HIGH-DENSITY HOUSING AT AN URBAN EDGE:
A BUILT-FORM PROJECTION

by

BARRY ZEVIN

S.B.A.D., Massachusetts Institute of Technology
1971

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARCHITECTURE

at the

Massachusetts Institute of Technology

June, 1973

Signature of Author .....
Department of Architecture, 11 May 1973

Certified by .....
Thesis Supervisors

Accepted by .....
Chairman, Departmental Committee on Graduate Students

2

ABSTRACT

High-Density Housing at an Urban Edge:
A Built-Form Projection

by Barry Zevin

submitted to the Department of Architecture on 11 May 1973 in partial fulfillment of the requirements for the degree of Master of Architecture.

This thesis presents a design study for a high-density building complex for community and university housing on a site at the northwest edge of the Charles River Basin in Cambridge, Massachusetts.

Thesis Supervisors:

Imre Halasz, Professor of Architecture

Maurice Smith, Professor of Architecture

3

TABLE OF CONTENTS

* I apologize for the format of the drawings. An unfolded copy may be found in Prof. Maurice Smith's office.
- BZ.

4

HYPOTHESES & INTENTIONS

The drawings that follow this text propose a high-density[1] building complex for community and university housing on a site at the northwest edge of the Charles River Basin in Cambridge. The exploration of methods of building-assembling which led to this projection took as its reference the following hypotheses:

[1] I am using "high-density" to indicate a ratio of built area to site area so large that it generates buildings in which elevators are required. The particular floor-area-ratio referred to in the drawings is about 4.0.

a *Recognizing that*
freedom to choose and to make (or partly make; or remake) one's dwelling place presupposes not only a particular set of political, social, and economic conditions: it also requires the existence of a range of built definitions from which to choose and upon which to act,

the design intends to
project a wide range of built, physical actualities whose diversity achieves meaning by enabling a wide range of human uses.

b *Recognizing that*
individuals whose norms of activity suggest different kinds of built facilities can mutually benefit by inhabiting in common a place where their proximity generates a dense mixture of physical definitions which all can share: close-grained diversity enhances the richness of choice,

the design intends to

mix a wide range of forms and uses in very close proximity, and to enable (insofar as built form can enable) all the inhabitants of the building complex and of the surrounding community to share this diversity of place and activity.[2]

[2] Any built place has an obligation to function as a part of the whole city or landscape, to add itself into the common wealth. A closed enclave cannot fulfill this obligation.

c *The norm of American urban organization indicates that many sites cannot be expected to support a close-grained mixture of residential and non-residential activity;*

but recognizing that
an adequate range of transportation and services (including commercial activity) must exist at any site before it can be considered as an appropriate location for housing,

and recognizing that
present institutions should change to better accommodate such a range of activities and built forms in close proximity,[3]

[3] This would require that the power to control the use of land account for the benefits of diversity, contrast, juxtaposition; that land-use decisions be made more particular and close-grained, and less uniform.

the design intends to
conserve and add to the non-residential activity presently occupying the site.

d *The current high-density prototype has often been used indiscriminately, without recognizing that its particular qualities may prove destructive or dysfunctional when applied to some sites and programs:*[4]

[4] Any prototype applied indiscriminately and uniformly produces a minimal and malfunctioning environment; the low-density suburban prototype

Recognizing that

6

has been used as badly as the high-density prototype.

building at high density should not be tolerated as a norm but seen instead as an extreme in the whole range of ways of building,

the design intends to
project only a special (though by no means unique) case, in which a redefined prototype is applied to a site and program whose particular characteristics allow a high-density solution.

e *Recognizing that*
building at high density introduces special problems for building technology as well as for site planning and program, and that the criteria adopted in standard practice and by building code minima do not necessarily provide adequate solutions to these problems,

the design intends to
meet more satisfactory criteria for sound isolation and fire protection.

f *Recognizing that*
a large building project may be executed in phases over a period of some years; and that the initial planning of such a project might specify criteria for particular, local built-form decisions for the entire project <u>without</u> specifying a finite building form,

this design,
on the other hand, does not intend to formulate or use

such a set of criteria but rather intends to project one possible outcome of such a process.

9 *Recognizing that*
calculations of the cost/economy of a building project should take into account, in addition to the traditionally calculated first-cost, the costs of maintaining and operating the buildings, the expense to the community utility and transportation systems, and the costs of any other measurable benefits or liabilities,

the design intends to
propose a built place which could be realized under a (future or experimental) system of allocating resources which would make such a broad accounting of costs:

8

DESIGN ASSUMPTIONS

Housing program

The proposed building complex is to include a range of sizes and kinds of dwelling units. The following list of unit types is partial and not exclusive: (The number of units of each type is not assumed to be fixed. The given square footages are approximate and normative, not absolute.)

1. LARGE APARTMENTS

Most of these units are to have direct access to the ground, to accommodate families with children.

large 5-bedroom apartment or housemaster's quarters *up to 4500 sq. ft.*

4-bedroom apartment *1100 to 1300 sq. ft.*

3-bedroom apartment *900 to 1200 sq. ft.*

2-bedroom apartment *800 to 1000 sq. ft.*

2. SMALL APARTMENTS

Community and married students' housing; perhaps some units for the elderly.

1-bedroom apartment, tutor's flat *650 to 800 sq. ft.*

studio apartment *500 to 600 sq. ft.*

visiting professor's apartment & seminar room *up to 1000 sq. ft.*

3. DORMITORY UNITS

250 to 300 net sq.ft. per person, plus 20 to 25 sq.ft. or more per person for common facilities to be shared by groups of 25 to 40 people. (These common facilities might be used for cooking, sewing, playing musical instruments, watching television, holding classes, or even for more particular activities like darkroom work, pottery-making, or working on electronic equipment.)

suites: small apartments with internal kitchen, bathroom, and common room; and individual bedroom/studies for 3 to 8 people.

larger groups of 20 to 40 bedroom/studies for one (or two or three) person(s), with kitchen(s), bathrooms, and common rooms shared by the entire group.

4. OTHER OPTIONS

The building complex should enable individuals or groups to introduce other types of dwelling arrangements in addition to the norms listed above. For example, fraternity houses or artists' loft-studios might be accommodated.

