ECONOMICS AND RISK
IN COMMERCIAL
REAL ESTATE DEVELOPMENTS

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Abstract

ECONOMICS AND RISK IN COMMERCIAL REAL ESTATE DEVELOPMENTS

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The development process for large commercial real estate projects is detailed in this thesis. Sources of risk in each phase of the development process are highlighted. A simplified method of risk analysis is developed using a PERT type procedure, combined with a mean and variance analysis of the Net Present Value equation. Risk is measured in terms of the standard deviation of Net Present Value and/or Internal Rate of Return. The methodology is applied to a 30 storey office building located in Western Canada. Attention is also directed at the sensitivity of economic performance to various energy conservation strategies.

ACKNOWLEDGEMENTS

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CHAPTER 1

1.0 INTRODUCTION

The commercial real estate business is characterized by long term investments, which are subject to potentially high risk and high profit margins. Commercial developments include land holdings, office buildings, shopping centres and other long term investments such as hotels.

The combination of high risk and high profit potential leads to the need for thorough financial analysis of a project by the developer-investor. In a financial analysis, risk must be balanced by the profit potential and measures identified to diminish economic risk through a combination of financing, leasing and design strategies.

1.1 OBJECTIVES

The objectives of this thesis are:

(i) to identify and describe the process of commercial real estate development with emphasis on sources of risk during all phases of the project life cycle (Chapter 2);

(ii) to develop a simplified technique for quantifying economic risk for use in investment decision-making, both at the overall project level and at the architectural and engineering design level (Chapter 3);

(iii) to present a detailed case study of an actual major commercial development. The case study deals with traditional investment analysis, deterministic analysis, sensitivity analysis, risk analysis and optimization.

The deterministic analysis is based on Net Present Value (NPV) approach. Risk analysis involves the use of a first and second moment approach which is patterned after a PERT type analysis.

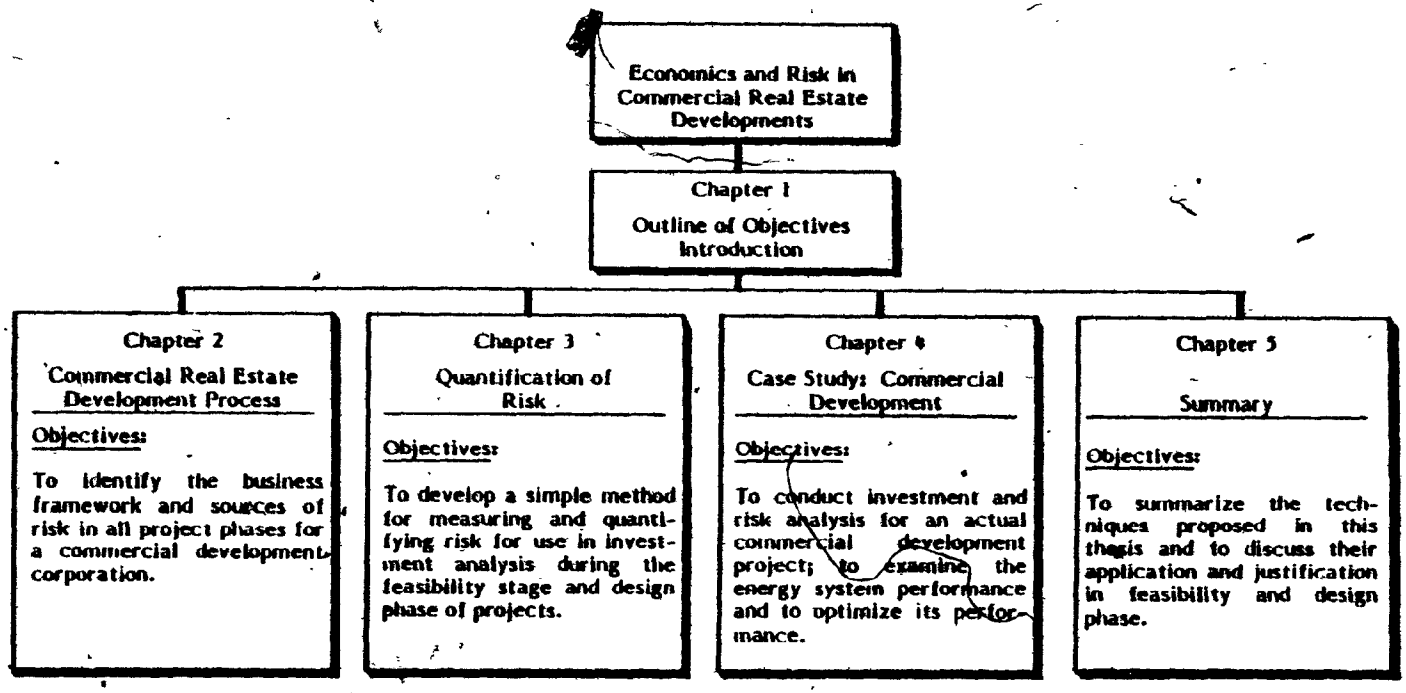
Design optimization is performed for the project's energy system.

Real estate investment analysis consists essentially of an analytical process in which the financial and design variables which can be controlled, are identified. Further judgments are required which pertain to future competition, scheduling, regulatory environments, technological change, costs, availability of energy supplies, etc., and are made in the face of considerable uncertainty. Hence the need for formalizing the treatment of risk in the investment decision process. The need for risk identification increases substantially for large commercial projects. Considerable effort is directed at trading-off or balancing risks with future rewards.

The overall structure of this thesis is depicted in Fig. 1.1

OBJECTIVES & CONTENT

Fig. 1.1



1.2 AUDIENCE

The audience of this paper is assumed to be familiar with privately owned and operated commercial real estate developments.

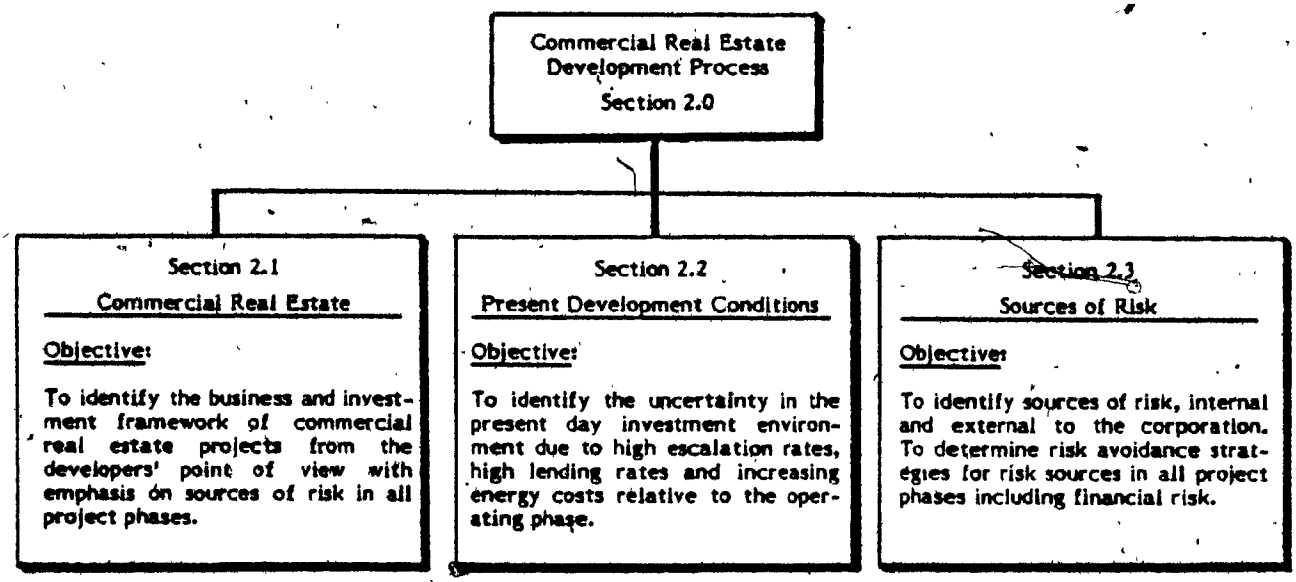
Basic knowledge of time-value of money concepts (Present Value), probability and statistics, has been assumed.

CHAPTER 2

Commercial Real Estate Development Process

2.0 COMMERCIAL REAL ESTATE DEVELOPMENT PROCESS

The objective of this chapter is to identify the business and investment framework for the commercial real estate development process with particular emphasis on sources of risk. The development process is one of decision-making in the face of uncertainty. Identification and reduction of risks are of importance as they could contribute to an increase of overall project profitability. The objectives and their sequence of treatment for this Chapter are shown in fig. 2.1.



OBJECTIVES AND TREATMENT OF CHAPTER 2.0
Fig. 2.1

2.1 COMMERCIAL REAL ESTATE

Real estate developers of city and suburban centres, office buildings, retail and shopping centres, as well as high rise apartment buildings and other types of residential complexes, have influenced our North American working and living environment in profound ways. New social and economic environments have been created which originated from the planning rooms of large real estate developers, city planners, architects and engineers.

Most large and successful real estate development organizations have prospered since the 1950's and they have been riding the crest of the "economic boom" years and post war population growth. Because of the highly visible nature of the real estate business, and the potential for large profits and losses, the successful developer is associated with a dynamic and risk prone business.

The nature of real estate developments involves highly leveraged financial investments, in which profits are channelled back into landholdings and other profitable real estate developments. The landholdings minimize the need for purchase of expensive land parcels at future dates, which at times is a key factor in the profitability of real estate developments.

Growth:

Real estate developers have been allowed since the 1950's to generate large assets within relatively short periods of time under favourable Federal, Provincial and Municipal policies aimed at creating and expanding the building industry. In the past, the building industries of North America have been able to attract relatively

inexpensive mortgage and financing funds for highly leveraged real estate investments.

The growth of developments in Canada over the past years is represented in Table 2.1. It shows the units and construction value of building permits issued annually in Canada since 1962[1]. The total Canadian development industry in the year 1979 amounts to a sizeable $14,143,943,000 whereas 1970 showed a total construction value of $4,700,759,000. These values are in current dollars. The developer is primarily involved with the "residential" and "commercial" categories shown. The "commercial" buildings in these figures however include: warehouses, hotels, clubs, restaurants, motels, hotels, office buildings, retail and wholesale stores, shopping centres, garages, theatres, and recreational buildings. The combined development value for the development industry consisting of "residential" and "commercial" totalled $9,101,235,000 or 64% of the total 1979 Canadian construction.

When the general building contracting industry is examined, information recorded by Statistics Canada for value of construction work performed for similar years, show substantially higher values for current dollars of total construction. Annual construction in Canada, shown in Table 2.2[2] for example, indicated a total construction value in 1977 of $35,803,418,000 current dollars. Building permit value for 1977 however showed a total of $12,418,810,000 or roughtly 1/3 of the overall construction costs.

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(1) Source: Statistics Canada, Ottawa, Catalogue File: 64-203, Annual Reports, "Summary of Building Permits".

(2) Source: Statistics Canada, Ottawa, Catalogue File: 64-207, Annual Reports, "The Non-Residential General Building Contracting Industry", 1977.

BUILDING PERMITS ISSUED ANNUALLY - CURRENT DOLLARS
CANADA 1962-1979
Table 2.1

LEGEND
Inst. & Gov. = Institutional & Government
* Row Housing is included with Apartments

SUMMARY OF BUILDING PERMITS ISSUED ANNUALLY
CANADA 1962 - 1979

SOURCE: STATISTICS CANADA
CATALOGUE: 64-203

YEAR	NUMBER OF DWELLING UNITS (UNITS)							ESTIMATED VALUE OF CONSTRUCTION (THOUSANDS OF DOLLARS)				
	SINGLE DWELLING	COTTAGES	DOUBLE DWELLING	ROW HOUSING	APARTMENTS	CONVERSIONS	TOTAL	RESIDENTIAL	INDUSTRIAL	COMMERCIAL	INST. & GOV.	TOTAL
1962	58,625	-	12,107	-	48,111	2,570	121,413	1,209,182	218,138	469,356	619,902	2,516,578
1963	67,398	-	14,178	-	62,141	2,188	145,905	1,462,166	281,048	460,122	619,890	2,823,226
1964	67,666	-	13,107	-	81,133	1,965	163,871	1,614,824	380,842	597,536	674,419	3,267,621
1965	66,011	-	13,646	-	85,506	1,582	166,745	1,756,769	430,324	782,845	839,662	3,809,600
1966	61,958	-	12,359	-	58,062	2,136	134,515	1,592,001	473,661	736,726	912,702	3,715,090
1967	65,441	-	13,867	-	81,914	2,257	163,479	1,923,644	424,947	677,001	1,042,241	4,067,833
1968	70,136	-	14,320	-	117,763	2,624	204,843	2,405,632	530,670	696,203	1,143,210	4,775,715
1969	65,765	-	11,702	-	114,942	2,581	194,990	2,429,190	567,048	839,155	1,060,158	4,875,551
1970	60,119	-	11,790	-	104,295	2,425	178,629	2,311,563	497,682	807,374	1,083,540	4,700,159
1971	84,055	2,708	16,657	--- *	124,648	2,337	230,405	3,203,063	460,925	1,069,785	996,355	5,730,127
1972	96,489	2,606	15,919	16,623	110,364	2,056	244,057	3,633,411	520,479	1,411,599	893,119	6,463,608
1973	112,428	2,644	14,185	16,067	123,861	2,047	271,232	4,763,082	853,754	1,970,340	971,762	8,558,938
1974	102,064	2,820	11,731	13,944	66,314	1,998	198,871	4,575,710	1,315,898	2,292,665	1,095,802	9,280,075
1975	118,635	2,592	16,725	19,460	80,798	1,460	239,670	6,128,940	875,826	2,251,483	1,341,786	10,598,035
1976	123,900	2,962	16,386	27,726	89,790	1,629	262,393	7,475,815	1,010,015	2,545,513	1,167,988	12,199,331
1977	106,768	2,958	19,782	24,307	97,853	1,971	253,639	7,612,531	1,011,957	2,444,382	1,350,940	12,418,810
1978	105,357	2,517	18,469	17,263	72,086	1,844	217,536	7,566,670	1,053,590	3,140,478	1,373,956	13,134,694
1979	102,227	2,164	15,828	11,521	54,251	2,146	188,137	7,767,074	1,315,545	3,727,162	1,334,162	14,143,943
1980												

Total Value of Construction Work Performed (Thousands, 1974 to 1977

Type of structure (thousands of dollars)	1974	1975	1976	1977
Residential	8,488,849	8,689,862	12,669,346	13,125,998
Single detached	1,838,540	1,740,892	4,958,674	4,660,075
Semi-detached including duplexes	298,434	355,349	480,918	586,068
Apartments including row housing	1,901,214	1,880,065	2,915,357	3,279,406
Other residential construction	2,998,432	2,793,344	4,284,407	4,660,061
Industrial	1,512,427	1,509,678	1,458,182	1,720,713
Factories, plants, workshops, food canneries, smelters	1,271,983	1,234,964	1,137,978	1,419,369
Mine and mine mill buildings	191,744	183,830	253,687	222,567
Railway stations, roadway buildings	41,998	56,251	47,566	56,104
Railway shops, engine houses, water and fuel stations	24,992	35,633	20,871	20,684
Commercial	2,909,131	3,732,465	3,627,760	3,638,683
Warehouses, storehouses, refrigerated storage, etc	183,139	157,733	187,016	419,718
Grain elevators	16,311	23,092	11,540	14,985
Hotels, clubs, restaurants, cafeterias, tourist cabins	118,647	264,718	198,698	224,632
Office buildings	1,191,192	1,490,800	1,806,796	1,668,271
Stores, retail and wholesale	838,921	816,855	691,300	736,244
Garages and service stations	188,148	194,959	194,478	209,470
Theatres, arenas, amusement and recreational buildings	328,520	780,408	516,637	300,751
Laundries and dry cleaning establishments	5,262	4,899	3,315	4,482
Institutional	1,382,661	1,568,902	1,994,471	1,661,686
Schools and other educational buildings	916,249	992,119	845,358	912,077
Churches and other religious buildings	28,855	39,087	52,193	58,089
Hospitals, sanatoria, clinics, first-aid stations, etc	179,621	268,050	425,792	408,186
Other institutional buildings	161,736	231,646	270,928	283,334
Other building construction	988,486	1,116,788	1,139,986	1,152,875
Farm buildings (excluding dwellings)	401,980	440,520	484,430	569,817
Broadcasting, radio and television, relay and booster stations, telephone exchanges	115,811	151,939	161,728	141,774
Aircraft hangars	14,729	17,418	28,978	19,743
Passenger terminals, bus, boat, air and other	117,066	139,980	122,987	108,193
Armouries, barracks, drill halls, etc	14,695	24,718	30,683	20,467
Bunkhouses, dormitories, camp cookeries, bush depots and camps	16,992	25,158	40,783	30,180
Laboratories	69,156	69,664	68,304	57,954
Other building construction	167,579	236,990	214,115	204,227
Total construction	24,691,878	28,376,144	33,131,199	35,803,418

Total Value of Construction Work Performed – Current and Constant Dollars by New and Repair, 1969 - 1978

Year	New		Repair		Total		Total construction as percentage of Gross National Expenditure	
	Current dollars	Constant 1971 dollars	Current dollars	Constant 1971 dollars	Current dollars	Constant 1971 dollars	Current dollars	Constant 1971 dollars
	millions of dollars						per cent	
1969	10,825	11,935	2,382	2,866	13,207	14,801	16.5	17.2
1970	11,320	12,004	2,461	2,707	13,781	14,711	16.1	16.6
1971	13,276	13,276	2,589	2,589	15,865	15,865	16.8	16.8
1972	14,469	13,689	2,820	2,638	17,289	16,327	16.4	16.3
1973	16,954	14,528	3,220	2,766	20,174	17,294	16.3	16.0
1974	20,772	14,987	3,921	2,883	24,693	17,870	16.8	16.0
1975	24,056	15,430	4,320	2,848	28,376	18,278	17.2	16.2
1976	28,145	16,250	4,986	2,980	33,131	19,230	17.4	16.2
1977	30,269	16,083	5,484	3,018	35,753	19,101	17.2	15.7
1978	31,913	-	5,952	-	37,865	-	-	-

NON-RESIDENTIAL GENERAL BUILDING CONSTRUCTION INDUSTRY

Table 2.2

2.1.1 Development Activities and Project Life Cycle:

The work of developers is done by a small number of highly specialized people, in the fields of finance, law, administration, architectural and engineering design. Developers assemble projects by looking for land sites upon which they can erect profitable real estate developments, such as suburban residential housing, apartments, condominiums, shopping centres and downtown office buildings.

The activities required of the developer for most major projects are performed partly in sequence and partly in parallel. The project development life cycle consist of the following critical milestone events for which major decisions are required:

PROJECT LIFE CYCLE

A. Feasibility Phase

1. Land option or ownership purchase
2. Zoning approval
3. Project programming
4. Conceptual design
5. Budget and scheduling
6. Internal approvals
7. External approvals
8. Financing of project

B. Design Phase

9. Working drawings and specifications
10. Tendering to contractors
11. Over-budget redesign
12. Construction contract negotiations

C. Construction Phase

13. Construction and administration
14. Project certification
15. Tenant fit up work

D. Operations Phase

16. Rental and leasing
17. Retrofits of project during O & M Phase
18. Termination phase
19. Sale of property

Some of the initial listed activities are of a critical nature, such that the project has the chance of being abandoned at that particular stage.

Initially, a small group of persons, the "development group" searches for land options or purchase of potentially "good" or strategic sites for a commercial development project. Local zoning by-laws limit general use of land properties for residential or commercial use, while further requirements regarding height, parking and green space exist to limit or direct socio-economic impacts. Zoning by-laws sometimes can be changed by an Order-in-Council of the city or municipality. The intended use of the property requires specific approvals by the zoning committees for such items as: road access, traffic density, water and sewer systems. In many cases, residents in the area might have to be polled or hearings held to determine the type and magnitude of objections for large controversial site developments. The use of preliminary plans and scaled down building models are used to illustrate the intended use of the site. Once grievances have been resolved, a development agreement can be signed with the local authorities.

During the above stages, the development team is in close contact with potential major or "anchor" tenants and tentative leasing agreements are used to assure the viability of the real estate development in the initial phases. A tentative development schedule and budget is worked out in order to determine the financial feasibility or profitability of the project. The overall financial analysis, prepared

for investment evaluation, is referred to as the "proforma". Many variations and changes might have to be made in order to maximize the profitability of the site within the constraints of the above-mentioned agreements. The proforma is used as a basis for arranging financing of the project.

When project and financial arrangements are deemed feasible from an investment point of view, final agreements are signed with major tenants. At this stage preliminary designs can be finalized and the developer enters into a contract with architects and engineers for the preparation of final design drawings and specifications. Subsequently, "design criteria" documents are issued by the developer to the architect, in which the specific requirements for the design of the project are transmitted for incorporation into the design. The developer will often work with a group of consultants who have earned a reputation for professionalism and satisfactory performance on previous projects of similar scope.

In the case where the developer acts as a general contractor an architect could be hired and some engineering disciplines such as mechanical or electrical design work could be performed by in-house engineers. A closer control on scheduling and budget design by the developer has been claimed for such arrangments. However, the large developer who is involved in multiple specialized projects which are geographically dispersed, usually is not equipped to provide the special manpower of simultaneous design efforts. It is therefore customary that architects and engineers of the developers' staff monitor the consultants for design and site inspection during construction. A single contract is usually signed with an architect who in turn will be responsible for the co-ordination of the work of his consultants.

Of critical importance are the budget cost and schedule of the development, which largely determines the profitability of the development and the risk exposure of the developer. Receipt of the bids from contractors confirms whether the architect had a good knowledge of the building costs of the design. Alternate prices, unit prices, or "add" and "delete" options sometimes allow for the original budget to be met. In many instances however, a project is found to be over-budget and redesign, retendering or cost-cutting negotiations are necessary and basic architectural and engineering concepts of the buildings will have to be modified. This process sometimes requires painful surgery, and re-evaluations of proforma and design are necessary to arrive at a design that meets the budget. A final construction contract will be signed subsequent to its approval by the developer and the general contractor commences the construction.

"Substantial completion" of a project is a legal term for which the architects and engineers determine virtual completion. This date typically initiates the start of the guarantee and warranty period and a lien period which terminates some 30 to 35 days later. After completion of the outstanding deficiencies, the general contractor is paid in full, in accordance with the contract, while the project is certified by the consultants as "complete".

Prior to building completion, as with shopping centres and office buildings, tenants are given move-in dates, after which they can "fit-up" their premises. Only a "base-building" is provided to the tenant and the premises usually consist of standard carpeted floors, ceilings, lighting and heating, ventilating and air conditioning (HVAC) systems. The tenant usually will provide partitioning and install ceiling systems. Sometimes this work will be performed by the developer under a "tenant allowance".

Tenant "fit-up criteria" describe the permissible "fit-up" work within the "base-building" components such that the integrity of the building is maintained and essential building components retained without alteration.

Building operation and management functions, after completion of the building, are often performed by the developer for the case of long-term real estate investments. Building management functions are the link between owner and tenant. Maintenance of the building must be such that building marketability, status and profitability can be maintained.

When buildings approach 10 to 15 years of age, it usually becomes necessary to upgrade them by way of fire protection systems, finishes, flooring or HVAC system changes, such that they remain competitive with new buildings. Often, tenant leases for office buildings are five years or multiples thereof, which permits a tenant to relocate to more modern or convenient locations in keeping with his status.

Sale of properties is usually determined by the profitability or economic life period of the investment and cashflow needs. In summary, a development company is not necessarily a physical builder but a business which co-ordinates the tasks essential for the construction, marketing, operation and maintenance of a successful project.

