A SCHEMATIC DESIGN OF THE AFFILIATED HOSPITAL CENTER, BOSTON, MASSACHUSETTS

by

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DEDICATION

This work is dedicated to André Golino, without whose help it would not have been possible.

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ABSTRACT

"A SCHEMATIC DESIGN OF THE AFFILIATED HOSPITAL CENTER, BOSTON, MA."
JOANNA ELIZABETH FROST
SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE ON MAY 9, 1975 IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARCHITECTURE.

The Affiliated Hospital Center, Inc., is a corporation of three Boston hospitals, the Peter Bent Brigham Hospital, the Boston Hospital For Women, and the Robert Breck Brigham Hospital. The purpose of the corporation is to make possible the construction of an Affiliated Hospital Center to be built in Boston and to house the three hospitals.

This thesis work consists of a diagrammatic design process aimed at developing an efficient Affiliated Hospital Center. The following steps were undertaken:

1. Exhaustive information gathering through observation, physical inspection of the hospitals and the surrounding environment, interviews with hospital personnel and program analysis
2. Information assembly of data useful to the design of the hospital including program, adjacency requirements, and traffic movement
3. Organization of material into useful tables, base maps, charts, matrices, contextural clay model and photographs
4. Design using diagrammatic acetate sheet plans and sections and a styrofoam model to illustrate physical form, traffic movement, and adjacencies
5. Analysis of designs and determination of optimal design in terms of efficiency, physical form and environmental impact.

The results of this thesis work are two models which represent efficient and generally satisfactory design solutions. Model "A" is a low block hospital and Model "B" is a tower hospital. Advantages and disadvantages of each design are compared and discussed. The conclusion is that each model has a different set of advantages, with the block hospital having certain advantages in terms of efficiency. Both models "A" and "B" could now be used to develop a final design for the Affiliated Hospital Center which would have an efficient and practical orientation. Selection of a final model would reflect the clients' conception of which set of advantages they deem more important.

THESIS SUPERVISOR: EZRA D. EHRENKRANTZ
TITLE: VISITING PROFESSOR OF ARCHITECTURE

I. INTRODUCTION & STATEMENT OF THE PROBLEM

A. DESCRIPTION OF THE AFFILIATED HOSPITAL CENTER

1. ORGANIZATION

The Affiliated Hospital Center is a corporation chartered in the state of Massachusetts consisting of three formerly independent hospitals; the organization is fourteen years old.

2. COMPONENTS

These three hospitals are the Peter Bent Brigham Hospital, the Boston Hospital for Women (the Boston Lying-In and the Parkway Division) and the Robert Breck Brigham Hospital. (See Appendix A for plans.) Each hospital is affiliated with the Harvard Medical School and all are located within a few miles of the school and each other in Boston, Massachusetts. All three are teaching hospitals with excellent reputations as leading medical facilities.

3. GOALS OF THE AHC

The AHC was formed for the express purpose of making possible the construction of new medical facilities for the AHC hospitals. Present facilities in each hospital are considered antiquated and inadequate. The organization is now working on architectural plans for the construction of a new hospital.

B. REASONS FOR WORKING ON THE PROJECT

1. TYPICAL PROBLEMS WITH HOSPITAL DESIGN

The AHC project was a good problem for me to work on because it presents some typical problems encountered in designing hospitals. The specific space problems and restrictions inherent in building a facility for caring for the sick, the com-

plex programming which must be done for the multiple functions a hospital building must house, the enormous task of sorting out the disparate user requirements, all of these are typical in any hospital architectural job. A hospital is a unique building in that it serves so many masters: the doctors, nurses, trustees, administration, unionized staff, the community. Each group has special, not necessarily congruent, requirements which the hospital must meet; it is part of the architect's job to understand these user requirements.

2. DESIGN METHOD

The AHC in particular was an excellent subject for thesis work because it is still in the design phase; the project had many problems, some of which can be related to the architect's design methodology. Instead of designing the hospital through an understanding of user requirements, more attention has been paid to the physical form of the hospital. The design method which I chose to pursue involved extensive observation of use of the existing hospitals, research into background information, programming, understanding and applying traffic movement patterns, working with adjacencies, using a diagrammatic approach rather than working drawings or renderings, and, in general, trying to define and establish a framework for an "efficient" hospital.

C. REASONS FOR OTHERS' INTEREST

1. INEFFICIENCY IS EXPENSIVE

In these days of spiraling medical costs, anything which can bring down the cost of delivering health care is worthy of interest. One reason why health care is expensive is that running a hospital is extremely costly. One way of curbing this cost is to make the

hospital run more smoothly and efficiently, so that fewer man-hours are wasted. It is clear that by designing an efficient hospital, real savings in time and money will be realized. The AHC can provide an example of how a preliminary design which incorporates observed and tested optimal adjacencies should favorably influence the final operation of the hospital. The money saved by minimizing unnecessary hospital trips should be well worth the money spent researching hospital efficiency.

II. HISTORICAL PERSPECTIVE

On April 22, 1960, one man with an idea sent a letter to six of his colleagues and thereby set in motion a series of events which would rock the foundations of Boston medicine for nearly a decade and a half. The man was Dean Berry of the Harvard Medical School; the six colleagues were doctors in prominent positions at hospital in the Harvard Medical School area; the idea was a proposal for the consolidation and improvement of these very hospital, the creation of the Affiliated Hospital Center.

Since that day in April 1960, a lot of water has flowed under the bridge. Hundreds of thousands of dollars, and years of concerted effort on the part of countless people have poured into the Affiliated Hospital Center project. Numerous schemes have been drawn up, proposed, and funded only to be put aside for one reason or another, by one group or another, or by some unavoidable circumstances.

The AHC project exists now, as it has for 14 years, only on paper and in the minds of those dedicated to realizing its completion. But the acutal scope of the projects has changed signficantly over the years, as time, money conflicts, and human friction have worn away at the once all-encompassing scheme.

The following pages represent a brief look at the history of the AHC, describing the important forces and events which reshaped the project and indicating the changes in the designs for the hospital.

A. HISTORY OF THE AHC PROJECT

Dean Berry's letter of April 22, 1960, did not fall on deaf ears. The six hospital trustees and doctors who received his letter represented a larger group of people who were distressed with both the antiquated facilities and the increasingly "run-down" image of the hospitals in the Harvard Medical School area. The hospitals which Dean Berry contacted and which became involved with the AHC proposal were the following : the Peter Bent Brigham Hospital, the Robert Breck Brigham Hospital, the Boston Lying-In Hospital, the Free Hospital, and Massachusetts Eye and Ear Infirmary, and the Children's Hospital Medical Center. With the exception of the MEEI, all hospitals were located within a two or three mile radius of each other with most of them in a four block ring around the HMS. Other hospitals existing in the immediate area which had an interest in the AHC project included the Deaconness , the Beth Israel, the New England Baptist, the Boston City, and the Hospital of the Good Samaritan. (See site plans in Appendix A to establish size and location of these facilities.)

The representatives of four hospitals in particular were distressed concerning their outmoded facilities: the PBBH, the RBBH, BLI and Free Hospital. These four hospitals were to evolve over the next decade into the main force of the AHC project. The obsolescence of these structures was painfully obvious, even fifteen years ago. Many of the buildings were well over one-half a century old. In hospitals renowned for high quality and specialized patient care, the patient areas were crowded, poorly ventilated and unnattractive. (Fifteen years ago the psychological impact of a depressing hospital environment on improving health was barely realized; now

it is a vital concern in hospital patient room design.) A large proportion of beds were in outmoded areas, in wards, which afford little or no privacy. Patient rooms were inadequate for effective use of technologically advancing medical equipment. Many beds were substandard in terms of health regulations. As more space was needed, hospital wings and additions moved outwards in a horizontal sprawl, creating inefficient distances between units and taxing mechanical and electrical systems. Supporting services were housed in makeshift quarters, especially as heating, cooling and ventilating needs increased. Utility systems in general, which were designed originally for a simpler technology, were overtaxed and undependable. Despite constant maintenance, systems became more unreliable as the complexity and confusion increased.

Perhaps what most disturbed the Dean, the hospital administrators, the trustees and the doctors was the possibility of the fading image of the medical complex of hospitals around the HMS. For years, since the days of Harvey Cushing, Sir William Osler, Ezekiel Hersey and John Collins Warren, Boston's hospitals, particularly those teaching hospitals affiliated with HMS, had been synonomous with the word "medicine". This implied not only the highest standard of quality medical care, but also equally high standards of new medical technology and new modern facilities. One only needed to look, for example, at the Peter Bent Brigham Hospital to detect that the modern facilities were lacking, and the suspicion that the quality of medical care might also fall short of expectations was not far behind. It was most probably the fear of loss of prestige which prompted this select group in 1960 to act on Dean Berry's suggestion of the unifying face-lift for the HMS hospitals, and act they did.

On August 22, 1961, a group of physicians and trustees, belonging to what they and Dean Berry referred to as an Affiliated Hospital Center, issued a credo called the Mission Hill report. It comprised a master plan for an Affiliated Hospital Center, and it incorporated both a philosophy and a program. The philosophy was a simple one: the AHC would be created with the major purpose of providing "superior patient care". In this report, the program was also fairly simple. There were to be 800 patient care beds (about 100 more than the four hospitals put together); there were to be vastly expanded out-patient and ambulatory care services. The AHC complex was to support a daily population of 7000 workers. Minimum and maximum beds and square footage were roughly estimated.

The Affiliated Hospital Center, Inc., was chartered on May 10, 1962. There appears to have been little debate on the subject of actual merger and/or dissolution of the identities of the participating hospitals. Each of the hospitals existed as a prominent institution, steeped in the tradition of great medicine. For such an institution to give up its name and identity seemed to the doctors to be the equivalent of forsaking the glories of the past and abandoning the prestige of their appointments, thereby jeopardizing their own status in the medical academic world. They decided to simply affiliate and not to merge into one, new corporate hospital. Doctors tend to be fairly conservative as a group, and no doubt the idea of affiliating hospitals seemed radical enough without considering the thought of merger.

AHC commissioned Bertrand Goldberg and Associates, architects and engineers, in June of 1964 to begin the master planning of the facility. The first

task, and the most important in terms of long range consequences, was to choose the proper location for the project. Several possibilities were investigated, including but not restricted to land owned by the four hospitals. Some of these included the following: the PBBH site along Shattuck Street, the RBBH site on Mission Hill, the old Boston City Jail, the U.S. Public Health Service Hospital (Brighton), and the House of the Good Shepherd.

A move out to the suburbs of Boston was also proposed; however, it was determined that this would inconvenience many Bostonian hospital users who did not have good public transportation at their disposal. (Surveys showed that 42% of inpatients and 62% of outpatients would come from the city of Boston.) In addition, a loss of 800 hospital beds from Boston and continually deteriorating residual facilities would have substantially disrupted the health care delivery system in the city. Furthermore, although a (projected) 42% of the patients of the four hospitals (future AHC patients) would come from outside the city proper and 15% would be referred from farther away, a re-location to the suburbs would not have helped them since there was no available public inter-suburban transportation. Also, according to the Department of Health, the number of conforming hospital beds (beds which conform to the Department's standards) outside the Boston area was higher than that in the Boston area. Finally, probably the best reason that a suburban site was not seriously considered was that the doctors and Dean Berry were against it. They were interested in two things: 1) retaining the prestige of the hospitals of the Harvard Medical School area and 2) locating the hospitals near the HMS for the doctor's convenience, since they were on staff at the hospitals and taught at the medical school.

The other sites were given careful consideration. Ulimately the land belonging to the PBBH north of Francis Street and residential land south of Francis were selected as first choice for several reasons: use of the PBBH facilities while the construction of the new facility was proceeding, closeness to HMS and to other hospitals with which the AHC was to associate, proximity to neighborhoods which would use the AHC most intensively. It is interesting to note that at this point in time there existed no active community support or opposition to the location of the AHC. The only locational controversy existed among those doctors who favored Francis Street for the convenience and those who preferred others.

The master plan assumed that new construction and not rehabilitation would be the method of establishing the AHC. This philosophy has been followed throughout the history of the project. Since money was never tight in those days and the image was all-important, new construction was, by process of elimination, the only choice. Recent, more practical analyses tend to stress other reasons for not rehabilitating. The costs of such a rehab job might be high as compared to the return. Heating systems, elevator locations, open wards and the labyrinthian character of the buildings are next to impossible to correct without demolishing the hospitals, according to Certificate of Need applications of the AHC. If the present buildings were rehabilitated, the hospitals involved would retain their independence and the economic saving of joint operating costs would not happen.

At the issuing of the AHC master plan in 1965, there was great optimism. Hill-Burton funding was flowing from the federal government with virtually no strings attached. Certificate of Need was an unheard of document. NIH funding was available for the seemingly endless demand for more research and

therefore more research facilities. The community was dormant and protest was non-existent. The doctors' three aims were stated in the master plan program: 1) attract new qualified personnel through a research incentive, new housing and recreation facilities, a new image, 2) physically organize and unify the medical disciplines with a resultant flexibility and 3) function more efficiently and economically. The rhetoric used to describe the AHC reflects the optimistic, utopian ideal: "It, as the 'Center', will mean excitement, the pla_ce where things happen,... attractive to everybody." (AHC Master Plan Report, 1965).

1. PLAN 1, 1965*

Plans were made for a gigantic complex which included housing, recreational facilities, grand plazas, the expansion of HMS, research towers, hospital towers and even traffic reorganization. The underground support services for the hospital were the size equivalent of two Prudential buildings , laid side by side. A vertical cluster of several towers was planned in the area of the present PBBH location.

2. PLAN 2, 1968

A master plan, like the one detailed above, is usually on a very large scale and includes possibilities of organization and expansion which are overly optimistic. Therefore, when plans for the actual AHC buildings began to be assembled in 1966-1968, they were more rational and realistic than the master plan (but only slightly so). The two Prudential towers had vanished, but the proposed structure with its four low bed towers was still very large, about the size of four city blocks. At this point the hospital was situated on the south side of Francis Street, with only a "small" ambulatory care facility placed on the north side, next to the PBBH. When it became known

* Numbers of plans refer to Appendix A; they are not AHC plan numbers.

that the new hospital was planned for that area, the tenants living in the houses south of Francis Street became upset. The AHC confronted its first external obstacle; it responded by planning to decrease the size of the new structure (reduce to three blocks) but did not relinquish the site. This occurred during the initial part of the protest movements, when the institution was still strong and public furor undirected. However, over the next five or six years, the plan modifications and compromises in response to outside pressures would come faster.

3. PLAN 3, 1970

The AHC began its retreat from community opposition by stretching back across Francis Street to the north. A three bedtower plan was drawn up, with each hospital owning and sharing a bedtower and support facilites, respectively (the Boston Lying-In Hospital and the Free Hospital had merged at this point, forming the Boston Hospital for Women). The proposed hospital was still a large facility with three slightly taller towers and it stretched via pedestrian and auto bridges across Francis. The community remained upset because the hospital was still to occupy residential space (Harvard University owned the land and rented the housing, so the tenant population had cause to believe it would be evicted). Efficient utilization of space was an issue in this plan; Hill-Burton and NIH funds were tighter and the AHC began looking seriously for ways to reduce costs. (Pedestrian and auto bridges, towers with fewer beds per floor were things that raised the price tag considerably.) New Certificate of Need regulations required detailed justification of expansion plans and costs. For these reasons, the AHC abandoned the idea of three bed towers.

4. PLAN 4: 1972

The architects' new plan was that two bed towers would use land more efficiently, reduce the inroad into the community south of Francis Street, and lower construction costs. Now, however, the issue of hospital autonomy began to be important, since three hospitals were to use two towers. The 1972 plan called for the PBBH to own the two bed towers and to lease one to both the RBBH and the BHW; this hierarchical arrangement caused a small but concrete amount of friction among the hospitals. The "bulk" space of the underground support facilities was decreased. With construction costs and facility size minimized, the AHC hoped to pick up the community support and federal government approval necessary to build.

5. PLAN 5, APRIL 1973

The appeasement tactics of retreating across Francis Street and reducing to two towers were unsuccessful in stilling neighborhood protest. Community planning committees continued to dissent, and the furor rose. Consumers were also afraid that the AHC would provide sophisticated and specialized care and not provide the neighborhood with primary care facilities. Certificate of Need requirements made community sanction for hospital expansion imperative; the community would not sanction a trans-Francis Street hospital. The AHC was forced to relinquish its plans for building south of Francis Street. However, land next to the PBBH belonging to the Good Samaritan Hospital was made available and planning for the AHC structure continued, although on a much smaller scale.

Fitting two towers on the new site became problemmatical; bed tower overhang, adequate parking and support facilities on the site created an entirely different project. The AHC, in applying for the Certificate of Need,

was insisting on being allowed to have its 688 beds; the Department of Public Health declared that about 500 beds would be closer to the AHC needs. Fund-raising drives gathered momentum as the need for private contributions rose in proportion to Hill-Burton's diminishing funding capacity. Financial feasibility studies (would the AHC 'break even', could it get state financing?) were done, along with size and patient projections, by several consulting firms in an attempt to establish the AHC's right to be built.

6. PLAN 6, NOVEMBER 1973

In 1972 and 1973, the idea of actual merger began to be discussed seriously. Complicated financing required that one legal corporation sign contracts to be eligible to receive loans; three hospitals could not share financial responsibility. This discussion of merger, along with the problem of siting two bedtowers on the small site north of Francis Street and, of course, the constant necessity of cutting costs, helped to clear the way for the next set of plans. By late 1973, the AHC plan for two towers had evolved into one tower, with a rectangular block of support facilities; all facilities, including the bedtower, were to be owned and shar equally by all three hospitals. The tower was taller than in previous schemes (12 or 13 stories), more beds per floor were allotted, and the hospitals' beds were layered.

7. PLAN 7, 1974

In April, 1974, the AHC's Certificate of Need (referring to the one tower plan with 688 beds) was approved. After that came the actual merger of the PBBH, the RBBH and the BHW into the Affiliated Hospital Center on January 1, 1975. Architectural plans changed to the extent that the bed tower

was fourteen stories high and had been moved off center. Support facilities above ground were triangular in shape, filling half the site; the rest of the site was open for short-term parking, entering, emergency vehicles. One problem remained and that was funding. Plans were prepared for a possible phasing of the project which would allow for less initial capital outlay.

At the time of this writing, a further set of plans is being prepared for the AHC project. Programming is a continuing process, with phasing and renovation as serious considerations. Whe ther the AHC will ever be built is a qu estion only the future will answer with any authority.

B. IMPORTANT POINTS

One can sit in judgment of the history of the AHC project and claim that there are obvious mistakes which were made. Overeagerness, lack of foresight, and bad judgment in the initial stages created situation s again and again which mitigated against the construction of the complex. The creators of the AHC idea can be criticized for trying to build a medical center for prestige and not for patients.

What is more important is to look for the less obvious oversights and errors which are responsible for the production of AHC designs which are unbuildable. A number of the AHC plans above represent proposals for buildings which are impractical, too expe nsive, too big, and too wasteful of space. When the working methods of the planners, consultants and architects are analyzed, certain ommissions become evident.

When budget cuts or new restrictions occurred, new designs were produced with reportedly little reworking of the program or new analysis by the consultants. Thus, a lack of correspondance between the

intricacies of the program and the plans for the hospital began to appear. As a result, architectural form and detailing occasionally had little to do with the proposed reality of the program; it became an end in itself.

Another oversight is that several important analyses of the existing hospitals did not occur. A great deal of information was collected (statistics of bed count, use, patient days, etc.), but information vital to the practical design of the AHC was not obtained. For example, a study of movement of people ("traffic movement") through the PBBH has never been undertaken. This type of study is indispensable, as it tells the architect/planner who is going where, when, and why. Without this, he has little idea of the dynamics or workings of the hospital. The whole issue of the hospital's environmental impact (traffic, noise, building height, recreational facilities, parking, green areas) is touched upon in response to the community outcry, but not thoroughly understood or managed. In fact, a careful analysis of the small site (3½ acres or about 118,000 square feet) as it relates to the enormous square footage of the proposed hospital (total GSF 1,071,875) was apparently not fully appreciated. (This gives an F.A.R. of about 12.6 which is extremely high). If 300,000 square feet of hospital space is put into renovated PBBH facilities, as one Certificate of Need application suggested, the F.A.R. can be reduced to 8, which is still quite high.

The fact that these studies, or other important ones, were not taken seriously questions the validity of the methods used to design the AHC. A design process which examines and projects the functioning

of the hospital is necessary to insure that the hospital, once built, will not be utterly useless. An attempt to use such a design method for the AHC is described in the next pages.

III. DESIGN METHOD & PROCESS

To develop a reasonable design for a hospital, three activities must occur: first, the necessary information (that which describes a hospital's functioning) must be assembled; second, it must be organized in a useful way; and third, it must be used to determine a design. These three activities were undertaken in this thesis, and are described in the order in which they occurred.

A. HISTORICAL SURVEY

The first step in the design process was to begin to understand what was to be designed. Since the reasons for the construction of the AHC were not clear, it was necessary to gain an historical perspective. The "Master Plan for the Affiliated Hospital Center", compiled by Bertrand Goldberg & Associates in 1965 was particularly helpful in discovering background information. Assistant Director Vick Stoughton, although not with the AHC since its inception, was able to clarify my understanding of who the actors were and why certain events occurred when they did. Various Certificate of Need proposals obtained from the AHC were interesting in terms of specific design proposals as well as implicit aims and arm twistings. Finally, interviews with persons (such as Peter Cooke of PBBH Engineering) gave helpful insights into areas of concern to the AHC (such as the proposed power plant).

B. PHYSICAL INSPECTION OF HOSPITALS, AREA & SITE

1.HOSPITALS

Having established an historical perspective, it became vital to physically examine the three hospitals which comprised the AHC. This was accomplished over a period of a few weeks by many "tours" of the hospitals. I was able to visit every hospital department in the PBBH and most departments in the BHW and RBBH. At this time I observed and recorded the activities, types of equipment, traffic, layout and

size and adjacencies of these areas. I was also able to conduct "walk-throughs", i.e., to accompany persons associated with the hospital on their activities for a day. PBBH doctors and nurses walked me through parts of their day; I had walked myself through within the past year as a out-patient (E.W.) when I broke my toe.

2. AREA & SITE

Many walking tours of the medical area provided information about the environment of the proposed AHC. The heavy medical orientation and excessive traffic was obvious, as was the lack of green space, restaurants. An historical base map which I obtained from the AHC was updated with the help of such excursions and augmented by a building height survey which I conducted. A examination of the proposed site was carried out numerous times.

C. INTERVIEWS

Several interviews with hospital personne 1 were conducted by me to begin to determine locational priorities and adjacencies. These interviews varied in length from 1-2 minutes to almost an hour.

1. MEDICAL STAFF & PATIENTS

Doctors, nurses and patients were able to give a fairly accurate idea of ward activities. Suggestions about the AHC were often in the form of "Don't do it like it is here", an indication of poorly functioning facilities.

2. NON-MEDICAL STAFF

Some of the non-medical staff were able to give locational suggestions. In terms of building requirements (electrical, HVAC, plumbing), and the function, location and servicing of heavy equipment, Peter Cooke, Chief Plant Engineer, PBBH, gave me very valuable information.

D. PROGRAM

A most important step in preparing the preliminaries to designing a hospital was to gather the proper information to do the programming. Because of limited resources, this process was shortcutted; a program prepared by the AHC for a Certificate of Need application was adopted as the basis for the design decistions of my thesis and treated as the final program for the project. This program (Certificate of Need, April 30, 1973) dictates the type and size of departments (square footage) and occasionnally indicates the functions of certain facilities (ambulatory care). The essence of the program is reproduced under the heading of "Departments" in the Key Program Data Chart, p. 25.

The AHC program is important not only for its explicit requirements but also for its implicit ones. The program calls for more square footage, combined facilities, an ambulatory care facility, improved (conforming) beds. Implicit in these directives are notions that higher square footage = more prestige, combined facilities = less staff for equal number beds, ambulatory care facility = placating the community, improved beds = more third party health insurance (Medicare) payments. These hidden reasons are not necessarily pejorative, but it is important for the architect to understand the real reason for a programming requirement.

E. KEY PROGRAM DATA CHART

Once the basic information was gathered, it was organized so that the information could be used to design but also that more information could be easily added and compared with other data. The first basic information organization and one of the most comprehensive was the Key Program Data Chart (see p. 25). This represented the program

KEY PROGRAM DATA

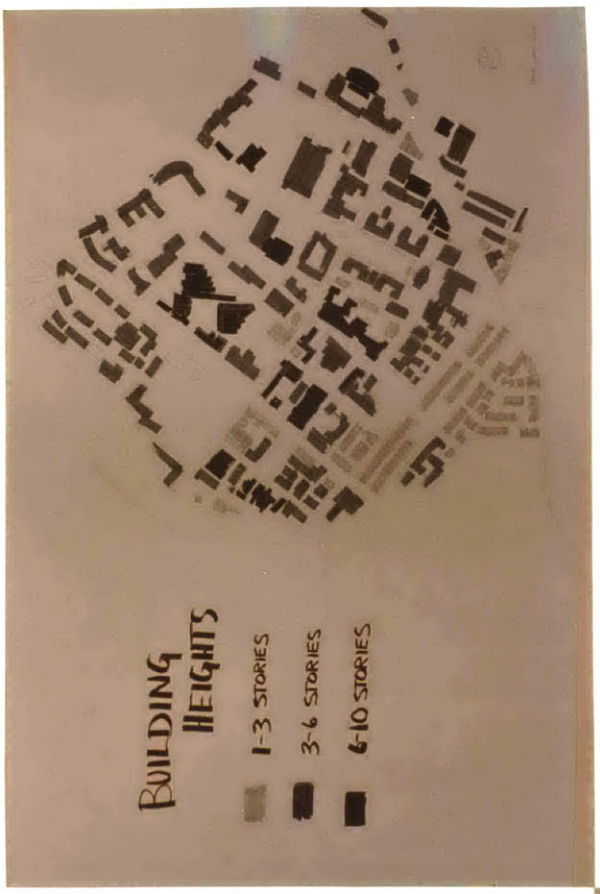
DEPARTMENTS	NSF	N/G	GSF	ACTIVITY	EQUIP	TRAFFIC/HR.	ADJAC.	LAYOUT
NURS. SERV. (TOTAL 688 BEDS)	6,300	.45	9,150					
MEDICAL (176)	61,300	(1.5)	91,600	EXAMINATION NURSING CARE TREATMENT OBSERVATION VISITORS DELIVERIES STAFF RELAX SP & REC. CARE FOR BABIES	BEDS (MOVABLE) WALL-MOUNTED IN STR. MOV. CARTS	MOD-HEAVY TRAFFIC; ALL HOURS (VISITING RESTR)		"COMMAND CENTRAL", ~~STAFF LOUNGE~~; DIRTY UTILITY; PT's ROOMS; NURS. STATION, MED ROOM; STERILE SUPPLY; BATHROOMS
SURG. (230)	76,200	(1.5)	114,000					
GYN. (80)	25,000	(1.5)	37,500					
OB. (120)	43,800	(1.5)	65,500					
NEWBORN	13,700	(1.5)	20,500					
I. MED/SURG. (56)	25,000	(1.5)	37,500	(AS ABOVE:) HEAVY MONITOR 'ROUND TH' CLOCK DATA PROC LAB WORK	HEAVY, IMMOV. COMPUTER, LAB. RESUSITATIVE GEAR	VERY RESTRICTIVE	(QUIET); NEAR CARDIAC LAB, O.R, BLD. BANK & RADIOL.	"COM. CTRL"; ADMIT; ON CALL RMS; LABS; DATA PROC. LAB; SINGLE RM.
C. CARDIAC C. U. (8)								
U. OTHER (8)								
OB.	5,000	(1.45)	7,300					
ADMIN. (NURS)	1,800	1.45	2,600	ADMIN OFFICES				TYPICAL OFFICE
E. HOLD. WARD (10)	3,200	(1.45)	4,650	OBSERVATION (3 DAYS MAX.)	MOV. BEDS	NORMAL RESTRICTED	NEXT TO E.W.	BEDS; STATION; STORAGE
SUBTOTAL	255,000		389,850					
ANC. FACIL.								
O.R.	31,000	(1.5)	46,500	CHANGE; SCRUB; ADMIT; PREP; OPERATE; RECOVER	MOV. TABLES/SCRUB SINKS/LIGHT/WALL MTD	MOST RESTRICTED	NEAR: E.W., BL. BAT, RADIOL, ~~OB BEDS & NURSERY~~	NON-COND. FLOORS/SPEC. HVAC/OR/PREP RM/SCRUB RM/RECOVERY
LABOR & DEL.	12,000	(1.5)	18,000	(A & I IN NURS. SERV. DEPTS) DEL RMS	MOV. BEDS/MONITOR EQUIP.	NORM. REST.	NEAR OR BEDS & NURSERY	PT ROOMS/LABOR RMS/DEL/U. SUITE (OR)
EMERG.	4,300	(1.5)	6,950	WAIT/TRIAGE/EXAM/PT. DISPOSIT; TEST	MOV. BEDS/WHEELCH/STRETCH.	BUSY ALL HOURS	NEAR HOLD W./GROUND FL. (VEHICULAR ACCESS)	TRIAGE/CAM CTRL/EXAM/ON CALL RM/LAB/STORAGE/DIRTY UTIL.
O.P.D./CLINIC	38,000	1.45	55,500	NON-EMER/NO BED EXAM/MINOR TREAT/REFER	MOV. BED WALL MTD EQUIP.	SCHEDULED/OPEN	SEP BLDG ?	WTG RM/ADM. DESK/EXAM RMS CHANGE RM/CONSULT.
LAB	41,900	1.30	80,500	TESTING	HEAVY, IMMOV. (BSMT)	SCHEDULED/OCC. LATE USES		REINF. FL/LARGE ROOMS
RAD 1. DIAG	48,300	1.40	67,500	WAIT/PICTURES/READING & PICT./RECORDS	IMMOV./LEAD PROT FOR STAFF	OPEN/ALL HOURS	NEAR E.W.	RAD. PROTECTION/WAITING RM READING RMS
2. R.T.	15,000	1.40	21,000	THERAPY/WAITING	BULKY, IMMOV./MONITOR	SCHEDULED		RAD PROT/MONITOR RM.
OCC & P.T.	7,000	1.30	9,100	O.T. REHAB PROCESS PT. THERAP ADJUNCT		SCHEDULED	NEAR NEURO & ICU	
PHARM.	9,800	1.25	6,000	DISPENSE, STORE MEDS RECORD PRESCRIP.	SHELVES/REFRIG.		NEAR CLINICS	2 WINDOWS/SECURITY
SOC. SERV.	1,600	1.45	2,320	COUNSELING WELFARE		SCHEDULED		OFFICE
DIAL.	2,885	1.50	4,300	BLOOD FILTERING	BEDS/DIAL MACH. (HEAVY) NURS. MONITOR	SCHEDULED		ANTISEPTIC ROOMS CENTRAL MONITOR
ANES.	10,300	(1.4)	14,400	OFF, STORAGE, PREP FOR O.R.	CARTS/DRUG STORAGE	MOSTLY SCHEDUL. (RESTRICTED)	NEXT TO O.R.	
NEURO.	2,000	(1.4)	2,800					
SUBTOTAL	239,585		339,370					
SERV. DEPTS.								
*FOOD	23,000	1.25	28,700	CAFETERIA; PT. FOOD PREP, SERVE, CLEAN-UP	REFRIG/COOKING/FOOD TRUCK/WASHING	SCHEDULED	NEAR GROUND FOR ? DELIVERIES	LARGE SPACES (BIG EQUIP)
H.S.KEEP.	2,359	1.25	2,950	CLEAN-UP/JANITAY/WASH/ADMINISTER	VACUUMS, MOPS, etc.	SCHEDULED		
LAUNDRY	1,460	1.25	1,830	COLLECT, SEND OUT, STORE, DISTRIBUTE LAUNDRY	STORAGE SHELVES	SCHEDULED	NEAR GR. FOR DELIV.	BIG STORAGE AREA
C.S.S.	7,658	1.25	9,550	COLLECT, STERILIZE, RECEIVE, DISTRIB, STORE	AUTOCLAVE/SHELVES REFRIG.	FAIRLY RESTRICTED (SCHEDULED)	O.R.	STORAGE/ANTISEPTIC
*C. GEN'L STORES	19,450	1.25	24,600	RECEIVE, STORE, SHIP DISTRIBUTE ALL SUPPLIES	STORAGE	SCHEDULED	NEAR GROUND	BIG AREA
EMPL. FACIL.	4,862	1.35	6,555	STORE, RELAX, MTG	LOCKERS, KITCH.		DECENTRALIZED	SMALL AREAS SCATTERED
BLDG. SERV.	34,130 (95,119)	1.25	42,600	MECH/ELEC.	HEAVY, MACH. TRANSFORM/GENERATOR		BSMT	LARGE AREA
SUBTOTAL	~~239,585~~		116,785					
ADJUNCT FAC.								
STAFF ON CALL	11,447	1.50	17,200	SLEEP, TALK, RELAX, EAT PHONE, DICTATE	BEDS, KITCH/PHONE/TV		E.W or BED FLOORS LIBRARY	PRIV RMS TO SLEEP/COMMON ROOMS KITCHEN
IN-SERV. TRAIN.	3,000	1.45	4,350	OFFICE, CLASSROM?				CLASSROOM OR THROUGH-OUT HOSP. OFFICE
WM. AUX.	1,200	1.10	1,320	ADM. VOLUNTEER GROUPS, MEET	OFFICE EQUIP	SCHEDULED	SNACK/GIFT ?	OFFICE/MTG ROOM
PUBLIC SP.	7,500	(1.10)	8,250	WAIT, VISIT, TALK, EAT READ, MEET	CHAIRS, TABLE, PHONE TV (FOOD?)	ALL HOURS, HEAVY TRAFFIC	NEAR ENTRANCES THRUOUT HOSP.	LOBBY, SNACK, MTG ROOMS, B.R, TELEPH. BOOTHS
ED & TRAIN.	21,125	1.45	30,600	TEACHING, READING, ROUNDING	CHAIRS, DESK, BL. BOARD, A.V., LIBRARY	SCHEDULED		AMPHITHEATRE, CONF RMS, LIBE & STUDY RMS
*RESEARCH	153,313	(1.3)	198,000	RES, NON-PATIENT TESTS	HEAVY, SPECIAL EQUIP	SCHEDULED	SEP BLDG ?	ANIMAL FACILITY, DATA, COLD STOR/TEMP CONTROL/SPECIAL ROOMS
DEP'T OFFICE	50,017	(1.4)	71,500	ADMIN, RECORDS	OFFICE EQUIP.	SCHEDULED	NEAR RESPECTIVE DEPARTMENTS	SMALL OFFICES THRUOUT HOSP.
*MED'L OFF. BLDG.	38,043	(1.4)	53,000	STAFF OFF. SEE PRIV. PTS, RECORDS, SEC'Y	OFFICE EQUIP, EXAM EQUIP	SCHEDULED	SEP BLDG?	
CHAP, MTG RM.	9,887	1.25	12,400	FAMILY MEDITATE		ALL HOURS		
SNACK/GIFT	1,200/1,200	1.25	4,250	USE BY VISITORS/SNACK, SIT, BUY	TABLES, KITCH SERV, SHOP, GIFTS, CASH REG.	SCHEDULED	NEAR LOBBY	GIFT: SMALL RM & STORAGE SNACK: KITCH, DINING RM, CLEAN-UP
* PARK	125,000	1.10	138,000	PARKING	TWO WHITE LINES & CAR	ALL HRS	NEAR HOSP.	SEP. FACILITY
* STORAGE	20,279	1.25	25,100	1. CENTRAL STORAGE 2. SCATTERED	SHELVES, TRUCKS, RECORDS	SCHEDULED	NEAR GROUND?	1. LARGE AREA-PRIMARY STORAGE 2. SMALL POCKETS THRUOUT HOSP.
DAY CARE	1,000	1.30	1,300	CHILD TENDING	TOYS, BEDS, KITCH, T.V.	SCHEDULED		SMALL ROOMS) EASY MONITORING
SUBTOTAL	445,305		565,170					
ADMIN SPACE								
EXEC. OFF.	8,465	1.45	12,200	ADMIN/CALL/MEET	OFFICE EQUIP.	SCHEDULED		PRIV RMS, SEC'Y/OFFICES
BUS. OFF.	7,249	(1.40)	10,000	BILLING, CLERICAL	OFFICE EQUIP.	SCHEDULED		OFFICE SETUP
ADMIT.	5,100	(1.25)	6,400	ADMIT PTS, TAKE INFO, SEND TO AD. TEST CTR	OFFICE EQUIP TEST CTR: X-RAY, BL. LAB	SCHEDULED (MOSTLY)	NEAR LOBBY	OFFICE LAB
MED REC/LIB	12,883	1.25	16,100	MAJOR STORAGE & RETRIEVAL & RECORDS	OFFICE EQUIP/FILES	SCHEDULED		OFFICE, LARGE STORAGE
DATA PROC.	4,166	1.10	4,560	COMPUTER WORK	COMPUTERS/HEAVY	SCHEDULED		LARGE SP.
PERSONNEL	888	1.45	1,280	HIRING, INTERVIEWING	OFFICE EQUIP.	SCHEDULED		TYP. OFFICES
PUBL. REL.	219	1.10	240	PUBLICITY, GRAPH.	OFFICE EQUIP GRAPHIC & EQUIP	SCHEDULED		OFFICE LAYOUT
SUBTOTAL	38,965		50,780					
TOTAL:	1,071,875		1,497,955					
NEW:	~~698,500~~		979,255					
*PRES:	378,375		468,700					

