerotic asphyxiations which can be accomplished in the seated position.

Door Locks are necessary on patient bedroom doors in some facilities to provide patients with the degree of security they believe they require. These locks are not intended to keep patients locked in their rooms, but rather to prevent unwanted visits by other patients. These locks are typically operated by a rounded thumb-turn from the interior of the room and can be overridden by a staff key from the exterior of the room. To prevent the lock bolts from being used to suspend wires or fibers while the doors are closed, these locks should be installed as low on the door and frame as possible. Mounting these locks between 46 to 61 centimeters (18 to 24 inches) from the floor should be adequate to prevent the bolts from being used in hangings.

Door Hinges on patient bedroom doors are the most difficult system to protect. Some hospitals use a central pivot point to avoid the use of hinges altogether. Central pivot points allow the door to swing in both directions to prevent patients from barricading themselves in their rooms. Unfortunately, central pivot points are impossible to protect from use in hangings.

Some facilities use hinges with hospital style tips over the joints. These tips have a rounded slope to prevent them from being used in hangings. Other facilities use ordinary hinges, but install them with the joint edge on the corridor side of the door jamb. As a result the doors swing into the corridor, potentially blocking the view of nursing staff and causing injury to other patients and staff. If nursing supervision is inadequate, either hinge arrangement can be used in hangings by simply looping a wire or fiber around the entire hinge when the door is open, and then closing the door to complete the act.

Some hospitals use continuous "piano style" hinges. These continuous hinges offer good protection from use in hangings, but ordinary door frames will not allow doors to swing in both directions. (These continuous hinges should also have sloped hospital tips.) While "double acting" hinges that allow doors to swing in either direction are available, their large joints on both sides of the door provide ample opportunities for hanging.

There is a solution that will provide a continuous hinge able to swing in both directions, but it is unorthodox and requires custom fabrication. This solution requires the hinge to be attached to a metal plate in the wall rather than to the door frame. The door jamb on the corridor side conceals this plate and is held in place by a hex key bolt. In normal operation this door will swing in toward the patient's room. In circumstances where the patient has barricaded his door, the exterior door jamb can be removed in seconds with a hex key and the door will swing out into the corridor. (See figure 1.3.1.) This arrangement necessitates that nursing staff carry this hex key with their other duty keys. This unorthodox arrangement will offer little resistance to the passage of fire or smoke and should not be used in fire or smoke barrier walls. Sprinklering of patient wards is highly recommended if this hinge arrangement is employed.

Exterior Windows should be designed to restrain patients from jumping to death or injury below, and to restrict their use as a platform for hanging. Even ground floor windows should be secured because even falls of short distances can cause severe injury, especially to the neck and spine. (Dept of Labor, p1-17) Window frames, whether metal or wood should have rounded edges, if possible, to reduce the incidence of head injury. Window frames should have no interior hardware that could be used for hanging. Ventilation openings in windows should be fitted with heavy duty insect screen to prevent contraband items from being passed inside. Windows for mental health facilities are typically constructed either of wired glass, laminated glass, or polycarbonate resin. Each has its own advantages and disadvantages.

Wired glass offers excellent strength for minimum cost, width and weight. A 10 millimeter (3/8 inch) section of wired glass is adequate to restrain most patients. However, the gridded pattern of wire reinforcement is considered unattractive and suggests the appearance of a detention facility rather than a place of healing. When wired glass is broken the glass remains held in place by the deformed wire reinforcement. While this is adequate to prevent the patient from leaving the premises, it is not sufficient to prevent the patient from injuring himself. Patients may seriously cut or abrade themselves on exposed glass edges and shards.

Laminated glass windows are more expensive but do not contain the gridded wire considered offensive in wired glass. These windows are constructed similarly to the glass of an automobile windscreen, with a reinforcing plastic matrix between layers of glass. An 11 millimeter (7/16 inch) section of laminated glass is of plastic is adequate to restrain most patients. Laminated glass shares one of the same shortcomings as wired glass; after it is broken the glass remains held in place by the deformed plastic matrix. Again, while this prevents unauthorized departures, patients may seriously cut or abrade themselves on exposed edges and shards.

No form of glass is completely satisfactory, therefore polycarbonate resin is recommended. Polycarbonate resin windows are also more expensive and also don't contain the offensive gridded wire. An 11 millimeter (7/16 inch) section of polycarbonate resin is adequate to restrain most patients and will not break or deform. Since polycarbonate panes may experience some flexure when struck, a continuous exterior glazing bead of at least 25 millimeters (one inch) in width is recommended to prevent windows from being sprung out. To prevent these windows from becoming cloudy in appearance, the most scratch and damage resistant grade should be used. (NHS Estates, p9)

Interior Windows are covered in the section concerning access and observation.

Window Locks and Ventilation The Joint Commission for the Accreditation of Healthcare Organizations requires that windows and vents in psychiatric units be arranged so they can be opened from the inside to permit venting of smoke and other combustion products and to permit any occupant direct access to fresh air during emergencies. The Joint Commission further requires -

> The operation of operable windows shall be restricted. Where windows or vents require the use of tools or keys for operation, the tools or keys shall be located on the same floor in a prominent location accessible to staff. Windows in buildings designed with approved, engineered smoke-control systems may be fixed construction. (AIA Design Considerations, p105)

The National Health Service suggests that natural ventilation should be an integral part of the design-

> Ventilation is crucial. One good suggestion is narrow, full height opening windows or solid panels, with a clear opening of no more than 125 millimeters (4.9 inches) in width. Reliable draught sealing is essential. The number of such opening lights (lites) will be proportional to the area of the room - at least one per five square metres (53.8 square feet) is required. (NHS Estates, p9)

Window Curtains are required in patient bedrooms to provide both privacy and solar control. Interior shading systems such as shades or blinds which utilize cords, metal blades, and other hardware that could be used for suicide, self injury, or as weapons against others are not recommended. Window curtains should be installed on a hang-proof track, held in place by collapsible plugs; these plugs are normally set to have a collective failure strength of about 50 pounds (22.7 kilograms). (See figure 1.3.2)

Testing Windows and Screens The Department of Defense uses the following criteria to test windows and security screens. Samples of screens or window assemblies are mounted in a channel frame welded to vertical supports. A 200 pound (90.7 kilogram) load, suspended from a cable, is allowed to swing in an arc and strike the screen at the center point, creating a shock load. The pendulum used is 13 feet long (3.96 meter), giving a two second time for one oscillation when released from any of the angles used in this test. The 200 pound weight used in this test is made of steel slugs 5/16 inches (eight millimeters) round and 1-1/8 inches (28.6 millimeters) thick. This makes a fairly rigid weight, whereas the human body has flexibility and will cushion the blow more than the weight used.

The weight is allowed to strike the screen three times, once from a distance of five feet (1.52 meters) and a height of one foot (30 centimeters), once from a distance of 6.92 feet (2.1 meters) and a height of two feet (61 centimeters), and once from a distance of 8.3 feet (2.53 meters) and a height of three feet (91 centimeters). (Refer to figure 1.3.3.) These distances effectively simulate a 200 pound (90.7 kilogram) individual striking the window or screen at 8.02 feet per second (2.44 meters per second), 11.32 feet per second (3.45 meters per second), and 13.88 feet per second (4.23 meters per second). Samples of windows or screens used in bedrooms and other confined spaces should resist simulated strikes at eight and eleven feet per second. Samples of windows and screens used in large open areas such as dayrooms or the ends of corridors should resist simulated strikes at nearly 14 feet per second.

Stairways, like windows, provide opportunities for injury via jumping (to stairs and landings below). Most stairways also provide an unobserved environment with a substantial rail ideal for hanging. A patient need only attach a length of rope (or other fiber) to the hand rail and jump over to the other side. It is desirable to keep stairways secured to prevent unauthorized patient access. However, it is not always possible to keep stairways secured; to demonstrate reasonable precautions, stairways in mental health facilities should be fitted with a vertical barrier between landings and flights of stairs to prevent jumping or hanging. (See figure 1.3.4.) This barrier should also be designed to prevent patients from climbing on it, risking further injury. This barrier should also be constructed of wire glass or wire mesh to allow observation of the stairway through the barrier. This barrier should also meet the test criteria described for windows and screens.

Stairways also provide areas for patients to hide from staff. Areas beneath the bottom flights of stairs should be sealed to prevent patients from hiding within. Patients may hide with the desire of injuring a staff member or other patient, or to avoid treatment. In a recent incident at Cincinnati's Bethesda Oak Hospital, a patient avoiding necessary surgery was found dead two days later where he had been hiding in the stairwell. (American Press, p2A) For this reason, areas beneath the bottom flights of stairs should be sealed and camera surveillance of stairways may be advisable. Additional guidance for the design of stairs and other exits are covered in the sections concerning control of access and observation for staff and patient safety, and fire safety.

Water Closets Typical hospital grade toilet fixtures are inadequate to resist vandalism and to prevent patients from using them to injure themselves and others. Hospital grade water closets are usually constructed of porcelain, and are easy to shatter. The results of such vandalism is a flooded, fetid facility and an abundance of large sharp porcelain shards. The water supply tanks and tank covers can also be detached and used as formidable weapons or shields. A better product for use in mental health facilities are cast iron, porcelain coated toilet fixtures, although the porcelain finish can be cracked with some effort, and these fixtures are not easily reconditioned.

Perhaps the best product available is the stainless steel, institutional grade water closet. These fixtures can resist great amounts of abuse. These water closets can be coated with a pleasant shade of chemically resistant urethane (CRU) to make them warmer to the touch and less institutional in appearance. These fixtures should have a self contained waste drain (inaccessible to patients) and remote water supply valves (typically on the other side of the wall in a secured room) to prevent flooding. These fixtures should also have push-button operated flush valves (tamper-resistant and hang proof) in lieu of water supply tanks. These flush valves should be fed by a cool water supply line isolated from the cool water supply feeding the showers to prevent scalding of other patients during flushes. These toilets also feature shallow bowls to prevent violent patients from holding other patients' heads under water. Water closet rooms should also be equipped with hang proof institutional grab bars. (See figure 1.3.5.)

Sinks Typical hospital grade sinks are likewise inadequate to resist vandalism and to prevent patients from using them to injure themselves or others. Hospital grade sinks are also usually constructed of porcelain, and are easy to shatter. Again, the results of such vandalism are a flooded facility and the production of large sharp ceramic shards. While porcelain coated cast iron sinks are a better product, they have the same shortcomings as cast iron water closets. Again, the stainless steel, institutional grade sink is perhaps the best product. These sinks can also be coated with CRU to make them warmer to the touch and less institutional in appearance. Sinks should also have relatively shallow basins to prevent violent patients from using them to hold other patients' heads underwater. These fixtures should also have a self contained waste drain and trap (inaccessible to patients) and remote water supply valves (typically on the other side of the wall in a secured space) to prevent flooding. These sinks should be equipped with hang-proof faucets and hardware (tamper-resistant).

Tubs and Showers Tubs should never be installed in mental health care facilities under any circumstances. The potential liability it too great because there is no way to drown-proof a tub. The installation of tubs is entirely inconsistent with taking reasonable measures to prevent suicide and injury.

Traditional shower enclosures constructed of tile and plaster require large amounts of maintenance, extensive cleaning, and present slipping hazards to patients. Prefabricated fiberglass shower enclosures require less extensive cleaning, but can easily be damaged by a violent patient. Solid acrylic shower enclosures are superior because they are extremely durable, require little maintenance, are easy to clean, and can be installed with slip resistant floors.

The water supply for these showers should be protected by a thermostat set at 40°C (105°F) to prevent scalding, and remote water supply valves (typically on the other side of the wall in a secured space) to prevent flooding. (DHSS, Hospital Bldg Note 35, p13) Showers should be fitted with tamper-resistant drains, hang-proof institutional shower heads, and hang-proof institutional grab bars. Shower curtains should be installed on a hang-proof track, held in place by collapsible plugs; these plugs are normally set to have a collective failure strength of about 50 pounds (22.7 kilograms).

Towel Racks and Clothes Hangers of conventional design present opportunities for suicide and self injury. The horizontal rod usually employed in towel racks, wardrobes, and closets can also be detached and used as a weapon. There are several alternatives available. Safety hooks are available which will collapse at desired design strengths. These hooks can be made of metal with neoprene compression rings, or completely out of rubber or vinyl. Special hang-proof clips are also available which also collapse when over loaded.

Mirrors in patient rooms, typically installed over the sinks, are necessary to allow patients to maintain a well groomed appearance. Good personal appearance facilitates patient self esteem, group socialization, and the process of therapy. Unfortunately, glass mirrors have always been associated with danger to patients and staff. Some hospitals have employed polished stainless steel mirrors attached to the wall with tamper-proof hardware to prevent injury. Unfortunately, these steel mirrors produce a hazy slightly distorted reflection. A more recent development are plastic mirrors with a backing of reflective mylar film. These plastic mirrors look more like ordinary mirrors, provide a sharp reflection, but create even greater visual distortions than steel mirrors. These distortions can be especially disturbing to some patients and may trigger hallucinations or other psychotic episodes. (Prohansky, p561)

The most recent development in institutional mirrors are models constructed of tempered laminated glass with sealed edges. This type of mirror is extremely shatter resistant, and must be exposed to an extraordinary amount of stress to break, therefore generating enough noise to alert nursing staff. When this type of mirror eventually does shatter it produces small, non-lethal fragments. These mirrors are typically anchored to the wall with tamper- proof bolts. Information on hallway security mirrors in contained in the section concerning access and observation.

Furniture in patient bedrooms should be of a solid streamlined design without exposed slats, dowels, posts, handles, sharp corners, etc. Large pieces such as wardrobes, desks, and beds may be bolted down to prevent patients from using them to erect barricades. Smaller pieces such as end tables, chairs, pillows, and rugs can be mobile to allow patients to develop preferred arrangements. Rugs and other textiles should be tightly woven to prevent patients from accessing the fibers therein. Pictures and artwork may be held on the wall with rubber pegs that will collapse under excessive loads. It may be desirable to mount pictures and artwork directly on solid boards or a similar matrix, without a frame, to prevent patients from destroying frames to access the mitered wood pieces therein.

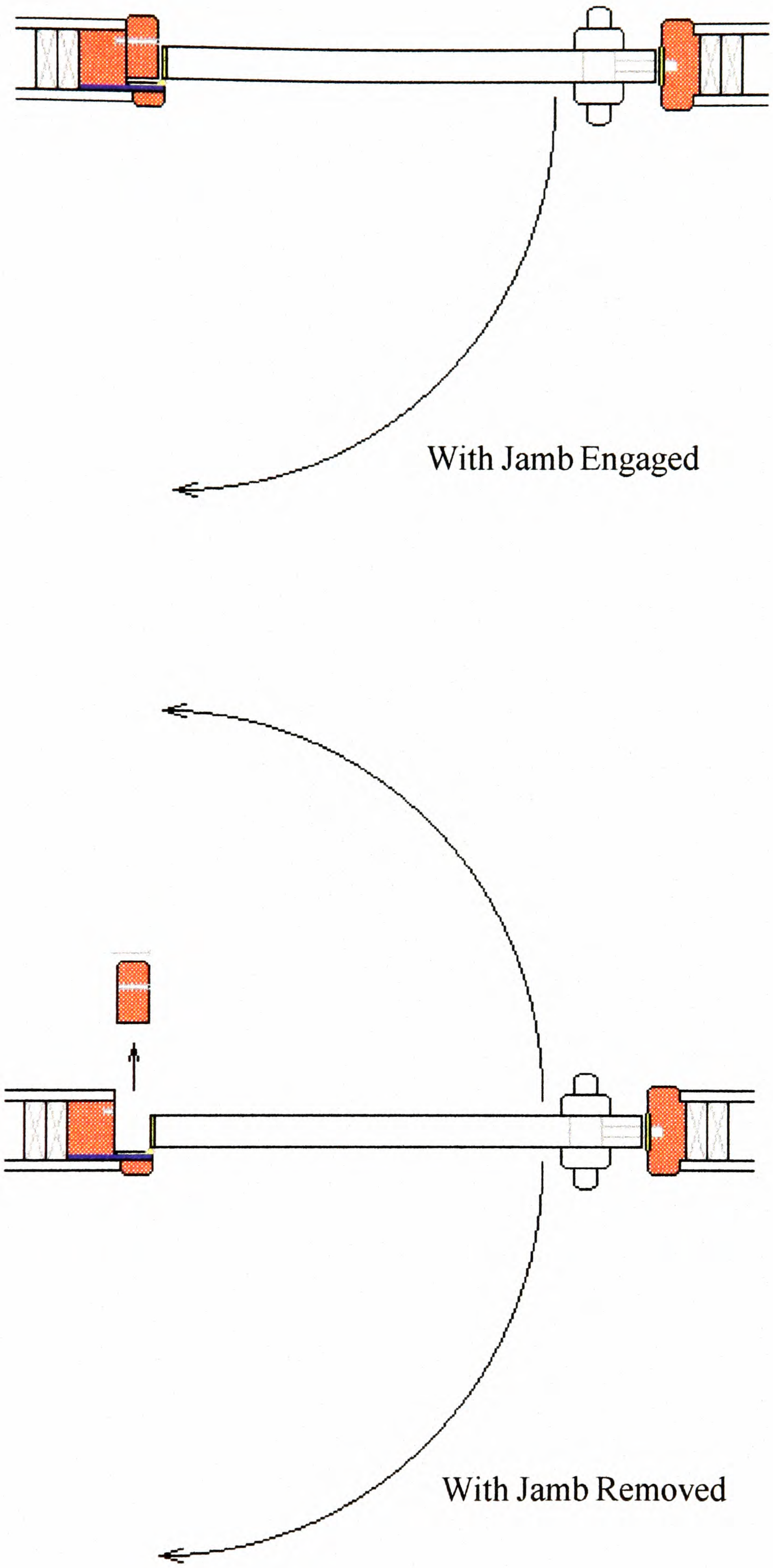
Acute Corners on interior walls and nursing stations should be rounded or eliminated to prevent injuries. Existing corners that cannot be altered should be padded or otherwise protected.

Seclusion Rooms are intended for short-term occupation by violent or out-of-control patients. The Royal College of Nursing defines their use as "the temporary removal of established opportunities for positive reinforcements ... achieved in clinical practice by physically removing the patient from his normal social setting and placing him in a barren room for a short period." (Royal College of Nursing, p2) Within a psychiatric nursing unit, a seclusion room provides additional security and protection for patients and staff. There should be at least one seclusion room for every 20 beds or so. (AIA Guidelines, p16)

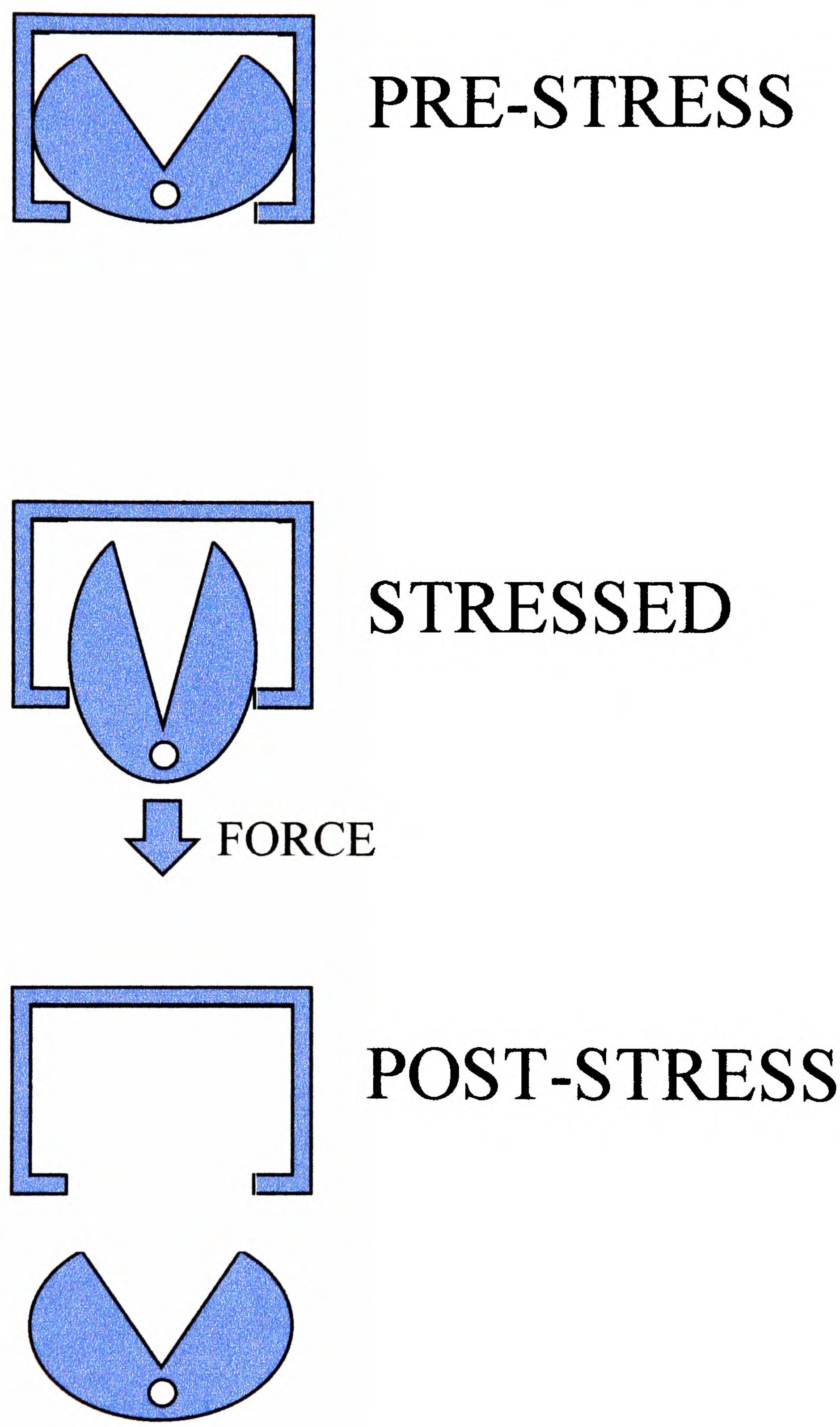
These rooms should be located for direct nursing staff supervision while maintaining the patient's right to privacy. Each room should be designed to provide temporary placement, care and observation for one patient and constructed to minimize the opportunity for hiding, escape, injury, or suicide. If a facility has more than one psychiatric nursing unit, the number of seclusion rooms may be based on the total number of psychiatric beds in the facility, with seclusion rooms grouped together. (AIA Guidelines, p16 & 44)

Additionally, the room should provide an environment with minimal sensory stimuli. The AIA interprets this to mean that exterior windows are not necessary, but this opinion is not held by all mental health professionals. (AIA Guidelines, p44) Some mental health professionals suggest that without an exterior window, a seclusion room will become unbearable for some patients after a very short period of time. If provided, special care should be taken in the design and placement of these windows to prevent patients "acting out" by exposing themselves to others outside the window. Intermittent frosting of the glazing is one solution. Seclusion room windows should also be oriented to private gardens and not toward public areas to avoid this contingency.

Seclusion rooms should have access to a toilet room adjacent to the seclusion room. Doors to seclusion rooms should be provided with locks. There should be viewports in the door, or other means of affording visibility of the occupant at all times. (AIA Guidelines p44) Special fixtures and hardware for electrical circuits (as described previously) should be used. Where the interior of the seclusion room is padded with combustible materials, these materials must be of a type acceptable to the local fire official or other authority having jurisdiction. The room area, including floor, walls, ceilings, and all openings should be protected with not less than one-hour fire rated construction. (AIA Guidelines, p16)

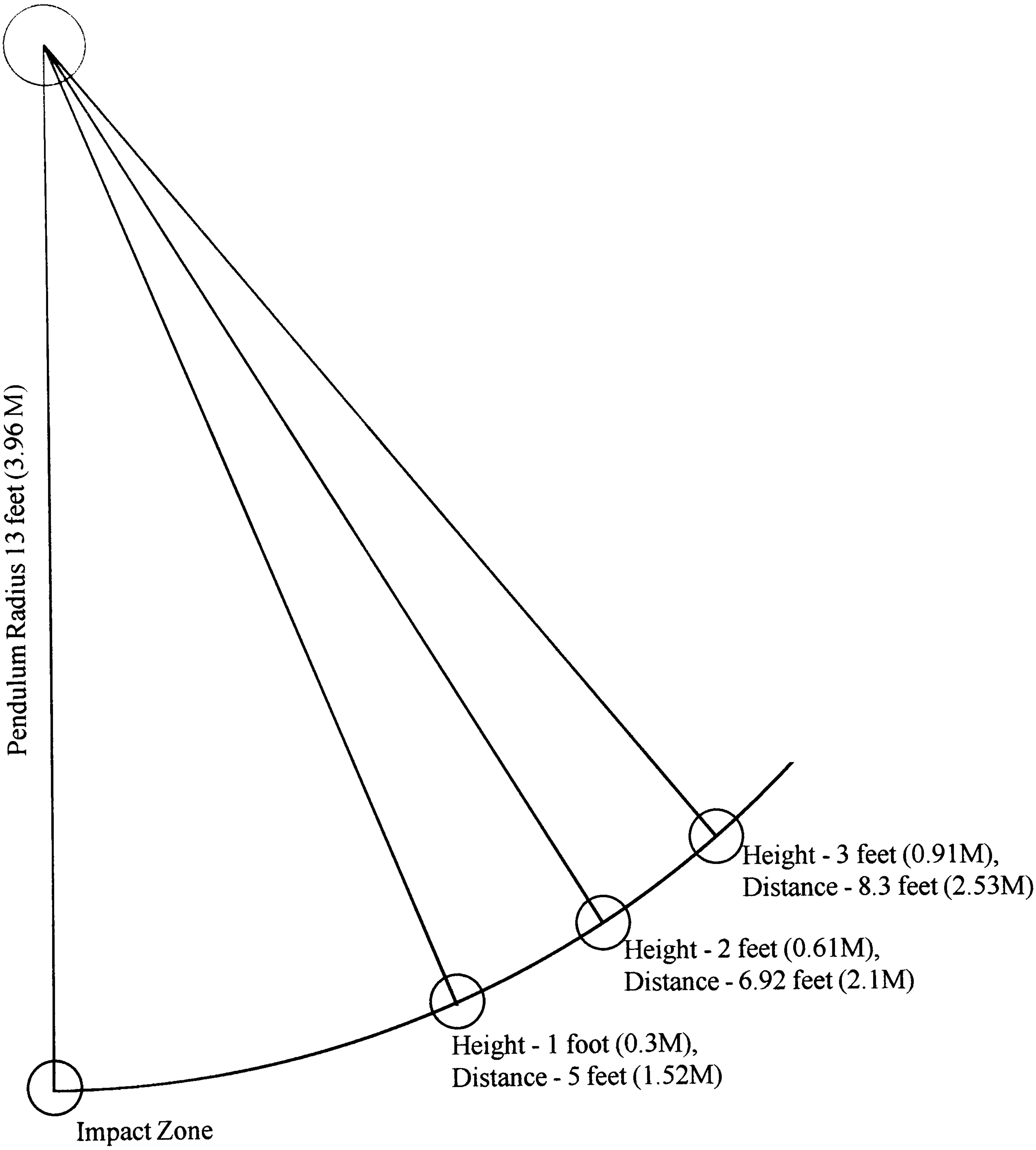


Reverse Swinging Doors - Figure 1.3.1



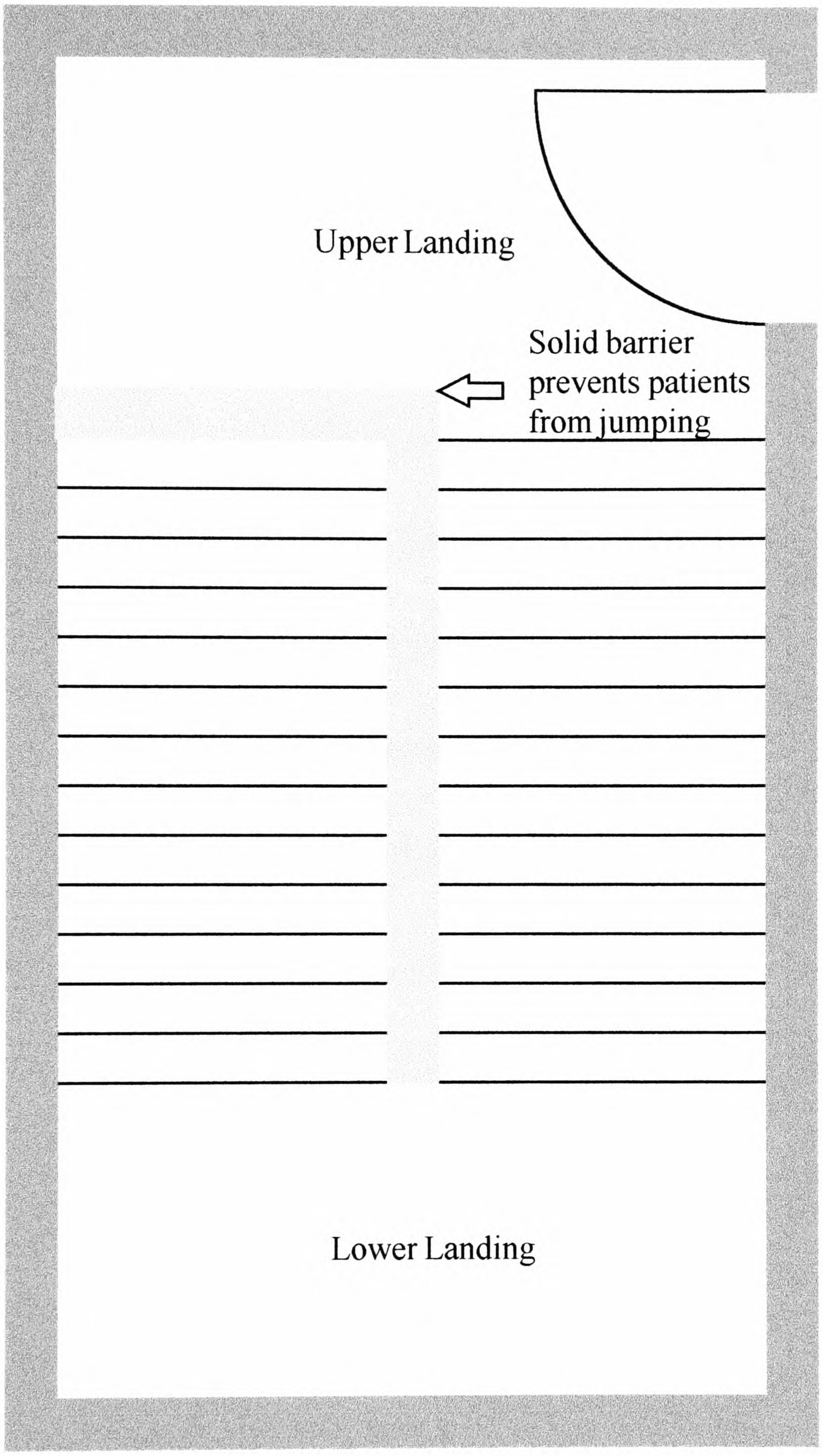
Hang-Proof Curtain Track

Figure 1.3.2

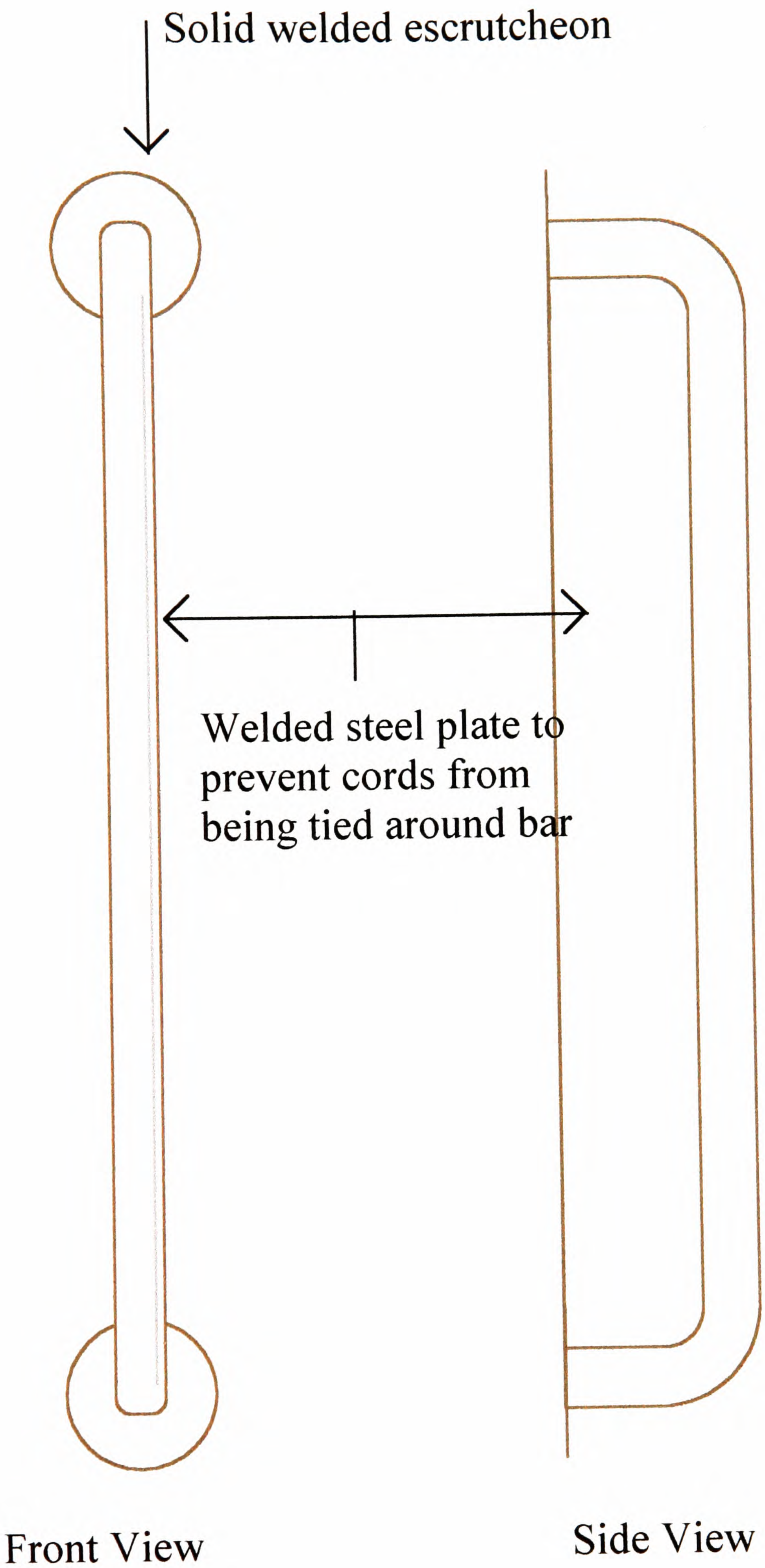


Window & Screen Test

Figure 1.3.3



Vertical Jump Barrier
Figure 1.3.4



Institutional Grab Bars - Figure 1.3.5

Chapter 2 - Environmental Design

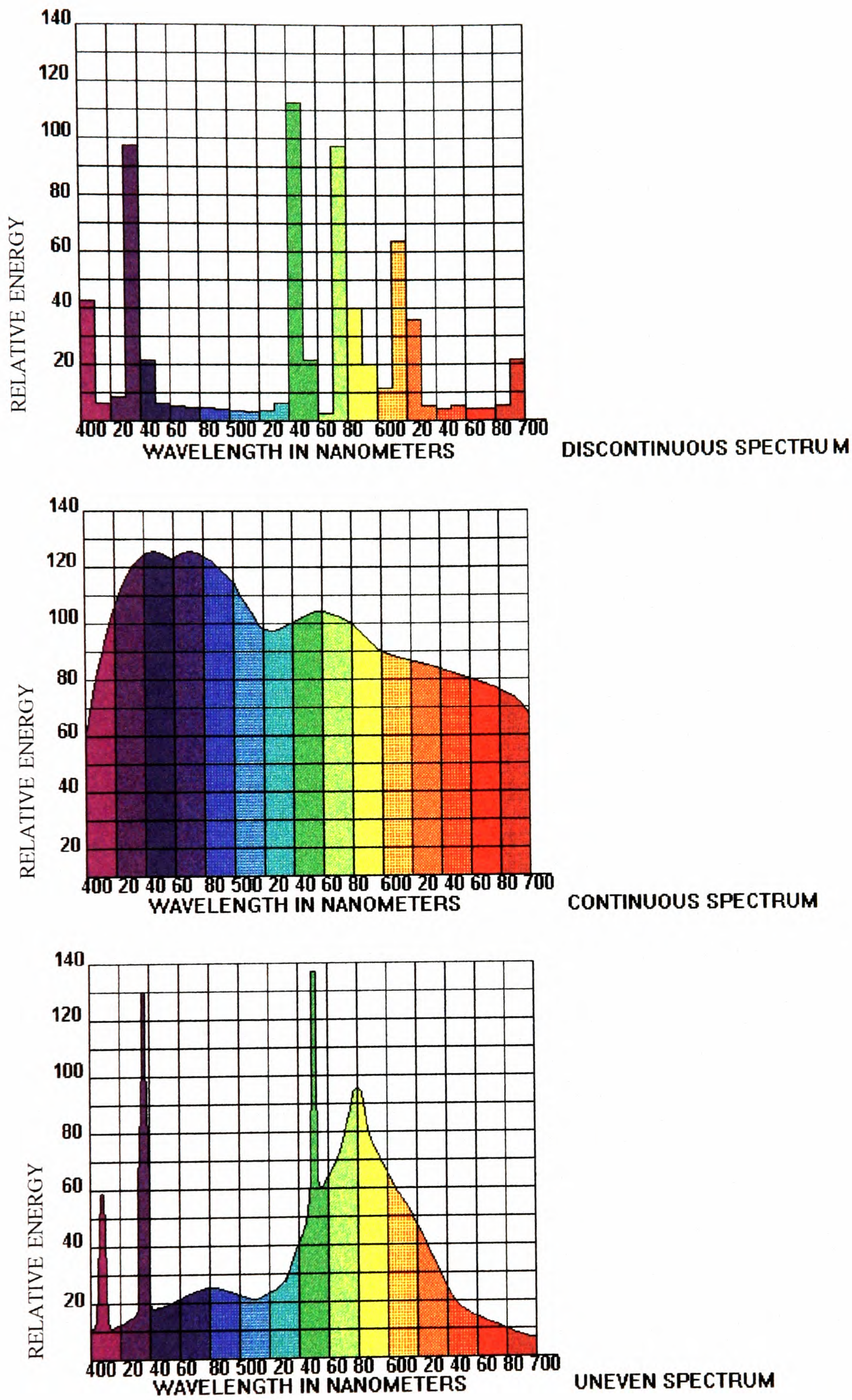
This chapter examines the environmental effects of different types of lighting, colors, finishes, and spatial arrangements on the patients and staff members of mental health care facilities. These facilities include local clinics offering outpatient diagnostic services and treatment at most military installations for mild mental disorders, social maladjustments, and alcohol and chemical dependency problems, as well as regional wards and hospitals for patients requiring more extensive inpatient treatment. This text provides recommendations to help clinical and design personnel select lighting, colors, finishes and spatial arrangements appropriate for healthy interior environments for patients and staff.

Section 2.1 - Interior Lighting

Our understanding of our environment is based on the perceptions of our five senses. The sense of sight is by far the primary means people use to orient themselves to their environment. Reflected light is the vehicle which transmits visual information from the environment to the eye. This light is converted to electrical impulses by the eye, and the optic nerve serves as a conduit to the brain where these impulses are processed. When we view our environment, not only do we perceive the colors and tones of the objects in our environment, but also the characteristics of the light source which reflects off these objects.

Since reflected light is so important to our perception of our environment, we should examine the primary sources of this light. The primary sources of light in health care facilities are natural daylight, incandescent lighting and fluorescent lighting.

Any light source may be graphically described by breaking it down into wavelengths and then measuring the strength of these wavelengths. On a standard spectral distribution chart, a light source is shown by wavelength (in nanometers) on the horizontal scale and the intensity (in relative energy) on the vertical scale. The result is a graphic illustration of the light's spectral range and its changing relative energy over that range. The colors of different sources may be illustrated by the lights' spectral distributions shown as continuous, smooth graphic lines (all visible wavelengths are produced by the source), uneven lines (containing all wavelengths, but some more than others), or discontinuous lines (some wavelengths are missing when viewed directly). Any of these combinations is capable of producing what we perceive as white light. (Nuckolls, 37) Three samples of spectral distribution charts are shown at figure 2.1.1.



Sample Spectral Distribution Charts

Figure 2.1.1

Human perception of light is based on the properties of the eye and the brain. In the eye there are two main types of light receptors, rods and cones. The rods are not color sensitive and are tuned to pick up low intensity light - they are therefore the main component of night vision. The cones are the color receptors with 10% sensitive to blue light, 45% to red light, and 45% to green light. This limited color information travels to the brain where a picture is constructed from the available light inputs. Color corrections and interpretations are made based on the varying proportions of the three types of light. For example, despite the fact the eye has no yellow receptor, we can see the color yellow. This is because the brain autonomically analyzes the proportion of green and red light received and registers the color yellow. The brain also examines the boundaries and discontinuities between colors of light and attempts to calculate the color(s) being observed.

This real-time processing also includes a continuous assessment of the color range of the entire visual field, a process which is responsible for the phenomenon of color constancy. Color constancy is manifested as the ability to perceive true colors under a variety of lighting conditions, and is most effective under natural lighting conditions and with the smoothly-varying spectrum provided by incandescent light sources. The uneven spectral output of fluorescent and discharge lamps has a negative effect on color constancy.

Discontinuity in the visible spectrum of light sources can have negative effects on our perception of the environment. For example, light sources high in blue and green spectral energy, but low in red and orange can cause even a normal human face with a healthy complexion to take on a ghoulish appearance. Conversely, light sources high in red spectral energy can make people look healthier than they really are. The lack of adequate lighting can also contribute to depression, not just among patients but among staff as well. (Goodnow, 6) The effect of interior colors and light colors also affect human behavior, but this will be discussed later in conjunction with interior finishes.

Natural Daylight - Indirect Variables

Natural daylight has long been accepted as the standard by which our perceptions are based, and the standard by which incandescent and fluorescent light are compared. The goal in most interior lighting schemes is to simulate the effects of natural lighting as much as possible. However, natural daylight is not a consistent light source because its effects can be altered by a number of variables. The indirect variables affecting natural light are of two types: *exterior* and *interior* effects. Daylight is altered by *exterior* effects such as weather, local terrain, landscaping, and reflection over water or desert. *Interior* effects include: fenestration (proportioning, arrangement, and design of doors and windows), daylight control systems (shades, blinds, louvers, etc.), interior decor, and artificial lighting systems. (Nuckolls, 45)

Although natural illumination may be adequate according to foot-candle standards (based on incident light intensity), fenestrated rooms remote from exterior views should employ additional daytime artificial lighting. Additional illumination will make occupants deep within the space feel that lighting levels are adequate by comparison with areas near windows. The sideward illumination from windows can also soften the harsh vertical illumination created by some ceiling mounted lighting systems. The thermal effects produced by extensive window glazing may also be controlled by limiting window size or by using tinted, shielded, or other heat-reducing glazing. (Nuckolls, 45) These are environmentally undesirable for many reasons: the radiant temperature of the pane causing discomfort, color distortion, and a gloomy view to the outside.

In most standard rooms, a window area between one and two-fifths of the fenestrated wall has been proposed as adequate by the British Lighting Division of the Chartered Institution of Building Services Engineers. British experts believe that this open area is a reasonable compromise among the factors of comfort, desire for exterior views, and HVAC gains or losses. (In the United States, a comparable measurement of twenty percent is considered well balanced as a standard architectural rule of thumb.) Supplementary illumination will also be desirable during daylight hours for areas remote from windows. (Nuckolls, 45) This ratio necessarily will vary from one climatic region to another.

Additionally, wide window openings can provide greater depth of daylight penetration than narrow openings. The shape of wide openings may also correspond to the normal lateral scan of eyes when room occupants are seeking information on weather, local activity, and so on. Long, wide openings generally are perceived as less glaring than tall narrow openings of equal area and luminance. In addition, occupants generally prefer wider openings when the primary views of interest are of nearby areas or activities. (Egan, 177)

Natural Daylight - Direct Variables

Important direct variables of natural daylight include: the position of the source, diffusion, color, timing and intensity.

<u>Position of Source</u> We usually assume the sun rises in the east and sets in the west. In fact, the sun assumes a southerly arc during most of its travel in the northern hemisphere. (Of course it assumes a northerly arc in most of the southern hemisphere.) Therefore, in northern

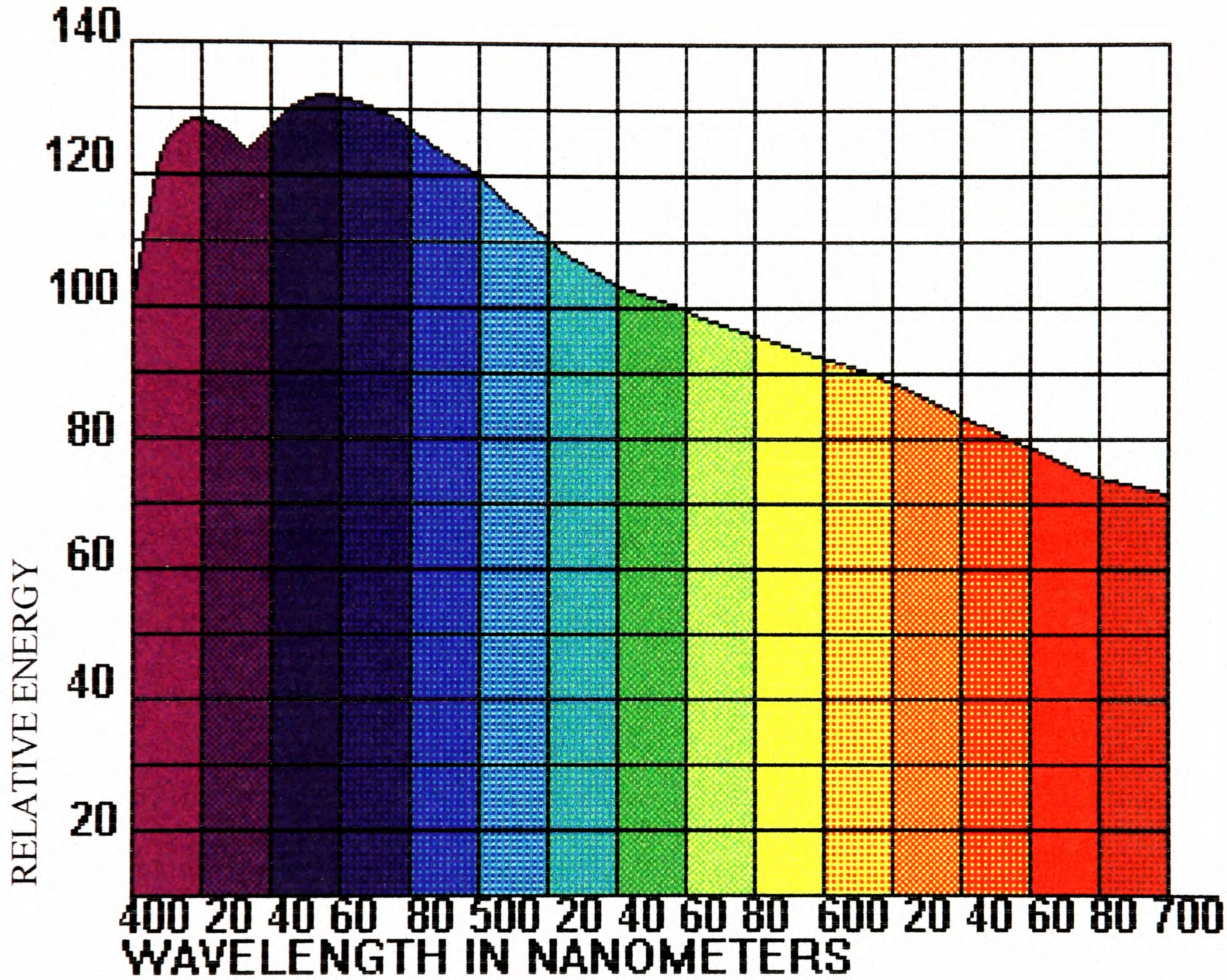
latitudes of the northern hemisphere, a southern orientation for windows is usually considered desirable because it allows for the maximum use of daylight, especially in winter months. However, in the southern latitudes of the northern hemisphere, northern exposures should be emphasized to avoid excessive solar gain. (Nuckolls, 46)

Diffusion The Lighting Division of the Chartered Institution of Building Services recommends the following three conditions be considered in any design based on daylight: "Incident light from overcast sky, incident light from clear sky only, and incident light from clear sky plus direct daylight." The division also notes a "uniformly overcast sky is normally 2-1/2 to 3 times as bright overhead as near the horizon," and that "except in the immediate vicinity of the sun, the clear sky is normally brighter near the horizon than overhead." (Kaufman, 7-1)

Color The color of daylight changes with the time of day, the cleanliness of the atmosphere, and the reflection of surrounding objects. Most studies of natural daylight for the United States have concentrated on conditions at noon in northerly latitudes. The International Council of Illumination (CIE) has set noon sunlight at the measurement of 4870 Kelvin. (Nuckolls, 46) The color temperature system of measurement is not based on the temperature produced by the light, but designates the relative color of a heated object, such as the filament of an incandescent lamp. This number, expressed in values of Kelvin, is the temperature of a theoretical radiator whose color matches that of the source being evaluated. (Nuckolls, 38)

Please note that sunlight and daylight are different and that each possesses its own distinctive color and color temperature. Sunlight refers to light directly received from the sun and the associated light reflected and diffused by the atmosphere; while daylight refers only to the light diffused and reflected by the atmosphere. Several studies have concentrated on the color of light produced by the sky (not including direct sunlight), and researchers determined that 6000 K represents an overcast northern sky. They have also determined that 10,000 K represents the condition of a clear blue northern sky. Color specialists in the textile and graphic arts industries have selected 7400 K as the color temperature of preferred daylight. In northern latitudes, this is a sky that is moderately overcast from the north. (Nuckolls, 47) The illustrated spectral energy distribution curve for 7400 K representing this preferred source is shown at figure 2.1.2.

Timing and Intensity   Direct sunlight is rarely an acceptable light source for interior lighting. In addition to heat problems, its intensity is difficult to control. As a result, there is usually an attempt to prevent direct sunlight from entering the interior spaces. On the other hand, daylighting is a very useful source - although not for all applications. Unless work areas are very near windows, or skylights/monitors or clerestories are used to bring daylight down from ceilings, most tasks performed away from windows are best served by controlled artificial light. Natural daylight, entering the interior from the side, can be effectively used to light passageways, waiting areas, transition zones (from exterior to interior), and special interest areas. (Nuckolls, 47)



Spectral Distribution of 7400°K

Northern Latitude Sky Moderately Overcast From The North

Figure 2.1.2

Daylight Sources

Obviously the source of daylight is the sun and the reflectance of the sun's light throughout the atmosphere; our use of the term "daylight source" refers to the type of aperture through which daylight enters the interior. Two questions should be considered when selecting any daylight source: Does it adequately control brightness from the sun and sky? Does it admit sufficient illumination to the interior space?

Unilateral Windows placed on an occupied space represent the simplest and most common method of daylighting. It is the one that lends itself to curtain-wall construction and continuous fenestration in multi-story architecture. To achieve optimal illumination within these spaces, the depth of a room should be limited to two times the height from the floor to the full room-width window height. As an illustration, if a window is eight feet (2.5 M) tall, then the optimal room should be no more than 16 feet (5 M) deep. This ratio can be pushed to 2.5 to 1 if the reflectance of interior surfaces is very high. When these ratios are exceeded, the deepest part of the room will lack adequate illumination when relying on daylighting alone. (Nuckolls, 48)

Bilateral Windows placed on opposing sides of a rectilinear interior space will effectively double the feasible room width for daylighting. Since there are now two possibilities for someone to face a window plane, brightness controls (blinds, curtains, etc.) become particularly important. (Nuckolls, 49) This type of arrangement is extremely rare in health care facilities due to the large size of most buildings and small size of most interior spaces.

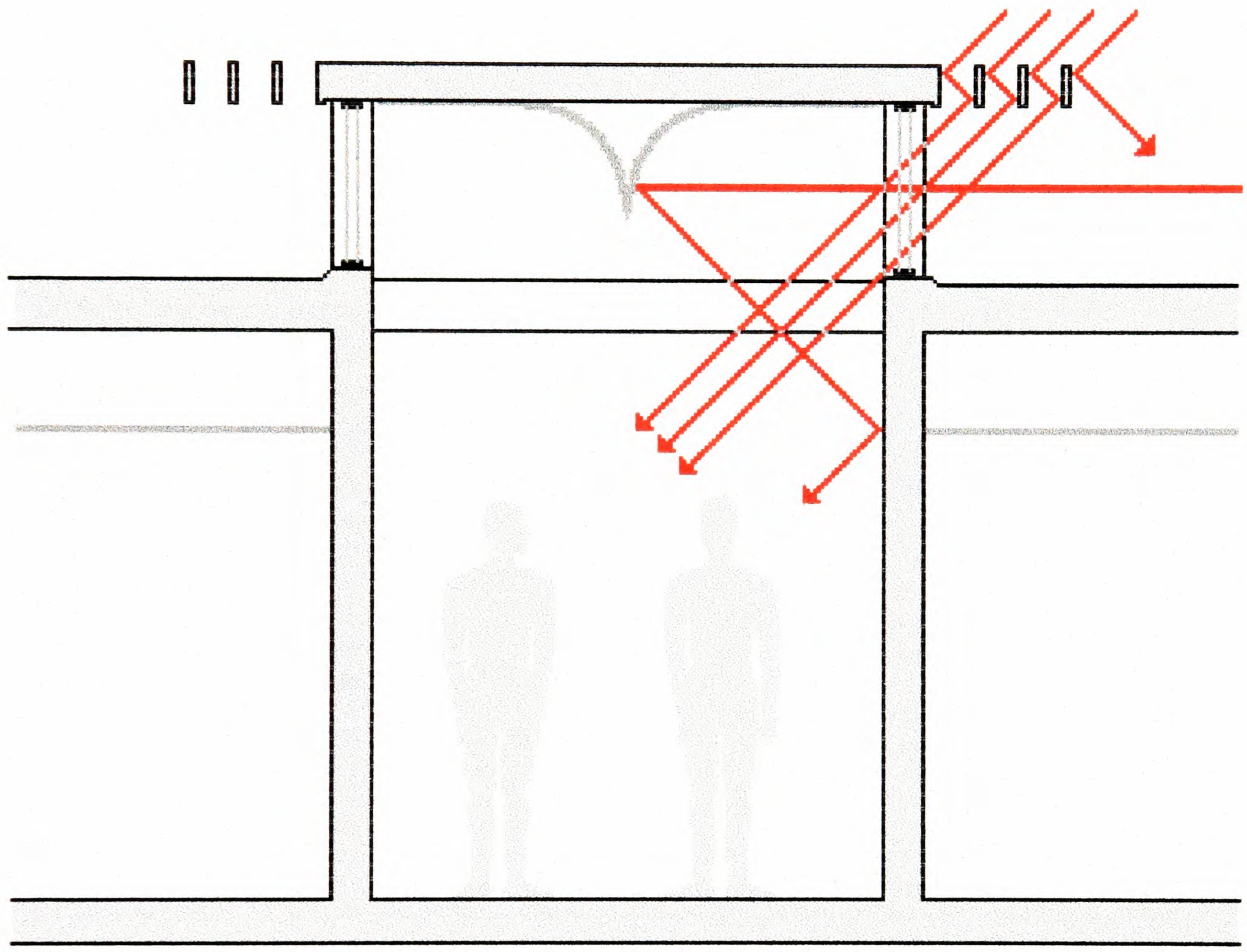
Much more common are interior spaces in which windows are mounted on adjacent room walls (the corner office effect). This type of space also can have nearly twice the feasible room width for daylighting as unilaterally lit rooms. These spaces are ideal for use as dayrooms, waiting rooms, group rooms, and any other space where large amounts of daylight are considered desirable. The exceptions are the southwest, and to a lesser degree the southeast, corners of health care facilities. Unless properly screened by exterior daylight controls such as overhangs or louvers, these rooms can become extremely uncomfortable during peak exposure to the sun. These peak exposure times would occur in the early morning in the southeast corner and in the late afternoon in the southwest corner. The function and scheduled usage of such areas should be considered when glazing is designed for these spaces.

Vertical Roof Sources For the most efficient control of light from these sources it is usually recommended that interior areas directly below the glazing and the interior ceiling area adjacent to the glazing be both diffuse and highly reflective. The two main types of vertical roof sources are *clerestories* and *monitors*. *Clerestories* are similar to the bilateral source described earlier (see figure 2.1.3), because they provide light from two opposing directions. Again it is important to provide adequate control of daylight entering these sources. Typically, clerestories should run east to west with glazing on the north and south sides. Clerestories oriented to the west and east are less efficient for daylighting because they do not follow the path of the sun. While glazing on the northern exposure can be nearly transparent, glazing on the southern exposure should be extremely diffused to prevent glare (unless well protected by overhangs or louvers). Clerestories are rare in most health care facilities, but can be effective for providing daylight in interior corridors and entry areas. They are not recommended for conference rooms or similar areas intended for assembly due to difficulty in controlling lighting levels.

Monitors are similar to clerestories, but they provide light from only one direction (see figure 2.1.4). Typically, monitors in northern latitudes should face south to follow the sun's path, and monitors in southern latitudes should face north to prevent excessive glare and heat gain. East and west oriented monitors are also useful but should be protected against harsh early morning/late afternoon sunlight. Monitors are also rare in most health care facilities, but they are easier to provide in multi-level facilities than clerestories, especially if upper floors are smaller than the lower floors.

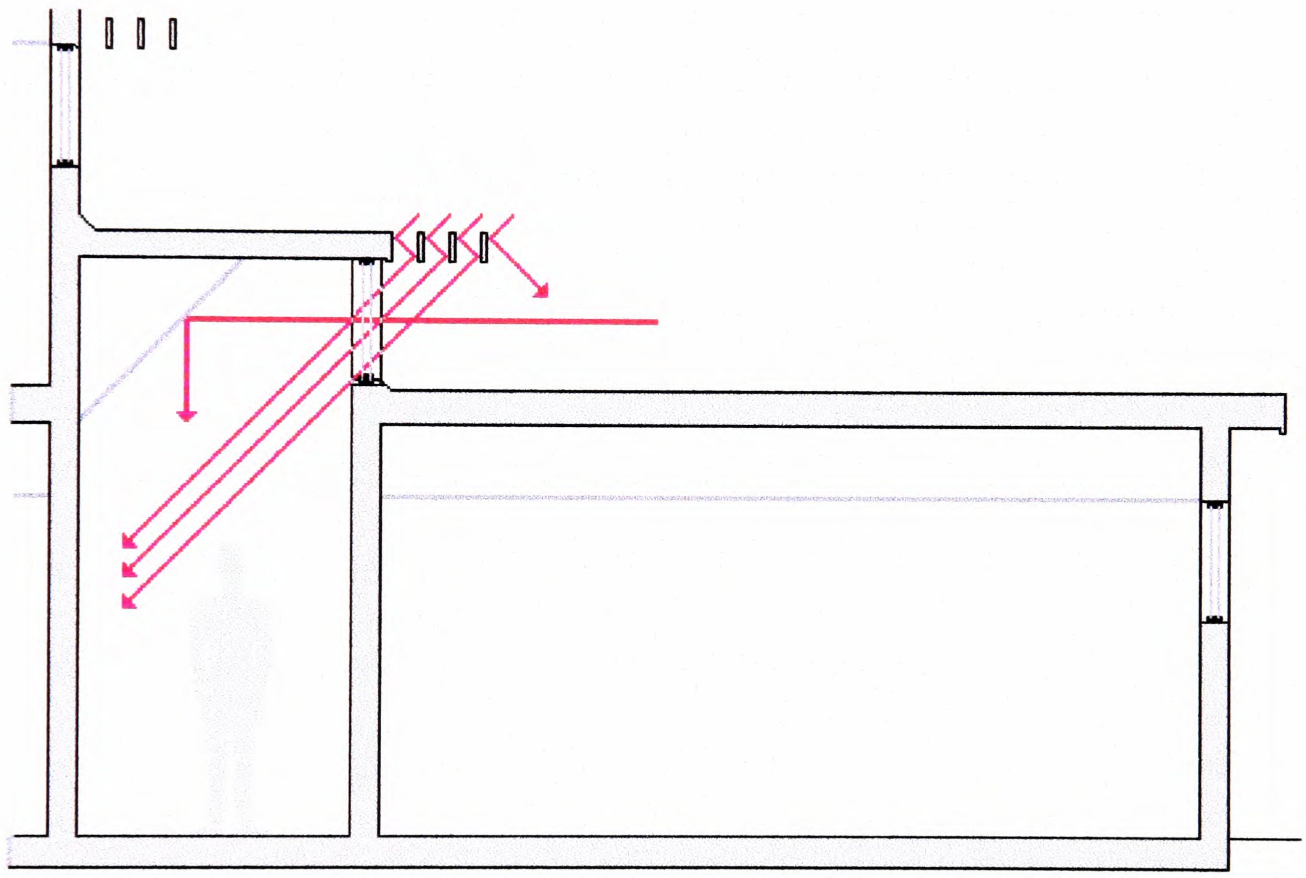
Clerestories and monitors should be designed so that there is no horizontal exposure of glazing to prevent incidents where objects may be dropped from upper floors through the glazing.

Horizontal Roof Sources   Horizontal roof openings (skylights) are reminiscent of the primitive roof holes used by our ancestors to let light in and let smoke out. Flat skylights have both drainage and dirt accumulation problems. They are also prone to the type of vandalism described above. Curved or slanted skylights can slightly improve these negative conditions. Both types of skylights often cause considerable heat build up and glare, and while brightness control is desirable it is difficult to achieve because they allow direct sunlight to enter all day. The practical lighting value of skylights is questionable, and due to their fragility they should not be used in rooms where security is required.



Typical Clerestory

Figure 2.1.3



Light Monitor

Figure 2.1.4

Psychological and Physiological Need for Windows

Windows are important to the general ambiance, in addition to the illumination of interior spaces. While many studies have considered the behavioral effects of facilities lacking adequate windows, very few of these studies have focused on health care facilities. However, it is possible to draw analogies between these buildings and health care facilities.

Research on underground factories in Sweden suggests that workers in windowless environments tend to suffer more fatigue and headaches, and express more negative feelings about their environment. (Fisher et al., 271) According to surveys by B.L. Collins, a lack of windows can be compensated for by providing high levels of lighting and ventilation, but his general conclusion is that workers do not like windowless environments. (Collins, 70, 88)

In office environments, the presence of windows also seems to be important. Research has shown that regardless of whether occupants are satisfied with most aspects of their offices, the lack of windows leads to dissatisfaction. (Ruys, 49) Other evidence of the importance of windows comes from studies of windowless schools. These schools were originally designed to reduce distraction in classrooms, and to lower heating costs and vandalism. Research suggests that the absence of windows in classrooms had no consistent effect on learning, but that it produced a negative effect on mood. (Karmel, 278)

Studies have also revealed that in work environments absent of windows, occupants attempt to compensate for a lack of windows by hanging travel posters and landscape pictures, but these attempts do not produce satisfactory results. (Fisher, 271) Windows are clearly important in work and classroom environments; it would be natural to infer that they are important in health care environments as well.

There is also a *physiological* need for windows, especially for individuals engaged in close work. Windows allow these persons to occasionally refocus their eyes at a distance greater than that available in a typical 10' x 10' (3 M x 3 M) treatment or work area. This variety in focal points helps to prevent excessive eye strain.

Daylight Control

Environmental design of interior spaces can incorporate numerous materials and architectural configurations and finishes to control natural light. These controls can range from exterior features such as landscaping to interior features such as interior finishes.

<u>Landscaping</u> Deciduous trees provide shade and protect against glare during the summer and after losing their foliage they allow sunlight to enter a building during the winter. Reflective ground covers (light colored gravel) can redirect light into the lower stories of facilities. Ground cover can also influence the interior illumination with unexpected effects such as green light reflected from large grassy areas. Designers of interior spaces should also be aware of the potential glare problems resulting from water surfaces such as lakes and reflecting pools. (Nuckolls, 50)

<u>Overhangs</u> Overhangs are properly designed when they shade windows from direct sunlight while reducing brightness on the upper sections of windows. Unfortunately, they can also reduce the amount of reflected sky light that can enter a space by up to 25% in temperate latitudes. Practical overhangs cannot provide complete shading from direct sunlight, without greatly reducing the amount of available daylight. (Nuckolls, 51) The provision of slatted horizontal overhangs is a partial answer to this problem - see figure 2.1.5.

Exterior Louvers   Horizontal louvers covering windows (exterior blinds, slatted sun screens, etc.) offer several advantages: (1) They prevent the entry of direct sunlight. A portion of sunlight and sky light is reflected to the ceiling, where it is then reflected down to horizontal surfaces (see figure 2.1.6). Light reflected from the ground is also permitted to enter interior spaces. (2) They limit the direct glare of large window masses. (3) Heat buildup radiated by the louver blades can dissipate outside of the interior space. (4) If louver blades can be moved (a manual or automatic process), there can be additional refinements to light control. Vertical louvers are not as useful, because of the angle of the sun at most locations, and as a result this type of louver is mostly decorative. (Nuckolls, 51)

Exterior louvers also have disadvantages: (1) Their horizontal surfaces collect dirt causing both unsightly conditions and a reduction in louver reflectivity and light control. (2) They can obscure exterior views. (3) Unless permanently positioned or automatically controlled, varying louver angles creates an inconsistent appearance in the building's exterior surface. (4) Louver operating mechanisms do not stand up well to adverse weather and require frequent maintenance. (Nuckolls, 51)

Glazing   Windows can be finished with either high or low transmission materials. High transmission materials include sheet glass, acrylic sheet, and formed shapes or glass block. Low transmission materials include reflectorized or tinted glass and plastic. The lower the transmission, the greater the "one-way" effect; high exterior illumination and low interior illumination means that you can see outside from inside, but not the other way around. High transmission of daylight and low transmission of heat are usually considered desirable. Unfortunately, most treatment of glazing that reduces heat gain also reduces light transmission.

