INFORMING DESIGN DECISIONS: AN APPROACH TO CORPORATE BUILDING DESIGN

by

MARC A. MAXWELL

Bachelor of Urban Planning and Design
College of Design, Architecture and Art
University of Cincinnati
Cincinnati, Ohio
198Ø

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Signature of the author________

Marc A. Maxwell
Department of Architecture
January 16, 1985

Certified by________________________

Ranko Bon
Assistant Professor of Economics in Architecture
Thesis Supervisor

Accepted by________________________

Shun Kanda
Chairman
Departmental Committee for Graduate Studies

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Submitted to the Department of Architecture on January 16, 1985 in partial fulfillment of the requirements for the degree of Master of Architecture.

This thesis is an investigation into design methodologies. How do we, as designers, prepare ourselves for decision making and evaluate our assumptions and decisions? The intent is to employ this information as a basis for integration of architectural design processes with economic principles, decision methods and management techniques widely used in related disciplines. Given that architects do use heuristics based on common knowledge and values, it is appropriate to analyze these constructs. Re-evaluation, in light of changes in society, technology and the practice of our profession, will enhance the usefulness of such techniques.

The myriad of decisions required in all design processes force the designer to economize. Conventions are employed to save designers from the rediscovery of past solutions. Once a procedure or physical configuration has been accepted into our 'set of rules', how is it kept current and consistent with its original intent? How can we use more analytical procedures (i.e., life-cycle costing) to heighten our understanding of the designs we create.

Integration of architectural design into the larger process of building development is a parallel concern. As buildings become more complex, so too does the process of designing them. How architects interact with their clients and users can determine the success or failure of a project. The relationships established between collaborators in each design exercise, also influence both the process and the product of our efforts. This study is the author's search for a more systematic and integrated approach to challenging or corraborating existing conventions. Formalizing their uses and organizing the process of acquiring such procedures is equally important. The value of such heuristics is greater efficiency in the building design process. Understanding of the overall development process can help designers make more informed decisions, leading to better designs and buildings. The intent of this study is to illustrate that issues confronting the architect's client can aid the designer in his/her tasks and selections without unduly constraining design goals and inspiration.

Thesis Supervisor: Ranko Bon
Title: Assistant Professor of Economics in Architecture

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PREFACE

This thesis is a personal exploration into the process of architectural decision-making. Investigation began with a search of current literature as to the process of design and how the architect and the client have traditionally viewed that process. The introductory chapter is a synopsis of that investigation, including information gleaned from the available literature, interviews, work experiences in both architectural design offices and more recently in a corporate Facilities Management group and research conducted specifically in the pursuit of this project. "Building Economics and Architectural Design" is the complilation of several theories about the design process, management techniques and the synthesis of these varying perspectives into a more comprehensive "model" of design. The third major section, "Issues in Building Economics," is a primer of the topics thought by the author to be most salient to this discussion. Some explanation of how both architects and corporate clients perceive such issues is also included here.

The "Park Square Building Case Studies," serve as illustration of the concepts outlined in the previous models and explanations. They have been used to test the "thesis" of this project. Each case was examined as a design and decision process. How economic analysis was utilized by the designer concerning the architectural design issues and by the corporate client as decision information was central to this research. The cases are intended to show examples of how financial and economic criteria, opportunities and constraints presently affect, or could affect building design and investment decisions. The case studies also include some additional analysis generated in the course of this research, to augment that which actually took place. Each case concludes with a short discussion of the economic indicators and analysis that might have been employed in the design and decision process and how this could be used to inform the architect.

The final section, "Conclusions," presents a general synopsis of the case studies, and those economic considerations that might have been explored by the architect. This essay is intended to highlight those economic and financial issues that are most useful for the designer and how our design methodology might be expanded to incorporate them. The last section of this study is based on the conceptual knowledge that can be inferred from this thesis investigation. The case studies and analysis of the theoretical model presented suggest that a new, more comprehensive model of architectural design would include design criteria generated by both the architect and the corporate decision-maker. In this way the architect can better inform him/herself of the issues most important to the satisfaction of the client's objectives for architectural design and the subsequent buildings produced.

INTRODUCTION

INTRODUCTION

> METHODOLOGY: 1. A body of methods, rules and postulates employed by a discipline: a particular procedure or set of procedures. 2. The analysis of the principles or procedures of inquiry in a particular field.(1)

This thesis is an investigation in the methodologies used by designers. Much of the architect's design activity has long been accepted as a personal and intuitive process, difficult to teach and rarely explained. The product, be it the completed design, drawing or building, is left to speak for itself. Often it is difficult for the architect to describe why a particular design decision was made. The client, similarly, has a hard time understanding how the design, or in some cases the building, came to look as it does. While there is little consensus in the field of architecture as to what a comprehensive body of knowledge identified as the basis of design would include, there are some generally applicable tasks and dilemmas to be dealt with. Given the evolving nature of the role of the architect in our society, and in the profession, it seems prudent to investigate how the processes and tools of the architect might also change.

The best teacher of architectural design and practice appears to be experience over time. The appropriate

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(1)Webster's Seventh New Collegiate Dictionary (1969).

knowledge can be acquired, and seems to become intuitive at some point in the career of architectural designers. Some of this knowledge base must therefore be transferable. Many of the techniques and procedures one learns over time are methods of problem and situational analysis. The intent of this research is to elucidate a methodology for making more informed decisions in architectural design. Often this seems to rely on asking the correct questions early enough in the design process to impact the eventual product. As a practical consideration, any investigation into a topic as complex as design methodologies must be bounded within manageable limits. The predisposition of this study is the practical use of economic and management techniques in architectural design. It seems most appropriate to further constrain this research to commercial and corporate clients, and projects. While there are realms of design that deal more clearly with personal expression and pursuits (e.g. single family custom housing) these do not lend themselves to discussion of the appropriate use of a more systematic approach to gathering and synthesizing design information. The intent of this thesis is not a more efficient diagram to build, but rather to expand the base of information and diagrams upon which to build.

WHAT THEY NEVER TAUGHT ME IN DESIGN STUDIO!

In proposing the thesis topic of building economics and its uses in the design process, the question was asked, "Why would a design student be interested in such issues?" As a student of architectural design, with a background in planning, and having worked as a project manager, it seems immensely apropos. While we are taught to design a space or building according to its program or ultimate use, rarely is there any discussion of how a project will or even could be realized. Only recently has the architect begun to accept the role of developer, taking ultimate control and responsibility for the entire design and realization process. More often, the architect is the designer and consultant to others.

The Church and Royalty historically served as the patrons of architecture, building and facilitating great works of art, including buildings, for various purposes. As discussed in the Future of the Architectural Profession seminar (2) the corporation has become the modern patron of architecture. With this shift in the facilitators, or financiers of buildings, so to have the priorities, purposes, and process of design. Hence, this study is an investigation into the potential changes in that process, given other shifts in the

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(2) Future of the Architectural Profession Study Group, Department of Architecture, M.I.T., Spring, 1983.

overall scheme of how buildings are created.

Much has been written in the very recent past on topics such as building economics, life cycle costing, and building evaluation. The myriad of publications illustrates how important this discussion has become. Given limited, and in some cases dwindling resources, and escalating costs of both materials and labor used in building, efficiency in the way we use finite commodities is imperative. The architect must remain the advocate of quality design, architecture of social value and good aesthetics. However, if we are to actually see our designs built we must also expand our expertise. This study is not meant as a departure from the traditional roles of architects, but rather a broadening. It is far easier to redesign a plan on paper than to reconfigure an existing building in the physical environment. Time and energy expended in evaluation and analysis of proposed designs seems a small expense in comparison to construction, renovation or demolition of poorly conceived buildings. One need only compare the dollar value of the designer's fees to the life cycle costs of any building project to see how well invested additional design time might be. While no one has yet determined exactly what the best level of design effort is, this too is an interesting topic worthy of further investigation. This study is intended to expand the types of questions the designer should ask of the client to aid in the creation and evaluation of architectural designs and alternatives.

This discussion is not to the end of continual reworking of designs. Rather it is intended as impetus to the architect to ask the right questions early on in the process of programming and designing buildings. Far too often enthusiasm to secure the commission and then to explore some new avenue of architectural expression propels us into the process without enough information upon which to proceed. Being the advocates of "design" should not preclude any thought towards practical or business concerns. How frequently have we heard the proclamation, "that's a problem for the engineer to solve" or "the owner will pay for it when he sees how much it will add...". By expanding the parameters of our thinking beyond the creation of space, architects are not necessarily throwing over good architecture for financial profitability. Hopefully there will always be a place for exceptional places in our buildings, exceptional buildings for that matter. But if there is no thought towards the business concerns, the long range benefits and costs of a building, there will likely never be a realized project at all. There is a balance to be achieved between good design and good business. And while some will argue that pure design is an artform in itself and does not require the legitimacy of physical presence, this too is a radical departure from the traditional notion of the profession of architecture.

If one accepts the corporation as one of the modern day patrons of architecture, it seems advisable to be conversant in the language of that field. One of the monumental tasks of the architect is the role of coordinator in the ever increasing complexity of the building process. It is important that the architect recognize when it's time to bring in another expert. This is not simply a method by which to diffuse responsibility and liability in a project, but a decision in the best interest of the client to employ the best available expertise. As our building technology becomes more sophisticated, the practice of architecture reflects this in a movement towards specialization. It is important that we not lose control of the overall process because of this division of expertise. Rather it is paramount that the architect know when to bring in the right consultants and be able to evaluate their work in relation to his/her own, as the designer is likely the only member of the team who maintains an understanding of the building as awhole. Herein lies a new skill for the designer, to facilitate the diverse work of others while keeping the conceptual integrity of the project. This must include not only the design concept, but the owner's thoughts about the use, life span and investment in the building.

BUILDING ECONOMICS

There are a myriad of decisions in any architectural design process, many of which can be based on economic as well as aesthetic concerns. Life cycle costs, the need for change and flexibility to accommodate such change over time, total benefits that might be derived from additional initial costs, and some comprehensive notion of the whole project and overall expenditures are all worthy issues. Each deserves some integration into the design and decision-making process. The intent is again, not the exclusion of more traditional concerns of architectural design, but rather, the expansion of the information considered useful in the process of architectural decision-making.

The corporate client of architectural services has long taken a more analytical view of buildings, seeing them as the huge capital investment they are. Architects need not only think of such discussions of economics as "budget" constraints. If one accepts the changing nature of buildings and spaces over their lifetimes, it is useful to match components and permanence consistent with this anticipated use or life span. In a recent article on professional practice, Barry LePartner stated, "Every client that entrusts his or her assets to a designer is looking to maximize that investment. Being alert of the most cost effective ways to spend a client's money does not necessarily mean finding the cheapest way." (3)

Issues of investment in new construction, renovation, preservation and maintenance can be used to the designer's and user's ultimate advantage. Building economics must however, be constructively and creatively applied. Corporate clients often have agendas and goals quite different from those of the architect, but not necessarily conflicting. The designer who is aware of the client's needs, beyond simple programmatic requirements, is far better prepared to work with and design successfully for that client. The concept of change over time again emerges. Design and material decisions might well be based on the client's needs such as initial costs, life cycle benefits and costs, and the expected useful life span of various components or projects. The timing of when such concepts are discussed with the client, as well as when they are included in the overall design process, is also critical. The inclination of architects to shun economic analysis of their designs may be a product of the past misuse of such devices. Building economics should not be employed only as a last ditch effort to rationalize questionable decisions, or to trim the total

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(3) Lee G. Copeland, "Architectural Education: Balancing the Practical with the Humanities," Architectural Record (January 1984) Pages 45-47.

project cost in the "eleventh hour". If the architect raises these issues early in the design process this analysis and subsequent criteria can be most useful. All too often the ramifications of design decisions are known too late in the process to efficiently or economically evaluate or change the design. If the designer were to include economic criteria throughout the design process, alternative design solutions could be constantly and consistently evaluated. Decisions between alternatives could then be decided in regards to these issues of investment and finance in addition to aesthetic and conceptual criteria. Few would dispute the notion that it is far more efficient to redesign a building on paper than to alter the physical building, but it is difficult to make this point to a project manager when the design budget is expended or the project several weeks behind schedule. Using economic criteria in design is not necessarily counter to the creative process, as many architects may believe. The aim of this study is to explore and illustrate how the architectural designer might better prepare him/herself with adequate tools and information with which to make more enlightened decisions in the design process.

Architects do think about optimizing designs; making the best use of scarce resources, including their own design time. Often this process is simply not thought of in these terms. A great deal of time is spent refining designs, working toward the most efficient, yet pleasing, balance of materials, craftsmanship and function. Without always employing explicit methodologies, architects do use "rules-of-thumb." Empirical analytical techniques are regularly utilized in the design process. Which building details and configurations worked well in past projects, how much time and energy is appropriate for a specific design task and what types of projects to specialize in, are all examples of economic principles applied to the practice of architecture. Most frequently these tools have been employed in the management of design offices.

Few architects claim to be experts on economic theory, but many are quite shrewd at analyzing market forces and demand for their services, as well as in marketing their own expertise. Design is not necessarily compromised by this savvy. An architect who cannot secure and fulfill commissions in some economically feasible manner will have little impact on the physical environment. While many appreciate the exceptional skills of the masterful designer, it seems prudent to prepare ourselves to design in light of the client's concerns for investment in buildings, and the constructibilty and maintenance of those investments.

When designers do employ economic analysis to building designs it is not always skillfully done. Often comparisons are made of unlike quantities. The objective of life cycle costing, or economic evaluation of building design, is not purely to justify higher first costs in a project. It grows out of a desire to maximize benefits derived from building expenditures and to minimize the total costs over time, the building's life-cycle. If a building is continually thought of in terms of the large capital investment it is, as well as the physical expression of the architect's skills, new concerns will emerge as central to the process. Decisions the architect is asked to make take on new meaning in this economic context.

The actual commissioning of the architect usually takes place after some investment decision by the client to move forward on such a project. The architect would be well advised to investigate what decisions have preceeded his/her involvement. As the designer is seen as the visionary in the building process, able to conceptualize a series of spaces and generate an architectural plan, it is appropriate to view the overall design through the perspective of the client, or owner of the eventual product. As an investment, all relevant inputs (costs) and outputs (benefits) should be accounted for, or at least considered in the planning process. Life-cycle costing is a method by which to accomplish this task. Each major decision in the design process can then be evaluated in this regard.

The architect should beware of subdividing the complex whole into its component parts. The role of the architect as "coordinator" suggests that the whole must be kept in mind, the integrity of the concept maintained. Similarly, the life-cycle cost and benefits should be considered in light of the entire sequence of the project, from inception through its realization and possible demolition. If the selection or development of a site is a component of the architect's services this discussion might be expanded to include site redevelopment, the second or third generation of use of a parcel of ground. Likewise, buildings should be thought of in the context of the economic process in which they exist. Few developers would undertake a large scale project without fully investigating the market forces present in the vicinity of a proposed new development. The architect should also become conversant, if not expert, on the applicable economic forces present in the context within which his/her work will take place.

In the Fall of 1983 the Department of Architecture at M.I.T. undertook a study of the Future of the Architectural Profession. The author of this thesis was a member of the assembled working group. Several of the conclusions of the draft report are appropriate to reiterate here. The following is a distillation of observations made during the many months of discussions:

> Demand for traditional architectural services is probably diminishing.

> In the future, the successful practitioner will need to be equipped with a mix of skills, knowledge and values...
>
> The architectural profession is diversifying its services and expanding its business horizons beyond traditional ones, and this is enhancing the potential of the future of the profession as a whole.
>
> The relationship between an architect and the client has always been among the most critical factors in acheiving design, as well as project and business success. In this regard, helping the client understand and convey his, her, or their needs, interpreting them and helping them to provide constructive input during the process has always been important and difficult. The complex and significant nature of today's building projects makes a successful relationship even more important.

In his draft final report, Bruce Anderson states,

> ... the design process is not the only asset of the architect. In addition, for a person trained in the design process to be able to apply it to buildings, he or she must understand buildings, products and materials, building and environmental science, engineering and technology, economics and finance, planning, landscape architecture and interior planning, real estate development and construction management, architectural history and human sociology. (4)

The specific aim of this thesis is investigation directed at several of these topics: economics and finance; management and planning. In the "Observations and Implications for Education" section of this seminar report is found the recommendation that future:

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(4) Bruce Anderson; Studies Director, "Draft Final Report: Studies of the Architectural Profession." M.I.T., September 1983, pg. 4.

> ...practitioners will need a full understanding of basic unchanging fundamentals in various fields of knowledge in which they deal. (ie, the list of topics appearing above) The emphasis here is on understanding of conceptual tools not on rote training of specific facts that change over time. Additionally, practitioners will need to have skills to easily access, interpret, evaluate and synthesize vast quantities of data and other information in light of their knowledge of basic fundamentals. Skills to organize information will be useful ...(5)

Dwindling resources, along with other costs associated with constructing buildings require more careful planning, designing and execution of resource-using projects. It becomes increasingly important for architects to possess the ability to satisfy clients' needs, not only architectural needs but those related to the cost and performance of their building. "Architects should be trained to understand the consequences of their design decisions ... economics training, including skills in analyzing the cost trade-offs of different design choices, their life-cycle cost implications ... is of great value in making more informed design decisions." (6)

While the objectives of such mandates seem clear, no systematic method for analyzing economic information concerning architectural designs exist today. Practitioners do use rules of thumb, but often in an haphazard fashion.

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(5) Ibid., pg.17.

(6) Ibid., pg. 18.

Many, especially younger designers, possess little understandable knowledge of the cadre of techniques that might be applied. The aim of this research is to elucidate such a methodology. Conversant in such knowledge, architects might better inform themselves of the larger ramifications of their decisions and be more fully prepared to communicate such facts to their clients.

Amos Rapoport, an architect, writer and educator, recently wrote about the need to downplay the importance of studio education in architecture:

> The purpose of design is to provide settings appropriate to the bio-social, psychological, cultural and other characteristics and needs of the different people for whom the design is being done. This means that the most important decision is what to do and why to do it rather than how it is to be done (which comes later), with which design has been traditionally more concerned. ... Furthermore the decision about what to do and why must be based on the best available information, on a body of literature, on research on man-environment interaction, on theory rather than the likes and dislikes of designers. In fact, I have argued that in its strong form this position may involve designing something that the designer dislikes or even detests. In setting explicit objectives for design, criteria are also set for evaluating how successfully goals have been met. When this process is repeated, there is hope of developing a cumulative body of knowledge and theory. (7)

Architecture as a profession often lacks clear design goals and criteria for evaluation. Rapoport believes these attributes are necessarily related to, and dependent on, a theory. As there is no valid theory of design to transmit, it is difficult to teach design at all. The approach most often taught is "subjective, illogical and not cumulative."

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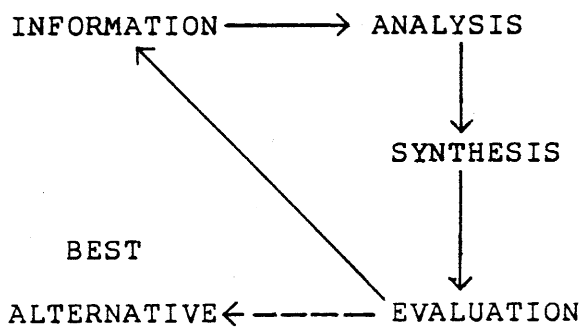
(7) Amos Rapoport, "Architectural Education: 'There is an Urgent Need to Reduce or Eliminate the Dominance of the Studio'," Architectural Record (October 1984) Pg. 100-103.

Architects may, in fact, be caught up in the decision of HOW to build rather than WHAT to build. A recent study, "Design Decision Making in Architectural Practice", examines the role of information, experience and other influences (including economics and the client) on the design process. (8)

This study provides a good description of th problems besetting the prevailing architectural design process. Employing a simplified, yet appropriate model for design, it defines design as the act of working on and solving a design problem.



From this study it seems clear that what the architect should build, "... receives the least attention -the initial idea is developed rapidly using little information and research but it also rarely changes much. This fundamental decision is based on the designers' own experience." (9)

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(8) Margaret Mackinder & Heather Mavin, Design Decision Making in Architectural Practice (Building Research Establishment, Institute of Advanced Architectural Studies, University of York, April 1982).

Mackinder and Mavin's summary report includes many useful observations. Initial design concepts are typically produced by experienced architects, after client contact, with little exploration of alternatives. Subsequent detailed decisions are made by less experienced staff, with or without client contact. The bulk of project time is spent on refinement, minor matters of detail, small changes and choosing materials. Architects most often do not record progress, decision routes or administrative matters. Projects progress at irregular speeds due to office workload, delays in negotiation and statutory approvals, problems of client communication, finances and site acquisition. Therefore, it is difficult to predict how long projects will be in design and in the architect's office. This leads to problems in meeting client deadlines and in predicting design fees.

Recurringly, experience is seen as a most important resource in the design process. Performance data is not systematically collected, so little methodology exists upon which to evaluate past successes and failures. Cost constraints are initiated in the client's budgetary process. Many large decisions are made based on financial criteria. Unrealistic or compressed timeframes limit the study of alternatives, analysis of client objectives and criteria. Many major decisions are based on cost criteria alone including lender's requirements and review. Often no clear

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(9) Rapoport, pg. 100.

guidance from the client exists early enough in the process to be effectively used by the architect.

The existing pattern of decision-making suggests design solutions are progressive. More detailed information is available only as the process continues. Problems that do arise are identified only after a fair amount of the design budget has been expended. Cost estimation is often done only after working drawings are fairly complete. Analysis takes place too late in process for effective use a design tool.

Many external influences exist in the decision process. Time factors, such as the delays mentioned above and cost constraints are always present, but do not overtly manifest themselves until detail decisions are being made. At that point cost can become a prime influence. Cost trimming, to meet budgets, often causes backtracking and stripping the building of its "design features", often generating animosity on the part of the architect toward his/her client. Architects, clients and users lack appropriate information at pertinent times in the design process. The vagueness of client intent and objectives further obscure the scope of the project and budget. Changes late in process, coupled with problems of communication, complicate the design process and easily overshadow the original intent. Changes often occur faster than the process can effectively react to these changes. LCC and energy conservation are usually not explicit topics during conceptual stages, although they are ultimately important to the client.

ARCHITECTURE AS A CORPORATE ASSET

As architects we must be able to see buildings through the eyes of our clients. The perceptions of the observer are as important as the conceptualization in the designer's mind and drawings. If the perspective from which a building is viewed is shifted, what effect does this have on our perception? Adopting a view of architecture and buildings from the standpoint of the corporate client does in fact affect the priorities of the observer. While many argue that the "corporate mentality" is an indefensible outlook, especially for the designer, many architects accept offered commissions. Michael Brill, an architect and noted researcher on productivity and design, recently stated that office buildings and the space they enclose are tools for the organization. (10)

Buildings represent a huge capital investment on the part of the developer. In the case of large commercial buildings, be they high rise or some other configuration, only large

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(10) Michael Brill; President of BOSTI, Buffalo Organization for Social and Technological Innovation, address to the "Search for Excellence, '84" Conference, M.I.T. Office of Facilities Management Systems, Cambridge, Mass. 15 October 1984.

corporations and governments command sufficient resources to undertake projects of such scale. So, in studying the effect of economic analysis on the design of commercial buildings, it seems only logical to assume the perspective of those most likely to instigate such a project.

GOOD DESIGN IS GOOD BUSINESS

Thomas J. Watson, Jr., Chairman of the Executive Committee, IBM Corporation, had what must have seemed to be strange ideas about the role of design in the business world. The following ideas are abstracted from an essay presented by Watson some years ago.(11)

He felt, "design must reflect the practical and the aesthetic in business but above all, 'good design must primarily serve the people.' Good design is a key element of corporate responsibilities to the nation and the world as well as business survival." Echoing the high standards of design Watson admired in the Olivetti Company and its design excellence, he developed a corporate philosophy and supporting policies with regard to design management. This included striving for a unified presence to the public, through IBM's products, employees and their architecture.

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(11) T.J. Watson, Jr. "Good Design is Good Business," The Art of Design Management (Philadelphia: University of Pennsylvania Press, 1975).

When queried on what constituted 'good design', Watson responded that it must compliment human activity and facilitate the tasks at hand. Design, color and building interiors should not dominate the worker or customer, although Tom Watson appeared to understand well the idea that architecture could be used to influence behavior. He endeavored to make others at IBM aware that cost per square foot was important, but so was premium design. Watson placed a high value on the architectural quality and image he brought to the corporation.

"Design in industry usually encompasses a mixture of the practical and the aesthetic." Similarly, Watson believed there was a healthy tension to be capitalized on between a good, strong designer and a "purposeful" company like IBM. The dialogue so created, between the architect and the corporation, could be used to the advantage of both. Corporations offered a new and powerful client for the field of architecture. Early in this century industry began to realize the opportunity good buildings provided for their image, productivity, and investment potential. In the pursuit of such characteristics in their buildings, corporations like IBM sought "Design Excellence." Watson wrote, if an organization is well designed, "...it can respond to the future. It can change its form and it will remain competitive. But if it is rigidly designed and inflexible, an industry can go out of business within a few decades." Watson saw architecture in the same light that he saw the corporation he headed for so many years. It must remain responsive if it is to endure and continue to be productive economically. "Certainly good design favors the relationship of the corporation with its many publics..." Other large corporations have begun to understand and have employed similar thinking to their buildings and the architectural image they create for themselves. Architects would be well advised to further their appreciation for a similar understanding.

The legacy of Mr. Watson's theories of business and architecture can still be seen in the corporate policy guidelines at IBM. The following illustrates this point as expressed in current corporate documents.

> IBM wants to maintain and extend its reputation for excellence in its buildings as well as its products.
>
> Excellence in architectural design is herein defined as the optimal balance of the following factors:
>
> a. Appearance- IBM building and building interiors should be simple, straightforward, attractive and contemporary. They should be well related to location and community. They should be devoid of extravagance, frills and unnecessary decoration. Within these limitations, the exploration of promising new methods of architectural expression is to be encouraged.
>
> b. Economy is the key to IBM's success and IBM buildings should reflect a respect for the economy of their appearance. Economy applies to the continuing costs of owning the building as well as

> the initial costs. True economy is the best balance of cost and utility.
>
> c. Function- the building design should provide the most efficient performance of its intended function.
>
> d. Quality- the quality of a building shall be consistent throughout all systems of the building including architectural, structural, mechanical, and electrical systems. The consistency shall carry through the interior design, layout, furniture and furnishings. The quality should be of a level to provide the optimum balance between initial cost and operating cost.
>
> e. Safety- the building design should consider safety of the employees, service personnel, and visitors.
>
> Ideally, excellence of design is obtainable through architectural attention rather than extra expenditure. However, additional investment may be required to achieve distinctive architectural results. If the additional investment is needed, the need should be treated as a project requirement.(12)

The ramifications to the architect are great in these few lines. Herein lies a notion of optimizing the balance between the aesthetic, the image of the building and the initial and long range costs. A company like IBM may be quite willing to pay more for a "better" building, but it most likely will also demand a higher level of design, predicated on a multitude of agendas. Flushing out the client's priorities presents a most promising expenditure of the architect's design time early on in any project.

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(12) IBM Corporate Facilities Practice. "Architectural Design," Document No.CFP 1200, May 1975.

ARCHITECTURE AS NEGOTIATION

The profession of architecture, and the way in which architects and non-architects think about the buildings and cities we create has changed markedly in the last decades. A shift in attitude about the role of the architect in the design process has taken place in the last 20 years, away from "professional imperialism" (Gans, 1978) and toward a more participatory notion of design. The designer's goal was, and is, to create environments which meet the needs of the inhabitants. Implicit in this goal is some recognition of optimization, satisfying as many client objectives and needs as possible through careful design.

Architect-client interaction is essential in this new process of design, since the objectives and needs of every client can be thought of as unique. Design solutions must be developed for the particular circumstance. Due to this "uniqueness", design solutions and their consequences are outside the expectations of the client and the architect. This new design process carries with it a high degree of uncertainty regarding the outcome, product and externalities of a project.

"Good" design relies upon bringing together the architect's professional expertise and the client's expertise concerning his/her own needs and desires. Together, architect and client formulate the solution, yet their respective goals and purposes, and therefore solution images, may conflict. As architect and client formulate images, they must be brought to light and negotiated.

Dana Cuff, in a series of papers about the process of design, has offered a theory that explains the complication set of interactions as the "process of negotiation" in architecture.(13)
Through these papers, Cuff puts forth a convincing set of arguments as to how architecture in large part emerges from the negotiations between people and that the design of these negotiations influences the design of spaces. This line of reasoning illustrates why an architect would want to look at such topics as design and decision processes to begin with. By better understanding the design process and the network of interactions involved, the architect can more easily communicate with the client, influence the design process and hence the actual form of relationships he/she may be called upon to create.

Cuff goes on to show how past study of the architectural

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(13) Dana Cuff, "Negotiating Architecture". Center for Planning and Development Research, Department of Architecture, University of California, Berkeley, 1981. and "The Context for Design". College of Environmental Design, University of Colorado, Boulder, 1982.

design process has taken what is actually, "a richly complicated, idiosyncratic, political, economically contingent activity and reduced it, as if rubbed with a coarse sandpaper, to a nondescript, objectified set of generalizations that corresponds neatly to a legal contract."(14)

Making generalizations about the design process while respecting its intricacy is not an easy task. Architects are taught early that there are no grounds for generalizations since each site, client and program is unique. In the same discussion many architects will reiterate that experience is the most important qualification for architectural practice. Only after one has encountered the problem of designing for many clients and a multitude of projects does one actually know how to proceed in this difficult and delicate set of tasks. While this may be true, it offers little hope or guidance to the architect as to a strategy for design. In today's architecture, with its increased complexity and liability, the specialization of technical skills, and at times uncertain economy, we must prepare ourselves with whatever means are available. The era of the lone architect, acting in all roles, truly the "master craftsman" of the building process, is no longer with us. Few individuals can survive the present context of design and building.

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(14) Ibid.

Architecture can then be thought of as a negotiation process. The building's requirements and form emerge from the interactions between the various participants. At times it may be difficult to clearly identify the client. Advocacy planning theory of the early 1970's presented the architect with a new model for design. It is now acceptable for the architect to work for the unseen client in terms of the design, while balancing and respecting the objectives of the known (paying) client. This new arrangement requires the architect to work on many levels simultaneously. It also further complicates the process in that the concerns of the obvious client, and the "real" client, those who will inhabit, work or experience the resultant architecture, must both be dealt with. Often the client is not an individual at all, but a public agency or corporation. When dealing with a corporate client it is likely a corporate representative, the in-house architect or coordinator, that the designer must work through. This person is clearly not the eventual inhabitant, yet is a force in the design process and an advocate of the company's interests. Again, these changes in the overall process of architectural design has caused many changes in the way in which architects must go about the practice of their profession. Many new obstacles have emerged between the architect, the design and the eventual user.

No matter how effectively architects and clients communicate, they will not always agree since they have different stakes and interests in the design process. Similarly, no two client-architect relationships will be exactly the same. Client and architect are brought together for a myriad of reasons. Often the discourse between parties is intended to be more casual and friendly than businesslike.(15)

As previously mentioned, many clients, especially corporate ones, are uncomfortable with this lax attitude toward the business of architecture. It is quite understandable that clients who are about to invest large sums of capital in the development of a building, as well as in the design itself, are understandably hesitant to forego a businesslike attitude toward the process and interactions themselves. Many projects only develop a good working relationship with the discovery of a common adversary like the building department or an uncooperative contractor. In this way the antagonist serves to unify the client and architect into a team, struggling for their common goal. How might the architect establish a more effective communication method with the client before such serious crises arise?

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(15) Dana Cuff, "Negotiating Architecture". Center for Planning and Architecture, Department of Architecture, University of California, Berkeley, 1981, page 2.

It seems promising to keep the client involved throughout the design process. This task can be time-consuming for the architect, but a project is more apt to run smoothly if the client participates in the decision-making, is kept abreast of incoming information and responds to new developments. Usually, clients are less flexible than architects in terms of acceptable solutions, perhaps rightly so. At the same time many architects complain that clients change their "needs" all too frequently. This makes communication even more important for the architect, to keep information flowing throughout the process. Cuff states that the architect must learn to "negotiate" changes as a project develops. New information and new directions are a part of the overall process. Simply because we do not like them does not mitigate their importance to the design. One must accept the dynamic process of design creation in light of the quickly shifting priorities of the corporate client. The successful architect will learn to willingly rethink the problem when new information or a problem surfaces.

How the architect deals with new information is also important to the overall design process. When clients are not aware that a change in one aspect has extensive implications, a ripple effect, the architect finds himself in a time-consuming, hence fee-consuming, situation. Simultaneously, the client is disappointed by the delay. Ideally, the client is clear and decisive so that the architect can proceed expeditiously, confident that the design solves problems adequately. But the architect who wants the client's careful consideration must be open minded about the changes that will lead to an appropriate building. The root of the problem of new information is within the architect: wanting to meet the client's needs and not wanting to lose money or design integrity.

Because architecture is a unique situation in which roles, outcomes, process, gains, losses, progress and conclusions are crucial but unclear, the negotiations that feed place making are complex.(16)

"Perhaps the prevailing discrepancy between architect and client both in actual and imagine terms is their attitude toward the budget. Clients maintain that architects either do not worry about the client's pocketbook, or do not know what things cost."(17)

When the design is held most sacred to the process a client may assume his economic situation is not being respected. Offices that do prepared careful cost estimates may use this as a promotional key or as an "additional service" for which they are entitled to additional compensation. Few clients understand the separation of the design of a building and

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(16) H. Rittle and M. Webber, "Dilemmas in the General Theory of Planning" <u>Policy Sciences</u> 4, (1973): pages 155-169.

(17) Cuff. page 3.

the cost estimation of that same project. One has little meaning to the non-architect without the other. A developer may care less about the building than its economic feasibility. Corporate clients, savvy in business affairs, will be disquieted by the relatively casual, inefficient operation of architectural offices in regard to the financial ramifications of their design decisions.

"From the architect's side the budget may get squeezed so tightly that the building gets martyred. To save money the client starts cutting the project down to the bare bones, sometimes cutting aspects important to the architect. In other instances the architects withhold informal cost estimates if money seems to be the single force driving the client's decision. Clients seem to have little difficulty understanding total costs. The architect might, however, adopt a strategy of talking about total costs only in relationship to total benefits over the economic life of the project."(18)
One client interviewed by Cuff mentioned that she never knew if her choices impacted the budget significantly or if her architect knew an acceptable and more economic alternative. It almost seemed "impolite" to discuss financial matters too extensively.

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(18) Ibid.

Client representatives further complicate the process of design. When the final decision rests further up the hierarchy, a design may be reworked several times until it satisfies the ultimate judge. Priorities or criteria for previous decisions are too easily lost as the information (the design) is passed up the hierarchy. Perhaps the two realms that seem most obviously slighted are the ramifications of both business and human interaction in architecture. This research argues for an interactionist model, that the building emerges from the unique constellation of interactions between actors during the design process. The final decision-maker may not have been present in the whole set of interactions that precipitated the design product. Since the client-architect interactions do not happen in isolation, the study of negotiations between architect and consultant, and the client and his/her representatives, will form the context for the client-architect relationship.

Cuff's writings go on to further examine the context for design. She has identified six characteristics of architecture that make it a complex and unique practice. With negotiation as the principle means for resolving design problems, the basic decision-making process of architectural design involves two or more parties who seek to implement a single outcome. Negotiators hold some common goal, hopefully the building they are about to create, in addition to many potentially conflicting interests. The following comments are extracted from Cuff's paper, "The Context for Design":

1. **The Responsive Art:** Architecture involves the union of art and business. Without clients, architects could not practice their art, and clients are key to an effective business operation since they subsidize the entire architectural endeavor. The ability to aesthetically manipulate form is considered part of the architect's special skill. "...the blending of esthetics, function, space and materials" (19)

The "art defense" is a justification for design decisions on the basis of subjectivity, mystery and autonomy rather than rationality, explanation or compromise. The client has every right to expect that the architect will be familiar with and will utilize normal procedures of business administration. There is a general attitude among architects that good design cannot always come from consistent, pragmatic business practices. "Architecture is no normal business." Good design requires commitment beyond the allotted time, accountant's ledger, and normal working hours. This attitude is institutionalized by higher education in the form of the "charrette". While the dedication of the designer is a precious commodity, this type of thinking spills over into the entire design process. An easy expansion of this theory negates the architect from considering the economic ramifications of design decisions as long as the "good design" criteria is fulfilled. Designers are capable of generating problems by a limited view of the total process of creating buildings.

2. **Diffuse Influence:** The influence is distributed across a number of participants. The evolution of a building always involves a number of people. Each participant most likely, has a differing agenda, interest, knowledge and goals with regard to the final product. Their combined influence upon the process then affects not only the way the problem is solved, but the resultant building as

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(19) An Architect's Handbook on Professional Practice. (Washington, D.C.: A.I.A., 1975) Chapter 4, page 3.

well. In this design process the architect cannot, and will not work in a vacuum. As our buildings have become more complicated, so too has the expertise that must be called upon. Employing a team approach to architectural design does increase the knowledge base to be called upon. It also further diffuses the influence of each individual participant. The legal ramifications, the sharing of responsibility, and hence liability, has greatly change the profession as a whole. Hopefully the architect can find a niche that allows some sense of control and coordination over the process. The architect is called upon to provide leadership and direction to the cadre of participants and to integrate the diverse input from each. The architect's office must do this from some position of "control", contributing the direction and integrity to the overall process. The attention paid to the user and their relative satisfaction in the past two decades has also led to increased participation in the design process by the user and the client. All this, in conjunction with escalating costs of buildings, has created a generation of clients less willing to subsidize architecture for its own sake.

3. **Ambiguity:** The role expectations, procedures, authority, allegiances, and expertise in any design process are ambiguous. Five aspects of design process negotiations were observed to capture a great deal of the ambiguity in professional practice.

Expertise: The architect provides the clearest example of overlapping expertise since design education is intended to at least touch upon all the skills that contribute to making places.

Authority: The client as the initiator and patron of the project is the ultimate authority. But because of the architect's expertise and role as coordinator, it is often his responsibility to assume that authority.

Role **Expectations:** When decision-making authority is ambiguous, a context exists in which role expectations are also unclear. The architect's role will be modified with each client. Because clients are most often the participants with the least experience in the design process, they are most uncertain about their role.

Allegiance: Because roles, authority and expertise are somewhat ambiguous, there is a strong tendency to form alliances or coalitions in order to safeguard one's interests. These allegiances are fragile.