data from the AHC Certificate of Need application of April 30, 1973, along with much of the information gathered from my interviews and observations in the three hospitals. The chart records the department and the corresponding projected net square footage (from the C/N). The net/gross factor is supplied by a master program of net to gross factors by departments from the V.A. Hospital Building System, Buildings Systems Development. The gross square footage is figured from the NSF and the net/gross factor. In the Activity, Equipment, Traffic/Hr, Adjacencies, and Layout columns is the data obtained from interviews and observations, the C/N, the Master Plan Report, and any other source of information. The chart represents the first attempt at adjacencies which will determine the hospital's design. Several of these adjacency decisions were continously modified throughout the design process.

F. BASE MAPS

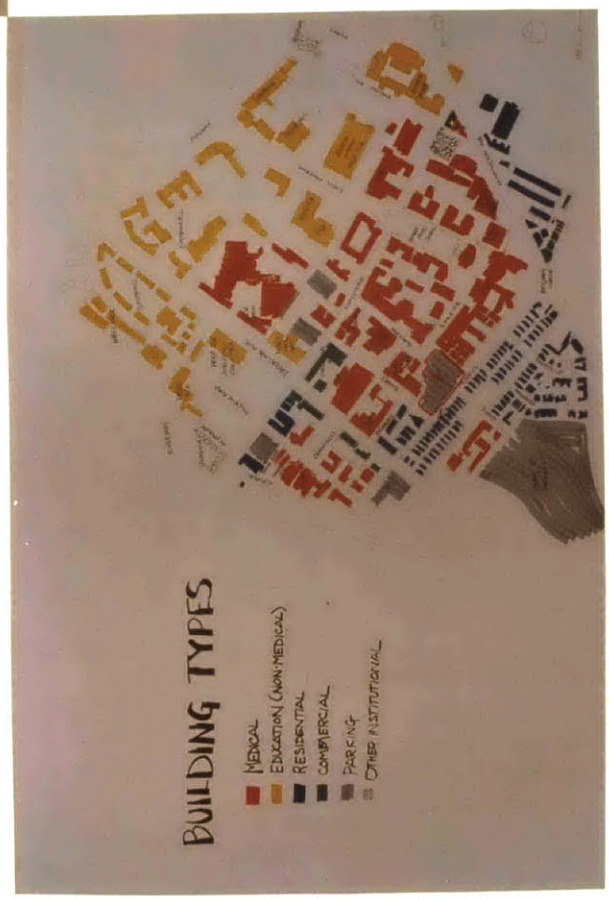
The next kind of information which was organized described the larger urban context of the proposed hospital. Three base maps (1"= 200'), blown up from an AHC historical map, were modified to include the latest renovations and building changes (see p. 27). These maps helped to record the AHC location and to provide details about the surroundings of the hospital.

The first map distinguishes the medical buildings from the other facilities in the area; name and type of building is recorded and the map is color coded by building function. Medical educational, residential, commercial and parking facilities are indicated. The second map describes the public access to the hospital, indicating MBTA routes, bus routes, highways and major streets leading to the hospitals.


BUILDING HEIGHTS
1-3 STORIES
3-6 STORIES
6-10 STORIES

BASE MAPS


TRANSPORTATION
MBTA SUBWAY or STREET CAR
MBTA BUS
MAJOR HIGHWAYS/ROADS
MEDICAL AREA
AHC SITE
MBTA GREEN LINE
RIVERSIDE
MBTA ORANGE LINE

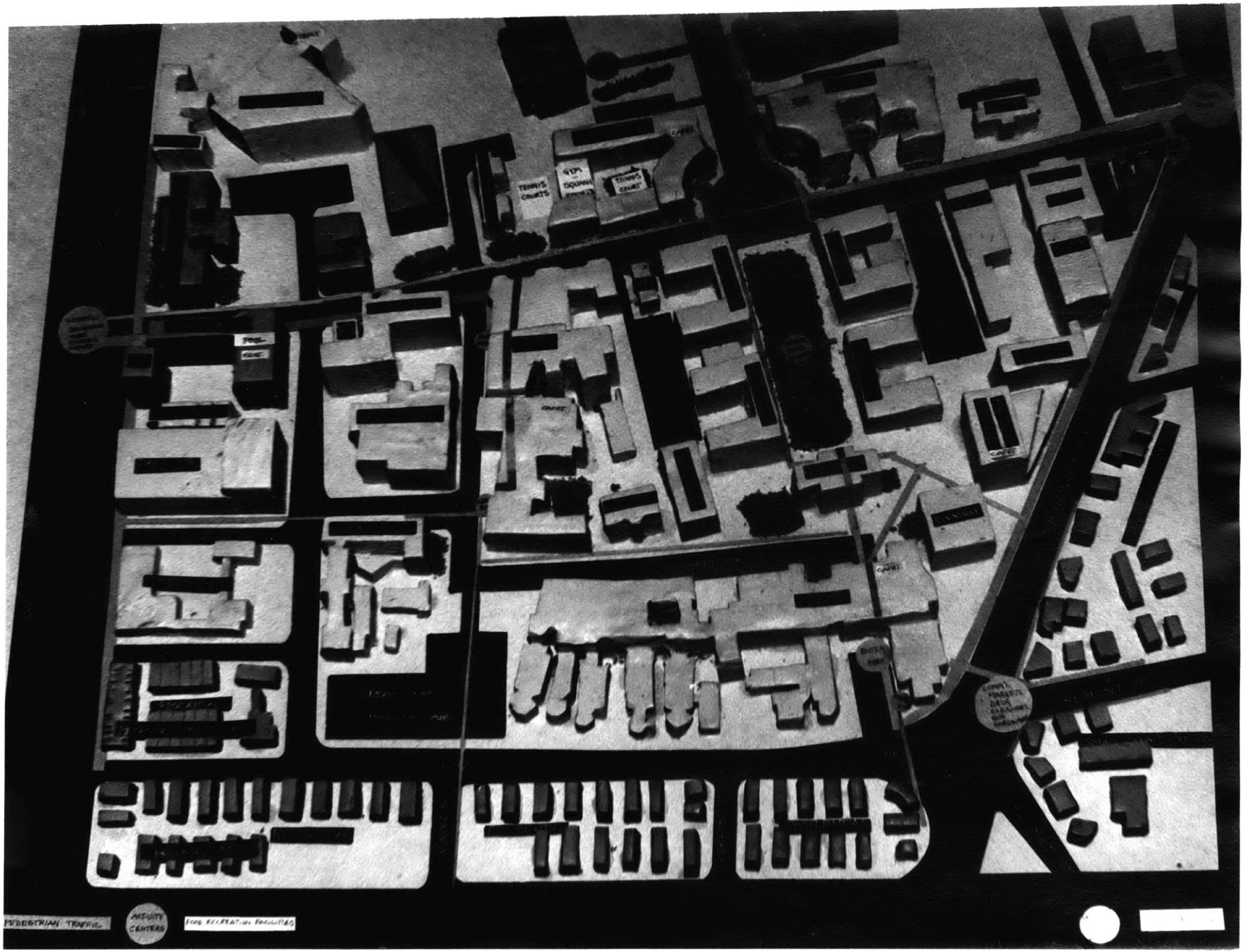

BUILDING TYPES
MEDICAL
EDUCATION (NON-MEDICAL)
RESIDENTIAL
COMMERCIAL
PARKING
OTHER INSTITUTIONAL

Map 3 gives the approximate building heights, in order to demonstrate how tall buildings are densely packed. The maps are helpful in indicating some environmental and locational conditions. Their inability to adequately portray the quality of the environment, i.e., the claustrophobic, non-green, congested and heavily "pedestrianated" qualities, became apparent later in the thesis work as was remedied by the construction of an urban contextural model.

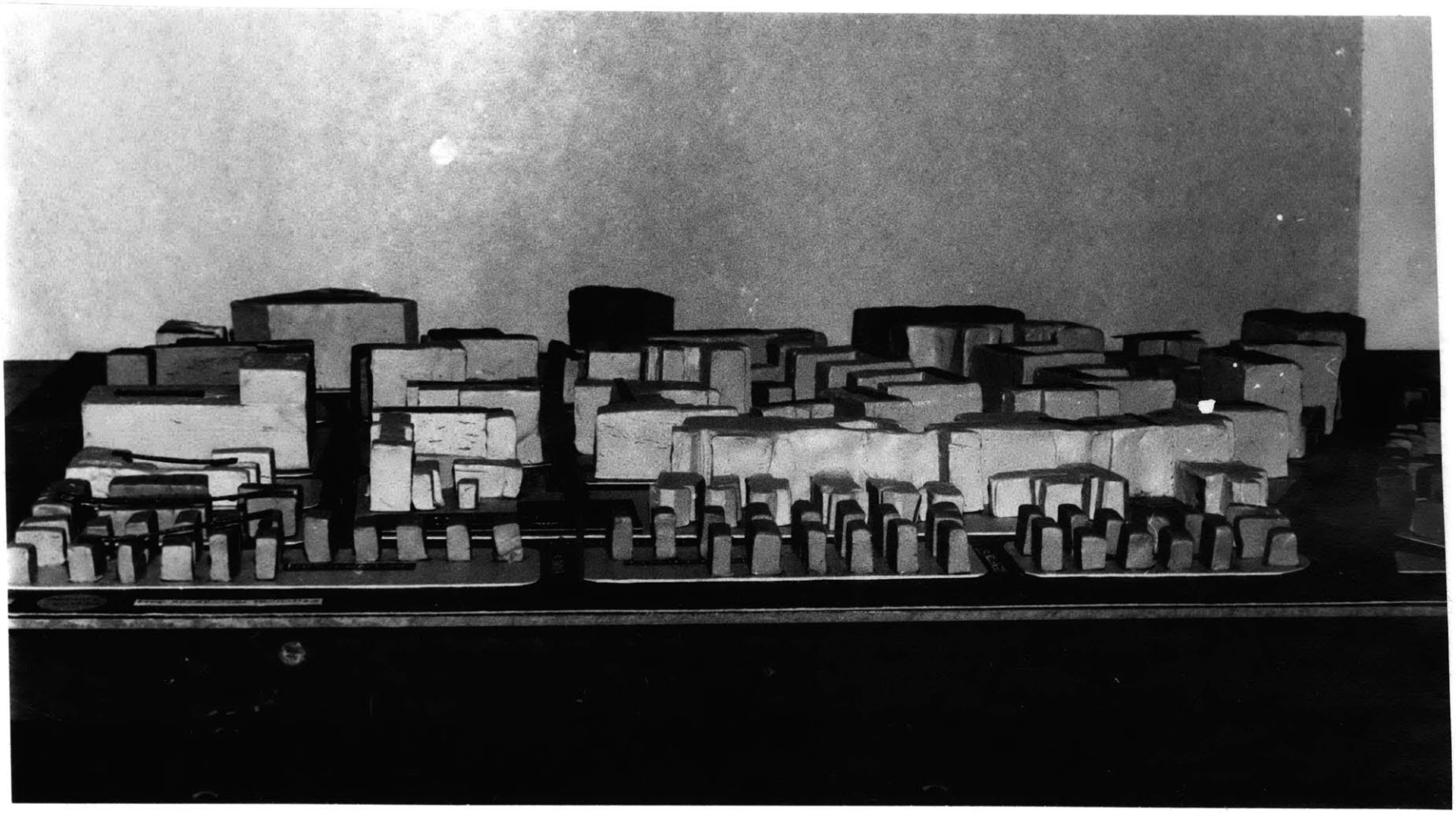
G. CLAY MODEL

To augment the base maps, I constructed a model of the area (1" = 100') with buildings made from clay, mounted on matte board and then on peg board (see pp. 29-30). The buildings are scaled by height, under two stories, two - six stories, and above six stories. This allows for an accurate feeling for the tallness of the buildings, the lack of setback, and the narrowness of the streets. Green areas (limited as they are) are indicated, as are pedestrian pathways (thick lines = more traveled).

Certain facts, including those just listed, become clear by examining the model. There is a good deal of pedestrian and vehicular traffic - too much, in fact, which creates intense congestion along Longwood Avenue. The need for traffic reorganization is real. There is also a genuine need for recreational facilities for medical center personnel. Streets need to be widened and buildings kept low and setback to counteract the claustrophobic effect. The concentration of medical buildings encroaching upon the Francis Street dwellings indicates a need for a transitional zone. The environmental advantages of the Francis Street location are apparent from the model: nearness to the



AERIAL VIEW, CLAY MODEL



EYE-LEVEL VIEW, CLAY MODEL

proposed power plant and parking facilities, to the neighborhoods which the AHC hospitals serve, to Brookline Avenue and Brigham Circle, and distance from the congested Longwood Avenue.

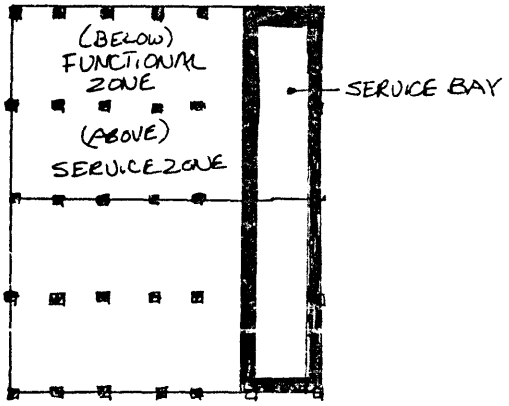
H. STYROFOAM MODEL

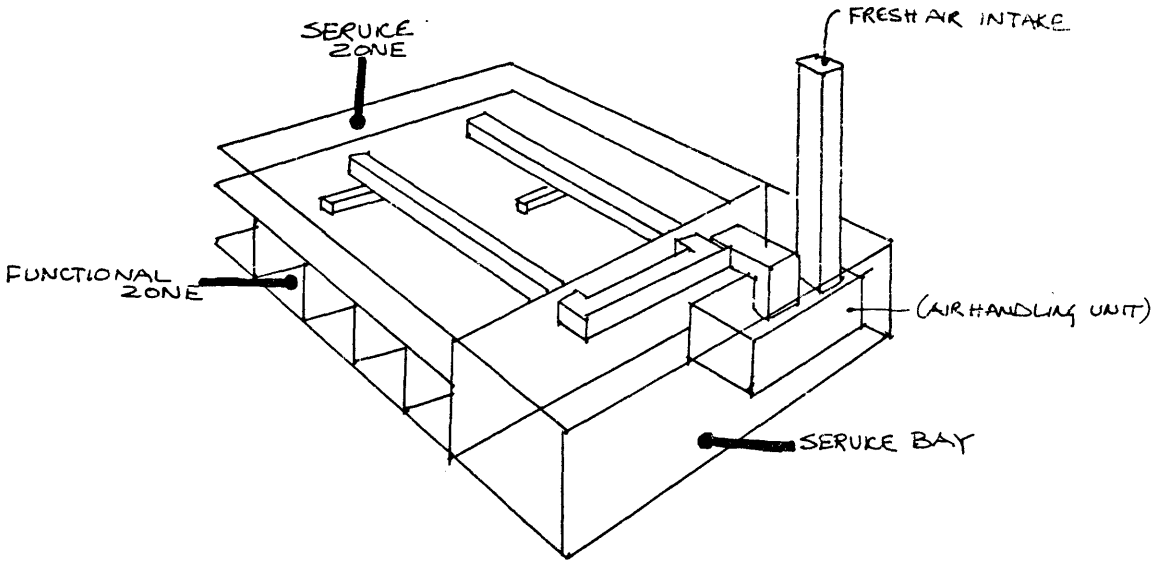
1. DESCRIPTION OF MODEL

Having laid the groundwork with the above information gathering and processing, the application of the data to the actual design of the AHC was the next step. There were two objectives of the first attempt at hospital design. The first was to adopt a design method which would allow for rapid production and evaluation of designs so that the major design and organizational issues could be quickly addressed. The second objective was to design in a manner both physical and diagrammatic (i.e., no actual walls, beams). Because it could be quickly assembled, photographed and disassembled, a styrofoam massing model was chosen as the best method for achieving these objectives.

The massing model was constructed from styrofoam building blocks. These blocks represent space modules which are described in the V.A. Hospital Building System. The space modules are based on substantial research by Building Systems Development of necessary and important dimensions used in patient care (i.e., door width related to gurney size; room size related to gurney turning radius). The module (#7) used in this thesis is 81' by 90' by 15' high; it is composed of 8 bays 22.6' x 40.6', two bays of which are service bays which contain mechanical, HVAC, plumbing and electrical services. The module is also subdivided into a functional zone (patient

care area) and a service zone above (horizontal distribution of services). See the following diagrams for illustration.





2. USE OF MASSING MODEL

The primary goal of the massing model was to establish the basic bulk of the hospital (i.e, to see how much cubic footage was programmed for the site) and to see how it might be arranged. Reasonable limitations of building height and horizontal and vertical massing were established. A general idea of possible layouts was obtained. This was valuable because certain design limitations (access, amount of blocks possible per floor, view restrictions) became apparent. First, it was often difficult to tell if a design was viable in terms of building function, since questions of adjacencies and department relationships were not answered by this method. Secondly, the physical reality of the blocks often interfered with the idea that the model is fairly diagrammatic. The former problem is the more important, as it limits the usefulness of the model.

To extend the usefulness of the model, I decided to assign a certain number of blocks to each department, depending upon the square footage allotted by the program. Each block represents 7200 square feet of area, so a department such as the O.R., which is allotted 46,500 gsf,would be assigned seven blocks. The blocks were then labeled with the appropriate department name. Using the Key Program Data Chart, I constructed models which reflected the desired adjacencies and therefore theoretically could be adjudged as viable or not. In actuality, there were many models which seemed viable. It became apparent that a method to test the adjacencies of each model in a functioning, dynamic situation was needed to discriminate between viable and non-viable designs. Since adjacencies should be governed by traffic movement, a traffic study was the next step.

I. TRAFFIC MOVEMENT STUDY

As I considered doing my own traffic study, certain facts became apparent. First, to do a comprehensive traffic movement study in the hospitals would require many months. A study was needed which would indicate the types of movement patterns in a similar hospital so that certain trends might be apparent. The problem with the latter solution was that the data might not be applicable.

After extensive research into the literature on movement in hospitals, I found a study published by the Ministry of Health, Great Britain, on "Traffic Movements and the Inter-Relation of Departments". The study was based on information gathered in hospitals in England and the United States over a period of nine years; its purpose was to calculate traffic movements for a model 600 bed hospital. The type and frequency, bulk and urgency of traffic generated in and out of each of the 18 model departments was calculated, and this produced traffic links between the departments. These links were weighted in terms of importance (according to frequency and type, bulk and urgency). A more detailed description of the elaborate weighting scale used to determine the traffic links is listed in Appendix B. Also in Appendix B are bar charts for each of the 18 departments describing in order of importance the traffic links from each department to the seventeen other departments. Thus, the study supplied information about interdepartmental traffic movement and suggested an operational definition for hospital efficiency: that is, an efficient hospital is one in which the most important movements, as determined by a multi-factorial rating scale, are shortest. I wanted my AHC adjacencies to reflect the results of this study. From my earlier research, adjacencies had been established for a static hospital situation. I wanted to compare those adjacencies with the adjacencies which came out of the traffic movement study.

A simple method to compare the two sets of adjacencies was needed.

J. MATRIX

1. DESCRIPTION OF MATRIX

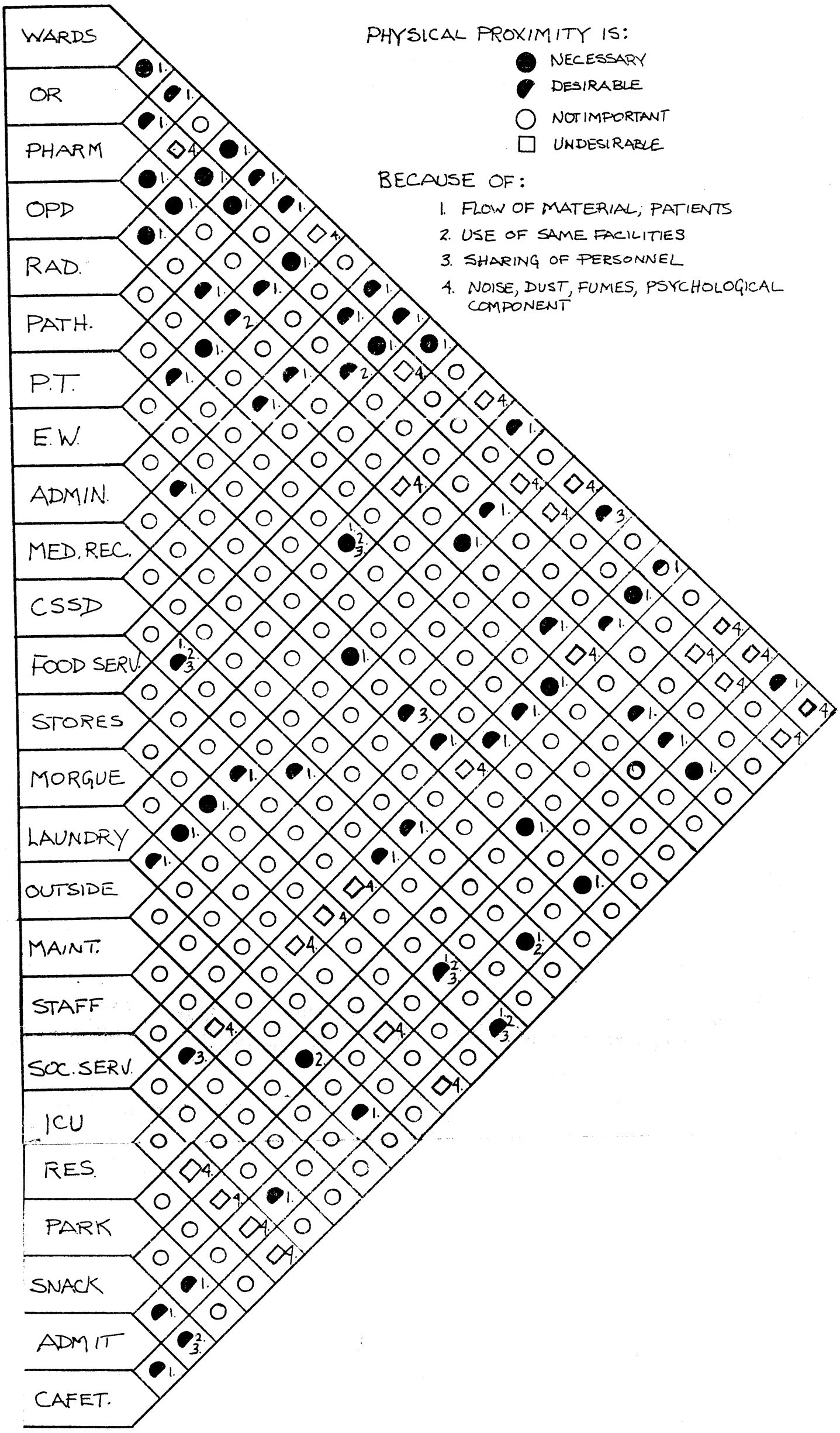
A method of organizing adjacency information so that it could be quickly read was adopted during research for a traffic movement study; a pamphlet entitled "Quantitative Methods for Evaluating Hospital Designs" offered a matrix on page 117 which could be used to organize the established adjacencies and the reasons for them. The matrix also provided an opportunity to record heretofore unthought of or unrecognized adjacencies. See p. 36.

The 18 departments listed in the Ministry of Health traffic study were used (to make comparison easier); these departments overlapped those listed in the AHC program (Key Program Data Chart). Seven more AHC departments not included in the traffic study were used. Four symbols were used to distinguish desired adjacencies from undesired adjacencies, and a numerical method indicated reasons for the relationship.

2. USE OF MATRIX

The matrix was then used to compare original, static adjacency determinations with the traffic movement study's adjacency priorities. Some differences were extremely interesting. For example, the matrix listed the O.R. as needing to be near the E.W. because surgical procedures occur in both. The traffic movement study called for the O.R. to be near the wards because of the vastly higher frequency and importance of O.R.- ward trips. The traffic movement study also introduced "outside the hospital" as a department and revealed that the OPD, pharmacy, and Physical Therapy should be nearby. The matrix did not reveal this relationship.