However, double (and triple) glazing can assist in heat control as well as providing insulation against local air temperatures. (Nuckolls, 51)

Transmission of diffused light can be accomplished with glass or plastic that is patterned, surface treated, opalized, or otherwise diffused. This type of diffusion is desirable in locations that require privacy or open onto unpleasant views. It is important to remember that the level of transmission and brightness decrease as diffusion increases. (Nuckolls, 52)

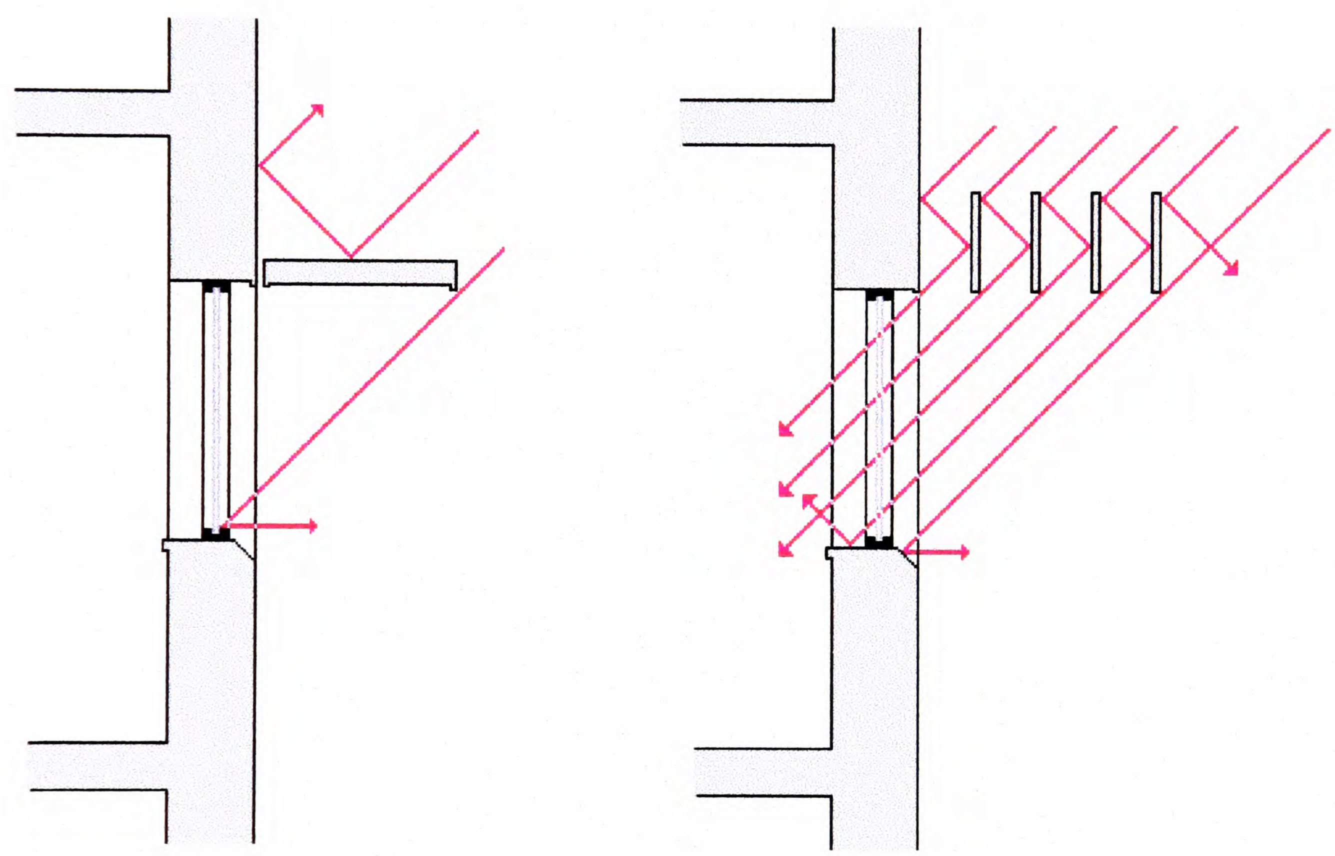
Laminated glass (a glass/plastic film/glass composite) can be employed in areas where security is required. The use of laminated glass and similar polycarbonate products enables the designer to use fewer security bars in the fabrication of windows and doors, thereby avoiding the appearance of a detention facility. Wired glass should be employed (per applicable codes) as required for fire resistant window and door assemblies.

<u>Interior Louvers</u> Horizontal louvers (venetian blinds) offer advantages similar to their exterior counterparts. However, they don't dissipate heat that is radiated to the interior. Metal louvers are superior to plastic louvers because of the concentration of heat that occurs between the blinds and the glass. Warping of plastic shades is commonplace and the heat can also cause the outgassing of toxic chemicals from the plastic to the interior air. Like vertical exterior louvers, interior vertical blinds are ineffective at controlling daylight transmission and serve primarily a decorative purpose. Venetian blinds may also present an unacceptable risk for patient self injury. Blinds encased between window panes can mediate this problem, but they are difficult to maintain.

<u>Shades and Draperies</u> can be used to reduce the size of the aperture and increase the diffusion of daylight; however, they offer limited directional control of daylight. Shades and

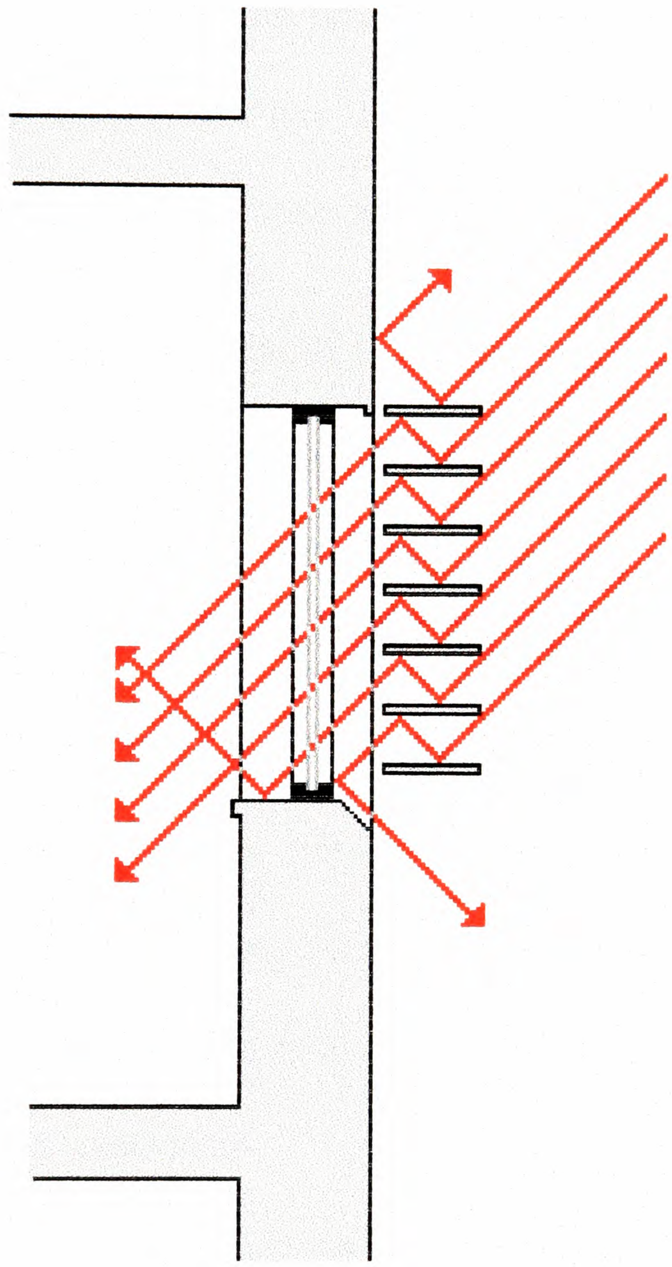
draperies should provide adequate opacity for patient privacy. Generally, they should not be black, should offer varying levels of opacity, and be capable of reflecting artificial light generated in the interior. (Nuckolls, 52) This can usually be achieved by using some combination of translucent shades, venetian blinds, and draperies. The exception is the blackout curtain necessary in sleeping rooms (especially in extreme northern latitudes of the northern hemisphere with very long summer days) and in areas where specific tests or therapies require varying levels of darkness.

Interior Finishes for Daylight Control As with all forms of illumination, an appropriately reflective interior reuses available light. Interior reflectivity generally equates with light colored interior finishes. Not only is reflection of interior light more economical, it creates a more uniformly lighted interior. Highly reflective casings and interior walls around glazing diminish the variation in intensity (glare) between the wall and its aperture. The same can be said of ceiling assemblies and the upper half of interior walls in regard to artificial light sources. Reflective walls and ceilings also allow reflected daylight to penetrate deeper into the building interior. (Nuckolls,52) Light colored interiors have the added benefit of generally being perceived as larger than equal sized, dark colored interiors.



Window Overhangs

Figure 2.1.5



Exterior Louvers

Figure 2.1.6

Incandescent Lighting

Incandescent lighting was once the primary means by which health care facilities were illuminated. The development of fluorescent lighting has made most applications for incandescent lighting in health care facilities obsolete. However, incandescent lighting is still valuable for some roles such as accent or mood lighting and emergency systems lighting. The three types of incandescent lighting that one is likely to find in health care facilities (excepting equipment such as surgical lights) are *general service*, *extended service*, and *tungsten-halogen*.

General Service incandescent lighting is produced by running electric current through a tungsten alloy filament in a volume of argon gas. The light produced typically follows a smooth spectral curve with large amounts of energy in the warm red zone, and very little energy in the cool blue and violet zones. Similarly, these lights produce very little ultraviolet radiation, but produce large amounts of infrared radiation (see figure 2.1.7). This is the primary weakness of incandescent lighting. While producing very little harmful ultraviolet radiation is desirable, large amounts of infrared radiation mean that significant amounts of energy are squandered generating waste heat. Additional energy must be expended in the form of ventilation and cooling to then eliminate this waste heat.

As stated earlier, the light produced by incandescents is predominantly in the warm red tones. As a result, this lighting emphasizes warm tones in the objects it reflects from. While this can be desirable in some applications, such as the attempt to provide an environment perceived as warm and cozy, it is undesirable in some areas because it alters our perceptions of true colors, especially those of skin tone. The predominance of warm red light in incandescent light makes skin tone look healthier and more vibrant, and this deception can be dangerous. Health care providers need to make accurate observations of their patients' health and this is complicated by the use of incandescent lighting. While incandescent lighting is desirable from an environmental point of view, it is undesirable from a diagnostic point of view. Therefore incandescent light should not be used as the primary light source in treatment and inpatient areas; area lighting should be full spectrum for diagnostic/health assessment purposes.

Extended Service lamps also produce a smooth spectral curve with large amounts of energy in the warm red zone, and very little energy in the cool blue and violet zones. Extended Service lamps are intended for use in applications where a lamp failure would cause great inconvenience, a nuisance, or a hazard, or where replacement labor costs are high or electrical power cost is unusually low. Therefore, for such applications where longer life is most important and a reduction of approximately 15 percent in light output is acceptable, available extended service lamps with a rated life of 2,500 hours are recommended.

Where replacement of burned-out lamps is an easy, convenient operation, such as in most office or exam areas, long life lamps are not usually recommended. For most general uses, incandescent lamps with the usual 750 to 1000 hour design life provide a lower unit cost for lighting than extended service lamps. Longer life is achieved by operating the lamp's filament at lower temperatures than normal. This also reduces the lamp's luminance. In most uses, the cost of power used during the lamp's life runs several times over the lamp's cost. (Kaufman, 8-11)

Tungsten-Halogen lamps also produce a smooth spectral curve with large amounts of energy in the warm red zone, with more energy in the cool blue and violet zones than ordinary tungsten filament incandescent lamps. Tungsten-Halogen lamps can be used to augment regular incandescent sources. Their construction is similar to general service incandescent lamps, except the filament operates in a volume of halogen gas rather than in a volume of argon gas. The advantages over regular incandescent lamps include excellent lumen maintenance and compactness. The source also provides a whiter light (higher color temperature) as well as longer life for similar light output.

There is also more ultraviolet light produced from tungsten-halogen lamps than from regular incandescent lamps due to higher filament temperature. The amount of ultraviolet radiation emitted is determined by the envelope material. Fused quartz and silica glass are capable of transmitting most of the utlraviolet light radiated by the filament, while special high silica glass and aluminosilicate glasses can absorb most of the ultraviolet radiation. Precaution against hazards to both people and interior objects and finishes are recommended in applications where tungsten-halogen lamps are operated at color temperatures over 3,100° K. Both visible light output and the relative ultraviolet light output are sharply increased at these temperatures. (Kaufman, 8-12) Large amounts of ultraviolet light are unhealthy, especially to the human eye, and accelerate the deterioration of paper and pulp products, unprotected wood, and rubber and plastic materials. The high temperature of tungsten-halogen lamps has also been implicated in building fires where flammable materials (curtains, paper, etc.) have come in contact with unprotected lamps.

Fluorescent Lighting

Fluorescent light is produced by creating an electric arc in a mercury vapor tube coated with fluorescent phosphors. Two types of spectral energy are produced by fluorescent lights: discontinuous narrow bands created directly by the electric arc that excites the fluorescent phosphors, and the mix of light produced by the phosphors themselves. (Nuckolls, 36) The amount of harmful ultraviolet radiation produced is small. Several mixtures of white light are available in fluorescent sources. In each, the narrow bands created by the electric arc are nearly the same. These phosphors can be formulated to individually produce six different colors of light: blue, cool green, green, gold, pink and red. (Kaufman, 8-21)

These phosphors are mixed to produce different effects, usually stressing either the blue or pink outputs. Four different color mixes are produced by all fluorescent lamp manufacturers: cool white, deluxe cool white, warm white, and deluxe warm white. The deluxe fluorescent colors offer spectral distributions that are comparatively even in color energy. Although cool white and deluxe cool white lamps may appear to produce the same color when you look directly at them, the colors reflected by them are not the same. The cool white will distort colors to a greater extent than its deluxe counterpart (with cool white, red is grayed while yellow, orange and blue are strengthened). There is a similar variation in the performance of warm white and deluxe warm white sources. Therefore, we should remember that the apparent color (that of the source viewed directly) does not always indicate a source's mix of light. (Nuckolls, 37-38)

Mercury vapor light sources with clear bulbs have a discontinuous spectrum, which explains why they distort colors so greatly (see figure 2.1.8). Mercury vapor was one of the first of the popular high intensity discharge (HID) light sources. The color problems led manufacturers to search for improvements. To improve spectral distribution metal halides (salts) have been mixed with mercury vapor, along with added phosphors. (Nuckolls, 38)

<u>Flicker Effect</u> is a common problem with fluorescent and discharge lamps. This is produced by lamps using an ordinary ballast that reflects the cycle rate of the source electricity, 50 to 60 cycles per second. The flicker effect is often accompanied by a low hum at a

corresponding audio frequency of 50 to 60 hertz. The flicker effect can be very irritating to some individuals and can trigger seizures among some susceptible epileptics. Flickering can be eliminated by utilizing a high frequency ballast, but special care should be used to select ballasts operating at a frequency higher than that of human hearing, around 20,000 hertz.

Fluorescent Lamp Styles Fluorescent lamps typically found in health care facilities consist of *four foot nominal* size, *two foot nominal* size, and *compact fluorescents*.

Four foot nominal size fluorescent lamps fit in two' x four' (60 cm x 120 cm) lighting fixtures that can accept from one to five 40 watt tubular lamps. Standard two' x four' (60 cm x 120 cm) lighting fixtures can be installed in both two' x four' and two' x two' (60 cm x 60 cm) acoustical ceiling grids.

Two foot nominal size fluorescent lamps are increasing in popularity because their two' x two' (60 cm x 60 cm) fixtures conform neatly into two' x two' acoustical ceiling grid. Two foot (60 cm) nominal size fixtures can be installed in many more locations than the four foot nominal size, and can be used to distribute light more evenly because of this flexibility.

Compact fluorescents look nothing like the long, thin fluorescent tubes that most people are familiar with. They have screw bases like standard incandescent bulbs, but that is where the similarity ends. Compact fluorescents contain their ballast in their bases, rather than having external ballasts like the four foot (120 cm) and two foot (60 cm) nominal lamps. These lamps are somewhat larger than standard incandescent lamps and may not fit into all fixtures designed for standard incandescent bulbs. While compact fluorescents can be costly (sometimes over $30), they have a very long life (12 times a standard incandescent bulb), and use only a quarter as much energy to produce the same levels of illumination. Like all fluorescent lamps, compact fluorescents contain small amounts of mercury, and cannot be disposed of as easily as incandescent lamps. (Bower, 326)

Comparison of Typical Fluorescent Lamp Colors Each of the typical fluorescent lamp colors possesses individual characteristics due to the mix of different color phosphors and sometimes halides. Reference the chart on the next page for a summary of these characteristics.

Table 2.1.1. Comparison of Typical Fluorescent Lamp Colors

Lamp Names	40 watt White Fluorescent	40 watt Cool White Fluorescent	40 watt Deluxe Cool White Fluorescent	40 watt Warm White Fluorescent	40 watt Deluxe Warm White Fluorescent	40 watt Daylight Fluorescent
° K Correlated	3500	4100	4200	3000	3000	6500
CRI*	60	67	89	53	79	79
Lamp appearance on neutral surface	yellow-white	white	white	pink-white	pink-white	white
Colors suppressed	red	red	none	blue, green, red	blue	none
Colors intensified	yellow	blue, yellow, orange	none	yellow, orange	yellow, orange	none
Lamp code prefix	F	F	F	F	F	F
Color abbreviation	W	CW	CWX	WW	WWX	D

* CRI - Color Rendering Index - Relative accuracy of color rendering on a scale from 1 to 100, with 100 being the most accurate.

Source: (Phillips, 16)

The characteristics of each of these lamps lend themselves to varying appropriate lighting tasks throughout health care facilities. These lighting tasks are summarized below.

White Fluorescent lamps are useful in areas where accurate color rendering is not necessary; typically in areas that are not normally occupied full-time by patients or staff. These areas include electrical and mechanical rooms, warehouses, storage areas, and janitor's closets. The light from these lamps has a slight yellowish (sometimes greenish) cast that renders it inappropriate for most mental health care applications. Red light is also suppressed by this type of lamp. Skin tones can appear jaundiced under this light, and its color rendering accuracy is inadequate for many health care tasks such as dispensing multicolored pharmaceuticals. Long term exposure to this color shift is also not good for the mental health of patients and staff.

Mercury vapor and metal halide lights are often used for these types of service spaces in other kinds of facilities, especially industrial, but they are not recommended for health care facilities. The light produced from mercury vapor and metal halide lamps is grossly inadequate for the color rendering necessary for maintenance personnel to match wiring colors, and for supply and laundry personnel to identify properly colored items. This is because many of the color wavelengths are missing; see figures 2.1.8 & 2.1.9. Additionally the ballasts for many mercury vapor and metal halide lighting systems can take up to a minute to warm up and illuminate the space.

Cool White Fluorescent lamps provide a slight improvement over ordinary white fluorescent lamps, especially in the representation of the blue end of the spectrum (see figure 2.1.10). Unfortunately, the red end of the spectrum is still inadequate for most health care applications and accurate rendering of skin tones. These lamps, like ordinary white fluorescent lamps, are useful in service areas that are not normally occupied full-time by patients or staff. However, due to the greater cost of cool white fluorescent lamps, you should probably use ordinary white fluorescent lamps in these service areas.

Warm White Fluorescent lamps do not provide any significant improvement over ordinary white fluorescent lamps. These lamps increase the representation of the yellow part of the spectrum, suppress the blue end of the spectrum, and do not enhance the red section of the spectrum (see figure 2.1.11). These lamps are the least effective of all fluorescent lamps in providing accurate color rendering. As a result these lamps are inadequate for most health care applications and too costly for use in service areas.

Deluxe Cool White Fluorescent lamps provide a great improvement over ordinary white fluorescent lamps, with a relatively even distribution of light throughout the visible spectrum (see figure 2.1.12). Of all fluorescents, deluxe cool white lamps most closely approximate the spectral distribution of sunlight. Please recall that the color and color temperatures of sunlight and daylight are different. The color temperature of a deluxe cool white fluorescent lamp is approximately 4,200°K, roughly corresponding to the color temperature of noon sunlight in northern latitudes measured at 4,870°K (see figure 2.1.13). Deluxe cool white fluorescent lamps also possess a color rendering index (CRI) of 89, based on the relative accuracy of color rendering on a scale from 1 to 100, with 100 being the most accurate. This CRI is higher than most other fluorescent lamps, even those that are designed to simulate daylight.

As a result of these qualities, deluxe cool white fluorescent lamps are appropriate for almost all mental health care applications. Recommended use areas include patient rooms, exam areas, treatment areas, clinical areas, pharmacies, and food preparation areas. These lamps are especially well suited for color matching in the warm component of the spectrum: reds, oranges, and yellows. It is often desirable for deluxe cool white fluorescent lamps to be augmented with incandescent light (on dimmer if possible) for mood lighting in patient rooms.

Daylight Fluorescent lamps also represent a great improvement over ordinary white fluorescent lamps, with a relatively even distribution of light throughout the visible spectrum (see figure 2.1.14). Daylight fluorescent lamps closely approximate the spectral distribution of daylight. The color temperature of a daylight fluorescent lamp is approximately 6,500°K, somewhat lower than the color temperature of daylight in a moderately overcast sky in the northern latitudes measured at 7,400°K (see figure 2.1.2). Daylight fluorescent lamps also possess a color rendering index (CRI) of 79, based on the relative accuracy of color rendering on a scale from 1 to 100. Since these lamps approximate the light produced by the sky, these lamps are especially well suited for color matching in the cool component of the spectrum: greens, blues, and violets.

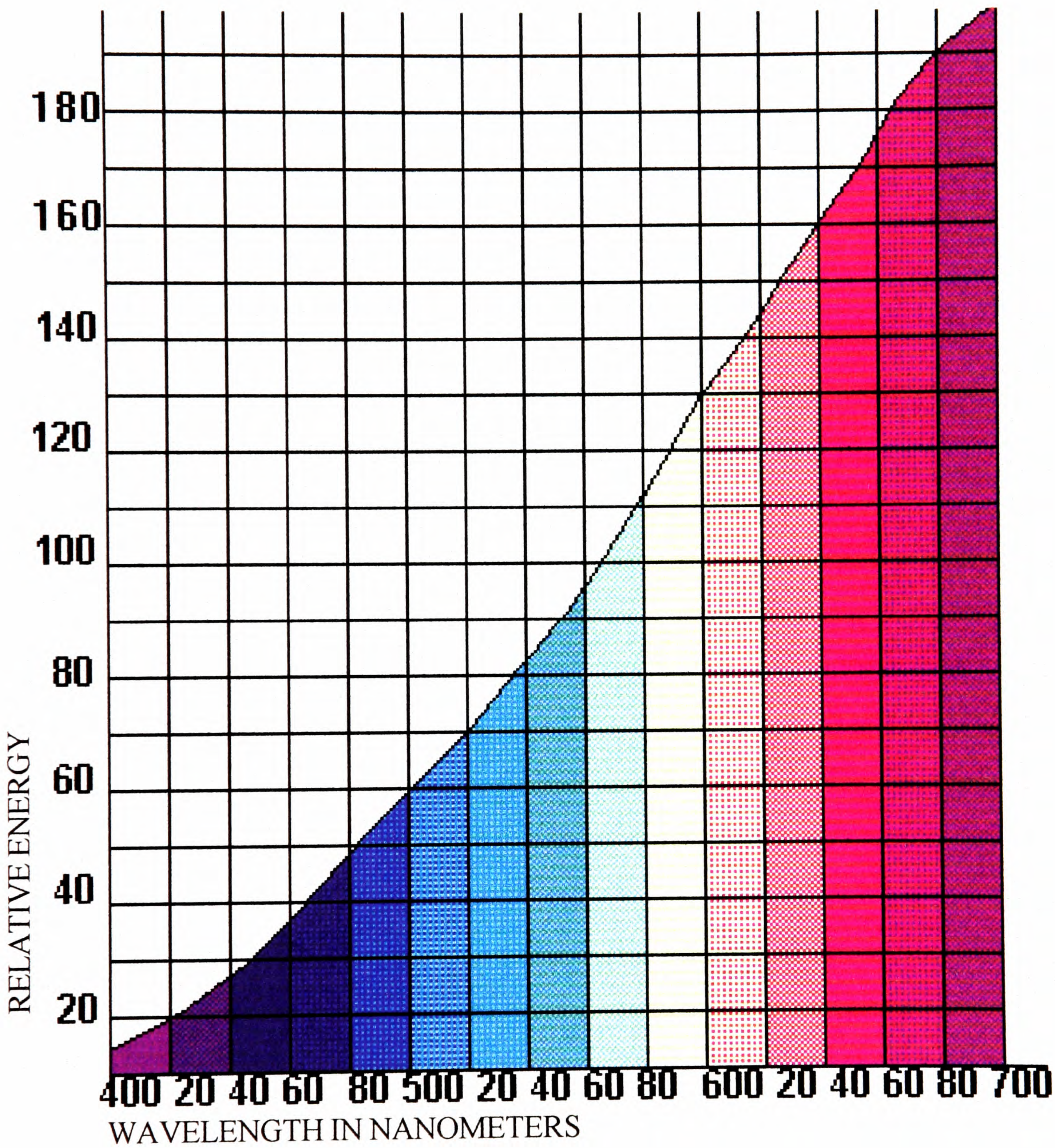
As a result of all of these qualities, daylight fluorescent lamps are also appropriate for most mental health care applications. The obvious question now emerges of whether deluxe cool white fluorescent lamps or daylight fluorescent lamps should be used. This depends on whether you wish to simulate the qualities of sunlight or daylight in the patient contact, and clinical areas of your facility. This decision should be driven by your color matching needs and by your budget. Daylight fluorescent lamps are more expensive than deluxe cool white fluorescent lamps.

Premium Quality Colortone lamps are a recent development in lighting technology. These lamps are capable of producing a CRI as high 95 with color temperatures of 7,500°K, nearly identical to natural daylight. These lamps are typically used in dental laboratories, the fashion industry, and other applications where near perfect color matching is essential. These lamps are even more expensive than daylight fluorescents and are often not available from retailers without special order. The expense and limited availability of these lamps would seem to preclude their use in most healthcare environments.

Deluxe Warm White Fluorescent lamps also represent an improvement over ordinary white fluorescent lamps; however, their distribution of light is skewed to the warm end of the visible spectrum (see figure 2.1.15). Of all fluorescents, deluxe warm white fluorescent lamps most closely approximate the spectral distribution of tungsten filament incandescent sources. The color temperature of a deluxe warm white fluorescent lamp is approximately 3,000°K, closely corresponding to the color temperature typical of incandescent lamps measured at 2,854° K. Deluxe warm white fluorescents also possess a color rendering index of 79, which is very good for fluorescent sources. Although these lamps approximate the color temperature of incandescent sources, they produce more light in the yellow/orange range and less in the red part of the spectrum. They also suppress the blue part of the spectrum.

As a result of these characteristics, deluxe warm white fluorescent lamps are only appropriate for a few mental health care applications. They lack the qualities necessary for color matching that are needed in some clinical environments. Like incandescents, their skewed distribution of light in the warm end of the spectrum emphasizes warm tones in the objects it reflects off. While this is sometimes desirable, such as in attempts to provide environments perceived as warm and cozy, it is undesirable in patient care areas because it alters our perceptions of skin tone, making it look healthier than true conditions.

Recommended use areas for deluxe warm white fluorescent lamps include dayrooms, waiting areas, corridors, classrooms and assembly areas, dining areas, lounges, and administrative areas. These lamps are not recommended for use in health care provider's offices if examinations or health assessments are conducted in these areas. Additionally, while these warm lights can be positive in mental health areas treating depression and related problems such as seasonal affective disorder, they may contribute to over stimulation of violent and hyperactive patients. (Faber, 85)



Spectral Distribution of 2854°K

Typical Incandescent Tungsten Filament Sources

Figure 2.1.7

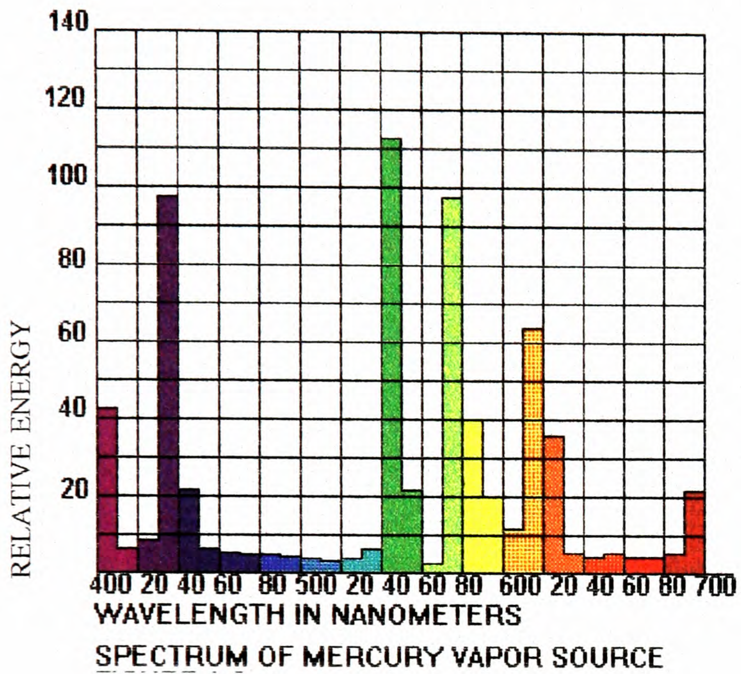


FIGURE 2.1.8

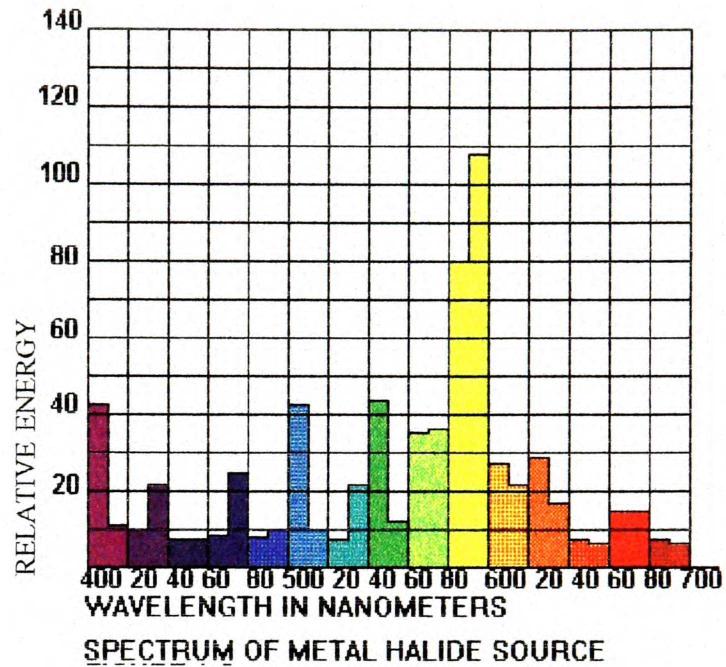


FIGURE 2.1.9

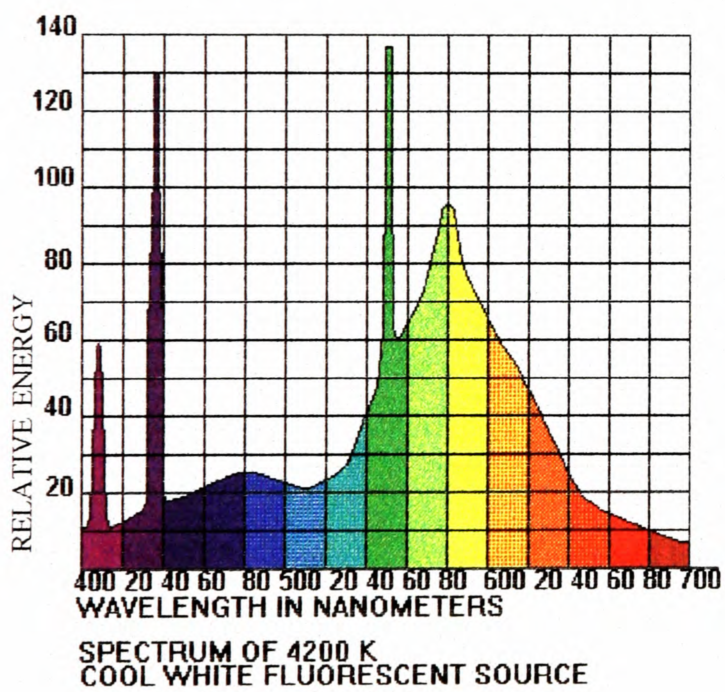


FIGURE 2.1.10

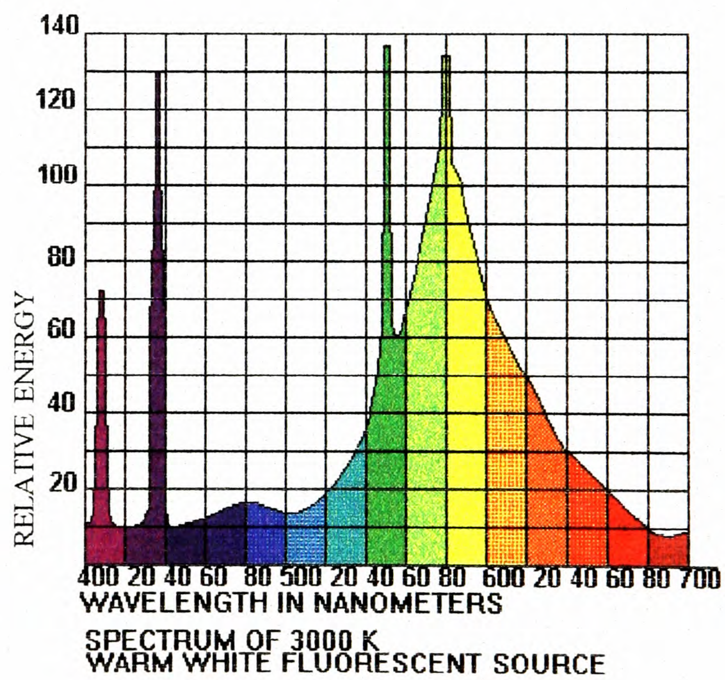


FIGURE 2.1.11

Figures 2.1.8 - 2.1.11

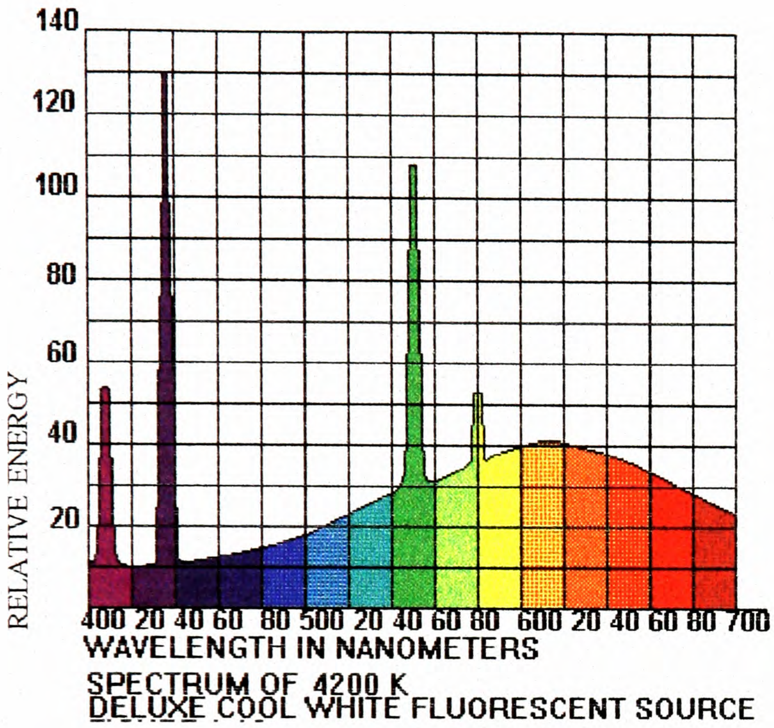


FIGURE 2.1.12

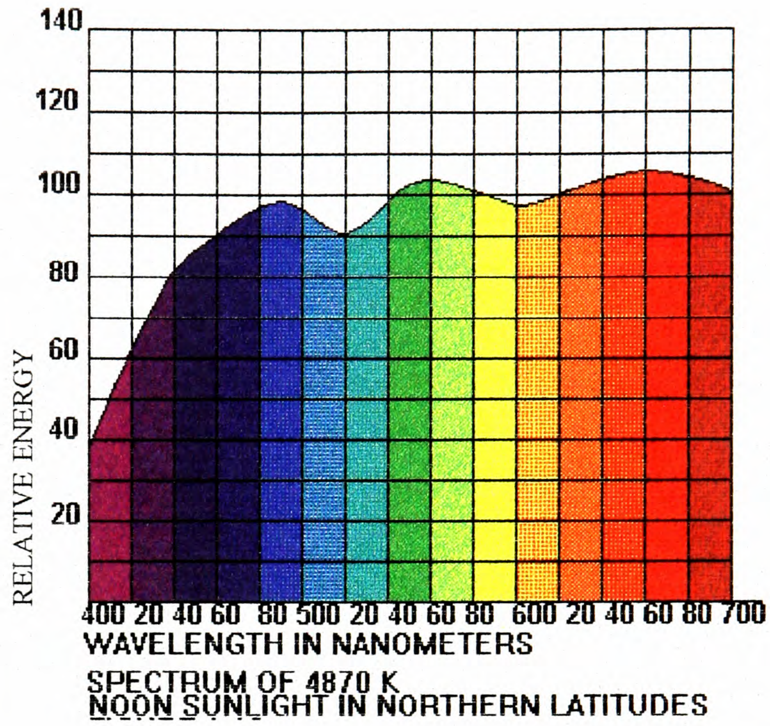


FIGURE 2.1.13

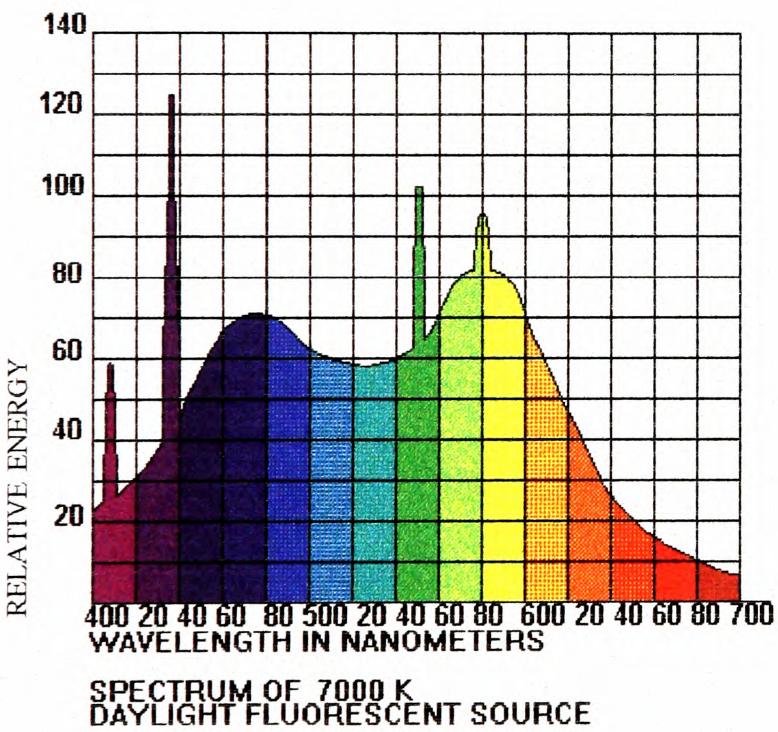


FIGURE 2.1.14

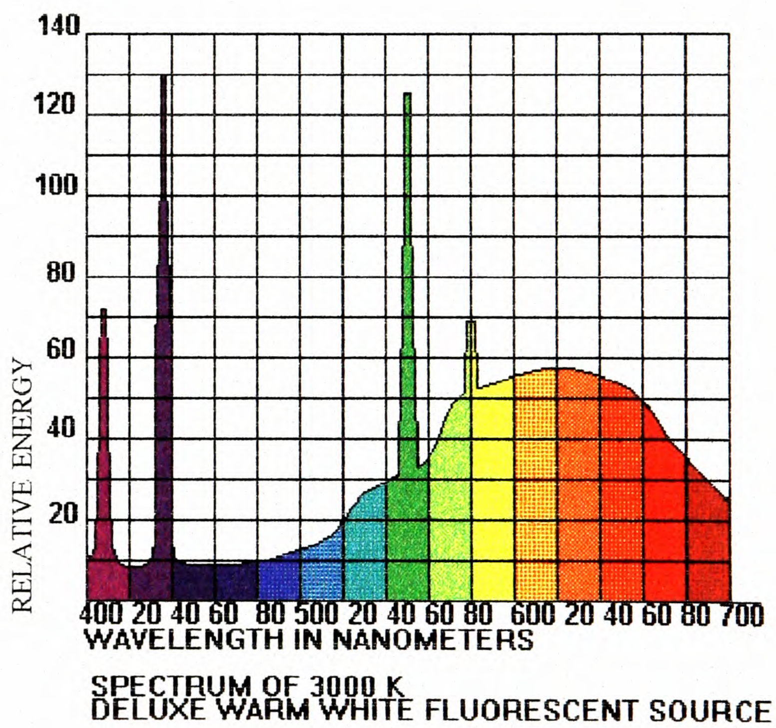


FIGURE 2.1.15

Figures 2.1.12 - 2.1.15

Interior Lighting and Seasonal Affective Disorder

Seasonal affective disorder (SAD) is a fairly common form of depression that afflicts five to six percent of the U.S. population annually. Another 14 to 15 percent suffer milder cases of the "winter blues." The symptoms of SAD are fairly predictable: loss of energy, concentration and drive, disruption of diurnal sleep and wake cycles, and withdrawal from social situations. The exact timing of these symptoms vary, with January and February being especially debilitating for many people, but in all cases the depression develops during the short dark days of winter. According to Dr. Norman Rosenthal, director of light therapy studies at the National Institute of Mental Health in Bethesda, Maryland, SAD differs from nonseasonal depression because "Instead of patients losing weight and sleeping less, as they do with classical depression, they overeat and oversleep and gain weight." (Goodnow, 6)

While the exact cause of seasonal affective disorder is unknown, it is theorized that the absence of adequate daylight causes chemical changes in the brain that bring on this form of depression. Not surprisingly, light therapy is one of the most promising treatments. Light therapy involves exposing the patient to 10,000 lux of light for prescribed amounts of time - typically 1/2 to 2 hours depending on their condition. Approximately 10,000 lux is the lighting level experienced half an hour after sunrise on a clear day. (Goodnow, 6) One lux is measured as a unit of illumination equal to one lumen per square meter, or to the illumination of one meter distant from the point source of one candle. Since one lux equals approximately 0.092 foot-candles, 10,000 lux would equal approximately 920 foot-candles.

Several companies manufacture devices that artificially deliver the benefits of sunlight, which stimulates the brain through the eye rather than through the skin, making tanning beds useless for treating this disorder. These devices vary from dawn simulators, to lighted visors, to slanted desktop boxes for work areas. Although early studies employed full spectrum lights, seeking to imitate the balance of natural sunlight, recent research has discovered that these lights are no better than other fluorescent lights in treating this affliction. (Goodnow, 6)

While it would certainly be impractical to light interior spaces in health care facilities to 920 foot-candles to combat seasonal affective disorder among patients and staff, there are obvious benefits from providing optimum lighting levels and exposure to natural daylight. This is especially important at health care facilities at northern latitudes that receive very little sunlight during the winter. Provision of optimum lighting and natural daylight may decrease the amount of the population developing this disorder and lessen the effect of its symptoms among people with SAD.

Recommended Lighting Levels

Different spaces in health care facilities require varying levels of illumination. The next page contains a table summarizing these lighting requirements for a sample of typical rooms in health care facilities.

Table 2.1.2, **Recommended Lighting Levels** in footcandles (and lux)

Administrative Space	50 (545)
Classrooms	70 (760),with dimmer
Conference Room	30 (330), with dimmer
Corridors	15 (165) daytime, variable switching 5 (55) nighttime, variable switching
Dayrooms	15 (165)
Dining Room	20 (220)
Drug Testing/Toxology	50 (545) general, 100 (1090) task
Exam/Treatment Rooms (Typical)	50 (545) general, 100 (1090) task
Exercise Room	30 (330)
Food Processing - General - Meat	70 (760) 100 (1090)
Group Therapy	30 (330)
Libraries	30 (330)
Locker Rooms/Toilet Rooms	20 (220) general, 70 (760) at mirrors
Lounge/Conference Room	15 (165) - 30 (330), variable switching
Nursing Station	30 (330) general, 70 task (760),variable switching
Offices	30 (330) general, 50 (545) task
Patient Bedrooms	10 (110) general, 30 (330) task
Pharmacy	100 (1090)
Play Observation	30 (330)
Psych Testing	50 (545)
Records	70 (760)
Sleep Studies/EEG	1 (11) - 10 (110), with dimmer)
Waiting Rooms/Form Writing	30 (330)
Occupational/Art Therapy	30 (330) general, 100 (1090) task

Section 2.2 - Interior Color Selection

Color, like lighting, can influence people directly, as well as psychologically. Direct effects include our varying perceptions of colored objects as they relate to the color of the surrounding environment, and varying illumination needs in different colored environments. (Fisher, 272) Care should be taken to select interior lighting and interior colors that complement each other. For example, a red color scheme would be ineffective if illuminated with cool white fluorescent lamps which suppress the color red.

Psychological and Physiological Color Effects

Research into these psychological effects has been going on for some time; studies as early as 1910 examined the interactions of human muscles and colored light. It was discovered by these early researchers that red, orange, yellow, green, and blue increased human muscular tension in declining amounts, with red causing the greatest tension and blue the least. Subjects of several early studies also showed an increase in pulse rate and elevated blood sugar levels in the presence of red light. (Nuckolls, 33) Since the eye and brain experience all color sensation via light transmitted to the eye, it doesn't matter whether the colors experienced are from a colored light source or from light reflected off a colored object.

Color also has independent effects on mood. People can experience some colors as mentally soothing and others as mentally arousing. For example, in 1966 researcher G.D. Wilson reported that red hues generate greater physiological arousal than green hues. (Wilson, 949) This serves to validate the earlier research conducted in the early twentieth-century.

As noted earlier, warm colors (red, orange & yellow) are usually experienced as stimulating, while cool colors (green & blue) are experienced as calming. (Some shades of blue are considered so calming as to be a depressant.) There are exceptions to this generalization. "Baker-Miller Pink" is a color considered a soothing shade developed to relieve stress on submarines. Named after the two naval officers that originated it, Baker-Miller Pink seems to have a calming effect, and tests in prison cells have yielded similar results. (Gallagher, 50) Perhaps this warm color is effective because of the absence of sunlight in submarines and most prison cells; perhaps not. All we know is that it is effective for these two applications.

Similar claims of a calming effect have been made about turquoise. (Gallagher, 50) Apparently, these claims are being accepted because this color is growing in popularity in health care facilities. This is interesting because of the cycle of color changes typical of health care facilities. In the early twentieth-century, white was the accepted color for walls, uniforms, and supplies. It is now believed that white interiors can cause optical overload similar to snow blindness; this is not a desirable condition in which to evaluate patient health. (Faber, 85) The middle of this century was characterized by the ubiquitous "hospital green" which was somewhat greener than today's popular color. This color was originally used to reduce glare and improve optical acuity in operating rooms, but it then spread throughout the hospital. (Pütsep, 67) The late 1960s and 1970s were characterized by an explosion of color in health care facilities - from earth tones to burnt orange. (In hindsight, many of these color schemes are quite offensive.) Now in the 1990s we find ourselves returning to cool green and blue tones. Green has long been thought to have a calming effect, even prior to scientific measurements of physiological stress. As far back as the eighteenth-century, the performer's lounge in a theater or concert hall was painted green to relieve stress. The name "green room" still survives even though they are not all green today.

Other Color Selection Factors

Obviously other factors besides psychology should be considered when selecting colors for health care facilities. If not, it would be possible to determine the best possible color treatment and use it everywhere. This is not the case; some colors are acceptable in some health care facilities but not in others. The cause of these differences are primarily *geographical factors* and *cultural factors. Patient preferences* and the requirements of *sanitation* are also very important.

Geographical Factors The weather, available sunlight, and terrain are different at every health care facility, and should be considered when selecting interior color schemes. Normally, warm colors should be emphasized in northern latitudes with little winter sunlight, and cool colors should be emphasized in southern latitudes with high heat and/or humidity. Another rational approach would be to emphasize very cool colors (blues) in rooms that experience harsh red early morning/late afternoon sun, moderately cool colors (greens) in rooms that experience midday sun, and warm colors (reds, oranges & yellows) in rooms that experience no sunlight. A combination of both of these approaches may also be effective. The demographics of the population being served should also be considered.

Cultural Factors Sociology as well as psychology can come into play when selecting colors. The following anecdote demonstrates how cultural factors can influence color selection. In 1989, Air Forces Iceland decided to paint the interior of several of its enlisted dormitories, primarily occupied by young white male American airmen. Iceland can be a fairly depressing place, even in the summer, so cool colors were clearly psychologically inappropriate. The need to introduce warm colors into these facilities was met with resistance because most warm colors were not considered "masculine" like the traditional Air Force blue. Red was ruled out because of the Air Forces Iceland mission - to track and intercept Soviet aircraft. Yellow was eliminated because it represented cowardice. Pink was inappropriate because it was considered effeminate. Orange was ruled out because it was seen as too "ethnic." Finally a compromise was reached - peach - which is actually a combination of all of the colors described. The color was tested in the main stairway of a dormitory and met no further resistance.

Typical color associations in western culture include:

Yellow is often associated with the sun, and also with danger or warnings.

Orange is said to be a very stimulating color. It is also associated with light and heat. Orange is considered to be symbolic of ambition and pride.

Red suggests vitality and health. It can also connote aggression, excitement, and possible violence. It is also said to improve appetite and sociability. Red can also represent danger or warnings.

Blue is associated with the sky, the ocean, and ice. It is said to symbolize truth, nobility, and purity.

Violet (Purple) is traditionally the color of royalty. It suggests dignity, and also has a religious association. Red - Purple is considered stimulating, and Blue - Violet is considered calming.

Green is associated with plant life, forests, grasslands, and other aspects of nature and the environment. (Downey, 21 - 23)

Patient Preferences Generally patients prefer blue tones the most, and orange the least, but many other factors come into play. A study conducted by Carpman, at one hospital in the American Southwest found that around 50% of the patients and staff strongly preferred purple, blue, and red tones for inpatient rooms, and strongly disliked yellow, and to a lesser extent disliked green and ivory. This study noted that the preference for blue and red is consistent with prior research, but that liking purple and disliking green were not. Apparently there can be a wide range of color preferences between different populations. (Carpman & Grant, 174-175) Every culture has its own norms and taboos and designers and administrators should be aware of them when selecting colors for health care facilities.

Requirements for flexibility usually do not permit sex differences from being considered when selecting interior colors and finishes for defense mental health facilities. Rarely can a ward or section be permanently devoted to the treatment of one sex. Therefore, the interior design of these facilities should be gender neutral.

Sensory Deprivation Stimulation is essential to the health of the mind. Regular stimulation of the mind via the five senses provides a sense of reference and helps maintain linear thought. Proper stimulation leads to the proliferation of additional connections between brain cells, supporting greater brain activity through new pathways. Deprivation of stimulation to the brain can lead to dramatic changes in the brain's efficiency with partial losses of memory, a lowering of intelligence quotient, personality changes including withdrawal and hallucinations. (Doman, p1)

Many interior designers now theorize that it is necessary to provide a full color interior to avoid sensory deprivation. This seems reasonable, because a monochromatic interior would seem lifeless and irritating over time to most individuals. For this reason, one should consider incorporating a full range of interior complementary and occasional contrasting colors (via furnishings, artwork, patterns, and details) into the selected color scheme. (Color constancy also relies on a visual field which contains a wide variety of different hues and can be distorted by large amounts of one hue.)

Sanitation As described earlier, white was the accepted color for walls, uniforms, and supplies for health care facilities in the early twentieth-century. The primary reason white was used was to provide easy assessment of sanitary versus unsanitary conditions. Predominant earth-tone and brown color schemes are very widely used in the late 1970s and early 1980s. The very reason for the popularity of these color schemes is the reason they are inappropriate for use in health care facilities - their ability to hide dirt. Although medicine is much more advanced today than it was in the early twentieth-century, we still need to be able to easily recognize dirt and unsanitary conditions in our health care facilities. For this reason, predominant earth-tone and brown color schemes (especially flooring) should be severely restricted in health care facilities.

Color Artwork and Photographs

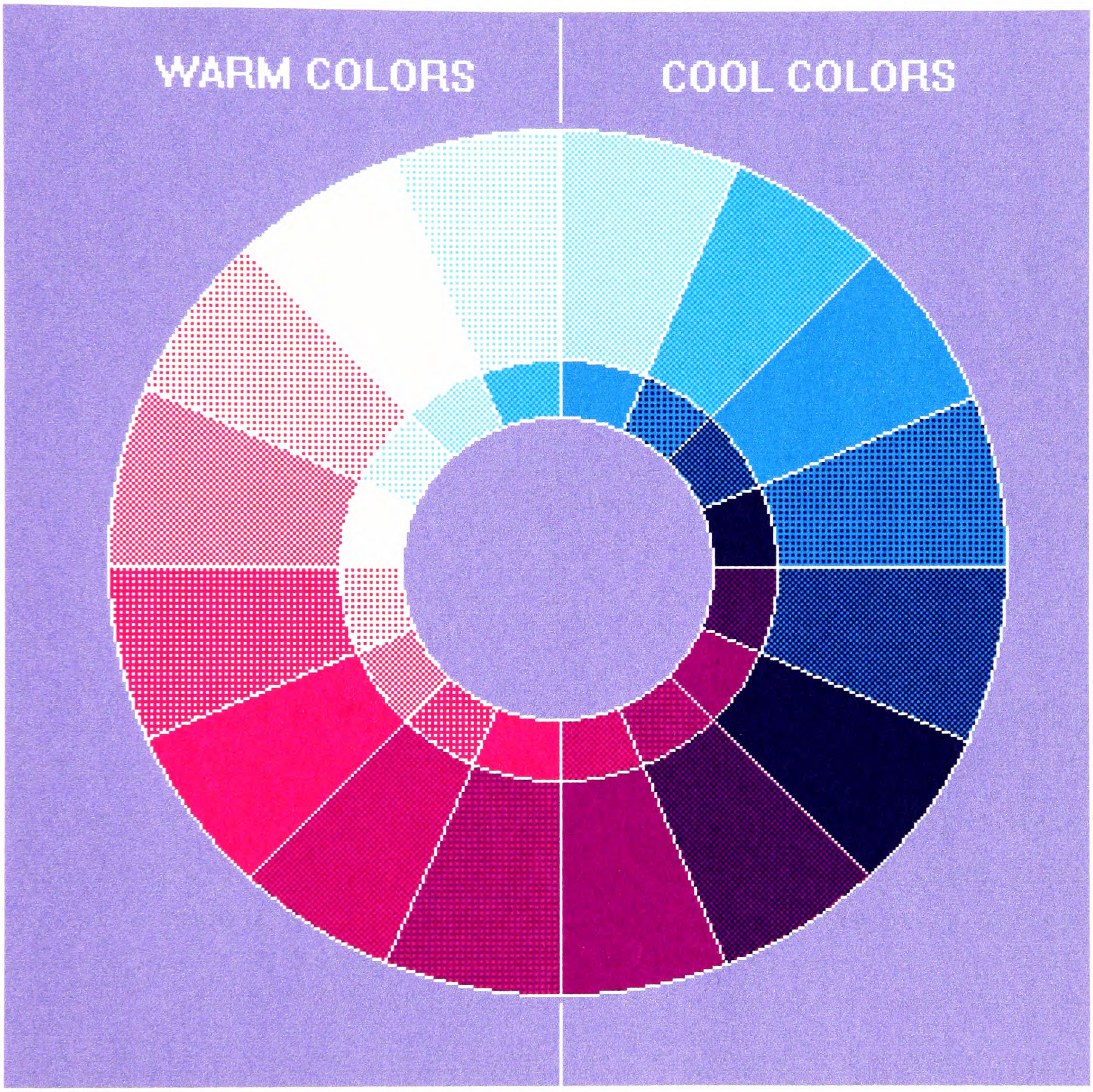
Color artwork and photographs can be useful in health care facilities to provide decoration and orientation cues in public areas, and to provide a sense of place and individuality to private areas. According to sociologist Janet Carpman, pictures on walls also provide visual complexity and reduce the sense of crowding in health care facilities. (Carpman & Grant, 175) In 1984, a study was conducted for the new University of Michigan Medical Center to discover patient's relative preferences for different types of artwork. This study used 71 images from a wide range of artwork styles, and 300 randomly selected inpatients were interviewed about their preferences for these images. For each image, they were asked whether they would definitely, probably, probably not, or definitely not choose to hang it in their own patient room.

Despite the diversity of images (subject, setting, and style) and types of inpatients (illness, length of stay, age, and education), patient's preferences were very consistent. Preferred images had natural subjects or settings (animals, water, valleys, mountains, farmland) and were rendered in a representational style. They preferred pictures to posters and liked texturally complex, organic images. Less favorably rated were pictures of people, urban scenes, still lifes, building interiors, sport scenes, and abstractions. However, pictures of people engaged in social situations may be useful to encourage dialogue in diagnostic and treatment areas. (Hathorn, p488)

Researchers interpreted these results to mean that hospital patients want to look at images far removed from their current situation; images that help them mentally escape to a more peaceful, natural, and beautiful setting. Most patients in this study disliked abstract art and commented that they did not want to look at art they couldn't understand. (Carpman & Grant, 172) Many hospitals operate an "art cart" to allow patients to select art for their rooms. This allows patients, especially long term inpatients, to avoid looking at art they don't like, and also enjoy some variety if they so choose.

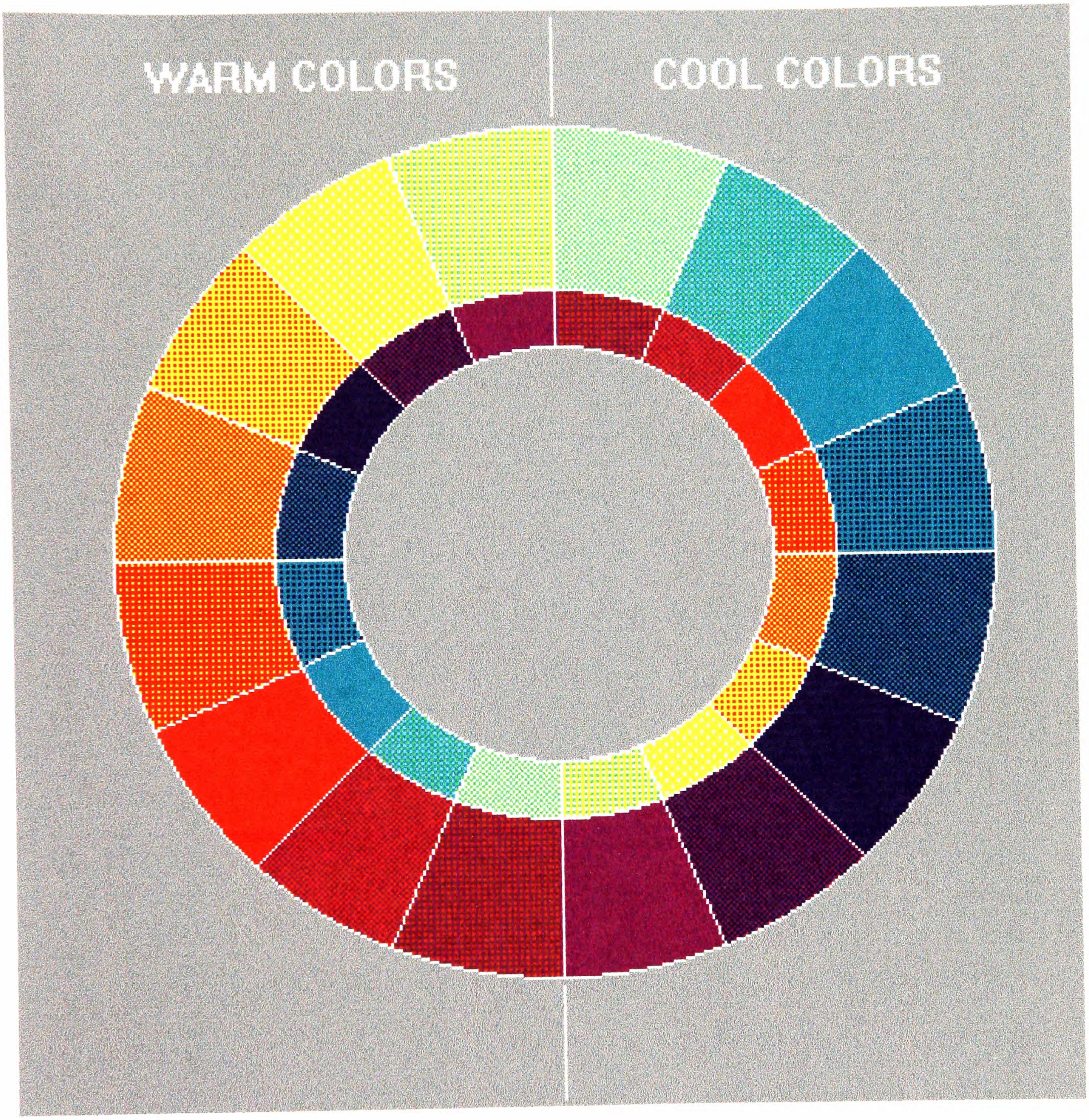
Color, Harmony and Contrast

Clashing color schemes can be disturbing to even the most well adjusted individuals. Designers often use complementary colors for harmonious effects and contrasting colors for dramatic effects. While a limited use of contrasting colors may be acceptable in mental health treatment facilities, an overall color scheme developed from complementary colors seems advisable. Figures 2.2.1 through 2.2.4 are provided to show examples of complementary colors, contrasting colors, and sample color schemes.



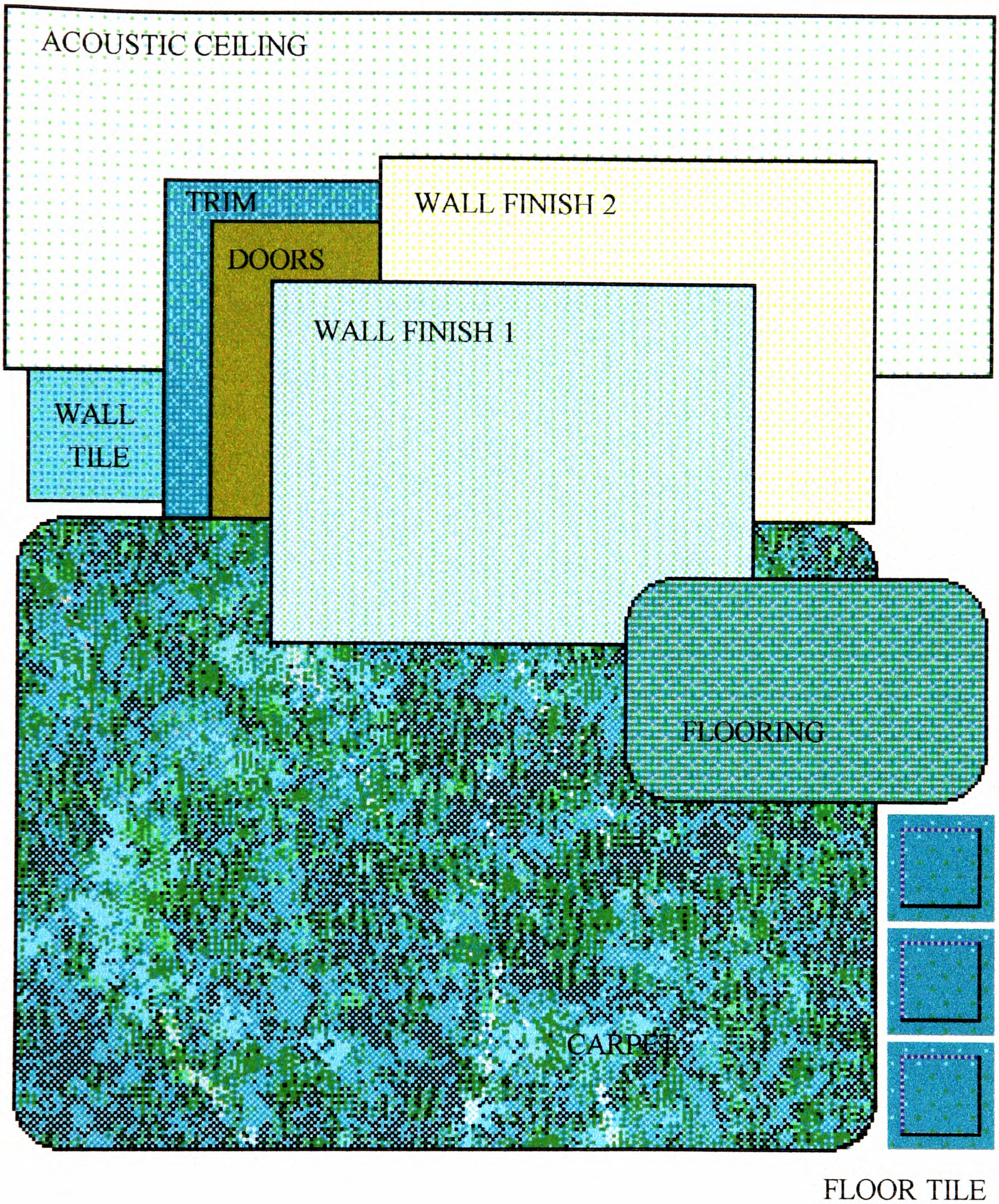
Warm & Cool Colors & Complementary Colors

Figure 2.2.1



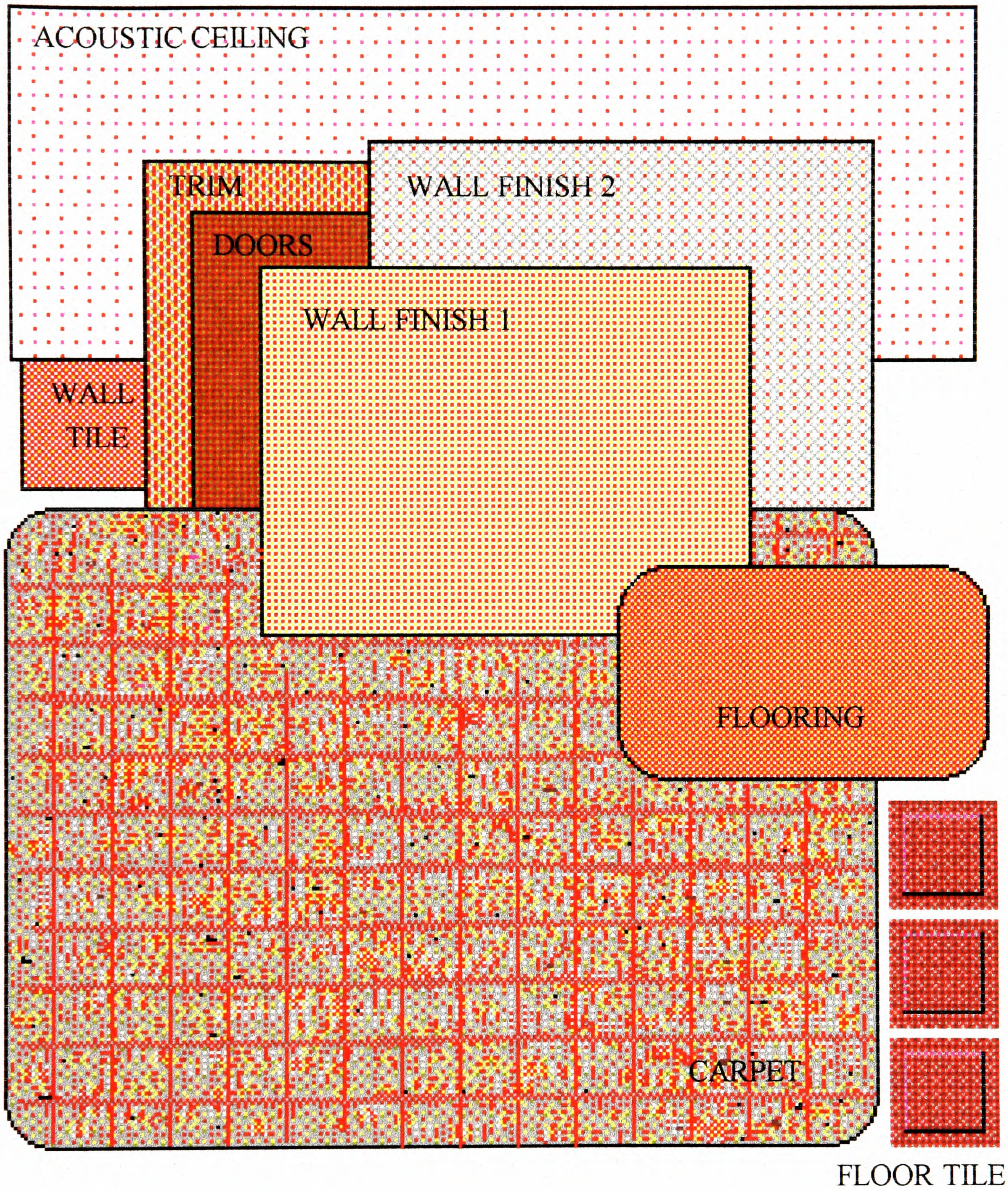
Warm & Cool Colors & Contrast Colors

Figure 2.2.2



Sample Cool Color Board

Figure 2.2.3



Sample Warm Color Board

Figure 2.2.4

Section 2.3 - Noise and Acoustics

After our sense of sight, our sense of hearing is the secondary means which people use to orient themselves to their environment. Sound is typically carried to our ears via waves of differential pressure in the atmosphere. These waves of differential pressure can be felt by many organs of the human body, but only the ears can convert these waves into useful information.