2.2 PRESENT DEVELOPMENT CONDITIONS

Present economic conditions are marked by spiralling inflation, energy costs and prime interest rates. Together, they have dramatically increased the risks and uncertainty of long-term real estate investments.

More importantly, present development conditions are marked by extreme volatility which makes the task of predicting future investment performance increasingly difficult and risky. The volatility of the prime interest rates since 1976, is shown in Fig. 2.2[(1)]. The unexpected up-surge of prime interest rates, together with short term bonds and discount rate, are evidence of very considerable fluctuations which currently are experienced with financial investments.

The energy costs of Fig. 2.3 represent the Canadian average residential costs and 100% efficiency conversion. Significant variations exist for different regions and for different burning efficiencies. The variation of energy cost with time in Canada are in figures 2.3 and 2.4 (note 2).

The elements of the development business described above have led the developer to use more rigorous methods of analyzing the profitability and risk associated with a project. It also appears that the use of computer assisted investment analysis with present worth, internal rate of return, sensitivity and risk analysis as well as statistical decision theories have increasingly been adopted by successful developer managements. Previously, they were considered esoteric and of academic interest only, but presently are becoming more and more common place in the project investment analysis process.

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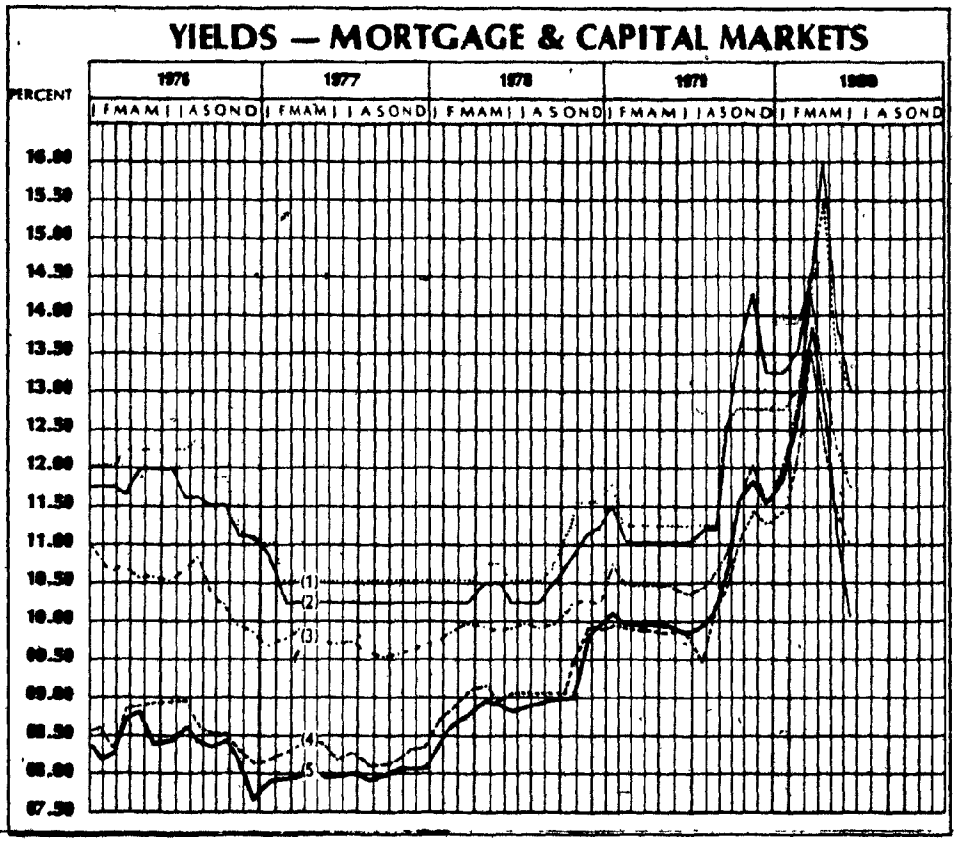
(1) Source: Morguard Trust - Canadian Mortgage market review, Number 5, Volume 16, June 1980.

(2) Source: Department of Energy, Mines and Resources, Canada, 1980.

HOUSING AND MORTGAGE ACTIVITY Source: C.M.H.C. and Bank of Canada Statistical Summaries

	HOUSING STARTS - Units				Apartment Vacancy Rate*	Newly Completed Unoccupied Dwellings	
	March		Year to Date				
	1980	From 1979	1980	From 1979		1980	1979
Halifax	87	- 63.7%	230	-34.2%	2.6%	182	195
Montreal	622	- 11.5%	1,632	-43.9%	3.5%	2,144	3,672
Ottawa	77	- 29.3%	403	-42.9%	4.2%	1,158	1,570
Toronto	1,124	+ 10.8%	3,070	+40.8%	1.0%	2,797	5,053
Winnipeg	9	- 95.0%	173	-83.7%	4.8%	1,897	1,532
Regina	38	- 90.7%	134	-85.9%	2.0%	308	132
Calgary	924	- 9.0%	2,011	-38.0%	1.0%	1,998	1,724
Edmonton	287	- 72.1%	1,580	-51.4%	2.8%	3,640	2,589
Vancouver	1,147	+114.7%	3,938	+52.5%	0.1%	632	1,704
CANADA-TOTAL**	4,909	- 23.7%	17,205	-17.6%	2.5%	18,371	24,617

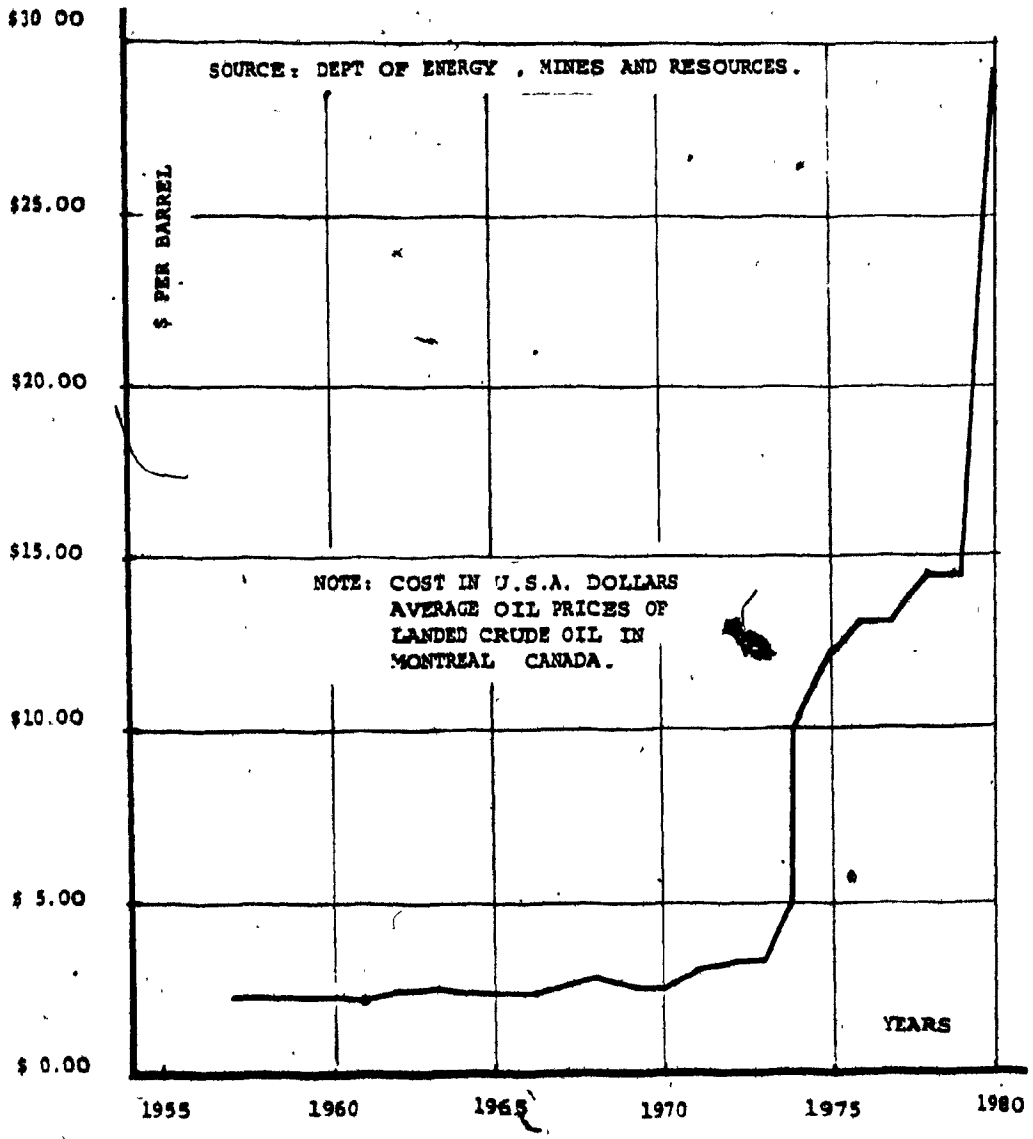
*As at April, 1980 (excludes newly completed units)
**For centres of 10,000 population and over



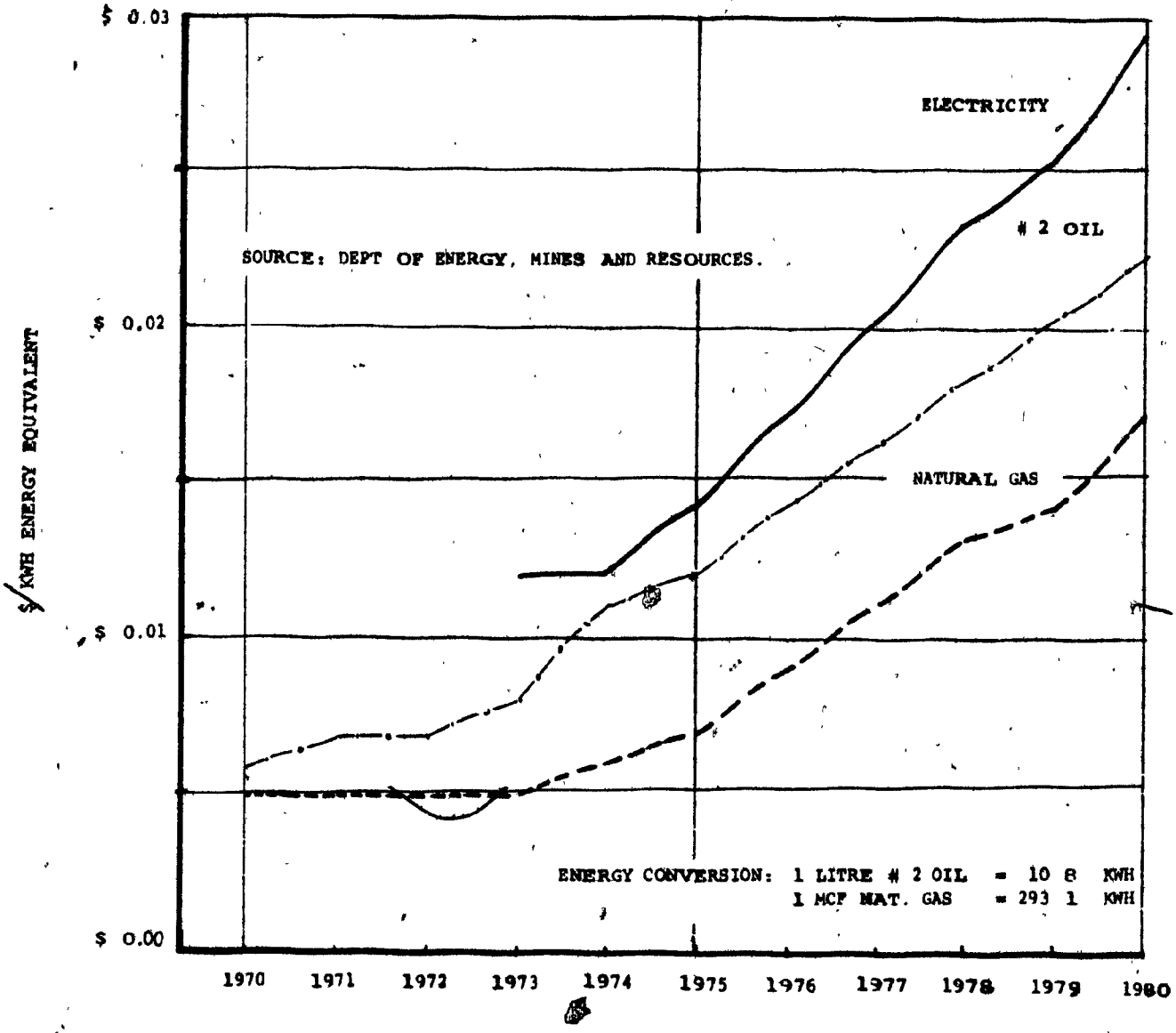
(1) Conventional Mortgage Rate 13.00%
(2) N.H.A. Mortgage Rate 13.00%
(3) Average Long-Term Corporate Bond Yield 11.70%
(4) Canadian Government 10-Year Bond Yield 11.00%
(5) Canadian Government 5-Year Bond Yield 10.15%

The above figures are as at June 13, 1980.

CANADIAN INTEREST RATES
Fig. 2.2



CANADIAN, IMPORTED ENERGY COSTS
Fig. 2.3



CANADIAN DOMESTIC ENERGY COSTS
Fig. 2.4

In recent years the developer has been faced with increased vacancy rates for office space as well as residential developments. The post war "boom years" with rapid growth appears to have made way for the reduced growth trends of the 1970's. As a result, more than ever before, developers have been forced into a highly competitive market in which consistently intelligent management decisions are required and streamlined organizations require execution of precisely formulated objectives.

Along with the many successful and massive real estate developments, there have been some devastating failures, as experienced with several condominium developments and office buildings throughout North America which remain vacant. Prime examples of failures resulting from a combination of high leverage, inadequate market research and inadequate cost planning and control have been described in references (27), (28) & (29).

2.2.1 Investment Analysis Processes

It is the objective of this section to analyze the individual and corporate motivations which govern commercial real estate investment decisions.

When basic ingredients of management investment decisions are examined it is found that each decision, as a result of some analysis, is based either on implicit or explicit consideration of risks or the probability of gains versus losses. In general, the motivations for an investment are governed by a complex set of criteria in which probability of gains or losses are evaluated against the magnitude of gains or losses.

Investment attitudes of individuals and corporations towards risk and reward vary with size of the investment and with time. They vary from being "risk averse" to "risk seeking". A vast majority of investors have a risk averse or conservative investment attitude, and consequently weigh the potential for loss higher than the potential for profit.

As stated in reference (5:50)* —"Investment decisions are not the simple maximizing decisions of the classical economics, but rather involve many incommensurables as well as many subjective elements. Each investor, whether a person or group decision, reflects a very complex mixture of objectives and sub-objective mind processes. They involve risks, probabilities, uncertainties, goals, value systems, biases, degree of analytical ability, stocks of applicable financial knowledge and tax shield situations."--

The investment atmosphere of real estate developers is subject to high risks which is reflected in the wide ranges of corporate profits. In a survey by James Lorimer of major Canadian development corporations for the year 1977, a widespread variation of corporate profitability could be observed. Table 2.3 summarizes corporate profitability information extracted from reference (35:267).

Of the 22 companies examined in 1977, the average return on equity investment before taxes was 21% while profits ranged from a high of +66% to a loss of -70%. The return on investment (ROI) is shown as "equity dividend". When the average ROI is computed from table 2.3 we find:

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* This is a reference entry; number of reference is placed before the colon sign, while relevant page numbers are placed after the colon.

$$ROI_{ave} = \frac{\sum ROI_i}{n} = 22.9\%$$

n = number of companies (22)

The standard deviation is indicative of the degree of risk and when computed for the above:

$$\text{Standard Deviation} = \sqrt{\frac{\sum (ROI_i - ROI_{ave})^2}{}} = 47.8\%$$

There is minimal information to indicate whether the extra risk and profitability for real estate investments in 1977 has kept pace with the increased yield offered by government bond issues in subsequent years.

When we examine the average earnings per common share for a major Canadian developer (11) as shown in Appendix A-2 we find little evidence to demonstrate increased profitability in recent years. It could be argued from this limited information that commercial real estate investments in recent years might have lost the original attractiveness from the investors point of view.

Other investment motivations by developers, in addition to high profit potential, are:

- taxation or tax shelter benefits
- asset accumulation through high financial leverage
- capital cost allowance
- capital gains of long term investments

The average effective tax rate on profits of the development corporations analyzed by J. Lorimer (35:27) and as shown in table 2.3 amounts to 19%. The average effective tax rate from 1975 to 1979 for a major Canadian developer (11) as obtained from annual reports and shown in Appendix A-2, amounted to 29.3% of reported "gross earnings". Again, the revenues and taxes for this real estate developer were characterized by large fluctuations.

Table 2.3

CANADA'S MAJOR PUBLIC REAL ESTATE CORPORATIONS: PROFITS AND TAXES, 1977

Company (All figures $000,000)	*Assets*	*Share-holders' equity*	*Declared pre-tax profit*	*Return on equity*	*Tax paid*	*Effective tax rate*	*Deferred tax*	*Total deferred tax*	*Deferred tax as % of shareholder equity*
Abacus Cities	244	27	18	66%	—	0%	8.9	16	59%
Allarco Developments	134	33	4.7	14%	—	0%	2.1	8.6	26%
Alliance Building	75	6	(4.2)	-70%	—	—	(3.2)	3.7	61%
Bramalea	347	34	13.1	38%	.8	6%	5.8	26.8	79%
Cadillac Fairview (1978)	1,405	168	41.1	24%	1.0	2%	17.6	94.4	56%
Campeau Corp.	625	34	3.6	10%	(.8)	22%	(1.8)	33.6	99%
Carma Developers	179	48	21.3	44%	4.4	21%	5.6	14.0	66%
Consolidated Building	109	20	6.5	32%	.01	.1%	3.2	10.7	165%
Costain Ltd.	148	22	11.9	54%	2.2	18%	3.6	13.5	61%
Daon Development	464	34	21.5	63%	—	0%	11.0	34.2	100%
Genstar	1,249	368	121	33%	45.7	37%	10.9	88.6	24%
Halifax Developments	48	9	.5	5%	—	0%	.2	.9	10%
Headway Corp.	115	14	4.8	34%	.007	0%	2.1	6.7	48%
Markborough Properties	205	50	6.9	14%	3.7	54%	(.6)	15.3	31%
S. B. McLaughlin	253	36	.9	2%	(.5)	-55%	(.8)	6.9	19%
Melcor Developments	68	21	7.5	36%	2.4	32%	1.1	3.6	17%
Nu-West Development	482	75	25.8	34%	5.3	20%	8.1	22.1	29%
Oxford Development (1978)	852	77	8.5	11%	—	0%	4.3	37.1	48%
Revenue Properties	114	21	(4.6)	-22%	(1.6)	-34%	—	3.6	17%
Sifton Properties	113	9	5.6	62%	1.3	23%	1.3	10.8	120%
Trizec	931	178	10.5	6%	.1	1%	5.6	39.8	22%
Y&R	95	26	3.7	14%	—	0%	1.8	10.9	42%
Totals	8,880	1,310	328.6	25%	64	19%	87	502	38%

2.3 SOURCES OF RISK

In this section the sources of risk internal and external to the development corporation are identified. In addition, the elements of risk throughout a project life cycle may vary substantially and their impact on the magnitude will be examined. Risk avoidance strategies will also be treated.

Risk is an inherent ingredient of all business decisions which deal with uncertainty and an unpredictable future. Options for decision-making in real estate developments do not lead to clear choices under most circumstances. Risk and decisions can involve quantifiable or non-quantifiable criteria. Non-quantifiable risk criteria cannot easily be measured but may contribute significantly to investment objectives and must be treated by way of subjective judgments.

Sources of risk to decision makers can be categorized under eight headings as treated in references (6), (27), (38) and (51).

(1) Insufficient Diversification

A singular large investment will have insufficient opportunity to average out the unfavourable with favourable outcomes as is the case for multiple investments.

This type of risk increases when the singular investment is large in terms of financial resources of the developer or investor.

To demonstrate the above, consider the example of investment alternatives A & B.

Alt. A: single investment.

CE_A = Expected cost of A = 100

CV_A = Coefficient of Variation of A = 0.10

Thus: SD_A = Standard Deviation of A = 0.1X100 = 10.

Alt. B two investments. $CE_{B1} = 50$ $CE_{B2} = 50$. Thus $CE_B = 100$.

CV_B = 0.10. Investments are uncorrelated

Then $SD_B = \sqrt{(0.1X50)^2+(0.1X50)^2} = 7.07$

Comparison: $SD_B < SD_A$, consequently risk has been reduced through diversification.

(2) Bias in Data and its Assessment

Bias on the part of decision makers is common and often subconsciously influences decisions depending on whether the bias is optimistic or pessimistic in nature. Influences which are not a part of an objective study, must be recognized or identified through analysis review procedures.

Examples of biased data can be demonstrated in project cost estimates, which often are of an optimistic nature and result in under-estimates or an over-budget situation after the design phase.

(3) Changing External Economic Environment

Where historical data have been used to estimate or extrapolate into future conditions, and past experience has been used directly without adjustment for expected or changing future economic or environmental conditions, risk will be introduced. In addition, management personnel must keep abreast of the latest political, economical and general development trends through business and trade magazines, conventions, shows, courses, etc. Up-to-date

knowledge of business affairs assures early reaction or anticipation of the organization with changing trends.

(4) Misinterpretation of Data

Misinterpretation and introduction of risk occurs when underlying factors of elements to be estimated are so complex that the relationship of one or more factors to the desired elements is misunderstood.

An example of the above can be demonstrated with project profitability data: a simple annual cash flow before taxes and debt service might project a favourable image to the investor. On the other hand, the complex dynamic investment analysis, in which debt service, time value of money, and real estate taxes are included, might show a miserable but more realistic investment alternative.

(5) Errors in Analysis

Errors can occur in analysis for either technical operating characteristics and/or financial implications of an investment project. In addition, errors of omission and lack of perfect input data in an investment analysis could result in a meaningless output and erroneous decision. Decisions, based on such data, usually affect investments adversely as costly corrections will occur during or after the project completion. An example of errors of omissions can be found in project budget estimates prior to the bidding process. An over budget situation can usually be attributed to improper estimating information.

(6) Managerial Talent Availability and Emphasis

The performance, as well as investment analysis of a real estate development process, depends substantially on the availability and intelligent application of joint and individual managerial talents. In general, managerial talent is an extremely limited resource within a corporation. Hence it follows that the results of some projects, subject to such involvement or performance, can suffer compared to the results of other projects and other managerial involvement. Risk therefore is the result of lack of availability or application of competent human resources.

Many organizations are keenly aware of the human element of corporate performance. They acknowledge that this element of risk can be reduced where proper corporate incentives, motivations, continuity or training in managerial skills is provided. Managerial talents in the development business appear scarce and a proven track record or performance often invites attractive offers for employment in similar and competitive business sectors. It is thought that the North American industry does not generally emphasize on-the-job training but rather spends money to attract seasoned managerial talents.

(7) Liquidity

Liquidity in general involves two criteria:

- potential to dispose of the project at the price for which it was purchased or constructed
- the ability to dispose of the project in a relatively short period of time.

Large real estate projects which are properly analyzed, designed and located, generally, appreciate in value and thus, unless severe cost overruns are experienced during construction, the developer can recapture all or most of his investment.

However, the large size of most projects precludes their quick disposal, as few buyers exist under such market conditions. Liquidity of a project might be considered when cash resources are clearly required or changing market conditions dictate termination of the project where profitability has been reduced in relation to other investment alternatives.