MATRIX



PHYSICAL PROXIMITY IS:

- NECESSARY
- DESIRABLE
- NOT IMPORTANT
- UNDESIRABLE

BECAUSE OF:

1. FLOW OF MATERIAL; PATIENTS
2. USE OF SAME FACILITIES
3. SHARING OF PERSONNEL
4. NOISE, DUST, FUMES, PSYCHOLOGICAL COMPONENT

MATRIX ADAPTED FROM "QUANTITATIVE METHODS OF EVALUATING HOSPITAL DESIGNS"

No other significant conflicts came out of a comparison of the matrix and the traffic movement study; one acted as a check on the other to avoid the possibility of oversight.

K.STYROFOAM MODEL II & ACETATE SHEETS

With adjacencies now determined by traffic movement, I decided to go back to the styrofoam model to see what layout options were still open to me. I realized that I needed a method to study and record the vertical and horizontal movement of people and materiale through the hospital in terms of the styrofoam models. This method would have to be diagrammatic.

1. DESCRIPTION OF METHOD

Acetate sheets, one per floor of each hospital model, were used to record the floor plans. On each sheet, I affixed cut-out paper symbols representing the traffic movement of patients, staff, visitors and materials (see photographs of sheets, Appendix C). These sheets had the advantage that they could be laid one on top of another to show vertical relationships of departments and, implicitly, vertical movement of people and goods. The vertical movements were specifically recorded in three cross-sections per model(also on acetate sheets).

The goals of the acetate and styrofoam method were to determine a diagrammatic hospital design for a dynamic situation, i.e., a functioning hospital. The acetate sheets depicted both the intra- and inter-departmental movement of people and goods. (The intra- departmental traffic was determined by the personal observation of each department and by analysis of the type of activity occurring in the department; interdepartmental traffic was given in the traffic movement study).

2. USE OF MODEL & ACETATE SHEETS

The acetate sheets (and photographs of the styrofoam model, Appendix C) were then used to compare the designs of the AHC to determine which design was optimal. Criteria for the design evaluation were efficiency, aesthetic appearance and environmental impact. The term efficiency is difficult to define, but in this case an efficient adjacency situation is one where the "important traffic" (according to frequency and type, bulk, urgency) occurs along short distances. On the acetate sheets, the fat lines, which represent a large volume of traffic, should be short. "Aesthetic appearance" also gives problems, since the models represent a diagrammatic situation; the term is meant to apply to the overall appearance of the massing model. The environmental impact criterion is used to asses the characteristics of the proposed hospital, such as the orientation to the neighborhood, the building height and size, the hospital entrances and subsequent traffic disruption.

IV. ANALYSIS OF DESIGNS

A. STYROFOAM MODEL "A" (SEE APPENDIX C FOR PHOTOGRAPHS & PLANS)

Two different types of models for the Affiliated Hospital Center were produced, along with corresponding series of floor plans and sections

1. DESCRIPTION Model "A" represents a hospital with a low block design; uniform maximum height is seven stories above ground. Most of the 3½ acre site is covered, but because the building is in the shape of an "H", two rectangular open areas occur on the Binney Street and PBBH sides. This allows for space on the site for emergency vehicles, with the E.W. located on Binney Street. Because of the large amount of square footage and the small site, the design follows one recommendation of the AHC program that 300,000 - 400,000 square feet of the proposed hospital can relocate in renovated PBBH facilities. In the Key Program Data Chart, 468,700 gsf of space is to be placed in PBBH buildings (asterisks). In order to accommodate the remainder of the square footage, four subgrade levels are planned. These contain much of the support services (labs, radiation therapy, laundry). According to the Certificate of Need application of April 30, 1973, soil conditions permit this construction.

2. ANALYSIS

a. APPEARANCE & ENVIRONMENTAL IMPACT

The height of model "A" is not offensive to the three-story Francis Street dwellings; in fact, the AHC building might be a transitional height between the taller CHMC buildings and Francis Street. The shorter building allows for more sunlight in the street. The bulk of the hospital, with no open space on Francis Street, might add to the claustrophobic feeling created by nearby medical buildings which have unrelieved bulk abutting narrow streets. Since all entrances are on Binney street which is narrow, this might cause vehicular traffic congestion along that street.

b. EFFICIENCY

With specific exceptions, model "A" is an "efficient" hospital. Most of the heavy traffic occurs along short distances which indicates that the departments are well located in relation to one another. A problem occurs in that the main entrance to the hospital on Binney Street is not located near the OPD on Shattuck Street. Therefore, what would occur is heavy OPD traffic entering from Binney Street, crossing through the hospital and entering the renovated PBBH facilities wherein is located the OPD. In this case, the heavy traffic (fat line) is long, and the situation is inefficient. The OPD is not near the neighborhood it serves (not visibly). nor on a through street or a street with public transportation, which is not a good situation.

"A" is an efficient hospital in the sense that there is little need for far vertical movement. With 12 blocks or 86,400 square feet per floor, there is good horizontal expanse; most departments can be located entirely on one floor and often departments with strong traffic links can be located on one floor. All surgical beds and the O.R. suite can be located on two floors which is very efficient. The O.R. suite is never further than three floors from the wards, E.W. and Diagnostic Radiology (high importance traffic links). In the same way, Labor & Delivery, obstetrical beds and Newborn Nurseries are all located on two floors, with L&D surrounded by ob beds. With four subgrade and seven above grade floors, the maximum vertical distance of any department from any other department is eleven floors. Materials which come in at ground or sub 1 floor travel up seven stories and down four, with several perimeter drops; distribution occurs along uniformly stacked floors, the materials can be

distributed to the vertical distribution points and then lifted to the appropriate floor with very little wasted time or effort. For entering or leaving the hospital or for lunching at the cafeteria, the staff only has a maximum of seven floors to negotiate.

The fact that "A" is essentially a horizontal hospital creates problems. The first is that a perimeter problem exists for the bed floors; each bed should have a view to the outside. With eight of the twelve space modules enclosed on three sides by other blocks, this is very difficult. More irregularity in building shape or use of courtyards will be necessary in the specific design. At this point, it is important to remember that the model is diagrammatic. In the final design work, attention must be paid to the perimeter condition. The other problem in "A" is that, although vertical movement is minimized, horizontal movement is increased, particularly on the bed floors. In most cases, it will be easier and faster to walk 20 feet horizontally than ascend 20' vertically, so the horizontal movement is more efficient. However, if a nurse has to walk within her department across the hospital and back (648') to fetch red topped tubes when she might have gone upstairs one flight (within her department) 15', the latter would be more efficient. Although horizontal movement is most often more desirable than vertical movement, this may not always be the case.

B. STYROFOAM MODEL "B" (SEE APPENDIX C FOR PHOTOGRAPHS & PLANS)

1. DESCRIPTION

Model "B" is a different type of hospital design than model "A". In "A" there is no great distinction between the support service floors and the bed floors. In "B", a three-story horizontally oriented support area is surmounted by a fourteen-story bed tower. The hospital

has three distinct sections: OPD (separate six-story complex), support services, and bed tower.

2. ANALYSIS

a. APPEARANCE & ENVIRONMENTAL IMPACT

The lobby and OPD entrances are located on Francis Street, with the advantage of being more visible and more accessible than when located on Binney Street as in "A". The tower does not adversely impact the Francis Street area (in terms of view or sunlight impediment) as it is set back toward CHMC. The sides of the hospital abutting Francis and Binney Streets are open at ground level which is pleasant. Again, bulk support space is located on four subgrade floors.

b. EFFICIENCY

The separation of the building into functional zones has the advantage of keeping one type of activity separate from another type, which prevents inefficient cross-traffic and allows for individualized environmental control (and subsequent savings). There are, however, 18 stories of vertical movement (including subgrade levels). Materials which are delivered at ground or sub 1 must be lifted to a maximum of fourteen stories instead of seven; the staff and visitors to the wards must travel further vertically, which requires more elevators and most probably more waiting. Fewer departments can now be located totally on one floor. Surgical beds are now on four floors, and L&D, ob beds and Newborn Nurseries are on four floors. The O.R. suite, being in the support block, is on one floor but is still a maximum of eleven floors from some ward beds (gynecological) and is two floors from the E.W. and Diagnostic Radiology.

Although vertical movement is increased and horizontal movement decreased (on bed floors in the tower), some horizontal movement is

increased over that in "A". Support services, located near Francis Street, are vertically and horizontally very distant from beds in the tower rooms facing Shattuck. A horizontal movement of almost 300' is necessary before a vertical movement of fourteen stories is possible. For this kind of reason (i.e., flow of personnel and materials between zones), "B" is inefficient. The bed floors have the advantage of being smaller (less horizontal movement) and being arranged so that more perimeter is open (every block open on two sides). More irregularity will be necessary to obtain the desired perimeter.

C. COMPARISON OF MODELS "A" AND "B"

In terms of vertical movement alone, "A" is more efficient since it minimizes the vertical; single departments or multiple departments with locational connections which are important can be located on two floors instead of four. Model "B" has more vertical movement, but restricts most of that to a small zone of the hospital. "B" also has less horizontal movement on each bed floor. Both hospitals have extensive horizontal movement in the support space, but because of tower location, "B" has more horizontal movement in the support area. Model "B" has better organized entering patterns which allow for less cross-traffic between zones.

V. CONCLUSIONS

From the above analysis, one can conclude that model "A" and model "B" have different advantages. While both are significantly more efficient than any presently existing AHC facility, model "A" has the advantage of allowing both goods and people to reach their destinations by travelling relatively short distances. Further work on model "A" would consist of relocating entrances and the lobby complex and rethinking exterior design to increase perimeter conditions for the bed floors.

Model "B" has the advantage of a higher perimeter to square footage ratio for the bed floors and of fitting in harmoniously and more "gently" with its proposed environment. Further work here would concentrate on bringing service area and bed tower closer together and on making each floor as self-contained and independent as possible, thus minimizing inefficient vertical traffic.

In a professional setting, I would consider sounding out the client at this point to see in which model the interest really lay. Design development could then proceed on that model.

VI. SUGGESTIONS FOR FUTURE WORK

An extensive traffic study should be done in each of the AHC hospitals to determine specific movement patterns in the existing facilities. Such a study could imply adjacencies, which,when carried over to the new building, would increase efficiency and save operating expenses.

The design development of models similar to "A" and "B" would provide a method for evaluating the traffic study information by experimenting

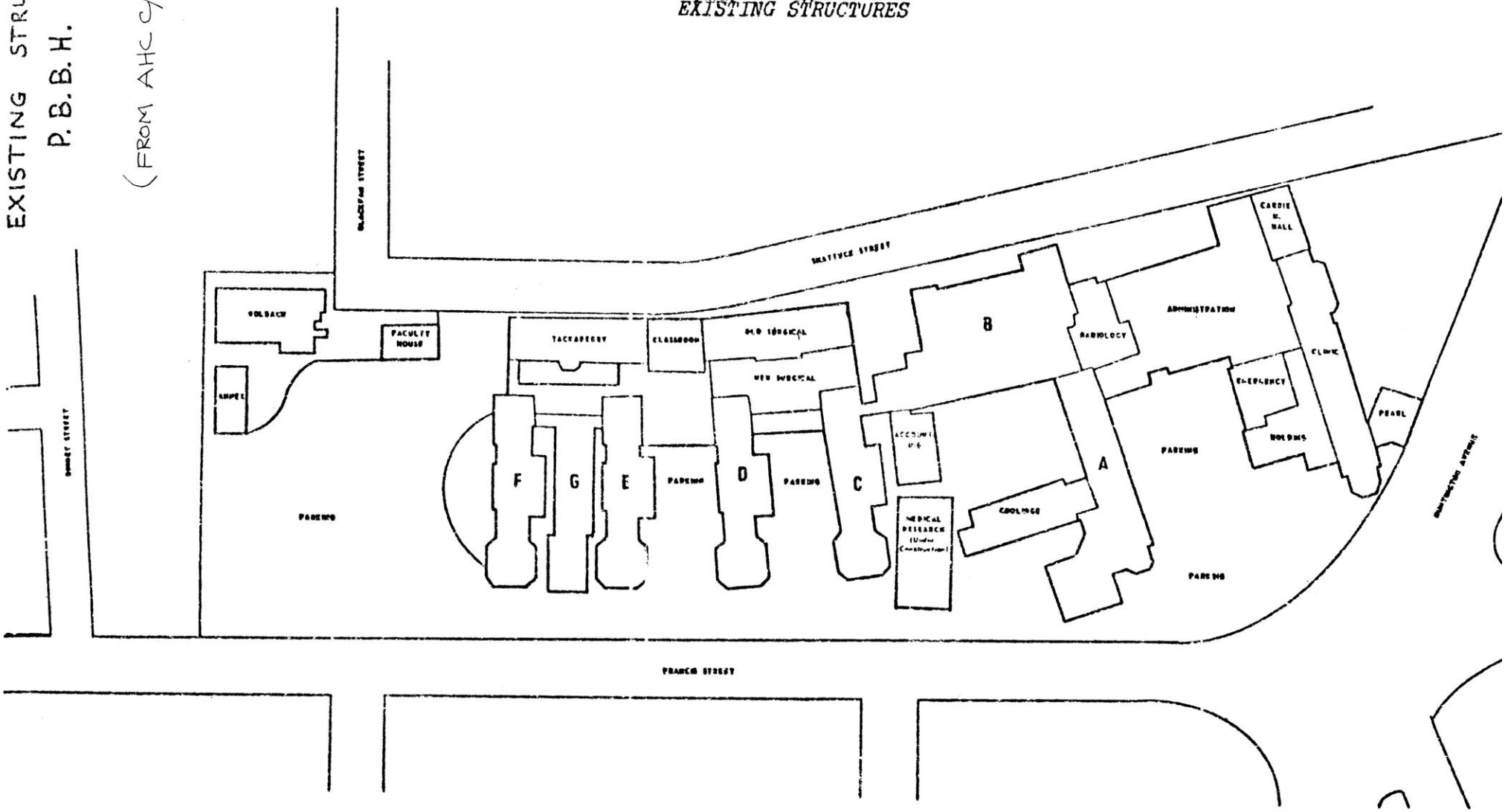
with recommended adjacencies to determine various efficiencies. If this kind of groundwork is done before final plans are made for the hospital, obvious inefficiencies can be avoided.

APPENDIX A:

PLANS OF EXISTING HOSPITALS

EXISTING STRUCTURES:
P.B.B.H.
47.
(FROM AHC c/N APRIL 73)

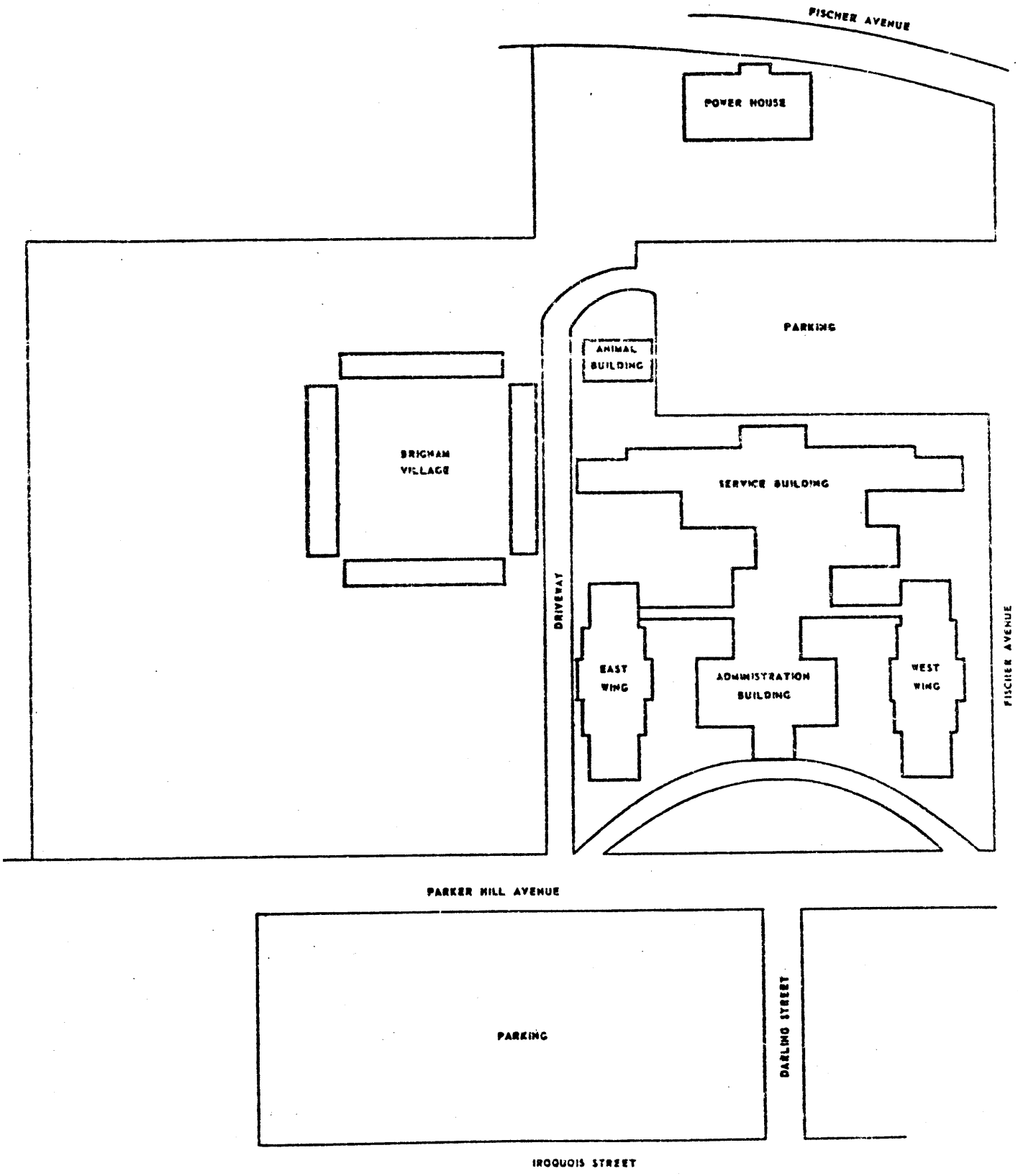
AFFILIATED HOSPITALS CENTER
PETER BENT BRIGHAM HOSPITAL
EXISTING STRUCTURES



AFFILIATED HOSPITALS CENTER

ROBERT B. BRIGHAM HOSPITAL

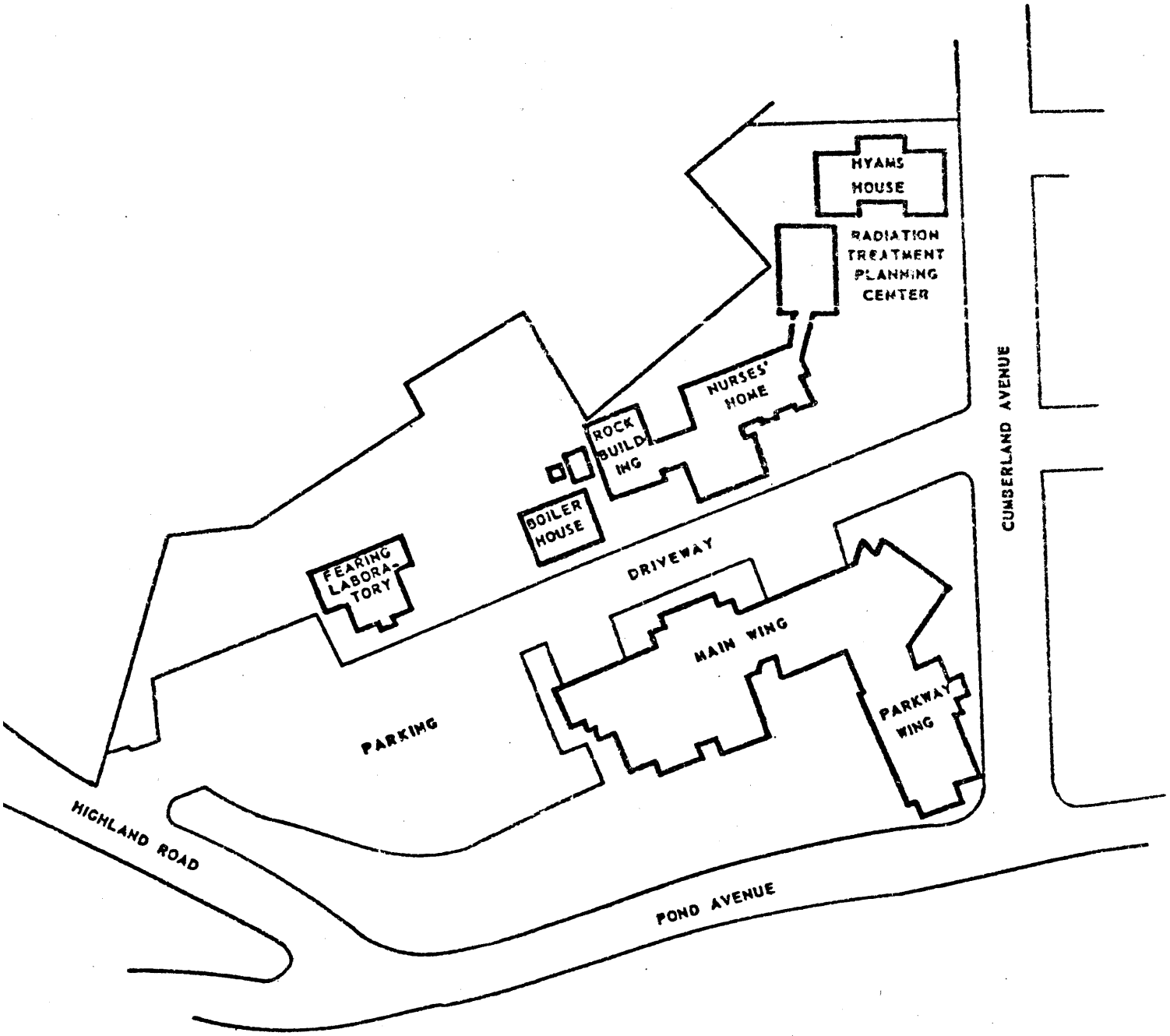
EXISTING STRUCTURES : R.B.B.H.



AFFILIATED HOSPITALS CENTER

BOSTON HOSPITAL FOR WOMEN
PARKWAY DIVISION

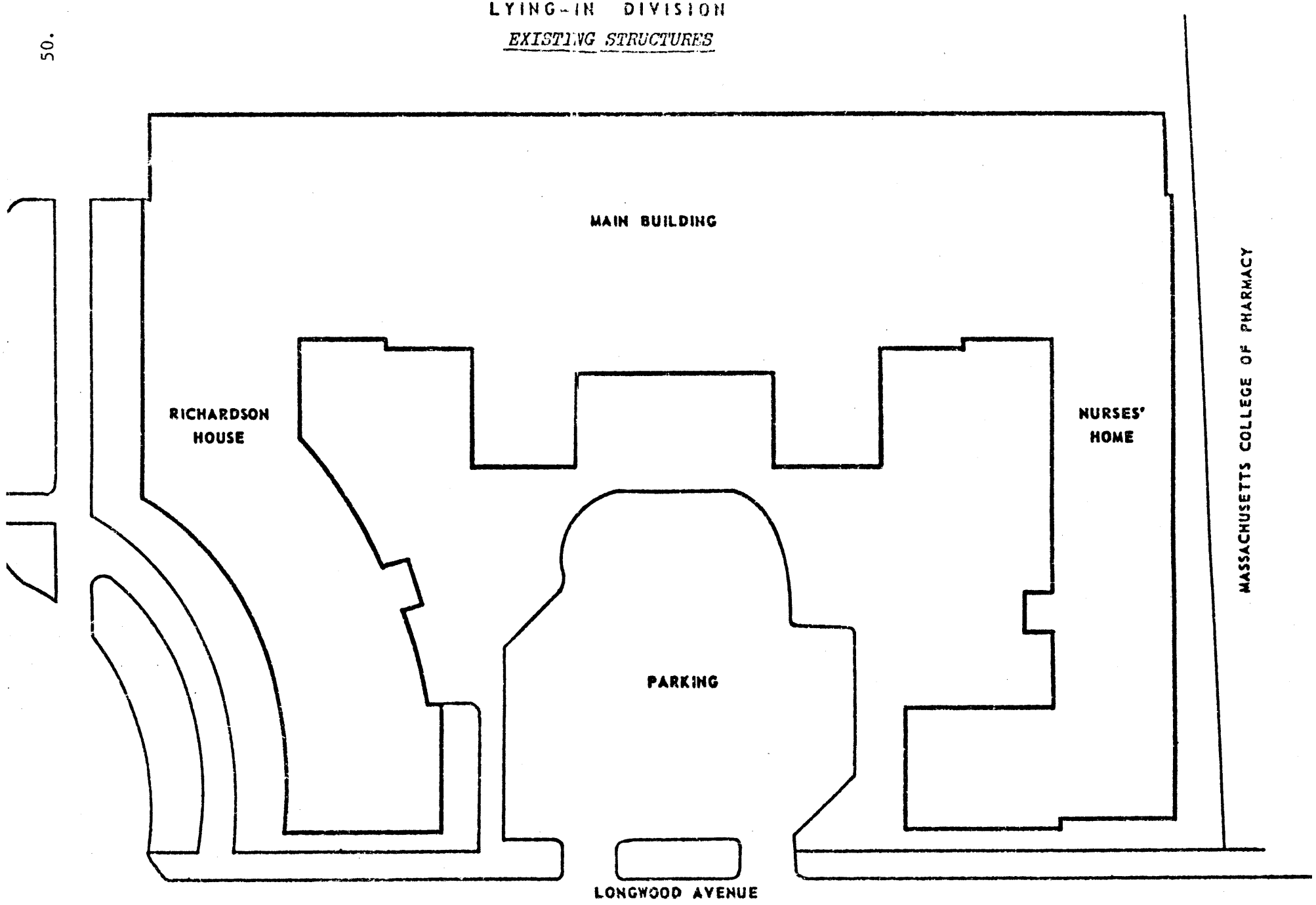
EXISTING STRUCTURES



AFFILIATED HOSPITALS CENTER

BOSTON HOSPITAL FOR WOMEN
LYING-IN DIVISION

EXISTING STRUCTURES



APPENDIX B:

THE EXPLANATION OF EVALUATION SYSTEM USED IN TRAFFIC STUDY

SAMPLE DATA FROM TRAFFIC MOVEMENT STUDY

BAR CHARTS FROM TRAFFIC MOVEMENT STUDY

EXPLANATION OF EVALUATION SYSTEM USED IN TRAFFIC MOVEMENT STUDY

EXCERPTS FROM TEXT: pp. 3-4

"26. The following three factors in relation to all types of traffic were evaluated: FREQUENCY AND TYPE , BULK, URGENCY.

27. FREQUENCY AND TYPE. The number of journeys are those which take place over 24 hours and the number of points allotted to each single journey (between departments or between a department and outside the hospital) is as follows:

a. The movement of people

In-patient	4 points
Out-patient	4 points
Out-patient with escort	2 points
Medical Staff	4 points
Nursing Staff	3 points
Other Professional & Technical Staff	3 points
Other Staff	1 point
All Staff (meals, off duty)	1/8 point
Visitors	1/8 point

Example: Nurse and attendant accompanying in-patient equals 8 points. Compensating adjustments for round trips are made.

b. The movement of goods
Appropriate points for each person moving goods plus weighting as shown below under "bulk".

c. The movement of vehicles: Ambulances ..... 10 points

28. BULK. The number of points shown are added for each single journey.

Very bulky (requiring mechanical aid)	2 points
Bulky (but can be carried by 1 person)	1 point
Light(papers, etc.)	no additional points

29. URGENCY Studies in this country, and in the U.S.A., have shown that the need for urgency in the movement of people and goods around hospitals is minimal and there is little evidence that hospitals would function better if traffic moved more quickly..... Where between departments the possibility of an emergency movement can still be held to exist, a weighting sufficient to ensure that this consideration outweighs any other is applied."

