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A married student housing redevelopment analysis: Pammel Court, Iowa State University

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A married student housing redevelopment analysis: Pammel Court, Iowa State University

by

Jason Chia-Sung Chang

A Thesis Submitted to the
Graduate Faculty in Partial Fulfillment of the
Requirements for the Degrees of
MASTER OF ARCHITECTURE
And
MASTER OF COMMUNITY AND REGIONAL PLANNING

Majors: ARCHITECTURE
COMMUNITY AND REGIONAL PLANNING

Signatures have been redacted for privacy

Iowa State University
Ames, Iowa
1991

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CHAPTER 1. INTRODUCTION

Design, or the organization of parts into a coherent whole, is involved in every aspect of one’s life, from coordinating the clothes one wears to arranging a table setting. As an intuitive or a conscious thinking process, design is an act of planning or creating, a matter of problem-solving method one uses continually. The primary purposes of this thesis are to exercise the design process in problematic architectural and planning situations and to create solutions to these problems.

A basic human need, and therefore one of the most important elements of one’s life, is shelter. And as a result of concern for the environmental needs of people, the author chose an architectural problem in the housing area. Specifically, the future redevelopment of a family-housing complex at Iowa State University was selected as the architectural and planning problem of this thesis.

Scope

In 1946, when the Department of Residence accepted the responsibility of providing housing for married students, a new era in the housing program at Iowa State University had begun. Viewed as a temporary provision in 1946, this development has since developed into a permanent and essential part of the university.

The original married community at Pammel Court consisted of approximately
1,000 temporary units, of which 528 still exist. As enrollment expanded, the university constructed additional units at Hawthorn Court, University Village, and Schilletter Village. With the completion of Schilletter Village in December 1977, the total number of units within the married community rose to 1,350. This figure is sufficiently large to allow for the decommissioning of certain Pammel Court units as new units are constructed.

Pammel Court is the greatest contributor of dwelling units to the married student housing community at Iowa State. But because they are temporary units, they require a tremendous amount of maintenance and have deteriorated considerably. The Department of Residence is currently decommissioning the oldest units as fast as new housing becomes available. First preference for new units has been on the decrease. Of the total applications for housing in 1985, there was a three-to-one ratio applying for housing other than in Pammel Court itself [33]. This ratio gives impetus to the decommissioning program, especially of the one bedroom units, because the two-bedroom Pammel Court apartments are preferred over the one-bedroom apartments.

In 1985, there was a 52.7% turnover rate in Pammel Court, which was 7% less rapid than that of the year before. The greatest turnover thus far has been 54.6%. These high rates indicate that additional units are needed and that redevelopment of Pammel Court should be undertaken. The decommissioning of Pammel Court is, therefore, an imminent and pressing concern of the residence department.

This thesis is a proposal for the redevelopment of Pammel Court married student housing. As a design thesis, it will augment text with drawings. Thus, exploration will involve both process and product.
Purpose

This thesis aims

1. to establish a credible body of knowledge compiled in written form to serve as a guide for the development of married student housing at Iowa State University;

2. to simulate as closely realistically as possible a set of circumstances that may be encountered in actual research and design of a married student housing development; and

3. to provide a graphic product proposing one architectural solution based on the student housing requirements established in this thesis.

Administrators in the Department of Residence and married student tenants all have opinions regarding the requirements of married student housing. This thesis, however, presents a compilation and analysis of perceptions of administrators, only.

In addition to providing written documentation of student housing requirements, this thesis has also afforded an invaluable educational experience in terms of architectural problem solving. Throughout the course of research and design, the author invariably encountered the fundamental demands placed on all architects, i.e. development of a skillful process and creation of a viable product. In the final analysis, both often determine the measure of success achieved in architectural problem solving.
CHAPTER 2. BACKGROUND AND HISTORY OF INSTITUTIONAL HOUSING

History of Institutional Housing

There is general agreement among educators that proximity of living and learning centers is a prime requisite for higher education [27]. Historically, however, institutional attitudes towards student housing are characteristically ambivalent. Of the many models available, those having had the greatest influence on American universities are 1) the Oxbridge, or English, concept developed at Oxford and Cambridge, and 2) the German concept developed throughout continental Europe.

The heart of the English concept was the firm belief that student and faculty should share a common life. Schilletter (1970) states that the idea was to develop the “whole student” in the context of “the collegiate way of life.” The English universities offered close “parental-like” supervision of students to help accomplish these goals. Institutional housing was the essence of this system, the purpose of which was to combine intellectual and social environments with a view towards educating the whole person.

In contrast, the German concept was based on the belief that the university should take no responsibility for the housing of students and should pay little or no attention to student activities outside the classroom. The sole purpose of German
boarding houses was to provide a place in which students could eat and sleep. Necessity, not responsibility, demanded that facilities be provided. It was not uncommon for large sleeping dormitories to house 200 students in the same room. The outcome of this attitude might have been easily calculated: lack of supervision at times resulted in disciplinary problems erupting frequently into riots and sometimes into open warfare [1].

Housing in American colleges and universities has gone through three phases, during which students have undergone all the worst experiences of students housed in Europe [27].

The first phase lasted from the nation's birth to 1865, or the end of the Civil War. Having already rejected the German system, the earliest American colleges attempted to imitate and to improve the English system of institutional housing. A number of problems, however, soon emerged. In adopting the English system, American schools found that they were too poor to provide the kind of architecture central to the English concept. Cost was one factor, and lack of building tradition another. English colleges provided a separate bedroom for each student, a luxury most American schools could not afford. Moreover, unlike their English counterparts, American professors were usually married and preferred to live some distance from the college. Thus, student-faculty interaction remained absent, and the early dormitories were no more than places to eat and sleep.

The effect of this arrangement was much the same as in Germany. With limited student-faculty interaction, student antagonisms grew, frequently developing into open conflicts between the students and their part-time keepers. Amidst a storm of controversies, American college presidents developed contradictory opinions on
housing although all agreed that poor housing made living dangerous and learning difficult. Despite ideological arguments in favor of developing greater self-reliance in students, the voices of the earnest advocates of campus housing prevailed [27]. As a result, the dormitory system continued in the East and the Midwest through the 1860s.

The second phase of institutional housing in America lasted from the time of the Civil War to about 1890. The end of the Civil War resulted in a radical change in housing systems, namely, a change from the poorly imitated English system to the unresponsive German system. The main reason for this change was that after the Civil War the rapid growth of public institutions contributed to the problem of housing an increasing number of students at a time when money was scarce. Therefore, housing lagged far behind other construction priorities. This lack of funds, in addition to growing criticism of the English system, resulted in institutional housing much more in the German style.

Two changes alleviated the housing shortage. First, private boarding houses increased in number and size and, second, fraternities and sororities, previously social-intellectual organizations, became purveyors of meals and beds on a large scale. According to Adelman (1969), this was a welcome development:

> Although fraternities have diminished since World War II, they did inculcate in a number of future academic leaders the unique concept and original American contribution to residential planning of using the residence as a method of producing well-rounded adjustable men for the industrial melting pot of the United States. (p.4-28)

But, the success of both fraternities and sororities was short-lived, and soon the gap between curricular and extracurricular life widened. The old English system
regained popularity, and by 1890 the tide had turned back towards the Oxbridge concept.

The social stratification accompanying the industrial boom and immigration after the Civil War led to a shift marking the beginning of the third phase of institutional housing in America. Privately endowed schools along the Eastern Seaboard attracted great numbers of wealthy students from all over the country, and private investors established palatial suites in which these students could live in ease and luxury. The enthusiasm with which this type of housing was greeted inspired administrators from other institutions to emulation. According to Dober (1963), however, "the motivation was not so much educational goals as conspicuous consumption."

From these beginnings arose the firm conviction among a large group of private school administrations that housing undergraduates and graduates was a duty binding on educational institutions. As a result, in higher education today, one of the sharpest distinctions between public and private facilities is that of the quality and quantity of campus housing. President Abbott Lowell of Harvard had a residential housing philosophy that considered housing not as an opportunity to indulge in conspicuous consumption, but as an opportunity to promote education. In sum, Lowell believed that because "all education beyond the grade of drill is self education, for the campus and the students, nothing is more important than an environment conductive to their educating themselves."

Along with Lowell, Woodrow Wilson of Princeton emphasized the university's residential responsibility, despite sentiment against it. This philosophy continued to gain credence, and after 1930, it prevailed in schools throughout the United States.

After World War II, another phase of university housing began. With the return
of the veterans, enrollments in colleges and in universities grew tremendously. Ac­
companying this growth was a substantial increase in the number of married students
attending. These students and their families created further housing difficulties.

It was thought that once the married veterans had graduated, the demand for
married housing would cease, and the problem was handled accordingly. Universi­
ties provided trailers and demountable houses acquired from World War II housing
projects. Additionally, the Federal Housing Authority, in an attempt to improve the
critical housing situation at universities, provided, under the Lanham Act, aluminum
barracks, which was the best the Authority could offer at that time. Enrollment of
married students continued to increase, however, and universities soon began to look
to permanent developments as replacements for temporary facilities. The precedent
established by universities of accepting the responsibility of housing singles and the
attempt to house the massive influx of married students to campuses after World
War II were important contributing factors to married students.

It is evident from this brief historical review that educational institutions in the
United States have assumed much of the responsibility for housing students. Whether
student housing complements the educational objectives of colleges and universities
is a question that will be explored in a later section. But clearly, beginning with
the Harvard house plan, American universities have accepted the responsibility of
providing students with something more than just shelter and have attempted to
create educational environments that are democratic, intellectual, and rewarding.
History of University Married Student Housing

Before World War II, marriage for the university or college student was discouraged throughout the United States, and married individuals were often barred from enrollment. It was believed that marriage would interfere with the pursuit of higher education. According to Clarke [19], university administrators felt that because married students would act irresponsibly and thus be disruptive influences on other students, they had removed themselves from the group deserving of a college education. It was estimated that before 1945 only 3% to 6% of all university and college students were married [31].

With the return of the thousands of married service men at the end of World War II and with the introduction of the G.I. Bill, attitudes towards married students began to change. Married student enrollment jumped to 20% of total enrollment in 1946 [31]. Temporary housing for veterans and their families sprang up on campuses all over the country in the form of surplus army and navy barracks no longer needed by the armed services. By the early 1960s, with the influx of Korean War veterans into the college system, married students still accounted for a surprising 22% of the student population [31]. The temporary situation that administrators had assumed themselves to be dealing with at the end of the wars turned out to be permanent. With increased demand for family-housing, schools began to provide permanent on-campus living units.

In 1970 total college enrollment in the United States numbered approximately 7,413,000, which included 1,758,000, or 23.7%, married students [15]. Lattore (1975) states that the significant increase in the married student population is a result of
1. the example set by the returning servicemen under the G. I. Bill;

2. the emphasis by American society on higher education for the masses, which has had the effect of extending the period of dependence on parents for support, and has increased the willingness of parents to continue financial support; and

3. the presence of factors favorable to early marriage in contemporary American society.

In a University of Florida study, Clarke [19] found that 60% of married student couples have at least one child. When applied to the national statistics stated earlier, the 1,758,000 married students, their spouses, and a minimum of 1,050,000 children equal an estimated 4,566,000 people in 1970. Despite this sizeable number, most institutions have neither explored carefully nor provided for the needs of these students and their families.

Although not directly concerned with nonstudents in the family unit, college and university administrators have recently become quite interested in how spouse and children affect student motivation and academic responsibilities. Most institutions now assume educational responsibility for the student as a whole person. Facilities and services such as student housing, personal and academic counseling, social and recreational activities, financial aid, daycare for children, and educational-cultural betterment programs are currently being established to assist married students in many areas of growth and development.

One of the most important areas of concern for the married student and his or her family has been housing. Long waiting lists for college and university apartments continue to plague housing administrative departments' even after 30 years of
History of Married Student Housing at Iowa State University

From its inception, the married student community at Iowa State University has conformed to the established student housing objectives presented by Schilletter (1970), but with one important distinction: the objective of providing an educational setting has been superseded by the objective of providing a “nonuniversity setting” appropriately reflecting traditional community life, or what Moen (1976) calls “the real world.” This attempt to imitate traditional community life has been centered around an organization comparable to a city governmental system. In fact, the married student community at Iowa State University represents a 30 year experiment in self-government. As Frederiksen (1990) states, “... the patterns of government are different but belief is the same. It [married student housing] is an attempt to teach citizenship, to teach a sense of responsibility to community.”

The married student community at Iowa State has witnessed a variety of design developments throughout its history. A brief historical analysis of each development should provide valuable insights for future planners of married student housing at that institution.

Pammel Court

The increase in enrollment following World War II caused the most critical housing shortage in the history of Iowa State University. This problem centered around the great number of veterans who were married and required housing for their families. In response to the influx of married students, the university purchased a number
of trailer units and demountable houses from World War II housing projects located in Wisconsin and Nebraska. The trailers were the first units available, and by January 1946 a small number were ready for occupancy. In addition to the trailer units and demountable houses, the University purchased 50 quonset huts to house two couples each and laid out 65 lots for privately owned trailers. By September 1946, the following units were occupied: 152 trailers, 50 demountable houses, 50 quonset huts, and 65 private lots, totaling 217 units housing 367 families [66]. Meanwhile the university had obtained 734 aluminum barrack units (534 two-bedroom and 200 one-bedroom units), and every effort was made to have these ready by the fall of 1946. The aluminum barracks, completely erected, were provided by the Federal Housing Authority under the Lanham Act. The University was to provide utilities, roads, walks, and drainage. Completion of the project was delayed until the fall of 1947. At its peak, Pammel Court consisted of 951 living units and housed 1,101 families (Figure 2.1). Construction of other married student housing projects, particularly of Hawthorn Court, alleviated the demand for many of the earlier short-term solutions built by the university, which by this time were showing signs of deterioration. As a result, all the trailer units were decommissioned by 1952, followed by the quonset huts in 1960, and finally the demountable houses in 1967 [66].

Administrators at Iowa State projected in 1947 that there would be only ten veterans left to be housed by 1951. Such was not the case, however, and 520 of the original 734 barrack units identified for decommissioning remained in use until 1988.
Figure 2.1: Iowa State University Campus
Hawthorn Court

The deterioration of existing temporary housing at Pammel Court south of the railroad tracks, as well as the growing demand for more married student housing, clearly indicated to administrators the need to expand the existing married student community. As a first step, several trips to inspect apartments for married students at other universities were undertaken. This stage of preparation was followed by a great deal of discussion among administrators as to what would be the best plan for Hawthorn Court. The project was designed by Ray Crites and was approved by an administrative committee established for that purpose.

The project was sited on a ten-acre parcel of land located northeast of campus (Figure 2.1). The site was desirable primarily because of its proximity to campus and the flatness of its surface, both of which eased construction problems. The living units consisted of 24 one-story buildings each containing four apartments, or units. The total cost for the 96 apartments was $703,000.00, or about $7,300.00 apiece. All were occupied by the fall of 1957.

In 1958, 100 more units were constructed east and south of the existing Hawthorn Court apartments. The units themselves were similar to those built in 1956 although there were a few minor alterations. The construction cost for these subsequent 100 units was $740,000.00, or about $7,400.00 apiece.

University Village

The construction of Hawthorn Court reinforced the commitment by university administrators to house the rising number of married students. The purchasing of 80 acres of land east of the University golf course proved timely because more married
student housing was needed, and the land was close to city storm and sanitation sewers, city water mains, and a new high school and shopping center (Figure 2.1).

The architectural firm of Savage and VerPloeg was selected as the project's architect. These architects were advised to visit other existing married student housing developments because of the favorable feedback received after this approach had been used for Hawthorn Court. After evaluating other developments, architects and administrators together agreed to adopt a townhouse living unit.

The architectural firm established the following project goals [66]:

1. a project cost allowing units to be rented at approximately $85.00 per month;
2. a net area of 630 sq. ft. per apartment;
3. an area density minimizing the extent of roads and utilities and allowing space for future development of the site to an eventual 1,000 apartment units; and
4. a design that would not create monotony due to regimented repetition.

Phase I of the project consisted of 300 units, including 268 townhouses, 24 two-bedroom apartments, and 8 one-bedroom apartments. Total cost of the project was $3,166,000.00, or about $11,000.00 per unit. All 300 units were occupied by September 1, 1966.

In 1968, construction of Phase II of University Village had begun. This development consisted of 200 two-bedroom townhouse apartments, a laundry building, and an administrative and maintenance building. Apartments were similar to the original project units, with some minor improvements. The laundry building was a one-story structure centrally located within the development area. The administrative and maintenance building was also a one-story structure similar in appearance to
the laundry building and the apartments. It contained administrative offices for the manager and other office help, maintenance shops for painters, carpenters, plumbers, and others, as well as a storage room. The building also contained a meeting room for the University Married Community (U.M.C.) Council and an office for the U.M.C. mayor. Total cost of the second phase of construction was $3,120,000.00; all 200 units were occupied by September 1968.

Schilletter Village

In June 1969, Phase III of University Village entered the planning stage. The project was to consist of 300 two-bedroom townhouse units similar in character to the existing 500 units occupied in University Village. This Phase was planned as a replacement housing program that would allow decommissioning and abandonment of facilities in Pammel Court. In March 1970, all bids were rejected for the Phase III project because of their high costs; bids were, on average, 20% above the estimated budget [33]. Further attempts to change material and construction techniques as a possible means of bringing the project within budget were also rejected on the grounds of the questionable quality such alterations would produce. In April 1970, Phase III of University Village was abandoned.

Because of the high rate of financing and the prohibitively high cost of construction, administrators began to seek low-cost housing alternatives. After much study and investigation, the university purchased a four-plex modular structure and erected the building to study the feasibility of factory-built units for married student housing. The experimental unit proved successful, and in December 1972 university officials proposed construction of 25 structures (100 apartments) based upon the modular
housing concept. This project was named Schilletter Village (Figure 2.1).

Structures were two stories in height, with two apartments per floor; each was constructed on a full basement, which provided storage, utility, and laundry areas in addition to shelter during storms. The buildings were bid using a narrative specification indicating number of rooms, size of rooms, acceptable plumbing fixtures, etc.; and modular unit builders were asked to propose their best solution to these minimum needs. Basements, utilities, roads, walks, and all other site work were bid using a separate site-development specification. The first units were occupied in the fall of 1974.

In May 1975, university administrators proposed the construction of seven additional four-plex units at Schilletter Village to house single students. An unexpected increase in single student enrollment created a housing demand exceeding the permanent design capacity (8,500 beds) available in the residence department. The demographics for the next 10-15 years did not support the construction of permanent high rise residence halls due to costs, repayment schedules, and time delays associated with such a project [33]. Therefore, a more temporary solution, that of housing single students in Schilletter Village, seemed the most logical course of action. The four-plex could be converted to replacement family housing as necessity dictated. This proposal was approved by the Board of Regents, and by September 1976, all seven buildings (112 beds) were occupied by single students.

Shortly after the completion of the additional seven four-plexes, housing administrators realized that the single student housing demand exceeded the additional 112 beds provided. Thus, an additional 32 four-plexes (512 beds) were purchased and scheduled to be occupied by September 1977. As noted earlier, the housing of single
students at Schilletter Village was intended as a short-term solution only: the original purpose of the project remained that of providing replacement housing for Pammel Court residents, thereby permitting the decommissioning of that development. Of more importance, however, is the fact that for the first time Iowa State University had housed single and married students together in one project. Therefore, any future planning for housing married students need not preclude the possibility of unexpected single student housing demand or the implications of such demand.

Since its inception in 1946, married student housing at Iowa State University has undergone tremendous change and growth. The early, formative years were represented by short-term solutions to what were believed the temporary after-effects of World War II. By the 1950s and 1960s, however, permanent solutions to what had by then proved a lasting cultural pattern—the married student family—were instituted. These solutions were facilitated by a prosperous building market, which resulted in long-term, low-maintenance, high-quality materials and construction methods. Finally, unstable enrollment projections and a tight money market produced a tentative solution for an unpredictable era. The result was a shift towards structures with low initial costs but relatively brief life-spans.

The residence department at Iowa State University has made its commitment to married housing clear by providing a growing financial investment in administration, social and recreational programs, and housing units. But what the future holds for married student housing developments at Iowa State University depends primarily upon four interrelated factors: first, whether university administrators will continue to react to financial constraints by producing more short-term housing solutions; second, how well future student enrollments can be projected and planned for; third,
whether housing single students in married student housing developments is a trend or an aberration; and fourth, whether University housing objectives will change and, more importantly, to what degree housing objectives will change the implementation of housing programs.

These are issues that must be confronted in the planning of additional married student housing developments at Iowa State University. From the outset, providing housing units to the swelling married community has been a process of "catch-up," with demand running ahead of supply. Historically, housing patterns at Iowa State have operated in a continual state of flux. In physical terms, lessons from the past illustrate that the degree to which new housing projects adapt and expand to meet new housing criteria will have a significant effect on the success of any proposed married student housing development.
CHAPTER 3. CLIENT: IOWA STATE UNIVERSITY, THE STATE BOARD OF REGENTS, AND THE CITY OF AMES

The Client

Client – Party to the building process, a symbiosis as necessary as that of a male and female being present at conception. Painters, musicians, even sculptors create their end product unilaterally for ultimate sale after the creative fact; architects’ clients must employ the architect before the creative fact (or act), and hence base their choice on reputation and past history, not present product. Clients have, therefore, much greater burdens in architecture. Those who are blessed with foresight, rather than mere hindsight, often are due as much credit for their impact on the history of architecture as the architect himself. . .[79]

The goals, objectives, and worldview of the final decision maker, or client, will help determine size, form, and direction of the architecture created. Architects depend entirely upon clients for their livelihood. This chapter contains information on this important ingredient in the architectural design process.

For any married student housing development at Iowa State University, the client is the State Board of Regents (Regents). This nine-member body appointed by the Governor of Iowa and confirmed by two-thirds of the State Senate governs the three state supported universities, including Iowa State University, the University of Iowa, and the University of Northern Iowa. The Regents’ responsibilities for these institutions include electing the president, the treasurer, and the secretary of each school,
employing and establishing salary levels for professors and staff, setting admission policies, establishing fees, and directing expenditures of appropriations and other income. The Regents not only are authorized to regulate academic and administrative activities but also are responsible for building programs. When dealing with specific building projects, the Regents appoint university administration as their representative.

Relations between the Regents and Iowa State University have been in effect since 1955, when a legislative act created the former. The Regents and Iowa State administration constitute a “bureaucratic” client, or one composed of a number of persons, all of whom contribute ideas and opinions. Unless lead by a strong spokesperson, the bureaucratic client will usually not have the effect on architectural product as will the individual client, works on a one-to-one basis with the architect and can thus produce a solution closely reflecting his or her input.

Organization

Central to the success of any married housing development is the organizational foundation upon which it rests. Whereas the users of married student apartments have quite well-defined ideas of what they want in housing, it is the paying client who will, in the final analysis, determine what the users’ essential needs are. Success in married student housing can often be measured by means of two factors: a) the degree of organization found in the governing administrative body; and b) the extent to which that administrative body commits itself to such housing.

Since 1946, the entire range of institutional housing needs at Iowa State University has been under the direction of the Department of Residence. These housing
needs have included financing, single and married housing units, food service, maintenance, and social educational programs. Administrators take pride in having achieved continuity of organizational management, as Charles Frederiksen (1990), the present Director of Residence, said:

We have succeeded financially since the days of that organizational arrangement even through times like the late sixties when other institutions were experiencing considerable vacancy problems—including University of Northern Iowa and University of Iowa... Many of those had rules requiring students to live in undergraduate housing and we (Iowa State University) had none.

The Department of Residence reported over 400 full-time employees in 1989-90 [25]; Figure 3.1 illustrates their administrative chain of command. The levels that each housing proposal must pass through depend upon its significance.

A proposal for additional married student housing begins at the office of the Assistant Director of Married Housing. Demand is based upon an established percentage of the married student enrollment that the Department of Residence commits itself to house. When married student enrollment increases, the number of married students that the Department of Residence commits itself to house increases, and thus causing a deficit of existing housing units arises. Before additional married student housing will be considered, however, the increases in enrollment must be shown to be part of long-term enrollment growth. In short, demand for additional married student housing is based upon enrollment increases that seem trends, not coincidences.

Once a trend is substantiated, the proposal is communicated to the Director of Residence and on up the various administrative levels until, ultimately, it is approved by the Regents. The only person who can revoke the Regents' decision is the Governor.
Figure 3.1: Hierarchical organization, Department of Residence, I.S.U.
Objectives

Although the overriding objective of university housing is to provide both food and shelter at the least possible cost to individual occupants, administrators are quick to point out that fulfilling physiological needs is only one aspect of married student housing at Iowa State University. The Annual Report of the Department of Residence (1975) elaborates:

It is our purpose, in married student housing, to provide an opportunity to experience and participate in student government, leadership and citizenship training through the organization of a council with councilmen and councilwomen, mayor, sheriffs, etc. The objective is a learning experience similar to that of any city or community to which the married student might migrate after graduation. These opportunities of service to fellow community members and training for self are contributions, we feel, to the total educational objectives of Iowa State University. (p.2-6)

Housing administrators believe that, as part of an educational system, they must have a mission. They have attempted to demonstrate their sense of mission through staffing, priorities, and spending. While providing and encouraging participation in a number of educational opportunities, the Department of Residence has also made an annual $500,000.00 commitment for program activities to insure that university housing is more than just a place to live [33].

One objective of married student housing at Iowa State, as discussed earlier, is to create an educational experience by organizing the community on city government patterns. Apartment units are grouped into zones, and councilpersons are elected to represent each zone and to serve in such a way as to reflect typical city government. The University Student Apartment Community (USAC) Council represents a 30 year experiment in self-government; during its history, it has initiated and supported
numerous programs, including an Arts and Crafts center, a day care center, a nursery school, a foreign student furniture exchange, and a number of outdoor recreational areas.

The social significance of the zone concept in married student housing has been well-established by past and present successes of its various programs. The architectural significance of the zone concept lies in the capability of future housing developments to provide an identifiable link between residents and the physical environments delineating their zones.

Goals

Since 1951, the Department of Residence has planned to phase out the remaining units now occupied in Pammel Court. But although a number of the Pammel units have been decommissioned throughout the years, 248 units are still occupied. Pammel’s longevity can be attributed mainly to the fact that students have preferred it to other university housing developments with higher rents. Recently, however, other factors have been affecting the desirability of living in Pammel Court. In 1974, Carl Moen [24], present Director of Married Housing, reported that there were three people applying for housing elsewhere to every one person applying for housing in Pammel Court. Moen went on to state that first preference for Pammel Court had been on the decrease for some time, a remark legitimizing the decommissioning program, to be followed by new construction. As Frederiksen (1957) notes,

The continuation of the decommissioning and replacement of Pammel represents a continuing major future physical plant concern. (p. 347-350)
Financing

From a financial point of view, the Department of Residence is a total self-liquidating enterprise. There are no state appropriated funds for the operation or the capital expenses of this department. All such expenses are paid out of rental income from married and single student housing and out of board fees [24].

Until 1925, housing at Iowa State University was the concern of the Board of Education (now Board of Regents), and budget requests for housing were granted through legislative appropriation. In 1925, the Iowa Legislature declared that housing at the state universities would no longer be considered an auxiliary service and that the institutions themselves would be required to become self-liquidating enterprises. In short, financial assistance for housing would no longer be forthcoming. Thus, from 1925 on, the Department of Residence has been a self-supporting financial entity.

From 1925 to 1964, all money required for capital was borrowed through private notes from either banks or insurance companies. Because amounts borrowed at that time were small, loans were validated by administrative signature and required no collateral or other backing. In the late 1950s, as a result of the baby boom, enrollment at Iowa State University began increasing annually by about 100 to 1,500 students. Furthermore, the cost of money increased at a time when more money was needed. As a result, the Department of Residence switched from private-note to revenue-bond financing.

In 1964, the first revenue bond was sold. If totaled $15,000,000.00, of which $7,000,000.00 was used to pay off all outstanding debts, and $8,000,000.00 was allocated to future housing construction. Since 1964, five additional bond sales have taken place. The Department of Residence is currently carrying an indebtedness of
over $29,000,000.00 [51].

All revenue bonds are written in the name of the State of Iowa, Iowa Board of Regents, Iowa State University, Department of Residence. By definition, however, a revenue bond, as opposed to a general obligation bond, places all payment obligations on the Department of Residence. In other words, if there is a default, the administrative body is obligated to pay.

The process by which housing developments are financed consists of six steps [33]:

1. The Regents approve plans to construct additional married student housing.

2. The Regents hire, at the Department of Residence's expense, bond consultants to determine the feasibility of revenue bond financing.

3. If the project is feasible, the bond consultants recommend repayment schedules and interest rates.

4. The Department of Residence presents its financing plan to the Regents for approval.

5. If the plan is approved, the Department of Residence prepares a brochure with a statement of conditions and advertises the bond sale for bidding.

6. If satisfactory, the lowest bid is awarded the bond sale.

Although revenue bonds represent one means of financing new construction, the Department of Residence may also finance constructions with their own reserve funds, which consist of existing surplus funds and improvement funds. Whether the
Department opts to use these reserve funds depends upon the scope of the proposed housing development.

City-university Relationships

Iowa State University and the City of Ames share concern for the existing housing situation. Nevertheless, there has been no policy established between city and university to regulate the housing market. Neither have specific guidelines been established to control or to coordinate the effects that the university, the City of Ames, or private developers have on the market in terms of quantity, quality, type, or distribution of housing. These factions operate independently but are all concerned with the effects of proposed plans on future markets. The only housing policy establishing any ratio or relation between the university and the private sector is the university’s traditional commitment to house approximately 45% of its student body. Obviously, this commitment limits the potential growth of the private market.

No off-campus housing patterns are yet identifiable in Ames. Only a limited number of private developers have provided off-campus apartments for groups of students. The university and the City of Ames, therefore, have the opportunity to take steps to protect the small scale and the pleasant intimacy of housing, both qualities that students seem to seek.

The Department of Residence’s housing policy concerning city development is simply to be a “good neighbor,” that is, to maintain friendly relations and a cooperative atmosphere. A housing committee composed of representatives from the city, private developers, and Department of Residence administrators meet regularly to discuss the housing situation and the effect that proposed additions may have on
Figure 3.2: Map of Ames, Iowa
the market. According to Director of Residence Charles Fredericksen, from the university's standpoint the purpose of this committee is not to seek approval from the city or from private developers for proposed housing additions, but merely to inform them of future developments. The university has never allowed private developers to influence the housing market for economic gain. The Department of Residence assesses the housing market in terms of the needs of students, not in terms of the needs of private developers, who are interested primarily in maintaining high rental rates.

City plan/campus plan

In 1968, Iowa State officials contracted the services of the planning firm of Johnson, Johnson, and Roy, Inc. to prepare a master plan for the Iowa State University campus. The resulting master plan (Figure 3.3) shows the proposed site to be maintained for married student housing. The redevelopment of Pammel Court into married student housing will conform to the long-range planning policy of the University, and the site will remain under the management of the residence department.

Inasmuch as the university is a state-owned institution and therefore not subject to local codes and ordinances, the zoning laws of the City of Ames are not applicable to married student housing in Pammel Court. Although the university is not legally bound to municipal regulations, it is sympathetic to their intent and tries to maintain the land-use patterns developed by the Ames City Planning Commission (Figure 3.3).

From the planning standpoint, redeveloping Pammel Court for married student housing should pose few problems because the new community will maintain the original function of the site. Since 1946, the City of Ames has planned community
Figure 3.3: Iowa State University campus master plan
services for Pammel Court according to the site's primary use as married student housing. The transitional effect that a redeveloped Pammel Court will have on traffic patterns, utilities, school enrollments, etc., will thus be minimal.

Just as any housing development must be planned for growth, the housing project itself will derive from growth in its surrounding environment. At present, forecasts for continued growth in both retail and industrial sectors indicate increased job opportunities, which will strengthen the financial base for married students. Additionally, an excellent parks and recreation system and the Iowa State Center have provided an enriching social and cultural atmosphere greatly stimulating students’ physical and intellectual development.

The redevelopment of Pammel Court should provide an opportunity to create an attractive entrance to campus. But because few Iowa communities with major population concentrations lie north of Ames, visitors arriving from this direction are not expected to cause major traffic problems.

Zoning

Laws established by the Ames Zoning Commission do not affect University housing. But, as with other municipal regulations, the university tries to respect the intentions of its neighbor. The comprehensive Plan for the City of Ames has zoned all areas surrounding Pammel Court for residential use.

Building codes and standards of practice

Building codes and standards of practice accepted and enforced by numerous state and federal agencies are pertinent to the redevelopment of Pammel Court. The
university is not subject to the Ames City Building Code or to other local ordinances and need comply only with provisions of the Iowa State Building Code. This code meets or exceeds all regulations and standards of local codes.

The purpose of the Iowa State Building Code is to mandate the minimum construction standards safeguarding life, health, property, and public welfare. The code attempts to meet this objective by controlling and regulating design, construction, H.V.A.C. system installation, plumbing, drainage and electrical systems.

The State Building Code, which applies to the redevelopment of Pammel Court, consists of six publications, all of which are applicable as though written into the code in their entirety, except for such portions altered by the Iowa State Building Code Advisory Council. These publications are

1. the Uniform Building Code;
2. the Uniform Mechanical Code;
3. the Uniform Plumbing Code;
4. the Uniform Building Code Standards;
5. the Uniform Fire Code; and
6. the National Electric Code.

Minimum standards

The United States Department of Housing and Urban Development (HUD) is a governmental agency with the stated objective of encouraging improvement in housing and residential land development standards and conditions. To this end, HUD has
published minimum property standards that provide the department with a unified set of technical and environmental standards. These standards define the minimum level of acceptability for design and construction of low-rent public housing, as well as that for housing approved for mortgage insurance purposes, and are intended to provide a sound technical basis for both plan and design of housing under the numerous HUD programs.

The Minimum Property Standards consist of three volumes: One- and Two-Family Dwellings, 4900; Multi-Family Housing, 4910; and Care-Type Housing, 4920. Publication 4910, Multi-Family Housing, will be of concern in this project. These standards apply to buildings and to sites of both subsidized and unsubsidized federally insured housing, as well as to low-rent public housing.

Although it does not fall under the jurisdiction of HUD, university married student housing is multifamily housing, and these minimum standards will thus be recognized as pertinent to the redevelopment of Pammel Court. Notwithstanding, married student housing is a unique architectural situation and as such affects the application of generalized criteria. For instance, the yearly turnover rate of the married student population is approximately 50%. Having short-term tenures, these students can do with less space and are willing to accept fewer amenities. Such factors must be considered when utilizing minimum standards in conjunction with the construction of married student housing. An outline of these minimum standards appears in Appendix A.

The HUD Minimum Standards contain criteria regarding site design, building design, materials, and construction. The chapters on site design and building design are of immediate concern to this project. These two chapters specify minimum site
and building requirements with respect to size and technical specifications. This information will be used, but will not outweigh other relevant design criteria such as site, function, and organization.
Figure 3.4: Land-use map of Ames, Iowa
CHAPTE R 4. USER: UNIVERSITY FAMILIES AND THEIR LIVING ENVIRONMENTS

Married student housing developments at state universities have a common characteristic: the paying client (residence department) is not the intended user (married students). Often the success of such developments lies with the ability, if not the necessity, of the client’s differentiating user needs from wants. The purpose of this chapter is to delineate user needs by comparing client requirements with direct user input and additional data based on evaluations, analyses, and recommendations of a number of housing authorities.

Enrollment Projections

Before future married student housing needs at Iowa State University can be estimated, future enrollment must first be projected. Expressing enrollment projections as a single value has little meaning because of the uncertainties involved in forecasting methods. A much better method is to predict a range in which enrollment might occur within a given year. For this purpose, two independent enrollment studies were used: one conducted by the ACUHO-I Apartments Committee and the other by the Department of Admissions and Records at Iowa State University. A comparison of these two studies establishes a range of possible enrollments for each
year from 1981-2000. This range can be used to predict future demands for married student housing at Iowa State University.