Thus in the case of liquidity, risk may arise because the developer is not able to recapture his monies when needed.

(8) Obsolescence

Rapid technological change, market trends and progress are characteristics of our economy. Features designed and introduced in the initial phases of the project life cycle might be superseded or represent obsolete technology at the opening date of a large real estate project.

An example of this could be found in the late 1960's when the Canadian Condominium Act permitted the sale of apartment buildings as condonimiums. Developers which initially were engaged in the design or construction of high rise apartment buildings realized the higher profit potential and market demand of the newly created condominiums. Many changed in mid-stream to deliver condominiums rather than apartment buildings to benefit from a newly created market.

Other examples relate to the increased awareness and need of energy efficient buildings in order to remain competitive in the present leasing markets. Single glazing buildings for instance are considered obsolete for most commercial real estate developments in Canada and the U.S.A.

The eight sources of risk as identified above, can be considered of internal or external nature relative to the development corporation. We will investigate both internal and external risk in the following sections.

2.3.1 Internal Risk

Internal risk is associated with the organization itself and is largely a result of human interactions relating to expertise, communication, motivations and efficiency. It usually is limited to a people-oriented process. A major source of internal risk is decision-making by management and the degree of sophistication they use for their investment analysis. Risk is increased by lack of the following organizational ingredients:

- experience
- information quality
- information quantity
- availability of equity capital

The organizational disciplines or structure of a development corporation usually includes the following:

- project co-ordination and planning
- financial and economics
- marketing and leasing
- project management
- architecture and engineering
- accounting
- legal
- property management

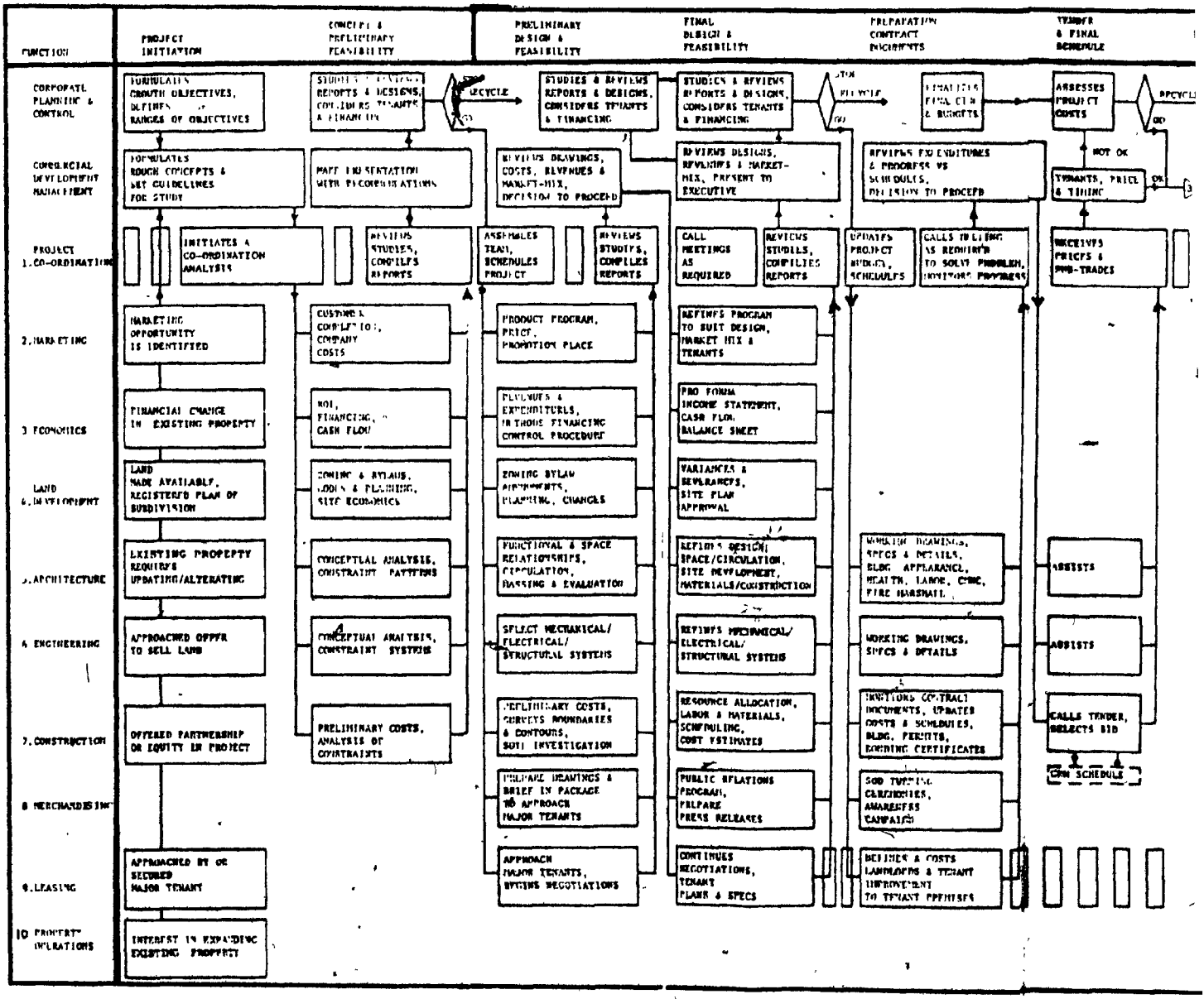
The functions, interactions and objectives in all project phases for a typical development corporation have been shown in Fig. 2.5 as obtained from reference (11).

The departmental functions during a project life cycle, shown in Fig. 2.5, indicate an iterative process of objectives, instructions, criteria and feedback which permit decision-making of personnel at different levels. Personal attitude, preferences and interpretations cause a source of risk when feedback to management from departments or personnel does not accurately reflect initial directives or objectives.

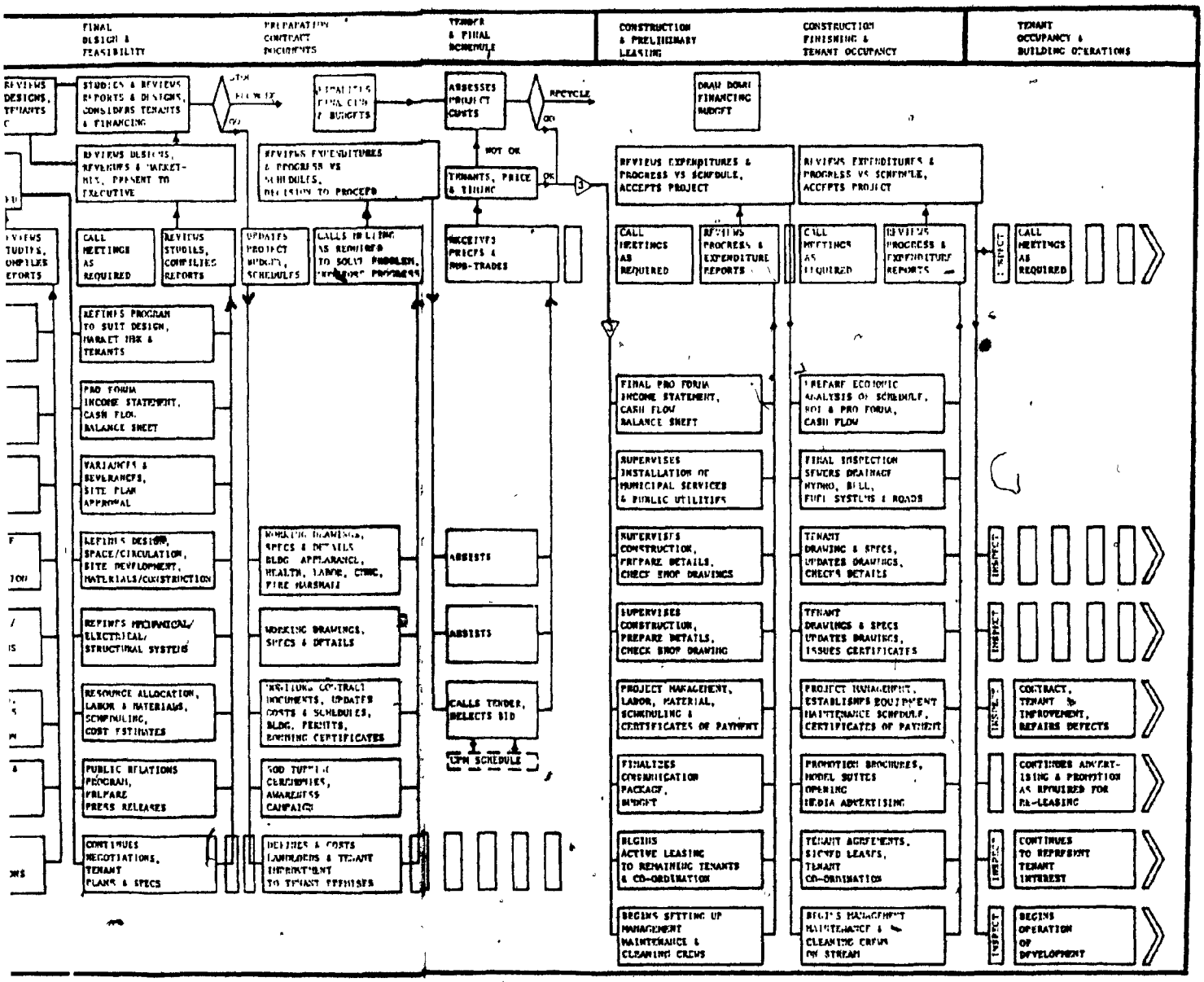
In its ideal form, objectives are conceived or formulated by upper management. Subsequently a strategy is developed and delegated to lower hierarchial levels. Delegation of objectives should be as clearly defined as possible and should generally respond to seven criteria in order to reduce risk of interpretation:

1.	What	objective description
2.	Why	rationale and justification
3.	Who	responsibility
4.	When	time period
5.	Where	information sources
6.	How	methods or procedures
7.	How Much	limits of resources, quality description.

It has been argued that decision-making powers of lower level management functions are based on greater quantity and quality of information. It is for these reasons, that decision-making authority is usually transferred to lower level management functions, in order to benefit from the more detailed knowledge.



FUNCTIONAL DEVELOPMENT ORGANIZATION
Fig. 2.5



GANIZATION

2 of 2

Risk which originates from employee job dissatisfaction and organization induced frustrations, very much remains a non-quantifiable ingredient of the internal risk and is therefore rarely considered in any corporate decision-making analysis.

Attitudes towards risk of individual decision makers or corporate groups, are of considerable interest, as they may vary substantially within the development organization. Management executives, familiar with alternatives faced on previous occasions, often decide by programmed procedures or rules of thumb, which are efficient in terms of the effort or the cost of decision-making. They often represent good, if not the best decisions, especially when similar decisions are made repeatedly. In such cases, experience equates to the development of good decision-making for similar circumstances without the aid of analytical evaluations. Although the above might apply to projects which are identical in nature, and which are executed largely under controlled circumstances, they do not apply to most real estate development projects.

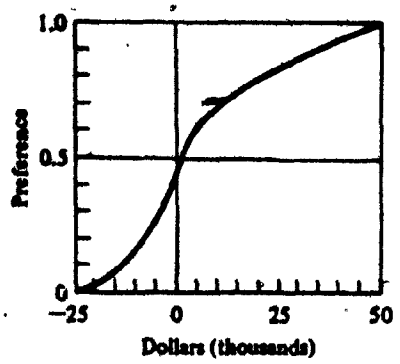
Some decisions, especially in commercial real estate developments, are unique and occur so infrequently that few executives can comprend the range of possible financial outcomes of investment decisions. Decisions and actions for most projects can vary significantly. The outcome of decisions are influenced by a risk range which involves probabilities of possible outcomes of the investment alternative. They involve decisions with respect to economics, finance, accounting, marketing and property management operations. When large amounts of information must be considered, a quantitative approach with an analytical analysis permits precisely defined choices and thus reduces the element of risk in decision-making. Analytical decision-making usually involves:

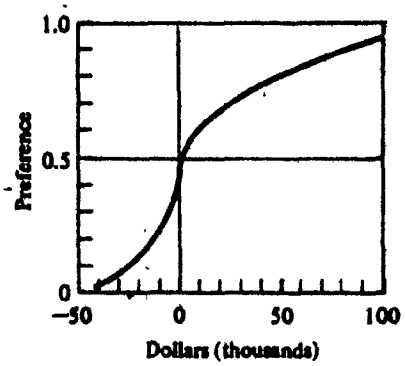
- more than one decision maker or provider of information
- large numbers of factors
- multiple sources of information and scope
- uncertainty or probability of occurrence
- cost of committed resources, manpower, capital and time
- complexity of alternatives and results.

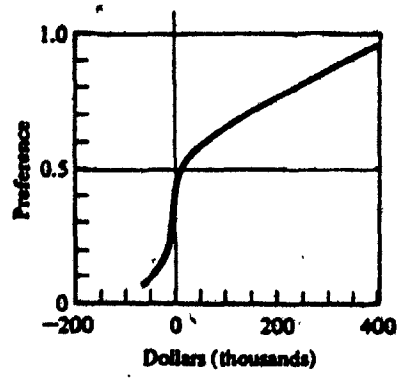
Once the available information has been condensed into a "probability of occurrence" and "financial exposure", a "utility curve" can be constructed from personal or group preferences and decisions can be made based on the investors risk attitude. Utility curves, obtained by R.O. Swalm (51:122,136) showed that risk attitudes among corporate decision makers would generally vary according to the magnitude of financial commitments. It is readily noticed from the utility curves obtained from the above reference and shown in fig. 2.6 that a general risk averse attitude exists. Most lower level business executives show a stronger risk averse attitude than upper level executives, who are generally responsible for larger financial commitments or resources.

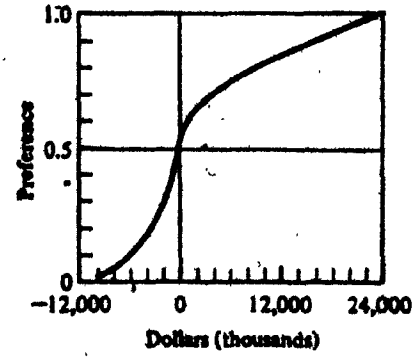
It was further shown in the survey by R.O. Swalm that "group decisions" resulted in greater risk taking than normally would be favoured by the individual responsible for a similar amount. Based on this information the reader might wonder whether executives jointly or individually serve the best interest of a corporation in the decision-making process. However, perception of risk and financial exposure will result in different risk attitudes at different management levels.

An overview of internal risk sources and avoidance strategies has been shown in fig. 2.7.









MANAGEMENT UTILITY FUNCTIONS
Fig. 2.6

Item	Source of Risk	Risk Avoidance Strategies
1.	Insufficient Diversification	- Investment diversification to include both long term and short term investment. - Risk diversification to include different economic markets, e.g. land banks, high rise residential and office developments and shopping centres. - Analyse project ranking
2.	Bias in Data and Its Assessment	- Independent internal review or analysis. - Multiple review or analysis. - Include concepts of "confidence level" or "probability" estimates. - Obtain "approximate range" estimates prior to evaluation.
3.	Changing External Economic Environment	- Keep management and personnel up-to-date with latest business and trade developments through periodicals, magazines, conventions and refresher courses. - Solicit input on probable trends prior to investment decisions. - Introduce probability and risk evaluations.
4.	Misinterpretation of Data	- Obtain independent or approximate estimates based on experience or past performance. - Substantiate approximations by detailed estimates and data. - Assign responsibilities for accuracy or verification of data. - Engage cost consultants for greater accuracy.
5.	Errors in Analysis	- Avoid simplistic or "rule of thumb" evaluation as only analysis. - Include dynamic investment analysis to show debt service and taxable income and varying discount and probability scenarios. - Include estimates of probability or measure of risk of investment.
6.	Managerial Talent Availability and Emphasis	- Financial and status recognition of experience and performance. - Provide required assistance and support to managerial staff in order to concentrate on main objectives. - Provide good working environment. - Emphasize precise objectives and sub-objectives. - Continuously upgrade and improve communication skills within organization. - Assure continuity of job functions.
7.	Liquidity	- Feasibility and investment analysis to include and anticipate measure of liquidity of corporate resources in terms of disposal time and disposal costs. - Include escape or termination planning.
8.	Obsolescence	- Periodic update of long-term projects. - Include flexibility of changes. - Include futuristic evaluations

INTERNAL RISK

Fig. 2.7

2.3.2 External Risk

External risk results from sources outside the development corporation and occurs during all phases of the project life cycle. It arises from interactions of the following general external influences:

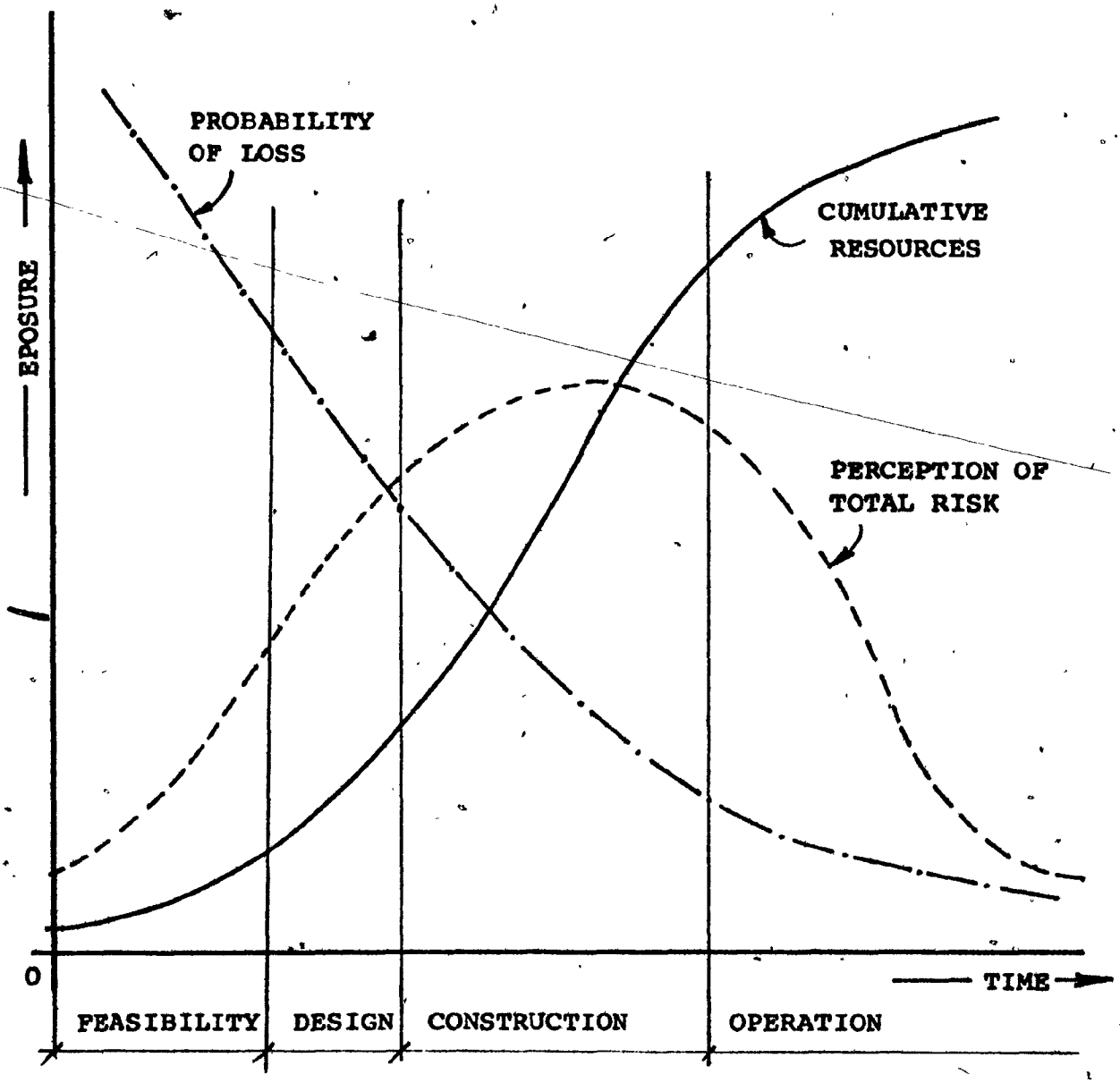
- market trends
- economic conditions or trends
- social fabric changes
- location or area changes
- capital cost escalation
- maintenance and operation cost escalations
- time constraints or overruns
- budget constraints or cost overruns
- tenant and market availability
- contractors and suppliers
- proficiency of design consultants
- etc.

The external risk exposure throughout the project life cycle phases is shown in fig. 2.8. The curves shown for "probability of loss" and risk are largely a conceptual issue and depend very much on the perception of the observer.

Probability of loss is greatest in the initial project life cycle stages whereas the cumulative outflow of committed resources during the same period are minimal for:

- manpower
- money
- materials

Risk is perceived as a function of the probability of loss and the cumulative resources. Due to the low cumulative amount of resources the high probability of loss at the initial project stages represents minimal risk. Perceived risk reaches a maximum during the design and construction phases as shown.



PROJECT LIFE CYCLE AND EXTERNAL RISK
Fig. 2.8

A brief identification of risk during each of the project phases follows below:

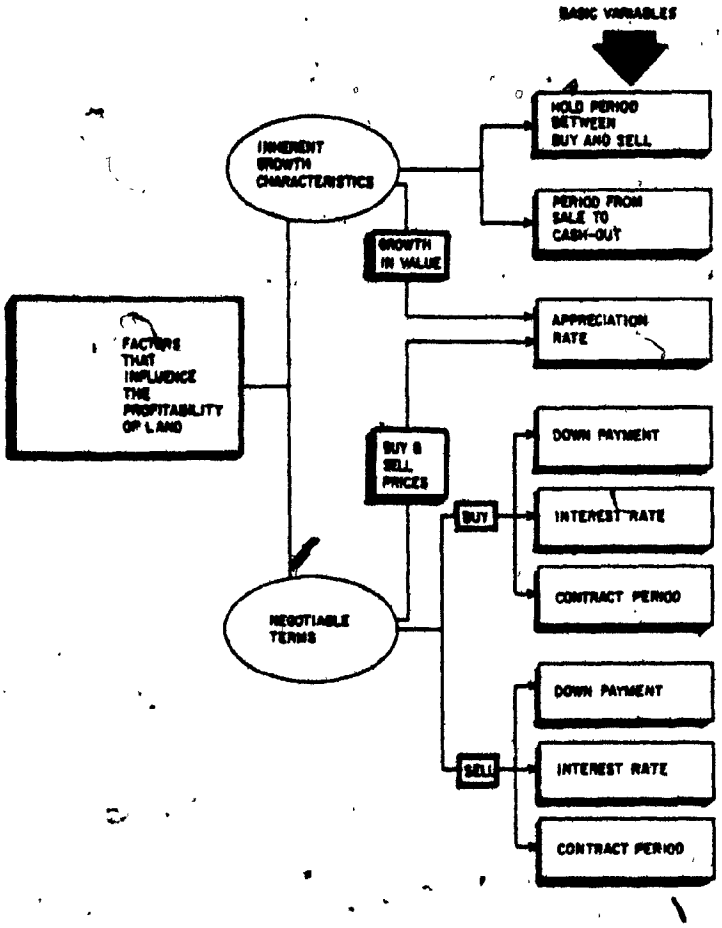
A. Feasibility Phase

A major source of external risk is securing land for the intended project. The overall investment profitability usually very much depends on the price of land which could amount to 20% of the overall cost of a large project (see page 106, table 4.3). As a hedge against inflation land is purchased outright or through options in order to reduce the risk of rapid price increases once a development potential becomes obvious in the marketplace. Once the feasibility of a project development starts to diminish, due to external economic or financial influences, the land might have to be sold. On the subject of land sale, liquidity and capital gains potential are major considerations prior to its purchase.