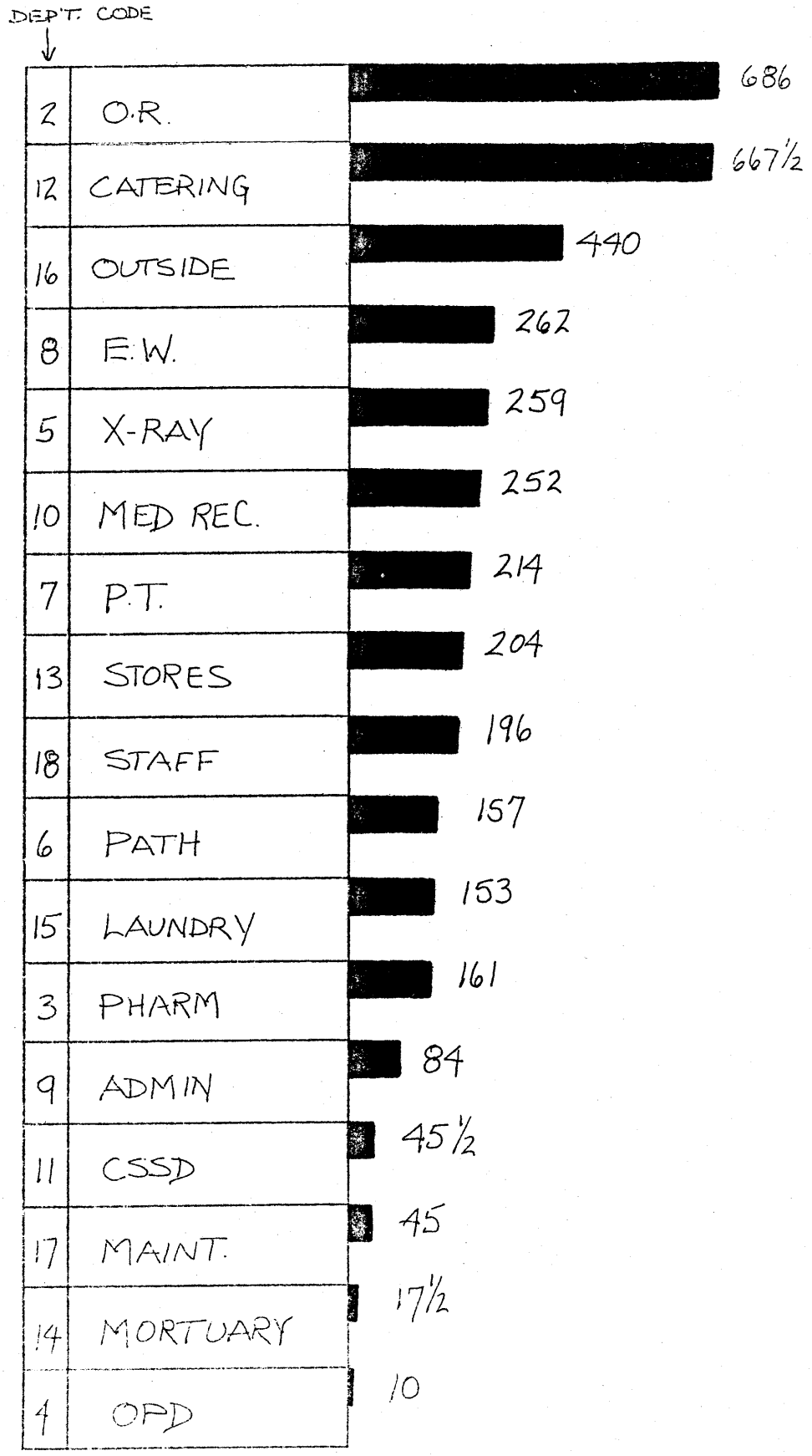
SAMPLE DATA FROM TRAFFIC MOVEMENT STUDY (p. 11)

DEPARTMENT: OPERATING ROOMS

CODE NUMBER: 2

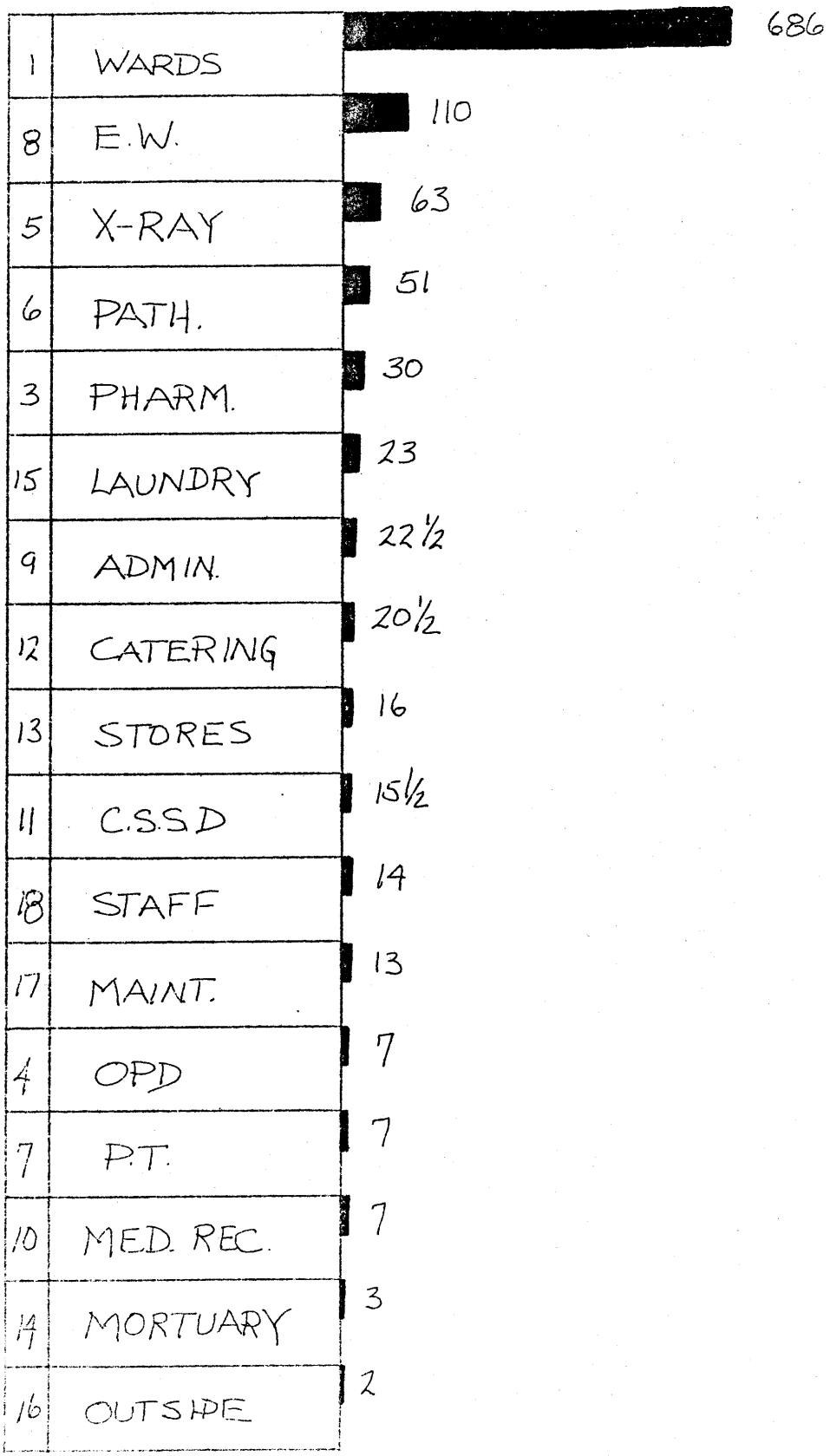
MOVEMENT - IN AND OUT (24 HOURS)	# OF JOURNEYS	CODE #	ASSES-MENT
PATIENTS			
Wards (from previous data sheets)	---	1	686
Accident & Emergency (4)	12	8	48x2
Special Examinations (X-ray)	2	5	16x2
STAFF			
(1) Own Medical, Nursing, Attendant, Portering, etc.			
On Duty	28	18	3½
	8	16	1
Off Duty	28	18	3½
	8	16	1
Meals and Breaks	108	12	13½
Ad Hoc Visits & Errands	3	9	9
	2	6	6
	2	5	6
	2	3	6
	1	13	3
(2) Laboratory Technicians	2	6	12x2
(3) Radiologists	3	5	18
(4) Maintenance	-	17	6
(5) Nursing Administration Rounds	2	9	6
VISITORS	4	9	½
DELIVERIES			
Sterile Supplies	4	11	12
Blood	2	6	4x2
Gases	2	3	4
Drugs, Medical Supplies	3	3	12
Instruments	2/7	3	1
Clean Linen (daily)	2	15	8
Cleaning materials	1/14	13	-
Hardware	1/30	13	-
Provisions	2/7	13	4
Stationary	1/30	13	-
COLLECTIONS			
Soiled Linen (daily)	2	15	8
CSSD Items Returned	-	11	-
Mortuary	1	14	3
Containers	1	13	2
Pathology	2	6	6
ROUTINE MESSENGER SERVICE			
Collection/Delivery of all other items (for other dep'ts)	8	3	7
such as reports, requisitions, post (Round Trips)	8	4	7
	8	5	7
	8	6	7
	8	7	7
	8	8	7x2
	8	9	7
	8	10	7
	4	11	3½
	8	12	7
	8	13	7
	8	15	7
	8	17	7
	8	18	7

1. WARDS & SPECIAL DEPARTMENTS

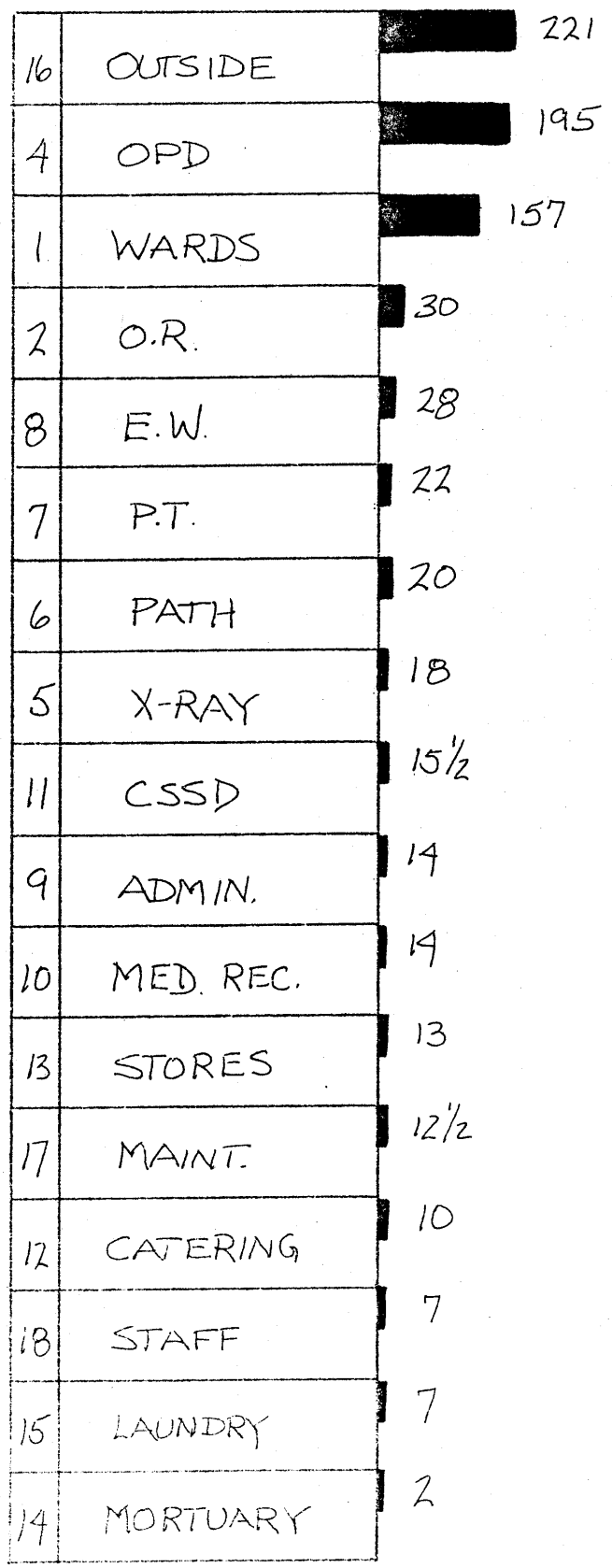


BAR CHARTS FROM: "TRAFFIC MOVEMENTS & THE INTER-RELATIONSHIP OF DEPARTMENTS," MINISTRY OF HEALTH, G.B., PP 10-39

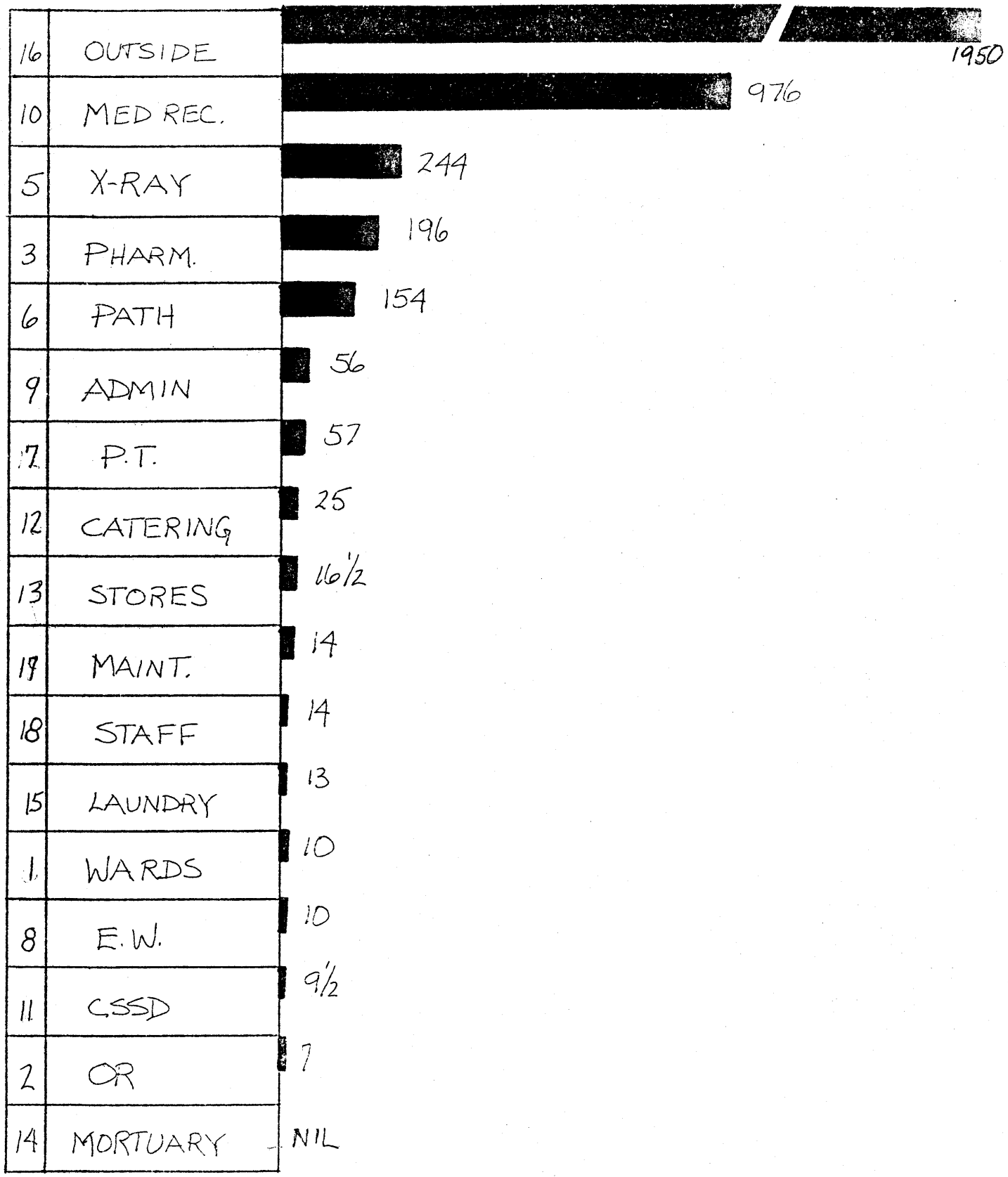
2. OPERATING ROOM



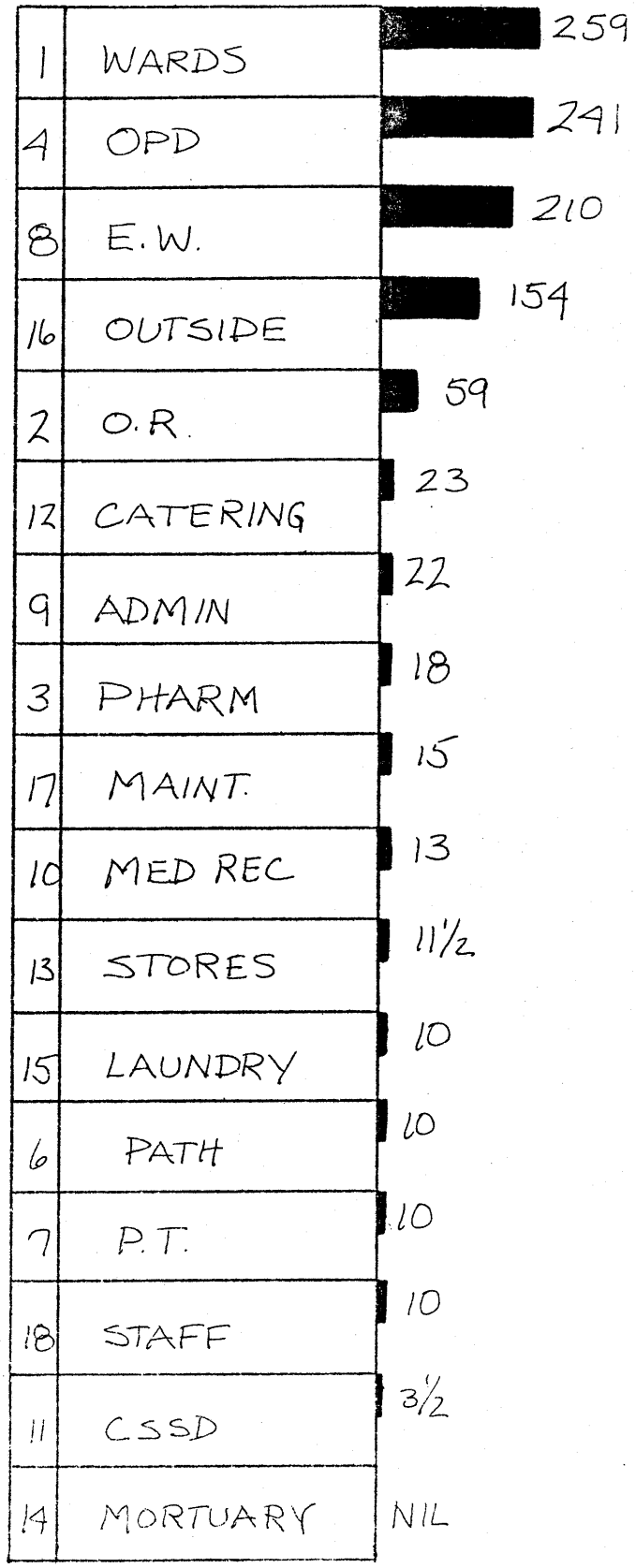
3. PHARMACY


16 OUTSIDE 221
4 OPD 195
1 WARDS 157
2 O.R. 30
8 E.W. 28
7 P.T. 22
6 PATH 20
5 X-RAY 18
11 CSSD 15½
9 ADMIN. 14
10 MED. REC. 14
13 STORES 13
17 MAINT. 12½
12 CATERING 10
18 STAFF 7
15 LAUNDRY 7
14 MORTUARY 2

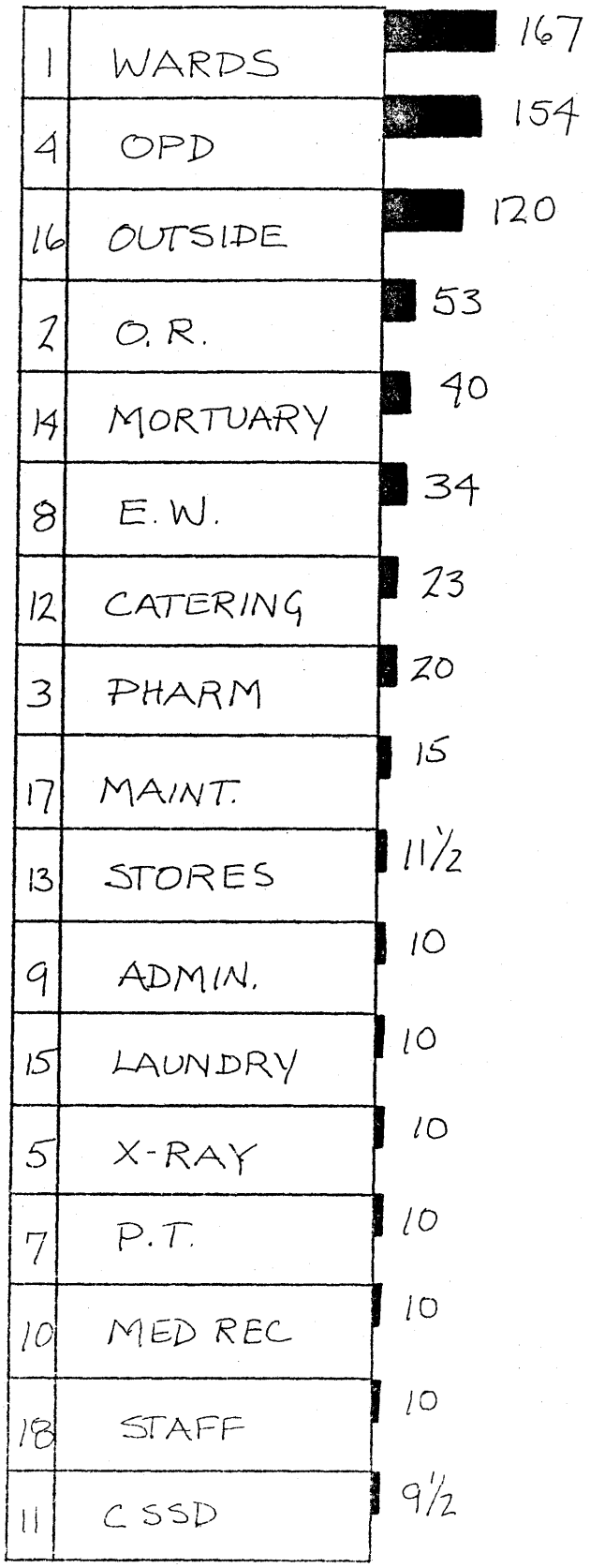
4. OUT-PATIENT DEPARTMENT



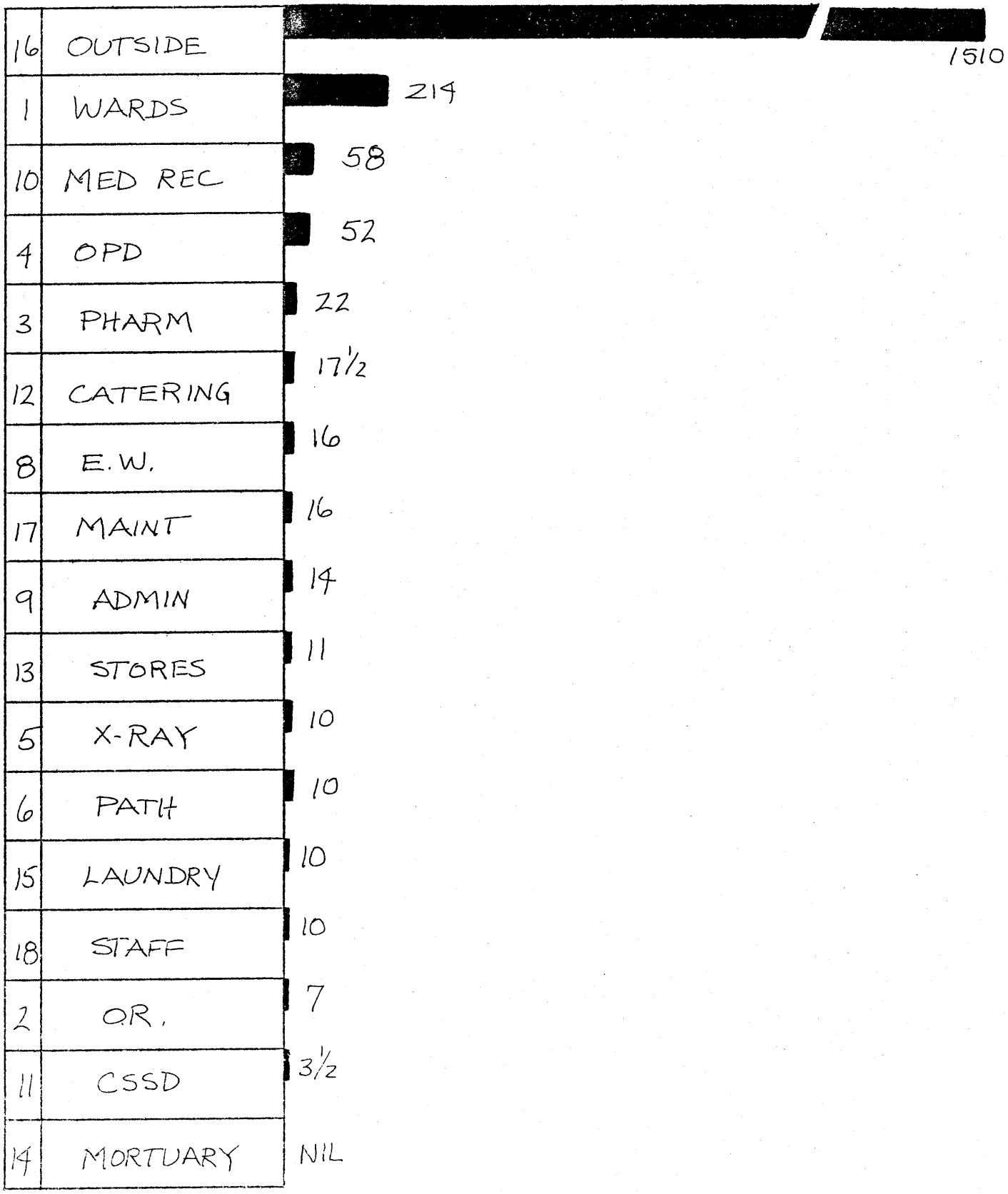
5. DIAGNOSTIC X-RAY



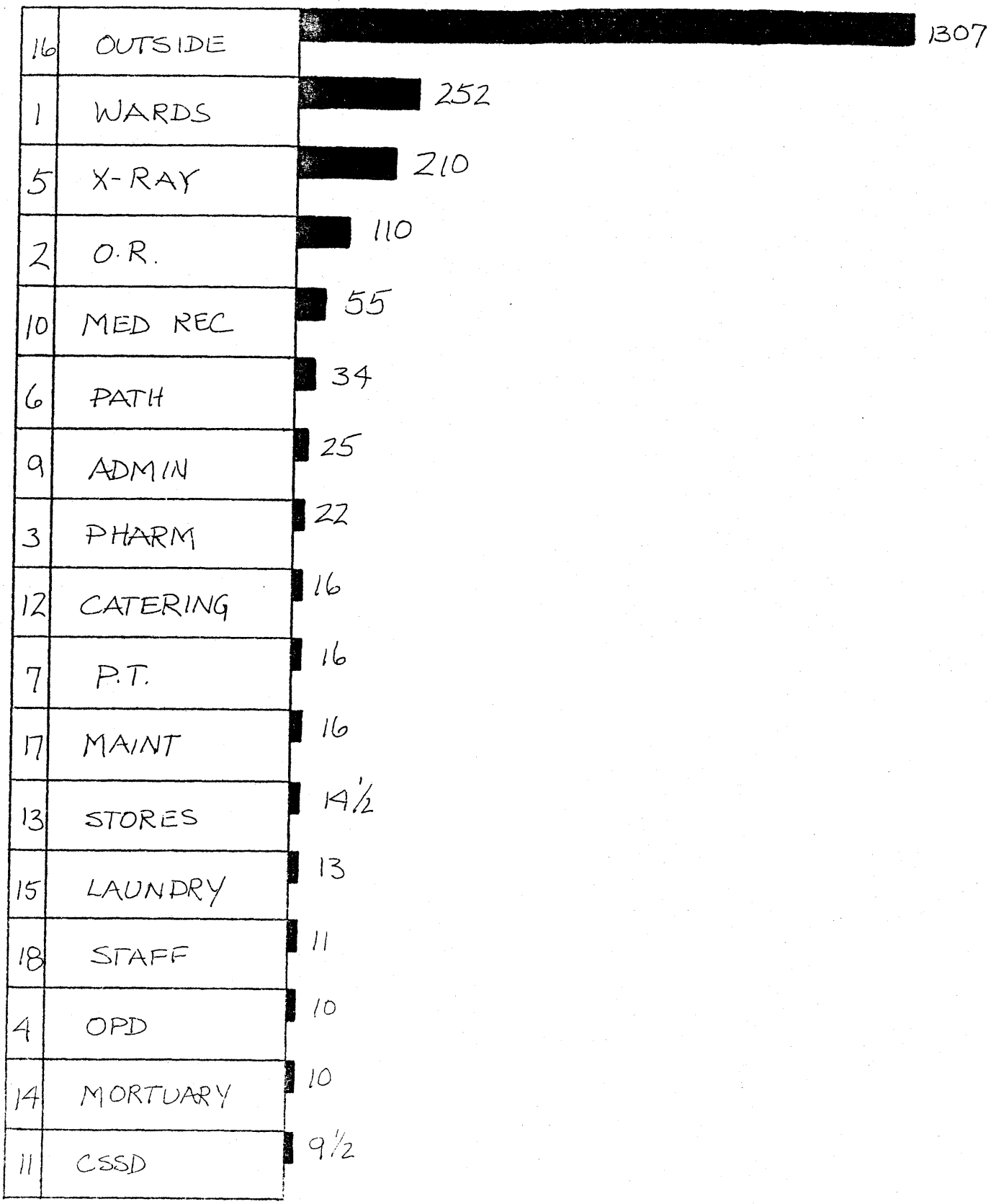
6. PATHOLOGY


1 WARDS 167
4 OPD 154
16 OUTSIDE 120
2 O.R. 53
14 MORTUARY 40
8 E.W. 34
12 CATERING 23
3 PHARM 20
17 MAINT. 15
13 STORES 11½
9 ADMIN. 10
15 LAUNDRY 10
5 X-RAY 10
7 P.T. 10
10 MED REC 10
18 STAFF 10
11 C SSD 9½