Sound pressure waves are collected by the outer ear and cause deflections of the eardrum. These pressure waves vary in frequency and amplitude and the deflections of the eardrum transmit corresponding vibrations to a system of small bones in the middle ear. These small bones act as mechanical levers to amplify these vibrations while passing them on to the inner ear. Inside the inner ear the fluid filled cochlea receives these vibrations and a network of cilia, with different zones of sensitivity for various frequencies of vibrations, respond to these vibrations by sending electrical pulses to the brain. In the brain these pulses are sorted out and interpreted as sound. (Egan, p31)

The human brain can perceive both the relative pressure and frequency of sound waves. The pressure is measured in microbars and converted to a logarithmic scale of *decibels* which approximate the perceived performance of human hearing. The frequency is measured in *hertz* or cycles per second.

The sound pressure levels of various sounds and noises are represented in figure 2.3.1. Whenever a ten decibel increase in sound pressure occurs, a perceived doubling in loudness is noticeable. A 20 decibel increase in sound pressure levels equals a quadrupling of loudness.

A-weighted sound levels (in decibels, abbreviated dBA) largely ignore low-frequency sound energy, just as most human beings do. Nevertheless, numeric decibel values in dBA often cannot totally represent human perception of noise and the effects of noise on human comfort. Weighted sound levels, therefore, should be used with caution, because human hearing and perception do not respond to sound in a simple, decibel averaged manner. In addition to sound level, an individual's sensitivity to sound varies with frequency, duration, content, and psychological factors. In spite of these limitations, the dBA can be used to generally predict human response to many kinds of environmental noise, such as vehicular transportation. (Egan, p31)

A normal ear can respond to sounds within the audio-frequency range of about 20 to 20,000 hertz. This range and other frequency ranges are shown in figure 2.3.2. The perceived audio-frequency range varies measurably with different people and ages, with the upper limit decreasing considerably with advancing age.

Noise criteria and noise ratings have been developed to express the human response to sound. For example, a low frequency sound of 63 hertz at 40 decibels would seem to the human listener to be equal in loudness to an upper frequency sound of 2,000 hertz at two decibels. This example demonstrates our relative insensitivity to low frequency sound. (Flynn et al, p66)

The terms noise and sound are often used indiscriminately. The major difference between the two is that noise is basically unwanted sound. A wide range of health and behavioral effects are associated with both sound and noise.

Noise and Physical Health

Excessive noise has been linked to spontaneous outbreaks of illness related to stress (Colligan, p10) and to the incidence of neurological and gastrointestinal problems. (National Academy of Sciences, p1-3) Several studies have found that frequent exposure to excess noise is associated with reports of acute and chronic illness (Cameron, p67-74) and with increased consumption of sleeping aids and the need to seek medical help (Grandjean, p3-43).

Aside from the expected sleeping problems, other studies demonstrate that exposure to high concentrations of noise such as living near an airfield or other sources of industrial noise, leads to heightened electrodermal activity, constriction of peripheral blood vessels, higher diastolic and systolic blood pressure, and increased catecholamine secretions. (Cohen, 1980, p331-345), (Frankenhaeuser & Lundberg, p139-149) & (Glass & Singer, p10-21) Additionally, workers in noisy environments exhibit lower blood pressures when they are wearing hearing protection. (Ising, p10-15) Obviously, exposure to excessive noise can degrade physical health.

Noise and Mental Health

As noted earlier, exposure to high noise levels leads to heightened physiological activity typical of stress. Since stress is a causal factor in mental illness, excessive noise can be considered a contributing factor in mental illness. Industrial surveys typically report exposure to high-intensity noise is associated with headaches, nausea, instability, argumentativeness, anxiety, sexual impotence, and mood changes. (Cohen, 1979, p559-572), (Miller, p729-764) & (Strakhov, p2) However, the results of these studies must be interpreted with caution, because other contributing factors are at play.

Airfield noise has also been linked with poor mental health. Researchers comparing psychiatric admission rates for high and low noise areas around Heathrow Airport found higher admission rates in the noisier areas. (Abey-Wickrama, p1275-1277)

Other sounds besides excessive noise should also be considered. Reverberation, echo effects and other forms of distortion to hearing are extremely disturbing to some mentally ill persons, especially among individuals subject to hallucinations. (Prohansky, p561)

Noise and Behavior

Since noise is known to be a contributor to stress, its effects on behavior should also be examined. Numerous studies of the effects of noise on social distance, aggression, and altruistic behavior have been accomplished.

Social Distance

While soft to moderate volume music may help reduce social distance in some settings, unwanted noise does not. Mathews, Canon, and Alexander discovered that noise levels as low as 80 decibels increased the distance at which individuals felt comfortable with each other. (Mathews, Canon & Alexander, p367-370) 80 decibels is roughly equivalent to the noise of a freight train from 50 feet (15 M) away. In a similar study, Appleyard and Lintell found less interaction among neighbors when exposed to loud traffic noise. (Appleyard, p84-101) However, these effects are not universal and may be gender dependent. Other studies have found that some females actually reduce their interpersonal distance when exposed to high noise levels. (Bell & Barnard, p3), (Kenrick,p572-579) The females in question lowered their social distance to similar females when exposed to high noise levels. Bell and Kenrick theorize that males exposed to excessive noise may prefer withdrawal to more distant, less affiliative social interaction, while females may prefer closer social interaction as a coping strategy.

Aggression

Several studies, based on the premise that increasing an individual's arousal level will also increase the intensity of aggressive behavior, have been conducted on noise and aggression. A study conducted by Geen and O'Neal found that test subjects exposed to a series of 60 decibel noise bursts were more likely to deliver an electric shock to test victims than test subjects not exposed to noise. (Geen & O'Neal, p289-292) A similar study by Glass and Singer utilizing 55 and 95 decibel noise bursts had comparable results. (Glass, Singer, et al., p577-595) In this study, one test group was given control of the noise, one group was not, and one group was exposed to no noise. Predictably, the group with control over the noise showed no greater propensity toward shocking their victims than the group exposed to no noise. However, the group lacking control of the noise bursts was more likely to shock their victims.

Helping Behavior

Aversive noise that makes individuals irritable or uncomfortable tends to make them less likely to offer assistance to others who need help. Several studies have been conducted in which test subjects had the opportunity to help a test confederate after he or she had dropped books or papers. Individuals exposed to loud noise (greater than 80 decibels) were less likely to help the confederate than individuals exposed to moderate noise (50 to 60 decibels), or to no noise at all. (Mathews & Canon, p571-577) (Page, p559-572) (Bell & Doyle, p995-959) The exact reasons for the suppression of helping behavior by noise are not known, but it is theorized that aversive noise may narrow attention and negatively affect mood. (Fisher, p114)

Concentration and Performance

Excessive noise can also negatively impact concentration and performance, especially unpredictable noise. Unpredictable noise requires more allocation of attention than predictable noise, causing greater interference with performance. A great deal of concentration is required for complex tasks, and any noise that distracts attention can hurt performance. Similar to research on aggression, it is theorized that lack of control over the stimuli is the most disturbing factor. When control is lost, more effort may be given to restoring control rather than to the task at hand. Excessive noise can also negatively effect concentration and performance after the noise has ceased. This lingering "noise fatigue" requires individuals to collect themselves and reallocate their attention to perform difficult tasks. (Fisher, p107-108)

Noise Control

Since aversive noise can have so many deleterious effects on performance, mental and physical health and social behavior, it should be appropriately controlled. Since most military installations are inherently noisy, mental health facilities should be sited away from airfields, flight paths, firing and maneuver ranges, and other sources of loud noise. It may also be necessary to use the natural landscape or construct walls or berms to deflect noise. External noise can also be minimized by utilizing materials and construction methods that limit the transmission of sound. Internal noise can also be minimized by these same materials and methods, and by the utilization of sound absorbing finishes.

<u>Sound Transmission</u>

The acoustic design of mental health facilities must maintain a balance between reducing noise to comfortable levels and preserving adequate noise levels for patient monitoring. This can be partially accomplished through the segregation of loud functions (such as music or group rooms) from quiet functions such as sleeping or consultation rooms). It is also necessary to inhibit sound transmission between rooms.

For example, if a patient room (or consultation room) has a noise level of 35 decibels, roughly equivalent to quiet conversation at one to two meters, an interior wall with a sound transmission class (STC) of 34 will practically negate all this noise. (Flynn, et al., p84) This STC 34 wall is representative of minimum interior construction, typically two by four inch (50 x 100 mm) studs between two layers of 5/8 inch (16 mm) gypsum board, and is rated to reduce the transmission of sound by 34 decibels over an average of several frequencies. (Doelle, p231) When the background noise level of about 10 decibels produced by the ventilation system is factored in, this quiet conversation would never be heard on the other side of the wall.

A patient room with a noise level of 45 decibels, roughly equivalent to normal conversation at one to two meters, would bleed approximately 11 decibels through an STC 34 wall. (Flynn, et al., p84) The 10 decibel ventilation noise in the adjoining room or corridor would easily mask the remaining sound.

However, a patient room with a noise level of 55 decibels, roughly equivalent to a raised voice at one to two meters, would bleed about 21 decibels through an STC 34 wall. (Flynn, et al. p84) The 10 decibel ventilation noise would be incapable of masking this sound. 34 decibels of sound inhibition seems to be appropriate for most spaces in mental health facilities because combined with the masking noise from ventilation, most routine noises can be concealed, but noises such as shouting and breaking glass can be detected.

Seclusion rooms, where patients are generally immune from injury and prone to be loud, may be enclosed by walls with an STC 50 rating as long as nursing staff can routinely monitor patient status. An STC 50 rating for interior walls can be achieved by a variety of means. By adding resilient bars between the gypsum board and the studs, and installing insulation between the studs of the previously described wall assembly, an STC 50 rating can be achieved. (Doelle, p232) Resilient bars are made from flexible metal and dissipate the vibration of the wall when exposed to sound; thus preventing the wall from acting as a diaphragm. The design of this wall should also be modified to place concrete impregnated gypsum board (blueboard) and perhaps a cushioned material on the patient's side of the wall to prevent patients from breaching the wall and injuring themselves.

Nursing Stations and Reception Areas, where staff usually need to monitor the activities of patients around them, should be as acoustically neutral as possible. Nursing stations, typically surrounded by glass, usually offer little resistance to the transmission of sound. 3/8 inch (10 mm) wired glass has an STC rating of about 25. (Flynn, et al., p197) 7/16 inch (11 mm) laminated glass has a similar rating. In most applications of either glass type, it is probably necessary to provide a 1.5 inch (36 mm) gap below the bottom rail of the glass and the work surface and a similar sized gap between the top rail of the glass and the ceiling, to allow sound to penetrate the enclosure. If 7/16 inch (11 mm) polycarbonate resin panes are used instead, these gaps would not be necessary since small holes can be drilled as necessary to allow sound to penetrate the enclosure. These measures are not necessary where nursing stations or reception areas abut a noisy room space such as a music or game room on one side. In fact a greater STC rating may be desired at these locations.

Sound Isolation

Sonic isolation is used to prevent sounds from being transmitted through the facility by the plumbing and heating, ventilation and air conditioning (HVAC) systems. This involves the use of gaskets (usually rubber or similar material) and insulators placed between pipes and the structural system to stop the transmission of sound and vibration (typically low frequency sound) from being carried through the building. If not properly isolated, the low frequency moan (and accompanying physical rumble) of the HVAC system can be disturbing to some building occupants. HVAC system components are often sited on their own isolated floor slabs, surrounded by rubber gaskets (or if outside, soil) to minimize these problems. The joints between air handlers and ducts should also be isolated with gaskets to prevent the transmission of electrical motor whine.

Sound Absorption

Sound absorption is necessary in many parts of mental health facilities to reduce overall noise levels and reverberation. The loudness of many rooms is as much a function of the reflectance of their walls, floors and ceilings, as it is the initial production of noise within the rooms. Hard smooth finishes are usually very sound reflective and bounce sound around within a room instead of allowing it to quickly dissipate. Soft, textured finishes are usually very sound absorptive and dissipate sound very quickly. Sound absorption is measured by a percentage of absorption versus reflection known as the Sound Absorption Coefficient (SAc).

For example, 5/8 inch (16 mm) gypsum board, with its hard smooth finish has an SAc of 0.29 at 125 hertz, 0.10 at 250 hertz, 0.05 at 500 hertz, 0.04 at 1,000 hertz, 0.07 at 2,000 hertz, and 0.09 at 4,000 hertz. (Flynn, et al., p192) This means that the gypsum board will reflect back about

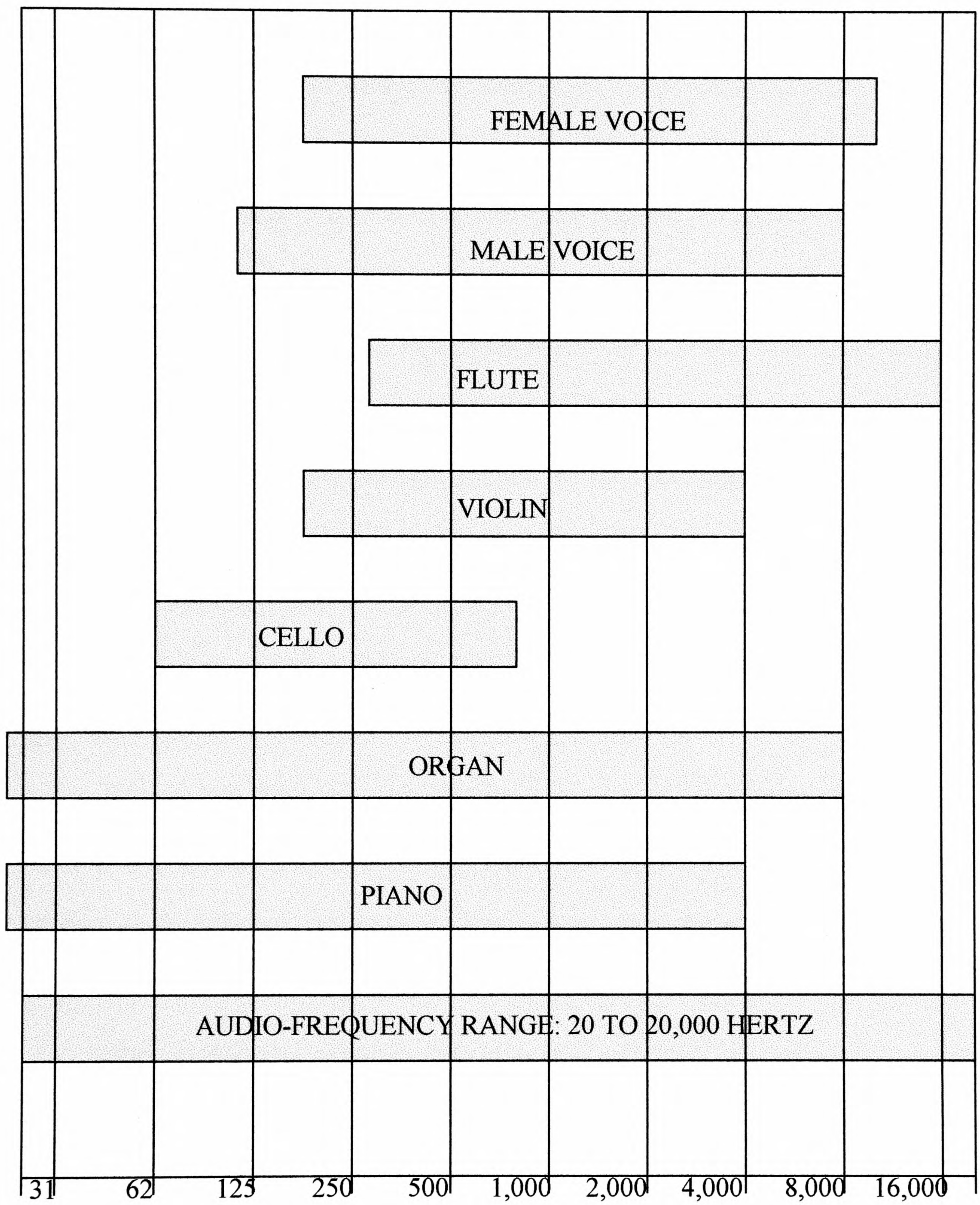
71% of available noise at 125 hertz and between 90% to 96% of available noise at the other frequencies. However, if this gypsum board is finished with a textured coating of acoustical plaster, its performance changes to an SAc of 0.07 at 125 hertz, 0.17 at 250 hertz, 0.50 at 500 hertz, 0.60 at 1,000 hertz, 0.68 at 2,000 hertz, and 0.66 at 4,000 hertz. (Doelle, p227) While more low frequency sound is reflected, the reflection of upper frequency is drastically reduced.

Even better performance can be achieved with 5/8 inch (16 mm) fissured acoustical tile with an SAc of 0.33 at 125 hertz, 0.39 at 250 hertz, 0.53 at 500 hertz, 0.77 at 1,000 hertz, 0.86 at 2,000 hertz, and 0.80 at 4,000 hertz. (Flynn, et al., p 193) Acoustical finishes of this type can greatly reduce ambient noise levels and reverberation within spaces, but do not prevent the transmission of sound to other spaces through walls, ceilings and floors. The function and furnishing of each room can also have profound effects on its acoustical performance. It should also be noted that while a wall or ceiling assembly may block or absorb some frequencies of sound very effectively, other frequencies (typically low frequencies) may not be significantly abated. For these reasons a qualified architect or engineer with considerable experience in acoustic control should be retained when planning and designing mental health care facilities.

JET BLAST ARTILLERY FIRE RIVETING	130	DEAFENING
	120	
SONIC BOOM ORCHESTRA FORTISSIMO ROCK BAND	110	PAINFUL
	100	
TRUCK UNMUFFLED LOUD STREET NOISE POLICE WHISTLE	90	VERY LOUD
	80	
LIGHT INDUSTRY TYPEWRITER NOISY OFFICE	70	LOUD
	60	
RAISED VOICES AVERAGE RADIO AVERAGE CONVERSATION	50	MODERATE
	40	
PRIVATE OFFICE QUIET CONVERSATION QUIET HOME	30	FAINT
	20	
RUSTLE OF LEAVES WHISPER HUMAN BREATHING	10	VERY FAINT

Sound Pressure Levels in Decibels

Figure 2.3.1



Sound Frequencies

Figure 2.3.2

Section 2.4 - Interior Finishes and Environmental Factors

Harmful Chemicals

With the advent of many new man-made materials now available on the market, health care and design personnel have more choices and more freedom than ever to develop their desired interior health care environment. Unfortunately, most of these new materials are dependent on chemical processes that either use harmful chemicals during manufacturing, or release harmful chemicals over time and exposure to heat. The release of these toxins can take two forms, through *outgassing* and through *structural respiration*. The formation of *free radicals* from these chemicals by ultraviolet light further compounds the problem.

Outgassing is the process of slow and invisible disintegration of a physical material in molecular form and its diffusion into the surrounding air. The material might consist of synthetic fabric, paint, adhesive, floor tile, etc. The molecular portion of such a disintegrating material becomes airborne, and when it is inhaled by a person sensitive to this material, the gaseous or airborne particles induce toxic reactions. (Nikel, 43)

Structural Respiration is the unwanted exchange of air between the exterior and interior of a building through structural barriers intended to keep out exterior air. (Nikel, 43) This exchange of air exposes people to airborne particles released by hidden materials in walls and ceilings such as insulation, friable asbestos, and vapors produced by wiring.

Free Radicals are formed when chemical pollutants are exposed to strong ultraviolet light, and these transformed compounds are particularly noxious. The ultraviolet light breaks the bonds between atoms in these molecules leaving the molecule fragments with unpaired electrons. Unpaired electrons naturally tend to seek out other electrons to establish a balanced pair, so they may exist at a lower energy state. This action of seeking another electron makes the atoms in these compounds extremely active, and they will seek out additional electrons wherever they can find them, including human skin, eyes, and respiratory systems. These free radicals damage the human body in two ways: firstly because these compounds will bond with human tissue more easily, and secondly because the appropriation of electrons from human tissue causes cellular damage. Exposure to free radicals is considered a contributing factor to cancer.

Sick Building Syndrome

Recent trends in weatherproofing, insulation, and sealing environments to prevent heat or cooling losses have greatly reduced the problem of structural respiration in health care facilities. Unfortunately, these same improvements now contribute to the problem of outgassing, because they prevent air exchange and effectively hold these toxins in the interior environment. Outgassing of man-made materials is known to be one of the main contributing factors to sick building syndrome. This is further complicated by the fact that approximately 30% of the population that suffers from some form of respiratory sensitivity. (Hoffman, 847)

Sick Building Syndrome is characterized by an increased frequency of a number of irritating symptoms of the eyes, nose, and throat; dryness and irritation of the skin; headaches and lethargy. Other symptoms associated with sick building syndrome can include nasal congestion, runny nose, excessive thirst, and nausea. (WHO, 1) Symptoms are generally experienced as being related to work because they grow worse during the day in the workplace and disappear or diminish when the workers leave the workplace. (Burge, 3-14) These symptoms occur on a regular basis, usually several times a week or more. There also seems to be a seasonal variation in the symptoms; they are reported to be more frequent and severe during winter months. (Skov, 17)

Personnel who complain of these symptoms report that the symptoms start gradually, days or months after they occupy a building or after alterations are made in a building. The personnel that complain are otherwise mostly healthy; however, those suffering from hay fever or asthma are more likely to complain of additional sinus and throat irritation, and of aggravation of their hay fever or asthma while staying in the building. (Skov, 17)

Obviously, the most inopportune location for sick building syndrome would be a health care facility. Therefore, to help prevent the onset of sick building syndrome in our health care facilities, we should select interior finishes and materials that will not contribute to this problem. The following guidance on interior finishes and their related environmental factors should help health care and design personnel select the appropriate materials.

Interior Finish Types and Characteristics

Information on interior finishes is presented in three general categories: wall and ceiling finishes, floor finishes, and furnishings. While some materials can be used for all three, wood for example, this is the most coherent way to present the information.

Wall and Ceiling Finishes

Plaster is a mineral product made primarily of gypsum. Its powder form when mixed with water hardens into a fairly inert rock-like material. The traditional method of application involves troweling a 1/2" (13 mm) thickness of plaster over metal or wood lath. Today, most designers opt for a less expensive plaster veneer which is troweled in a 1/8" (3 mm) layer over plasterboard. Plasterboard (often called blueboard because of its color) is a sheet product that consists of a gypsum core with paper facing on each side. Although it looks similar to gypsum board, the paper is specially treated so a thin coat of wet plaster will properly adhere. (Bower, 257)

Both plasterboard and plaster can contain small amounts of synthetic additives. In spite of this, a completely plastered wall, whether traditional or veneer method, is usually very inert. In fact, it is actually one of the least polluting wall and ceiling finishes available. This is because a cured plaster surface is so hard and dense that it is subject to almost no outgassing. (Bower, 257) It should be noted that most plasterboard requires a decorative treatment. It can receive a textured surface with colored plaster, or it can be troweled smooth and painted. (Nikel, 45) Due to the brittleness and irregularity of its surface finish it is not usually suitable for the installation of wallpaper, vinyl wall covering, or textiles.

Plaster and plasterboard have three basic disadvantages. Firstly, since the application requires skill, it can be difficult to locate experienced plaster contractors in some areas. Secondly, plasterwork is more expensive than the installation of typical gypsum wallboard (drywall). Thirdly, plasterwork is more difficult than gypsum board to seal in an airtight manner. When the joints of a plaster wall are finished, they are taped with a fiber-mesh tape, rather than the paper tape used with gypsum board. The fiber-mesh tape is less flexible and can develop air leaks when the structure experiences movement. (Bower, 258)

Gypsum board, like the plasterboard used in veneered plaster construction, is a board product possessing a gypsum core and paper facing on both sides. Gypsum board is available in a standard 4' (1.2 m) width and in lengths of 8', 10', 12', 14', and 16' (2.4 m, 3 m, 3.6 m, 4.2 m, & 4.8m). The paper facing on gypsum board is made from recycled newspapers and the residual smell of printing ink can be bothersome to some people. (Bower, 258) The chemical fire-retardants in the paper on some types of gypsum board can also outgas and be irritating. (Nikel, 45) The paper is not usually a problem, as long as gypsum board is specified with paper formulated for hypersensitivity, and the paper is then sealed with an acceptable paint. When a tolerable paint is used gypsum board can be as inert as plaster. (Bower, 259)

Foil-backed gypsum board can be used as a diffusion barrier to block both moisture and pollutants from structural respiration. The foil backing blocks the diffusion of pollutants released by insulation, wiring, and other sources. Foil-backed gypsum board also eliminates another possible minor source of emissions - the back surface of the gypsum board. Like the front, this surface is covered with recycled newspaper. (Bower, 261)

Joint Compound Finishing gypsum board requires applying paper tape and two or more coats of joint compound to all seams. In most applications two coats are acceptable, but if the wall will be painted with a gloss or semi-gloss paint, an additional coat is required. After the joint compound has dried, it is lightly sanded to remove any ridges or imperfections. Some gypsum board finishers choose to use a damp sponge instead to smooth the joints. A sponge will leave no sanding dust, so clean-up before painting will be easier. If sanding is used, the ventilation system in the work area should be turned off until the dust settles and is cleaned up; otherwise, the ductwork could become filled with gypsum board dust. Premixed gypsum board compounds are much more offensive than the gypsum board itself. They contain a variety of ingredients such as antifreeze, adhesives, fungicides, preservatives, etc. Fortunately there are non-toxic compounds available; these products are shipped in powder form and mixed with water on the job site. (Bower, 260)

Acoustical Ceiling Panels are the most commonly found ceiling finish in health care facilities. These panels can be used in most public areas in mental health care facilities except where security measures are required - monolithic plaster or gypsum board ceilings are preferable for such areas. Acoustical ceiling panels are usually stippled, fissured, or textured for acoustical control. Typically these panels are suspended in a two' x four' (60 cm x 120 cm) or two' x two' (60 cm x 60 cm) metal grid, but other sizes are available. There are three major types of lay-in acoustical tile commonly found in health care facilities: vinyl faced fiberglass panels, mineral fiber panels, and clean room ceiling panels. Acoustical panels are rated on several factors such as noise control, sound transmission, light reflectance, and flame spread; these performance factors should be considered when selecting panels for various health care functions.

Metal grid may be exposed or concealed behind the acoustical panels. Generally, maintenance and panel damage resulting from opening the ceiling assembly are less of a problem with exposed grid. A more practical way to de-emphasize the appearance of the grid is to use *tegular* panels. These panels have a recessed edge that allow the acoustical panels to hang below the level of the grid. Grid with a baked enamel finish is preferable to painted grid because there is almost no associated off-gassing of volatile organic chemicals (VOCs). Stainless steel grid is also available for humid/wet areas such as bathrooms and whirlpool areas to prevent rust.

Vinyl faced fiberglass panels are inexpensive but have two major shortcomings: they are extremely light in weight and are faced with a glossy vinyl film. They are easy to identify because the fiberglass core is usually yellow in color. The light weight causes problems because drafts and air pressure changes often cause panels to blow out of place. The vinyl film is not only unattractive due to a wrinkled appearance resulting from humidity changes, but this vinyl film is subject to offgassing of VOCs. Additionally, fiberglass has recently become suspect as injurious to the respiratory system. This type of tile is present in many older ceilings in health care facilities and should be replaced with mineral fiber panels. Vinyl faced fiberglass panels are not suitable for most new health care applications.

Mineral fiber panels are made from a fairly inert material commonly known as rock wool or mineral wool. Mineral wool is produced by steam blasting and cooling molten silicate rock. Silicates are the major building block for most rocks, except for sedimentary rocks such as limestone and dolomite. Fiberglass is also a silicate product, but it is more highly refined. Mineral wool is usually gray and sponge-like in composition, and is usually painted with water based latex paint to seal the material and provide the necessary light reflective surface. Vinyl faced mineral wool panels are also available, but like the fiberglass panels they are subject to the outgassing of volatile organic chemicals. Mineral fiber panels sealed with water based latex paint are suitable for most health care applications and produce very few VOCs.

Vinyl Wall Covering has been incriminated as being disturbing to sensitive persons. The petrochemicals used to make the vinyl are partially to blame, but the plasticizing chemicals used to make the wallcovering pliable are the main offenders. In addition to the basic stock material, the necessary adhesives are also a source of outgassing because they are of petrochemical derivation. (Nikel, 46) Vinyl wall covering is known to release formaldehyde, volatile organic compounds, and silicones into interior air. (Knöppel, 115) For these reasons, the application of vinyl wall covering should be severely limited in health care facilities and never installed in areas that would cause long term patient irritation (inpatient psychiatric units).

Wallpaper is less popular than it has been in the past, partly due to the advent of vinyl wallcovering and wall textiles. Despite its connotation as an "old fashioned" product, it has many of the hazards associated with new artificial materials. Wallpaper is known to release volatile organic chemicals into interior air. (Knöppel, 115) The printed decoration of the paper is made with outgassing types of inks and paints. These decorations, in addition to the adhesives required to stick the paper to the wall, also have the potential for outgassing. It should not be presumed that wallpaper seals in the adhesive - the porosity of the paper is sufficient to allow the molecular diffusion of pastes, glues, and other forms of adhesives. The use of natural adhesives (wheat or potato flour mixtures) tends to promote mold growth which can also irritate sensitive patients and personnel. (Nikel, 45) For these reasons, the application of wallpaper should be limited in health care facilities and never installed in areas of long term patient occupation. Wall fabrics will be discussed under the general topic of textiles.

Interior Paints Most interior paints on the market are of two types: *solvent-based* and *water-based. Solvent-based* paints can contain up to 60 percent VOCs while *water-based* paints typically contain less than 10 percent VOCs. Clearly, water-based paints are the better finish for health care facilities. Painters, routinely exposed to high levels of VOCs, have a higher incidence of cancer than any other tradesmen. VOCs have also been linked to loss of balance and nervous system dysfunction in painters. (Bower, 265)

Although lower in VOCs, water-based paints are subject to spoilage due to mold or bacterial contamination. To minimize this problem manufacturers add biocides to make the paint poisonous to microbes. Most paints, if exposed to continuous high humidity, can be attacked by mold even after they're dry. The primary purpose of these biocides is to extend the shelf life of paint while in liquid form in the can. Unfortunately, these biocides affect people as well as mold and bacteria. Formerly, mercury was used as a fungicide in some interior paints but this is now banned; however it is still legal in exterior paints. (Bower, 266) Exposure to heavy metals such as mercury can cause nerve and brain damage as well as numerous other health problems. Therefore, you should never use exterior grade paints for any purpose inside a health care facility due to the possibility of trace amounts of mercury.

Another health concern related to heavy metals is the presence of lead in old paint in existing health care facilities. As lead paint deteriorates it becomes a deadly airborne dust that can be inhaled by patients and staff. Lead oxides were often used as whitening or brightening agents in many paints. The test to determine if lead is present is fairly simple, but the process to remove it is exacting and laborious and should only be done by professional lead paint removal contractors.

Low-Outgassing Paints Water-based paints should be adequate for most health care applications, however *low-outgassing paints* should be considered for areas of long term patient occupation (inpatient units). Although low-outgassing paints contain mainly synthetic ingredients, they are formulated to have very little odor. While originally developed for chemically sensitive individuals, they are now being used by environmentally conscious people with no particular health concerns. One company produces a low-biocide paint that is basically a conventional water-based paint with 90 to 95 percent less biocide than usual. Another manufacturer is now promoting a zero-VOC interior paint. Pace Chem Industries is a good source for such paints. While these products are low-outgassing, it should be noted that all have an odor during application and for some time afterward until the finish is cured. Most of the curing of water-based finishes takes place within two weeks but some sensitive individuals can detect odors for as long as several months. (Bower, 266)

Glazed Wall Coatings are intended for problem areas in health care facilities where other finishes will not adhere, lack adequate durability, or lack adequate chemical resistance. The two main types useful in health care facilities are vitreous cement and vitreous epoxy.

Vitreous Cement wall coating is a glazed cementitious finish for both interior and exterior use, containing 90 percent Portland cement and inorganic aggregates. It can be applied over masonry, concrete, plaster, cement asbestos board, and gypsum board. Adhesion of this coating is excellent due to the chemical reaction of the Portland cement during curing. (Sweet's, 9800/VIT) It provides a hard, seamless, mottled ceramic-like finish that can conform to complex curves and is ideal for filling rough surfaces such as concrete block. The thickness will vary from 1/32" (.75 mm) to 1/16" (1.5 cm) based on the porosity and texture of the substrate. This material is available in a wide variety of solid and mottled color combinations in high gloss and matte finishes. (Sweet's, 9800/POL) It can be used to simulate speckled granite and other fine stone. This material has an extremely inert and incombustible finish that is particularly useful in remodeling existing buildings of opportunity (even those with concrete block interior walls) for health care use.

Vitreous Epoxy wall coating is a two component, thermosetting epoxy resin coating, for both interior and exterior use, that provides an extremely tough durable finish, highly resistant to all acids, alkalis, solvents, greases, and oils. Typically applied in four coats, it will adhere to almost any structural or finish material, including ceramic tile. Vitreous epoxy provides a seamless ceramic-like finish of extreme hardness. The necessary thickness is similar to vitreous cement. This material is recommended for areas where extreme resistance to chemical and solvent attack is required, or where graffiti is a problem. Graffiti can be cleaned off this surface with solvent without degrading the wall coating. (Sweet's, 9800/VIT) Like vitreous cement wall coating, this material is available in a wide variety of solid and mottled color combinations in gloss and satin finishes. This material can likewise be used to simulate speckled granite and other types of stone. A clear coating is available for porous materials such as brick. This material is also extremely inert, and fire resistant. (Sweet's, 9800/POL) This material is useful in remodeling existing health care facilities because it is the only material effective at covering existing ceramic tile.

Floor Finishes

Ceramic Tile can be used for either a floor or wall finish. Small tiles are preferable because large tiles can be pried loose and fashioned into weapons or projectiles. Ceramic tile is made from various combinations of clay, shale, gypsum, talc, vermiculite, and sand. It is fired in kilns at temperatures between 900° and 2,200° Fahrenheit (480° & 1,200° C), yielding a very inert product. Generally, ceramic tile is classified as either glazed or unglazed. The glaze is a glass-like coating applied to the surface of tile to provide color, decoration, texture, or resistance to abuse. (Bower, 277) Usually only glazed tile is used in health care facilities because unglazed tile is porous and subject to staining and contamination.

Installation of ceramic tile on walls usually requires the use of organic adhesives derived from asphalt, vinyl mastics, or epoxies. This is because cement mortar is not a practical means to adhere tile to the wall because of the associated problems with weight, gravity, and thickness. (Bower, 277) Unfortunately, all organic adhesives release volatile organic chemicals into interior air, even after the tile has been grouted. If ceramic tile must be installed on interior walls, epoxy adhesives are recommended because they release far fewer VOCs than other organic alternatives. The shortcoming of epoxy adhesives is their brittleness and lack of flexibility. A good alternative to ceramic tile on walls is structural glazed block. It can be glazed on one or both sides as needed and is extremely durable and environmentally inert.

Installation of ceramic tile on floors is not subject to the same limitations as walls because cement mortar releases no toxins into interior air. The use of ceramic tile in most locations where vinyl composition tile might be used can drastically reduce the amount of outgassing in health care facilities. Most ceramic floor tile in health care facilities is installed using thin mortar beds rather than thick beds to avoid additional weight. Thick mortar beds are required for large thick tiles such as quarry tiles. Generally small tiles, such as one or two inch (2.5 cm or 5 cm) mosaic tiles, are preferable for most health care applications because they are less subject to damage from impact forces and hospital carts. Grout for the joints between the tile should be some color that doesn't stain easily in a health care environment (blood, betadine, urine, etc.). Grout should also be cement-based without petrochemical additives to prevent outgassing.

Vinyl Tile, like vinyl wall covering, has also been incriminated as being disturbing to sensitive persons. The petrochemicals used to make the vinyl are partially to blame, but the plasticizing chemicals used to make the tile pliable are the main offenders. In addition to the basic stock material, most of the necessary adhesives are also a source of outgassing because they too are of petrochemical derivation. (Nikel, 46) Vinyl tile is known to release VOCs, and silicones into interior air. (Knöppel, 115) Unfortunately, it is almost impossible to avoid using vinyl tile in health care facilities; carpet (as discussed below) is environmentally far worse and most other floor finishes are cost prohibitive.

It is therefore necessary to work out some type of compromise. Generally, the harder the vinyl flooring, the less outgassing will occur, due to the relative absence of plasticizers. Adhesives also vary greatly in their outgassing potential; selection of an adhesive or mastic that has been tested by an accredited laboratory as having low levels of outgassing will reduce VOC levels in interior air. The application of hard paste wax over vinyl tile will also help seal in the products of outgassing. Soft waxes and liquid waxes should be avoided because they don't seal the tile and outgas harmful chemicals of their own; (Silver, 101) usually VOCs and silicones. (Knöppel, 115) Therefore, try to use hard vinyl tile, low outgassing adhesive, and hard paste wax to minimize the effects of outgassing. It is also possible to reduce the amount of airborne toxins by using sealed concrete rather than vinyl tile in large storage/logistics areas.

When replacing existing vinyl tile, be sure to have the tile and the underlying adhesive or mastic tested for the presence of asbestos. In the past, asbestos fibers were added to vinyl tile and mastic for additional reinforcing strength. When these materials are left in place they pose little threat to interior air. It is even possible to install new vinyl tile or carpet over the vinyl asbestos tile (VAT) without ill effects. The problem emerges when the old VAT is removed; asbestos fibers then become airborne (friable), and pose a threat to patients and staff.

Seamless Vinyl, like vinyl tile, has also been identified as disturbing to sensitive individuals because it releases VOCs and silicones into interior air. (Knöppel, 115) Again the petrochemicals used to make the vinyl are partly to blame, but the plasticizing chemicals used to make the vinyl pliable are the main offenders. Since seamless vinyl contains more plasticizers than vinyl tile, it naturally pollutes more. However, due to the fact that the vinyl is seamless, there is very little outgassing from the adhesives. In fact, if the edge of the seamless vinyl can be sealed with an acrylic caulk, there is practically none. Seamless vinyl is a good material for areas where a sterile environment is required such as operating rooms, procedure rooms, and delivery rooms. Seamless vinyl is known to tear fairly easily, especially when large pieces of equipment are moved. If given a choice, terrazzo is a better material for the reasons described below.

Linoleum Flooring is composed of linseed oil and a variety of other natural materials and is relatively environmentally innocuous. However, linoleum flooring is relatively soft, and easy to abrade, and is therefore unsuitable for most healthcare applications.

Natural Rubber Floorıng is a very durable finish, but inappropriate for most healthcare applications because it contains natural allergens. These allergens are compounds produced by the rubber tree to repel insects and other pests, and cause allergic reactions in many people. High concentrations of these allergens have been linked to recent increases in demand for natural rubber and associated shortcuts in manufacturing processes. (Tomlinson)

Terrazzo Flooring, like ceramic tile flooring, releases no toxins into interior air. Because it is monolithic and seam free, it is an excellent finish for surgical areas, procedure rooms, and delivery rooms. It consists of a mixture of colored cement and marble chips. When water is added, it is trowelled smooth and allowed to harden. The surface is then polished with powerful grinding machines to produce a smooth, durable, sterile, and inert surface. The main limitations of terrazzo flooring are its weight and expense.

Carpeting is today's most popular floor covering in health care facilities. Some people believe that no health care facility is complete without carpeting, and that carpet is essential for patient and staff comfort. Nothing could be further from the truth. Although there are negative health effects associated with many other interior materials, carpeting is probably the worst offender. It can affect health one way when new, because of airborne fiber and new carpet fumes, or when old, as a reservoir for dirt, mold, and dust mites. (Bower, 273) Carpet is not a very cost effective or durable material since its average life cycle is only about eight years. Carpet is also a poor environmental choice because it is usually made from non-renewable resources, but unfortunately nylon carpeting is the only type allowed under Department of Defense specifications. Any carpet used in inpatient mental health areas should be tightly woven from small fibers to prevent patient self injury.

Carpeting - Artificial Hazards Beginning in October 1987, over 20,000 square yards (16,700 sm) of new carpeting were installed in an Environmental Protection Agency (EPA) office building in Washington DC. Soon, many of the employees became extremely ill; eventually some became permanently disabled with Multiple Chemical Sensitivities (MCS). (Bower, 273) MCS usually develops after long term exposure to pollution. Individuals with MCS then become hypersensitive to a wide variety of synthetic pollutants such as exhaust gases and artificial fragrances. Often they become intolerant of synthetic clothing, plastic materials, paints, adhesives, or printing inks. (Bower, 24) After a great deal of controversy, all the carpet was removed. The problem was believed to be related to a chemical called 4-phenylcyclohexene (4-PC), a toxic gas released from the carpet. (Bower, 273)

Partially as a result of the EPA's carpet problems, the New York State Attorney General petitioned the US Consumer Product Safety Commission (CPSC) to require warning labels on new carpeting, carpet pads, and adhesives. He cited the fact that besides 4-PC, there are over a hundred other gases released by new carpet, some of which are toxic or carcinogenic. (Bower, 273) Most of the gases are VOCs (Knöppel, 115) such as solvents that can directly enter the bloodstream after being inhaled. (The effect is very similar to the sophomoric practice of sniffing glue.) The petition also pointed out that children and pregnant women are at increased risk. Despite the fact that half of the state attorneys general in this country also signed the petition, and the CPSC had received hundreds of complaints about new carpeting, the petition was denied. (Bower, 273)

In October 1992, "The CBS Evening News" hosted by Dan Rather and "Street Stories" with Ed Bradley both reported on tests conducted by the Anderson Laboratory in Dedham, Massachusetts, in which mice actually died from breathing air blown across carpeting. (Bower, 273) Physiologist Rosalind Anderson observed the mice gasp, turn blue, lose their balance, experience lung hemorrhages, and suffer paralysis. Some of the samples used to kill mice were as much as twelve years old and had already outgassed many of their toxins. (Bower, 45) Not believing the test to be valid, the carpet industry sponsored Carpet and Rug Institute performed their own tests and achieved the same results - **dead mice**. In early 1993, the EPA obtained similar results, yet there is still no system in place to warn the public of this health threat. (Bower, 273)

In late 1991, the Carpet and Rug Institute in Dalton, Ga. established an independent labeling program called the Indoor Air Quality Carpet Testing Program. The criteria were based on an emission factor measured in mg/m^3 per hour to test for VOCs in environmental air chambers. Maximum specific requirements are as follows:

Total Volatile Organic Compounds (TVOC)	0.5 mg
Styrene	0.4 mg
4-phenylcyclohexene	0.1 mg
Formaldehyde	0.05 mg

If sampled carpets fall within these criteria, they are eligible for the institute's indoor air quality program label. While this is analogous to the fox guarding the henhouse, it is the only standard available in the absence of government regulation.

Carpeting - Natural Hazards Mold spores, dust mites, bacteria, and other microorganisms make their home in carpeting. While some of these tiny creatures are relatively benign, others are highly allergenic - particularly the airborne feces of dust mites. The reason microorganisms thrive in carpeting is because there is so much sustenance there. Dust mites thrive on flakes of dead human skin we all shed daily. Mold can eat virtually anything and will be prolific in higher relative humidities such as when carpet is attached to a cold or damp concrete slab. Carpet can also become contaminated with food, body fluids, and feces - attracting a host of microbes.

Carpet Pads are also subject to outgassing. Natural fiber pads are better than synthetic pads, but not significantly, since they are usually held together with some type of adhesive and may be chemically treated. (Bower, 274) Department of Defense specifications only allow synthetic carpet pads.

Carpet Installation The adhesives and glues used to install carpet can be worse sources of outgassing than the carpet itself. In June of 1990, a chemical gas detection alarm was triggered at the Seattle Children's Hospital by carpet installation. The sensor was in the hospital's poison center where chemical tanks are stored but no chemical leaks were discovered. After a brief investigation, it was discovered that the alarm was triggered by carpet glue vapors from a nearby room. Like paints, these adhesives can be solvent-based or water-based. Obviously water-based adhesives are preferable. (Bower, 274) If you **must** have carpeting in your health care facility, please observe the following suggestions.

Try to limit carpeting to offices, corridors and common areas in outpatient areas.

Exclude carpet from inpatient floors and ensure that inpatient areas are isolated from carpeted outpatient areas by means of separate HVAC zones.

Exclude carpet from patient rooms and other areas of long-term patient occupation. Easily cleaned natural area rugs can be used instead to promote patient comfort.

Allow unrolled carpet to "air out" in a warehouse for several weeks before installation to allow some of the more noxious vapors to dissipate.

Use only water-based adhesives and provide adequate ventilation during installation and curing.

Try to limit health care services during carpet installation and curing period.

When possible, accelerate curing by providing a “bake out” period of at least a week at temperatures in excess of 90° Fahrenheit (32°C). Provide necessary air changes during this process to prevent VOCs in interior air from reaching potentially toxic levels.

Carpet Cleaning Millions of microorganisms in carpeting represent only a fraction of the problems involved in keeping carpet clean. If the outside of the facility was once painted with lead paint, the surrounding contaminated soil can be tracked indoors. Similarly, lawn pesticides, herbicides, fertilizer, and animal waste can be tracked in and eventually build up on the carpet.

Most portable vacuum cleaners have very inefficient filters that aren't able to capture the fine particles of dust that are sucked in. They simply blow a considerable amount of dust and debris back into the room. (Bower, 274) In fact, dust mites can flow through this type of vacuum cleaner without injury. After vacuuming, this fine dust can float around in the air for up to a half hour. Once airborne, this fine dust is easily inhaled into your lungs. Vacuum cleaners equipped with microfilters that can capture this dust and the dust mites are available, but they are much more expensive than standard equipment.

Wood Flooring, while very attractive, is difficult to maintain due to its relatively soft and porous nature. Wood flooring in health care settings is inappropriate because it is easily abraded and can absorb urine and other fluids. Simulated wood finishes, some quite convincing in appearance, are available in both vinyl tile and vinyl roll stocks.

Interior Furnishings

Wood, Plywood & Particle Board Although outgassing usually refers to the gases emitted by synthetic products, it is a term sometimes applied to naturally occurring materials as well. Softwoods such as pine, redwood, and cedar are known to outgas low levels of terpenes (turpentine related compounds), chemicals that can negatively affect some sensitive individuals. (Bower, 44) It is these terpenes that drive moths away from woolens in a cedar chest or closet.

Hardwoods, derived from deciduous trees, are usually a healthy interior material for most people, but since each species of wood has a unique odor, sensitive individuals may find some woods more benign than others. Maple, beech, birch, and tulip poplar are usually the best tolerated. (Bower, 44)

The wood products industry uses two different kinds of glue to laminate paneling, plywood, and particle board. All construction grade laminations (both interior and exterior grades) use a waterproof phenol-formaldehyde (PF) resin. Most particleboard, medium density fiberboard, and cabinet grade plywood uses a cheaper non-waterproof urea-formaldehyde (UF) resin. UF resins outgas about ten times more formaldehyde than PF resins. Unfortunately it is the UF containing products that are typically used indoors for cabinets, shelving, parquet flooring and paneling. While no laminated wood products are ideal for health care facilities, if you must use them, specify they are to be fabricated with phenol-formaldehyde resins. (Bower, 44)

Interior Stains & Sealants Like interior paints, interior wood stains are either solvent or water-based, and contain the same relative amounts of VOCs. Therefore, water-based stains are preferable for use in health care facilities. Stains are usually used as a first coat on wood. They are then covered with a clear protective finish which tends to seal in any residual odors from the stain. In general, synthetic low outgassing finishes seem to make better sealants than natural finishes. (Bower, 267) Although this may seem ironic, artificial sealants are less permeable than natural sealants. Among artificial sealants, acrylic is the most preferable because it provides the hardest, clearest, most inert seal. (Bower, 270)

Interior Textiles can include fabric wall covering, furniture cushions, beds and bed linen, and window treatments. Most interior textiles on the market today are some form of petrochemical derivative and are therefore subject to outgassing VOCs. (Knöppel, 115) Window treatments are the most prone to this problem because exposure to sunlight and heat accelerates this process. Low outgassing natural fabrics should be used in place of synthetic textiles to reduce the amount of VOCs in interior air.

Upholstery stuffing can also pollute interior air because much of it is made of foam rubber or expanded polyurethane. These materials in their solid forms are fairly innocuous, but when expanded to have large surface areas they release an abundance of formaldehyde and VOCs. (Knöppel, 115) This process is accelerated every time someone sits on this furniture and forces the cellular air into the surrounding room air. Although not perfect, stuffing made from polyester pile produces far less outgassing problems. Even better are stuffings from natural fibers over encased wire coils; although old fashioned, they produce almost no outgassing problems. (Nikel, 63)

Cabinets and Casework can be found throughout health care facilities and can be major contributors to the pollution of interior air. Three major types are commercially available: *wood laminates, plastic composites,* and *metal.*

Wood Laminates like the plywood discussed earlier are manufactured with urea-formaldehyde (UF) resin which outgasses about ten times more formaldehyde than phenol-formaldehyde (PF) resin. If wood laminates must be used, specify that UF resins be used in their manufacture. It is easy to be fooled by cabinet appearance because many wood laminate cabinets are clad in a thin plastic veneer to make them look like solid plastic cabinets. While PF resin is preferable to UF resin, other cabinet products produce far less volatile organic chemicals.

Plastic Composites are probably a better choice than wood laminates because they are typically manufactured from very hard plastics with less potential for outgassing. This type of cabinet weighs the least and has the most flexibility for reconfiguration and customization for changing user needs. However some users, particularly in laboratories, have criticized plastic composites as not being durable enough for constant use and equipment loads.

Metal cabinets and casework are probably the most durable available. Metal cabinets also produce the least outgassing of any other choices because their factory finish is usually baked on at very high temperatures. However, cabinets repainted with solvent-based paints on-site are highly suspect as contributors to indoor air pollution. Metal cabinets are often criticized as looking old-fashioned, but with the variety of embossed textures and finishes now available, this criticism is probably no longer valid. If a natural look is desired, solid wood drawer and cabinet fronts are available.

A variety of countertop materials are available for all types of cabinets, but most are constructed of plastic laminates over plywood, solid plastic, or stainless steel. Plastic laminates over plywood are inferior because of their tendency to outgas from the plywood and the plastic adhesive, and because they are not very durable. Solid plastic produces much less outgassing but again may not be as durable as required. Stainless steel is superior because it provides a hard, sanitary, inert surface on which to work. (Bower, 285-287) However, stainless steel is significantly more expensive than other alternatives.

Section 2.5 - Spatial Analysis

The form and function of buildings are often analyzed, but the analysis of architectural space is often overlooked. The matter for analysis concerns the structure of space, the sequences and the permeability between one space and others adjacent to it. Architectural space can be analyzed in terms of topological relationships and measured by properties such as 'depth' - that is, the number of layers of space one passes through from the outside of a building to reach an internal location. (Markus, p5) The reverse of this procedure is also applicable.

Spatial analysis has its roots in the views of the philosopher Michel Foucault. Foucault supported the idea of a building as a domain of knowledge, and that buildings were mechanisms in which different forms of power and knowledge masquerade. Foucault also believed a discourse was consitituted by the rules in which spaces are formed and the conditions in which they emerge. (Foucault, 1980, p55-77)

> Once knowledge can be analysed in terms of region, domain, implantation, displacement, transposition, one is able to capture the process by which knowledge functions as a form of power and disseminates the effects of power. (Foucault, 1980, p69)

According to Thomas Markus, a pioneer in the field of spatial analysis, the analysis and mapping of spatial structure in buildings and cities relates directly to characteristic social structures - therefore maps of space are also maps of society.

> A focus on social relationships and the analysis of social structure appear to provide the links between the analyses and aid the discovery of meaning. For this purpose 'social' is used to define three levels of relationship in each of which the self appears directly or by empathy. The first relationship is that of self to self; the relationship which answers the universal questions of 'who am I?', 'where am I going?' and 'what am I becoming?' The second level is that of the relationship of self to others and, hence, others to others. The third level is that of self (or others) to Other - the cosmic order and meaning whose presence is not only at the core of creation stories, philosophical and religious systems...(Markus, p6)

It is not possible to describe all the complexities involved in spatial analysis in the context of this thesis, but essentially it is the mapping of spaces and the linkages between them. Spatial analysis can be performed on towns and buildings, and each has its own methodology. We will focus on spatial analysis of buildings. According to Bill Hillier, in *The Social Logic of Space,* 1984; "A building is therefore at least a domain of knowledge, in the sense that it is a certain spatial ordering of categories, and a domain of control, in the sense that it is a certain ordering of boundaries." (Hillier, p146)

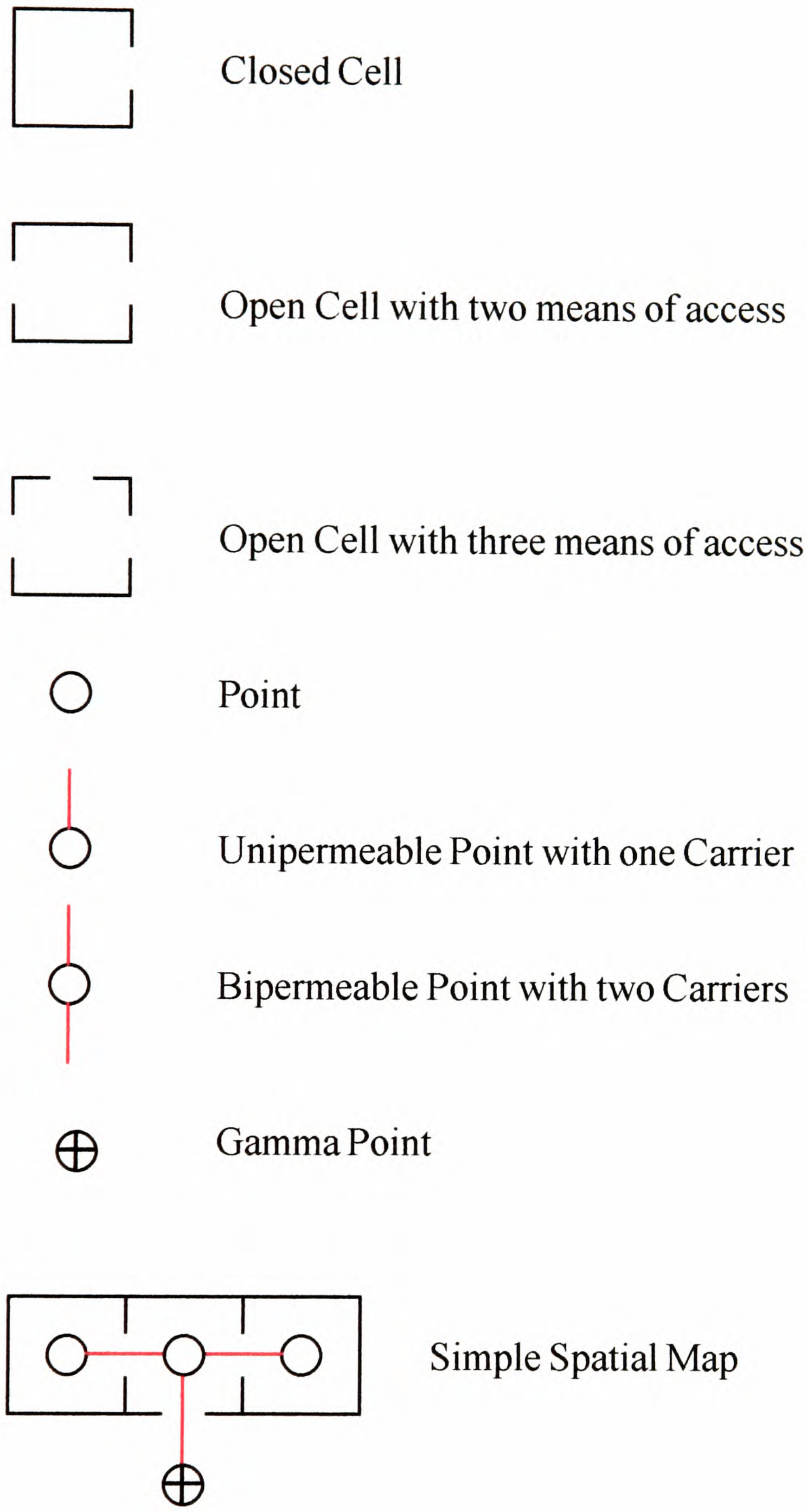
A building especially subject to domains of control and ordering of boundaries is a mental health treatment facility. By performing even the most rudimentary spatial mapping of two typical health care floor plans, we can recognize aspects of social structure. Terms used in the spatial analysis of buildings by Hillier are 'cells,' 'carriers' and 'points.' Cells can be 'closed' or 'open.' Closed cells represent rooms with only one access. Open cells represent rooms with two or more means of access. Points signify that a space is (or can be) occupied. Carriers connect points to each other through the cells. Gamma points indicate points that are considered to be outside the 'gamma.' In this context, outside the 'gamma' can mean outside the building or inside a zone of special significance. (Hillier, p147) These terms are illustrated in figure 2.5.1.

The spatial maps in figure 2.5.2 show a typical racetrack style floor plan and a typical right angle (or cross shaped) floor plan. The racetrack style floor plan has utility and support spaces in the central core, patient rooms along the perimeter, and a dayroom along one side. The cross shaped floor plan has utility and support spaces in one wing, patient rooms in the other three wings, and a dayroom in the center.

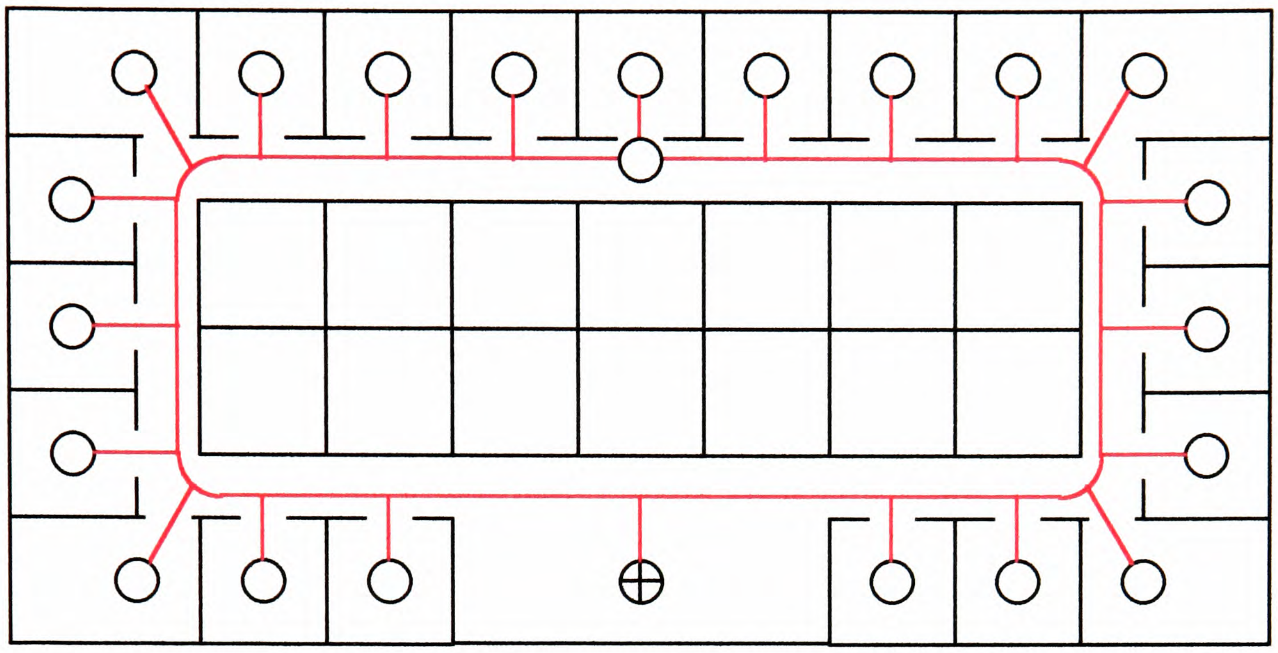
The point in each cell represents a patient in a patient room. Each patient room is a closed cell with only one point of access. The corridors are open cells with numerous means of access. The dayrooms are represented by the gamma cell. In the racetrack style plan the corridor acts as one large open cell, while in the cross shaped plan each of the three small corridors act as an open cell. The closed cells in the racetrack style floor plan are connected to the open cell in an individual manner, while the closed cells in the cross shaped floor plan are attached to the open cells in interconnected clusters.

Now that the floor plans have been described in the nomenclature of spatial analysis, let us attempt an interpretation of the spatial maps. Immediate social interaction in the racetrack style floor plan is limited to the neighboring rooms on either side of a patient room with a long path to the center of social activity in the dayroom. The right angle, or cross shaped floor plan shown in figure 2.5.2 is quite different. Instead of only two immediate social links as in the racetrack style floor plan, the patient rooms have these links and additional links to as many as three other patient rooms across the corridor. These cross connected social links serve to create a small social network in each wing of the facility. These three small social networks converge in the central dayroom. Clearly the cross shaped floor plan offers many more opportunities for social interaction than the race track style floor plan. The racetrack style floor plan actually seems to discourage social interaction.

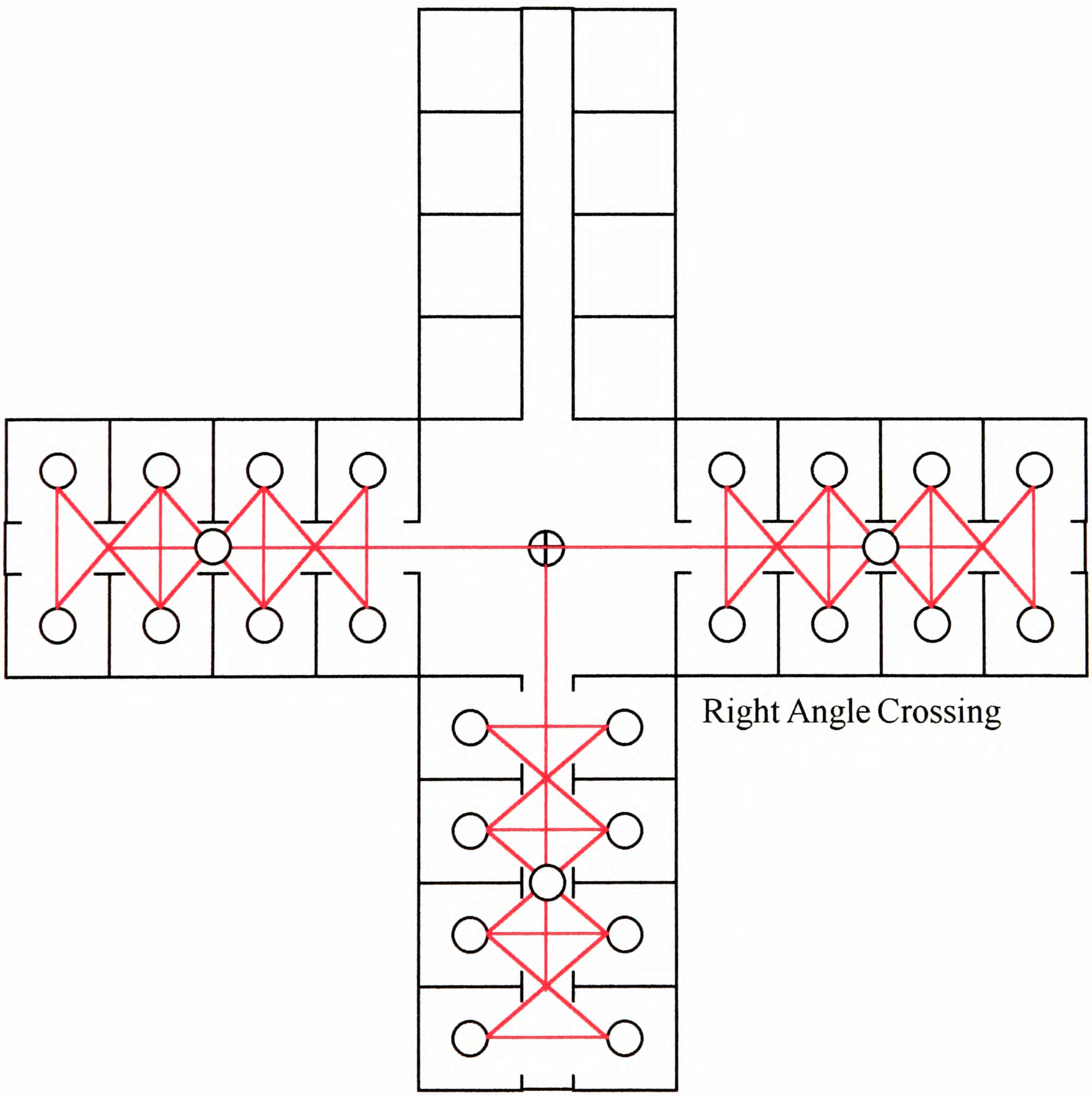
Since the lack of social interaction is a contributing factor toward alienation in institutions, designs such as the racetrack style floor plan should be avoided and designs such as the cross shaped floor plan should be utilized.