The greatest projected enrollment for each study occurs in 1990-91, with an estimated enrollment of 25,599 students at Iowa State University. Enrollment declines continually by 144-713 students each year for the four-year period from 1991-92 through 1994-95, and increases by 93 students in 1995-96, 141 in 1996-97, 232 in 1997-98, 396 in 1998-99, and 387 in 1999-2000. Refer to Table 4.1 and Table 4.2 for a thorough comparison of these studies.

Iowa State University is situated advantageously in that it has sufficient resources and is located near a large metropolitan area from which to attract nontraditional students. The Higher Education Facilities Commission has prepared a report dealing with nontraditional students and higher education. This report indicates that Iowa adults are in various stages of planning to attend college part-time. The effect that this will have on enrollment at Iowa State will depend in part upon how hard the university works to attract nontraditional students.

**Projected Married Student Housing Demand**

Planning future married student housing needs requires establishment of the total number of required units. Currently, the Department of Residence attempts to house 40% of married student enrollment at Iowa State University [33]. This figure does not represent a hard and fast rule but rather a figure that residence department officials feel provides an adequate number of alternative housing solutions for those desiring housing at I.S.U. Moreover, the 40% figure has been used successfully in the past, and the married student housing developments built have established an
**Table 4.1: Fall-quarter enrollments, I.S.U.**

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**Prior to Fall 1971 off-campus graduate (not specials and undergraduates) were included in the figures.**

*The College of Design was established by combining curricula from the College of Agriculture, Engineering, and Home Economics (Family and Consumer Sciences).**

*The College of Business Administration was established from the School of Business Administration in the College of Sciences and Humanities.*

**The College of Family and Consumer Sciences was the College of Home Economics previous to July 1, 1987.*
Table 4.2: Ten-year planning indicators, I.S.U.

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<th>Year</th>
<th>Total Fall Enrollment</th>
<th>Undergrad</th>
<th>Grad</th>
<th>% Grad</th>
<th>Men</th>
<th>Women</th>
<th>% Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>21,831</td>
<td>18,568</td>
<td>3,263</td>
<td>14.9%</td>
<td>13,498</td>
<td>8,333</td>
<td>38.2%</td>
</tr>
<tr>
<td>1977</td>
<td>22,803</td>
<td>19,498</td>
<td>3,305</td>
<td>14.5%</td>
<td>13,941</td>
<td>8,862</td>
<td>38.9%</td>
</tr>
<tr>
<td>1978</td>
<td>23,052</td>
<td>19,746</td>
<td>3,306</td>
<td>14.3%</td>
<td>14,151</td>
<td>8,901</td>
<td>38.6%</td>
</tr>
<tr>
<td>1979</td>
<td>23,486</td>
<td>20,144</td>
<td>3,342</td>
<td>14.2%</td>
<td>14,305</td>
<td>9,181</td>
<td>39.1%</td>
</tr>
<tr>
<td>1980</td>
<td>24,258</td>
<td>20,808</td>
<td>3,460</td>
<td>14.3%</td>
<td>14,744</td>
<td>9,524</td>
<td>39.2%</td>
</tr>
<tr>
<td>1981</td>
<td>24,202</td>
<td>20,801</td>
<td>3,401</td>
<td>14.1%</td>
<td>14,814</td>
<td>9,388</td>
<td>38.8%</td>
</tr>
<tr>
<td>1982</td>
<td>24,906</td>
<td>21,342</td>
<td>3,564</td>
<td>14.3%</td>
<td>15,405</td>
<td>9,501</td>
<td>38.1%</td>
</tr>
<tr>
<td>1983</td>
<td>26,020</td>
<td>22,209</td>
<td>3,811</td>
<td>14.6%</td>
<td>16,253</td>
<td>9,767</td>
<td>37.5%</td>
</tr>
<tr>
<td>1984</td>
<td>26,321</td>
<td>22,695</td>
<td>3,626</td>
<td>13.8%</td>
<td>16,361</td>
<td>9,960</td>
<td>37.8%</td>
</tr>
<tr>
<td>1985</td>
<td>26,529</td>
<td>22,795</td>
<td>3,734</td>
<td>14.1%</td>
<td>16,360</td>
<td>10,169</td>
<td>38.3%</td>
</tr>
<tr>
<td>1986</td>
<td>26,431</td>
<td>22,559</td>
<td>3,872</td>
<td>14.6%</td>
<td>16,091</td>
<td>10,340</td>
<td>39.1%</td>
</tr>
<tr>
<td>1987</td>
<td>25,707</td>
<td>21,742</td>
<td>3,965</td>
<td>15.4%</td>
<td>15,407</td>
<td>10,300</td>
<td>40.1%</td>
</tr>
<tr>
<td>1988</td>
<td>25,448</td>
<td>21,462</td>
<td>3,986</td>
<td>15.7%</td>
<td>15,083</td>
<td>10,365</td>
<td>40.7%</td>
</tr>
<tr>
<td>1989</td>
<td>25,489</td>
<td>21,412</td>
<td>4,077</td>
<td>16.0%</td>
<td>15,124</td>
<td>10,365</td>
<td>40.7%</td>
</tr>
</tbody>
</table>
administrative body able to handle and maintain this amount of housing.

A second planning figure used by the Department of Residence is that married student enrollment comprises 17% of the total student body. Figures released by the Department of Admissions and Records show (Table 4.1) that married student enrollment was only 13.6% of total student enrollment in 1988. Nevertheless, the 17% figure seems to have accurately represented married student enrollment in the recent past, and therefore the assumption will be made that this figure is valid.

Because there are no statistics regarding how many families consist of two students, the results of the married student housing questionnaire found in Appendix C will be used. In line with the data collected, it will be assumed that 79% of married student families consists of one-student and that the remaining 21% consists of two-student families.

Current enrollment-projections provided by the Office of Admissions and Records are shown in Tables 4.1 4.2, along with the corresponding numerical values for the various married student percentages, which are based on the assumptions cited above. That past enrollment projections have consistently been conservative should not be overlooked. According to university projections, peak demand for married student housing will occur in 1999, when 1,718 units will be required. Subtracting the existing 956 units now available in University Village, Hawthorn Court, and Schilletter Village from this figure leaves a demand for 762 additional housing units to be located in Pammel Court. These 762 new units will be divided proportionally between East and West Pammel Court, depending upon the corresponding area of each development. Pammel Court is approximately 35.7 acres in size and comprises 58% of the total land area of Pammel Court. Consequently, Pammel Court will be developed to contain a
maximum of 386 units.

If the targeted figure of 1,741 units exceeds future demand, the residence department does have two viable options to compensate for a housing surplus. It may choose either (1) to house more than 40% of the married student body or (2) to house single students in existing married student housing, which is currently being done. These two options will insure that future housing commitments are fulfilled.

**Students and Their Families' Preferences**

As indicated earlier, user needs should be an integral element in the design process of all architecture; in point of fact, a building cannot be truly successful unless it meets the needs of its users.

Recently, five surveys exploring the makeup and the needs and preferences of student families have been conducted. A summary of the results of these surveys has been compiled and appears in Appendix C. The five surveys included

1. Dileep Dhavale’s (D.D.), conducted in 1976 at the University of Northern Iowa family-housing facilities as part of a report to the Regents;

2. Gary Snider (G.S.), conducted in 1978 at Iowa State University student apartment facilities, as part of a master’s thesis;

3. Department of Landscape Architecture student interviews (L.A.) of students with families living in university apartments at Iowa State University, conducted in 1977 for fulfillment of course requirements for Landscape Architecture 313;

4. Ritts, Ann Linda’s survey (RL), conducted in 1987 at Iowa State University student apartment facilities, as part of a master’s thesis;
Table 4.3: Married student housing demand, I.S.U.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total enrollment (a)</th>
<th>17% married (b)</th>
<th>40% housed (c)</th>
<th>Units occupied (d)</th>
<th>Additional units required (e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>25,448</td>
<td>4,326</td>
<td>1,730</td>
<td>1,318</td>
<td>412</td>
</tr>
<tr>
<td>1989</td>
<td>25,489</td>
<td>4,333</td>
<td>1,733</td>
<td>1,278</td>
<td>455</td>
</tr>
<tr>
<td>1990</td>
<td>25,599</td>
<td>4,352</td>
<td>1,741</td>
<td>1,220</td>
<td>521</td>
</tr>
<tr>
<td>1991</td>
<td>25,066</td>
<td>4,261</td>
<td>1,704</td>
<td>1,146</td>
<td>558</td>
</tr>
<tr>
<td>1992</td>
<td>24,353</td>
<td>4,140</td>
<td>1,656</td>
<td>1,130</td>
<td>526</td>
</tr>
<tr>
<td>1993</td>
<td>24,152</td>
<td>4,106</td>
<td>1,642</td>
<td>1,105</td>
<td>537</td>
</tr>
<tr>
<td>1994</td>
<td>24,008</td>
<td>4,081</td>
<td>1,632</td>
<td>1,080</td>
<td>552</td>
</tr>
<tr>
<td>1995</td>
<td>24,101</td>
<td>4,097</td>
<td>1,639</td>
<td>1,055</td>
<td>584</td>
</tr>
<tr>
<td>1996</td>
<td>24,242</td>
<td>4,121</td>
<td>1,648</td>
<td>1,030</td>
<td>618</td>
</tr>
<tr>
<td>1997</td>
<td>24,474</td>
<td>4,161</td>
<td>1,664</td>
<td>1,005</td>
<td>659</td>
</tr>
<tr>
<td>1998</td>
<td>24,870</td>
<td>4,228</td>
<td>1,691</td>
<td>980</td>
<td>711</td>
</tr>
<tr>
<td>1999</td>
<td>25,257</td>
<td>4,294</td>
<td>1,718</td>
<td>956</td>
<td>762</td>
</tr>
</tbody>
</table>

- (a) Source: Dean of Admissions and Records Office
- (b) Source: Department of Residence
- (c) Source: Department of Residence
- (d) Source: Department of Residence
- (e) Assumed Pammel Court would receive proportional number of units
Table 4.4: Enrollment by type of housing, I.S.U.

<table>
<thead>
<tr>
<th>Housing Type</th>
<th>Men</th>
<th>Women</th>
<th>Total</th>
<th>% of Total University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraternities &amp; Sororities</td>
<td>1,320</td>
<td>687</td>
<td>2,007</td>
<td>7.9%</td>
</tr>
<tr>
<td>Residence Halls</td>
<td>4,855</td>
<td>3,915</td>
<td>8,370</td>
<td>32.8%</td>
</tr>
<tr>
<td>University Student Apartments</td>
<td>1,174</td>
<td>548</td>
<td>1,722</td>
<td>6.8%</td>
</tr>
<tr>
<td>Living with Parents</td>
<td>496</td>
<td>307</td>
<td>803</td>
<td>3.2%</td>
</tr>
<tr>
<td>Off-Campus in Ames</td>
<td>4,971</td>
<td>3,434</td>
<td>8,405</td>
<td>33.0%</td>
</tr>
<tr>
<td>Commuters</td>
<td>1,246</td>
<td>1,133</td>
<td>2,379</td>
<td>9.3%</td>
</tr>
<tr>
<td></td>
<td>14,062</td>
<td>9,620</td>
<td>23,682</td>
<td></td>
</tr>
<tr>
<td>No Information</td>
<td>1,062</td>
<td>741</td>
<td>1,803</td>
<td>7.1%</td>
</tr>
<tr>
<td>TOTAL UNIVERSITY</td>
<td>15,124</td>
<td>10,365</td>
<td>25,489</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Table 4.5: Fall-enrollment data by gender, I.S.U.

**FALL ENROLLMENT DATA BY MEN AND WOMEN**
A Ten Year Comparison

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Fall Enrollment</th>
<th>Men</th>
<th>Women</th>
<th>% Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 1980</td>
<td>24,268</td>
<td>14,744</td>
<td>9,524</td>
<td>39.2%</td>
</tr>
<tr>
<td>Fall 1981</td>
<td>24,202</td>
<td>14,814</td>
<td>9,388</td>
<td>38.8%</td>
</tr>
<tr>
<td>Fall 1982</td>
<td>24,906</td>
<td>15,405</td>
<td>9,501</td>
<td>38.1%</td>
</tr>
<tr>
<td>Fall 1983</td>
<td>26,020</td>
<td>16,253</td>
<td>9,767</td>
<td>37.5%</td>
</tr>
<tr>
<td>Fall 1984</td>
<td>26,321</td>
<td>16,361</td>
<td>9,960</td>
<td>37.8%</td>
</tr>
<tr>
<td>Fall 1985</td>
<td>26,529</td>
<td>16,360</td>
<td>10,169</td>
<td>38.3%</td>
</tr>
<tr>
<td>Fall 1986</td>
<td>26,431</td>
<td>16,091</td>
<td>10,340</td>
<td>39.1%</td>
</tr>
<tr>
<td>Fall 1987</td>
<td>25,707</td>
<td>15,407</td>
<td>10,300</td>
<td>40.1%</td>
</tr>
<tr>
<td>Fall 1988</td>
<td>25,448</td>
<td>15,083</td>
<td>10,365</td>
<td>40.7%</td>
</tr>
<tr>
<td>Fall 1989</td>
<td>25,489</td>
<td>15,124</td>
<td>10,365</td>
<td>40.7%</td>
</tr>
</tbody>
</table>
Table 4.6: Married students, fall 1989, I.S.U.

<table>
<thead>
<tr>
<th>College</th>
<th>Enrollment</th>
<th>Married</th>
<th>Percent Married</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>1,986</td>
<td>136</td>
<td>6.8%</td>
</tr>
<tr>
<td>Business Administration</td>
<td>1,683</td>
<td>160</td>
<td>9.5%</td>
</tr>
<tr>
<td>Design</td>
<td>2,050</td>
<td>113</td>
<td>5.5%</td>
</tr>
<tr>
<td>Education</td>
<td>1,862</td>
<td>229</td>
<td>12.3%</td>
</tr>
<tr>
<td>Engineering</td>
<td>4,315</td>
<td>237</td>
<td>5.5%</td>
</tr>
<tr>
<td>Family &amp; Consumer Sciences</td>
<td>1,390</td>
<td>103</td>
<td>7.4%</td>
</tr>
<tr>
<td>Sciences &amp; Humanities</td>
<td>7,784</td>
<td>493</td>
<td>6.3%</td>
</tr>
<tr>
<td>Veterinary Medicine</td>
<td>342</td>
<td>94</td>
<td>27.5%</td>
</tr>
<tr>
<td>Graduates</td>
<td>4,077</td>
<td>1,797</td>
<td>44.1%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>25,489</td>
<td>3,362</td>
<td>13.2%</td>
</tr>
</tbody>
</table>

COMPARATIVE FIGURES

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrollment</td>
<td>25,489</td>
<td>25,448</td>
<td>25,707</td>
<td>26,431</td>
<td>26,529</td>
</tr>
<tr>
<td>Married</td>
<td>3,362</td>
<td>3,469</td>
<td>3,568</td>
<td>3,550</td>
<td>3,647</td>
</tr>
<tr>
<td>Percent Married</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Total)</td>
<td>13.2%</td>
<td>13.6%</td>
<td>13.9%</td>
<td>13.4%</td>
<td>13.7%</td>
</tr>
<tr>
<td>(Grads)</td>
<td>44.1%</td>
<td>46.4%</td>
<td>44.7%</td>
<td>45.3%</td>
<td>47.2%</td>
</tr>
</tbody>
</table>

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September 26, 1989
marf89
5. Moore, Forrest, and Hinkle's interest-opinion survey (M.F.H.) of student families at Colorado State University, conducted in 1972 to expand research information on such students.

The D.D. survey involved two separate questionnaires. One was hand-delivered to 220 students living in three different university family-housing facilities at University of Northern Iowa. A total of 185 were collected. The other questionnaire was sent by mail with stamped return envelopes to 232 students with families living off-campus; only 109 were returned. All students were selected by random sample from the family student population.

Both surveys included multiple-choice as well as open-ended questions. The 30-question survey for the on-campus students seems to have been too lengthy, but the majority of questions were multiple-choice. The off-campus questionnaire included only 15 questions and may have been less time-consuming. Most results were presented as percentages, or rankings. As indicated earlier, a major criticism of the D.D. survey is of the structural-type preference question; otherwise the data obtained seem reliable. Only the results D.D. considered important were included in this report. Yet it seems that the complete results of a document of this nature (a report to the Regents supporting the building of additional housing at U.N.I.) would be important.

The G.S. survey, along with a stamped, self-addressed envelope, was hand-delivered to 100 student families living in three different on-campus housing facilities at I.S.U. A total of 66 responses were returned. It was not stated how participants were selected. The 19 questions consisted of multiple choice and a few open-ended questions. The length of the questionnaire seemed reasonable. Results for most questions were presented as percentages or as number of responses. Results from three
questions were not reported with the main body of results, but despite these three unanswered questions, results seemed reliable.

The L.A. interviews consisted of work completed by two different classes in the winter and the spring quarters of 1977. All interviews were conducted at University Village. Spring-quarter interviews consisted of 42 interviews based on a list of 26 questions. Subjects were residents of University Village, Pammel Court, Hawthorn Court, or Schilletter Village. In both classes, subjects were chosen from a random sample.

One interview was conducted by each class member, which resulted in a number of interviewer-introduced variables including mannerisms, techniques, and personal styles, all of which could have affected results. Because respondents knew that student interviewers were landscape architecture majors, bias may have been introduced into the study. For the most part, however, answers were recorded in an orderly fashion producing an overall impression of competence and reliability.

The R.L. study incorporated four different survey methods: Normal Group Technique, Questionnaire, Tradeoff, and Response Questionnaire. But only the results of the Response Questionnaire are considered in this thesis. The survey randomly choose non-foreign residents living in Hawthorn Court, University Village, or Schilletter Village and asked them to participate in a session in which they were asked to answer a written questionnaire regarding student housing. Because every question was explained carefully during each session, results seem reliable.

The M.F.H. study was conducted at two separate student family-housing villages at Colorado State University. The survey questionnaire, sent by mail, contained both rating scales and open-ended questions. Of the 400 questionnaires sent out, 186 were
returned. The survey was actually conducted in 1968 although results were published in January 1972 [54]. The opinion survey seems to have been carefully developed and to have gathered quality research data.

One general problem with asking students with families about housing preferences is that their present housing influences responses. For example, if a student is currently experiencing a shortage of storage space, that element may seem the most outstanding problem for student family-housing. A few months later, this priority may give way to a more immediate one. Thus, it is important to look at more than one survey and to compare results. This is not to say that any one survey is invalid, but simply that when forming conclusions, one should try to draw from several sources.

As a result of their different emphases, the five surveys did not all ask the same questions, and in some instances, only one survey asked a particular question. Results not verified should be viewed with discretion. But all things considered, understanding of student preferences can be developed by condensing and compiling the five surveys.

Description

Demographic data from the surveys combined give a clear indication of the background of the users, that is, the students and their families. The majority of couples are in their early 20s and have been married for about three years. An average of 57% of households indicates that only the husband attends school; in 32% of households both husband and wife attend, and in 11% only the wife attends. Slightly greater than half of the students are in graduate school, and in the majority of all
households the wife supports the family financially by working outside the home. As would be expected, the great majority of families are residents of Iowa and citizens of the United States. The average length of stay in family housing is about 15 months.

Averaging data from the five studies shows that 37.5% of all families have children. A majority of families with children have only one child, usually of preschool age. Approximately 10% of families have only one parent living in the unit.

Because the majority of families are supported by the student's spouse, financial matters are important. Dhavale reported that in 1976 the average earned income at I.S.U. for couples living on-campus was $6,369 with 50% of all couples making less than $6,250. With scholarships, loans, and assistance from parents, the total average annual income from all sources amounted to $7,446.

A great proportion of the time and energy of students with families is devoted, along with balancing financial burdens, to their studies. According to Reeves (1963), life for the young family can be strenuous because the pressure of college life is combined with the pressure of newly married life. These pressures are exacerbated if children are involved. The people involved in the development of a new family-housing project must be sensitive to this situation: housing should help meet the needs, not add to the burdens, of a student family.

General preferences

All the studies reviewed asked student families what they liked, or what the advantages of family housing were, and what they disliked, or what the disadvantages of such housing were. The obvious advantages were that apartments were inexpensive, near campus, available, and good quality. Additionally, they housed people with
commonalities (age, interests, goals, etc.). These responses suggest that future family housing should hold construction costs down so that rent charged will be low, should choose sites as close as possible to campus, should provide a sufficient number of units to meet demand, and should maintain high standards whenever possible.

The major problem cited was noise. Snider's survey showed that 60% of those polled were dissatisfied with interior acoustical privacy and that 45% were not satisfied with exterior acoustical privacy. Using common walls, floors, and ceilings between units helps reduce initial construction costs but also introduces the problem of sound transmission between units. This is a problem not only in student housing, but in all housing utilizing common barriers. Acoustical control is a major element of privacy, which, as stated before, is an important factor in housing satisfaction.

Students also complained that apartments were cold in the winter. This problem is due directly to lack of insulation and design sensitivity. Proper passive energy conservation design techniques could eliminate this problem in future housing. Such techniques include selecting proper building orientation, configuration, envelope, and materials. By providing wind screens and breaks, landscaping can also play an important role in reducing both energy consumption and air infiltration. The D.D. survey asked U.N.I. students if they would pay higher rent for a better-insulated unit. An overwhelming majority—of 95%—replied that they would. These students realized that a well-insulated home would keep the unit warmer in colder weather, require less energy for heat, and thus reduce utility bills.

In the 1970s, depletion of the world's energy reserves sparked a growing sensitivity to energy use and conservation. Many design principles, such as building orientation, that had been developed over the years were forgotten after the Second
World War as a result of dependence upon mechanical systems and of a misperceived abundance of energy. And it was in this era that most student family-housing facilities were built. With sky-rocketing utility costs and diminishing energy reserves, the basic design principles once overlooked are now being applied again to produce energy-efficient buildings. In this era, energy efficiency should be pursued in the planning of any building, including university family-housing.

Another oft-cited disadvantage was poor maintenance. Numerous studies have shown that satisfaction with a housing development depends in part upon how well management handles maintenance and other problems. Aside from the designer’s opportunity to specify low-maintenance materials, this area is beyond the scope of the architect’s responsibilities and of this thesis.

When the L.A. survey asked what amenities were important, over half the respondents cited laundry facility, outdoor storage, nursery school, and indoor recreation facilities. The most popular athletic facilities were tennis courts and swimming pools. Forty-three percent of respondents felt that it was important to have garages and a special area for automobile repair. A majority indicated in both the D.D. and G.S. surveys that they would rent a garage if available nearby. The L.A. survey showed that 71% were satisfied with parking, even without garages.

Only 33% felt that a study hall was necessary, but investigation shows that a majority of those responding positively were parents. Families with children may not have extra quiet space for study and thus may need a study area outside the dwelling. Play areas for children were important to only 20% of respondents. This response rate is significant because play areas were not listed with the other amenities, and subjects included it of their own initiative. When placed on a list of amenities, playgrounds
ranked sixth most important in a list of 20. Evidently, playgrounds are important to student families.

Within units, the most important elements are provision of adequate kitchen cabinets, closet space, bathtubs with showers, clothes line space, washer and dryer set-ups, private patios, and garden plots. Storage is a frequently-cited problem in general housing, as well as in student housing. That storage space is regarded as dead space makes it an easy element to cut back when economics dictate. But as a result, it frequently is a pressing need for student families.

The amenities cited by students indicate that family-housing design should concentrate on providing space for laundry equipment in the apartment and for clothes lines near the units. If constraints prohibit such space in each unit, adequate laundry facilities must be provided elsewhere. Both indoor and outdoor storage should be included in any new design: present housing evidently fails to meet the storage needs of most student families. The D.D. report found that exterior storage was a necessity. Outdoor recreation areas for both adults and children also ranked high. Although a majority of students would rent garages, the cost and the reduction of open space on the site might make this amenity impractical. Because a great percentage of respondents are satisfied with existing parking situations, garages may not be a wise investment.

Physical needs

Married student families have the same housing aspirations as do every other cultural group in this country. Given the choice, college students would opt for single-family detached housing. Ownership of a single family detached dwelling is
a deeply ingrained norm in American society. Nevertheless, there are numerous constraints often preventing such aspirations from being realized. These constraints lower expectation of housing type, which in turn seems to lower housing satisfaction. Research conducted by Williams (1971) has shown that acceptability of housing types diminishes in relation to how greatly the housing type deviates from the single family detached dwelling. In other words, satisfaction with housing will depend upon how well, given all constraints, a specific housing type incorporates the characteristics of a single family detached dwelling.

The most significant constraint experienced by the married student family is undoubtedly cost. Residents responding to the questionnaire reproduced in Appendix C state that the primary advantage of living in married student housing is “low rent.” Deciding what specific housing type is best suited to married student housing is difficult given the financial constraints. But 74% of tenants responding to the married student housing questionnaire (Appendix C) describe their stay in married student housing at Iowa State University as “pleasant” or better, even though 27 out of the 71 respondents lived in Pammel Court. Therefore, it can be assumed that the housing types currently used have produced fairly high levels of satisfaction.

The physical needs of the student family are not unlike the physical needs of any family. The most notable exception is that student families require additional space for study purposes. Because cost dictates minimization of the quantity of space, the quality of space, defined as how well the space fulfills the functions and activities taking place within it, becomes paramount. The quality of space for married student families depends upon how well the functions and the activities of student families are interpreted and taken into account by the designer. This chapter will emphasize
the qualitative rather than the quantitative needs of married student families.

**Open Space** Open space may be defined as all land not occupied by a building. Open space includes adult’s recreational space, children’s play space, roads, bike trails, walks, service space, parking, and private outdoor courts. Open space is bounded and crossed by a vehicular network but may require separate spaces safe from auto intrusion. The open space itself will often facilitate movement. According to Untermann and Small (1977), “... it is essential to realize that open space is in itself a fully operative circulation subsystem assuming a variety of important functions.” Although it is restricted to pedestrians and bicycles it has all the attributes of a system. It has continuity: the entire site can be traversed without one’s leaving the system. It has nodality: the pathways converge on points of amenity, commercial and community centers, and schools. It has its own internal hierarchy of use, from fully public through semipublic to private. It represents an attempt to resolve the conflicting demands for safety (through surveillance and intensive use) and privacy.

The size and location of open space will depend upon such factors as building type, density, family characteristics, existing land patterns, and surrounding site. Determining size and location may be accomplished by viewing open space in terms of both ownership and hierarchy.

Open space can be classified broadly into three forms of ownership: public, semipublic, and private. The major distinctions amount the three types of ownership is that usage becomes quite restrictive with private ownership, somewhat restrictive with semipublic ownership, and nonrestrictive with public ownership. Recognition of the different types of ownership depends largely upon the physical cues found within
the open space. Walls and gates provide an obvious physical separation of space, but changes in elevation or material, landscaping, and low or transparent fencing can, too. Newman (1972) describes the distinguishing of ownership of open space as the creating of “zones of influence” and asserts that if ownership is clear to inhabitants, they will maintain better surveillance and defend the space more readily than if ownership remains ambiguous.

Untermann and Small (1977) have categorized ownership of open space hierarchically, each category serving specific functions, yet all being related to satisfy community: the community system, analogous to public ownership; the neighborhood system, analogous to semipublic ownership; and the development system, analogous to private or semiprivate ownership.

Community open space is the primary and largest open space in the development. It should express the essential characteristics of the land and be capable of guiding and controlling the form of development. Community open space is used primarily for passive activities such as walking, resting, bicycling, getting somewhere, or going nowhere. Space for additional active recreational activities is usually located on the fringe of community open space but remains visible and accessible by walkways and paths.

Neighborhood open space is the most used movement system connecting the pedestrian in his dwelling with all major public facilities. Most children’s play spaces are located in the neighborhood open space because the location allows supervision but keeps noisy play activities away from units. The neighborhood open space must be sufficiently continuous to connect all neighborhood spaces. Connections can be made through a variety of pedestrian routes joining residents with tot lots, meeting
and rest areas, and other public facilities. Neighborhood open space extends private space into semipublic and public space. It also provides a range of opportunities for social interaction.

Development open space refers to the open space found immediately adjacent to the building. This space must be carefully planned to insure privacy. At the same time, to take advantage of extended views and natural light, it should directly relate to the larger, more public spaces beyond its borders.

One of the benefits of categorizing open space lies in the avoidance of ambiguous space, which seems to belong to no one. Lack of identity can result in maintenance and security problems because no one will feel responsible for this unclaimed space.

Adult outdoor recreational space Various forms of active recreational activities including basketball, baseball, and tennis, are abundantly found within walking distance of the Iowa State University campus. More passive forms of adult recreation such as picnicking, walking, and bicycling, could be located anywhere within the open space because they are far less disruptive. Research has shown that in recreational areas family-sized (e.g. picnic tables) and group-sized (e.g. football fields) amenities are preferable over individual-use amenities. The married student questionnaire (Appendix C) shows that respondents rank adult recreational space between “important” and “important but not essential.”

Children’s outdoor play space The English publication *Housing the Family* (1974) has compiled numerous studies and reports on children’s play space. A few of the observations and recommendations contained in that study are listed here.
• Children younger than 11 years old play outside more if they live in dwellings with ground-or first-floor access.

• The number of children who use play areas is significantly influenced by the amount of play space per child and by the type of equipment available.

• Play areas are used by children of all ages although they are less popular with children older than 11.

• Children will play on or near roads if these are the areas nearest the home.

• Private outdoor space used for play should be adjacent to either the kitchen or the living area.

• Seventy-five percent of children, regardless of age, but especially those younger than five years of age, play near the dwelling.

• Where children play is greatly influenced by layout, density, and height of the development; what they do is not.

• Play space should be provided on the basis of 33 square feet per child.

DeChiara/Koppelman (1978) divides play space into two types: play lots and playgrounds. The former are provided for preschool children up to six years of age, whereas the latter are provided for children from six to twelve years of age. Play lots may or may not be incorporated in the playground.

Play lots may include (1) an enclosed area for play equipment, (2) an open turfed area for active play, and (3) a shaded area for quiet activities. Play lots should be located within 300 to 400 feet of each living unit served. The enclosed area for
play equipment should be based on a minimum of 70 square feet per child. A fully equipped play lot will require about 4,000 square feet and will serve up to 50 preschool children. An additional space at least 40 feet square with a turf surface should be provided for active play.

The playground may include (1) a play lot for preschool children, (2) an enclosed playground equipment area, (3) an open turfed area for active games, (4) shaded areas for quiet activities, (5) a paved multipurpose area, (6) an area for field games, and (7) circulation and buffer space. The playground should be located within 1/4 to 1/2 mile of every family dwelling. The smallest playground accommodating essential activity spaces is about three acres, which can serve approximately 110 elementary-school aged children.

Observations from the various married student housing developments discussed in Chapter 3 indicate that amount and type of play space provided do influence whether space is used. Furthermore, location plays a key role. Decentralized play spaces located directly behind the back yards of the clustered units at Hillside Courts are extensively used whereas the fully equipped play space located on the opposite side of a heavily traveled access road at University Village is only rarely used.

Residents responding to the married student housing questionnaire (Appendix C) rate the need for children’s outdoor play space between “important” and “important but not essential.” Nevertheless, provision for children’s outdoor play space is regarded as more desirable than that for adult recreational space.

Parking Movement and storage of automobiles pose one of the greatest site planning problems in any housing development. Each automobile requires approxi-
mately 350 square feet to park and to maneuver. In addition to the demands that cars place on site acreage, they pose problems in terms of contradictory location parameters. Parking should be located close to the units for convenience, but away from the units for safety. A number of small parking lots are less obtrusive than one large parking lot is, but they are more expensive.

Untermann and Small (1977) offer the following suggestions for planning parking areas:

- Minimize the cars in each unit: 10 to 12 cars is a comfortable number.

- Orient the parking lot to the houses it will serve. The connection should be obvious, and the parking spaces should seem like part of the cluster. Pedestrians should be able to walk in front of cars towards their houses.

- To satisfy most orientation requirements, orient single-loaded parking lots parallel to a row of houses running roughly east-to-west.

- Orient double-loaded court parking north-to-south.

- Make the most efficient use of space with perpendicular parking. Plant each parking court to soften and to buffer it. Trees screen best, with one tree to every two to three cars producing overall visual protection. Shrubs provide extra buffer and may be necessary in certain locations.

The U.S. Department of Housing and Urban Development (1972) has established these minimum parking requirements:
The various married student developments described in Chapter Five provide a variety of parking lot configurations. University Village and Schilletter Village use cul-de-sac type parking lots, which are close to units but also serve as children's play space. Hillside Courts use parking clusters in the center of roadways, a system with certain disadvantages in terms of maneuverability and aesthetics.

A majority of residents (79%) responding to the questionnaire (Appendix C) report owning one automobile; 20% state that they own two. Thus, the average parking-stall-per-unit ratio in married student developments at Iowa State University is 1.6. Residence Department guidelines require two parking stalls per unit for new married student housing [51]. Residence department administrators also recommend planning for additional parking stalls should the development ever house single students.

Refuse removal Garbage storage represents another important requirement of married student housing. Garbage containers should be easily accessible for truck pick-up but at the same time should remain as inconspicuous as possible because they are rather unsightly. Landscaping and wall enclosures help camouflage obtrusive containers, but screening does not compensate for poor location. For example, at

<table>
<thead>
<tr>
<th>Space</th>
<th>45</th>
<th>60</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stall depth perpendicular to aisle</td>
<td>17'-6&quot;</td>
<td>19'-0&quot;</td>
<td>18'-0&quot;</td>
</tr>
<tr>
<td>Aisle width</td>
<td>12'-8&quot;</td>
<td>18'-0&quot;</td>
<td>26'-0&quot;</td>
</tr>
<tr>
<td>Unit parking depth</td>
<td>47'-8&quot;</td>
<td>56'-0&quot;</td>
<td>62'-0&quot;</td>
</tr>
<tr>
<td>Stall width parallel to aisle</td>
<td>12'-8&quot;</td>
<td>10'-6&quot;</td>
<td>9'-0&quot;</td>
</tr>
</tbody>
</table>
Hillside Courts and Schilletter Village, garbage containers are placed in the center of the parking lots and attract undue attention. The solution at University Village, where containers are placed at the end of parking lots and are enclosed on three sides by walls, is much less obtrusive. Observation at the various housing developments cited in Chapter Five has shown that these containers are also used as community bulletin boards. Therefore, a small display board should be placed by each container to provide space for community news, announcements, etc.

Building needs  Selecting the appropriate building type depends upon a number of factors such as student input, demographic information, historical influence, density, site topography and configuration, and surrounding site conditions. Each factor, as elaborated on in this text, suggests a one- or two-story building as appropriate for replacement housing at Pammel Court. Row housing (terrace housing), patio housing, and walk-up apartments are all building types responding well to the requirements laid out thus far.

Material and labor costs are the most influential determinants of building materials and construction methods. The typical response to financial constraints has been to use conventional materials and methods of construction, with the hope that proven technology will help hold down rising labor and material costs. Although such an approach has merit, one should not preclude other alternatives. The creative and inventive use of yet unproven combinations and systems may offer an even more acceptable solution to offsetting building constraints.

The unit type to be used in future married student housing has been well-defined by administrators and students alike: both groups have opted for the exclusive use
of two bedroom units. Residence officials state that such units simplify moving, and single students state that the extra space a two-bedroom apartment affords far outweighs the slight increase in rent (Fisher, 1976; Hollins, 1976; Moen, 1976).

**Unit space needs**  The U.S. Department of Housing and Urban Development has published a volume entitled F.H.A. Minimum Property Standards for Multifamily Housing, which contains a significant amount of pertinent information related to married student housing. Although housing at Iowa State University is not legally bound to follow F.H.A. guidelines, this thesis will apply the standards’ minimum requirements because they represent a significant body of research as well as years of experience in multifamily housing. Appendices A and B outline building requirements as set forth in Chapter 3 of the F.H.A. standards. These requirements are incorporated in this thesis.

The average gross square footage of six various two-bedroom apartments evaluated in the F.H.A. standards was 707 square feet. The average net-to-gross ratio was 0.73, i.e., space used for circulation, walls, columns, and shafts accounted for 27% of the total square footage of the dwelling unit. In contrast, Macsai (1976) recommends allocating 15%-20% for circulation space when planning the square footage of apartment units.