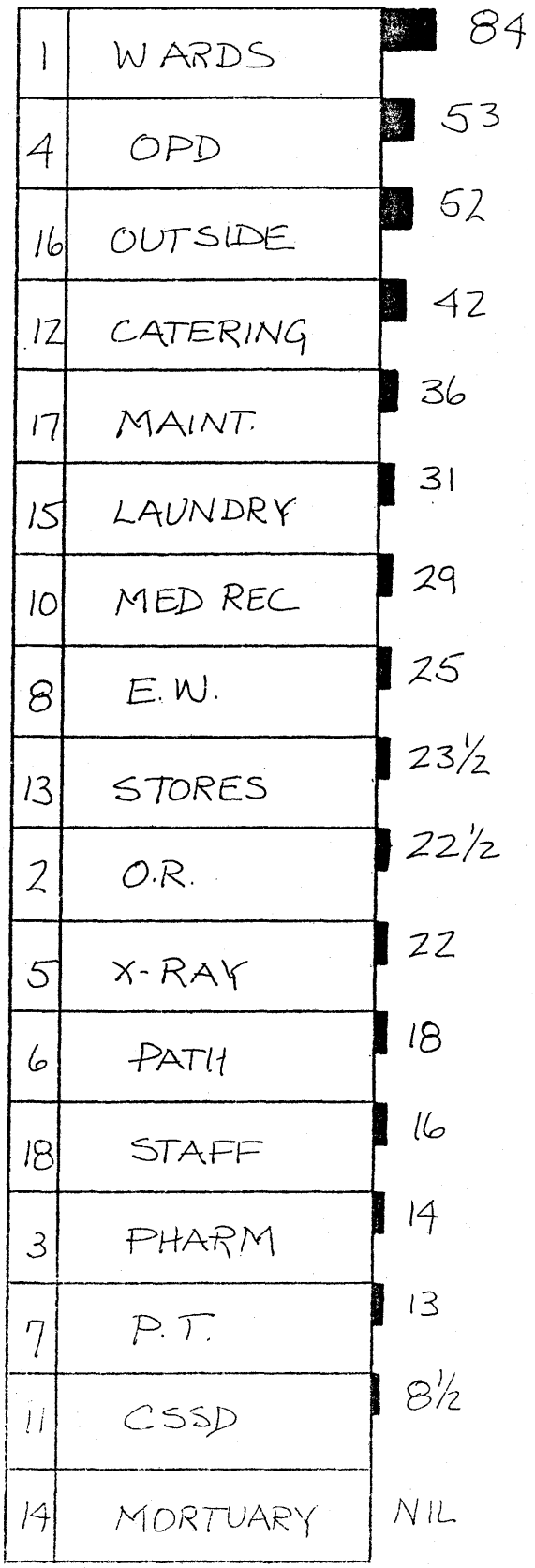
7. PHYSICAL THERAPY



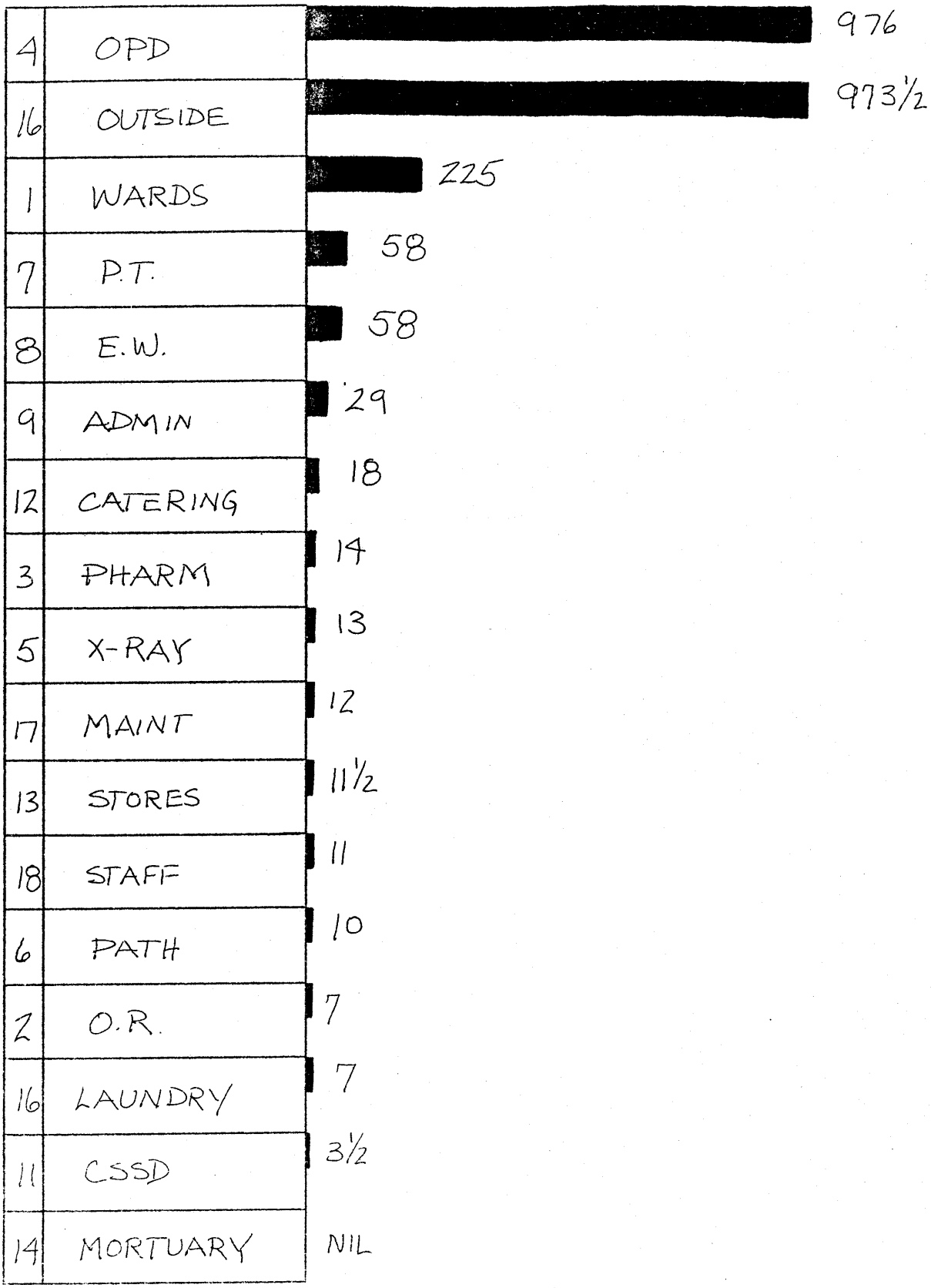
8. EMERGENCY WARD



9. ADMINISTRATIVE OFFICES



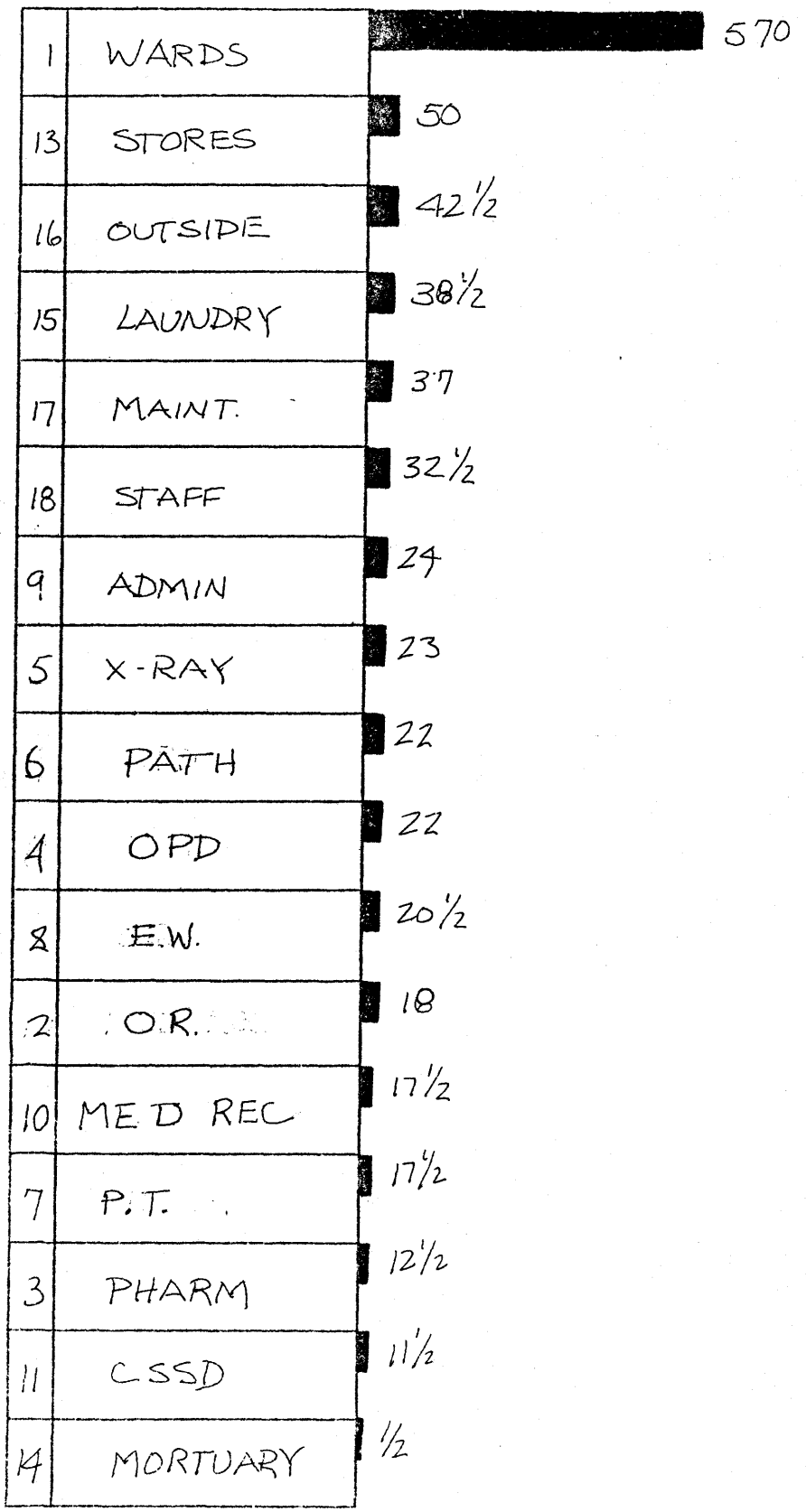
10. MEDICAL RECORDS



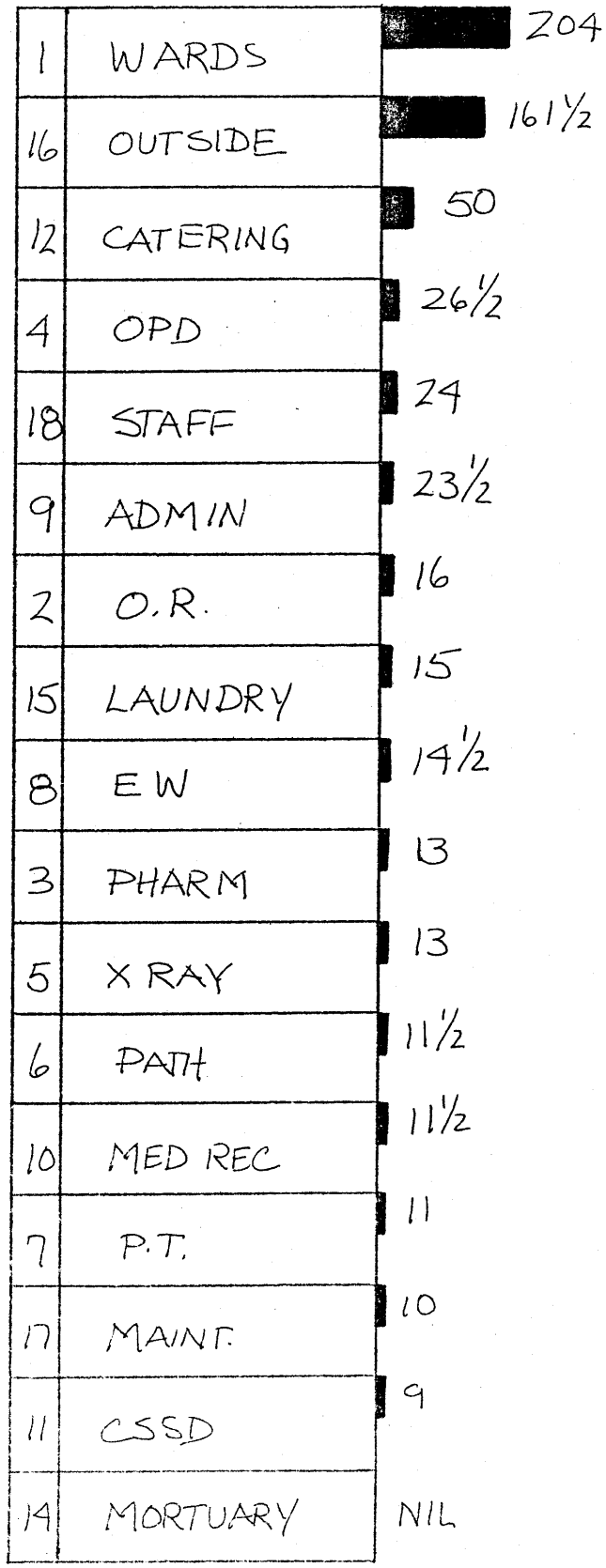
11. CENTRAL STERILE SUPPLY DEP'T.

1	WARDS	45½
2	O.R.	15½
3	PHARM	15½
15	LAUNDRY	15
12	CATERING	11½
17	MAINT.	10
4	OPD	9½
6	PATH	9½
8	E.W.	9½
13	STORES	9
9	ADMIN	8½
18	STAFF	7
5	X-RAY	3½
7	P.T.	3½
10	MED REC	3½
16	OUTSIDE	3
14	MORTUARY	NIL

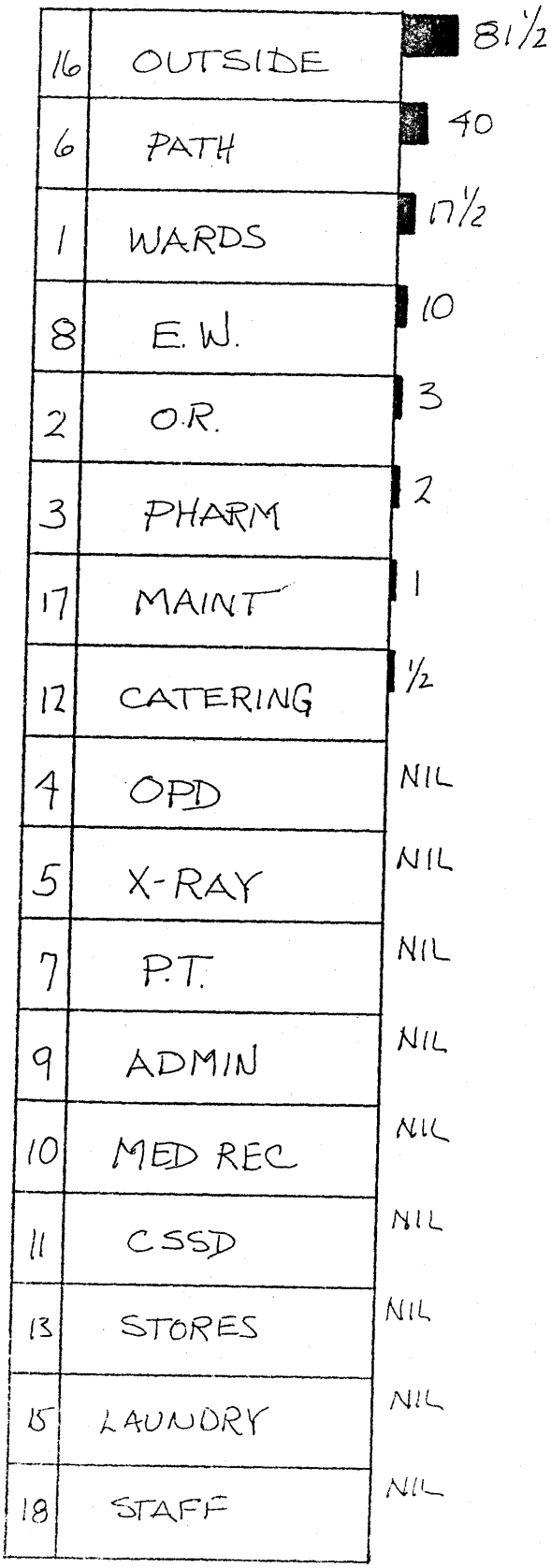
12. CATERING


1 WARDS 570
13 STORES 50
16 OUTSIDE 42½
15 LAUNDRY 38½
17 MAINT. 37
18 STAFF 32½
9 ADMIN 24
5 X-RAY 23
6 PATH 22
4 OPD 22
8 E.W. 20½
2 O.R. 18
10 MED REC 17½
7 P.T. 17½
3 PHARM 12½
11 CSSD 11½
14 MORTUARY ½

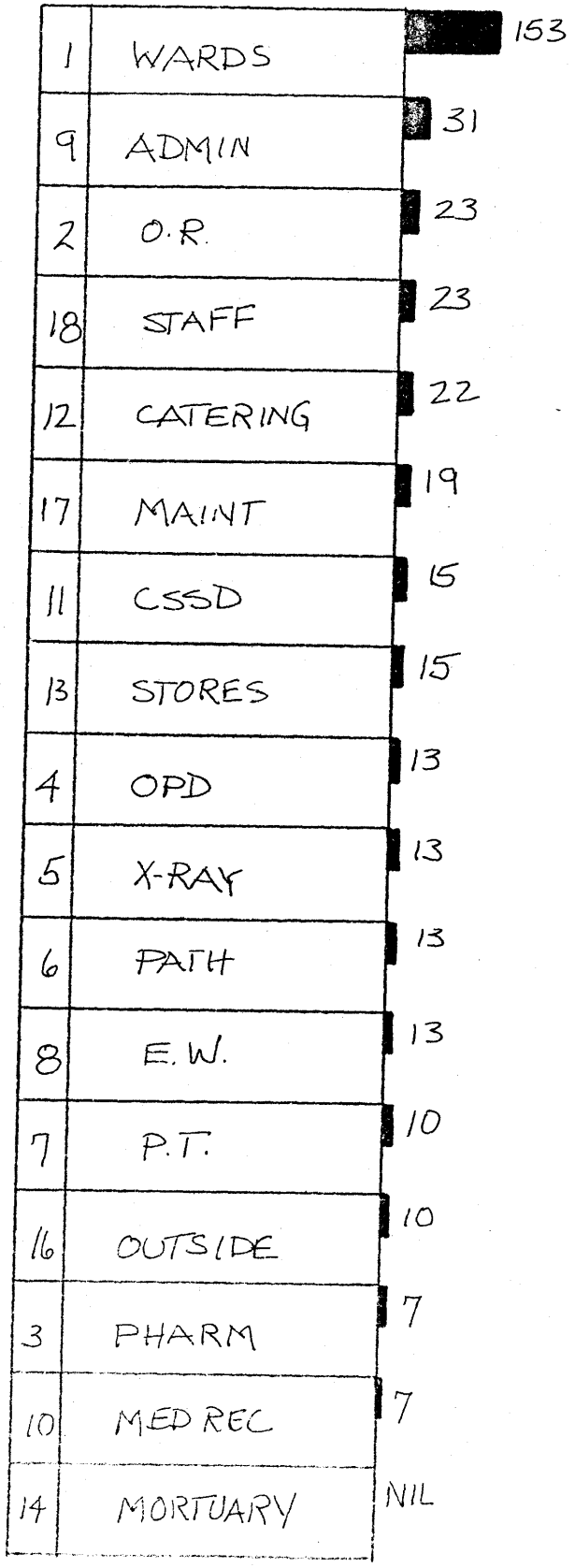
13. STORES


1 WARDS 204
16 OUTSIDE 161½
12 CATERING 50
4 OPD 26½
18 STAFF 24
9 ADMIN 23½
2 O.R. 16
15 LAUNDRY 15
8 E W 14½
3 PHARM 13
5 X RAY 13
6 PATH 11½
10 MED REC 11½
7 P.T. 11
17 MAINT. 10
11 CSSD 9
14 MORTUARY NIL

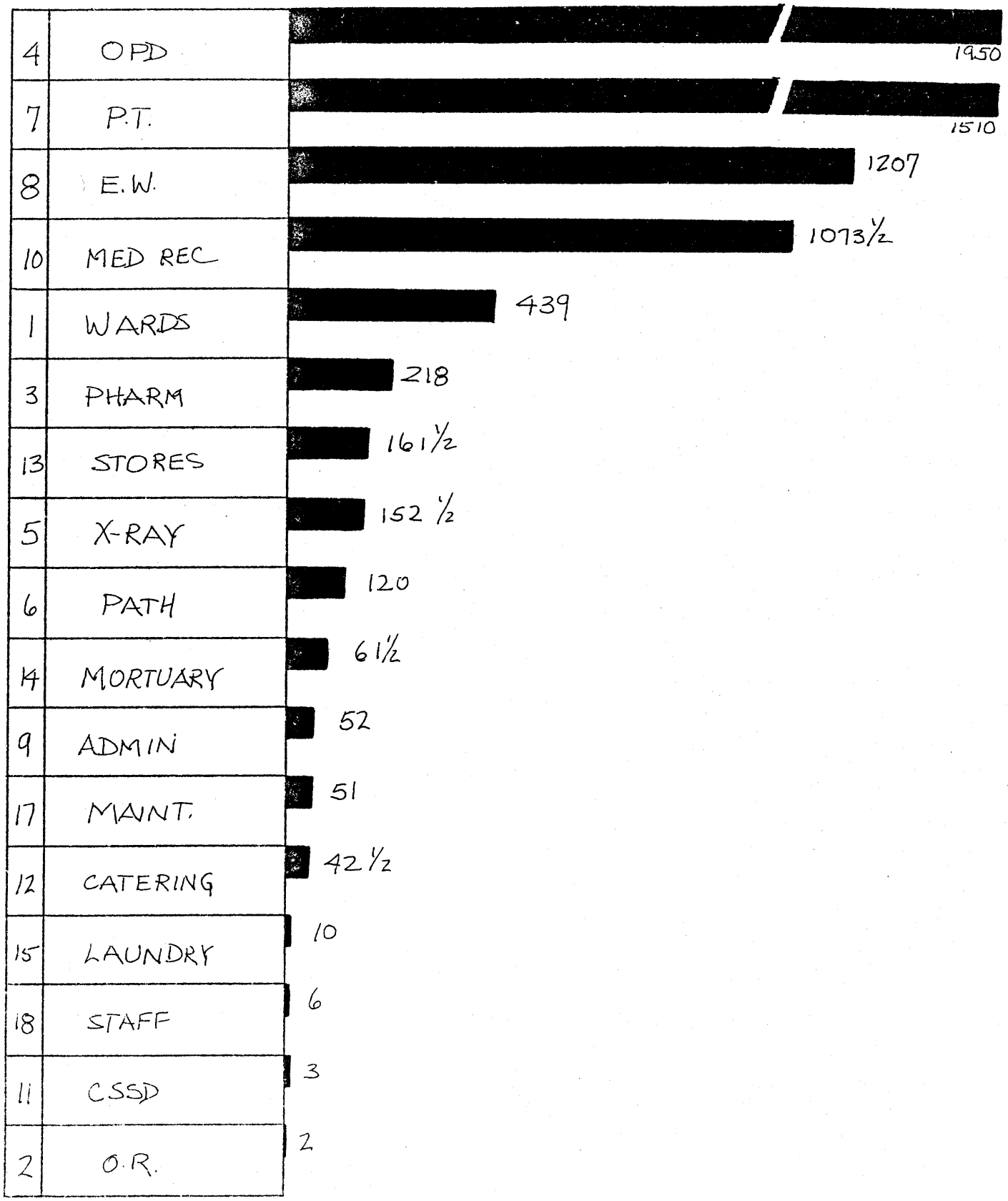
14 MORTUARY


16 OUTSIDE 81½
6 PATH 40
1 WARDS 17½
8 E.W. 10
2 O.R. 3
3 PHARM 2
17 MAINT 1
12 CATERING ½
4 OPD NIL
5 X-RAY NIL
7 P.T. NIL
9 ADMIN NIL
10 MED REC NIL
11 CSSD NIL
13 STORES NIL
15 LAUNDRY NIL
18 STAFF NIL

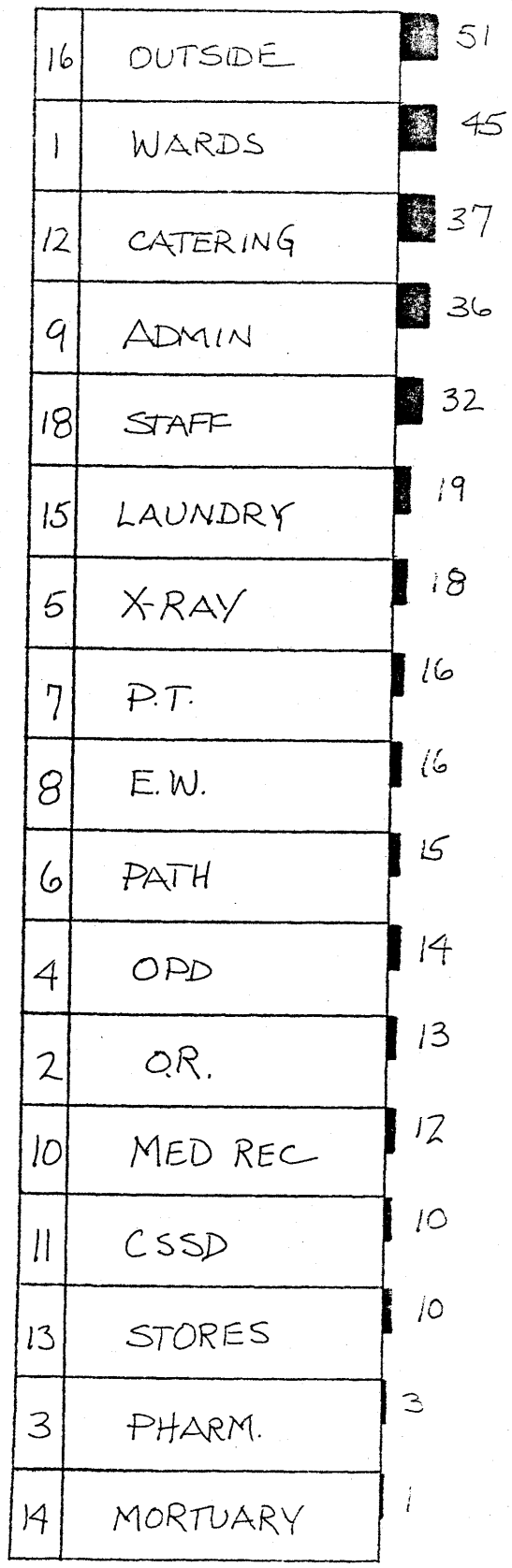
15. LAUNDRY


1 WARDS 153
9 ADMIN 31
2 O.R. 23
18 STAFF 23
12 CATERING 22
17 MAINT 19
11 CSSD 15
13 STORES 15
4 OPD 13
5 X-RAY 13
6 PATH 13
8 E.W. 13
7 P.T. 10
16 OUTSIDE 10
3 PHARM 7
10 MED REC 7
14 MORTUARY NIL

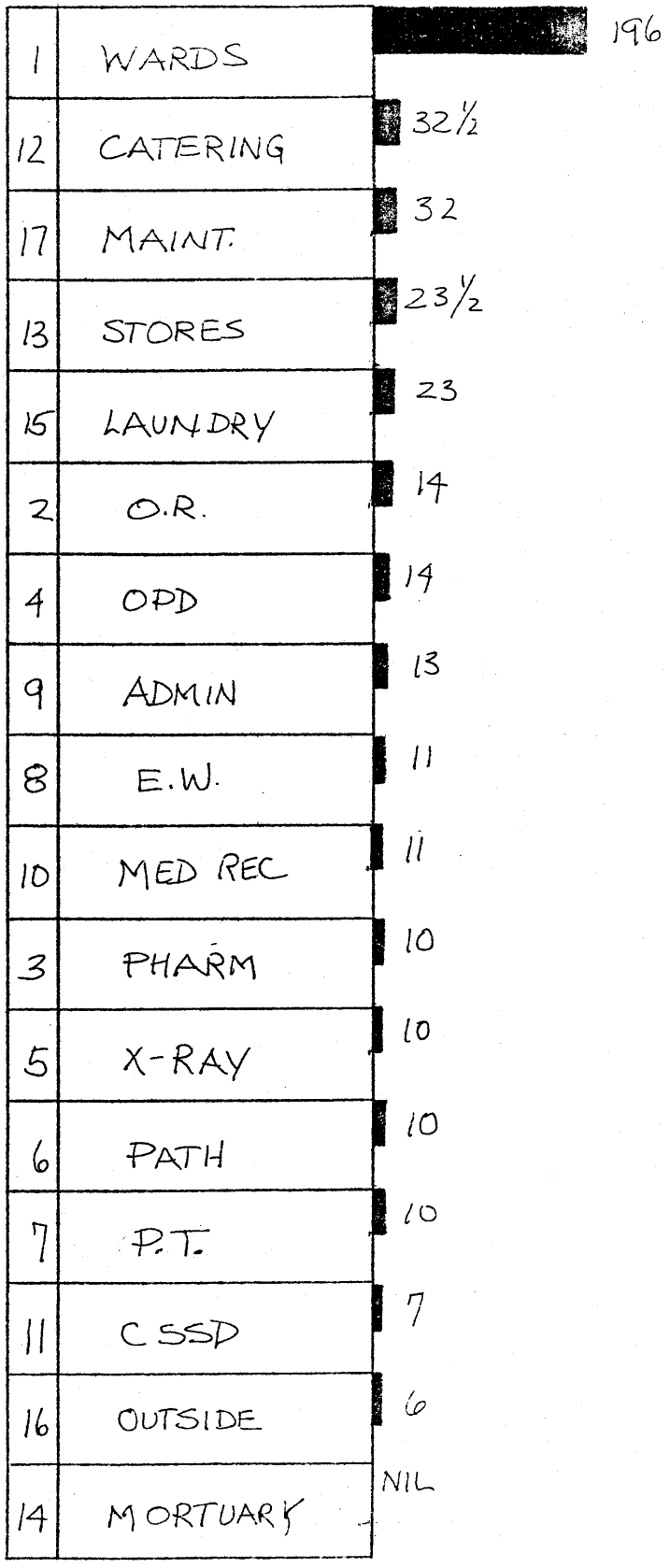
16. OUTSIDE THE HOSPITAL



17. MAINTENANCE SERVICES



18. STAFF ACCOMMODATION



APPENDIX C:

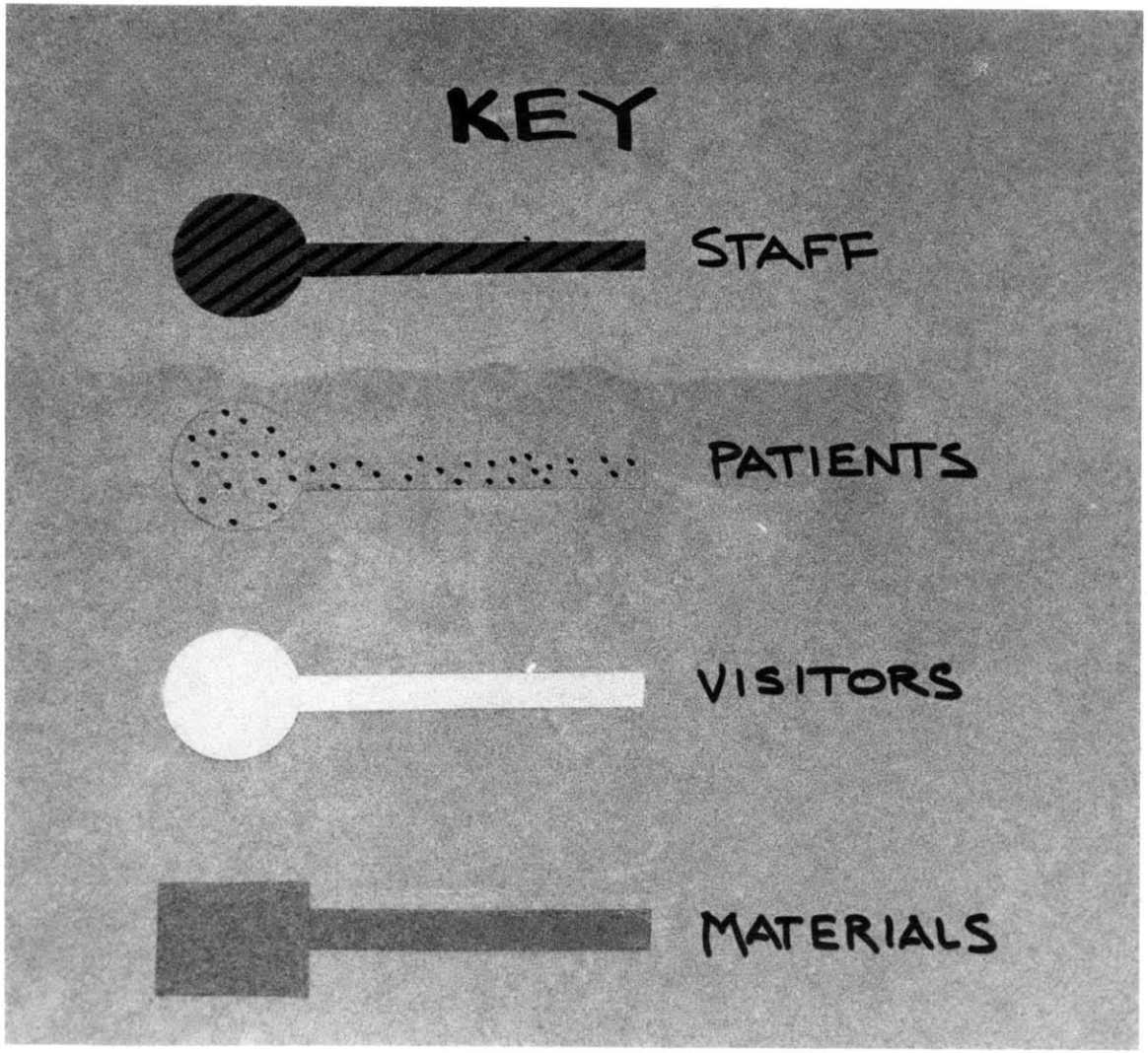
KEY FOR ACETATE SHEETS

PHOTOGRAPHS OF STYROFOAM MODEL "A"