Terms used in Spatial Maps of Buildings
Figure 2.5.1



Race Track



Right Angle Crossing

Spatial Maps of Floor Plan Types

Figure 2.5.1

Chapter 3 - The Cognitive Environment

According to environmental psychologists, Stephen and Rachel Kaplan, the person familiar with a setting possesses something useful and valuable. "But what is this 'something'? What does it mean to be familiar?" (Kaplan & Kaplan, 1982, p5)

The Kaplans assert that a person who is familiar with an environment acts as if the essentials of that environment were already "stored in the head." Therefore, being familiar means being less dependent on obtaining new information from the environment. Persons need not pay as close attention, and need not be as sensitive to feedback because they know it is there, and know what to expect. "Decisions can be made without waiting, without careful testing." (Kaplan & Kaplan, 1982, p5)

> Stated simply, a person who is familiar with an environment acts as if there were a model, or map, of the environment stored in the head. This analogy is appealing because models and maps are conveniently compact relative to what they stand for and because they can be manipulated. (Kaplan & Kaplan, 1982, p5)

This idea that people carry bits of code around with them that helps them relate to their environment has definite applications to hospital and clinic way finding and the design of facilities that patients can relate to.

Section 3.1 - Cognitive Mapping and Way Finding

What is Cognitive Mapping?

The modern concept of cognitive mapping has its basis in the work of E.C. Tolman, who theorized how rats learned to map their environments, in the late 1940's. Tolman described the rats as storing environmental cues in the form of a mental representation of their surroundings. (Tolman, 1948, p189-208)

> We believe that in the course of learning a maze something like a field map of the environment gets established in the rat's brain... The central office itself is more like an old-fashioned telephone exchange... The incoming pulses are usually worked over and elaborated in the central control room into a tentative, cognitive-like map of the environment. (Moore & Golledge, 1976, p9)

In this passage, Tolman describes the cognitive or mental map as an internal direction system, but through the subsequent decades the term has increasingly been used to describe the maps produced for urban, geographic, psychological, and social research. Hand drawn cognitive maps have been drawn at a variety of scales, from cognitive maps of a subject's house to cognitive maps of the subject's place in the world. (Gould & White, 1974, p1-10)

Kevin Lynch, an urban researcher, further contributed to the field of cognitive mapping by asking subjects to externalize their internal maps. Tolman's rat research was thus expanded into the human theatre of geographical and environmental perception. Influenced by research conducted by nineteenth - century French architects who asked subjects to draw maps of Paris and identify the most important places, Lynch began experimenting with methods for recording the cognitive maps of research subjects. He found that the most effective way of observing an individual's subjective environmental experience was the most straightforward - to ask the subject to draw a map.

Lynch asked groups of Bostonians to draw maps of Boston, and certain landmarks such as the Revere House, Boston Commons, and the collateral paths between the landmarks were found to be widely known. However, large sectors of Boston turned out to be relatively unrepresented in most of the cognitive maps. Lynch concluded that apparently these areas were not significant to the internal maps of the surveyed Bostonians. (Lynch, 1960, p36)

D. Hooper also applied the same technique to New Yorkers in the late 1960s. He also found that the psychological representations of New York City tended to focus on landmarks with the majority of the city having no cognitive representation in the minds of the inhabitants. (Ittelson, 1973, p25) It appears that based on these studies, landmarks are the key to understanding the cognitive mapping process.

Understanding Cognitive Maps

The results of Lynch's Boston studies, like Hooper's in New York City, also indicate that landmarks are the most important key to understanding cognitive maps. Actually, five keys to interpreting cognitive maps were defined by Lynch: paths, edges, districts, nodes, and landmarks. Paths are defined as major thoroughfares such as streets, riverways, walkways, or corridors. Edges are defined as linear limits of cognitive maps that do not function as a path, for example a wall or a shoreline. Districts are defined as larger section of a cognitive map that have a homogenous character or identifiable characteristics such as building size, architectural style, or distinctive landscape. Nodes are defined as principal points of focus in the environment, usually associated with intersection of major cognitive paths or interruptions in them, such as a downtown square, a traffic circle, or a freeway interchange. Lynch defines landmarks as specific man made or natural features that are used for reference points and which are generally visible from a distance. (Porteous, 1977, p103)

Deviations in Cognitive Maps

Cognitive maps are not perfect cartographic representations of the environment; if they were, they would be of little or no use to the researcher, planner, or designer. That kind of map data is easily available from recorded drawings and other surveyed measurements. It is the distortions in cognitive maps that provide insights into the cognitive perceptions of the environment.

J. Fisher, P. Bell, and A. Baum have defined three standard deviations in cognitive maps. (Fisher, 1984, p31) The first type is the deviation of omission. Minor paths and details are often omitted, and occasionally even large districts and major landmarks are left out. The second type is the deviation of distortion. Portions of cognitive maps may be drawn too close together, too far apart, or improperly aligned. For example, nonparallel paths can be represented as parallel, nonperpendicular paths can be represented as perpendicular, and curved paths can be represented as straight. Distortions can also emerge in scale differences; these scalar differences can sometimes be interpreted as priority differences placed on various parts of the map. For example, areas with which a subject is familiar or which are highly esteemed by the subject may be drawn at a larger scale than less familiar or less esteemed areas. The third type is the deviation of augmentation. Features may be added to a cognitive map that do not exist or have ceased to exist. For example, a subject might draw a nonexistent peninsula on a shoreline, an extra street, or a building that isn't there. Augmentation is common in verbal communication when people refer to their internal cognitive maps. Direction givers, especially the elderly, often refer to landmarks that no longer exist when giving directions.

A fourth deviation not fully described by Fisher and his associates is rectilinear normalization. Christopher Wickens describes rectilinear normalization as the tendency towards mapping along north to south and east to west lines in cognitive maps.

> The strength of the predominant N-S-E-W grid we impose upon our internal representation of geography is sufficiently great that it induces some very systematic biases collectively as our tendency to engage in rectilinear normalization... This cognitive distortion into the rectilinear grid thereby induces consequent errors and distortions in their survey knowledge of the area. (Wickens, 1984, p190)

In a related example, Milgram and Jodelet observe that Parisians tend to force their mental representation of the Seine River into a straight east to west flow which it does not possess. (Wickens, 1984, p 190) Chase and Chi have similar findings based on a study in which subjects were asked to draw maps of Carnegie-Mellon University from memory. The cognitive maps produced in this study all placed nonrectilinear intersections into rectilinear north to south and east to west intersections. Curiously only one group on campus was immune to this rectilinear normalization - the local architects. (Chase & Chi, 1979, p2-9) Howard and Kerst also found that when subjects were asked to recall maps of their campus environment, they tended to misrepresent them as clusters of buildings oriented to the four primary directions. (Howard, 1981, p495-504) There is obviously a tendency among people to interpret their environment along an X-Y axis.

Way Finding Lessons from Cognitive Maps

According to Stephen and Rachel Kaplan, cognitive maps code proximity and distance, order and sequence. Cognitive maps include paths between some things and not others. In these maps there are regions and levels, allowing one to deal with the same domain at different scales. They report -

> ...cognitive maps have a set of relational spatial properties that constitute what we call structure. Spatial information is therefore intrinsic to the cognitive map. Without the relational properties one would be unlikely to anticipate next events and could hardly be surprised at the way the events unfold. A person who is working on a way finding problem and has thereby called up a cognitive map is quite obviously functioning within a spatial framework. (Kaplan & Kaplan, p51)

Way Finding Experiments

Experiments in way finding have been conducted that provide insights to the working of cognitive maps. Behaviorist G.D. Weisman, studying way finding in university buildings, found that the single most effective predictor of disorientation was the structure of the building. Subjects rated geometric patterns that corresponded to the corridor structure of the buildings on a scale of relative simplicity. Then other subjects rated the actual buildings and the buildings corresponding to the patterns rated relatively simple were the least likely to cause disorientation. Weisman also believed that since such overall structures are not something that building users tend to see all at once, that cognitive maps are built over many experiences as well as to the underlying structure that makes learning the cognitive map variably difficult.

Weisman conducted a related study concerning signage. Posted directions providing information would seem intuitively to be an appropriate aid to way finding. On the contrary, Weisman found that the buildings with the most signs were the most likely to cause disorientation. This apparent paradox was resolved when it was revealed that the buildings with the most confusing structures were the ones with the most signs. Apparently, the signs were used in an attempt to compensate for way finding difficulties that were already present. (Weisman, p189)

Recommendations for Improving Way Finding

Based on what we have learned concerning cognitive mapping and way finding the following generalizations can be made.

1. Keep floor plans simple and understandable.

2. Keep signage clear and at a functional minimum.

3. Provide distinct paths through buildings and between buildings.

4. Provide clear limits (edges) to areas within the building, its site, and campus (if applicable).

5. Provide clear directional information at crossings and intersections (nodes). This does not necessarily mean signage. This information can take the form of color, texture, shape, or other discernible features.

6. Divide the site into districts which have identifiable characteristics such as building size, architectural style, or distinctive landscape (if possible).

7. Incorporate existing landmarks or provide new landmarks for points of reference. These landmarks could be unique trees, fountains, sculptures, or other distinctive features.

8. Try to make your building(s) and site features generally conform to an X-Y axis for easy understanding. Understand however that lines need not be absolutely straight. The experience of some buildings and sites is enhanced by curves.

9. Consider using cognitive mapping during the design process to produce a more recognizable building(s) and site, or use cognitive mapping on existing buildings and sites to identify and improve way finding problems.

Section 3.2 - Recognition of Domestic Architecture

The text *Psychiatric Hospitals Viewed by Their Patients*, (Raphael, p2-10) along with my informal interviews with patients suggest that most psychiatric patients do not relate well to hospital environments because these environments do not correspond to their innate sense of what is a comfortable place to live in. The National Health Service in Great Britain also suggests that psychiatric hospitals be designed with a domestic appearance to emulate the architecture of traditional houses. For example, they recommend that these facilities should have pitched roofs. (NHS Estates, 1993, p2-9) Since this relation to domestic architecture is desirable, then what features should psychiatric facilities possess to make them more responsive to the inner needs of patients? What code should be employed to enable patients to recognize their environments?

To address the issues of recognition and symbolism in the built environment, works in symbolic as well as environmental psychology, and architecture are reviewed to determine a direction for the further study of the formal language of buildings.

Precedent in symbolic psychology in the area of the socio-cultural language of form is first explored in Carl Jung's *Memories, Dreams, and Reflections*, 1969. Jung describes the symbolic nature of the house in terms of his own subconscious mind, where psychological trauma in the built environment makes its primary connections. The following is from one of Jung's dream sequences which demonstrates the strong psychological tie to the house.

> I was in a house I did not know, which had two stories. It was 'my house'. I found myself in the upper storey, where there was a kind of salon furnished with fine old pieces in the rococo style. On the walls hung a number of precious old paintings. I wondered that this should be my house, and thought, 'not bad'. But then it occurred to me that I did not know what the lower floor looked like. Descending the stairs, I reached the ground floor. There everything was much older, and I realized this part of the house must date back from about the fifteenth

or sixteenth century. The furnishings were medieval; the floors were of red brick, everywhere it was rather dark. I went from one room to the other thinking, 'now I must really explore the whole house'. I came upon a heavy door and opened it. Beyond it, I discovered a stone stairway that led down to the cellar. Descending again, I found myself in a beautifully vaulted room which looked extremely ancient. Examining the walls, I discovered a layer of brick among the ordinary stone blocks, and chips of brick in the mortar. As soon as I saw this I knew that these walls dated from Roman times. My interest by now was intense. I looked more closely at the floor. It was on stone slabs, and in one I discovered a ring. When I pulled it, the stone slab lifted, and again I saw a stairway of narrow stone steps leading down into the depths. These, too, I descended, and entered a low cave cut into the rock. Thick dust lay on the floor, and in the dust were scattered bones and broken pottery, like remains of a primitive culture. I discovered two human skulls, obviously very old and half disintegrated. Then I awoke. (Jung, 1969, p184)

Jung interpreted this dream as;

> It was plain to me that the house represented a kind of image of the psyche - that is to say, of my then state of consciousness, with hitherto unconscious additions. Consciousness was represented by the salon. it had an inhabited atmosphere, in spite of its antiquated style. The ground floor stood for the first level of the unconscious. The deeper I went, the more alien and the darker the scene became. In the cave, I discovered the remains of a primitive culture, that is the world of the primitive man within myself - a world that can scarcely be reached or illuminated by consciousness. The primitive psyche of man borders on the life of the animal soul, just as the caves of prehistoric times were usually inhabited by animals before man laid claim to them. (Jung, 1969, p183)

Thus, according to Jung, the house is a representation of both your outermost and innermost self. Jung also saw disruptions in the house as reflected in the mind. For example, this dream interpreted by Jung of a Man who had recently faced the death of a close friend; "I was being led through a ruined house by a tall, calm man, dressed all in white. The house was alone in a field, its walls of rubble, the layout and doorways no longer visible. The man led me slowly through the house pointing out how it used to be, where rooms connected, where doorways led to the outside world." (Jung, 1969, 183) Through these initial passages from Jung the bond between the psyche and the house becomes apparent.

Clare Cooper in *The House as the Symbol of the Self*, 1974, expanded upon Jung's work. She suggests that the meaning of the house moves to universal patterns which are not accounted for completely by the theory of an individual unconscious;

> Jung recognized that the more archaic and universal the archetype made manifest the symbol. Since self must be an archetype as archaic as man himself, this may explain the universality of its symbolic form, the house, and the extreme resistance of most people to any change in its basic form. For most people the self is a fragile and vulnerable entity; we wish therefore to envelope ourselves in a symbol-for-self which is familiar, solid, inviolate, unchanging. Small wonder, then that in Anglo-Saxon law it is permissible to kill anyone who breaks and enters your house. A violation of the self (house) is perhaps one of man's most deep seated and universal fears. Similarly the thought of living in a round house or a houseboat or a mobile home is, to most people, as threatening as is the suggestion that they might change their basic self concept. (Cooper, 1974, p 549)

Amos Rapoport parallels these works in *House Form and Culture*, 1969, where the house is presented as the cultural reflection of society. The failing of modern architecture, according to Rapoport is that builders have forgotten the primal man, or that entity described as the subconscious by Jung and the self by Cooper;

> We have seen that some of the dominant characteristics of primitive and vernacular building lose force with the greater institutionalization and specialization of modern life. Our different view of time involving a strong sense of linearity, progress, and historicity, replaces the more cyclic concepts of primitive man. As a result modern man, particularly in the United States, stresses change and novelty as being the essence - a very different situation from that prevailing under the conditions we have been discussing. The clear hierarchy of primitive and vernacular settlements is lost, reflecting the general loss of hierarchies within society, and all buildings tend to have equal prominence. The desanctification of nature has led to the dehumanization of our relationship with the land and the site. (Rapoport, 1969, p360)

The conditions which Rapoport reports relate directly to the lack of recognition in the built environment. Especially disturbing is his suggestion that modern architecture strips away the message from the building and makes specific building types unrecognizable.

This sentiment is echoed by the philosopher, Michel Foucault - "Is it surprising that prisons resemble factories, schools, barracks, hospitals, which all resemble prisons?" (Foucault, 1972, p228)

Rapoport's work also relates to a lecture series given by architectural historian, Mary Alice Dixon Hinson, at the University of North Carolina at Charlotte in 1984. For example, it has been theorized that man's first dwellings evolved from the structures that contained and sanctified the fire. In the primitive man's dwelling, the fire was the physical and symbolic center of the home. When this element is removed and replaced with a television set, much of man's psychological continuity is disrupted. Man's inseparable connection to the magical flickering flame of the primal man is still strong in the twentieth century. During the Boer war and the two world wars, the wives and mothers of British servicemen were told in a popular song to "keep the home fires burning"; suggesting that after the fire is gone, so is much of the spirit of the house.

Joseph Rykwert in *On Adam's House in Paradise*, 1972, has similar views to the other writers in this survey of precedents. Rykwert relates man's desire for the ideal environment to his fascination with the primitive hut. According to Rykwert, man naturally yearns for the home of his ancestors. To illustrate this he describes how the Greeks made their old wooden domestic architecture, which climate had rendered obsolete, into sacred stone architecture. The image of the archaic home went past symbolic significance and assumed a religious significance. (Rykwert, 1972, p72-73) The prevailing theme of Rykwert's work is the psychological connection that people hold toward the homes of their forefathers. Man needs a reflection of the house of the past in his home of the present.

Architect and writer Charles Jencks in *The Architectural Sign*, 1980, contends that many sociological and psychological studies have shown again and again that working class and middle class people dislike the humane and artistic solutions of modern architects. "They find them inhuman and inartistic, to put it charitably, because they don't have the conventional signs of domesticity, protection and identity and because they do signify 'council housing', 'social deprivation', 'estate', 'anonymity', 'the wrong side of the tracks', 'factory', and so forth." (Jencks, 1980, p112)

Architectural Elements and Recognition

Recognition of housing seems to be concentrated in a small number of elements in the house. These elements are roof lines; fireplaces; and screening in the form of porches, stoops or similar devices; and appropriate massing and height. When these elements are not present or are disguised, the occupant has difficulty in associating the structure with the image of house and home. Architectural cognition in the built environment is reinforced when these elements are present and articulated. The preference for domestic environments to institutional environments and these domestic elements should be considered when developing mental health treatment facilities.

<u>Roof Lines: Symbolism and Environmental Psychology</u>

A Pattern Language, 1977, by Christopher Alexander dissects the built environment into a formal language guide, or expressions in form of the symbolic and socio-cultural relationships which have great bearing on the phenomenon of recognition in the built environment. This lexicon of form not only recognizes the ability of architectural elements to influence the occupant, but also gives advice to the designer on how to use these elements to the best advantage.

Alexander contends that "The roof plays a primal role in our lives. The most primitive buildings are nothing but a roof. If the roof is hidden, if its presence cannot be felt around the building, or if it cannot be used, then people will lack a fundamental sense of shelter". (Alexander, 1977, p570) Mr. Alexander also contends that the "psychological sheltering" function cannot be created by a pitched or large roof, which is merely added to the top of an existing structure. The roof only performs its cognitive function if it contains, embraces, covers, and surrounds the process of living. It is believed by Mr. Alexander that the roof must be large and visible to reinforce the psychological and symbolic needs of the occupant, and that it must also include living quarters within its volume, and not merely underneath it. (Alexander, 1977, p 570)

Carl Jung in Dreams, Memories and Reflections, 1969, also believed that the symbolic and cognitive nature of the house must have its roots in the primal interpretation of the house. Anglo-Saxon Americans on the most part relate their house to the house of their ancestors. (Jung, 1969, p183) Looking back to the medieval halls of the Anglo-Saxons, one finds the pitched roof to be the dominant architectural feature, in many examples nearly touching the ground and dwarfing the side walls.

Amos Rapoport in House Form and Culture, 1969, believes that both children and adults naturally have an inclination towards pitched roofs, almost as if they had an archetypal property.

> ...'roof' is a symbol of home, as in the phrase 'a roof over one's head', and its importance has been stressed in a number of studies. In one study, the importance of images - i.e., symbols - for house form is stressed, and the pitched roof is said to be symbolic of shelter while the flat roof is not, and is therefore unacceptable on symbolic grounds. Another study of this subject shows the importance of these aspects in the choice of house form in England, and also shows that the pitched, tile roof is a symbol of security. It is considered, and even shown in a building society advertisement, as an umbrella, and the houses directly reflect this view. (Rapoport, p134)

Rapoport also reveals that in a study of London children that had never lived in anything but high rise housing, when asked to draw the house in which they would like to live, a significant pattern emerged. Invariably the house drawings with pitched roofs outnumbered all other drawings. Despite the fact that these children had never lived in this symbolic environment, they still recognized it before they did their own homes. (Rapoport, p134)

A similar American study reported by George Rand in *Children's Images of Houses* found that both children and adults are very conservative about their images of home and shelter. "Despite 50 years of the flat roofs of the 'modern movement,' people still find the simple pitched roof the most powerful symbol of shelter." (Rand, 1972, p6-9-2 - 6-9-10)

A similar French study conducted by Menie Gregoire in *The Child in the High Rise* reports:

> At Nancy the children from the apartments were asked to draw a house. These children had been born in these isolated apartment slabs which stand up like a house of cards upon an isolated hill. Without exception they each drew a small cottage with two windows and smoke curling up from a chimney on the roof. (Gregoire, p 331-333)

Architect and writer Charles Jencks found collaborating evidence of Gregoire's study in France. In *The Architectural Sign*, Jencks states that many people, including architects, prefer to live in traditional buildings with familiar architectural elements because these old buildings have a wealth of appropriate meaning derived from old, as opposed to new form. He points out that the inhabitants of Le Corbusier's Pessac found that his stark white cubical forms lacked a proper sense of shelter and protectiveness, so they shortened the modern ribbon windows, added shutters and more window mullions; they gave articulation to the blank white surfaces by adding window boxes, cornices and eaves. Some of the residents went so far as to construct the old Bordeaux sign of protection, the pitched roof. (Jencks, p111)

Franklin D. Becker in *Housing Messages*, 1977, finds the pitched roof significant that while the function and role of the house has changed, reflecting changes in family and community structure, the pitched roof has remained a constant symbol. Mr. Becker claims that at least in America, Britain, and much of Western Europe, the pitch of the roof seems to be the crucial symbolic element in the perception of a domestic environment. (Becker, p17)

Roof Lines; Examples in Architecture

The most prominent architect of the twentieth century in America, Frank Lloyd Wright, must have been aware of the pitched roof's importance to the symbolic recognition of the house. Wright made his pitched roofs forceful and strong in all of his domestic compositions. While his contemporaries constructed houses that were more likened to sugar cubes or miniature factories, Wright recognized the need for this symbolic link towards home that the pitched roof provides.

The Robie House, 1908, in Chicago, is probably one of the world's best known and most influential houses. Much has been written about its broad sweeping pitched roof and cantilever system, but little has been written about this house on symbolic grounds. It should be recognized that this house is a distillation of symbolic needs made manifest in form. The pitched roof and the massive fireplace and chimney dominate the scheme. The broad eaves envelope and surround the space; they communicate to the occupant and visitor that this is not only a dynamic building but one of iconic significance. One needs but to glance once at the structure to immediately recognize it as a house.

Glenn Robert Lym, in *A Psychology of Building*, 1980, reveals Wright's personal philosophy towards the pitched roof. According to Lym, the single pitched roof was the symbol of security and unity for Wright. In 1890, the twenty-year old Wright built a small house in the growing, upper middle class Chicago suburb of Oak Park and moved in with his child bride. For almost twenty years this house met the needs of Wright as the symbol of his growing, united family and his prosperous architectural practice. (Lym, p54-55)

However, as Wright became discontent with his family life a new form emerged. The houses he built maintained the gabled appearance of unity on the front, but would erupt into smaller segmented roofs in the rear. This "keeping up of appearances" for Wright by retaining the frontal gable eventually collapsed about the same time he filed for divorce. Wright then saw the house as a form which encouraged family members to be free individuals, each seeking their own destiny and independence. This form culminated in Taliesin, in which the pitched roofs as allusions to independent family members sought their own direction but all came together at the heart of the house. (Lym, p56-58)

The Tucker House, by Venturi and Rauch, in Katonah, New York is another example of architects knowingly placing symbolic elements to enhance recognition. This unusual house, built in 1975, uses an exterior aedicule of a pitched roof house superimposed on the framework of an international style house. (An aedicule is a miniature house, usually with a pitched roof, that is part of an architectural composition.) An enormous pitched roof is also added over the international style structure to overshadow the entire building through its distorted proportions. An additional interior aedicule merges the shape of a traditional house and the fireplace into one element. Venturi and Rauch are expressing the contradictions between modern architecture and the symbolic requirements for housing. This house appears to be a piece of architectural commentary foreshadowing the Postmodernist movement.

The Horizon House, constructed in Philadelphia in the 1970s is an excellent example of a mental health treatment facility which uses its roofline and related elements to promote the appearance of harmony within the community. This two story, gabled roof building with brick walls, arched entrances, and numerous windows fits into its residential context rather than overshadowing it. The arched entrances provide a strong sense of arrival but possess an intimate scale unlike the monumental entrances on many health care facilities. The architect, Francis Kaufman, said "the building was purposely underplayed" to "prevent it from being a discordant element in the area. We wanted people who use the building to feel like people - not patients." (Redstone, p118).

Fireplaces: Symbolism and Environmental Psychology

"No place is more delightful than one's own fireside" said Cicero, the Roman poet, two millennia ago. This statement may still be valid today.

Christopher Alexander in *A Pattern Language*, 1977, contends that "There is no substitute for fire." In elaboration of this point he states that "Television often gives focus to a room, but it is nothing but a feeble substitute for something which is actually alive and flickering within the room. The need of fire is almost as fundamental as the need for water. Fire is an emotional touchstone, comparable to trees, other people, a house, the sky." (Alexander, p389) Although Alexander believes that the fireplace is wholly insufficient in meeting heating needs and controlling temperature in a house, he still believes it to be a vital element of the house due to people's emotional attachment to it.

Gaston Bachelard in *The Psychoanalysis of Fire*, 1964, makes a convincing argument for the necessity of the domestic fire in the following quote:

> The fire confined to the fireplace was no doubt for man the first object of reverie, the symbol of repose, the invitation to repose. One can hardly conceive of a philosophy of repose that would not include a reverie before a flaming log fire. Thus in our opinion, to be deprived of a reverie before a burning fire is to lose the first use and the first truly human use of fire. To be sure, a fire warms us and gives us comfort. But one only becomes aware of this comforting sensation after quite a long period of contemplation of the flames; one only receives comfort from the fire when one leans his elbows on his knees and hold his head in his hands. This attitude comes from the distant past. The child by the fire assumes it naturally. Not for nothing is it the attitude of the thinker. It leads to a very special kind of attention involved in watching or observing. Very rarely is it utilized for any other kind of contemplation. When near the fire, one must be seated; one must rest without sleeping; one must engage in reverie on a specific object... (Bachelard, p14)

Bachelard also suggests that fire can serve as a catharsis for nihilistic emotions:

> But the reverie by the fireside has axes that are more philosophical. Fire is for the man who is contemplating it an example of sudden change ... and an example of a circumstantial development. Less monotonous and less abstract than flowing water, even more quick to grow and change than the young bird, we watch every day in its nest in the bushes, fire suggests the desire to change, to speed up the passage of time, to bring all life to its conclusion, to its hereafter. In these circumstances the reverie becomes truly fascinating and dramatic; it magnifies human destiny; it links the small to the great, the hearth to the volcano, the life of a log to the life of a world. The fascinated individual hears the call of the funeral pyre. For him destruction is more of a change, it is a renewal. (Bachelard, p16)

Franklin D. Becker, in *Housing Messages*, 1977, states that fireplaces are still incorporated into houses because they strengthen the image of home and hearth in houses that might otherwise elicit very few positive responses. (Becker, p17) Becker agrees with Alexander that, while the fireplace and hearth are functionally obsolete because of the advent of modern heating systems, the fireplace is still a valid part of the home because of the psychological associations attached to it. (Becker, p17

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Fireplaces; Examples in Architecture

Again reference must be made to Frank Lloyd Wright and his ability to reinforce recognition in housing. The fire was always the focus of Wright's compositions of domestic architecture. (Walker, p184) The fireplace served as the anchor from which the dynamic forces of the house would spring forth, or alternatively the fireplace and chimney would serve as a spine to which the appendages of the house would be tied - very much the same as the limbs of the human body are connected to the backbone. Wright's fireplaces would be placed in such a way that they were visible from many vantage points inside and outside the house. (Walker, p197) With so much attention and homage paid to the fire, Wright must have recognized its significance in making a house feel a home. Also, the consistent way in which Wright always placed the fireplace at center stage may indicate some formal patterns in which recognition may be strengthened. The pyrocentric house of Frank Lloyd Wright, that being the house with the fire at its heart seems not only to reflect man's psychological needs but man's physiology as well.

Reference again is made to the Tucker house, by Venturi and Rauch in Katonah, New York. In this particular house the fireplace and mantle are so arranged to appear like a house within a house. This aedicule demonstrates the knowledge Venturi and Rauch must have had of the inherent symbolic significance of the house as the container of the fire. As stated earlier, it has been theorized that man's first structures served as shelters for the fire, often of a sacred nature.

Perhaps much of man's psychological necessity for the fire in the home does stem from his primitive past. The necessity of removing the smoke from a shelter necessitated placing the fire at the center of the structure where the smoke might issue from the highest point of the shelter. This is the case in American Indian architecture, where the tipi, hogan, kiva, and many other traditional housing forms shared the distinction of having their fire at the center. it may be that the structural necessity of the pyrocentric house in these cases made the fire a natural setting of ceremony and emotional gathering. Its constant presence to satisfy physical needs may have led to the psychological need that man now has for it. (Walker, p19-37)

Screening; Symbolism and Environmental Psychology

A survey of the following information suggests that screening in from the street in the form of a porch, stoop, or similar device has great impact on the recognition of domestic environments. The psychological and implied physical security which such devices provide is linked to the occupants' total recognition of the domestic environment. These devices have archaic, historical, and modern applications.

Amos Rapoport in *House Form and Culture*, 1969, supports the view that screening devices enhance the recognition of the house. "One could ask whether the definition of territory, which seems basic to the house, makes life easier by giving cues for behavior (the house as a social mechanism), and whether people, like animals, feel more secure and better able to defend themselves on home ground." (Rapoport, p80) According to Rapoport, these screening devices, in the form of porches or stoops, provide visual cues which reinforce the feeling of security within a domestic environment.

Oscar Newman parallels this view in *Defensible Space*, 1972, where he demonstrates that crime is reduced where there is a symbolic progression of symbolic barriers; walls, piers, stoops, hedges, etc. Newman expresses the view that defining zones through screening devices reinforces opportunities for visual surveillance that are recognized by both occupants and potential intruders. (Newman, p64-65)

Christopher Alexander in *A Pattern Language*, 1977, has several views which are pertinent to the role of the porch or stoop as territorial definer which enhances recognition in the built environment. "Buildings, and especially houses, with a graceful transition between the street and inside, are more tranquil than those which open directly off the street." (Alexander, p549) Alexander elaborates on the idea of recognition by describing an experiment in which people were shown photographs and drawings of house entrances with varying degrees of transition, and later asked them which of the images had the most "houseness." He found that the more screening and transitions were evident, the more "houselike" the structure. (Alexander, p550)

Alexander also expresses the following views on the domestic environment and screening:

> "We have within our natures tendencies toward both communality and individuality. A good house supports both kind of experience: the intimacy of a private haven and our participation in a public world. The old front porch, traditional in American society solved this problem perfectly. Where the street is quiet enough and the house in near enough to the street, we cannot imagine a better solution." (Alexander, p665)

Screening; Examples in Architecture

Screening elements in the form of porches and stoops have been known as early as Neolithic times. (Newman, p5) A contemporary example of this device can be observed in the mud house of the African Sudan. The device exists simply as a low curved mass in front of the dwelling. It declares simply, but strongly, that this is the point where the territorial prerogatives of the tribe are diminished by the interests of the members of the family unit.

The rural houses of medieval Scandinavia and other parts of northern Europe with similar cultures used an interior screening device rather than an exterior one. Due to the frigid climate, a visitor would enter the house to escape inclement weather, but would venture no further than the first ceiling beam unless invited. This beam, set considerably lower than the rest, effectively screened the private zone.

The Pompeiian street also used a screening device but in a more sophisticated manner. The platform at the entry to each house and the positioning of windows to survey the street entry drew the line between public and private domains, thus reinforcing the Pompeiian's image of his house. (Reed, 1971)

Housing along the streets of eighteenth-century Dutch Town, New York, was also accentuated by the use of screening devices. These houses, typical of their time, defined the personal realm of the house by a simple raised platform with periodic wooden posts. This device at the point where the entry meets the street appears to have enforced the territorial claims involved in housing recognition. (Newman, p7)

Donn Logan and Sam Davis in *Housing and Urbanism*, 1977, has compared the front stoop of the nineteenth-century rowhouse as a reduced version of the front garden. Logan believes that the projecting stair in this tight urban context provided an intermediate zone for interchange. Apparently without this element, the house lacks the same feeling of "houseness" that was described earlier. (Davis, p43) "The front porch or stoop often takes on more significance than it would in the single family house, since it is often the only physical (element) communicating the identity of the household." (Davis, p17)

Massing; Symbolism and Environmental Psychology and Examples in Architecture

A survey of the following information suggests that massing, and gradations in scale have great impact on the recognition of a domestic environment.

Christopher Alexander in *A Pattern Language*, 1977, states that "A building cannot be a human building unless it is a complex of still smaller buildings or smaller parts which manifest its own internal social forces." (Alexander, p469) Alexander believes that a building is the visible, concrete manifestation of a social group or social institution. Since every social institution is composed of smaller groups and affiliations within it, Alexander is of the opinion that a "human" building, that is a building that reflects the social and psychological needs of the occupants, will always reveal itself, not as a monolith, but as a complex of these smaller institutions made manifest and concrete. (Alexander, p469)

Franklin D. Becker, in *Housing Messages*, 1977, has similar thoughts on the context of domestic architecture. Becker is of the opinion that the central image of the free standing unit strongly reinforces the image of home. (Becker, p17) Becker goes on to infer that the rising popularity of the mobile home, rather than apartments in some parts of the United States, may be because of the detached symbolic nature of the mobile home as opposed to the monolithic nature of apartment flats. (Becker, p22)

Oscar Newman in *Defensible Space*, 1972, observed a similar phenomenon among students at Sarah Lawrence College in Bronxville, New York. Newman found that students preferred the dormitories which most closely resembled free standing houses despite the fact they lacked some of the modern conveniences of the modern dormitories. (Newman, p76) Newman believes that the relationship to the old housing form may have contributed to the students' sense of security. While Newman's work is primarily involved in physical security and crime prevention, it becomes clear that the psychological dimension to security is extremely important to the experience of domestic environments. Perhaps the students chose the detached buildings as an echo of their own houses where they were protected as children.

Amos Rapoport in *House Form and Culture*, 1969, relates the American preference for free standing houses to an archaic social myth. Rapoport believes that the free standing house is based on the ideal that a man's home is his castle. The fairly recent American ideal of independence, according to Rapoport, also contributes to this view. (Rapoport, p60-70)

William Michelson in *Most People Don't Want What Architects Want*, 1968, provides additional evidence to support the claim that massing contributes to recognition of domestic environments. By polling seven hundred people at random, he discovered that 85 percent of the total preferred detached units, 66 percent of those not dwelling in detached units actually preferred detached units, and that 98 percent of those currently dwelling in detached units preferred detached units.

In a related note; Humphrey Osmond in *Function as the Basis of Psychiatric Ward Design*, suggests that groups of four to eight people are "especially liable to form beneficial, supportive and constructive relationships, and that these can be enhanced by the presence of a nurse trained in group activity." (Osmond, p564) Such an arrangement of patients and staff could be accomplished by compartmentalizing facilities into smaller, recognizable, constituent parts.

An excellent example of effective building massing in a mental health treatment environment is the Catholic Psychiatric Hospital near Trier, Germany. The hospital is divided into a campus of low-rise gabled buildings clustered in a wooded grove surrounded by agricultural fields. The individual buildings are broken down into smaller masses with roof masses broken down by dormers. The exterior walls of the buildings are further broken down to a smaller, human scale by the juxtaposition of brick and half timbering. The combination of massing, sheltering pitched roofs, materials, and landscaping contribute to produce a very pleasant environment.

An example of poor building massing in a mental health treatment environment is the Air Force Medical Center at Sheppard Air Force Base in Texas. Most of the wards in this 200 bed hospital are devoted to the care of the mentally ill. This seven story building is composed of three large monolithic blocks which collide at right angles with no apparent organization. The continuous bands of windows serve to streamline each block into one large mass rather than break up the building mass (as windows typically do). Large exterior bands of hospital green tile serve to intensify this effect. The facility does not rest on its flat empty site, but rather vertically erupts from the ground. The environment created suggests alienation and depersonalization.

Another example of poor building massing for a psychiatric facility is the Manhattan Rehabilitation Center, designed by Gueron Lapp and Associates in the 1970s. Although this building is only four stories in height, it has a monumental scale because of its blank brick walls, lack of windows, high parapet, massive piers and wide striated concrete bands. The building lacks any concession to human scale. Set in a tight urban setting it appears to be a fortress against New York City. The style in which it is built is commonly called brutalism, and it certainly befits this facility.

Height; Symbolism and Environmental Psychology and Examples in Architecture

According to Rapoport, height is typically used in buildings to signify high status, power, or both. Prior to the development of high-rise buildings, height suggested religion - church spires in towns, cathedral towers in cities, and tall temple complexes in Asia; or height suggested nobility and power - medieval keeps and towers of feudal lords, strongholds and fortresses of warlords, and the elevated houses of high caste families in Asia. (Rapoport, p58 & 107-111) Both of these connotations of height, religious power and the power associated with high status individuals shared a characteristic - most people were afraid of both of them.

An example of a frightening looking psychiatric hospital is Stone House in Dartford, England. Constructed as the London Lunatic Asylum in the mid-nineteenth century, the building's overall height is not so much the problem as its imposing tower. Constructed of gray stone in the castellated style, this tower is visible from a mile away and contributes to the grim scene. The tower also draws undo attention to the facility. Local residents often refer to the tower as "where they keep watch on the nutters." The structure is in fact a water tower, but this otherwise useful feature detracts from the environment of care. This nineteenth-century facility currently provides care to outpatients and a small inpatient population.

Another example of a fear inspiring psychiatric facility is the Buffalo State Hospital built near Buffalo, New York around 1880. This building, designed by H.H. Richardson in his typical "Richardsonian Romanesque" style has twin towers rising over 250 feet (over 75 meters) replete with turrets and spires. These towers rise from the center of the complex and forcefully dominate the five linked pavilions on either side. The building is similar in appearance to the design for London's Royal Courts of Justice, first proposed by Alfred Waterhouse in 1867.

While these towers might be appropriate for a monument glorifying the seat of an empire, they are inappropriate for a building with therapeutic goals.

Tall buildings today are not held in high esteem; they are usually considered to be either corporate buildings or high rise housing, neither of which have positive associations among most people. The high rises of pre-war Europe and America were greeted with great acclaim, but by the 1970's people were extremely dissatisfied. Part of the problem was the idea among post-war planners and architects that if low status people could be put into the kind of buildings that high status people typically occupied, they would begin to behave like high status people. Of course this was nonsense. High rise buildings actually make people's behavior worse in many cases, thus perpetuating the fearful image of old. Compounding the problems of post-war high rise buildings of all types was the bland International Style architecture that obliterated variety and beauty through its conformity. While we are not seeking to develop housing, but rather treatment facilities, they share many of the same problems - especially among long stay patients.

Becker relates that high rise buildings are seen by their occupants as impersonal places that are difficult to form personal attachments to. In many cases it may be difficult or impossible to identify the window(s) of one's own room(s) from the exterior. Becker's studies of high rise housing also suggest that it is more difficult to develop friendships and beneficial social networks in high rise buildings. These feelings of isolation and impersonality also make vandalism much more common in high rise housing. (Becker, p52-60)

Newman's studies of high rise buildings also relate that violence is much more common in and around high rise housing for the poor that it is around low rise housing for the poor because of the lack of personalization, feelings of anomie, and limited opportunities for people to observe interior corridors, entrances and adjacent outdoor spaces. These problems became so pronounced at some buildings, such as the Pruitt-Igoe in St. Louis, Missouri, that they had to be demolished within twenty or so years of their construction. (Newman, p29-78)

Aside from symbolism and negative associations, height in mental health treatment facilities has its own problems. It denies easy patient access to outdoor spaces - in non-smoking buildings this can result in illicit smoking and fires. Additionally patients and staff must either use stairs (typically with poor visibility) or elevators (small constrained spaces) to access outdoor spaces. The "birds eye" view from tall buildings can also be disturbing to some patients. Height also complicates the ability of staff to observe patients. Tall buildings also do not fit into the context of rural or suburban sites more suitable for inpatient mental health treatment facilities.

Recommendations for Recognition

Rooflines: The seemingly overwhelming preference for the pitched roof in domestic architecture suggests that it may be appropriate for mental health treatment facilities as well - especially inpatient facilities where patients are expected to live.

Fireplaces: While there will probably be reservations toward putting a fireplace in a mental health treatment facility, their ability to induce feelings of comfort and calm should not be underestimated. It is possible to acquire or construct tamper proof gas fire enclosures that will present no great risk to patients and staff.

Screening elements are no more difficult to incorporate into mental health treatment facilities than they are into houses and other types of buildings. They appear to make the transition between the interiors and exteriors of buildings more secure.

Massing: The idea of building a campus of smaller buildings rather than a single large building should be considered for both inpatient and outpatient facilities.

Height: While there are no hard and fast rules, based on the inherent problems and negative associations, excessive height should be avoided when developing mental health treatment facilities. While single floor buildings are ideal, two-storey buildings may be workable if they provide easy and safe access to outdoor spaces. While there is always the temptation to take advantage of economies of scale inherent in taller structures, three storey buildings (or greater) seem questionable.

Section 3.3 - Symbolism of Form in Architecture

Psychologist, Olivier Marc, built upon Jung's work on the psychology of dreams and symbols in his *Psychology of the House*, 1977. Marc suggests that we are constantly influenced on a subconscious level by the symbolism present in the form of our built environment. While there are perhaps thousands of potential symbols, obvious and concealed, that might be encountered in a single days experience with buildings, Marc has distilled these symbols down to five basic forms: the circle, square, triangle, cross, and ether (similar in shape to a rain drop). (Marc, p46-118) If a symbolic language of some type exists, perhaps it is possible to communicate through it.

According to environmental behaviorist Amos Rapoport, the use of symbols is a powerful means of nonverbal communication:

> ...symbols communicate, that they are social, that they are related to status and represent the social order and the individual's place in it, are all notions that can be studied in other ways - notably through nonverbal communication. If culture is, indeed, a system of symbols and meanings that form important determinants of action and social action as a *meaningful* activity of human beings, this implies a commonality of understanding, that is, common codes of communication. (Rapoport, p48)

Olivier Marc is not alone in his belief that a small number of simple symbols can be very descriptive and powerful. The seventeenth-century Japanese Zen artist known as Sengai executed a painting he entitled *Universe*; this unique painting included only a circle, a triangle, and a square, each touching the other. The Japanese interpretation of this work is that the circle represents the cosmos which is connected to man (the square), via the triangle (aspiration). The symbol for man in this case carries extra meaning because its rendering is incomplete.

The Five Basic Forms

There are numerous potential meanings ascribed to each of the five basic forms; I will start with those assigned by Marc.

The Circle is described by Marc as being the symbol for the universe or cosmos, and as the symbol for water. (Marc, p 41, 48 & 119) Marc also describes the circle as the symbol for the womb. He suggests that the houses of aboriginal people almost always are built in the form of the circle because of the maternal protection implied in its shape. (Marc, p12) Perhaps, not coincidentally, these round houses or shelters among aboriginal and nomadic peoples are usually the domain of the woman. They are her responsibility to construct and often her property.

Art historian, James Hall, ascribes several meanings associated with circles. For example, the circle can be seen as symbolic of the temple of a pagan god or goddess, especially in Italian paintings from the sixteenth-century. These temples are often painted as a round building, the pillars forming a circular colonnade which supports a domed roof. In the renaissance, the circle and sphere were looked upon as symbols of perfection and their concept of god. For example, the Holy Trinity is still depicted as three interconnected circles. God was seen as the cosmic mind which took the form of a sphere containing the whole universe - spirit, mind and matter. The circle was also used during the renaissance as the representation of heaven as concentric choirs of angels. (Hall, p297)

W.R. Lethaby, in *Architecture; Mysticism and Myth*, 1890, ascribed several other meanings associated with circles. In classical times, the circle was considered symbolic of the cosmos, and men sought to relate their temples to the cosmos by means of a circular plan or spherical section. (Lethaby, p43) Good examples of this are the Temple of the Oracle at Delphi and the Pantheon in Rome. Likewise, the ancient Chinese believed that heaven was round while the altar of the earth was square. The sovereigns of the Chan dynasty, 1152 - 250 BC, worshipped in a building which they called the Hall of Light which was built as a square of about 30 meters (110 feet) by 30 meters at the base to represent the earth, and surmounted by a dome to represent the heavens above. (Lethaby, p45)

Likewise, the ancient people of the British Isles worshipped at circular temples such as Stonehenge in which they related the earth to the heavens. Stonehenge is a particularly sophisticated example of this because the structure is also an observatory and an agricultural calendar. The prehistoric people of North America as well as Europe and the British Isles also built circular temple mounds as the vehicle through which the dead would enter the afterlife. The circle was the symbol of fertility, birth and renewal in Europe until the advent of Christianity; this pagan symbol survives until the present day in the form of the Easter egg.

The symbolism of the circle can perhaps be summarized as being associated with the universe's life giving and nurturing natural forces, usually associated with the female among ancient polytheistic peoples and contemporary aboriginal societies, and only recently with the power of a masculine monotheistic God.

<u>The Square</u> is described by Marc as being the symbol for the earth and the symbol for man. (Marc, p44) According to Marc:

> That a square can also be seen as a symbol for the earth is not surprising. The ancients believed the earth was two dimensional with four corners. In the west this flat board of the earth was supported by the titan Atlas, and in the east on the back, or backs - depending on the version, of the giant turtle(s). (Marc, p119)

Plato also considered the cube the symbol for the earth. Plato theorized that there were only five regular elemental solids which could be inscribed within a sphere, with all their apexes touching the sphere, and believed they were the forms of the atoms which produced all things at creation. The tetrahedron was associated with fire, the cube with earth, the octahedron with air, the icosahedron with water, and the dodecahedron with the universe. (Mann, p20-21)

Lethaby also cites the square as the symbol of man's creation - the city -a place distinct from the circular realms of nature. The square was considered the ideal shape for a city by ancients of both the near and the far east. (Lethaby, p63) One of the first references to the ideal city as a square occurs in Chapter 48 of the Old Testament book of Ezekiel. The square city first became widespread in the west with the colonization by the Roman Empire. The Roman legions would typically develop their camps in the shape of a square with streets running north to south and east to west. From these square camps, square cities would often emerge. Lethaby also describes that the square was also symbolic to ancient people of the four compass points - the means with which man related himself to his world. (Lethaby, p54-56) The Ka'ba, also known as the black cube of Mecca, is Islam's holiest site, and has always been considered by the faithful as the place where man (the pilgrim) meets the center of the universe. (Lethaby, p41-42)

The symbolism of the square can perhaps be summarized as being associated with man's perception of his place in the universe, both as terrestrial home and his attempted mastery of it. The square can also be seen as the masculine counterpoint to the more feminine circle.

The Triangle is described by Marc as being the symbol for aspiration, fire and creative power. (Marc, p41 & 119) According to Marc:

> ...in houses drawn by Bambara, Eskimo, Amazonian or Afghan children, the triangle is placed *between* the square, representing the earth, and the disc, representing heaven, in a vertical composition. Here the square stands for the house (do we not talk of the main body of a building?), and the triangle is the roof, uniting the square with the sky. Hence the child will often place a circle on the point of the roof, turning it into a face, and adding arms and legs to make it in his own image. (Marc, p44)

The children's drawings that Marc has studied are not unique to the ethnic groups cited. These drawings of houses seem typical of those I have seen in Europe and North America, with the characteristic square block of the house, a simple triangle for the roof, with a smiling sun above, sometimes with a wisp of smoke curling out of a chimney. I have also observed American children drawing the type of anthropomorphic house figures that Marc describes. It would seem that children in many parts of the world share a common notion of what they believe a house should be, and the form of a triangle figures prominently in this idea.

That Marc might associate the triangle with aspiration is understandable because in many houses, the triangular roof form has an appearance similar to that of an arrow pointed heavenward. The association of the triangle with fire is not as straightforward, but if one considers it, most fires (particularly outdoors) are first built as a triangle before being set alight. The tongues of a flame can also be seen as a triangle.

The concepts of fire and aspiration are linked by many myths, most notably that of Prometheus. In Greek mythology, Prometheus, the son of the titan Iapetus, stole fire from the gods and gave it to mankind. The fire was seen not merely as a natural element but as the divine spark of wisdom that distinguished man from the lesser creatures, the source of his knowledge of the arts and sciences. His punishment from Zeus for this deed was to be chained to a mountain where an eagle would come every day to peck at his liver. (Hall, p254) The concepts of fire and aspiration are still linked today. Examples of this are such phrases as "fire in the belly" and "burning passion."

Fire is used as a symbol for religious passion - for example after the resurrection, Jesus delivered the Holy Ghost unto the apostles in the form of fire. Jehovah is also described in the bible as having a fiery appearance too intense to gaze upon. Jehovah was also believed to communicate to Moses from a burning bush. The triangle as the symbol for fire has been a part of the Judaeo-Christian tradition at least since the time of Solomon. The seal of Solomon, very similar to the star of David, was composed of four interlocking triangles signifying fire, air, water, and earth. The fire triangle, pointing upwards, dominated the symbol. (Mann, p25)

The triangle was used in the renaissance to signify the eye of God. (Hall, p118) This symbol is still used today, the most notable example being the blazing triangular eye of Jehovah at the summit of a great pyramid on the back side of the American one dollar note. The triangle is also used as one of the symbols of the Holy Trinity. (Hall, p308) The triangle also figures powerfully in the religion of the ancient Egyptians and the Indians of pre-Columbian Central America. The Central American pyramid was used as the ceremonial platform used by the priests to worship and make sacrifices (sometimes burnt) to their gods. The Egyptian pyramid was an instrument through which the Pharaoh aspired to enter his afterlife.

The symbolism of the triangle can perhaps be summarized as being associated with man's aspiration to a link to the greater cosmos and his god(s). The symbolism of the triangle as a "divine spark" or fire seems to have a strong relation to the concept of aspiration or desire in religion and mythology.

<u>The Cross</u> is described by Marc as being the symbol for the human condition. (Marc, p48) According to Marc:

> ...we have invested the cross with the drama of our condition through the death of Christ or the crucifixion of al-Hallaj. Thus the cross proclaims the rebirth of mankind, where each man sees the road to individual accomplishment marked according to his cross. Christ proclaimed himself as the second Adam. The first Adam was born with the cross; the second was resurrected through the cross. (Marc, p48)

The cross while usually associated with spiritual redemption or salvation via Christ is also a symbol of man's physical mortality. The markers in Christian cemeteries, especially those for the war dead, usually are inscribed with a cross or the markers are shaped like crosses.

Marc notes that children's drawings of human beings "instinctively" express the human body with the arms extended in the cruciform shape. He also notes that many of the peoples of ancient Europe, among them the Neolithic people of Sweden, drew the human body with a cross imposed on a round torso. (Marc, p46-48) The cross in pre-Christian Europe was a common symbol but it was usually associated with Zeus or Jupiter in the south, Taranus in Celtic Europe, and Thor in Germanic Europe. While most people recognize Zeus and Thor as gods of the storm, invested with the power of thunder and lightning, few are familiar with Taranus, sometimes called Jupiter Taranus. The crosses associated with these gods are the wheels of their divine sky chariots. In this setting the cross is symbolic of a god's power. (Green, p205&225)

The sign of the Ankh from ancient Egypt was very similar to the form of the Latin cross, the only difference being that the head piece was an open loop; this cruciform emblem was the symbol for the soul and life. (Baker, p50) The cross in the time of Moses was a symbol for sacrifice for the Israelites, particularly the mark of animal blood in the form of a cross on the door on the eve of the Passover. (Hall, p78) The cross in the time of Solomon was known as the sign of health and healing. (USA, p9D) This symbol endures as the symbol for the International Red Cross and the symbol for medicine.

The cross has also been a symbol of martial virtues among fighting men since medieval times. Contemporary examples of this are various medals awarded for valor: Great Britain's Victoria Cross, Germany's Iron Cross, America's Distinguished Service Cross, South Vietnam's

Gallantry Cross, the French and Belgian Croix de Guerre, etc. The cross as a symbol for valor seems to relate to Marc's ideas when one considers that valor is not only the manifestation of courage but also of sacrifice.

The cross has been a widespread architectural form since the days of early Christianity. There was also limited incidence of its use in pre-Christian Rome and in the East. Greek and Latin crosses have been interpreted into cruciform floor plans for some of the greatest (and smallest) churches in Christendom. The cruciform floor plan was also used in the design of some of the earliest hospitals in Europe and continues to be used in the design of health care facilities today. While the cross form was (and is) used in hospitals to allow maximum observation of patients, it may have some iconographic value as a symbol for health and healing.

The symbolism of the cross can be summarized as having a duality much like two sides of a coin. While it is associated with the condition of man and his struggle with onerous issues such as his own mortality, the cross can also be seen as a symbol for the redemption and healing of spirit and body.

Ether is described by Marc as being the symbol for the light intangible substance of the universe and God; also as being the symbol for the spiritual things that cannot be known. (Marc, p60-119) Lexicographer Ernest Baker defined the term *ether* as "A fluid of extreme subtlety and elasticity assumed to exist throughout space and between the particles of all substances, forming the medium of transmission of light and heat; the upper air, the higher regions of the sky, the clear sky." Baker defines the term *ethereal* as "Of the nature of ether; resembling celestial ether, light, airy, tenuous, subtle, exquisite, impalpable, spiritual." (Baker, p491-492) These definitions seem consistent with Marc's use of the term.

According to Marc: this symbol, which he draws to resemble the illumination from a single candle or similarly as tear or pear shape, is observable in many forms. For example, the onion domes of the churches of Byzantium and Russia, and the roof shape of temples, shrines and palaces from north Africa, through Arabia, Persia, and India, to beyond Indonesia. Marc believes this form also translates into the church spire throughout the west. (Marc, p60-119) Both of these forms are generally associated with the tallest parts of these buildings which may explain the perceived relationship with "rarefied air."

The Sixth Composite Form

Marc also identified <u>the crossed circle</u> as a composite symbol of great significance. Marc considers the crossed circle the symbol of perfection and also as the symbol for a kind of higher consciousness where man is at peace with himself and the universe. (Marc, p46-119) It appears that Marc was strongly influenced by Jung's writings in developing this assessment -

> So these depths, that layer of utter unconsciousness in our dream, contain at the same time the key to individual completeness and wholeness, in other words to healing. The meaning of 'whole' or 'wholeness' is to make holy or to heal. The descent into the depths will bring healing. It is the way to the total being, to the treasure which suffering mankind is forever seeking, which is hidden in the place guarded by terrible danger. This is the place of primordial unconsciousness and at the same time the place of healing and redemption, because it contains the jewel of wholeness. It is the cave where the dragon of chaos lives and it is also the indestructible city, the magic circle or *temenos*, the sacred precinct where the split-off parts of the personality are united.
>
> The use of a magic circle or mandala, as it is called in the East, for healing purposes is an archetypal idea. When a man is ill the Pueblo Indians of New Mexico make a sand-painting of a mandala with four gates. In the centre of it they build the so called sweat-house or medicine-lodge where the patient has to undergo the sweat-cure. On the floor of the medicine-lodge is painted another magic circle - being thus placed in the centre of the big mandala - and in the midst of it is the bowl with the healing water.
>
> The water symbolizes the entrance to the underworld. The healing process in this ceremony is clearly analogous to the symbolism which we find in the collective

> unconscious. It is the individuation process, and identification, with the totality of the personality, with the self. In Christian symbolism the totality is Christ, and the healing process consists of the imitatio *Christi*. The four gates are replaced by the arms of the cross. (Jung, 1976, p137-138)

Jung goes on to say -

> It is the idea of the magic circle which is drawn round something that has to be prevented from escaping or protected against hostile influences. ...In the east you find the mandala not only as the ground-plan of temples, but as pictures in the temples, or drawn for the day of certain religious festivals. In the very centre of the mandala there is the god, or the symbol of divine energy, the diamond thunderbolt. Round this innermost circle is a cloister with four gates. Then comes a garden, and round this there is another circle which is the outer circumference.
>
> The symbol of the mandala has exactly this meaning of a holy place, a temenos, to protect the centre. And it is a symbol which is one of the most important motifs in the objectivation of unconscious images. It is a means of protecting the centre of the personality from being drawn out and from being influenced from outside. (Jung, 1976, p200-201)

This seems to be a very ancient symbol. Perhaps its oldest incidence is from cave drawings in Bohuslän, Sweden from Neolithic times. (Marc, p 46) Ancient Sanskrit speakers knew this symbol as a round swastika symbolic of good fortune and well-being. (The Nazis also had a round swastika, but it was composed of a double inscribing of the lightning rune *Sig* "sieg/success", and was used as a symbol of victory.) As described earlier, it also appears as the symbol for the sky/storm gods in pre-Christian Europe. The old Celts also knew this figure as Saint Brigid's cross and it was worn for good fortune. This practice continues today, despite the fact that Brigid wasn't a saint at all but an ancient goddess of nature. This symbol appeared on ensigns of the Roman legions after the conversion of Constantine as a combination of the letters Chi and Rho. The crossed circle was also known in medieval times as a symbol for "magick" and alchemy.

The Maya of Central America used this figure to signify the intersection of time and space. This symbol was considered sacred in their calendar based religion. This design occurs in forty of more locations in Central America, particularly in the region of Teotihuacan, and have a basically similar form - a cross shape surrounded by concentric circles. The plans of many Mayan cities/religious complexes are based on this form. (Mann, p70)

The crossed circle is still being used today with mystical connotations. Perhaps the most obvious example is the Celtic or "high" cross. These crosses can be found throughout Brittany, Cornwall, Wales, Ireland, and Scotland, and appeared shortly after the conversion of the Celts in the sixth and seventh-centuries. While many insist that it is symbolic of unity with Christ, it is obviously a reinterpretation of old pagan beliefs and symbolism through a Christian icon. These crosses are still popular for grave markers and are worn as charms by many modern Celts and New Age believers.

The symbolism of the crossed circle can perhaps be summarized as being associated with spiritual perfection through a unity with nature, the cosmos, and supernatural forces. This symbol of unity survives to the present day albeit with a newer Christian interpretation.

Recommendations concerning the use of symbolism are withheld until after the analysis of the survey in the next section.

Section 3.4 - Reactions to Symbolism

The Survey

While Marc offers some compelling ideas concerning the symbolic power of the five basic forms described in the previous chapter (cross, circle, square, triangle, and ether), it would be imprudent to adopt these ideas without testing. Therefore, I developed a questionnaire to test the ability of these forms to communicate abstract ideas. Rather than test all of Marc's stated symbolic meanings of these forms, I elected to test only the one I considered the most abstract - the relationship between the triangle and aspiration. Several questions also pertain to secondary suggested meanings ascribed by Marc to the circle. Most of the questions pertain to symbolic meanings appropriate to the design of mental health treatment facilities. The questionnaire asks the respondent to identify which of the following meanings were suggested by the five basic forms: aspiration, health, healing, unity, completion, confinement, freedom, and comfort. These questions are accompanied by illustrations of each of these forms rendered in a neutral shade of gray.

In order to prepare the respondent for such abstract questions, these questions are preceded by several simple questions where they are shown illustrations of buildings and rooms, and asked which look more comfortable than others. Specifically, respondents are asked about their feelings of comfort towards pitched roofs to flat roofs; buildings constructed of concrete, brick, or stone; and rooms with squared ceilings, round vaulted ceilings, and pitched vaulted ceilings. Respondents are also asked about any feelings of discomfort associated with these buildings and rooms. No weighting of questions or responses were employed in this survey.

To close the questionnaire, respondents are asked whether they prefer horizontally or vertically oriented windows and views, and their preference of fenestrated or unfenestrated windows. Similar to the opening of the questionnaire, I desired to close the questionnaire with some relatively simple questions. Although the opening and closing questions are simple, they are also important to the planning and design of mental health treatment facilities. A copy of the questionnaire is at figure 3.4.1.

This questionnaire was fielded to 25 psychiatric patients, 25 health care providers, and a control group of 25 university students in the United Kingdom. An equivalent sample was surveyed in the United States. The UK psychiatric patients were between the ages of twenty to forty, with 32% female and 68% male. This ratio was similar to the number of females and males institutionalized in the British hospitals I visited. The US psychiatric patients were between the ages of twenty to forty, with 25% female and 75% male. This ratio was also similar to the number of females and males institutionalized in the US hospitals I visited. Although their diagnosis was not disclosed to me, most of the patients surveyed in both countries appeared to be suffering from a depressive disorder. A minority of patients in both countries appeared to be suffering from some form of dissociative disorder.

The UK health care providers were between the ages of twenty to forty, with 72% female and 28% male. This ratio was similar to the number of females and males employed by the British hospitals, clinics and centers I visited. The US health care providers were between the ages of twenty to forty-five, with 42% female and 58% male. This ratio was also similar to the number of females and males employed by the US hospitals and clinics I visisted. The difference between these ratios can probably be explained by the greater number of male nurses in the United States.

The UK students were between the ages of twenty to thirty, with 36% female and 64% male. The US students were between the ages of twenty to thirty, with 38% female and 62% male. These ratios were slightly different from the sex ratios of the University of Greenwich and the University of Texas at Arlington, which both had a ratio of about 50 to 50 when the survey was conducted in 1996. Female students at both locations generally felt less inclined to participate in the survey. Since the sex ratios of the available student samples were similar to the sex ratios of the patient samples, no attempt was made to obtain additional female responses.

Survey Basis

Along with Jung's Symbolic psychology, the survey is also based on the theories of Humanistic and Gestalt psychology. Humanistic therapy is based on the assumption that creating conditions that will allow patients to be comfortable and true to their basic natures will enhance the outcome of therapy, regardless of the method of therapy employed. Such an environment would allow patients to make as many of their own decisions as possible and encourage self-actualization and fulfillment. (Davison, p541) According to Dr. Carl Rogers, a pioneer in humanist therapy:

> People can be understood only from the vantage point of their own perceptions and feelings, that is, from their phenomenological world. To understand individuals, then, we must look at the way they experience events rather than at the events themselves, for each person's phenomenological world is the major determinant of behavior and makes that person unique.
>
> Healthy people are innately good and effective; they become ineffective and disturbed only when faulty learning intervenes.
>
> Healthy people are purposive and goal-oriented; they do not respond passively to the influence of their environment or to their inner drives. They are self directive.

> Therapists should not attempt to manipulate events for the individual; rather they should create conditions that will facilitate independent decision making by the client. When people are not concerned with the evaluations, demands, and preferences of others, their lives are guided by an innate tendency for self-actualization. (Davison, p542)

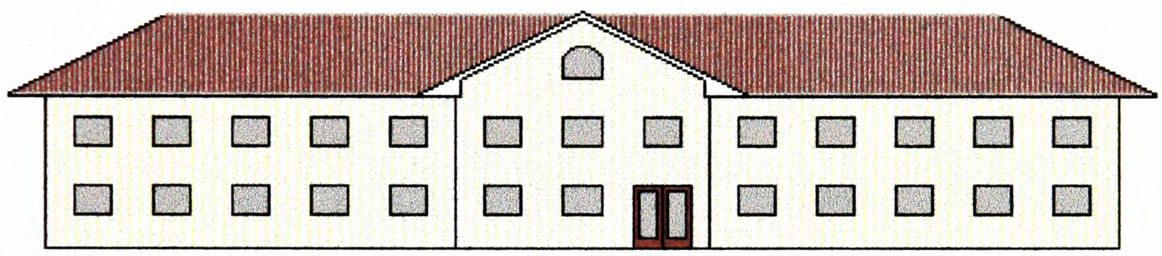
Similarly, Frederich Perls, the progenitor of Gestalt therapy believed that people have an innate goodness and that this basic nature should be allowed to express itself. Gestalt therapists, emphasize the creative and expressive aspects of people, rather than the negative aspects on which psychoanalysts often seem to concentrate. Gestalt therapy draws primarily from Gestalt psychology, a branch of psychology concerned primarily with perception and the concept of wholeness. (Davison, p548) Gestalt psychology asserts that all experience consists of gestalten, integrated structure, and that the response of an organism to a situation is a complete and unanalyzable whole rather than a sum of responses to specific elements in a situation. (Guralnik, p587) Based on these precepts, one can infer that the environment for therapy is nearly as important as the therapy itself.