The assumption will be made that space activities and furnishings, as outlined in the F.H.A. minimum requirements (Appendix A) for multifamily housing, are valid for married student housing unless otherwise noted. There are, however, certain unique housing needs that must be addressed in married student housing.
Kitchen-dining-living space  When asked how well the room sizes satisfied living requirements, respondents to the questionnaire (Appendix C) indicate that only the kitchen-dining space, is too small. When asked what specific changes should be made, 53 out of 98 respondents refer to improvements within the kitchen, including more counter space, more cabinet space, and more maneuvering space. The square footage of kitchens and the lineal footage of counter space in the housing developments are as follows:

<table>
<thead>
<tr>
<th></th>
<th>Size</th>
<th>Lin. ft. of counter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pammel Court</td>
<td>65 sq.ft</td>
<td>4 ft.</td>
</tr>
<tr>
<td>Hawthorn Court</td>
<td>60 sq.ft</td>
<td>4 ft.</td>
</tr>
<tr>
<td>University Village</td>
<td>50 sq.ft</td>
<td>5 ft.</td>
</tr>
</tbody>
</table>

Because married student housing is based on minimum space requirements, the kitchen/dining/living space may take a number of forms, such as a combined kitchen/dining room, a dining/living room, or a kitchen/dining/living room with no partitions between spaces. If the kitchen is not a separate space, it should at least have the capacity to be screened off in some manner. The kitchen may also serve as the location for a washer and/or dryer. Combining laundry facilities with the kitchen produces more counter space, which aids both functions. Finally, the kitchen should have visual access to the living space and to childrens’ outdoor play space so that play activities may be supervised.

The living space should incorporate physical and visual access to outdoor private or semiprivate space to extend the personal space of each tenant and to enable individual families to exert territorial influences on specific exterior spaces. The desk
and chair listed under the H.U.D. living area requirements (Appendix A) should be
substituted with shelving because the living space in married student apartments is
not conducive to study.

The average areas of living, dining, and kitchen spaces reviewed in the exemplars
are given (two-bedroom units only):

<table>
<thead>
<tr>
<th></th>
<th>Exemplars (Ave.)</th>
<th>H.U.D. (minimum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Living</td>
<td>136 sq.ft.</td>
<td>160 sq.ft.</td>
</tr>
<tr>
<td>Dining</td>
<td>49 sq.ft.</td>
<td>100 sq.ft.</td>
</tr>
<tr>
<td>Kitchen</td>
<td>49 sq.ft.</td>
<td></td>
</tr>
<tr>
<td>Living/Dining</td>
<td>173 sq.ft.</td>
<td>210 sq.ft.</td>
</tr>
<tr>
<td>Kitchen/Dining</td>
<td>109 sq.ft.</td>
<td>120 sq.ft.</td>
</tr>
</tbody>
</table>

**Bedrooms** The rooms demanding the greatest flexibility in married student
apartments are the bedrooms, which must function appropriately for three unique
users: (1) a childless couple that uses the second bedroom as a study; (2) a couple with
one or two children; and (3) four single students who require sleeping and studying
space. The needs of all three combinations must be analyzed carefully when planning
bedroom space. The average size of the primary bedrooms reviewed in Chapter 5
was 111 sq. ft., and the average size of the secondary bedrooms was 90 sq.ft.

**Bathrooms** Care must be taken when placing separate bathroom units back-to-back. Although such a practice may have some economical benefits, the party
wall must ensure maximum acoustical separation. Bathrooms for the handicapped
also require additional space and equipment considerations. The average size of the
bathrooms reviewed in the exemplars was 35 sq. ft.

**Mechanical** All the married student communities reported on in Chapter Five incorporate gas-fired, forced-air mechanical systems and individual water heaters. The space allocation for such services averages 11 square feet. Access to mechanical storage should be kept as clear as possible. University Village residents place their dining tables in front of the mechanical space door, which causes a few problems. Even worse, the mechanical space in the units at Hillside Courts is accessible only after the refrigerator is moved, which is clearly undesirable. Individually metering all utility services to tenants has the advantage of allowing each family to pay only for what it consumes.

**Private outdoor space** Although private outdoor space may be categorized as open space, it will be listed under unit needs to emphasize the fact that private exterior space should be viewed in terms of providing an extension of interior space and should be planned around the specific activities and functions taking place within individual family units. These activities include gardening, sunbathing, sitting, relaxing, playing, barbecuing, reading, and generally enjoying the outdoors. Proper orientation is important when designing private outdoor space. Southeast, south, or southwest orientations are most desirable. The space should not constantly be shaded by trees or by other buildings. Views of adjacent units should be screened, but views of semipublic and public zones are quite desirable. Private outdoor space may be defined by physical objects (walls, fences, gates) or by more subtle means such as changes in paving texture, elevation, or landscaping. Untermann and Small (1977) recommend a minimum area of 100 sq. ft., whereas Cooper (1975) recommends a
minimum of 200 sq. ft. The private outdoor space should have direct access to the living space and, if possible, be visually linked to the kitchen so that parents can supervise children's play. Respondents questioned in the survey reproduced in Appendix C rate private outdoor space as “important” although only one development reviewed in the exemplars (University Village) incorporates private outdoor space into its design.

Unit need determinants  There are three additional determinants, not previously discussed, important in married student housing developments. Each of these three will either directly or indirectly influence activities and functions of the spaces and inhabitants involved in student housing.

Acoustical privacy  The most common complaints cited by users of married student housing, as well as by those of other multifamily housing types, are the problems associated with noise control. Most multifamily housing, due to space limitations and economic constraints, use numerous construction and spatial configurations such as party walls and back-to-back bathrooms that are potential acoustical problems. But the technology does exist to control unwanted noise, and these technologies should be applied.

Perhaps the added costs of noise control would become secondary if builders viewed acoustical privacy as a necessity rather than as a luxury. The importance of acoustical privacy is well-documented by the married students responding to the questionnaire reproduced in Appendix C. The second most cited disadvantage of living in married student housing was the fact that units were “noisy.” The second most cited needed improvement was “soundproofing.” The Minimum Property Standards
(1972) of H.U.D. specify a minimum sound transmission class rating of 45 STC and a 45 Impact Insulation Class (IIC) for living units, whereas Macsai (1976) recommends 50 STC and 55 IIC average ratings. Tenant sensitivity to noise should not be equated with income level or apartment size. Therefore, Macsai’s ratings or higher, if will be used possible in married student housing at Pammel Court.

Energy conservation  Although the phrase “energy conservation” has become a cliche, energy conserving principles in housing design have yet to be fully realized. Energy conservation has recently come to the modern building, but energy-saving design principles have been around for thousands of years. The age-old passive methods of energy conservation such as natural ventilation and solar radiation can be utilized to regulate environments for human use. When controlled by the intelligent use of building orientation, form, envelope, and plant materials, these passive design principles add little or no additional cost to apartment units. This thesis will emphasize the passive elements, as differentiated from the active elements, of energy conservation. Although designers have an ethical obligation to apply their skills towards energy conservation, they also must meet the needs of both clients and users.

Even with the burdensome financial constraints that a married student family confronts, 93% of families surveyed feel new housing units should be designed to conserve energy even if it means that rent payments will be slightly higher (Appendix C). But the resident department is ambivalent towards energy conservation. Although it feels obligated to conserve energy whenever possible in new housing units, any solution requiring a significant financial commitment would require substantial proof of long-term need. After all, it is the obligation of the tenant, not of the residence
department, to pay for utility consumption.

**Building codes** Although new building construction at Iowa State University is not subject to local codes or ordinances, building codes and standards of practice incorporated in the January 4, 1978 revised Iowa State Building Code require compliance. The State Building Code consists of six publications (see p. 33) applicable as though written into the code in their entirety, except for such portions altered by the Iowa State Building Code Advisory Council. A comprehensive listing of these changes can be found in Section 104 of the Iowa State Building Code.

**Sociopsychological needs**

Regardless of the particular dwelling type used in married student housing, to student families, the dwelling becomes home. Although a house is simply the physical aggregation of various elements, the idea of home embraces the satisfaction of a wide variety of personal concerns, aspirations, motivations and values, as well as personal well-being. Hayward (1975) describes the concept of home as “…a label applied voluntarily and selectively to one or more environments to which a person feels some attachment.” The pressing questions are what the label means and when it is applied. To provide a context in which to understand research and theory on this topic, Hayward (1975) researched the meanings ascribed to home by different people. Eventually, he developed five clusters of related definitions of the word.

The first of these concerns home as a *physical structure.* That is, as a place, a physical environment, or a structure. When home is considered a physical dwelling primarily, the inhabitants themselves receive little or no emphasis.
The second concerns home as a local area, a neighborhood, or a territory. Lyman and Scott’s (1972) definition of territory implies a physical area involving personalization and defense. More importantly, however, home as territory also includes familiarity, belonging, predictability, and a spatial framework of behavior. Establishing territorial boundaries can be seen as a ritual for claiming ownership and individuality. The idea of a psychological tie with a local area is fundamental to the concept of home as territory.

A third group of meanings concerns home as a *locus in space*, a central point of reference in the world. The locus serves a function similar to that of a bell tower on campus. It assists the individual in orienting to his environment and in interrelating linkages and settings. Establishing a home changes the world from homogeneous to differentiated space, thereby enabling one to secure a common base to explore outward from or retreat into.

Some people think of home as an integral part of themselves. This leads to a fourth cluster of descriptors concerning *self and self-identity*. Home embodying self-essence or self-identity, an extension of self, or the inner self, or home inseparable from self are examples. Self-identity involves the need to create expressions and symbols of the self and to incorporate this need into the dwelling. It is this concept, more than any other, that separates one’s house from one’s home.

Finally, home may be conceptualized as a social and cultural unit. The emphasis may be on the family, on the dwelling, or on the community as a whole. Extensive study of families and communities has focused on social life and social relationships, while paying scant attention to the setting in which these lives and relationships take place. But home can be viewed as a source of social and cultural identification. In
this instance, it engenders a sense of belonging someplace, in a particular place that
is quite familiar and easily delineated and in which one feels “at home.”

Hayward’s analysis of the many connotations of the word home establishes a
fundamental link between the sociopsychological and physical aspects of married
student housing. Understanding the ramifications that sociopsychological behavior
have on users of married student housing requires that the designer become cognizant
of psychological and physical conceptualizations of that word.

But applying social and psychological dimensions to housing design poses a num­
ber of questions to the designer. What are the various sociopsychological concepts
applicable to married student housing? What influence does the built environment
have on these concepts? And, finally, what influences do these concepts have on
married student families?

Behavioral scientists state that there are tolerance limits set by the biological,
psychic, and social nature of humans [55]. Once these limits have been exceeded, cer­
tain effects or consequences, commonly called deficits, are produced. The immediate
effect of a condition that exceeds a limit and produces a deficit is stress.

Lang (1971) has described the design environment as a system of surfaces having
three functions:

1. to maintain the physiological states necessary for people to attain their goals;

2. to allow, or perhaps to configure, specific patterns of behavior required by
   people to attain their goals; and

3. to support, to some extent, the psychological states necessary for people to
   attain their goals by fulfilling certain symbolic needs.
If this process produces an environment unresponsive to human needs and behavior, it will not be used if potential users have a choice. If they do not have a choice, a stressful situation results. The stress will be physiological if the first of the three design functions mentioned previously is not met. If the other two are not met, the stress will become psychological in nature. If this stress is not quickly removed, other consequences will follow. Sociologists divide these consequences into three types: adjustment, adaptation, and pathology. Psychologists, however, divide these consequences into three somewhat different types: alarm, adaptation, and exhaustion (Selye, 1965). The psychological manifestations of alarm are anger and fear; those of adaptation are coping procedures; and those of exhaustion are psychoses.

The key to insuring that the built environment provides a healthful social and psychological atmosphere is the designer's awareness of users' behavioral limits. In regards to this thesis, determination of behavioral limits requires an understanding of the specific sociopsychological concepts applicable to married student housing. There are three interrelated concepts related to spatial limitations that are especially pertinent to the construction of multifamily housing. These three concepts are privacy, crowding, and territoriality.

Probably the most frequently acknowledged and universal human need associated with housing is privacy. Altman (1976) defines privacy as “selective control of access to the self or to one’s group.” Westin (1967) provides a systematic analysis of the concept of privacy in terms of the four states of privacy, which he identifies as solitude, intimacy, anonymity, and reserve. The importance of Westin's privacy states is that they indicate how differently sized units (individuals and groups) are involved in
privacy phenomena and how settings make a difference. Westin also describes the four functions of privacy, which he identifies as personal autonomy, emotional release, self-evaluation, and limited and protected communication.

Privacy is a continually changing process that reflects a momentarily ideal level of interpersonal contact, which can range from wanting to be accessible to others, to wanting to be alone. Too much or too little privacy is unsatisfactory, and people seek an optimal level of social interaction (Altman, 1976). In other words, the system will be in a state of equilibrium if it can be achieved. When a person or a group attempts to seclude itself from others and is unable to do so, it will feel crowded; when the outcome is overachieved privacy, i.e., more seclusion and withdrawal than desired; it will feel isolated. Thus, ideal privacy is a desired balance of interaction, with an imbalance in either direction being unsatisfactory.

One mechanism used to achieve the desired privacy level is environmental behavior. How people use doors, windows, furniture arrangements, and home designs has been the traditional route to understanding privacy. But the role that the physical environment plays in regulating privacy is quite complex. One such environmental privacy mechanism is that of "personal space," or the invisible boundary surrounding the self (Hall, 1966; Sommer, 1969).

Hall (1966) proposed four distance zones linked to personal contact: (1) intimate distance, ranging from body contact to about 18 inches; (2) personal distance, spanning 1.5 to 4 feet; (3) social distance, spanning 4-12 feet; and (4) public zone, extending beyond 12 feet. These zones represent hypothetically appropriate or "correct" distances within which different interactions with people occur. Violation of personal space boundaries against the desire of the person or persons may be a basis
for discomfort, tension, or conflict (Sommer, 1969).

Territories represent another mechanism for the regulation of privacy. The most common form of human territory is the room, or a physically enclosed space allowing the individual or individuals to be alone and separated from others. In housing, the need for individual privacy is usually fulfilled through the provision of separate bedrooms. There are also more subtle ways in which territories may serve to regulate privacy: that is, by symbolically rather than physically enclosing delegated space. Through the careful articulation of changes in paving texture, changes in elevation, fences, landscaping, gates, and so on, territories gain definition and therefore provide privacy through the realization of symbolic boundaries.

The second important behavioral constraint closely related to privacy is that of crowding. Although numerous studies of crowding have provided some insight into the nature of this phenomenon, a certain degree of confusion is still evident concerning the terms *crowding* and *density*. Many use these terms interchangeably. But *density*, which involves spatial limitations only, is different from *crowding*, which involves restrictive or generally physical aspects of limited space resulting in psychophysical reactions by the individual. In other words, crowding is not merely a matter of density. It is a psychological phenomenon resulting from the interaction of a relatively high density of people with other social, personal, and physical-environmental variables (Stokols, 1976).

Choi et al. (1976) have studied in some detail the factors affecting crowding. They consider density a neutral condition, and the other social, personal, and physical-environmental factors sufficient cause for crowding. Thus, these researchers define crowding as relative rather than absolute.
Two social factors influencing one's experience of crowding are the kind of activity (e.g., individual vs. group) and the type of personal interaction (e.g., cooperative vs. competitive) taking place. Additionally, crowding does not always have a negative effect on the individual. For instance, depending upon the situational norm, people may find crowding enjoyable and even stimulating at times (e.g., in parties, bars, and streets). Cultural norms differ greatly however, as to whether people will perceive the same degree of crowding in a given situation.

Personal factors influencing one's experience of crowding are emotional and physical state (fatigue, boredom, interest, etc.) and personality and temperament (anxiety, aggressiveness, patience, impulsiveness, etc.). In addition, where one has lived, or what Choi et al. (1976) call the "accustomed milieu," will affect one's perception of crowding when there is an environmental shift (e.g., from rural to urban).

Although the social and personal factors affecting crowding are significant, they are at the same time variables over which the designer has little or no control. Yet there are numerous physical environmental factors that affect crowding and that the designer is able to regulate. Such physical-environmental factors include net usable area, vistas, amount of natural light (Schiffenbauer et al., 1977), number of openings, length-to-width aspect, location of partitions (Desor, 1972), color, and visual complexity (Davis, 1976).

In general, the experience of crowding tends to cause psychological and/or physiological stress and therefore often leads to adaptive behavior. The first and most obvious type of adaptive behavior occurs when the individual simply leaves the crowded area. Another way of adapting is to augment the extent of personal space. Repeatedly experiencing crowding conditions will sometimes increase human adaptability,
or, in other words, change one's standard of crowding. Crowding as a psychological phenomenon, then, is only indirectly related to mere numbers or densities of people. The significant element seems to be frustration in the achievement of some purpose because of the presence of others. Crowding is thus directly related to privacy and also to the third and last sociopsychological concept, territoriality.

*Territoriality*, defined as the need of individuals and of groups to claim some geographical area as their own, is another human need best satisfied through the provision of specific environmental or spatial conditions. The specific environmental condition that can fulfill this need is the availability of a fixed, circumscribed area that the individual or group has the capacity to control. Gutman (1972) states that a territory, because it is a fixed area, can be said to exist even when the individual identified with it is not physically present. Thus, territory differs from personal space, which is something an individual carries around with him.

According to Lyman and Scott (1972), territoriality is “carved out space, which affords opportunities for idiosyncrasy and identity.”

Central to the manifestation of these opportunities are boundary creation and enclosure ... Thus the opportunities for freedom of action — with respect to normatively discrepant behavior and maintenance of specific identities — are intimately connected with the ability to attach boundaries to space and command access to or exclusion from territories. (p.65-82)

Proshansky et al. (1972) view territoriality somewhat differently. First, they see the basic function of territoriality as that of providing the minimal amount of physical space required by a human to be free of physical discomfort or pain. In addition, and more importantly,

He must be able to move freely within and between physical settings to
satisfy not only his hunger, thirst, sex, and other biological drives, but also his needs for affiliation, achievement, success, and other complex social motives. (p.29-43)

Territoriality, whether achieved through dominance, mutual consent, aggression, or administrative authority, establishes which individuals have access to what areas of a physical setting, and therefore, to what extent the needs of each will be satisfied.

Newman (1972) has applied the behavioral reactions of territoriality regarding specific physical configurations to form a sociophysical phenomenon that the author has named, defensible space. Newman’s concept of defensible space provides one example of how a specific behavioral need can manifest itself as a physical component of the built environment:

Defensible space is a term used to describe a residential environment whose physical characteristics—building layout and site plan—function to allow inhabitants themselves to become the key agents in ensuring their own security. . . The physical elements that are used to create defensible space have a common goal: to release the latent sense of territoriality and community among inhabitants so as to allow these traits to be translated into inhabitants’ assumption of responsibility for preserving a safe and well-maintained living environment. (p.228-232)

Although there has been considerable research into how various social and psychological concepts have been incorporated into housing design, the results have usually centered around certain isolated cases. But Newman (1972) and Cooper (1975) have compiled and documented extensive research into proposed guidelines serving the gamut of multifamily housing. Although drawn from the work of both researchers, these guidelines represent a consensus of the findings of numerous other studies. It should be emphasized at the outset that these guidelines are only recommendations and thus can be debated and possibly refined before being incorporated into extant
married student housing guidelines.

Just as density is only one aspect of crowding, it is also only one aspect of overall user satisfaction. In the final analysis, satisfaction is based on a number of variables, including the units, overall size, relation to open space, variety, and protection of privacy. Subdividing a large housing complex into small identifiable clusters will help satisfy residents' needs for privacy and identity as well as heighten their feelings of security. Density should be based on the actual density in each cluster. A greenbelt several blocks away that prevents each resident from having a view onto a common space to private space will then help to insure that the privacy of the occupant is honored. Additionally, by defining the boundaries of private space, the resident will perceive it as an extension of his or her territory and as a source of identification.

A semiprivate transition space between the privacy of the home and the publicness of the street will also provide an important locale for casual socializing. In moderate-to-high density housing, even the addition of a canopy over the front door or a recessed space off a long access corridor is often sufficient to suggest a semiprivate entrance. Of greater importance is the number of people gaining access through shared indoor space. Although the exact number of families that should share access through indoor space ranges, evidently the greater the number, the more likely that such space will be viewed as public rather than as private, thereby reducing the amount of supervision each occupant will feel responsible for.

For reasons of both noise control and visual privacy, care should be taken not to place paths too near buildings when pedestrian circulation is being designated. Nor should paths be placed at a level higher than that of windows or of private open space. Cooper notes that the building should be set back at least 12 feet from the
public sidewalk; if closer, either thick planting or fencing should screen the windows.

Finally, designers should make every effort to provide a private garden, a yard, a patio, or a balcony for every unit. Numerous studies have shown that most families attach some importance to having some private open space attached to the house (Appendix A). As mentioned earlier, there should be a clear delimitation between private and public space. There should also be clearcut differentiation between private space and adjacent private spaces; otherwise, tension from neighbors will clarify where the territorial boundaries of one’s private space ends and where those of the other begin. When balconies are employed in the design scheme, their usage will depend a great deal upon how private they are. Because it can more successfully fulfill resident needs for privacy and shelter, a recessed balcony is generally preferable to one that is cantilevered. But cantilevered balconies can be made adequately private with solid or semi-solid walls.

In summary, several means by which the physical components of multifamily housing projects can respond to three specific social-psychological concepts—privacy, crowding, and territoriality—have been outlined. It seems that fulfilling the human sociopsychological needs associated with the built environment will often entail finding an appropriate middle ground between two potentially conflicting needs, with the designer’s job being to see that these needs are met in as balanced away as possible. Examples of potentially conflicting needs are the need for neighborliness and a sense of community versus the need for privacy from persons looking into homes or yards, or versus the desirability that public areas be informally surveyed from dwellings, as well as the need for security engendered by an introverted site-plan excluding nonresidents versus the desire to relate to the larger community.
Cooper (1975) points out one rule of thumb pertaining to choosing between conflicting needs. Using a hierarchy of psychological needs based upon the work of Abraham Maslow, Cooper has developed her own hierarchy which, in order of importance from high to low, consists of shelter, security, comfort and convenience, socializing and self-expression, and finally, aesthetics. The implications of such a hierarchy to designers are that a higher need must always take precedence over a lower one. Not until the higher needs have been satisfactorily met will the lower ones emerge into consciousness.

There is an additional conflict facing the designer of married student housing. This conflict is user needs versus low income levels. Given ample space, there is little doubt that all the social-psychological needs of the users could be met. Space provides flexibility and in turn flexibility provides maximum freedom of choice. Unfortunately, married student housing developments are usually constructed using tight and inflexible budgets. Inasmuch as costs dictate the quantity of space, decreasing the physical size of apartment units can limit the flexibility of units should tenants opt to adapt these environments. Although the physical environment itself does not dictate sociopsychological behavior, a growing body of research indicates that the physical environment does influence specific patterns of behavior. Because the extent to which married student housing fulfills the various sociopsychological needs of users depends in part upon the configuration of the physical components in space, it is imperative that the designer understand and interpret correctly the social and psychological needs of the married student family.
CHAPTER 5. EXEMPLARS: CRITIQUES OF EXISTING UNIVERSITY MARRIED STUDENT HOUSING

Critiques

Defines critique as "a critical examination or estimation of a thing or situation (as a work of art or literature) with a view to determining its nature and limitations or its conformity to standards." Criticism itself can be described as the design process in reverse. According to Wayne Attoe (1976), that term denotes prescribing and judging, interpreting, and describing. Prescriptive criticism is the assessment of the environment being discussed in relation to the standards one has developed. Interpretive criticism is the interpretation of a work so that readers will see what the critic is observing. Descriptive criticism is the presentation of facts pertinent to one's encounter with the environment in question. These three areas should form the basic elements of a critique.

Critiques begin at the personal level, usually by relying on direct observations of the subject. A critic strives for objectivity in expressing observations, but one's own biases make this difficult. It is therefore important to know the critic's biases as well as the critique's general purpose.
Critique Scope and Procedure

The following university married student housing critiques will be based primarily on this writer's observations. It is to be understood that the comments in each critique reflect this writer's opinion and that others may view the subject differently.

The procedure for these critiques was developed from a diagram created by Professor Sidney Robinson at Iowa State University, for a course on criticism of design (Figure 7.1). The diagram illustrates how observer and object come together in the development of a critique. The observer brings background preferences (biases), state of mind, and preparation experience to the critique. The object, divided into physical and human factors, produces functional and sensory (aesthetic) elements. Time also plays a role with regard to both observer and object.

A standard format has been developed to ensure that the same elements are observed in each project. Project information and description are based on factual information, whereas observation is based primarily on the opinion of the writer. These three elements are subdivided and presented in list form. The list form for the critique was chosen, instead of the standard journalistic approach, to facilitate comparison of different projects and their specific elements.

Critic's Motive and Biases

The motive for developing these critiques was to evaluate the merits and the dements of existing university married-student housing examples. It is hoped that the results will promote better environments in future designs such as the design of the I.S.U. married student housing project. Analysis of examples presented in this
Figure 5.1: Procedure for critique diagram
thesis may indicate which concepts or ideas are worth pursuing and which are not.

The more one works and studies in a specific area, the higher one's levels of understanding, expectation, and bias. A mechanic, for example, will be more sensitive to the fine tuning of an automobile engine than will the average person. This idea also applies to architects and to planners.

Not only is this critic biased with regard to architecture and planning in general, but he is also biased with regard to university married student housing, as a result of having lived in such housing. Thus, while providing insight into the problems of married student families, he may also be providing a biased viewpoint.

**Luther Sherman Ross Student Residence, Drake University**

**Project Information**

**Location:** See Figure 5.2

West of Drake University Campus

**Date Built:** 1961

**Owner:** Drake University

**Designer:** Harry Weese and Associates

**Project Description**

**Size:** 49 one-level units in five-story structure

**Material:**

- Exterior — brick and concrete
- Interior — mostly concrete block with some Gypsum Wallboard
Structure: Load-bearing concrete; concrete pour floors

Form: Color — red brick with gray concrete trim
Texture — typical brick and concrete finish
Shape — simple rectangular box five-stories high

Site Plan: See Figure 5.3
density approximately 49 units per acre

Floor Plan: See Figure 5.4
33 one-level one bedroom units with 500 square feet each
16 one-level, two-bedroom units with 640 square feet each

Observations

1. Project relation to surrounding buildings and landscape

Blends well with urban fabric
Large trees help site to mix well with surrounding sites
Brick and stone buildings surrounding site are matched by the materials used on the housing site

2. Traffic

Vehicle — Two parking lots on north and south sides of the site are shared with other rental housing, thereby creating competition for parking spaces; parking directly next to the building
Figure 5.3: Ross married student residence site plan
Figure 5.4: Ross married student residence floor plan
Pedestrian — No conflict with vehicle traffic; path to campus does not cross site vehicle traffic; exterior balcony access ways to individual apartments could present problems

3. Landscaping

Shrubs (evergreen and deciduous) and mature deciduous trees
Open balconies are pleasant to walk on because of close foliage from trees
Effective use of shrubs for screening parking and streets from housing
Pleasant landscaping

4. Building orientation and configuration

Oriented to the east and west, with the living-room windows to east
Simple rectangular shape with no projections, except for the balcony walkways; thus, the majority of units heat only two walls
Built before energy crisis
First level units are slabs on grade
Balconies act as overhangs protecting large living room windows

5. Aesthetics

Well proportioned, nice-looking building
Wing walls and balconies break up surfaces, thereby creating visual interest
Landscaping complements building and site
Air conditioning units and supporting board in windows create eyesore.

6. Functional factors

Site — works well
Building set back from streets and screened with landscaping
Structure feels nestled into site
Comfortable walking distance from campus
Laundry located on first level
Parking in scale with site
Floor plan works adequately
Must cross diagonally through living area from front door to reach rest of the unit
Kitchen small, opens into living area, and located along one wall creating little counter space and cupboard area
Space originally provided for air conditioning above front door too small

7. User responses

Physical use — like the facilities, works well for their needs
Three-foot high refrigerator simply not large enough
Windows only single-pane and not tight enough in winter
Acoustics between units very good
Psychological effect — each unit has own entry with defining wing walls
All apartment looks alike
Social structure — common balcony walkways provide means to meet neighbors

8. Views

Views both east and west are nice
Living room view to the east has long vistas

9. Privacy

No exterior private space
Acoustical privacy between apartments excellent
Visual privacy in living room poor because access balcony runs directly in front of windows; some tenants keep curtains drawn

10. Storage

Interior — general storage good, in kitchen poor
Exterior — no storage provided

11. Equipment

Four-burner stove, small refrigerator, central heat, furniture (davenport, dining table and chairs, coffee table, two end-tables, bed and headboard, dresser-desk combination, desk lamp, and living room lamp) are provided
User must provide own unit air conditioner
No clothes-lines
12. Safety

Balconies in winter and rain may be hazardous
If children are allowed to play on balconies, and unsafe situations could arise
Enclosed play space for children good, but not well-kept

13. Handicapped

Apartments readily adaptable
Any floor would work because elevator is provided
Parking spaces would have to be enlarged

14. Client response

Enough units to house students who want housing
Furniture replacement and repair continual problem
No organization of student tenants
Little unity within housing between students
Maintenance good
Generally pleased with buildings' performance

15. Economics

Exterior — no paint required, all materials permanent, maintenance-free materials
Interior - painting of walls and ceilings, and replacement of equipment provided
User has no expenses, especially with furniture provided
16. Maintenance

Garbage — located in room within the building, so not in view and no problem except that users living on upper levels have to carry it down.

Snow removal — parking lots no problem, but balconies must be watched.

Units — only waxing floors and painting walls and ceiling.

Hawthorn Court, Iowa State University

Project Information

Location: See Figure 5.5
Northeast of the Iowa State University main campus

Date built: Phase I — 1956
Phase II — 1970

Owner: Iowa State Board of Regents

Designer Phase I — Ray Crites
Phase II — Ray Crites and Leonard Wolf

Project Description

Size: 49 four-plex one-story rowhouses; 196 units

Material: Exterior — painted vertical wood siding pea gravel roofing
Interior — painted Gypsum Wallboard
Structure: Wood frame

Form:  
- Color — three unit colors: light brown, light green, dark red  
- Texture — vertical grooved siding  
- Shape — rectangular with sections set back, gable roof

Site Plan:  
- See Figure 5.6  
- density approximately 10 units per acre

Floor Plan:  
- See Figure 5.7  
- one-level two-bedroom units 600 square feet each

Observations

1. Project relation to surrounding buildings and landscape

   Low one-story horizontal building related well to open land on east  
   No barriers between train tracks on north and housing  
   Same height as housing to the west

2. Traffic

   Vehicle — Only cars dealing with Hawthorn Courts use streets; parking spaces directly off street; parking directly next to unit  
   Pedestrian — No continuous sidewalks; therefore, pedestrians walk in streets
Figure 5.5: Iowa State University Campus
Figure 5.6: Hawthorn Court site plan
Figure 5.7: Hawthorn Court floor plan
3. Landscaping

Well-established trees and bushes in front of units
Some foliage in enclosed open spaces, but not enough to block view from apartment to apartment
Landscaping needed to break up spaces

4. Building orientation and configuration

Built before energy crisis
Same unit design faces all four directions
Overhangs shade most windows in the summer
Simple rectangular shape with common walls between units
Slab on grade

5. Aesthetics

Rows of units broken up with setbacks;
Simple and well-proportioned

6. Functional factors

Site — Works well, generally; no laundry within close walking distance; not enough parking for visitors and specific units hard to find; units placed too close to streets may cause noise and light problems from cars; clotheslines are well-hidden between units;
Floor plan — Acceptable; visitor must walk past bedrooms and kitchen to enter living area; open partition between bedroom and
living area is aesthetically pleasing, but concerns about noise and light. Kitchen too small, not much counterspace; location for air conditioner in kitchen window not good; although ventilation good

7. User response

Physical use — users like, especially those with children (relation between unit and outdoor play space);
Psychological effect — each unit has own entry, creating sense of belonging or owning, but each unit looks alike;
Social structure — grouped so that front looks towards road and parking, which is shared by neighbors so that interaction can occur;
Much interaction through the parents of meeting childrens’ playmates’

8. Views

Front bedroom windows face parking and street;
Rear living room windows face common green space

9. Privacy

No exterior private space; open patio space provided in open area;
Living room windows can often be seen into from other apartments;
Acoustical privacy between units acceptable;
100

Acoustical privacy within unit between the living area and the bedroom with an open partition could present problems

10. Storage

Interior — kitchen needs more;
Exterior — shed in back of unit available, but not large enough for bikes

11. Equipment

Four-burner stove, refrigerator, heating equipment, clothesline provided;
No shower provided;
Unit air conditioner user provides, but space for equipment is provided;
Space and hook-up for washer

12. Safety

Interior open area good for children, buildings and fences give sense of enclosure, but children could still get out;
Pedestrians walk in streets, creating automobile conflict

13. Handicapped

One unit provided, and more could be converted;
One-story units make conversion easy;
No curb cuts;
Parking spaces would have to be widened for maneuvering wheel-chair

14. Client response

Great demand, especially among couples with children;
Maintenance basically good, except for painting exteriors and fences;
Good acoustically from apartment to apartment;
Major complaint - no showers; √
Good alternative to other types offered;
Individual utility meters good;
Basically, a successful complex

15. Economics

Exterior — painting required of units and fences with gravel built-up;
roof needing repair frequently now after 20 years;
User has no expenses added because of materials used or room configuration

16. Maintenance

Garbage — white receptacles at each corner make it easy for trucks to load, but constitutes a major visual element throughout the complex;
Snow removal — no problem;
Exterior of units — paint and roof care;
Interior of units — materials such as tile floors are long-lasting and require waxing only;
Gypsum Wallboard requires painting

University Village, Iowa State University

Project Information

Location: See Figure 5.9;
North of the Iowa State University main campus

Date built: Phase I — 1968;
Phase II — 1970

Owner: Iowa State Board of Regents

Designer: Savage & VerPleog Architects

Project Description

Size: Phase I — 300 units;
Phase II — 200 units

Material: Exterior — brick and wood cedar shingles;
Interior — Phase I: brick party walls and Gypsum Wallboard; Phase II: Gypsum Wallboard; Both phases: exposed wood decking ceiling on second level

Structure: First level — load-bearing brick;
Second level — wood frame
Form:  Color — red brick with white mortar, gray natural weathering cedar wood shingles;  
Texture — typical brick texture and rough thin shingles;  
Shape — simple rectangle with mansard roof

Site plan:  See Figure 5.9;  
Density approximately 15 units per acre

Floor plan:  See Figures 5.10 and 5.11;  
One-story, two-bedroom units with 550 square feet; two-story, two-bedroom townhouses with 770 square feet

Observations

1. Project relation to surrounding buildings and landscape

   Low two-story building and earth tones help relate development to land;
   Complex steps up hill adapting to the slope of the land;
   Open areas within site contribute to open feel of surrounding site

2. Traffic

   Vehicle — Only cars dealing with University Village and Schilletter Village use roads; parking spaces directly off street and in parking lots; walking distance from parking to units convenient;
   Pedestrian — Sidewalks used throughout site are often wholly separated from vehicular traffic
Figure 5.8: Iowa State University campus
Figure 5.9: University Village site plan
Figure 5.10: University Village floor plan - one level with two bedrooms
Figure 5.11: University Village floor plan - two house
3. Landscaping

Token landscaping — not much for the project’s age;
Some evergreens used in enclosed open spaces, but not enough to block view from apartment to apartment;
Very little shrubbery used;
Needs landscaping

4. Building orientation and configuration

Same unit design faces all four directions;
Minimal overhangs used on lower level, and no overhangs on upper;
Simple rectangular shape with common walls between units;
Slab on grade;
Mansard roof with connections to building could cause infiltration problems;
Built before energy crisis

5. Aesthetics

Complexity and fenestration of exterior provide interest;
Rows of units often broken up with setbacks and patio fences

6. Functional factors

Site — Interesting because of the complexity of the unit lay-out, but can confuse the visitor; long walk to campus in convenient; laundry in center of site;
Floor plan — Works quite well although kitchen and dining area cramped; relation between entry and stairs works; interior character comfortable, with oakwood work and the exposed wood decking on the second level.