The profitability or risk of landholdings is discussed by William Benke (7:76) and influences on profitability of land sale, obtained from this reference, are shown in fig. 2.9.

Other external risks during the feasibility stage are caused by errors obtained from external sources and applied for project budget and schedule preparation. Usually budget and schedule estimates prove to be "optimistic" and affect the project viability adversely during the later phases of the development.

Financing of the project during the relatively "steady state" conditions of the early 1960's used to be rather predictable in terms of lending rates for construction loans and mortgages. In the recent years many developers face a variable financial lending market, anxious to secure mortgages at the lowest or most advantageous



INFLUENCES OF LAND SALE
Fig. 2.9

rates. The risk or uncertainty of financing is further increased when five year or three year renegotiable mortgages are demanded by the lending institutions. The issue of project financing is of considerable importance during this phase and later phases of the project life cycle. The project financing options open to the developer are briefly discussed below.

Available on the mortgage market are many mortgage types which have variable interest rates and payment schedules. Lately, with high inflation rates, mortgage interest rates are usually renegotiated every three to five years. Variations and combinations of mortgage types are summarized in Table 2.4.

Lease financing, as a long term loan is a variation of debt financing to avoid the problems arising from lack of real estate collateral. In the case of lease financing no fixed debts are created by the developer and no debt is entered on the financial statements. Usually interest rates are higher to cover risk to the lender. Lease financing is usually arranged between a developer and major tenant. In lease financing the lessee usually acquires the building capital as the holder of a lease-hold mortgage. The lessee owns the building erected upon the site, as long as he meets his obligations to the lessor. At the end of the lease financing the developer becomes the owner of the property. To the tenant, repayment of mortgage principal is not a tax deductible expense but a form of rent. In this respect tax advantages are possible for the tenant. The developer on the other hand conserves capital for other high leveraged investments. Disadvantages to the developer are the absence of capital cost allowance write-of of the building. A lack of liquidity exists in subsequent sale because of fixed longterm and often transferable lease-financing agreements to the prospective buyer.

Long Term Financing		
Item	Type Mortgages	Particulars
1	Conventional	Closed and fixed straight term payment.
2	Insured	Private insurance of mortgage to permit low interest.
3	Guaranteed	Federally guaranteed and assisted, low interest.
4	Blanket	Includes several properties of new developments.
5	Package	Mortgage in which appliances and equipment are included.
6	Open End	Mortgage to be expanded to include upgrading or large maintenance costs.
7	Purchase	Owner becomes mortgagee.
8	Wrap Around	Includes first mortgage in remortgaging real estate.
9	Trust Deed	Hired party (trustee) holds mortgage in trust as security for mortgage payments.
10	Mortgage Bond	Collective group of persons supplying mortgage.
11	Land Contract	Seller retains title of land until mortgage paid.
12	Lease with Option to Purchase	Similar to land contract, but with option to purchase to protect use and occupancy.

LONG TERM FINANCING OPTIONS
Table 2.4

Lease financing is often arranged between major tenants and the developer for retail centres and office buildings. Most public institutions, hotels and chain store organizations enter long-term lease agreements for 10 to 30 years duration. Rent paid to the developer will often completely amortize the investment while providing a return to the developer. At the end of the long term lease period, title of the property could transfer to the tenant in the form of an option-to-buy. Leases for long term duration do not necessarily provide the developer with a constant income and lease payment by the major tenant can be leased for a percentage of the dollar volume of business (percentage lease).

Other forms of lease financing include the "buy-build-sell" lease and the "sale-leaseback" arrangement, both of which involve funding of the short term capital for construction by the major tenant and subsequent sale to the developer with lease by the tenant. "Buy-build-sell" leases are tenant financed projects in which the developer surrenders the use of the property until the moment of occupancy by the tenant. Tax advantages in this lease-financing arrangement, favor the tenant in capital cost allowance. Depending on the lease-financing agreement the developer might be prevented from claiming tax write-offs for capital cost allowance in lease-back arrangements. Due to the high interest rates of capital and recent high inflationary tendencies, financial "sharing", or "piece of the action" arrangements are made whereby both developer and major tenant share in the risk of the real estate development. The methods and arrangements vary from a "gradual", to a "higher" rate of participation of revenues by the money lenders as a percentage of the gross return above a target of gross income by the developer. Both developer and tenant or money lender could be participants in the title. Joint ventures between developers, money lenders and tenants vary extensively but the

most common arrangement is one where the developer provides no capital for the development but provides for the management, construction, marketing and promotion. Subsequently, the developer and lenders share on a predetermined basis in the net proceeds after debt service. Risk to the developer in this arrangement is reduced to a minimum. For further details of such arrangements, the reader is referred to references (28; 113-129), (47) and (55; 436-439).

In summary, the risks in financing of real estate developments apply equally to developer and money lender but they each assume different risks. Financing is subject to market conditions and the economic laws of supply and demand. Generally the money lender carefully reviews the development for market value and will try to minimize the unknowns or risk. Risk due to inflation or interest rate increases are common to developer as well as lender. Unless the interest rate of long term financing is pegged relative to prime bank interest rates or federal or provincial bank issues, the rate of inflation favours the developer and adversely effects the lender.

Financial risk is an external risk to the investor or developer and refers to the risk created by debt financing. When the amount of leverage financing increases the debt service increases. Financial risk essentially is a cash flow problem which relates to the investor's ability to pay fixed obligations created by debt financing. As liquidity decreases, the financial risk usually increases.

Investment risk is the overall risk, which includes financial risk, and relates to the probability that the development or investment will not generate the expected or minimum acceptable profitability or rate of return as a net income before debt service.

The options open to the developer to reduce financing risk are:

- obtain optimum possible financial arrangement
- determine earning capacity sufficiently high
- study and appraise market conditions for the development
- insure where possible the risk (e.g. CMHC)
- obtain long term, fixed interest rates
- pool the risks, partnerships, e.g. lease-back arrangements
- include diversification.

It is important to consider the risk to the developer generated by large fluctuations or escalations of the lending rates. Sensitivity of interest rates is further discussed in Section 4.4, Sensitivity.

B. Design Phase

External risk sources during the design stage primarily pertain to the design consultants. Architectural and engineering design fees amount to only four or five percent of the general contract price (see fig. 4.10), for large projects and usually are not a factor in risk evaluation.

Of considerable importance however is the performance of the consultants to deliver a project design within the specified budget. The impact of a budget overrun in excess of 10% of the construction budget will cause great consternation amongst the developers' financial, architectural and engineering disciplines alike. Often consultants will claim that incomplete or inadequate or excessive design guidelines were provided by the developer. Periodic reviews of the design and interim budget evaluations usually are a means to reduce the occurrence of large budget overruns. In extreme cases, major surgery in redesigns are necessary to fit the original project financial performance while anticipated time losses add to the project costs in the meantime.

Most large developers include a clause in the consultant's agreement requiring a redesign within budget at the expense of the consultant when a budget overrun greater than five or ten percent occurs . The reluctant acceptance of such a clause by the consultants often has the desired results in reducing this element of risk.

The cautious developer will engage a cost consultant to monitor the design in terms of the construction budget. The large developer, staffed with in-house estimators, architects and engineers will monitor the design of the project continuously for budget performance, design compliance, quality of documents and schedule of the tender documents.

The architect, as an artist will usually have a dominant role in the design and unlike engineering disciplines, does not necessarily contribute scientific knowledge to the structure, but determines building aesthetics, concepts, massing, layouts, circulation and environmental characteristics of the development.

The artistic aspects of a project such as facade treatment, interior and exterior landscaping and finishes, touches on the cost of buildings and their marketability. A particularly "pleasing" building or landmark will have a favourable impact on the leasability of the premises and hence on the developer's potential for profit.

The unresolved question remains however, if artistic contributions would effect marginal increases of potential income and if these benefits exceed the resultant increased building costs. From a building cost point of view, the subject of art could be viewed as a risk factor which can not easily be quantified.

Risk during the design stage becomes evident only during later project development phases. The Consultants' proficiency or design completeness will reduce the "extras" during the construction phase. They include the following categories:

- error and omissions
- lack of co-ordination
- code requirements and interpretations

Usually some contingency will be carried by the developer to cover the above mentioned inadequacies. Depending on project type they range from 1-1/2 to 5% of the total construction budget. It is for the above reasons that risk to the developer can be reduced by engaging reputable consulting groups. Where possible a well designed and executed project often makes for repeat business involving the same consultants.

C. Construction Phase

Risk during this project phase may be described in terms of the three project management criteria:

- cost control
- schedule control
- project quality control

All three of these criteria affect the economic performance of a building project.

Schedule and budget are controllable to some extent and it is important to realize that the developer and contractor have the option of shortening the construction duration by "fast-tracking". The options for construction time compression are shown in fig. 2.10 and discussed in reference (54:23).

Fast tracking construction schedules involve "turnkey" and "project management" type construction options. In large projects, the design time is considerable and overall design-construction time can be substantially reduced by fast tracking. Benefits derived include potentially more favourable financing terms and earlier revenues.

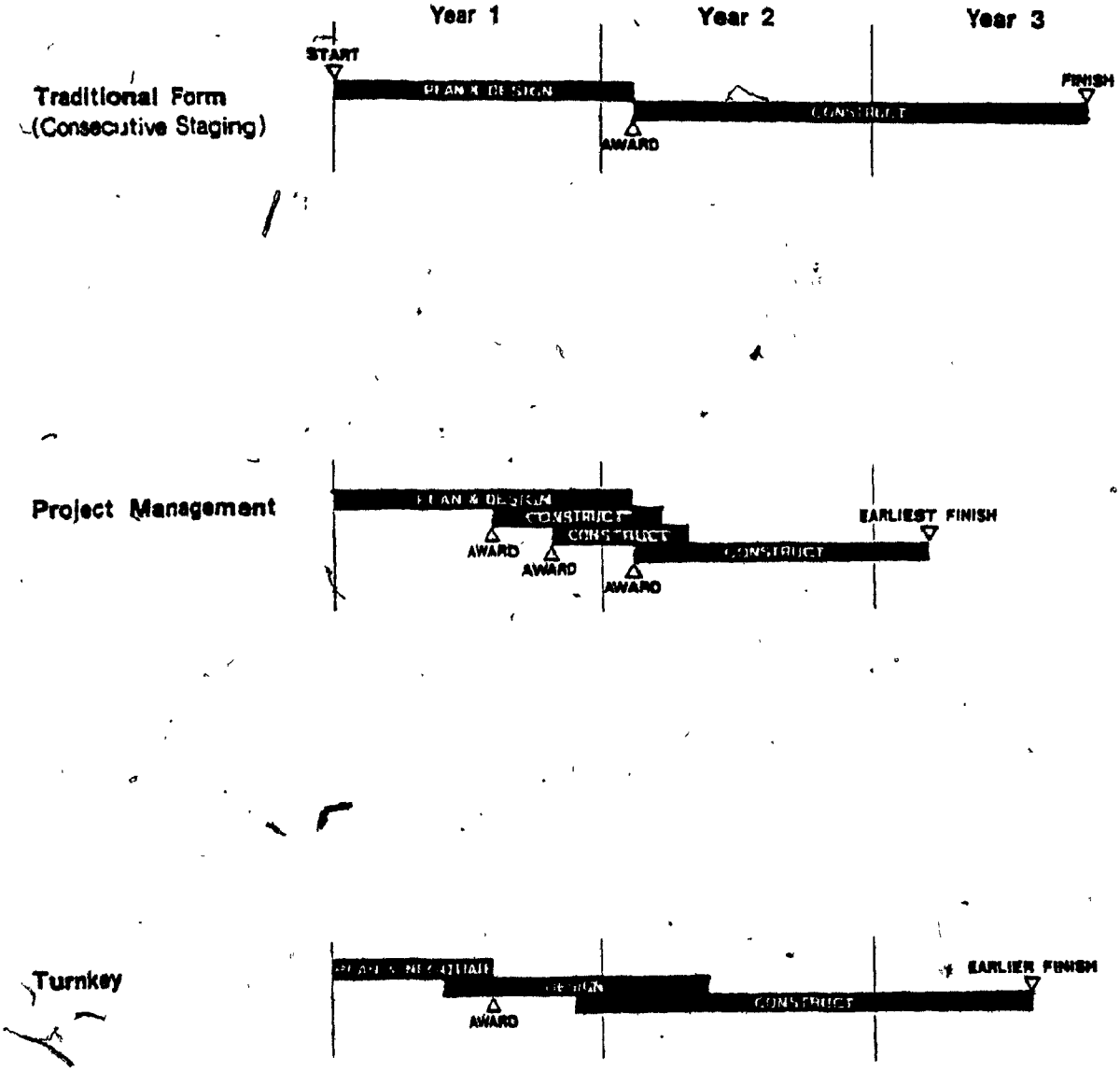
By means of a sensitivity analysis, as described in section 4.4 of this paper, the influence of construction time compression can be determined for each project in terms of profitability criteria.

Although favourable financing and early revenue can be generated by fast tracking the potential exists for increases of construction costs. Extra allowances must be made to cover the increased risks as a result of:

- errors and omissions
- incomplete design details
- lack of co-ordination
- escalation.

Depending on project size, consultant and developer experience etc., contingencies and risk exposure increase with compression of design-construction periods because the ability to generate fully coordinated design documentation is reduced. Risk avoidance strategies must concentrate on the overall project profitability and determine "optimum" time compression for a given project type, size and period.

Risk of an uncontrollable nature is imposed on the developer when sudden material or labour shortages affect the project or when delivery delays, strikes or weather plays havoc with the project budget and schedule. The risks of these external influences are usually carried directly by the developer without any changes to the building program.



CONSTRUCTION PHASING
Fig. 2.10

D. Operating Phase

The start of the operating and maintenance (O & M) Phase of the building results in a definite and different form of business risk.

Property managers have the delicate task of attracting tenants and keeping vacancies to a minimum. They must negotiate in the local real estate markets for optimum lease commitments in terms of income and lease duration.

The profitability during the O & M phase will vary during the investment or economic life of the building. A major risk item during this phase can be the type of lease agreement between owner and tenants.

During the "steady state" economic days, a gross lease was common. However, the recent and unpredictable increases in energy and maintenance costs of buildings have made way for the virtual exclusive use of triple net leases in commercial real estate. The risk of unpredictable escalation of energy, material and labour costs is transferred from the landlord to the tenants in this type of lease.

It is important to determine the risk exposure as a result of the various types of commercial leases in the investment analysis. The types of leases are briefly described below in order of decreasing risk exposure to the developer.

(1) Gross Lease
(2) Escalation Gross Lease
(3) Net Lease
(4) Net, Net Lease
(5) Net, Net, Net or Triple Net Lease
(6) Percentage Lease or Net plus Percentage Lease

The gross lease represents the greatest risk to the developer because of a fixed gross income while O & M costs increase due to inflation and aging of the project. The lessor, or landlord accepts the costs of allocated operation and maintenance costs, insurance, real estate taxes and all utility costs, such as electricity, natural gas, oil, water and sewer charges. This type of lease has virtually disappeared with large developers of commercial office space and retail real estate developments.

A fairly common lease for office space leasing arrangements especially with major anchor tenants is the escalation gross lease. In this agreement, the lessee, or tenant pays a gross lease or base amount for the first year or so called base year. Subsequent years are escalated and reviewed annually usually based on audited cost increase statements for all O & M charges listed under the gross lease. Escalation gross leases might include maximum specified annual escalation dollar amounts or percentages of the base year, to limit risk exposure to the lessee. Usually short term leases averaging five years are negotiated. The maximum escalation percentage in the lease could be exceeded with actual building operation and the developer assumes this risk especially when long term leases have been negotiated.

Net leases are common for retail areas, such as shopping centres. Under the net lease, the tenant pays a base lease plus the proportionate or allocated real estate taxes. The lessor pays all other charges.

Net, net lease arrangements include a base rent and the proportionate and allocated charges for real estate taxes and insurance premiums of the leased space.

Triple net lease arrangements include the base rent and the proportionate or allocated charges of real estate taxes, insurance premiums and all operation and maintenance costs, including energy costs. This type of lease is most often used in office and retail commercial space.

Percentage leases are generally used with relatively short term (five years or less) for retail areas. The tenant pays a base amount and the developer shares in the success of the retail operation. The tenant usually is obligated to pay a percentage (approximately 8%) of gross sales revenue over and above the base lease price which usually is a net-net-net or triple-net lease.

Depending on the lease type, the O & M costs during the operating phase of high rise office buildings, as reported annually by "BOMA", reference (10), are of interest to the developer, as they affect the profitability of the investment during this phase. Although net leases in general shift the burden and risk of O & M costs to the tenant, an energy efficient building with low maintenance cost, if it can be demonstrated to the prospective tenant, will always seem attractive and permit a high degree of marketability. In recent years, tenants have developed a keen awareness for building O & M costs and are found to "shop around" for the "best" building in terms of location, quality, image and low O & M costs where net-type leases are involved.

It is for the above reasons that the developer will still try to improve his market position of leasable space through low O & M building costs.

In a survey by "BOMA" (10) in an annual report for 1978, a breakdown of expenditures of high rise office buildings was obtained as a percentage of total annual costs. These results have been shown in fig. 2.11 for respectively Canadian and American office buildings. From this figure 2.15 it can be immediately noticed that the major cost components as a percentage of total O & M costs for Canadian office buildings are:

- real estate taxes 36%
- energy cost 10%
- building cleaning 10%

Energy cost in particular, is a diminishing resource and subject to OPEC control. It is expected that this percentage will dramatically increase if present trends continue.

From the BOMA annual reports (10) a condensed summary of all USA and Canadian office buildings was obtained and is shown in Table 2.5. It should be noted that data shown in this table represents averages obtained for each item in surveys and do not necessarily add up to give the totals shown. Total operating expenses as shown in Table 2.5 have escalated from $\$4.23/ft^2/yr$ in 1971 to $\$5.47/ft^2/yr$ in 1976. The "depreciation" costs as shown are not a real cash flow and should be deducted from the above amounts. In addition, the total energy costs were shown starting in 1973 and previously included electrical and HVAC systems.

Average energy costs in USA and Canadian office buildings, according to the 1978 BOMA survey exceed $\$1.17/ft^2$.

The results of a building energy consumption survey in 1976 by Ontario Hydro (42) of 80 major Ontario office buildings are shown in fig. 2.12. Note that the spread in annual building energy consumption ranges from 19 KWH/ft^2/yr to 88 KWH/ft^2/yr. From a subsequent report by Ontario Hydro in 1978 an update of this report showed that the same buildings consumed 9.9% less energy relative to 1976. It was also reported that use of electricity as a source of energy reduced by 10[illegible]% over the same period. Despite these savings, overall energy costs went up drastically as a result of large energy cost price increases.

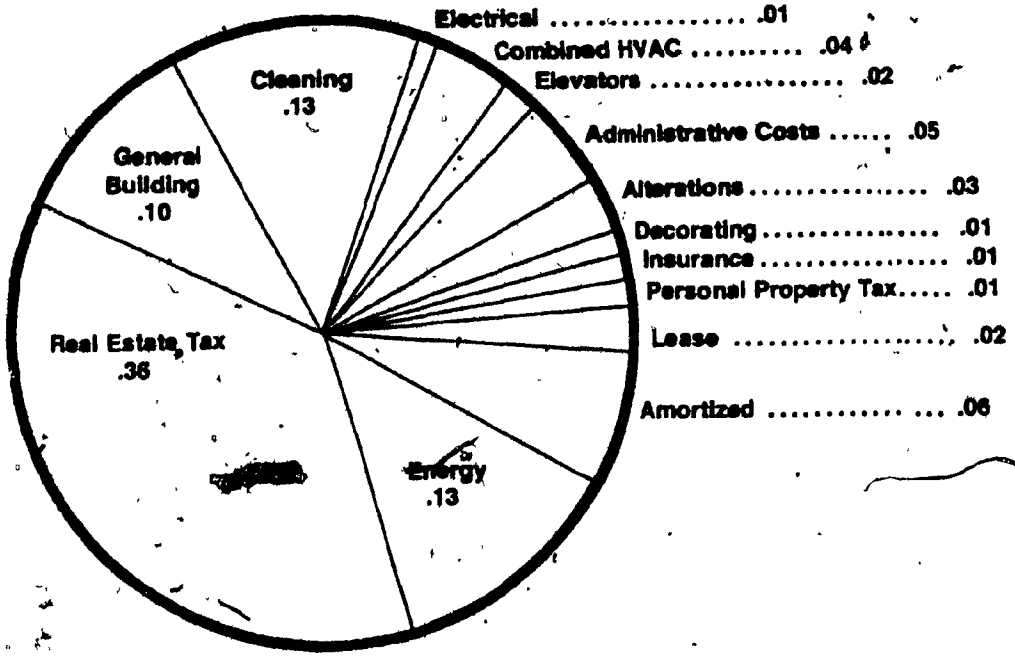
Relative to the overall costs paid by the tenant, energy could be viewed as a small fraction of the annual cost per square foot of office space. As an example, consider the average office occupancy of 150 ft^2/person, an average salary of $20,000/yr and lease expenses of $10/ft^2/yr (triple-net) with extra O & M charges of $5/ft^2/yr. The total overhead to the tenant amounts to:

$$\frac{\$20{,}000/\text{yr}}{150\ \text{ft}^2} + \frac{\$10/\text{yr} + \$5/\text{yr}}{1\ \text{ft}^2} = \$148.33/\text{ft}^2/\text{yr}$$

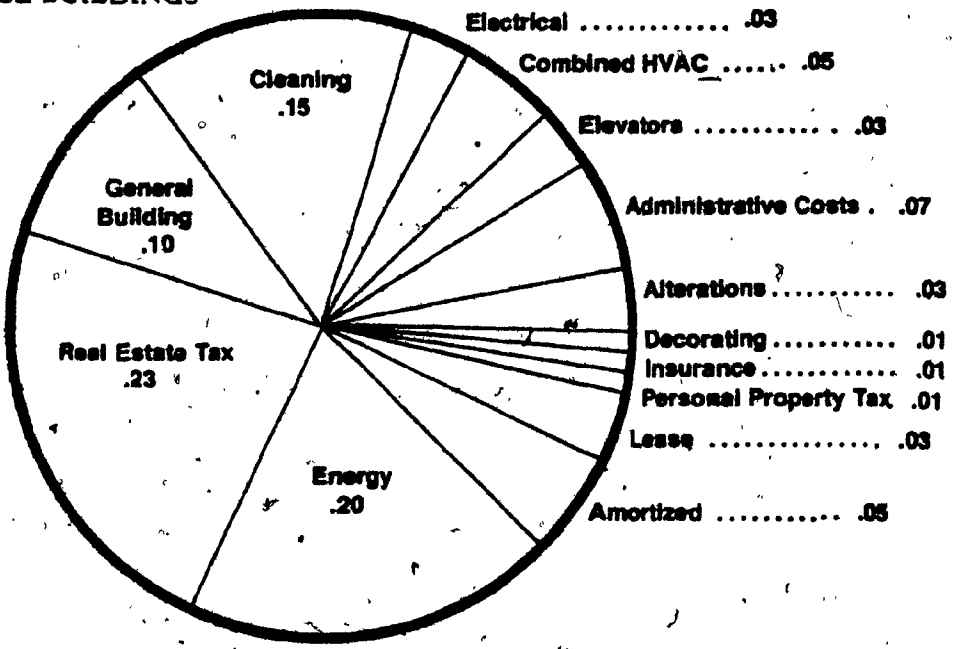
If out of the O & M charges $1/ft^2/yr is spent on energy, the impact of a 10% energy saving amounts to $0.10/ft^2/yr or 0.07% of the tenants' total annual overhead costs.