PHOTOGRAPHS OF ACETATE SHEET PLANS & SECTIONS, MODEL "A"

PHOTOGRAPHS OF STYROFOAM MODEL "B"

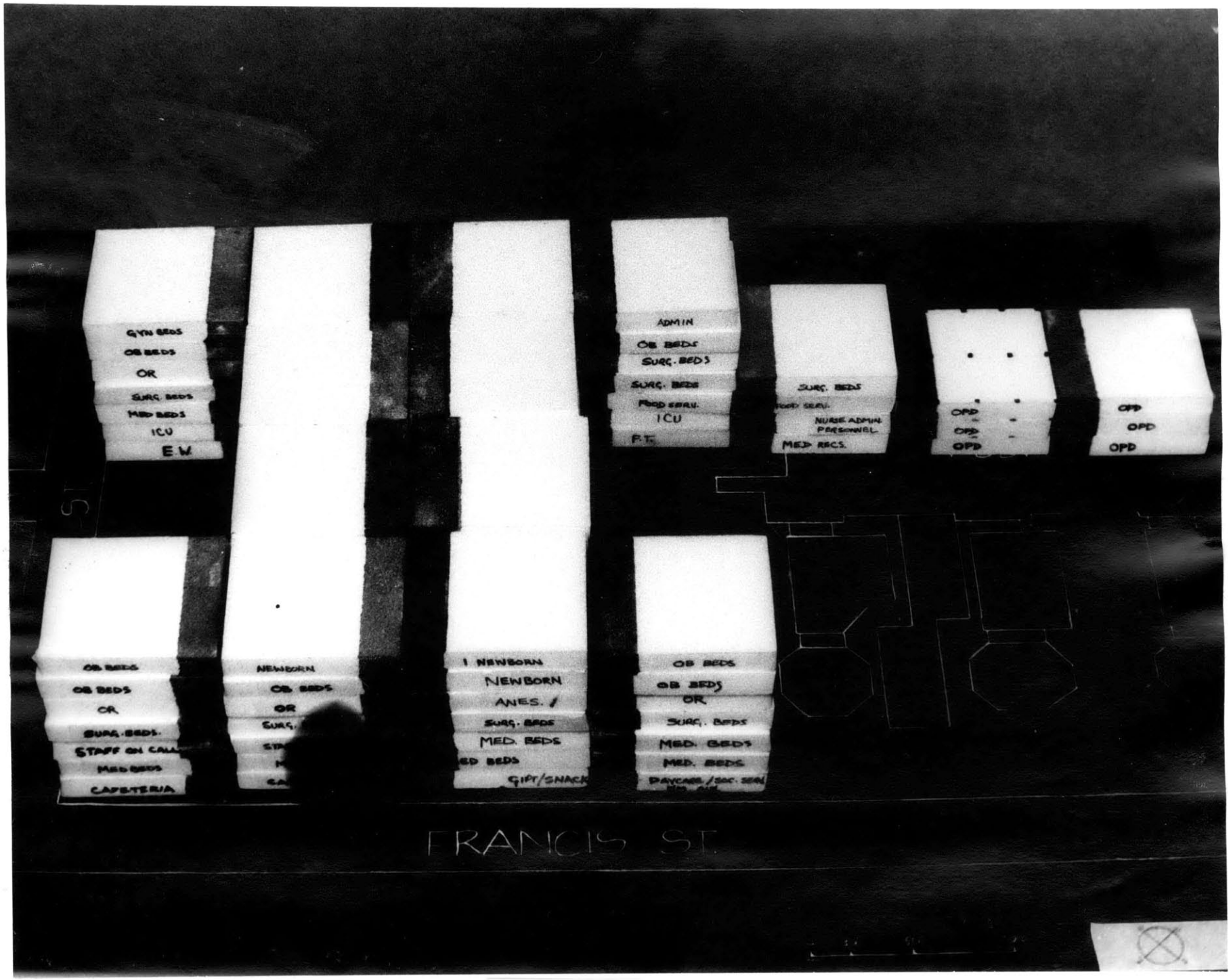
PHOTOGRAPHS OF ACETATE SHEET PLANS & SECTIONS, MODEL "B"



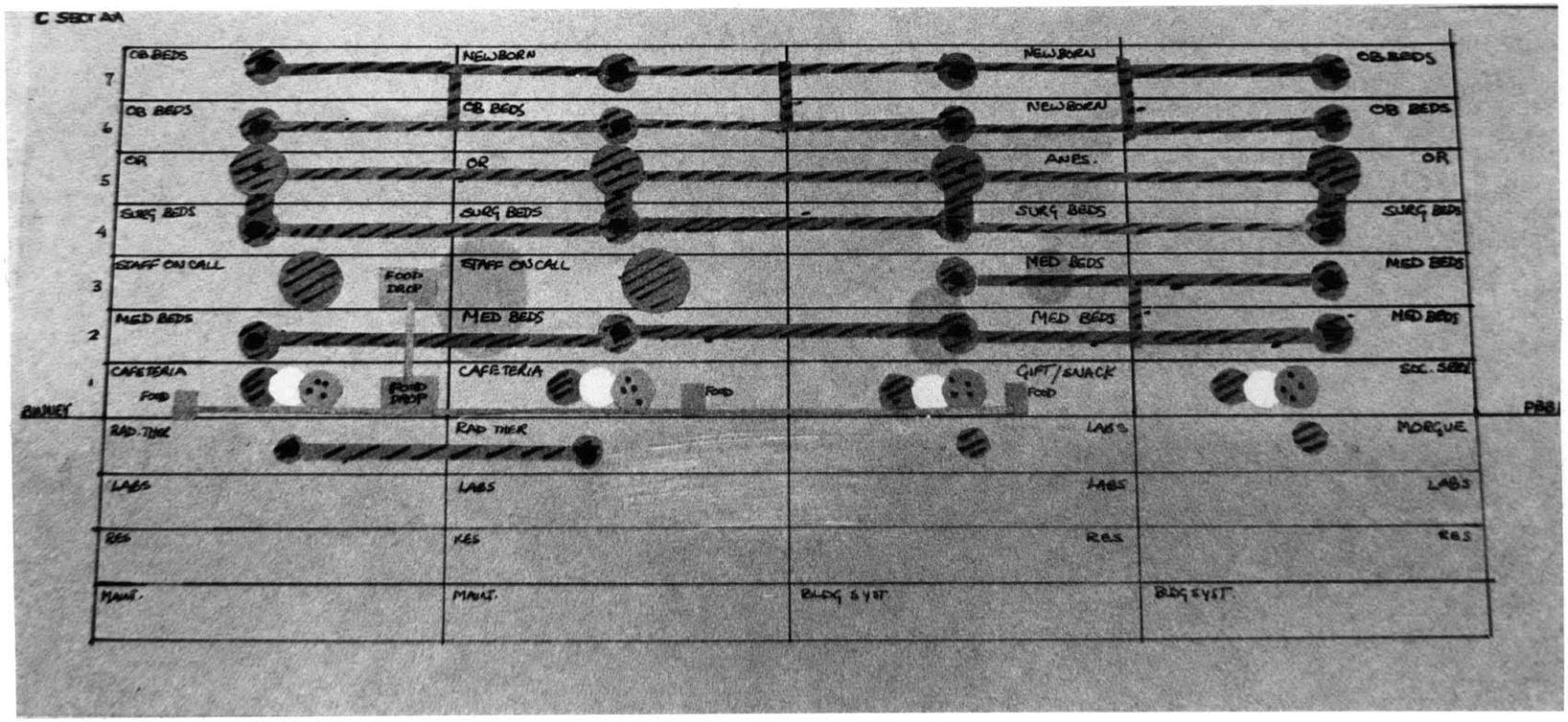
KEY TO ACETATE SHEETS


OB BEDS
OB BEDS
OR
SURG. BEDS.
STAFF ON CALL
MED BEDS
CAFETERIA
NEWBORN
OB BEDS
OR
SURG. BEDS
STAFF-ON-CALL
MED BEDS
CAFETERIA
NEWBORN
NEWBORN
ANES.
SURG. BEDS
MED BEDS
MED BEDS
GIFT/SNACK
OB BEDS
OB BEDS
OR
SURG. BEDS
MED. BEDS
MED. BEDS
DAYCARE/SOC. SERV
NM. AUX.
SURG. BEDS
SERV.
NURSE ADMIN PERSONNEL
ED RECS.
OPD
OPD
OPD
OPD
OPD
OPD

MODEL "A"

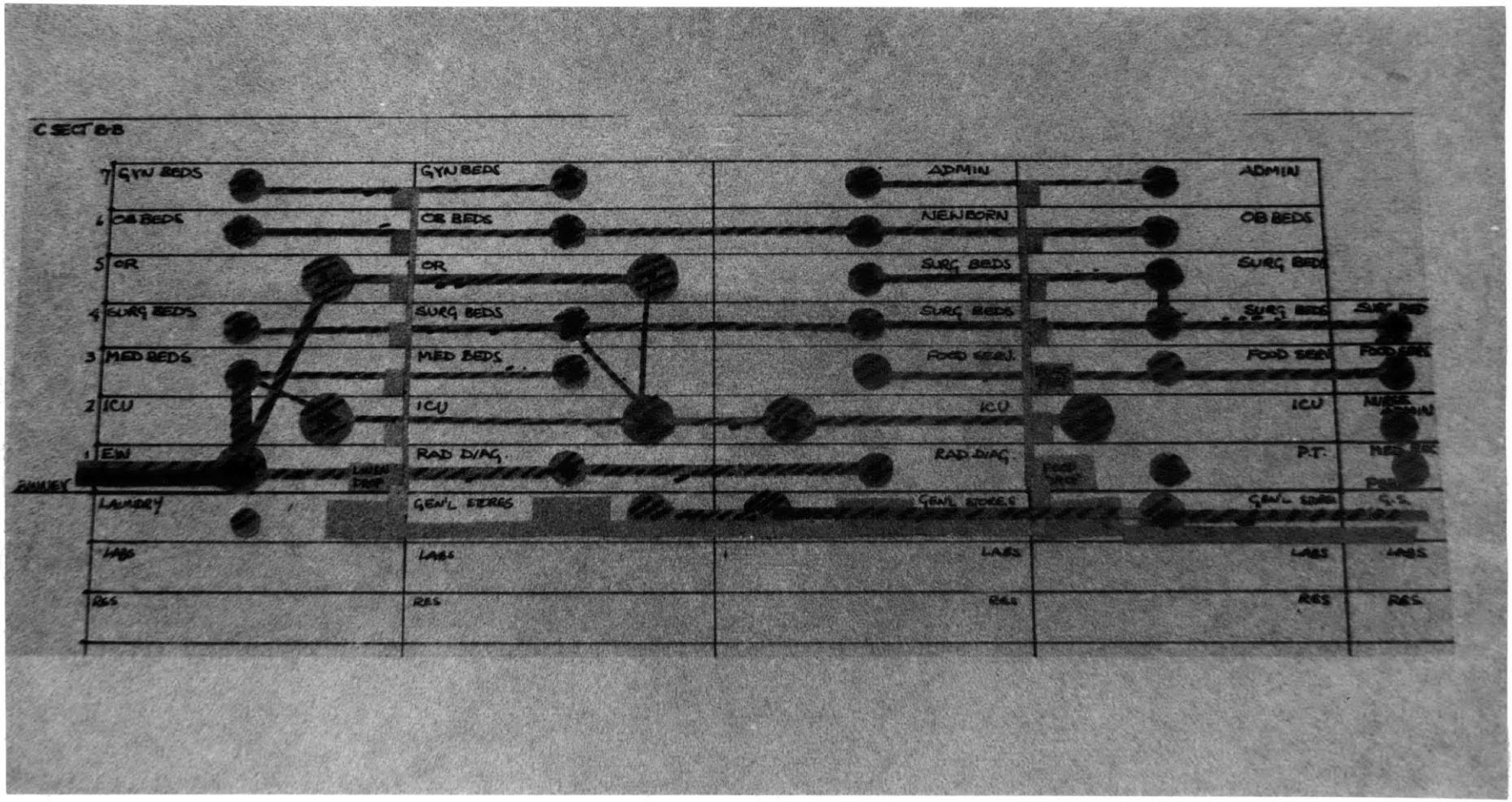

GYN BEDS
OB BEDS
OR
SURG BEDS
MED BEDS
ICU
E.W.
ADMIN
OB BEDS
SURG. BEDS
SURG. BEDS
ICU
F.T.
SURG. BEDS
NURSE ADMIN.
PERSONNEL
MED RECS.
OPD
OPD
OPD
OPD
OPD
OPD
OB BEDS
OB BEDS
OR
SURG. BEDS.
STAFF ON CALL
MED BEDS
CAFETERIA
NEWBORN
OB BEDS
OR
1 NEWBORN
NEWBORN
ANES. /
SURG. BEDS
MED. BEDS
GIFT/SNACK
OB BEDS
OB BEDS
OR
SURG. BEDS
MED. BEDS
MED. BEDS
FRANCIS ST.

MODEL "A"

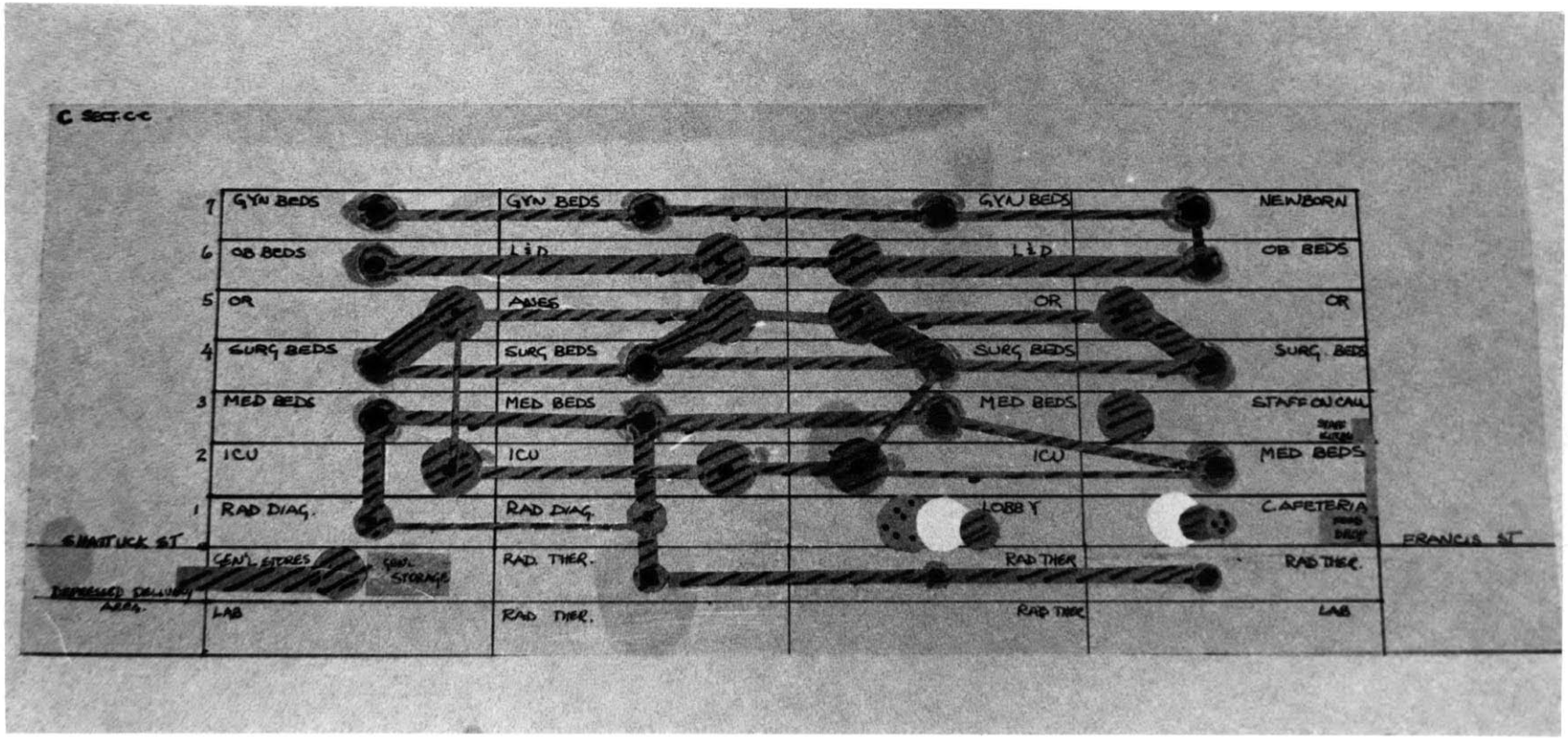


SECTION A-A, MODEL "A"

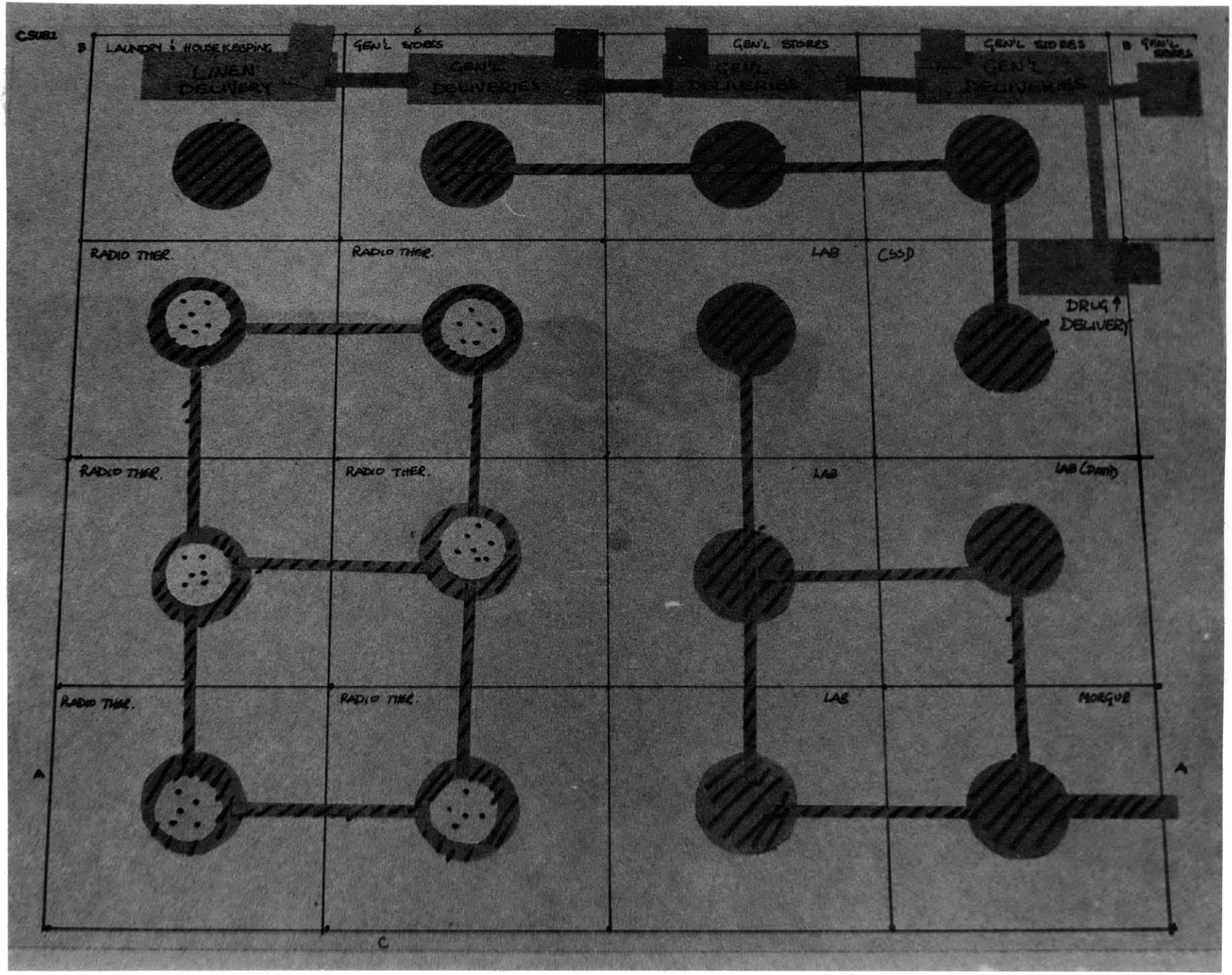
VISITORS CIRCULATE THROUGHOUT HOSPITAL, EXCEPT IN O.R. SUITE OR L&D SUITE; THEY ARE OMMITTED FROM SECTIONS FOR SIMPLIFICATION. PATIENTS MOVE WITH STAFF EXCEPT WHERE INDICATED (NO BLUE (DARK) CIRCLE INSIDE RED (STRIPED) CIRCLE).



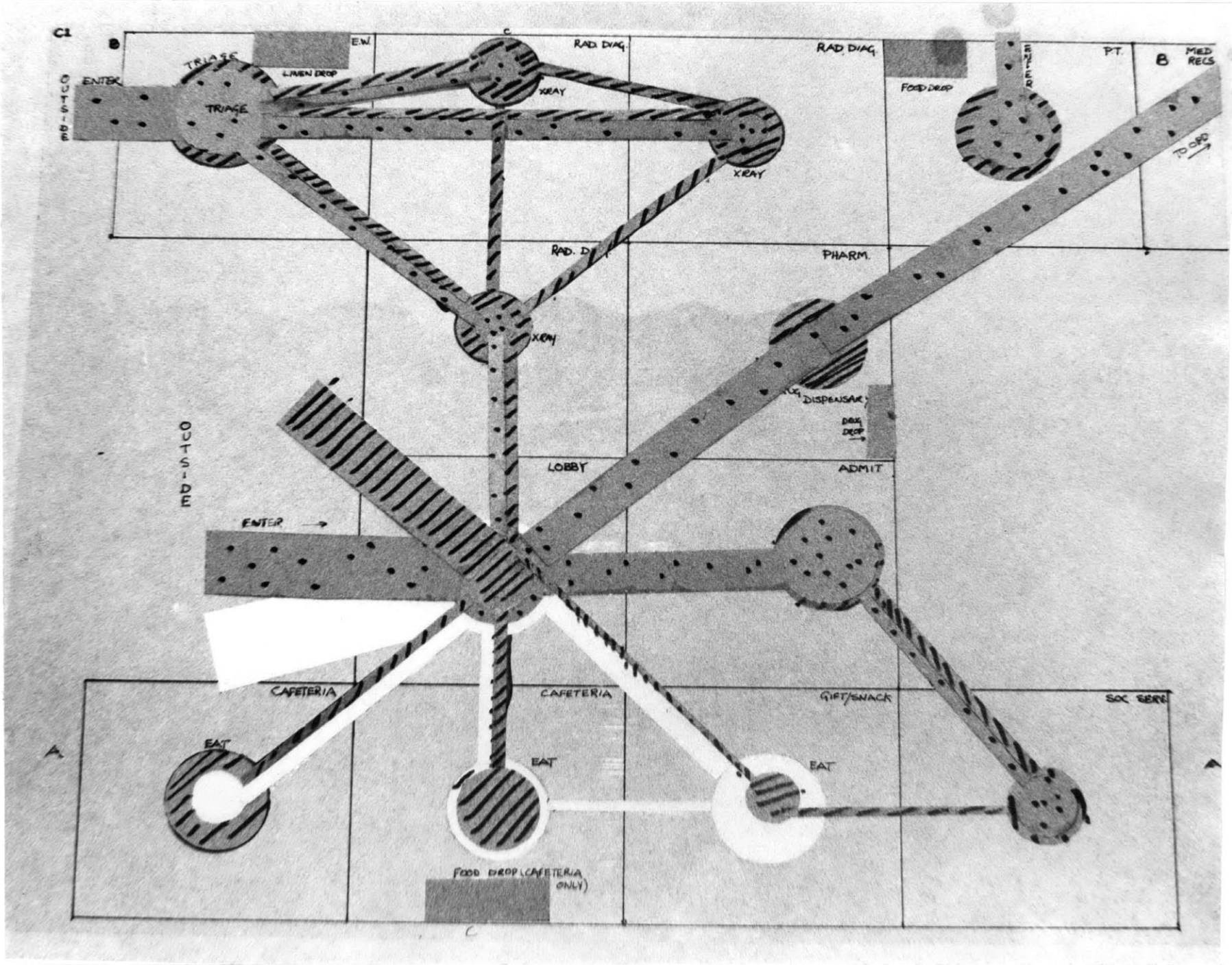
SECTION B-B, MODEL "A"

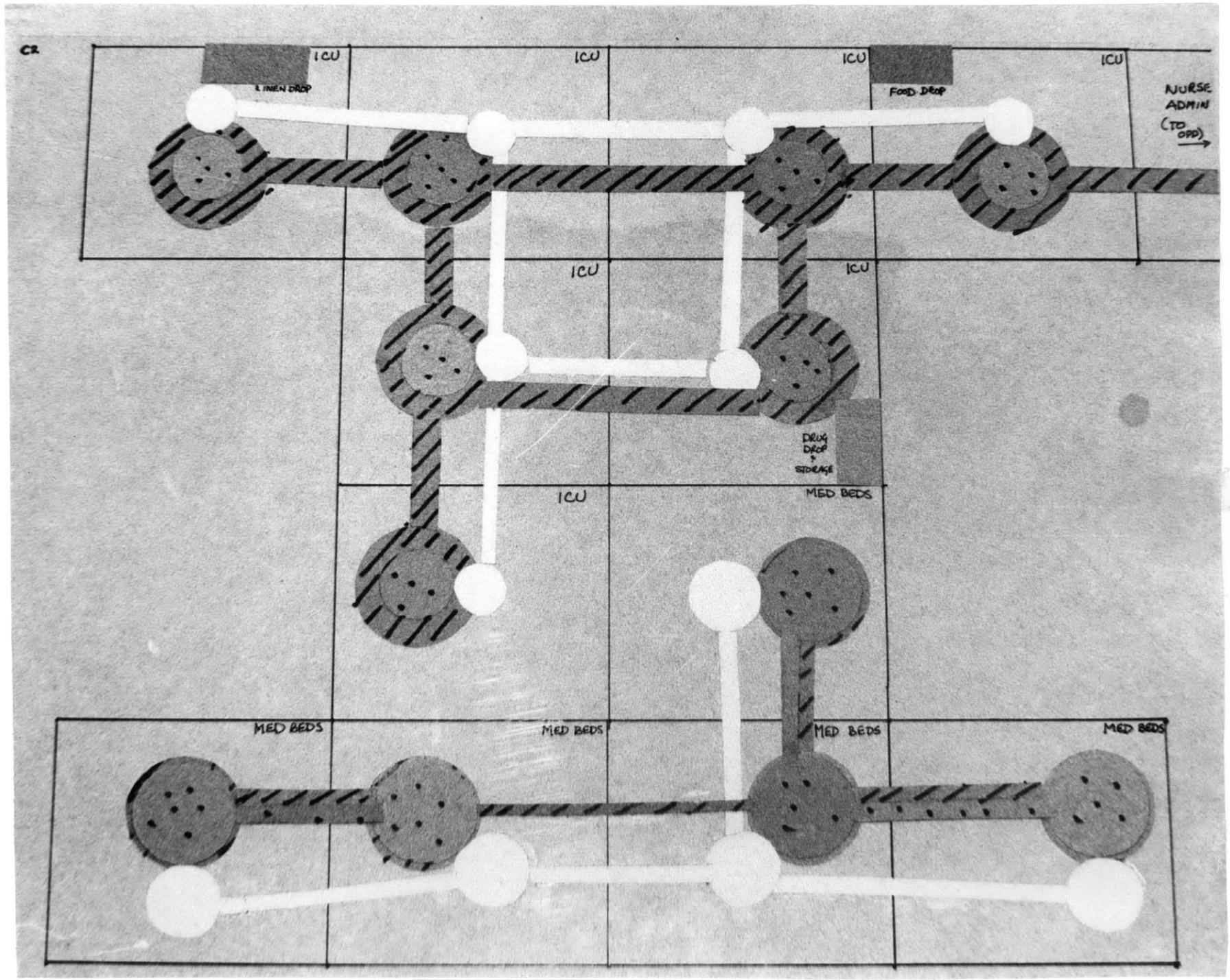


SECTION C-C, MODEL "A"

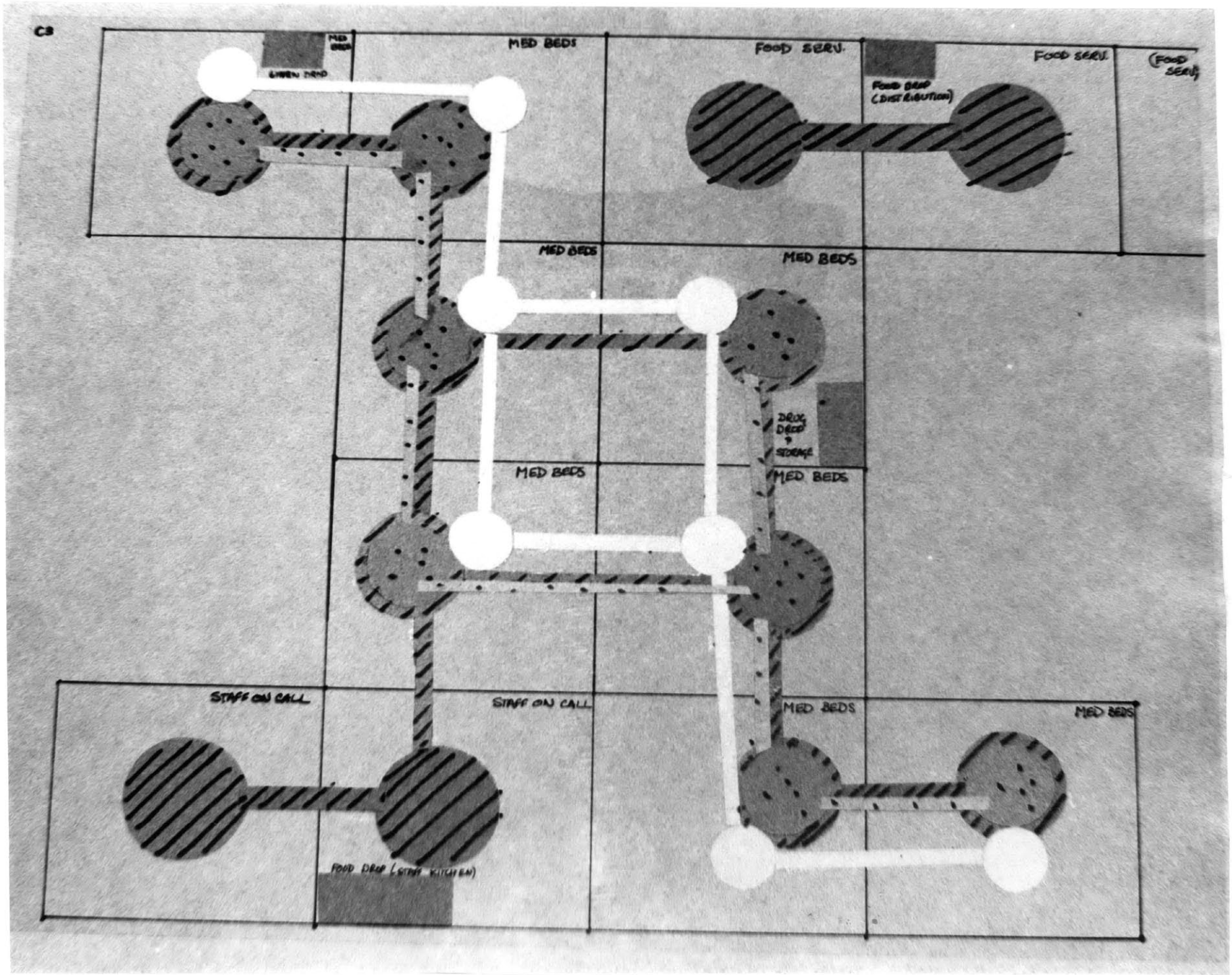


FIRST BASEMENT, MODEL "A"