7. User response

Physical use — pleasing layout, but acoustical problems;
Psychological effect — each unit has own entry and private patio; all units look exactly alike;
Social structure — front doors face common walkways, providing a means of interaction; fenced patios isolate neighbors.

8. Views

Front windows look out on private patios and either common walkway or parking areas beyond;
Sliding glass livingroom window looks out on common green space.

9. Privacy

Patio fences provide maximum privacy, but also prevent user from interacting with neighbors, even if desired;
Large sliding-glass livingroom window can often be seen into from other apartments;
Acoustical privacy between units poor, and a major problem.

10. Storage
Interior — adequate, with long bedroom closets and storage under stairs;

Exterior — no covered storage area; therefore, enclosed patios become storage areas, at times creating unattractive spaces

11. Equipment

Four-burner stove, refrigerator, heating equipment, central antenna, shower provided;

Air conditioner and clothes-line user provides, but space for this equipment is available

12. Safety

Children use sidewalks and other hard surfaces to play on;

No fenced-in areas near most units for children;

Play areas with equipment are located only on the extreme sides of the site, streets must be crossed to get to them;

Stairs in units could be hazardous for small children;

Common green spaces provide limited closure for children, but no barriers restricting children are provided;

Fenced-in patios provide a safe play space for young children

13. Handicapped

No facilities provided;

Sidewalks contain no curb cuts;
Parking spaces wide enough for handicapped to enter and exit from car;
Two-story units are not adaptable, but one-story, two-bedroom units may be

14. Client response

Basically pleasing complex; good housing alternative;
Bricks require little maintenance;
Major problem with acoustics;
Playgrounds have not worked out well; originally, each open space was to include play equipment.

15. Economics

Exterior — no painting required, but shingles could eventually need repair;
Use of cedar shingles and oak woodwork might have increased initial cost, but have given the units character;
The user has no major expenses added because of materials used or room configuration

16. Maintenance

Garbage — red receptacle placed in parking areas; brick walls hide containers;
Receptacles are noticeable, but do not draw attention;
Screens have been modified, leaving them rough and in poor condition;

Snow removal — streets no problem; slope site makes clearing walks difficult in some areas;

Exterior of units — materials used need no special attention;

Interior of units — materials such as tile floor are long-lasting and require only occasional waxing

Schilletter Village, Iowa State University

Project Information

Location: See Figure 5.12;

North of the Iowa State University main campus

Date built: From 1973 to 1978

Owner: Iowa State Board of Regents

Designer: Solar Built Homes;

Crose – Gardner & Associates landscape architects

Project Description

Size: 64 two story four plexes: 256 units, with student family is living in 121 units and single students living in 135 units

Material: Exterior — painted aluminum siding;

Interior — painted Gypsum Wallboard
Structure: Wood frame

Form: Color — light green with black and white trim;
Texture — smooth horizontal clapboard siding;
Shape — rectangularly shaped, with low pitched gable roof

Site plan: See Figure 5.13;
Density approximately 10 units per acre

Floor plan: See Figure 5.14;
One-level, two-bedroom unit with 655 square feet

Observations

1. Project relation to surrounding buildings and landscape

High two-story green buildings have little relation to University Village directly south or to flat terrain surrounding the complex;
Long narrow open spaces within the site open on to surrounding landscape only once

2. Traffic

Vehicle — Only vehicles concerned with family housing use streets;
both parking lots and parking directly off street used; parking directly next to unit;
Pedestrian — Walkway in common open area spine helps separate traffic
Figure 5.12: Iowa State University campus
Figure 5.13: Schilletter Village site plan
Figure 5.14: Schilletter Village floor plan
3. Landscaping

Token landscaping leaves the site stark and plain;
Berming occasionally used, but with little impact;
Needs plantings

4. Building orientation and configuration

Built just before and after energy crisis;
Same unit design faces all directions;
Small overhang on second-level windows from roof;
Simple rectangle with no fenestration could help conserve energy;
Floor and ceiling are only shared surfaces with other units;
Basement used

5. Aesthetics

Units plain and monotonous;
No landscaping or fenestration to give the buildings character;
Colors used are dull;
Floor tile of a dominating color; should be neutral

6. Functional factors

Site — Functions adequately; parking seem the major element dictating design; parking takes up a large portion of the site; a long walk to campus; those without washer and dryer, must carry laundry to the University Village central laundry;
Floor plan — Must walk through living room to move to other rooms from entry; through ventilation good; wood paneling and colored tile floor limit tenant’s ability to choose color scheme; circulation space in buildings beside units not well-cared for by tenants; storage adequate

7. User response

Physical use — apartment layout adequate; acoustical privacy poor; apartments cold in winter; buildings feel crowded;
Psychological effect — two doors into building for all four apartments; all apartments look alike;
Social structure — Common circulation within each building forces users to meet neighbors

8. Views

Living room windows look out on ribbons of common open spaces;
Kitchen and bedroom windows look into parking areas

9. Privacy

No exterior private space;
Acoustical privacy between units poor;
Units can be seen into easily from other units and walkways

10. Storage

Interior — general storage good, lockable areas in basement useful;
Exterior basement provides ample storage for bikes and for other articles.

11. Equipment

Four-burner stove, refrigerator, heating equipment are provided;
Hook-ups and space for both washer and dryer are provided in basement area;
Air conditioning units provided by user, but space is provided;
No clotheslines provided.

12. Safety

Interior stairways provide safety in all weather;
No enclosed play space for children;
Basically safe site.

13. Handicapped

No units provided;
Stairs in common circulation areas prevent wheelchairs from being used.

14. Client response

Vehicle traffic and pedestrian-bike traffic are effectively separated;
Common circulation good, forces neighbors to meet;
Acoustics good between apartments;
May constitute maintenance problem in future;
Availability of washer and dryer hook-ups is convenient for user

15. Economics

Exterior and interior — paint required for both outside and interior walls;
Cheaper initial cost of construction may result in greater maintenance cost in the future;
No expenses because of materials or room configuration

16. Maintenance

Garbage — Although easy for truck to reach, receptacle located in middle of parking lot is in prominent view of site:
Snow removal — no problem;
Units — walls can easily be gashed and ruined; if sheet floor tile is damaged, replacement will be difficult

College Courts, University of Northern Iowa

Project Information

Location: See Figure 5.15;
Southwest of the University of Northern Iowa campus

Date built: Phase I — 1956;
Phase II — 1958

Owner: Iowa State Board of Regents
Designer: E. E. Cole (then U.N.I. University Architect)

Project Description

Size: Phase I — 12 duplexes;
     Phase II — 12 duplexes;
     Total 24 duplexes = 48 units

Material: Exterior — Painted concrete block;
          Interior — Painted concrete block

Structure: Concrete block with wood roof truss

Form: Color — turquoise-painted block;
      Texture — smooth typical concrete block with mortar joints;
      Shape — simple rectangular shape with hip roof

Site plan: See Figure 5.16;
          Density approximately 10 units per acre

Floor plan: See Figure 5.17;
           One-level, two-bedroom with 650 square feet

Observations

1. Project relation to surrounding buildings and landscape

   Low one-story horizontal apartments with hip roof respect flat land;
   Good relation with private housing directly to the south in same style
   and height;
Figure 5.15: University of Northern Iowa campus
Figure 5.16: College Courts site plan
Figure 5.17: College Courts floor plan
No relation between College Courts and five-story dormitories to the north.

2. Traffic

Vehicle — Traffic mainly for housing, but streets can serve married student housing; parking spaces directly off street in groups of four cars; parking directly next to unit;

Pedestrian — Students walk in street because of inadequate, narrow sidewalks

3. Landscaping

Some small trees, but no shrubbery;

Common open areas need more foliage to block views from apartment to apartment;

One of the two open areas has more trees than does the other

4. Building orientation and configuration

Built before the energy crisis;

Great majority of units have large windows facing either north or south;

Roof overhang helps shade windows in summer;

Simple rectangular shape with one common wall reduces energy consumption;

Slab on grade

5. Aesthetics
Units plain, cold, and drab;
Duplexes are set back from others, thus helping break up monotony;
Floor tile of a dominating green color; should be neutral

6. Functional factors

Site — Works well; specific units easy to find; close to campus; units placed close to parking and streets may cause noise and light problems;
Floor plan — Poor circulation: students must walk diagonally through living room to get from front door to bedrooms and kitchen; poor arrangement of rooms: bathroom opens into kitchen and one bedroom opens into living room; kitchen counter space and cupboard space too small; ventilation good, though

7. User response

Physical use — Duplexes are a convenient distance from campus;
Psychological effect — each unit has own entry creating a sense of belonging or owning, but each unit looks alike;
Social structure — grouped so that windows and front door are oriented towards street and parking; little chance for social interaction in front of unit, but shared space in common open area in rear provides such an opportunity

8. Views

Front living room windows face parking and street;
Rear bedroom and kitchen windows are high and require user to stand to see into common open area;
Common open areas filled with poles and wires from telephone and clotheslines, thereby creating an unpleasant sight

9. Privacy

No exterior private space;
Small open patio directly behind unit in common open area;
Good acoustical privacy between units and within units

10. Storage

Interior — general storage good; kitchen storage inadequate;
Exterior — no storage available

11. Equipment

Four-burner stove, refrigerator, heating equipment, clotheslines provided;
Unit air conditioner user provides;
No space for washer provided

12. Safety

Basically safe site;
Enclosed common open areas good for children playing;
Walking in streets because of poor sidewalks produces hazard

13. Handicapped
Readily adaptable;
One-story units make conversion easy;
Parking spaces would have to be widened to make maneuvering a
wheel-chair possible

14. Client response

Quite popular units;
No maintenance required except painting;
Proximity to campus and duplex style desirable;
Fair amount of socializing among residents;
Dull appearance;
Generally successful units

15. Economics

Exterior and interior — painting required, but no major expenses
inasmuch as construction is of concrete block; User has no ex­
penses because of materials used or room configuration

16. Maintenance

Garbage — blue receptacles off to the side of the streets on concrete
pads; close enough in color that they blend with units, but because
of position they stand out;
Snow removal — no problem;
Exterior of units — paint only;
Interior of units — painting of walls and waxing of tile floors
Hillside Courts, University of Northern Iowa

Project Information

Location: See Figure 5.18;
South of the University of Northern Iowa campus

Date built: 1972

Owner: Iowa State Board of Regents

Designer: Hunter, Rice and Engelbrecht Architects

Project Description

Size: 278 one- and two-story units; 80 one-bedroom units;
198 two-bedroom units

Material: Exterior — Weathering cedar wood siding;
Interior — Painted Gypsum Wallboard

Structure: Wood frame

Form: Color — gray;
Texture — vertical grooved siding;
Shape — angular forms in rigid octagon pattern, flat roof

Site plan: See Figure 5.19;
density approximately 17 units per acre

Floor plan: See Figures 5.20 and 5.21;
One-level, one-bedroom with 465 square feet;
One-level, two-bedroom with 680 square feet;
Two-level, two-bedroom with 825 square feet

Observations

1. Project relation to surrounding buildings and landscape

Low one- and two-story buildings with wood siding relate well trees along nearby creek;
Complex steps up hillside adapting to the slope of the land;
Open areas within the site are closed off to large open areas surrounding the site

2. Traffic

Vehicle — Only vehicles concerned with family housing use streets; parking in pods off the street spine; parking space quite tight, making maneuvering difficult; parking directly next to unit but visitors park at entrance lot.

Pedestrian — Maximum separation planned between pedestrian and vehicles, but students walk to class down the streets, not down the sidewalks

3. Landscaping

Token landscaping — not much for the project’s age;
Needs landscaping;
Figure 5.18: University of Northern Iowa campus
Figure 5.19: Hillside Courts site plan
Figure 5.20: Hillside Courts floor plan – one level, one and two bedroom
Figure 5.21: Hillside Courts floor plan – town house
Berming used to add interest;
Some small trees used in enclosed open spaces, but not enough to block view from apartment to apartment;
Only mature trees appear by the creek, and little shrubbery is used

4. Building orientation and configuration

Built before energy crisis;
Same unit design faces all directions;
No overhangs on large living room windows, and only minimum on bedroom;
Angular forms cause many exposed surfaces, and this increases envelope area;
Common walls between units save energy;
Most units slabs on grade, but some have shared basement storage areas

5. Aesthetics

Interesting and exciting as a result of varied angles and recesses;
Wood weathering at different rates creates conflict;
Parking hidden from off-site views of housing;
Parking takes up about one-half the open space;
Garbage receptacles have become focal point of site

6. Functional factors
Site — Rigid orderly plan make it easy to find specific unit; pedestrian and vehicle access spines do not separate these two elements as planned; distance to campus acceptable in good weather but perhaps not in cold or rain; laundries distributed throughout site

Floor plan — Room relations work well; through ventilation good; angled walls present problem for furniture, but add character; all interior colors neutral, so tenant can choose color scheme; balconies on second level units are too small

7. User response

Physical use — mixed reactions but generally favorable; acoustical privacy between units, especially units above and below each other not good; long, winding road to site a major complaint;

Psychological — each unit has own entry and back door with patio or balcony; appearance of units depends upon the type of unit and the number of bedrooms;

Social structure — front doors face parking, and neighbors usually meet in parking lots or on open patios in the common open area

8. Views

Front windows look out on parking;

Large living room window looks out on common open space (pod);

view is stopped by units on the other side, except for units on edges of site, when look out on surrounding open land;

Some second story units look out, over housing units, to campus
9. Privacy

No exterior privacy; patios completely open;
Units can be seen into from other units;
Acoustical privacy for most units poor

10. Storage

Interior — little storage space within unit, small bedroom closets;
   central storage in bins in basement areas which are damp, dirty,
   and unsafe for storing items of value;
Exterior — None provided for grills, lawn chairs, and bikes

11. Equipment

Four burner stove, refrigerator, heating equipment, clothes lines, central antenna provided;
Central air or unit air conditioners provided for most apartments;
Washer hook-up provided in two bedroom units

12. Safety

Outdoor stairways to second story apartments provide a hazard in winter and rain;
Fenced common open areas (pods) between units good playground for children, access directly through unit’s back door;
Parking pods present potential for accidents because of tight turns and obstructed views
13. Handicapped

No units provided could easily remodel ground level unit;
Parking stalls and doors in units would have to be widened for wheel chair;
Curb cuts would have to be made

14. Client response

Maintenance high;
Skylights leak and doors have been a big problem;
Acoustical problems, crowded feeling, and tight parking arrangement have been constant complaints;
Units look great from distance but at a close distance lose attractiveness and conflicts like the different wood colors appear

15. Economics

Exterior — no paint required but wood looks as though repairs will soon be needed; repairs on flat roof have been frequent;
Interior — user may have trouble placing furniture in angular rooms and may have to find furniture that will fit

16. Maintenance

Garbage — blue receptacles placed in the center of the parking pod are reached by the truck backing down access street making it difficult for vehicles to exit;
Snow removal — difficult because of no place to dump snow and the sharp turning radius in the parking pod;
Units - exterior wood siding no special care and interior only painting walls and waxing floors

Hillside Courts Addition, University of Northern Iowa

Project Information

Location: See Figure 5.22;
South of the University of Northern Iowa campus

Date built: 1978

Owner: Iowa State Board of Regents

Designer: Stenson, Warm, and Grimes Architects, Inc.

Project Description

Size: Five-eight plexes two-stories high: 40 units

Material: Exterior — Weathering cedar wood siding;
          Interior — Painted Gypsum Wallboard

Structure: Wood frame

Form: Color — light brown;
      Texture — smooth with vertical grooves;
      Shape — simple rectangular shape, with balconies and steps to second level projecting from rectangle; gable roof
Site plan: See Figure 5.23;
Density approximately 10 units per acre

Floor plan: See Figure 5.24;
One-level, two-bedroom units with 670 square feet

Observations

1. Project relation to surrounding buildings and landscape

   Housing does not reflect slope of land;
   Form of housing does not complement existing Hillside Courts units;
   Wood siding may eventually blend with existing units, but at present appears quite different;
   No landscaping has been planted to carry existing trees and foliage near the creek into the site

2. Traffic

   Vehicle — Only vehicles concerned with family housing use streets;
   parking in one lot for addition and faced to the rear of the apartments;
   Pedestrian — Buildings separate parking from pedestrian walkways, so isolation occurs; separation works well; distance between parking and units not too far, but pedestrians must walk around units

3. Landscaping
Figure 5.22: University of Northern Iowa campus
Figure 5.23: Hillside Courts Addition site plan
Figure 5.24: Hillside Courts Addition floor plan
Project just completed, so too early to see what effect landscaping will have and how much planting will occur; Shrubs have already been planted around air conditioning units, which is a good sign

4. Building orientation and configuration

Built after energy crisis;
Largest windows face northeast and northwest to capture view of campus;
Master plan shows additional units facing all directions;
Orientation to sun has been ignored;
Simple rectangular eight plexes with protruding kitchens;
Common walls, floors, and ceilings help save energy;
Slabs on grade;
Overhangs on second level, but windows on lower level unprotected

5. Aesthetics

Simple and well-proportioned;
Interest is added with the steps and balconies of the second story units;
Materials and colors blend well;
Open space between units adequate;
Changes in roof level help break up rectangular form of buildings

6. Functional factors
Site — Units are too close to parking lot, and buffer zone is needed; pedestrian and vehicle traffic separated well; distance to campus acceptable in good weather but perhaps not in cold or rain; planned common laundry has not been built, and therefore users must walk to laundries in Hillside Courts; no clotheslines;

Floor plan — Room relations work well; through ventilation good; living room small; general storage adequate, walk-in closets useful; counterspace and cabinets too small; floor tile light with brown color, so hide dirt; generous window areas

7. User responses

Physical use — units have been open for too little time to tell; early reports indicate user satisfaction;

Psychological effect — each unit has own entry; all units look alike;

Social structure — front doors face common open areas and walkways, thereby creating encounters in pedestrian areas as well as in parking areas

8. Views

Front livingroom and kitchen windows look out on common green space;

Some views extend all the way to campus;

Rear windows look directly on the parking lot in one-half of units, creating an unpleasant view
9. Privacy

Early indications report acoustics between apartments is adequate;
No private exterior space provided;
Units can be seen into from other units

10. Storage

Interior — ample walk-in closet provided in master bedroom; general storage adequate;
Exterior — none provided

11. Equipment

Four-burner stove, refrigerator, heating equipment, central air conditioning, shower provided;
No washer space inside apartment and no outdoor clothesline provided

12. Safety

Exterior stairways to second floor units may be hazardous in winter;
No enclosed exterior play space for children;
Separation of traffic good

13. Handicapped

Five out of 40 apartments are equipped to handle handicapped;
Distance from parking to unit might be a problem
14. Client response

Initial response from tenants has been favorable;
Housing office likes units;
Too early to predict maintenance requirements;
Solid core doors, sliding type windows, and room layout are positive features;
Living room small, but at least there is no view into kitchen;
Problems with cracking and cleaning of bathtubs will be circumvented by avoidance of fiberglass tubs

15. Economics

Exterior — no paint needed on wood siding, but stairs and decks must be painted to match siding, which will be a recurring problem;
User has no expenses added because of materials used or room configuration

16. Maintenance

Garbage — receptacles well-in placed parking lot behind office area; receptacles are quite far from some units;
Snow removal — parking lot is easy to clean and there is ample room for dumping snow;
Exterior of units — no maintenance for weathering wood siding, but stairs and decks on second floor will require painting;
Interior of units — paint for walls and waxing of tile floor
Evaluation

For comparative purposes, exemplars of various site and unit characteristics of selected married student housing developments. I have been described, from which numerous recommendations may be drawn.

There seems little relation between construction date and other project characteristics. But type of construction and type of material do seem related to construction date. During the prosperous 1960s university commitments to married student housing resulted in the use of long-lasting, low-maintenance materials such as masonry and concrete. In the 1970s use shifted to conventional woodframe constructions with exterior wood siding.

Buildings were consistently two stories in height, although type varied from that of townhouse to two-story walkup. Developments ranged from 200 to 500 units, with site acreage ranging from 16 to 40 acres. Average density was 12.4 units per acre.

One of the most notable variations was in quality and quantity of site amenities. Children’s outdoor play space ranged from a sandbox to a fenced-in, hard-surfaced, fully equipped playground (University Village). Nevertheless, location and not quantity of play equipment seemed the best gauge of how intensely play space was used. The large centralized playgrounds in University Village seemed rather poorly located and were used infrequently. The southernmost playground was located across one of the main arterial streets and away from the units, which caused a safety hazard. Probably the most successful play spaces are found at Hillside Courts, where a satellite play space concept was utilized. More, smaller spaces closer to units seems to result in better adult supervision and in more intense use by children.

Adult’s recreational spaces, like children’s play spaces, differed considerably. No-
ticeably less space was allocated for adults. Whether student families find little time for recreation or prefer to use outside recreational sources is unknown. When adult recreational spaces were furnished, family sized (picnic tables) and group sized (football field) amenities were preferred over individual amenities.

The communal laundry facilities found in most of the developments followed a number of different approaches. One popular solution (Moen, 1976; Hollins, 1976) was to locate laundry facilities in the basements of developments (Schilletter Village). One unpopular application was the satellite facilities found in the basements of six Hillside Court units. Vandalism and safety hazards evidently due to lack of supervision were cited as major problems (Hollins, 1976).

Some of the housing developments studied offered residents storage bins located in the basements of apartment structures. Basement storage is clearly preferable to none at all, but locating storage space within the unit itself was cited as more desirable because of the security risks associated with basement storage (Hollins, 1976; Fisher, 1976).

One unique facet of each project was site circulation. Hillside Courts represents a rather novel attempt to segregate pedestrian/vehicular circulation, but at this project visitor parking seemed poorly located. Pedestrian entrances/exits opposite vehicular entrances/exits work well, as seen at Hillside Courts and at Hawthorn Court. The cul-de-sac arrangements offered safety benefits not found in the projects utilizing 90-degree off-street parking.

The use of dumpsters in trash and garbage removal was not undesirable as long as containers were inconspicuously placed. Trash containers placed in the middle of the parking lot drew undue attention even when containers were screened.
Pedestrian circulation paralleled vehicular circulation in most of the housing developments. Hillside Courts, as mentioned previously, took a novel approach to pedestrian/vehicular circulation. There were, however, two serious drawbacks to this approach. The first and most obvious is that cross circulation poses safety hazards. Second, sidewalks are located too close to units, which results in a lack of privacy for the tenant and in a loss of anonymity for the pedestrian.

The predominant unit type in married student housing is a two-bedroom apartment. Housing administrators unanimously agreed that two-bedroom units are preferred by married students over one-bedroom units (Moen, 1976; Hollins, 1976; Fisher, 1976). The apparent trend in building methods is conventional woodframe construction. Administrators point out that efforts to incur the low initial costs of woodframe construction, as opposed to the high costs of material and labor for other methods such as masonry, have resulted from the financial constraints placed on new housing developments (Moen, 1976; Hollins, 1976).

All developments are individually metered and equipped with gas fired, forced air furnaces. But the housing administrator notes that such a method is unpopular and uneconomical (Fisher, 1976). Additionally, the furnace’s position behind the refrigerator at Hillside Courts is not advisable from a maintenance standpoint (Hollins, 1976).

In regard to unit amenities, dishwashers and garbage disposals were evidently viewed as luxury items and thus were not incorporated in any of the projects. All unit, however, were equipped with refrigerator and stove. Most apartments at Hillside Courts were equipped with central air conditioning, but a more economical method was simply to furnish a wall opening and a 220-volt receptacle and to gave tenants the
option of providing their own window unit. Laundry amenities differed among sites. When group laundry facilities were provided, most units were equipped only with a washer hook-up and a shared clothesline (Hawthorn Court). Only University Village provided private outdoor space for the tenants in the form of fenced-in entrance courts providing child play space, garden and flower space, clothesline space, and a visual screen for outdoor storage. Outdoor storage was noticeably missing from all other married student housing developments. Only one unit type in Hillside Courts allocated space specifically for study activities. In this instance, the study, located off the top of the stairway, also doubled as additional storage space if the second bedroom was used for study activities.

The individual units visited in this report ranged in size from 490 G.S.F. to 900 G.S.F., with average two-bedroom unit size being 707 G.S.F. Units were all rather small overall but efficiently laid out. One particular space, the kitchen consistently seemed too small. Future housing developments will require careful reevaluation to insure that all kitchen activities have adequate space.

Conclusion

The seven exemplars examined provide a variety of different answers to university married student housing needs. The foregoing critiques indicate that although each housing complex had certain faults, it also had characteristics solving specific problems associated with housing the university family. Examples of design concepts that have either worked well or have been unsuccessful can constitute valuable reference material for the designer of similar developments.

The critiques establish that all seven complexes studied exhibited noteworthy
strong and weak design elements. These elements are listed below.

**Ross Residence Hall**

1. Strong elements – good acoustical control between units, a fully developed landscaping plan, and, as a result, good views;
2. Weak elements – poor visual privacy, no exterior private space or storage, small kitchen-dining area

**Hawthorn Court**

1. Strong elements – safe children’s play space and good relation between apartment and exterior play space;
2. Weak elements – inadequate landscaping, no exterior private space, and small kitchen-dining area

**University Village**

1. Strong elements – well-functioning floor, exterior private space and warm, exposed wood interior spaces;
2. Weak elements – acoustical problems between units, no exterior storage, and inadequate landscaping

**Schilletter Village**

1. Strong elements – abundant exterior and interior storage space in basement, and space for both washer and dryer;
2. Weak elements – mundane appearance, poor-quality materials, no exterior private space, monotony, acoustical problems, and crowding.

**College Courts**

1. Strong elements – safe children’s exterior play space, proximity to campus, and duplex units;
2. Weak elements – poor floor plan, mundane appearance, no exterior private space or storage, and inadequate landscaping
Hillside Courts

1. Strong elements – pleasing aesthetic qualities (form and human scale) and stimulating environment: unique units;

2. Weak elements – ill-conceived separation of vehicular and pedestrian traffic, inadequate landscaping, high maintenance costs, acoustical problems, and no exterior private space

Hillside Courts Addition

1. Strong elements - well-conceived floor plan, separation of pedestrian and vehicular traffic by way of parking lot, and pleasant view to campus;

2. Weak elements - no exterior private space or storage, poor landscaping and solar orientation

This summary of the strengths and weaknesses of these university married student housing projects provides a sound foundation from which to begin programming and design phases of future married student housing units at Iowa State University. The information gathered from these critiques can play a useful role in the development of an appropriate solution to this specific housing problem.
Introduction

This thesis has documented observations of the Pammel Court married student housing development at Iowa State University, that lead to a number of general conclusions. An ever-increasing financial investment in maintenance and upkeep of these temporary units has resulted in diminishing returns for the Residence Department. The Pammel barracks units have become impractical for the married student population and a visual eyesore for passersby. In fact, Pammel Court belies the university’s otherwise vigorous and progressive building program. The one factor more responsible for the longevity of Pammel than any other, demand, has diminished dramatically, reaffirming the need for redevelopment.

A historical review of married student housing presented in Chapter Two has established the residence department’s commitment to married housing, as evidenced by an enormous financial investment in housing units and in various social, educational, and recreational programs. On the community level, the city of Ames has forecast continued growth in retail and industrial sectors, which indicates a promising job market for spouses. An excellent parks and recreation system complemented by the Iowa State Center provides an enriching social and cultural atmosphere greatly enhancing physical and intellectual development.
A comparative analysis of selected existing married student housing developments, presented in Chapter Three, shows that married student housing units averaging 707 gross square feet for a two-bedroom unit are smaller overall than those found in the private sectors. And the degree to which married student housing complexes incorporated physical and sociopsychological aspects found in single family detached housing influences how well such complexes are received by tenants. Developments including features such as private ground floor entrances, extended personal space, zones of influence, and a variety of opportunities for social interaction are highly desirable among married student families.

Married student family needs are shown to be similar, in most respects, to the needs of any other family. As shown by the results of the married student housing questionnaire reproduced in Appendix A, married students do tolerate less than ideal conditions in terms of quantity of space and still maintain fairly high levels of housing satisfaction. Notwithstanding, they still demand that the quality of their living space be responsive to their needs, as outlined in Chapter Five.

Deterioration of the existing Pammel units, as well as future enrollment projections, have confirmed the need for additional married student housing. The Residence Department, through financial investment and administrative organization, has demonstrated a commitment to fulfilling the needs of the married student population. Review and analysis of both past and present married student housing developments have provided valuable insights into future housing needs. And, finally, interviews with student tenants and with housing administrators, combined with research by other housing authorities, have produced a large volume of data on student housing needs. In its investigative purpose, four steps were outlined: need establishment,
commitment, research, and data. Thus, the logical next step is to condense all this information and to synthesize the information regarding multifamily housing in general and that regarding the unique aspects of married student housing at Iowa State University.

Such a process will involve the creation of an architectural program. One purpose of this chapter is to present such a program in verbal and in graphic form. The program, or problem analysis, will establish the various goals and requirements of housing married student families at Pammel Court. The program will be followed by a problem statement outlining the unique aspects of housing married students at Pammel Court and serving as an interface between the program and the program analysis (Pena et al., 1977). The program analysis forms the transition from verbal to graphic communication of the program requirements. The next pages of activity data sheets in conjunction with background information and requisite maps, diagrams, and tables, constitute the complete architectural program to be used by the designer.

Site Description

West Pammel Court consists of roughly 21 acres of land located north of the Iowa State campus (Figure 7.1). Close proximity to campus distinguishes Pammel Court as an ideal location for married student housing. Hawthorn Court is located east of Pammel Court, and University Village and Schilletter Village are located farther north. Bordering West Pammel to the north and west is the university golf course, which also contains the Squaw Creek flood plain.

The flood plain is designated as an open green belt in the Ames future land use plan (Figure 4). Maintained as open recreational space, the Squaw Creek valley
Figure 6.1: Pammel Court, I.S.U.
provides a valuable link between the university and the Ames city park system and subsequently serves the recreational needs of Pammel Court residents.

The site is completely bordered by vehicular transportation routes, with Stange Road on the eastern border, the 13th Street extension running along the northern border, and the elevated railroad tracks running from the northwest to the southeast corner of the site. The elevated railroad tracks, physically and symbolically, separate Pammel Court from the rest of campus and thus produce a community with an identity of its own. This effect is congruent with the Residence Department's desire to create a "nonuniversity setting" for married student housing. There is also a natural propensity for the community to relate with the other married student housing developments and with the larger community of Ames.

The existing site currently consists of 169 structures, all of which will be demolished before new housing units are constructed (Figure 6.2). Additionally, Pammel Court currently contains a nursery school, a day-care center, a grocery store, a recreation hall, an arts and crafts building, a study hall, and a laundry. Although married student housing administrators would ideally like to continue all of these services in any new development, the residence department has refused to guarantee financial support for any of the facilities. Therefore, due to their uncertain status, the existing services now available in Pammel Court will not be considered in this thesis. This is not to say, however, that their placement and subsequent relations to each other and to new housing units should be ignored in future design proposals.

Because Pammel Court already functions as married student housing, a full range of utility services to the site already exists. Thus, transition to serving the new housing units should be fairly simple.
Figure 6.2: Existing site plan, Pammel Court, I.S.U.
One possible disadvantage of the Pammel site is the relatively flat landform. Drainage is a planning problem potentially requiring extensive site grading and disruption of existing utility lines.

The most aesthetically pleasing characteristic of the development is its variegated landscaping. Mature trees abound on the land, and there is an undisturbed timber area in the northwestern corner of the site. Every attempt should be made to maintain and to utilize the existing plant materials for their aesthetic and energy conserving values.

The Ames City Planning and Zoning Commission has published a volume entitled “Land Use Policy Plan” (1976a), which describes the climate of Ames:

Ames lies in the central part of the State of Iowa. Since it is far removed from any sizable body of water, the climate tends to fluctuate quite widely. The temperatures are recorded in extremes of heat and cold, from almost 40°F below zero to 110°F above. The mean annual temperature as recorded at the United States Weather Bureau Station in Ames is 48°F. The mean temperature for the summer is 71.6°F, while in winter, it is 21.4°F. In an average year, the frost free season is about 159 days. During the winter months, a considerable number of days never reach a maximum temperature of 320°F or above. For seven months (April through October) there is generally little or no incidence of the temperature falling below the freezing point. The number of days with maximum temperatures over 90°F, and those with lows under 0°F can vary considerably from year to year. An average of 120 days per year have clear skies. October 4th is the average date for the first killing frost, while April 30th brings frost free days.

Precipitation varies greatly from one year to another, and from one season to another. Generally, there is more precipitation in spring and summer than winter. Lowland flooding occurs almost annually in Ames. The flood plain areas are sometimes inundated for weeks during a wet year. This is due to the high water table in the land upon which the City lies. The annual precipitation recorded in Ames averages about 31 inches. Past data indicate that the Ames area can receive 1.5 inches of rain in an hour.
period an average of once every two years. Snowfall, which averages 21.6 inches, accounts for approximately one-tenth of the annual precipitation. The relative humidity in Ames is quite static throughout the year. The level is relatively high in that the monthly average never falls below 50 percent.

Winds average just under ten miles per hour for each month although they have reached as high as 76 miles per hour. Due to its landlocked location, and its basically horizontal landscape, the Ames area is very vulnerable to tornadoes, which occur from April through September.

With all of these extremes in climate, the native vegetation in Iowa has to withstand adverse conditions from the harsh colds of winters to the floods, and yet survive the scorching droughts. Man's settlement has reduced some of these extremes, yet the climate remains basically unchanged.

Figure 6.3 displays a variety of climate data on a monthly basis. Temperature mean, extreme, and frequency data are included in the upper portion of the chart, followed by information on relative humidity, wind speed and direction, solar angles and intensity, and precipitation.

Views from the proposed site differ significantly in terms of magnitude and desirability, depending upon the direction observed. Views to the south terminate abruptly at the elevated railroad tracks and become relatively localized. Views to the east overlook Stange Road and beyond East Pammel Court. The most desirable views are to the north and west, which overlook the Squaw Creek valley and the University golf course. Because of the sloping topography, these vistas are unbroken.

Pammel Court serves as the northern gateway, both physically and visually, to the Iowa State campus. Any development of Pammel Court will have a strong influence on visitors' first impressions of Iowa State by virtue of the development's location and elevation.

There are a number of circulatory routes around and through the proposed site.
Figure 6.3: Climate summary, Ames, Iowa
Vehicular traffic to and from campus travels along Stange Road to the east of the site. Cross-town traffic utilizes 13th Street, which borders the northern edge of the development. There is a designated bicycle path parallel to Stange Road and leading from campus to University Village and to Schilletter Village. Pedestrian traffic from north and east runs parallel to Stange Road. On-site bicycle and pedestrian traffic normally utilizes the pathways parallel to Stange Road but may utilize the Pammel tunnel (Figure 6.2).

Noise is a constant problem. The most obvious and intense source of noise is the railroad tracks, which are frequently used. Moreover, traffic noise associated with the heavily used thoroughfares bordering the site is a potential problem, particularly at the intersection of Stange Road and 13th Street. Every attempt should be made to minimize the transmission of noise into proposed housing units. When the new units cannot be sited away from the noise-producing areas, other forms of natural noise barriers such as earth berms and landscaping, or man-made barriers such as fences and specially designed apartment walls should be employed.

Activity Data

The following data sheets constitute both verbal and graphical representation of the specific activities comprising this architectural program. The purpose of the data sheets is to define and to identify the qualitative characteristics of each activity, as outlined in Chapter Five, and the quantitative requirements of each activity. Determination of quantitative requirements has been influenced by numerous sources. The sources include the exemplars analyzed in Chapter Five, the H.U.D. Minimum Property Standard recommendations, as presented in Appendix A, and ultimately, the
space requirements necessary to facilitate activities and relations unique to married student housing at West Pammel Court.