Procedures: Along with the above ambiguities, also unclear are the procedures by which a project will evolve --the course of actions that will be taken, the sequence of events, the way to go about reaching agreement, the means to develop an idea. or when a project should end. If the next step is unclear, the significance of the current step is ambiguous. Some architects say a phase is completed whenever the architect is willing to call it quits and the client approves the work. The approval, then, and not the conclusive development of the work itself, determines the end of a phase. The work is not intrinsically complete, but the architect and client agree to call it complete.(20)

4. **Unexpected Outcomes:** Although a single, specific solution is expected, neither the architect nor the client knows what that outcome will be. The process itself shapes the expectation and therefore outcomes. In discussions between actors in the design process, the relationship of a particular issue to the overall project is not fully known. Decisions do not derive from an overall vision, but help to create it. Buildings take on character over time, through use, and must be evaluated in relation to the human activity they accommodate. The design process leads to unexpected outcomes due to the principle planning media, drawings and conversations, which are simulations of the outcomes.

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(20) A.I.A., Chapter 9.

> The architect's primary function is to act as the owner's professional advisor. He develops his best solution for the project from the owner's criteria, prepares statements of probable costs, advises on the selection of materials, systems, and equipment to be used, advises on the selection of contractors, and acts as the owner's agent in dealing with others associated with the project. (21)

The architect works with the material provided, and shortcomings can be blamed on insufficient information.

5. **Open-ended Deliberation:** Since the information needed to make decisions is always somewhat incomplete, and every issue is potentially negotiable, the design process could go on indefinitely. Schedules and deadlines are established but there is no clear, consistent method for determining the time required to complete a task. The schedules may conform to external pressures which often overshadow the internal time demands (e.g. complexity of the project.) The design process is constrained by these deadlines, the number of waking hours the participants can devote to the project, and economics. Architectural projects characteristically take longer than expected, but they are not endless. Architects and clients need some constraints in order to find a place to start and in order to establish constants, so that everything is not negotiable. There is simultaneously too much and too little information.

6. **Buildings Matter:** The stakes are significant and the consequences serious. Buildings have a significant impact on the lives of architects and clients who plan them, and on the people who use them. Design decisions can be considered calculated risks that will have some consequences. The architect and client have significant stakes in the design negotiation process. The nature of those respective stakes are quite different. The

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(21) A.I.A., Chapter 9, page 3.

client's motivation to invest in architectural design is the anticipated satisfaction of some needs and desires. As financiers of the architectural enterprise, all clients clearly have some economic resources at stake. In addition, the building will make a statement about the client. Clients may or may not be able to articulate the statement they wish to present, or be aware how it might be accomplished, or be able to recognize whether the drawings represent that building.

Cuff concludes this paper with her intent to demystify some aspects of professional architectural practice. This potential she believes lies in helping all participants become more effective in the design context through greater understanding of its intricacies. For the purposes of this research, Cuff's description of the interactions between the architect and the client serve as an excellent model of the design process. The following section defines building economics and client financial considerations as they relate to the architectural design process.

BUILDING ECONOMICS AND ARCHITECTURAL DESIGN

BUILDING ECONOMICS AND ARCHITECTURAL DESIGN

> In the long run, buildings are judged in terms of the trinity of appearance, convenience and cost. The economic building is not necessarily the cheapest building but the one that provides the best value for the money, that is the one that is of good appearance and convenience in relation to the costs of constructing, running and operating it. (1)

Building economics begins to give the architect a set of tools by which to work toward establishing a balance between aesthetics, convenience and costs associated with buildings. This concept might also be thought of as "economizing" in the building process. The intent is to optimize the utilization of scarce resources while satisfying some human wants and needs for building. Architects seem to occupy an excellent position to economize in the design process. The ramifications of this process reach far beyond the initial cost of construction. In the planning and design stages of a building, relative expenditures of time and materials are small when compared to the whole building. Design and consultation fees usually amount to less than 10% of the total construction costs. "Similarly, the capital costs invested by the time construction is completed often are but a small fraction of the operation and maintenance costs associated with the project's whole life cycle. The

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(1) P.A. Stone, Building Economy, Design, Production and Organization, 2nd edition.(Pergamon Press 1976): page xi.

decisions and commitments made during that period have a much greater influence on what expenditures later in the project will be." (2)

In terms of commercial and office buildings the relative nature of design and construction of a building is minuscule in comparison to the salary expenses that will be paid to the eventual inhabitants of that structure. The point is not to diminish the investment in the building itself, but to illustrate how decisions made early in the design process carry more significance than we may have thought and therefore deserve more attention and analysis than they have previously received. It is also important to understand that the level of control the architect has in the eventual product decreases as the process unfolds. The architect enjoys maximum influence over the design at the project's inception. As procurement and construction ensue the architect's ability to regulate and alter the course of events wanes. The time and energy spent in the design process is therefore more effective and economically efficient in influencing the physical building. All of this presupposes that there is some need or desire for the architect to regain some level of control in the design and building process.

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(2)B.C. Paulson, "Research and Development",<u>Directions in Managing Construction</u>, edited by D.S. Barrie. (New York, N.Y.: John Wiley and Sons 1981), pages 422-424.

Buildings should be thought of in terms of the capital investment they represent. This is most easily understood in conjunction with commercial and corporate buildings. The development of such "non-residential" buildings is based on some expectation of profit from the required investment. As with other factors of production, buildings are viewed as one component necessary for producing whatever it is that company exists to produce. Unlike residential construction, which is more closely tied to the prevailing interest rate, representing the cost of borrowing money, corporate building is contingent on potential profit. From this vantage point it is not so difficult to view (or analyze) buildings from an economic perspective.

Architectural design is not the only opportunity to economize in the building process. It is, however, possibly the best. Five factors are drawn together in the production of buildings. They include: the client, the designer, the contractor, the producers of building materials, and the economic environment in which this production takes place. The client's role lies not only in providing the investment dollars to actually build the project, but in his/her ability to inform the designer as to the needs and priorities of the building. The architect must maintain a central role in the planning process, helping the client articulate the needs and priorities. This is often a most difficult responsibility. The architect's expertise must then unfold, in meeting those needs "... with a solution which is economic to construct and operate." (3)

Construction represents capital investment. Corporations frequently use retained income to finance construction and renovation projects. In this way earnings can be reinvested in the business and therefore are not perceived as profits, for tax purposes. Funds are thereby channelled into building without the need to borrow them. This practice somewhat negates the Keynesian investment model, which suggests the influence of interest rates on level of construction. Such investment is so financed, out of retained earnings, in the expectation of future profit.

THE ECONOMICS OF DESIGN

Given the scarce nature of virtually all resources, it is important to recognize the value of economic theory to the design process. Since absolute information is never available, the architect and the financial manager must always work with assumptions. The same types of analytical techniques that have just been discussed in relation to physical designs and alternatives can also be applied to the design process itself. While designs may always be further

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(3) Stone. Building Economy Page 4.

refined, there is a point at which more refinement adds to the cost of design without marginally improving the quality or economy of the final product. The term "good design", as it used in this study, is intended to imply that the highest reasonable level of quality and utility has been generated in the design. After that point in the design process, diminishing returns set in. Each additional unit of design time yields less improvement to the total design relative to its own costs. In undertaking life cycle-costing and similar economizing techniques, the designer must remain aware of such issues. The architect's time should be allocated to these exercises to cut life-cycle costs to their minimal levels while insuring acceptable utility to the entire project.

Pareto's Law suggests a method by which to allocate this effort. Buildings are made up of a variety of individual systems that are interrelated to create the larger total building. Each component system can be ranked by its relative cost to the other components. The most expensive system components are few in number and should be given the greatest scrutiny. The architect can thereby maximize the utility of his/her time, concentrating on only those systems and details which have the potential to yield the highest return from design time spent refining them. For each phase of a building's development and useful life the optimal allocation may vary. The Park Square Building case studies, found in a later section of this document, relate primarily to renovation with only limited new construction. The importance of this discussion is not reduced, simply altered from a similar investigation into totally new development projects.

USING ECONOMIC ANALYSIS IN BUILDING DESIGN

Economic analysis can help clarify the objectives of the project. The need to collect pertinent information to actually conduct the analysis forces the designer and the decision-maker to assess the goals of the project and to set criteria upon which to evaluate the alternatives. Analyzing the economic ramifications of various alternatives requires the designer to offer scenarios to be compared. Often the exercise of generating different schemes is precipitated by this need for comparison. As analysis and design continue the level of detail in both will become progressively more fine. The methods of economic analysis contemplated in this study require some declaration, or at least notion, of time horizons. For the designer this can serve as very useful information. Key decisions can be made relative to the owner's time frame as well as the architect's. While the baseline date, the date or year from which all financial calculations will be made, is essential to the financial strategy, the architect is often not aware of the ramifications of missing this timing. Following through on

LCC requires some discussion of the useful or anticipated life span of buildings, their components and uses. Creating a climate in which the client and the architect can share their perceptions on such issues will provide both with new insight into the entire design and building process.

Similarly, the architect can use this forum for ascertaining the owner's priorities in relation to which costs factors are most important. Initial capital and investment costs, financial scenarios, operations, alteration, salvage and functional use cost for the owner are relevant to this discussion. Often the client has determined a set of measures for economic comparison. This information can be quite useful to the architect, to focus component and design decisions on those characteristics and schedules the owner finds most appropriate for his/her own analysis. The point here is that economic analysis can be used to generate a level of discussion not always present between the client and the architect actively engaged in the design process. One should not expect the decisions to emerge from the analysis exercises themselves. These methods provide additional information for the owner and the architect to base and evaluate decisions. Making assumptions for the analysis causes the participants to simultaneously step back from and entrench themselves in the design process.

WHAT CONSTITUTES VALUE IN CORPORATE ARCHITECTURE

As previously mentioned, "good" value, like "good" architecture, is extremely difficult to define. Certainly there are several perspectives for this question for the architect and the corporate manager or investor. While architects will long argue the relative merits of aesthetics, corporate managers are often quick to place a monetary value on a building. This may be based solely on the costs associated with that project. Possibly some estimation of the benefits derived from that building and investment has been calculated into this dollar amount. Herein lies a method for the architect to educate the client. Large expenditures may be required in construction, operation and alterations of a building. This can, however, only be reasonably viewed in conjunction with the support and benefits generated by that building. Only recently have researchers begun to calculate the value that might be attached to enhanced work environments. Despite the infancy of this inquiry, the interest in this research is telling. Corporations are concerned with the cost and the value generated by their investment in buildings and work spaces.

As a total system, the architect might consider each input into the project (each component, energy for design, construction and operation costs) and begin to understand the potential benefits (outputs) that are likely to result. Thinking about the outputs anticipated; the benefits, the production process facilitated, the expended energy, would focus the architect on matters of great importance to the business manager. While he may be concerned with the satisfaction and well-being of those who visit and work in this space, that is but another component in the overall building system.

This discussion of economic evaluation does not negate the importance of aesthetics in architecture. How aesthetics are viewed by the corporate client is of great consequence to the architect. By more fully understanding the perception and expectations of the client as to the output, be it production, image or investment, the designer will be better prepared to make the decisions required by the design process. When the outputs of the project are not considered, a large portion of the building life-cycle, its ongoing use, is probably not being fully considered.

As the profession of architecture has learned to think about energy conservation as a requisite of "good" design, so too we must expand our concern to the other by-products of design decisions. Wasted energy is not unlike a component that cannot be serviced or easily repaired, or a detail that requires constant maintenance. These add up to constant losses in the system, dollars that must be spent simply to keep the total building operating, yet without a useful product of their own.

CLIENT INVESTMENT DECISIONS

As it is important to understand the changing nature of the value of dollars over time, so too can costs be evaluated in terms of when they are encountered in the building's life-cycle. The client may have specific concerns about when expenditures are incurred. The architect can chart the sequence of events for a building or component given the specific circumstances and its importance to the client. There may well be some optimal distribution of costs from the client's perspective. The whole building and all its component parts may not need to last the entire expected life span to meet the owner's financial plan. Total expenditures can be broken down into their component parts, initial costs, maintenance and operation, replacement costs, future, demolition and salvage costs. Criteria for decision-making may change given their timing in the overall building and investment life-cycle. Decisions on the best course of action for the corporate client are likely to be based on capital budgeting as well as more aesthetic and functional criteria. The role of the architect who is versed in the economic characteristics of the project can thus be expanded with this additional knowledge. This information can assist the architect in channelling his/her attention and time to those directions and decisions that the client's financial and functional criteria suggests. While the architect must remain the conceptual leader of the design project, there are often issues upon which the client is immovable. Further design investigation in some cases is of little value to the process.

The corporate client is often quite sophisticated in investment decision-making. Keynesian economic theory sets investment independent from income and more closely aligned with the prevailing interest rate. As interest rates increase, the level of investment drops. Architects feel this change in the number of building starts and more directly, after some lag time, in the number of commissions they receive. At the microeconomic level, each client (firm) makes investment decisions of which buildings, renovation and rent are but components, based on the expected rate of return. This measure is of the profit anticipated from that investment. When applied to architectural alternatives, through life-cycle analysis, it is possible to determine the rate of return on additional costs associated with various alternative schemes and/or components. In this way both the architect and the client can begin to evaluate the additional benefits that might be expected from added expenditures, as well as the total expenditure. Timing, in some circumstances, becomes the critical issue. The client's investment decisions are linked not only to the eventual building, but to the interest rate and to the anticipated return. The architect is often only apprised of the capital budget after it has been finalized in the client's organization. How much more reasonable might that budget, the client's expectations and the designer's vision be if the architect was invloved early in the financial process.

Additional decision criteria for the corporate client may include payback periods, discounted present value and the marginal efficiency of investment (described above as the internal rate of return.) Difficulties exist with all these methods of evaluation. While payback analysis suggests the fastest return on the investment, it does not necessarily consider long-term benefits or those accrued over time. Present value calculations better represent total benefits and costs derived in the future. A more accurate analysis considers total benefits, minus total costs associated with an investment over time. The product of this analysis gives some idea of the net benefits in present dollars. The caveat here, as with other long-term analytical techniques, is in predicting future costs and benefits accurately. There is a degree of uncertainty to all of these methods. That uncertainty is far less, however, than the risk one might associate with such decisions made without any recognition of future or long range consequences.

FLEXIBILITY BY DESIGN

As an example of economic significance to the building design process, long term flexibility is one central issue to corporations. For designers and architects the concept of flexibility must be dealt with as a comprehensive and integral part of the overall design process. The total building system and its parts must all address issues of flexibility or be, potentially, a hindrance to the entire system. The limitations of any subsystem, for example the HVAC or lighting, can effectively negate the flexible nature, and investment in that flexibilty, of other systems in the building. A general assumption for architectural design suggests that we rarely rearrange the structure and exterior enclosure systems in buildings. The basic concern here is for long term maintenance. It is therefore thought by many designers that flexibility is not of great consequence to the exterior design of a building. The structure, while under normal circumstances is unlikely to be drastically rearranged is, however, of interest in this discussion. The configuration of the "immovable" structural elements will forever determine the way in which the enclosed spaces can be used. The interior layout is, of all building characteristics, the most likely to require flexibility to meet the owner and user's demands. The use of space is possibly the most uncertain of attributes.

For the architect, some understanding of the corporate organization is helpful, not only for the more traditional activity of "programming" spaces, but for informing the designer as to the necessity of physical changes to be expected. Often organizations rely on such flexibility for their survival. Currently, the automation of the office workplace puts large demands on the built environment to accept and facilitate rapid rearrangement. The architect must evaluate individual decisions in light of this need for changeability. Mike Wodka, of the Facilities Management Institute, in a recent article contends that this analysis can most effectively take place if the designer looks at the facility in terms of its key elements. (4)

As mentioned, the exterior building shell and the interior envelope, making up the building structure, embodies little direct flexibility. Structural constraints do impact the other four major elements Wodka identifies: the technical system, process support, space delineation and process support furnishings. While these sound like complicated characteristics, they are quite easily explained and appropriate for the architect to consider throughout the design process.

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(4) Mike Wodka, "Flexibility: The Answer to Uncertainty", EOD, Page 28-30.

The technical system concerns the primary distribution of utility service through a building. For corporate users, as technology enters the work environment, it is essential that the main distribution system be designed to accommodate change. While the service itself may remain fixed, the system should be able to expand and contract its capacity as requirements change. The process support relates to the termination of the utility distribution system. The recepticle assemblies for the electrical system, ventilation outlets and light fixtures are all process (work) supports that must bridge the gap between the main distribution and the end user. The systems and components must be designed so as to be easily reactive to the change in use, design and work flow of the space they serve.

Space delineation refers to the elements introduced into the building shell to divide it into usable rooms, enclosures, stairwells, etc. Both fixed and movable walls have become commonplace in the architect's repertoire. When designers are asked to consider space flexibility, open office systems and landscapes quickly come to mind. This type of space utilization has awakened the profession to the corporate necessity for latitude in the ways that they can use and divide their spaces. In relation to flexibility, it is also important to consider permanence as well. This paper has discussed the longevity of buildings; this is a direct product of the durability of the materials from which they are constructed. The structure, be it steel, concrete or some other material, can be considered permanent for the life of that building. While the exterior wall system may also be "permanent," there is a possibility for change. The core of a commercial building is unlikely to be substantially changed, although components therein might (elevators or plumbing fixtures). Each of these elements has a descending order of permanence. A structure of concrete is more irrevocable, without substantially altering the entire building, than a core built of masonry units. Fixed offices may be built of metal studs and gypsum wallboard, while more temporary ones might be constructed of some demountable, full height partitioning system. Work areas that are of a short lived nature, requiring a greater degree of flexibility, will likely be created out of movable, low-height partitioning systems (systems furniture). Each method of space definition carries with it a characteristic level of permanence and flexibility. As space designers have developed such means to deal with business requirements, so too must the architect develop design methods that generate buildings and space that can more easily accommodate changes in use and function. Overall building layout and configuration of interior spaces can effect the flexibility as much as the method of physical division.

Architects often see themselves as the only advocates of drama in our buildings. Despite this desire for what Vitruvius called "delight" in architecture, Mike Wodka suggests present day architects must create spaces that allow for "two-dimensional planning." As building technologies have advanced, the distances easily spanned have also increased. Wodka recommends 6,000 to 10,000 square foot blocks of space for office use, with no permanent space dividers (columns, walls, cores). Typical core office buildings, especially high rise ones, contain floor areas of around 20,000 square feet with exterior core depths of 35-40 feet. For the flexibility required today, 75-80 feet seems more appropriate between fixed walls. This allows for subdivision into various function areas. So, what for years was thought to be a most efficient office building plan, the "donut," with its utility core at the center, is now seen as a hindrance to flexibility. The narrow space this configuration creates permits only limited options in density and arrangement.

A potential new role for the architect includes designing, and convincing client decision makers to build, "breathing space" into new projects. Additional space, while adding to the gross volume and hence the initial cost, will ultimately allow for the greatest flexibility in use. Another method to gain breathing space without radical increases in net square footage means reducing fixed enclosed spaces, like individual offices, to accommodate the largest variety of new spaces. Today's office uses include terminal rooms, communications, printer and processor stations. In his article, Wodka advocates programming and building these spaces into our buildings from the outset. Ultimately, the designer must be more careful to ask the client about his/her functional requirements and be prepared to respond to these needs in the physical planning process. To this end, a recently completed project for the Microelectronics Center of North Carolina was designed specifically for long range flexibility. Senior management in the client's organization mandated flexible design to the architects, O'Brien/Atkins Associates. They cited four basic principles for future physical adaptability: Oversized architectural systems (adding floor-ceiling height to accommodate possible use and utility distribution changes); providing excess communication and utility system capacity (all areas were cabled with an overhead wireway); spatial separation of permanent elements and uses from those most likely to change; and anticipation of potential growth scenarios. This last principle was applied to both interior and exterior architectural design. Inside, offices are constructed of demountable partitions. Outside, the building configuration and siting is such to allow easy expansion in any of several directions without constraints from the topography or property boundries. The cladding material, a light weight panel system, was chosen specifically to allow for expansion. This project required additional effort by both the owner and the architect to study future scenarios and how the building might be made adaptable to uncertain needs. Often architects become engrossed in the exterior image to the exclusion of such mundane space planning exercises. Then architects wonder why they are relegated to exterior ornamentation and the clients' in-house facility staff is given responsibility far above that of the architect.

The architect who considers this space planning function can potentially make more informed, larger architectural moves without compromising the client's flexibility. The Facilities Management Institute suggests that designers work with reduced individual work station guidelines. The past generation of architects used a 1/3:2/3 ratio for circulation to use space. A new ratio has emerged that starts with 40% of a space assigned to individual functions and 60% to group needs, uses and circulation.(5)

This change better facilitates flexibility to reconfigure space as technology enters the workplace and existing uses are rapidly replaced with new ones. Such office automation includes a ratio of one computer terminal per office worker. This fact alone carries great significance for the utility systems of new buildings. HVAC, electrical, data and telecommunications wiring are quite different given this 1:1

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(5) Ibid., page 29.

ratio. Older buildings are totally unprepared to absorb the heat load and cabling requirements created by such computer usage in office buildings. The term, "severest possible demand" has been coined to express this potential condition. Architects and their consultants must ascertain the severest plausible demand, the "worst case", for wiring, heating and ventilating loads and design, at least in capacity, for such needs into their projects. Current design standards do not allow for additional loads on building systems. As the profession has attempted to keep building costs down by sizing mechanical systems as close to projected requirements as possible, we have severely limited the flexibility of those buildings. The additional capital costs to expand the building size, utility distribution or mechanical system in the design stage is relatively inexpensive to construction initially, in comparison to adding it later when the need is at a crisis point. The architect must educate him/herself, as well as the client, to the necessity of building this flexibility into a project. Wodka's projection is that this level of flexibility, including HVAC, lighting and service distribution runs about 10-15% above overall construction costs. Not building this potential in up front ultimately costs between 25-60% of the original construction costs for subsequent alterations. This assumes a building can in fact be efficiently renovated. While designing in flexibility adds to the initial costs, the long term value far exceeds its expense. Flexibility is not just durability, but must include the costs associated with a building's resistance to change. The expected payback from additional initial investment is in the ability to accommodate unforseen future needs at substantially less cost in future capital expenditures.

ISSUES IN BUILDING ECONOMICS

ISSUES IN BUILDING ECONOMICS

This section represents a primer of issues included in the previous section. This is by no means an exhaustive list of the economic principles that could be applied to architectural design. From the perspective of this research it does include those topics most salient to the Park Square Building case studies. It also serves to further clarify the preceding set of "models" as to how architects might begin to view buildings beyond their design characteristics.

LIFE CYCLE COSTING

Buildings, if well constructed and maintained, are very durable. Their physical lifespan may be from 50-60 years for even the cheapest of materials, to centuries in duration. As buildings can be thought of as an aggregate of individual building systems, so too they are the collection of components. The whole physical life of a structure may outlive individual components. Some may need repair or replacement at differential spans from others. The productive life of parts depends on how well they continue to meet the needs or functions they were installed to perform.

Life-cycle costing (LCC) offers the designer and the owner a method by which to evaluate alternatives. By considering total costs, in addition to initial or capital costs, it offers the owner greater understanding of the whole project costs. LCC allows the decision-maker to calculate operating and maintenance expenses, as well as construction costs. Increasing the perspective, in this instance the time horizon, from which the architect views a design, the more encompassing and accurate his/her information will be. Again, the intent is to improve the design decisions and selections the architect makes, in terms of the building's life span and the owner's use and economic criteria. LCC is a systematic method by which to assess a very complex set of problems and selections.

Long-term costs include both initial and recurring (operating and maintenance) ones. While most corporate clients are certain to understand the ramifications of capital expenditures (initial costs), often there is too little concern for energy, repair, replacement and other recurring costs that effect the final return on that investment. All costs must somehow be accounted for. Better that this should take place early in the design process rather than later, when corrections are both more difficult and costly. The architect will be called upon to make assumptions in the process of life-cycle costing exercises. The heuristics mentioned earlier in this paper are of great value in this regard. LCC requires some conception of the anticipated life span of various components and the building itself. Service life seems best assumed on experiential knowledge. The architect may rely heavily on past experiences. "Guard against unrecorded, intuitive LCC. Even when one alternative offers enormous economic advantages over competitors, a recorded LCC is better than a mental one."(1)

Several types of LCC comparisons exists. Total life-cycle costing is most useful for the owner committed to a project but unsure of the most economic components. Payback analysis provides the owner with some idea of the time required to recoup inital costs through savings in recurring ones. Total costs and benefits analysis is most useful for the client interested in long-term investment. All of these methods require a base understanding of a few economic principles. Each should also be subjected to "sensitivity analysis", a method for assessing the relative effect a change in the input variables has on the resulting output. In this way a range of possible outcomes can be explored. This will help the designer assess the correctness of his/her initial assumptions and to check the validity of the estimated economic value of alternatives. Undertaking this kind of analysis is most useful in the design process. Changes in the scope or specifics of a project are more easily

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(1) C.W. Griffin, "Life-cycle Costing Primer", Progressive Architecture (December 1982): pages 61-62.

accomplished early in the development process, on paper, rather than in the building itself. It allows for more creative testing of alternatives and their relative advantages, when they can be utilized to their fullest potential.

In economic theory past expenditures are just that, past. Future costs can be evaluated only in relation to future values. A building is only worth renovating or repairing if the value generated through alternative uses is greater than that which might be obtained by demolition and construction of a new building. A change in use may indicate this second scenario as the more economically efficient, despite the appearance of an "unreasonable", potentially more expensive approach.

The economic life may, in fact, be much shorter than the physical durability of a building. This concept carries great significance for the way in which corporations (and thereby architects) should perceive their buildings. Economic life is affected by economic possibilities, thus a structure's life-cycle is threatened by physical deterioration, technical obsolescence and financial obsolescence.

The costs of development of a building represent only the initial expenditure. As previously described, over a structure's life it must be operated and maintained. This servicing includes the energy to keep it and its inhabitants running, HVAC, lighting and daily cleaning, in addition to repairs, replacement of worn components and recurring maintenance. "If the construction cost is spread over the life of the building in the form of a mortgage payment, the annual amount is usually equivalent to the average annual cost of maintenance and servicing, the proportions varying with the type of building and the local levels of costs." (2)

COST PLANNING

While client budgets are only loosely figured in the early stages of building planning, these assumptions can provide useful insight ito the owners' strategies. A guaranteed maximum price usually emerges near the end of the planning, design and contractural phases. The finances of a building project are critical to developer and corporate clients. "Once design is complete it is difficult to reduce the costs without either complete redesign or reducing the standards of fittings and finishes." (3)

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(2) P.A. Stone, Building Economy: Design, Production and Organization-A Synoptic View, 3rd edition (New York: Pergamon Press 1983), page 242.

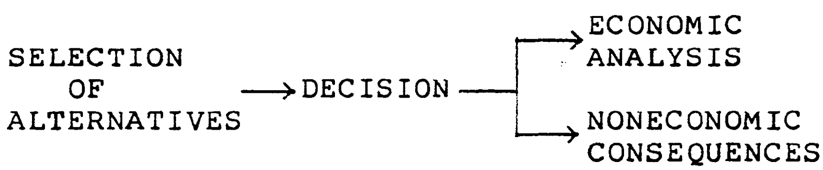
(3) Ibid., page 237.

Given the importance of financial and economic considerations to the building process, it is clear these issues should enter the design process. Corporate clients use such criteria in deciding whether or not to build, renovate, buy or rent buildings. Large initial decisions, including program, budgets and schedules are made based on the economics of the project. Architects often see these project characteristics only after the decision has been made and view them as constraints. They do determine the function, level of amenity and specific timing for the designer. Using financial and economic analysis as a tool provides a method for the architect to enter and add to these discussions. The "schematic" decisions set the context for those decisions that follow. The frustration for the architect often lies in the secondary decisions that are order of magnitude less influencial than the ones that were made before his/her involvement.

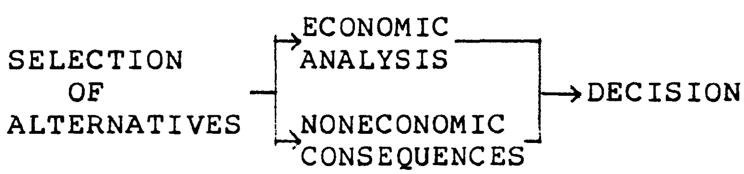
For architects, these early decisions may concern the site, which begins to suggest building orientation and configuration. External envelope and interior configurations may also be predetermined by early decisions in the overall process. While the more "systems" oriented discussions may wait for the involvement of the architect and the myriad of consultants that follow, these selections affect not only initial costs but ongoing ones as well. The most effective use, therefore, for economic and financial analysis is in these larger, most expensive factors. As previously mentioned, recurring costs of energy and operations may far outstrip first costs. The architect must learn how to employ building economics as an analysis and decision tool.

The following diagrams illustrate how such techniques are employed in the design process:

ASSESSMENT



CHOICE



FIRST COSTS AND RECURRING COSTS

Operating and maintenance costs need also be considered in the design process. Inclusion of continuing costs gives both the owner and the architect a more accurate indication of the ramifications of their decisions. "Thus design alternatives can be evaluated by comparing the differences in the costs-in-use as against the differences in appearance and comfort, the two attributes, which, because they are subjective, cannot be easily given a money value." (4)

Given a life expectancy of 60-100 years, continuing costs of energy, upkeep, and operation, are incurred well after the "long-term" financing has been retired. For the owner with long range expectations of occupying or operating a building, first costs are but a small portion of the total cost picture. This does begin to illustrate how better understanding of the corporate expectations can inform the architect during the design stage. If only short term connection with the building is anticipated it is less attractive for the owner to spend additional initial costs to reduce the recurring and long term total costs. Buildings often outlast the original developers involvement. This fact alone helps explain why decisions are sometimes made in the design process that compromise life-cycle economy, in favor

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(4) Stone. Building Economy. page 247.

of lower first costs. It also provides some criteria upon which to calculate what level of expenditure is worhtwhile, given the future life expectation of the client for the building. This estimate should considered both the functional and financial time horizon. While it may be questionable, the use of inexpensive and potentially less durable materials and components, may in fact be a financially sound judgement. The nearer a building is to its expected economic life span the less effective it is to repair or maintain that which should soon be altogether replaced. This replacement, or redevelopment if the whole building is in consideration, then generates new economic life into the project. Past expenditures are sunk costs in an economic sense and are, therefore, irrelevant to this future investment decision. It is often quite difficult for the architect to reconcile this notion with the value intrinsic to old and historic architecture. It does, however, make what is often dubbed the "corporate mentality" of redevelopment and capital budgeting more understandable.

Life-cycle costing evaluation has been used most successfully in comparing building design and planning solutions. The architect can predict the relative costs of alternative designs and components. This exercise, like other analytical techniques, is valuable in gauging the ramifications of various design alternatives. The final effects of each individual selection are often realized far in the future from when they are made. They are also inticately tied to the myriad of other decisions, some made in connection with others, and some made totally in isolation from the total building design. To simplify this seemingly insurmountable task, the architect should eliminate from such calculations those attributes which are common to all alternatives being compared. It is the differences that should be evaluated, not those things that are constant. Costs and benefits should be calculated to ascertain the economic costs and relative merits of each alternative. The product of such analysis should be some understanding of the net benefits over time of each possibility and its attendant costs.

> Clearly, the more certain the designer or planner wishes to be about the accuracy and reliability of his choices, the more necessary it is to use these various techniques for evaluating his solutions. The application of such techniques usually requires a knowledge of the technical behavior of materials, components, and engineering services, and of costing techniques which is greater than most designers can hope to have. Hence the need for close cooperation between the various professions with the design process.(5)

One method for initial cost planning involves elemental target type. A plan representing each element expenditure is produced prior to final design. While this method does not provide guidance as to how to maximize return in terms of value for money in each design feature, it can provide an

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(5) Ibid., pages 252-253.

estimation of costs based on the various sub-systems of a building. Often it is more useful to consider the building as a whole. This can be better accomplished through comparitive cost planning, evaluation of each alternative in terms of cost and consequences (benefits). Overall cost targeting includes square foot cost or cubic cost estimate. This type of gross estimate can then be adjusted according to the client's requirements for costs, quality and flexibility. One can then disaggregate the total estimate into separate building components (walls, roof, floors) based on similar buildings and adjusted for specifics and local market conditions. Cost plans are always calculated on design plans is whatever state of completion. Here again, the cost estimator is working with imperfect information. If some analysis of costs, rather than happening at the end of the design sequence, commences early, the architect can then finalize plans in relation to each component's target budget. Adjustments can then be made to align costs, quality and the final design. Hopefully, the trade-offs between the various cost and component decisions can be made with some knowledge of the ramifications. Bid prices can then be evaluated in comparison to target figures.

Comparative cost planning requires a more dynamic process. The designer works, not in isolation, but with a construction estimator (a "quantity surveyor" in the British terminology). As the designer generates alternative design solutions, the estimator places a price on each alternative. This can be employed to establish a systematic estimate of cost for each building system, component and alternative. Each potential design decision can then be analyzed and compared with similar solutions and against the total anticipated project costs. At the time of Stone's writing, few comparative cost exercises had gone beyond initial cost estimates. Operating and maintenance costs could also be subjected to such analysis. By this method a longer range evaluation could be provided.

DISCOUNTING

Long-term debt and cost-escalation are key to the understanding of buildings as a corporate investment. The true value of money decreases over time. This is due in part to inflations, the continuing increase in price levels in our economic system. This concept is most simply illustrated by streams of fixed payments made over an extended period of time (i.e., mortgages).

Discounting is a method by which one can compare the values of money over long periods of time. The durability of buildings makes this comparison essential for accurate evaluation between alternative courses of action. Discounting also allows the decision maker to understand the escalation of real value as opposed to nominal inflation. A discount rate is used to relate the present value of an amount to future dollars. It is typically expressed as a percentage, used to reduce the future dollars into present day value. Standard present value analysis provides a mechanism for taking a long-term view of capital expenditures and their implications. This calculation reflects the fact that dollars spent or received in the future have less value or worth than those spent or received today. If the "future dollars" were available today, the investor is likely to employ that money in some way to increase its amount (or value) over time. We often think of the interest income of a savings account as the safest and probably lowest rate of return on that money. There is a lower rate of return, but there is no risk involved either. Discounting does take into account that there is no interest income on future dollars received. The discount rate may be the interest rate commonly available or the desired rate of return on an investment.

When the discounting calculation is applied to future payments or expenditures one can compare present values of both near and long range consequences. Alternative design decisions can be economically analyzed by computing their value in both costs and benefits in the present as well as in their likely future. As architects, we have been prone to compare alternatives on first cost alone. This may be due to the limited involvement of the architect after the construction and initial occupancy period. For the owner, especially a long term one, this is not the full story. The discounted value is more meaningful for the architect because it expresses the stream of costs in comparable terms and in units that may be evaluated against construction costs. Value engineering, a phrase for similar engineering analysis, has been used in the recent past to evaluate project alternatives and long term costs and benefits. While the precise formula will not be quoted here, it will be more fully explained when actually used in subsequent calculations.

LEVERAGE

The term leverage refers to the use of borrowed funds in connection with an investment in real property. The greater the ratio of borrowed funds to investors funds --defined as equity, the greater the financial leverage. For a real estate developer this financial leverage is a very attractive economic attribute of a project. By leveraging a project, the investor hopes to receive a return on the money borrowed, as well as his/her own invested capital. Often, this is in the form of increased value of property and buildings through inflation. Corporations that develop projects on such expectations, do so by mortgaging a project at an interest rate lower than their expected rate of return on that building. As the prevailing interest rate climbs, these expectations will carry a higher degree of uncertainty and are, therefore, less attractive. During times of high inflation the use of borrowed funds can more assuredly increase the rate of return.

Relating leverage to the concept of building life-cycle, it is prudent to remember that financial performance of real estate and building investments are not constant over their lifespan. There are, however, predictable stages of uncertain duration. The design stage requires expenditures without immediate returns, as do the procurement and construction stages. Any project will remain in transition until construction is completed and through an initial operating period, which is full of problems and the fine tuning of building systems. The next phase for commercial buildings is the sustained middle period of full occupancy and productivity. The cash flow and net benefits of this phase are those on which the financial planning is based. Age eventually afflicts most buildings. Benefits and cash flow deteriorate. Many factors determine a commercial property's residual value. Rents typically diminish as a building ages and becomes less desirable. It becomes increasingly difficult for the owner to provide proper maintenance, debt service and financial return. Maintenance tends to be deferred, leading to further deterioration. Abandonment may be the final step in the building life-cycle, preceding demolition and redevelopment.

Project feasibility analysis requires serious consideration of possible timing scenarios and likely outcomes. Some issues to be included are:

How local assessment policies affect tax liability and project feasibility?

What kind of financing is available and at what rates?

Is the location appropriate for the proposed use?

What market conditions and trends are apparent in the project area?

What problems are most likely to be encountered in the construction or renovation process?

How closely can costs be estimated? Revenue?

What rate of return is acceptable for this investment, and at what level of uncertainty (risk)?

How closely can operating expenses be estimated?

Are there any political obstacles to successful completion?

What special tax relief, loans or subsidy programs are available?

Analysis of building costs over time requires the use of discounting techniques. As previously described, discounting replicates the cost of borowing money in the market place or the interest that sum might reasonably be expected to generate if not invested in the contemplated project. 10% is typically used to illustrate the return on money simply invested in a savings account. It indicates the minimum attractive rate of return stipulated by the owners. Saving is considered the "safest" possible use for the money. Often projects are evaluated in light of the risk associated with that project. In this case the interest plus an increment which reflects the risk involved is used for evaluation. Calculations would then be made with a discount rate of 12-15%. The Federal Government, in the Office of Management and Budget Circular A-94, suggests a rate of 10% be used for programs and projects. This rate of return is considered to be before taxes and after inflation. For real property purchase or lease evaluation 7% is thought to be appropriate.

Discounting future costs and benefits allows for more realistic comparison. Present and future sums may only be accurately evaluated if one considers the trade-offs between today's and tomorrow's dollars. The higher the discount rate the less important future costs are relative to initial costs. Stated another way, it is less worthwhile to try to avoid future costs by increasing initial cost if the discount rate is relatively high. As the anticipated life-cycle becomes longer, annual savings needed to justify extra capital expenditures flatten out. Very short life cycles and high discount rates require great accuracy in both the assumptions used and the calculations. Analysis over very long life cycles tend to be less valuable than short ones. For LCC analysis 10-30 year life spans seem most appropriate to consider.

In projects with large financing requirements the length of time in development prior to occupancy can be quite important. This includes planning, design and construction time. These costs along with initial capital investment should be calculated as today's dollars. These expenditures incurred before the baseline date, used in future costs calculations, should be evaluated differently from long term streams of payments or benefits. The analysis of scheduling scenarios can thus be realistically compared against the investors' criteria. Design-build, fast-tracking, and delaying renovation are all methods to meet critical owner and financiers' requirements. The time horizon or cutoff date for financial calculations should include functional as well as economic criteria.

Buildings, and corporate investment in them, serve many purposes beyond sheltering business activity. As expert consultants to corporations on issues of what to build and how to build it, architects need to understand how tax incentives might influence the architectural process. Decisions are often based on investment and financial criteria that may seem far from the design process. This does not, however, negate their importance to the architect or the eventual architectural project.