Questionnaire

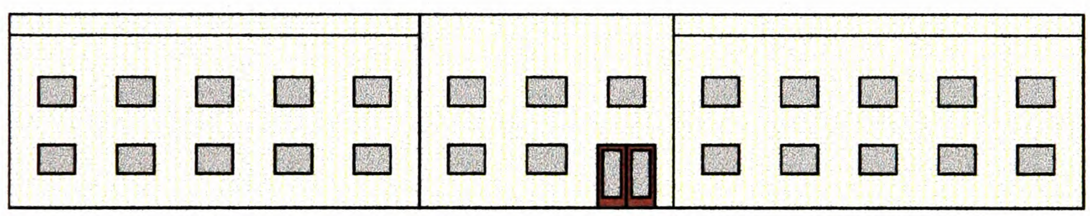
- Page 1 Which building looks more comfortable? _________
- Page 1 Why? ____
- Page 2 Which building looks the most comfortable? _________
- Page 2 Why? ____
- Page 2 Which building looks the least comfortable? _________
- Page 2 Why? ____
- Page 3 Which room looks the most comfortable? __________
- Page 3 Why? ____
- Page 3 Which room looks the least comfortable? __________
- Page 3 Why? ____
- Page 4 Which shape suggests aspiration? _________
- Page 4 Which shape suggests health?_________
- Page 4 Which shape suggests healing? _________
- Page 4 Which shape suggests unity? __________
- Page 4 Which shape suggests completion? __________
- Page 4 Which shape suggests confinement? _________
- Page 4 Which shape suggests freedom? _________
- Page 4 Which shape suggests comfort? _________
- Page 4 What meanings (if any) do you ascribe to these shapes? ________________
  ____
- Page 5 Which window shape do you prefer? _________
- Page 5 Why? ____
- Page 6 Which view do you prefer? _________
- Page 6 Why? ____
- Page 7 Which window layout do you prefer? _________
- Page 7 Why? ____
- Page 8 Which window do you prefer? __________
- Page 8 Why? ____

1

A

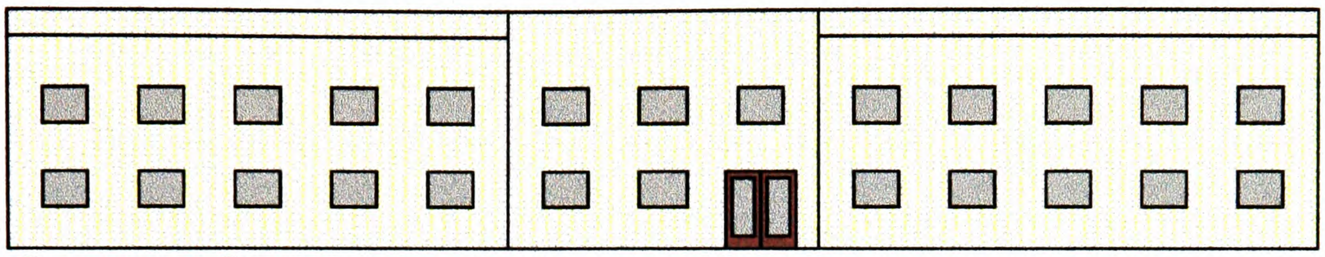


B



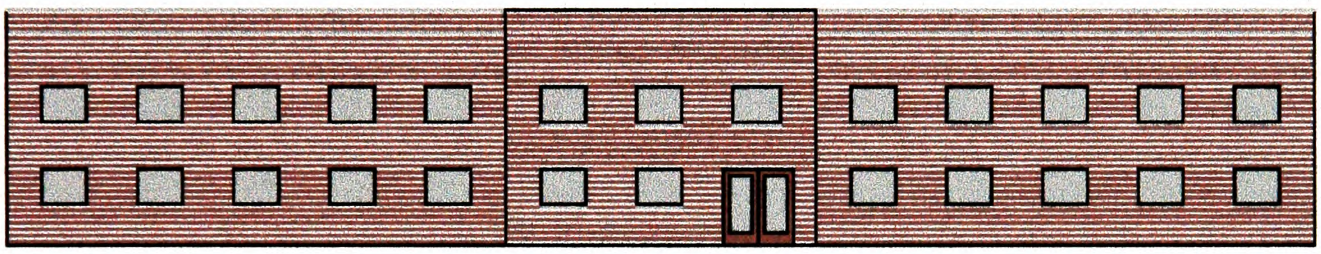
2

A



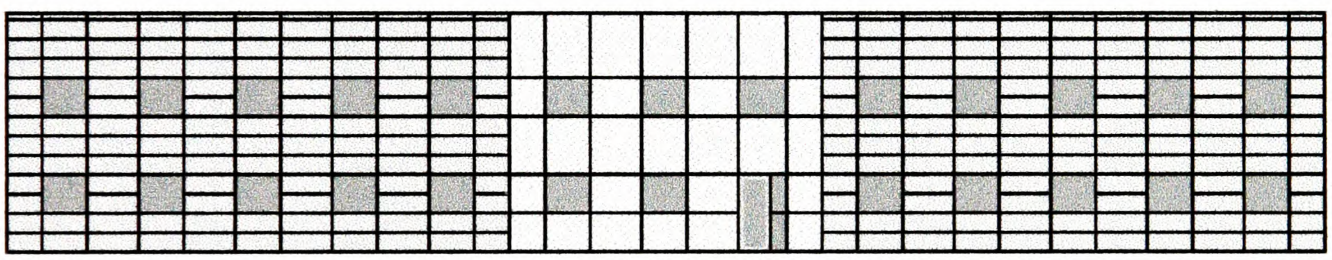
Concrete or Stucco

B



Brick

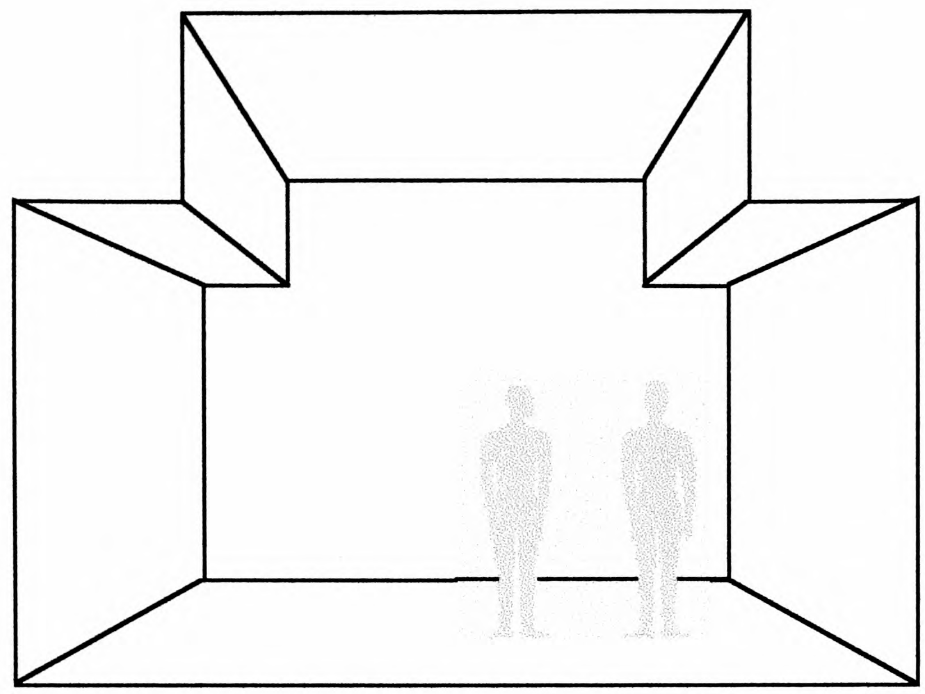
C



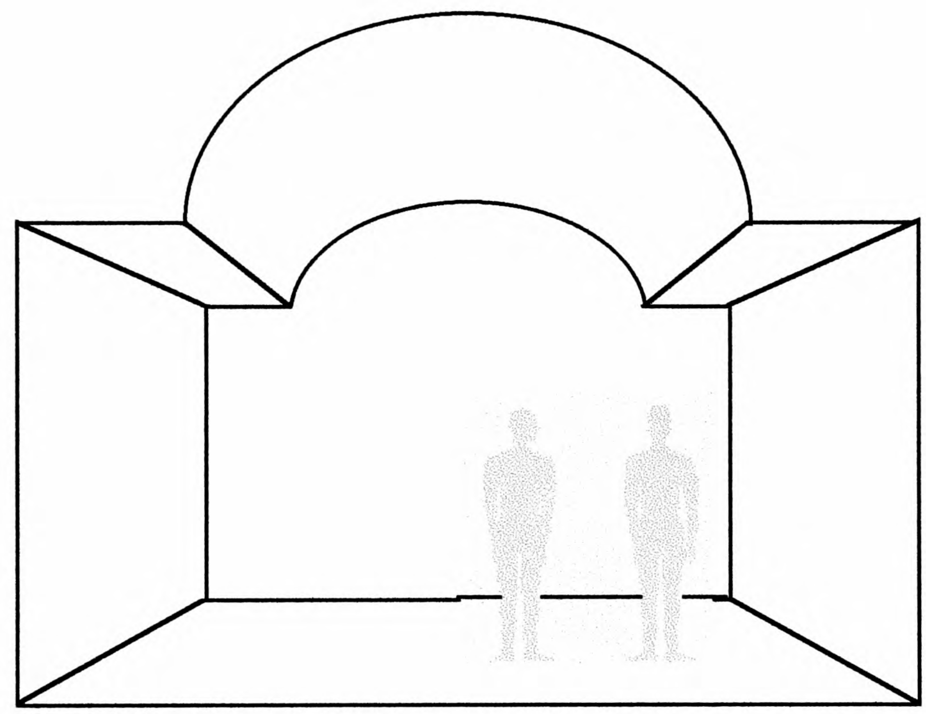
Stone

3

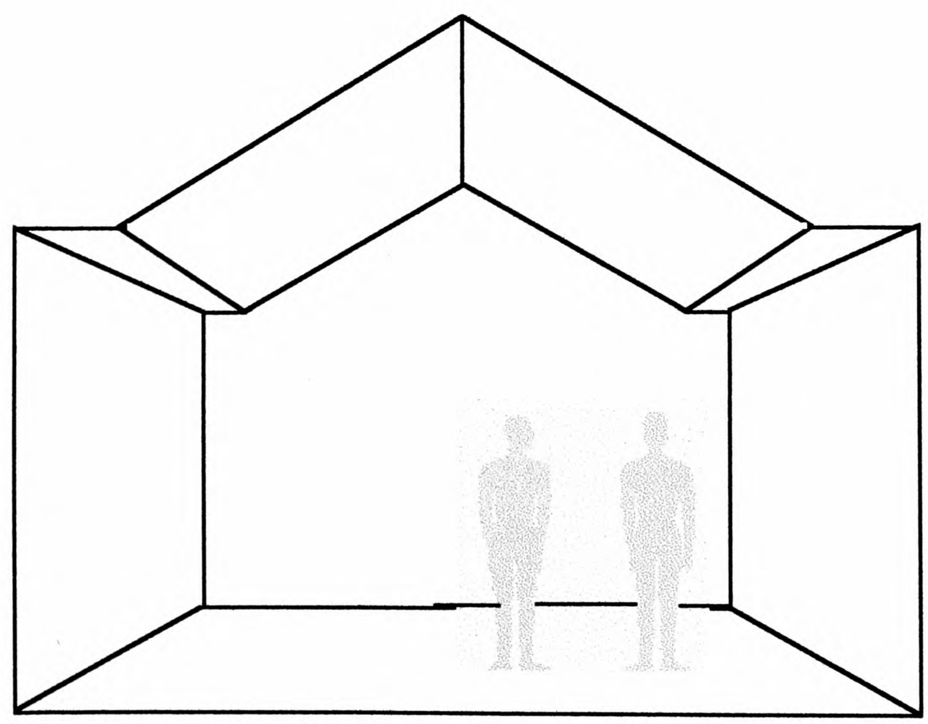
A



B



C



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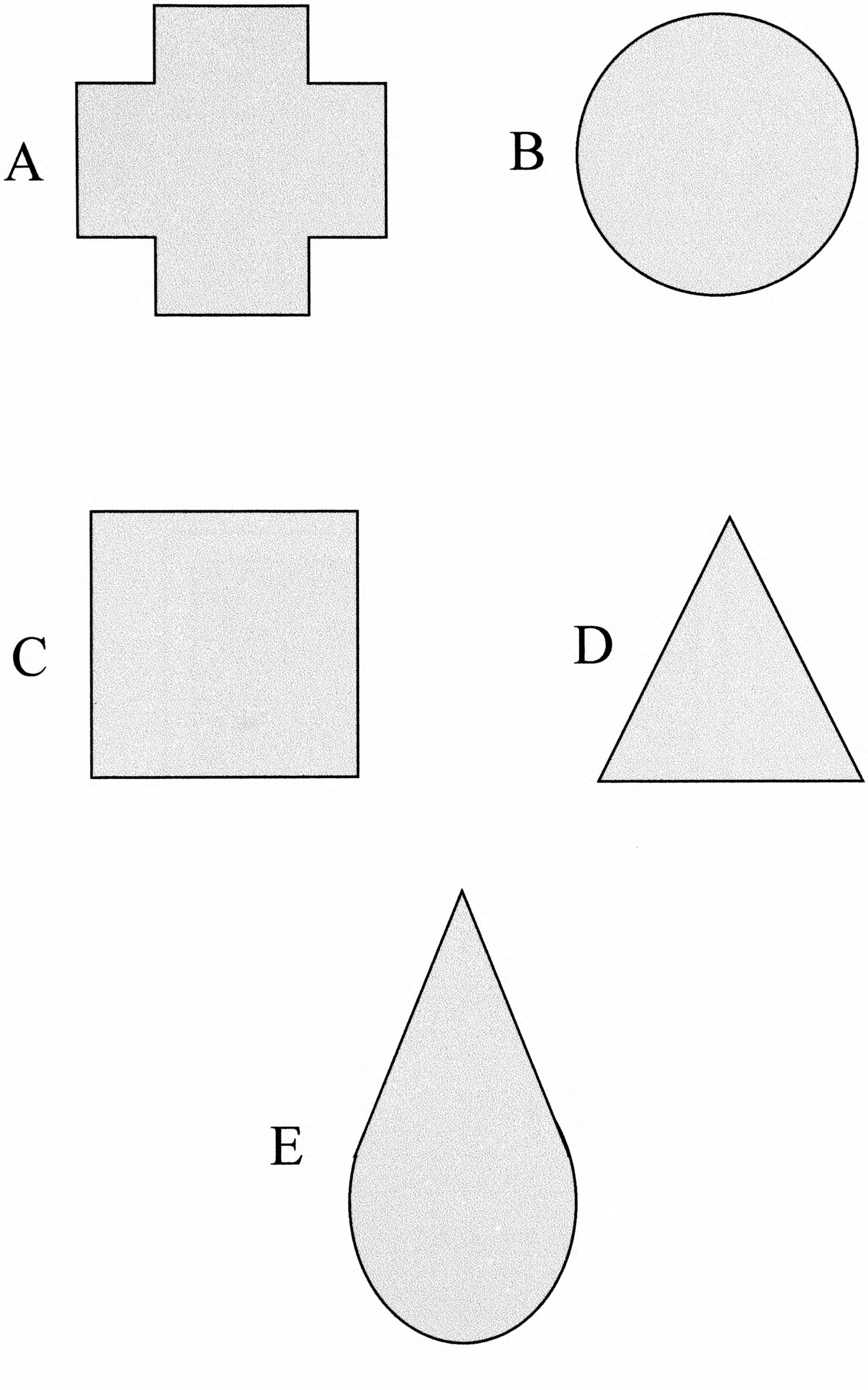
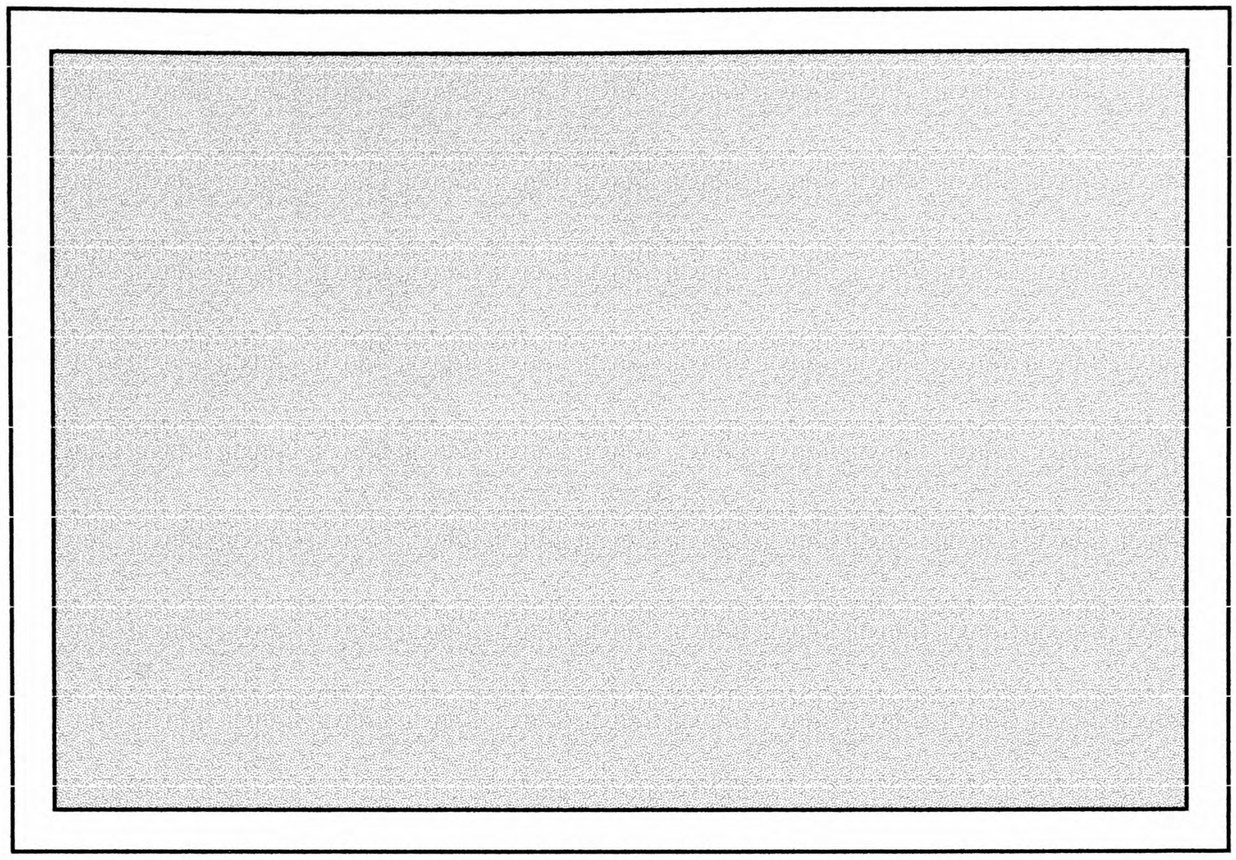
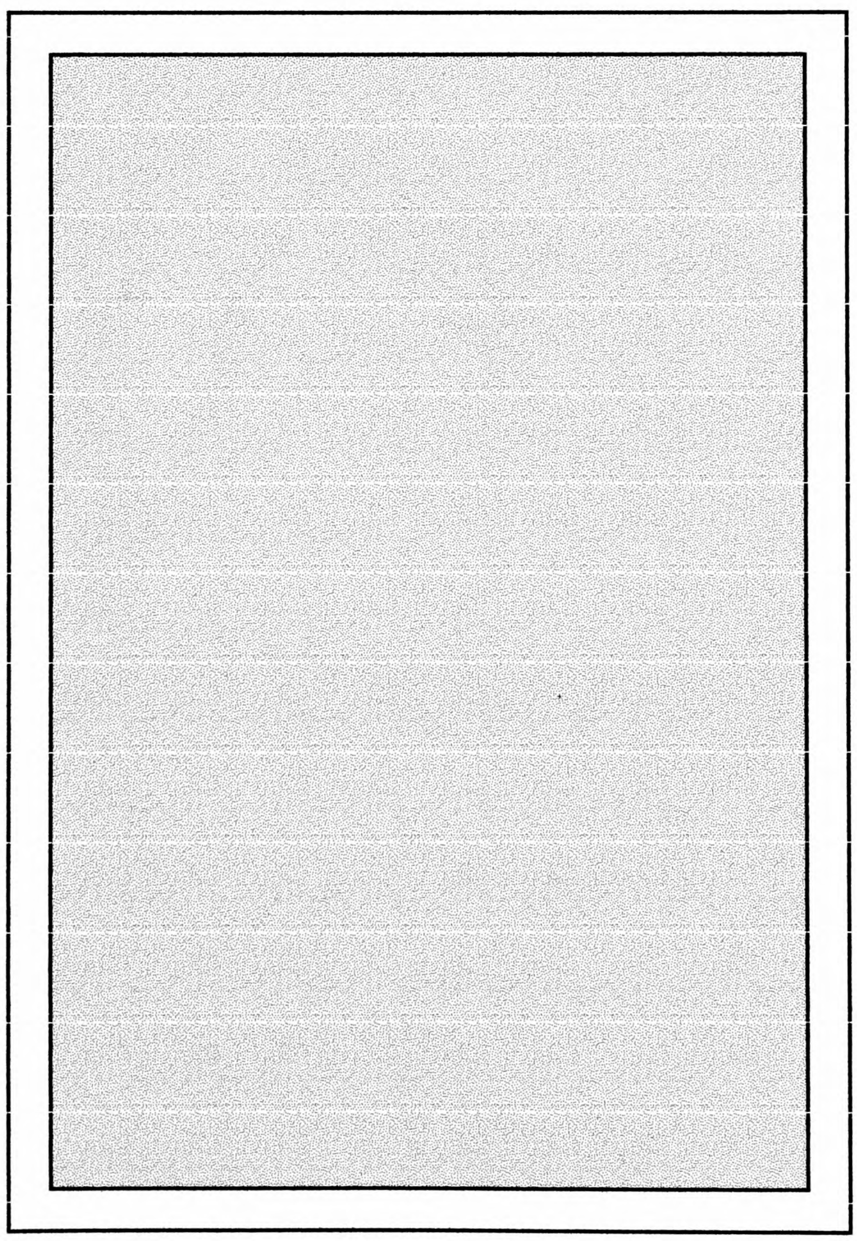


5

A



B



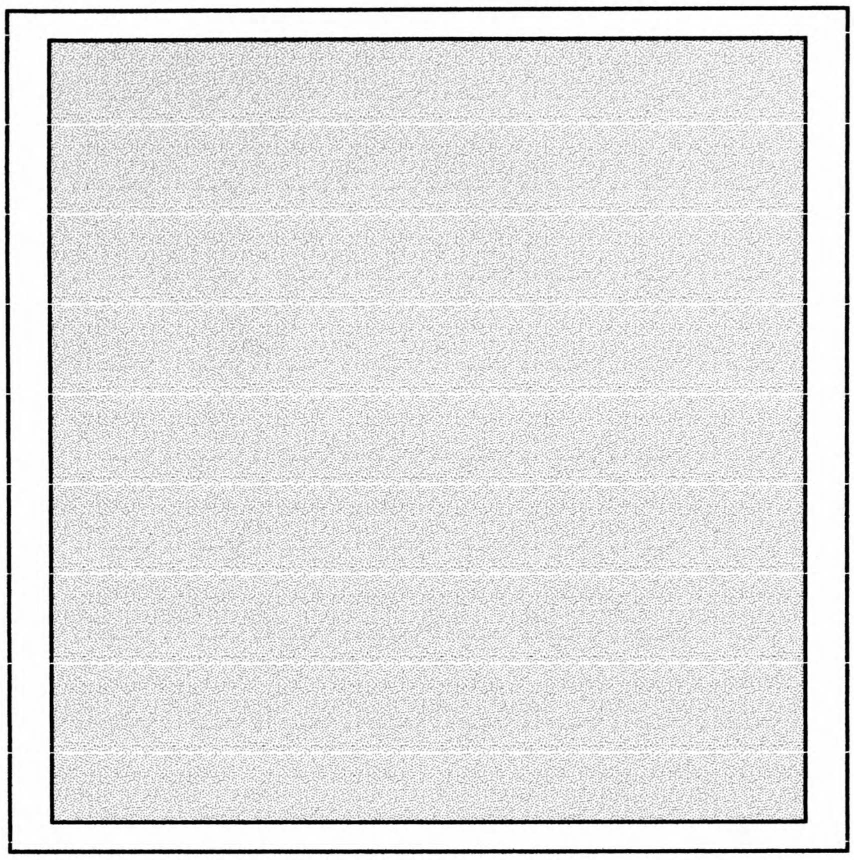
6

A

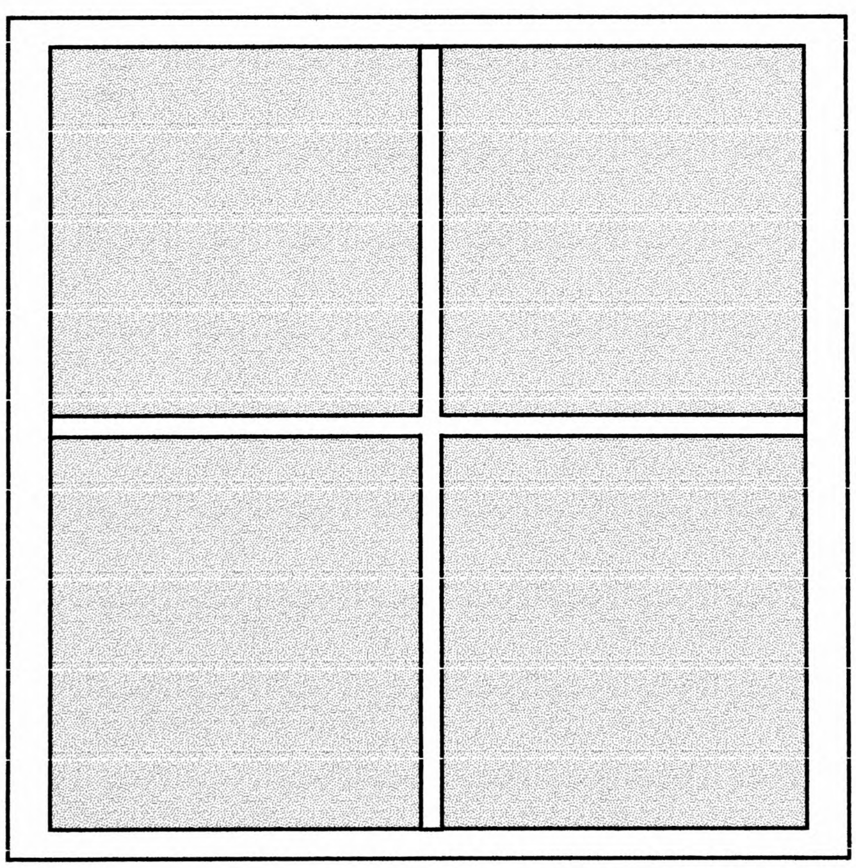
B

7

A

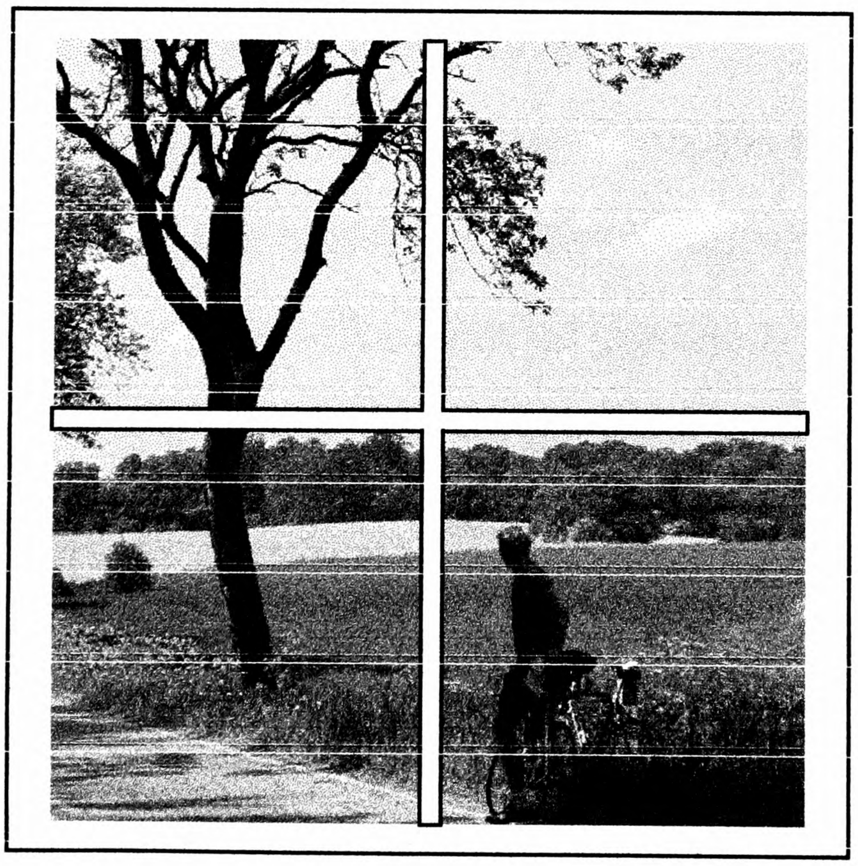


B



A

B



Survey Findings

Roof Types: The survey showed an overwhelming preference among respondents of all groups for the pitched roof building. The belief that the pitched roof building was more comfortable than the flat roofed building was as high as 100% among respondent categories. There was no significant difference in these results among patient, health care provider, student, or national samples of respondents.

Exterior Finish: There was also a strong preference for the brick exterior among respondents of all groups. The belief that the building with the brick exterior was more comfortable than buildings with stone or concrete, stucco, or similar finishes averaged around 70% among respondents. The concrete exterior ran a distant second between 20 and 25%. Respondents generally replied that the brick building had warmer appearance than the other alternatives. There was no significant difference in these results among patient, health care provider, student, or national samples of respondents.

There was also a corresponding belief among respondents of all groups that the building with the stone exterior was less comfortable than buildings with brick or concrete, stucco, or similar finishes. This belief was held by 68% of respondents. The only significant variance among respondent groups was the finding among US university students that the concrete or stucco exterior was considered nearly an uncomfortable as the stone exterior.

There was some concern that the survey respondents might be reacting to the color of the materials in the illustrations instead of giving their overall assessment of the materials. To test this premise, a separate survey was conducted without illustrations. This survey was administered to 51 residents of Southeast London (Blackheath) and 100 residents of Fort Worth, Texas. Approximately 59% of the Blackheath respondents indicated that brick was more suggestive of comfort, with 41% indicating the same belief about stone. None of the Blackheath residents considered concrete suggestive of comfort. 58% of the Fort Worth residents indicated that brick was more suggestive of comfort, with 39% indicating the same belief about stone. Only 3% of the Fort Worth residents considered concrete suggestive of comfort. When residents of both Blackheath and Fort Worth were asked why brick was more suggestive of comfort, the usual responses were that brick was considered warmer than stone (both in feeling and in color).

While the second survey suggests that the color illustrations of the first survey may have produced a slight influence on the results, it showed that a majority of the survey participants found brick to be more suggestive of comfort.

Room Comfort: The survey showed an overwhelming preference among respondents of all groups for the round vaulted room. The belief that the round vaulted room was more comfortable than the squared and pitch vaulted rooms averaged 83% among UK respondents and 72% among US respondents. The only significant difference among respondent groups was that Americans at 23% were much more accepting of the pitch vaulted rooms than Britons at 8%.

The survey showed a distinct distaste among respondents of all groups for the squared room. 71% of respondents believed the squared room to be less comfortable than other alternatives. There was no significant difference in these results among patient, health care provider, student, or national samples of respondents.

Suggestion of Aspiration: A plurality of respondents, 38% among Britons and 44% among Americans, found that the triangle suggested aspiration. The ether shape ran a close second at 36% among Britons and 27% among Americans. The similarity of these shapes may contribute to the similarity of the findings. The only significant difference among respondent groups was that the British patients found the ether shape to suggest aspiration.

<u>Suggestion of Health and Healing</u>: A majority of respondents, 86% among Americans and 72% among Britons, found that the cross suggested health. The circle ran a distant second at 10% among Americans and 19% among Britons. There was no significant difference in these results among patient, health care provider, student, or national samples of respondents.

A majority of respondents, 59% among Americans and 54% among Britons, also found that the cross suggested healing. Again the circle ran a distant second at 8% among Americans and 24% among Britons. The only anomaly among respondent groups was that the American patients found the triangle equally as representative of healing as the circle at 43% each.

<u>Suggestion of Unity</u>: A majority of respondents, 64% among Britons and 71% among Americans, found that the circle suggested unity. There was no consistent secondary preference for other shapes. There was no significant difference in these results among patient, health care provider, student, or national samples of respondents.

<u>Suggestion of Completion</u>: A majority of US respondents (54%) and a plurality of UK respondents (42%) found that the circle suggested completion. The square ran a close second among UK respondents (40%) and a distant second among US respondents (32%). The only anomaly among respondent groups was that the British patients found the square more suggestive of completion (46%) than the circle (37%).

<u>Suggestion of Confinement and Freedom</u>: A majority of US respondents (63%) and a plurality of UK respondents (43%) found that the square suggested confinement. The triangle ran a distant second among US respondents (17%) and a close second among UK respondents

(39%). Again, the only anomaly among respondent groups was that the British patients found the triangle more suggestive of confinement (46%) than the square (37%). Both of these shapes were identified by respondents as being hard or closed.

A plurality of US respondents (32%) found that the ether shape suggested freedom, with the circle following at 21%. A plurality of UK respondents (34%) found that the circle suggested freedom, with the ether shape following at 30%. The only deviation from these trends was among American psychiatric patients - a plurality of whom found the triangle (44%) most suggestive of freedom with the circle following at 28%.

Suggestion of Comfort: A majority of respondents, 56% among Britons and 52% among Americans, found that the circle suggested comfort. The ether shape was secondary preference at about 25% for both national groups. The only deviation from this trend was among American students - who found the circle most suggestive of comfort (67%) with the triangle as their secondary preference (25%).

Window Preferences: A majority of respondents, 75% among Britons and 84% among Americans, found the horizontal window shape more appealing than the equal sized vertical window. This finding was consistent among all respondent groups and especially pronounced among American psychiatric patients (100%). When a pleasant pastoral view was added to the window, the preference for the horizontal shape rose to 91% among Britons and 89% among Americans. Curiously enough, this gain was achieved by merely using a black and white image. Again, this finding was consistent among all respondent groups and especially pronounced among American psychiatric patients (100%).

The survey found that a majority of Americans (68%) and Britons (53%) preferred the unfenestrated window to the fenestrated window. This finding is consistent with all respondent groups except for British health care providers - 56% of whom found the fenestrated window more appealing. The researcher had experienced some concern that patients might find the fenestration suggestive of bars or restraints, but there was no suggestion of this from the survey. When a pleasant pastoral view was added to the window, the preference for the unfenestrated window rose to 83% among Americans and 69% among Britons. This finding was consistent among all respondent groups including the British health care providers.

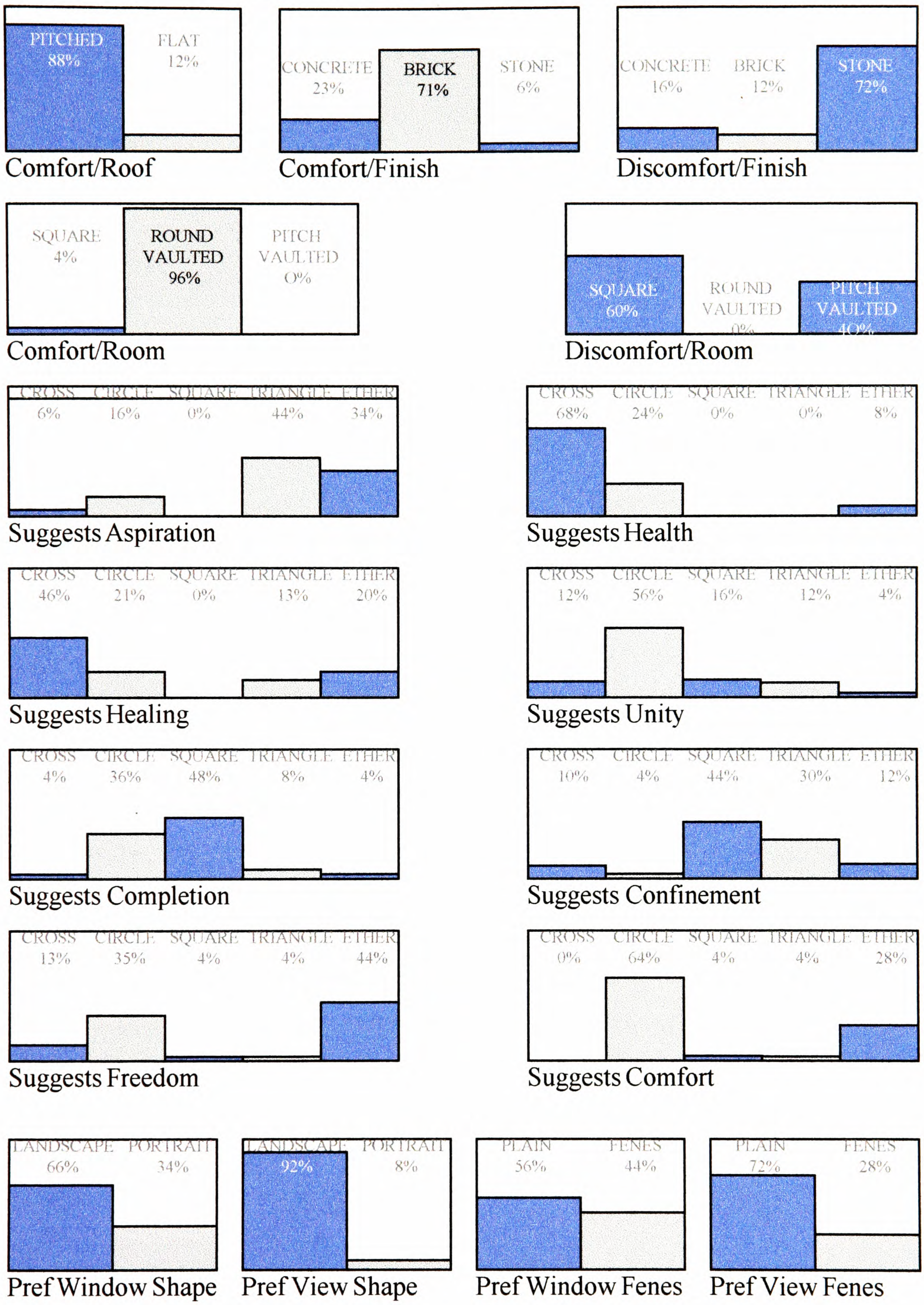
Correlations: While the majority of respondents believed the round vaulted ceiling most suggestive of comfort, individuals within this group also had consistently similar responses to other portions of the survey. Analysis of the survey results indicates a strong correlation between individual perceptions of the round vaulted ceiling, the pitched roof, the brick exterior, and the circle.

Among British students believing the round vaulted ceiling most suggestive of comfort, 88% found the pitched roof most suggestive of comfort, 71% found the brick exterior most suggestive of comfort, and 63% had the same belief about the circular shape. Among the British health care providers expressing the belief that the round vaulted ceiling was most suggestive of comfort, 100% believed the pitched roof to be most suggestive of comfort, 84% believed the brick exterior to be most suggestive of comfort, and 63% had the same belief about the circular shape. Among the British patients that believed the round vaulted ceiling was most suggestive of comfort, 100% found the pitched roof most suggestive of comfort, 83% found the brick exterior most suggestive of comfort, and 50% expressed this belief about the circular form.

Among American students believing the round vaulted ceiling most suggestive of comfort, 100% found the pitched roof most suggestive of comfort, 83% found the brick exterior most suggestive of comfort, and 81% had the same belief about the circular shape. Among the American health care providers expressing the belief that the round vaulted ceiling was most suggestive of comfort, 100% believed the pitched roof to be most suggestive of comfort, 50% believed the brick exterior to be most suggestive of comfort, and 43% had the same belief about the circular shape. Among the American patients that believed the round vaulted ceiling was most suggestive of comfort, 100% found the pitched roof most suggestive of comfort, 71% found the brick exterior most suggestive of comfort, and 43% expressed this belief about the circular form.

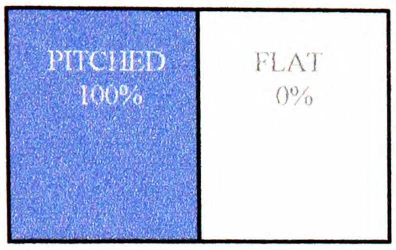
Sex Differences: Although a variety of minor sex differences were found in the survey responses, none were consistent across the six groups polled. For example; among U.K. patients, 56% of males and 22% of females found the circle suggestive of comfort. Among U.K. health care providers, a near parity of 57% of males and 61% of females found the circle suggestive of comfort. Similarly, among U.K. students, 63% of males and 67% of females shared this opinion. Among U.S. providers, 57% of males and 44% of females found the circle suggestive of comfort. Among U.S. students, 60% of males and 71% of females believed the circle to be suggestive of comfort. Among U.S. patients, 41% of males and 67% of females found the circle suggestive of comfort. Aside from such minor variations (of which this was the most pronounced example) no notable and consistent sex differences were found in survey responses.

UK UNIVERSITY STUDENTS

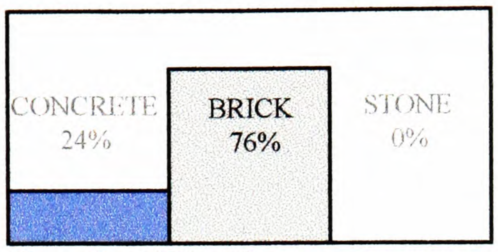


Detailed Tabulation - Figure 3.4.2

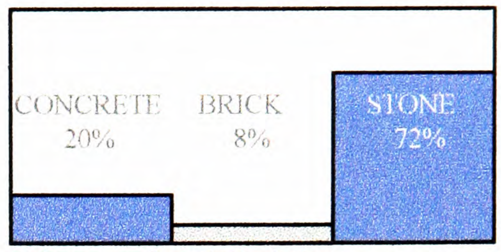
UK HEALTH CARE PROVIDERS



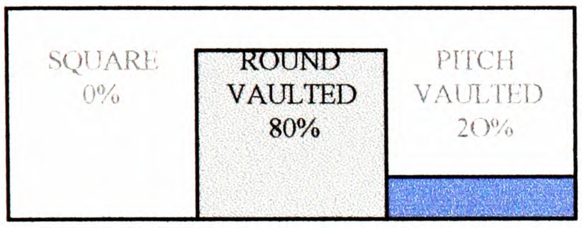
Comfort/Roof



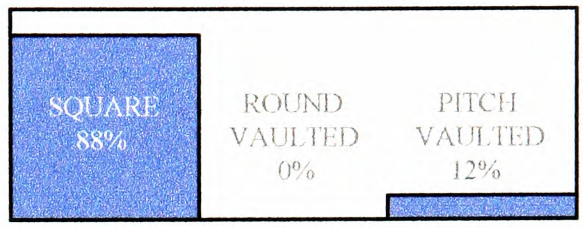
Comfort/Finish



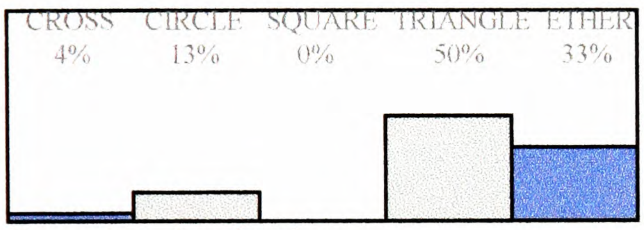
Discomfort/Finish



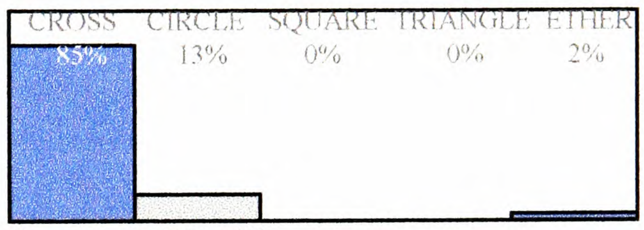
Comfort/Room



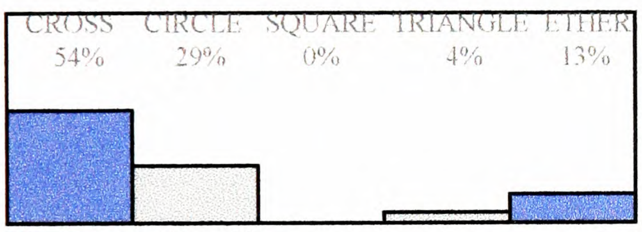
Discomfort/Room



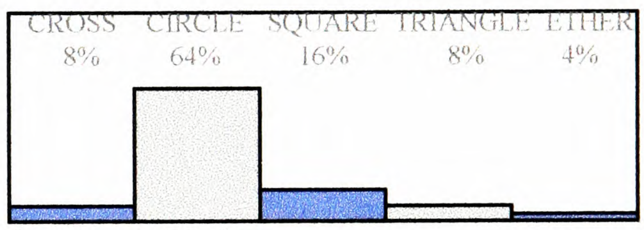
Suggests Aspiration



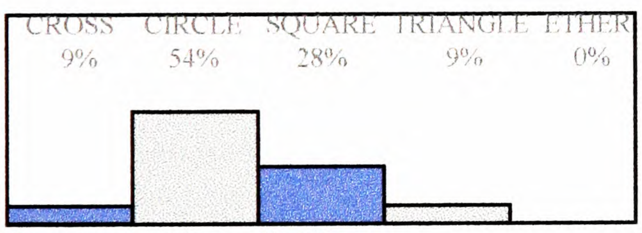
Suggests Health



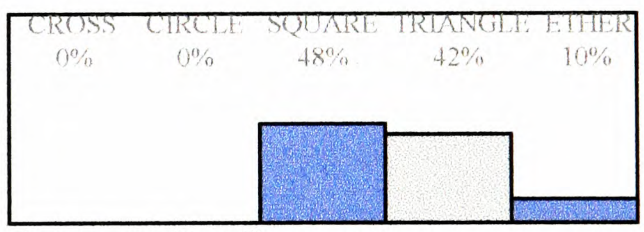
Suggests Healing



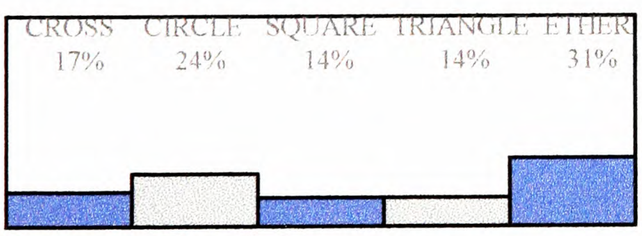
Suggests Unity



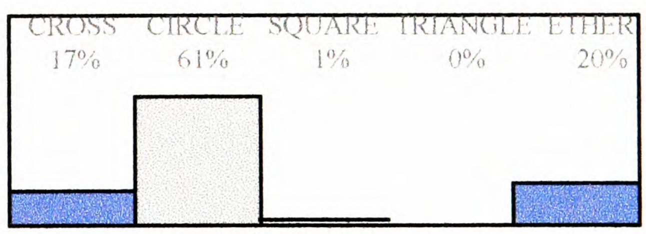
Suggests Completion



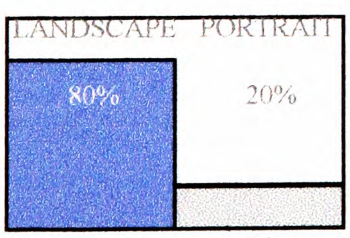
Suggests Confinement



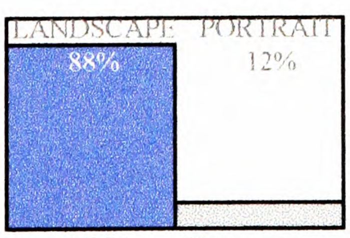
Suggests Freedom



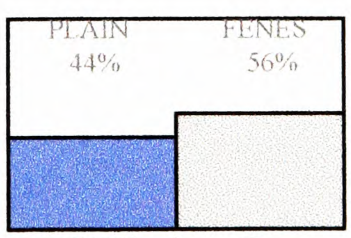
Suggests Comfort



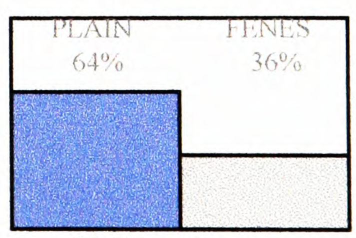
Pref Window Shape



Pref View Shape

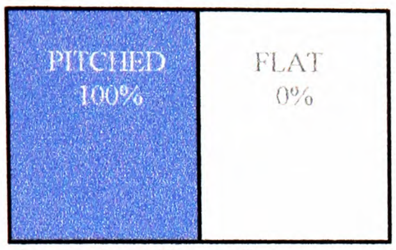


Pref Window Fenes

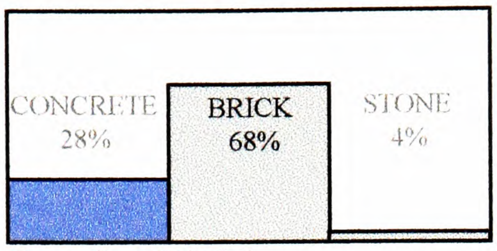


Pref View Fenes

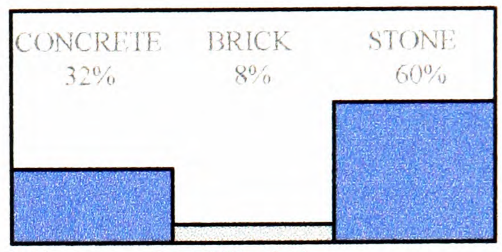
UK PSYCHIATRIC PATIENTS



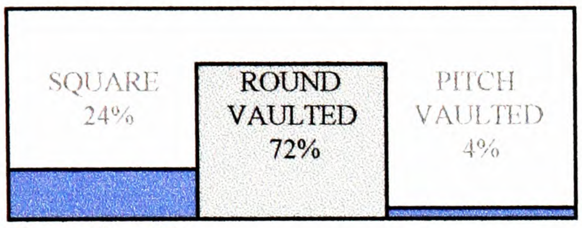
Comfort/Roof



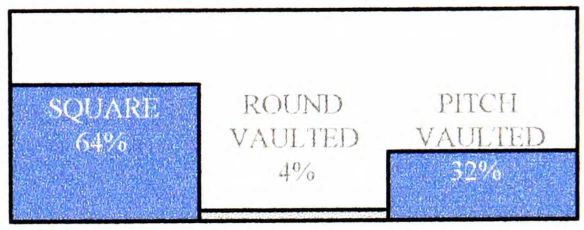
Comfort/Finish



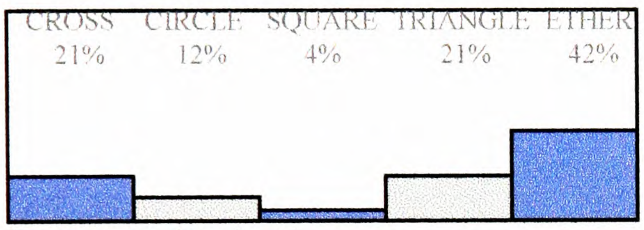
Discomfort/Finish



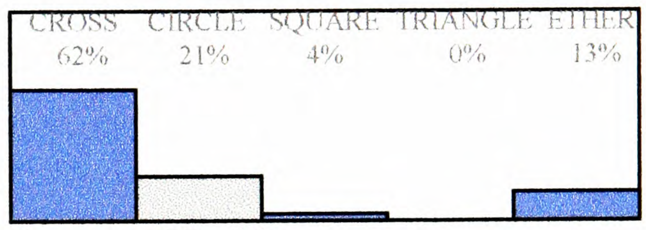
Comfort/Room



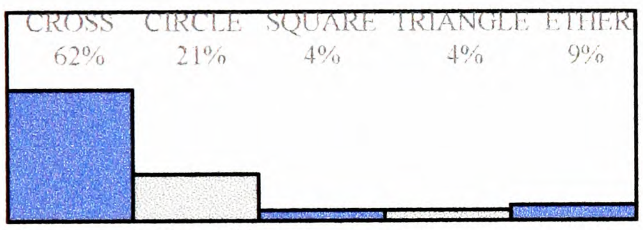
Discomfort/Room



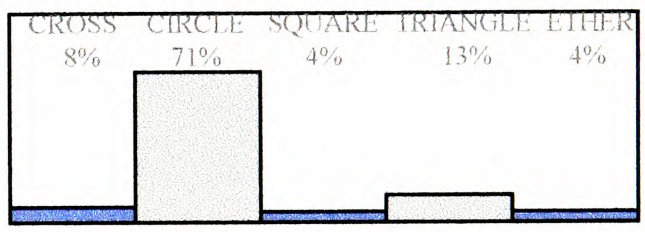
Suggests Aspiration



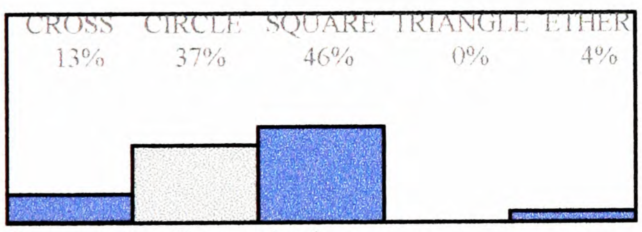
Suggests Health



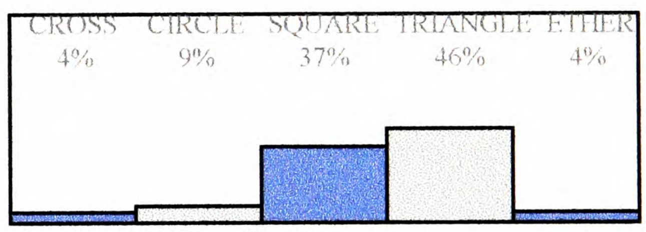
Suggests Healing



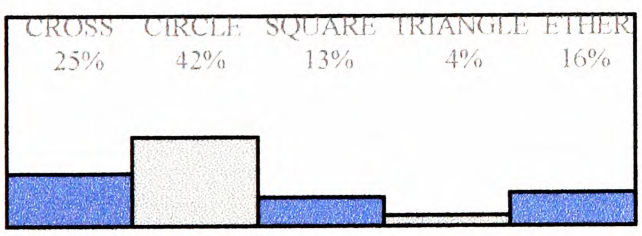
Suggests Unity



Suggests Completion



Suggests Confinement



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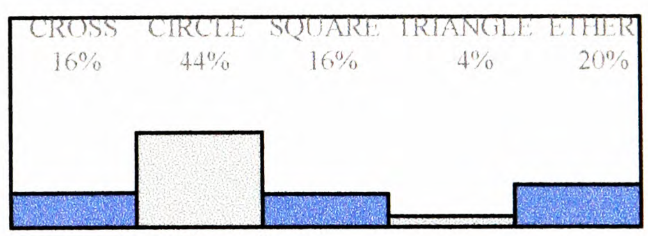
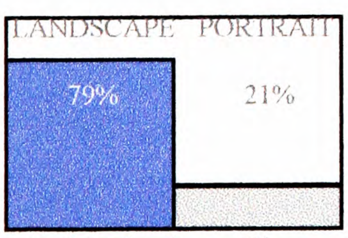


Suggests Comfort



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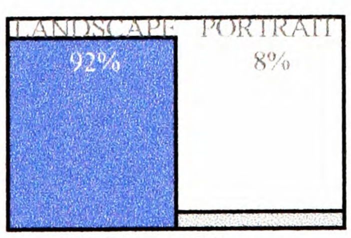

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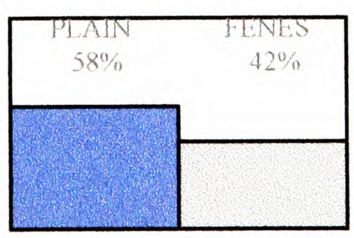

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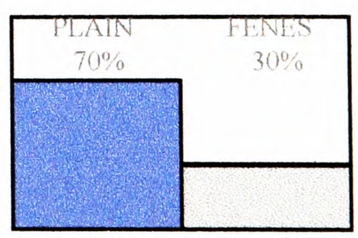

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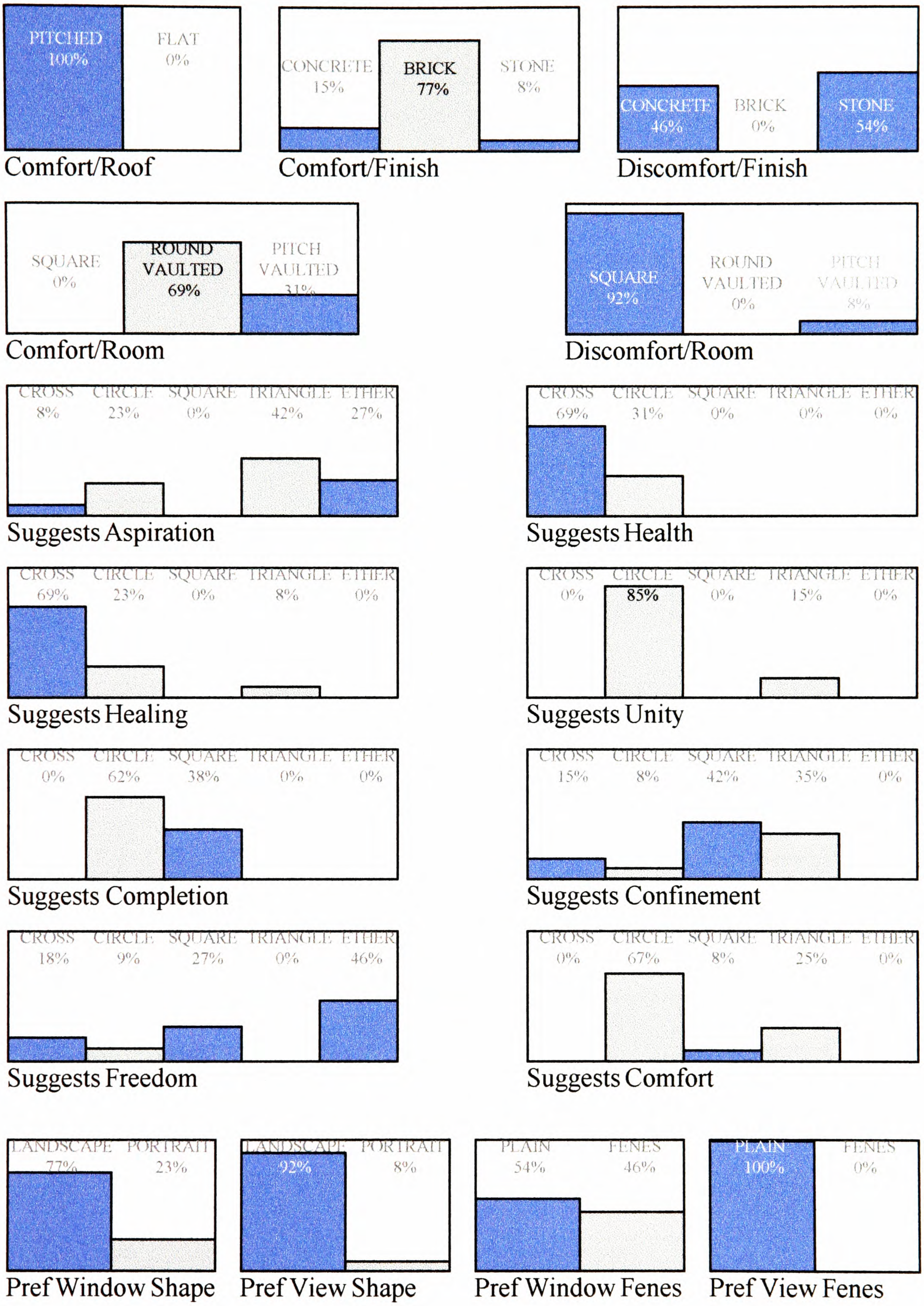
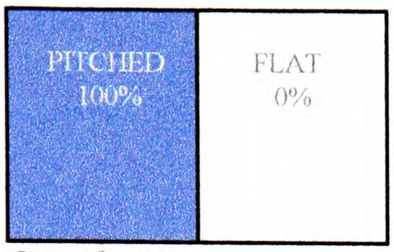
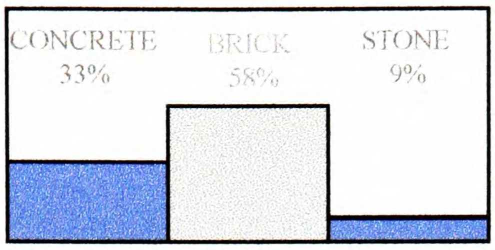
US UNIVERSITY STUDENTS



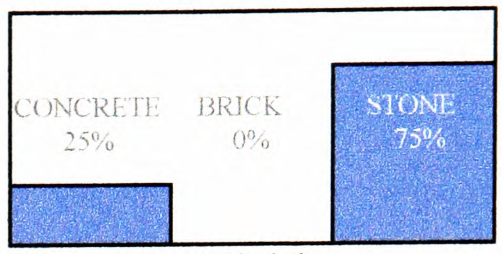
US HEALTH CARE PROVIDERS



Comfort/Roof



Comfort/Finish



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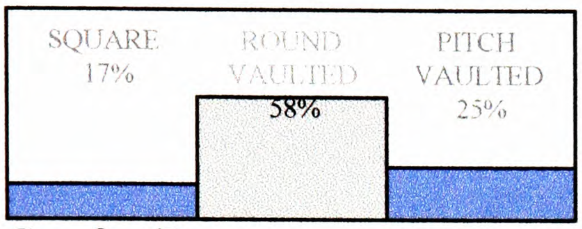
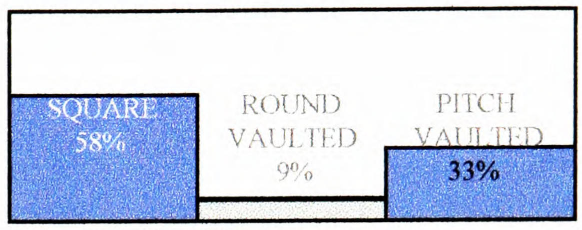
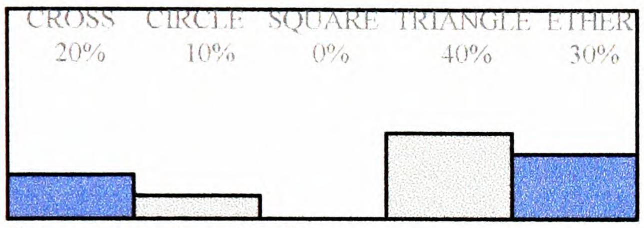


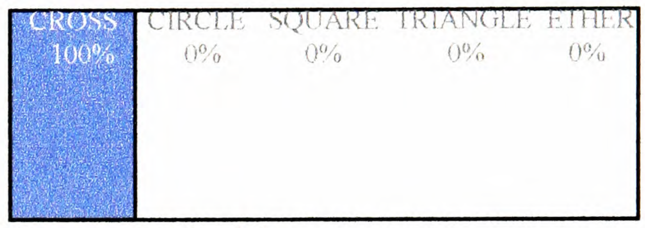
Comfort/Room



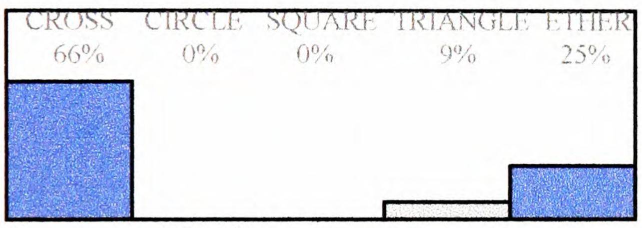
Discomfort/Room



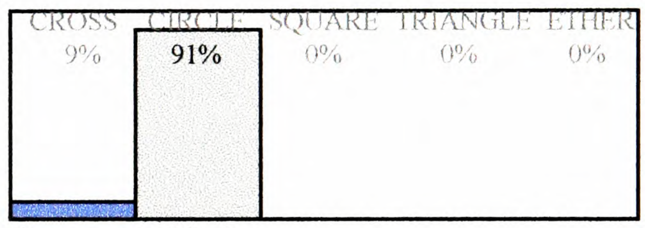
Suggests Aspiration



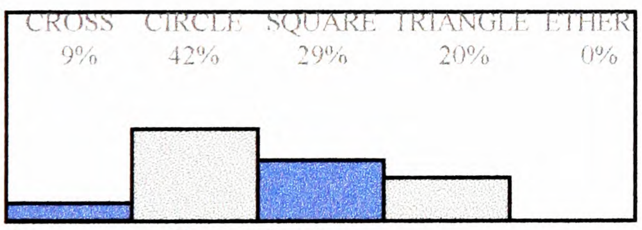
Suggests Health



Suggests Healing



Suggests Unity



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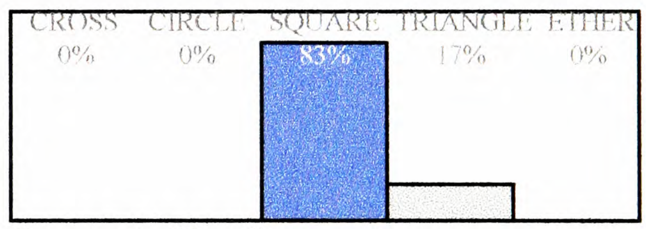
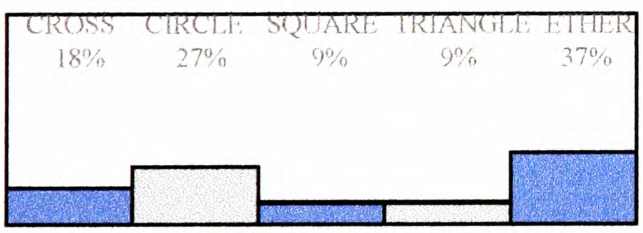
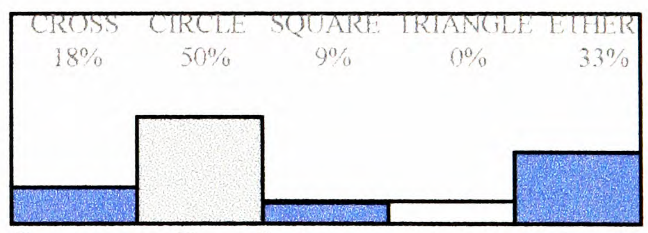