Net/gross ratios were computed by averaging net/gross ratios of the exemplars (Table 1) with the 80-85% net/gross ratio recommended by Macsai (1976). Handicapped units will not contain stairs, and the net/gross ratio was therefore assumed to be 5% higher than the ratio for a typical unit.

To illustrate how the programmed units compare with average U.S. apartment units, Table 6.2 reproduces Macsai's average values. The table shows that the 843 gross square footage programmed for the new housing units in West Pammel Court is below average for a two-bedroom apartment in the United States but exceeds the H.U.D. minimum and the exemplar average of 707 g.s.f. Because the 843 g.s.f. accurately reflects the users' minimum requirements, it will be assumed appropriate and acceptable.

**Activity Title: Entry/Exit 18 N.S.F.**

**Description**

- putting on and taking off outerwear
- storing coats, boots, umbrellas, etc.
- greeting visitors
- controlling access to dwelling unit
- providing transition from semiprivate to private, interior to exterior space
Functional Relations  Directly accessible to food preparation and living room; indirectly accessible to bathroom, dining, bedrooms, and general storage

Services/Special Conditions

• 110 V electrical service

• exterior overhang at entrance

• interior/exterior artificial

• light at entrance (inside and outside)

Equipment/Furnishings

• 1 - mailbox (exterior)

• 1 - address sign

• 2' - 0" * 3' - 0" coat closet with rod and shelf

Activity Title: Living Room 160 N.S.F.

Description

• entertaining, reading, studying, listening to music, viewing television, children’s playing, conversation, and relaxing

• space should accommodate a variety of lifestyles and furniture arrangements

• 160 sq. ft. minimum, according to H.U.D. standards (Appendix A)

• 11'-0" smallest dimension (Appendix A)
• 7'-6” minimum clg. ht. (Appendix A)

• 136 sq. ft. avg. in exemplars

**Functional Relations**  Directly accessible to entry/exit, private exterior space; overlapping with dining but contiguous to kitchen, with visual access; indirectly accessible to bathroom, general storage, and bedrooms

**Services/Special Conditions**

• 110 V electric service

• 220 V air conditioner

• natural ventilation

• direct sunlight

• television antenna

• exterior view

• wall opening for air conditioner

**Equipment/Furnishings**

• 1 – couch/3' - 0” * 6' - 10”

• 2 – easy chairs/2' - 6” * 3' - 0”

• 1 – television set/1' - 4” * 2' - 8”

• 2 – tables/1' - 6” * 2' - 6” 8 lineal feet of 12” shelves
Activity Title: Kitchen/Dining 120 N.S.F.

Description

- kitchen-preparing, cooking, serving, and storage of food, trash disposal, utensil cleaning, and storage
- dining-formal and informal eating (primary); table games, paper work, studying, hobbies, and conversation (secondary)
- visual access to children’s play areas, interior and exterior is desirable
- screening device between kitchen and dining is desirable
- 120 sq. ft. minimum according to H.U.D. standards (Appendix A)
- 7'-6” minimum clg. ht. (Appendix A)
- 109 sq. ft. avg. in exemplars
- 5'-0” minimum between cabinets in kitchen for handicapped

Functional Relations  Dining space overlapping with living room space; kitchen contiguous to living room with visual access; direct access to entry/exit; circulatory proximity to bathroom, bedroom, and general storage.

Services/Special Conditions

- 110/220 V electrical service
- natural/mechanical ventilation
• gas hook-up

• exterior view

• hot and cold water service with drainage

• removable partition between kitchen and dining

• exhaust fan

• durable and hygienic work surface

Equipment/Furnishings

• 1 – 24” dbl. sink w/(2) 21” lin. counters

• 1 – range/24” * 30” w/(l) 24” lin. counter

• 1 – refrig./24” * 36” w/(l) 15” lin. counter

• 1 – mixing counter 36” lin. counter

• 38 sq. ft. of shelf area

• 8 sq. ft. of drawer area

• 1 – dining table/2’ – 6” * 4’ – 0”

• 4 – dining chairs/1’ – 6” * 1’ – 6”
Activity Title: Laundry Space 18 N.S.F.

Description

• washing and drying clothes; storing laundry supplies
• should be acoustically isolated from bedrooms and study

Functional Relations  Adjacent to food preparation

Services/Special Conditions

• 110/220 V electrical service
• hot and cold water service with drainage
• outside dryer vent

Equipment/Furnishings

• 1 – washer/24” × 30”
• 1 – dryer/24” × 30”
• 12 lin. feet of 12” shelving

Activity Title: Primary Bedroom 132 N.S.F.

Description

• sleeping, resting, love making, dressing, grooming, storing clothes, conversing, convalescing, reading in bed, studying
• requires acoustical separation from other spaces in unit, exterior noise, and adjacent housing units

• 120 sq. ft. min. according to H.U.D. standards (Appendix A)

• one uninterrupted wall space of at least 10 ft. (Appendix B)

• 9'-4" minimum dimension (Appendix A)

• 2' – 0" × 5' – 0" closet with rod and shelf minimum (Appendix A)

• 7'-6" min clg. ft. (Appendix A)

• 111 sq. ft. avg. in exemplars

• 2' – 0" × 7' – 0" avg. closet in exemplars

Functional Relations Directly accessible to bathroom; close circulation proximity to secondary bedroom; indirectly accessible to kitchen/dining, living room, and general storage.

Services/Special Conditions

• 110 V electrical service

• natural ventilation

• telephone receptacle

• acoustical isolation

• direct sunlight

• exterior view
Equipment/Furnishings

- 1 - double bed/4' - 6" * 6' - 10"
- 1 - dresser/1' - 6" * 4' - 6"
- 1 - chair/1' - 6" * 1' - 6"
- 1 - bed stand/1' - 6" * 2' - 0"
- 1 - crib/2' - 6" * 3' - 6"
- 1 - desk/2'-0"x3'-6"
- 1 - 2'-0"x8'-0" closet w/rod and shelf

Activity Title: Secondary Bedroom 121 N.S.F.

Description

- sleeping, resting, dressing, grooming, storing clothes, conversing, playing, convalescing, reading in bed
- requires acoustical separation from other spaces in unit, exterior noise, and adjacent housing units
- may function as a study space, extra storage hobby room, or guest bedroom for childless families (Appendix A)
- 80 sq. ft. minimum dimension (Appendix A)
- 7'-6" min. clg. ht. (Appendix A)
• 2' - 0" * 3' - 0" closet w/rod and shelf minimum (Appendix A)

• 90 sq. ft. avg. in exemplars

• 2' - 0" * 7' - 0" avg. closet in exemplars

**Functional Relations**  Directly accessible to bathroom; close circulation proximity to primary bedroom; indirectly accessible to kitchen/dining, living room, and general storage

**Services/Special Conditions**

• 110 V electrical service with telephone receptacle

• natural ventilation

• acoustical isolation

• direct sunlight

• exterior view

**Equipment/Furnishings**

• 1 - double bed/4' - 6" * 6' - 10"

• 1 - dresser/1' - 6" * 4' - 4"

• 1 - chair/1' - 6" * 1' - 6"

• 1 - bed stand/1' - 6" * 2' - 0" 2' - 0" * 6' - 0" closet w/rod and shelf minimum
Activity Title: Bathroom 60 N.S.F.

Description

- toileting, bathing, grooming, and personal care, (handicapped require a clear space of 5 ft. in diameter, grab bars, insulated pipes, special fixture mounting heights, and 32" clear door opening)

- requires acoustical isolation between adjacent housing units

- 7'-0" minimum clg. ht. according to H.U.D standards (Appendix A)

- 35 sq. ft. avg. in exemplars

Functional Relations   Directly accessible to bedrooms; indirectly accessible to kitchen/dining, living room, and study space

Services/Special Conditions

- hot and cold water w/drainage

- nonslip easily maintained floor surface

- 110 V electrical service

- air exhaust fan

- acoustical isolation

- handicapped: 5' diameter maneuver space, mirror 38" from floor, 18" high water closet, grab bars
Equipment/Furnishings

- 1 - bathtub w/shower/60” * 32” * 15”
- 1 - shower/3’ - 0” * 4’ - 9” for handicapped units
- 1 - lavatory w/counter/2’ - 0” * 3’ - 0” minimum
- 1 - water closet/22” * 27” accessories: grab bar and soap dish in shower, shower curtain rod, toilet paper holder, 2 towel bars, mirror, and wall mounted medicine cabinet

Activity Title: Linen Storage 3 N.S.F.

Description

- storing towels, blankets, sheets, etc.
- 10 sq. ft. minimum shelf area, according to H.U.D. standards (Appendix A)

Functional Relations  Adjacent to bathroom and bedrooms.

Services/Special Conditions  none

Equipment/Furnishings

- 12 lineal feet of 12” shelving w/minimum of 12” o.c. spacing
Activity Title: General Interior Storage 18 N.S.F.

Description

• storing items not used in daily living such as suitcases and off-season clothing

• should be located in central holding space (example: basement storage)

• 140 cu. ft. minimum according to H.U.D. standards (Appendix A)

• 10.5 sq. ft. avg. in exemplars

Functional Relations  Indirect access from living room and bedrooms

Services/Special Conditions  none

Equipment/Furnishings

• 12 lineal feet of 12" shelving

Activity Title: Mechanical Equipment 12 N.S.F.

Description

• storing furnace and hot water heater

• should be acoustically isolated

• 11 sq. ft. avg. in exemplars

Functional Relations  Centrally located within unit
Services/Special Conditions

- hot and cold water w/drainage
- 110 V electrical service
- gas hook-up

Equipment/Furnishings

- 1 - furnace/1' - 6" * 2' - 6"
- 1 - water heater/1' - 6" diameter

Activity Title: Private Exterior Space 128 N.S.F.

Description

- exterior space providing extension of interior space
- gardening, sunbathing, sitting, relaxing, playing, barbecuing, reading, drying laundry, and generally enjoying the outdoors
- southeast, south, or southwest orientation desirable
- views to adjacent units screened; views into semi-public spaces desirable
- provides social connection to rest of development
- visual link to kitchen, so parents can supervise children's play
- Cooper (1975) recommends 200 sq. ft. minimum
- 112 sq. ft. at University Village, I.S.U.
**Functional Relations**  Direct access to living room and exterior storage; visual link to semipublic space.

**Services/Special Conditions**

- 110 V electrical service
- hose bib

**Equipment/Furnishings**

- 4 - lawn chairs/2' - 4" * 2' - 4"
- 1 - barbecue grill/2' - 0" diameter
- 1 - table/2' - 0" * 2' - 0"

**Activity Title:** Exterior Storage 28 N.S.F.

**Description**

- storing bicycles, tires, lawn chairs, children’s toys, barbecue items, etc.
- should be lockable by tenant
- 140 cu. ft. minimum according to H.U.D. standards (Appendix A)

**Functional Relations**  Contiguous to exterior private space

**Services/Special Conditions**  none
Table 6.1: Space summary

<table>
<thead>
<tr>
<th>Activity titles</th>
<th>Space analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N.S.F.</td>
</tr>
<tr>
<td><strong>Typical unit</strong></td>
<td></td>
</tr>
<tr>
<td>Entry/exit(excluding circulation space)</td>
<td>6</td>
</tr>
<tr>
<td>Living room</td>
<td>160</td>
</tr>
<tr>
<td>Kitchen/dining</td>
<td>120</td>
</tr>
<tr>
<td>Laundry space</td>
<td>18</td>
</tr>
<tr>
<td>Primary bedroom</td>
<td>132</td>
</tr>
<tr>
<td>Secondary bedroom</td>
<td>132</td>
</tr>
<tr>
<td>Bathroom</td>
<td>40</td>
</tr>
<tr>
<td>Storage</td>
<td>3</td>
</tr>
<tr>
<td>General interior storage</td>
<td>18</td>
</tr>
<tr>
<td>Mechanical equipment storage</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total net square feet</strong></td>
<td>641</td>
</tr>
<tr>
<td><strong>Net/gross ratio(%)</strong></td>
<td>76</td>
</tr>
<tr>
<td><strong>Total gross square feet</strong></td>
<td>843</td>
</tr>
<tr>
<td><strong>Handicapped unit</strong></td>
<td></td>
</tr>
<tr>
<td>Bathroom</td>
<td>60</td>
</tr>
<tr>
<td><strong>Total net square feet</strong></td>
<td>661</td>
</tr>
<tr>
<td><strong>Net/gross ratio(%)</strong></td>
<td>81</td>
</tr>
<tr>
<td><strong>Total gross square feet</strong></td>
<td>816</td>
</tr>
<tr>
<td><strong>Exterior</strong></td>
<td></td>
</tr>
<tr>
<td>Private exterior space</td>
<td>128</td>
</tr>
<tr>
<td>Exterior storage</td>
<td>28</td>
</tr>
</tbody>
</table>
Table 6.2: Average gross size for apartments in the United States (Macsai, 1976)

<table>
<thead>
<tr>
<th>Unit</th>
<th>Low</th>
<th>Medium</th>
<th>Luxury</th>
<th>HUD minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency (1 bath)</td>
<td>450</td>
<td>500 to 550</td>
<td>600+</td>
<td>380</td>
</tr>
<tr>
<td>1-bedroom (1 bath)</td>
<td>650</td>
<td>700 to 800</td>
<td>900+</td>
<td>580</td>
</tr>
<tr>
<td>2-bedroom (2 baths)</td>
<td>950</td>
<td>1100 to 1200</td>
<td>1250+</td>
<td>750</td>
</tr>
<tr>
<td>3-bedroom (2 baths)</td>
<td>1,250</td>
<td>1350 to 1450</td>
<td>1600+</td>
<td>900</td>
</tr>
</tbody>
</table>

Equipment/Furnishings none

Building Cost

Appendix D contains 14 exemplars of building construction cost analyses of multifamily housing projects taken from *Costs and Trends of Current Building Projects*, Region A Edition/Mid-Year 1979. This publication is compiled and issued semianually by F. W. Dodge, McGraw-Hill Information Systems Company. The data are collected randomly from architects in Region A, which includes North Dakota, South Dakota, Minnesota, Iowa, Wisconsin, Michigan, Indiana, and Northern Illinois.

All area and volume calculations presented in the exemplars follow procedures outlined in AIA document No. D101, the Architectural Area and Volume of Buildings. The construction cost figures quoted in the exemplars are exclusive of such items as professional fees, land costs, site development costs, special foundation costs, and movable furnishings and equipment costs.

The 14 exemplars were selected on the basis of their similarity in terms of both character and scope to the proposed housing project presented in this thesis.
Table 6.3: Project cost estimate for 1991

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Construction</td>
<td></td>
</tr>
<tr>
<td>[843 g.s.f. x $34.72 per sq.ft. x 198 units]</td>
<td>$6,418,500.00</td>
</tr>
<tr>
<td>+[816 g.s.f. x $34.72 per sq.ft. x 22 units]</td>
<td></td>
</tr>
<tr>
<td>B. Movable furnishings - stove and refrigerator</td>
<td>103,500.00</td>
</tr>
<tr>
<td>$375.00 x 12% inflation rate for 2 years</td>
<td></td>
</tr>
<tr>
<td>(Brown, 1979)</td>
<td></td>
</tr>
<tr>
<td>C. Architect’s fee - 5% of A(Brown, 1979)</td>
<td>321,000.00</td>
</tr>
<tr>
<td>D. Site development - 10% of A(Brown, 1979)</td>
<td>642,000.00</td>
</tr>
<tr>
<td>E. A/E fee for site development - 9% of D(Brown, 1979)</td>
<td>5,000.00</td>
</tr>
<tr>
<td>F. State permits/inspection(Brown, 1979)</td>
<td>5,000.00</td>
</tr>
<tr>
<td>G. Plant services/telephone/misc.(Brown, 1979)</td>
<td>10,000.00</td>
</tr>
<tr>
<td>H. Inspection(Brown, 1979)</td>
<td>50,000.00</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$7,608,000.00</td>
</tr>
<tr>
<td>I. Contingencies (10% of subtotal)</td>
<td>760,800.00</td>
</tr>
<tr>
<td>Total</td>
<td>$8,368,800.00</td>
</tr>
</tbody>
</table>

The table above shows the project cost estimate for 1991. The average building cost of the exemplars presented in Appendix D was $27.68 per square foot and $2.65 per cubic foot. These building costs will be adjusted to 1991, assuming a 12% yearly inflation rate. If the various other development costs taken from Brown (1979) are correct, the project cost estimate for 1991 would be as described in Table 6.3.

**Problem Statement**

The following statements link the program, or problem analysis, and the design synthesis. The statements are conceptual in nature and are designed to emphasize the
aspects of housing married student families in West Pammel Court. The statements serve as a guide for generating design concepts and provide the principal criteria with which to evaluate design solutions.

- Multifamily structures should incorporate as many of the characteristics of single-family, detached housing as possible. The design should make possible various levels of social interaction, provide maximum freedom of choice, extend personal space from interior to exterior, and establish zones of influence on all exterior space.

- The community should be capable of functioning with a minimal amount of support from the university to provide a "real world" living experience to the tenants.

- Every attempt should be made to conserve existing landscaping for its aesthetic and energy conserving value.

- Energy conservation, especially passive applications such as natural ventilation, building orientation, form, envelope, and plant materials, should be incorporated into all aspects of the design.

- Because of the frequent turnover rate of the units and the fluctuating tenant composition, the housing units should maintain a consistent overall size, but at the same time be flexible in form and capable of adapting and adjusting to a variety of student lifestyles. The units must accommodate any of the following tenant compositions: one student or two students; students with or without children; student families or four single students.
• Through the physical manipulation of materials and space, the community should reinforce the "zone concept" by providing small identifiable clusters of living units similar in size to existing zones.

• The community should relate, both physically and visually, to the Squaw Creek flood plain and greenbelt to provide a recreational link between the development and the Ames parks system.

• The community should honor the scale of adjoining married student housing and provide a sense of continuity and compatibility.

• Maintenance for both tenants and housing staff should be minimized through durable material selection and prudent construction.

• Style, form, scale, and materials of existing married student housing and of region in general development should be considered and respected.

• West Pammel Court, by virtue of its location as the northern entrance to campus, will strongly influence travelers' first impression of Iowa State University. Therefore, the development should have an open and inviting character.

Program Analysis

The program analysis constitutes the transition from verbal to graphic communication of program requirements. The purpose of the program analysis is to restate graphically the various elements and requirements contained within the program and the problem statement so that the designer's understanding of the problem can increase. Thus, the program analysis functions as a graphical synopsis of the program.
The program analysis contains a space/activity summary, a site/space comparison, a site analysis, and complex and unit diagrams of functional relations (DFR’s). The space/activity summary (Figure 6.5) is a graphical representation of the area required for programmed activities. The areas are blocked out to permit relative size comparisons. The combined space requirements for the entire 220 units are placed on the site to portray graphically the relation of building area required to site buildable area.

The site analysis is a graphical representation of specific site relations including climate, vehicular and pedestrian circulations, landform, site biology, and noise.

The diagram of functional relations (DFR) is an abstract diagram representing the relations of activity spaces to each other. The diagram relates functions by proximity and circulation. Activities requiring circulatory proximity to other activities are shown by relative placement on the diagram. Graphic symbols are used to distinguish certain relations or requirements such as exterior view, acoustical isolation, pedestrian and vehicular circulations, and special mechanical requirements. Both a complex DFR (Figure 7.1) and a unit DFR (Figure 7.1) are presented.
Figure 6.4: Space/activity summary
Figure 6.5: Site analysis
CHAPTER 7. AN ARCHITECTURAL SOLUTION
Figure 7.1: Complex and unit diagram of function relationships/exterio isometric
Figure 7.2: Diagram of functional relationship: site(vehicular/pedestrian)
Figure 7.3: Site plan
Figure 7.4: Floor plans
Figure 7.5: Elevations/sections
Figure 7.6: Interior perspectives
CHAPTER 8. CONCLUSION

The preliminary design for a future family-housing development at Iowa State University, which is presented in Chapter Six, is a response to the problem statement cited in the program. The following summary describes how the design was affected by consideration of each statement.

Client Goals

Family housing should reflect the housing goals of the Family housing Office and the Iowa State University administration. Goals include providing a living environment conducive to the physical, mental, and social well-being of students and their families.

This item is being fulfilled inasmuch as a new housing facility is being built and the university is attempting to provide housing for all students who are eligible and desire university housing. The use of H.U.D. Minimum Property Standards helps insure that the minimum needs of students and their families are met.

The university has established a building philosophy advocating creative designs. These designs are developed to promote pace-setting standards and to contribute to the betterment of the general public and of society. The solution of the problem should reflect this attitude.
This statement is addressed in the preliminary solution in two primary ways. The first is by providing as many characteristics of attached-family housing as possible to increase user satisfaction. This is evident by the emphasis on providing visual and acoustical privacy between units, private exterior space, and adequate storage. The second area of concentration is energy conservation. The primary orientation of all units to the southeast is a departure from past site planning practices, which have usually oriented the same apartment design in all directions. An exception is U.N.I., in which window areas are oriented to the southeast and protected with overhangs to exploit the benefits of the winter sun and to reduce the harsh effects of the summer sun.

For a number of the tenants, university family-housing represents the first living environment in which they are both living on their own and living in a family situation. The living units should respond to this first experience by providing a warm, comfortable, and inviting environment.

Wood elements are integrated into the design of units to provide for the feeling of warmth and comfort. Examples include wood siding on walls in the entry-stair area, wooden kitchen cabinets and built-in closets in bedrooms, wood soffits above windows, and wood doors. The open planning in the living-kitchen-dining area helps to increase the size of each room visually. The vistas through the large windows into the patio and exterior open spaces also aid in increasing the visual size of these living areas. Warmth is also achieved by the warm tone of wooden exterior siding.

Tenants approach dwellings from the parking lot, along landscaped walkways. Each unit entrance is identified by a small entry patio that becomes a transitional space between private interior and public exterior space.
Maintenance should be kept to a minimum for both the housing staff as well as the user. Appropriate materials and planning principles should be used.

The approach taken in regard to this item was to specify materials requiring little maintenance. Cedar wood siding with a natural finish was used because it is not only an economical finished exterior material, but it requires a minimum of maintenance. Resilient tile floors, such as vinyl-asbestos tile, were cited by the I.S.U. Housing Administration as being the easiest and the most economical floors to maintain. The use of native plants for landscaping enhances the chance that plants will grow well and stay healthy. Plants requiring a minimum of trimming and care will be used. Examples of native Iowa plants that could be used include white oak and black maple for overstory trees, eastern red cedar and white pine for coniferous trees, arrowwood viburnum and serviceberry for understory plants, and coralberry and gray dogwood for shrubs.

As a publicly financed institution, monies for initial and long range costs for housing are the public's responsibility. Life-cycle costing should be used so that the project is evaluated in terms of the total cost through the years and not the initial cost, Life-cycle costing would protect the public and may reduce cost over the long run.

Because of the limited scope of this thesis, a life-cycle cost analysis was not carried out. Nevertheless, this thesis will discuss the steps involved in such an analysis. A life-cycle cost analysis can be defined as any technique allowing assessment of a solution or alternative solutions with respect to relevant economic consequences over a given period of time (Haviland, 1977). The most important aspect of this method is that it deals with both present and future costs and relates the two as a basis for
making decisions. To ensure an accurate estimate, an extensive data bank of information on costs, such as materials and labor, is needed. Computers have become quite helpful in the storing of information and the rapid analysis of costs.

The basic procedures involved in life-cycle cost analysis were compiled by an American Institute of Architecture task-force (Haviland, 1977) and are summarized in the following list:

1. Clarify the objective of the analysis.

2. Identify the alternatives to be analyzed.

3. Establish the period in which the analysis starts and how long it runs. The useful life of apartments is usually 40 years (Haviland, 1977).

4. Select the cost factors to be considered. These may include initial investment costs, facility operation and maintenance costs, repair and replacement costs, alteration and improvement costs, and energy costs.

5. Determine the life-cycle cost measure to be used, this is, either total costs in “today’s” dollars or total costs expressed as a uniform annual equivalent over the years the life-cycle analysis runs.


7. Analyze the results.

It must be remembered that life-cycle cost analysis deals only with economic consequences. Throughout decision-making, important noneconomic issues such as aesthetics should be identified and considered along with the economic analysis.
Providing as many aspects of attached-family housing as possible in family-housing units is a critical element in solving this design problem. These aspects include

1. providing acoustical and visual privacy between units and within the unit itself;
2. providing private exterior space separate from general public open areas; and
3. providing adequate interior and exterior storage.

The research presented in Chapter Four indicated that if the single-family and duplex housing types were not feasible, then the type most nearly acceptable to the user was the townhouse, which allows excellent visual separation between living and sleeping portions of the house.

The L-shaped unit plan of the solution evokes both a feeling of separation between the living-kitchen-dining area and a feeling of openness. Views from windows in the kitchen-dining area look onto the open common space, and the windows in the living room provide a vista onto the private patio area. The common walls between the units utilize a double wall system producing a 53 S.T.C. rating, which creates an efficient sound barrier.

Three patio areas are provided to provide alternatives to users. A secluded patio space has been provided directly off the living room for privacy. A semiprivate area off of the kitchen-dining area gives users the chance to be seen while remaining separated from onlookers. The third area is the entry patio, in which users can sit and converse with passing neighbors.
Storage areas are provided both inside and outside the unit. Exterior storage is provided next to the entry patio for bicycles and tricycles, whereas a lockable enclosed storage area is provided in the private patio area.

The users' need for identity should be recognized and respected. Items such as individual exterior doors, sidewalk approaches, landscaping, housing numbers, and other elements can all work together to meet the users' need for identity.

The units have separate sidewalk approaches, entry patios, exterior doors, and large house numbers. Variations in fences indicate where units separate. Flower beds for each unit appear directly outside the living room windows, giving users the chance to plant flowers of their own choice. Neutral colors are used in the interior of the unit to allow users to choose their own color schemes.

Landscaping should be incorporated into the project to create a complete design. Landscaping is an important element, not only in the general appearance of the project, but also in helping providing for the mental well-being of users. It should be recognized as an undeletable aspect of project and budget.

Because landscaping is an important aspect of the complete design, it has been designed in conjunction with the apartment units. Overstory (canopy) trees, understory trees, and shrubs have all been used to enhance the site's appearance and to create volumes of space, screens, and wind barriers. The western portion of the site has been developed into two areas containing an open play field and a preschool. This area would provide a picnic and recreation area adjoining the units.
As university family-housing, the living units must provide for the activity of studying. Adequate area and separation within the unit should be available.

Each unit has been programmed and designed to allow adequate room for a study desk in the primary bedroom. For families with children, this would permit separation of study and other activities. For the majority of tenants, the secondary bedroom could be used as a study. The townhouse design provides a physical separation between the noisy activities of the living-kitchen-dining area on the lower level and the quiet activities of the upper level. When other family members are sleeping, the student can obtain separation by studying in the living or dining area.

Because as great as 40 percent of families may have children, exterior play areas should be provided that are safe, attractive, and usable.

The private patio space provides an exterior play area allowing visual surveillance of children by parents inside the unit. The open space between units also provides play spaces that can be seen from units.

An area for activities requiring larger spaces is located to the west of units. This will provide an attractive area for enjoying the outdoors.

Community Goals

This facility should be compatible with the characteristics of the site with any existing housing units.

The site slopes gently, providing a natural vehicle for stepping units down the site, and thus the split level concept seemed to work naturally. Cedar siding with a
natural finish was used. The scale of the complex is the same as that of the other complexes, with two-story units being used.

Energy conservation should not be compromised. Fenestration, orientation, materials, overhangs, insulation, and other passive energy techniques should all work together to produce an energy-efficient design.

An energy-efficient design has been achieved by a number of passive techniques. The small windows in the kitchen and foyer landing allow visual contact with the entrance side and induce natural ventilation. The townhouse design reduces exposed wall surfaces to the exterior by means of common walls between units.

Exterior walls have been increased to a 2 * 6 wood stud frame instead of the standard 2 * 4 frame. This allows 51/2 inches of insulation to be used, which creates an R-factor of approximately 20 hr-ft² per BTU. The roof’s 101/2 inches of insulation helps produce an R-factor of approximately 33 hr-ft² per BTU. These details will substantially reduce the energy consumption of each unit from the standard 2 * 4 construction without significantly increasing initial cost. A small increase in cost will be offset by savings in future operating costs.

It is recognized that other devices could have been introduced to save energy such as active solar technology, but the cost effectiveness of these systems are not yet proven. The completed design might be described as an initial step towards providing housing that reduces the consumption of energy resources.

Traffic patterns should be designed and evaluated to ensure adequate separation of vehicular and pedestrian traffic.
The problems created by vehicular and pedestrian traffic have been kept to a minimum. Play areas can be reached from units without users’ crossing vehicular traffic. The underpass located at the major access road provides students the opportunity to walk through the entire family-housing site to school without crossing the most heavily traveled road. Parking has been designed so that tenants are not required to cross any vehicular traffic patterns to reach their apartments from their cars.

The preliminary design presented in this thesis has been developed by interpreting the problem statements of the client and of the projected users, as described in the program. As a result, the design constitutes a responsive solution to family-housing needs at Iowa State University. Many of the basic principles applied in this design’s specifically, the provisions of as many aspects of attached-family housing as possible and of energy efficient design, can apply directly to other housing situations.
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APPENDIX A. H.U.D. MINIMUM PROPERTY STANDARDS FOR MULTI-FAMILY HOUSING, CHAPTER FOUR: BUILDING DESIGN

The following statements have been taken directly from the U.S. Department of Housing and Urban Development's Minimum Property Standards for Multi-family Housing. The introduction to the standards and Chapter 4 (Building Design) have been included as an aid to the programming and design phases of this problem. If an H.U.D. loan is obtained to help finance the family-housing project then the design must comply with these minimum standards. If a loan is not used then these standards should be used as guidelines.

Introductory Statement

These Minimum Property Standards are intended to provide a sound technical basis for the planning and design of housing under the numerous programs of the Department of Housing and Urban Development. The standards describe those characteristics in a property which will provide present and continuing utility, durability, desirability, economy of maintenance, and a safe and healthful environment.

A property complying with these standards is considered technically adequate in all HUB field office Jurisdictions. The requirements contained herein define the minimum level of quality acceptable to HUB in each specific condition. The use of minimum standards alone, however, will not necessarily achieve an acceptable or desirable end-product. Other factors, such as the appropriateness of the building to the site and to the neighborhood, and the acceptability of the property as a whole must

Consideration of environmental quality is addressed throughout the text for specific subjects. As a general policy, development of all properties must be consistent with the national program for conservation of energy and other natural resources, and care must be exercised to avoid air, water, land and noise pollution and other hazards to the environment.

The Minimum Property Standards consist of three volumes of mandatory standards. These are One and Two-Family Dwellings, 4900; Multifamily Housing, 4910; and Care-Type Housing, 4920. Variations and exceptions for seasonal homes intended
for other than year-round occupancy are listed in 4900. Exceptions for elderly housing are listed in 4900 and 4910. A Manual of Acceptable Practices, to be issued in the near future, 4930, will contain back up and illustrative material for the three volumes of mandatory standards.

An effort has been made to present the material in the standards in the simplest manner that will define a minimum level of acceptability and allow consistent interpretation by all users. The standards have been oriented to types of buildings rather than to programs or type of occupancy. Where practicable, requirements have been stated in performance terms to permit flexibility. Dependence has been placed upon nationally recognized building industry standards and reference to them has been employed in the several appendices to each volume.

Where no specific level of performance is stated in the standards, the Manual of Acceptable Practices may be used to determine acceptance or equivalence. This manual is not an additional standard, but is intended, as the name implies, to provide illustrations and data representing good current practice in residential design and construction technology. It provides a broad coverage of information and is a guidance document only.

The numbering system is the same for all three volumes of standards, and for the major subject headings of the Manual of Acceptable Practices. Within this numbering system, Chapter 5, Materials, and Chapter 6, Construction, are further subdivided into the sixteen divisions of the Uniform Construction Index, a recognized industry standard. This numbering system should permit each volume of standards to be used independently, or with the Manual of Acceptable Practices.

**Purpose**

These new physical standards for housing have been developed to improve and expand residential quality in our nation, and to accomplish the following purposes:

1. To combine the diverse standards for private housing for mortgage insurance financing with those for low-rent public housing into a single unified set of standards;

2. To update the various minimum property standards and related guide material following a careful review and analysis of previous provisions;

3. To provide improved design and construction standards based more on performance than has been true in the past, with appropriate flexibility to meet local conditions;

4. To encourage design innovations and improved building technologies giving promise of increased quality and reduced costs; and
5. To aid national and local efforts being made to improve the environmental factors of urban areas.

Chapter 4. Building Design

400 GENERAL
Building design shall provide for a safe, secure, healthful, and attractive living facility and environment suited to the social, economic, and recreational needs of resident families and individuals. It shall provide for ease of circulation and housekeeping; visual and auditory privacy; appropriate light and ventilation; fire and accident protection; economy in maintenance and use of space; accessory services; and sanitation facilities.

401 SPACE PLANNING

401-1 GENERAL
In projects designed for both elderly and for families with children, living units for the elderly shall be located in separate structures, floors or wings of the building and any indoor and outdoor community facilities shall be separated.

401-2 NON-RESIDENTIAL SPACES

401-2.1 Community Social Rooms
Where community social and recreational rooms are provided, they shall be designed in accordance with the needs of the occupants and shall have adjacent toilet facilities for men and women. An adjacent storage area shall be provided. Such spaces are required for housing for the elderly.

Community rooms and public toilets located in buildings required to be accessible to the physically handicapped shall be designed in accordance with ANSI A117.1.

401-2.2 Management and Maintenance Space
Space shall be provided commensurate with the number of living units served. Also, space shall be provided for necessary staff where social services are provided.

401-2.3 Common Laundries
Common laundry facilities containing space for automatic washers, dryers and sorting tables shall be located near the elevators or other pedestrian traffic center for the convenience and safety of the users. The space within the laundries shall be visible from an adjacent public area.
401-2.4 Project Storage

Space for storage of maintenance supplies and equipment such as paint, hand tools, lawn mowers, snow blowers, etc. shall be provided in accordance with the needs of the project.

401-2.5 Facilities for Trash and Garbage Disposal

1. Provide for the temporary sanitary storage of trash and garbage and for its subsequent disposal or removal.

2. When trash chutes are installed, provide at least one hopper in a separate room on each floor in buildings more than 3 stories in height.

3. Design and construction of incinerators and trash chutes shall be of appropriate size and type and in accordance with NFPA Standard No. 82, Incinerators and Rubbish Handling. Each trash chute hopper shall be located in a roof of not less than 20 sq ft.

4. Incinerators shall be designed and equipped to control stack emission to levels below maximum prescribed limits of governing air pollution regulations.

401-2.6 Optimal Project Facilities in Housing for the Elderly

Where the following facilities are provided, they shall comply with the following:

1. Occupational or Physical Therapy — Provide space for services and for storage of equipment.

2. Dietitian's Office — a dietitian is to be employed, provide suitable office space convenient to the kitchen.

3. First Aid or Health Room — These facilities and any accompanying infirmary shall be designed for observation, minor treatment, or short term care of project residents. Where these services are provided, facilities for an attending nurse are required.

4. Nursing Facilities — designed for either short-term or long-term care for project residents shall be as follows:

   (a) Facilities may be provided initially within the project or by residential units specially designed for conversion to nursing facilities at a later date.

   (b) Facilities shall be grouped in a separate wing, floor or auxiliary building.
(c) The dining unit and patient rooms shall comply with requirements of the Minimum Property Standards for Care-be Housing.

(d) The nursing portion of the project shall be clearly incidental to the purpose of providing housing, and the ratio of nursing beds to living units shall not exceed 1 to 4.

5. Medical Facilities — Are a project doctor's office with examination and treatment rooms is provided, it shall be designed to serve only project residents. Spaces provided for rental to doctors, dentists, oculists, opticians, etc., shall be within the limits of allowable commercial space and located so as not to interfere with the residential space.