DEPRECIATION

For the corporate client, depreciation plays an important role in the economic ramifications of building decisions. Depreciation is a method of accounting, "...that aims to distribute the cost of a tangible capital asset, less any salvage value, over the estimated useful life of the units in a systematic and a rational manner."(6)
Many methods of allocating the expenditures to be depreciated exist, each with its own specific advantage to the investor. For corporations heavily investing in buildings, real estate and other capital assest, depreciation is one of the, "least understood but most important aspects of taxation." (7)

Buildings are acquired by corporations to support the production of that firm. Investment in buildings is thus based on the future revenue generated by that asset. Depreciation allows for the systematic allocation of expenditures in buildings to be matched to the annual revenue created by that investment. This method of allocating large capital costs over time acts as an incentive for corporations to invest in such assets.

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(6) J.J. Adrian, Construction Accounting: Financial, Managerial, Auditing and Tax (Reston, Va.: Reston Publishing Co., Inc. 1969) page 30.

(7) Ibid., page 339.

Through various depreciation methods, the investment in buildings can reduce the tax liability for the investor and thereby decrease the cash obligation for the firm. Depreciation benefits over time actually have the ability to affect the real worth of an investment, making it even more attractive to the investor. Accelerated methods are possible for tangible property with a useful life of three years or more. Buildings meet these requirements and are therefore attractive investments for corporations. Through accelerated depreciation the cash-flow benefits can be realized over a shorter period of time.

TAX INCENTIVES FOR CORPORATE ARCHITECTURE

Changes are currently being considered to the Economic Recovery Tax Act of 1981. The significance of these proposed changes lies in the effect they may have on corporate investment in architecture. The proposed tax simplification plan will eliminate parts of the 1981 statutes. Currently the Accelerated Cost Recovery System (ACRS) allows corporations to write-off investments in plant and equipment (capital expenditures) at a faster rate. By allowing larger deductions for depreciation per year, corporations save about $25 billion per year. The theory behind this set of laws was to lower taxes on such investments, making them more financially attractive to businesses and to stimulate increased capital investment.

This seems to have been a successful move, as witnessed by increased construction activity. Supply-side economists have said that ACRS has stimulated investment in plant (buildings) and equipment at record rates.

The current system allows almost all investments to be depreciated over 3, 5, 10, 15 and 18 years. This replaced the previous system which was related to the concept of the useful-life of an investment. This method spread the permissible deductions over longer periods of time, tied to the length of time in which an asset was actually used. If the ACRS is repealed, corporations will no longer be able to quickly write-off expenditures in buildings. This could lead to a serious reassessment of such investments from a financial perspective.

Corporations may also be foregoing Investment Tax Credits (ITC) and accelerated depreciation available under the present set of laws. These economic incentives might make the difference in justifying construction, expansion and renovation projects. ITC amounts to a one time tax reduction for applicable equipment and furniture, usually taken in the first year of occupancy, while depreciation is a long term incentive to building. Envisioned in the early 1960's to stimulate investment in business capacity and modernization, ITC reduces an investor's tax liability in the form of a one time deduction directly from taxes owed.

A better understanding of ITC and ACRS regulations can help the architect advise his/her clients in making more informed decisions related to buildings, plant and equipment. While not stating all the idiosyncracies of the Internal Revenue Service code, it is important to note that certain components used in buildings are covered by ITC. Qualified rehabilitated buildings are also included at 15, 20 and 25% rates based on the age of the structure and adherence to certain criteria. In both rehabilitation and new construction projects, ITC can be taken only with straight-line depreciation. ACRS cannot be applied in tandem with ITC. It is, however, more beneficial in immediate tax savings than any other form of depreciation.

Tangible property, which includes raised flooring systems, furniture, partitioning systems and carpeting also qualify for ITC. Whether a particular capital expenditure qualifies for ITC depends on the circumstances of its attachment to the building. The criteria for ITC is met if a component is removable and transportable. In conjunction with the Economic Recovery Tax Act and ACRS, ITC can significantly affect the financial attractiveness of new construction and rehabilitation projects. Idiosyncracies of the building process, property use and permanance of design must be included in determining eligibility under these laws.

"Literally thousands of dollars of tax credit and accelerated depreciation might be overlooked by not doing a thorough evaluation during the initial planning stages. Performing a complete ITC evaluation may be the difference between a financially feasible project and one that dies on the drawing board." (8)

For corporations that base building investment on return of investment or net cost after taxes, such information can provide essential criteria for decision making in the design process.

Internal Revenue Service rules do change from year to year, and most are subject to interpretation. General tax benefits for corporate investment in buildings are complimented by several methods of income tax adjustments. Tax savings can be generated from deduction of sales tax paid on capital components and replacement. Occupancy related expenditures for operation, maintenance, energy and property taxes are all tax deductible in the year they are incurred. Depreciation of capital components can also be applicable for deductions from a corporation's gross tax liability. LCC analysis techniques illustrate the need to consider and assess the financial merits of depreciation, ITC, financing and tax costs on the development, construction and long term characteristics of a building.

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(8) Timothy T. Tevens, "Are You Missing Out On Hefty Tax Credits?", Facilities Management and Design (October 1984): pages 76-78.

The Dodge/Sweet's 1985 Construction Outlook credits the Economic Recovery Tax Act's accelerated depreciation provisions for the office building boom of 1983 & 1984. Often corporate demand for tax shelters has proved to be of more importance than the resultant space itself. (9)
This article also reiterates the connection of office building construction to larger macroeconomic forces. This type of construction peaked two years ago, in its cyclical pattern, prior to other categories of commercial building. Besides the demand for tax shelters, this is attributed to a change in the space/worker ratio. The floor area per worker has increased due to the introduction of more high technology equipment (computers and their peripherals), even as the individual work station grows smaller.

USEFUL LIVES OF ELEMENTS

In addition to the functional use and economic life span, buildings and their components must be designed and evaluated in terms of wear, periodic renewal and replacement cycles. The anticipated useful life will be different for the various parts. The designer can "design in" concurrent or differential obsolesence, depending on the

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(9) "Dodge/Sweet's 1985 Construction Outlook", Architectural Record, (November 1984): page 45.

durability of the material or component initially selected. This does provide for an important comparison. While the owner/client rarely considers such criteria in his/her analysis of a design alternative, the architect might begin to match anticipated life-spans to meet the owners investment scenerio. It may well be that the owner might want to invest periodically in component renewal. This would be quite reasonable if the owner has a long term commitment to a project. The replacement costs can be seen as generating new economic life into an old building. Directly matching the life expectancies of several components might create a condition in which the owner cannot reasonably repair or replace all of them simultaneously. As architects design new buildings and make selections for renovation schemes thoughts of the life-span of the contemplated systems might well be considered.

The IRS has published useful life guidelines (Revenue Procedure 62-21) for tax purposes. As with the discount rates cited above, the architect can adopt these estimates for use in economic evaluations.

USE	YEARS
BANKS	50
OFFICE BLDG	45
STORES	50
SERVICE EQUIPMENT	10
SITE IMPROVEMENT	20
BUILDING EQUIPMENT	
A/C over 20 tons	20
BOILERS	20
RADIATORS	25
AWNINGS	5
ELEVATORS:	
freight	25
passenger	20
ROOFS (tar & gravel)	20
WINDOW BLINDS	8

PARK SQUARE BUILDING CASE STUDIES

INTRODUCTION TO THE PARK SQUARE BUILDING CASE STUDIES

1923 Rendering of the Park Square Building

Using the Park Square Building in conjunction with a case study methodology, the following cases are presented to both elucidate and illustrate the decision models employed. This exploration will include economic as well as architectural criteria that is, in fact, considered in the process of decision-making. As previously described, looking at the renovation process is appropriate for the architectural designer. While all the issues raised here may not seem directly applicable to the design of new buildings, the similarities are greater than the differences. Likewise, the market for renovation and reuse of older buildings is of great interest to architects as a source of new work. Corporate decision-makers are also re-evaluating renovation in light of the rising costs of new construction. Each of the cases presented will be described in light of the actual criteria used in the design and specification process. Additional information will be provided to illustrate how the architect and owner (client) might have better informed themselves for selections they would be asked to make. This methodology will compare the physical design with the economic analysis, life-cycle costs and benefits, materials, maintenance and feasibility decisions. The advantage of focusing on a specific building is in the simultaneous review of the various analytical techniques used in the profession today, rules-of-thumb and their usefulness to the decision-maker.

View from 2nd Floor Lobby into Main Entrance Vestibule

A rich set of past events, tenets and scenarios can be examined in the Park Square Building. Its location in the Park Square area of Boston enhances its potential for continued investment and attention. Given its tumultuous history, a varied set of architectural, financial and building technology issues will be considered. As previously stated, the aim of this investigation is how designers might prepare themselves for decision-making, what information or analysis is perceived as useful, how design decisions are made and by whom. This particular building, and a series of cases constructed from recent events, will be used as a focus. The objective is to elicit a more systematic approach to design and decision-making in similar circumstances. The physical results of past decisions can be used to evaluate past selections from among alternatives. The aim is to find out if, and how, additional analysis techniques may have altered the outcome. Concentrating on this single commercial property is used as a mechanism by which to bound this study. A description of the building and its immediate environs will follow, creating a more understandable context in which to compare and critically analyze architectural and economic decisions over time.

Conceived as a landmark, the Park Square Building was built in 1923 as the largest mixed-use development of its time in Boston. Built under the direction of a consortium of notable business people, it claimed to be the most modern, strictly fire-proofed, first class office building in New England. Such men as Charles Adam, treasurer of Harvard College; Edgar Champlin, president of Massachusetts Trust Company and George Smith, president of the New England Power Company served on the original board of directors. Amory Eliot was the first president of the Park Square Building Company. The following excerpt is from the leasing brochure published at the building's inception:

> The completion of this $6,000,000 development in 1923 will mark the fulfillment of a purpose; to provide a new center for Boston's business life. The Park Square Building; 600 feet long, 75 feet wide and 11 stories high, will be a landmark on account of it's size. It's appearance and location will make it a noteworthy addition to the entire city. The exterior is to be Indiana limestone, with ornamental iron show windows of a distinctive type in the first story and with steel windows, glazed with plate glass throughout the office floors, which materially will increase the daylight illumination of the interior. In addition, the relatively narrow width of the building makes the natural light unusually efficient, particularly in the large undivided floor areas which are to be an important feature of the building. There are few buildings in the country which offer an acre of floor space on each floor with uninterrupted space on four sides. The equipment usually found in first class buildings has been enlarged and improved upon with the idea of leaving nothing undone which would add to the comfort and convenience of the tenants. The number and arrangement of the elevators -twelve high speed passenger and one freight -has been determined after the most careful compilation of data in connection with comparable installations ... Special attention to the planning of the retail stores has been given by the architect because of the wide streets and accessibility of this district are sure to make it a prominent retail section for merchandise of the better class.

Bounded by Berkeley, St. James, Arlington and Providence Streets, the building is representative of commercial buildings constructed early in the 20th century in Boston. The Park Square Building lies within one of the most concentrated and coherent collections of such structures in the city. (1)

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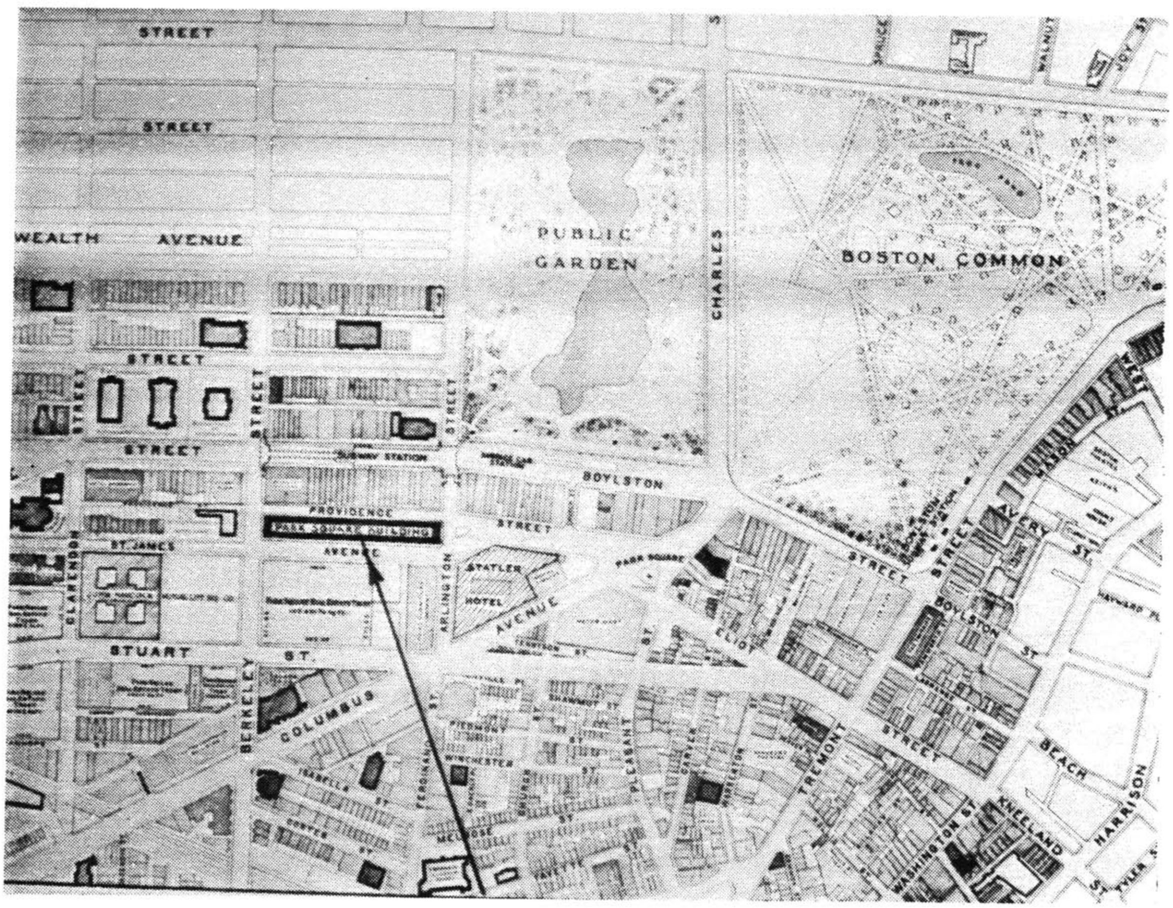
(1) John H. Englund, from an unpublished paper on the Park Square Building. Jung-Brannen Associates, Boston, Mass. October 1983.

This area was formerly occupied by railroad yards and the terminus of the Boston and Providence Railroad. This land became available for development early in the century, after having sat unused for many years. Its adjacency to the fashionable Back Bay neighborhood made it especially attractive. As the area filled with new business concerns it became a district of office buildings, many serving the insurance industry.(2)



1923 Locational Map

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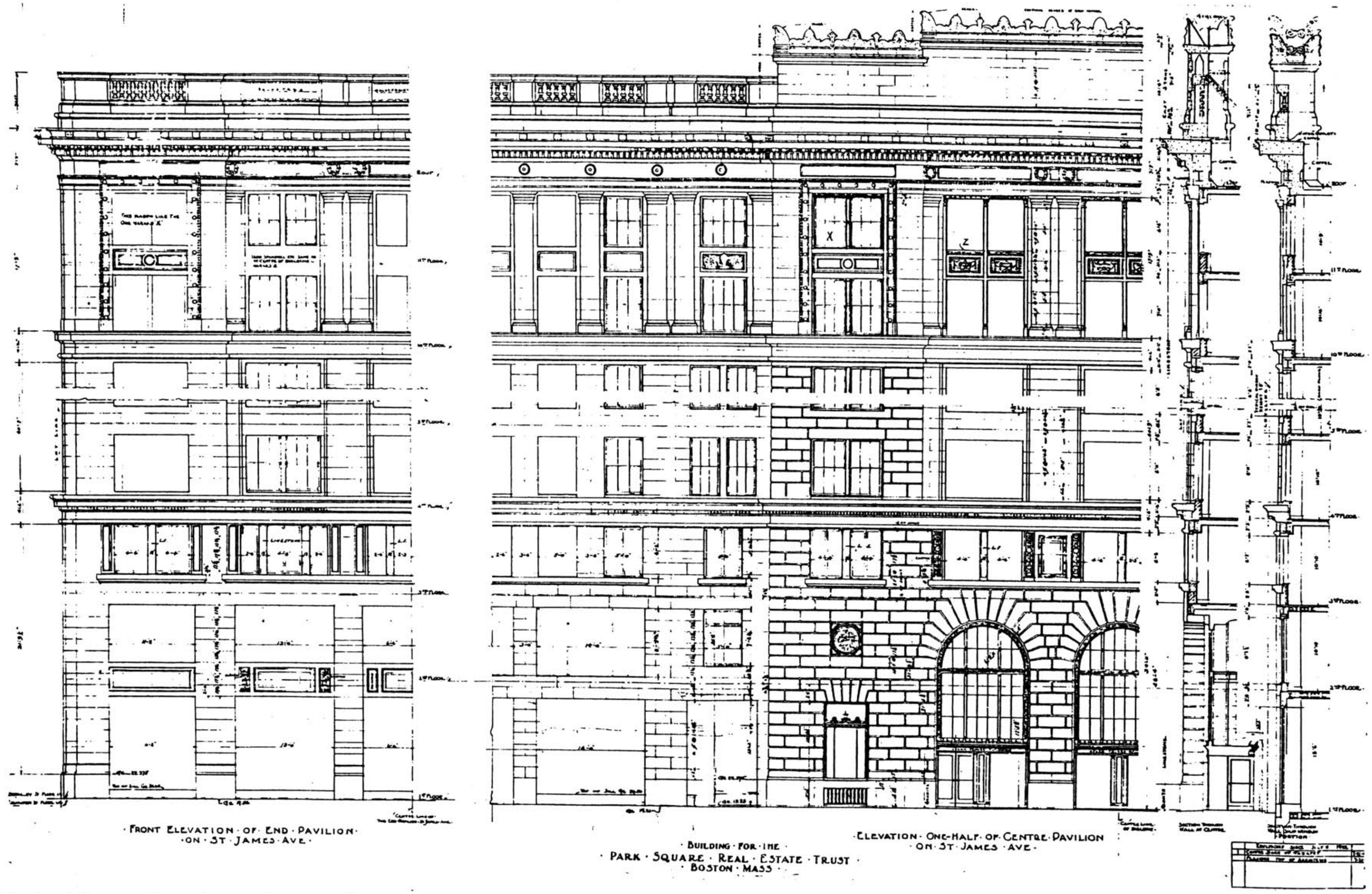
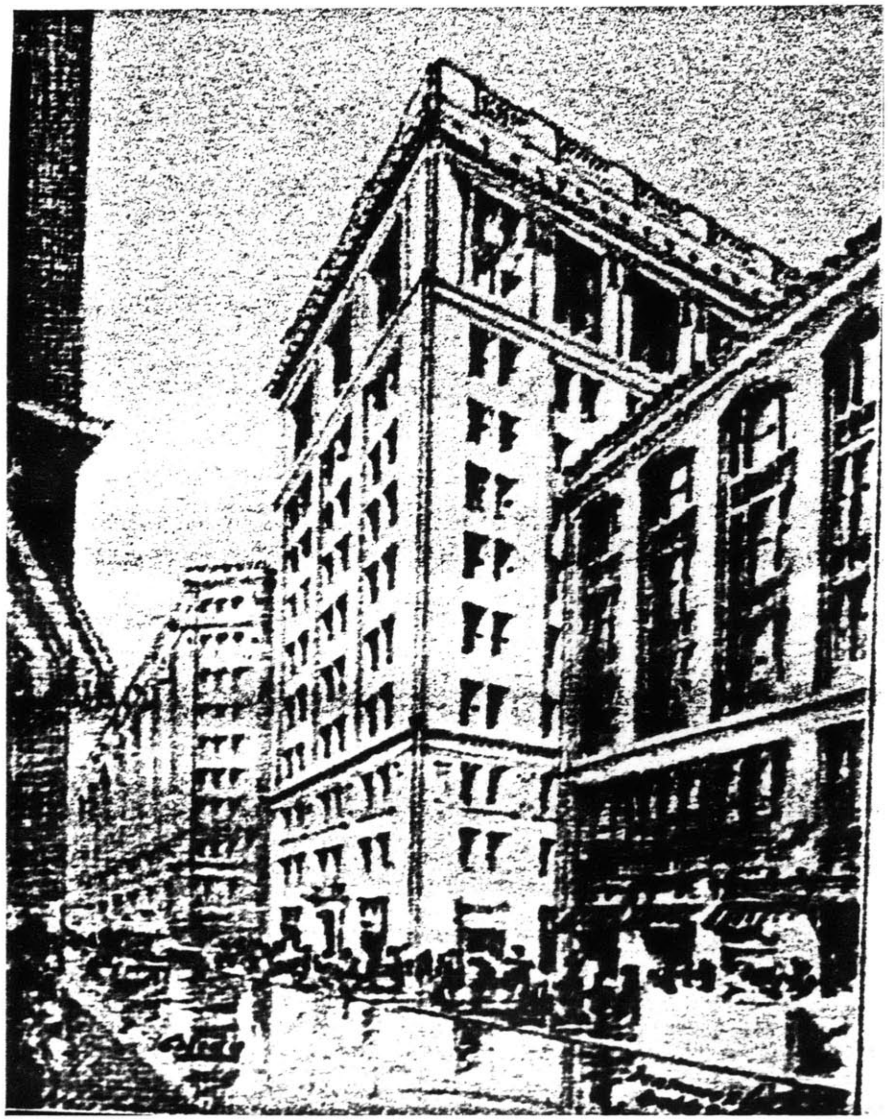
(2) Walter Muir Whitehead, <u>Boston: A Topographical History.</u> (Cambridge, Mass.: Belknap Press of Harvard University Press. 1968) pages 189-190.



Detail of the Exterior Wall, from the original working drawings

The architects of the original building, Desmore, LeClear & Robbins, designed three buildings in this area. The Park Square Building was the first, in 1923, followed by the Salada Tea Building in 1927 and the Paine Furniture Company building in 1941, directly across St. James Avenue. All of these buildings exhibit classical ornamentation, although they each lack the exuberance found in other buildings in the Back Bay district. These three commercial buildings, as in the case of many of their neighbors designed by other architects of the time, are fairly plain. Surfaces are only somewhat enlivened by low relief, classical in nature and comparatively simple. In the case of the Park Square Building the organization is tri-part; characterized by a three story base, the six story body and a two stroy attic or cornice. The entryway makes use of a vaulted vestibule, plain moulded panel decoration and the rusticated masonry of the exterior.



1923 Sketch from Arlington and Bolyston Streets

The organization of the St. James facade is broken into three distinct areas horizontally as well as vertically. A central frontice-piece is flanked by two end pavilions, each set slightly forward of the main rusticated frontice-piece. The cornice, a decorative parapet (now removed) was carried by these articulated ends visually. The decorative detail is thought to be from the French Classical tradition, evidenced by its lightness and comparative delicacy. The exterior is further articulated by lion head gargoyles punctuating the original cornice, double pilasters and the stepped corners of the building.

Like many high-rise buildings of the 1920's, the first floor is typified by a central passageway, designed to let the city into the base, filled with the shops envisioned by its creators. This suggests some predisposition of the time to invest in collective space, an interior passage. The Park Square Building arcade is not unlike the train and subway tunnels through which many came to work in the area. It does, however, include a peculiar realignment, angling slightly north toward the Berkeley Street end. Don Lyndon, in his book The City Observed, compares the ground floor scheme of the Park Square Building to that of the Faneuil Hall Markets.(3)

Its long narrow concourse is lined with shops, some of which can be entered from both St. James Avenue and the interior passage, while others, those on the north, are accessible only through the building's arcade. The center of the building is further punctuated by a spacious lobby opening

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(3) Donlyn Lyndon, The City Observed: Boston, A Guide to the Architecture of The Hub. (New York: Vintage Books, 1982) page 191.

to St. James Avenue. The series of ground level spaces gives the Park Square Building all the potential more modern buildings often lack, lobby space that invites the pedestrian inside. The elevators are located directly behind this lobby, linking the street level to the offices above. Oddly, the elevator shafts are lit by windows, continuing the fenestration without a break up 11 floors. The bulk of the building is the projection of the property lines up, "rendered simply as a long, uneventful, undemanding wall."(4)

The Ground Floor Shopping Arcade today

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(4) Ibid.

The building was only recently rescued from years of neglect, in Lyndon's words, "only barely." The building was saved from this neglect in 1980 when purchased by a new consortium of investors. Having fallen prey to an era of only superficial and essential maintenance this building, like many of its Back Bay neighbors, was classified as class "C" office space. (5)

During the 1970's, a perception of pessimism among commercial building managers flourished in the Park Square area. The midtown and Back Bay area seemingly could not compete with the prestigious downtown office market, especially due to the rapid redevelopment during the Kevin White administration. Great uncertainty existed in the Back Bay market. The area was perceived as aesthetically desirable yet it had a commercial vacancy rate of over 30%. The building stock was aging and several redevelopment schemes, including the Park Square project, the only recently completed State Transportation Building and work on the Boylston Street properties, were stalled. The largest percentage of available office space in the vicinity of the Park Square Building was class "B" & "C." This space is characterized by construction prior to 1960, often with structural obstructions and varying levels of modernization

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(5) The Office Industry Survey, Interim Report, Boston Redevelopment Authority, Research Dept. 1977.

and maintenance. Class "B" space is distinguished by continual maintenance, very good physical conditions and well maintained lobby and accessways.

Typical tenant corridors prior to renovation

The decision to invest in the Park Square Building was most likely based on market forces similar to those identified by the Boston Redevelopment Authority.(6)

The late 1970's brought about a tightening in the office space market. The vacancy rates early in the decade dwindled while inflationary pressures drove up rental rates,

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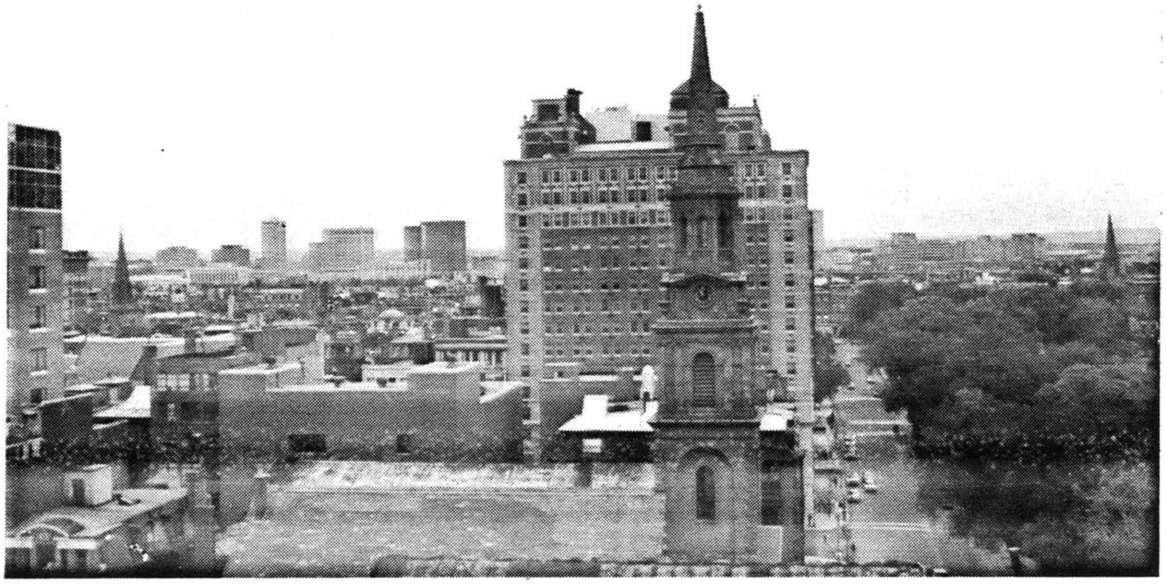
(6) Ibid., Part II: Tenant Responses

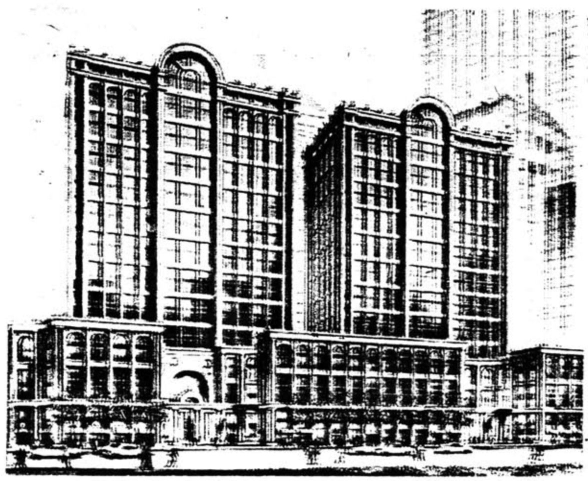
tax rates and energy costs. As financing strategies changed for new construction, office space (class "A") became very expensive. These forces all precipitated an elevation in the interest and ultimate demand for class "B" office space. During this resurgence, locational factors began to work in favor of the Park Square and Back Bay neighborhoods. Close proximity to downtown, the MBTA and supportive businesses with substantially lower rents all made this location attractive. While Government Center rents were running at $25-35 per square foot, the rental rates in the vicinity of Park Square were $15-20 per square foot. The richness of the area, coupled with a perceived improvement in the image of the area, added to its desirability. Corporate decision-makers and employees alike have taken great reassurance from recent development in the area. Witness the construction activity on Boylston Street, at the Prudential Center, Copley Place and the Four Seasons Hotel/Condominium Building. In this climate the Park Square Building is undergoing a renaissance of its own.



View from the Eleventh Floor, looking northeast

Standard Tenant Elevator Lobby

THE PARK SQUARE/BACK BAY MARKET FOR DEVELOPMENT



Rendering of the new New England Life proposal (7)

Within a four block radius of the Park Square Building over $1/2 billion worth of construction and development projects are underway. The following is a synopsis of those projects to illustrate the vitality of the neighborhood, in both an architectural and a financial sense. On the block immediately to the west of the Park Square Building, the New England Life Insurance Company has proposed a 27 story, twin tower building, also set on St. James Avenue. These new buildings would include 1.3 million square feet of office space, 100,000 square feet of retail space and underground

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(7) This and the following illustrations are reprinted from The Boston Globe, "The Livable City?", Sunday Supplement, 11 November 1984.

parking for 1,000 cars. Designed by Phillip Johnson and John Burgee, it is estimated to cost $288 million (or $221 per square foot) and is currently under design review by the City of Boston and the Neighborhood Civic Advisory Committee.

The Four Seasons Hotel (officially named Park Plaza)

The Four Seasons Hotel and Condominium building is nearing completion on Boylston Street opposite the Public Garden. A brick-faced building, it will include restaurants, shops and a health club, in addition to 290 hotel rooms and 100 condominiums. This project represents the second introduction of residential use in the Park Square district following the recent Ritz-Carlton expansion on Arlington Street. Developed by a consortium of four investors and designed by the WZMH Architectural Group, the Four Seasons Complex will ulitmately cost $85 million when finished in mid-1985.

Rendering of the Haddassah Way Project; Boylston Street

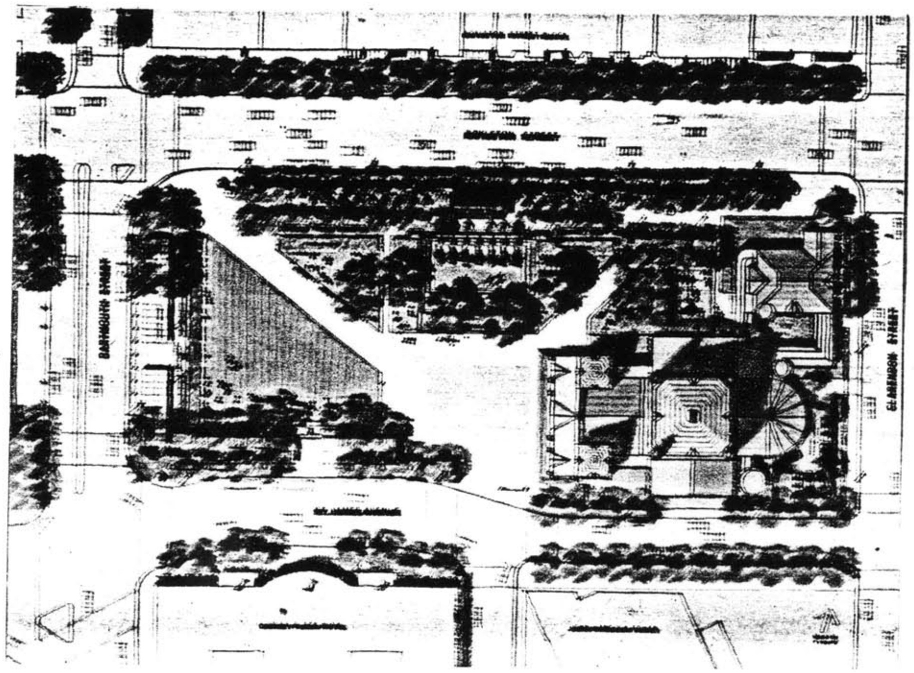
As part of the larger Park Plaza urban renewal project, the Hadassah Way development will include 1/2 million square feet of retail space, 90,000 square feet of offices and 111 condominiums. 168 parking spaces will be located under the complex. Presently in review at the Boston Redevelopment Authority, this Architects Collaborative design has a projected cost of $78 million or $156 per square foot.

399 Boylston Street

One block north of the Park Square Building, 399 Boylston Street has just been completed. This 13 story building is faced with red brick and limestone, with bay windows on the lower floors and arched windows above. It is topped with a multifaceted, 5 story, reflective glass structure. Designed by CBT/Childs, Bertman, Tseckares and Casendino, Inc., it cost is placed at $36 million for 209,000 square feet (or $172 per square foot).

One Exeter Place, built for $158 per square foot in 1984

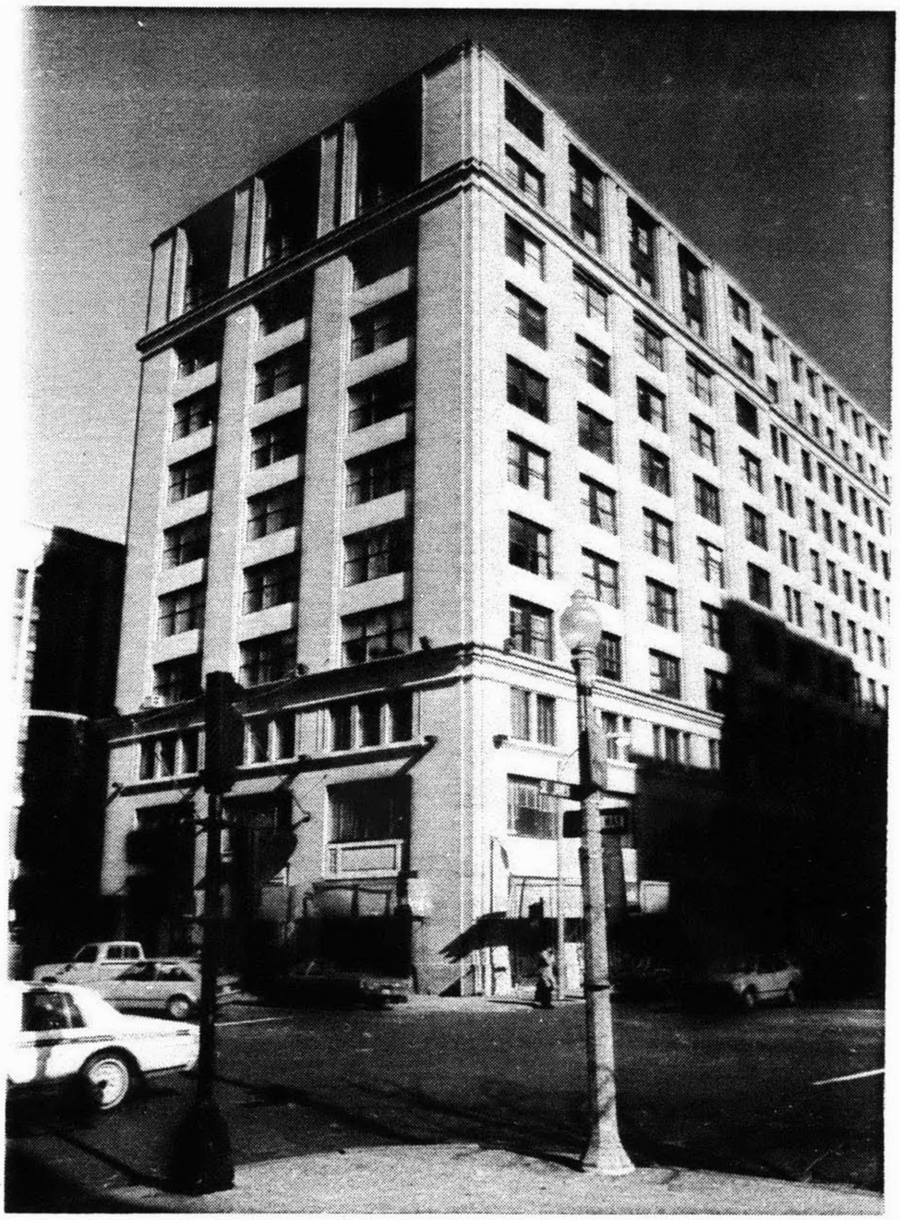
Further down Boylston Street, at Exeter Street, One Exeter Place is near completion. Built for $30 million and designed by Jung-Brannen Associates, this building contains 190,000 square feet of office space in its 14 stories. Clad in brick and green-tinted glass, it includes a mansard-style roof, bay windows and a three story atrium.