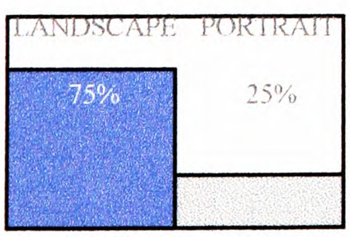
Suggests Confinement



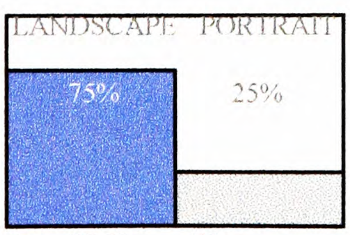
Suggests Freedom



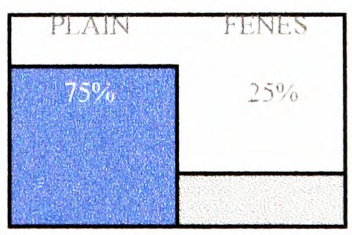
Suggests Comfort



Pref Window Shape



Pref View Shape



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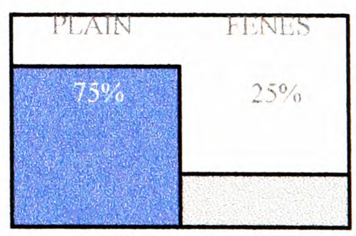
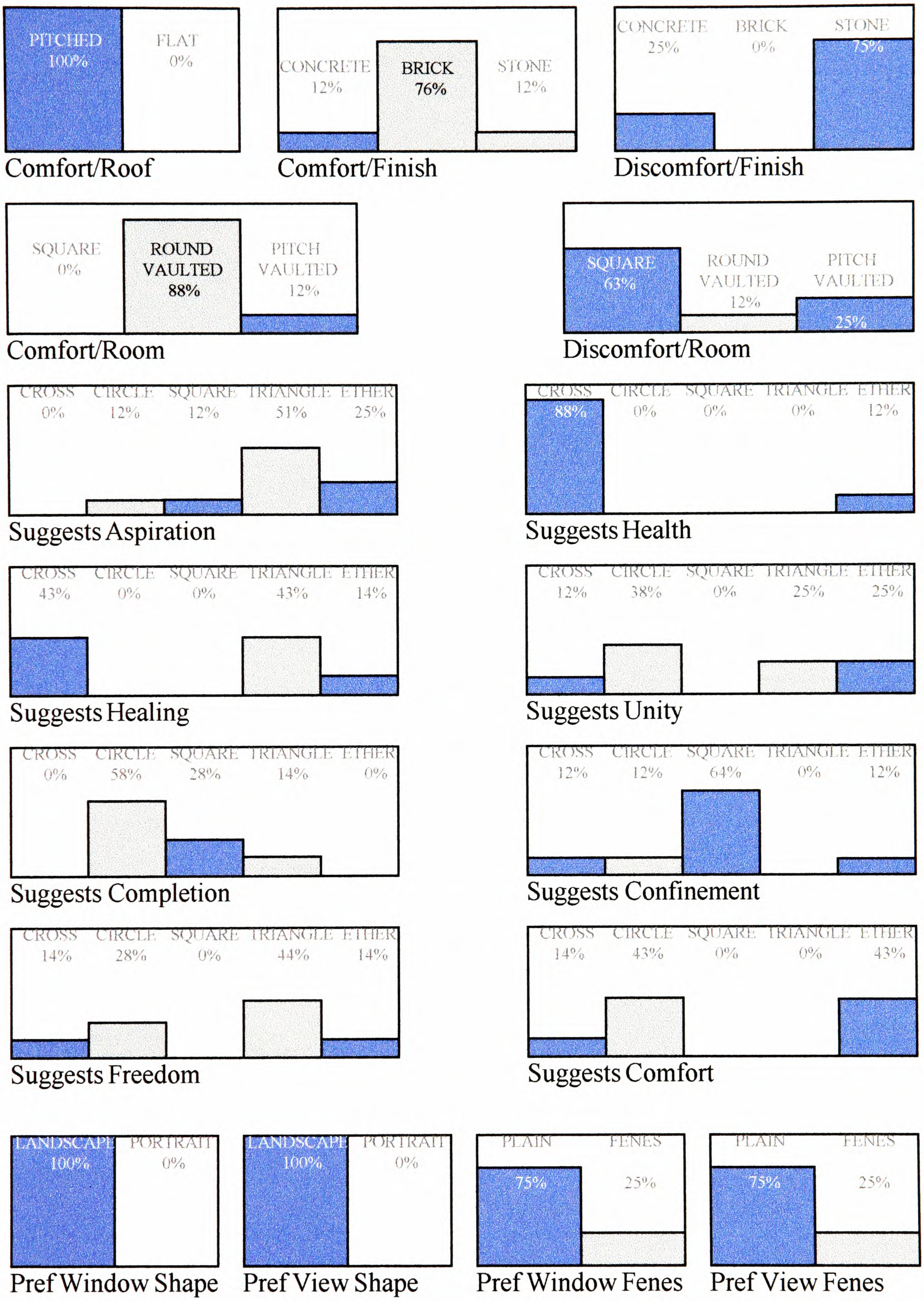
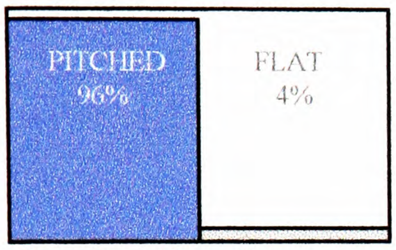


Pref View Fenes

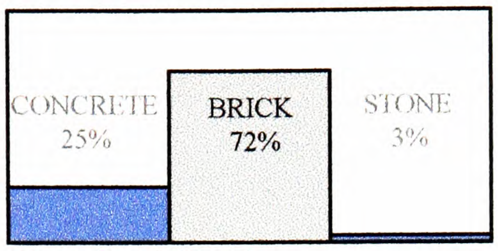
US PSYCHIATRIC PATIENTS



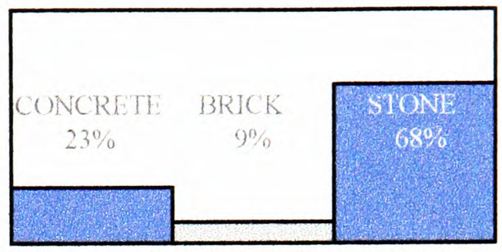
UK COMPOSITE



Comfort/Roof



Comfort/Finish



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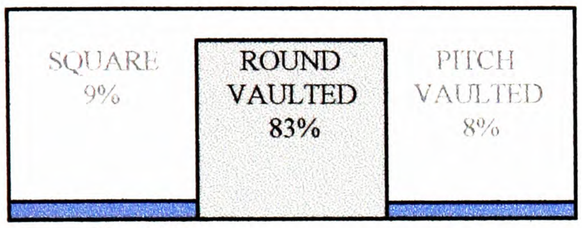
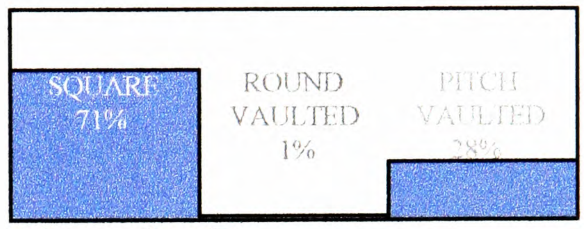
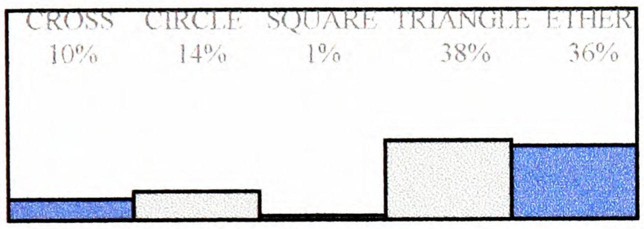


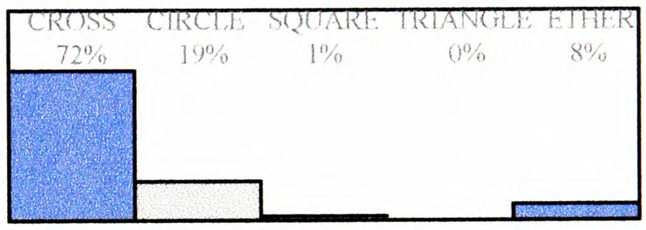
Comfort/Room



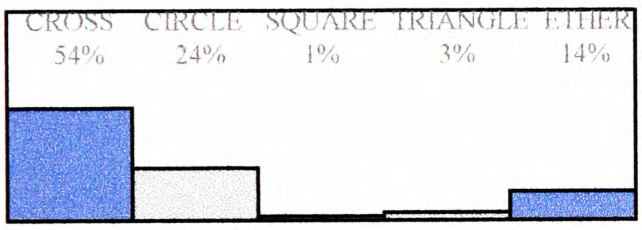
Discomfort/Room



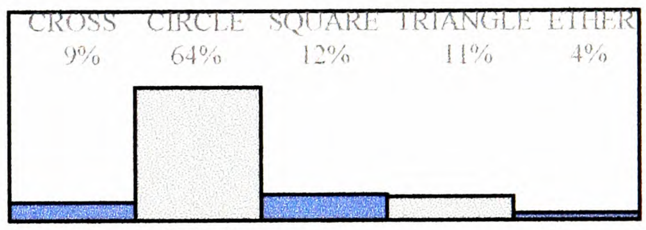
Suggests Aspiration



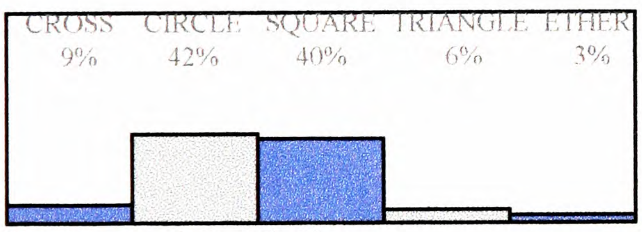
Suggests Health



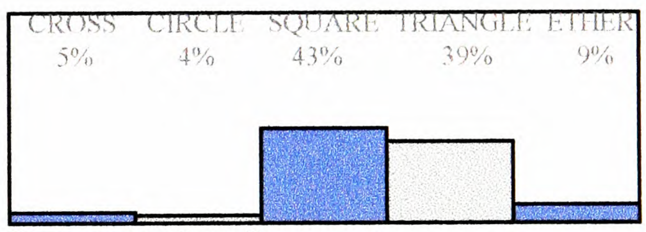
Suggests Healing



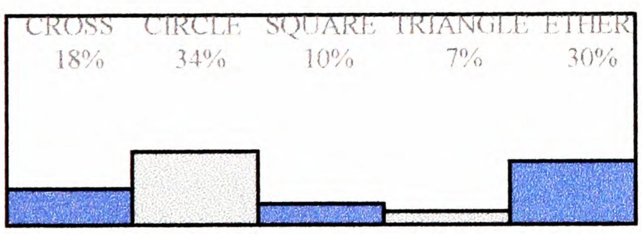
Suggests Unity



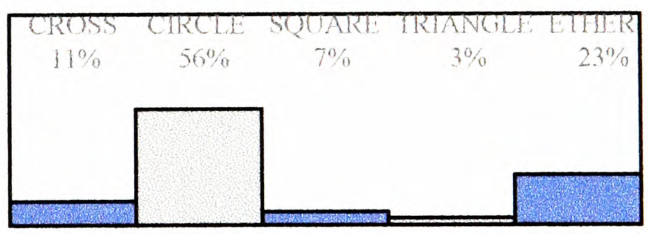
Suggests Completion



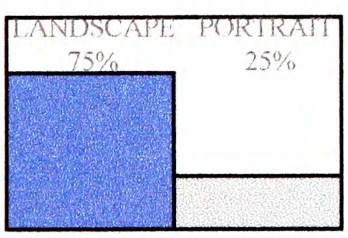
Suggests Confinement



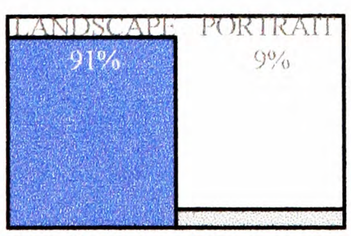
Suggests Freedom



Suggests Comfort



Pref Window Shape



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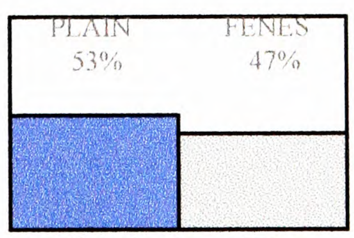

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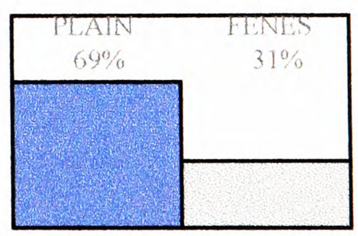
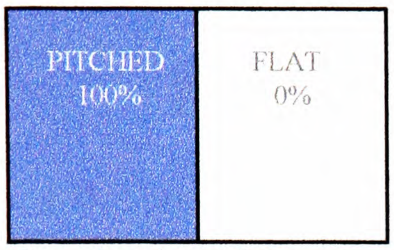


Pref View Fenes

US COMPOSITE



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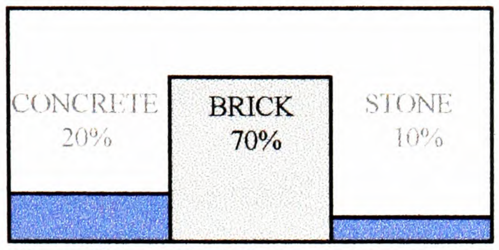
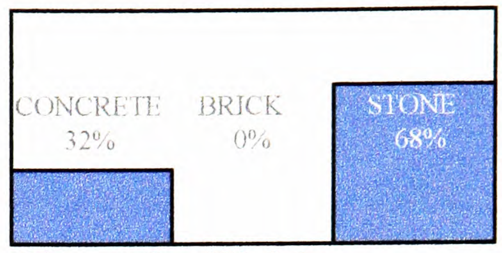


Comfort/Finish



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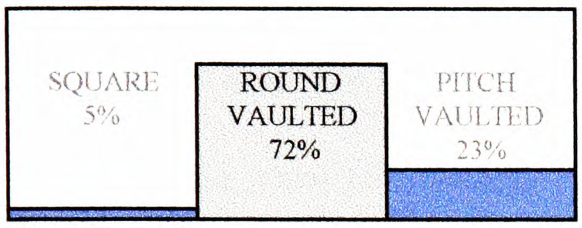
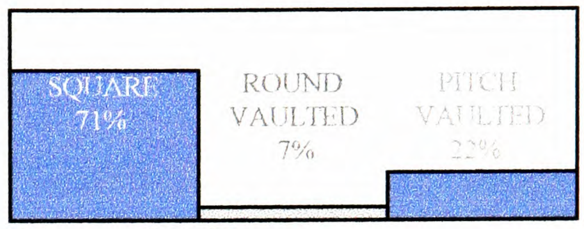
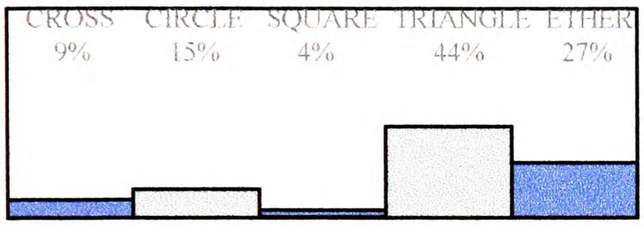


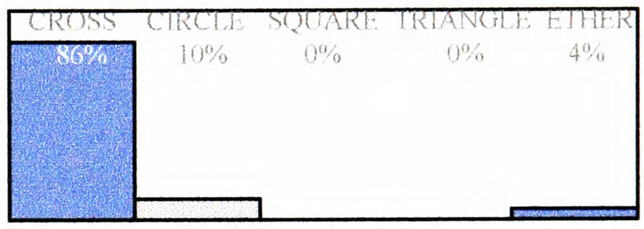
Comfort/Room



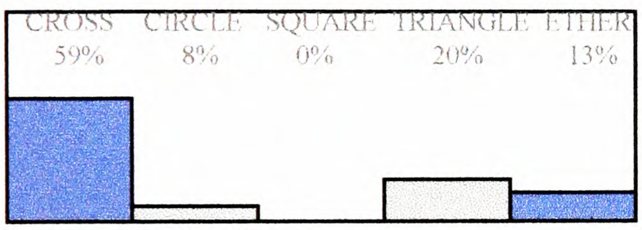
Discomfort/Room



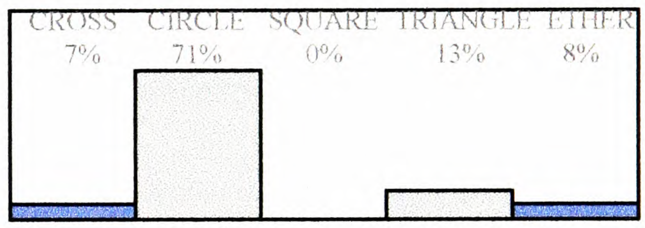
Suggests Aspiration



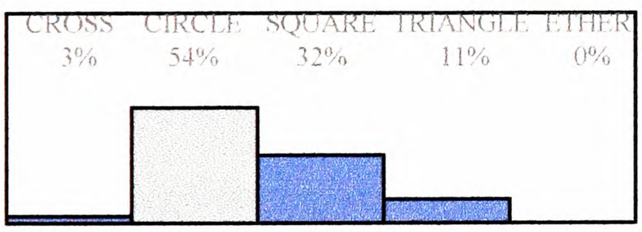
Suggests Health



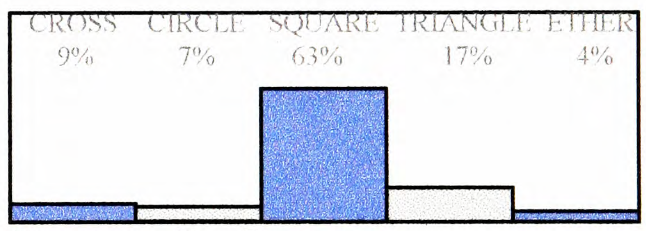
Suggests Healing



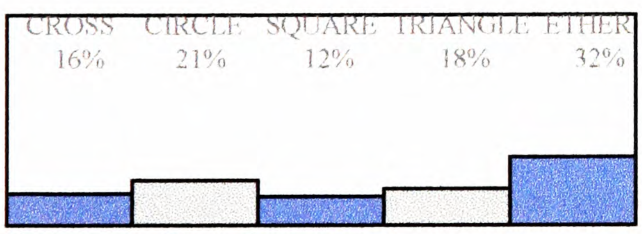
Suggests Unity



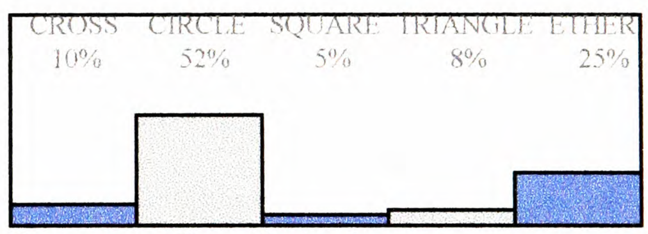
Suggests Completion



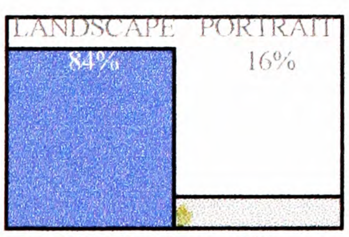
Suggests Confinement



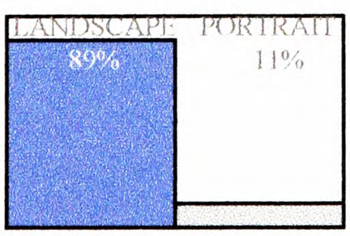
Suggests Freedom



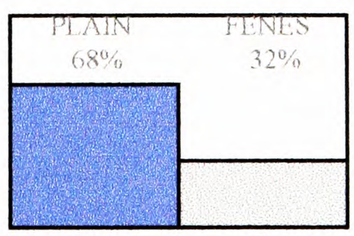
Suggests Comfort



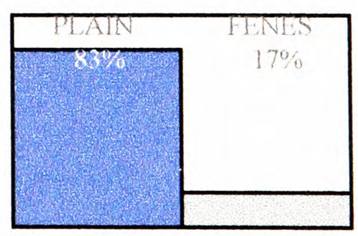
Pref Window Shape



Pref View Shape



Pref Window Fenes



Pref View Fenes

Interpretation and Recommendations

Roof Types: The survey found a nearly universal preference for the pitched roof and a corresponding rejection of the flat roof. As noted earlier, the pitched roof is a symbol of domesticity and protection. Survey respondents generally described it as being more "homey" or "homely" than the flat roofed alternative. It is easy to understand why students, patients, and health care providers on both sides of the Atlantic would believe that a building with a pitched roof is more comfortable than a flat roofed building. The thing that is difficult to understand is the reason so few health care facilities use this symbol of comfort. Hospitals striving to present a modern, state of the art appearance seem to have forgotten the psychological needs of patients. Therefore, the use of pitched roofs is recommended to bolster perceptions of comfort.

Exterior Finish: The survey found a strong preference for brick as an exterior finish material. Brick was preferred to both concrete and stone. Survey respondents noted that the concrete exterior looked too modern, and that the stone exterior looked cold. Brick is a material possessing both human scale and warmth. It is a material borne of fire. The color of most brick also suggests warmth.

While stone is available in a variety of colors, gray is the color most available and most often used. Aside from being described as cold by the respondents, many disliked the color gray in particular for the exterior finish. No respondents objected to the color of the concrete exterior, only the choice of material. The concrete exterior was rendered in the most common color used for concrete and stucco buildings - a light yellowish tan - a warm color.

Based on the results of the survey, brick is suggested for the exterior finish to suggest comfort to patients, staff, and visitors. If concrete or stone must be used because of local requirements, limit the palette to warm colors.

Room Comfort: The round vaulted room was considered far more comfortable than the pitch vaulted or square ceiling rooms. There was a corresponding finding of the circle as being symbolic of comfort. The square ceiling room was also considered very uncomfortable. There was a corresponding finding of the square as being symbolic of confinement. Respondents' feelings toward the pitch vaulted room were mixed, especially in the United States where an equal number of respondents considered it comfortable and uncomfortable. The perceived acceptance of the round vaulted room and the associated rejection of the square ceiling room may be representative of the general rejection of modern architecture among the majority of people. These perceptions may also be related to the symbolic associations of the shapes. Regardless of the reason, people seem to respond to the round vaulted room, and this shape should be employed to suggest comfort.

The Circle: Respondents generally found the circle suggestive of unity, completion, and comfort. The circle was also found to be the secondary symbol of health and healing, just behind the cross. These are all positive associations and the circle and associated rounded forms may be used to cultivate these associations in health care facility design.

The Square: Respondents generally found the square suggestive of confinement. The square ceiling room was also considered very uncomfortable. While it is nearly impossible to construct a building without using squares, the square should not be emphasized in the design because of these negative associations.

The Triangle: The triangle was found by respondents to be suggestive of aspiration. The triangle in the form of the pitched roof is also seen as a symbol of comfort. However, the triangle on its own was seen as a secondary symbol of confinement - possibly because of the closed form and the sharp corners. These are characteristics that the square shares with the triangle. We can infer from the survey that the triangle is appropriate in roof forms, but that sharp corners and closed forms should be avoided.

The Cross: Respondents generally found the cross suggestive of health and healing. These are both positive associations and the cross form may be used to cultivate these associations in health care facility design.

Ether: Respondents generally found the ether form suggestive of freedom in the United States and as the secondary symbol of freedom (closely behind the circle) in the United Kingdom. Respondents suggested that its shape was the least closed and most free flowing. The ether form was also found to be the secondary symbol of aspiration (closely behind the triangle). This could be because the ether form possesses characteristics of both the circle and the triangle. While direct applications of the ether form to health care design may be difficult, its free flowing characteristics were considered desirable by respondents.

The Crossed Circle: Although the crossed circle (a composite form) was not included in the survey to avoid excess complication and confusion, one can infer that it could combine associations of health, healing, unity, completion, and comfort.

Window Preferences: Respondents generally preferred horizontal windows without fenestration. Respondents especially preferred this configuration when a pleasant view was offered. This arrangement seems to provide the most free view of nature.

Correlations: The survey results indicate a strong correlation between individual perceptions of the round vaulted ceiling, the pitched roof, the brick exterior and the circle. It appears that these attributes are inextricably linked in the minds of survey respondents. While this link appeared in both the U.K. and U.S. samples, it appears strongest within British survey participants. The combination of these attributes in health care facility design would probably enhance the overall perception of comfort by building occupants.

Chapter 4 - Site Development

The focus of this chapter is site development for mental health treatment facilities. Site development in this usage represents the relationship of the buildings to their sites and amenities such as parks and gardens provided. The historical background of mental health treatment facilities and their associated site development are reviewed. Emerging trends for the site development of mental health treatment facilities are examined. The basis for patients' need for natural surroundings are discussed along with the requirements for good hospital garden design.

Section 4.1 - Foundations of Mental Health Treatment Facility Site Development

Early European Site Development

The first facility known to be developed for treating the mentally ill was the ancient Greek Temple of Aesclepius. (Center, p6) Although Egyptian and Hellenistic healing temples existed prior to the third-century B.C. temple in Epidaurus, this temple was the first to specialize in healing the mind. The temple was considered very beautiful, for both its design and surrounding landscape. According to C.D. Leakey, the psychological benefit of convalescing in such an environment was considered a primary factor in the curative process. (Leakey, p94-97) Epidaurus was a city filled with sculpture, amphitheaters, gardens, paintings, music, and dance. The largest theater seated about 10,000 people and featured performances of several dramas, comedies and tragedies one after another. After an extensive variety of intense emotions, many spectators had a cathartic experience and believed they had been healed. (Center, p7)

The relationship between institutional design and therapeutic objectives was also recognized by classical Roman architects. Environmental factors such as noise, climate, wind, and surroundings were considered in the design of health temples. Roman temples of health were usually very spacious with large gardens and courts, located in quiet areas with favorable climates. (McClure, p135)

After the fall of Rome, medieval hospitals were still arranged along the Roman model. Although architectural form varied because of local culture and construction techniques, these facilities still featured large open areas, with gardens, cloisters, and access to nature. (McClure, p135) Medieval hospitals were usually attached to a monastery or abbey and built with the same techniques and materials - as a result many of these hospitals were places of great beauty.

Before the close of the Crusades in the fifteenth-century, there were very few European mental hospitals. There were however, thousands of leper hospitals. As the scourge of leprosy gradually waned, attention moved to mental illness. The leprosariums, usually well ventilated buildings with considerable grounds, were converted to asylums for the confinement and care of the mentally ill. (Davison, p14)

Physical accommodation in asylums declined significantly between the fifteenth and eighteenth-centuries. By the late eighteenth-century, asylums in England and France were known to keep their inmates chained in dark, fetid dungeons. Many patients, especially women, were confined in a naked state with little protection from the elements. (Foucault, 1965, p 60 -70)

In the late eighteenth-century, Jeremy Bentham proposed a radical design for prisons and asylums and continually pressed parliament for construction funds. Bentham's panopticon penitentiaries were to be round, six story buildings with cells around the perimeter. At the center was to be an inspection area, disconnected from the rest of the building. From this dark core, keepers could maintain constant surveillance while remaining unseen. (Semple, p115) This design placed prisoners in solitary confinement while allowing no privacy whatsoever, and no respite from the constant spectacle of scores of fellow inmates. No contact with fellow prisoners or nature was permitted by Bentham's scheme. The panopticon was described as "a cruel ingenious cage, a pitiless contraption, designed for control and subjugation" by Foucault. (Foucault, 1972, p205)

This harsh form of punishment never gained support from parliament. Bentham's plans offended the conscience of the British people and only one facility of this type was constructed during his lifetime - on the banks of the Neva river in Russia. (Semple, p256-259)

While panopticon plans never caught on for psychiatric hospital design, radial plans were widely used in prison and psychiatric hospital designs in the nineteenth-century. Radial facilities were built with intersecting wings and central observation areas. The first facility of this type was Eastern State Penitentiary in Pennsylvania, constructed about 1830. Although an American innovation, this design became very widespread in Britain. Radial prisons had as few as three, or as many as 16 radial arms, resembling a wagon wheel or octopus. Radial hospitals were usually cross shaped with four wings, or designed as a combination of connected radial crosses; less often in spoked wheel configurations typical of radial penitentiaries. (Evans, 1982, p96-103)

Perhaps the most celebrated example of a radial mental health treatment facility was the Glasgow Lunatic Asylum constructed shortly after the Eastern State Penitentiary. This building, designed by William Stark, was unusual because the four arms flanked a central rotunda with a semi-conical dome. Patients were strictly segregated by sex, deportment, and behavior. The four outdoor spaces between the arms were further divided by walls to create eight separate yards to prevent mixing by various classifications of patients while taking exercise. This facility was also unusual because of its refined, classically inspired architecture and the overall beauty of the scheme. Ironically, the more "enlightened" city of Edinburgh erected a stark, unadorned asylum by Robert Adam just a few years previously. This semi-circular facility known as Bridewell was partially based on Bentham's Panopticon but the missing half of the circle was replaced with an attached castellated chapel. This structure and its adjacent prison walls contributed to a very grim scheme.

Although radial plan facilities were usually better lit and ventilated than the facilities that preceded them, they were still far from perfect. Hospitals with more than four arms had poor views, with cell blocks facing each other at acute angles. Outdoor areas were usually limited to triangular exercise yards between cell blocks. As a norm, these exercise yards were paved and lacked views to nature. These paved, wedge shaped yards also tended to trap sound and were therefore prone to excessive noise and echo.

Numerous social, political, and economic factors played contributing roles in the deplorable institutional conditions which prevailed by the late eighteenth and early nineteenth-centuries. Two are particularly important to the development of institutions. Organized religion had influenced society to believe the mentally ill were being punished for their sins. Therefore, it was easier to overlook the suffering of the mentally ill. Another major factor was increasing urbanization, crowding existing institutions into squalid conditions, and preventing new institutions from being built. These conditions continued until the Victorian period, when government took greater responsibility for public welfare, and a large number of rural and suburban hospitals were built to relieve overcrowding and squalor.

Early American Site Development

During the colonial era, the mentally ill in America were usually cared for by their families in their own homes. Before the mid-eighteenth-century, hospitals were rare in America because of the small population and low degree of urbanization. As large cities developed along the east coast, the mentally ill without benefit of family care were housed in poor houses along with the blind, the orphaned, the aged, and the crippled. (McClure, p137)

The first general hospital built in America also provided care for the mentally ill; although very poor care. Philadelphia's Pennsylvania Hospital was established in the mid-eighteenth-century as a combined effort of the legislature and private support. Within the hospital, mentally ill patients were required to inhabit basement cells about three meters square (10 feet square). These cells lacked daylight, and were cold, dark, and uncomfortable - clearly wrong for the support of physical and mental health. However, this facility was touted as having the most benevolent and humane care available. (McClure, p 138)

The first facility in America established specifically for the care of the mentally ill was Virginia's Williamsburg Hospital in 1770. This hospital provided two floors of above grade patient rooms with window views and access to a large back garden. The facility was well lit and ventilated and considered comfortable the standards of the day. Unfortunately, the Pennsylvania model was most emulated by other states, with mentally ill patients warehoused in the cellars or attics of general hospitals, out of sight and out of mind.

Moral Treatment and Site Development

The reform movement known as "moral treatment" developed independently under two leaders; namely Phillipe Pinel in France and William Tuke in England.

Pinel removed the chains of the prisoners at Bicêtre and treated them as sick human beings rather than as something subhuman. Patients once considered dangerous strolled through the grounds without inclination to create discord or harm anyone. Light and airy rooms replaced the dungeons and some patients who had been incarcerated for years were soon restored to health and eventually discharged. (Davison, p15-16)

While Pinel was a physician, Tuke was a layman and devout Quaker. Tuke's philosophy was based on the benevolent influence of his faith. After the mysterious death of a Quaker at York Asylum in 1791, Tuke established a "retreat" for mentally ill Quakers. The name "retreat" avoided the stigma of "madhouse or asylum." (Jones, p20) Tuke's retreat was intended as a refuge for the troubled, and sought to provide a familial atmosphere for the patient, as demonstrated by the non-institutional appearance of the buildings and grounds. (Deutsch, p93) Emphasis was placed on interaction between patients and staff, outdoor exercise, and a range of productive activities designed to occupy patients' time in a meaningful and therapeutic way. (Jones, p21)

The philosophy of moral treatment was highly influential well into the nineteenth-century. A large number of hospitals for the mentally ill were built on this model. Generally these institutions were built on rural or suburban sites with large gardens. However, hospitals embracing moral treatment were not the only facilities society employed to deal with the mentally ill; many mentally ill persons continued to be inappropriately housed in jails, penal facilities, and poor houses.

Twentieth-Century Site Development

Government intervention at a massive scale in North America, and to a lesser degree in Europe, resulted in the construction of huge city hospitals, many caring for over 10,000 mentally ill patients. These large urban institutions resulted from the perceived need of economies of scale, and the necessity of attracting large numbers of qualified staff. These facilities were often constructed as tall, multi-floor buildings with little or no access to natural space, and offered little more than views of a crowded city from available windows. (McClure, p163)

Emerging Trends in Site Development

The closure of many large psychiatric hospitals, both in Europe and North America, in the 1980s and 1990s due to changing legislation concerning patient rights and government budget cuts has resulted in a large number of the mentally ill being placed in decentralized care or "care in the community." A large number of the mentally ill are now among the homeless as well.

Care in the community necessitates the operation of both inpatient and outpatient treatment facilities, with patients referred between the two. These facilities can be collocated or operate separately from each other. Within a mental health care network one might typically find a district facility that encompasses one or more inpatient units, day hospital for patients needing oversight while family members are working, and an outpatient treatment center (clinic). Under this type of operation you would typically find dispersed clinics and perhaps day hospitals that are also a part of this network. These facilities might also be operated in conjunction with a district general hospital. The configuration of facilities within a mental health care network should be tailored to the community's unique needs.

There are two contrasting philosophies concerning the siting of psychiatric units. The first view is that mental health units should be located in a psychiatric hospital specifically designed and built for the treatment of the mentally ill. The second view is that psychiatric units should be located within a district general hospital.

Psychiatric Units within a Psychiatric Hospital

With proper security, this arrangement allows patients to enjoy the most freedom of the facility and the grounds because they will not interact with medical patients and visitors, and not suffer their unkind stares and statements. This scheme allows patients greater privacy, a better environment for care, and better access to natural settings. This arrangement also places psychiatric patients as the first priority for administration and staff so they will not be relegated to the back wards or upper wards of the hospital. One disadvantage of this scheme is that it complicates the provision of medical care for psychiatric patients, especially those with long term health problems. Another disadvantage is the tendency of patients to be stigmatized in the community if they are known to be in a psychiatric hospital. Visitation by family and friends may also be more difficult if travel distances are greater than those to their district general hospital.

Psychiatric Units within a District General Hospital

The main advantages of this arrangement are the easier provision of medical care to psychiatric patients, the lack of stigmatization for being an inpatient in a psychiatric hospital, easier visitation, and the economies of scale: shared laundry, pharmacy, food service, etc. with the district general hospital. Again a disadvantage of this scheme is the security complications involved with housing psychiatric patients and medical patients in the same facility. Psychiatric patients in this type of facility typically do not enjoy much freedom of movement or access to the grounds, and are often segregated into less desirable wards within the facility. Another disadvantage are the urban sites typical of most district general hospitals, necessarily urban because of the needs of the emergency department and ambulance teams to provide immediate, centralized care. If security is inadequate, there can also be problems with contraband items or substances and even sexual favors being exchanged between medical and psychiatric patients.

Peter Barefoot, a designer experienced in the development of psychiatric units at district general hospitals, offers the following:

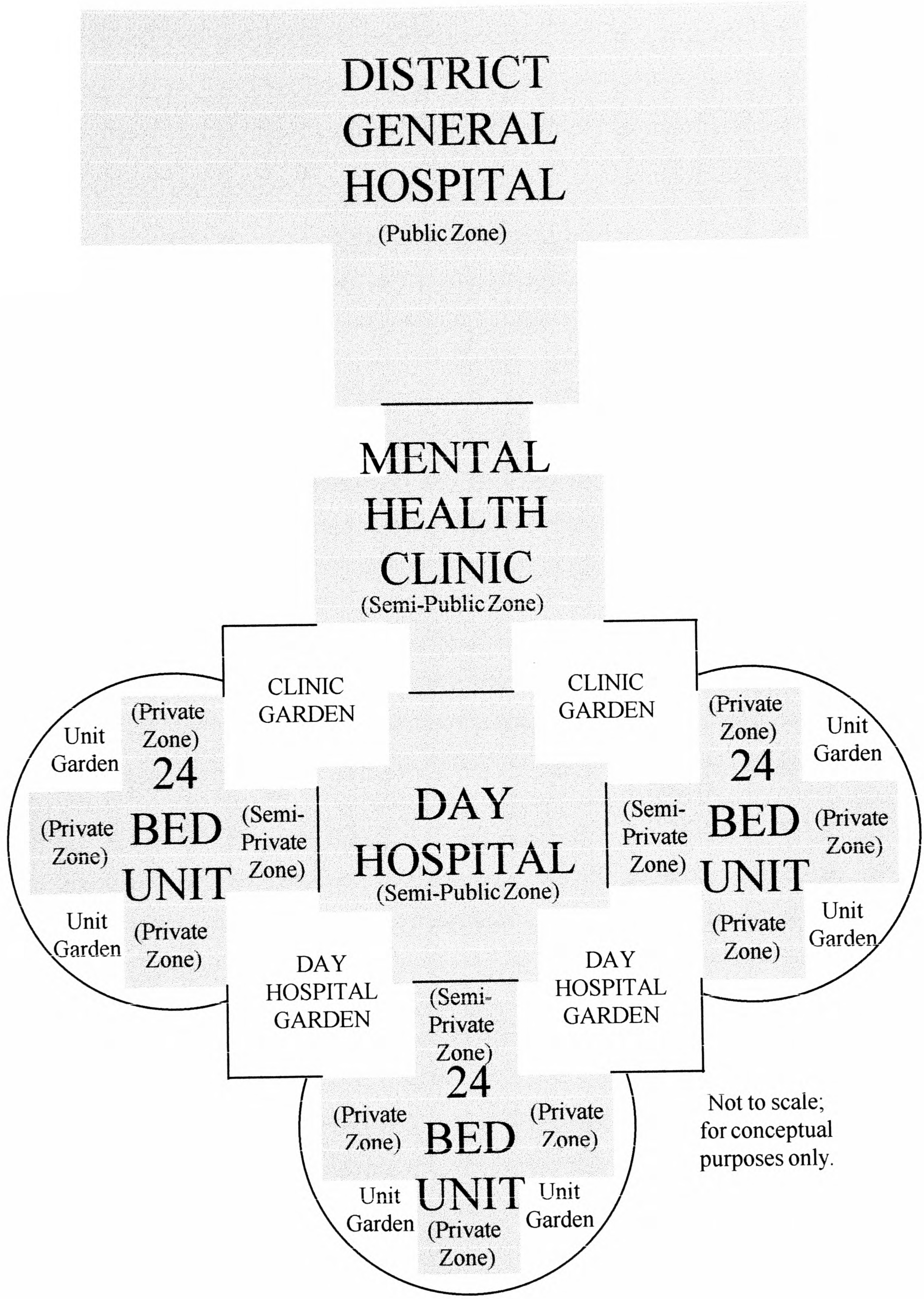
> I hold the view that the worst place to build an acute psychiatric facility is in a medical or surgical ward block of a general hospital. The envelope is fixed, the services are fixed, even the location of utility rooms has been fixed, and the problems of a brief which should be designed for therapeutic care of patients who do not spend their hospital days in bed, and who will have totally different day-time activities, cannot be solved satisfactorily by a standard hospital ward layout.

No amount of empathetic care can offset the wrong basic layout; this was evident in most of the units in general hospitals which I saw...(Barefoot, p99)

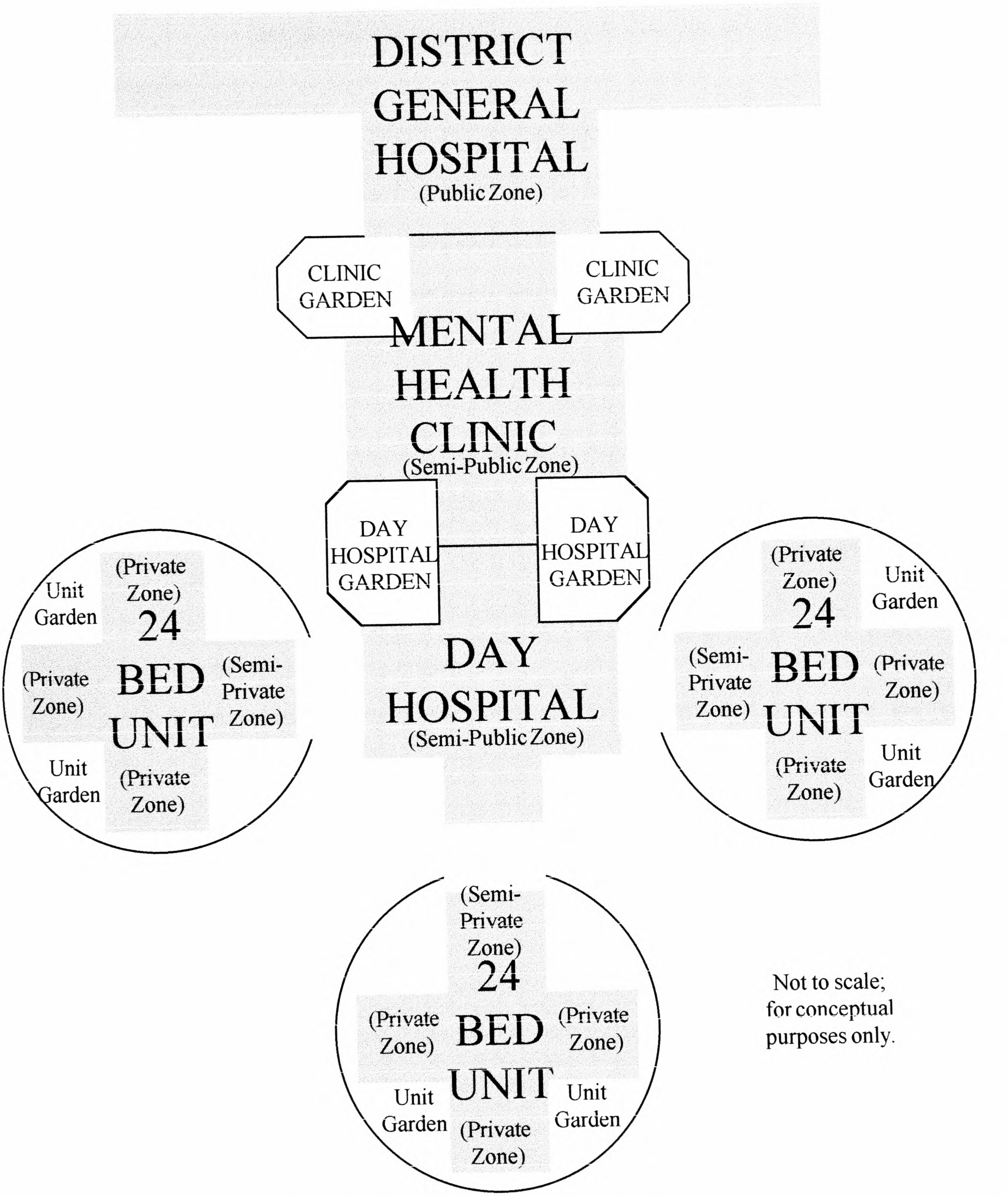
Alternative Site Development

A good alternative to both of these arrangements is to have the psychiatric hospital *at*, rather than *in*, the district general hospital. In this arrangement visitors would enter through a main district general hospital reception area and would be directed to a separate wing or block of the facility. The psychiatric section would receive logistical support from the district general hospital but there would be no interaction between medical and psychiatric patients. The psychiatric section would need its own private gardens, where patients could be observed by mental health staff but not easily observed by medical patients. The provision of separate grounds would seem to necessitate a suburban or country site. (Unfortunately rural sites are not always possible for many district general hospitals because of the requirements of emergency departments.) This alternative arrangement would overcome all of the disadvantages of either scheme, but aside from the shared logistical support, it would seem to be nearly as costly as building separate facilities.

A mental health clinic attached to the district general hospital would serve as a good buffer between the district general hospital and the mental health unit(s). A day hospital could also be included in this buffer. Such an arrangement would ease the transition of patients from one level of care to another and would provide a concentration of mental health practitioners on site for consultation. This scheme would also allow for the easy sharing of resources such as art and music therapy rooms and supplies, books, recordings, etc. This arrangement would also ease the travel requirements of practitioners with a combination of inpatient and outpatient case loads. The following illustrations offer two examples of how up to three 24 bed units could effectively be connected to a district general hospital: attached units and dispersed "cottage plan" units. While the attached units might be more convenient for staff, the dispersed units would probably seem cozier for patients.



Attached Units - Figure 4.1.1



Dispersed "Cottage Plan" Units - Figure 4.1.2

Section 4.2 - Mental Health Treatment Facilities and Nature

Biophilia

Harvard biologist, Edward O. Wilson, has theorized that people are naturally attracted to nature because of a genetic predisposition. He has coined the term "biophilia" (based on the Greek words for 'life" and 'love'), to describe this genetically programmed need for other living things. In his book, *Biophilia: the Human Bond with Other Species*, 1984, he defines biophilia as the innate tendency to focus on life and living processes which leads to an emotional affiliation of human beings to other living things. (Wilson, p1-10)

Wilson suggests the origin of biophilia lies in our evolutionary history beginning millions of years ago with the origin of genus Homo.

> For over 99 percent of human history, people have lived in hunter-gatherer bands, totally and intimately involved with other organisms...The brain evolved in a biocentric world, not a machine-regulated world. It would be therefore quite extraordinary to find that all learning rules related to that world have been erased in a few thousand years. (Wilson, p8-10)

Wilson's ideas echo those of microbiologist, René Dubos: "We are shaped by the Earth. The characteristics of the environment in which we develop, condition our biological and mental well-being and the quality of our life." (Suzuki, p1) Today, most people in industrialized countries live in urban environments in which contact with nature has been drastically reduced. According to Wilson:

> The biophilic learning rules are not replaced by modern versions equally well adapted to artifacts. Instead, they persist from generation to generation, atrophied and fitfully manifested in the artificial new environments into which technology has catapulted humanity. For the indefinite future, more children and adults will continue, as they do now, to visit zoos than attend major sports events. (Wilson, p15)

Dr. Roger S. Ulrich reports in *Biophilia, Biophobia, and Natural Landscapes*, 1993, that medical patients exposed to scenes of nature (particularly scenes with water, and pastoral scenes with non-threatening animals) experienced lower stress (as measured by blood pressure) than patients exposed to urban scenes. While all natural scenes elicited this response, scenes of grasslands at the edge of woods and water scenes were found to be more calming than mountain and forest scenes. (Ulrich, 1993, p98-104) The beauty of parks and trees are often noted as potentially therapeutic but the presence of animals is often forgotten. Encounters with animals, particularly dogs and cats, are often used as part of the treatment program for withdrawn children and elderly people. These encounters are known to markedly lift the spirits of these patients.

The Importance of Views and Scenery

Records on recovery after kidney surgery in a suburban Pennsylvania hospital between 1972 and 1981 were examined to determine whether assignment to a room with a window view of a natural setting might have restorative influences. 23 surgical patients assigned to rooms with windows looking out on a grove of trees had shorter postoperative stays, received fewer negative progress evaluation comments in nurse's notes, and took fewer potent analgesics than 23 matched patients in similar rooms with windows facing a brick building wall. (Ulrich, 1984, p420)

A similar study conducted at the Uppsala University Hospital among heart surgery patients yielded similar results. Patients exposed to natural views (as opposed to man made views) experienced less discomfort during recovery. (Lunden, p7) While these studies focused on the recovery of surgical patients rather than psychiatric patients they are exceptionally demonstrative of the power of nature. Although there have been no comparable studies of views with psychiatric patients, the following summary of a study of psychiatric patients and art choices is very enlightening.

A study of the effects of different types of wall art on psychiatric patients in another Swedish hospital yields insights concerning the positive influence of natural scenes. Short-term patients, some of whom were experiencing moderate levels of anxiety, were studied in a ward extensively decorated with paintings and prints reflecting a wide variety of styles and subject matter. Interview data indicates that patients responded positively to wall art dominated by natural content (a rural landscape or a vase of flowers) but tended to react negatively to abstract paintings and prints where the content was either ambiguous or unintelligible. (Ulrich, 1986, p55)

An analysis of records kept over a 15 year period yielded information regarding strongly negative responses and actions directed to paintings and prints considered unacceptable by patients. These actions included strong complaints to staff and even vandalism (such as tearing a picture from the wall and smashing the frame) - surprising actions from individuals in an unlocked ward for patients classified as nonaggressive and not prone to violence. Seven paintings and prints had been the targets of such attacks, and all of them showed a consistent pattern of abstract content. During the 15 year history of the ward, apparently no acts of vandalism had been directed at a picture depicting nature. (Ulrich, 1993, p106)

Recommendations

It would seem that views of nature and access to nature positively impact the physical and mental health of patients. This would suggest that the ancient Greek and Roman mode of site development with generous access to gardens is the proper approach. The following recommendations for the development of hospital gardens are offered by the Center for Health Design, a non-profit organization centered in Martinez, California:

Accessibility. A therapeutic garden should be accessible and should have surfaces and contours that enable safe, free movement with as few barriers as possible.

Comfort and User-Friendliness. A garden should include ample seating - both movable chairs and permanent benches with backs. This gives patients some control by allowing them to move into or out of sunshine, shade, or breezes, to join with others or to sit in solitude. Interpretive signs may be provided to provide plant information. (Individual plots for garden therapy may also be provided if consistent with the treatment program.)

Visibility. Gardens should be visible not only from a horizontal plane, but should be visible from higher elevations. (This suggestion should be balanced with the patients' need for privacy. Gardens should also visible from patient rooms and fully visible from nursing stations.)

Diversity of Sensory Input. A garden should provide as much sensory stimulation as possible and interest people on as many levels as possible. Gardens and outdoor spaces can appeal to all the senses at once. The more diverse the plantings, the more diverse the wildlife that will be attracted to the garden, offering even more sensory stimulation. (The use of special feeders to attract birds, squirrels, and/or butterflies should also be considered.) Plants should vary in height, blooming time, texture, color and fragrance, and should provide multi-season interest.

Water and Sounds are particularly important to patients with low visual acuity. Gardens with fountain pools and other forms of moving water can provide soothing sounds as well as visual beauty. They can also provide opportunities for patients to dip their fingers in the water to interact with aquatic life (goldfish, frogs, etc.). (Indoor fish tanks can also provide visual interest, especially during harsh winter weather.)

Design Variety. A therapeutic garden, regardless of size, needs a clear definition of where it begins and ends, and each space should offer functional and aesthetic variety. A facility's gardens can be made up of many such spaces: a somewhat private space that allows for contemplation and reflection, a space for exercise, a space that gives shelter from sun and wind, and spaces that encourage social activity. Designers should take advantage of vertical as well as horizontal space - using trees, climbing plants and vines adds layers of dimension and maximizes the space available.

Relief from Interior Spaces. A variety of plant material, differences in temperature, sounds associated with nature, patterns of sunlight, and spatial relationships all blend to create an environment that contrasts sharply with the sterile environments of many hospitals. Some patients lose their sense of time and place after long periods of hospitalization - contact is believed to help maintain patient self orientation. (Edge-Gumbel, p26-28)

Chapter 5 - Demonstration of Design Principles

Clearly, the planning and design of mental health treatment facilities is not a simple task. One must consider security requirements, fire safety, access and observation, prevention of suicide and injury, lighting, interior design, acoustics, the physical environment, the cognitive environment, symbolism, site development, as well as individual concerns. Perhaps the most daunting task is the integration or synthesis of these concerns into a rational, cohesive, and therapeutic environment for the provision of care. The following demonstration of design principles will explain how this may be accomplished.

A synthesis of these concerns is shown via a demonstration of design principles. This demonstration includes detailed descriptions and drawings of a hypothetical inpatient unit and outpatient clinic. These designs of hypothetical facilities are intended to demonstrate an integration of thesis findings and design principles and not as a definitive design or prototype. Since every site and building program are different and require their own design solution, it would be inappropriate to dictate a single solution.

The drawings are preceded by thorough descriptions of how the hypothetical facilities accommodate the many requirements detailed in this thesis. Descriptions of security, fire safety, symbolism, cognitive, environmental, and site development features are provided for the inpatient unit. Only security features are described for the outpatient clinic, because the other design requirements are substantially similar to the inpatient unit requirements.

Inpatient Unit - Security Aspects

The following security features were incorporated to demonstrate how they could be integrated into the design of an inpatient unit.

The provision of a prominent entry gives clear expression of the approved access to the unit. The visitation/screening room is adjacent to the entry to prevent contraband items from entering the unit. There is a clear differentiation of security zones, from public to private, with clear control points where these zones intersect.

The seclusion room is near the nurse station for easy monitoring. The nurse station also acts as a security checkpoint and has its own *in suite* toilet and lavatory so the nurse station may be manned at all times. The core of the nurse station is centrally located to allow observation of all main spaces, corridors, and gardens. Walls around the nurse station and adjacent walls are transparent to allow observation of patients. Doors to patient suites are also transparent to allow observation of patients. Large glazed areas are provided along exterior walls allow easy monitoring of gardens from the nursing station.

Showers are near the nurse station to minimize the risk of patients being assaulted, and to minimize the risk of patient hanging. If the project budget and treatment program allow, patients may have private rooms with *in suite* toilets to minimize the risk of assaults. Rooms have solid ceilings to prevent absconding. Shatterproof polycarbonate windows are provided in patient rooms to deter patients from absconding. Utility centers in locked cabinets in corridors allow electricity and water to be cut off for any patient room. All emergency exits from patient zones lead to a secure garden area. The combination of a berm and a "ha-ha" reduce the visual impact of the security fence.

The provision of high roof eaves deters patient access to the roof. Similarly, a steep roof slope deters patients from absconding over the roof. Easy to grip roofing materials such as clay or concrete tiles are avoided.

Inpatient Unit - Fire Safety Aspects

The following fire safety features were incorporated to demonstrate how they could be integrated into the design of an inpatient unit.

The nurse station is the location of all alarm panels, fire protection system controls and over-rides. Units may be divided into smaller smoke compartments to prevent the spread of smoke (the leading cause of death in fires). The facility is completely protected with automatic sprinklers, and high risk areas such as smoking and food preparation areas are protected by manual sprinklers operated from the nursing station. All rooms are protected by smoke alarms with local report and notification on an annunciator panel in the nurse station. All fire exits from patient zones lead to a secure garden area. Fire exits are clearly marked, visible, and accessible.

Inpatient Unit - Symbolic Aspects

The following symbolic features were incorporated to demonstrate how they could be integrated into the design of an inpatient unit.

Circles are associated with the universe's life giving and nurturing forces. Survey respondents also found circles suggestive of comfort, unity, and completion. Circles and curves are used in the floor plan, sections, and interior elevations to suggest these positive connotations.

Crosses have a duality like two sides of a coin; while associated with the condition of man and his struggle with mortality, it is also seen as the symbol of redemption and healing of spirit and body. Survey respondents found the cross suggestive of health and healing. The crossed circle is associated with spiritual perfection through a unity with nature, the cosmos, and supernatural forces. Crosses are used in the floor plan to suggest these positive connotations.

Fire and fireplaces are strong symbols of home and comfort and can be used to make a building appear more comfortable and home-like. Building mass is broken into smaller sections to suggest human scale, intimacy, and domesticity. Negative associations of squares are mitigated by off-center window placements and round vaulted ceilings in patient rooms. Survey respondents found round vaulted rooms more comfortable.

Triangles are associated with man's aspiration of a link to the greater cosmos and his god(s). The symbolism of the triangle as a "divine spark" or fire seems to have a strong relationship to the concept of aspiration or desire in religion and mythology. Survey respondents found the triangle suggestive of aspiration. Triangular vaults and windows, particularly in Gothic and Islamic architecture, are expressive of this aspiration toward heaven. The roof shape also has the triangular features typical of a pitched roof. The pitched roof is also a strong symbol of domesticity. Triangles are used in roof dormers, and window forms to suggest these positive connotations.

Brick, especially warm color brick, is suggestive of stability, warmth, and human scale. Survey respondents believed that brick provided more comfort than stone or concrete. Brick is used to suggest these feelings of comfort.

Window seats of patient rooms and fire exit enclosures at the ends of corridors break down building mass into smaller masses to suggest human scale, intimacy, and domesticity.

Traditional domestic appearance and use of traditional materials are easier for patients to understand and relate to (as opposed to modern architecture).

Inpatient Unit - Cognitive Aspects

The following cognitive features were incorporated to demonstrate how they could be integrated into the design of an inpatient unit.

The building is laid out as a cross with simple right angles for easy wayfinding. Exterior views from major spaces, corridors, and patient rooms ease orientation. The fireplace serves as a directional node at the crossing to assist differentiation of each suite of patient rooms. Controlled fire can also induce feelings of comfort and calm.

The design provides clear limits (edges) of the building and site to ease patients' understanding of their environment. Landmarks, such as trees, fountains, and sculptures, are provided as points of reference. The building is divided into distinct zones to aid orientation. Building mass is divided into smaller pieces to make the building more easily understandable. Interior finishes, colors, patterns, and textures vary in each suite to aid wayfinding. The unit is divided into three suites of eight patients each because groups of four to eight are especially liable to form beneficial, supportive, and constructive relationships.

Screening elements and porches make the transition between interiors and exteriors appear more secure. Building height in this model is limited to one story to avoid the negative connotations of tall buildings. This model could be built as a two story building with lower risk patients on the upper floor (with easy and safe access to outdoor spaces). The roof has broad sheltering eaves to enhance feelings of shelter and security. The prominent entry aids wayfinding and defines the access path.

Inpatient Unit - Environmental Aspects

The following environmental features were incorporated to demonstrate how they could be integrated into the design of an inpatient unit.

Natural fiber area rugs provide acoustic dampening and don't pollute. Floors underneath are wood grain vinyl (unplasticized, hard) for good appearance, easy care, and lack of pollution.

Patient gardens are oriented to take best advantage of available sunlight. Light from landscaped gardens is softer and more filtered than direct sunlight. Glazed exterior walls and transparent exterior doors fulfill the psychological and physiological need for windows. Light monitors allow natural daylight to penetrate deeply into corridors, typically the darkest part of a building. Slatted horizontal window overhangs are used to deflect direct sunlight. Transom windows at ends of corridors suggest greater space and allow additional reflected light in.

A cool color scheme is provided for corridors and common areas to promote calm. Natural color wood doors, beams and trim (warm color) are used to balance the cool color scheme and bring in natural design elements. Acoustic plaster is used on ceilings to limit noise. The seclusion room is segregated from main patient areas for acoustic control. The low wall and berm deflect some unwanted noise from the site. Wind and noise effects are also moderated by trees.

The cross shaped floor plan is used to encourage social interaction. Neutral color schemes in patient rooms allow colors, patterns, and artwork consistent with the individual patient's treatment program to be selected. Windows in patient rooms are oriented horizontally, consistent with views of nature, and survey preferences. Ventilation panels are provided on each side of windows to allow patients more control of their environment.

Inpatient Unit - Site Development Aspects

The following site development features were incorporated to demonstrate how they could be integrated into the design of an inpatient unit.

Patients have direct, unobstructed access to gardens. All major spaces and patient rooms have views to gardens. Window seats in patient rooms and covered porches allow patients to experience nature, even during foul weather. The pool helps attract wildlife (especially birds) and can host fish and amphibians for patient encounters. Views of water are known to have a calming influence. Garden plots are available to implement a gardening therapy program. The use of a "ha-ha" allows views to extend beyond the site. Animal feeders are placed among the landscaping to attract wildlife (birds and squirrels).

Outpatient Clinic - Security Aspects

The following security features were incorporated to demonstrate how they could be integrated into the design of an inpatient unit.

The prominent entry gives clear expression of the approved entry to the clinic. The rear section of the reception and administration area acts as a security checkpoint. The reception area is centrally located to allow observation of all main spaces, approaches, corridors, and gardens. This arrangement also allows the staff to observe patients as they approach the facility, and then "buzz" them in at the entry. Clear doors to office suites allow observation of all public areas in the clinic. There is a clear differentiation of security zones, from public to private, with clear control points where these zones intersect.

Toilets are located near the reception area to minimize risk of patients and staff being assaulted, and to deter patient self injury. Utility centers in locked cabinets in corridors allow electricity and water to be cut off to toilets. All fire exits from patient zones, while operable from the interior, are inoperable from the exterior to prevent unauthorized access. Walls adjacent to the reception area are transparent to allow observation.

The Key Aspect

The key design element that allows the requirements to harmonize is the cross form. It optimizes observation, exposure to nature, views, and natural light, and provides a clear understandable form. When the cross form is combined with the pitched roof, it is possible to develop an environment suggestive of comfort. Other features such as round vaulted ceilings and curved interior forms can be integrated into this basic framework to increase the suggestion of comfort.

Drawings and Annotations

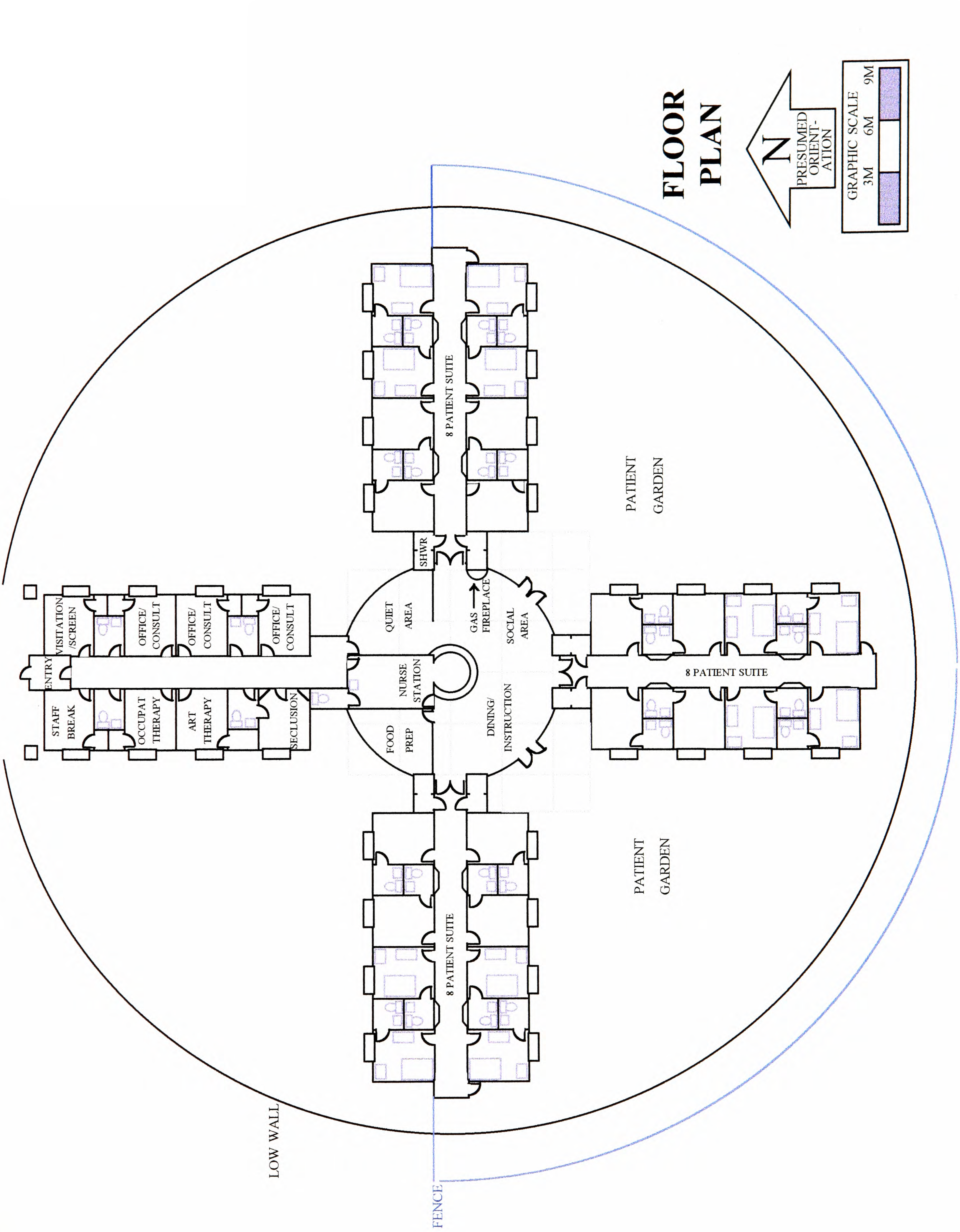
The first set of drawings of the inpatient unit and outpatient clinic is provided without annotations to allow a clear view of details. The second set of drawings is provided with annotations to allow a clear understanding of design principles. Again, the security tab is the only set of annotations provided for the outpatient clinic because aside from security, the other design requirements are substantially similar to the inpatient unit design. (Please note that these drawings and annotations are arranged facing each other in book leaf fashion for the convenience of the reader.)