6. Central Dining — Space is required to provide meals for the occupants of living units which do not contain cooking and dining facilities. Seating and circulation space for the number of persons to be served at one time shall be provided on the basis of the following table and chair sizes:

<table>
<thead>
<tr>
<th>Number of Persons</th>
<th>Table Size</th>
<th>Chair Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2' - 6” x 3’ - 2”</td>
<td>1’ - 6”, wheelchairs, 2’ - 1” x 3’ - 6”</td>
</tr>
<tr>
<td>6</td>
<td>3’ - 4” x 4’ - 0”</td>
<td>3’ - 6”</td>
</tr>
</tbody>
</table>

7. Central Kitchen Facilities - are required where central dining is provided. The kitchen shall be bed and equipped for adequate and efficient food storage, preparation in proper sequence, serving, dish and utensil cleaning and storage, and refuse storage and removal. Except in small installations (under 20 living units), the dishwashing activity shall be separated from that of food preparation. All cabinets and equipment provided shall be designed and installed to prevent contamination by insects, rodents, other vermin, splash, dust and overhead leakage.

8. Central Bathing Facilities - shall be located on the same floor and in close proximity to the living units served, i.e. those without bathing facilities. When provided, a central bathroom shall contain:

(a) A tub or shower for each 15 persons or less to be served by the facility.
(b) Space or dressing and space for the movement of wheelchairs.
(c) Adequate lavatories and compartmented water closets. Enclosure of water closets is not required when the water closet is within a room used by only one bather. Conditions where a bather must enter the public corridor to reach a water closet are not acceptable.
(d) At least one lavatory and one water closet suitable for wheelchair users shall be provided in accordance with ANSI A117.1.
401-3 LIVING, DINING, BEDROOMS

401-3.1 Living Area

1. Each dwelling unit shall contain space that is conducive to general family living and group activities such as entertaining, reading, writing, listening to music, watching television, resting and frequently children's play.

2. Space shall be provided in the living area to accommodate the following furniture or its equivalent with comfortable use and circulation space:
   - 1 - couch, 3' - 0" * 6' - 10"
   - 2 - easy chairs, 2' - 6" * 3' - 0"
     (1 - for efficiency apt.)
     (3 - for 4 or more bedroom units)
   - 1 - desk, 1' - 8" * 3' - 6"
   - 1 - desk chair, 1' - 6" * 1' - 6"
   - 1 - television set, 1' - 4" * 2' - 8"
   - 1 - table, 1' - 6" * 2' - 6"

401-3.2 Dining Area

1. Each dwelling unit shall contain space for dining. This area may be coined with the living room or kitchen, or it may be a separate room.

2. Space for accommodating the following size table and chairs with proper circulation space in the dining area shall be provided for the intended number of occupants as shown:
   - (Efficiency or 1 bedroom) 2 persons, 2' - 6" * 2' - 6"
   - (2 bedrooms) 4 persons, 2' - 6" * 3' - 2"
   - (3 bedrooms) 6 persons, 3' - 4" * 4' - 0" or 4' - 0" round
   - (4 or more bedrooms) 8 persons, 3' - 4" * 6' - 0" or 4' - 0" * 4' - 0"
   - Dining chairs, 1' - 6" * 1' - 6"

401-3.3 Bedrooms

1. Each dwelling unit shall have space(s) allocated to sleeping, dressing and personal care.

2. Each bedroom shall accommodate at least the following furniture or its equivalent with comfortable use and circulation space:
(a) Primary Bedroom: (required in each non-elderly living unit except efficiency)
   2 - twin beds, 3' - 3" * 6' - 10"
   1 - dresser, 1' - 6" * 4' - 4"
   1 - chair, 1' - 6" * l' - 6"
   1 - crib, 2' - 6" * 4' - 6"
   (may be located in another room in addition to the required furnishings)

(b) Secondary Bedrooms:
   • Double Occupancy Bedroom:
     1 - double bed, 4' - 6" * 6' - 10"
     1 - dresser, 1' - 6" * 3' - 6"
     1 - chair, 1' - 6" * 1' - 6"
   • Single Occupancy Bedroom:
     1 - double bed, 3' - 3" * 6' - 10"
     1 - dresser, 1' - 6" * 3' - 6"
     1 - chair, 1' - 6" * 1' - 6"
     1 - desk, 1' - 8" * 3' - 6"

3. In housing for the elderly, beds shall be accessible from two sides and one end.

401-3.4 RESERVED

401-3.5 Combined Spaces

1. Where required habitable rooms are combined into multi-use spaces for compatible functions, the furniture requirements and circulation space shall be applied to the multi-use space.

2. For efficiency apartments, the coined living-dining-sleeping space shall accommodate the living space requirements in 401-3.1, dining space in 401-3.2, and sleeping space requirements in 401-3.3b(3).

3. For housing for elderly, the combined living-sleeping space shall accommodate the living space requirements in 401-3.1 and sleeping space requirements in 401-3.3b(3).

401-3.6 Optional Minimum Room Sizes Based on Sq Ft Area

Table 4-1.1 may be used in lieu of furnishability requirements in 401-3.1 through 401-3.5. When the table is used for any room, it shall be used throughout the project for all rooms of living units.
**TABLE 4-1.1**
MINIMUM ROOM SIZE

1. Minimum Room Sizes for Separate Rooms

<table>
<thead>
<tr>
<th>Name of Space(1)</th>
<th>Minimum Area (Sq Ft)</th>
<th>Least Dimen-</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LU with 0-BR</td>
<td>LU with 1-BR</td>
</tr>
<tr>
<td>LR</td>
<td>NA</td>
<td>160</td>
</tr>
<tr>
<td>DR</td>
<td>NA</td>
<td>100</td>
</tr>
<tr>
<td>BR(secondary)</td>
<td>NA</td>
<td>120</td>
</tr>
<tr>
<td>Total area, BR's</td>
<td>NA</td>
<td>120</td>
</tr>
</tbody>
</table>

2. Minimum Room Sizes for Combined Spaces

<table>
<thead>
<tr>
<th>Name of Space (1)(4)</th>
<th>Minimum Area (Sq Ft)</th>
<th>Least Dimen-</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LU with 0-BR</td>
<td>LU with 1-BR</td>
</tr>
<tr>
<td>LR-DA</td>
<td>HA</td>
<td>210</td>
</tr>
<tr>
<td>LR-DA-SL</td>
<td>250</td>
<td>NA</td>
</tr>
<tr>
<td>LR-DA-K(5)</td>
<td>NA</td>
<td>270</td>
</tr>
<tr>
<td>LR-SL</td>
<td>210</td>
<td>NA</td>
</tr>
<tr>
<td>K-DA(6)</td>
<td>100</td>
<td>120</td>
</tr>
</tbody>
</table>

Notes for Table 4-1.1:

1. Abbreviations:
   - LU = Living Unit
   - LR = Living Room
   - DR = Dining Room
   - DA = Dining Area
   - O-BR = LU with no separate Bedroom
   - K = Kitchen
   - HA = Not Applicable
   - BR = Bedroom
   - SL = Sleeping Area

2. Primary bedrooms shall have at least one wall space of at least 10 ft uninterrupted by openings less than 44 in. above the floor.

3. The minimum dimensions of a combined room shall be the sum of the dimensions of the individual single rooms involved, except for the overlap or combined use of space.

4. For two adjacent spaces to be considered a combined room, the horizontal opening between spaces shall be at least 8 ft - 0 in., except that between kitchen and dining functions, the opening may be reduced to 6 ft - 0 in. Spaces not providing this degree of openness shall meet minimum room sizes required for separate rooms.
5. A combined LR-DA-K shall have a clear opening between the kitchen and dining area of at least 4 ft - 0 in.

6. These required minima apply when the only eating space is in the kitchen.

7. The floor area of an alcove, or recess off a room, having a least dimension less than required for the room, shall be included only if it is not more than 10 percent of the minimum room size permitted and is useful for the placement of furniture.

401-4 KITCHEN, BATHS, LAUNDRY

401-4.1 Kitchen

- Each living unit shall include adequate space to provide for efficient food preparation, serving and storage, as well as utensil storage and cleaning up after meals.

- Kitchen fixtures and countertops shall be provided in accordance with Table 4-1.2. Required countertops shall be approximately 24 in. deep and 36 in. high. Clearance between base cabinet fronts in food preparation area shall be 40 in. minimum.

- Required countertops may be combined when they are located between two fixtures – stove, refrigerator, sink. Such a countertop shall have a minimum frontage equal to that of the larger of the countertops being combined. This combined counter may also be the mixing counter when its minimum length is equal to that required for the mixing counter. Countertop frontages may continue around corners. A 72 in. compact kitchen with wall cabinets may be used in efficiency apartments except in housing for the elderly.

- In housing for the elderly, a 72 in. compact kitchen with wall cabinets and with refrigerator not below the countertop may be used in any size living unit.

**TABLE 4-1.2**

COUNTERTOPS AND FIXTURES

(Minimum Frontages in Lineal In.)

<table>
<thead>
<tr>
<th>Work Center</th>
<th>Number of Bedrooms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Sink</td>
<td>18</td>
</tr>
<tr>
<td>Countertop, each side</td>
<td>15</td>
</tr>
<tr>
<td>Range or Cooktop Space(2)(3)(6)</td>
<td>21</td>
</tr>
<tr>
<td>Countertop, one side(4)</td>
<td>15</td>
</tr>
<tr>
<td>Refrigerator Space(5)</td>
<td>30</td>
</tr>
<tr>
<td>Countertop, one side(4)</td>
<td>15</td>
</tr>
<tr>
<td>Mixing Countertop</td>
<td>21</td>
</tr>
</tbody>
</table>
Notes for Table 4-1.2:

1. When a dishwasher is provided, a 24 in. sink is acceptable.
2. Where a built-in wall oven is installed, provide an 18 in. wide counter adjacent to it.
3. A range burner shall not be located under a window nor within 12 in. of a window. Where a cabinet is provided above a range, 30 in. clearance shall be provided to the bottom of an unprotected cabinet, or 24 in. to the bottom of a protected cabinet.
4. Provide at least 9 in. from the edge of a range to an adjacent corner cabinet and 15 in. from the side of a refrigerator to an adjacent corner cabinet.
5. Refrigerator space may be 33 in. when refrigerator door opens within its own width.
6. When a range is not provided, a 30 in. wide space shall be provided.

- Kitchen storage shelf area shall be provided in accordance with Table 4-1.3. At least one third of the required area shall be located in base or wall cabinets. At least 60 percent of the required area shall be enclosed by cabinet doors.

<table>
<thead>
<tr>
<th>TABLE 4-1.3</th>
<th>STORAGE AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQ FT</td>
<td>Number of Bedrooms</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Minimum Shelf Area</td>
<td>24</td>
</tr>
<tr>
<td>Minimum Drawer Area</td>
<td>4</td>
</tr>
</tbody>
</table>

Notes for Table 4-1.3:

1. A dishwasher may be counted as 4 sq ft of base cabinet storage.
2. Wall cabinets over refrigerators shall not be counted as required shelf area.

3. Shelf area above 74 in. shall not be counted as required area.

4. Inside corner cabinets shall be counted as 50 percent of the shelf area, except where revolving shelves are used, the actual shelf area may be counted.

5. Drawer area in excess of the required area may be counted as shelf area if drawers are at least 6 in. in depth.

- In housing for the elderly, at least one half of the 10 percent of the living units with bathroom designed for wheelchair occupants shall have kitchen equipment, work space and storage space that is accessible to and usable by wheelchair occupants.

401-4.2 Baths

1. Each dwelling unit shall have one bathroom containing a bathtub with a minimum outside width of 30 in., a lavatory and water closet. In other bathrooms showers may be substituted for bathtubs. Bathrooms shall provide for comfortable access to, and use of, each fixture. Bathrooms shall be convenient to the bedrooms.

2. Bathrooms shall be provided with the following accessories:

(a) Grab-bar and soap dish at tub or shower
(b) Shower curtain rod or enclosure at shower
(c) Soap dish at lavatory (soap dishes may be integral with the fixture)
(d) Toilet paper holder at water closet
(e) Mirror and medicine cabinet or equivalent enclosed storage
(f) One towel bar convenient to tub and lavatory.

3. Each half bath shall be provided with Items 3, 4, 5, and 6, in 401-4.2b.

4. Stall showers shall have a minimum area of 1024 sq in. and a least dimension of 30 in.

5. Water impervious wainscot shall be provided at walls around showers or tub-showers to a height of 6 ft from finished floor.

6. Additional requirements for housing for the elderly.

(a) Bathtubs shall be at least 5 ft long and shall be provided with at least two grab-bars.
(b) A stall shower with a seat and grab bars may be provided in lieu of a bathtub.

c) Tub or shower bottom surfaces shall be slip resistant.

d) Grab bars shall be installed to sustain a dead weight of 250 pounds for 5 minutes.

e) Fixtures in bathrooms of at least 10 percent of the living units of each type (other than types containing more than one floor within the living unit) shall be arranged and space provided to permit access and use by a person in a wheelchair. In all such bathroom, the entire length of at least one side of the tub shall be accessible to the bather. A stall shower, if provided, shall be at least 4 ft sq, without curbs, and with ha ails and access in accordance with ANSI A117.1. The lavatory shall comply with ANSI A117.1.

401-4.3 Laundry

1. Where common laundry is not furnished, provide space in each living unit for a clothes washing machine equipped with power supply and water and waste piping or a laundry tray.

2. Where other drying facility is not furnished, provide space in each living unit for a dryer equipped with power supply and vent to the outside.

401-5 Closets and General Storage

401-5.1 Closets and storage space shall be provided for living and housekeeping items and equipment within each living unit and shall be appropriately located in relation to use. Adequate additional general storage space shall be provided.

401-5.2 Bedroom Closets

Each bedroom shall have accessible clear hanging space equipped with rod and shelf which meets or exceeds the following:

   - Primary and double occupancy bedrooms 2'-0" deep x 5'-0" wide
   - Single occupancy bedrooms 2'-0" deep x 3'-0" wide

In dwellings designed for wheelchair users, one bedroom closet shall have a rod adjustable to 48 in. height above the floor.

401-5.3 Coat Closet

Provide at least a 2 ft x 2 ft (clear floor area) coat closet convenient to the entrance.
401-5.4 Linen Storage shall be provided as follows:

1. Minimum shelf area: 10 sq ft for 2 bedrooms or less; 15 sq ft for 3 or more bedrooms.
2. Spacing of shelving: not less than 12 in. o.c.
3. Shelving over 74 in. above floor shall not be counted as required area.

401-5.5 General Storage

1. Usable general storage space shall be provided for the storage of items and equipment essential to the use of the occupants. This storage shall be in addition to required closets and kitchen storage. The minimum total volume of general storage for each living unit shall conform to either column 1 or column 2 of Table 4-1.4.

<table>
<thead>
<tr>
<th>GENERAL STORAGE EQUIPMENTS</th>
<th>Cubic Feet of Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Column 1 (a)</td>
</tr>
<tr>
<td>0 BR</td>
<td>100</td>
</tr>
<tr>
<td>1 BR</td>
<td>150</td>
</tr>
<tr>
<td>2 BR</td>
<td>200</td>
</tr>
<tr>
<td>3 BR</td>
<td>275</td>
</tr>
<tr>
<td>4 BR or more</td>
<td>350</td>
</tr>
</tbody>
</table>

Notes for Table 4-1.4:
(a) This storage shall be located entirely within the living unit.
(b) At least one half of this storage shall be located within the living unit.

2. Each living unit having one or more bedrooms shall have at least one separate closet for general storage or utility purposes located in a conveniently accessible place within the unit. This closet shall be at least 6 sq ft in area and full room height. The remainder of the general storage may be located in bedroom and coat closets provided this space is in addition to the required closet space.

3. Common storage shall be in a dry area with space divided into lockable compartments or closets for each living unit.

4. Where exterior project maintenance is performed by tenants, provide at least 50 cu ft additional storage space per living unit, conveniently located to the outside.
5. Where the project is designed for families with children, provide at least 50 cu ft of storage space per living unit conveniently located to the exterior for bicycles, prams, etc.

401-6 GARAGES AND CARPORTS

401-6.1 Where garages or carports are provided, they shall be designed to provide space for full size cars as well as for convenient opening of doors and circulation around cars. Their location shall provide convenient vehicular access as well as convenient access to living units.

401-6.2 Parking by Occupants

1. When parking of cars is not by an attendant, the minimum dimensions of parking spaces shall be as follows:

<table>
<thead>
<tr>
<th>Space</th>
<th>Parking Angle (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stall depth perpendicular to aisle</td>
<td>45 60 90</td>
</tr>
<tr>
<td>Aisle width</td>
<td>17'-6&quot; 19'-0&quot; 18'-0&quot;</td>
</tr>
<tr>
<td>Unit parking depth</td>
<td>47'-8&quot; 56'-0&quot; 62'-0&quot;</td>
</tr>
<tr>
<td>Stall width parallel to aisle</td>
<td>12'-8&quot; 10'-6&quot; 9'-0&quot;</td>
</tr>
</tbody>
</table>

2. Buildings required to be accessible to the physically handicapped shall have at least 5 percent of the parking spaces (with a minimum of 2 spaces) arranged for wheelchair users in accordance with ANSI A117.1.

401-6.3 Parking by Attendant

When parking of cars is by an attendant, the minimum dimensions shall be as follows:

<table>
<thead>
<tr>
<th>Space</th>
<th>Parking Angle (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stall depth perpendicular to aisle</td>
<td>45 60 90</td>
</tr>
<tr>
<td>Aisle width</td>
<td>17'-2&quot; 18'-10&quot; 18'-0&quot;</td>
</tr>
<tr>
<td>Unit parking depth</td>
<td>47'-0&quot; 55'-0&quot; 58'-0&quot;</td>
</tr>
<tr>
<td>Stall width parallel to aisle</td>
<td>11'-4&quot; 9'-3&quot; 8'-0&quot;</td>
</tr>
</tbody>
</table>

401-6.4 For light and ventilation requirements, see 403.
401-7 CEILING HEIGHTS

401-7.1 Ceiling heights shall be such that they do not create an unpleasant sensation and do not physically restrict the movement of occupants and furnishings.

401-7.2 Ceiling heights clear under beams or other obstructions shall be in accordance with Table 4-1.5.

<table>
<thead>
<tr>
<th>TABLE 4-1.5</th>
<th>MINIMUM CLEAR CEILING HEIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitable Rooms</td>
<td>7'-6&quot;</td>
</tr>
<tr>
<td>Halls within living unit, Baths</td>
<td>7'-0&quot;</td>
</tr>
<tr>
<td>Luminous Ceilings</td>
<td></td>
</tr>
<tr>
<td>-Within living unit</td>
<td>7'-0&quot;</td>
</tr>
<tr>
<td>-Public Corridor</td>
<td>7'-4&quot;</td>
</tr>
</tbody>
</table>
| Sloping Ceilings | at least 7'-6" for 1/2 the room with no portion less than 5'-0"
| Public Corridors | 7'-8" |
| Public Rooms | 8'-0" |
| Basements without | |
| Habitable Rooms | 6'-8" |

402-1 GENERAL

Space and facilities shall be provided for convenient access to and circulation within dwellings for occupants and for movement of furniture and supplies. The relationship of rooms within the living unit and the relationship of living units to each other shall provide a degree of privacy coemnsurate with desirable living conditions.

402-2 ENTRANCE FACILITIES

402-2.1 Entrances shall be designed and equipped to control access to dwellings and to prevent forcible entry.

402-2.2 Bin entrances and principal service entrances shall have appropriately sized exterior platforms when access is not from a paved area such as a porch, terrace, garage or carport.

402-2.3 In housing for the elderly, a foyer or vestibule shall be provided at all living unit entrances opening directly to the exterior where customary in cold climates.
402-2.4 The primary entrance to the following types of buildings and facilities shall be readily accessible to the physically handicapped in accordance with the provisions of ANSI Standard A117.1, specifications for Making Buildings and Facilities Accessible to, and Usable by, the Physically Handicapped:

1. Housing for the elderly or handicapped;
2. Elevator residential structures;
3. Buildings containing 25 or more housing units;
4. Nondwelling structures appurtenant to residential structures described in a, b, and c;
5. Nondwelling facilities appurtenant to and located in residential structures described in 1., 2., and 3.

402-3 DOORS AND OPENINGS

402-3.1 Doorways shall be sufficiently large to admit persons, furniture, and equipment.

402-3.2 Minimum doorway widths shall be:

<table>
<thead>
<tr>
<th>Public Doors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Main entrance to building</td>
<td>3'-0&quot;, 6'-0&quot; for double doors</td>
</tr>
<tr>
<td>Secondary public entrance to bldg.</td>
<td>3'-0&quot;</td>
</tr>
<tr>
<td>Service entrance to building</td>
<td>2'-8&quot;</td>
</tr>
<tr>
<td>Public stairway</td>
<td>3'-0&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Private Doors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Main entrance to living unit</td>
<td>3'-0&quot;</td>
</tr>
<tr>
<td>Secondary entrance to living unit</td>
<td>2'-8&quot; (5'-0&quot; sliding glass doors may be used)</td>
</tr>
<tr>
<td>Bathrooms, toilets in living unit</td>
<td>2'-0&quot;, 2'-8&quot; for elderly or wheelchair access</td>
</tr>
<tr>
<td>Habitable rooms</td>
<td>2'-6&quot;, 2'-8&quot; for elderly or wheelchair access</td>
</tr>
</tbody>
</table>

402-3.3 A door is required at each entrance to a building, living unit, and required stairway enclosure; within the living unit, a door is required at each opening to a bedroom, bathroom and toilet room.

402-3.4 Locking devices at doors and windows shall be as follows:

1. Each exterior doorway or doorway leading to garage areas, public hallways, terraces, balconies, or other areas affording easy access to the premises, shall be protected by a door which, if not a sliding door, shall be equipped with a dead lock using either an interlocking vertical bolt and striker, or
a minimum 1/2 in. throw dead bolt, or a minimum 1/2 in. throw self-locking dead latch. Locks shall not require the use of a key for operation from the inside.

2. All sliding doors, first floor and basement windows, and windows opening onto stairways, fire escapes, porches, terraces, balconies, or other areas affording easy access to the premises, shall be equipped with a locking device. A sliding door used as a main or service entrance shall be equipped with a keyed locking device.

3. Swinging entrance doors to a living unit shall be keyed alike.

4. Bathroom, toilet room, and primary bedroom doors shall be equipped with a privacy lock which can be opened from the outside in an emergency.

402-3.5 All entrance doors, including storm and screen doors, opening outward shall be provided with a safety door check. Main and secondary public doors shall be equipped with a door closer.

402-3.6 Exit doors other than from individual living units shall swing in the direction of exit travel; exit doors giving access to public stairways shall not overlap the required effective width of the landing more than 6 in.

402-3.7 Reserved

402-3.8 Door and window openings shall be planned to take advantage of adjacent exterior conditions and to avoid violation of interior privacy.

402-3.9 An access opening of 18 in. x 24 in. minimum shall be provided to each crawl space and an access opening of 14 in. x 22 in. minimum shall be provided to each attic space. See Table 6-1.1.

402-3.10 When the attic or crawl space contains mechanical equipment, the access opening and any accompanying areaway shall be of sufficient size and shape to permit replacement of the equipment.

402-3.11 Attic and crawl space access openings shall not be located within living units.

402-4 HALLS AND CORRIDORS

402-4.1 Halls and corridors shall provide convenient, safe, and unobstructed circulation within living units, and between living units and other spaces to various means of exit.
402-4.2 Minimum clear widths of halls and corridors shall be:

1. Public halls:

<table>
<thead>
<tr>
<th>Length</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 10 ft</td>
<td>3'-6&quot;</td>
</tr>
<tr>
<td>10 ft to 30 ft</td>
<td>4'-0&quot;</td>
</tr>
<tr>
<td>30 ft to 100 ft</td>
<td>4'-0&quot;</td>
</tr>
<tr>
<td>More than 100 ft</td>
<td>5'-0&quot;</td>
</tr>
<tr>
<td>Housing for elderly</td>
<td>5'-0&quot;</td>
</tr>
</tbody>
</table>

2. Exterior access corridors: 5 ft

3. Halls within living units: 3 ft

4. Halls within living units for wheelchair access: 3 ft - 4 in.

5. The width of corridors at elevators shall be greater than the width of the corridor at other locations, except where the elevator is serving six living units or less per floor. The increase in width shall be at least 20 percent for corridors or hallways less than 5 ft wide, and at least 12 percent for corridors from 5 ft to 7 ft wide.

402-4.3 Projections, except handrails, and obstructions such as columns and door swings shall not reduce the required width. Screen and storm doors may swing into exterior access corridors but drinking fountains, exterior awnings or casing window swings, etc. shall not reduce the required width.

402-4.4 All exits shall provide a continuous and unobstructed means of travel from any point in a building to a public way.

402-4.5 Maximum Lengths

1. In corridors affording access to a stairway or horizontal exit in two directions, the distance between a living unit entrance and an stairway or horizontal exit shall not exceed 100 ft measuring from the center lines of the doorways. This distance may be increased to 150 ft where building is protected by automatic sprinklers.

2. In dead-end corridors affording access in only one direction to a required exit, the distance between a living unit entrance and the exit shall not exceed 35 ft measuring from the center lines of the doorways.

3. The distance of travel within a living unit between the door of the most remote room and a doorway to an exit corridor shall not exceed 50 ft. item The distance of travel to an exit stairway or exterior door from any
point within a boiler room or other area of high fire hazard shall not exceed 50 ft.

402-5 CIRCULATION
Each bedroom shall have access to a bathroom without an intervening bedroom, kitchen, or principal living or dining area. Bedrooms shall not afford the only access to a required bathroom, except in one bedroom units. Neither a bedroom nor a bathroom shall afford the only access to a habitable room.

402-6 STAIRWAYS

402-6.1 Stairways and landings shall provide for safe ascent and descent under normal and emergency conditions and for the transport of furniture and equipment.

402-6.2 Public stairways shall be designed in accordance with the criteria of Table 4-2.1 and NFPA 101 Life Safety Code.

<table>
<thead>
<tr>
<th>TABLE 4-2.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUBLIC STAIRWAY DESIGN</td>
</tr>
<tr>
<td>Minimum clear headroom</td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>6'-8&quot;</td>
</tr>
<tr>
<td>Minimum tread (1)</td>
</tr>
<tr>
<td>Maximum riser (1)(3)</td>
</tr>
</tbody>
</table>

Notes:
1. All treads shall be the same width and all risers the same height in a flight of stairs.
2. Plus 1 1/8 in. nosing minimum on closed riser, plus 1/2 in. nosing minimum on open riser.
3. buildings required to be accessible to the physically handicapped, the maximum riser is 7 1/2 in. Open risers shall not be used.

402-6.3 Minimum Clear Widths

1. Stairways serving a total building occupancy of 50 or less shall be at least 3 ft 0 in. wide. Stairways serving a building occupancy of more than 50 shall be at least 44 in. wide. Handrails may project into the required width of a stairway not more than 3 1/2 in. on each side.
2. The occupancy load per floor shall be based upon a gross floor area of 200 sq ft per person.

402-6.4 Landings
Minimum dimension in the direction of travel shall not be less than the width of the stairway it serves.

402-6.5 An isolated flight of interior stairs shall contain a minimum of 3 risers and a maximum of 18 risers. A flight containing 2 risers is acceptable only when it is separated by a landing from another flight of stairs and located within a living unit.

402-6.6 Private interior stairs shall be the same as public stairs except that:

1. Minimum width shall be 2 ft - 8 in. clear of handrails;
2. Maximum riser height 8 1/4 in.; housing for the elderly, 7 1/2 in.;
3. Winders are permitted, except in housing for the elderly, provided the tread width at a point 18 in. from the converging end is not less than the tread width in the main run of the stair.

402-7 RAMPS
Ramps with slopes of not are than 1 in 10 having slip-resistant surfaces and conforming to all applicable stairway criteria shall be an acceptable means of entrance and egress, except that ramps for tenant use in buildings required to be accessible to the physically handicapped shall be designed in accordance with ANSI A117.1.

402-8 HANDRAILS AND FAILINGS

402-8.1 Handrails and railings shall be provided where needed to protect occupants from falls.

402-8.2 Exterior platforms, porches and stairs extending 2 ft or more above grade shall have railings or enclosures at least 36 in. high.

402-8.3 Railings or enclosures at exterior corridors and balconies and roof decks accessible to occupants shall be continuous and at least 42 in. in height and the balustrade shall be designed to prevent the passage of a spherical object having a diameter greater than 5 in.

402-8.4 Railings at Stairs
1. Stairs shall have a continuous handrail on at least one side and railings at open portions of sides where the change of level exceeds 2 ft.

2. In buildings required to be accessible to the physically handicapped, public stairs shall have handrails in accordance with ANSI A117.1.

3. Interior public stairs 44 in. or more in width shall have handrails on both sides.

4. All interior stairwells including those in attics shall have railings around open sides.

402-8.5 Requirements for handrails at ramps shall be same as for stairs.

402-8.6 In buildings required to be accessible to the physically handicapped, ramps for tenant use shall have handrails in accordance with ANSI A117.1.

402-8.7 In housing for the elderly, handrails complying with ANSZA117.1 shall be provided on at least one side of all tenant corridors (except within living units).

402-9 ELEVATORS

402-9.1 General
Elevators shall provide safe, dependable, economical and easily operated vertical transportation for the anticipated passengers to be served and shall provide adequate service to sustain continued acceptance.

402-9.2 Install at least one elevator in each of the smoke compartments required by 405-5.2. As an alternative where elevators are grouped together off a lobby, the lobby may be separated from each smoke compartment by a one-hour fire-rated wall and a 3/4 hr fire door.

402-9.3 Service Required

1. Elevators shall be provided in buildings of:
   (a) Five or more stories;
   (b) Four stories where deemed necessary by the HUD field office to satisfy market considerations;
   (c) Three or more stories in housing for the elderly;
   (d) Two story housing for the elderly where central dining facilities are located on a floor level other than the floor level of living units which do not have cooking and dining facilities.
   (e) Two or more stories in housing with living units above the first floor intended for occupancy wheelchair users.
2. At least one of the required elevators shall be large enough to accommodate
a wheelchair in accordance with ANSI A117.1.

3. In housing for the elderly, at least one elevator car in each building should
be of the 2500 lb service type suitable for handling ambulance stretchers.
See 614-2.3.

402-9.4 Service or Combination Elevators
In elevator type buildings, at least one service elevator shall be provided for the
loading of furniture and equipment. When a separate elevator is not provided,
at least one of the passenger elevators shall have a minimum capacity of 2500
lbs and minimum size as required for service elevator under 614-2.3.

402-9.5 Handrails
Tenant elevator cars shall be provided with a handrail in accordance with ANSI
A117.1.

402-9.6 Elevators for Commercial Space
Separate elevator service shall be provided for public commercial space on upper
floors, and shall not stop at floors between the entrance level and the commercial
level. (This requirement does not apply to facilities designed for exclusive use
of the building occupants).

403 LIGHT AND VENTILATION

403-1 GENERAL
Provide light and ventilation to achieve a healthful environment within the
dwelling and so located as to provide an acceptable degree of comfort. Structural
spaces shall have natural ventilation to reduce conditions conducive to
decay and to release stored heat.

403-2 LIGHT

403-2.1 Artificial Lighting
Provision for artificial lighting of interior spaces shall be provided in all major
areas including walk-in closets, heating rooms, storage rooms and garages. The
amount of illumination shall comply with Table 4-3.1, see 616.

403-2.2 Natural Lighting
Natural light shall comply with Table 4-3.1.
VENTILATION

The arrangement in plan of living units shall make possible an adequate circulation of natural air through all habitable rooms. The amount of natural and mechanical ventilation shall comply with Table 4-3.1, see 615.

ACOUSTIC CONTROL

GENERAL

Living units shall be designed to provide an acoustically controlled environment in relation to exterior noise and noise from adjacent living units and public spaces.

SOUND TRANSMISSION LIMITATIONS

Mechanical equipment shall be located and installed to minimize transmission of objectionable sound.

Sound Transmission Class (STC) shall be determined in accordance with ASTM E90 and ASTM E413.

Impact Insulation Class (IIC) shall be determined in accordance with ASTM E 492-73T Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine.

Living units shall be provided with acoustic separation in accordance with Table 4-4.1.

<table>
<thead>
<tr>
<th>LOCATION OF PARTITION</th>
<th>STC</th>
<th>IIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Living unit to living unit, corridor (1) or public space (average noise) (2)</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Living unit to public space and service areas (high noise) (3) (5)</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOCATION OF FLOOR-CEILING</th>
<th>STC</th>
<th>IIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor-ceiling separating living units from other living units, public space (4) or service areas (2)</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Floor-ceiling separating living units from public space and service areas (high noise) (3) including corridor floors over living units.</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>
Notes for Table 4-4.1:

1. These values assume floors in corridors are carpeted; otherwise increase STC by 5.
2. Public space of average noise includes lobbies, storage rooms, stairways, etc.
3. Areas of high noise include boiler rooms, mechanical equipment rooms, elevator shafts, laundries, incinerator shafts, garages and most commercial uses.
4. Does not apply to floor above storage rooms where noise from living units would not be objectionable.
5. Increase STC by 5 when over or under mechanical equipment which operates at high noise levels.

405 FIRE PROTECTION

405-1 GENERAL
The planning and construction of buildings shall provide means of egress which will permit persons to leave the building with safety, and not be harmed by fire, smoke or heat and provide a high degree of property preservation.

405-2 TYPES OF CONSTRUCTION All residential buildings shall be classified into one of the following construction types:

- Type 1 - Fire Resistant
- Type 2 - Noncombustible
  - Sub-types: 2a and 2b
- Type 3 - Exterior Protected
  - Sub-types: 3a and 3b
- Type 4 - Wood Frame

See Appendix A for definitions of each construction type.

405-3 MIXED TYPES OF CONSTRUCTION
Where more than one type of construction is used in a building, the following limitations shall apply:
Type 1 construction shall be supported only by Type 1 construction. Type 2 construction shall be supported only by Type 1 or 2 construction. Type 3 construction shall be supported only by Type 1, 2 or 3 construction.
FIRE RESISTANCE REQUIREMENTS

The fire resistance of the walls, floors, roofs, etc. shall meet provisions of Table 4-5.1. Fire resistance ratings shall be determined by ASTM E 119 "Standard Methods of Fire Tests of Building Construction and Materials" or by estimation when an ASTM E119 test is available as a benchmark.

**TABLE 4-5.1**

FIRE PROTECTION REQUIREMENTS
MINIMUM FIRE RESISTANCE RATINGS IN HOURS BY TYPES OF CONSTRUCTION (1)

<table>
<thead>
<tr>
<th>Elements of Construction</th>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
<th>Type 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2a</td>
<td>2b</td>
<td>3a(2)</td>
<td>3b(6)</td>
</tr>
<tr>
<td><strong>Exterior Walls</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bearing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Under 30 ft separation</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>- 30 ft and over separation</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Non-bearing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Under 10 ft separation</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>- 10 ft to 30 ft separation</td>
<td>1</td>
<td>1</td>
<td>3/4</td>
<td>1</td>
</tr>
<tr>
<td>- Over 30 ft separation</td>
<td>NC</td>
<td>NC</td>
<td>NC</td>
<td>NC</td>
</tr>
<tr>
<td><strong>Interior Walls and Partitions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire, and lot-line walls</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Bearing</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Non-bearing</td>
<td>NC(5)</td>
<td>NC(5)</td>
<td>NC(5)</td>
<td>C</td>
</tr>
<tr>
<td>Exit enclosure of stairways, elevator shafts, etc. (3)</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Partitions separating living units and enclosing public corridors</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Material</td>
<td>Code</td>
<td>Width</td>
<td>Height</td>
<td>Thickness</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------</td>
<td>-------</td>
<td>--------</td>
<td>-----------</td>
</tr>
<tr>
<td><strong>Columns, Beams, Girders, Trusses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor/Ceiling Assemblies (10)</td>
<td>2(10)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Roof/Ceiling Assemblies (4)</td>
<td>1(4)</td>
<td>1/2</td>
<td>1(5)</td>
<td>3/4(5)</td>
</tr>
<tr>
<td><strong>Walls, Floors AND Ceilings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Of lobbies and corridors between exit stairways and exterior</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2. Separating commercial from residential</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2NC</td>
</tr>
<tr>
<td>3. Enclosing service spaces (9)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4. Enclosing tenant general storage area</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5. Separating garage from residential</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>For 1 to 4 cars</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>For more than 4 cars</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Public Stairways</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Exterior Stairways and Exterior Corridors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Shaft Enclosures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Construction Enclosing Boiler, Heat or Incinerator Rooms, Fuel Storage and Trash Chutes (11)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Notes for Table 4-5.1:

1. Abbreviations:
   0 designates that no specific fire resistance rating is required.
   L.U. = Living Unit
   NC designates noncombustible construction, but no specific fire resistance rating is required.
   C designates that the structural members of the construction may be of combustible materials, but no specific fire resistance rating is required.