Common facilities

These facilities are to be open to all residents; most of them should probably be at or near the ground. Again, the list is

10

partial:

meeting rooms
workshops and laboratories (woodworking, bicycles, electronics, photography, whatever...)
a small library
data terminals
a day care facility
garden plots, if possible
sports and recreational facilities (table tennis, pool, squash, basketball, handball, tennis, skating)
parking for residents – is assumed to be provided in a new structure between Vassar Street and the railroad right-of-way.

Public facilities

On the site,

a public square for daily encounters and for festivals
a delicatessen & newsstand *3000 sq. ft.*
a pub/beer garden/café *up to 3000 sq. ft.*
a coin-operated laundry *1500 sq. ft.*
(replaced) Joyce Chen restaurant *about 12000 sq. ft., plus on-site parking for 70 to 100 cars*
a sailing & boating facility

Near the site,

an urban rail transit stop is *assumed* to exist at Fort Washington, on the present railroad right-of-way;

at the transit stop,
a food store, pharmacy, dry cleaner, bank, café, ...

A note on density and sunlight

Most if not all units in the building complex should receive at least a few hours of direct sunlight each day all year, and all units must have a view onto sunlit spaces. (This applies as well to existing buildings adjacent to the site.)

Fire protection

The design assumes fire zones of 9600 sq.ft. (as allowed by the Boston Building Code for L2 occupancy with unprotected non-combustible type 2C construction[5]), separated by walls and floors of 4-hour fire resistance rating and equipped with automatic fire doors and H.V.A.C. dampers as required by the Boston Building Code. All infill structure within these zones is to meet the requirements for protected noncombustible type 2B construction (3/4-hour fire resistance rating for all elements[6]).

The building must meet all applicable fire protection requirements of the Boston Building Code. In addition, the design assumes that the entire building complex will be equipped with automatic sprinklers, smoke detectors, and alarm systems; with special communications equipment for fire department use, with elevators safe for fire

[5] Boston Building Department. Building Code-City of Boston, 1970. Table 2-2.

[6] Ibid. Table 2-1.

department use, with openable windows, stairways vented at top and bottom, and with one smokeproof tower (stair accessed only from balconies open to the outside) per fire zone.

The design must meet the following requirements for capacity of exit stairways:

NUMBER OF FLOORS	OCCUPANTS PER UNIT WIDTH OF STAIR[7]	UNITS OF WIDTH REQUIRED @ 9600 sq.ft./zone / 140 sq.ft./occupant = 70 occupants per zone	NUMBER AND SIZE OF STAIRS REQUIRED, @ 2 units/44" + ½ unit/additional 12"
8	25	3	2 stairs @ 44" each.
10	20	3½	2 @ 44"
12	18	4	2 @ 44"
14	15	5	1 @ 44" + 1 @ 60"
16	14	5	1 @ 44" + 1 @ 60"
18	13	5½	2 @ 60"
20	12	6	2 @ 60"

(Maximum allowable travel distances per Boston Building Code do not control under these circumstances.)
(No allowances are taken for sprinklers, for additional horizontal egresses, or for zones smaller than 9600 sq.ft.)

Sound isolation

The building should meet the following criteria:

transmission loss S.T.C. 50 between units,

7 From Sherwin P. Asrow and Anthony Vilar (eds.), Fire Protection of Highrise Buildings (Chicago: Chicago Committee on Highrise Buildings, 1972), page 231.

13

transmission loss 40 between privacies within units, impact noise ratings (I.N.R.) greater than zero.

The design assumes the use of staggered-stud partitions, resilient clips for lath and wallboard, fully gasketed doors, and carpeting (whenever another floor surface is not clearly more desirable); the design further assumes that careful attention will be given to mechanical systems (air ducts in particular) and to openings in floors and walls. Floated floors would be desirable.

Wind effects at the ground

A tall building on the given site would undoubtedly create wind problems at the ground. These might be minimized by making careful wind tunnel tests during the design process. In the absence of such tests, the design presented here proposes a sheltered path through much of the site and avoids small penetrations through the building at the ground.

Structural systems

Primary structural system

brick bearing walls
steel columns encased in concrete poured *in situ*
precast concrete ledger beams
prestressed concrete floor planks

concrete flat slab floors poured *in situ*

(floors designed for live load of

100 psf (corridor or public use)
+ 40 psf (private occupancy)
+ 40 psf (dead weight of infill structure)
180 psf total design live load)

Secondary (infill) structural system

steel stud partitions

steel columns (intumescent paint where exposed)

punched nailable steel joists with 2" lightweight precast concrete short-span floor plank and 2" gypsum panel ceiling

OR

any construction (including wood) treated to meet the required 3/4-hour fire resistance rating.

Mechanical systems

H.V.A.C.

central air conditioning and heating by forced air, with independent systems at perimeter when required

Elevators

estimated at 120 bedrooms per car

15

BIBLIOGRAPHY

Adelman, Howard. The Beds of Academe. Toronto: Praxis Books, 1969.

Areggor, Hans, and Otto Glaus. Highrise Building and Urban Design. New York: Praeger, 1967.

Asrow, Sherwin P., and Anthony Vilar (eds.). Fire Protection of Highrise Buildings. Chicago: Chicago Committee on High-Rise Buildings, 1972.

Benevolo, Leonardo. History of Modern Architecture. 2 vols. Cambridge: MIT Press, 1971.

Bland, John, and Norbert Schoenauer. University Housing in Canada. Montreal: McGill University Press, 1966.

Blijstra, R. Town-Planning in the Netherlands Since 1900. Amsterdam: P. N. van Kampen and zoon, 1964.

Boston Building Department. Building Code--City of Boston. Boston: Building Department, 1970.

Buckley, Michael, and Michael Guran. "Townframe," Research, Vol. 3, No. 1, December, 1971.

Building Officials' Conference of America. BOCA Basic Building Code. Fifth edition. Chicago: Building Officials and Administrators International, 1970.

Burnham, Daniel H., and Edward H. Bennett. Plan of Chicago. New York: DaCapo Press, 1970.

Cambridge Historical Commission. Report Three: Cambridgeport. Cambridge: MIT Press, 1971.

Caminos, Horacio, John F. C. Turner, and John A. Steffian. Urban Dwelling Environments. Cambridge: MIT Press, 1969.