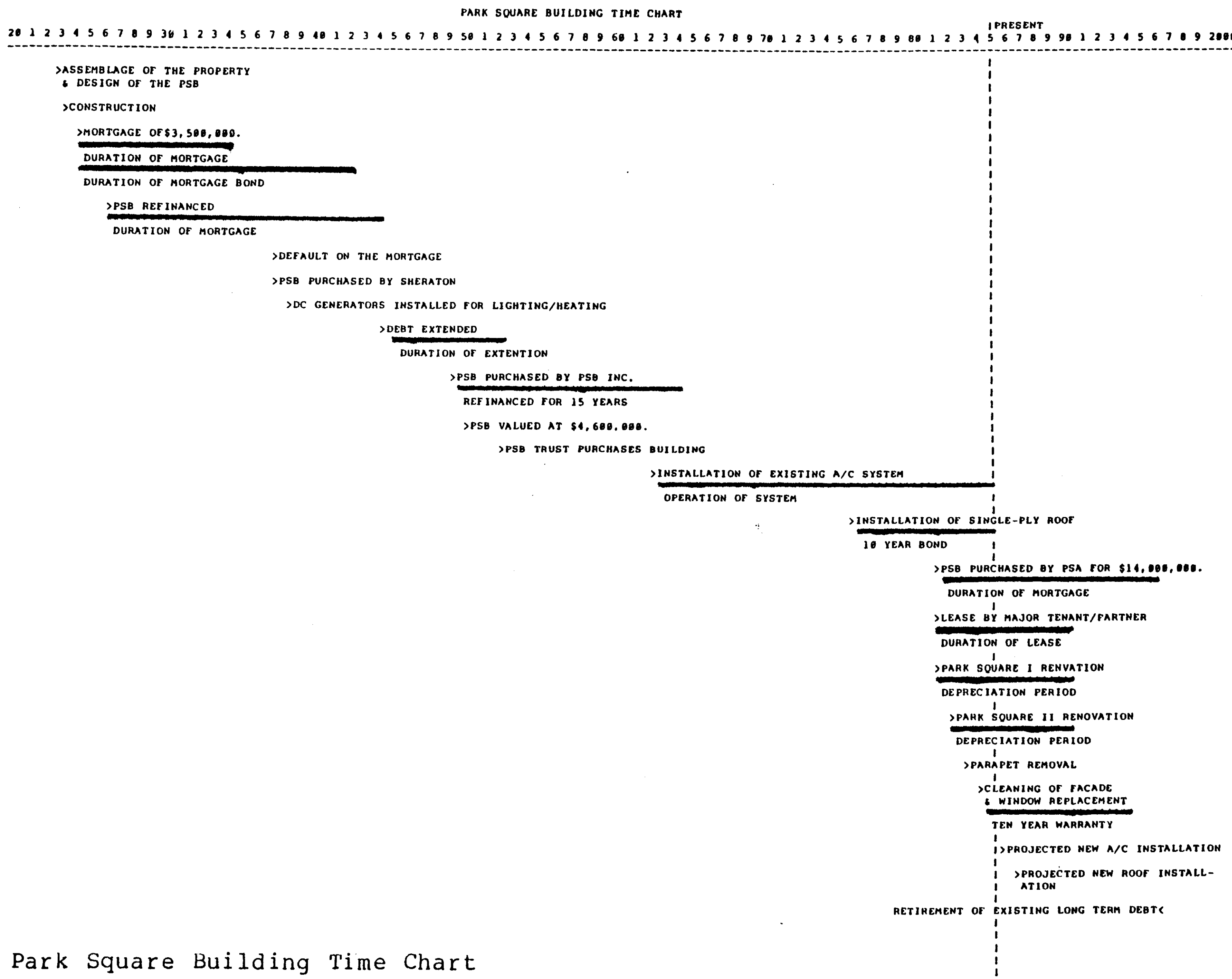
The latest plan for Copley Square

Copley Square is about to undergo yet another facelift. Following a national competition in 1983, the scheme of Dean Abbott of Clack & Rapuano was chosen by the City of Boston. Presently fund raising is underway for the $4 million needed to increase the grass area and rework the fountain. Copley Square has anchored any number of past and recent development schemes, including Copley Place, the Boston Public Library, the John Hancock Tower and the ever surviving Trinity Church.

A recent market survey conducted by Spaulding and Slye indicated office rents in the Back Bay area running from $16 per square foot for the renovated 120 Boylston Street building, to $38 per square foot for Copley Place. The Park Square Building rents space at the lower end of this range, at $19-20 per square foot.



Park Square Building from the corner of St. James Avenue and Berkeley Street



Park Square Building Time Chart

PARK SQUARE BUILDING CHRONOLOGY

1893

7/19/1893: Olde Colony Railroad assigns to the City of Boston an easement to raise the level of Providence Street and grade the bank from Berkeley Street to Church Street, for the sum of $1.00.

1900

Site used as terminus for the Boston and Providence Railroad

1911

3/11/1911: New York, New Haven and Hartford Railroad Company grant an easement to the City of Boston to grade, slope and maintain the land abutting Providence Street forever.

1917

1/2/17: Declaration of Trust, formation of the Park Square Real Estate Trust, made up of Armory Eliot, Charles Adams, George Smith, Edgar Champlin, and Frederick Bradlee.

1/2/17: New York, New Haven and Hartford Railroad deeds 28,681 S.F. parcel bounded by Berkeley Street to the west.

1/2/17: Park Square Real Estate Trust also purchases the rights to land abutting Clarendon Street from N.Y./N.H. and H. Railroad and M.I.T., both transactions at an interest rate of 4% over 5 years.

1918

9/28/18: Restrictions to the deed

1922

3/29/22: Property deed transferred from New York, New Haven and Hartford Railroad to the Park Square Building Company of Boston, constituting the balance of the existing site, 16,758 S.F., bounded by Arlington Street.

4/6/22: Eliot et al transfers title to entire parcel to the Park Square Building Company of Boston. On the same day PSB Co. of Boston arranges with the Prudential Insurance Company for a mortgage of $3,000,000 at an interest rate of 6-1/2%, to be repaid yearly in the amount of $120,000. Proceeds to be dispersed $750,000 in advance, $1.0 million at building erection, and $1.25 million at building completion. A serial mortgage bond for $1 million is issued by the International

Trust Company for the PSB Co., in $1,000 denominations to be repaid at $100,000 per year from 1933-1942. Interest rate to be 7% per annum.

4/6/22: Entire site bounded by St. James Avenue, Arlington, Providence and Berkeley Streets now assembled; 43,458 square feet total area. Design begins on the Park Square Building. Construction commences and requires approximately 12 months to complete building.

1923

Opening of the Park Square Building, initial cost of $6,000,000, designed by Desmore, LeClear, and Robbins

4/4/23: Lease to Boston Elevated Railway Company, expiring on 6/30/33.

11/12/23: Lease to K.M. Danielson, expiring on 12/31/33.

12/1/23: Lease to Standard Oil of New York, expiring 4/30/34.

1924

1/18/24: Lease to National Shawmut Bank of Boston for arcade space, for a period of 25 years. Rent to be $15,000/year for years 1-5, $20,000/yr for 6-10, $30,000 for 10-15, and $35,000/yr for the last 10 years. Duplicate leases appear between the International Trust and Prudential as mortgagees.

6/19/24: Aggregate mortgage of $3,500,000 held by the Prudential Insurance Company. $500,000 2nd mortgage taken by the PSB Co. on this day at a rate of 6%, to be repaid in one payment on 4/6/32.

6/19/24: Indenture of PSB serial bonds to the First National Bank of Boston as successor to the International Trust Company.

1926

8/31/26: Old Colony Trust buys mortgage for the Park Square Building.

1927

Salada Tea Building constructed, also designed by Desmore, LeClear, and Robbins

1929

12/13/29: Old Colony National Bank of Boston assigns all outstanding mortgages to the First National Bank of Boston, including the PSB Co.

1932

3/4/32: Refinancing of the mortgages with the Prudential Insurance Company, $2,660,000 extended to 4/6/42 at a rate of 6% for the first 5 years and 5-1/2% for the following 5 years.

1937

2/8/37: Affidavit affixed to title, $700,000 remains overdue, $2,560,000 remains unpaid on the mortgage. PSB to be auctioned at noon, 3/8/37. $75,000 cash to be paid at time of auction.

2/11/37: R. G. Emerson, for the First National Bank of Boston, buys the Park Square Building for $700,000.

2/26/37: Discharge of obligation issued by Prudential at the satisfaction of the mortgage.

6/16/37: Park Square Building Inc. agrees to pay the First National Bank of Boston $3,454,375 on or before 2/11/47, payable quarterly after 6/1/37. A down payment of $87,558.33 was made. PSB Inc. is composed of Robert Moore, preident, T.S. Harris, Treasurer, and O. A. Schlaikjer, Clerk.
6/16/37: Sheraton Buildings Inc. acquires PSB from the Park Square Building Inc. Page Brown signs deal for Sheraton.

1938

Conditional sale of Universal Unaflow Engine and a 600KW DC Generator to the Park Square Building Inc. for the sum of $16,000. Used to provide heating and light to the building.

9/24/38: Totman's Inc. leases Arcade stores #24 and 25 and the candy counter for $4,000 per year, monthly payments to be made.

1941

Paine Furniture Building constructed directly across St. James Ave. from the Park Square Building, also designed by Desmore, LeClear, and Robbins

1944

8/25/44: Robert Moore, president of the PSB Inc. asks for and receives and extention of the First National mortgage until 2/11/52.

1945

12/19/45: Dischagre of obligation issued by the First National Bank for satisfaction of the 6/16/37 mortgage.

1949

2/24/49: John Hancock Mutual Life Insurance Company finances the PSB for PSB Inc.: $2,600,000 at 4% for a period of 15 years. Quarterly payments of $52,000 to be made.

8/1/49: Park Square Building Camera and Photo leases Arcade stores #18 and 19 and Storage bays #12 and 13 in the basement for the yearly sum of $5,000 from Park Square Building Inc., Page Browne, president.

1950

10/31/50: Financial statement filed reports: net fixed asset value of the PSB of $4,600,000; yearly income of $1,141,371.42; operating expenses of $492,590.00; Real Estate taxes of $264,386.66; Interest and Debt payments of $103,595.57; Federal Income tax of $75,257.01 for a net income of $121,686.80.

1951

3/9/51: Park Square Building Inc. and Post Office Square Company consolidate into Post Office Square Company. Signed by Robert L. Moore and Ernest Henderson for PSB Inc., and Ernest Henderson and Page Browne for PO Sq. Inc..

1952

1/11/52: Park Square Building Trust, composed of H. Gorin, S. Friedman, R. Cable, J. Rabinovitz and F. Leeder; take the deed to PSB from W. E. French for the sum of $1.00. All existing leases expire on or before 7/31/85. J. Rabinovitz appoints Sidney Rabb as successor; R. Cable assigns Henry Cohen; and S. Friedman assigns Henry Friedman.

1/14/52: Indenture of lease To Park Square Camera and Photo to Sheraton Buildings Inc.

1/30/52: Sheraton Buildings Inc. transfers title to Thomas J. Hillen. Hillen accepts 1st mortgage of $2,299,262.30 (of an original $2,600,000) from the John Hancock Mutual Life

Insurance Company. Sheraton holds a 2nd mortgage of $1,650,000 for Hillen at 4% per annum. All existing leases expire on or before 11/30/71.

1/30/52: Hillen grants title of the PSB to the Park Square Building Trust. 1st mortgage held by John Hancock, 2nd held by Sheraton.

4/28/52: Outstanding 2nd mortgage refinanced at 8% for any unpaid balance over $250,000.

1956

6/20/56: F. Leeder assigns to E. Leeder as successor as trustee, Celia Leeder to succeed Earle.

6/29/56: S. Friedman, deceased on 6/5/56, assigned H. Friedman as successor, Henry accepts.

1957

11/18/57: F. Leeder revokes Celia as his successor and appoints E. Leeder, to be succeeded by Laurel Chase.

1958

1/10/58: H. Friedman appoints Isay Friedman as successor, to be succeeded by Arthur Friedman.

1960

2/3/60: Robert Cable, deceased on 1/18/60, had appointed Herman Cohen as successor, who accepts.

3/29/60: H. Gorin appoints Estelle Gorin as successor, and Judith Gilfix to succeed Estelle.

6/9/60: Robert Cable, having died on 1/18/60, had appointed Herman Cohen to succeed, who accepted on 2/3/60. H. Cohen then assigns Austin Cohen to succeed him, and Irving Purlmutter to succeed Austin.

1966

2/2/66: Joseph Rabinovitz, who succeeded S. Rabb as trustee resigns from the Trust.

3/3/66: S. Rabb nominates Norman Rabb as successor.

1969

7/15/69: Earle Leeder accepts appointment to the Trust in place of Frank Leeder, who died 6/26/69.

1971

7/21/71: H. Gorin rescinds the appointment of Estelle Gorin to succeed him and appoints Rosalind E. Gorin to succeed, revokes Judith Gilfix's appointment outright.

1973

8/31/73: Herman Cohen resigns from the Trust, Austin Cable accepts position.

1975

8/6/75: H. Gorin, deceased, had appointed Rosalind Gorin as trustee, Estelle Gorin formally renounces any position , R. Gorin assigns Walter Salmon as successor, to be succeeded by Estelle Gorin.

1977

1/3/77: H. Friedman appoints Jerry Friedman to succeed him and Ann Strem to succeed Jerry.

1980

Negiotaions begin on the sale of the building.

1981

January: Interviews begin for designer for the Phase I office renovation project

1/19/81: Park Square Building Trust articles are amended to allow PSB Corporation to take over all assets of The PSB Trust if the Corporation controls 90% of the outstanding stock. Signed by Rosalind Gorin, E. Leeder, and H. Friedman.

1/30/81: Park Square Building Trust transfer title for the building to Park Square Building Corporation for the sum of $1.00.

February: 2/2/81: Park Square Building Corporation transfers PSB to the Park Square Associates for the sum of $13,950,000; PSA is a general partnership of TBC Associates and 31 St. James Associates; waiver of all Corporate Excise Tax Liens from PSB Corp. to PSA. PSB Corporation composed of H. Friedman, R. Gorin, Edward Katenberg, E. Leeder, and Austin Cable. Long term debt refinanced for 15 year period, new owners begin to rework tenant standards and look at a series of projects to upgrade the building, Jung-Brannen and Associates hired as consultants to the Partnership

May: 5/1/81: Park Square Associates becomes a limited partnership, consisting of the same parties as the previous general partnership; TBC Associates and 31 St. James Associates.

September: Phase I Office Renovation Project occupied

1982

May: Demolition begins on the 5th and 6th floors for Phase II office renovation project

September: Phase II project occupied

1983

September: Parapet Removal project commences

1984

May: Cleaning and restoration of the exterior of the entire building

August: Window replacement project begins, scheduled for completion by mid-December

November: work begins on resheathing rooftop penthouses

1985

New air conditioning system, projected December, 1983 PSB Capital Expenditure Budget

1986

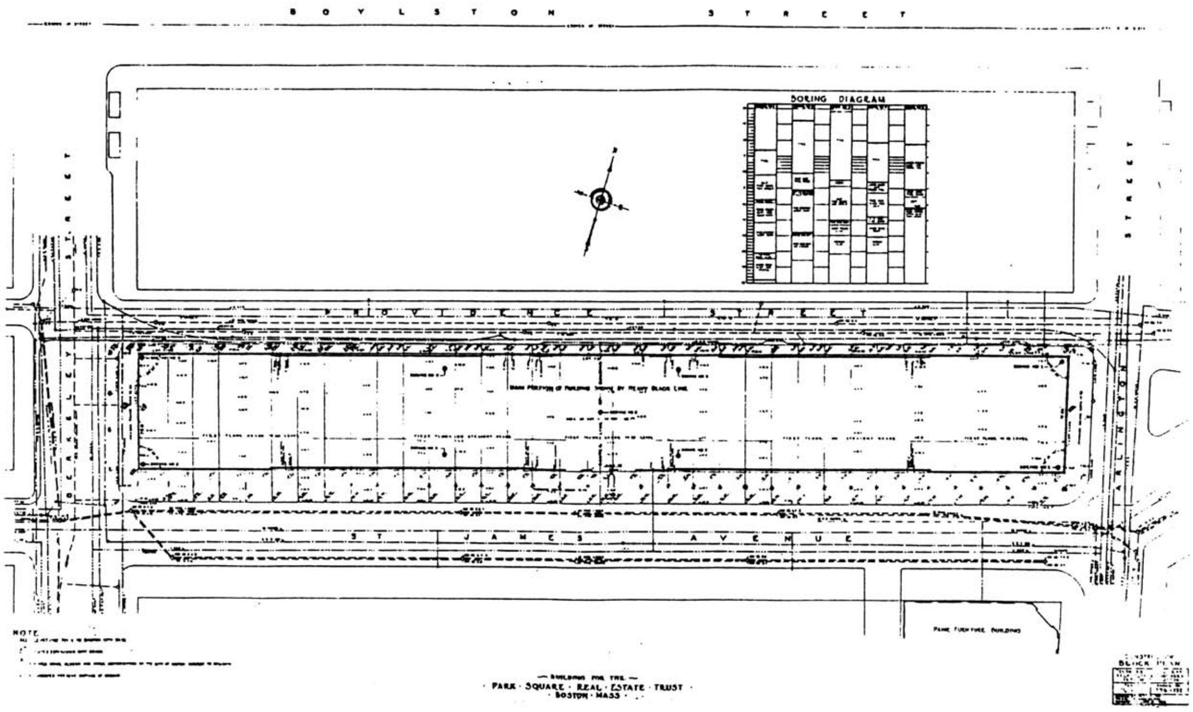
Installation of new emergency generators, gas turbines and related wiring and new roof, projected December, 1983 PSB Capital Expenditures Budget

1991

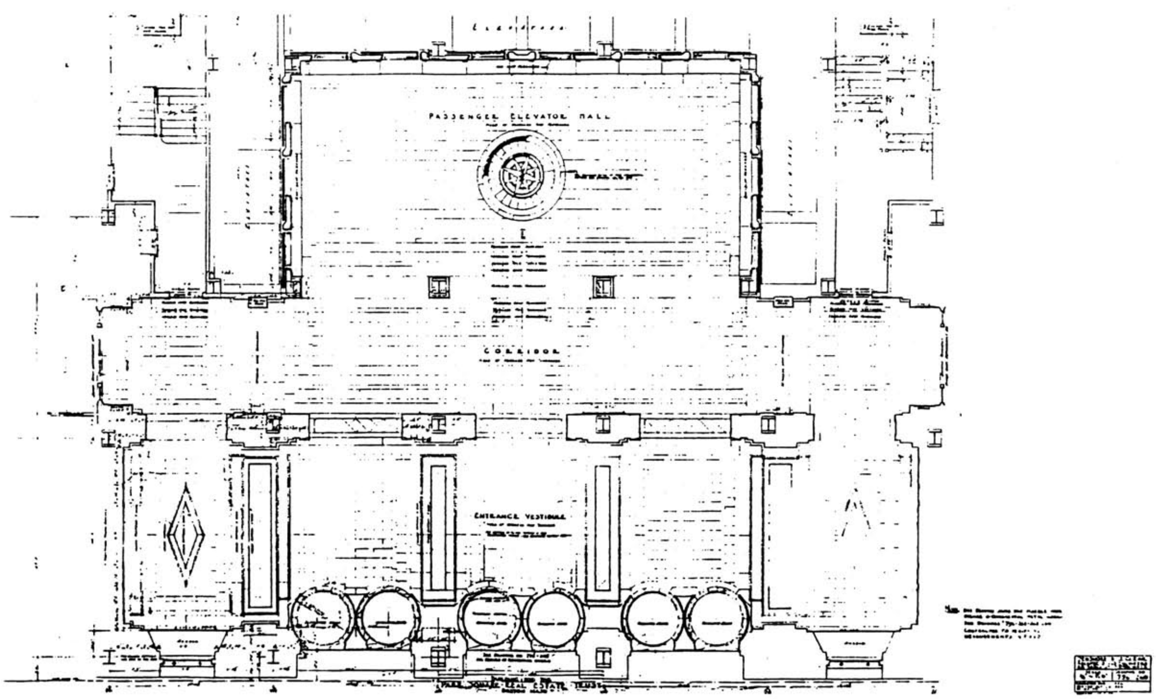
Expiration of TBC lease, addendum #3

1996

Retirement of existing long term debt by Park Square Associates.



1922 Block plan of the Park Square Building



Original Vestibule Lobby Plan

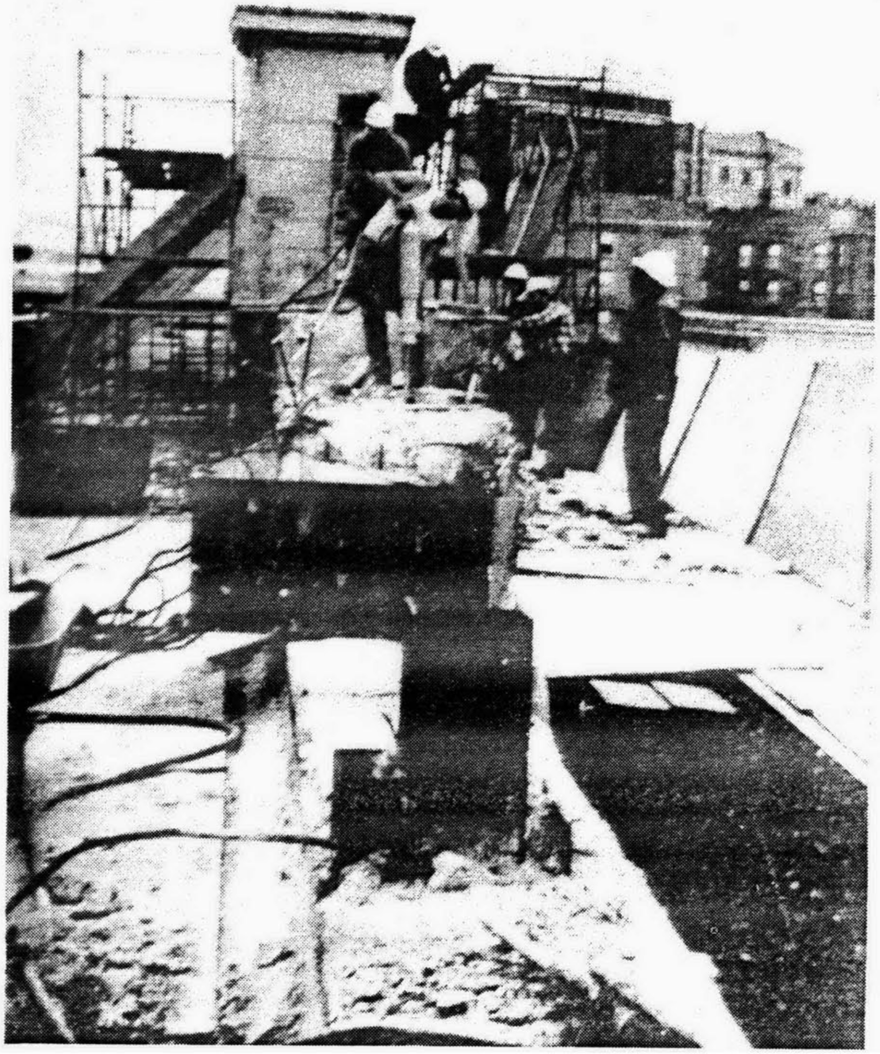
PARAPET REMOVAL

The original eleven foot high ferrous concrete decorative parapet had to be removed in the Fall of 1983, to prevent further spalling shards from falling to sidewalk. Reportedly, a lion head gargolye fell to the sidewalk early one morning. Deterioration was blamed on the continuous freeze-thaw cycle, exposure to acid-rain, and age of concrete cornice work. Reinforcing steel was not galvanized at the time of the building's construction. The copper sheeting had worn thin from the repeated bending caused by the yearly expansion and contraction of the building mass. It was decided there was no alternative but to remove the entire decorative parapet.

The removal project was no small undertaking. The whole building was wrapped in scaffolding, reaching a height of fifteen stories. The assemblage is believed to have been the largest of its kind ever used in Boston. A protective "brow" was installed at the second floor level to protect pedestrians while the work was underway above. 1,400 linear feet of building perimeter were eventually involved. A second brow was erected at the cornice line to act as a platform for the actual demolition work. All staging of the operation took place from the Providence Street alley side of the building. While St. James Avenue was the logical choice for setting the three cranes used throughout the project, the City of Boston would not grant a sidewalk permit. Arlington and Berkeley Streets, and St. James Avenue were thought to be too heavily travelled for the city to grant such a staging permit. Much of the crane operator's work was accomplished with the aid of walkie-talkies and workmen directing from the opposite side of the building. As the parapet was demolished pieces were then lowered to disposal units also stationed in the alley. The entire project was divided into 3 component phases for scheduling. To accurately assess the duration of each, a rating of the relative difficulty was assigned to each phase by the architect and the contractor. The basic cornice removal received a rating of 1.0. The removal of the more elaborate cornice over the St. James Avenue entrance was rated a 1.5, and the cornice above the elevator shaftway on the Providence Street side was assigned a difficulty rating of 2.5.

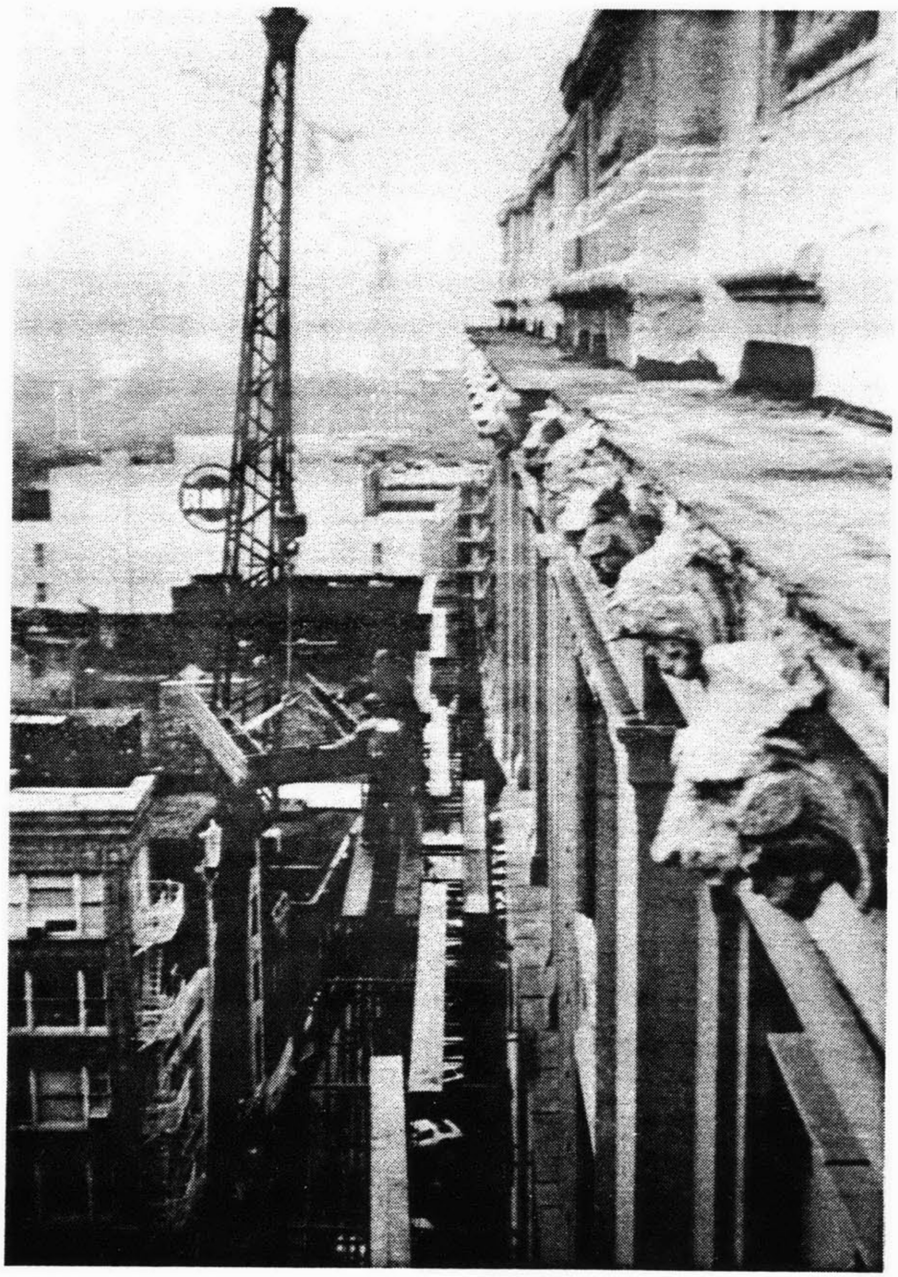
Scaffolding on the St. James Avenue Facade

The next step was to seal the rough edge left by the removal of the parapet. Jung-Brannen Associates specified lead coated copper for the flashing over the window headstones that were to remain. Membrane roofing was used for the remainder of the waterproofing over the new, lower parapet to match the existing roofing. Repair and reflashing of new edge included an 18" snow cap and a wire guard rail, rather than the pipe rail originally contemplated. This treatment serves its functional purposes but has definitely altered the appearance of the Park Square Building. These decisions were made after some review of the "dollar value and methodology" by the architect and the owner. The encapsulation of the edge has been examined by an independent roofing consultant. His recommendation is that it is sufficiently sound to last 3-5 years in its present configuration. The issue then is the visibility created by the removal of the parapet. The building appears bare, all the rooftop mechanical equipment, penthouses and piping is exposed and visible. There is also some concern for the vulnerability of this equipment to the wind without the protection previously provided by the 11' parapet. A new decorative trim or cornice has yet to be installed. The decision rests with the final disposition of the potential roof expansion project. If that project does not proceed the decision will depend on whether the existing roofing is replaced, a scenario which has also been discussed.



Demolition work on the upper brow

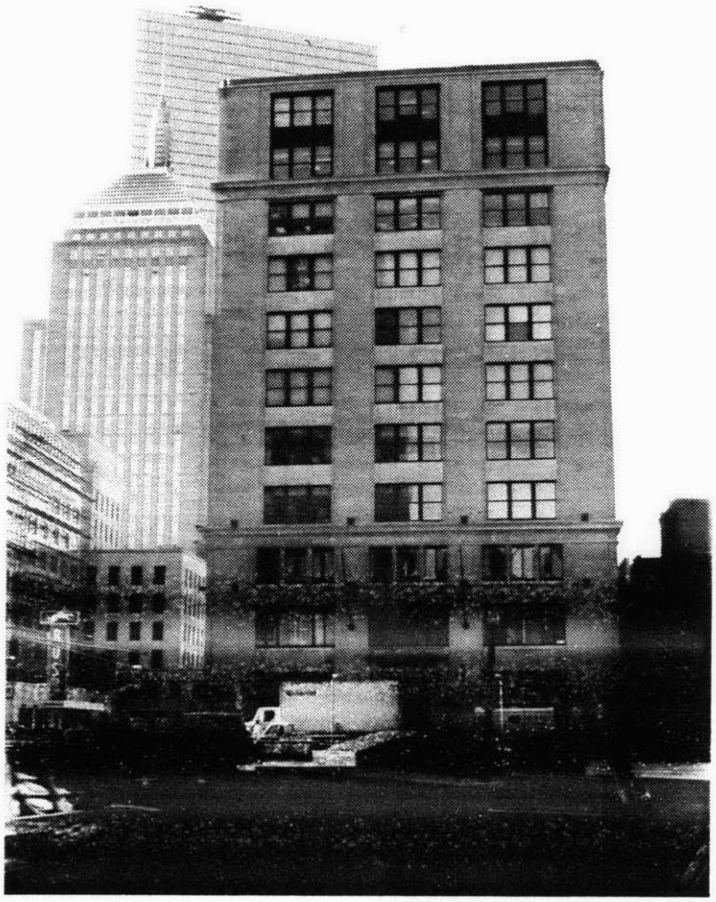
The final cost of the project, including scaffolding, demolition and removal of the debris came to over $1 million. If the roof expansion project should come to fruition the demolition expenditure will be accounted for as a cost of that project. The estimate for replacing the parapet with a new decorative cornice has been placed at approximately $500,000. This project was tabled by the building management in May of 1984, pending the outcome of the roof expansion and the roof replacement projects.



Deteriorated conditions of the Concrete Parapet necessitated its removal

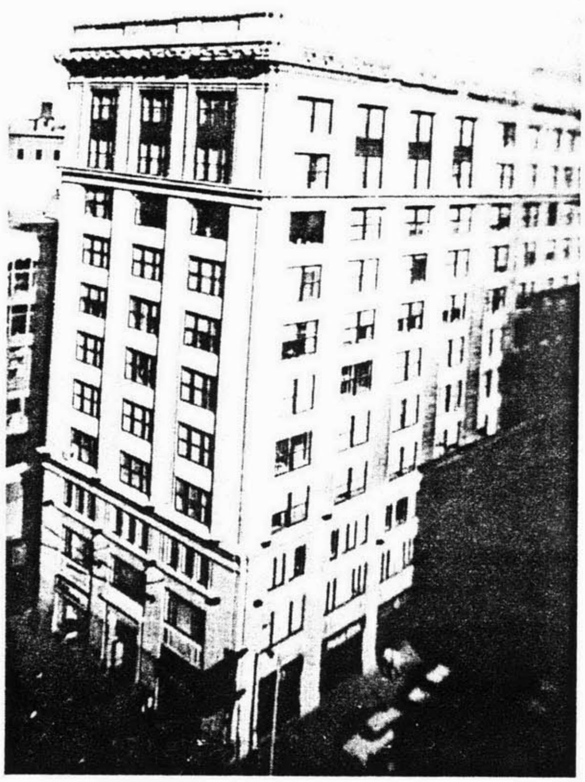
Existing roof today, with Edge Encapsulation visible. Note the pipe and wire railing detail.

The Park Square Building before cornice removal.



The Park Square Building today, without parapet and cornice.

As this case suggests, some expenditures, potentially quite large ones, are difficult to foresee. The cornice and parapet had to be removed, not only as a precursor to the possible roof expansion project, but as a matter of life-safety. For the owner this investment in the building was most likely unplanned. It also cannot be immediately rationalized as adding to the revenue producing ability of the building. It does, however, allow the owner to continue operating the entire building without endangering the passersby, reducing a great risk and liability. In this way it should be accounted for as a "cost of doing business", not unlike insurance premiums. More systematic preventative maintenance and inspection may have identified the potential problem at an earlier date, allowing for a more planned, or at least budgeted, expenditure. It is unlikely that this project could have been postponed for any substantial period of time. The owners did chose to include their architect as advisor, coordinator and supervisor for the subsequent demolition process. In this manner corporations are asking architects to become a part of the life-cycle of buildings and decisions related to them.



The Park Square Building
with parapet

without parapet

WINDOW REPLACEMENT PROJECT

The interest in the possibilities presented by window replacement is enormous. Windows long have been identified as a major source of heat loss in residential buildings. Commercial and institutional users are now investigating energy savings and opportunities for economic, as well as, aesthetic gains. In an era of unsurpassed building rehabilitation and reuse, development economics and preservation interests are generating new analysis of window replacement techniques and alternatives.

> While basic structures remain serviceable, windows, because they have been poorly maintained, are unsuitable for the new occupancy, or have simply worn out, usually need serious attention. Next to roofing systems and components, windows are the most vulnerable to the elements, highly susceptible to deterioration, and the most likely part of a building's exterior to be in need of extensive repair or replacement. New uses and contemporary expectations also pose unprecedented performance demands on fenestration systems ...among these demands are: resistance to rain penetration, air infiltration, intruders, heat loss or gain, provision of visual and acoustic privacy, ventilation, easy maintenance and safe use. (1)

As with any building component today, contemplating any replacement project offers many alternatives for the architect and owner. A multitude of manufacturers, each marketing an entire product line, offer an overwhelming

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(1) Thomas Vonier, "Next Window, Please," Progressive Architecture, (August 1984): page 1Ø4.

number of window types and constructions for consideration. Each variation carries special implications pertaining to its use, environmental elements, structural loads, appearance, initial and maintenance cost. In this case, dealing with an aging (if not historic) building, preservationists see windows as one of the most important character-defining architectural elements. A building's fenestration may in fact be the greatest single visual ordering device. In the owners' desire to upgrade and modernize the Park Square Building, the windows were quickly identified as a project worth pursuing. From an energy standpoint, a building with 1,425 sixty year old single pane, steel frame windows seems ripe for retrofit. The existing double-hung windows had been neglected, painted shut and generally abused for many years. The building requires an annual expenditure of almost $1,000,000 for energy to heat and air condition 480,000 square feet of commercial space. Employing the services of Jung-Brannen Associates, the partnership's architect of choice, as consultants, the window replacement project began over a year ago. Three overall issues were immediately identified as central to the selection process. They included building operation, architectural detail, and energy conservation. Each of these issues was further defined to establish a list of criteria against which each potential product and method could be evaluated.

Given the existing rough window openings, how should the architect proceed? With the irregular dimensions from window to window and floor to floor, few "stock" window units seemed acceptable. Surveying the "custom" window market produced a long list of possible alternatives. While the existing frames were steel, aluminum clad or extruded frames were considered to cut down on the transmission of heat through the frames themselves. The construction of aluminum frames required a thicker section for strength than steel, resulting in an "unhistoric" appearance. Aluminum does, however, offer advantages in terms of flexibility in sizes and sections, colors and coatings, and low maintenance. Aluminum framing was eventually decided to be less sturdy than the steel, especially as it related to the attachment of hardware, the construction of corners and the number of components used in each individual window unit. The large window size, up to 4',6" x 6',6" high, also suggested the more rigid steel frames. A compromise seemed plausible, to investigate a steel frame which included a thermal break. Similar to the extruded aluminum products, this would have employed a hard plastic or rubber insulator between metal components; again adding to the number of parts and materials to be incorporated into each frame unit.

A solid steel frame, most similar to the original, was eventually selected. Thinner than its aluminum counterpart, yet quite strong and capable of welded joints, the steel frame was available in a diverse selection of shapes, sizes and paint/coating colors. The steel frame was known to be more expensive and to require more careful periodic painting and maintenance. The conductive properties of a single metal frame made it less effective in retarding heat loss and condensation than an aluminum system. The decision, in respect to costs and energy savings, of steel over the aluminum framing was made in light of the total cost of the installation process. This included removal of the existing windows, insulating the exposed building cavity and installation of the new units, fitting and finishing. The savings of the less expensive frame would have been negligible after the increased costs of attaching the aluminum frames to the existing steel supports. It would also have dictated a more complicated transition and trim piece between the new frame and the existing interior finish condition.

The original double-hung configuration, split by an horizontal bar at its mid-point is replicated in the new window unit. The frame configuration follows the guidelines suggested by the National Park Service (2) and used the old window form as its precedent.