2. In type 3a construction the corridor walls, floors and ceilings, partitions enclosing vertical openings, stairways, columns and beams shall be 2-hr. noncombustible for structures of 3 or more stories, and 1-hr. noncombustible for one or 2 stories.

3. In buildings of types 1, 2a and 3a construction, not more than 3 stories in height, and having not more than 12 living units within a fire area, exit enclosures may have a fire resistive rating of one hour.

4. Roof construction with ventilated attic need only have ceiling assemblies with a finish rating of at least 25 minutes.

5. The use of fire-retardant treated wood is acceptable for non-load bearing vertical construction and for roof assemblies including purlins and decking where access to the roof is not provided.

6. In type 3b construction when exposed heavy timber is used the following minimum sizes shall be used:

<table>
<thead>
<tr>
<th>Component</th>
<th>Supporting floors (inches)</th>
<th>Supporting roofs (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columns</td>
<td>8 x 8 nominal</td>
<td>8 x 6 nominal</td>
</tr>
<tr>
<td>Beams and girders</td>
<td>6 x 10 nominal</td>
<td>4 x 6 nominal</td>
</tr>
<tr>
<td>Floors and roof</td>
<td>4 nominal</td>
<td>2 nominal or</td>
</tr>
<tr>
<td>decks</td>
<td></td>
<td>1 1/8 plywood with</td>
</tr>
<tr>
<td></td>
<td></td>
<td>exterior glue</td>
</tr>
</tbody>
</table>

7. In type 3b buildings more than 3 stories and in type 4 buildings more than two stories having a single exit, interior stairways shall be of noncombustible materials.

8. In type 3b and 4 buildings not more than 2 stories in height exterior stairs and exterior corridors may be combustible.

9. Service spaces are paint, carpentry or maintenance shops and other spaces where flammable materials are stored.
10. Floor/ceiling assemblies within a two story living unit may have a 1/3 hr fire resistance rating, where limited to one living unit In building height, and walls separating units are at least 1 1/2 hr rating.

11. Individual living unit heater rooms not included in this requirement.

12. Members supporting one floor (deck) or roof only may have a fire resistance of 2 hours.

405-5 **HEIGHT AND AREA LIMITATIONS**

**405-5.1** The height, number of stories and fire areas per floor, between exterior walls, or between exterior walls and firewalls, for each type and subtype of construction shall not exceed those given in Table 4-5.2.

**405-5.2** For buildings containing more than 8 living units per floor, each floor shall be divided into at least two smoke compartments by a one-hour fire-rated wall containing a 3/4 hour fire door with a closer and holder activated by a smoke detector, except that compartmentation is not required where buildings are equipped throughout with an automatic sprinkler fire extinguishing system. See 402-9.2 for location of elevators.

| TABLE 4-5.2 |
| MAXIMUM HEIGHT AND AREA LIMITATIONS |

Floor area, per floor, in sq ft, according to type of construction (1) (2) (3)

<table>
<thead>
<tr>
<th>Maximum High Type</th>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
<th>Type 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stories Feet</td>
<td>1</td>
<td>2a</td>
<td>2b</td>
<td>3a</td>
</tr>
<tr>
<td>8 or more U</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td>7 U 80 U</td>
<td>U</td>
<td>12,000</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td>6 U 70 U</td>
<td>U</td>
<td>15,000</td>
<td>NP</td>
<td>7,500</td>
</tr>
<tr>
<td>5 U 60 U</td>
<td>U</td>
<td>20,000</td>
<td>NP</td>
<td>10,000</td>
</tr>
<tr>
<td>4 U 50 U</td>
<td>U</td>
<td>24,000</td>
<td>6,000</td>
<td>12,000</td>
</tr>
<tr>
<td>3 U 40 U</td>
<td>U</td>
<td>27,000</td>
<td>9,000</td>
<td>15,000</td>
</tr>
<tr>
<td>2 U 30 U</td>
<td>U</td>
<td>30,000</td>
<td>12,000</td>
<td>18,000</td>
</tr>
<tr>
<td>1 U 15 U</td>
<td>U</td>
<td>33,000</td>
<td>15,000</td>
<td>21,000</td>
</tr>
</tbody>
</table>

Notes for Table 4-5.2:

1. Abbreviations: U = Unlimited; NP = Not Permitted
2. See 405-6 for heights and areas where only a single exit is provided.
3. Where a building is equipped throughout with an approved automatic sprinkler system, the maximum allowable areas given in Table 4-5.2 may be increased by 50 percent.

405-6 EXITS

40-6.1 General

1. Exit systems shall be of the number, size, arrangement and capacity (number of persons) to permit prompt escape of occupants in the event of fire or other hazardous conditions.

2. All means of egress shall provide a continuous and unobstructed path of travel from any point in the building to a public way.

3. For additional egress requirements see 402.

405-6.2 Number of Exits

Every living unit shall have access to at least 2 separate exits which are remote from each other and are reached by travel in different directions, except that a common path of travel is permitted under certain conditions, see 402-4.5 and 405-6.3.

405-6.3 Conditions Where a Single Exit is Acceptable (Except for item (1) below, a single exit is not acceptable in housing for the elderly)

1. A living unit, which has an exit directly to the street or yard at ground level or by way of an outside stairway or an enclosed stairway with fire-resistance rating of 1 hr or more serving that living unit only and not communicating with any floor below the floor of exit discharge or other area not a part of the living unit served.

2. A one story building containing a maximum of 8 living units.

3. A 2 story building containing a maximum of 8 living units and not more than 4 units per floor with one hr fire resistive enclosed stairway immediately accessible to all living units.

4. A 3 or 4 story building having not more than 4 living units per floor with a smokeproof tower, or a fire resistive enclosed stairway with a 2 hr rating for a four-story building and a one hr rating for a three-story building immediately accessible to all living units.

405-6.4 Access to the Roof

In buildings of three or more stories in height and having roof slopes of less than
20 degrees, a stairway or stair ladder shall provide access to the roof, except in three story buildings access may be by scuttle located in a public area.

405-6.5 Door Opening Ratings

1. The fire resistance of a wall opening requiring a fire-rated door shall not be less than that shown in Table 4-5.3.

<table>
<thead>
<tr>
<th>Location</th>
<th>Rating</th>
<th>Max. Temp. Rise/30 Min.</th>
<th>Rated Frame &amp; Hardware</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 hr fire wall</td>
<td>1 1/2 hr</td>
<td>450 F</td>
<td>Yes</td>
</tr>
<tr>
<td>2 hr stair enclosure</td>
<td>1 1/2 hr</td>
<td>450 F</td>
<td>Yes</td>
</tr>
<tr>
<td>1 hr stair enclosure</td>
<td>3/4 hr</td>
<td>450 F</td>
<td>Yes</td>
</tr>
<tr>
<td>Furnace, trash room or other hazardous areas</td>
<td>1 1/2 hr</td>
<td>—</td>
<td>Yes</td>
</tr>
<tr>
<td>1 hr rated wall</td>
<td>3/4 hr (a)</td>
<td>—</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Notes for Table 4-5.3:

(a) Doors to living rooms from public corridors may have a 20 minute rating with a maximum temperature rise of 450 F/20 minutes, and shall be installed to minimize the passage of smoke.

(b) Where a building is equipped throughout with an automatic sprinkler protection system, doors may have a 20-minute fire resistance rating except at openings in fire walls.

2. Each door, frame and hardware required to be fire-rated including entrance doors to living unit, shall bear a label of a testing agency having re-examination services. Ratings shall be determined in accordance with NFPA No. 252 “Standard Methods of Fire Tests of Door Assemblies.”

3. Fire doors shall be installed in accordance with NFPA No. 80, “Standard for the Installation of Fire Doors and Windows.”

4. Fire-rated doors, including entrance doors to living units, shall be equipped with self-closing devices. If fire rated doors are to be left open either occasionally or at all times, they shall close automatically by a smoke detector and electromagnetic door holder.

405-6.6 Exit Signs and Emergency Lighting
1. Access to exits shall be marked in all cases where they are not immediately visible to the occupants. Every exit sign shall have the word “EXIT” in plain legible letters not less than 6 in. high, with the principal strokes of letters not less than 3/4 in. wide and shall be illuminated with not less than 5 footcandles.

2. Any building with more than 25 living units and all housing for elderly or handicapped shall have emergency exit lighting for every public space, corridor, stairway, elevator and other means of egress. Minimum of one footcandle measured at the floor shall be provided.

405-7 INTERIOR FIRE PROTECTION

405-7.1 Firewalls, and Lot-Line Walls

1. Firewalls, and lot-line walls shall form a continuous fire and smoke barrier between fire areas from foundation to the roof and be so constructed as to assure structural stability in the event the construction on one side is removed or destroyed by fire.

2. For firewalls, and lot-line walls where the roof framing, sheathing and covering are combustible, the fire area wall shall extend at least 18 in. above the top of the roof.

3. Fire and lot-line walls may be carried up to the underside of the roof sheathing and sealed tightly in the following conditions:
   (a) Where construction is Type 1 or Type 2 or the roof supports and decking are fire retardant treated wood.
   (b) Where the roof construction provides one hour protection against sheathing burnthrough with a Class A brand (tested in accordance with the Burning Brand Test of ASTM E108) for a width of 6 ft on each side of the wall and roof covering material throughout is at least Class C classification (ASTM E108).

4. Metal conduit-protected wiring shall be installed in lot-line walls and firewalls. Electrical outlets shall not be installed back-to-back in fire rated partitions and walls. Heating ducts and plumbing may be placed in firewalls only where the wall construction provides a minimum of 2 hr fire resistance rating on each side of the ducts or plumbing. Recessed cabinets shall not be placed in firewalls.

405-7.2 Firestopping
1. Firestopping shall be provided in all walls and partitions, floors, stairs, attic or cornice construction, around chimneys, pipe and duct openings, to cut off all concealed draft openings, horizontal and vertical, so as to form an effectual fire and smoke barrier between stories and between the upper story and the roof.

2. Subdivision of Concealed Floor and Roof Spaces of Combustible Construction:
Concealed spaces within floor construction shall be fire-stopped into areas not exceeding the living units and in corridors not to exceed 30 ft in length. The fire resistance shall equal that of the enclosing partitions. Attic spaces shall be subdivided into areas not exceeding 3,000 sq ft by one hr fire-rated partitions.

405-8 INTERIOR FINISH

405-8.1 General
Interior finish materials of walls, partitions (either fixed or movable), ceilings and other exposed interior surfaces, such as acoustic or fixed decorative treatment, and interior trim materials shall be appropriate to the location and conditions of service and not subject to excessive surface flame spread.

405-8.2 Flame Spread and Smoke Generated Ratings According to Locations
Interior finish materials shall not exceed the surface flame spread ratings given in Table 4-5.4.

405-8.3 Flame Spread Tests
Flame spread ratings for wall, ceiling and floor surfaces shall be determined by an independent testing laboratory or recognized association laboratory in accordance with ASTM E84. ASTM E162 may be used for kitchen cabinets and similar items. Floor finish materials may have a flame spread index of not more than shown in Table 4-5.4 when tested in accordance with UL Standard No. 992.

405-8.4 Smoke Generated Tests
Reserved - pending evaluation of test procedures.

405-8.5 Marking
Except for conventional homogeneous materials whose flame spread characteristics have been determined by test and are in common usage, all finishing materials shall be marked to indicate the maximum flame spread rating.
TABLE 4-5.4
FLAME SPREAD RATING AND SMOKE GENERATED LIMITATIONS OF INTERIOR FINISHES (1) (4) (5)

<table>
<thead>
<tr>
<th>Location Within Building</th>
<th>Surface Flame Spread Rating - Maximum Range</th>
<th>Maximum Optical Smoke Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corridors or hallways and other exits</td>
<td>0-75</td>
<td>0-200 [8]</td>
</tr>
<tr>
<td>Within living unit except for kitchen (3)</td>
<td>0-200</td>
<td>—</td>
</tr>
<tr>
<td>Kitchen space within living unit (2)</td>
<td>0-75</td>
<td>—</td>
</tr>
<tr>
<td>Public rooms and entrance 5 aces</td>
<td>0-75</td>
<td>0-200 [8]</td>
</tr>
<tr>
<td>Lobbies and corridors between exit stairway and exterior</td>
<td>0-25</td>
<td>—</td>
</tr>
<tr>
<td>Service rooms, enclosing heat producing or other mechanical equipment, and all other fire hazardous areas</td>
<td>0-25</td>
<td>0-75 [4]</td>
</tr>
</tbody>
</table>

Notes for Table 4-5.4:
Abbreviation: Ceil. = Ceiling
[ ] = Index number for UL Standard No. 992

1. Doors (except closet doors exceeding 6 ft in width), trim around openings, baseboards, moldings and chair rails may be excluded in the calculation of flame spread limitations.

2. The flame spread rating of combustible kitchen cabinet doors, exposed end panels and bottoms and counter tops shall not exceed 200. Cabinet frame rails, stiles, Mullions and toe strips are exempted.

3. Flame spread rating of walls and ceiling in housing for the elderly shall not exceed 75.

4. Draperies when provided shall be flameproof in accordance with NFPA Standard No. 701 “Flameproof Textiles.”
5. Where automatic sprinkler protection is provided, the flame spread ratings may be increased in the following amounts, 0-25 to 0-75 and 0-75 to 0-200.

405-9 BUILDING DISTANCE SEPARATION

405-9.1 The minimum distance of a building from a lot line is determined by 304-2 for planning purposes. See also Table 4-5.1 for fire protection requirements. The following additional provisions relate to the distance of a building to a lot line or another building.

405-9.2 Where there are openings in an exterior wall less than 10 ft from a parallel wall having an exterior finish with a flame spread rating greater than 25, provide protected openings having a 3/4 hr fire endurance in accordance with ASTM E 163.

405-9.3 Unprotected openings shall not be more than 20 percent of the total wall area when distance separation is 10 to 20 ft and 30 percent when distance separation is 20 to 30 ft.

405-10 EXTERIOR WALL OPENINGS

405-10.1 Opening Protectives

Exterior wall opening protectives, where required, shall be fire windows, doors or shutters bearing an approved testing laboratory label of a testing agency having re-examination services. Fire rated window assemblies shall be installed in accordance with NPPA No. 80.

405-10.2 Vertical Separation of Openings

An exterior wall opening directly above another opening in the same wall and not equipped with an opening protective shall have at least a 3 ft vertical separation between the openings with fire resistance in accordance with Table 4-5.1, or the openings shall be separated by horizontal construction extending outward at least 2 ft from the wall with fire resistance equivalent to wall requirements. This provision not required where a building is equipped with automatic sprinkler protection throughout.

405-11 BALCONIES AND PORCHES

405-11.1 Open or enclosed balconies or porches attached to Types 1, 2 and 3a construction shall be constructed of noncombustible materials.

405-11.2 Balconies or porches of combustible materials, either open or enclosed, and not used as primary means of egress, may be used with Type 3b or 4 construction as shown below.
405-11.3 For Type 3b construction, balconies or porches shall be noncombustible, unless the distance separation from the balcony or porch to any adjacent structure or its balcony or porch exceeds 30 ft.

405-11.4 For Type 4 construction, the distance separation of combustible balconies or porches from an adjacent structure or its balcony or porch shall be at least 24 ft where located on floor above grade, and at least 30 ft where located 2 floors above grade.

405-12 ROOF COVERINGS

405-12.1 Roof covering materials for Types 1, 2, and 3a construction shall meet Class A or B classifications with the following exception:

Buildings which are 3 stories or less in height, and where there is more than 30 ft distance separation to another building or interior property line, the roof covering may be Class C classification.

405-12.2 Roof covering materials for Types 3b and 4 construction shall meet the Class C classification except:

1. Where buildings are 3 stories or less in height, roof coverings having no fire retardant qualities may be used in accordance with the following schedule:

<table>
<thead>
<tr>
<th>Distance Separation</th>
<th>Maximum Roof Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 ft</td>
<td>3000 sq ft</td>
</tr>
<tr>
<td>25 ft</td>
<td>3800 sq ft</td>
</tr>
<tr>
<td>30 ft</td>
<td>4600 sq ft</td>
</tr>
<tr>
<td>More than 30 ft</td>
<td>Not limited</td>
</tr>
</tbody>
</table>

2. If the roof overhang is more than 6 in., the required distance separation shall be the distance as measured between the eaves of adjacent buildings.

405-12.3 Roof covering materials shall be tested in accordance with ASTM E108 and Underwriter's Laboratories No. 790.

405-13 PENTHOUSES

405-13.1 Penthouses, used for other than mechanical equipment, having an area exceeding 20 percent of the roof area shall be considered a story of the building.

405-13.2 Exterior walls and roof of penthouses shall be constructed to provide a fire resistance rating as required for exterior nonbearing walls of the type of building upon which the penthouse is located, except that a penthouse not over 15 ft above the roof and set back from the edge of the roof more than 8 ft is not required to have a designated fire resistance rating.
405-14 **FIRE ALARM AND EXTINGUISHING SYSTEMS**

405-14.1 **Fire Alarm Systems**

1. Every building of eight or more living units, in which each unit does not have direct access to the exterior at grade level, shall be equipped with a manual fire alarm system. Each floor shall have at least one or more manual fire alarm boxes and sounding devices at visible points in the natural paths of escape from fire and near each exit from a fire compartment.

2. Central corridor type buildings 4 or more stories in height shall have an alarm system which transmits an alarm automatically to the fire department which is legally committed to serve the area in which the building is located, or to a 24 hr monitoring service inside or outside the building. An annunciator which indicates the fire floor shall be located at a central point within the building.

3. Buildings eight or more stories in height shall have a zoned noncoded alarm system that sounds an alarm on the fire floor, floor below the fire floor and the floor above the fire floor and provision at central monitoring point to activate a general fire alarm.

4. All fire alarm systems shall be electrically supervised.

5. Not less than one automatic smoke detector, which may be a single or multiple station alarm device, shall be installed in each living unit near the sleeping areas.

6. All smoke detectors that control fire doors or elevators shall automatically initiate a general fire alarm when activated.

405-14.2 **Fire Extinguishing System**

1. For all buildings four stories or more in height, an automatic sprinkler protection system shall be provided in all corridors, public spaces, service areas and utility areas.

2. Sprinkler systems shall be equipped with an automatic alarm initiation device that will activate the general alarm system for the building.

405-14.3 **Equipment and Installation**

1. Fire alarm, smoke detectors and extinguishing equipment shall be listed by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment, and whose listing states either that the equipment meets nationally recognized standards or has been tested and found suitable for use in a specified manner.
2. Smoke detectors shall be either the ionization chamber or photoelectric type. When installed in living units they shall meet Underwriters Laboratories Standard No. 217 Single and Multiple Station Smoke Detectors. Those connected to the building general fire alarm system or designed to activate fire doors shall meet UL Standard No. 167 for ionization chamber and 168 for photoelectric type detectors. They shall bear the label of a testing and approval laboratory that indicates they have been tested and approved under the requirements of the UL standards. The laboratory shall be one which maintains a periodic follow-up service of the labeled devices to insure compliance with the original approval.

3. All smoke detectors shall operate from the building electrical circuit. The detector mounting shall be permanently attached to an electrical outlet box and the detector wired into a general electrical circuit, except those which activate fire doors may be incorporated in the door closer. There shall be no switches in the circuit to the detector other than the overcurrent protective device protecting the branch circuit.

4. Installation of fire alarm and extinguishing systems shall be in accordance with NFPA No. 72A for the fire alarm systems and NFPA No. 13 for sprinkler systems. Spacing of sprinkler heads in corridors shall be positioned 15 feet on maximum centers.

405-15 STANDPIPES

All buildings 5 stories or 55 ft or greater in height shall be equipped with standpipes of number, size and construction in accordance with NFPA No. 14 "Standpipe and Hose Systems" for Class I services.
APPENDIX B. SUMMARY OF CLARE COOPER'S GUIDELINES FOR LOW RISE MULTI-FAMILY HOUSING

The following guidelines were developed by Clare Cooper (1975, p. 207-273) for low-rise multi-family housing. Multi-family housing, in this particular case, includes all housing except for the single-family-detached house. The guidelines are meant to serve only as recommendations and are not hard and fast rules.

SITE LAYOUT

General Site-Planning and Design Considerations

1. A multi-family housing development should be large enough to provide adequate on-site space for children's activities, and yet not so large as to take on a project-like appearance.

2. Density per se is not as important a predictor of satisfaction as is density combined with a number of other variables, including overall size, relationship to open space, variety, and protection or privacy.

3. A clear delineation should be made between publicly-controlled space (streets), community-controlled space (shared open space, play areas, communal laundries, etc.), and privately-controlled biguity as to who has access to, responsibility toward, and control over that space.

4. Most people feel that quietness and attractiveness are among the most desirable attributes of a residential neighborhood.

5. Families with children under about the age of 10 highly value a safe (i.e., accident-free) residential environment.

6. It is essential that a delicate balance be struck between the need for community and the need for privacy.

7. A stronger sense of security and community is likely to arise when access to the site by outsiders is discouraged.
8. Many residents in moderate or high-income multi-family housing prefer the development to be distinguishable in some way from its surroundings.

9. The lower the income group being housed, the less "avantgarde" should be the architecture, and the more conforming to local standards of average middle-class taste.

10. A degree of homogeneity of the population is required for any housing development to evolve into a community.

**Arrangement of Dwelling Units on the Site**

1. Each moderate to large-size housing scheme needs a variety of dwelling sizes, so that families can, if they choose, move within the development as their space needs change.

2. Most people like to live near those who are in a comparable stage in the lifecycle.

3. Families with small children have special locational requirements; ideally, ground-level units with enclosed yards or patios, overlooking, from a slightly elevated position, an enclosed common space for preschool play activity.

4. Dwellings should not be arranged so as to either strongly encourage or strongly discourage neighbor contact.

5. Neighbor contacts tend to be greater when dwellings are grouped around a common pedestrian open space or shared facility.

6. The number of dwellings grouped around a common open space large enough for play should vary between approximately 20 and 100.

7. A variety of orientations should be provided, since people vary in their need for local contacts.

8. Complaints about traffic noise will be less where dwellings face onto pedestrian courts or pathways.

**Access to Dwellings**

1. The form of access appears to have crucial implications for privacy, sociability, and feelings of loneliness.
2. A semiprivate transition space between the privacy of the home and the publicness of the street, footpath or access way provides an extremely important locale for casual socializing.

3. Security is much enhanced when entrances to individual dwellings or groups of dwellings are under potentially continuous surveillance.

4. A delicate balance must be struck between designing for ease of surveillance and designing for privacy.

5. Where access via shared indoor space is unavoidable, the number sharing that space is crucial.

6. Where access is provided from a shared indoor space, the following preferences seem to hold:
   - Families with children generally prefer half-open galleries or outdoor corridors, since these can double as play areas if wide enough.
   - Childless families often prefer access from interior landings or corridors, since they are often carpeted, which cuts down on noise and appears more luxurious to residents and visitors.
   - All kinds of families generally prefer entry off small stair landings to access from long horizontal spaces.

Communal Open Space

1. Common open space will only be used if it is attractively landscaped; provided with benches, play equipment, and other social foci; a commonly used route between dwellings and other common facilities such as parking, laundry, garbage sheds, manager’s office, etc.; and where there is easy access to it from the dwellings it serves.

2. Recognition of a common open space as the indisputable territory of a group of dwellings provides, for many residents and their children, a needed sense of place and belonging.

3. Many families with children, once they have experienced it, like to have access to shared communal open space for play and will be prepared to make do with relatively small private yards or patios in return for this shared space.

4. Considerable dissatisfaction will be expressed with both private and communal outdoor space unless the boundaries between the two are strictly defined and privacy is ensured in the former.
5. Maintenance of communal open space is a crucial factor in resident satisfaction with it.

6. Children in the active-group-play age range prefer to play in moderately sized, spatially enclosed outdoor areas, and supervising adults like to be able to oversee the whole of such an area from some place in the dwelling.

7. For reasons of aesthetics, identification of subareas within the development, and variety of play areas, a series of connected, medium-sized spaces, of varying shape and appearance, is more suitable than one large or several identical spaces.

8. In designing a site of limited dimensions, maximum use should be made of existing adjacent public space.

Children’s Play and Teenage Activities

General guidelines

1. Children tend to play anywhere and everywhere and not just in designated play spaces.

2. Children will be attracted to safe, interior landscaped areas of Radburn-type layouts only if they find them more interesting play spaces than the surrounding roads or parking areas.

3. Children prefer to play and move around in an environment that is varied and full of surprises.

4. The most frequent outdoor play activity of children is moving around the home neighborhood.

5. Children tend to play more frequently on hard surfaces than on grass.

Needs of preschool children

1. Children under 6 and their parents have very distinct needs, and it is critical that they be met. Most children under 6 like to play within site and/or calling distance of their parents or other adults known to them.

2. Small children tend to play close to the most frequently used entrance to a dwelling or building.
3. Specific design requirements for tot lots include:

- a location which is both sheltered and sunny, especially in the late morning and early afternoon,
- a location close to the dwellings whose residents are most likely to use it.
- planting or fencing to give a sense of enclosure and security.
- scaled-down play equipment (slide, swings, climbing blocks, etc,)
- a sand pit with water spigot and good drainage.
- flat surfaces surrounding or within the sand area for sand castles, etc,
- areas for tricycling.
- grass for rolling on.
- comfortable benches with a view for supervising adults.

4. Accommodation for supervised child-care should be considered in larger housing developments (approximately over 200 households),

**Needs of children aged 5 through 10 years**

1. Children aged approximately 5-10 will be the most frequent users of public outdoor areas, and it is this group in particular who will tend to use the whole site area for their play activities. Specific playgrounds for children in this group should also be provided.

2. Play spaces for preschoolers and for 5-10 years old should be separate, for safety reasons, but not necessarily completely segregated.

3. The use of an equipped playground depends largely on the variety of the equipment provided and the location of the playground.

4. It is probably better to provide a number of small, closely spaced play equipment areas situated at the junction of routes than one or two large, widely spaced areas.

5. Play equipment should be selected with two important criteria in mind: children’s preferences and durability.

6. Conventional play equipment tends to be a better investment than specially designed play sculpture.
7. Specially designed play structures will be used if they include a number of features popular with children.

8. Facilities should be provided for basketball for 5-to 10-years old.

9. Space should be provided for informal softball games.

10. Where possible, an adventure playground or place for creative play should be provided.

11. Neighborhood play provision should not be regarded as a substitute for play space within the housing development.

**Needs of teenagers**

1. Teenagers like informal gathering places where they can "watch the action".

2. Teenage boys need a place for basketball.

3. Some teenage boys will welcome a place where they can work on their cars.

4. The gym and the swimming pool are the two indoor public recreation facilities used most widely by teenagers.

5. Where the housing development is large enough, indoor social space should be provided for teenagers.

6. Teenagers like to have access to informal commercial recreation facilities.

**Community Facilities**

1. Where relatively less mobile population groups constitute a sizable proportion of the population being housed, more on-site community facilities should be provided than for mobile, working adults.

2. Certain kinds of desirable facilities may not be feasible in developments of less than about 200 units. However, a simple meeting or recreation room should be provided in smaller developments.

3. In moderate-to-higher-income developments, the most used and requested adult recreation facilities are swimming pools and tennis courts.

4. Indoor recreation facilities must be supervised by salaried personnel ...
5. Indoor space should provide at least one or more medium-sized rooms for committee meetings and one community room for large meetings, dances, etc., that could be adapted for use by pre-school children. Adjacent to this should be a small kitchen, a small office, storage space, and toilets.

6. Community workshop space should be provided wherever possible for carpentry, electrical repairs, art projects, etc.

7. In large developments, the community building might function as a multiservice center.

8. Day-care and day-nursery facilities on the site or very close by are especially desirable in projects housing lower-income tenants.

9. Special care should be taken in providing laundry facilities.

Parking

1. Communal parking should be in a number of small, covered, locked structures wherever possible; if in open lots, they should be visible from at least some of the dwellings being served.

2. Where parking is provided in communal lots, the design should ensure that:
   - Spaces are numbered and assigned, and clear directions are provided to visitor parking areas.
   - Lockable storage cabinets for tools, etc., are provided for each resident parking space.
   - Hose bibs are located so as to serve each group of spaces.
   - Parking areas are screened from the street by means of planting, walls, berms, or changes in level.
   - Access from the parking area to the units is as direct as possible ...
   - Trees provide shade and filtered screening from the dwellings, so that cars can still be seen, but the overall effect is softened.

3. If open parking is provided, it should preferably be in a number of small lots, rather than in one or two large lots.

4. Where densities are such that most of the parking must be provided underground or in large multilevel structures, great care should be taken to ensure that these are pleasant, well lit, and well ventilated.
Garbage Disposal

1. when possible, most families will prefer to have their own garbage cans close to the kitchen entrance.

2. If communal collection points for garbage are provided, they should be:
   - conveniently situated for all, but especially for large families;
   - not so visible as to become an eyesore, and not so close to dwellings and private open space as to create problems with odors;
   - enclosed or otherwise screened from view, including the view from above, with unpainted wooden or concrete fences, so that unsightly chipping of painted or stuccoed surfaces is avoided;
   - inaccessible to children at play and animals, and impervious to strong winds;
   - provided with a hose bib for easy cleaning;
   - easily approachable by collection vehicles.

3. Several studies have reported complaints regarding refuse disposal via chutes, if, in the case of walk-up apartments, refuse chutes are provided, care should be taken that:
   - hoppers and chutes are large enough so as not to become blocked with normal-sized garbage;
   - other provisions are made for the disposal of bulky items of refuse;
   - hopper surrounds are easily maintained and cleaned;
   - hoppers are easily accessible to the families they serve, and are under cover;
   - chutes do not pass by bedrooms of dwellings, thus causing disturbance when used late at night.

4. As is the case with most communal facilities, the fewer the number of families sharing each facility (refuse hopper, garbage shed, etc.), the greater will be the sense of individual responsibility and the better the upkeep of the facility.
Pedestrian Circulation

1. Layout of the footpath system should:
   - accommodate predictable traffic patterns;
   - run parallel to all access roads and adjacent streets;
   - minimize nuisance and annoyance to individual dwellings;
   - take cognizance of the location of off-site facilities;
   - be multipurpose.

2. Footpaths are important locales for children's play and should:
   - provide a safe and interesting play circuit,
   - be sufficiently wide to accommodate children on bicycles and adults on foot,
   - discourage fast cycling or noisy skateboarding on long, downhill sections, close to dwellings,
   - discourage cycling in the vicinity of housing for the elderly.

3. Detailed design features which facilitate pedestrian circulation and footpath maintenance include:
   - rounded corners and intersections.
   - ramped entrances and level changes.
   - wider pavements near entrances to buildings.
   - provision of handrails besides stairs and ramps.
   - sloped to drain in wet weather.

Landscaping and Street Furniture

1. Several housing evaluation studies have shown that the exterior appearance of individual dwellings matters less to residents than the layout and landscaping of the scheme as a whole, consequently, a considerable proportion of the budget design effort should be spent on landscaping and site planning.

2. The designers must make it clear to the client, the builder, loaning authorities, and management that landscaping, play equipment, fences, benches, etc., are not "extras" that can be eliminated at the construction phase without altering the whole social and aesthetic effectiveness of the design.
3. The landscaping of the whole site must be carefully planned, installed and reasonably well-established before occupancy.

4. All portions of the site should be designed with functions or activities in mind.

5. Use of the site by children must be a critical consideration in landscape design.

6. When considering the inclusion of a grassed area, the designer must decide whether its purpose is solely for appearance or, additionally, for children's use.

7. Ownership and maintenance arrangements for common open space affect what can be planned.

8. Provide planting spaces where individual households can add to the general landscaping of the development.

9. Windows at ground level should be screened for privacy.


11. Choose trees to enhance the microclimate.

12. Choose trees so as to minimize maintenance problems.

13. Other than lawns, all planted areas next to hard surfaces must have wooden edges, raised borders, or retaining walls.

14. Ground cover and shrub plantings should be used only where it is specifically desired to keep people off.

15. Plan hard surfaces around play equipment areas.

16. Include: litter receptacles, drinking fountains, lighting, benches, and tables, benches with backs, public telephones.

17. Outdoor sitting areas should be provided, if possible, in all the following locations:
   - adjacent to, and slightly above, preschool play areas for supervising adults, elderly onlookers, etc.;
   - within viewing and calling distance of playgrounds for 5 to 10 years old for supervising adults, children observing others playing, etc.;
256

- along frequently used pathways or overlooking scenes of activity (playgrounds, streets, etc.), for those who like to sit and "watch the action". If numbers of elderly people are also housed on the site, benches should be placed every two to three hundred feet for frequent resting;
- in quiet, secluded, and private spots for lovers and those who want to read or sit quietly alone;
- in central, visible locations or close to a community building or basket area, for teenage socializing; benches at these locations should be arranged in L-shapes or U-shapes for sizable groups to talk together;
- in locations overlooking attractive, green, quiet spaces in the development;
- in elevated locations where there is a more distant view of the town.

Private Open Space

1. The designer should make every effort to provide a private garden, yard, patio, or balcony for every unit, with the size in some degree proportional to the size of unit.
2. Residents should have a choice as to whether or not to take care of a yard or patio.
3. It is essential that clear delimitation be made between private and public space.
4. Where private open space is intended for leisure-time activities (rather than solely for utilitarian functions or display), it is essential that it be fenced for privacy.
5. Front yards, often used for display of gardening prowess, should be fenced or otherwise treated so as to discourage trampling by children and dogs without blocking the view of passersby.
6. The optimum size for a yard has not been determined, but a few studies report that residents will tend to complain when yards are less than 200-300 square feet.
7. Ground level private open space should preferably be within view of the kitchen and lead out to a safe communal play area.
8. There should be adequate control over access from private to public open space.
9. Apartments not at grade should, if at all possible, have access to a balcony of usable dimensions.
10. Balconies will be used only if they are reasonably private.

11. Where possible, the balcony should be adjacent to the living room with floor-to-ceiling sliding glass doors separating the two.

12. Balcony drainage should be adequate.

13. The balcony should be screened in such a way that small children on the balcony and adults sitting in the dwelling can see out.

14. The balcony should be such dimensions that it is reasonably cheap and easy to screen the space in and convert it into interior living space, if so desired.

15. Balconies will be used only if they are of reasonable dimensions for use.

Information and Maintenance

1. If possible, the manager should live on the premises.

2. Physical design should take account of projected maintenance and replacement policies.

3. Designers and management should prepare a residents' manual.

4. Potential uses of public spaces should be made clear to residents.

5. Dwellings should be easy for visitors to locate.

6. Domestic animals should be permitted.

Security

1. All public areas on the site should be so arranged that they are readily and continuously under casual surveillance by residents from within their dwellings, and by passersby.

2. The higher the lighting level in public outdoor areas, the less the likelihood of nighttime crime.

3. Entrances and building lobbies should prevent or minimize free access by vagrants or other undesirables.

4. All front doors should have a fish eye type peephole with an effective view angle of at least 90 degrees.
5. Special care must be taken with windows at ground level.

6. All shared indoor activity areas (e.g., laundry rooms) should be enclosed and secured so that nonresidents cannot use them unless permitted by residents.

BUILDING CONSIDERATIONS

General Design Goals

1. The ideal dwelling for most families is a single-family house.

2. Factors which appear to promote contentment with the dwelling in low-income to moderate-income families are, in probable order of importance:
   - internal space sufficient for family activities.
   - room arrangement and materials that enhance easy and cheap maintenance.
   - sufficient aural and visual privacy from neighbors and passersby.
   - sufficient privacy within the house.
   - interior pleasing in appearance.
   - exterior appearance is pleasing and lends the dwelling some individuality.