Under present conditions, energy increases do not pose significant risks to the developer, given the triple net lease scenarios. This item will be further explored in Section 4.3, Sensitivity Analysis and Section 4.4, Optimization.

CANADIAN OFFICE BUILDINGS



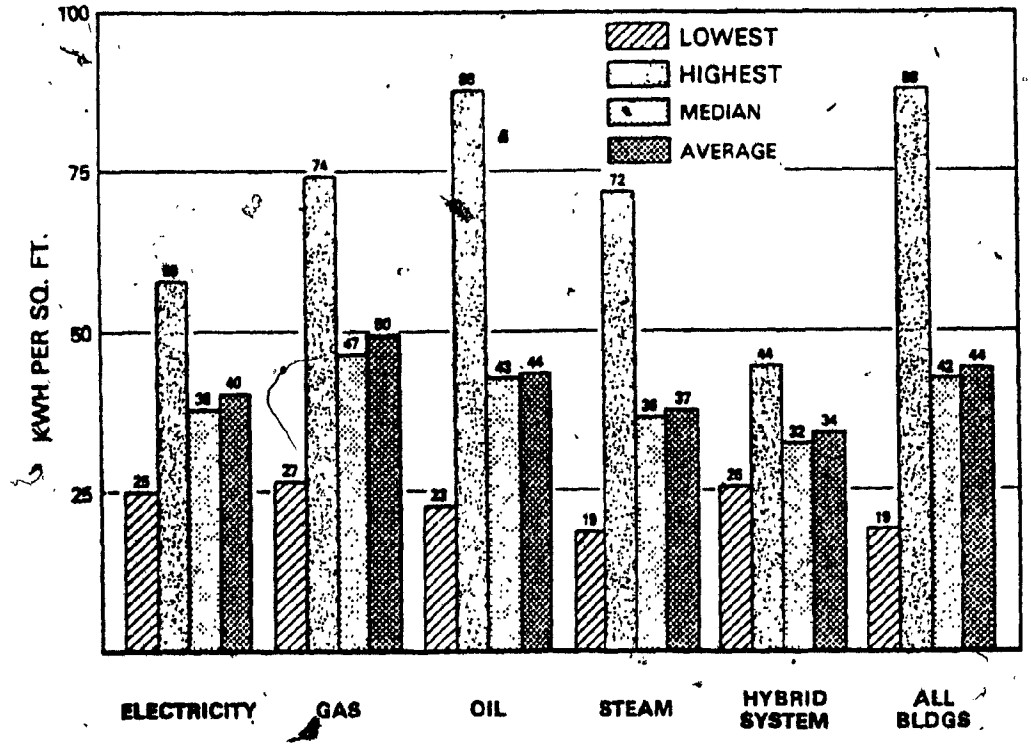
USA OFFICE BUILDINGS

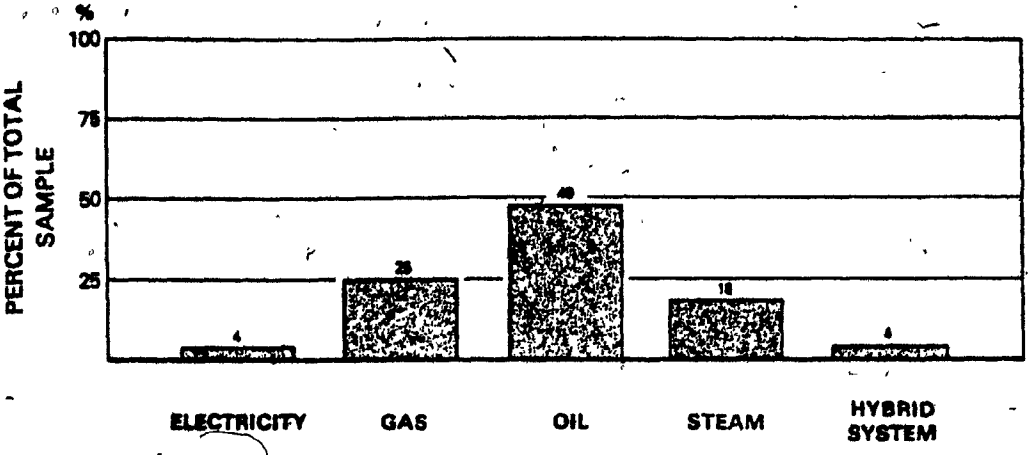


1978 O & M COSTS - HIGH RISE OFFICE BUILDINGS
Fig. 2.11

O & M SURVEY - CANADA - USA						
	Annual Specific Costs in $/ft^2/yr					
NATIONAL AVERAGES USA - CANADA	1971	1972	1973	1974	1975	1976
Cleaning	$0.68	$0.67	$0.70	$0.72	$0.75	$0.79
Electrical System	0.22	0.25	0.09	0.08	0.10	0.09
Heating	0.17	0.20	0.09	0.09	0.09	0.10
Air Conditioning-Ventilating	0.24	0.27	0.13	0.11	0.12	0.12
Combined HVAC	---	---	---	---	---	---
Plumbing System	---	---	---	---	---	---
Elevators	0.10	0.10	0.16	0.16	0.17	0.17
General Expense - Administration	0.20	0.24	0.26	0.22	0.28	0.29
General Expense - Building	0.27	0.26	0.28	0.39	0.41	0.45
Energy	---	---	0.56	0.69	0.85	0.99
TOTAL OPERATING	$2.04	$2.09	$2.27	$2.49	$2.76	$2.98
Tenant Alterations	0.15	0.14	0.15	0.15	0.12	0.17
Repairs - Maintenance	0.13	0.12	0.13	---	---	---
Tenant Decorating	0.06	0.06	0.08	0.08	0.06	0.07
TOTAL CONSTRUCTION	$0.26	$0.25	$0.28	$0.19	$0.14	$0.18
Insurance	0.05	0.05	0.05	0.05	0.06	0.06
Property Taxes	0.97	1.03	1.14	1.21	1.21	1.34
Personal Prop. Assess.	0.02	0.04	0.08	0.09	0.12	0.13
Depreciation	0.92	0.96	0.98	1.04	1.00	.99
TOTAL FIXED CHARGES	$1.94	$2.08	$2.25	$2.28	$2.23	$2.47
TOTAL EXPENSE	$4.23	$4.37	$4.88	$4.80	$4.97	$5.47
Net (before Capital Charges)	1.32	1.39	1.46	1.69	1.88	2.00
Rental Income	5.14	5.28	5.39	5.75	6.22	6.53
Miscellaneous Income	0.08	0.08	0.32	0.22	0.20	0.25
TOTAL INCOME	$5.20	$5.34	$5.66	$5.93	$6.43	$6.80
TOTAL RENTAL AREA FT^2	121,205,958	134,215,783	145,247,683	162,888,965	254,964,658	277,835,879
TOTAL OF BUILDINGS SURVEYED	653	638	676	721	1,023	1,132
VACANCY RATES PERCENTAGE	—	—	—	4.1	4.8	6.0

O & M SURVEY - CANADA - USA
Table 2.5





1976 ENERGY CONSUMPTION SURVEY (ONTARIO HYDRO)
Fig. 2.12

CHAPTER 3

Quantification of Risk in Real Estate Investment Analysis

3.0 QUANTIFICATION OF RISK IN REAL ESTATE INVESTMENT ANALYSIS

The main objective of this chapter is to derive a simplified method of risk analysis which can be readily used for commercial real estate investments. The method involves a combination of existing computer software programs and additional manual calculations.

Most developers and investors limit themselves to the use of deterministic analysis, and no allowance is made for the fact that the inputs are of a probabilistic nature.

Existing software programs are based on "Present Value" computations in which future cashflow streams are converted into "present dollar" amounts. Profitability is measured by Internal Rate of Return (IRR) or Net Present Value (NPV) of the investment.

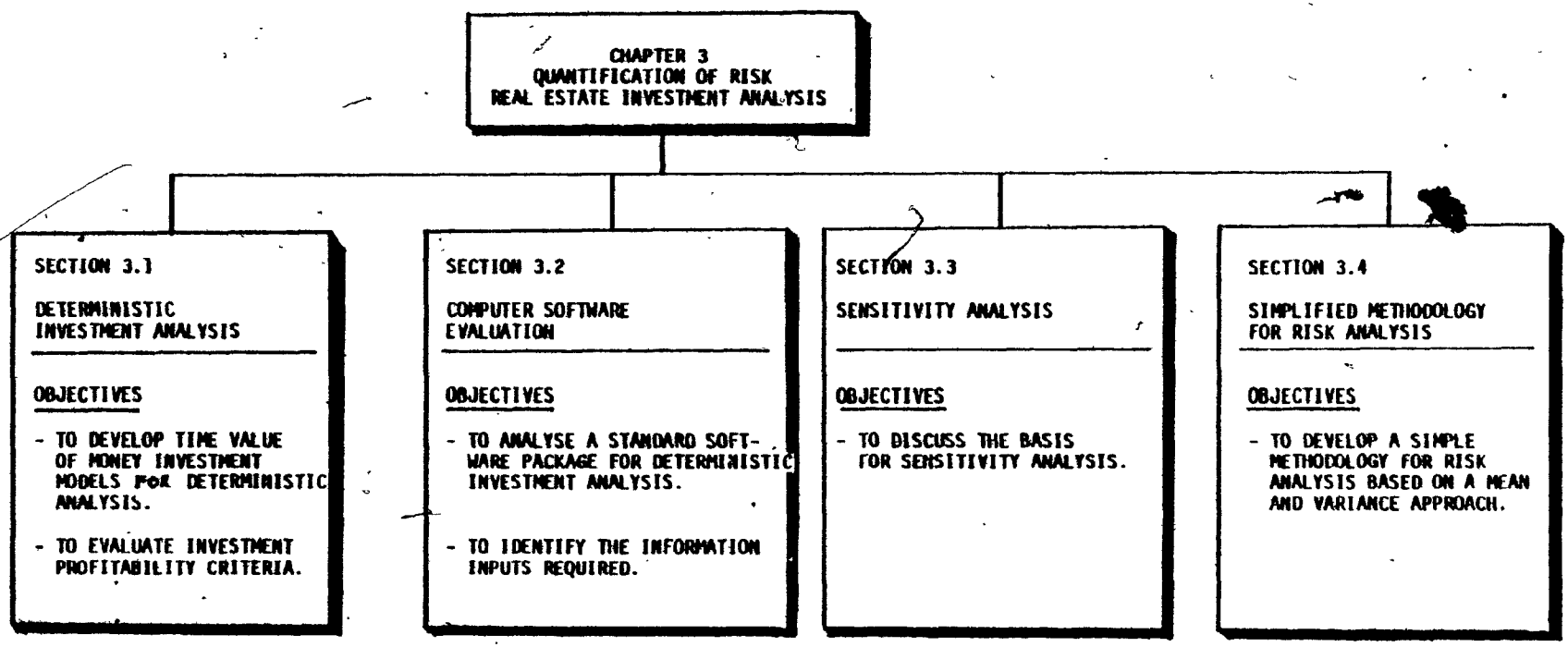
"Risk Analysis" is based on the above described analysis but with the added requirement that the input and output parameters be treated as probabilistic. Risk Analysis permits quantification of the project's profitability range and the likelihood of different outcomes within this range. As such, the combined measure of profitability and probability range provides the investor with a measure of risk associated with the project.

When a relatively simple method of risk analysis is possible with existing software programs, the developer will be motivated to use risk analysis in order to measure risk and then take steps to reduce it.

This chapter is organized as follows: First, the basic relationships used for determining a projects' NPV and IRR are developed. Subsequently, an existing software package, based on the use of time value of money concepts is discussed. The issue of "sensitivity analysis" is then treated. Finally, a simplified method for conducting risk analysis is presented.

An overview of Chapter 3, showing subobjectives is depicted in figure 3.1.

CHAPTER 3, SUBOBJECTIVES
Fig. 3.1



3.1 DETERMINISTIC INVESTMENT ANALYSIS

The objective of this section is to provide a basis for the investment analysis in which time value of money concepts are included. Profitability criteria such as IRR and NPV are used in the deterministic analysis and compared briefly with the "traditional" investment analysis methodology.

In traditional investment analysis the concepts of time value of money are absent and escalations of costs or rental income as a function of time and appreciation or depreciation are ignored. Instead "the first full operating year" is used to determine the viability of the project in a longterm investment analysis. Investment decisions, based on the traditional analysis therefore carry a high degree of risk because of the simplified and minimal use of information. Needless to say, longterm investment decisions based on such an analysis might contribute to erroneous decisions and a higher degree of risk.

As stated previously, the traditional investment analysis is based on the "first full operating year" at which time the building is "leased-up" with tenants. The profitability at this moment in time is commonly measured by the following criteria:

- Net Operating Income(NOI)
- Cashflow
- Return on Investment
- Equity yield or dividend

Some of the above terms require qualification statements with respect to gross or net income, before or after taxes and debt service.

The inadequacies of the traditional investment analysis include the following:

- First operating year annual income is capitalized as a single constant static variable.
- No residual real estate value is considered.
- No allowance is made for equity build-up.
- No allowance or probability of variable annual income are considered.
- No allowance for or probability of variable annual expenses are considered.
- No consideration for time value of money is made.
- No allowance for escalation of costs and income items is made.
- The impact of taxation on profitability is not treated.
- No probability or risk quantifiction is considered.
- Alternative investments cannot be evaluated based on varying cashflow with time.
- Potential appreciation or depreciation of buildings and land are ignored.

The measure of investment risk in the traditional investment analysis must make allowances for a range of probable outcomes of project profitability which are not defined or quantified in such analysis. S.A. Pyhrr (44:13) reflects on this situation as follows:

- "Real estate decision makers claim they take "calculated risks", but few of them make very clear just how they calculate these risks. Traditionally, because of the difficulties, the dislike or the lack of knowledge of how to deal explicitly with risk, in decisions, most people concentrated on a few key assumptions about the future, examined a few rules of thumb, mulled over the situation, and then decided. Although some of the risk considerations were explicit, most of the mathematics or risk was left to the four horsemen of the implicit decision-making apparatus: judgment, hunch, instinct, intuition" -

For further information about traditional investment analysis the reader is referred to the many existing references: e.g. (16) (28) (31) (37).

"Deterministic" investment analysis is based on time value of money concepts and allows for additional parameters such as: cost and rent escalations, interest rates, debt service, taxes, capital cost allowances, land and building value appreciation or depreciation, as well as equity reversion.

A deterministic analysis is sometimes referred to as "dynamic" to indicate the continuously changing money value with time. In contrast, the traditional investment analysis can be termed "static" because of constant unadjusted dollar value.

An accurate investment model is possible with deterministic analysis due to the added components of "complexity" and "time factors". Inclusion of probability in the investment model aids in assessing the variability encountered in real-world investments . The investment model components are shown in figure 3.4.

The reference of time for the deterministic investment analysis is taken at time zero (t=0) which starts at the beginning of the construction period. (see also appendix D. - page 6). The cashflows for the project are shown in figure 3.4 and the following expressions for before and after tax cashflow can be derived:

Definition of the time functions of Figure 3.4 are as follows:

t_o = time zero

t_a = start of operation phase

t_c = end of investment period

t_f = end of lease-up period.

INVESTMENT MODEL DESIGNATION	MEASURE OF INVESTMENT PERFORMANCE	MODEL COMPONENTS		
		COMPLEXITY OF VARIABLES	TIME FACTOR ADJUSTMENTS	PROBABILITY
1. TRADITIONAL ANALYSIS	N.O.I. BEFORE TAXES AND DEBT - SERVICE	FEW	STATIC	DETERMINISTIC "LIKELY"
2. DETERMINISTIC ANALYSIS	I.R.R. OR N.P.V. AFTER TAXES AND DEBT - SERVICE	MANY	DYNAMIC	DETERMINISTIC "LIKELY"
3. RISK ANALYSIS	MEAN VALUE STANDARD DEVIATION OF I.R.R. OR N.P.V. AFTER TAXES AND DEBT - SERVICE	MANY	DYNAMIC	PROBALISTIC "MEAN VALUE" STANDARD DEVIATION

FINANCIAL INVESTMENT MODELS
Fig. 3.2

$$BTCF_t = R_t - O_t - M_t - TR_t - A_t - I_t \quad (3.1)$$

$$ATCF_t = (1-\gamma)\, BCTF_t - \gamma\,(A_t - CCA_t) \quad (3.2)$$

in which:

- $BTCF_t$ = Before tax cashflow in period t
- $ATCF_t$ = After tax cashflow in period t
- γ = tax rate
- R_t = Revenue in period t
- O_t = Operating expenses in period t
- M_t = maintenance expenses in period t
- TR_t = Tax, real estate in period t
- A_t = Payment on Mortgage principal in period t
- CCA_t = Capital Cost Allowance in period t
- I_t = Interest payment on Mortgage in period t

The Net Present Value (NPV) is defined as:

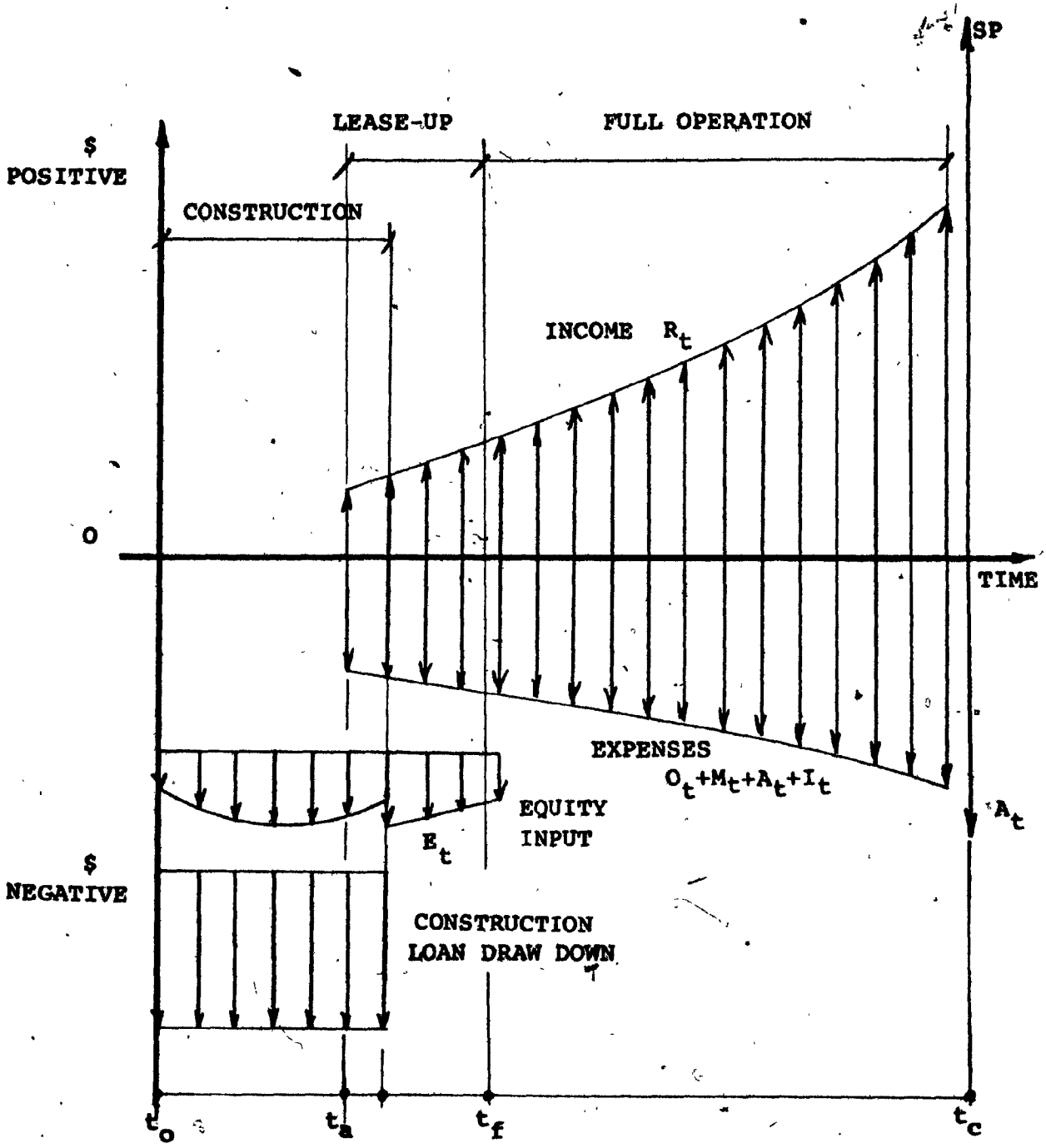
$$NPV = \sum_{t_a}^{t_f} \frac{ATCF_t}{(1+r)^t} + \sum_{t_f}^{t_c} \frac{ATCF_t}{(1+r)^t} + \frac{SP}{(1+r)^{t_c}} - \sum_{t_o}^{t_c} \frac{E_t}{(1+r)^t} \quad (3.3)$$

SP= Sale price

r = Discount rate

i.e. the project NPV is the discounted cashflow of the sum of after tax cash flows during lease-up period, plus after tax cashflows during full operation, plus the discounted Sale price at the end of the project holding period, minus the equity input, discounted over its relevant periods.

The discount rate reflects the rate of inflation plus a minimal acceptable after tax rate of return expected from similar classes of investments.



PROJECT CASHFLOW VS. TIME
Fig. 3.4

Similarly, the IRR can be defined as that discount rate which makes the sum of the discounted cash reversion from the project, after taxes, to the investment horizon under consideration, equal to the initial cash equity investment. The IRR therefore represents the yield on equity still left in the project based on considering cashflow streams at different time periods, after taxes, debt service and equity reversion.

The formula for IRR can be defined as:

$$0 = \sum_{t_a}^{t_f} \frac{ATCF_t}{(1+IRR)^t} + \sum_{t_f}^{t_c} \frac{ATCF_t}{(1+IRR)^t} + \frac{SP}{(1+IRR)^{t_c}} - \sum_{t_o}^{t_c} \frac{E_t}{(1+IRR)^t} \qquad (3.4)$$

Substitution of $ATCF_t$ in the above formulas can be performed easily to expand the expressions for NPV and IRR.

The expressions for NPV and IRR in formula 3.3 and 3.4 respectively form the basis for conducting a deterministic investment analysis.

According to I.R. Cooper (16:17) the IRR remains the most valuable measure of project profitability as it permits a single measure of equity yield by which any other investment alternative can be compared with.

Because of close approximation of a real-world investment modelling, the deterministic investment analysis has reduced the risk and unknowns when compared to the traditional investment analysis as it requires that each of the cashflow items describing reinvestment be identified and measured.

3.2 COMPUTER SOFTWARE

In this section, an existing software package, directed at performing the type of analysis discussed in the previous section, is examined. The purpose is to identify the information inputs required for such an analysis. At a later stage we will demonstrate the use of such a program for sensitivity and risk analysis.

The software computer program discussed and used in this paper is the commercially available "Canadian Building Economic Evaluation Study" (CBEES) program, as developed jointly by York University - Toronto and Portland Cement Association (43). The description of program input and output sections are further detailed in Appendix B.

Input for the CBEES program are briefly described below and in terms of the time models shown in figures 3.5.1 - 3.5.5.

The General Time module - input section 1

The time models assumed for income and expenditure items in CBEES are shown in figure 3.5.1. Time zero is taken as start of construction. The basic unit of time is the month.