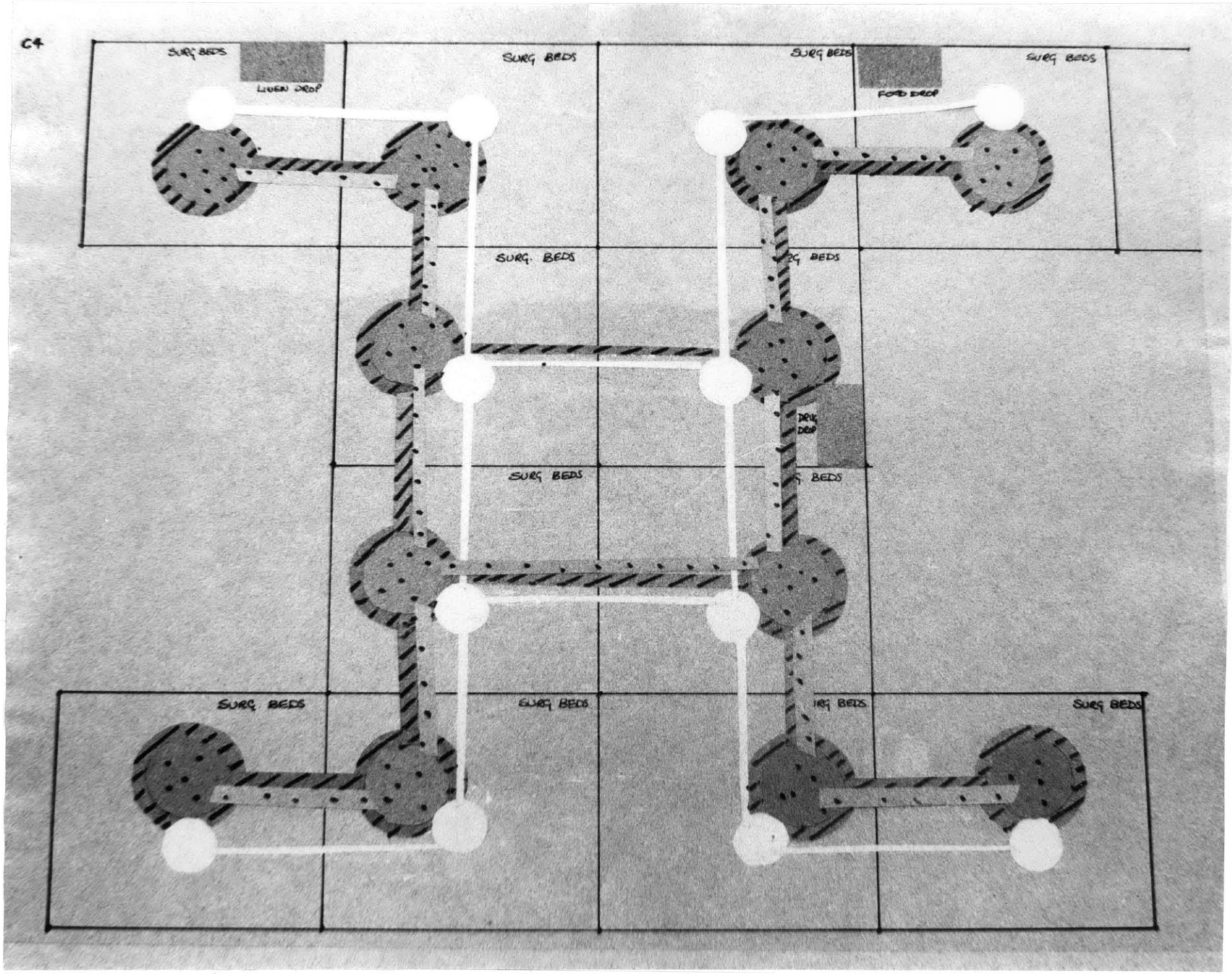

C1
B
C
OUTSIDE
ENTER
TRIAGE
TRIAGE
E.W.
LINEN DROP
RAD. DIAG.
XRAY
XRAY
RAD. DIAG.
FOOD DROP
ENTER
P.T.
B
MED RECS
TO OPD
RAD. D
XRAY
PHARM.
DISPENSARY
DRUG DROP
OUTSIDE
LOBBY
ADMIT
ENTER
CAFETERIA
CAFETERIA
GIFT/SNACK
SOC SERV
EAT
EAT
EAT
FOOD DROP (CAFETERIA ONLY)
A
A
C



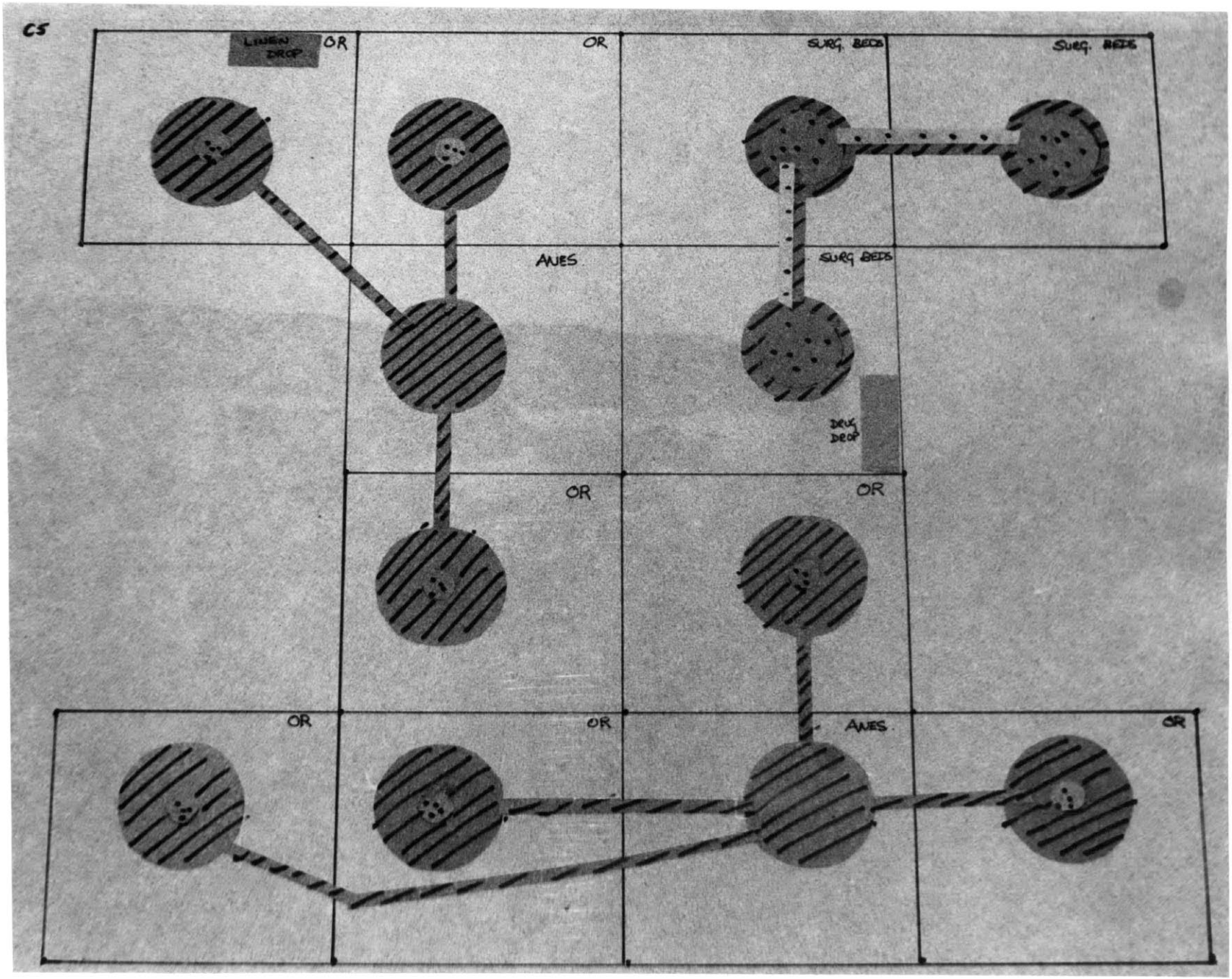
SECOND FLOOR, MODEL "A"



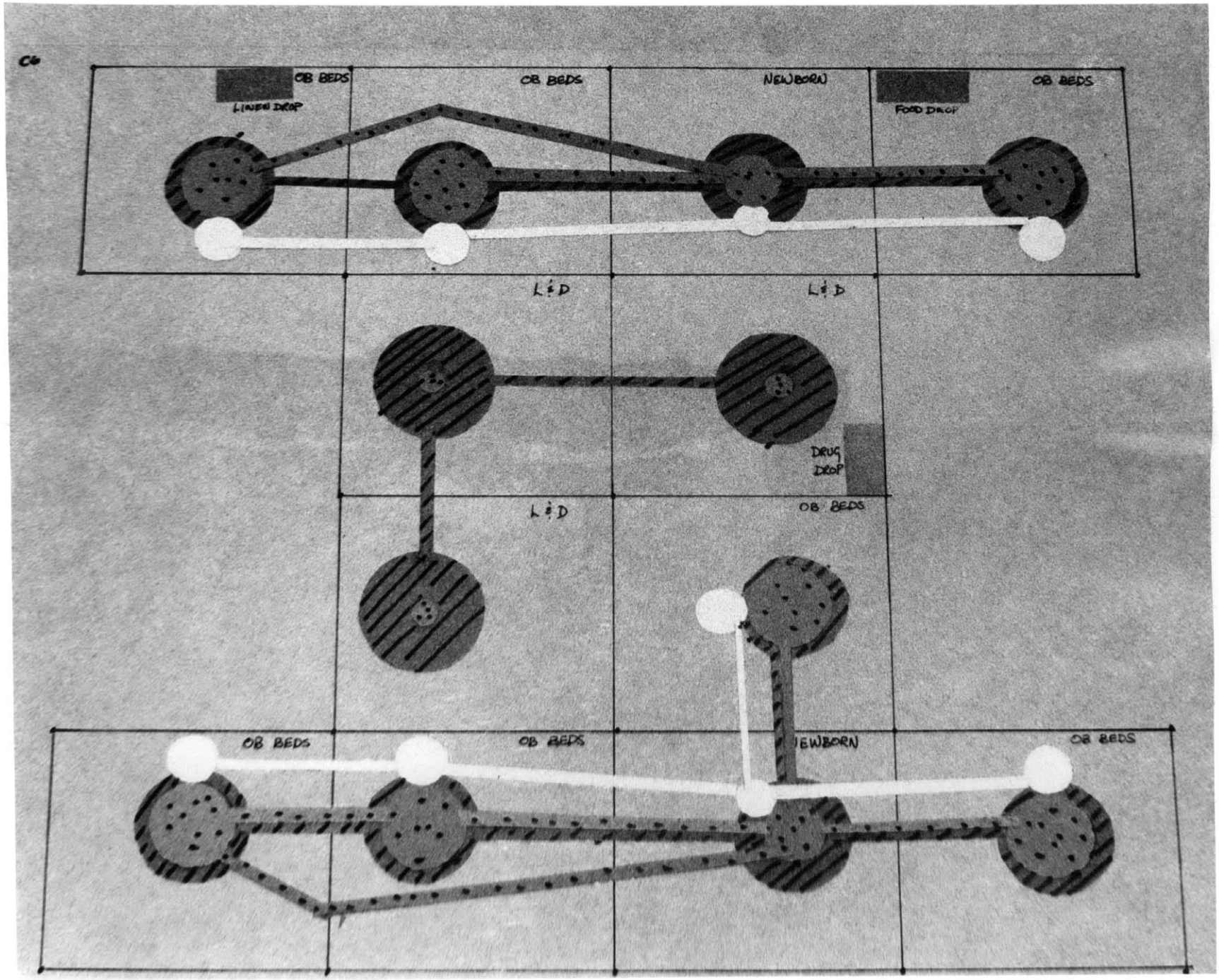
THIRD FLOOR, MODEL "A"



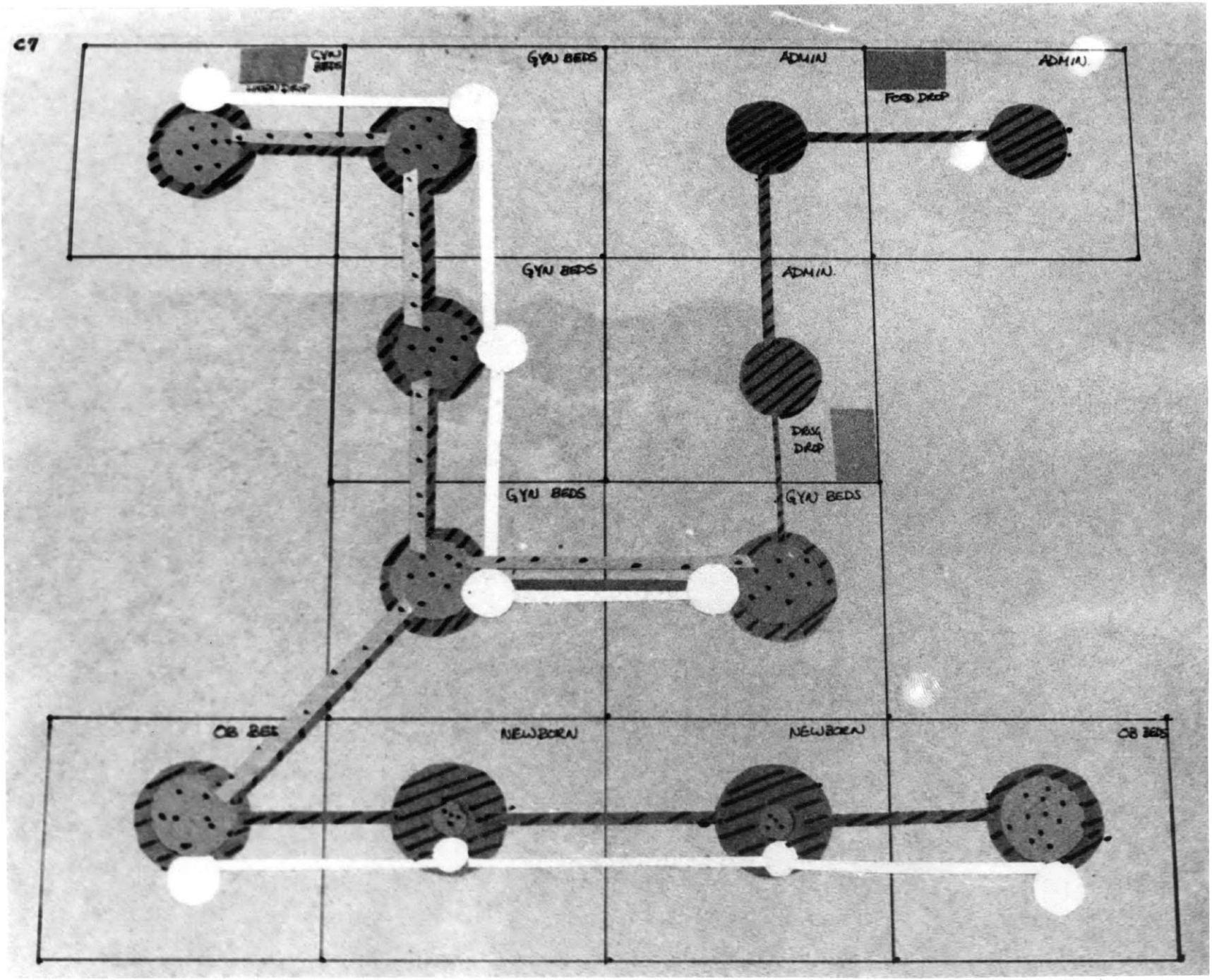
FOURTH FLOOR, MODEL "A"



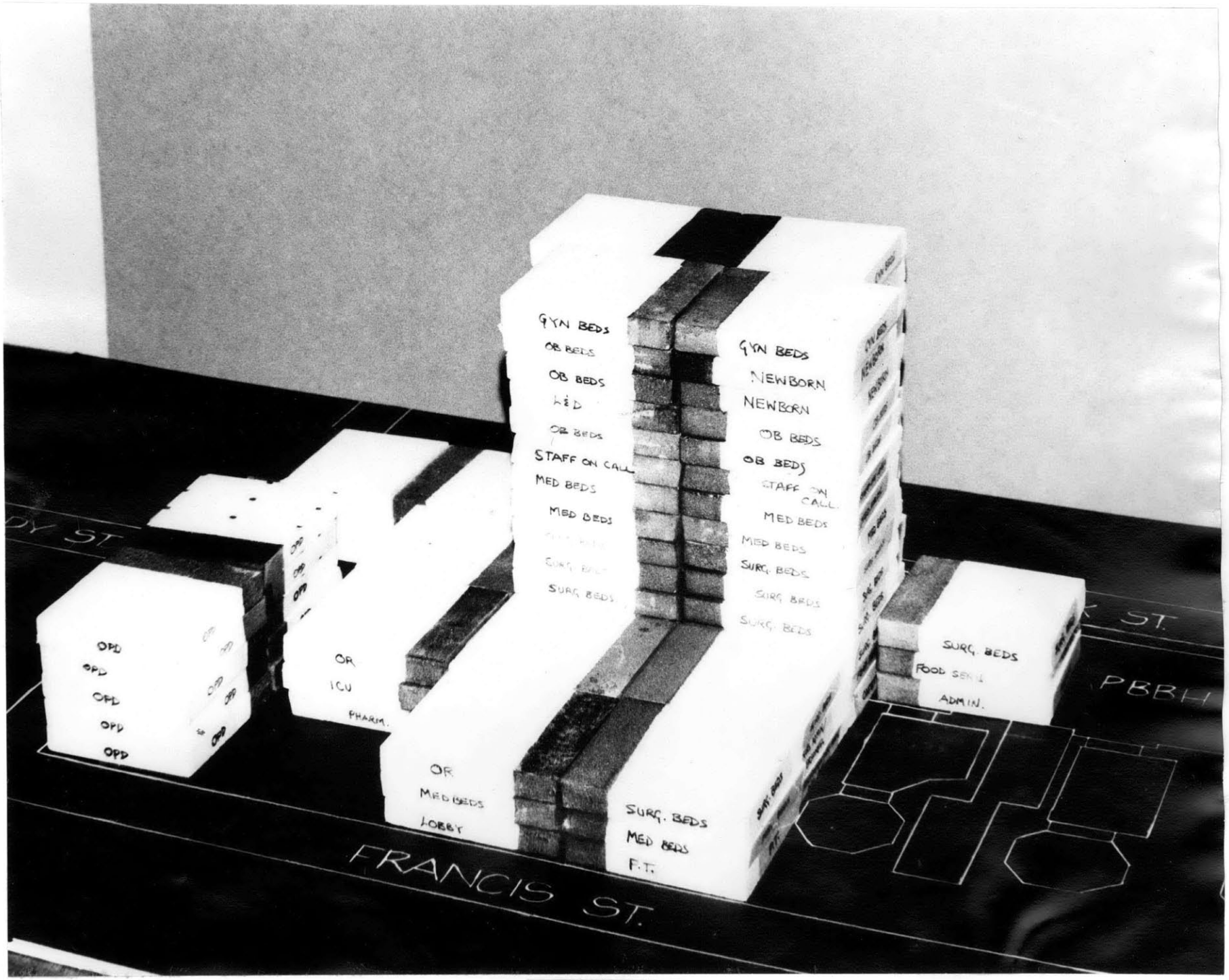
FIFTH FLOOR, MODEL "A"



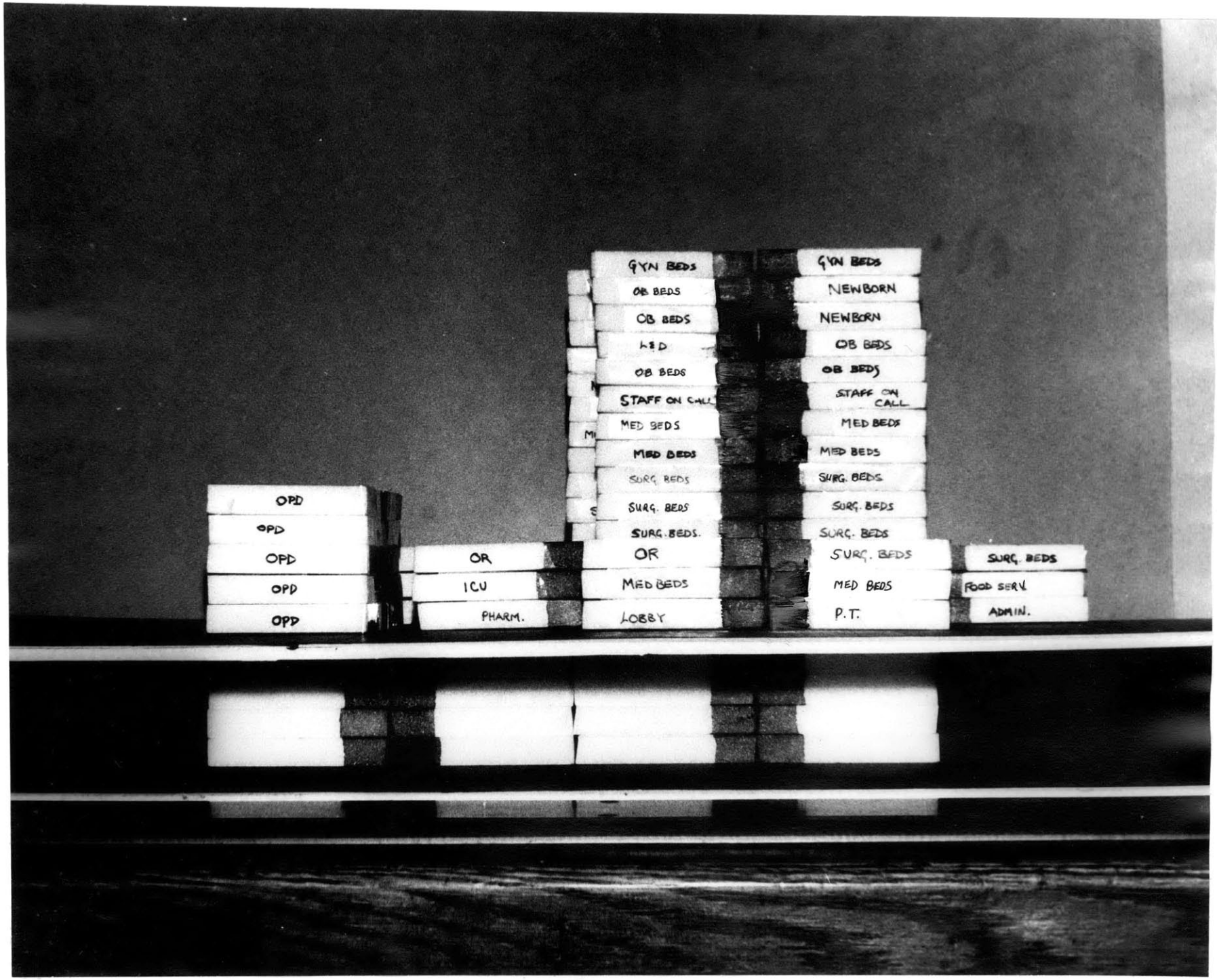
SIXTH FLOOR, MODEL "A"



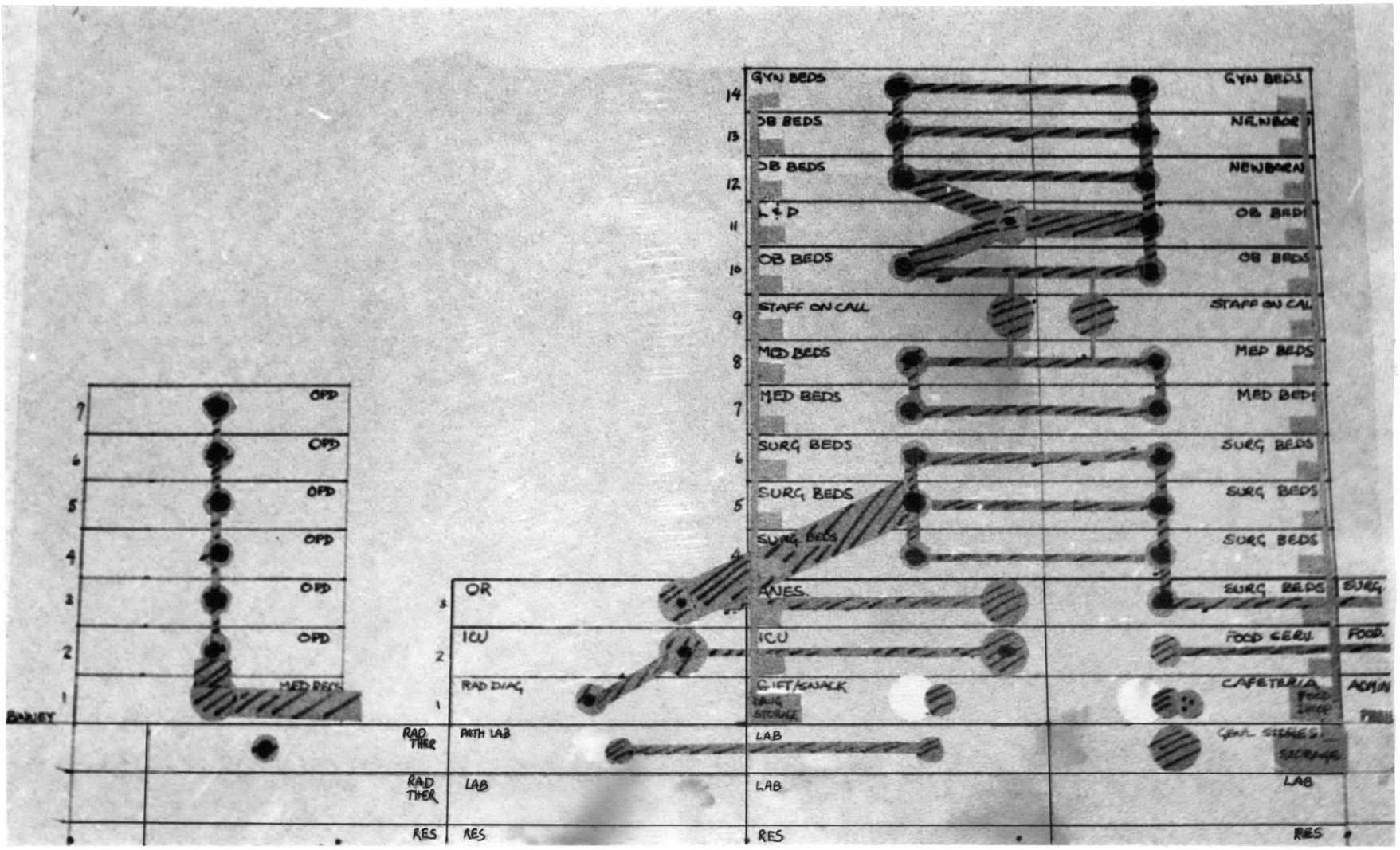
SEVENTH FLOOR, MODEL "A"


GYN BEDS
OB BEDS
OB BEDS
L&D
OB BEDS
STAFF ON CALL
MED BEDS
MED BEDS
SURG BEDS
GYN BEDS
NEWBORN
NEWBORN
OB BEDS
OB BEDS
STAFF ON CALL
MED BEDS
MED BEDS
SURG. BEDS
SURG BEDS
SURG. BEDS
OPD
OPD
OPD
OPD
OPD
OR
ICU
PHARM.
OR
MED BEDS
LOBBY
SURG. BEDS
MED BEDS
F.T.
SURG. BEDS
FOOD SERV.
ADMIN.
DY ST.
K ST.
PBBH
FRANCIS ST.