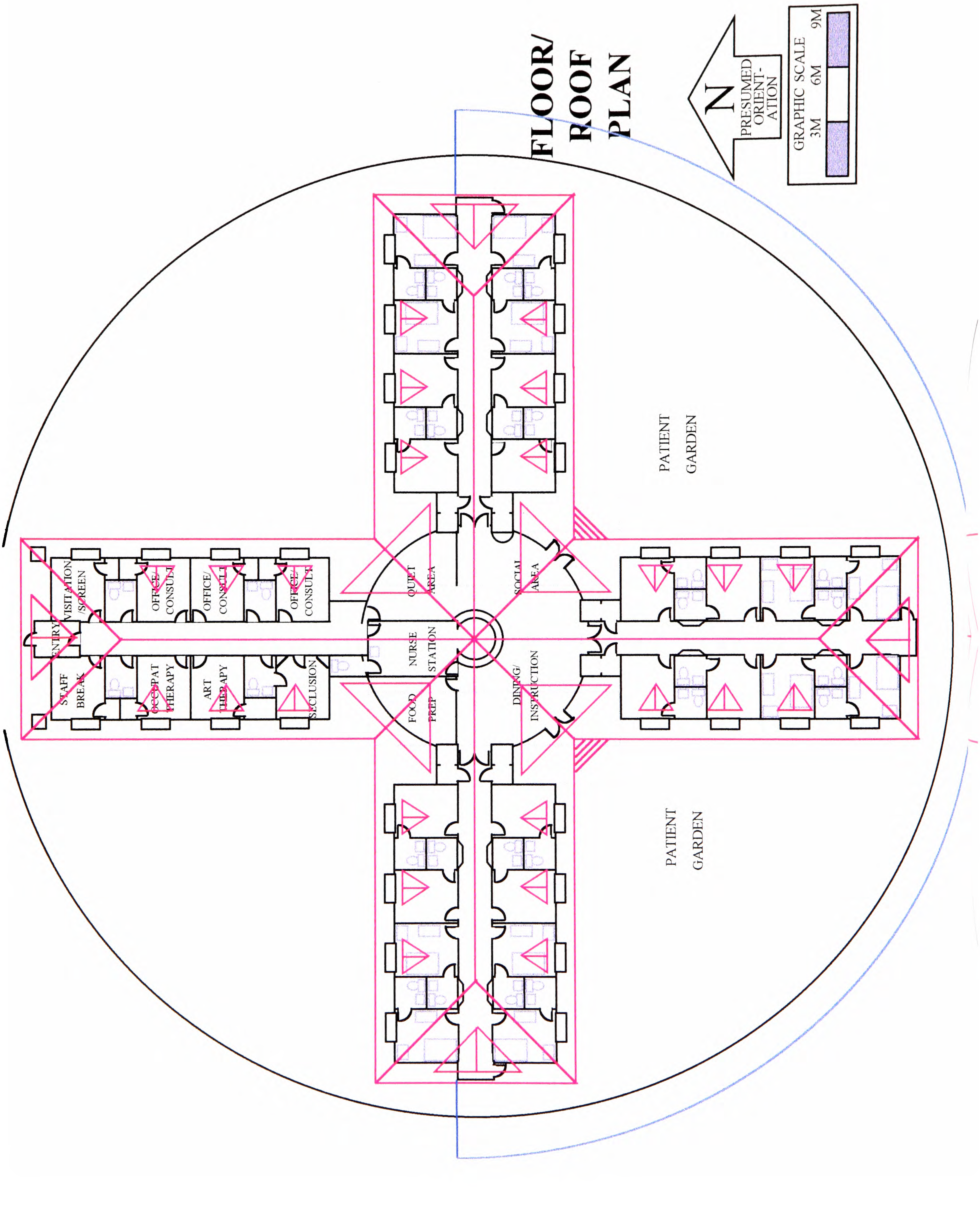
INPATIENT UNIT
DEMONSTRATION OF DESIGN PRINCIPLES

THE FIRST SET OF DRAWINGS ARE PROVIDED WITHOUT ANNOTATIONS TO ALLOW A CLEAR VIEW OF DETAILS.

THE SECOND SET OF DRAWINGS ARE PROVIDED WITH ANNOTATIONS TO ALLOW A CLEAR UNDERSTANDING OF DESIGN PRINCIPLES.

* THESE DRAWINGS ARE PROVIDED AS A DEMONSTRATION OF DESIGN PRINCIPLES AND NOT AS A DEFINITIVE DESIGN OR PROTOTYPE. EVERY SITE AND BUILDING PROGRAM ARE DIFFERENT AND REQUIRE THEIR OWN DESIGN SOLUTION.


FLOOR PLAN
N
PRESUMED ORIENT-ATION
GRAPHIC SCALE
3M
6M
9M
8 PATIENT SUITE
8 PATIENT SUITE
8 PATIENT SUITE
PATIENT GARDEN
PATIENT GARDEN
SHWR
QUIET AREA
GAS FIREPLACE
SOCIAL AREA
NURSE STATION
DINING/ INSTRUCTION
FOOD PREP
ENTRY
VISITATION /SCREEN
OFFICE/ CONSULT
OFFICE/ CONSULT
OFFICE/ CONSULT
STAFF BREAK
OCCUPAT THERAPY
ART THERAPY
SECLUSION
LOW WALL
FENCE


FLOOR/
ROOF
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GRAPHIC SCALE
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VISITATION
/SCREEN
STAFF
BREAK
OFFICE/
CONSULT
OFFICE/
CONSULT
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CONSULT
OCCUPAT
THERAPY
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AREA
SOCIAL
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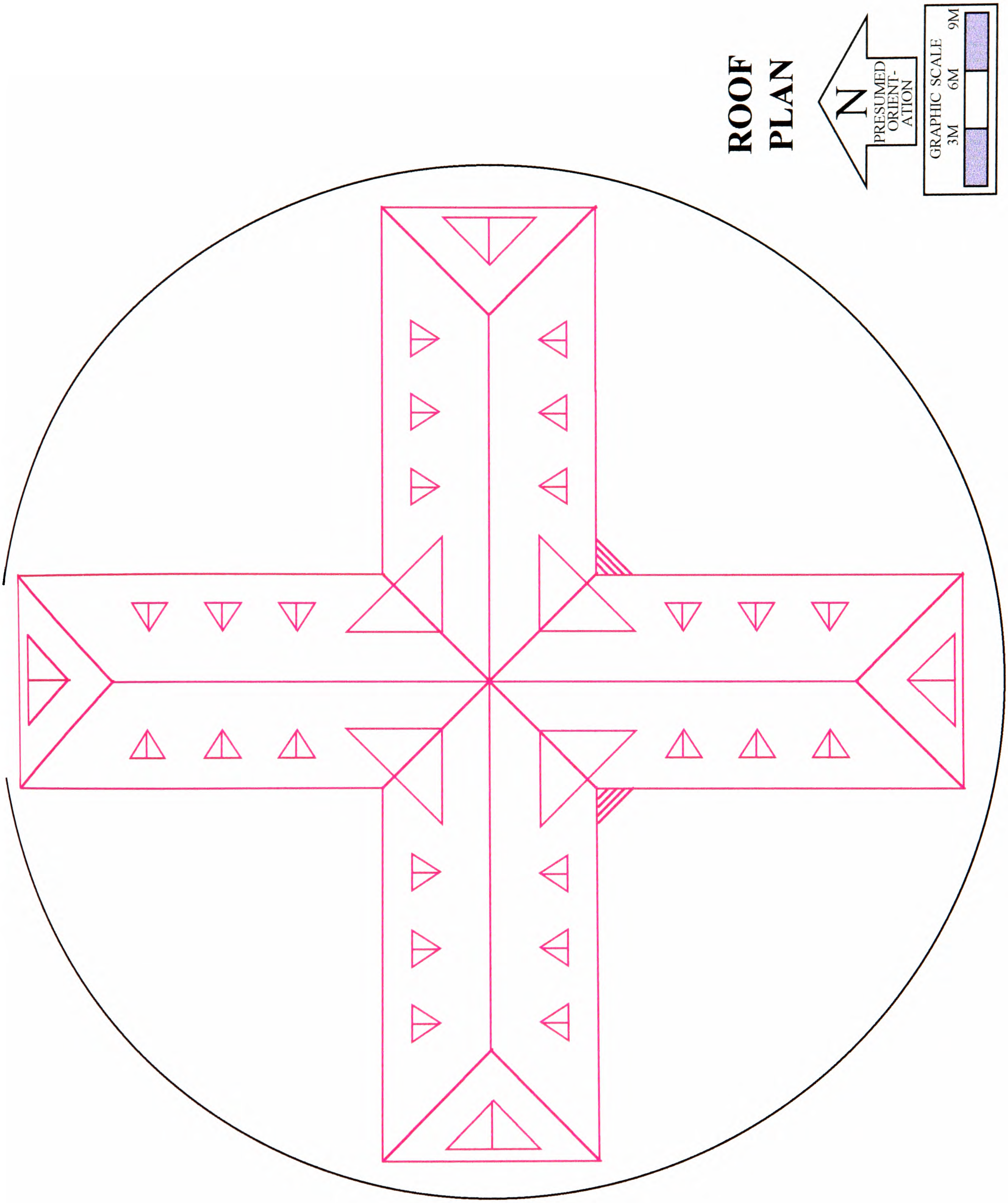
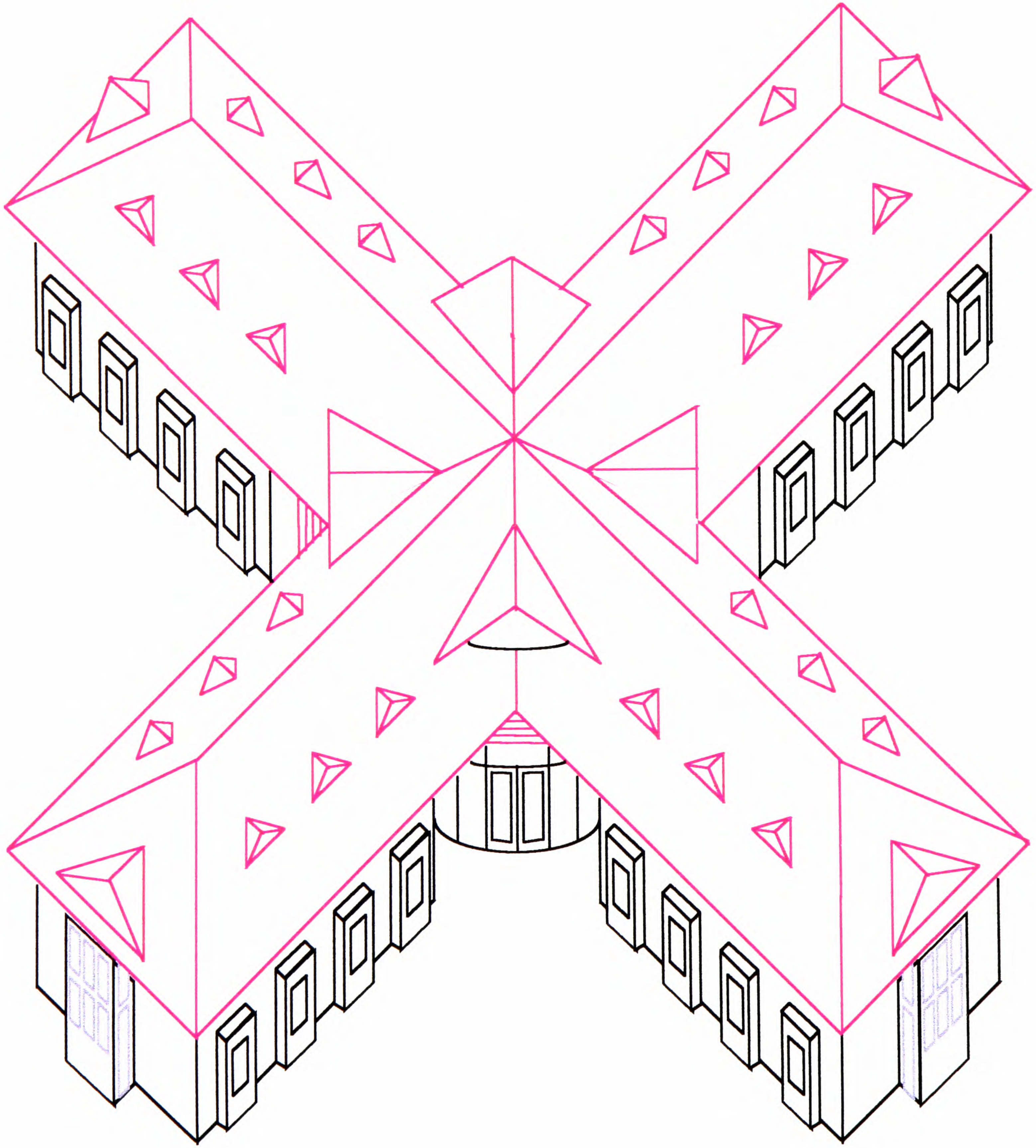
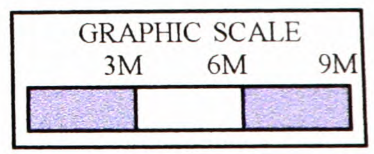
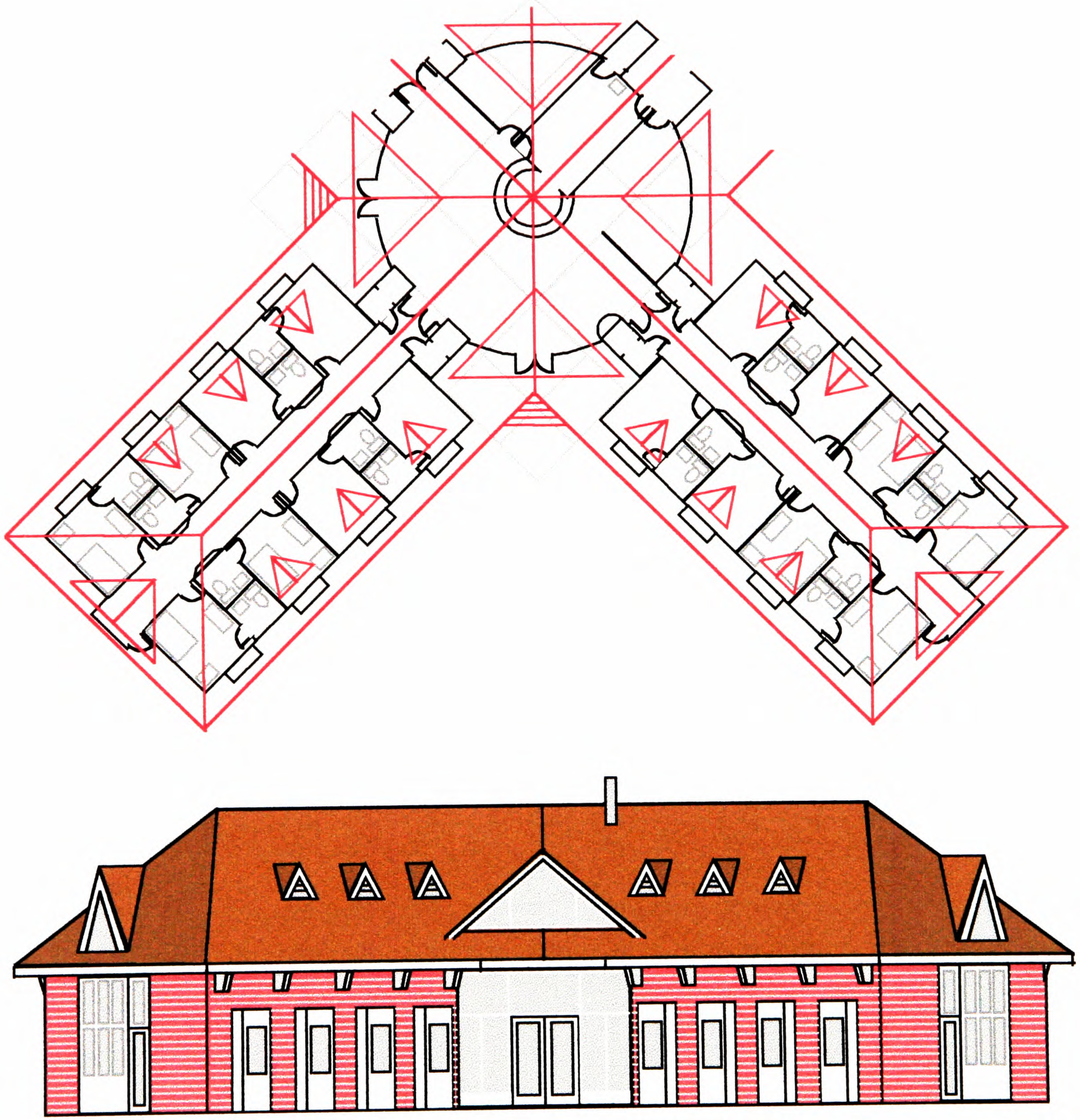
NURSE
STATION
FOOD
PREP
DINING/
INSTRUCTION


ROOF PLAN
N
PRESUMED ORIENT-ATION
GRAPHIC SCALE
3M 6M 9M

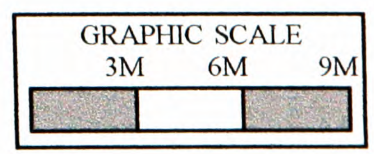


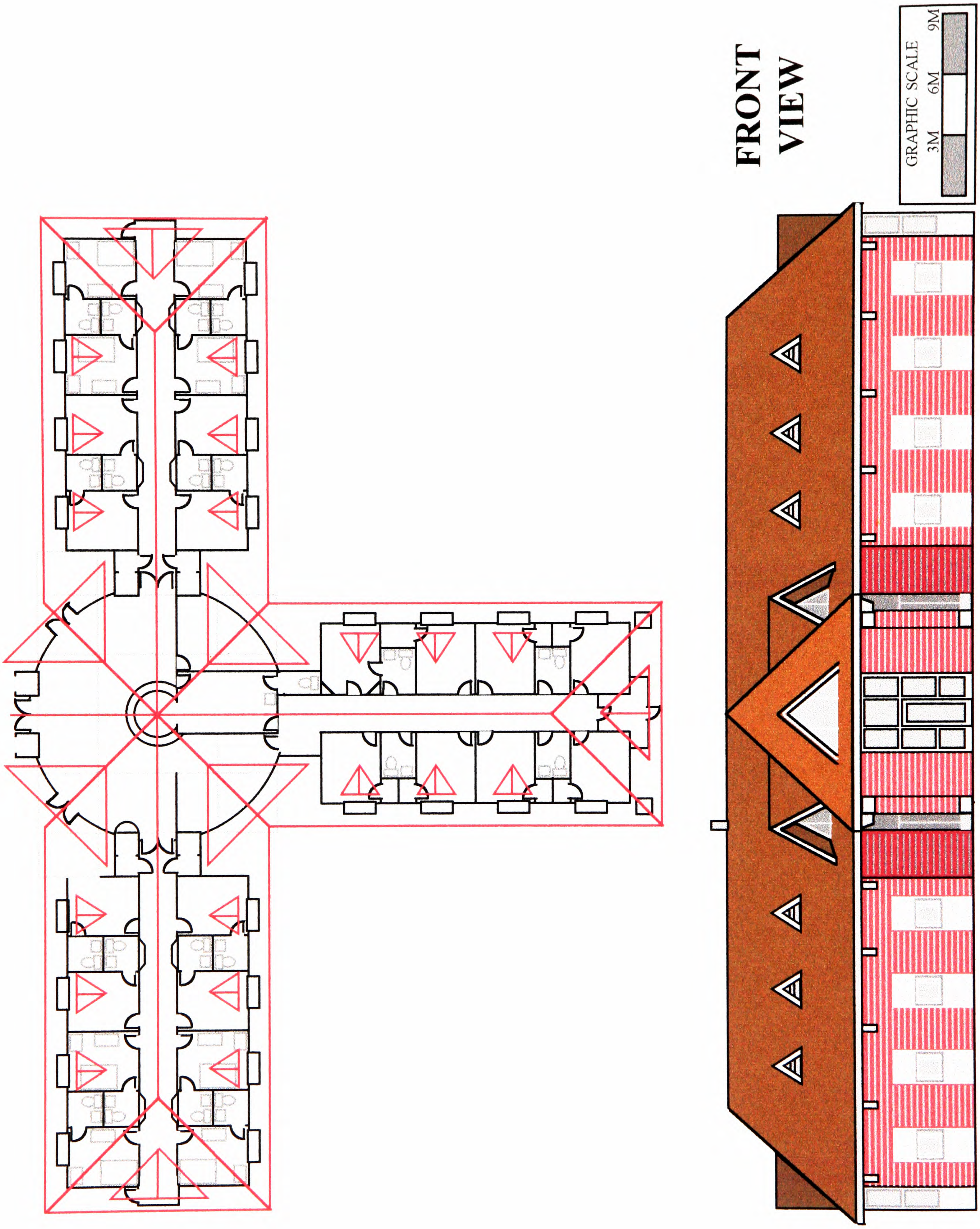
ISOMETRIC VIEW

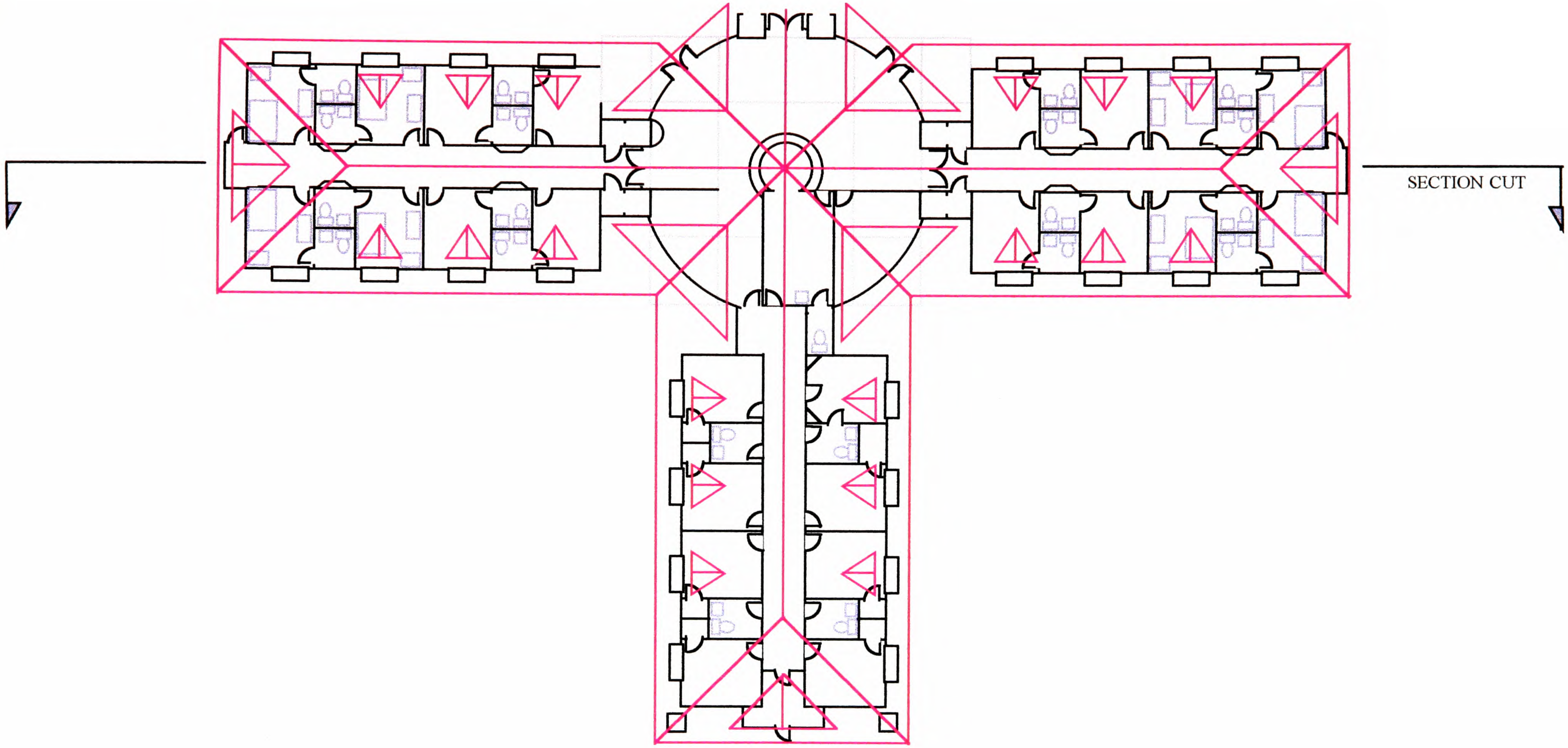


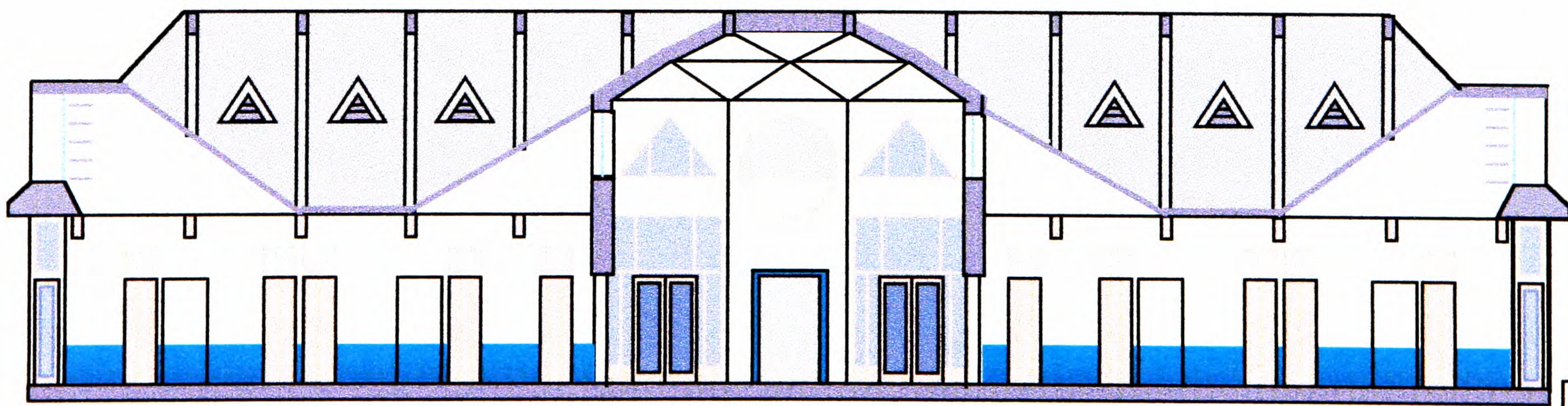


OBLIQUE VIEW



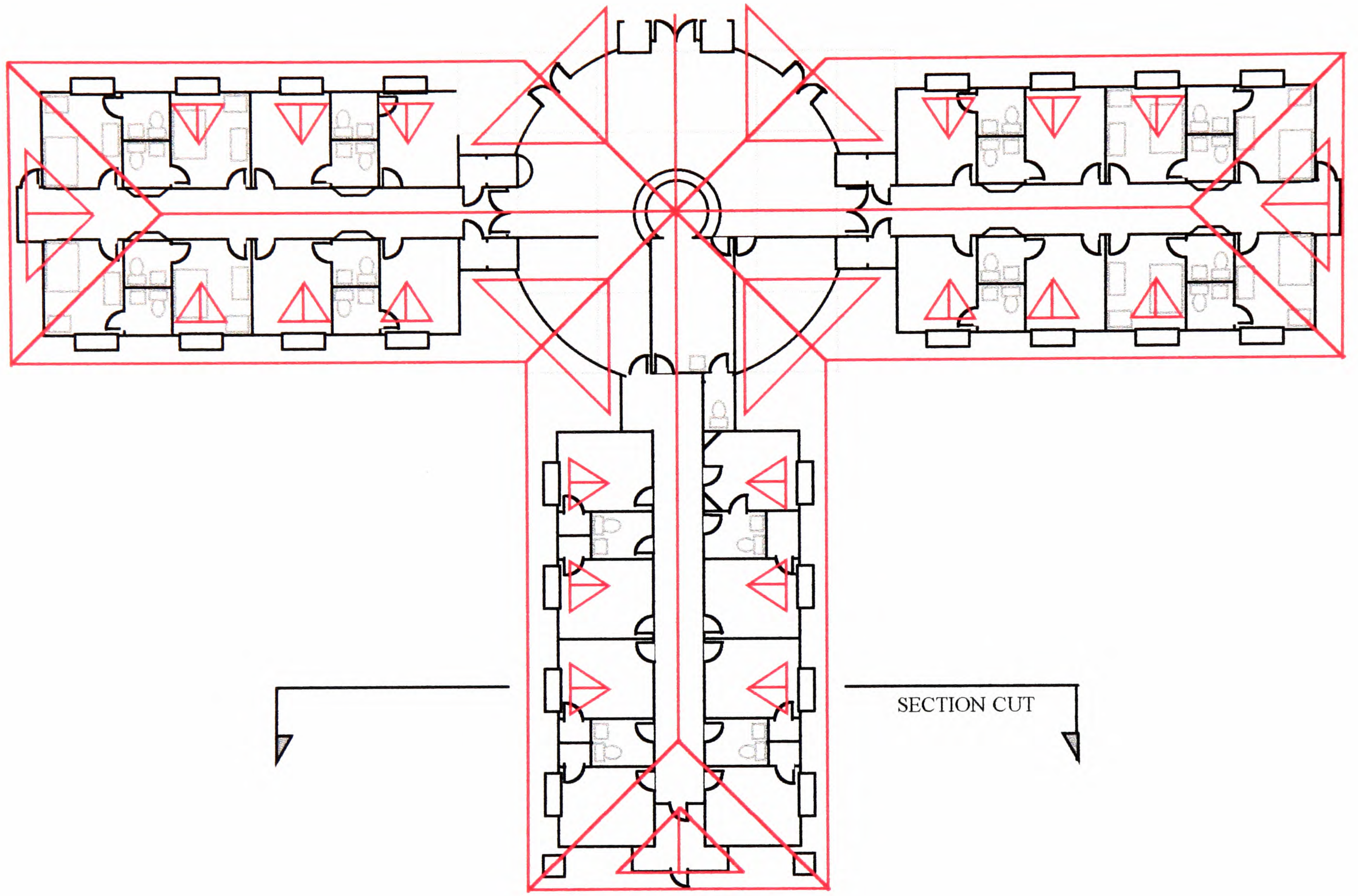

FRONT VIEW
GRAPHIC SCALE
3M
6M
9M

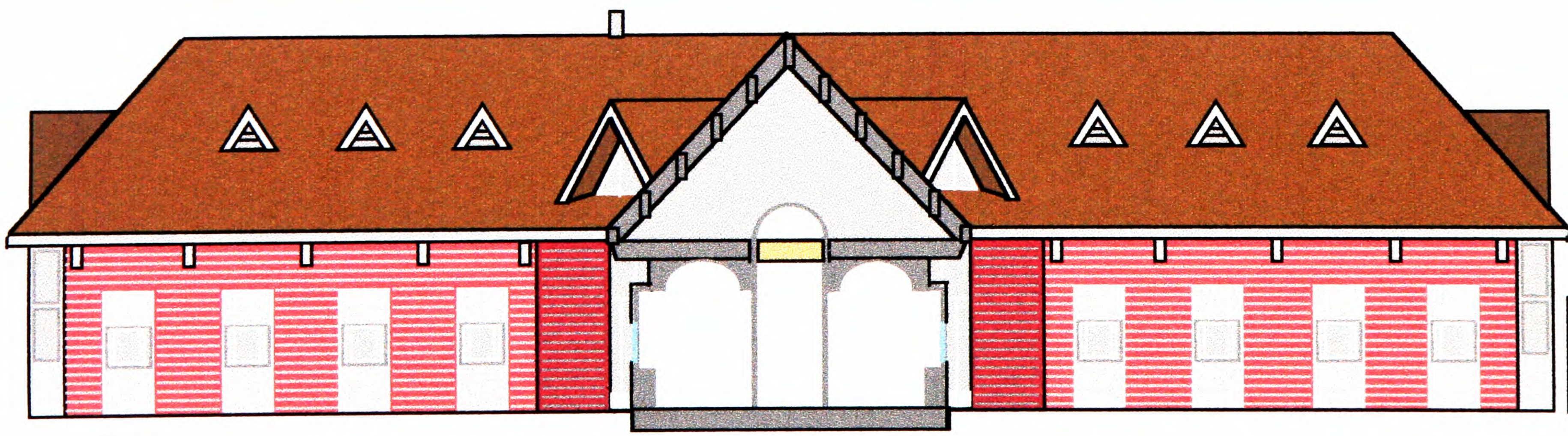




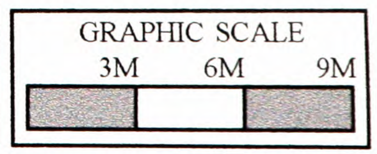
LONG SECTION VIEW

GRAPHIC SCALE
3M 6M 9M

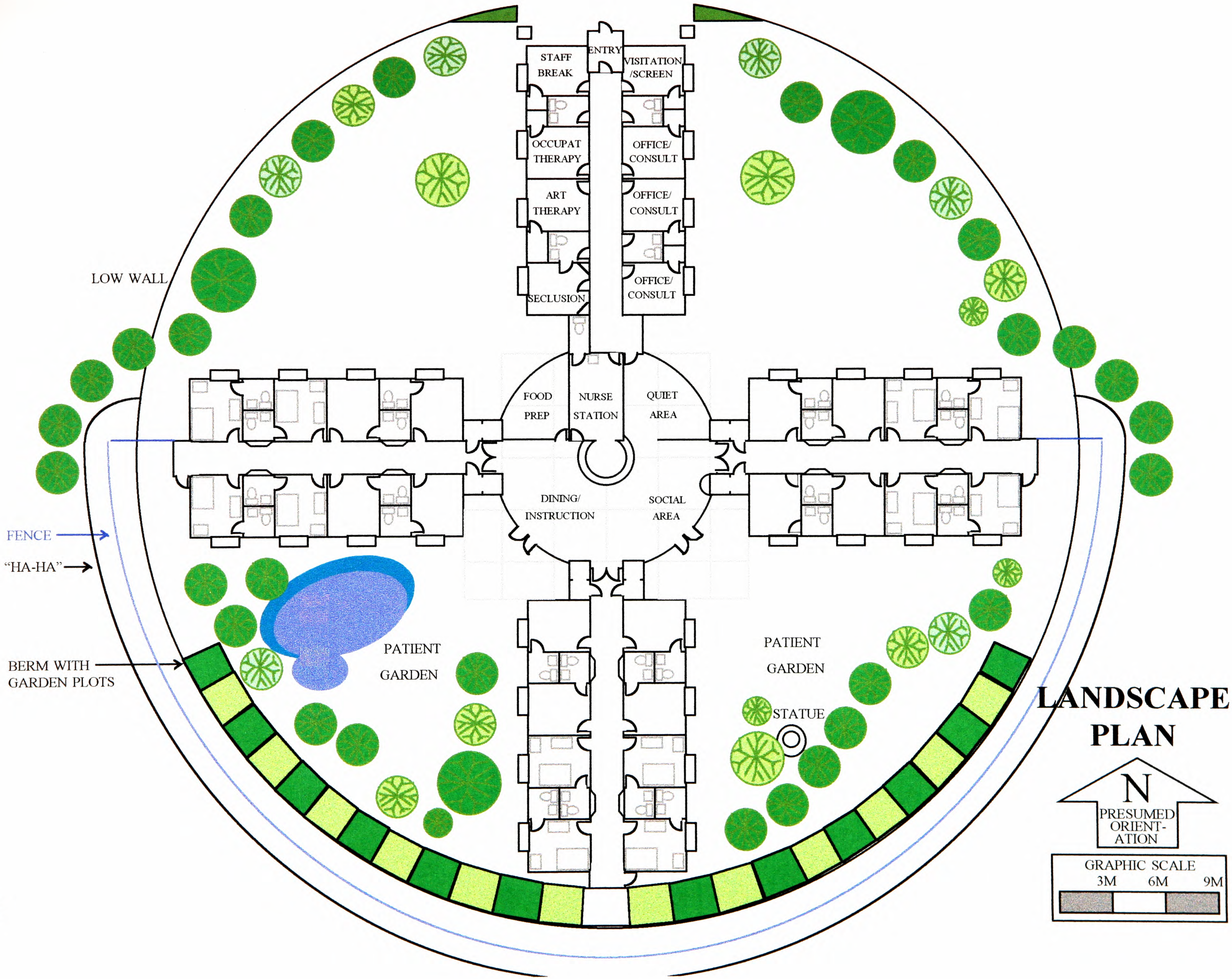




SHORT SECTION VIEW



LANDSCAPE PLAN



INPATIENT UNIT
SECURITY TAB A

1 - PROMINENT ENTRY GIVES CLEAR EXPRESSION THAT THIS IS THE APPROVED ACCESS TO UNIT (OPENED BY NURSE KEY).
- THE VISITATION/SCREENING ROOM ADJACENT TO PREVENT CONTRABAND ITEMS FROM ENTERING UNIT.

2 - SECLUSION ROOM NEXT TO NURSE STATION FOR EASY MONITORING.

3 - REAR SECTION OF NURSE STATION ACTS AS SECURITY CHECK-POINT AND HAS *IN SUITE* TOILET AND LAVATORY.

4 - CORE OF NURSE STATION CENTRALLY LOCATED TO ALLOW OBSERVATION OF ALL MAIN SPACES, CORRIDORS AND GARDENS.

5 - CLEAR DOORS TO PATIENT SUITES ALLOW OBSERVATION.

6 - SHOWERS NEAR NURSE STATION MINIMIZE RISK OF PATIENTS BEING ASSAULTED. ALSO MINIMIZES RISK OF PATIENT HANGING.

7 - PRIVATE ROOMS WITH *IN SUITE* TOILET MINIMIZES RISK OF PATIENTS BEING ASSAULTED.
- ROOMS HAVE SOLID CEILINGS TO PREVENT ABSCONDING

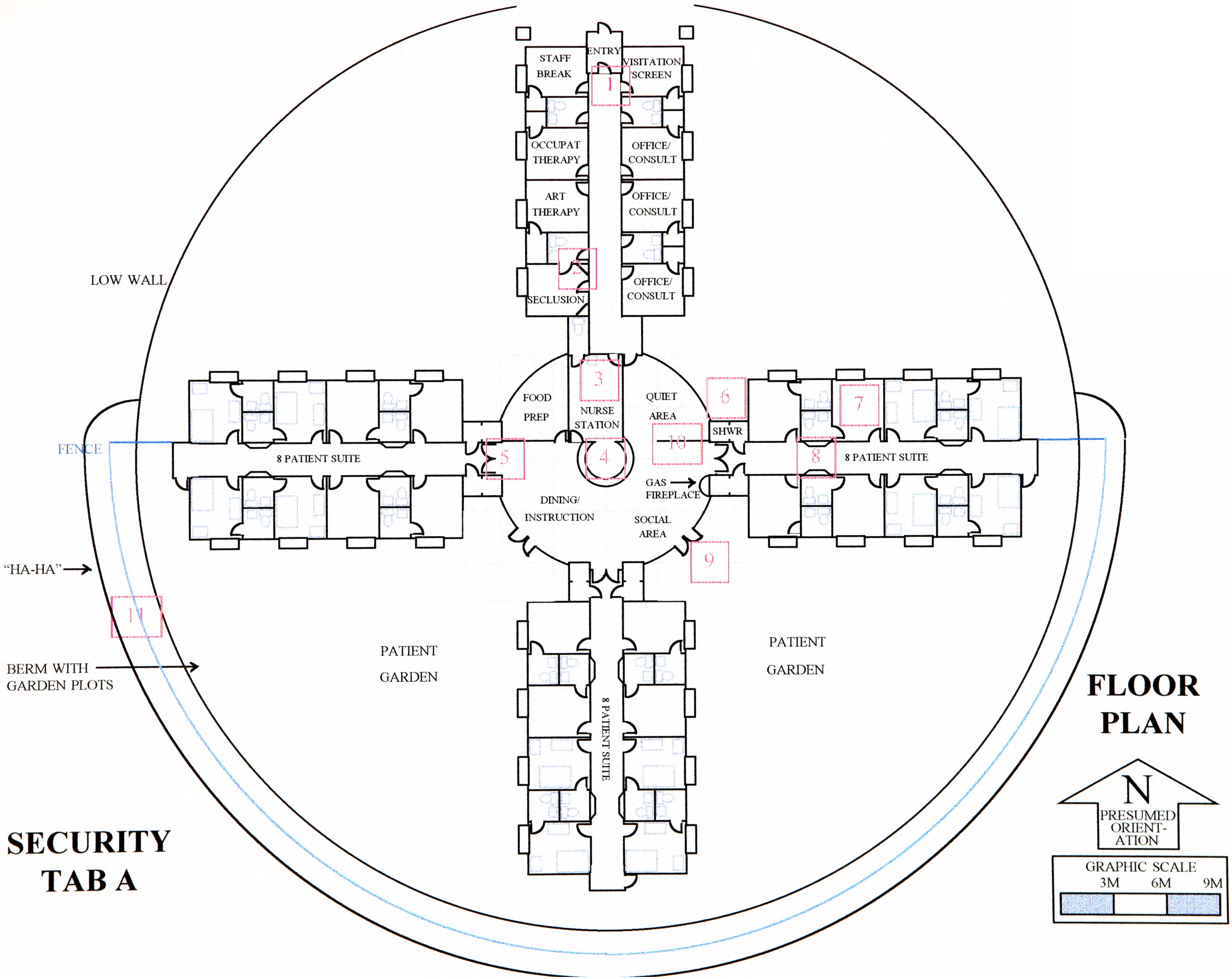
8 - UTILITY CENTERS IN LOCKED CABINETS IN CORRIDOR ALLOW ELECTRICITY AND WATER TO BE CUT OFF FOR ANY PATIENT ROOM.

9 - ALL FIRE EXITS FROM PATIENT ZONES LEAD TO A SECURE GARDEN AREA.

10 - WALLS AROUND NURSE STATION AND ADJACENT WALLS ARE TRANSPARENT TO ALLOW OBSERVATION.

11 - COMBINATION OF BERM & “HA-HA” REDUCE VISUAL IMPACT OF FENCE.

FLOOR PLAN



SECURITY TAB A

INPATIENT UNIT
SECURITY TAB B

12 - HIGH ROOF EAVES DETER PATIENT ACCESS TO ROOF.

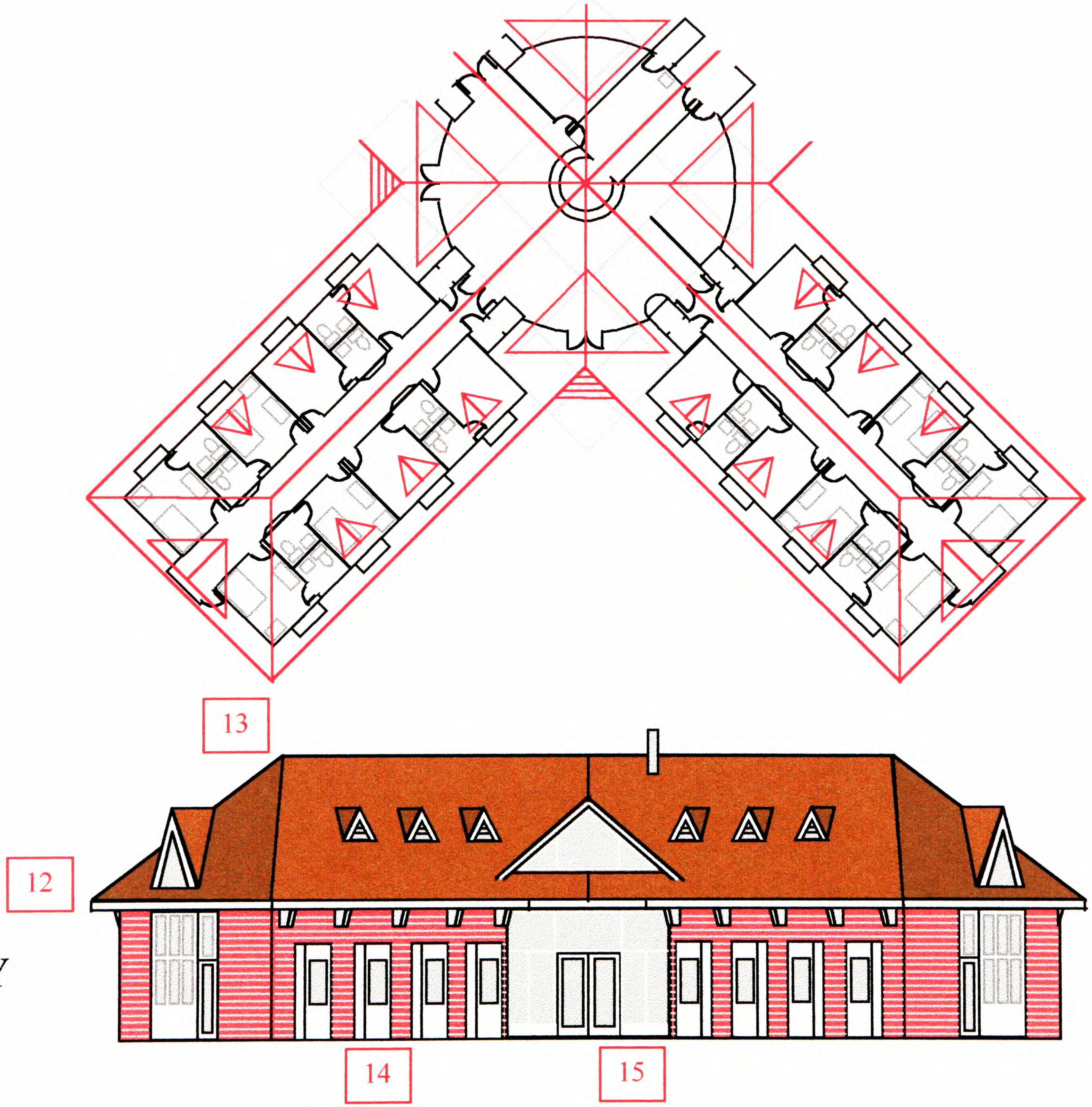
13 - RELATIVELY STEEP ROOF SLOPE DETERS PATIENTS FROM ABSCONDING OVER THE ROOF. AVOID TACTILE ROOFING MATERIALS SUCH AS CLAY OR CONCRETE TILES THAT ARE EASY TO GRIP.

14 - POLYCARBONATE WINDOWS ARE GENERALLY SHATTERPROOF AND DETER PATIENTS FROM ABSCONDING.

15 - LARGE GLAZED AREAS ALLOW EASY MONITORING OF GARDENS FROM THE NURSING STATION.

SECURITY TAB B

OBLIQUE VIEW



INPATIENT UNIT
SECURITY TAB C
(ZONES)

1 - PUBLIC ZONE INCLUDES THE PARKING AREAS, LOBBIES, OUT-PATIENT PHARMACY SERVICE AREAS, AND RECEPTION AREAS..

2 - SEMI-PUBLIC ZONE INCLUDES OUTPATIENT DIAGNOSTIC AND TREATMENT AREAS (INCLUDING DAY HOSPITAL) PHARMACY DEPARTMENTS, OUTPATIENT GROUP ROOMS, OUTPATIENT DINING AREAS, OUTPATIENT TOILETS, AND PROVIDER OFFICES.

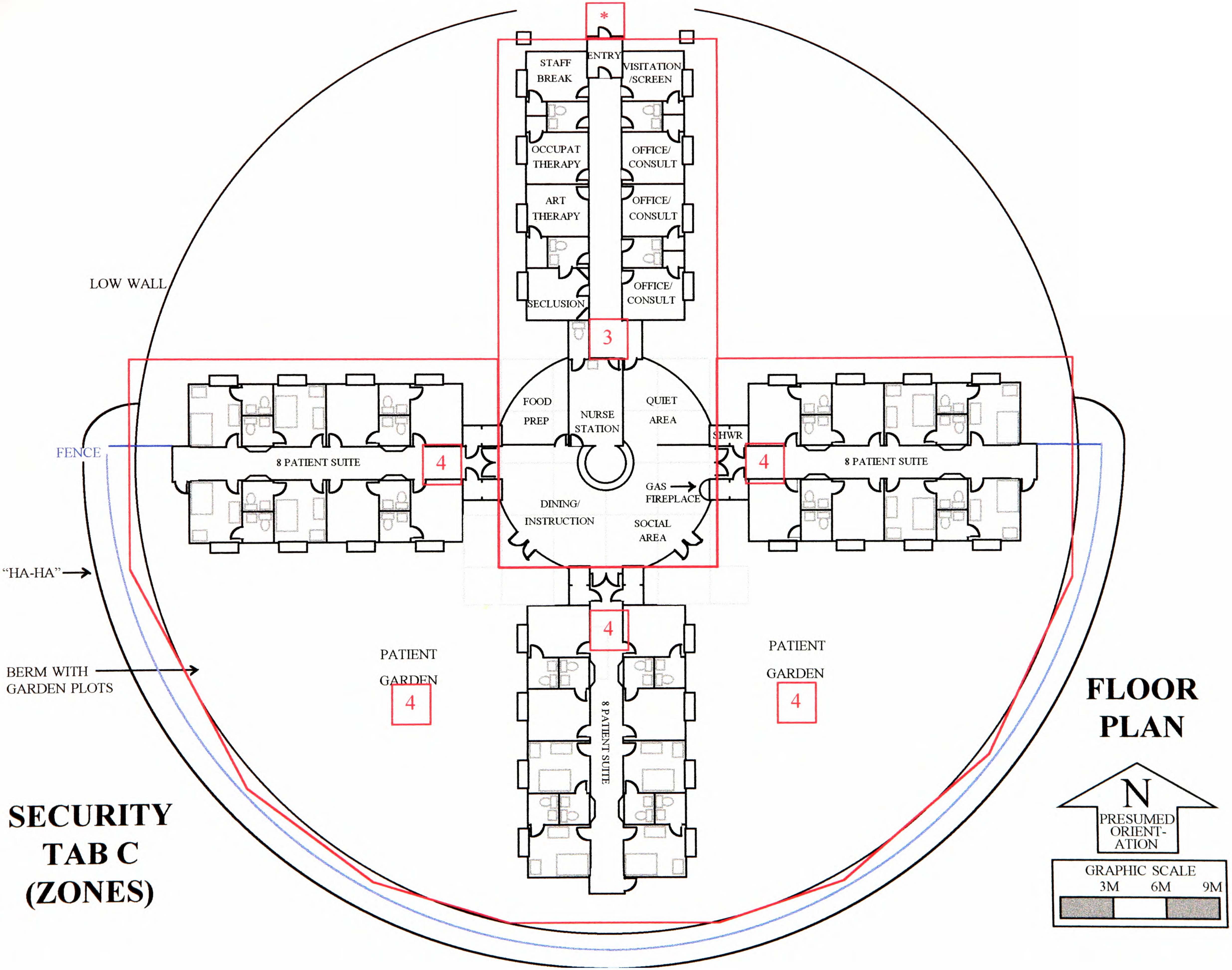
3 - SEMI-PRIVATE ZONES INCLUDES WARD SUPPORT SPACES SUCH AS NURSING STATIONS, NURSING SUPPLY ROOMS, DAYROOMS, VISITATION ROOMS, INPATIENT DINING AREAS, INPATIENT DIAG-NOSTIC AND TREATMENT AREAS, AND SECLUSION ROOMS.

4 - PRIVATE ZONE INCLUDES PATIENT GARDENS, BED ROOMS, TOILETS & SHOWER ROOMS, AND SECURED LINEN CLOSETS/UTILITY CENTERS

* - PLEASE NOTE THAT IF THIS BUILDING WERE CONNECTED TO A DISTRICT GENERAL HOSPITAL AND/OR A CLINIC ZONES 1 & 2 WOULD BE IN THE DISTRICT GENERAL HOSPITAL AND/OR CLINIC. IF THIS BUILDING WERE A STAND ALONE UNIT, THERE WOULD ONLY BE A PUBLIC ZONE AT THE ENTRY AND NO SEMI-PUBLIC ZONE.

SECURITY TAB C (ZONES)

FLOOR PLAN



INPATIENT UNIT
FIRE SAFETY TAB

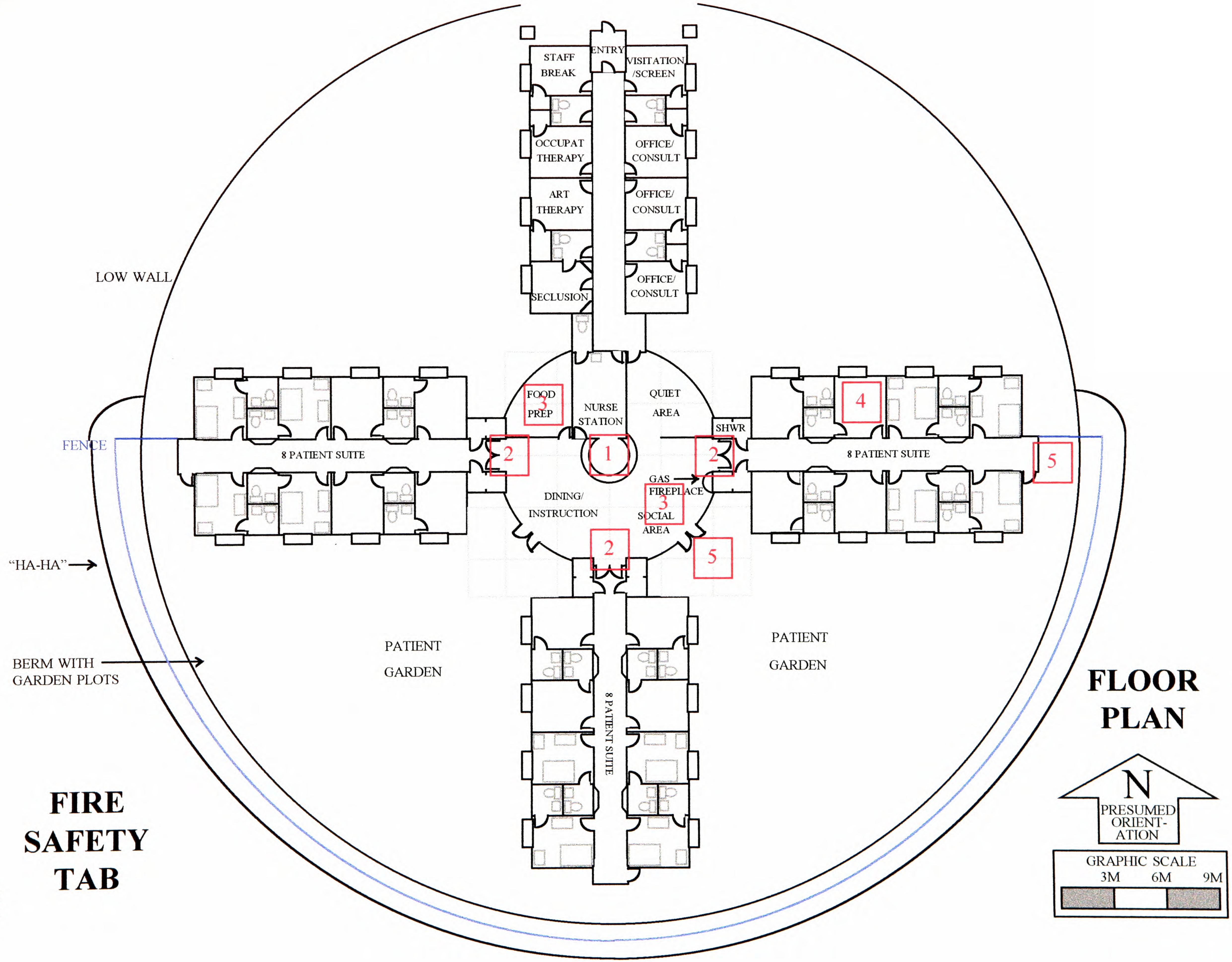
1 - NURSE STATION IS THE LOCATION OF ALL ALARM PANELS AND FIRE PROTECTION SYSTEM CONTROLS AND OVER-RIDES.

2 - 24 BED UNIT IS DIVIDED INTO THREE SMALLER SMOKE COMPARTMENTS TO PREVENT THE SPREAD OF SMOKE (THE LEADING CAUSE OF DEATH IN FIRES).

3 - ALTHOUGH THE FACILITY IS FULLY SPRINKLERED, HIGH RISK AREAS SUCH AS SMOKING AND FOOD PREP AREAS ARE PROTECTED BY MANUAL SPRINKLERS OPERATED FROM THE NURSE STATION.

4 - ALL ROOMS PROTECTED BY SMOKE ALARMS WITH LOCAL REPORT AND NOTIFICATION ON AN ANNUNCIATOR PANEL IN THE NURSE STATION.

5 - ALL FIRE EXITS FROM PATIENT ZONES LEAD TO A SECURE GARDEN AREA.
- FIRE EXITS CLEARLY MARKED, VISIBLE AND ACCESSIBLE.



ENTRY
STAFF BREAK
VISITATION /SCREEN
OCCUPAT THERAPY
OFFICE/ CONSULT
ART THERAPY
OFFICE/ CONSULT
SECLUSION
OFFICE/ CONSULT
LOW WALL
FOOD PREP
NURSE STATION
QUIET AREA
SHWR
8 PATIENT SUITE
8 PATIENT SUITE
FENCE
DINING/ INSTRUCTION
GAS FIREPLACE
SOCIAL AREA
"HA-HA"
PATIENT GARDEN
PATIENT GARDEN
BERM WITH GARDEN PLOTS
8 PATIENT SUITE
1
2
2
2
3
3
4
5
5
FLOOR PLAN
N
PRESUMED ORIENT- ATION
GRAPHIC SCALE
3M 6M 9M
FIRE SAFETY TAB

INPATIENT UNIT
SYMBOLISM TAB A

1 - CIRCLES ASSOCIATED WITH THE UNIVERSE'S LIFE GIVING AND NURTURING FORCES. SURVEY RESPONDENTS ALSO FOUND THE CIRCLE SUGGESTIVE OF COMFORT, UNITY, & COMPLETION.

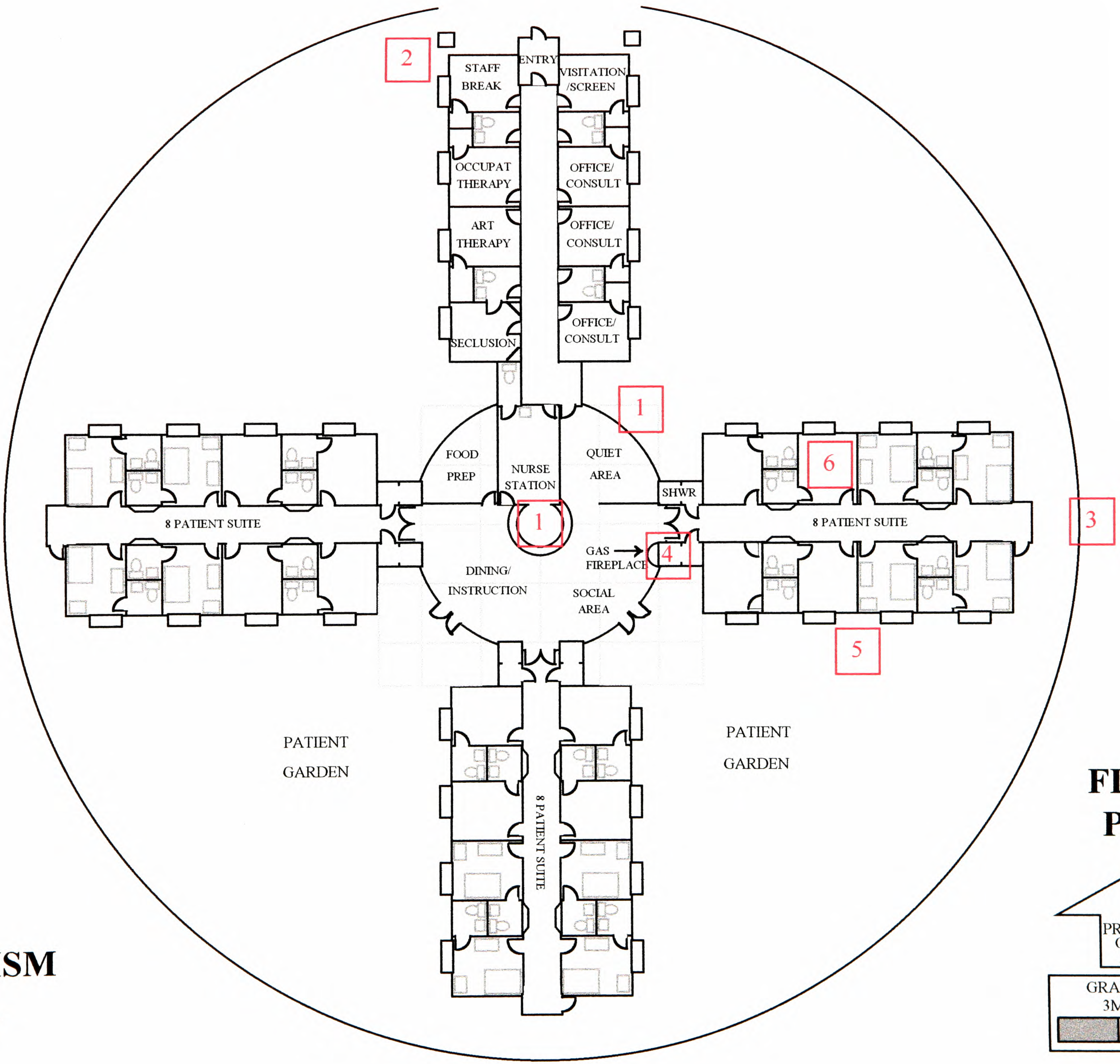
2 - CROSSES HAVE A DUALITY LIKE TWO SIDES OF A COIN. WHILE ASSOCIATED WITH THE CONDITION OF MAN AND HIS STRUGGLE WITH MORTALITY, IT IS ALSO SEEN AS THE SYMBOL OF REDEMPTION AND HEALING OF SPIRIT AND BODY. SURVEY RESPONDENTS FOUND THE CROSS SUGGESTIVE OF HEALTH AND HEALING.

3 - THE CROSSED CIRCLE IS ASSOCIATED WITH SPIRITUAL PERFECTION THROUGH A UNITY WITH NATURE, THE COSMOS, AND SUPERNATURAL FORCES.

4 - FIRE AND FIREPLACES ARE STRONG SYMBOLS OF HOME AND COMFORT.

5 - BUILDING MASS BROKEN INTO SMALLER BUILDINGS TO SUGGEST HUMAN SCALE, INTIMACY AND DOMESTICITY.

6 - NEGATIVE ASSOCIATIONS OF SQUARES MITIGATED BY OFF CENTER WINDOW PLACEMENTS AND ROUND VAULTED CEILINGS. SURVEY RESPONDENTS FOUND ROUND VAULTED ROOMS MORE COMFORTABLE.



FLOOR PLAN

N
PRESUMED ORIENT-ATION

GRAPHIC SCALE
3M 6M 9M

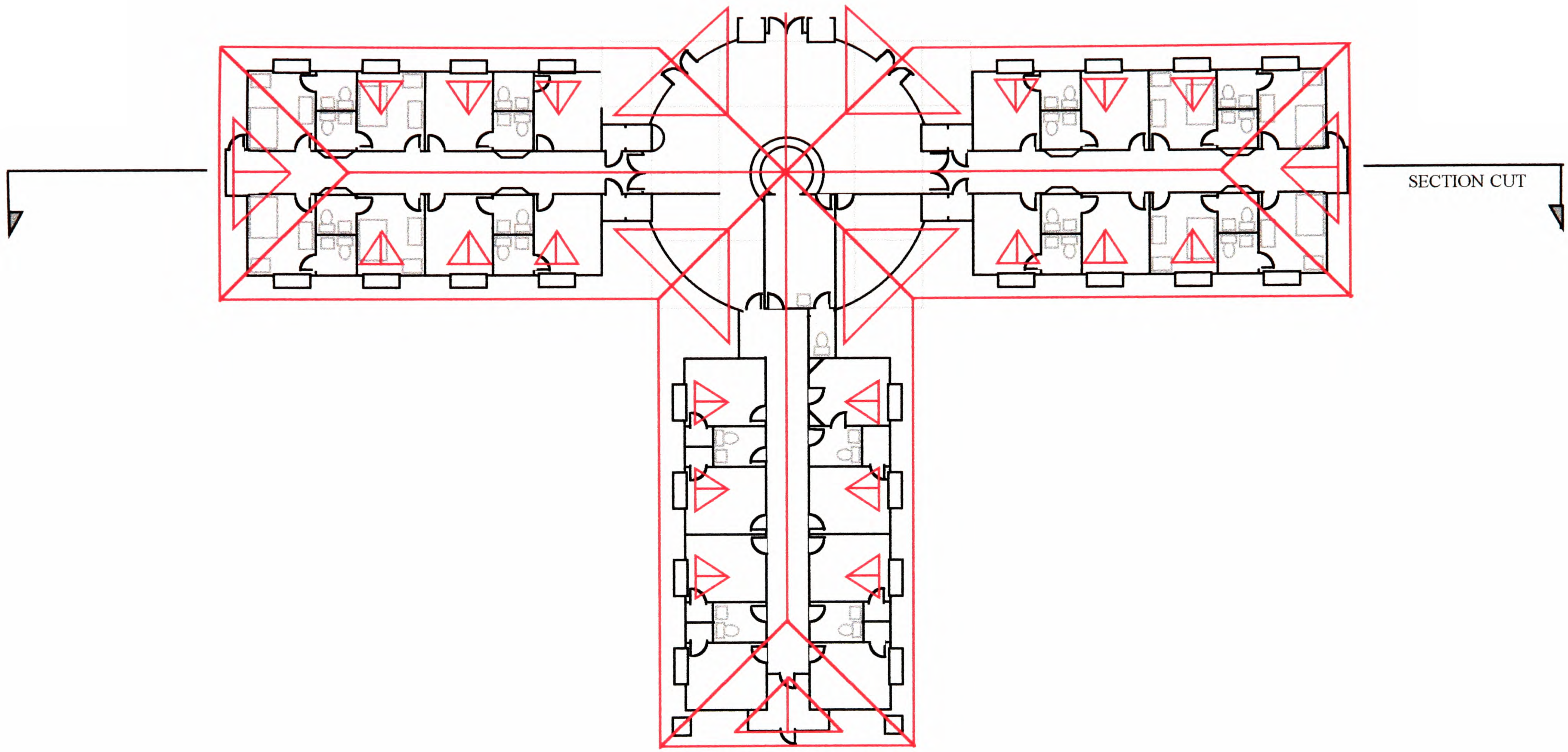
SYMBOLISM TAB A

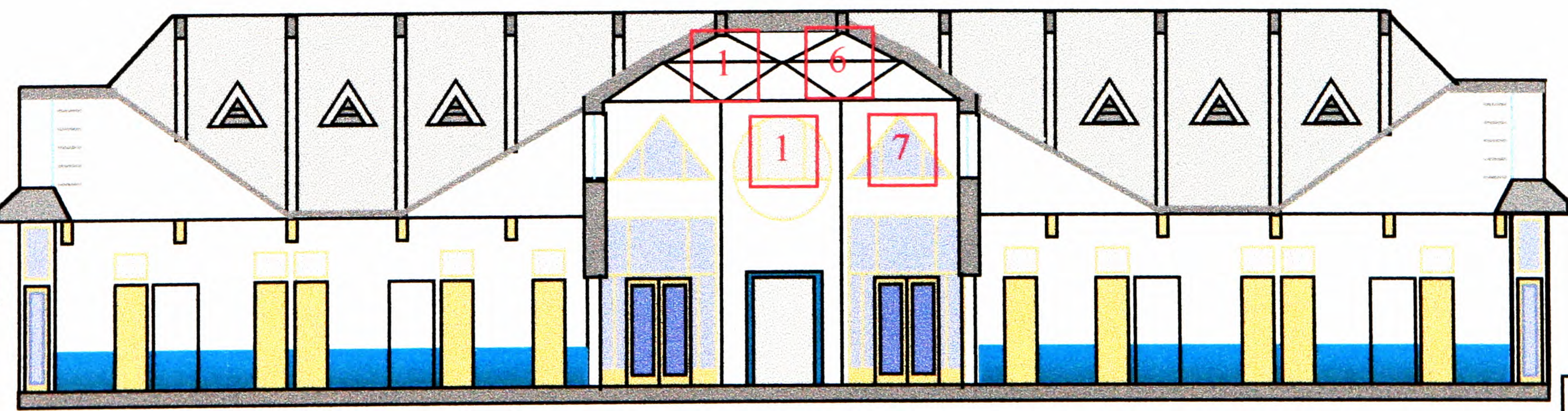
INPATIENT UNIT
SYMBOLISM TAB B

1 - CIRCLES ASSOCIATED WITH THE UNIVERSE'S LIFE GIVING AND NURTURING FORCES. SURVEY RESPONDENTS ALSO FOUND THE CIRCLE SUGGESTIVE OF COMFORT, UNITY, & COMPLETION.