Commonwealth of Massachusetts Special Commission on the Charles River Basin. Report on Proposed Improvements of the Charles River Basin. Boston: Commonwealth of Massachusetts Special Commission on the Charles River Basin, 1929.

Coull, A., and B. Stafford Smith (eds.). Tall Buildings. New York: Pergamon Press, 1967.

Cullen, Gordon. The Concise Townscape. New York: Van Nostrand Reinhold Co., 1961.

DeCarlo, Giancarlo. Urbino. Trans. Loretta Schaeffer Guarda. Cambridge: MIT Press, 1970.

Deeson, A. F. L. The Comprehensive Industrialised Building Annual, 1966. London: House Publications, Ltd., 1964.

de Wolfe, Ivor. The Italian Townscape. London: The Architectural Press. 1963.

Diamant, R. M. E. Industrialised Building 1. London: Iliffe Books, Ltd., 1965.

Diamant, R. M. E. Industrialised Building 2. London: Iliffe Books, Ltd., 1965.

Dober, Richard P. Campus Planning. New York: Reinhold, 1963.

Doelle, Leslie L. Environmental Acoustics. New York: McGraw-Hill, 1972.

Donat, John (ed.). World Architecture 4. New York: Viking Press, 1967.

Downes, Wm. Howe. The Charles River Basin. Boston: Wright and Potter Co., 1894.

Goody, Joan E. New Architecture in Boston. Cambridge: MIT Press. 1965.

Great Britain Department of the Environment. Cars in Housing/ 2. London: Her Majesty's Stationery Office, 1971.

Great Britain Ministry of Housing and Local Government. Dimensions and Components for Housing. London: Her Majesty's Stationery Office, 1963.

Great Britain Ministry of Housing and Local Government. Families Living at High Density. London: Her Majesty's Stationery Office, 1970.

Great Britain Ministry of Housing and Local Government. Service Cores in High Flats: Mechanical Ventilation of Inner Rooms. London: Her Majesty's Stationery Office, 1963.

Great Britain Ministry of Housing and Local Government. Service Cores in High Flats: Sanitary Plumbing. London: Her Majesty's Stationery Office, 1962.

Great Britain Ministry of Housing and Local Government. Some Aspects of Designing for Old People. London: Her Majesty's Stationery Office, 1968.

Great Britain Ministry of Housing and Local Government. Space in the Home. London: Her Majesty's Stationery Office, 1965.

Higginson, Henry L., et al. The Improvements of the Charles River Basin. Boston: Wright and Potter, 1901.

International Association of Plumbing and Mechanical Officials. Uniform Plumbing Code, 1970 edition. Los Angeles: International Association of Plumbing and Mechanical Officials, 1969.

International Conference on Wind Effects on Buildings and Structures. Wind Effects on Buildings and Structures, Vols. I and II. London: Her Majesty's Stationery Office, 1965.

International Council for Building Research, Studies, and Documentation (CIB). Weathertight Joints for Walls. Oslo: Norwegian Building Research Institute, January, 1968.

Jeanneret-Gris, Charles Eduoard (Le Corbusier). The City of Tomorrow. Trans. Frederick Stchells. Cambridge:MIT Press, 1971.

Jeanneret-Gris, Charles Eduoard (Le Corbusier). Manière de Penser L'Urbanisme. Geneve: Éditions Gonthier, 1963.

Jeanneret-Gris, Charles Eduoard (Le Corbusier). The Marseilles Block. Trans. Geoffrey Sainsbury. London: The Harvill Press, 1953.

Jensen, Rolf. High Density Living. London: Leonard Hill, 1966.

Katz, Robert D. Design of the Housing Site: A Critique of American Practice. Urbana: Small Homes Council-Building Research Council, University of Illinois, 1966.

Kira, Alexander. The Bathroom. Ithaca: Center for Housing and Environmental Studies, Cornell University, 1966.

Liebbrand, Kurt. Transportation and Town Planning. Trans. Nigel Seymer. Cambridge: MIT Press, 1970.

Lin, T. Y. Design of Prestressed Concrete Structures. New York: John Wiley and Sons, 1963.

Lynch, Kevin. The Image of the City. Cambridge: MIT Press, 1960.

Lynch, Kevin. Site Planning. Cambridge: MIT Press, 1962.

MIT Committee on Student Environment. An Interim Report on Housing for Men at MIT. Cambridge: MIT Committee on Student Environment, 1963.

MIT Department of Architecture. Highrise Housing in Steel: The Staggered Truss System. Cambridge: MIT Department of Architecture, 1967.

MIT Planning Office. Graduate Residence Report. Cambridge: MIT Planning Office, 1964.

MIT Planning Office. Statement of Goals and Objectives for MIT Housing. Cambridge: MIT planning Office, 1969.

Matson, Theodore M., Wilbur S. Smith. and Frederick W. Hurd. Traffic Engineering. New York: McGraw Hill, 1955.

Matthew, Robert M., "The Planning and Location of High Buildings," Symposium on the Design of High Buildings. Edited by Sean Mackey. Hong Kong: Hong Kong University Press, 1962.

McGuinness, William J., and Benjamin Stein. Mechanical and Electrical Equipment for Buildings. New York: John Wiley and Sons, Inc., 1971.

McHarg, Ian L. Design with Nature. Garden City, New York: Doubleday/ National History Press, 1969.

Merritt, Frederick S. (ed.). Mechanical and Electrical Design of Buildings for Architects and Engineers. New York: McGraw Hill, 1966.

Mokk, Laszlo. Prefabricated Concrete. Trans. Gabor Beke. Budapest: Akademiai Kiado, 1964.

Mullins, William, and Phyllis Allen. Student Housing. London: Crosby Lockwood and Son, 1971.

National Fire Protection Association. National Fire Codes, Vol. 4: Building Construction and Facilities. Boston: National Fire Protection Association, 1973.

Nervi, Pier Luigi. Structures. Trans. Giuseppina and Mario Salvadori. New York: F. W. Dodge Corporation, 1956.

North Carolina State College of Agriculture and Engineering, School of Design. Student Housing Survey. Raleigh, North Carolina: North Carolina State University, 1968.

Parkin, P. H., H. J. Purkis, and W. E. Scholes. Field Measurements of Sound Insulation Between Dwellings. London: Her Majesty's Stationery Office, 1960.