MODEL "B"

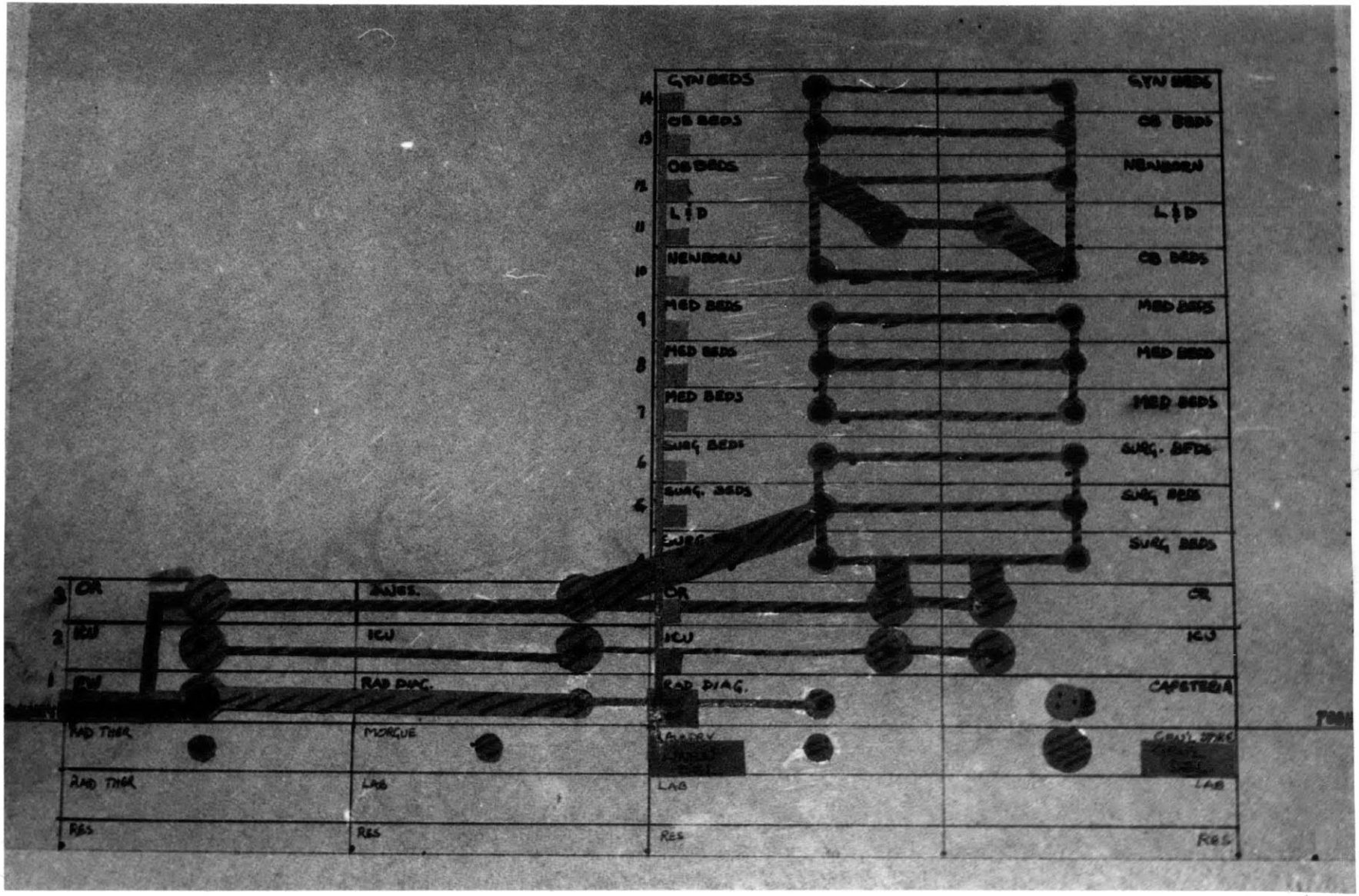

GYN BEDS
OB BEDS
OB BEDS
L&D
OB BEDS
STAFF ON CALL
MED BEDS
MED BEDS
SURG. BEDS
SURG. BEDS
SURG. BEDS.
OR
MED BEDS
LOBBY
GYN BEDS
NEWBORN
NEWBORN
OB BEDS
OB BEDS
STAFF ON CALL
MED BEDS
MED BEDS
SURG. BEDS
SURG. BEDS
SURG. BEDS
MED BEDS
P.T.
SURG. BEDS
FOOD SERV.
ADMIN.
OPD
OPD
OPD
OPD
OPD
OR
ICU
PHARM.

MODEL "B"

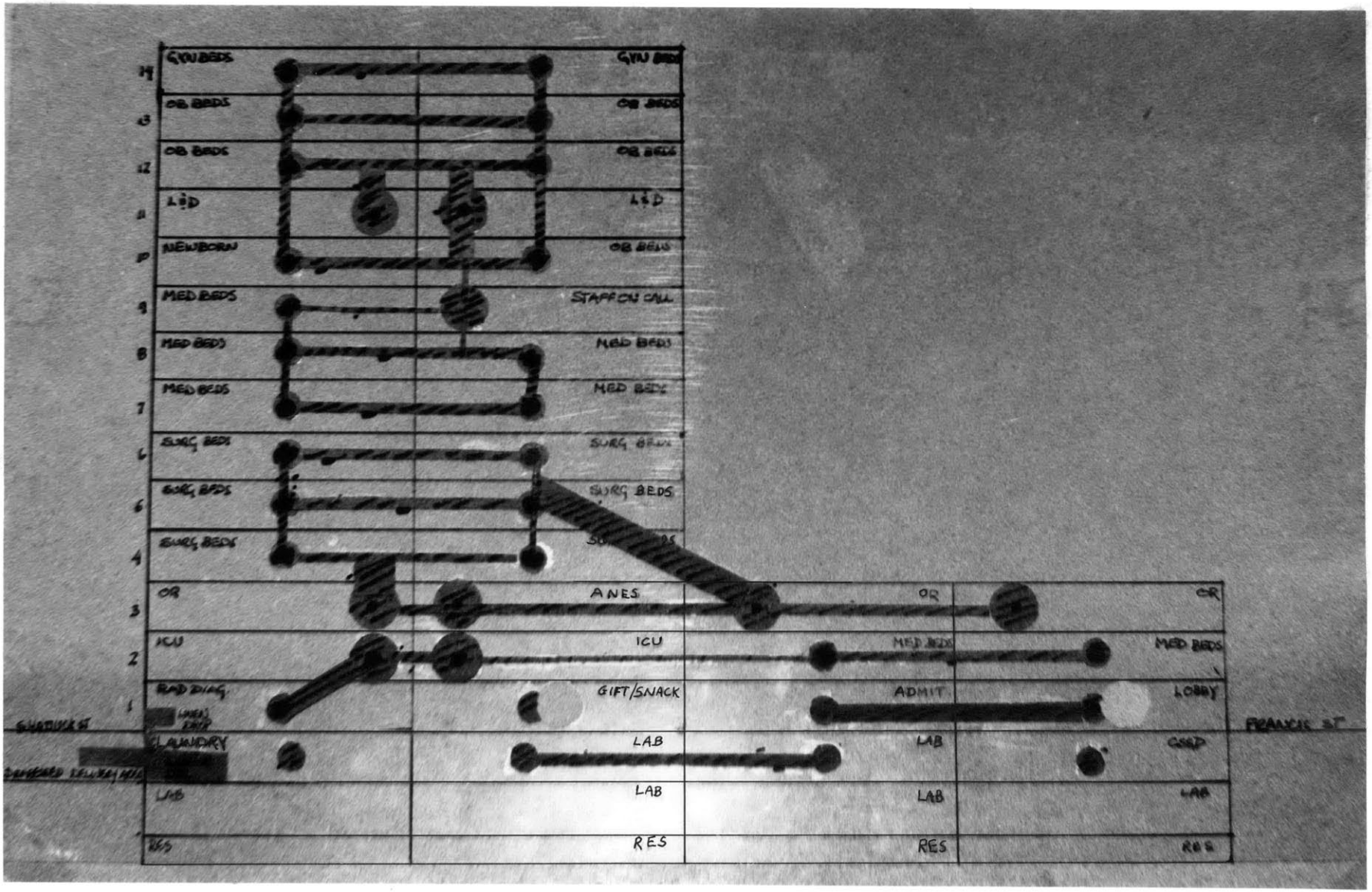


SECTION A-A, MODEL "B"

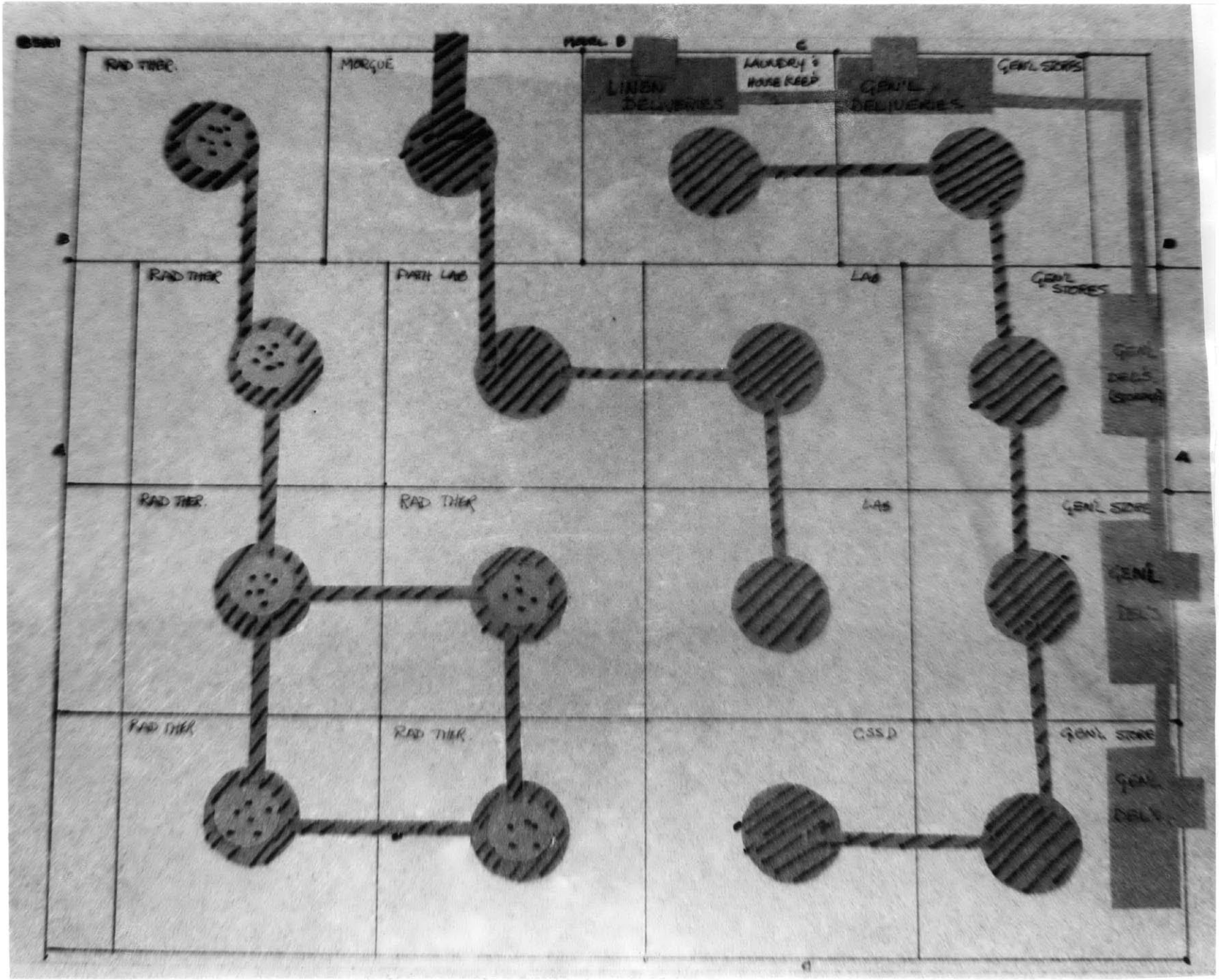
VISITORS CIRCULATE THROUGHOUT HOSPITAL, EXCEPT IN O.R. SUITE OR L&D SUITE; THEY ARE OMMITTED FROM SECTIONS FOR SIMPLIFICATION. PATIENTS MOVE WITH STAFF EXCEPT WHERE INDICATED (NO BLUE (DARK) CIRCLE INSIDE RED (STRIPED) CIRCLE).



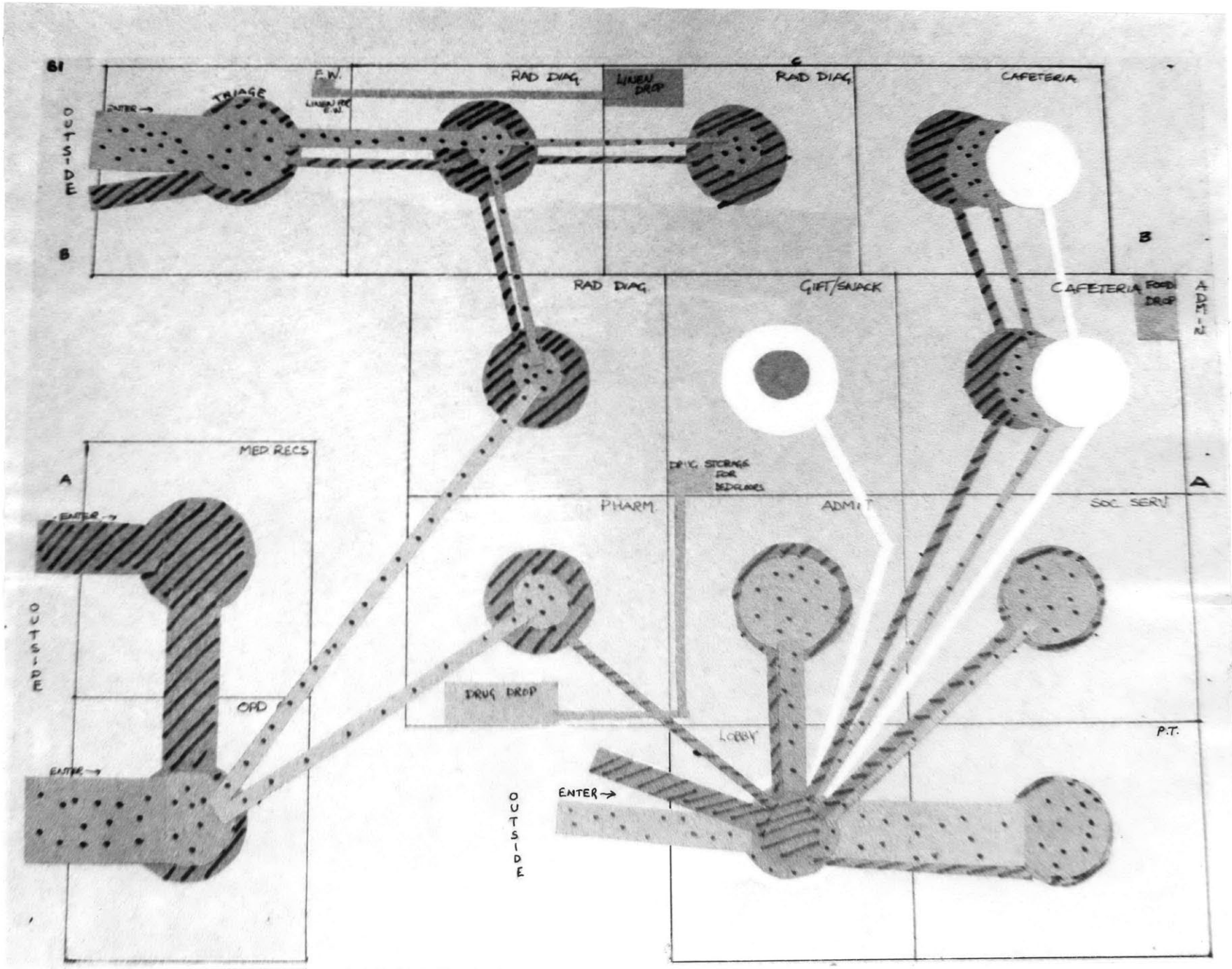
SECTION B-B, MODEL "B"



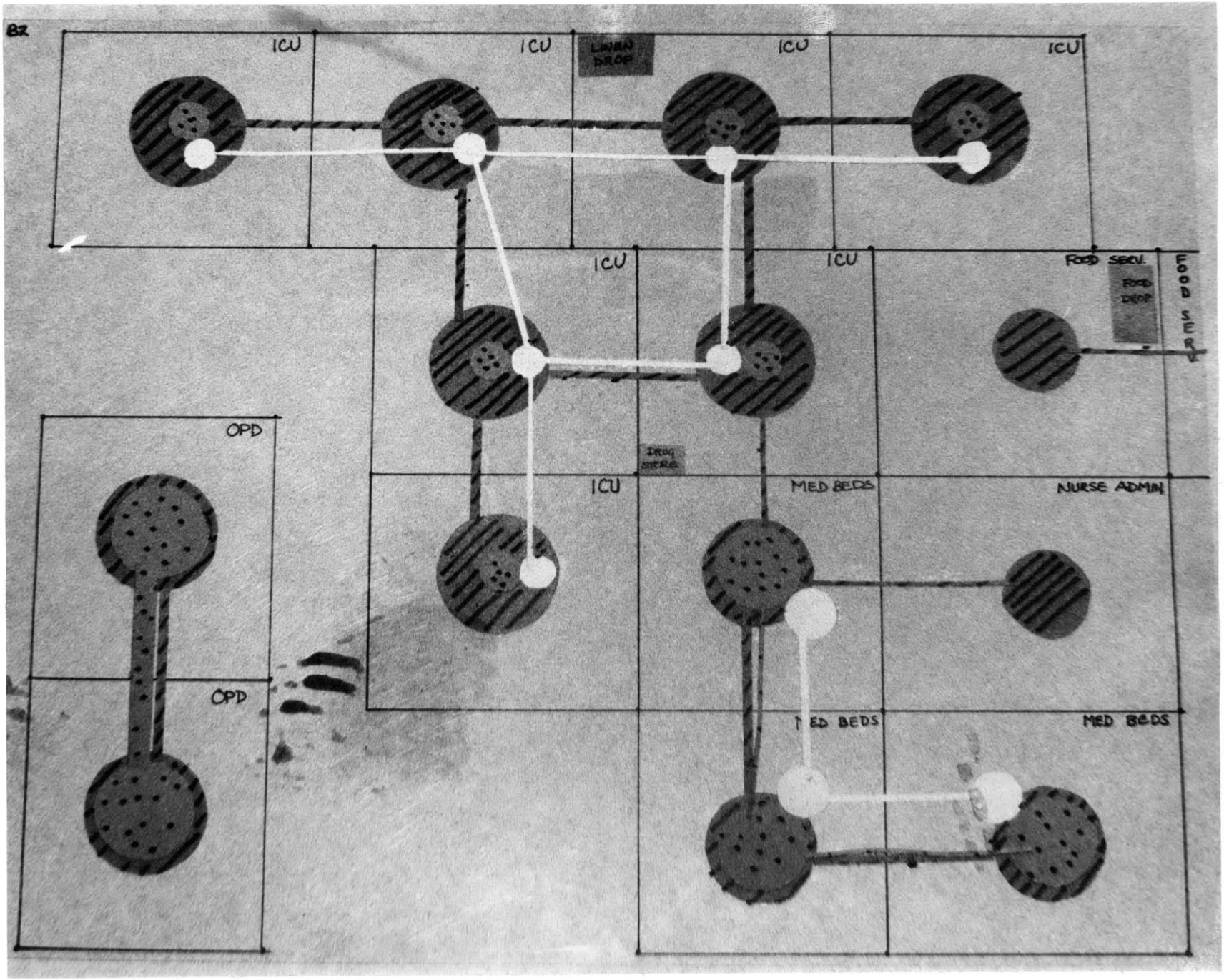
SECTION C-C, MODEL "B"



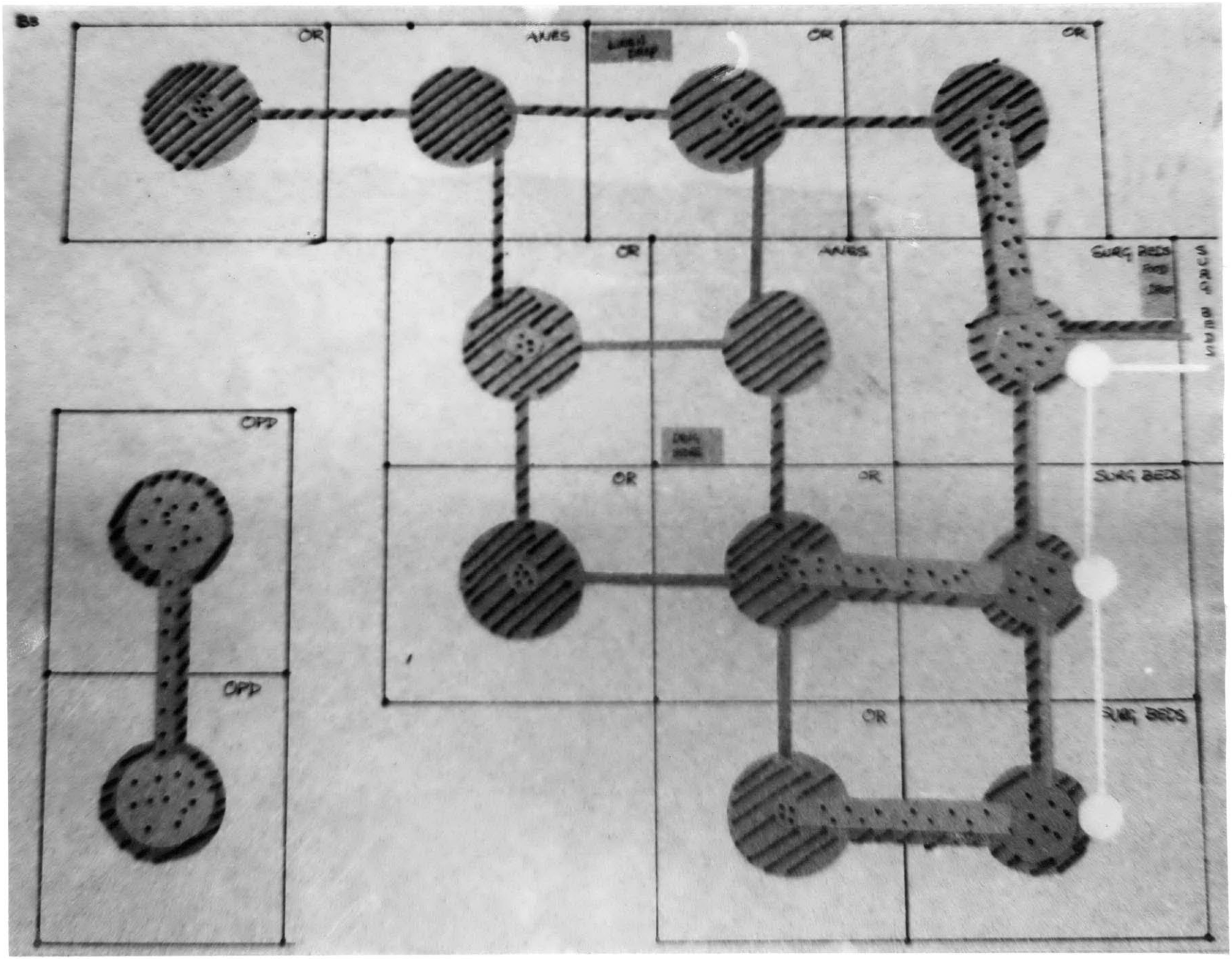
FIRST BASEMENT, MODEL "B"



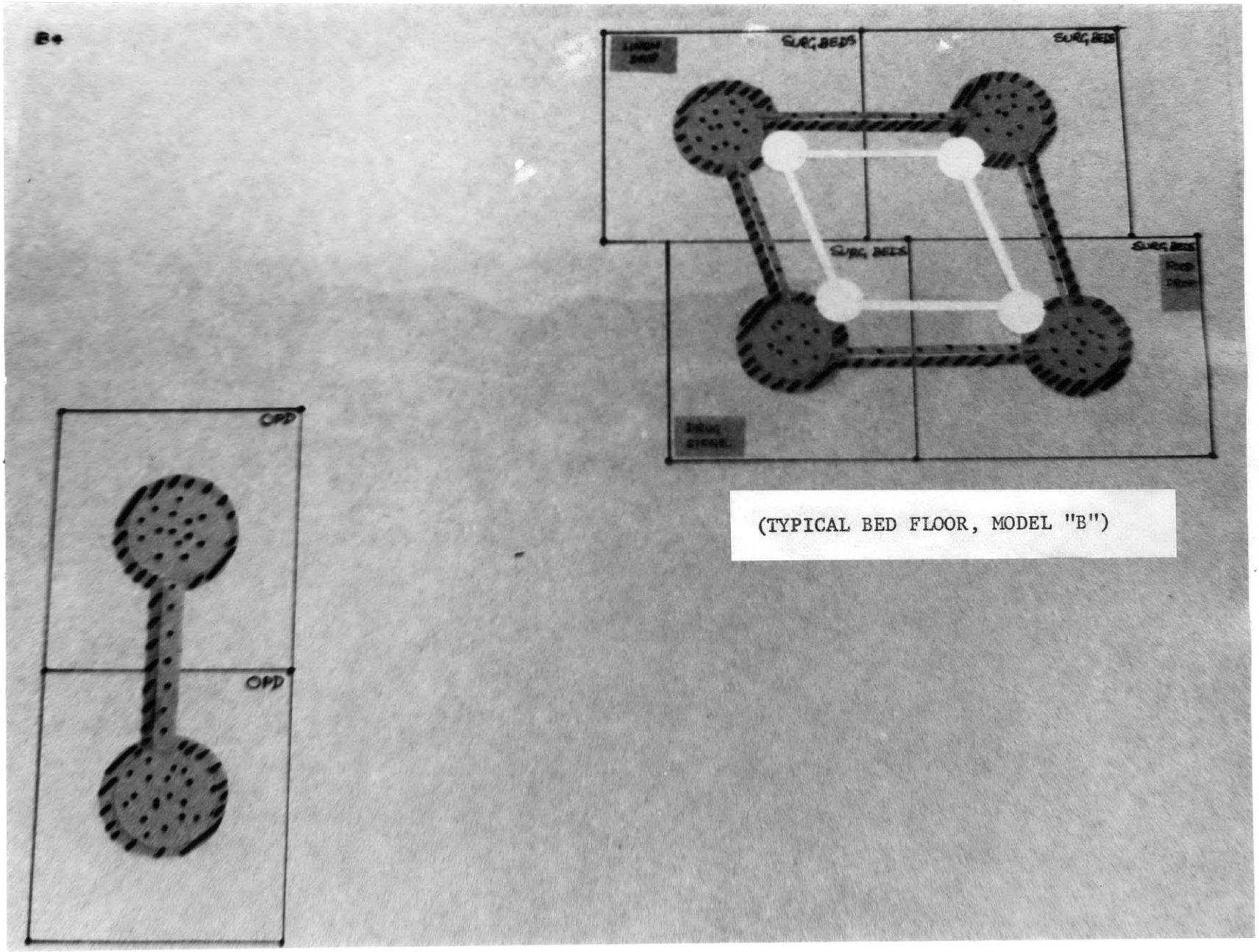
FIRST FLOOR, MODEL "B"



SECOND FLOOR, MODEL "B"

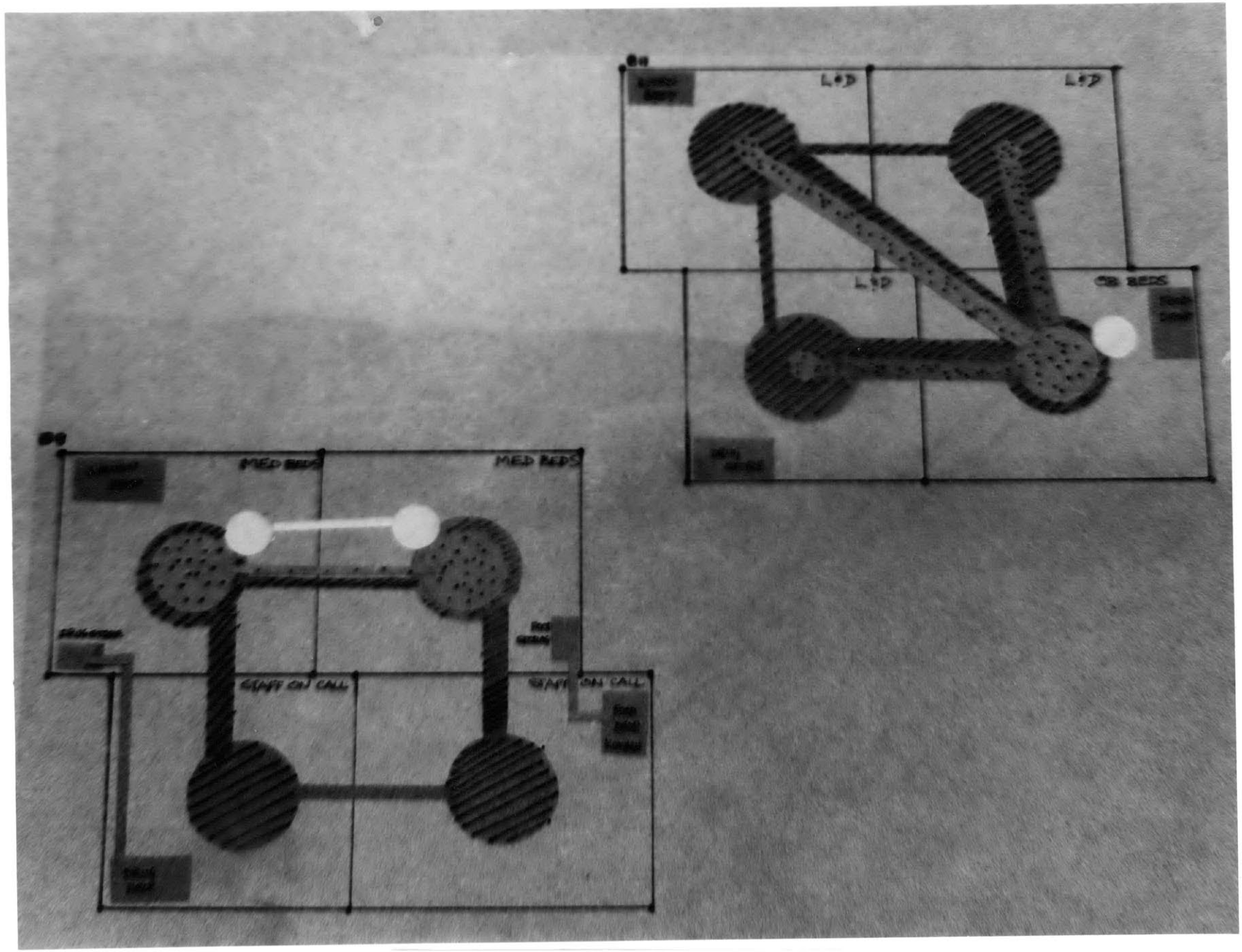


THIRD FLOOR, MODEL "B"



(TYPICAL BED FLOOR, MODEL "B")

FOURTH FLOOR, MODEL "B"



NINTH & ELEVENTH FLOORS, MODEL "B"

BIBLIOGRAPHY

1. Affiliated Hospital Center, Inc., Certificate of Need Applications, April 1973; October 1973; November 1973; and March 1974; Boston, Ma.
2. Architectural Record Book, Hospitals, Clinics and Health Centers, F.W. Dodge Corp., U.S.A.; 1960.
3. Bell, George, International Symposium on Hospital and Medical School Design, Dundee, 1961, E.S. Livingstone, Ltd., London; 1962.
4. Building Systems Development & Stone, Marraccini & Patterson, V.A. Hospital Building System, Research & Development Studies, U.S. Government Printing Office, Washington, D.C.; 1972.
5. Cruickshank, Herbert, Planning, Design and Construction of Hospital Buildings for the National Health Service, Department of Health & Social Security, Washington, D.C.; 1973.
6. Delon, Gerald & Smalley, Harold, Quantitative Methods for Evaluating Hospital Designs, Department of HEW, Maryland; 1970.
7. Ezra D. Ehrenkrantz & Associates, Final Report for the Affiliated Hospital Center, Ezra D. Ehrenkrantz & Associates, New York; 1975.
8. Goldberg, Bertrand, The Affiliated Hospital Center Master Plan Report, Bertrand Goldberg & Associates, Boston; April, 1965.
9. Harrell, George, Planning Medical Center Facilities, Pennsylvania State University Press, Pennsylvania; 1974.
10. Ministry of Health, Hospital Building Bulletin:"Traffic Movements and the Inter-Relation of Departments, Her Majesty's Stationary Office, London; 1966.
11. Rosenfield, Isadore, Hospital Architecture and Beyond, Van Nostrand Reinhold Co., New York; 1969.
12. Rosenfield, Isadore, Hospital Architecture: Integrated Components, Van Nostrand Reinhold Co., New York; 1971.