6 - NEGATIVE ASSOCIATIONS OF SQUARES MITIGATED BY OFF CENTER WINDOW PLACEMENTS AND ROUND VAULTED CEILINGS. SURVEY RESPONDENTS FOUND ROUND VAULTED ROOMS MORE COMFORTABLE.

7 - TRIANGLE ASSOCIATED WITH MAN'S ASPIRATION TO A LINK TO THE GREATER COSMOS AND HIS GOD(S). THE SYMBOLISM OF THE TRIANGLE AS A "DIVINE SPARK" OR FIRE SEEMS TO HAVE A STRONG RELATION TO THE CONCEPT OF ASPIRATION OR DESIRE IN RELIGION AND MYTHOLOGY. SURVEY RESPONDENTS FOUND THE TRIANGLE SUGGESTIVE OF ASPIRATION.





SYMBOLISM TAB B

LONG SECTION VIEW

GRAPHIC SCALE
3M 6M 9M

INPATIENT UNIT
SYMBOLISM TAB C

7 - TRIANGLE ASSOCIATED WITH MAN'S ASPIRATION TO A LINK TO THE GREATER COSMOS AND HIS GOD(S). THE SYMBOLISM OF THE TRIANGLE AS A "DIVINE SPARK" OR FIRE SEEMS TO HAVE A STRONG RELATION TO THE CONCEPT OF ASPIRATION OR DESIRE IN RELIGION AND MYTHOLOGY. SURVEY RESPONDENTS FOUND THE TRIANGLE SUGGESTIVE OF ASPIRATION.

- ROOF AND MECHANICAL VENTS, AND LIGHT MONITORS HAVE BEEN RENDERED THE TRADITIONAL SHAPE OF TRIANGULAR DORMERS.

8 - THE ROOF SHAPE IS ALSO HAS THE TRIANGULAR FEATURES TYPICAL OF A PITCHED ROOF. THE PITCHED ROOF IS ALSO A STRONG SYMBOL OF DOMESTICITY.

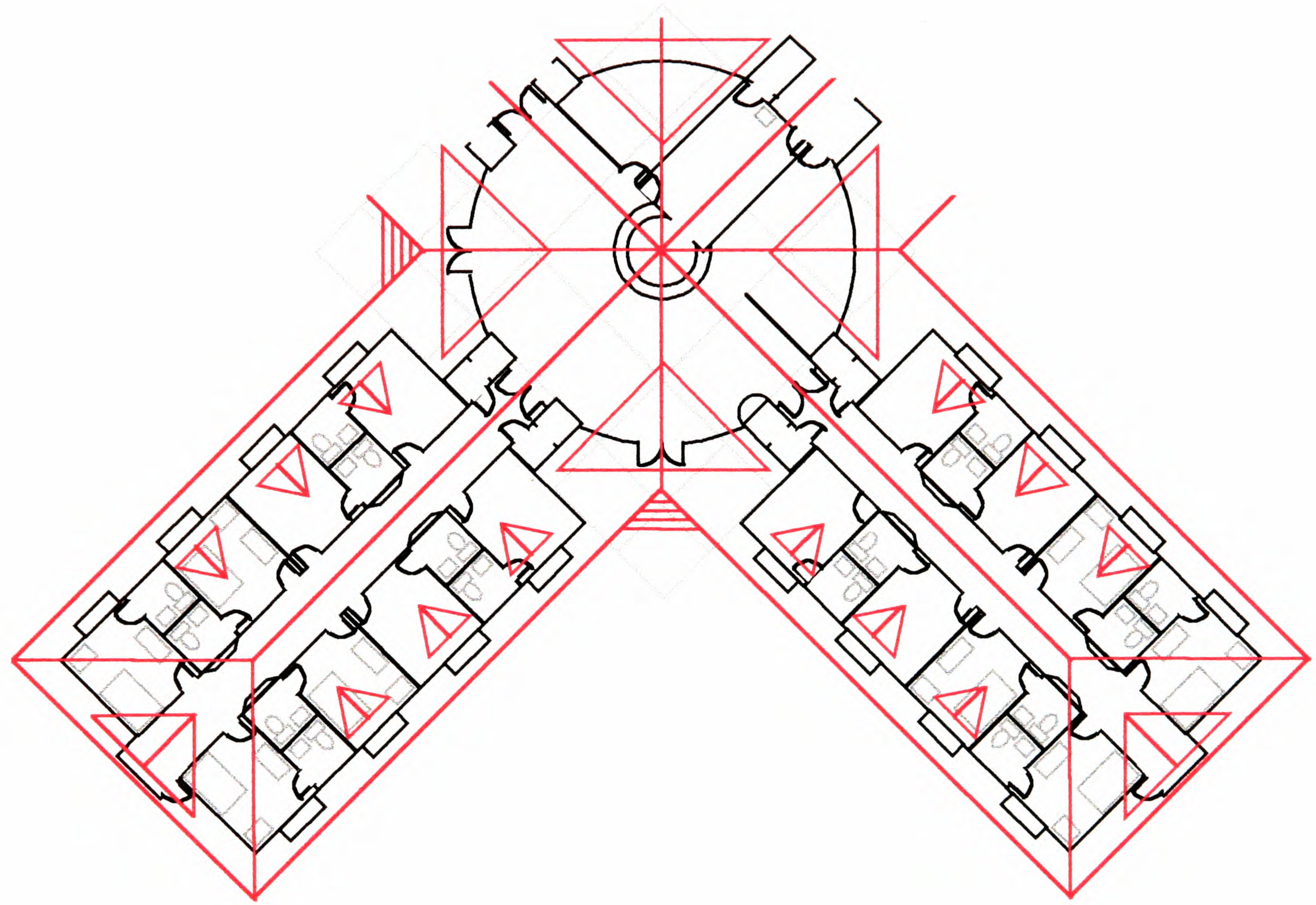
- SURVEY RESPONDENTS ALSO SHOWED AN OVERWHELMING PREFERENCE FOR THE PITCHED ROOF FORM

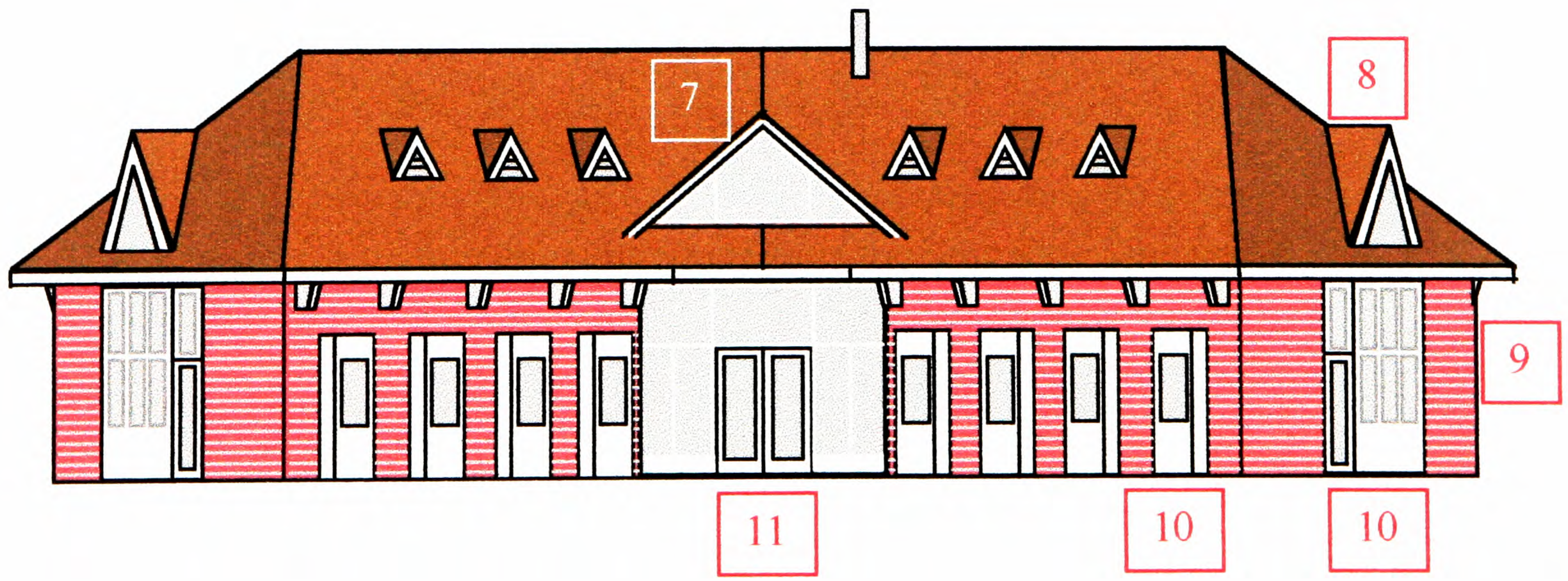
9 - BRICK, ESPECIALLY WARM COLOR BRICK, IS SUGGESTIVE OF STABILITY, WARMTH, AND HUMAN SCALE.

- SURVEY RESPONDENTS BELIEVED THAT BRICK PROVIDED MORE COMFORT THAN STONE OR CONCRETE.

10 - WINDOW SEATS OF PATIENT ROOMS AND FIRE EXIT ENCLOSURES AT THE ENDS OF CORRIDORS BREAK DOWN BUILDING MASS INTO SMALLER MASSES TO SUGGEST HUMAN SCALE, INTIMACY AND DOMESTICITY.

11 - TRADITIONAL DOMESTIC APPEARANCE AND USE OF TRADITIONAL MATERIALS EASIER FOR PATIENTS TO UNDERSTAND AND RELATE TO (AS OPPOSED TO MODERN ARCHITECTURE).





SYMBOLISM
TAB C

OBLIQUE
VIEW

GRAPHIC SCALE
3M 6M 9M

INPATIENT UNIT
COGNITIVE TAB A

1 - BUILDING IS LAID OUT AS A CROSS WITH SIMPLE RIGHT ANGLES FOR EASY WAYFINDING.

2 - EXTERIOR VIEWS FROM MAJOR SPACES, CORRIDORS, AND PATIENT ROOMS EASE ORIENTATION.

3 - FIREPLACE SERVES AS A DIRECTIONAL NODE AT THE CROSSING TO ASSIST DIFFERENTIATION OF EACH SUITE OF PATIENT ROOMS.
- FIREPLACE CAN INDUCE FEELINGS OF COMFORT AND CALM.

4 - DESIGN PROVIDES CLEAR LIMITS (EDGES) OF THE BUILDING & SITE.

5 - LANDMARKS, SUCH AS TREES, FOUNTAINS, SCULPTURES, ARE USED AS POINTS OF REFERENCE.

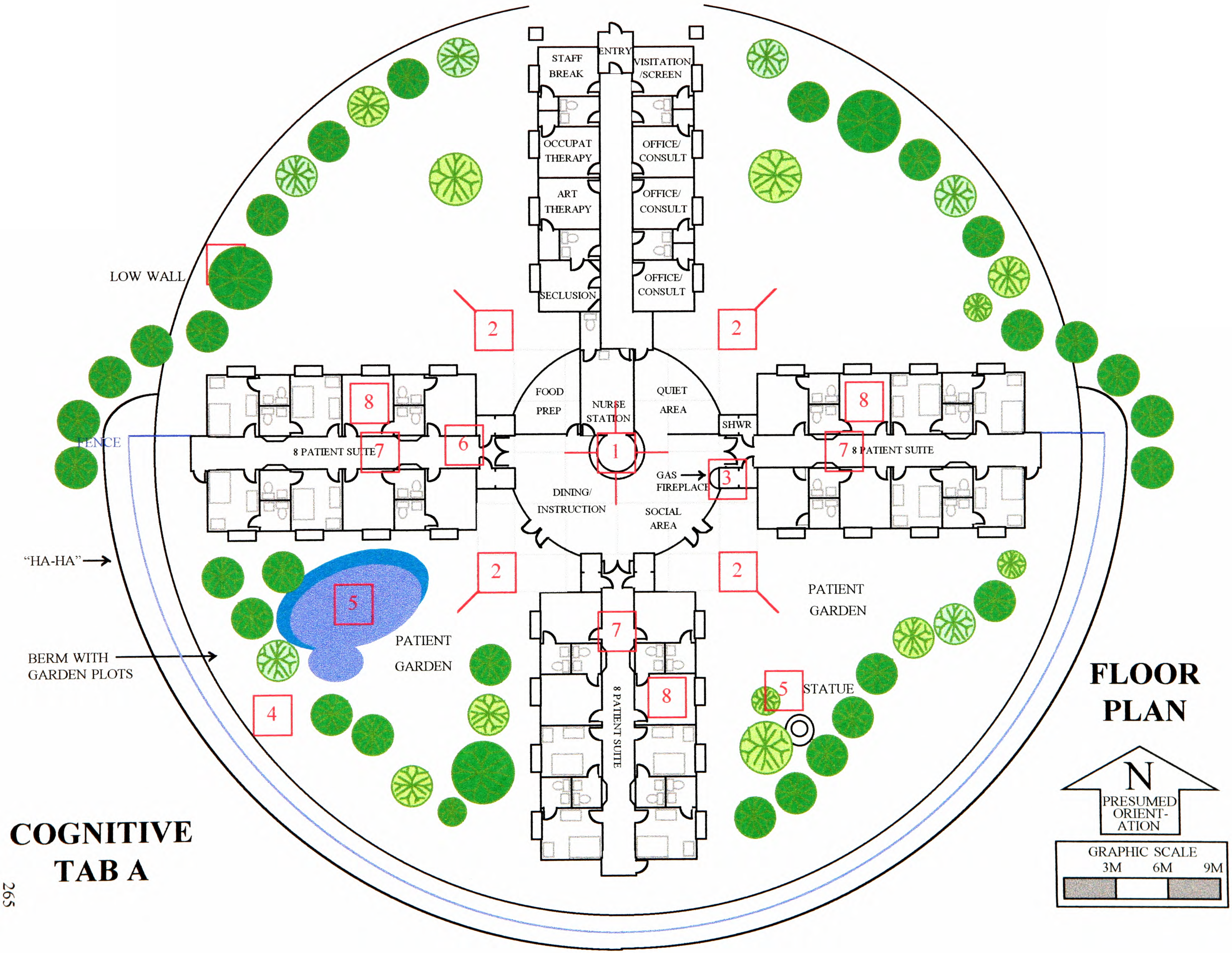
6. - BUILDING DIVIDED INTO DISTINCT ZONES TO AID ORIENTATION.
- BUILDING MASS DIVIDED INTO SMALL PIECES TO MAKE BUILDING MORE EASILY UNDERSTANDABLE.

7. - INTERIOR FINISHES, COLORS, PATTERNS, TEXTURES, VARY IN EACH SUITE TO AID WAYFINDING.

8. - UNIT IS DIVIDED INTO THREE SUITES OF 8 PATIENTS EACH BECAUSE GROUPS OF 4 TO 8 ARE ESPECIALLY LIABLE TO FORM BENEFICIAL, SUPPORTIVE, AND CONSTRUCTIVE RELATIONSHIPS.

COGNITIVE TAB A

FLOOR PLAN



INPATIENT UNIT
COGNITIVE TAB B

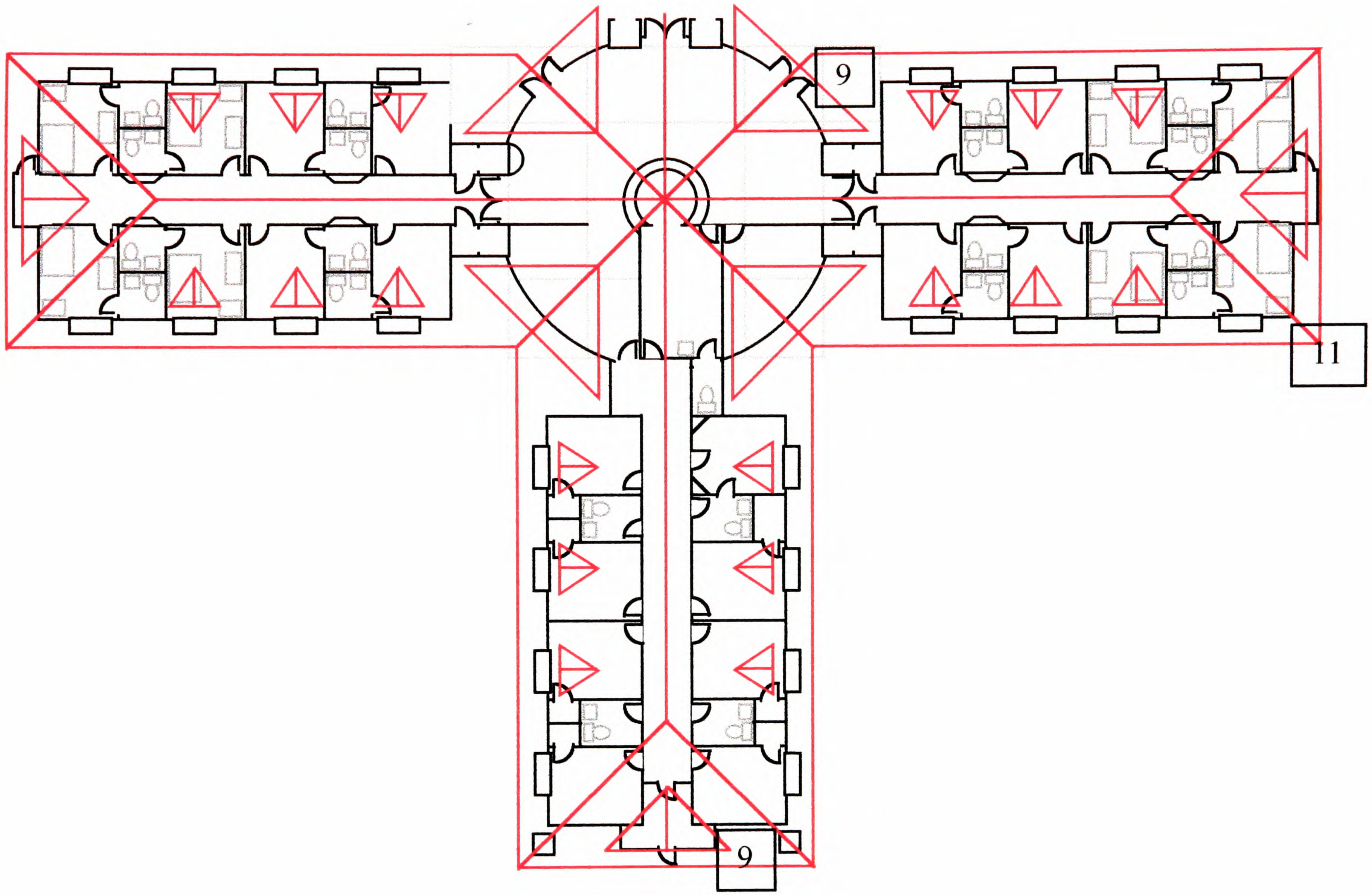
9 - SCREENING ELEMENTS AND PORCHES MAKE THE TRANSITION BETWEEN INTERIORS AND EXTERIORS APPEAR MORE SECURE.

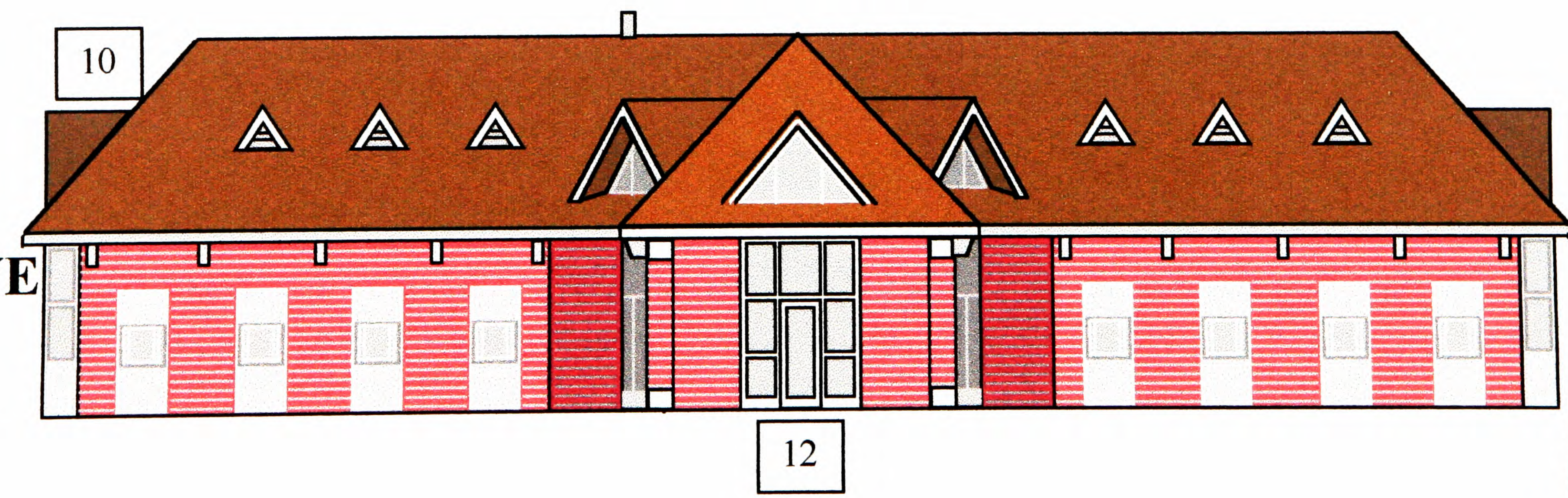
10 - BUILDING HEIGHT IN THIS MODEL IS LIMITED TO ONE STORY TO AVOID NEGATIVE ASSOCIATIONS OF TALL BUILDINGS. THIS MODEL COULD BE BUILD AS A TWO STORY WITH LOWER RISK PATIENTS ABOVE (WITH EASY AND SAFE ACCESS TO OUTDOOR SPACES).

- THE PITCHED ROOF IS ALSO EASY FOR PEOPLE TO RELATE TO.

11 - ROOF HAS BROAD SHELTERING EAVES TO ENHANCE THE FEELINGS OF SHELTER AND SECURITY.

12 - PROMINENT ENTRY AIDS WAYFINDING & DEFINES ACCESS PATH.





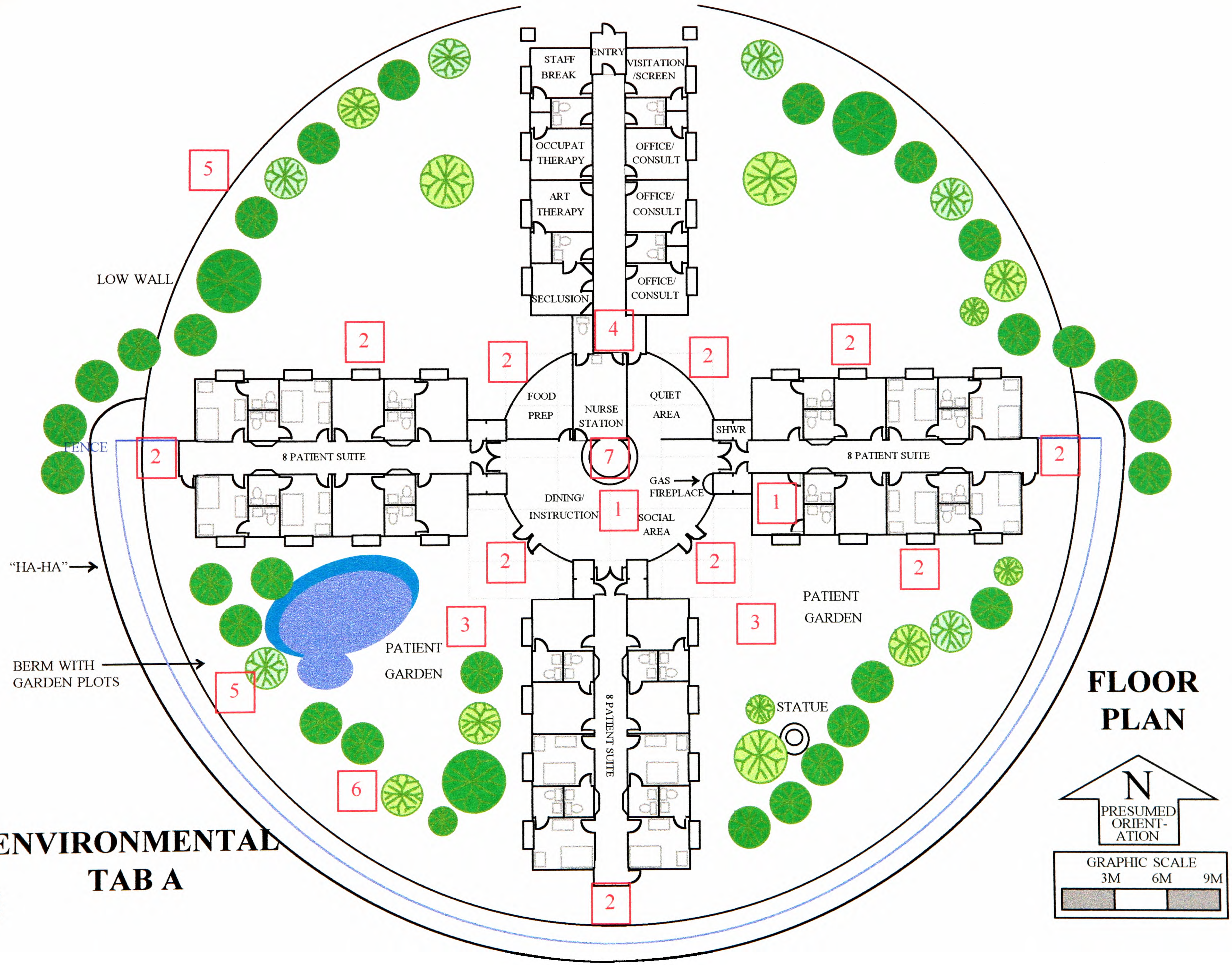
COGNITIVE TAB B

FRONT VIEW

GRAPHIC SCALE
3M 6M 9M

INPATIENT UNIT
ENVIRONMENTAL TAB A

1 - NATURAL FIBER AREA RUGS PROVIDE ACOUSTIC DAMPENING AND DON'T POLLUTE.
  - FLOORS UNDERNEATH ARE WOOD GRAIN VINYL (UNPLASTICIZED, HARD) FOR GOOD APPEARANCE, EASY CARE, AND LACK OF POLLUTION.
2 - NATURAL LIGHT ALLOWED TO PENETRATE MOST SPACES INCLUDING CORRIDORS.
3 - PATIENT GARDENS ORIENTED TO MAKE BEST ADVANTAGE OF SUNLIGHT.
  - LIGHT FROM LANDSCAPED GARDENS IS SOFTER AND FILTERED.
4 - SECLUSION ROOM SEGREGATED FROM MAIN PATIENT AREAS FOR ACOUSTIC CONTROL.
5 - LOW WALL & BERM DEFLECT SOME UNWANTED NOISE FROM SITE
6 - WIND & NOISE EFFECTS MODERATED BY TREES.
7 - CROSS SHAPED FLOOR PLAN ENCOURAGES SOCIAL INTERACTION.



ENVIRONMENTAL TAB A

INPATIENT UNIT
ENVIRONMENTAL TAB B

7 - LIGHT MONITORS ALLOW NATURAL DAYLIGHT TO PENETRATE DEEPLY INTO CORRIDORS, TYPICALLY THE DARKEST PART OF A BUILDING.
  - HORIZONTAL LOUVERS USED TO DEFLECT DIRECT SUNLIGHT.

8 - LIGHT MONITORS ALLOW NATURAL DAYLIGHT INTO THE CENTRAL SPACE, CREATING A CHEERFUL AIRY ENVIRONMENT.

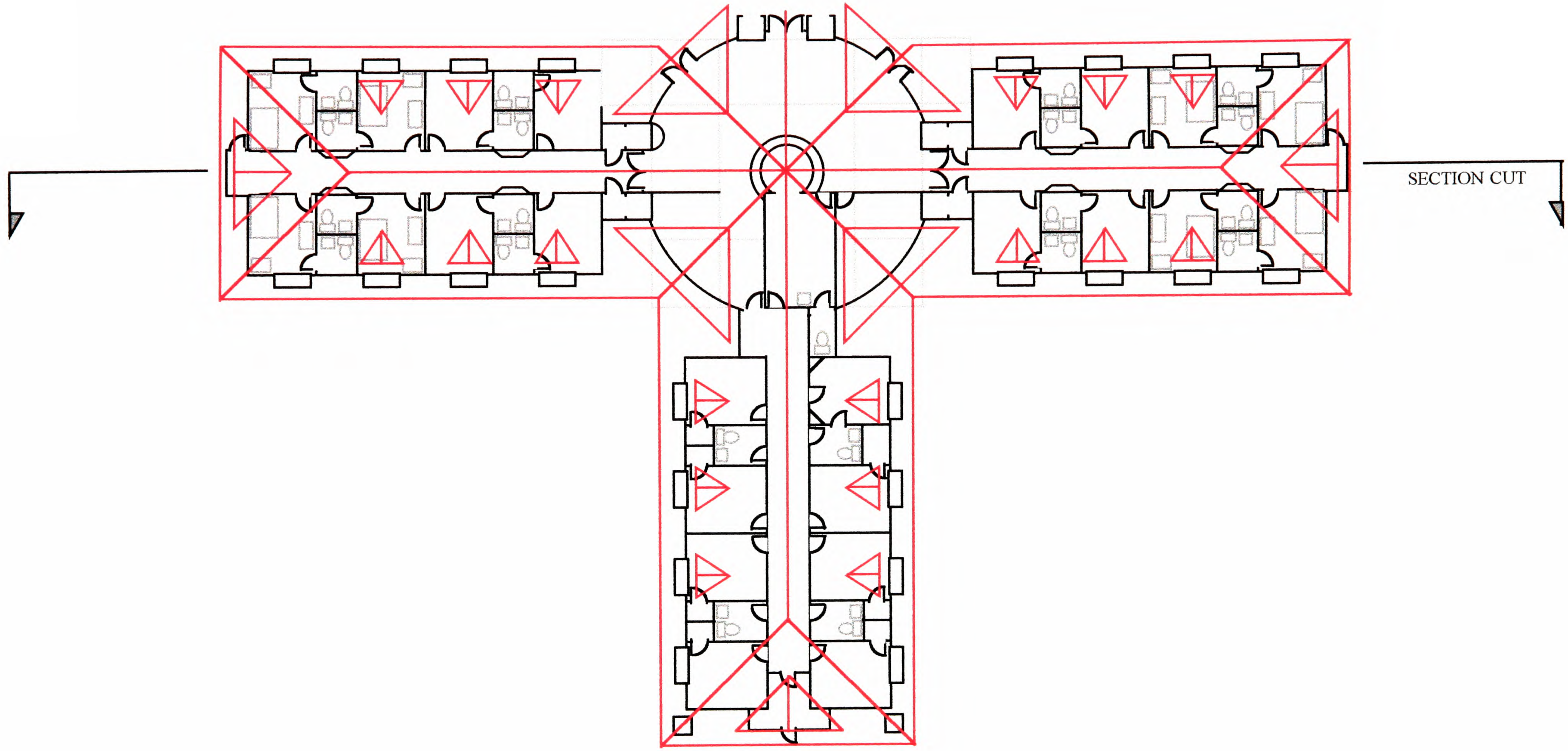
9 - TRANSOM WINDOWS AT ENDS OF CORRIDORS SUGGEST GREATER SPACE AND ALLOW ADDITIONAL REFLECTED LIGHT IN.

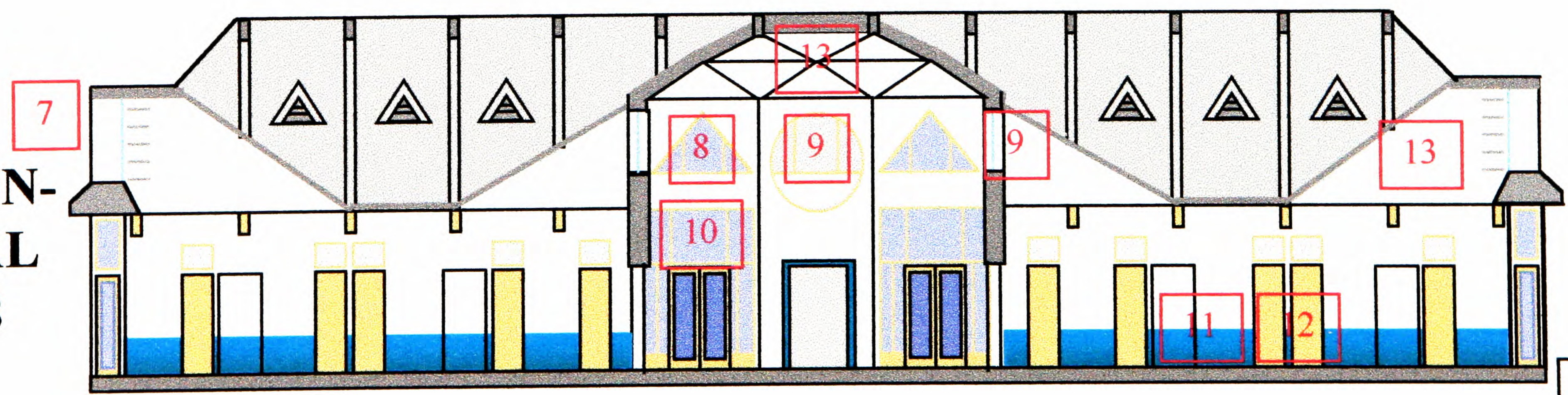
10 - GLAZED EXTERIOR WALLS AND TRANSPARENT DOORS FULFILL THE PSYCHOLOGICAL AND PHYSIOLOGICAL NEED FOR WINDOWS.

11 - COOL COLOR SCHEME FOR CORRIDORS AND COMMON AREAS TO PROMOTE CALM.

12 - NATURAL COLOR WOOD DOORS AND TRIM (WARM COLOR) USED TO BALANCE COOL COLOR SCHEME AND BRING IN NATURAL DESIGN ELEMENTS.

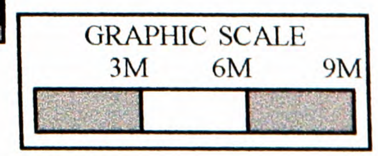
13 - ACOUSTIC PLASTER USED ON CEILINGS TO LIMIT NOISE.





ENVIRON-MENTAL TAB B

LONG SECTION VIEW

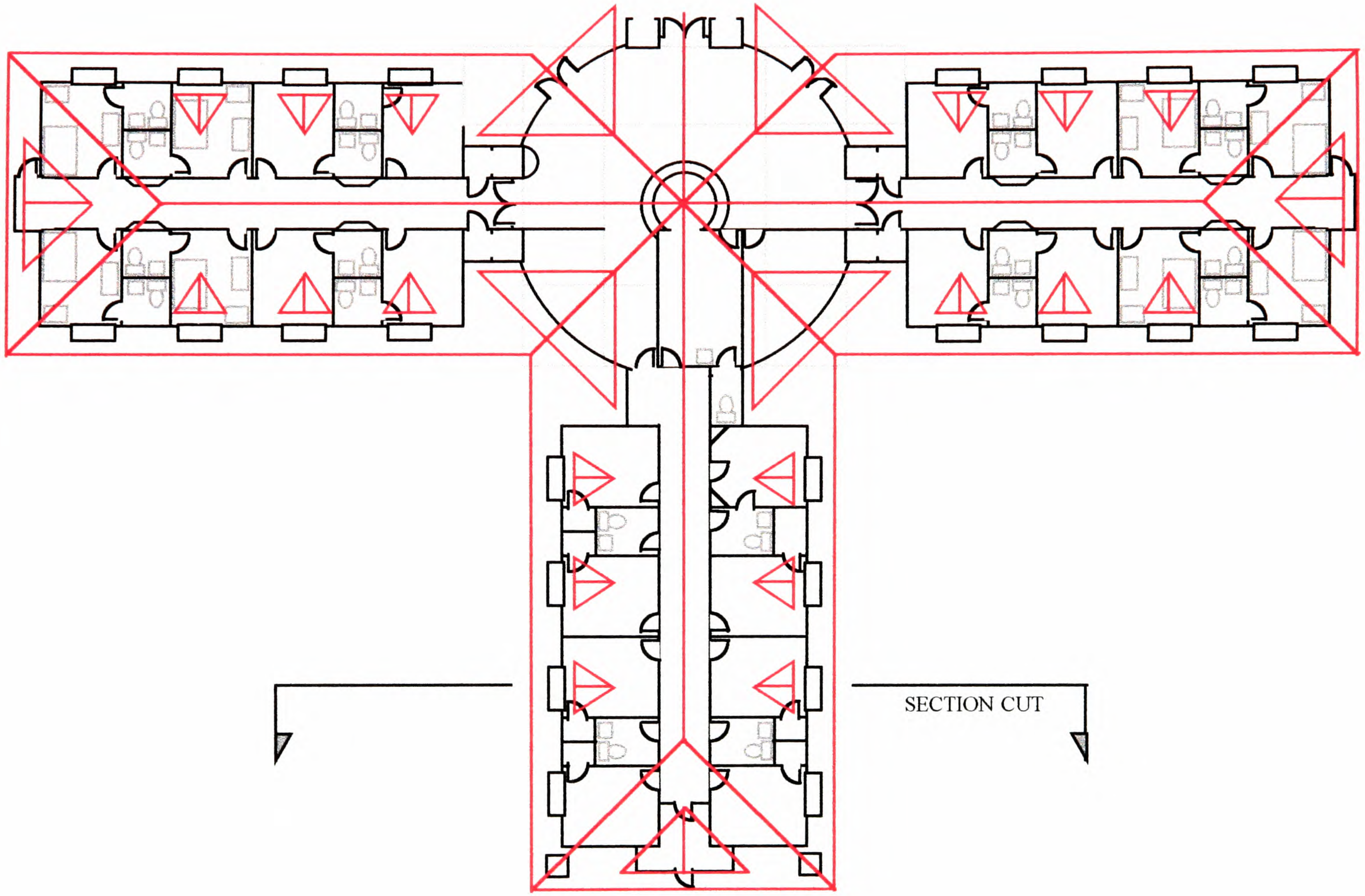


INPATIENT UNIT
ENVIRONMENTAL TAB C

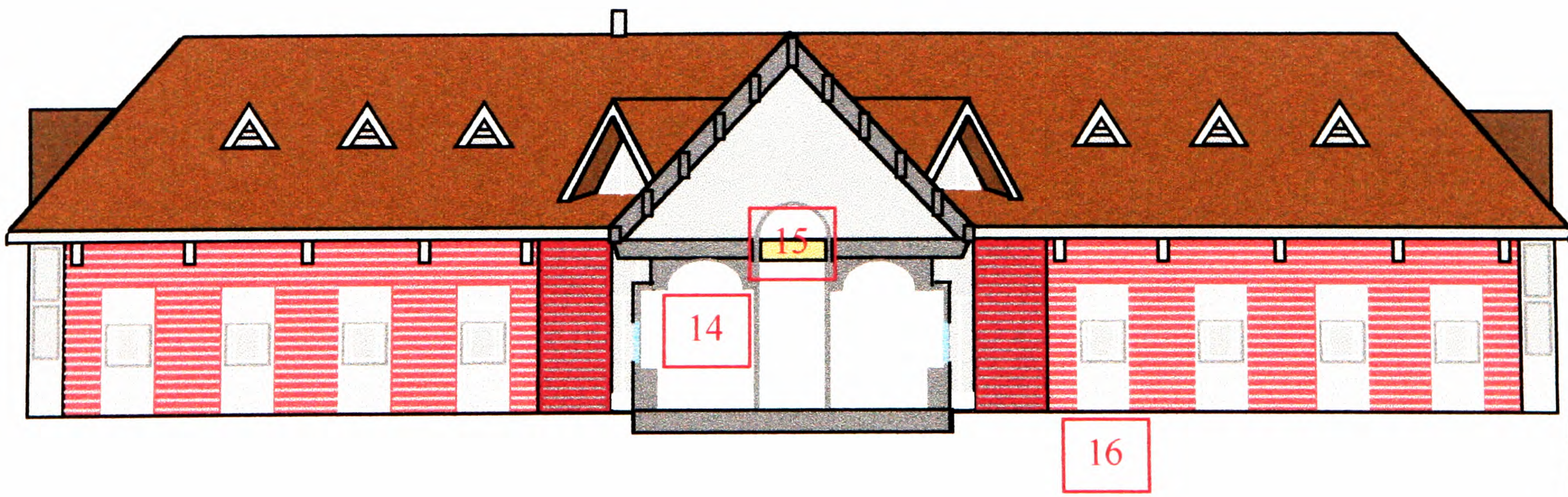
14 - NEUTRAL COLOR SCHEME IN PATIENT ROOMS ALLOWS COLORS, PATTERNS, AND ARTWORK CONSISTENT WITH THE INDIVIDUAL PATIENT'S TREATMENT PROGRAM TO BE SELECTED.

15 - NATURAL COLOR WOOD BEAMS (WARM COLOR) USED TO BALANCE COOL COLOR SCHEME AND BRING IN NATURAL DESIGN ELEMENTS.

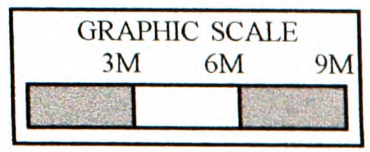
16 - WINDOWS IN PATIENT ROOMS ARE ORIENTED HORIZONTALLY, CONSISTENT WITH VIEWS OF NATURE, AND SURVEY PREFERENCES.
- VENTILATION PANELS ARE PROVIDED ON EACH SIDE OF WINDOW TO ALLOW PATIENTS MORE CONTROL OF THEIR ENVIRONMENT.



ENVIRON-
MENTAL
TAB C

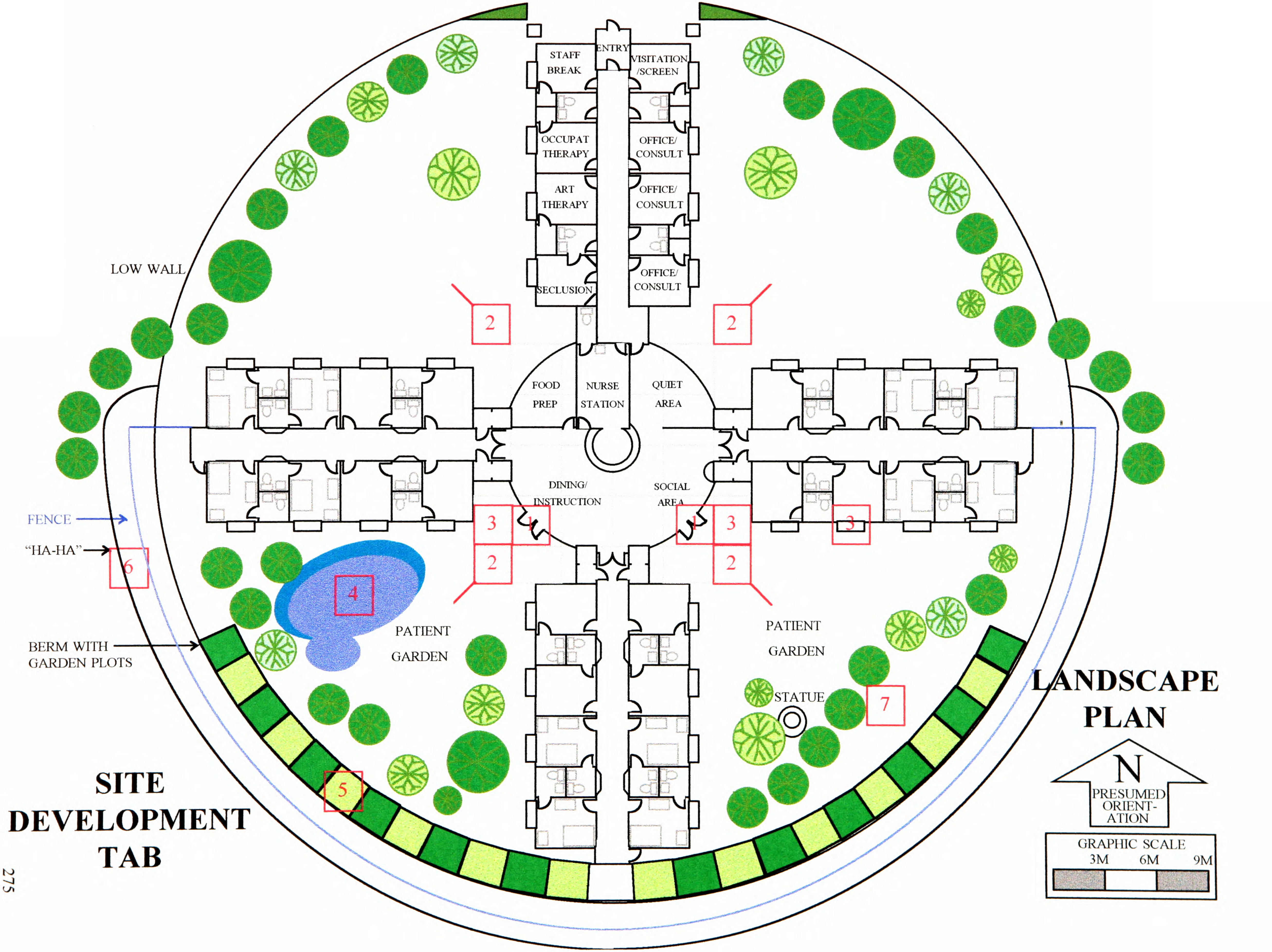


SHORT
SECTION
VIEW



INPATIENT UNIT
SITE DEVELOPMENT TAB

1 - PATIENTS HAVE DIRECT, UNOBSTRUCTED ACCESS TO GARDENS.
2 - ALL MAJOR SPACES AND PATIENT ROOMS HAVE VIEWS TO GARDENS.
3 - WINDOW SEATS IN PATIENT ROOMS AND COVERED PORCHES ALLOW PATIENTS TO EXPERIENCE NATURE EVEN DURING FOUL WEATHER.
4 - POOL HELPS ATTRACT VISITING WILDLIFE (ESPECIALLY BIRDS) AND CAN HOST FISH AND AMPHIBIANS FOR PATIENT ENCOUNTERS.
- VIEWS OF WATER KNOWN TO HAVE CALMING INFLUENCE.
5 - GARDEN PLOTS AVAILABLE TO IMPLEMENT A GARDENING THERAPY PROGRAM (IF APPLICABLE).
6 - USE OF "HA-HA" ALLOWS VIEWS TO EXTEND BEYOND SITE.
7 - ANIMAL FEEDERS AMONG LANDSCAPING TO ATTRACT WILDLIFE (BIRDS & SQUIRRELS).



SITE DEVELOPMENT TAB
LANDSCAPE PLAN
ENTRY
STAFF BREAK
VISITATION /SCREEN
OCCUPAT THERAPY
OFFICE/ CONSULT
ART THERAPY
OFFICE/ CONSULT
SECLUSION
OFFICE/ CONSULT
FOOD PREP
NURSE STATION
QUIET AREA
DINING/ INSTRUCTION
SOCIAL AREA
LOW WALL
FENCE
"HA-HA"
BERM WITH GARDEN PLOTS
PATIENT GARDEN
PATIENT GARDEN
STATUE
1
2
3
4
5
6
7
N
PRESUMED ORIENT- ATION
GRAPHIC SCALE
3M
6M
9M

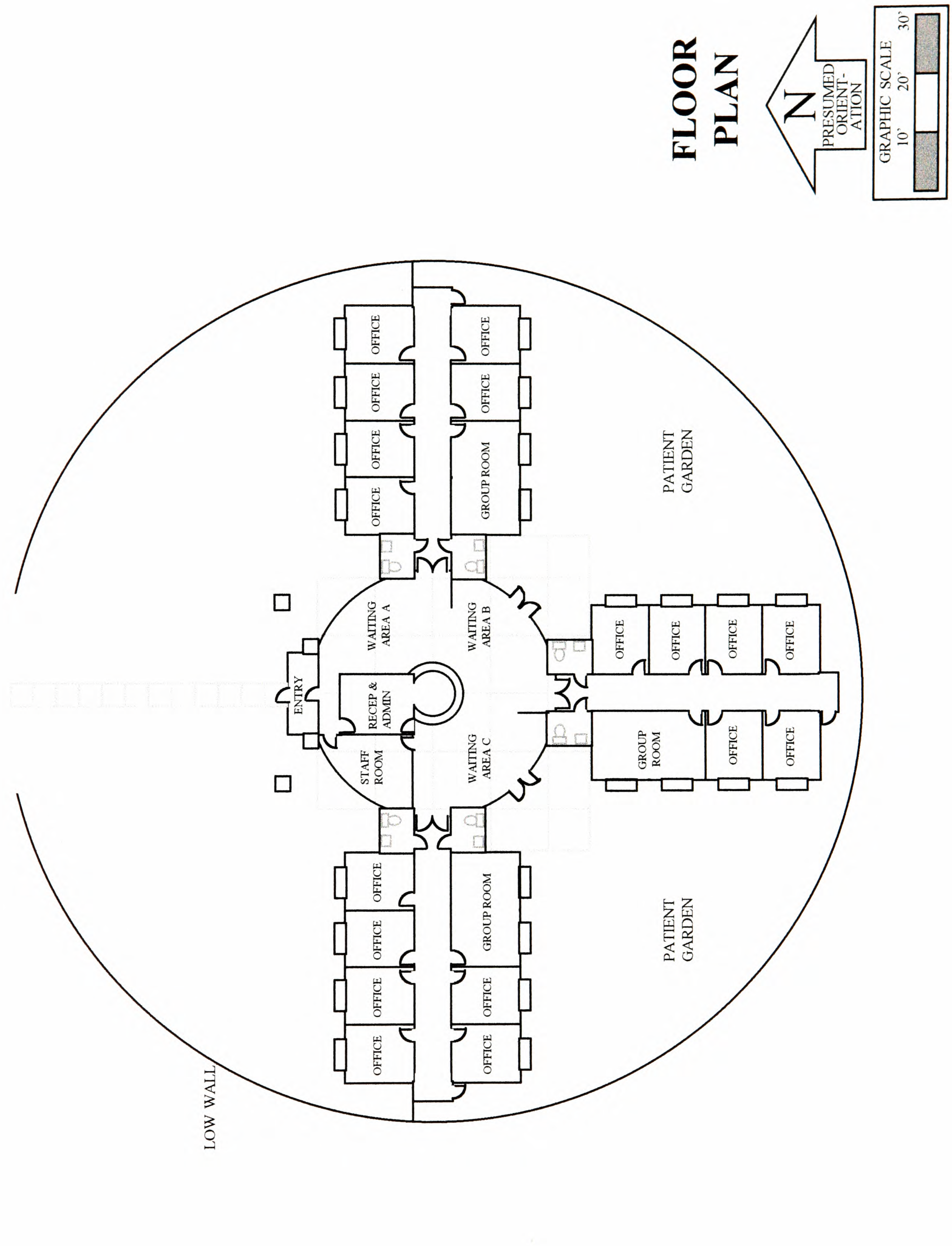
OUTPATIENT CLINIC
DEMONSTRATION OF DESIGN PRINCIPLES

THE FIRST DRAWING IS PROVIDED WITHOUT ANNOTATIONS TO ALLOW A CLEAR VIEW OF DETAILS.

THE FOLLOWING SECURITY TAB IS PROVIDED WITH ANNOTATIONS TO ALLOW A CLEAR UNDERSTANDING OF DESIGN PRINCIPLES.

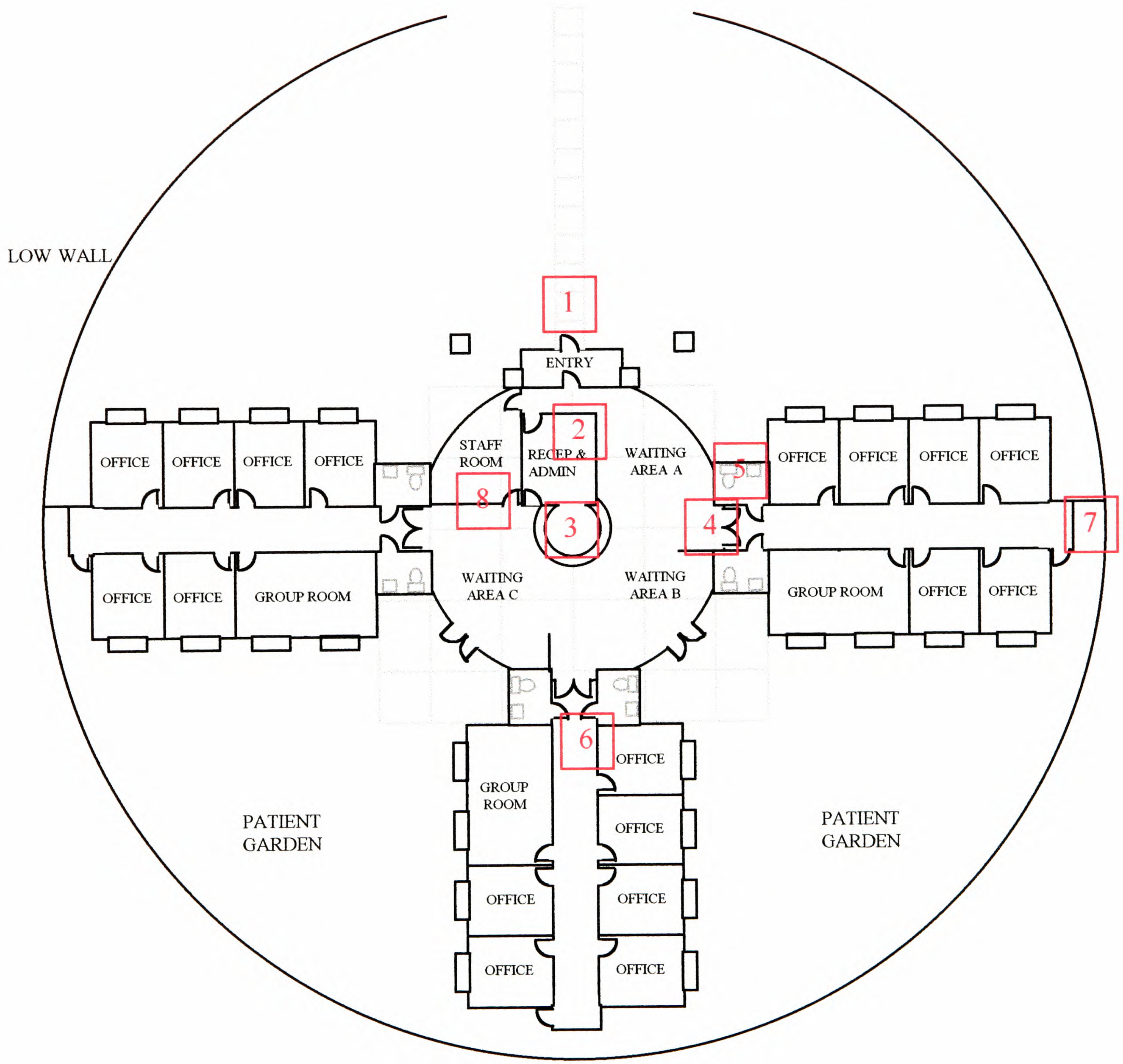
* THE SECURITY TAB IS THE ONLY SET OF ANNOTATIONS PROVIDED BECAUSE ASIDE FROM SECURITY, THE OTHER DESIGN REQUIREMENTS ARE SUBSTANTIALLY SIMILAR TO THE INPATIENT UNIT DESIGN.

** THESE DRAWINGS ARE PROVIDED AS A DEMONSTRATION OF DESIGN PRINCIPLES AND NOT AS A DEFINITIVE DESIGN OR PROTOTYPE. EVERY SITE AND BUILDING PROGRAM ARE DIFFERENT AND REQUIRE THEIR OWN DESIGN SOLUTION.

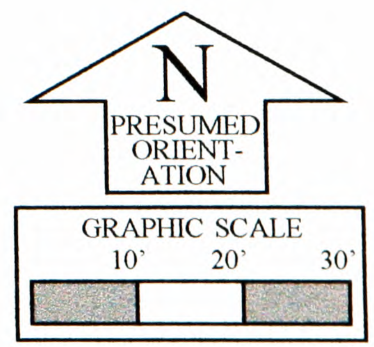

FLOOR PLAN
N
PRESUMED ORIENT-ATION
GRAPHIC SCALE
10'
20'
30'
LOW WALL
ENTRY
RECEP & ADMIN
STAFF ROOM
WAITING AREA A
WAITING AREA B
WAITING AREA C
OFFICE
GROUP ROOM
PATIENT GARDEN
PATIENT GARDEN

OUTPATIENT CLINIC
SECURITY TAB

1 - PROMINENT ENTRY GIVES CLEAR EXPRESSION THAT THIS IS THE APPROVED ACCESS TO CLINIC (PATIENTS ARE BUZZED IN).
2 - REAR SECTION OF RECEPTION & ADMIN ACTS AS SECURITY CHECK-POINT.
3 - CORE OF RECEPTION CENTRALLY LOCATED TO ALLOW OBSERVATION OF ALL MAIN SPACES, APPROACHES, CORRIDORS AND GARDENS.
4 - CLEAR DOORS TO OFFICE SUITES ALLOW OBSERVATION.
5 - TOILETS NEAR RECEPTION TO MINIMIZE RISK OF PATIENTS & STAFF BEING ASSAULTED/PATIENT SELF INJURY.
6 - UTILITY CENTERS IN LOCKED CABINETS IN CORRIDOR ALLOW ELECTRICITY AND WATER TO BE CUT OFF TO TOILETS.
7 - ALL FIRE EXITS FROM PATIENT ZONES ARE LOCKED TO THE EXTERIOR TO PREVENT UNAUTHORIZED ACCESS.
8 - WALLS AROUND RECEPTION AND ADJACENT WALLS ARE TRANSPARENT TO ALLOW OBSERVATION.



FLOOR PLAN



SECURITY TAB

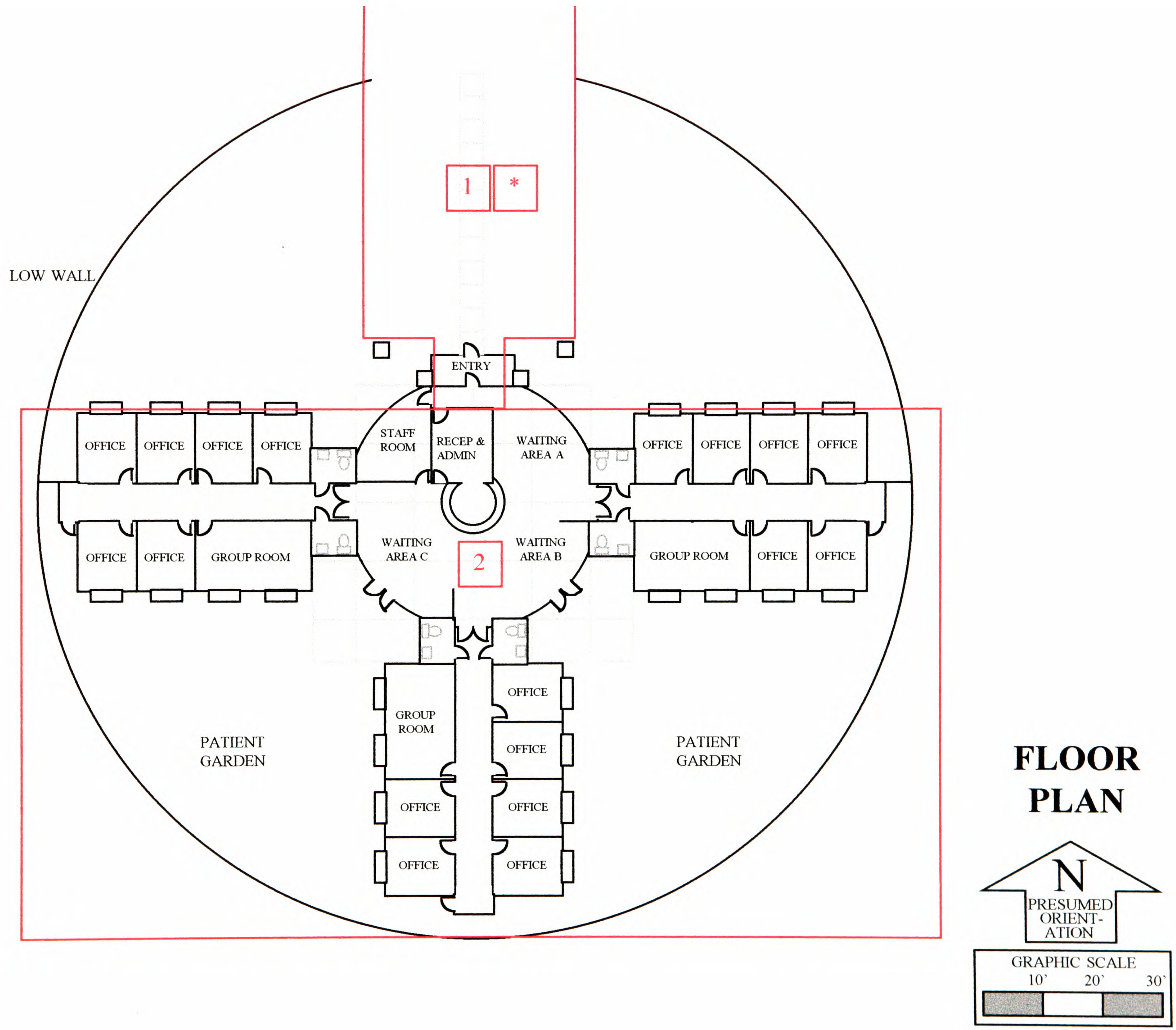
OUTPATIENT CLINIC
SECURITY TAB B
(ZONES)

1 - PUBLIC ZONE INCLUDES THE PARKING AREAS, LOBBIES, OUT-PATIENT PHARMACY SERVICE AREAS, AND RECEPTION AREAS..

2 - SEMI-PUBLIC ZONE INCLUDES OUTPATIENT DIAGNOSTIC AND TREATMENT AREAS (INCLUDING DAY HOSPITAL) PHARMACY DEPARTMENTS, OUTPATIENT GROUP ROOMS, OUTPATIENT DINING AREAS, OUTPATIENT TOILETS, AND PROVIDER OFFICES.

* - PLEASE NOTE THAT IF THIS BUILDING WERE CONNECTED TO A DISTRICT GENERAL HOSPITAL, ZONE 1 WOULD BE IN THE DISTRICT GENERAL HOSPITAL.

SECURITY TAB B (ZONES)



FLOOR PLAN

Conclusion

This thesis examined and provided guidance on security requirements, environmental design, the cognitive environment, and site development. A demonstration of how these disparate requirements may be harmonized to develop secure and therapeutic facilities was also provided.

The proper design of security measures in relation to patients' personal needs and rights was examined. Related fire safety requirements and facility design measures minimizing the risks of suicides, self injuries, and assaults were also described. Examination of two common health care floor plans revealed that it is inherently easier to maintain effective access control and observation of patients in cross shaped plans as opposed to race track style plans.

Environmental design issues including lighting, color, acoustics, construction materials, air quality, and spatial analysis were examined in the context of mental and physical health. Spatial analysis of the same common hospital floor plans revealed that the cross shaped floor plan encourages social interaction, while the race track style plan discourages interaction.

Cognitive mapping, wayfinding, symbolism, and perceptions of suitable physical environments and architectural design were examined in the context of mental health treatment facilities. Past research has suggested psychiatric patients have difficulty making cognitive adjustments to most mental health treatment facilities, and that this can negatively effect the outcome of treatment. An illustrated questionnaire was developed to help determine what types of facilities patients can relate to and experience relative comfort. This questionnaire was used to examine patient and staff perceptions of building types and architectural design as they apply to providing comfortable and healthy environments. This questionnaire was fielded to 25 psychiatric patients, 25 health care providers, and a control group of 25 university students in the United

Kingdom. An equivalent sample of 75 was surveyed in the United States. A second survey, without illustrations, was fielded in both countries to verify findings from the first survey.

These surveys revealed that perceptions of the built environment expressed by psychiatric patients, health care providers, and students do not significantly vary between these categories. Surprisingly, there was no significant difference between the perceptions of British and American survey respondents either. Additionally, there were no notable sex differences in the survey results The survey revealed a consistent belief among survey respondents in all categories that buildings possessing features generally associated with domestic buildings (houses) were more comfortable than other building types. Buildings with pitched roofs and brick exteriors were considered especially suggestive of comfort. Buildings with flat roofs were nearly universally rejected. Horizontal windows were considered preferable to the more common vertically oriented windows. This effect was more pronounced when the windows framed a pleasant natural view. Curved interior forms were also found to be suggestive of comfort. Examination of individual questionnaire responses revealed a strong correlation between the pitched roof, brick exterior, round arched interiors and circular shapes as suggestive of comfort.

Past, current, and emerging patterns of mental health treatment facility development and site development were reviewed in relation to their environmental settings. Several studies were cited suggesting a strong correlation between exposure to the pleasant aspects of nature and improved mental and physical health.

The culmination of this thesis is a demonstration of design principles with a set of annotated drawings of a hypothetical inpatient unit and outpatient clinic.. These drawings are provided to demonstrate an integration of thesis findings and design principles. These drawings are not a definitive design or prototype, because every site and building program are different and require their own design solution. This demonstration of design principles considers security requirements, fire safety, access and observation, prevention of suicide and injury, lighting, interior design, acoustics, the physical environment, the cognitive environment, symbolism, site development, and additional concerns. Although difficult, these annotated drawings demonstrate that it is possible to balance these disparate requirements to develop mental health treatment facilities that provide secure, comfortable, therapeutic environments.

The demonstration of design principles exposes the key design element allowing these requirements to harmonize as the cross form. It optimizes observation, exposure to nature, views, and natural light, encourages social interaction, and provides a clear understandable form. When the cross form is combined with the pitched roof, it is possible to develop an environment suggestive of comfort. Other features such as round vaulted ceilings and curved interior forms can be integrated into this basic framework to increase the suggestion of comfort.

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