As the windows are used for ventilation, to balance the aniquated heating and air conditioning systems, an operable

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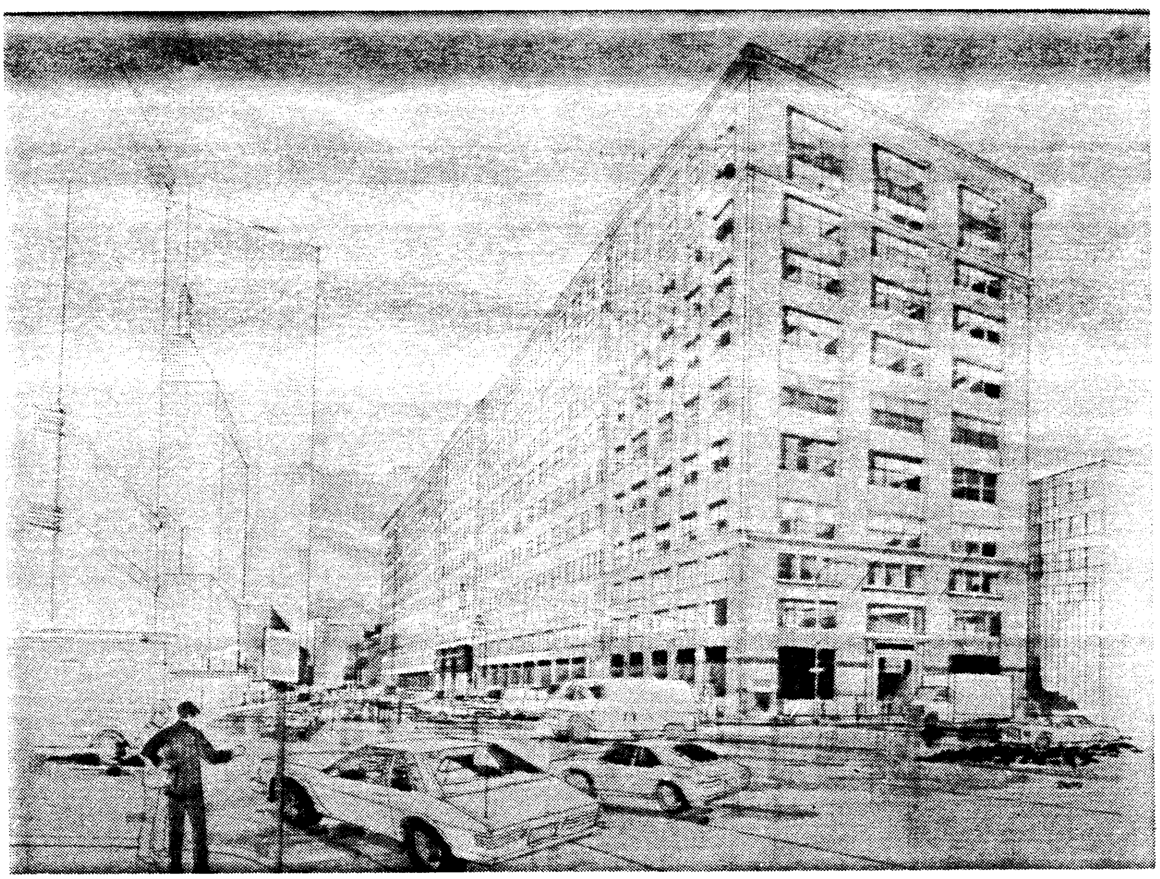
(2) Ibid., page 107.

sash was required. A fixed glass, single light alternative was discussed at one time. Quickly discarded, this scenerio would have given the building a decidedly "modern" appearance and could not meet the ventilating requirement. Rather than another double-hung configuration, an awning type lower sash was specified, allowing for an exterior appearance much like the original, bisected with an horizontal framing member. The awning configuration also minimizes the physical stress on the frame and on the occupant over the lifting of a large double-hung unit.



Rendering illustrating the predominance of the fenestration at the Park Square Building

Antiquated Ventilating and Air-Conditioning System

The most difficult decision involved the glazing to be installed. Several alternative glazing and frame units were installed in the Park Square Building for visual evaluation. The appearance of the building was an important consideration, in conjunction with potential energy savings. Reflective and tinted glazings offered the best energy conservation characteristics but compromised the exterior image of the building. Heat mirror glass was contemplated, adding substantially to the initial costs. This alternative would, however, have significantly lowered the recurring energy costs. The 600 feet of south facing facade seemed a likely candidate to make maximum use of this potential. The added cost, however, made it seem prohibitive to use on all four sides of the building.

Changing the glazing on the north facade to the less expensive clear glass was another alternative. Facing the Providence St. Alley and a large block of buildings on Boylston St. this side of the building is shaded by its own bulk. This would allow those sides of the building exposed to sunlight to be protected while less costly tinted glass could be used on the "back" side. Clear glass with an applied protective film and several variations of tinted glass were also considered. The decision was made to use a tinted thermopane glazing unit with 1/4" glazing, an 1/2" air space and a film laminated to the outside face of the interior glass. Each of the alternatives was minimally analyzed. Given the myriad of plausible alternatives, one might have expected a more systematic evaluation procedure.

Each manufacturer and supplier was asked to provide a ten year warranty for their portion of the project. All were able to do so, except the Southwall Corporation, the source of the HEAT MIRROR glazing discussed. They initally provided a five year warranty, amended themselves verbally to the ten year duration and never followed through in writing. From the variety of alternative units discussed three were installed in the building, each by a different manufacturer for evaluation. A vacant suite on the fourth floor that faces south was chosen for this demonstration project. Each unit was evaluated in terms of installation, visual appearance, water infiltration and water penetration. The last two tests were conducted by an independent engineering firm.

The visual criteria seemed the most thoroughly considered. Much discussion took place over the color of the framing unit. Robert Brannen advocated an "oyster shell" to harmonize with the exterior limestone. The building management was interested in the durability and maintenance, in addition to the appearance.

The Hopes window was the final choice. Constructed of a steel frame with a SOLARBAN urethane coating, this unit was decided to be the best compromise of all the identified criteria. The Hopes window includes a fixed upper sash with an operable awning lower sash, opening to 8". The glazing is made up of a TWINDOW unit, employing an organic seal, insulating glass manufactured by PPG. The glazing itself is 2 1/4" light of glass with a SUNGATE LOW-E coating fused to outside surface of inside glass. The PPG tinted glass was used on all faces. The Heat Mirror contemplated for the south face (St. James Ave.) was eventually rejected on the basis of its initial cost, limited warranty and its availablitity from a only a single source.

Bob Barstow, a consulting engineer, advising the Park Square Associates, indicated a "2 year payback" in the Partners Meeting minutes April, 1984, based on additional costs of the Sungate glazing system. Two characteristics of this unit were thought to be most influential to a reduction in the overall energy costs incurred by the building. The winter U value was estimated to be .31 for this configuration while only .49 for a clear glass. This fact illustrates the reduction in heat transmission through the window and frame. The R value was established to be 1.33. This too represents a potential for lessening the energy costs by increasing the reflectivity of the fenestration and thereby lowering the heat gain on the exposed faces. The initial expenditure of an additional $90,000 for the Sungate unit, will save $73,700 annually, in Barstow's calculations for energy costs. While these calculations were based on the Southwall HM-88 product, The PPG equivalent was in fact installed in the building. The use of tinted glass will increase reflectivity by 50%, cutting down on heat gain and thereby lessening A/C load. Double glazing will cut down on transmission by 50%, also lessening the load on the heating system. Simultaneous improvements to the radiator control system, individual sensors and control valves, will aid the heating system. Both of these changes will essentially give the system an extra floor worth of capacity. The building manager's calculations show that the $60,000/month gas bill will most likely be cut by $10-15,000/month during the heating season.

On the aesthetic concerns, the aluminum panning finish was changed to "oyster shell" at Jung-Brannen's suggestion. It was felt this color would be less conspicuous and more easily worked into tenant finish schemes. The frame itself is medium bronze, coated, as previously mentioned, with a urethane. Jung-Brannen was involved throughout the decision and installation process, acting as supervisor and consultant on an hourly fee basis.

The initial bid estimate was $1,350,000. Alternatives affecting the appearance and the addition of the Sungate glazing system brought the final pricing to $1.5 million. Given 1,425 windows, this amounts to approximately $1,000 per unit. The intial estimate and budget represented an anticipated expenditure of $800 per window unit. 70-80% of existing tenant leases allow for such improvements to be amortized over 10-15 years at "market rates" (see escalation clauses). This permits the expenditure to be allocated back to the building tenants as a capital improvement.

The actual window delivery was 2 months late. Park Square Associates hoped to complete installation by winter to minimize the inconvenience to tenants, lessen heat load and ease the strain on the antiquated heating system. As of mid-November, 1984 the installation was still underway. Much of the installation took place from inside the building. Only repair of the interior finishes directly around the window units required work on the tenant space. The 2nd floor, with its odd window conditions and the 6th floor at the Arlington Street end, with its windows blocked up from the inside, required great deviation from the typical installation procedure. The existing steel frame units were removed and the wall cavity packed with new batt insulation. The new steel frame was then secured to the old steel supporting anchors. The entire perimeter of the unit was caulked and the glazing unit installed.

Awning Window, as installed

This project was very thoroughly considered. From its inception the owners, building manager and consultants were all evaluating alternatives on many levels of criteria simultaneously. First costs seemed to be balanced against long term benefits to the building's operation, maintenance, and architectural detail. The need for ventilation generated particular requirements on the window and HVAC system. The architectural character of the building was ultimately respected, preserving the scale and setback of the original units while updating the building technology employed. Since several other projects involving the Park Square Building were still under consideration, the uncertainty was great. The potential for the roof expansion project necessitated that the system be flexible enough to be used in other ways; the possibility of an entirely glass enclosure system, using compatable components to the lower building. Another unknown at the time of this decision process was the disposition of reworking of the HVAC control system and the possibility of a total mechanical upgrading of the lower building in the event of an addition to the roof.

ALTENATIVE WINDOW TYPES

HOPES ARCHITECTURAL WINDOWS

Steel frame, urenthane finish, anwing type operable sash
2 cam locks
butyl glazing tape
silicone sealant
1" double glazing, PPG Twindow, PPG Solarban coating
Uc=.49
PPG glazing with Sungate Low-E film
aluminun panning
$1,350,000 initial estimate

MODU-LINE

Aluminum frame with integral thermal break, awning type operable sash
2 cam locks
butyl glazing tape
silicone sealant
no panning
1" double glazing
Uc=.61
$1,145,360 initial estimate

AMS

Aluminum frame with integral thermal break, awning type operable sash
2 cam locks
butyl glazing tape
silicone sealant interior and exterior
1" double glazing
aluminum panning
Uc=.67

THREE RIVERS

Aluminum double hung, most similar to existing window
1" double glazing
$950,180 initial estimate

SINGLE HUNG UNIT

aluminum frame, single pivot operable unit
most interference with existing interior blinds
1 1/2"thermalized glazing system
Uc=.67

In this first case, the window replacement project, a study period of 10 years is used to match the warranties provided by the window framing and glazing manufacturers. In simplified terms the annual present value of the window replacement project as installed is $796,639. This figure includes a 10% tax credit on the initial expenditure as an energy conservation measure. This tax credit was not actually taken at the time of this study. It does however, include the client's initial cash requirements, operating, maintenance and energy costs, as well as income tax adjustments applicable to this project. The total life-cycle costs amount to just over $9 million when one considers the energy consumption of the building. This illustrates how decisions made by the architect impact the client in far reaching, and often costly, ways.

BLCC analysis was used to explore this project in economic terms. The first analysis in this case examines the project as it actually happened. A second study illustrates the same project without the use of the more expensive and more energy efficient glazing unit. If the architect, or decision-makers, had employed such an analysis at the appropriate time in the process, prior to the final selection, they may have subsequently explored the alternatives more rigorously. For an initial additional expenditure of $94,500, the reduction in life-cycle costs, over the 10 year study period, amounts to $468,925, mostly in saved energy costs. Given the ramifications of such a decision and the magnitude of the dollar value over time, the architect and the client may well have more systematically investigated and evaluated the possible alternatives. The PPG product seems to have been a good choice in an economic sense. Other glazing materials, offering even greater energy conservation might have been acceptable to the client if he/she had been fully apprised of the financial consequences of such an investment. This does, however, illustrate the potential benefits of including such analysis in the architectural design process. It requires the architect to collaborate, as previously mentioned, with other building experts. Engineers can often provide the energy consumption analysis necessary to calculate the potential savings. If the architect is to regain, or maintain, some level of leadership in the decision process he/she might use this type of analysis to illustrate his/her understanding of the entire project and its consequences.

A third BLCC analysis was performed using a discount rate of 12.5%, rather than the typical 10%. The program allows the easy exploration of alternative financial conditions and alternative capital component schemes. Employing this program the architect can quickly evaluate both assumptions and variations. Those which offer some advantage could then be studied in a more comprehensive manner. The architect could thus restrict design development to those scenarios which seem most promising, a method toward optimizing the design process, as well as the design itself. A discount rate of 12.5% suggests a lower total life-cycle cost, \$8,200,000, but a higher annual cost after tax adjustments.

The last analysis used in this case lenghtened the study period to 20 years. This would allow the client to assume a truly long range perspective of the contemplated capital investment. The full benefits of time on a stream of periodic payments can be realized with this view of the project. Ultimately, the expenditure for the window replacement would be repaid with "less valuable" money in the future, due to normal inflation. While the total financed project costs would be higher, the annual cash obligation for the building owner would be approximately \$100,000 less per year. The financial criteria and objectives of the client are most important to such decisions. The architect could make more informed decisions and advisements to the client if these concerns were included in the selection process. Often they presently fall outside the realm of "design" and are discussed only in the presence of tax consultants and accountants. The architect could make use of this information if he/she asked for it and illustrated how architectural design decisions can affect the building owner. The following table is a summary of the several BLCC analysis and comparison runs. The more lengthy BLCC files can be found in Appendix A.

WINDOW REPLACEMENT PROJECT BLCC SUMMARY

<u>Project as installed:</u>

Initial costs: $1,605,600

Yearly energy costs: $904,000

Total Present Value (including operating and energy costs):

10 year study period		20 year study period	
annual	total LCC	annual	total LCC
$1,468,359	$9,002,430	$1,070,489	$9,113,679
after tax adjustments:			
$796,639	$4,895,000	$273,850	$4,218,679

<u>Without SUNGATE glazing</u>

Initial costs: $1,511,100

Yearly energy costs: $1,312,208

Total Present Value:

10 year study period	
annual	total LCC
$1,581,780	$9,719,352
after tax adjustments:	
$857,575	$5,269,425

$94,500 savings in initial investment therefore yields a $791,423 increase in 10 year energy costs, $322,499 greater tax adjustments mostly due to increase energy expenditures for a total life-cycle cost increase of $374,425.

<u>12.5% discount rate</u>

Total Present Value:

annual	total LCC
$1,481,113	$8,200,079
after tax adjustments:	
$809,452	$4,481,475

Installation of the new window units on the 11th floor, Berkeley Street end, mid-November, 1984.

OFFICE RENOVATION AT THE PARK SQUARE BUILDING

In 1980, as the partnership and purchase agreements for the Park Square Building were being finalized, plans had begun by one major investor to renovate space for its own employees. A financial investment firm, with a staff of over 1,000 in Boston, had determined the Park Square Building would be both a good investment and location for several of its more "back-room operation" departments. Phase I of this project included approximately 20,000 square feet on the top floor. Several architects were interviewed for space planning services. The goals of this first renovation project were to provide modern, air-conditioned, class "A" quality space for a staff of 100. Major difficulties included adapting the long, narrow configuration (75' x 300') and utilization of the outdated mechanical systems. The initial budget, in 1981, was set at $20 per square foot. Services requested by the client included development of a space program for each functional unit, planning space configurations and base drawings, refining the design and selecting materials, colors, furnishings and fixtures. The architect was also held responsible for firm budget estimates and code compliance. The final phase of this development process was to culminate in construction documents and specifications, as well as, on-site supervision of the construction and installation. Several firms interviewed for the project, submitting fee requests of between 9.5 & 12% of the total project costs. One architect immediately questioned the $20 per square foot budget figure, suggesting $25-30 per square foot as more realistic for class "A" space renovation.

Of the various work plans offered by each architectural firm several common objectives emerged. Since this initial project represented the first of many phases, the development of standards and an appropriate design concept for space utilization was important. Although no absolute decisions had been made, the use of an open office furniture system was to be seriously considered. Discussion ensued as to the optimal method to utilize the space given structural bays of only 17 feet and the resulting forest of columns. This focused attention on the issues of acoustic privacy, HVAC and lighting requirements. The need for flexibility in both space division and mechanical services also had to be addressed. A schedule was developed by the client that allowed 180 days for the entire project, including design and construction.

Ultimately, the firm of Professional Design Incorporated (PDI) was selected by the client. While cost was not the sole criterion, PDI's initial fee submission was the lowest of the three main competitors. Several managers involved with the decision process cited the personalities of the architects as very influential. The "chemistry" seemed right with respect to PDI and those who would be coordinating the project for the corporation. PDI's size was also a factor. While large enough to handle a project of this magnitude, they were small enough to provide the special attention the client knew they would demand. The project manager from PDI was important to the decision, the client was knowledgable enough to know that they would be buying the services of that individual and not the entire firm.

The new owners of the Park Square Building were in the process of updating a tenant standards program at the time of Phase I renovation. Due to the transitional nature of the building standards and the client's partnership in the building, no pressure was exerted on this project to adhere to any prescribed specifications. The Partnership deferred to the client and made an allowance of $8.60 per square foot for fit-up expenditures. Critical building components were identified as the lighting system; doors, frames and hardware; and the ceiling system. Other design conversations centered around radiator enclosures and controls; the base building air-conditioning and fresh air cycles; flooring; partitioning; and window treatments. Jung-Brannen Associates were employed by the Park Square Associates to refine the building standards, while PDI was left to specify materials for the client's space. Flexibility, durability and costs all appear to have been criteria for the design decisions subsequently made.

The client's decision to move into the Park Square Building utilizing systems furniture was a great departure from previous experience. The long and narrow shape of the Park Square Building necessitated a seemingly radical approach to space planning. The limited utility distribution and antiquated HVAC systems made the justification of this expenditure much more reasonable. Architects have only recently accepted systems furniture partitioning as a viable alternative to building fixed offices. For the corporate client, furniture partitioning systems offer several advantages. Such "portable" systems qualify for investment tax credits not available for leasehold expenditures for fixed office construction. Because they do not need to be attached to the ceiling, lights and air diffusers can serve many work stations. Mechanical systems do not necessarily need to be relocated with every rearrangement as in the case of more traditional fixed wall offices. Several levels of enclosure are possible, provided by different height panels. With each successively higher panel, a greater degree of visual and acoustic privacy can be obtained. Panels can be specified for sound absorbtion requirements. The open office environment provides a mix of activity noises and converstaions to act as background sound masking. With proper acoustical treatment of the ceilings and floors, in addition to the panels themselves, is often preferrable to the relative silence of more traditional fixed office plans.

In this latter circumstance conversations can be more noticeable and distinct, resulting in less perceived acoustical privacy.

Each work station can be fitted to meet the precise requirements of its occupant, while maintaining a "standard" look. Experience at the Park Square Building has shown a reduction in square footage requirements per employee over other methods of space division this company has used. The panel partioning system adds to the employee perception of having a "territory" that is his/her own. As for flexibility, systems furniture can be quickly disassembled and reassembled as functional needs change. For this corporation, which recurringly restructures their organization, office configuration must also be relatively easily rearranged to keep pace with user requirements.

The electrical, communication and data cabling requirements of the office in the 1980's are staggering. Systems furniture panels are available with "raceway" constructions, integrated conduits for feeding individual work stations with the necessary cables. Each grouping of work stations can be serviced from a single base in-feed connection. Compared with "hard-wiring" each station or office, this method requires less technical installation and a greater initial investment in the furniture system itself. Reconfiguration is more efficient in that the electrician need only disconnect and reconnect the in-feed for each group of linked stations.

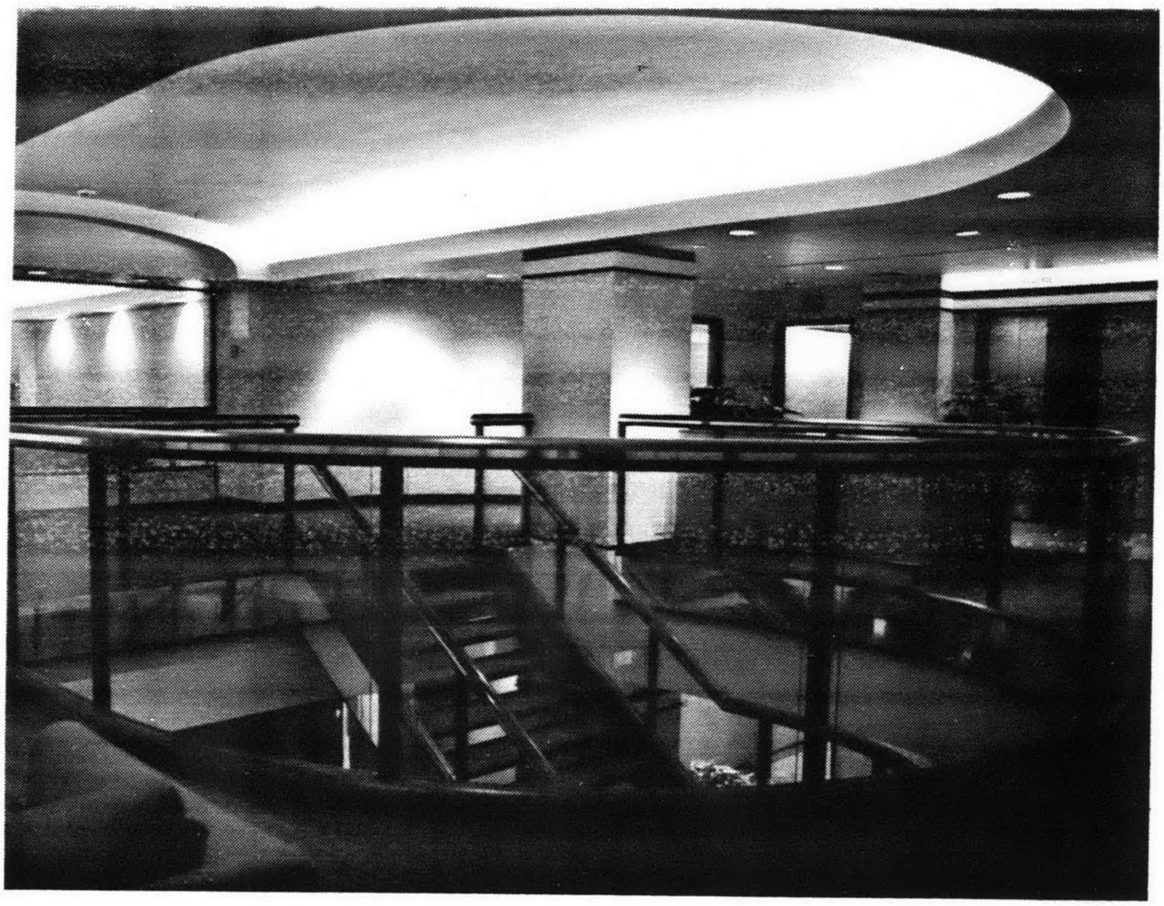
Lighting can also be made more flexible by employing systems furniture. While general overhead lighting can remain fixed, task lights can be installed to meet particular needs. Ambient (indirect) lighting can be added, utilizing the partition raceways for electrical service. Most systems allow for a variety of fixtures attached not to the building, but to the furniture system. A major economic incentive is provided through reduced electrical installations, flexibility to accommodate changing requirements and in the time and labor saved in rearrangements over more traditional space defining methods. While iinvestment tax credits were not used in this project, this corporation is now investigating more rigorously employing this economic advantage on future purchases.

Following the renovation, installation of systems furniture (Westinghouse Architectural Systems) and the relocation of approximately 100 employees from a downtown office building to the Park Square Building, a new master occupancy plan was developed. This plan, in early 1982, called for the renovation of 82,000 square feet, the entire fifth and sixth floors, known as the Park Square II project. The space was to become available for renovation, due to tenant turnover, in July of 1982. The occupancy plan called for relocation of personnel by September, leaving only 60 days for the actual demolition and reconstruction. The intent by the client was to quickly relocate five major groups from the more expensive downtown location and to sublease that space at a profit for the company. A method of phased moves was employed, occupying sections of the total project in 20,000 square foot increments as the space was completed. The entire project was occupied over a six week period of successive moves. Ultimately the relocation was several weeks late due to difficulty in obtaining carpet tiles from the manufacturer.

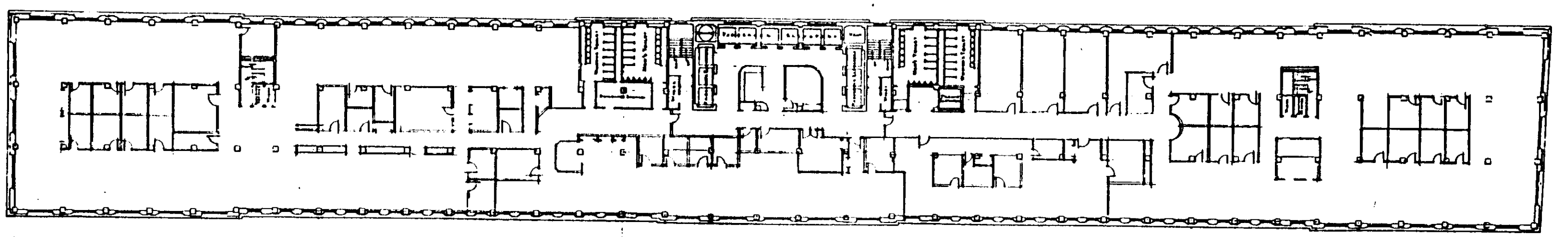
An overall design concept similar to that used on the 11th floor, Phase I project was employed. All fixed offices are built in the center bay running the length of the building. This allows for the perimeter space, along the windows on all four sides, to be used for open office work stations. In this ways the natural light reaches as many work areas as possible. Those functions that do require "closed-door" privacy do so at the expense of a position nearer the windows. No exterior window offices have been built. Fixed offices are constructed of gypsum wallboard over 3 1/2" metal studs. A 2' x 2' lay-in, acoustic ceiling system is used throughout both floors. This allows for easy relocation of either the 2' x 2' fluorescent light fixtures or the HVAC diffusers. Accent lighting is used in the lobby, corridors and in private offices. Both valance fluorescent and recessed incandescent fixtures are used. Plants and planters have been included intermittently to "soften" the space. Carpet tiles were selected for all but the lobby and a few private offices. The reasoning for this was to permit maximum possible flexibility to replace carpet as necessary due to possible wear, reconfiguration and damage. Travertine marble was specified for the main elevator lobby for durability and as an accent.

The selecion of wallcovering materials seems most questionable of all the finish decisions made. A "flocked" vinyl wallcovering was specified that defies maintenance. All corridors, offices and interior partitions were covered with this vinyl. In the two years since installation much of it shows signs of wear, stains and damage. Some other wallcovering or paint of a more durable, or more easily repairable, nature might have proved a better choice. 600 yards of this flocked vinyl are about to be replaced at a costs of approximately $10,000. The exterior window walls, doors and frames are all painted, and have been repainted and touched up as needed.

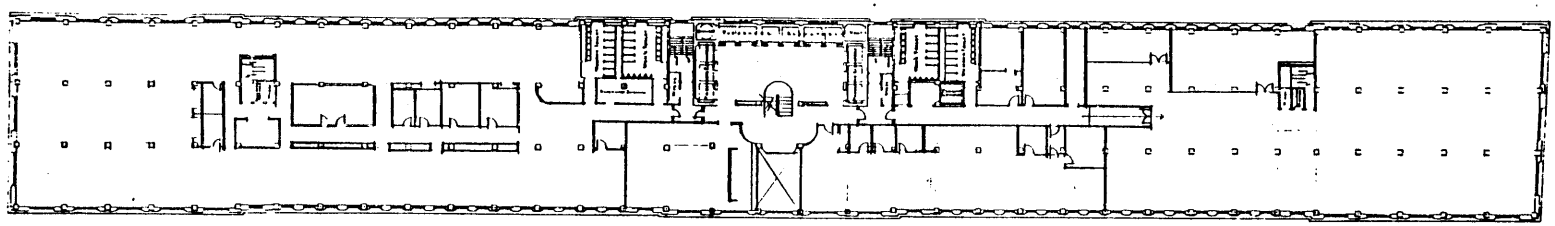
To facilitate movement between the two floors, a major design feature was introduced into the elevator lobbies. A glass and steel stair connecting the fifth and sixth floors was constructed, along with an atrium just beyond the stair, facing St. James Avenue. Instead of the typical lay-in ceiling, a smooth plaster ceiling with a sculpted light cove was installed. The travertine marble and broadloom carpet add to the richness of this space. As throughout the Park Square Building, brass has been used for miscellaneous metalwork, in this case including trim on the stair and its railings.



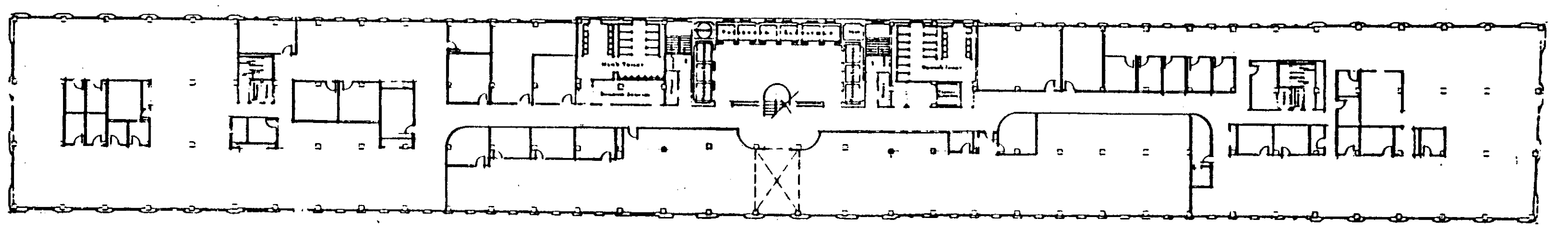
Atrium Stair greets 5th and 6th floor employees and visitors



Eleventh Floor



Sixth Floor



Fifth Floor

Fifth, Sixth and Eleventh Floor Plans

Quite late in the process a management decision was made with respect to the total budget. A reduction of approximately 10% was to be recaptured. It is not clear why or how this was to be accomplished, only that it was a decision made by the parent corporation. With construction 90% complete and finish materials already en route, a mad scramble ensued to remove whatever could be to save this amount. Ultimately only one-third of the desired cost reduction was realized. Most of this was taken out of the systems furniture order, the last major expenditure remaining not yet installed. In hindsight this cost reduction was ill-fated. Many times the amount returned to the company was spent in the subsequent two years replacing that which had been eliminated, at a premium cost.

The financial characteristics of the Park Square II project are representative of other investments in buildings and space made by this company. Envisioned as a long term commitment to the building, the quality and extent of the renovation exhibit this expectation. Simultaneous with the general office renovation, design and construction began on a "state-of-the-art" computer facility in the Park Square Building for the same client. These projects together represent a $4.7 million investment. This expenditure is being depreciated over the remaining life of the existing lease. Depreciation represents the means by which the original cost of this capital asset is recovered through a series of annual deductions. In 1982 that meant the project cost would be carried over a period of only eight years. As the remaining years on the lease diminish, it becomes increasingly difficult to financially justify large expenditures in the building. Because the period for economic recovery becomes successively shorter as the lease nears expiration, the capital expenditures must be amortized over a shorter time. Greater cash outlay per year is required to repay these expenditures. Beyond leasehold improvements, such as this renovation project, other costs must also be accounted for. Fixed assets, including furniture and equipment, are similarly depreciated over their useful life. Prior to the Park Square II project, furniture had been depreciated over a 20 year period. While this is an artifically long time, possibly peculiar to this company, it does represent a method to seemingly inflate profits by carrying capital expenditures over a longer period of time. Each year only a very small percentage of the total expenditure is depreciated. A difficulty potentially arises when the economic life is thus prolonged, possibly beyond the actual useful life of the component. This is the very opposite condition from when a building is renovated or replaced simply because it has physically exceeded its economic life.

This corporation, like many others, fully allocates all capital costs back to the user groups. Leasehold and fixed asset expenditures are charged back to each division occupying that space, at a rate representing that year's cost to the company. This expenditure is in turn charged to customers, through the product price. In this way corporations must view the cost of their buildings, leasehold improvements and fixed assets as a factor of production. Ultimately, it has a real effect on the cost of their product and on their ability to compete in the marketplace.

When questioned about the criteria upon which design decisions were made, one corporate executive cited only two. One was the "test for reasonableness"; did the proposed design, detail, or layout meet the functional needs of the user group? The efficiency of the design to the intended occupant was most critical. The second test was against the estimated budget. Envisioned in the range of $25-28 per square foot, the project eventually missed this criteria by a large percentage. The final project came in at $36.03 per square foot. One explanation for this is the result of a conceptual change. Originally this renovation was to be a backroom operation with its aesthetics matched to its function. As those groups were identified for the eventual space, the level of finish was elevated to meet the expectations of those units. Equity between the various buildings surfaced as an important concern late in the process of programming and design. Two managers had parallel control and responsibility for this project. The financial management came from the Corporate Real Estate executive, while the aesthetic and programming review lay with the Facilities Manager. This arrangement is strikingly similar to that of the subdivision of responsibility and liability between the architect and his/her consultants.

Operational office environment of the 6th floor, a product of the Park Square II project, has been totally reconfigured to meet the user group's functional needs

BLCC analysis focuses attention on several points. The study period of 8 years represents the economic life span anticipated by the client. The project will be fully depreciated over the remaining life of the existing lease. The capital costs are divided between leasehold expenditures; including construction, finish materials (carpet, ceilings and wallcoverings), mechanical systems and the systems furniture purchased to outfit this project. The systems furniture is differentiated to allow calculation of the potential investment tax credits (ITC). Operating and maintenance costs are based on actual building experience in the two years since occupancy. The first LCC analysis run represents the project as developed. (This and all LCC analyses can be found in Appendix A.) An LCC analysis (PSBIIA) includes the ITC adjustments that were not taken at the time of the initial capital investment. These adjustments amount to a tax savings of $129,025 or an annual present value of $24,185. This savings might have been reinvested in the project, used to offset the cost reduction in the furniture order or used to upgrade additional areas or materials.

Comparative LCC analysis contrasts the project as realized with the potential advantages offered by the application of appropriate knowledge of tax law and construction methods. The net savings of $97,500 in present value represents roughly 4% of the total project costs. This is approximately 67% of the entire project contingency budget authorized for this project. The architect might have used this amount in more creative ways or effectively returned it to the client, if the financial ramifications of the project design and components had been more fully considered.

COMPARATIVE LCC ANALYSIS - PARK SQUARE WINDOWS AND WITHOUT SUNGATE

STUDY PERIOD: 10 YEARS
CONSTRUCTION PERIOD: 0 YEAR(S)
STARTING DATE: 1984
BASE DATE FOR DISCOUNTING: 1984
DISCOUNT RATE: 10.0% (NOMINAL)
SALES TAX RATE: 5.0%
TAX STATUS: FOR PROFIT
FED TAX RATE: 46.0%
STATE TAX RATE: 0.0%
PROPERTY TAX RATE: 3.3%
CAPITAL GAINS RATE: 28.0%
BASE CASE LCC FILE: WINDOWSLCC
ALTERNATIVE LCC FILE: WIND1LCC

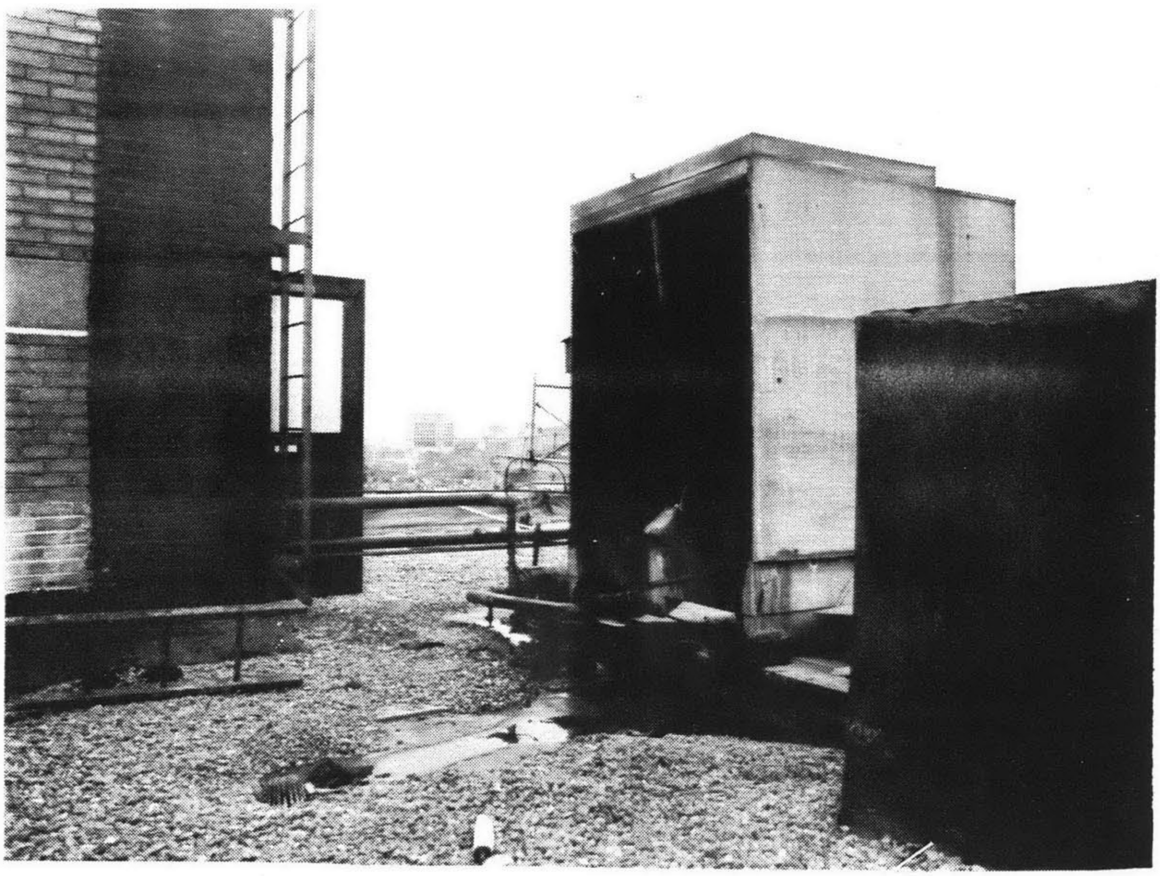
PRESENT-VALUE COSTS:	BASE CASE: PARK SQUARE	ALTERNATIVE: WITHOUT SUNGA	ALTERNATIVE - BASE CASE
CASH REQUIREMENTS AS OF OCCUPANCY	$1,605,600	$1,511,100	-$94,500
PRIN. AND INT. PAYMENTS AFTER OCCUP.	$0	$0	$0
ANNUAL & NON-AN. RECURRING COSTS	$145,300	$165,897	$20,597
PROPERTY TAXES	$0	$0	$0
ENERGY EXPENDITURES	$7,271,530	$8,062,953	$791,423
INCOME TAX ADJUSTMENTS BEFORE OCCUP.	$0	$0	$0
INCOME TAX ADJUSTMENTS DURING OCCUP.	-$4,127,430	-$4,459,404	-$331,974
RESALE VALUE AT END OF STUDY (NET)	$0	$0	$0
TOTAL P.V. LIFE-CYCLE COST	$4,895,000	$5,280,546	$385,546

REDUCTION IN FUTURE COSTS DUE TO ALTERNATIVE (SAVINGS) =	-$480,046
LESS: ADDITIONAL NET INITIAL INVESTMENT REQUIRED BY ALTERNATIVE*=	$94,500
NET SAVINGS FROM ALTERNATIVE RELATIVE TO BASE CASE =	-$385,546

ROOF EXPANSION PROJECT

In the late summer of 1983 the Park Square Building Partnership met. Several items were discussed including the possibility of adding two or three floors to the Park Square Building. Jung-Brannen presented a preliminary scheme of two floors of sloping glass, similar to their renovation for the Meridien Hotel. The partners were enthusiastic at the possibilties presented by this project. Not only could it increase the rentable area, hence revenue, of the building, it would generate new economic life in the aging structure purchased 2 1/2 years earlier and potentially add to its visibility on the skyline. It was suggested that cost estimates and a "critical path" for the project be established before a final decision was made. Long term occupancy projections, as well as existing problems with the building's antiquated windows were discussed. The meeting ended with one partner's desire to meet on a more regular basis.