Parker, Harry. Simplified Engineering for Architects and Builders. New York: John Wiley and Sons, Inc., 1967.

Prestressed Concrete Institute. PCI Design Handbook. Chicago: Prestressed Concrete Institute, 1971.

Purkis, H. J., Building Physics: Acoustics. New York: Pergamon Press, 1966.

Rasmussen, Steen Eiler. Towns and Buildings. Cambridge: MIT Press, 1969.

Richards, Ian. Abbeys of Europe. Feltham, Middlesex: Hamlyn, 1968.

Riker, Harold C., and Frank G. Lopez. College Students Live Here. New York: Education Facilities Laboratory, 1961.

Schmitt, Karl Wilhelm. Multistory Housing. New York: Praeger, 1966.

Shurtleff, Arthur A. "The Development of the Charles River Basin," New Boston Magazine, Vol. 2., No. 7, (November, 1911), 246-248.

Sitte, Camillo. City Planning According to Artistic Principles. Trans. George R. Collins and Christiane Craseman Collins. New York: Random House, 1965.

Smithson, Alison and Peter. Ordinariness and Light. Cambridge: MIT Press, 1970.

Stein, Clarence S. Toward New Towns for America. Cambridge: MIT Press, 1966.

Tryon, George H. (ed.). Fire Protection Handbook. Thirteenth edition. Boston: National Fire Protection Association, 1969.

United States Department of Housing and Urban Development. A Guide to Airborne, Impact, and Structure Borne Noise-Control in Multifamily Dwellings. Washington: United States Department of Housing and Urban Development, 1971.

United States Urban Advisors to the Federal Highway Administrator. The Freeway in the City. Washington: United States Government Printing Office, 1968.

University of California. Student Housing Cost Study, URBS Publication 3. Berkeley: University of California, October, 1967.

Venturi, Robert. Complexity and Contradiction in Architecture. New York: Museum of Modern Art, 1966.

Waddell, Joseph J. (ed.). Concrete Construction Handbook. New York: McGraw Hill, 1968.

Wright, Frank Lloyd. The Work of Frank Lloyd Wright: The Wendingen Edition. New York: Bramhall House, 1965.

Wright, Frank Lloyd. Writings and Buildings. Edited by Edgar Kaufmann and Ben Raeburn. New York: World Publishing Co., 1960.

Yergzes, Lyle F. Sound, Noise and Vibration Control. New York: Van Nostrand Reinhold Co., 1969.