3. Units with a double aspect are most desirable.

4. There is a general preference for one-level or split-level dwellings.

5. Structures should be built of locally acceptable materials.

6. The exteriors of dwellings should be articulated or individualized as much as possible.

7. Exterior materials should be selected to wear well and facilitate future maintenance.

8. Most people like to “put their mark” on the place in which they live.

9. Most people are more concerned about interfamily than about intrafamily privacy.

10. Provide extra living space that residents can finish.
11. Economy and convenience of upkeep rank high as attributes of a dwelling among low-income.

12. Units with three or four bedrooms must have living, dining, and kitchen areas that are considerably larger than units with one or two bedrooms.

The Kitchen

1. It is important that the kitchen and dining area be well and cheerfully lit by natural and artificial light.

2. It should be possible to casually supervise children playing elsewhere while an adult is working in the kitchen.

3. The kitchen should include, or open onto, a noncarpeted dining area which is large enough to accommodate the whole family plus two or three visitors.

4. Square kitchens are preferred over narrow ones.

5. The stove, sink, and refrigerator should all be within easy access of each other.

6. Ideally, there should be at least 12 feet of counter space for working on in the kitchen.

7. There should be, ideally, a small bookshelf or office space in the kitchen.

8. Kitchen fixtures should be selected to make working as efficient and hazard-free as possible.

9. The kitchen should be designed in accordance with the size of the family.

10. There are frequent complaints about the type, size and location of storage facilities in the kitchen in multifamily housing.

11. Cleaning and maintenance in the kitchen should be as easy and effective as possible. Economy and convenience of upkeep rank high as attributes of a dwelling among low-income families.
The Living Room

1. A living room oriented toward private open space or communal landscaped areas is generally preferred over one oriented toward the street or toward parking areas.

2. Since the living room is rarely used in the morning in most households, it should be oriented to the southwest to receive sunlight later in the day.

3. Most people want a small foyer or entrance hall.

4. In the case of large families, two separate living areas should be provided if at all possible.

5. The living room should be large enough to accommodate all members of the family plus a few guests in a sitting area away from the circulation space.

6. Families with no children are more likely to prefer a single, larger living room to separate living and family rooms.

7. The shape of the living room and location of doors and windows should encourage flexibility in arrangement of furniture and use of the room.

8. There should be one wall in the living room uninterrupted by windows; this wall should be long enough so that a sofa can be set against it.

9. Windowsills should be high enough to allow furniture placement underneath, but at least one window should be low enough to permit looking out while seated (sill should be about 12-14" from floor).

10. It should be recognized that a low-income family may not have money to furnish a large room.

Bedrooms

1. The largest bedroom should fulfill the following criteria:
   - be oriented to morning sun.
   - be oriented toward a pleasant view.
   - be located in a private sector of the dwelling.
   - be adequately sound screened.
   - be reasonably close to children’s bedroom(s).
be large enough to contain necessary furniture.

2. Single bedrooms need space for at least one bed, a bedside table, a chair, and a chest of drawers, with space for a small desk and additional chair.

3. Preadolescent children often prefer to share a bedroom with a sibling; it may therefore be preferable to provide a preponderance of double occupancy spaces.

4. Bedrooms may have to double for other activities, especially if the living room is not supplemented by a second family area or den.

5. The use of demountable partitions can permit residents to use spaces flexibly.

6. An appropriately placed bedroom would allow for the addition or removal of other units by sealing or opening doors.

Bathrooms

1. In a one-bedroom or two-bedroom dwelling, one bathroom is adequate; in units with three or more bedrooms, a second half-bath (toilet and basin) is desirable.

2. Where there is only one bathroom, locate it so that it can be used with equal ease by guests and by family members.

3. Both shower and tub facilities should be provided if at all possible.

4. Ideally, there should be space in which to put a changing table, with room beneath for diapers, etc. If there is no small child in the family, this space could be used for storage.

5. The sink should be adequately designed for the needs of everyone in the family.

6. The toilet should, if possible, fulfill the following design criteria:

   - It should be hung from the wall to make cleaning around it easier.
   - For physiological reasons, it is better if the toilet is a low fixture, 8 inches from the floor, so one really squats when using it.
   - The toilet should be located in such a way that, with the lid down an adult can conveniently sit on it while bathing a young child in the tub.
   - There might be a shelf to the side of the toilet for books, magazines, ashtray, and a light.

7. The bathroom should also fulfill the following design criteria:
There should be room for a dirty clothes hamper.
There should be hooks for hanging clothes, and an adequate number of
towel bars.
It should be possible to fix drying lines over the tub or in the shower.
It should, if possible, have natural light and places to put plants.
The room needs mechanical as well as natural ventilation.
The floor should be of a nonslip, nonpitted surface.

Services, Finishes, and Laundry Facilities

1. Provide space for a washer and dryer.

2. There should be adequate space for linen storage located close to bedrooms and
bathroom.

3. It is important, especially for low-income families, to have a heating system with
low running costs and with consumption of heat under the tenants’ control.

4. If wall heaters are provided, they should be located so that:
   - the maximum amount of space is heated from each unit;
   - the heat does not all rise up the stairs (where interior stairs are present),
     leaving the downstairs living areas minimally heated;
   - furniture arrangements are not limited by their location.

5. Ceiling or wall lights should be included in living rooms and bedrooms, since
the purchase of lamps means an extra cost to low-income families. In addition,
lamps in children’s bedrooms and rooms used for play are easily subject to
damage.

6. Carpeting should be provided, since this is an item few low-income to moderate-
income families can afford.

7. Washable paint should be used on all interior walls for ease of maintenance,
especially where small children are expected to live in units.
Sound Control

1. Where units are located one above the other, all floors (except kitchen, bathroom, and storage areas) should be carpeted for sound control. Interior stairs and corridors should also be carpeted whenever possible.

2. Rooms potentially used for noise-producing activities like the living room (for watching TV or listening to the stereo); the toilet; the kitchen (for running a dishwasher or garbage-disposal unit); should not be located next to the bedrooms of an adjacent unit.

3. Communal indoor facilities which may be noise-producing (for example, non-carpeted corridors or access stairs, communal laundry, garbage chutes) should not be located adjacent to the bedrooms of dwellings.

4. Where budget limitations suggest that there may be sound-transference problems, special care should be taken to isolate noise-producing elements in the community.

5. Dwellings should be located vis-a-vis outdoor sound sources so as to minimize complaints of noise.

Storage

1. There should be an area for bulk storage within the dwelling.

2. There should be a storage shed for equipment used outdoors.

3. Provide an alternative to garage storage.

4. Provide additional storage space for upwardly-mobile families.
APPENDIX C. SUMMARY OF RESULT OF FIVE SURVEYS

The following is a summary of the results of five surveys conducted at three different university family-housing complexes. As a result of different emphases in the surveys, not all of the same questions were asked, in some cases only one survey covered a particular question. The source of each question and finding is indicated by the following abbreviations:

- DD ... Dileep Dhavale's survey at the University of Northern Iowa.
- GS ... Gary Snider's survey at Iowa State University.
- LA ... Landscape Architecture Class interviews at Iowa State University.
- RL ... Ritts Ann Linda's survey at Iowa State University.
- MFH ... Moore, Forrest, and Hinkle survey at Colorado State University.

An average of the results of the five surveys is given when appropriate and is indicated by the abbreviation "Ave."
DEMOGRAPHIC DATA

<table>
<thead>
<tr>
<th>Which spouse is the student?</th>
<th>DD</th>
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<th>LA</th>
<th>RL</th>
<th>MHF</th>
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<td>28%</td>
<td>27%</td>
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<td></td>
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<tr>
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<td>64%</td>
<td>62%</td>
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<tr>
<td>Wife</td>
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<td>8%</td>
<td>11%</td>
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Student status

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Mean length of marriage

3 yrs.

Ave. length of stay

15 mo.

Residency

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<td>Out of state</td>
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<td>Citizen of U.S.</td>
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Which spouse works?

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<td>Both</td>
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<td>Husband</td>
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<tr>
<td>Wife</td>
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Children

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<td>76%</td>
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<td>58%</td>
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<td>46%</td>
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<td>One child</td>
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<td>Two</td>
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<td>Three</td>
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<td>DD</td>
<td>GS</td>
<td>LA</td>
<td>RL</td>
<td>MHF</td>
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<td>Parents in family</td>
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</tr>
<tr>
<td>Wife</td>
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<td>Car per family</td>
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<td>66%</td>
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<tr>
<td>Two</td>
<td>24%</td>
<td>33%</td>
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<tr>
<td>Three</td>
<td>0.5%</td>
<td>1%</td>
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FAMILY STUDENT PREFERENCES

1. Advantages of living in married student housing (ranking in order of most mentioned)

<table>
<thead>
<tr>
<th>Inexpensive</th>
<th>DD</th>
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<tbody>
<tr>
<td>Availability</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Convenience: close to campus</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Good apartments</td>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Social life*
Environment: nice atmosphere, good for children
With people own age and situation | 3  | 3  |    |     |
Maintenance | 4  |    |    |     |

2. Disadvantages of living in married student housing (ranking in order of most mentioned)

<table>
<thead>
<tr>
<th>Apartment noise</th>
<th>DD</th>
<th>GS</th>
<th>LA</th>
<th>MFH</th>
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<tbody>
<tr>
<td>Parking facilities</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Poor maintenance</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Privacy</td>
<td>5</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crowded feeling</td>
<td>6</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Cold in winter</td>
<td>8</td>
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<tr>
<td>Inside fixtures(plumbing)</td>
<td>1</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

3. What amenity should be included in married student housing? (LA)(Ranked in order of most mentioned)

- Laundry ... 78%
- Meeting rooms ... 40%
- Outdoor storage ... 65%
- Basketball courts ... 35%
- Nursery school ... 58%
- Study hall ... 33%
- Indoor rec hall ... 53%
- Picnic area ... 33%
- Tennis court ... 45%
- Children’s play area ... 20%
- Swimming pool ... 45%
- Baseball field ... 18%
- Store ... 45%
- Auto repair area ... 43%
- Garages ... 43%

4. What unit amenities are most important? (Ranked according to highest scores)

<table>
<thead>
<tr>
<th>Amenities</th>
<th>DD</th>
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</thead>
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<tr>
<td>Shower</td>
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</tr>
<tr>
<td>Adequate kitchen cabinets</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Adequate closet space</td>
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<td>1</td>
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<tr>
<td>Bath tub</td>
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</tr>
<tr>
<td>Adequate laundromats</td>
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<td>3</td>
</tr>
<tr>
<td>Playground for children</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Clothes line</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Abundant windows</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Storage area in basement</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>TV antenna system</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Landscaped surroundings &amp; well cared for</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Provisions to install washer &amp; dryer</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Built-in book shelves</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Area for outdoor adult games</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Private backyard patio</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Garden plots</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>Study room</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Garbage disposal unit under sink</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Recreation &amp; community theater</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>Small grocery store</td>
<td>20</td>
<td>9</td>
</tr>
</tbody>
</table>
SITE LAYOUT

1. Would you rather live in a place that included large public open spaces or included individual lots? (LA)
   - Public open spaces ... 54%
   - Individual lots ... 46%

2. Do you feel private exterior space is important?
<table>
<thead>
<tr>
<th></th>
<th>GS</th>
<th>LA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>91%</td>
<td>79%</td>
</tr>
<tr>
<td>No</td>
<td>9%</td>
<td>21%</td>
</tr>
</tbody>
</table>

3. Do you like or dislike the landscaping provided and general exterior appearance? (GS)
<table>
<thead>
<tr>
<th></th>
<th>Like</th>
<th>Dislike</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landscaping</td>
<td>52%</td>
<td>48%</td>
</tr>
<tr>
<td>General exterior appearance</td>
<td>59%</td>
<td>45%</td>
</tr>
</tbody>
</table>

4. Is exterior storage necessary? (DD)
   - Extremely necessary ... 48%
   - Necessary ... 44%
   - Unnecessary ... 8%

5. Are you satisfied with your parking? (LA)
   - Yes ... 71%
   - No ... 29%

6. Are you satisfied with exterior entertaining and recreation? (GS)
   - Yes ... 53%
   - No ... 47%
BUILDING CONSIDERATIONS

Give that the total size of the new university apartment must remain constant, but the relative size of individual areas, spaces, or rooms could vary. (RL) Walls, dividers and doorway can be placed in an apartment to fully or partially isolate or connect area, space, or rooms. (RL)

- (a) ... very important
- (b) ... important
- (c) ... neutral
- (d) ... unimportant
- (e) ... very unimportant
<table>
<thead>
<tr>
<th>Requirement</th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
<th>(e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main living area should be larger to provide more group space.</td>
<td>5%</td>
<td>28%</td>
<td>30%</td>
<td>31%</td>
<td>6%</td>
</tr>
<tr>
<td>Main living area should be larger to provide for study area or alcove.</td>
<td>0%</td>
<td>9%</td>
<td>28%</td>
<td>34%</td>
<td>28%</td>
</tr>
<tr>
<td>Bedrooms should be larger to provide more private, personal space.</td>
<td>16%</td>
<td>31%</td>
<td>28%</td>
<td>22%</td>
<td>2%</td>
</tr>
<tr>
<td>Bedrooms should be larger include study area or alcove</td>
<td>18%</td>
<td>45%</td>
<td>12%</td>
<td>24%</td>
<td>1%</td>
</tr>
<tr>
<td>Kitchen should be larger to provide for dining.</td>
<td>16%</td>
<td>28%</td>
<td>16%</td>
<td>22%</td>
<td>16%</td>
</tr>
<tr>
<td>Living or lounge activity space should be larger to provide for dining.</td>
<td>6%</td>
<td>21%</td>
<td>16%</td>
<td>34%</td>
<td>22%</td>
</tr>
<tr>
<td>Bathroom should be larger to provide for linen closet and vanity counter.</td>
<td>18%</td>
<td>55%</td>
<td>13%</td>
<td>8%</td>
<td>6%</td>
</tr>
</tbody>
</table>
Coat closet and bulk storage at entry should be larger.

<table>
<thead>
<tr>
<th></th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
<th>(e)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3%</td>
<td>5%</td>
<td>24%</td>
<td>42%</td>
<td>27%</td>
</tr>
</tbody>
</table>

Bathroom and closets should be smaller.

<table>
<thead>
<tr>
<th></th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
<th>(e)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0%</td>
<td>5%</td>
<td>34%</td>
<td>36%</td>
<td>25%</td>
</tr>
</tbody>
</table>

Kitchen should be separated from living room by a wall or doorway.

<table>
<thead>
<tr>
<th></th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
<th>(e)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5%</td>
<td>22%</td>
<td>19%</td>
<td>31%</td>
<td>22%</td>
</tr>
</tbody>
</table>

Kitchen should have pass through counter open to living and dining space.

<table>
<thead>
<tr>
<th></th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
<th>(e)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15%</td>
<td>57%</td>
<td>12%</td>
<td>10%</td>
<td>6%</td>
</tr>
</tbody>
</table>

Entry to apartment should be into a separate foyer area.

<table>
<thead>
<tr>
<th></th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
<th>(e)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2%</td>
<td>19%</td>
<td>34%</td>
<td>24%</td>
<td>21%</td>
</tr>
</tbody>
</table>

Bedroom should be separated from living room by a wall or doorway.

<table>
<thead>
<tr>
<th></th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
<th>(e)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>73%</td>
<td>25%</td>
<td>0%</td>
<td>0%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Study area should be completely open to the bedroom.

<table>
<thead>
<tr>
<th></th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
<th>(e)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13%</td>
<td>39%</td>
<td>27%</td>
<td>12%</td>
<td>9%</td>
</tr>
</tbody>
</table>

1. Would you prefer mixed or uniform building styles? (LA)

- Mixed ... 44%
- Uniform ... 56%

2. What type unit should the new housing units be? (DD)

- Duplex, triplex, fourplex, etc. ... 41.55%
- Single level apartments ... 21.26%
- Mobile homes ... 3.86%
- Townhouses ... 27.54%
- Other ... 5.80%

3. Off-campus married students living units (DD)
• Own or rent house ... 71.7%
• Own or rent duplex ... 8.1%
• Own mobile home ... 5.1%
• Rent apartment ... 15.2%

4. How many bedrooms do you need?

<table>
<thead>
<tr>
<th></th>
<th>DD</th>
<th>GS</th>
</tr>
</thead>
<tbody>
<tr>
<td>One bedroom</td>
<td>24%</td>
<td>9%</td>
</tr>
<tr>
<td>Two bedrooms</td>
<td>67%</td>
<td>86%</td>
</tr>
<tr>
<td>Three bedrooms</td>
<td>9%</td>
<td>5%</td>
</tr>
</tbody>
</table>

5. Satisfaction with space allocation, arrangement, and amount? (GS)

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space allocation and arrangement</td>
<td>84%</td>
<td>16%</td>
</tr>
<tr>
<td>Amount of space overall</td>
<td>64%</td>
<td>36%</td>
</tr>
<tr>
<td>Kitchen-dining room</td>
<td>30%</td>
<td>70%</td>
</tr>
<tr>
<td>General storage</td>
<td>60%</td>
<td>40%</td>
</tr>
<tr>
<td>Living, bath, bedroom</td>
<td>70%</td>
<td>30%</td>
</tr>
</tbody>
</table>

6. Would you want to walk directly outdoors from your apartment? (LA)

• Yes ... 89%
• No ... 11%

7. If garages were available and close, would you rent one?

<table>
<thead>
<tr>
<th></th>
<th>DD</th>
<th>GS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>63%</td>
<td>55%</td>
</tr>
<tr>
<td>No</td>
<td>37%</td>
<td>45%</td>
</tr>
</tbody>
</table>

8. Satisfaction with interior and exterior acoustical privacy? (GS)

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>Exterior</td>
<td>55%</td>
<td>45%</td>
</tr>
</tbody>
</table>

9. Do you like your views?

<table>
<thead>
<tr>
<th></th>
<th>GS</th>
<th>LA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>50%</td>
<td>43%</td>
</tr>
<tr>
<td>No</td>
<td>50%</td>
<td>57%</td>
</tr>
</tbody>
</table>
10. Should the new units be well insulated to avoid heat loss even if it meant that the rents will be slightly higher? (DD)

- Yes ... 95%
- No ... 5%

11. Should the following be included in apartments: (DD)

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carpet in bedrooms</td>
<td>45%</td>
<td>55%</td>
</tr>
<tr>
<td>Refrigerator and stove</td>
<td>99%</td>
<td>1%</td>
</tr>
<tr>
<td>Air conditioning</td>
<td>83%</td>
<td>17%</td>
</tr>
<tr>
<td>Furniture</td>
<td>30%</td>
<td>70%</td>
</tr>
</tbody>
</table>
SOCIOPSYCHOLOGICAL CONSIDERATIONS

1. Do you feel safe?

<table>
<thead>
<tr>
<th></th>
<th>GS</th>
<th>LA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>65%</td>
<td>92%</td>
</tr>
<tr>
<td>No</td>
<td>35%</td>
<td>8%</td>
</tr>
</tbody>
</table>

2. Do you feel crowded? (LA)

<table>
<thead>
<tr>
<th>Housing</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pammel Court</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>University Village</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Schilletter Village</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Hawthorn Court</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>18</td>
<td>22</td>
</tr>
</tbody>
</table>

3. What social aspects do you like best about married student housing? (MFH)

- Commonalities; same interests, goals, age ... 26.5%
- Friendly neighbors; nice people ... 18.0%
- Meet people; from around nation and world ... 13.7%
- Good for children ... 4.2%
- Commonalities; all have same problems(only) ... 2.6%
- Commonalities; all have same income(only) ... 2.5%
- Privacy; able to do what I want ... 2.6%
- Nonscorable results(negative) ... 30.0%

4. What social aspects do you dislike most about married student housing? (MFH)

- General negative remark; poor ... 35.5%
- Opportunity to meet people; physical layout prevents contact, need more organized activities or recreational facilities for contact ... 17.1%
- Inconsiderate neighbors; noisy, untrustworthy ... 15.8%
- Privacy; neighbors too close, living in a fishbowl, snoopy people ... 13.2%
- Positive or neutral statement; no complaints ... 6.6%
5. Do you feel part of the neighborhood? (LA)
   - Yes ... 40%
   - No ... 60%

6. Are you satisfied with the opportunity to meet others? (GS)
   - Yes ... 65%
   - No ... 35%

7. What kind of social activities have already been created by the couples in your building? (MFH)
   - None ... 45.0%
   - Eating: barbecue, potluck dinners ... 26.7%
   - Recreation: bridge, cards, TV ... 8.9%
   - Gatherings: teas ... 6.7%
   - Sports: bowling, volleyball ... 6.7%
   - Parties ... 6.1%

8. How frequently do activities occur?

<table>
<thead>
<tr>
<th></th>
<th>MFH</th>
<th>GS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>28.3%</td>
<td>22%</td>
</tr>
<tr>
<td>Rarely</td>
<td>25.3%</td>
<td>45%</td>
</tr>
<tr>
<td>Sometimes</td>
<td>14.7%</td>
<td>28%</td>
</tr>
<tr>
<td>Often</td>
<td>7.5%</td>
<td>5%</td>
</tr>
<tr>
<td>Unanswered</td>
<td>24.2%</td>
<td></td>
</tr>
</tbody>
</table>

9. Where does the couple with whom you socialize most live? (MFH)
   - Outside of the married student housing complex ... 51.1%
   - In another building ... 25.8%
   - Within your building ... 19.9%
   - No response ... 3.2%

10. Is social interaction a significant benefit of married student housing? (GS)
    - Yes ... 47%
    - No ... 53%
11. Should families with children live near families without children? (LA)

- Yes ... 56%
- No ... 37%
- Have choice ... 7%
**APPENDIX D. BUILDING COST EXEMPLARS FROM COSTS & TRENDS OF CURRENT BUILDING PROJECTS, F. W. DODGE**

### BUILDING TYPE: LOW RISE APARTMENTS
- **LOCATION:** STEPPENWOLF, MI
- **Architect:** ARCHITECTS GROUP LTD.

<table>
<thead>
<tr>
<th>Bids Rec'd</th>
<th>10-78</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SIZE:</strong> Total fl area</td>
<td>73,140 sq ft</td>
</tr>
<tr>
<td>Volume</td>
<td>185,120 cu ft</td>
</tr>
</tbody>
</table>

**DIMENSIONS:**
- | SHAPE: Rectangular |

**CONSTRUCTION:**
- Wd. frmd. walls.
- Roof truss plyd. & shing., asph. Int. drywalls painted. SGG.
- Fl. carpet, sheet, vinyl.

**MECHANICAL EQUIPMENT:**
- Hot water baseboard.

**SPECIAL FEATURES:**
- 32 units.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure</td>
<td>$437,000</td>
</tr>
<tr>
<td>Plumbing</td>
<td>72,645</td>
</tr>
<tr>
<td>HVAC</td>
<td>63,655</td>
</tr>
<tr>
<td>Electrical</td>
<td>52,640</td>
</tr>
<tr>
<td>Built-in Eqpt</td>
<td></td>
</tr>
</tbody>
</table>

**Total:** $627,030

| Cost per sq ft | 27.10 |
| Cost per cu ft | 3.19 |

---

### BUILDING TYPE: APARTMENT BUILDING
- **LOCATION:** CHICAGO, IL
- **Architect:** A. OERAN

<table>
<thead>
<tr>
<th>Bids Rec'd</th>
<th>04-79</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SIZE:</strong> Total fl area</td>
<td>6,000 sq ft</td>
</tr>
<tr>
<td>Volume</td>
<td>40,000 cu ft</td>
</tr>
</tbody>
</table>

**DIMENSIONS:**
- | SHAPE: Rectangular |

**CONSTRUCTION:**
- Wd. frmd. roof, composition cover.
- Int. drywalls painted.
- Fl. carpet.

**MECHANICAL EQUIPMENT:**
- Forced air.

**SPECIAL FEATURES:**
- 8 units.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure</td>
<td>$106,000</td>
</tr>
<tr>
<td>Plumbing</td>
<td>9,000</td>
</tr>
<tr>
<td>HVAC</td>
<td>10,000</td>
</tr>
<tr>
<td>Electrical</td>
<td>12,000</td>
</tr>
<tr>
<td>Built-in Eqpt</td>
<td>10,000</td>
</tr>
</tbody>
</table>

**Total:** $150,000

<p>| Cost per sq ft | 27.50 |
| Cost per cu ft | 3.75 |</p>
<table>
<thead>
<tr>
<th>BUILDING TYPE:</th>
<th>CONDO, ROWHOUSE</th>
<th>APARTMENT BUILDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCATION:</td>
<td>SISTER BAY, WI</td>
<td>NEW CARLISLE, IN</td>
</tr>
<tr>
<td>Architect</td>
<td>ASSOC. ARCH. &amp; ENC.</td>
<td></td>
</tr>
<tr>
<td>Bids Rec'd</td>
<td>10-78</td>
<td>10-78</td>
</tr>
<tr>
<td>SIZE: Total fl area</td>
<td>6,308 sq ft</td>
<td>62,000 sq ft</td>
</tr>
<tr>
<td>Volume</td>
<td>50,136 cu ft</td>
<td>670,000 cu ft</td>
</tr>
<tr>
<td>DIMENSIONS:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHAPE:</td>
<td>Rectangular</td>
<td>Rectangular</td>
</tr>
<tr>
<td>CONSTRUCTION:</td>
<td>Wd. fnd. valls.</td>
<td>Wd. fnd. valls.</td>
</tr>
<tr>
<td></td>
<td>Staccato bd. finish.</td>
<td>Roof - asph. shing.</td>
</tr>
<tr>
<td></td>
<td>Int. drywalls painted, vinyl.</td>
<td>Int. drywalls painted.</td>
</tr>
<tr>
<td>MECHANICAL EQUIPMENT:</td>
<td></td>
<td>Gas, heat pump.</td>
</tr>
<tr>
<td>SPECIAL FEATURES:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Structure     | $36,800         | $1,112,140        |
| Plumbing      | $7,420          | $187,261          |
| HVAC          | $6,885          | $138,637          |
| Electrical    | $4,100          | $69,132           |
| Built-in Eqpt | $4,000          | $172,630          |
| **Total**     | **$106,715**    | **$1,000,000**    |
| Cost per sq ft | $24.77          | $32.26            |
| Cost per cu ft | $3.23           | $3.23             |

<table>
<thead>
<tr>
<th>BUILDING TYPE:</th>
<th>FAMILY HOUSING</th>
<th>APT. BUILDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCATION:</td>
<td>MAPLEWOOD, IN</td>
<td>PLYMOUTH, MN</td>
</tr>
<tr>
<td>Architect</td>
<td>LUNGREN ASSOC.</td>
<td>REESE ASSOC.</td>
</tr>
<tr>
<td>Bids Rec'd</td>
<td>2-79</td>
<td>6-79</td>
</tr>
<tr>
<td>SIZE: Total fl area</td>
<td>37,750 sq ft</td>
<td>106,300 sq ft</td>
</tr>
<tr>
<td>Volume</td>
<td>301,925 cu ft</td>
<td>750,000 cu ft</td>
</tr>
<tr>
<td>DIMENSIONS:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHAPE:</td>
<td>Rectangular</td>
<td>Irregular</td>
</tr>
<tr>
<td>MECHANICAL EQUIPMENT:</td>
<td></td>
<td>Gas fired hydronic</td>
</tr>
<tr>
<td>SPECIAL FEATURES:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| Structure     | $550,911       | $1,617,200     |
| Plumbing      | $75,608        | $195,000       |
| HVAC          | $61,861        | $285,000       |
| Electrical    | $32,450        | $143,500       |
| Built-in Eqpt | $29,080        | $41,000        |
| <strong>Total</strong>     | <strong>$769,910</strong>   | <strong>$2,287,000</strong> |
| Cost per sq ft | $20.39         | $11.92         |
| Cost per cu ft | $2.35          | $2.43          |</p>
<table>
<thead>
<tr>
<th>BUILDING TYPE:</th>
<th>APARTMENT BUILDINGS</th>
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</thead>
<tbody>
<tr>
<td>LOCATION:</td>
<td>LE GRAND, IA</td>
</tr>
<tr>
<td>Architect</td>
<td>VOORNEES - SHELTON</td>
</tr>
<tr>
<td>Bids Rec'd</td>
<td>10-78</td>
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<tr>
<td>SIZE: Total ft. area</td>
<td>13,048 sq ft</td>
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<td>Volume: 143,578 cu ft</td>
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<td>92' X 28'</td>
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<tr>
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<td>Wd. frmr. brick veneer. Int. drywall painted. SOP. Wd. roof asph. shing. Fl. carpet &amp; VAT.</td>
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<tr>
<td>MECHANICAL EQUIPMENT:</td>
<td>Elect. baseboard. No A/C.</td>
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<tr>
<td>SPECIAL FEATURES:</td>
<td>5 bldgs. - 20 units.</td>
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<tr>
<td></td>
<td>Structure: $294,426</td>
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<tr>
<td></td>
<td>Plumbing: 36,500</td>
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<td></td>
<td>HVAC: 3,530</td>
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<td></td>
<td>Electrical: 22,370</td>
</tr>
<tr>
<td></td>
<td>Built-in Eqpt: 76,610</td>
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<tr>
<td></td>
<td>Total: $385,544</td>
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<tr>
<td></td>
<td>Cost per sq ft: $29.35</td>
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<tr>
<td></td>
<td>Cost per cu ft: $2.62</td>
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<tr>
<td>LOCATION:</td>
<td>NEW VIRGINIA, IA</td>
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<td>Architect</td>
<td>VOORNEES - SHELTON</td>
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<td>Bids Rec'd</td>
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</tr>
<tr>
<td>SIZE: Total ft. area</td>
<td>6,080 sq ft</td>
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<tr>
<td></td>
<td>Volume: 65,360 cu ft</td>
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<td>DIMENSIONS:</td>
<td>48' X 65'</td>
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<td>SHAPE:</td>
<td>Rectangular</td>
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<tr>
<td>CONSTRUCTION:</td>
<td>Wd. frmr., brick veneer. Int. drywall painted. SOP. Wd. truss roof - asph. shing. Fl. carpet &amp; VAT.</td>
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<tr>
<td>MECHANICAL EQUIPMENT:</td>
<td>Elect. baseboard. No A/C.</td>
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<tr>
<td>SPECIAL FEATURES:</td>
<td>2 stories - 8 units.</td>
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<tr>
<td></td>
<td>Structure: $100,000</td>
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<td>Plumbing: 14,000</td>
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<td>HVAC: 2,000</td>
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<td>Electrical: 11,600</td>
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<td>Built-in Eqpt: 7,900</td>
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<td>Total: $135,500</td>
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<td></td>
<td>Cost per sq ft: $22.29</td>
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<td>Cost per cu ft: $2.07</td>
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<tr>
<td>LOCATION:</td>
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<td>Architect</td>
<td>VOORNEES - SHELTON</td>
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<td>Bids Rec'd</td>
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</tr>
<tr>
<td>SIZE: Total ft. area</td>
<td>6,300 sq ft</td>
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<tr>
<td></td>
<td>Volume: 63,000 cu ft</td>
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<td>DIMENSIONS:</td>
<td>48' X 63'</td>
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<td>SHAPE:</td>
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<tr>
<td>MECHANICAL EQUIPMENT:</td>
<td>Elect. baseboard. No A/C.</td>
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<tr>
<td>SPECIAL FEATURES:</td>
<td>14 units.</td>
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<tr>
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<td>Structure: $102,402</td>
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<tr>
<td></td>
<td>Plumbing: 12,273</td>
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<td></td>
<td>HVAC: 3,610</td>
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<td></td>
<td>Electrical: 22,370</td>
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<tr>
<td></td>
<td>Built-in Eqpt: 76,610</td>
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<tr>
<td></td>
<td>Total: $116,707</td>
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<td></td>
<td>Cost per sq ft: $21.70</td>
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<td>Cost per cu ft: $2.17</td>
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<table>
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<th>BUILDING TYPE:</th>
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<tbody>
<tr>
<td>LOCATION:</td>
<td>BEERKE, TN</td>
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<tr>
<td>Architect</td>
<td>SANNORN - STEKETEE</td>
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<td>Bids Rec'd</td>
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<tr>
<td>SIZE: Total ft. area</td>
<td>16,255 sq ft</td>
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<tr>
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<td>Volume: 174,700 cu ft</td>
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<tr>
<td>MECHANICAL EQUIPMENT:</td>
<td>13.7 BTU HVAC.</td>
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<td>SPECIAL FEATURES:</td>
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<td>Structure: $378,654</td>
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<tr>
<td></td>
<td>Plumbing: 55,200</td>
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<tr>
<td></td>
<td>HVAC: 55,588</td>
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<td></td>
<td>Electrical:</td>
</tr>
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<td>Total: $493,442</td>
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<td></td>
<td>Cost per cu ft: $2.62</td>
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<tr>
<td>Location:</td>
<td>LA PORTE, IN</td>
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<tr>
<td>Architect:</td>
<td>C. HENDRICKS</td>
</tr>
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<td>Bids Rec'd:</td>
<td>04-79</td>
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<tr>
<td>Size: Total ft²</td>
<td>3,892 sq ft</td>
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<tr>
<td>Size: Total ft³</td>
<td>18,920 cu ft</td>
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<td>Dimensions:</td>
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<td>Shape:</td>
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<tr>
<td>Construction:</td>
<td>Wood framed, brick walls, trusses, interior drywall painted, carpet floors.</td>
</tr>
<tr>
<td>Mechanical Equipment:</td>
<td></td>
</tr>
<tr>
<td>Special Features:</td>
<td></td>
</tr>
</tbody>
</table>

| Structure | $86,416 |
| Plumbing  | $9,266  |
| HVAC      | $7,153  |
| Electrical| $3,482  |
| Built-in Equipment | $9,705 |
| Total     | $115,000 |

Cost per sq ft: $29.55
Cost per cu ft: $2.35

| Structure | $32,888 |
| Plumbing  | $5,200  |
| HVAC      | $2,200  |
| Electrical| $2,930  |
| Built-in Equipment |     |
| Total     | $55,322 |

Cost per sq ft: $37.19
Cost per cu ft: $1.86

---

<table>
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<tr>
<th>Building Type:</th>
<th>APARTMENTS</th>
<th>APARTMENT</th>
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<tbody>
<tr>
<td>Location:</td>
<td>CLIDEN, IA</td>
<td>BERVIN, IL</td>
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<tr>
<td>Architect:</td>
<td>RIDU - LEE DREYER</td>
<td>H. J. MCCARY</td>
</tr>
<tr>
<td>Bids Rec'd:</td>
<td>12-78</td>
<td>03-79</td>
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<tr>
<td>Size: Total ft²</td>
<td>11,780 sq ft</td>
<td>6,300 sq ft</td>
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<tr>
<td>Size: Total ft³</td>
<td>107,724 cu ft</td>
<td>63,000 cu ft</td>
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<td>Dimensions:</td>
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<td>Shape:</td>
<td>Rectangular</td>
<td></td>
</tr>
<tr>
<td>Construction:</td>
<td>Wood framed, wood studs, trusses, interior drywall painted, plank flooring &amp; VAT.</td>
<td>Wood framed, wood studs, trusses, interior drywall painted, wood floors &amp; VAT.</td>
</tr>
<tr>
<td>Mechanical Equipment:</td>
<td></td>
<td>Electric heat.</td>
</tr>
<tr>
<td>Special Features:</td>
<td></td>
<td>2 units/3 Br/unit.</td>
</tr>
</tbody>
</table>

| Structure | $217,195 |
| Plumbing  | $14,000  |
| HVAC      | $24,000  |
| Electrical| $18,000  |
| Built-in Equipment | $10,000 |
| Total     | $283,195 |

Cost per sq ft: $25.11
Cost per cu ft: $2.65

| Structure | $111,696 |
| Plumbing  | $10,092  |
| HVAC      | $7,992   |
| Electrical| $2,720   |
| Built-in Equipment | $16,500 |
| Total     | $150,000 |

Cost per sq ft: $22.81
Cost per cu ft: $2.38