The two floor addition was studied in terms of its impact on the existing roof and mechanical systems. Since the building's cooling towers sit on the existing roof, they would need to be relocated. The possibility of building over the existing roof, with its many penetrations for mechanical supports and recent history of small leaks at the penthouses, was an attractive chance to start anew. A cost of $37,000 was estimated for the relocation of the existing chilled water piping, the dry coolers of one tenant's computer facility and new structural supports for those cooling towers that would need to be moved. New electrical capacity would also be required to handle the mechanical system.



Existing Cooling Tower, note condition of roof and penthouse.

Two schemes were discussed, based on the assumption that new windows would be installed prior to this project lowering the heating and cooling load of the present eleven floors.

The first scheme replaced the two existing steam absorption chillers with new electric-driven centrifugal ones, to be located either on the new roof or in a new roof mechanical room. Above that, new and smaller cooling towers would also be installed. This system would carry the whole building, including the two new floors. Greatly more efficient than the existing system, it was calculated to run at a 50% savings over the current operating cost, for an initial investment of $700,000. The second scheme left the existing chillers in place, replaced the cooling towers and provided for a new centrifugal chiller to carry the new floors and the transitional spring and fall loads of the lower floors. The price for this system was placed at $400,000.

The initial scheme of two floors in a trapezoidal form quickly gave way to a three floor design. Composed of a moment frame and totally glazed, this scenario introduced a vaguely cylindrical form running the length of the building. It was believed that the bulk of the capital costs would be incurred with either plan and the additional floor would add considerably to the rentable area. The next major concern was with the existing building structural system to carry this new load. Weidlinger Associates; Consulting Engineers, were retained to conduct a structural feasibility study. Although the building was thought to be sturdy enough for the expansion, seventeen columns were identified for specific testing. Interestingly, one contractor familiar with the Park Square Building commented on how sturdy the structure was. Despite its total lack of expansion joints over its 600 foot length, there were no major structural cracks, in his experience. While it is assumed a monolithic concrete structure such as this would undergo great expansion and contraction cycles (witness the parapet deterioration), the basic building has seemingly retained its structural integrity. The differential expansion of the limestone faces of the three exposed sides and the brick of the shaded northern facade would suggest a problem, yet none has been found. The recent cleaning of the facades attests to the lack of damage to the exterior walls.

A review of the three level scheme advised that the second plan was more aerodynamically shaped and worked well to keep the entire building structurally stable. Wind tunnel testing was authorized at a cost of $10,000. One additional structural variation was discussed. Weidlinger was directed to study the possibility of reducing the number of columns, thereby increasing the bay spacing and usable area of the new floors. The placement of elevators was also discussed at this stage of design development. Three existing elevator shafts, only one of which is operational for service use, were identified on the east end of the tenant lobby. These could be renovated to provide direct service to the new top floors. Jung-Brannen was asked to study this and the possibility of adding limited elevator service from the present eleventh floor to the additional floors.

Aside from structural considerations, the addition of three stories to the Park Square Building posed two important questions. How can such a project be undertaken without "disrupting the coherence of a district united by similar building height, materials and style?" (1)
This question seems somewhat less important a year after it was first asked. Several new buildings in the area, two on Bolyston Street, one block to the north, have made no attempt to respect the form, height or materials of the district. Secondly, the proposed New England Life development on the site directly across Berkeley Street will dwarf the Park Square Building with or without three additional stories, at its projected 27 stories. The more pertinent question lies in whether a complimentary form can be found in regard to the new addition in relationship to the old portion of the building. The document cited from Jung-Brannen makes no mention of the financial ramifications of the various scenarios discussed. The fact that the building management could provide no overall estimate of cost is telling in itself. The latest proposal has been labelled from the "French Classical" period, to harmonize with the existing building form and derivation. Aside from

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(1) John H. Englund. from an unpublished paper on the Park Square Building. internal document for Jung-Brannen Associates; Architects and Planners, Boston, Mass., 1983.

those historical justifications, the juxtaposition of glass and the present limestone is thought to be the least disruptive scheme to the integrity of the district. A new projecting cornice would be added to visually separate the new from the old. This would restore the original roof line that was minimized with the removal of the old decorative parapet. The in-curving form should further de-emphasize the addition in bulk, while making it distinctive in character.

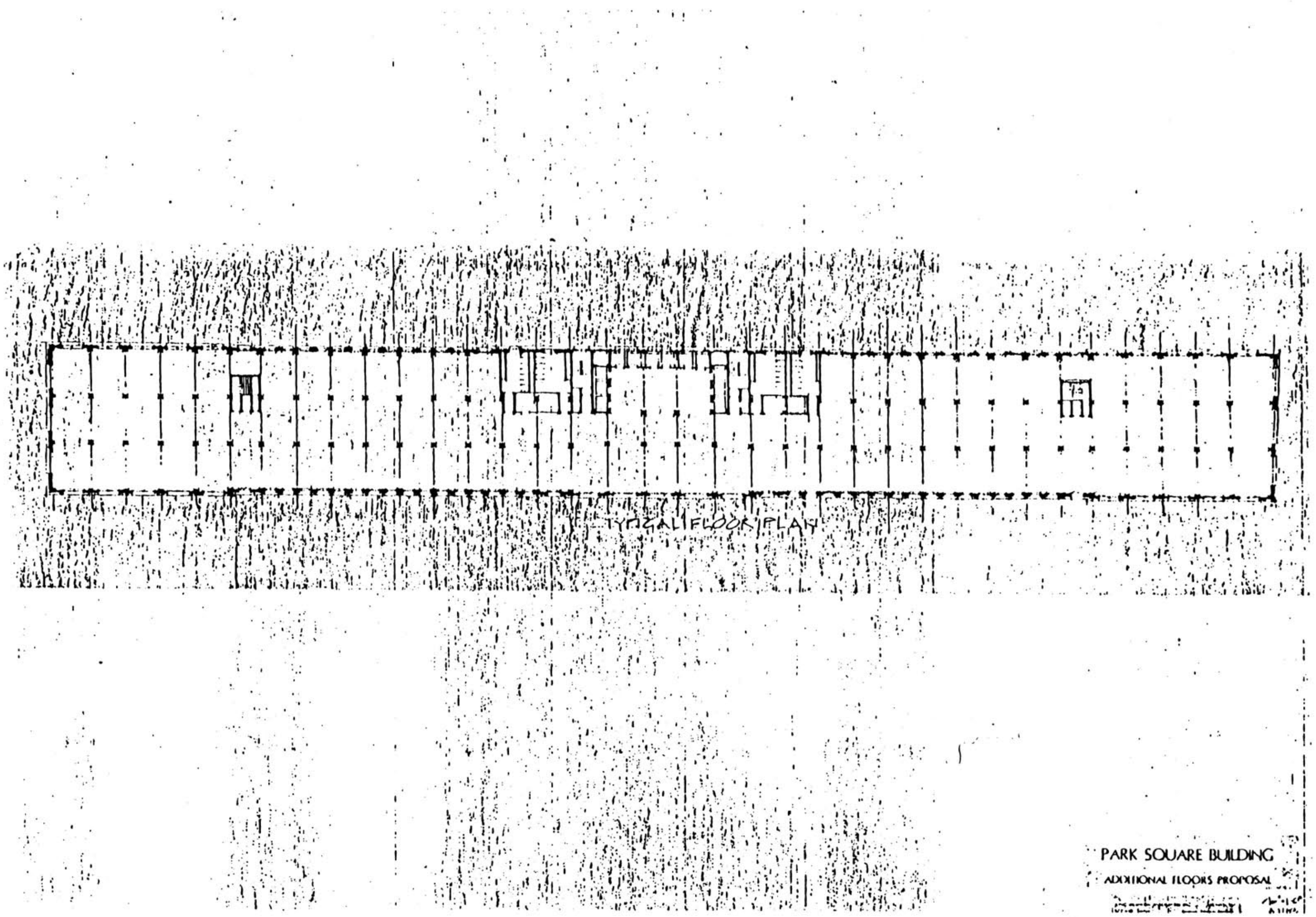
At the time of this project development the parapet was being removed at a rate of twenty feet per day. The need for moving quickly on the expansion scenario was urged on by this demolition work in progress. The partners once again expressed their desire to offer "first-class office space" at the Park Square Building. While the building was/is not of great architectural importance, it does represent a style of its time and presents a formidable presence due to its size. Jung-Brannen advocated following in its conceptual beginnings and creating a "modern" statement of great distinction.

A 155 foot height limitation constrained the project in one dimension, as did the existing building itself, constructed to the property lines. The question of fire protection was also raised. This question remains unresolved at this writing. The entire design development process was tempered by the zoning and code requirements, in addition to the politics of such a project. The Boston Redevelopment Authority would need to approve the final scheme and a discussion of the BRA's attitudes ensued.

Review would also include the Back Bay Architectural Commission, the Back Bay Business Association and the Back Bay Neighborhood Association. The parapet removal has visibly demonstrated the Park Square Associates' activities to the neighborhood. The entire project is contingent upon variances by the City Board of Appeals. Various scenarios for seeking such approvals have been discussed.

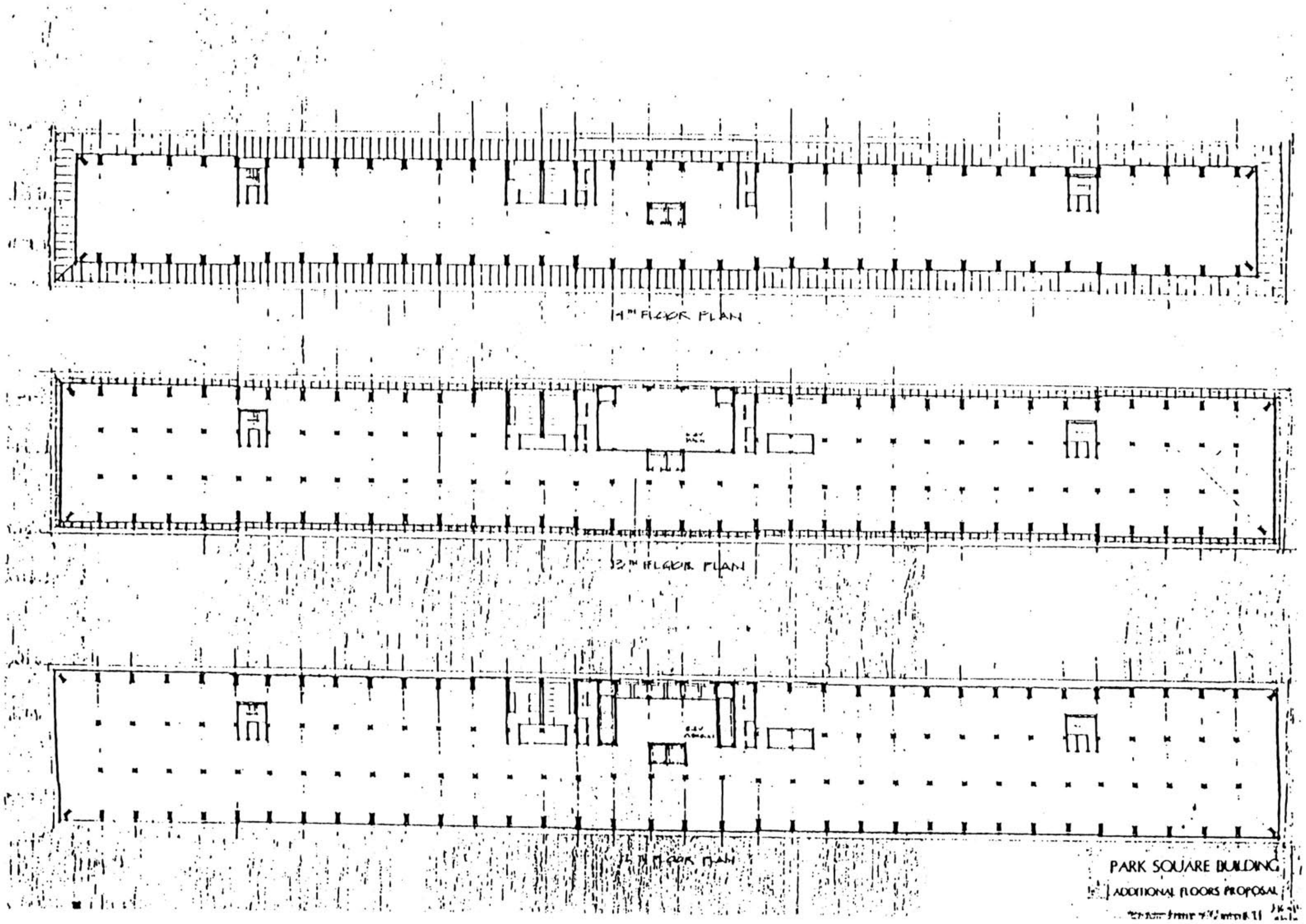
The latest scheme, three stories, has the following area estimates as prepared by Jung-Brannen Associates:

Floor	Gross Area	Rentable	Usable
12	44,165	41,820	32,380
13	42,815	41,465	32,430
14	35,505	34,555	28,865
Total	122,485	117,840	93,675
Percentage of Gross Area		96.2%	76.5%

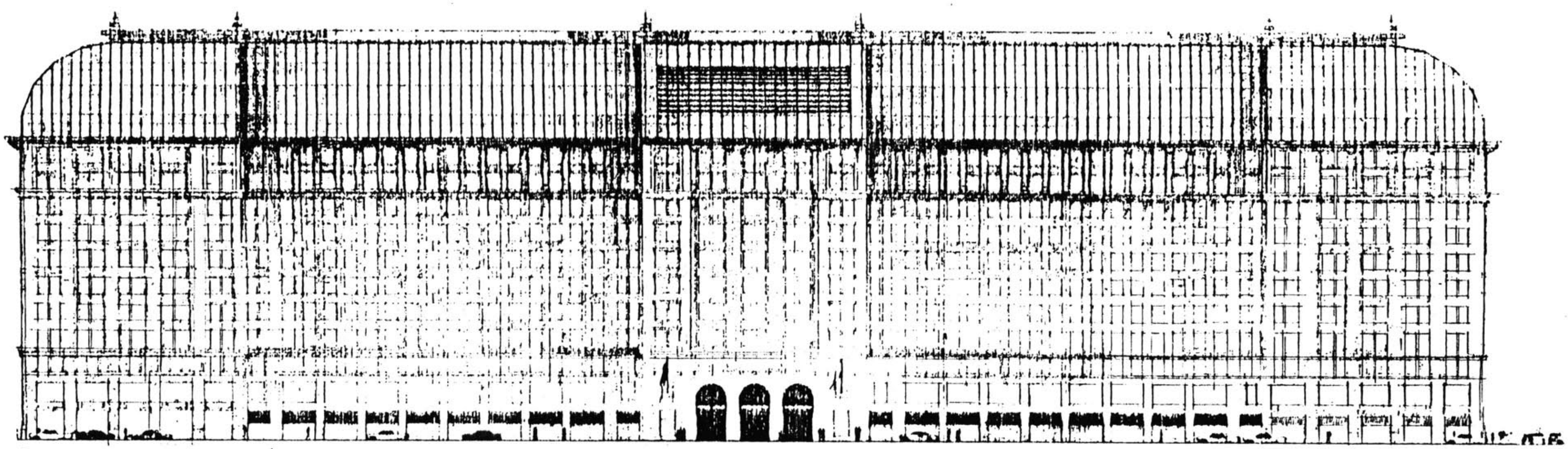


Typical Lower Floor Plan

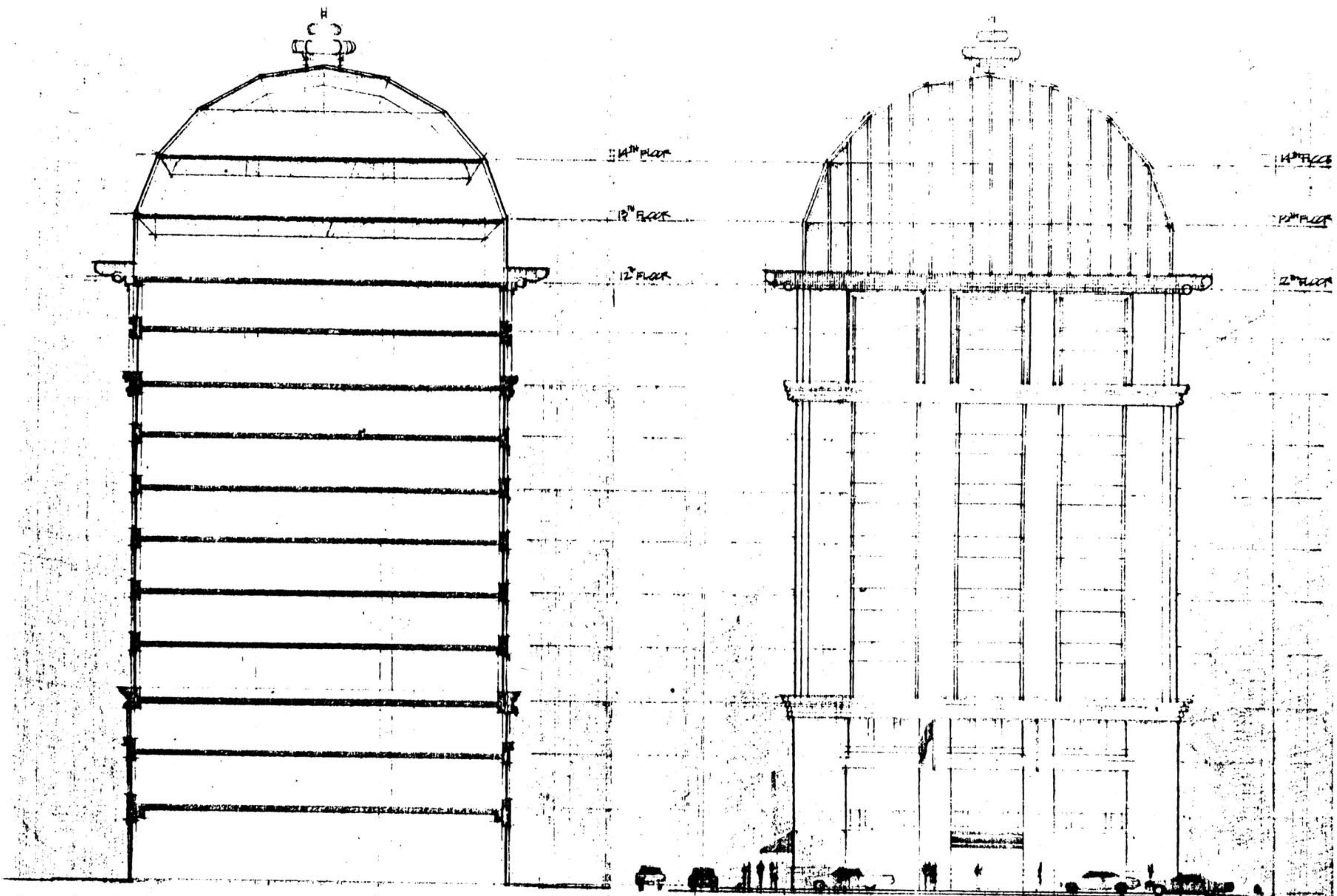
Three story addition superimposed on the existing Park Square Building



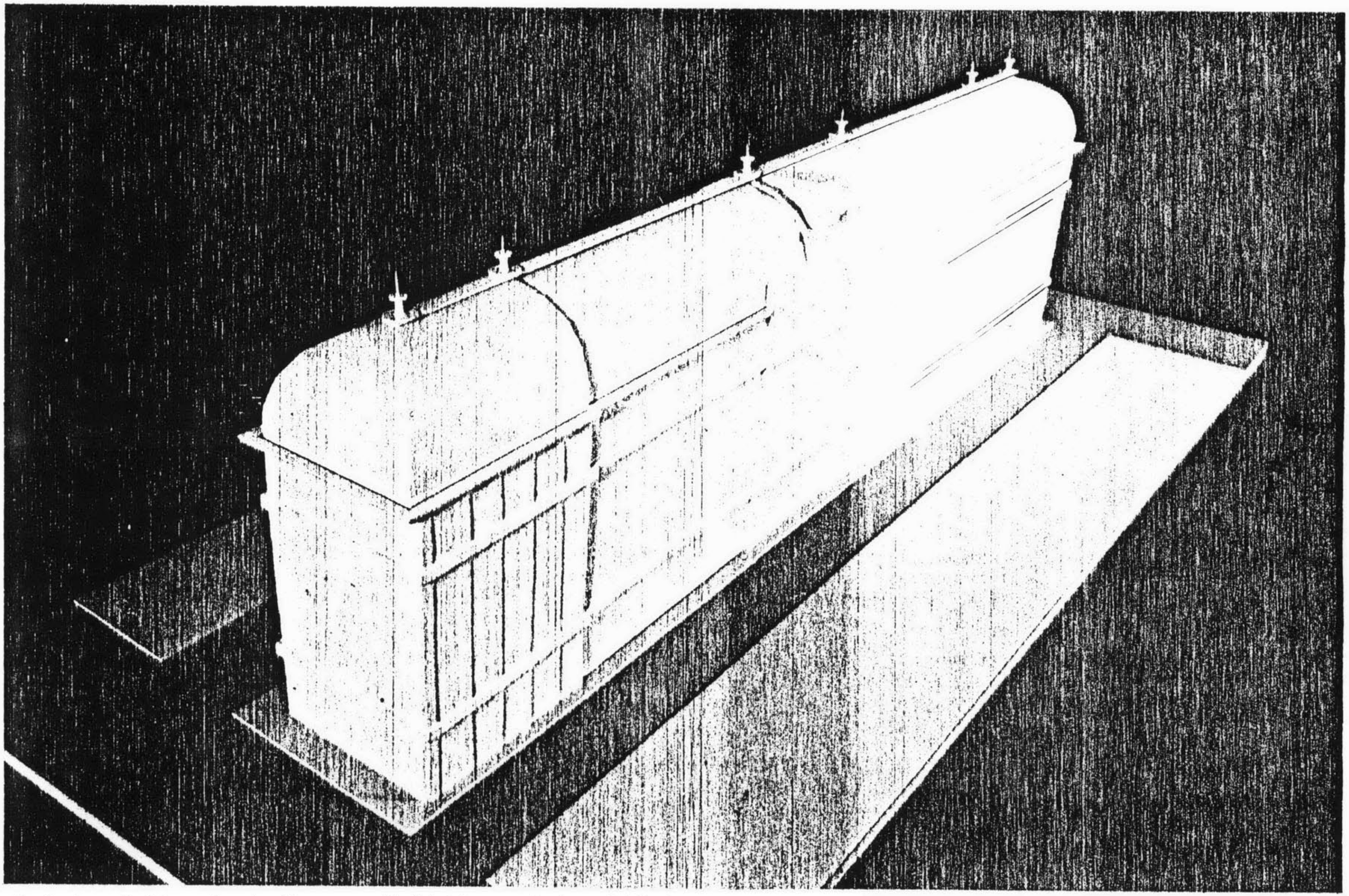
Three new floor plans



St. James Avenue Elevation including the new addition



Sections through the proposed addition



Model of the Park Square Building with addition

BLCC analysis was applied to the roof expansion project to illustrate the long run ramifications of such an undertaking. Assuming straight line depreciation, as has been the case with other recent investments in the Park Square Building, no investment tax credits or abatements, and that the owners will finance the entire development expenditure over a period of 15 years at 13% interest, the LCC analysis yields the following results. The total cost for construction amounts to $15,729,000 in 1986 (year 1), if one accepts the architect's estimate of $120 per sqaure foot. Over the life-cycle of that investment, in discounted present value, total financing amounts to $16.7 million, or an annual cost of $2.7 million. Operating expenses, including energy, can be projected at $825,000 per year, for a total yearly obligation of $3.5 million. Standard income tax adjustments yield $1,270,425 per year, roughly divided equally between deductions for operating and maintenance costs and debt service (financing interest payments). The net cash outlay, per year, would thus be $2,271,000. If the resultant rentable space were leased at $30/square foot per year (2), income generated would be $3,535,200.

For the first year of operation, 1986, the net revenue would be $1,264,000, after taxes, operating and maintenance costs. The total life-cycle project costs after income tax

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(2) Estimate extracted from Spaulding & Slye Boston Area Report. Spaulding & Slye Brokerage Operations, published quarterly, (Boston, Mass. October 1984).

adjustments would be $3,617,000 or $588,752 in annual present value. The overall tax advantage offered by this project is greater than its adjusted life-cycle costs. It is clear from this simple analysis that, from a financial standpoint, this project is an attractive opportunity for the investors. As the design process has already undergone several adjustments to increase the rentable area while meeting zoning and building code requirements, it is clear the client is quite concerned with these issues. It behooves the architect to understand them as well. The overall design proposal is being evaluated by the client for its aesthetics, initial and long term costs, and total benefits.

The BLCC program allows for exploration of the initial, two story scheme. A comparative analysis explores its life-cycle costs in relation to the three story scheme discussed above. While the two story project offers a lower total present value life-cycle cost it would also generate considerably less revenue. The additonal investment if $1.2 million over the 10 year study period required for the extra floor would likely generate that amount per year in additional rent, or $7,630,000 in discounted present value of that period. The negative savings to investment ratio is the result of the alternative, in this case the three story expansion, being more expensive than the base case. From this analysis the architect and owner would most likely continue development of the three story scenario, undaunted by the higher initial cost estimate. One design exploration might include the possibility of increasing the rentable floor area, or number of floors of the expansion project while respecting the height and bulk limitations of the site.

Another BLCC analysis investigates the consequences of increasing the study period to 30 years. Over this longer period, operating, maintenance and energy costs become substantially more important to the building owner. The degree of uncertainty associated with the assumptions required for life-cycle analysis also increases with the study period. Energy costs are projected to escalate at a constant rate of 7.7% in this analysis. Given the recent trends, this may represent an unreasonable expectation. It does illustrate how shorter periods may in fact yield more accurate analysis for the owner and the architect. The total annual value of financing costs are lower over this extended period. In effect the owner is spreading the same obligation over a considerably longer period. The tax advantage is also less for this 30 year period, suggesting that a shorter term of ownership might actually be more profitable for the client, if profit is a major criteria. Recurring costs become increasingly important to the total costs charcteristics of a project as the time horizon is lengthened. For the client contemplating a long term occupancy, development of the total building design may prove to be a very profitable investment. For the architect who can illustrate an understanding for such concerns to that client, this offers an opportunity to push project design development into new frontiers.

COMPARATIVE LCC ANALYSIS - 2 FLOOR EXPANSION AND 3 FLOOR EXPANSION

STUDY PERIOD: 10 YEARS
CONSTRUCTION PERIOD: 1 YEAR(S)
STARTING DATE: 1985
BASE DATE FOR DISCOUNTING: 1985
DISCOUNT RATE: 10.0% (NOMINAL)
SALES TAX RATE: 5.0%
TAX STATUS: FOR PROFIT
FED TAX RATE: 46.0%
STATE TAX RATE: 0.0%
PROPERTY TAX RATE: 3.3%
CAPITAL GAINS RATE: 28.0%
BASE CASE LCC FILE: RE2LCC
ALTERNATIVE LCC FILE: RE3LCC

PRESENT-VALUE COSTS:	BASE CASE: 2 FLOOR EXPAN	ALTERNATIVE: 3 FLOOR EXPAN	ALTERNATIVE - BASE CASE
CASH REQUIREMENTS AS OF OCCUPANCY	$101,349	$151,406	$50,057
PRIN. AND INT. PAYMENTS AFTER OCCUP.	$11,174,920	$16,694,240	$5,519,320
ANNUAL & NON-AN. RECURRING COSTS	$1,551,274	$2,317,171	$765,897
PROPERTY TAXES	$818,718	$1,223,085	$404,367
ENERGY EXPENDITURES	$1,010,458	$1,531,845	$521,387
INCOME TAX ADJUSTMENTS BEFORE OCCUP.	$0	$0	$0
INCOME TAX ADJUSTMENTS DURING OCCUP.	-$5,218,596	-$7,806,211	-$2,587,615
RESALE VALUE AT END OF STUDY (NET)	-$7,024,496	-$10,493,910	-$3,469,414
TOTAL P.V. LIFE-CYCLE COST	$2,413,626	$3,617,623	$1,203,997

REDUCTION IN FUTURE COSTS DUE TO ALTERNATIVE (SAVINGS) = -$1,153,940
LESS: ADDITIONAL NET INITIAL INVESTMENT REQUIRED BY ALTERNATIVE*= -$50,057

NET SAVINGS FROM ALTERNATIVE RELATIVE TO BASE CASE = -$1,203,997

SAVINGS-TO-INVESTMENT RATIO = -23.05

CONCLUSIONS

CONCLUSIONS

In examining architectural design and decision-making from a corporate perspective several issues have recurrently surfaced. Corporations view their buildings as instrumental to their business, in that they support production and cast a visible image for the company. As such, buildings and their design should be dealt with in business terms. This is not to diminish the importance of architectural design. Many corporate decision-makers seek the level of discussion fostered by "creative tension" between themselves and the architect. There is, however, another agenda beyond aesthetics. By considering the economic and financial objectives and ramifications of design decisions this thesis has exposed this other agenda.

The case studies have been used to test the models presented in the first sections of this text. Repeatedly, the interrelated nature of economic, financial and design decisions has become apparent. Few architectural decisions can, or should, take place in isolation from these other concerns. As exhibited in the office renovation case, budget affects the scope and level of detail in a project, but so do the client's objectives for the use and flexibility of the resultant space. Corporations also consider that the costs of constructing, maintaining and operating their buildings ultimately affect the price they must charge for their services or goods. While in the Park Square Building studies this has not been an explicit factor, it does point out the importance of including recurring and long term costs in the design decision process.

The window replacement project provides an example of how operating costs, in this case energy costs, can be of great consequence to the overall life-cycle character of an architectural decision. An additional expenditure of $1ØØ,ØØØ for a superior glazing material yields a 1Ø year benefit of four times that amount. In several of the Park Square Building examples energy and financing expenditures equal or exceed the initial investment during the ten year study period. The interrelated nature of component and design decisions can also be witnessed in the ramifications of this selection on the antiquated HVAC system, which in turn is under consideration for replacement in light of the potential roof expansion.

Similarly, the financial incentives for investment in buildings are quite great for corporations. The analysis of the proposed roof expansion project illustrates total life-cycle tax adjustments that are larger than the net life-cycle costs. Investment tax credits are also important. The architect and the owner should include discussion of how various construction and component selections affect the applicability, and hence financial advantages, of a project design. For the owner they can provide appreciable economic benefits. For the architect this offers a method by which to redistribute a project budget to obtain the greatest "value" for the client's investment. Depreciation also impacts the life-cycle costs of an expenditure in buildings for the owner. The expected life-span and replacement cycle should be considered in relation to the building, other components and the owner's financial objectives. Often, as in the Park Square Building, owners desire periodic reinvestment in their buildings. Many are most interested in the equity appreciation their investment in buildings offer. Understanding the client's time horizon for a building or a project can lead the architect to a far greater understanding of the design task with which he/she is involved. Lengthening the perspective from which the architect views architectural design begins to introduce long term benefits and costs into the design "equation". In the roof expansion case a larger initial investment will generate a more economically attractive project to the owner, considering both life-cycle costs and revenues.

What has emerged from this research is that there are several economic models for buildings. Each includes some conception of the passage of time and the owner's objectives for their investment. Some corporations build great works of architecture for the image and visual attention they command. For these companies the cost of design is considered a marketing expense. For others, like the consortium of investors who originally envisioned and constructed the Park Square Building, the goal is to build the largest, most modern or automated structure around and create a relatively "safe," income producing investment. Still others see buildings as a means to quick profit. Initial capital investments are made solely on the expectation that after a brief period of ownership, and little or no supplimental expenditure, the building can be sold for a profit. Previous owners of the Park Square Building may have fallen into this category.

Each model suggests that owners, to some degree, perceive buildings as a factor of production. They house the business of that company, or are a product in themselves, and are thus treated much like other capital assets. Decisions are based on total costs and expected benefits, useful life-spans, durability and functional flexibility. Components are replaced and upgraded as long as the whole "system" continues to function well and meet the needs of its owners and users. This description is by no means exhaustive. It does however give the architect some conception of the various perspectives clients assume. Many do view their buildings as a part of the capital investments necessary for the pursuit of their corporate objectives. For these clients decisions are made in quite a different fashion from the investor seeking only quick turnaround and profit.

For all these owners, buildings have several simultaneous, interrelated lives. The physical, sheltering properties are tied to the aesthetic characteristics, which are in turn connected to the building's economic life. Rejuvenation of an older building can come in the form of recladding the facade, renovating interior space, or simply through refinancing. In the case of the Park Square Building this last method has been most influencial in injecting new life into a very sturdy, yet seemingly undistinguished building. Periodic reinvestment has injected new financial life into the building throughout its history. Many architects seem to perceive buildings as finite commissions and "completed" works of art without fully understanding the financial, economic and life-cycle characteristics of their product. Taking cues from the owner, investors and users, architects can expand their conception of buildings to include these attributes that fall outside the traditional "space-making" and aesthetic concerns of architecture.

Likewise, the total building must function as a unified system. The financial building must somehow coincide with the physical one. The seemingly independent systems and components should not only coexist, but should function in an integrated fashion. The parts need be selected and assembled in such a way as to be compatible with one another not only in use but in life-span. Through economic analysis the architect and the owner can examine the ramifications of alternative selections in terms of initial and recurring costs. In this way total costs and benefits can be compared and decisions made from a more informed perspective. The Park Square Building cases illustrate the interrelated nature of what appear to be isolated projects. Upon closer inspection each impacts other projects as well as the building as a whole. The windows affect the HVAC system and the possibilities left open for the roof expansion project. The parapet removal also impacts that potential addition, the appearance of the entire building and the roof itself. Each of these projects has, or will, alter the financial character of the total building.

The economic analysis performed on each of the Park Square Building cases is an example of the type of exploration that might be included in the design process. Repeatedly, if life-cycle or economic analysis were included in the design process at all, it was quite late in the sequence of events and used as justification rather than a decision tool. This analysis would prove far more useful to the architect and the owner if included early in the overall process. It also serves as impetus to bring in consulting experts at an earlier point in design, leading to more complete information, expertise and coordination in the design process.

Through more systematic economic analysis the architect should be able to inform the client, as well as him/herself, of the total life-cycle costs and benefits in addition to the effect of individual decisions on the initial investment. The focus is thereby shifted from those attributes of buildings which are more important to the architect to those that the client is most often concerned with. Such economic evaluation can serve as a prioritizing device for the architect, helping to discriminate which design variables are "worth" additional attention in pursuit of an "optimal" level of design. Better understanding the objectives of the client concerning a building and investment can aid the architect in his/her design tasks and the allocation of scarce design time.

Inclusion of costs and benefits to be derived from architectural projects has not been systematically employed in decision-making. The most difficult task required of this methodology is to accurately estimate the costs and benefits anticipated from our designs. This effort can be somewhat simplified by estimating and comparing only those variables that change from one scheme to another, as many costs remain the same regardless of the alternative approaches contemplated. In this way design alternatives can be evaluated against each other by comparing their differences and considering them in light of client criteria and objectives.

Truly long term consequences have not been systematically considered in the design processes examined here. This includes not only financial consequences but more physical design issues such as long term flexibility. The architects involved in these projects all mention flexibility in the initial conceptual stages of each project. However, the final designs and documents suggest that flexibility, like other long term considerations, fall prey to the process of negotiating the final design within complex sets of constraints. The client seems partially responsible. Often there is a lack of understanding of how one decision impacts others, and that some of the broad conceptual decisions made early in the total process affect all subsequent ones.

The use of analytical techniques in design, specifically financial and economic analysis, would address many of these issues. However, the designer and the business manager should not believe that economic analysis can substitute objective reasoning for subjective judgement. The importance of aesthetics in design remains paramount. What is apparent from this investigation is that analysis can focus decision-makers, both the architect and the corporate manager, on the most pertinent issues. Architects are employed by corporate clients to lead the design process. The use of accepted business methods can add to the architect's persuasiveness in this role. "However convinced architects may be of their leadership perogatives, they will only be meaningful if others are persuaded to follow." (1) The corporate client may represent the best opportunity to assert this leadership. They may, however, require assurance or convincing. Architects need to illustrate to corporate management that they are "whole" building experts, aware of corporate concerns in addition to architectural ones. The architect must be steadfast in his/her evaluation of the project's opportunities. The providence of architectural design lies in envisioning what might be. Considering the building through its life sequences can aid the designer in assuming this view. But the architect should make every effort to understand the myriad of constraints and requirements for each project, so that their designs can satisfy the greatest set of client objectives.

The corporate building owner clearly understands the relationship of initial costs to long term expenditures. The architect need also exhibit this cognizance in terms of economic and spatial trade-offs as well as the effect of time on the process and the building. Balancing user needs, financial criteria and aesthetics are critical tasks for the architect. Understanding the long term consequences of

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(1) Martin McElroy, "How Big Corporations Choose Design Firms," Architectural Record, (October 1984): pages 41-43.

building decisions is also essential to the design process. The architect who can clearly show that his/her expertise in buildings goes beyond the conceptual design and extends into the total life sequence of a structure will be far more influential to the corporate user of architectural services.