Briggs Field

Westgate courtyard

DAY CARE / 3rd Floor

DELI

PUB GARDEN

LOBBY

LOBBY

LOBBY

LOBBY

LOBBY

LAUNDRY

new Boyle Gym, RESTAURANT

boat harbor

Charles River

Memorial Drive westbound

Memorial Drive eastbound

GROUND LEVELS
/ PUBLIC SPACE

0 40 FEET

VASSAR STREET

Briggs Field

Westgate PARKING

LOADING

Westgate 1

AUDREY STREET

LOADING

Westgate 2

LOADING

AMHERST ALLEY

Joyce Chen PARKING upper level

Joyce Chen PASSENGER DROP-OFF

LOADING

MEMORIAL DRIVE westbound

MEMORIAL DRIVE eastbound

boat harbor

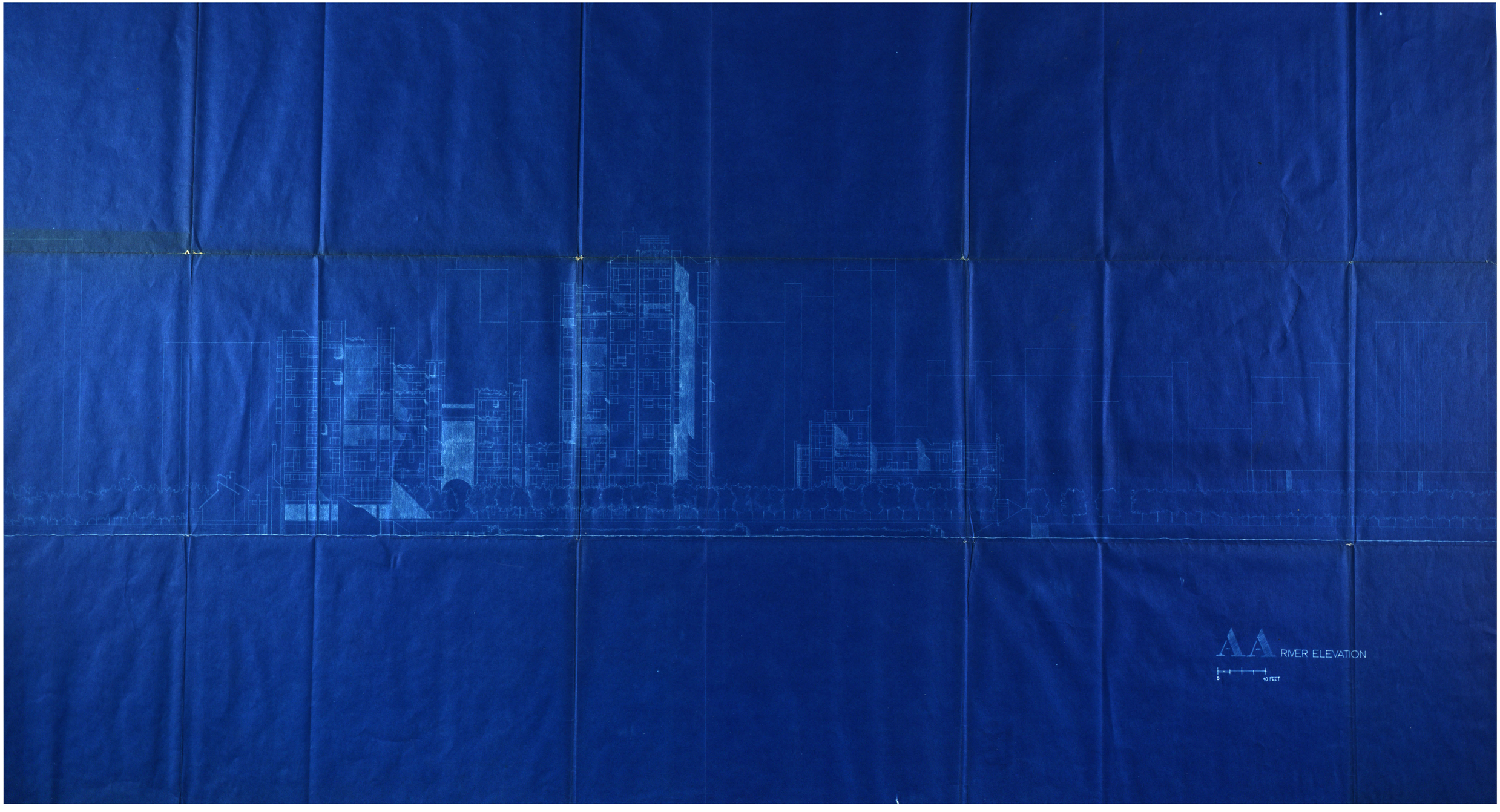
quay

Charles River

PARKING & VEHICULAR CIRCULATION

0 40 FEET

landscaping & non-public space not shown


AA
RIVER ELEVATION
0
40 FEET

BB PUBLIC SPACE

0 40 FEET