Equity input to the project is determined by the difference between total project costs and the mortgage capital. Costs of construction including financing, fees, etc. are entered under the total project costs and capitalized in the program. The program makes no allowance for any bridge financing cost due to a deferred mortgage takeout.

Project profitability is computed for 3 periods as specified by the user and at the end of each period, equity reversion or project sale is assumed. The discount rate is entered as a constant percentage throughout the investment period.

Sale price: (SP_t) - input section 2

The project market value is determined by appreciation/depreciation rates for land and buildings for which different rates can be assumed. This appreciation process is modeled by estimating appreciation (or depreciation) rates for four different time periods: 0-1 year, 2-5 year, 6-10 year and 11+ year periods, subsequent to construction completion. The SP at the end of the investment period is determined by the cumulative effects of land and building appreciation shown in figure 3.5-2. Of importance is the market value of the project at the end of the construction period, which is used as the basis for the time model.

Revenue (R_t) - input section 3

The program permits the following input modelling:

The revenue derived from leased space is determined from the income streams of various lease units (eg: office space & retail space) at different rates ($\$/ft^2/yr$). In addition, full occupancy, subject to a standard vacancy rate is only obtained at the end of the lease-up period. Rental rates are usually paid monthly and lease-period agreements remain fixed during the lease term. At the end of each lease term the rental rate will be increased by a predetermined escalation rate (%/yr). An arbitrary lease- up rate can be programmed for 3 month lease-up periods or increments. The input models for (R_t) are shown in figure 3.5-3.

Operating & Maintenance: Expenses (O_t,M_t) Input section 4

The O&M expenses are based on full occupancy, and are escalated annually, starting at t_o - start of construction. During the lease-up period a percentage of the total expenses can be programmed. Real estate taxes are treated as a cost item and included in O&M expenses as shown in figure 3.5-4.

Taxes (T_t) - input section 4

Income taxes are entered as a percentage for each of the first five years of net income and start at t_o, beginning at the construction period. Tax rate beyond the 5th year is assumed to be the same as the 5th year. The taxation time model is shown is figure 3.5-5.

Mortgage Principle (A_t) and Interest Costs (I_t) - input section 5

The mortgage amount can be assumed at a constant value or be determined by capitalizing the net operating income at some specified capitalization rate (CR). A blended mortgage principle and interest payment schedule based on equal monthly payments is assumed by the program. Interest rate is entered in the program as a single value for a mortgage period of up to 40 years.

Debt service payments are determined by the program. Outstanding mortgage principle at the end of the investment period is determined and deducted from the sale price (SP) at equity reversion.

Capital Cost Allowance: (CCA_t) - input section 6

The CCA or depreciation rate applies to building value only and is taken at the end of construction as a constant annual rate. The maximum CCA rates are taken in each year and any losses incurred are used to shelter income from other investments.

The output of the CBEES program is printed in 9 sections, and listed below:

1. Description of Project and Options Selected
2. Cost Data
3. Revenue Data
4. Operating Data

5. Financial Data
6. Capital Cost Allowances and Depreciation Schedules
7. Tax Data
8. Cash Flow Tables
9. Economic Evaluation

The cashflow tables of output section 8 include the following columns:

A Net Revenue (Gross Possible less vacancies and bad debts)

B Cash Annual Operating Expenses

C Net Operating Revenue

D Principal Payment

E Mortgage Interest

F Tenants' Operating Expenses

G Project Capital Cost Allowance

H Deductions from Income

I Taxable Income

J Income Tax

K Annual Cash Flow Generated by Operations

L Discounted Cash Flow Generated by Operations

M Cumulative Discounted Cash Flow Generated by Operations

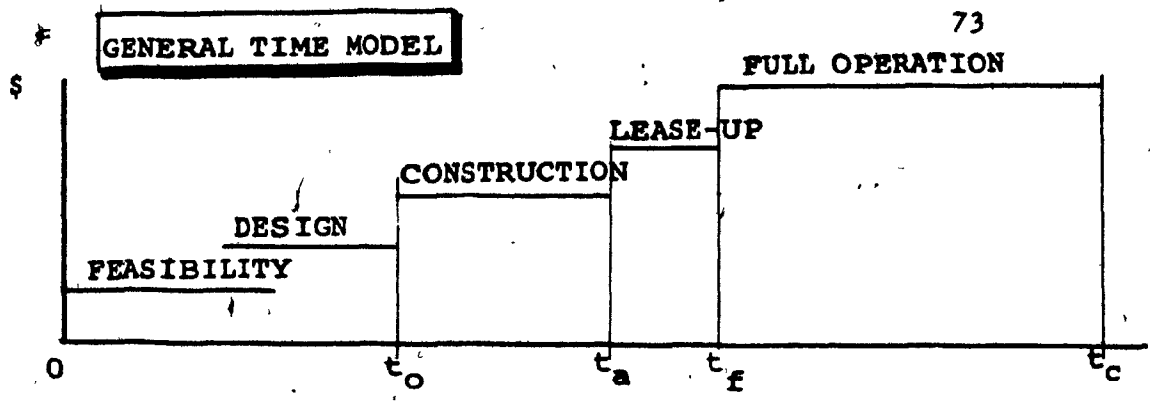
N Equity Dividend (non-discounted)

Columns A to J are calculated based on the accrual method of flow of funds. Columns K, L and M are calculated on the actual flow of receipts and disbursements. Cash flows obtained by subtracting from Net Operating Revenue the Debt Service and Income Tax (C - D - E -J) will be the accrued cash flow. The cash flow displayed in column K has assumed that disbursements are paid one month after they were incurred.

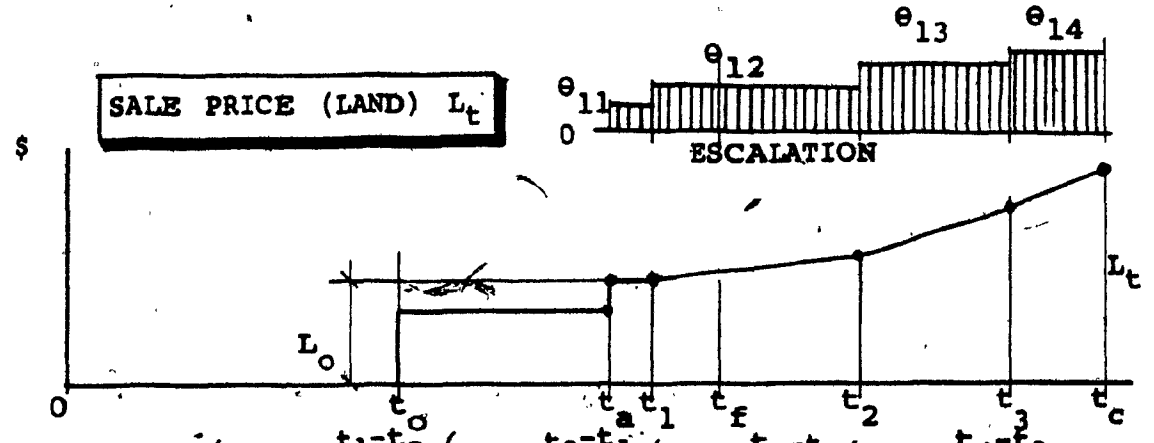
A sample input and output of the CBEES program has been included in Appendix C.

In summary, the CBEES program serves as a basis for a comprehensive analysis of a real estaste investment. It is noted that considerable input information is required, as all phases of the investment are treated.

3.5-1

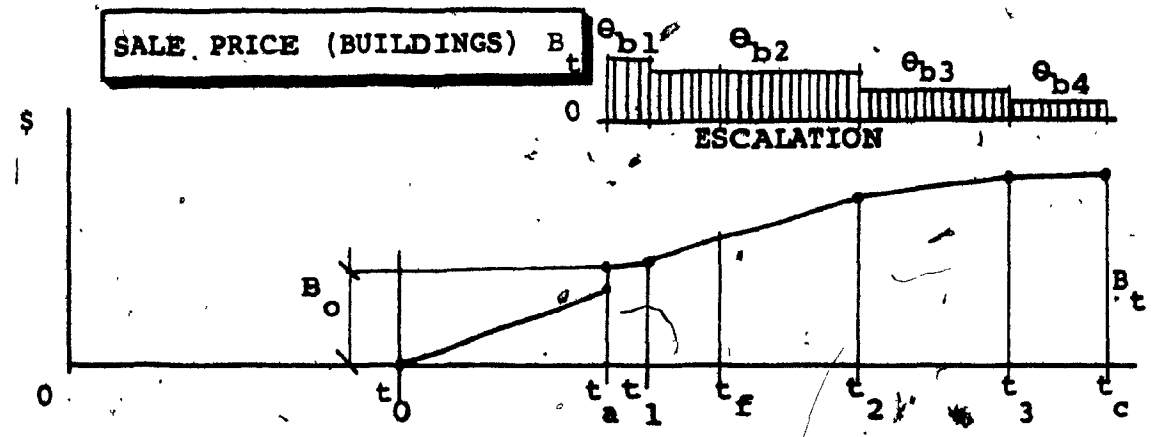


3.5-2



$$L_t = L_0 (1+\theta_{11})^{t_1 - t_a} (1+\theta_{12})^{t_2 - t_1} (1+\theta_{13})^{t_3 - t_2} (1+\theta_{14})^{t_4 - t_3}$$

FOR $t_c \geq t_3$



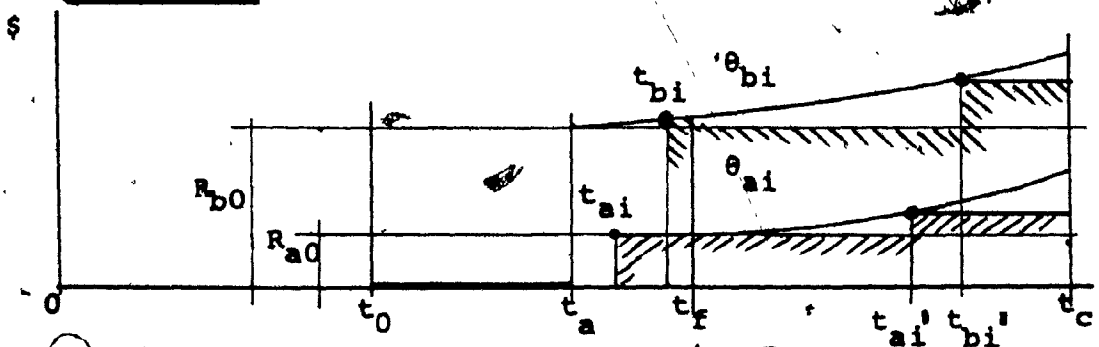
$$B_t = B_0 (1+\theta_{b1})^{t_1 - t_a} (1+\theta_{b2})^{t_2 - t_1} (1+\theta_{b3})^{t_3 - t_2} (1+\theta_{b4})^{t_c - t_4}$$

FOR $t_c \geq t_3$

CBEES INPUT TIME MODELS
Fig. 3.5

RENT (R_t)

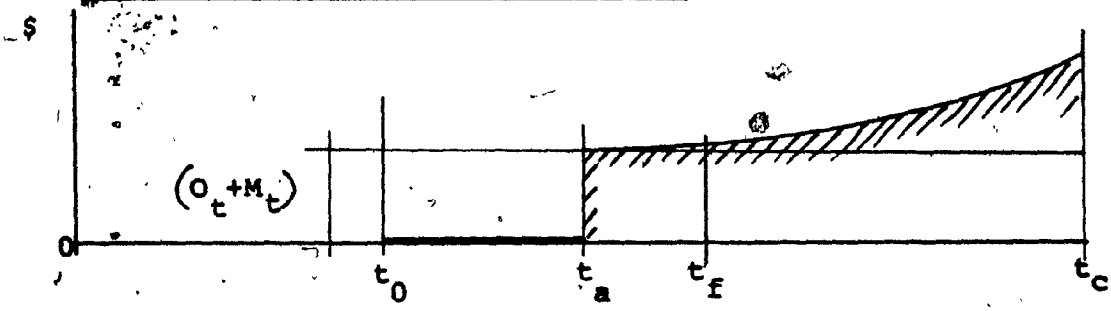
3.5-3



$$R_t = \sum_{t=t_a}^{t_c} \sum_{i=1}^{n} R_{ai}\left[(1+\theta_a)^{t_{ai}-t_a}(t_{ai}'-t_{ai})\right] + \sum_{t=t_a}^{t_c} \sum_{i=1}^{n} R_{bi}\left[(1+\theta)^{t_{bi}-t_a}(t_{bi}'-t_{bi})\right]$$

OPERATION & MAINTENANCE (O_t+M_t)

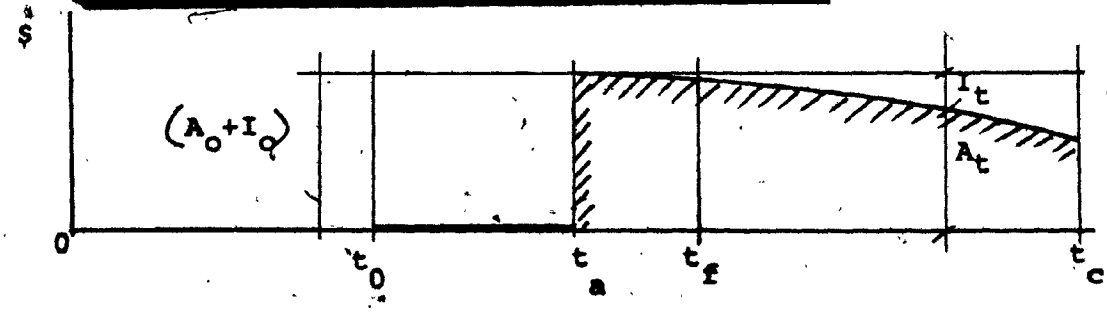
3.5-4



$$(O_t+M_t) = \left[O_o(1+O_o)^t + M_o(1+O_m)^t\right]$$

MORTGAGE PRINCIPLE (A_t) & INTEREST (I_t)

3.5-5



$$(A_t+I_t) = (A_o+I_o)$$

CBEES INPUT TIME MODELS
Fig. 3.5

3.3 SENSITIVITY ANALYSIS

Of interest to the investor is the sensitivity of economic performance of the investment to changes in both controllable and uncontrollable variables (i.e. energy consumption, energy cost escalation rate, etc.). It is possible to conduct a sensitivity analysis, using a software program such as CBEES. Emphasis is placed on the meaning of such sensitivity analysis, and the derivation of sensitivity coefficients.

As shown in formula's 3.3 and 3.4 the project profitability criteria for IRR or NPV can be expressed in the following general equations:

$$NPV = f(x, x_2, \ldots x_m) \tag{3.5}$$

The function for IRR can be denoted by (F) where:

$$F = f(x, x_2, \ldots x_m, y) = 0 \tag{3.5}$$

$$\text{where } y = \hat{IRR} \tag{3.6}$$

Using a "Taylor series" expansion for a general multivariable function about a base point, NPV_o can be expressed in the following equation:

$$NPV = NPV_o + \sum \left.\frac{\delta f(\underline{x})}{\delta (x_i)}\right|_o \Delta x_i + \tfrac{1}{2} \sum_{i=1}^{m} \sum_{j=1}^{m} \left.\frac{\delta^2 f(\underline{x})}{\delta x_i \, \delta x_j}\right|_o \Delta x_i \, \Delta x_j \tag{3.7}$$

Similarly the IRR can be expressed as:

$$F = F_o + \sum \left.\frac{\delta f(\underline{x}, y)}{\delta x_i}\right|_o \Delta x_i + \left.\frac{\delta f(\underline{x}, y)}{\delta y}\right|_o \Delta y + \tfrac{1}{2} \sum_{i=1}^{m} \sum_{j=1}^{m} \left.\frac{\delta^2 f(\underline{x}, y)}{\delta x_i \, \delta x_j}\right|_o \Delta x_i \Delta x_j$$

$$+ \tfrac{1}{2} \sum_{i=1} \left.\frac{\delta^2 f(\underline{x}, y)}{\delta x_i \delta y}\right|_o \Delta x_i \Delta y_j + \tfrac{1}{2} \frac{\delta^2 f(\underline{x}, y)}{\delta y^2} + \ldots\ldots\ldots\ldots\ldots \tag{3.8}$$

When the higher order terms are neglected in expressions 3.7 and 3.8 we can define

$$\frac{\delta f(\underline{x})}{\delta x_i} = \text{Sensitivity Coefficient (SC)} \qquad (3.9)$$

If we wish to maintain a constant NPV and trade off two variables, i and j simultaneously, we then have:

$$\frac{\delta f(\underline{x})}{\delta x_i} \Delta x_i + \frac{\delta f(\underline{x})}{\delta x_j} \Delta x_j = 0 \qquad (3.10)$$

or:

$$\Delta x_i = \frac{-\left(\frac{\delta f(\underline{x})}{\delta x_j}\right) \Delta x_j}{\left(\frac{\delta f(\underline{x})}{\delta x_i}\right)}$$

or:

$$\frac{\Delta x_i}{x_j} = \left(\frac{-\frac{\delta f(\underline{x})}{\delta x_j}}{\frac{\delta f(\underline{x})}{\delta x_i}} \cdot \left(\frac{x_j}{x_i}\right) \right) \frac{\Delta x_j}{x_j} \qquad (3.11)$$

The expression in between brackets is referred to as the "trade-off coefficient" (TC)

$$\frac{\Delta x_i}{x_i} = (\text{TC}) \frac{\Delta x_j}{x_j} \qquad (3.12)$$

Formulas 3.11 and 3.12 express the relationship between the percentage change in one variable and that in another required to keep NPV constant, assuming small changes in the independent variables.

A similar relationship can be derived for IRR:

Changes in any variable will change IRR as follows:

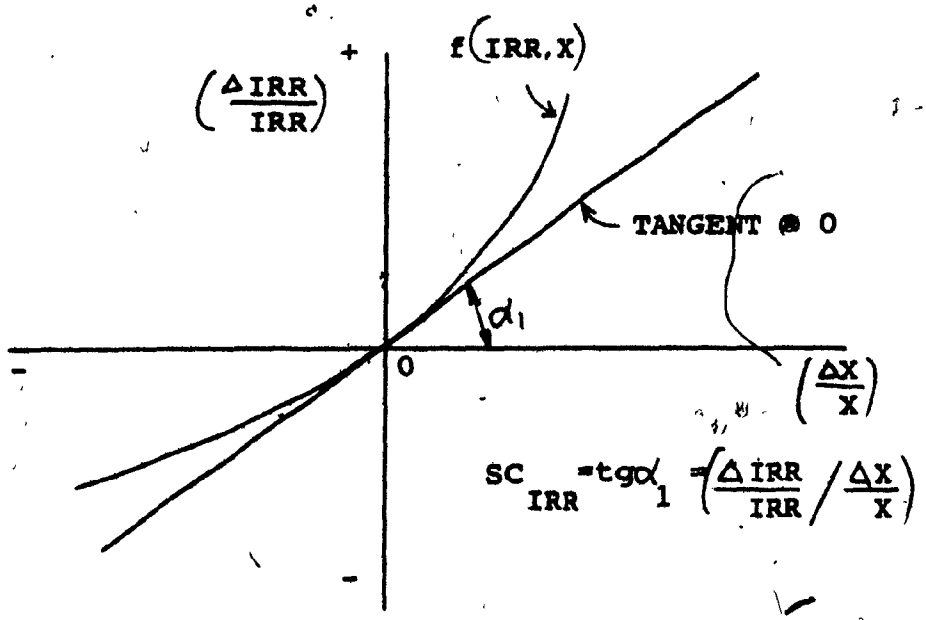
$$\frac{\delta f(x,y)}{\delta x_i} \Delta x_i + \frac{\delta f(x,y)}{\delta y} \Delta y = 0 \qquad (3.13)$$

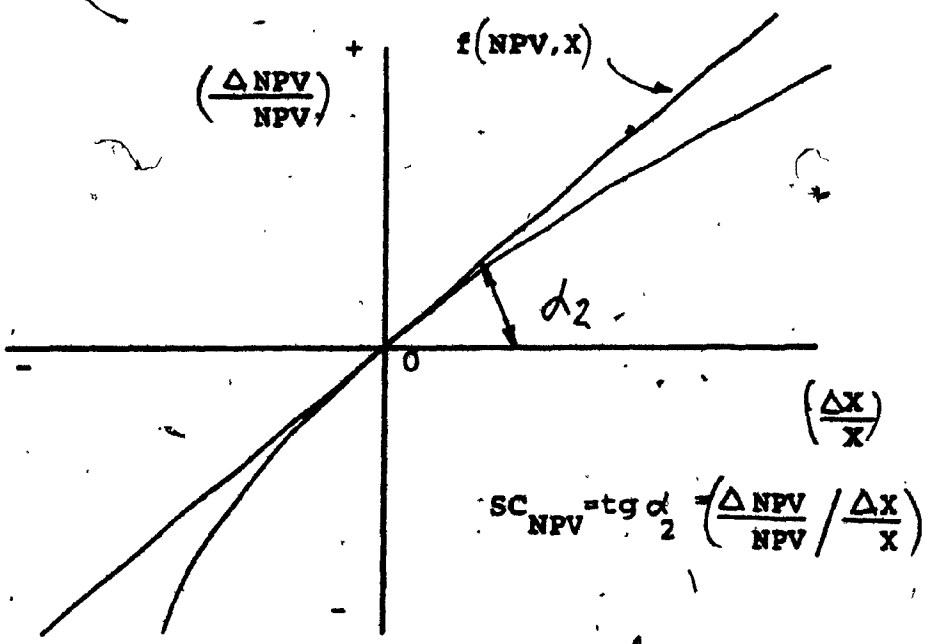
$$\text{or: } \Delta y = \left(\frac{-\frac{\delta f(\underline{x},y)}{\delta x_i} x_i}{\frac{\delta f(\underline{x},y)}{\delta y}} \right), \qquad \frac{\Delta y}{y} = \left(\frac{-\frac{\delta f(\underline{x},y)}{\delta x_i}}{y \frac{\delta f(\underline{x},y)}{\delta y}} \right) \Delta x_i \qquad (3.14)$$

Substitute for y= IRR (3.6)

$$\text{then} \qquad \frac{\Delta IRR}{IRR} = (SC) \Delta x_i \qquad (3.15)$$

The actual sensitivity coefficients and Trade-off coefficients can be obtained directly by using the CBEES program. A base IRR or NPV is determined and changes of input parameter x: will result in changes of Δ NPV or ΔIRR. The changes of input parameters will effect output IRR and NPV values, and the relationships can be expressed in terms of a sensitivity equation or in graphical form as shown in figure 3.6. A sensitivity analysis will be demonstrated in Chapter 4.