Many readily accessible tools for performing such economic analysis exist today. The BLCC program used in the case studies is but one example of available tools architects might employ. Expert systems are only now beginning to offer promising applications to the architectural design and analysis process. Design exploration using expert systems may some day soon include delineation of constraints, generation of alternative solutions and evaluation of these alternative designs. "Computers soon may become 'partners' in the design process, providing expert knowledge and advice on numerous aspects of building design and construction." (2)

Computers offer the architect improved documentation techniques for recording decision processes, coordination and manipulation of data. Many architects are employing these tools in their work as a matter of course. Computer aided design and drafting offer increased speed for

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(2) Fred I. Stahl, "Expert Systems," Progressive Architecture, (October 1984): pages 61-63.

generating alternatives and updating documents. By more quickly handling the information flow for the architect, the computer frees up time for more creative tasks. In light of the appropriateness herein described for economic analysis in the design process, the computer is invaluable. Quantity take-offs, cost estimation and financial analysis can all be generated very quickly. Alternative schemes can be more fully understood and evaluated with a minimal expenditure of time. The selection process between various design choices is still left to the designer.

The need to coordinate and process complex information should foster a renewal in the multi-disciplinary approach to architectural design. Each example from the Park Square Building included several expert consultants in addition to the architect. It is unlikely that the architect could conceive of him/herself as expert in the myriad of related, necessary disciplines involved in the design process. A more rational approach includes the various areas of expertise (planning, architecture, engineering) at an early stage, during the determination of the scope and feasibility of a project, not only when a problem is encountered later in design. The corporate client wants, often insists, that the architect remain the overall coordinator of the design process, the client's guardian of the conceptual base of the project. Daniel Rose, of Rose Associates Inc., a large development company based in New York City, stated at a recent conference that he "...insists on decisions by the largest possible number of experts, combining experience and skill. The best value in our designs are obtainable with the best experts to 'design out' problems initially. The building is usually as good as the 'brainpower' employed."(3)

The architect and assembled consultants can design problems out of buildings with careful consideration of maintenance and operational concerns, in addition to aesthetic design. The earlier in the process of design the entire team is brought "on board", the more likely they are to achieve notable results.

This multi-disciplinary approach to architectural design should be expanded to include operating, leasing and construction experts as well as the more common engineering, design and legal team. There are always trade-offs involved in the design process. It is beneficial to make selections between alternatives with as complete knowledge and expertise as possible. Buildings are perceived by corporate clients as long term investments. With such a perspective, investors are anxious to manage those investments for the best possible equity appreciation. Many understand that lower initial costs do not necessarily save money over the

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(3) "In Search of Excellence" Facilities Management Conference; sponsored by the Massachusetts Institute of Technology. Cambridge, Mass. 15 October 1984.

long run, due to the likelihood of higher operating and replacement costs. Quality design is perceived as an asset to their investment, but only when the aesthetics are in balance with the investment and operational aspects of the building. Scope and feasibility studies should include the business/financial plan for the development. This allows unusual costs, as well as expected ones, to be viewed in proper perspective, given the corporate needs and goals for particular projects.

Some architectural firms are employing this philosophy of design. Current professional literature is full as "case studies" of recent projects that have successfully included economic and financial considerations into architectural design. Corporate clients are demanding responsive, creative, cost-conscious and functional architectural designs. Good design is based on problem-solving at many levels simultaneously, not simply passing responsibility from architect to consultant and back to the client. While image is important, so is the quality of environment and investment created.

Therefore, the need exists for the architect to be more aware of the corporate concerns for their buildings and to address these issues in the design process. These include image, aesthetics, function and economics. Changes in technology, management and organizational structures will undoubtedly change the buildings that house them. This study does not attempt to suggest that the architect should simply apply pro forma formulas to building design. One lesson from the Park Square Building case studies is that every rule set in regard to decision-making, design and space delineation has many exceptions. Rather, architectural design should expand beyond its traditional role in the overall process. Allied fields lie just outside the profession, many of them, such as engineering and real estate development, are already employing more systematic analysis to test, challenge and confirm alternative scenarios. Architectural design should consider adopting a similar methodology so that our buildings might satisfy a larger set of criteria. Aesthetic design should be considered in light of the host of additional issues and attributes of buildings.

This research suggests that corporate clients know full well their investment and long range objectives. Architects must include this information in their design criteria. The architect must exhibit understanding of client concerns and negotiate design within that context. We lessen our credibility as decision-makers by not informing ourselves and our clients of the full ramifications of good building design, corporate organizational needs and long term costs and benefits.

It may be difficult to place a quantifiable value on good architectural design. This does not diminish the importance of striving for the "best" possible design, meeting the largest set of architectural and financial objectives. Trade-offs are undoubtedly required. The intuitive skills do exist, many architects exhibit them. The practice of architecture should grow more systematic in its methodology. We must open ourselves up to the available expertise that can provide useful design information and criteria that falls beyond the traditional skills of the architect. When working for corporate clients, we should inform ourselves with the knowledge of their goals and criteria to positively impact the performance of our designs and their buildings. Architects cannot design solely for architects, we must include the user and patron alike. The economic models and principles included in this study should serve as a means toward broadening our conception of what is useful design information. Economic performance, building efficiency and effectiveness, aesthetics and client satisfaction should all become integral to the process of architectural design.

APPENDICES

APPENDIX A: BLCC

THE NATIONAL BUREAU OF STANDARDS BLCC PROGRAM

A computer program, known as BLCC, has recently been prepared by Steve Peterson of the National Bureau of Standards. Currently distributed for testing purposes only, the following cases include estimations and comparisons of building and project life-cycle costs generated through use of the BLCC program. Meeting ASTM standards for such analysis, BLCC includes interest and tax rates, depreciation allowances, capital gains and depreciation recapture taxes. It is designed as a user-oriented building economics analysis tool for use with desk-top computers. The program calculates a comprehensive life-cycle cost analysis of buildings and building systems and is capable of comparing alternative design solutions in terms of their relative economic performance.

BLCC requires user input. Project and building data as well as financial assumptions must be provided. A discount rate of 10% is assumed unless changed by the user. A short description of other basic financial assumptions is included here to clarify the process of economic analysis performed. Additional definitions appear in the Glossary section. The "study period" refers to the number of years over which costs will be evaluated. The tax status for the Park Square Building is for profit, although BLCC can calculate for private-residential and tax exempt status. Income tax savings from depreciation, operating and maintenance, energy costs and capital gains are included for commercial and rental properties. The discount, interest and price escalation rates are all in nominal terms and include general inflation.

The marginal federal income tax and capital gains rates represent those that a profitable corporation might expect to pay. The property tax rate is that of the existing Park Square Building. While the expected building life is 30 years, the economic life is set at 15 years which is the duration of the long term financing of this project. As in past capital expenditures at the Park Square Building, no special tax credits or compensations are included in this first analysis, although they might have been. This is based on the Park Square Associates' insistence that none are contemplated. Straight line depreciation is used and is taxed as capital gains. A sales tax rate of 5% is applied to the cost of major components to reflect Massachusetts Sales Tax. Current law allows for the deduction of sales tax from taxable income.

For analysis, a property tax assessment factor is applied. The Park Square Building is taxed at a rate of 32.54% of its assessed value. This rate has changed over the years, as has the assessment, due to administrative policies of the City and County. Combined Federal and State marginal tax rate is set at 46% and capital gains tax rate at 28% to reflect accepted financial standards for corporate investors. These particular figures are taken from similar analysis of corporate real estate transactions. (1)

The BLCC program has been used in this study to calculate the life-cycle costs for several recent and proposed architectural projects at the Park Square Building. This analysis provides the architect and corporate decision-maker with a ready method for assessing the long term ramifications of their actions. The BLCC also served in this investigation as a checklist for data collection. Many of the variables required to run the BLCC had not been previously considered prior to attempting to run the program. The architect using such analysis techniques might not only approach architectural problems in a different light, but in a more informed fashion.

Each BLCC analysis conforms to the following pattern. The Building Characteristics File appears first, describing the project in economic terms. Capital component, estimated loan costs and estimated energy costs are then exhibited. These assumptions are used to calculate the life-cycle analysis which contains two parts. The first is a

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(1) D. Neidich & T. Steinberg, "Corporate Real Estate: Source of New Equity", Harvard Business Review, (July-August 1984): pages 76-83.

reiteration of basic characteristics, including initial component cost and financial requirements. Part II represents the life-cycle cost analysis, beginning with cash requirements, operation, maintanence, energy and tax liabilities. Income tax adjustments are then figured and finally subtracted from projected life-cycle costs. Each change in building or project characteristics requires that a new analysis be computed. The BLCC does allow for alternative projects to be compared and several of these comparative life-cycle cost analyses do appear in this section.

WINDOW REPLACEMENT PROJECT

BUILDING CHARACTERISTICS FILE

FILE NAME: WINDOWS
FILE LAST MODIFIED ON 12-13-1984 00:14:00

PROJECT TITLE: PARK SQUARE WINDOWS

BASIC LCC ANALYSIS ASSUMPTIONS:

STUDY PERIOD: 10 YEARS
CONSTRUCTION PERIOD (PRIOR TO OCCUPANCY): 0 YEAR(S)
PROJECT STARTING DATE: 1984
BASE DATE FOR DISCOUNTING: 1984
DISCOUNT, INTEREST, AND PRICE ESCALATION RATES INCLUDE INFLATION (NOMINAL)
DISCOUNT RATE (ANNUAL): 10 %
TAX STATUS: FOR PROFIT (1)
MARGINAL FEDERAL INCOME TAX RATE: 46 %
MARGINAL STATE INCOME TAX RATE: 0 %
PROPERTY TAX RATE (% OF ASSESSED VALUE): 3.254 %
PERCENT OF CAPITAL GAINS SUBJECT TO INCOME TAXATION: 28 %
DEPRECIATION RECAPTURE METHOD: 3
DEPRECIATION BASIS ADJ. FACTOR: 0 %
SALES TAX RATE: 5 %

CAPITAL COMPONENT AND REPLACEMENT COST DATA:

NUMBER OF CAPITAL COST COMPONENTS: 2
CAPITAL COST COMPONENT DATA:

COMPONENT NAME	FRAMIMG	SOLARBAN G
INITIAL COST	1460000	90000
PORTION SUBJECT TO SALES TAX	70.00%	100.00%
EXPECTED COMPONENT LIFE(YRS)	10	10
DEPRECIATION METHOD	(3)	(3)
DEPRECIATION LIFE (YEARS)	5	5
DEPR. ACCELERATION RATE	0.00%	0.00%
SALVAGE VALUE (CONSTANT $)	0.00%	0.00%
ADD´L FIRST YR DEPRECIATION	0.00%	0.00%
AVG PRICE ESC RT DURING CONST.	0.00%	0.00%
AVG PRICE ESC RT DURING OCC.	7.00%	7.00%
PROP. TAX ASSESSMENT FACTOR	0.00%	0.00%
TAX CREDIT (% OF 1ST COST)	10.00%	10.00%
RESALE VALUE (% OF 1ST COST)	0.00%	0.00%
NUMBER OF REPLACEMENTS	0	0

COST-PHASING SCHEDULE BY YEAR OF CONSTRUCTION AND AT OCCUPANCY:

AT OCCUPANCY	100.00%	100.00%

NO REPLACEMENTS TO ANY CAPITAL COST COMPONENTS

OPERATING AND MAINTENANCE COST DATA:

ANNUAL RECURRING O AND M COST = $18600
ANNUAL RATE OF INCREASE FOR A.R.C. = 5.00%
NUMBER OF NON-ANNUAL RECURRING O AND M COSTS = 0
ANNUAL RATE OF INCREASE FOR N.A.R.C. COSTS = 0.0%

ENERGY COST DATA:

NUMBER OF ENERGY TYPES = 2

ENERGY TYPE NO. 1 = ELECTRICITY
ANNUAL COST = $559000
NUMBER OF DISCRETE TIME INTERVALS = 1

#	DURATION (YEARS)	ANNUAL RATE
1	10	7.7%

ENERGY TYPE NO. 2 = FUEL
ANNUAL COST = $345000
NUMBER OF DISCRETE TIME INTERVALS = 2

#	DURATION (YEARS)	ANNUAL RATE
1	1	7.7%
2	9	7.7%

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B L C C   A N A L Y S I S

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PART I - INITIAL ASSUMPTIONS AND COST DATA

PROJECT NAME: PARK SQUARE WINDOWS
RUN DATE:12-13-1984 00:43:37
BLDG. CHAR. FILE NAME: WINDOWS , LAST MODIFIED 12-13-1984 00:14:0
LCC OUTPUT FILE NAME: WINDOWSL, CREATED 12-13-1984 00:40:35
STUDY PERIOD: 10 YEARS (1984 THROUGH 1993)
OCCUPANCY BEGINS: 1984
AFTER-TAX DISCOUNT RATE: 10.0% (NOMINAL)
TAX STATUS: FOR PROFIT
INCOME TAX RATE: 46.0% (COMBINED FEDERAL, STATE, CITY)
EFFECTIVE CAPITAL GAINS TAX RATE: 12.9%
NOMINAL PROPERTY TAX RATE: 3.25%
NOMINAL SALES TAX RATE: 5.00%

INITIAL CAPITAL COMPONENT COSTS (NOT DISCOUNTED)

	ACTUAL COST	SALES TAX	TOTAL COST
TOTAL FOR FRAMIMG	$1,460,000	$51,100	$1,511,100
TOTAL FOR SOLARBAN GLAZING	$90,000	$4,500	$94,500
TOTAL PROJECT COST	$1,550,000	$55,600	$1,605,600

FINANCIAL REQUIREMENTS (NOT DISCOUNTED)

A. INVESTOR´S INITIAL CASH REQUIREMENTS (UP TO AND INCLUDING OCCUPANCY):
(NOT ADJUSTED FOR INCOME TAX SAVINGS)

	YEAR	PROJECT	´POINTS´	INTEREST	TOTAL
AT OCCUPANCY	1984	$1,605,600	$0	$0	$1,605,600
TOTAL		$1,605,600	$0	$0	$1,605,600
PLUS PREPAID PROPERTY TAXES AT OCCUPANCY					$0
TOTAL CASH REQUIREMENTS					$1,605,600

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PART II - LIFE-CYCLE COST ANALYSIS: DISCOUNT RATE = 10.0% (NOMINAL)

	PRESENT VALUE (1984)	ANNUAL VALUE
A. INVESTOR'S INITIAL CASH REQUIREMENTS: (EXCEPT PREPAID PROPERTY TAXES)		
DURING CONSTRUCTION	$0	$0
AT OCCUPANCY	$1,605,600	$261,304
SUBTOTAL	$1,605,600	$261,304
C. OPERATING, MAINTENANCE & RELATED COSTS:		
ANNUALLY RECURRING COSTS (NON-ENERGY)	$145,300	$23,647
NON-ANNUALLY RECURRING COSTS	$0	$0
ENERGY COSTS	$7,271,530	$1,183,408
PROPERTY TAXES	$0	$0
SUBTOTAL	$7,416,830	$1,207,055
E. INCOME TAX ADJUSTMENTS * :		
TAX SAVINGS FROM O AND M COSTS	($3,411,742)	($555,245)
TAX SAVINGS FROM DEPRECIATION:		
INITIAL INVESTMENT	($574,779)	($93,543)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM SALES TAX:		
INITIAL INVESTMENT	($0)	($0)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM INTEREST AND POINTS:		
DURING CONSTRUCTION	($0)	($0)
DURING OCCUPANCY	($0)	($0)
TAX CREDITS:		
INITIAL INVESTMENT	($140,909)	($22,932)
REPLACEMENTS TO CAPITAL	($0)	($0)
SUBTOTAL	($4,127,430)	($671,720)
F. REMAINING VALUE AT END OF OCCUPANCY	($0)	($0)
LESS: CAPITAL GAINS TAX LIABILITY	$0	$0
SUBTOTAL	($0)	($0)
G. TOTAL LIFE-CYCLE PROJECT COST:		
BEFORE INCOME TAX ADJUSTMENTS	$9,022,430	$1,468,359
AFTER INCOME TAX ADJUSTMENTS	$4,895,000	$796,639

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* INCOME TAX SAVINGS ARE DISCOUNTED FROM THE END OF THE YEAR IN WHICH THEY ARE EARNED;
TAX CREDITS AND TAX SAVINGS FROM SALES TAX ON INITIAL INVESTMENT

BUILDING CHARACTERISTICS FILE

FILE NAME: WINDOWS1
FILE LAST MODIFIED ON 12-13-1984 00:24:04

PROJECT TITLE: PARK SQUARE WINDOWS WITHOUT SUNGATE GLAZING

BASIC LCC ANALYSIS ASSUMPTIONS:

STUDY PERIOD: 10 YEARS
CONSTRUCTION PERIOD (PRIOR TO OCCUPANCY): 0 YEAR(S)
PROJECT STARTING DATE: 1984
BASE DATE FOR DISCOUNTING: 1984
DISCOUNT, INTEREST, AND PRICE ESCALATION RATES INCLUDE INFLATION (NOMINAL)
DISCOUNT RATE (ANNUAL): 10 %
TAX STATUS: FOR PROFIT (1)
MARGINAL FEDERAL INCOME TAX RATE: 46 %
MARGINAL STATE INCOME TAX RATE: 0 %
PROPERTY TAX RATE (% OF ASSESSED VALUE): 3.254 %
PERCENT OF CAPITAL GAINS SUBJECT TO INCOME TAXATION: 28 %
DEPRECIATION RECAPTURE METHOD: 3
DEPRECIATION BASIS ADJ. FACTOR: 0 %
SALES TAX RATE: 5 %

CAPITAL COMPONENT AND REPLACEMENT COST DATA:

NUMBER OF CAPITAL COST COMPONENTS: 1
CAPITAL COST COMPONENT DATA:

COMPONENT NAME	FRAMIMG
INITIAL COST	1460000
PORTION SUBJECT TO SALES TAX	70.00%
EXPECTED COMPONENT LIFE(YRS)	10
DEPRECIATION METHOD	(3)
DEPRECIATION LIFE (YEARS)	5
DEPR. ACCELERATION RATE	0.00%
SALVAGE VALUE (CONSTANT $)	0.00%
ADD´L FIRST YR DEPRECIATION	0.00%
AVG PRICE ESC RT DURING CONST.	0.00%
AVG PRICE ESC RT DURING OCC.	7.00%
PROP. TAX ASSESSMENT FACTOR	0.00%
TAX CREDIT (% OF 1ST COST)	10.00%
RESALE VALUE (% OF 1ST COST)	0.00%
NUMBER OF REPLACEMENTS	0

COST-PHASING SCHEDULE BY YEAR OF CONSTRUCTION AND AT OCCUPANCY:
AT OCCUPANCY 100.00%

NO REPLACEMENTS TO ANY CAPITAL COST COMPONENTS

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B L C C   A N A L Y S I S

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PART I - INITIAL ASSUMPTIONS AND COST DATA

PROJECT NAME: WITHOUT SUNGATE
RUN DATE:01-05-1985 00:14:31
BLDG. CHAR. FILE NAME: WINDOWS1, LAST MODIFIED 01-05-1985 00:11:4
LCC OUTPUT FILE NAME: WIND1LCC, CREATED 01-05-1985 00:13:24
STUDY PERIOD: 10 YEARS (1984 THROUGH 1993)
OCCUPANCY BEGINS: 1984
AFTER-TAX DISCOUNT RATE: 10.0% (NOMINAL)
TAX STATUS: FOR PROFIT
INCOME TAX RATE: 46.0% (COMBINED FEDERAL, STATE, CITY)
EFFECTIVE CAPITAL GAINS TAX RATE: 12.9%
NOMINAL PROPERTY TAX RATE: 3.25%
NOMINAL SALES TAX RATE: 5.00%

INITIAL CAPITAL COMPONENT COSTS (NOT DISCOUNTED)

	ACTUAL COST	SALES TAX	TOTAL COST
TOTAL FOR FRAMIMG	$1,460,000	$51,100	$1,511,100
TOTAL PROJECT COST	$1,460,000	$51,100	$1,511,100

FINANCIAL REQUIREMENTS (NOT DISCOUNTED)

A. INVESTOR´S INITIAL CASH REQUIREMENTS (UP TO AND INCLUDING OCCUPANCY):
(NOT ADJUSTED FOR INCOME TAX SAVINGS)

	YEAR	PROJECT	´POINTS´	INTEREST	TOTAL
AT OCCUPANCY	1984	$1,511,100	$0	$0	$1,511,100
TOTAL		$1,511,100	$0	$0	$1,511,100
PLUS PREPAID PROPERTY TAXES AT OCCUPANCY					$0
TOTAL CASH REQUIREMENTS					$1,511,100

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PART II - LIFE-CYCLE COST ANALYSIS: DISCOUNT RATE = 10.0% (NOMINAL)

	PRESENT VALUE (1984)	ANNUAL VALUE
A. INVESTOR'S INITIAL CASH REQUIREMENTS:		
(EXCEPT PREPAID PROPERTY TAXES)		
DURING CONSTRUCTION	$0	$0
AT OCCUPANCY	$1,511,100	$245,925
SUBTOTAL	$1,511,100	$245,925
C. OPERATING, MAINTENANCE & RELATED COSTS:		
ANNUALLY RECURRING COSTS (NON-ENERGY)	$165,897	$26,999
NON-ANNUALLY RECURRING COSTS	$0	$0
ENERGY COSTS	$8,062,953	$1,312,208
PROPERTY TAXES	$0	$0
SUBTOTAL	$8,228,850	$1,339,207
E. INCOME TAX ADJUSTMENTS * :		
TAX SAVINGS FROM O AND M COSTS	($3,785,271)	($616,035)
TAX SAVINGS FROM DEPRECIATION:		
INITIAL INVESTMENT	($541,405)	($88,111)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM SALES TAX:		
INITIAL INVESTMENT	($0)	($0)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM INTEREST AND POINTS:		
DURING CONSTRUCTION	($0)	($0)
DURING OCCUPANCY	($0)	($0)
TAX CREDITS:		
INITIAL INVESTMENT	($132,727)	($21,601)
REPLACEMENTS TO CAPITAL	($0)	($0)
SUBTOTAL	($4,459,404)	($725,748)
F. REMAINING VALUE AT END OF OCCUPANCY	($0)	($0)
LESS: CAPITAL GAINS TAX LIABILITY	$0	$0
SUBTOTAL	($0)	($0)
G. TOTAL LIFE-CYCLE PROJECT COST:		
BEFORE INCOME TAX ADJUSTMENTS	$9,739,950	$1,585,132
AFTER INCOME TAX ADJUSTMENTS	$5,280,546	$859,385

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* INCOME TAX SAVINGS ARE DISCOUNTED FROM THE END OF THE YEAR IN WHICH THEY ARE EARNED;
TAX CREDITS AND TAX SAVINGS FROM SALES TAX ON INITIAL INVESTMENT ARE REALIZE
D
IN THE FIRST YEAR OF OCCUPANCY.

COMPARATIVE LCC ANALYSIS - PARK SQUARE WINDOWS AND WITHOUT SUNGATE

STUDY PERIOD: 10 YEARS
CONSTRUCTION PERIOD: 0 YEAR(S)
STARTING DATE: 1984
BASE DATE FOR DISCOUNTING: 1984
DISCOUNT RATE: 10.0% (NOMINAL)
SALES TAX RATE: 5.0%
TAX STATUS: FOR PROFIT
FED TAX RATE: 46.0%
STATE TAX RATE: 0.0%
PROPERTY TAX RATE: 3.3%
CAPITAL GAINS RATE: 28.0%
BASE CASE LCC FILE: WINDOWSLCC
ALTERNATIVE LCC FILE: WIND1LCC

PRESENT-VALUE COSTS:	BASE CASE: PARK SQUARE	ALTERNATIVE: WITHOUT SUNGA	ALTERNATIVE - BASE CASE
CASH REQUIREMENTS AS OF OCCUPANCY	$1,605,600	$1,511,100	-$94,500
PRIN. AND INT. PAYMENTS AFTER OCCUP.	$0	$0	$0
ANNUAL & NON-AN. RECURRING COSTS	$145,300	$165,897	$20,597
PROPERTY TAXES	$0	$0	$0
ENERGY EXPENDITURES	$7,271,530	$8,062,953	$791,423
INCOME TAX ADJUSTMENTS BEFORE OCCUP.	$0	$0	$0
INCOME TAX ADJUSTMENTS DURING OCCUP.	-$4,127,430	-$4,459,404	-$331,974
RESALE VALUE AT END OF STUDY (NET)	$0	$0	$0
TOTAL P.V. LIFE-CYCLE COST	$4,895,000	$5,280,546	$385,546

REDUCTION IN FUTURE COSTS DUE TO ALTERNATIVE (SAVINGS) =	-$480,046
LESS: ADDITIONAL NET INITIAL INVESTMENT REQUIRED BY ALTERNATIVE*=	$94,500
NET SAVINGS FROM ALTERNATIVE RELATIVE TO BASE CASE =	-$385,546

COMPARATIVE LCC ANALYSIS - WITHOUT SUNGATE AND PARK SQUARE WINDOWS

STUDY PERIOD: 10 YEARS
CONSTRUCTION PERIOD: 0 YEAR(S)
STARTING DATE: 1984
BASE DATE FOR DISCOUNTING: 1984
DISCOUNT RATE: 10.0% (NOMINAL)
SALES TAX RATE: 5.0%
TAX STATUS: FOR PROFIT
FED TAX RATE: 46.0%
STATE TAX RATE: 0.0%
PROPERTY TAX RATE: 3.3%
CAPITAL GAINS RATE: 28.0%
BASE CASE LCC FILE: WIND1LCC
ALTERNATIVE LCC FILE: WINDOWSLCC

PRESENT-VALUE COSTS:	BASE CASE: WITHOUT SUNGA	ALTERNATIVE: PARK SQUARE W	ALTERNATIVE - BASE CASE
CASH REQUIREMENTS AS OF OCCUPANCY	$1,511,100	$1,605,600	$94,500
PRIN. AND INT. PAYMENTS AFTER OCCUP.	$0	$0	$0
ANNUAL & NON-AN. RECURRING COSTS	$165,897	$145,300	-$20,597
PROPERTY TAXES	$0	$0	$0
ENERGY EXPENDITURES	$8,062,953	$7,271,530	-$791,423
INCOME TAX ADJUSTMENTS BEFORE OCCUP.	$0	$0	$0
INCOME TAX ADJUSTMENTS DURING OCCUP.	-$4,459,404	-$4,127,430	$331,974
RESALE VALUE AT END OF STUDY (NET)	$0	$0	$0
TOTAL P.V. LIFE-CYCLE COST	$5,280,546	$4,895,000	-$385,546

REDUCTION IN FUTURE COSTS DUE TO ALTERNATIVE (SAVINGS) = $480,046
LESS: ADDITIONAL NET INITIAL INVESTMENT REQUIRED BY ALTERNATIVE*= -$94,500

NET SAVINGS FROM ALTERNATIVE RELATIVE TO BASE CASE = $385,546

SAVINGS-TO-INVESTMENT RATIO = 5.08

ADJUSTED IRR (@ REINVESTMENT RATE OF 10.00%) = 29.41%

* NET INITIAL INVESTMENT IS THE CHANGE IN CASH REQUIREMENTS AS OF OCCUPANCY LESS THE CHANGE IN INCOME TAX ADJUSTMENTS BEFORE OCCUPANCY.

* *

PART II - LIFE-CYCLE COST ANALYSIS: DISCOUNT RATE = 12.5% (NOMINAL)

	PRESENT VALUE (1984)	ANNUAL VALUE
A. INVESTOR'S INITIAL CASH REQUIREMENTS:		
(EXCEPT PREPAID PROPERTY TAXES)		
DURING CONSTRUCTION	$0	$0
AT OCCUPANCY	$1,605,600	$290,006
SUBTOTAL	$1,605,600	$290,006
C. OPERATING, MAINTENANCE & RELATED COSTS:		
ANNUALLY RECURRING COSTS (NON-ENERGY)	$129,780	$23,441
NON-ANNUALLY RECURRING COSTS	$0	$0
ENERGY COSTS	$6,464,699	$1,167,665
PROPERTY TAXES	$0	$0
SUBTOTAL	$6,594,480	$1,191,106
E. INCOME TAX ADJUSTMENTS * :		
TAX SAVINGS FROM O AND M COSTS	($3,033,461)	($547,909)
TAX SAVINGS FROM DEPRECIATION:		
INITIAL INVESTMENT	($547,368)	($98,867)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM SALES TAX:		
INITIAL INVESTMENT	($0)	($0)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM INTEREST AND POINTS:		
DURING CONSTRUCTION	($0)	($0)
DURING OCCUPANCY	($0)	($0)
TAX CREDITS:		
INITIAL INVESTMENT	($137,778)	($24,886)
REPLACEMENTS TO CAPITAL	($0)	($0)
SUBTOTAL	($3,718,606)	($671,661)
F. REMAINING VALUE AT END OF OCCUPANCY	($0)	($0)
LESS: CAPITAL GAINS TAX LIABILITY	$0	$0
SUBTOTAL	($0)	($0)
G. TOTAL LIFE-CYCLE PROJECT COST:		
BEFORE INCOME TAX ADJUSTMENTS	$8,200,079	$1,481,113
AFTER INCOME TAX ADJUSTMENTS	$4,481,473	$809,452

* *

* INCOME TAX SAVINGS ARE DISCOUNTED FROM THE END OF THE YEAR IN WHICH THEY ARE EARNED;
TAX CREDITS AND TAX SAVINGS FROM SALES TAX ON INITIAL INVESTMENT

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B L C C   A N A L Y S I S

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PART I - INITIAL ASSUMPTIONS AND COST DATA

PROJECT NAME: PARK SQUARE WINDOWS 20YEARS
RUN DATE:01-01-1980 01:23:28
BLDG. CHAR. FILE NAME: PSB620 , LAST MODIFIED 01-01-1980 01:20:1
LCC OUTPUT FILE NAME: LCC620 , CREATED 01-01-1980 01:21:24
STUDY PERIOD: 20 YEARS (1984 THROUGH 2003)
OCCUPANCY BEGINS: 1984
DISCOUNT RATE: 10.0% (NOMINAL)
TAX STATUS: FOR PROFIT
INCOME TAX RATE: 0.0% (COMBINED FEDERAL, STATE, CITY)
EFFECTIVE CAPITAL GAINS TAX RATE: 0.0%
NOMINAL PROPERTY TAX RATE: 3.25%
NOMINAL SALES TAX RATE: 5.00%

INITIAL CAPITAL COMPONENT COSTS (NOT DISCOUNTED)

	ACTUAL COST	SALES TAX	TOTAL COST
TOTAL FOR FRAMIMG	$1,460,000	$51,100	$1,511,100
TOTAL FOR SOLARBAN GLAZING	$90,000	$4,500	$94,500
TOTAL PROJECT COST	$1,550,000	$55,600	$1,605,600

FINANCIAL REQUIREMENTS (NOT DISCOUNTED)

A. INVESTOR´S INITIAL CASH REQUIREMENTS (UP TO AND INCLUDING OCCUPANCY):

	YEAR	PROJECT	´POINTS´	INTEREST	TOTAL
AT OCCUPANCY	1984	$1,605,600	$0	$0	$1,605,600
TOTAL		$1,605,600	$0	$0	$1,605,600
PLUS PREPAID PROPERTY TAXES AT OCCUPANCY					$0
TOTAL CASH REQUIREMENTS					$1,605,600

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PART II - LIFE-CYCLE COST ANALYSIS: DISCOUNT RATE = 10.0% (NOMINAL)

	PRESENT VALUE (1984)	ANNUAL VALUE
A. INVESTOR´S INITIAL CASH REQUIREMENTS: (EXCEPT PREPAID PROPERTY TAXES)		
DURING CONSTRUCTION	$0	$0
AT OCCUPANCY	$1,605,600	$188,593
SUBTOTAL	$1,605,600	$188,593
C. OPERATING, MAINTENANCE & RELATED COSTS:		
ANNUALLY RECURRING COSTS (NON-ENERGY)	$236,549	$27,785
NON-ANNUALLY RECURRING COSTS	$0	$0
ENERGY COSTS	$7,271,530	$854,111
PROPERTY TAXES	$0	$0
SUBTOTAL	$7,508,079	$881,896
F. REMAINING VALUE AT END OF OCCUPANCY	($0)	($0)
G. TOTAL LIFE-CYCLE PROJECT COST: BEFORE INCOME TAX ADJUSTMENTS	$9,113,679	$1,070,489

* *

* INCOME TAX SAVINGS ARE DISCOUNTED FROM THE END OF THE YEAR IN WHICH THEY ARE EARNED;
TAX CREDITS AND TAX SAVINGS FROM SALES TAX ON INITIAL INVESTMENT .

PARK SQUARE II OFFICE RENOVATIONS

BUILDING CHARACTERISTICS FILE

FILE NAME: PSBII
FILE LAST MODIFIED ON 12-20-1984 00:27:22

PROJECT TITLE: PARK SQUARE II RENOVATION

BASIC LCC ANALYSIS ASSUMPTIONS:

STUDY PERIOD: 8 YEARS
CONSTRUCTION PERIOD (PRIOR TO OCCUPANCY): 1 YEAR(S)
PROJECT STARTING DATE: 1982
BASE DATE FOR DISCOUNTING: 1982
DISCOUNT, INTEREST, AND PRICE ESCALATION RATES INCLUDE INFLATION (NOMINAL)
DISCOUNT RATE (ANNUAL): 10 %
TAX STATUS: FOR PROFIT (1)
MARGINAL FEDERAL INCOME TAX RATE: 46 %
MARGINAL STATE INCOME TAX RATE: 0 %
PROPERTY TAX RATE (% OF ASSESSED VALUE): 3.254 %
PERCENT OF CAPITAL GAINS SUBJECT TO INCOME TAXATION: 28 %
DEPRECIATION RECAPTURE METHOD: 3
DEPRECIATION BASIS ADJ. FACTOR: 0 %
SALES TAX RATE: 5 %

CAPITAL COMPONENT AND REPLACEMENT COST DATA:

NUMBER OF CAPITAL COST COMPONENTS: 2
CAPITAL COST COMPONENT DATA:

COMPONENT NAME	LEASEHOLD	SYST FURN
INITIAL COST	2158130	380000
PORTION SUBJECT TO SALES TAX	0.00%	100.00%
EXPECTED COMPONENT LIFE(YRS)	15	10
DEPRECIATION METHOD	S.L. (1)	S.L. (1)
DEPRECIATION LIFE (YEARS)	8	8
DEPR. ACCELERATION RATE	0.00%	0.00%
SALVAGE VALUE (CONSTANT $)	0.00%	0.00%
ADD'L FIRST YR DEPRECIATION	0.00%	0.00%
AVG PRICE ESC RT DURING CONST.	7.00%	7.00%
AVG PRICE ESC RT DURING OCC.	7.00%	7.00%
PROP. TAX ASSESSMENT FACTOR	0.00%	0.00%
TAX CREDIT (% OF 1ST COST)	0.00%	0.00%
RESALE VALUE (% OF 1ST COST)	100.00%	0.00%
NUMBER OF REPLACEMENTS	0	0

COST-PHASING SCHEDULE BY YEAR OF CONSTRUCTION AND AT OCCUPANCY:

1	0.00%	0.00%
AT OCCUPANCY	100.00%	100.00%

NO REPLACEMENTS TO ANY CAPITAL COST COMPONENTS

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OPERATING AND MAINTENANCE COST DATA:
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ANNUAL RECURRING O AND M COST = $210160
ANNUAL RATE OF INCREASE FOR A.R.C. =  3.70%
NUMBER OF NON-ANNUAL RECURRING O AND M COSTS = 0
ENERGY COST DATA:
----------------
NUMBER OF ENERGY TYPES = 2

ENERGY TYPE NO. 1 = ELECTRICITY
ANNUAL COST =    $186333
ANNUAL RATE OF INCREASE DURING CONSTRUCTION =  7.7%
PRICE INCREASES DURING OCCUPANCY:
NUMBER OF DISCRETE TIME INTERVALS =  1
  #  DURATION  ANNUAL
     (YEARS)   RATE
   1     8       7.7%

ENERGY TYPE NO. 2 = FUEL
ANNUAL COST =    $115000
ANNUAL RATE OF INCREASE DURING CONSTRUCTION =  7.7%
PRICE INCREASES DURING OCCUPANCY:
NUMBER OF DISCRETE TIME INTERVALS =  1
  #  DURATION  ANNUAL
     (YEARS)   RATE
   1     8       7.7%
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B L C C   A N A L Y S I S

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PART I - INITIAL ASSUMPTIONS AND COST DATA

PROJECT NAME: PARK SQUARE II RENOVATION
RUN DATE:12-23-1984 09:21:41
BLDG. CHAR. FILE NAME: PSBII , LAST MODIFIED 12-20-1984 00:27:2
LCC OUTPUT FILE NAME: PSBIILCC, CREATED 12-21-1984 00:05:43
STUDY PERIOD: 8 YEARS (1982 THROUGH 1989)
CONSTRUCTION PERIOD: 1 YEARS (1982 THROUGH 1982)
OCCUPANCY BEGINS: 1983
AFTER-TAX DISCOUNT RATE: 10.0% (NOMINAL)
TAX STATUS: FOR PROFIT
INCOME TAX RATE: 46.0% (COMBINED FEDERAL, STATE, CITY)
EFFECTIVE CAPITAL GAINS TAX RATE: 12.9%
NOMINAL PROPERTY TAX RATE: 3.25%
NOMINAL SALES TAX RATE: 5.00%

INITIAL CAPITAL COMPONENT COSTS (NOT DISCOUNTED)

INVESTMENT CATAGORY	YEAR	COST PHASING	ACTUAL COST	SALES TAX	TOTAL COST
LEASEHOLD	1983	100.0%	$2,309,199	$0	$2,309,199
TOTAL FOR LEASEHOLD			$2,309,199	$0	$2,309,199
SYST FURN	1983	100.0%	$406,600	$20,330	$426,930
TOTAL FOR SYST FURN			$406,600	$20,330	$426,930
TOTAL PROJECT COST			$2,715,799	$20,330	$2,736,129

FINANCIAL REQUIREMENTS (NOT DISCOUNTED)

A. INVESTOR'S INITIAL CASH REQUIREMENTS (UP TO AND INCLUDING OCCUPANCY):
(NOT ADJUSTED FOR INCOME TAX SAVINGS)

	YEAR	PROJECT	'POINTS'	INTEREST	TOTAL
DURING CONSTRUCTION	1982	$0	$0	$0	$0
AT OCCUPANCY	1983	$2,736,129	$0	$0	$2,736,129
TOTAL		$2,736,129	$0	$0	$2,736,129
PLUS PREPAID PROPERTY TAXES AT OCCUPANCY					$0
TOTAL CASH REQUIREMENTS					$2,736,129

B. BORROWING REQUIREMENTS:
(1) TEMPORARY FINANCING (DURING CONSTRUCTION):

YEAR	AMOUNT BORROWED	INTEREST RATE	POINTS PAID %	POINTS PAID AMOUNT	TYPE	PAYMENTS/ YEAR
1982	$0	0.00%	0.00%	$0		0
TOTAL	$0			$0		

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PART II - LIFE-CYCLE COST ANALYSIS: DISCOUNT RATE = 10.0% (NOMINAL)