CC PUBLIC SPACE

0 40 FEET

DD PUBLIC SPACE

0 40 FEET

28

0 16 FEET

Office

Lobby

Delicatessen

upper part of pub

Pub

Mechanical

Office

Pub garden

Offices

Gallery wall

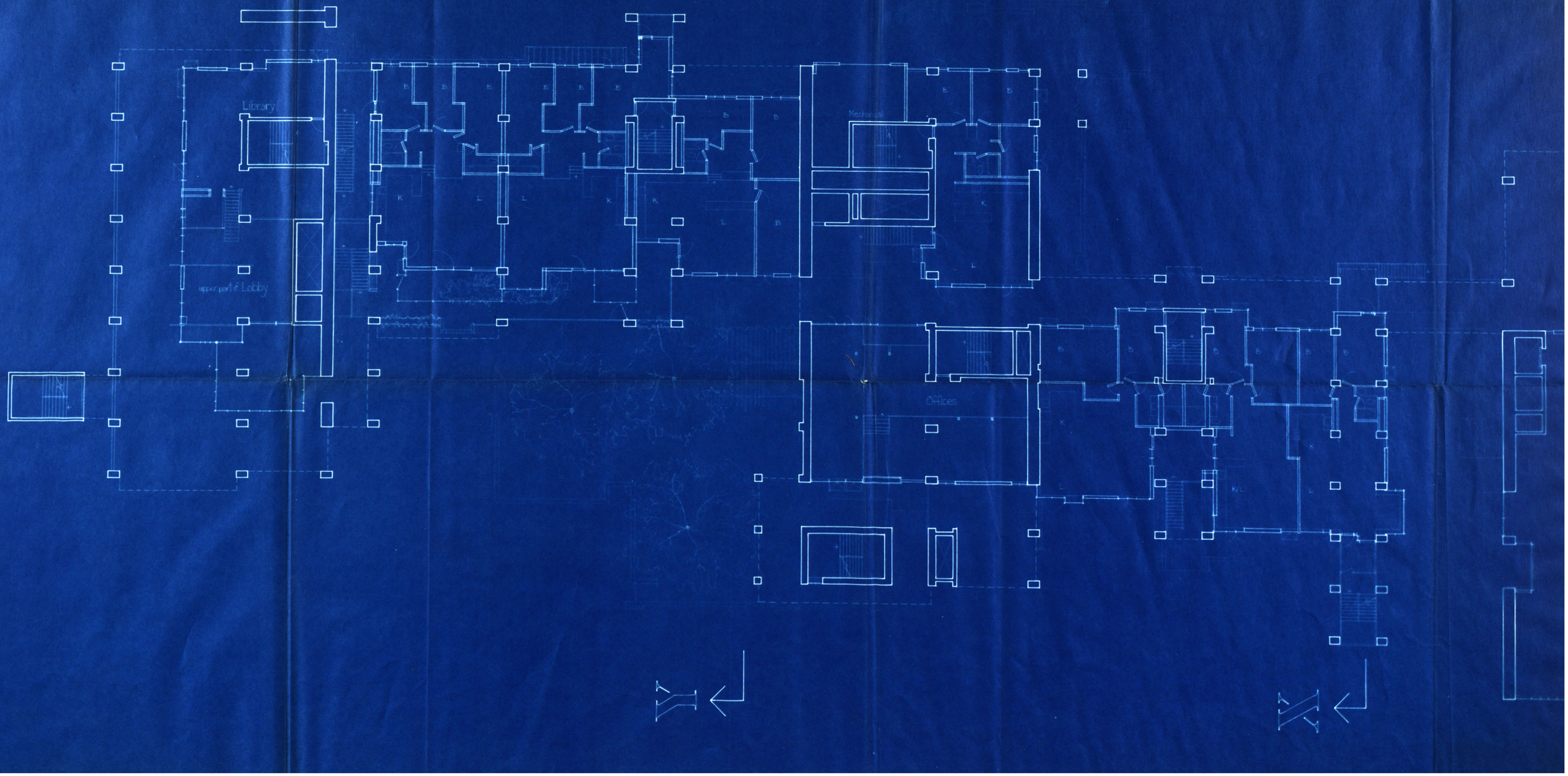
Arcade wall

Amherst Walk

MEZZANINE

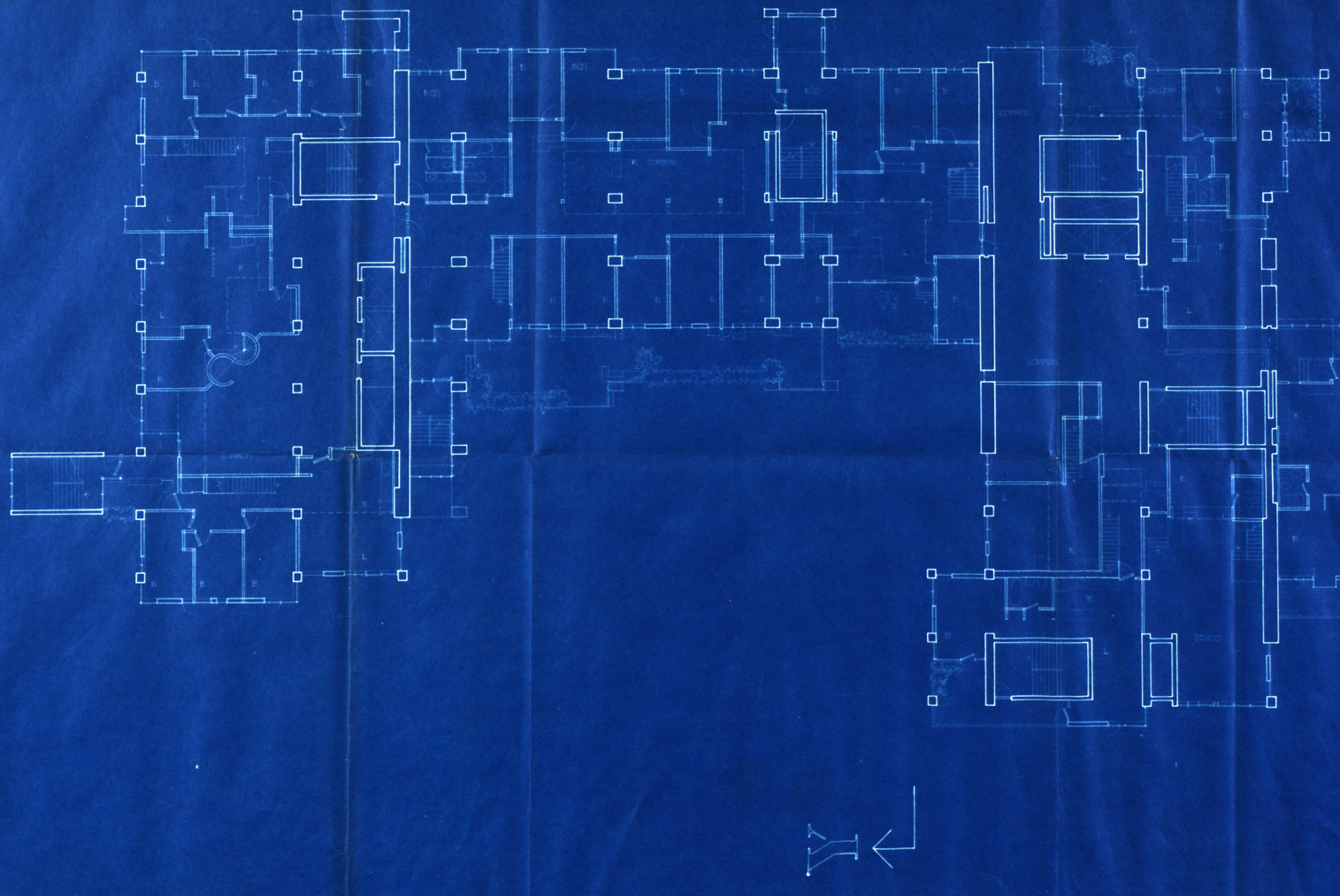
+28

16 FEET



74

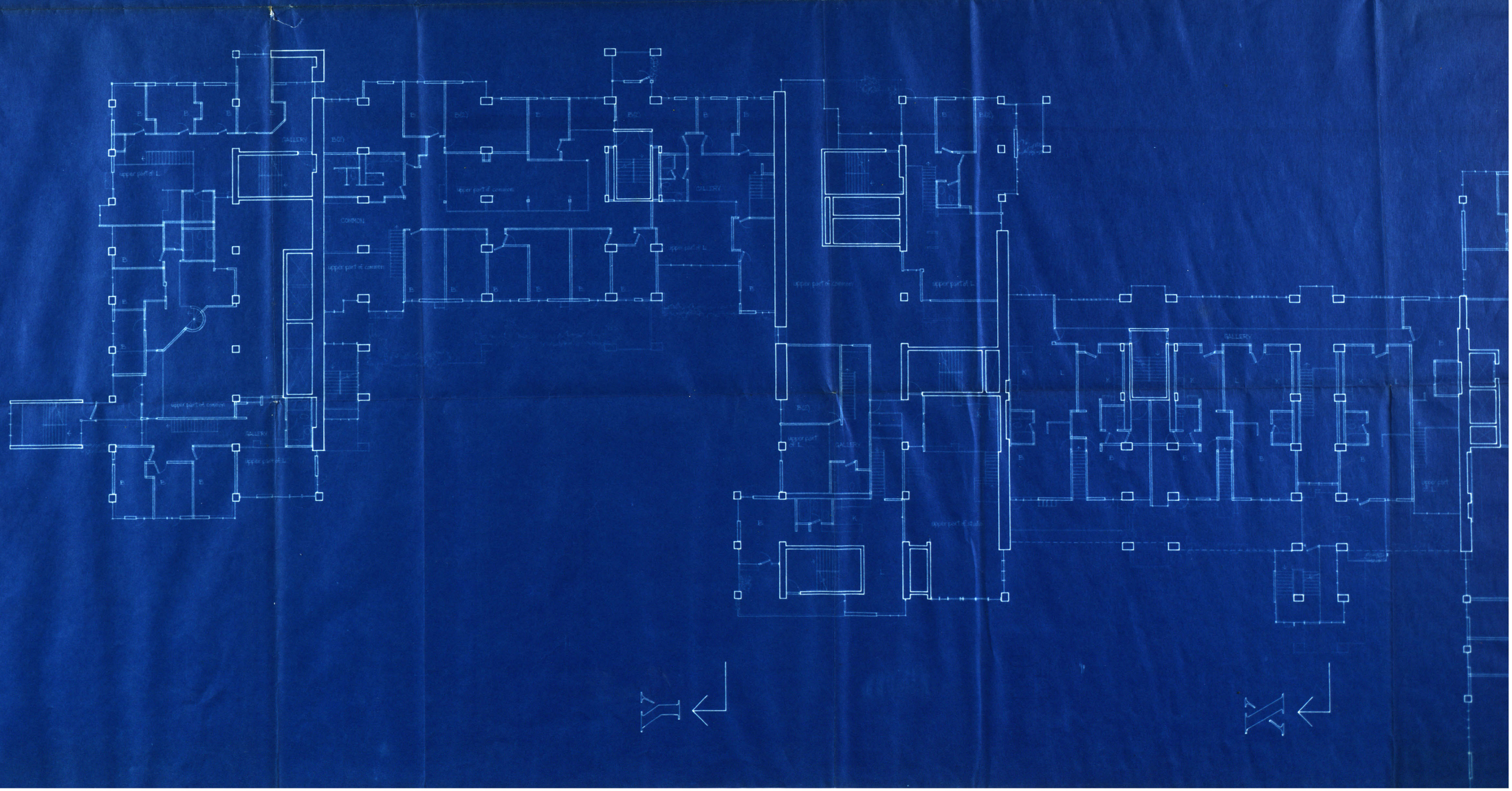
0 16 FEET



MEZZANINE