SENSITIVITY
Fig. 3.6

3.4 SIMPLIFIED METHODOLOGY FOR RISK ANALYSIS

It is the objective of this section to seek a simplified or "quick and dirty" method for conducting risk analysis which will yield a range of outcomes for net present value and internal rate of return and their relative likelihood of occurrence. A basic approach is described herein. Additional future work required to refine the approach is also highlighted. We start by examining the net present value equation so that we might exploit its structure. First, we note that each term in the equation may be written as some base year revenue or cost multiplied by a time function consisting of the escalation rate and the discount rate. Consequently, the NPV equation may be written as:

$$NPV = \sum_{i=1}^{n} Z_i = \sum_{i=1}^{n} X_i \cdot Y_i \qquad (3.16)$$

in which:

X_i is a base year income or expense item; and

Y_i is the present work of the time model

i.e.

$$Y_i = \sum_{j=t}^{T} \left(\frac{1+0_i}{1+r} \right)^j \qquad (3.17)$$

in which is the annual escalation rate (assumed to be invariant with time) for the i^{th} component. The form of the NPV equation is similar to the calculation for PERT methods. Consequently, the use of the assumptions and calculations used in a PERT method analysis (39:275) have been adopted, resulting in a mean and variance approach (33.79) to risk analysis. The seven steps required for the risk analysis are as follows:

i) Assess which components in the net present value equation are deterministic and which are probabilistic (Note that some X_i and Y_i in equation 3.16 are known with almost certainty).

ii) For each probablistic input variable, estimate the most likely (m), otimistic (a) and pessimistic (b) value. The optimistic and pessimistic values correspond to the 5 and 95 percentiles.

iii) As per the PERT approach (39:225), estimate the mean and standard deviation for each probabilistic input variable as follows:

$$\text{Mean} = \frac{a + 4m + b}{6} \tag{3.18}$$

$$\text{Standard Deviation} = \frac{b - a}{3.2} \tag{3.19}$$

The basis for the denominator being 3.2 rather than the more common was stated by Moder and Phillips (39:285) as follows:

"As mentioned above, a and b were originally defined as the 0 and 100 percentiles of the distribution of t, and therefore the divisor in equation (3.18) was 6 in place of the above value of 3.2, in the original development of PERT. This is the basis of another argument in favour of our 5 and 95 percentile definitions of a and b. In the paper by Moder and Rodgers, it is shown that the difference (b-a) varies from 3.1 to 3.3 (average of 3.2) standard deviations for a wide variety of distribution types ranging from the exponential distribution to the normal distribution, including rectangular, triangular and beta type distributions. For this same set of distributions, the difference between the 0 and 100 percentiles varies, however, from 3.5 all the way to 6.0. Thus, the use of the 5 and 95 percentiles for a and b leads to an estimator of the standard deviation that is robust to variations in the shape of the distribution of t. This is of some importance, because in general, we do not know the shape of the distribution of t, and further, we wish to avoid making any specific assumptions about it."

iv) For components of the NPV equation which are functions of the basic input variables, the mean and variance of these components can be calculated using the following approximations (6:180) and (48:32).

If Y is the component which is a function of the random variable X, i.e.:

$$Y = g(X) \tag{3.20}$$

then the mean or expected value of Y: $\overline{Y} = E[Y] = E[g(X)] \approx g(\overline{X})$ (3.21)

The variance of Y: $Var[Y] = Var[g(X)] \approx Var[X] \left[\left.\frac{dg(x)}{dx}\right|_{\overline{x}}\right]^2$ (3.22)

and the standard deviation.

$$\sigma_y \approx \left|\left.\frac{dg(x)}{dx}\right|_{\overline{x}}\right| \sigma_x \tag{3.23}$$

These relations are applied to the time model functions below. For the case of a typical product term in the NPV equation, $Z_i = X_i Y_i$, if X_i and Y_i are assumed to be uncorrelated, then the mean: $\overline{Z_i} = E[Z_i]$ is:

$$\overline{Z_i} = \overline{X_i}\,\overline{Y_i} \tag{3.24}$$

and:

$$Var[Z_i] = \overline{x_i}^2 \sigma_{Y_i}^2 + \overline{Y_i}^2 \sigma_{x_i}^2 + \sigma_{x_i}^2 \sigma_{Y_i}^2 \tag{3.25}$$

v) Once the mean and variance for each of the X_i, Y_i in equation 3.16 are known, the mean and variance for NPV can be calculated using the following relationships (6:180). If,

$$W = \sum a_i \cdot S_i \tag{3.26}$$

then the mean $$\overline{W} = \sum a_i \cdot \overline{S_i} \tag{3.27}$$

and: $$\sigma_W^2 = \sum a_i^2 \sigma_{S_i}^2 + 2\sum_{i=1}^{n}\sum_{j=1}^{n} a_i a_j \rho_{x_i x_j} \sigma_{x_i} \sigma_{x_j} \tag{3.28}$$

We make the key assumptions that all of the components of the net present value equation are uncorrelated, i.e. $\rho_{S_i S_j} = 0$ for all i, j. This is reasonable for many of the base year costs and incomes. It is less so for the time factors since the inflation rates may be correlated. Applying the above relations and assumptions, we have:

$$NPV = \sum_{i=1}^{m} Z_i = \sum_{i=1}^{m} \overline{X}_i \overline{Y}_i \tag{3.29}$$

$$\sigma_{NPV}^2 = \sum_{i=1}^{m} \sigma_{Z_i}^2 = \sum_{i=1}^{m} (\overline{X}_i^2 \sigma_{Y_i}^2 + \overline{Y}_i^2 \sigma_{X_i}^2 + \sigma_{X_i}^2 \sigma_{Y_i}^2) \tag{3.30}$$

vi) Knowing NPV and NPV and invoking the central limit theorem, (6:180) we can state that NPV is normally distributed for m reasonably large. We can then use either utility theory or direct probability statements to asses the merit of an investment.

If utility theory is applied, it is useful to consider an exponential utility function of the form (48:12):

$$U(NPV) = \frac{1}{a}(1 - e^{aNPV}) \tag{3.31}$$

in which a is the coefficient of risk aversion. For $a > o$, U(NPV) is a strictly concave function and represents aversion toward risk. For a = 0, U(NPV) = NPV. This represents risk neutrality, also known as expected value decision making. For $a < 0$, U(NPV) is a strictly convex function. All risk adjusted values exceed their corresponding expected payoffs, and hence this function reflects a positive reference for risk.

In accordance with our previous assumptions, NPV is normally distributed with meah NPV and σ^2_{NPV}, i.e.

$$f(NPV) = \left(2\pi \sigma^2_{NPV} \right)^{-\frac{1}{2}} \cdot \exp.\left[\frac{-(NPV - \overline{NPV})^2}{2\sigma^2_{NPV}} \right] \qquad \text{for: } -\infty < NPV < \infty \tag{3.32}$$

The expected utility of NPV is then:

$$U(NPV) = \int_{-\infty}^{+\infty} U(NPV)\, f(NPV)\, d\,NPV \tag{3.33}$$

and according to Gupta & Cozzolino[1]:

$$U(NPV) = NPV - \tfrac{1}{2} a \sigma^2_{NPV} \tag{3.34}$$

where U (NPV) is called the "certainty equivalent". If U (NPV) is less than zero, the investment is undesirable.

An alternative to the use of utility theory is to work directly with the normal distribution itself. In this case, the decision criterion might be that the probability of NPV being negative be less than a specified member, p, be a minimum: i.e.

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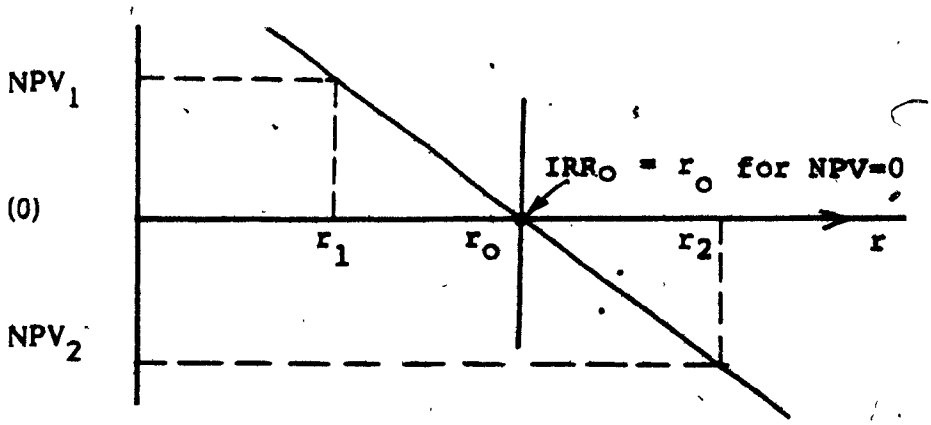
1) Gupta, S.K. and Cozzolino, J.M.
Fundamentals of Operation Research for Management Holder-Day 1975.

$$P\left[NPV<0\right] \leq p = \text{mimimum}$$

for the investment to be acceptable.

vii) If it is desired to work with IRR the internal rate of return, some difficulties arise as IRR is an implicit function of the net present value equations and thus difficult to establish. An approximate method of seeking its distribution as an explicit function is as follows. Compute NPV for different values of discount rate such that NPV_1 is greater than zero, and NPV_2 is less than zero. Denote the corresponding discount rates by r_1 and r_2. Graphically, we have:



Then:

$$IRR_o = \frac{NPV_1}{NPV_1 - NPV_2} \cdot (r_2 - r_1) + r_1 \qquad (3.36)$$

We require the following two fundamental relationships for multivariable situations. According to Benjamin & Cornell (6:180).

$$Y = g(X_1, X_2, \ldots X_n)$$

$$\overline{Y} = E\left[Y\right] \approx g(X_1, X_2, \ldots X_n) + \tfrac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{d^2 g}{d X_i d X_j}\bigg|_{\overline{X}} Cov\left[X_i, X_j\right] \qquad (3.37)$$

and:

$$Var\left[Y\right] = \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{d g}{d x_i}\bigg|_{\overline{x}} \frac{d g}{d x_j}\bigg|_{\overline{x}} Cov\left[X_i, X_j\right] \qquad (3.38)$$

Then since NPV is a random variable with mean $\overline{NPV}$ and variance σ^2_{NPV}, we have:

$$\overline{IRR} = \left[\frac{\overline{NPV}}{\overline{NPV_1}-\overline{NPV_2}}(r_2-r_1)+r_1\right] + \left[\frac{1}{2}\left(\frac{d^2 IRR}{d\ NPV_1^2}\right)\sigma^2_{NPV_1}\right] + \left[\frac{1}{2}\left(\frac{d^2 IRR}{d\ NPV_2^2}\right)\sigma^2_{NPV_2}\right] +$$

$$+\left[\left(\frac{d^2 IRR}{d\ NPV_1 d\ NPV_2}\right)\rho_{NPV_1,NPV_2}\sigma_{NPV_1}\sigma_{NPV_2}\right] \qquad (3.39)$$

$$Var[IRR] = \left[\left(\frac{d\ IRR}{d\ NPV_1}\right)^2\sigma^2_{NPV_1}\right] + \left[\left(\frac{d\ IRR}{d\ NPV_2}\right)^2\sigma^2_{NPV_2}\right] +$$

$$+\left[2\left(\frac{d\ IRR\ d\ IRR}{d\ NPV_1 d\ NPV_2}\right)\rho_{NPV_1,NPV_2}\sigma_{NPV_1}\sigma_{NPV_2}\right] \qquad (3.40)$$

Partial differentials of formulas 3.39 and 3.40 are shown below:

For base formula: 3.36

$$IRR = \left[\frac{NPV_1}{NPV_1-NPV_2}(r_2-r_1)+r_1\right]$$

Then:
$$\frac{d\ IRR}{d\ NPV_1} = (r_2-r_1)\cdot\frac{(NPV_1-NPV_2).1-NPV.(1)}{(NPV_1-NPV_2)^2}$$

or:
$$\frac{d\ IRR}{d\ NPV_1} = \frac{(r_2-r_1)-NPV_2}{(NPV_1-NPV_2)^2} \qquad (3.41)$$

$$\frac{d^2 IRR}{d\ NPV_1}^2 = (r_2-r_1)\cdot\frac{NPV_2.\ 2\ (NPV_1-NPV_2)}{(NPV_1-NPV_2)^4}$$

or:
$$\frac{d^2 IRR}{d\ NPV_1}^2 = \frac{2(r_2-r_1).NPV_2}{(NPV_1-NPV_2)^3} \qquad (3.42)$$

$$\frac{d\ IRR}{d\ NPV_2} = \frac{+(NPV_1)}{(NPV_1-NPV_2)^2} \cdot (r_2-r_1) \qquad (3.43)$$

$$\frac{d^2 IRR}{d\ NPV_2^2} = \frac{-2(NPV_1)(NPV_1-NPV_2).-1\ (r_2-r_1)}{(NPV_1-NPV_2)^4}$$

or: $$\frac{d^2 IRR}{d\ NPV_2^2} = \frac{2.\ NPV_1(r_2-r_1)}{(NPV_1-NPV_2)^3} \qquad (3.44)$$

$$\frac{d^2 IRR}{d\ NPV_1 d\ NPV_2} = (r_2-r_1)\frac{-1.(NPV_1-NPV_2)^2 - NPV_2.2(NPV_1-NPV_2)}{(NPV_1-NPV_2)^3}$$

$$\frac{d^2 IRR}{d\ NPV_1 d\ NPV_2} = -\frac{(NPV_1+NPV_2)(r_2-r_1)}{(NPV_1-NPV_2)^3} \qquad (3.45)$$

As mentioned in step (iv), it is necessary to compute the mean and variance of the time models Y_i. From equation 3.17, Y_i is given by:

$$Y_i = \sum_{j=t}^{n} \frac{(1+\theta_i)^j}{(1+r)^j} = \sum_{j=t}^{n} \frac{1}{(1+k_i)^j} \qquad (3.46)$$

in which θ_i, is the escalation rate which is a random variable with mean $\theta_i = \frac{a_i+4m_i+b_i}{6}$ and Standard Deviation $\sigma_{\theta_i} = \frac{b_i-a_i}{3.2}$, r is the discount rate.

$\overline{Y_i}$ and $\sigma_{Y_i}^2$ may then be computed as follows. First, compute the equivalent discount rate k_i as: $\frac{1}{\frac{(1+r)}{(1+\theta_i)}} = \frac{1}{(1+k_i)}$

or

$$k_i = \left(\frac{r-\theta_i}{1+\theta_i}\right) \qquad (3.47)$$

Substitution of k_i into time model equation(3.46) for Y_i :

Then $$Y_i = \sum_{j=t}^{T} \frac{1}{(1+k_i)^j} = \sum_{j=1}^{T} \frac{1}{(1+k_i)^j} - \sum_{j=1}^{t-1} \left(\frac{1}{(1+k_i)}\right)^j$$

$$Y_i = \sum_{j=t}^{T} \frac{1}{(1+k_i)^j} = \left(\frac{(1+k_i)^T - 1}{k_i (1+k_i)^N}\right) - \left(\frac{(1+k_i)^{t-1} - 1}{k_i (1+k_i)^{t-1}}\right) \qquad (3.48)$$

Now, from equation 3.47 and 3.21 the mean value of k_i :

$$\bar{k}_i = \frac{r - \bar{\theta}_i}{1+\bar{\theta}_i} \qquad (3.49)$$

and from 3.22 the variance of k_i :

$$\text{Var}\left[k_i\right] \approx \text{Var}\left[\theta_i\right] \left[\frac{d\, k_i}{d\, \theta_i}\Big|_{\bar{\theta}_i}\right]^2$$

$$\text{Var}\left[k_i\right] \approx \sigma_{\theta_i}^2 \left[\frac{(1+\theta_i)(-1) - (r-\theta_i)(1)}{(1+\theta_i)^2}\right]$$

$$\text{Var}\left[k_i\right] \approx \sigma_{\theta_i}^2 \left[\frac{-(1+r)}{(1+\theta_i)^2}\right]^2 \qquad (3.50)$$

Then

$$E\left[Y_i\right] \approx \frac{(1+\bar{k}_i)^T - 1}{k_i (1+\bar{k}_i)^N} - \frac{(1+\bar{k}_i)^{t-1} - 1}{k_i (1+\bar{k}_i)^{t-1}} \qquad (3.51)$$

and

$$\text{Var}\left[Y_i\right] \approx \text{Var}\left[k_i\right] \left[\frac{d\, Y_i}{d\, k_i}\Big|_{\bar{k}_i}\right]^2 \qquad (3.52)$$

$$\text{where } \frac{d\,Y_i}{d\,k_i} = \left[\frac{\bar{k}_i(1+\bar{k}_i)^N\left(T(1+\bar{k}_i)^{T-1}\right)-\left((1+\bar{k}_i)^T-1\right)\left(\bar{k}_i N(1+\bar{k}_i)^{N-1}+(1+\bar{k}_i)^N\right)}{(\bar{k}_i(1+\bar{k}_i)^N)^2}\right]$$

$$+\left[\frac{-\bar{k}_i(1+\bar{k}_i)^{t-1}(t-1)(1+\bar{k}_i)^{t-2}-\left((1+\bar{k}_i)^{t-1}-1\right)\left(\bar{k}_i(t-1)(1+\bar{k}_i)^{t-2}+(1+\bar{k}_i)^{t-1}\right.}{(\bar{k}_i(1+\bar{k}_i)^{t-1})^2}\right]$$

From the seven steps identified above, it is now possible to perform a deterministic analysis using the mean values determined from the PERT estimates. The CBEES programs is then used to perform the "mean" program input computations for IRR and NPV. The standard deviation and variance for IRR and NPV need to be determined as functions of discount rate and time function as derived in the above formulas. It should be noted that derivations for the time model use a deterministic value. Time periods themselves however are also a variable function and some descrepancy will be introduced with this simplified approach.

In order to demonstrate the use of the mean IRR and NPV and associated probabilistic dispersion, consider the example shown in Appendix C. A supplementary computer program was developed within the Concordia University Centre of Building Studies to perform these computations and the test case of section 4.5.

The mean value for IRR and NPV, can be derived from a mean value input estimate. The Standard Deviation as a measure of risk will be computed from two subsequent program inputs for discount rates and r_1 and r_2. This results in values for NPV_1 and NPV_2 from which σ_{IRR} and σ_{NPV} can be computed as described above.

CHAPTER 4

TEST CASE

Real Estate Investment Analysis

4.0 TEST CASE - REAL ESTATE INVESTMENT ANALYSIS

Objectives of this chapter are the following:

1. To present a detailed case study of a large multi-use commercial real estate project consisting of a high rise office tower and a lower level retail area;

2. To perform a standard investment analysis, using the developer's "proforma", and the criteria of equity dividend or return on investment based on triple net leases;

3. To perform a deterministic investment analysis, using Present Value analysis which includes all phases of the project including construction, lease-up, operation and sale of the project. Investment analysis will be performed with triple net leases, for the "likely" and "expected" values;

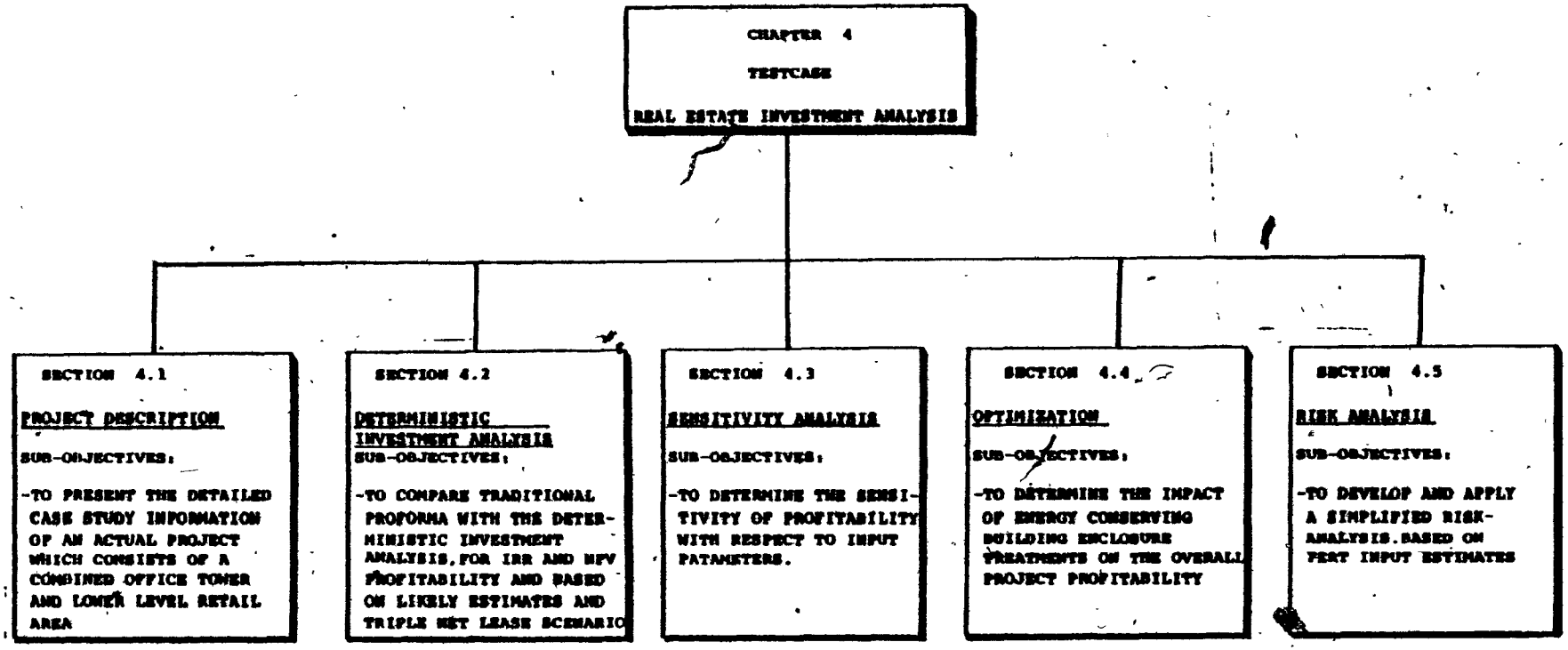
4. To perform a sensitivity analysis for "expected" values;

5. To perform a risk analysis, for the triple net lease case using the concepts presented in Chapter 3; and

6. To investigate the influence of enclosure treatments on energy consumption and economic performance for the gross lease scenario.

The objectives are further illustrated in Fig. 4.1.

CHAPTER 4 - SUBOBJECTIVES
Fig. 4.1



4.1 PROJECT DESCRIPTION

In this section the project is described and a breakdown of projected costs, revenues and building areas as prescribed in the developer's proforma is presented.

The project was started in early 1979 and was nearing completion at the time of issue of this paper. Data used for the analysis has benefited from adjustments made to projections of cost estimates and rental rates immediately prior to construction phase.

Since the analysis by the developer was performed in the traditional manner (i.e. "proforma"), certain data required for a comprehensive investment analysis, along the lines described in Chapter 3, was augmented from various sources as referenced herein.

The information provided in this section, includes the updated and final estimates, obtained immediately prior to construction. They therefore reflect the final building design documentation and summary of market studies. Although not provided in this paper, substantial market analysis had been commissioned and performed. Marketing information was supplied to substantiate projected lease-up periods and rental rates and was based on area information, populaton trends, income and area growth populations. This information has been omitted for sake of brevity.