	PRESENT VALUE (1982)	ANNUAL VALUE
A. INVESTOR'S INITIAL CASH REQUIREMENTS: (EXCEPT PREPAID PROPERTY TAXES)		
DURING CONSTRUCTION	$0	$0
AT OCCUPANCY	$2,487,390	$466,246
SUBTOTAL	$2,487,390	$466,246
C. OPERATING, MAINTENANCE & RELATED COSTS:		
ANNUALLY RECURRING COSTS (NON-ENERGY)	$1,103,052	$206,760
NON-ANNUALLY RECURRING COSTS	$0	$0
ENERGY COSTS	$2,148,680	$402,757
PROPERTY TAXES	$0	$0
SUBTOTAL	$3,251,732	$609,518
E. INCOME TAX ADJUSTMENTS * :		
TAX SAVINGS FROM O AND M COSTS	($1,495,796)	($280,378)
TAX SAVINGS FROM DEPRECIATION:		
INITIAL INVESTMENT	($691,132)	($129,548)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM SALES TAX:		
INITIAL INVESTMENT	($7,729)	($1,449)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM INTEREST AND POINTS:		
DURING CONSTRUCTION	($0)	($0)
DURING OCCUPANCY	($0)	($0)
TAX CREDITS:		
INITIAL INVESTMENT	($0)	($0)
REPLACEMENTS TO CAPITAL	($0)	($0)
SUBTOTAL	($2,194,657)	($411,375)
F. REMAINING VALUE AT END OF OCCUPANCY	($1,729,842)	($324,249)
LESS: CAPITAL GAINS TAX LIABILITY	$202,406	$37,940
SUBTOTAL	($1,527,436)	($286,309)
G. TOTAL LIFE-CYCLE PROJECT COST:		
BEFORE INCOME TAX ADJUSTMENTS	$4,211,685	$789,455
AFTER INCOME TAX ADJUSTMENTS	$2,017,029	$378,080

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* INCOME TAX SAVINGS ARE DISCOUNTED FROM THE END OF THE YEAR IN WHICH THEY ARE EARNED

BUILDING CHARACTERISTICS FILE

FILE NAME: PSBIIA
FILE LAST MODIFIED ON 12-21-1984 00:11:09

PROJECT TITLE: PARK SQUARE IIA

BASIC LCC ANALYSIS ASSUMPTIONS:

STUDY PERIOD: 8 YEARS
CONSTRUCTION PERIOD (PRIOR TO OCCUPANCY): 1 YEAR(S)
PROJECT STARTING DATE: 1982
BASE DATE FOR DISCOUNTING: 1982
DISCOUNT, INTEREST, AND PRICE ESCALATION RATES INCLUDE INFLATION (NOMINAL)
DISCOUNT RATE (ANNUAL): 10 %
TAX STATUS: FOR PROFIT (1)
MARGINAL FEDERAL INCOME TAX RATE: 46 %
MARGINAL STATE INCOME TAX RATE: 0 %
PROPERTY TAX RATE (% OF ASSESSED VALUE): 3.254 %
PERCENT OF CAPITAL GAINS SUBJECT TO INCOME TAXATION: 28 %
DEPRECIATION RECAPTURE METHOD: 3
DEPRECIATION BASIS ADJ. FACTOR: 100 %
SALES TAX RATE: 5 %

CAPITAL COMPONENT AND REPLACEMENT COST DATA:

NUMBER OF CAPITAL COST COMPONENTS: 2
CAPITAL COST COMPONENT DATA:

COMPONENT NAME	LEASEHOLD	SYST FURN
INITIAL COST	2158130	380000
PORTION SUBJECT TO SALES TAX	0.00%	100.00%
EXPECTED COMPONENT LIFE(YRS)	15	10
DEPRECIATION METHOD	S.L. (1)	S.L. (1)
DEPRECIATION LIFE (YEARS)	8	8
DEPR. ACCELERATION RATE	0.00%	0.00%
SALVAGE VALUE (CONSTANT $)	0.00%	0.00%
ADD'L FIRST YR DEPRECIATION	0.00%	0.00%
AVG PRICE ESC RT DURING CONST.	7.00%	7.00%
AVG PRICE ESC RT DURING OCC.	7.00%	7.00%
PROP. TAX ASSESSMENT FACTOR	0.00%	0.00%
TAX CREDIT (% OF 1ST COST)	5.00%	10.00%
RESALE VALUE (% OF 1ST COST)	100.00%	0.00%
NUMBER OF REPLACEMENTS	0	0

COST-PHASING SCHEDULE BY YEAR OF CONSTRUCTION AND AT OCCUPANCY:

1	0.00%	0.00%
AT OCCUPANCY	100.00%	100.00%

NO REPLACEMENTS TO ANY CAPITAL COST COMPONENTS

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B L C C   A N A L Y S I S

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PART I - INITIAL ASSUMPTIONS AND COST DATA

PROJECT NAME: PARK SQUARE IIA
RUN DATE:12-23-1984 09:31:31
BLDG. CHAR. FILE NAME: PSBIIA , LAST MODIFIED 12-21-1984 00:11:0
LCC OUTPUT FILE NAME: PSBIIALC, CREATED 12-21-1984 00:03:51
STUDY PERIOD: 8 YEARS (1982 THROUGH 1989)
CONSTRUCTION PERIOD: 1 YEARS (1982 THROUGH 1982)
OCCUPANCY BEGINS: 1983
AFTER-TAX DISCOUNT RATE: 10.0% (NOMINAL)
TAX STATUS: FOR PROFIT
INCOME TAX RATE: 46.0% (COMBINED FEDERAL, STATE, CITY)
EFFECTIVE CAPITAL GAINS TAX RATE: 12.9%
NOMINAL PROPERTY TAX RATE: 3.25%
NOMINAL SALES TAX RATE: 5.00%

INITIAL CAPITAL COMPONENT COSTS (NOT DISCOUNTED)

INVESTMENT CATAGORY	YEAR	COST PHASING	ACTUAL COST	SALES TAX	TOTAL COST
LEASEHOLD	1983	100.0%	$2,309,199	$0	$2,309,199
TOTAL FOR LEASEHOLD			$2,309,199	$0	$2,309,199
SYST FURN	1983	100.0%	$406,600	$20,330	$426,930
TOTAL FOR SYST FURN			$406,600	$20,330	$426,930
TOTAL PROJECT COST			$2,715,799	$20,330	$2,736,129

FINANCIAL REQUIREMENTS (NOT DISCOUNTED)

A. INVESTOR'S INITIAL CASH REQUIREMENTS (UP TO AND INCLUDING OCCUPANCY):
(NOT ADJUSTED FOR INCOME TAX SAVINGS)

	YEAR	PROJECT	'POINTS'	INTEREST	TOTAL
DURING CONSTRUCTION	1982	$0	$0	$0	$0
AT OCCUPANCY	1983	$2,736,129	$0	$0	$2,736,129
TOTAL		$2,736,129	$0	$0	$2,736,129
PLUS PREPAID PROPERTY TAXES AT OCCUPANCY					$0
TOTAL CASH REQUIREMENTS					$2,736,129

B. BORROWING REQUIREMENTS:
(1) TEMPORARY FINANCING (DURING CONSTRUCTION):

YEAR	AMOUNT BORROWED	INTEREST RATE	POINTS PAID %	POINTS PAID AMOUNT	TYPE	PAYMENTS/ YEAR
1982	$0	0.00%	0.00%	$0		0
TOTAL	$0			$0		

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PART II - LIFE-CYCLE COST ANALYSIS: DISCOUNT RATE = 10.0% (NOMINAL)

	PRESENT VALUE (1982)	ANNUAL VALUE
A. INVESTOR'S INITIAL CASH REQUIREMENTS: (EXCEPT PREPAID PROPERTY TAXES)		
DURING CONSTRUCTION	$0	$0
AT OCCUPANCY	$2,487,390	$466,246
SUBTOTAL	$2,487,390	$466,246
C. OPERATING, MAINTENANCE & RELATED COSTS:		
ANNUALLY RECURRING COSTS (NON-ENERGY)	$1,103,052	$206,760
NON-ANNUALLY RECURRING COSTS	$0	$0
ENERGY COSTS	$2,148,680	$402,757
PROPERTY TAXES	$0	$0
SUBTOTAL	$3,251,732	$609,518
E. INCOME TAX ADJUSTMENTS * :		
TAX SAVINGS FROM O AND M COSTS	($1,495,796)	($280,378)
TAX SAVINGS FROM DEPRECIATION:		
INITIAL INVESTMENT	($651,401)	($122,101)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM SALES TAX:		
INITIAL INVESTMENT	($7,729)	($1,449)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM INTEREST AND POINTS:		
DURING CONSTRUCTION	($0)	($0)
DURING OCCUPANCY	($0)	($0)
TAX CREDITS:		
INITIAL INVESTMENT	($129,025)	($24,185)
REPLACEMENTS TO CAPITAL	($0)	($0)
SUBTOTAL	($2,283,951)	($428,113)
F. REMAINING VALUE AT END OF OCCUPANCY	($1,729,842)	($324,249)
LESS: CAPITAL GAINS TAX LIABILITY	$194,198	$36,401
SUBTOTAL	($1,535,644)	($287,847)
G. TOTAL LIFE-CYCLE PROJECT COST:		
BEFORE INCOME TAX ADJUSTMENTS	$4,203,477	$787,917
AFTER INCOME TAX ADJUSTMENTS	$1,919,526	$359,804

* *

* INCOME TAX SAVINGS ARE DISCOUNTED FROM THE END OF THE YEAR IN WHICH THEY ARE EARNED;
TAX CREDITS AND TAX SAVINGS FROM SALES TAX ON INITIAL INVESTMENT ARE REALIZE

IN THE FIRST YEAR OF OCCUPANCY.

ROOF EXPANSION PROJECT

BUILDING CHARACTERISTICS FILE

FILE NAME: RE3
FILE LAST MODIFIED ON 12-23-1984 11:06:35

PROJECT TITLE: 3 FLOOR EXPANSION

BASIC LCC ANALYSIS ASSUMPTIONS:

STUDY PERIOD: 10 YEARS
CONSTRUCTION PERIOD (PRIOR TO OCCUPANCY): 1 YEAR(S)
PROJECT STARTING DATE: 1985
BASE DATE FOR DISCOUNTING: 1985
DISCOUNT, INTEREST, AND PRICE ESCALATION RATES INCLUDE INFLATION (NOMINAL)
DISCOUNT RATE (ANNUAL): 10 %
TAX STATUS: FOR PROFIT (1)
MARGINAL FEDERAL INCOME TAX RATE: 46 %
MARGINAL STATE INCOME TAX RATE: 0 %
PROPERTY TAX RATE (% OF ASSESSED VALUE): 3.254 %
PERCENT OF CAPITAL GAINS SUBJECT TO INCOME TAXATION: 28 %
DEPRECIATION RECAPTURE METHOD: 3
DEPRECIATION BASIS ADJ. FACTOR: 0 %
SALES TAX RATE: 5 %

CAPITAL COMPONENT AND REPLACEMENT COST DATA:

NUMBER OF CAPITAL COST COMPONENTS: 1
CAPITAL COST COMPONENT DATA:

COMPONENT NAME	CONSTRUCT
INITIAL COST	14700000
PORTION SUBJECT TO SALES TAX	0.00%
EXPECTED COMPONENT LIFE(YRS)	30
DEPRECIATION METHOD	S.L. (1)
DEPRECIATION LIFE (YEARS)	10
DEPR. ACCELERATION RATE	0.00%
SALVAGE VALUE (CONSTANT $)	100.00%
ADD´L FIRST YR DEPRECIATION	0.00%
AVG PRICE ESC RT DURING CONST.	7.00%
AVG PRICE ESC RT DURING OCC.	7.00%
PROP. TAX ASSESSMENT FACTOR	32.54%
TAX CREDIT (% OF 1ST COST)	10.00%
RESALE VALUE (% OF 1ST COST)	100.00%
NUMBER OF REPLACEMENTS	0

COST-PHASING SCHEDULE BY YEAR OF CONSTRUCTION AND AT OCCUPANCY:

1	0.00%
AT OCCUPANCY	100.00%

NO REPLACEMENTS TO ANY CAPITAL COST COMPONENTS

MORTGAGE LOAN DATA:

	CONSTRCT. LOAN	PERMANENT LOAN(S)
LOAN NUMBER	-	1
% OF TOTAL COST MORTGAGED	100.00%	100.00%
LOAN TYPE	2	1
ANNUAL INTEREST RATE	13.00%	12.75%
LIFE OF LOAN (YEARS)	0	15
NUMBER OF PAYMENTS/YR	1	12
POINTS PAID (% OF LOAN)	0.00%	0.00%

OPERATING AND MAINTENANCE COST DATA:

ANNUAL RECURRING O AND M COST = $362556
ANNUAL RATE OF INCREASE FOR A.R.C. = 3.70%
NUMBER OF NON-ANNUAL RECURRING O AND M COSTS = 0
ANNUAL RATE OF INCREASE FOR N.A.R.C. COSTS = 0.0%

ENERGY COST DATA:

NUMBER OF ENERGY TYPES = 2

ENERGY TYPE NO. 1 = ELECTRICITY
ANNUAL COST = $119192
ANNUAL RATE OF INCREASE DURING CONSTRUCTION = 7.7%
PRICE INCREASES DURING OCCUPANCY:
NUMBER OF DISCRETE TIME INTERVALS = 1

#	DURATION (YEARS)	ANNUAL RATE
1	9	7.7%

ENERGY TYPE NO. 2 = FUEL
ANNUAL COST = $73733
ANNUAL RATE OF INCREASE DURING CONSTRUCTION = 7.7%
PRICE INCREASES DURING OCCUPANCY:
NUMBER OF DISCRETE TIME INTERVALS = 1

#	DURATION (YEARS)	ANNUAL RATE
1	9	7.7%

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B L C C   A N A L Y S I S

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PART I - INITIAL ASSUMPTIONS AND COST DATA

PROJECT NAME: 3 FLOOR EXPANSION
RUN DATE:12-23-1984 11:12:05
BLDG. CHAR. FILE NAME: RE3 , LAST MODIFIED 12-23-1984 11:06:3
LCC OUTPUT FILE NAME: RE3LCC , CREATED 12-23-1984 11:11:16
STUDY PERIOD: 10 YEARS (1985 THROUGH 1994)
CONSTRUCTION PERIOD: 1 YEARS (1985 THROUGH 1985)
OCCUPANCY BEGINS: 1986
AFTER-TAX DISCOUNT RATE: 10.0% (NOMINAL)
TAX STATUS: FOR PROFIT
INCOME TAX RATE: 46.0% (COMBINED FEDERAL, STATE, CITY)
EFFECTIVE CAPITAL GAINS TAX RATE: 12.9%
NOMINAL PROPERTY TAX RATE: 3.25%
NOMINAL SALES TAX RATE: 5.00%

INITIAL CAPITAL COMPONENT COSTS (NOT DISCOUNTED)

INVESTMENT CATAGORY	YEAR	COST PHASING	ACTUAL COST	SALES TAX	TOTAL COST
CONSTRUCT	1986	100.0%	$15,729,000	$0	$15,729,000
TOTAL FOR CONSTRUCT			$15,729,000	$0	$15,729,000
TOTAL PROJECT COST			$15,729,000	$0	$15,729,000

FINANCIAL REQUIREMENTS (NOT DISCOUNTED)

A. INVESTOR'S INITIAL CASH REQUIREMENTS (UP TO AND INCLUDING OCCUPANCY):
(NOT ADJUSTED FOR INCOME TAX SAVINGS)

	YEAR	PROJECT	'POINTS'	INTEREST	TOTAL
DURING CONSTRUCTION	1985	$0	$0	$0	$0
AT OCCUPANCY	1986	$0	$0	$0	$0
TOTAL		$0	$0	$0	$0
PLUS PREPAID PROPERTY TAXES AT OCCUPANCY					$166,547
TOTAL CASH REQUIREMENTS					$166,547

B. BORROWING REQUIREMENTS:
(1) TEMPORARY FINANCING (DURING CONSTRUCTION):

YEAR	AMOUNT BORROWED	INTEREST RATE	POINTS PAID %	POINTS PAID AMOUNT	TYPE	PAYMENTS/ YEAR
1985	$0	13.00%	0.00%	$0	INTEREST ONLY	1
TOTAL	$0			$0		

(2) PERMANENT FINANCING (AT OCCUPANCY):

LOAN NO.	AMOUNT BORROWED	LIFE	INTR. RATE	POINTS PAID PERCENT	POINTS PAID AMOUNT	TYPE	PAYMENTS/ YEAR
1	$15,729,000	15 YRS	12.75%	0.00%	$0	AMORTIZED	12
TOTAL	$15,729,000				$0		

* *

PART II - LIFE-CYCLE COST ANALYSIS: DISCOUNT RATE = 10.0% (NOMINAL)

	PRESENT VALUE (1985)	ANNUAL VALUE
A. INVESTOR'S INITIAL CASH REQUIREMENTS: (EXCEPT PREPAID PROPERTY TAXES)		
DURING CONSTRUCTION	$0	$0
AT OCCUPANCY	$0	$0
SUBTOTAL	$0	$0
B. FINANCING PAYMENTS (AFTER OCCUPANCY):		
PRINCIPAL	$7,094,131	$1,154,537
INTEREST	$9,600,107	$1,562,373
SUBTOTAL	$16,694,240	$2,716,910
C. OPERATING, MAINTENANCE & RELATED COSTS:		
ANNUALLY RECURRING COSTS (NON-ENERGY)	$2,317,171	$377,109
NON-ANNUALLY RECURRING COSTS	$0	$0
ENERGY COSTS	$1,531,845	$249,301
PROPERTY TAXES	$1,223,085	$199,052
SUBTOTAL	$5,072,101	$825,461
E. INCOME TAX ADJUSTMENTS * :		
TAX SAVINGS FROM O AND M COSTS	($2,282,020)	($371,388)
TAX SAVINGS FROM DEPRECIATION:		
INITIAL INVESTMENT	($0)	($0)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM SALES TAX:		
INITIAL INVESTMENT	($0)	($0)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM INTEREST AND POINTS:		
DURING CONSTRUCTION	($0)	($0)
DURING OCCUPANCY	($4,224,275)	($687,481)
TAX CREDITS:		
INITIAL INVESTMENT	($1,299,917)	($211,556)
REPLACEMENTS TO CAPITAL	($0)	($0)
SUBTOTAL	($7,806,211)	($1,270,425)
F. REMAINING VALUE AT END OF OCCUPANCY	($11,148,810)	($1,814,417)
LESS: CAPITAL GAINS TAX LIABILITY	$654,896	$106,581
SUBTOTAL	($10,493,910)	($1,707,836)
G. TOTAL LIFE-CYCLE PROJECT COST:		
BEFORE INCOME TAX ADJUSTMENTS	$11,423,830	$1,859,176
AFTER INCOME TAX ADJUSTMENTS	$3,617,623	$588,752

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BUILDING CHARACTERISTICS FILE

FILE NAME: RE2
FILE LAST MODIFIED ON 12-23-1984 10:21:17

PROJECT TITLE: 2 FLOOR EXPANSION

BASIC LCC ANALYSIS ASSUMPTIONS:

STUDY PERIOD: 10 YEARS
CONSTRUCTION PERIOD (PRIOR TO OCCUPANCY): 1 YEAR(S)
PROJECT STARTING DATE: 1985
BASE DATE FOR DISCOUNTING: 1985
DISCOUNT, INTEREST, AND PRICE ESCALATION RATES INCLUDE INFLATION (NOMINAL)
DISCOUNT RATE (ANNUAL): 10 %
TAX STATUS: FOR PROFIT (1)
MARGINAL FEDERAL INCOME TAX RATE: 46 %
MARGINAL STATE INCOME TAX RATE: 0 %
PROPERTY TAX RATE (% OF ASSESSED VALUE): 3.254 %
PERCENT OF CAPITAL GAINS SUBJECT TO INCOME TAXATION: 28 %
DEPRECIATION RECAPTURE METHOD: 3
DEPRECIATION BASIS ADJ. FACTOR: 0 %
SALES TAX RATE: 5 %

CAPITAL COMPONENT AND REPLACEMENT COST DATA:

NUMBER OF CAPITAL COST COMPONENTS: 1
CAPITAL COST COMPONENT DATA:

COMPONENT NAME	CONSTRUCT
INITIAL COST	9840000
PORTION SUBJECT TO SALES TAX	0.00%
EXPECTED COMPONENT LIFE(YRS)	30
DEPRECIATION METHOD	S.L. (1)
DEPRECIATION LIFE (YEARS)	10
DEPR. ACCELERATION RATE	0.00%
SALVAGE VALUE (CONSTANT $)	100.00%
ADD´L FIRST YR DEPRECIATION	0.00%
AVG PRICE ESC RT DURING CONST.	7.00%
AVG PRICE ESC RT DURING OCC.	7.00%
PROP. TAX ASSESSMENT FACTOR	0.00%
TAX CREDIT (% OF 1ST COST)	10.00%
RESALE VALUE (% OF 1ST COST)	100.00%
NUMBER OF REPLACEMENTS	0

COST-PHASING SCHEDULE BY YEAR OF CONSTRUCTION AND AT OCCUPANCY:

1	0.00%
AT OCCUPANCY	100.00%

NO REPLACEMENTS TO ANY CAPITAL COST COMPONENTS

MORTGAGE LOAN DATA:

	CONSTRCT. LOAN	PERMANENT LOAN(S)
LOAN NUMBER	-	1
% OF TOTAL COST MORTGAGED	100.00%	100.00%
LOAN TYPE	2	1
ANNUAL INTEREST RATE	13.00%	12.75%
LIFE OF LOAN (YEARS)	0	15
NUMBER OF PAYMENTS/YR	1	12
POINTS PAID (% OF LOAN)	0.00%	0.00%

OPERATING AND MAINTENANCE COST DATA:

ANNUAL RECURRING O AND M COST = $242720
ANNUAL RATE OF INCREASE FOR A.R.C. = 3.70%
NUMBER OF NON-ANNUAL RECURRING O AND M COSTS = 0
ANNUAL RATE OF INCREASE FOR N.A.R.C. COSTS = 0.0%

ENERGY COST DATA:

NUMBER OF ENERGY TYPES = 2

ENERGY TYPE NO. 1 = ELECTRICITY
ANNUAL COST = $79860
ANNUAL RATE OF INCREASE DURING CONSTRUCTION = 7.7%
PRICE INCREASES DURING OCCUPANCY:
NUMBER OF DISCRETE TIME INTERVALS = 1

#	DURATION (YEARS)	ANNUAL RATE
1	9	7.7%

ENERGY TYPE NO. 2 = FUEL
ANNUAL COST = $47400
ANNUAL RATE OF INCREASE DURING CONSTRUCTION = 7.7%
PRICE INCREASES DURING OCCUPANCY:
NUMBER OF DISCRETE TIME INTERVALS = 1

#	DURATION (YEARS)	ANNUAL RATE
1	9	7.7%

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B L C C   A N A L Y S I S

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PART I - INITIAL ASSUMPTIONS AND COST DATA

PROJECT NAME: 2 FLOOR EXPANSION
RUN DATE:12-23-1984 11:20:37
BLDG. CHAR. FILE NAME: RE2 , LAST MODIFIED 12-23-1984 11:18:5
LCC OUTPUT FILE NAME: RE2LCC , CREATED 12-23-1984 11:19:58
STUDY PERIOD: 10 YEARS (1985 THROUGH 1994)
CONSTRUCTION PERIOD: 1 YEARS (1985 THROUGH 1985)
OCCUPANCY BEGINS: 1986
AFTER-TAX DISCOUNT RATE: 10.0% (NOMINAL)
TAX STATUS: FOR PROFIT
INCOME TAX RATE: 46.0% (COMBINED FEDERAL, STATE, CITY)
EFFECTIVE CAPITAL GAINS TAX RATE: 12.9%
NOMINAL PROPERTY TAX RATE: 3.25%
NOMINAL SALES TAX RATE: 5.00%

INITIAL CAPITAL COMPONENT COSTS (NOT DISCOUNTED)

INVESTMENT CATAGORY	YEAR	COST PHASING	ACTUAL COST	SALES TAX	TOTAL COST
CONSTRUCT	1986	100.0%	$10,528,800	$0	$10,528,800
TOTAL FOR CONSTRUCT			$10,528,800	$0	$10,528,800
TOTAL PROJECT COST			$10,528,800	$0	$10,528,800

FINANCIAL REQUIREMENTS (NOT DISCOUNTED)

A. INVESTOR'S INITIAL CASH REQUIREMENTS (UP TO AND INCLUDING OCCUPANCY):
(NOT ADJUSTED FOR INCOME TAX SAVINGS)

	YEAR	PROJECT	'POINTS'	INTEREST	TOTAL
DURING CONSTRUCTION	1985	$0	$0	$0	$0
AT OCCUPANCY	1986	$0	$0	$0	$0
TOTAL		$0	$0	$0	$0
PLUS PREPAID PROPERTY TAXES AT OCCUPANCY					$111,484
TOTAL CASH REQUIREMENTS					$111,484

B. BORROWING REQUIREMENTS:
(1) TEMPORARY FINANCING (DURING CONSTRUCTION):

YEAR	AMOUNT BORROWED	INTEREST RATE	POINTS PAID %	POINTS PAID AMOUNT	TYPE	PAYMENTS/ YEAR
1985	$0	13.00%	0.00%	$0	INTEREST ONLY	1
TOTAL	$0			$0		

(2) PERMANENT FINANCING (AT OCCUPANCY):

LOAN NO.	AMOUNT BORROWED	LIFE	INTR. RATE	POINTS PAID PERCENT	POINTS PAID AMOUNT	TYPE	PAYMENTS/ YEAR
1	$10,528,800	15 YRS	12.75%	0.00%	$0	AMORTIZED	12
TOTAL	$10,528,800				$0		

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PART II - LIFE-CYCLE COST ANALYSIS: DISCOUNT RATE = 10.0% (NOMINAL)

	PRESENT VALUE (1985)	ANNUAL VALUE
A. INVESTOR'S INITIAL CASH REQUIREMENTS:		
(EXCEPT PREPAID PROPERTY TAXES)		
DURING CONSTRUCTION	$0	$0
AT OCCUPANCY	$0	$0
SUBTOTAL	$0	$0
B. FINANCING PAYMENTS (AFTER OCCUPANCY):		
PRINCIPAL	$4,748,724	$772,833
INTEREST	$6,426,194	$1,045,833
SUBTOTAL	$11,174,920	$1,818,666
C. OPERATING, MAINTENANCE & RELATED COSTS:		
ANNUALLY RECURRING COSTS (NON-ENERGY)	$1,551,274	$252,463
NON-ANNUALLY RECURRING COSTS	$0	$0
ENERGY COSTS	$1,010,458	$164,447
PROPERTY TAXES	$818,718	$133,243
SUBTOTAL	$3,380,450	$550,153
E. INCOME TAX ADJUSTMENTS * :		
TAX SAVINGS FROM O AND M COSTS	($1,520,770)	($247,498)
TAX SAVINGS FROM DEPRECIATION:		
INITIAL INVESTMENT	($0)	($0)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM SALES TAX:		
INITIAL INVESTMENT	($0)	($0)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM INTEREST AND POINTS:		
DURING CONSTRUCTION	($0)	($0)
DURING OCCUPANCY	($2,827,678)	($460,191)
TAX CREDITS:		
INITIAL INVESTMENT	($870,149)	($141,613)
REPLACEMENTS TO CAPITAL	($0)	($0)
SUBTOTAL	($5,218,596)	($849,302)
F. REMAINING VALUE AT END OF OCCUPANCY	($7,462,875)	($1,214,549)
LESS: CAPITAL GAINS TAX LIABILITY	$438,380	$71,344
SUBTOTAL	($7,024,496)	($1,143,204)
G. TOTAL LIFE-CYCLE PROJECT COST:		
BEFORE INCOME TAX ADJUSTMENTS	$7,632,222	$1,242,109
AFTER INCOME TAX ADJUSTMENTS	$2,413,626	$392,806

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B L C C   A N A L Y S I S

PART I - INITIAL ASSUMPTIONS AND COST DATA

PROJECT NAME: 3 FLOOR EXPANSION (30 YEARS)
RUN DATE:12-23-1984 11:32:01
BLDG. CHAR. FILE NAME: RE330 , LAST MODIFIED 12-23-1984 11:30:2
LCC OUTPUT FILE NAME: RE330L , CREATED 12-23-1984 11:31:21
STUDY PERIOD: 30 YEARS (1985 THROUGH 2014)
CONSTRUCTION PERIOD: 1 YEARS (1985 THROUGH 1985)
OCCUPANCY BEGINS: 1986
AFTER-TAX DISCOUNT RATE: 10.0% (NOMINAL)
TAX STATUS: FOR PROFIT
INCOME TAX RATE: 46.0% (COMBINED FEDERAL, STATE, CITY)
EFFECTIVE CAPITAL GAINS TAX RATE: 12.9%
NOMINAL PROPERTY TAX RATE: 3.25%
NOMINAL SALES TAX RATE: 5.00%

INITIAL CAPITAL COMPONENT COSTS (NOT DISCOUNTED)

INVESTMENT CATAGORY	YEAR	COST PHASING	ACTUAL COST	SALES TAX	TOTAL COST
CONSTRUCT	1986	100.0%	$15,729,000	$0	$15,729,000
TOTAL FOR CONSTRUCT			$15,729,000	$0	$15,729,000
TOTAL PROJECT COST			$15,729,000	$0	$15,729,000

FINANCIAL REQUIREMENTS (NOT DISCOUNTED)

A. INVESTOR´S INITIAL CASH REQUIREMENTS (UP TO AND INCLUDING OCCUPANCY):
(NOT ADJUSTED FOR INCOME TAX SAVINGS)

	YEAR	PROJECT	´POINTS´	INTEREST	TOTAL
DURING CONSTRUCTION	1985	$0	$0	$0	$0
AT OCCUPANCY	1986	$0	$0	$0	$0
TOTAL		$0	$0	$0	$0
PLUS PREPAID PROPERTY TAXES AT OCCUPANCY					$166,547
TOTAL CASH REQUIREMENTS					$166,547

B. BORROWING REQUIREMENTS:
(1) TEMPORARY FINANCING (DURING CONSTRUCTION):

YEAR	AMOUNT BORROWED	INTEREST RATE	POINTS PAID %	POINTS PAID AMOUNT	TYPE	PAYMENTS/ YEAR
1985	$0	13.00%	0.00%	$0	INTEREST ONLY	1
TOTAL	$0			$0		

(2) PERMANENT FINANCING (AT OCCUPANCY):

LOAN NO.	AMOUNT BORROWED	LIFE	INTR. RATE	POINTS PAID PERCENT	POINTS PAID AMOUNT	TYPE	PAYMENTS/ YEAR
1	$15,729,000	15 YRS	12.75%	0.00%	$0	AMORTIZED	12
TOTAL	$15,729,000				$0		

*

PART II - LIFE-CYCLE COST ANALYSIS: DISCOUNT RATE = 10.0% (NOMINAL)

	PRESENT VALUE (1985)	ANNUAL VALUE
A. INVESTOR'S INITIAL CASH REQUIREMENTS:		
(EXCEPT PREPAID PROPERTY TAXES)		
DURING CONSTRUCTION	$0	$0
AT OCCUPANCY	$0	$0
SUBTOTAL	$0	$0
B. FINANCING PAYMENTS (AFTER OCCUPANCY):		
PRINCIPAL	$6,075,188	$644,451
INTEREST	$10,957,800	$1,162,395
SUBTOTAL	$17,032,980	$1,806,846
C. OPERATING, MAINTENANCE & RELATED COSTS:		
ANNUALLY RECURRING COSTS (NON-ENERGY)	$4,608,823	$488,901
NON-ANNUALLY RECURRING COSTS	$0	$0
ENERGY COSTS	$4,052,475	$429,884
PROPERTY TAXES	$3,061,805	$324,794
SUBTOTAL	$11,723,100	$1,243,578
E. INCOME TAX ADJUSTMENTS * :		
TAX SAVINGS FROM O AND M COSTS	($5,264,590)	($558,464)
TAX SAVINGS FROM DEPRECIATION:		
INITIAL INVESTMENT	($0)	($0)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM SALES TAX:		
INITIAL INVESTMENT	($0)	($0)
REPLACEMENTS TO CAPITAL	($0)	($0)
TAX SAVINGS FROM INTEREST AND POINTS:		
DURING CONSTRUCTION	($0)	($0)
DURING OCCUPANCY	($4,820,685)	($511,375)
TAX CREDITS:		
INITIAL INVESTMENT	($1,299,917)	($137,894)
REPLACEMENTS TO CAPITAL	($0)	($0)
SUBTOTAL	($11,385,190)	($1,207,732)
F. REMAINING VALUE AT END OF OCCUPANCY	($6,412,842)	($680,270)
LESS: CAPITAL GAINS TAX LIABILITY	$709,873	$75,303
SUBTOTAL	($5,702,969)	($604,967)
G. TOTAL LIFE-CYCLE PROJECT COST:		
BEFORE INCOME TAX ADJUSTMENTS	$23,204,530	$2,461,519
AFTER INCOME TAX ADJUSTMENTS	$11,819,340	$1,253,786

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* INCOME TAX SAVINGS ARE DISCOUNTED FROM THE END OF THE YEAR IN WHICH THEY ARE EARNED;
TAX CREDITS AND TAX SAVINGS FROM SALES TAX ON INITIAL INVESTMENT ARE REALIZE IN THE FIRST YEAR OF OCCUPANCY.

APPENDIX B: GLOSSARY

GLOSSARY

Accelerated depreciation: A depreciation method resulting in larger deductions from income in the early years than the straight-line method.

Amortization: The periodic repayment of debt under a loan agreement; payments made to reduce debt on a periodic basis.

Annual benefit: The dollar value of goods and services expected to result from a program or project for each of the years it is in operration.

Annual cost: The expected annual dollar value of resources, goods and services required to establish and carry out a program or project. All economic costs including acquisition, possession and operation costs muct be included.

Benefit-cost ratio: Present value benefit divided by present value cost.

Cash flow schedule: A schedule of anticipated cash intake and outgo over time, ordinarily reflecting anticipated revenues from sales or rentals, anticipated operating expenses and debt-service requirements, any cash contributed by the owners or by others and the resulting net cash returns to the owners after payment of operating expenses and debt service. Cash flows may be discounted to arrive at an estimate of their present value for purposes of investment analysis.

Construction loan: An interim loan used to finance the construction of buildings and other improvements on a site.

Discount factor: The factor for any specific discount rate which translates expected cost or benefit in any specific future year into its present value. The discount factor is equal to $1/(1+r)^t$, where r is the discount rate and t is the number of years since the date of initiation, renewal or expansion of a program or project.

Discount rate: The interest rate used in calculating the present value of expected yearly costs and benefits.

Double declining balance depreciation: A method of depreciation that begins by calculating the straight-line depreciation rate, doubling it and applying the resulting factor to the undepreciated portion of the cost or value of the improvements in each accounting period. Depreciation taken in each period is deducted from the undepreciated balance so that this method results in declining depreciation estimates over time. This method is also known as 200 percent declining balance; other percentages, such as 150 percent or 125 percent of straight-line, may also be used and are permitted for certain classes of property under existing income tax law.

Equity: The value of the owner's interest in real estate has over and above any leins against it; the owner's cash investment, augmented by any debt reduction or value gains; the value of the property minus any existing mortgages and leins.

Escalating annually recurring costs: Those costs which escalate in real value such as: service/maintenance which involves increasing amounts of work as building/components age and/or an escalation in cost different from general inflation; fuel costs; frequent replacements which escalate at a different rate than general inflation.

Gross floor area: The area determined by measuring all the space on the floor, or in the building, from the inside finished surface of the exterior walls.

Interim loan: A short-term loan, ordinarily secured by a forst mortgage, used to finance property acquisition and improvements. May take the form of an acquisition, development or construction loan.

Joint venture: A legal arrangement in which two or more parties undertake to share the risks and rewards of a venture on an agreed basis.

Leasehold: The lessee's ownership interest in the property.

Leverage: The use of fixed-cost funds to acquire property that is expected to produce a higher rate of return either by way of income or through appreciation.

Limited partnership: A form of ownership in which partners are divided into two classes: the general partner or partners who actively manage the operations of the group and bear full responsibility for its affairs, and the limited partners, whose exposure is normally limited to the amounts for which they are obligated under the terms of the partnership agreement and who have no control over the affairs of the partnership.

Loan-to-value ratio: The ratio between the original principal amount of a mortgage loan and the actual or appraised value of the property.

Mortgage: A legal instrument under which property is pledged to secure the payment of a debt or obligation, subject to statutory requirements governing the procedure for foreclosure in the event of default.

Net operating income: Gross property income less operating expenses and property taxes. Does not reflect any further deductions for mortgage payments, income taxes, depreciation or non-operating expenses.

Non-recurring future costs: including such needs as: major replacement; non-annual maintenance and repair; implementation costs for major alterations to that which already exists.

Present value benefit: Each year's expected yearly benefit multiplied by its discount factor and then summed up over all years of the planning period.

Present value cost: Each year's expected yearly cost multiplied by its discount factor and then summed over all years of the planning period.

Present value net benefit: The difference between present value benefit and present value cost.

Rentable area: The actual space on each floor, rented by a tenant, including his/her share of the public areas, washrooms, lobbies, and pro rated share of space used by the entire building (i.e. elevators and fire stairs).

Sale and leaseback: A means of financing the ownership or development of improved property by purchasing the property and leasing it back to the owners or developers at a rent intended to cover normal debt-service requirements plus transaction costs including any profit required by the purchaser.

Soft costs: Development costs other than those devoted to land and actual construction, such as interest on borrowed funds, architectural and other fees, marketing costs and incidental costs.

Straight-line depreciation: A depreciation deduction calculated by subtracting from the initial cost or value of the improvements any anticipated salvage value and then dividing the estimated economic life of the improvements into that figure. The resulting amount is the same for each year of the economic life of the property, hence the term "straight-line."

Sum-of-the-years-digits depreciation: A depreciation method using an arbitrary formula based on the anticipated depreciable life of the improvements. This method yields results roughly comparable to those of the double declining balance method and is generally allowed where that method is permitted under existing law.

Sunk costs: Those funds already spent or irrevocably committed. Such costs include: study costs; construction work already started or completed; design costs where the expense is obligated by contract regardless of design solution. Sunk costs should be ignored in life-cycle costing calculations.

Uncertainty: Actual costs and benefits in future years are likely to differ from those expected at the time of decision. For those cases for which there is a reasonable basis to estimate the variability of future costs and benefits, the sensitivity of proposed programs and projects to this variability should be evaluated.

Uniform annually recurring costs: Expenditures including: service contracts; preventive maintenance; scheduled minor replacements; annually recurring costs which increase in price at the same rate as general inflation.

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