+74

0 16 FEET



+138

0 10 FEET

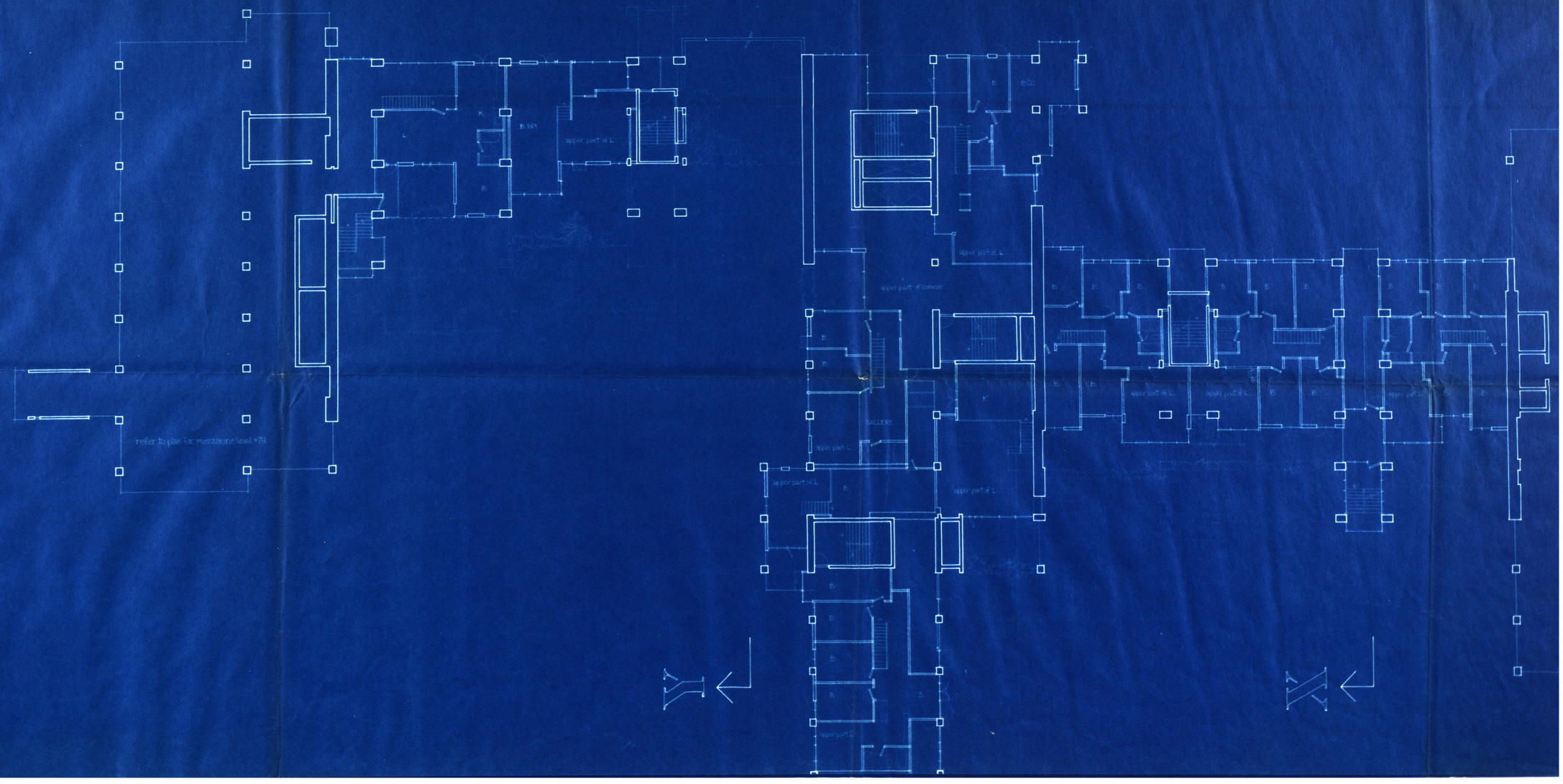
refer to plan for level +74

COMMON

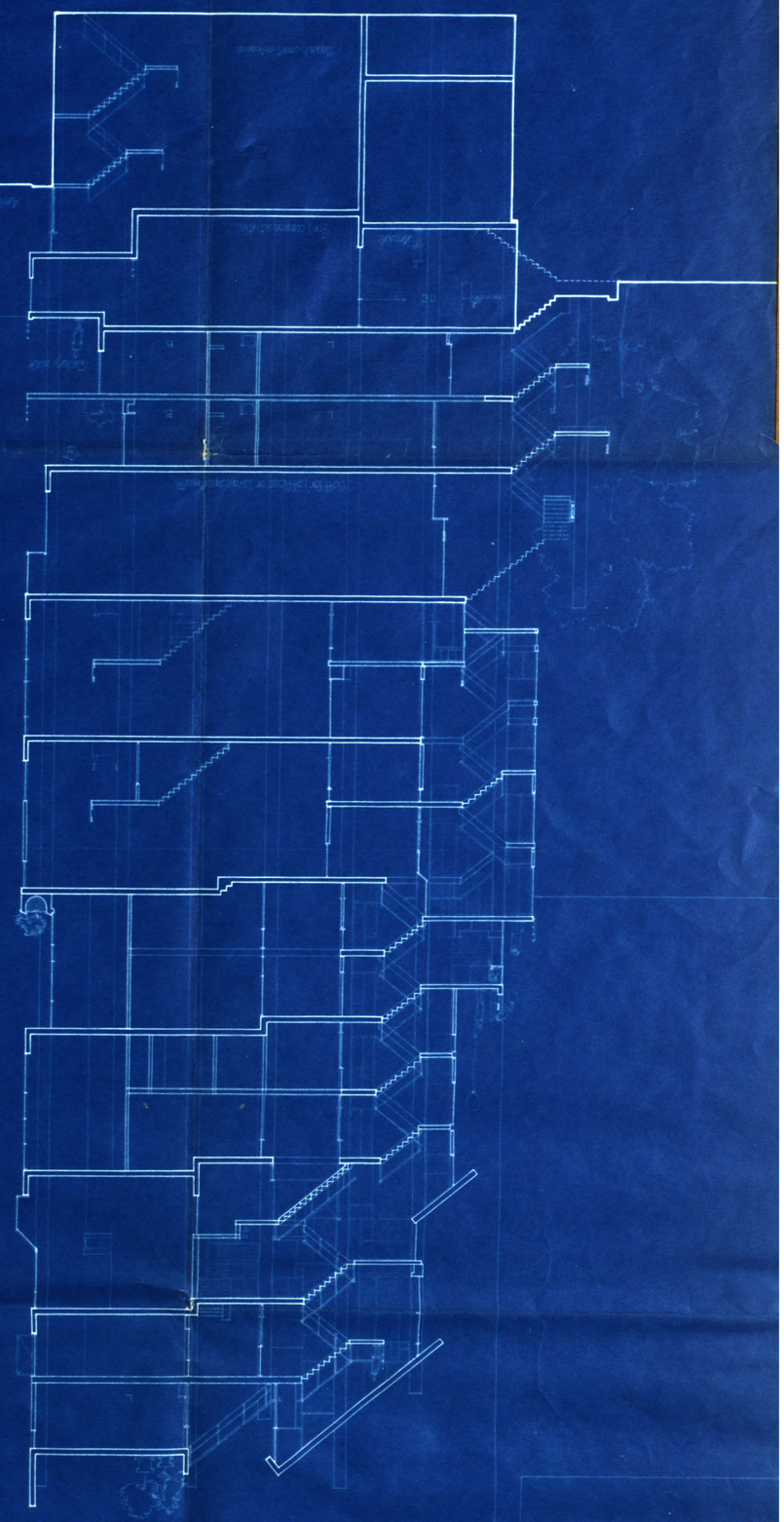
MEZZANINE

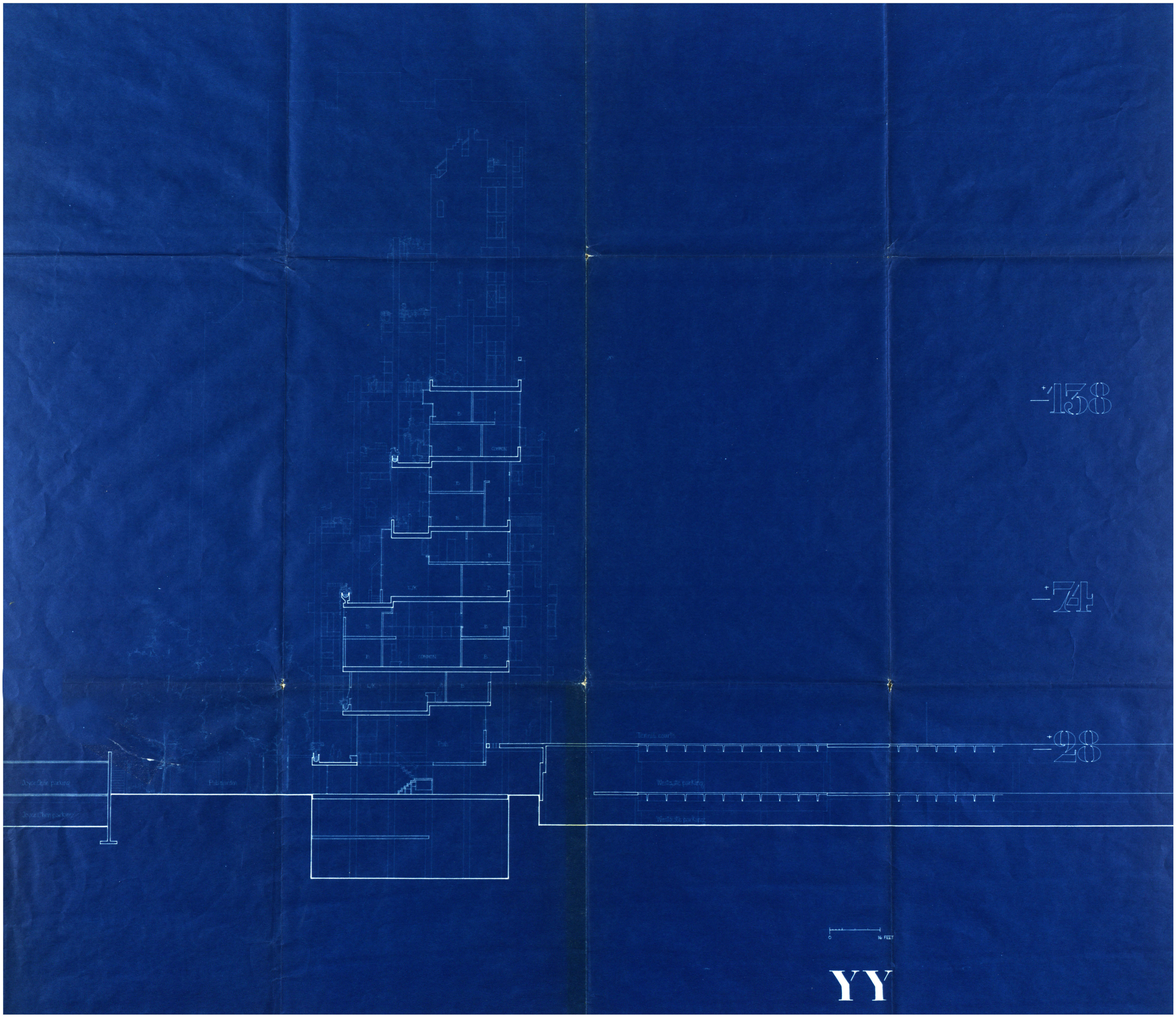
+138

0 16 FEET



XX




+138
+74
+28
COMMON
Pub
Tennis courts
Westcastle parking
Westcastle parking
Joyce Dale parking
Joyce Dale parking
Pub garden
0
16 FEET
YY