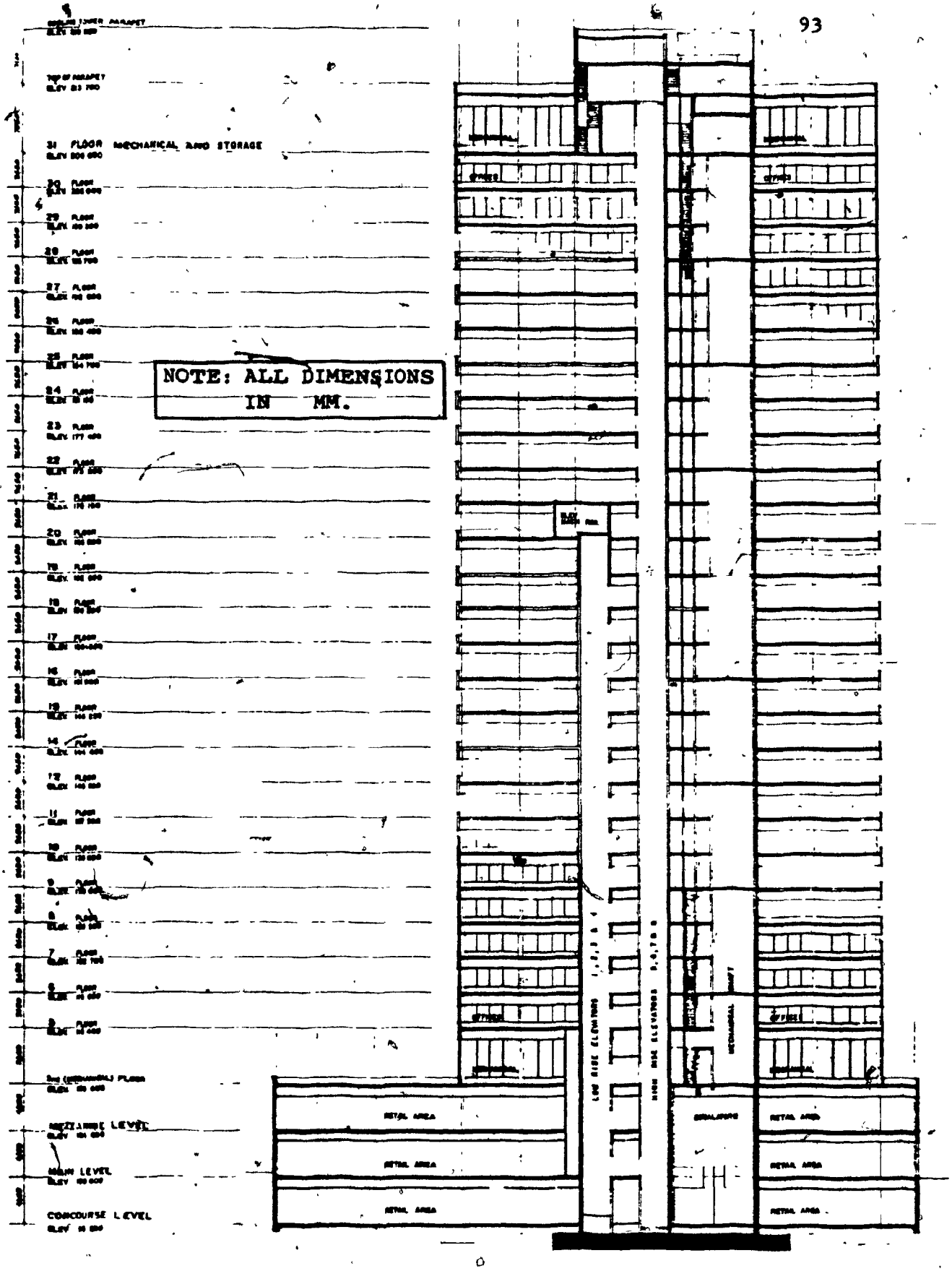
The data and information used and provided by the developer corresponds to the most likely values in the risk analysis performed in section 4. Consequently, they are referred to throughout this chapter as "likely".

4.1.1 Project Definition:

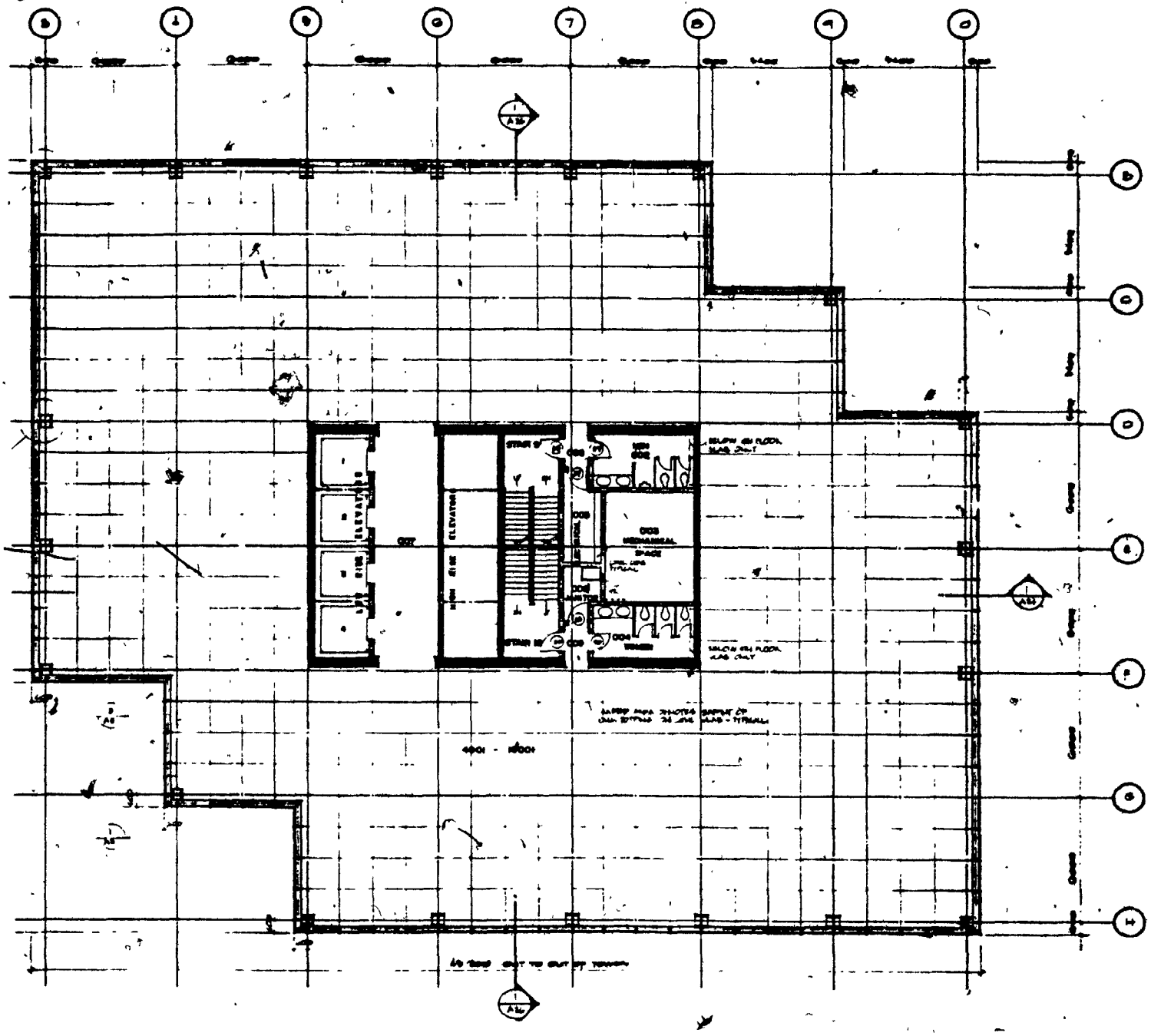
Planning for a multi-use commercial real estate project consisting of three (3) levels of retail space and a high rise office building with adjacent enclosed parking space in Western Canada was initiated in early 1979. Based on investment analysis and various design concepts and proforma statement iterations, a decision was made to proceed with the development. The development process as described in Fig. 2.5 of chapter 2 was largely adhered to. The project may be described as follows.

The complex consists of a 30 storey office tower, of which the lower three levels (basement, ground level and mezzanine level) are planned for retail use and are connected by escalators and elevators. The remaining 27 high rise floors include two mechanical floors. Low rise elevators serve 14 floors and express elevators serve 11 high rise floors. Note that numerically, there is no 13th floor. A building elevation and typical floor plan are shown in figures 4.2 and 4.3 respectively. The high-rise office floor plan does not include the low level elevators. The complex has a gross floor area of 420,441 ft^2 (office and retail area). Within this total, approximately 347,474 ft^2 of net leasable office space is available while net retail area consists of 72,967 ft^2. A breakdown of gross and net leasable areas is shown in Table 4.1.

Of a gross floor area of 14,474 square feet per floor, the rentable area is 13,124 ft^2 (91%) on low rise floors and 13,474 ft^2 on high rise floors (93%). The ratio of useable to rentable space on multi-tenant floors is nearly 91% on both low and high rise floors.



BUILDING ELEVATIONS
Fig. 4.2.



NOTE: ALL DIMENSIONS IN MM.

TYPICAL BUILDING FLOOR PLAN
Fig. 4.3

Also included in the project is an above ground, six storey heated parking facility of 126,000 ft^2 and a capacity of 355 cars. The garage area is linked to the complex above grade. An underground link across the street to a future rapid transit system and major centres is included for this development and considered vital according to the market analysis.

The overall land area for the building is 32,000 ft^2. The land area for the parking complex is 19,100 ft^2.

As a special marketing feature, an early decision was made to include design features which will permit some 6% more daylight per floor than the simplest square form and accommodate eight corner offices per floor. The irregular typical floor design was thought to make an attractive statement on the downtown skyline when compared to the completely rectangular shape of buildings nearby.

The building is served by eight high-speed gearless elevators in two banks. Four serve low rise floors, one through fifteen inclusive, at a speed of 500 feet per minute. Four serve the high rise floors, sixteen through twenty-nine, with service from the first and second retail level, at speeds of 700 feet per minute.

The building has sprinkler protection throughout and smoke detectors at every floor with smoke exhaust and stairwell pressurization systems as per local building codes. Security systems allow for programmed elevators during after hours and 24 hour building watch tour security.

The mechanical systems were designed to accommodate maximum tenant fit-up flexibility of partitions while maintaining efficient control and energy use. A Variable Air Volume (VAV) air distribution system was chosen which permitted minimum office core sizes. High pressure "express" air duct risers from a central fan system serves the VAV boxes on each floor. Perimeter office floor heating was designed for hot water radiation at the window locations. Sequential heating and cooling control of radiation and VAV boxes by means of pheumantic thermostats was designed for the perimeter areas. Two (2) central system mechanical rooms, complete with chillers, boilers, pumps and fans, are installed on the top floor and fourth floor and allow for up and down feed of air and water for Heating, Ventilation and Air Conditioning (HVAC). A schematic of the HVAC system is shown in fig. 4.4.

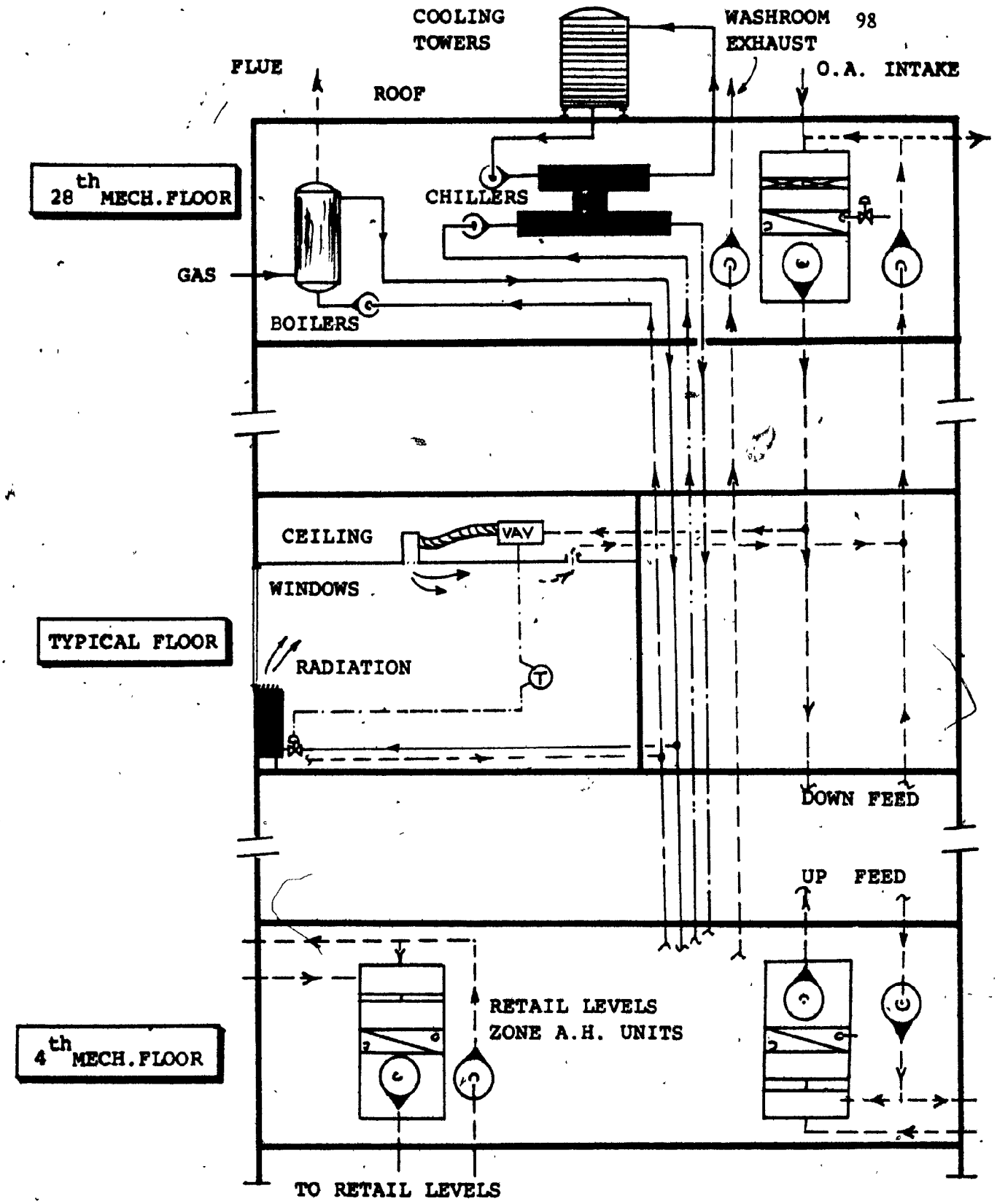
The building wall systems consists or 4" insulated aluminum panels with green tinted double glazing window sections. Glass area and wall panel area for the typical wall module represents approximately 48% and 52% respectively of the total building perimeter area. Neutral tone sun drapes are provided on all windows. Details of the typical wall section are shown in fig. 4.5.

A common five foot by five foot ceiling module, with recessed fluorescent light fixtures sufficient to maintain an illumination of 75 foot-candles at desk level, is thought possible with a "checkerboard" light fixture layout. This amounts to an average 2.3 w/ft^2 energy consumption for lighting including standard balasts. Light switching for each floor, with tenant switching override, forms part of the design. Special light fixtures with aluminized parabolic reflector design and "warm" light fluorescent tubes are used to obtain maximum lighting efficiency and

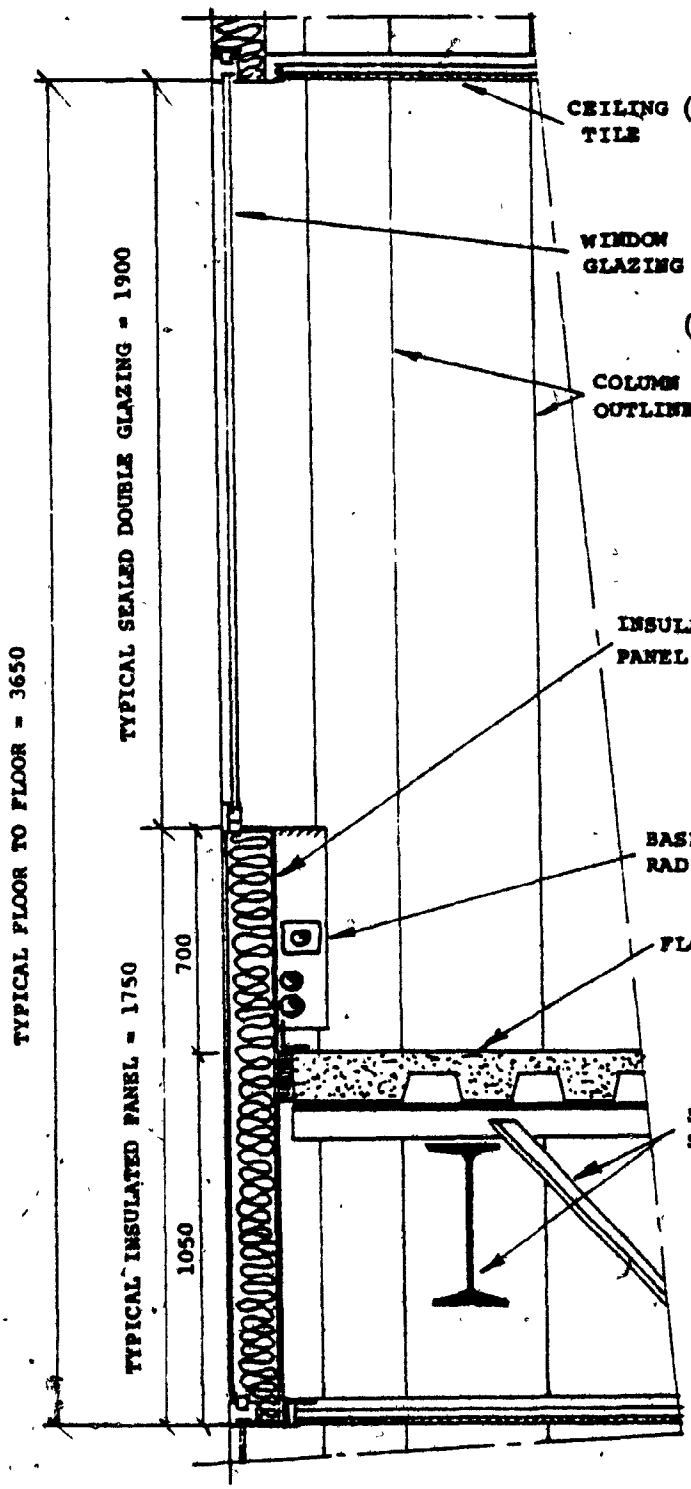
	Gross ft^2	Rentable ft^2
LAND AREA		
OFFICE SITE	32,000	—
PARKING SITE	19,100	—
	51,100	
BUILDING AREA		
A. RETAIL		
Concourse Level	31,375	21,782
Street Level	28,423	21,935
Mezzanine Level	25,663	21,750
Ground Floor Parkade & Underground Pedway	15,900	7,500
TOTAL RETAIL	101,361	72,967
* B. OFFICE		
2 Part Floors (3 & 4)	28,948	14,474
11 Typical Low Rise (5-15)	159,214	144,364
14 Typical High Rise (16-30)	202,638	188,636
2 Mechanical & Elevators Rooms (2 & 31)	14,474	—
TOTAL OFFICE	405,272	347,474
RETAIL & OFFICE AREA TOTALS	506,633	420,441
C. PARKING		
Floor Area (6 storeys)	126,200	
BUILDING AREA TOTALS	632,833	420,441

* NOTE: No 13th Floor

AREA SUMMARY
Table 4.1



HVAC SYSTEM SCHEMATIC
Fig. 4.4



(i) Windows:

- double glazing
- green solar tint
- U = 0.56 BTU/hr/ft^2/°F (15MPH)

(ii) Walls:

- prefabricated insulated panels
- aluminized reflective exterior
- 4" AS 530 fibreglass insulation
- U = 0.06 BTU/hr/ft^2/°F (15 MPH)

BUILDING PERIMETER SECTION
Fig. 4.5

minimum energy consumption. Extra costs for the special light fixtures are estimated at $200,000 and included in the budget estimates. The mechanical and electrical systems are consistent with first class office space comfort standards.

4.1.2 Project Schedules

At an early stage during the feasibility analysis, and prior to design, it was decided that the compressed construction time and early income streams of a "fast track" construction method would be most advantageous and produce favourable cash flows for the development. Important effects were the anticipated reduction of interim financing and carrying costs with the benefits of an early capture of a buoyant tenant market.

In addition, design time allowed for the consultants was similarly compressed to a three month design period. The compressed design and construction periods required a greater than normal contingency and 5% was carried in the project development budget. The nature of the design documentation was referred to as "scope" drawings, which would be developed between the architect and the contractor. Nevertheless a guaranteed maximum price contract was agreed to between developer and contractor. Where design quality, content or details could not be determined at time of tender, cash allowances were included in the construction contract to cover detailed items, such as landscaping, carpet selection, interior finishes, hardware and artwork.

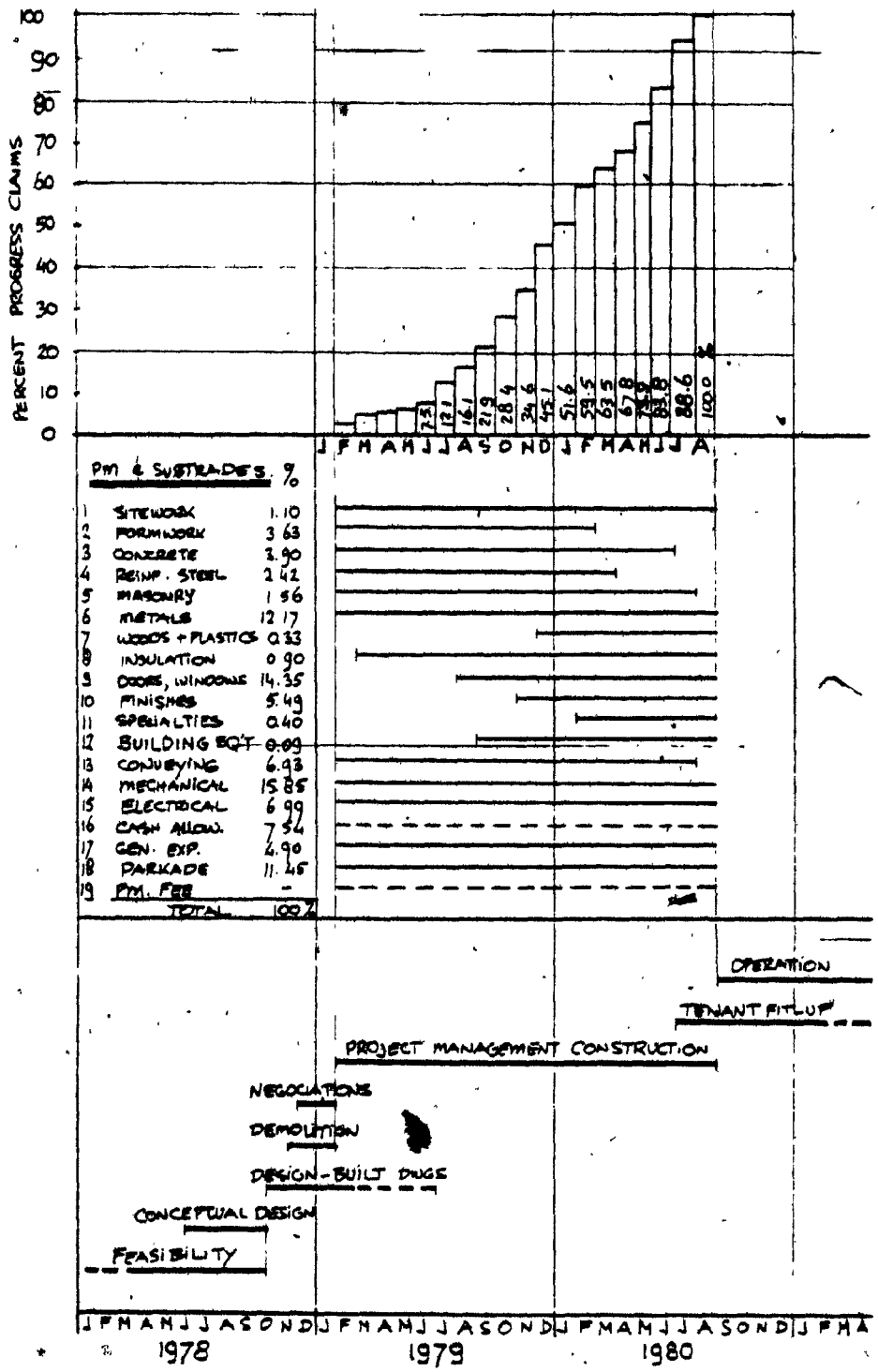
The developer claimed in the final analysis, that the increased cost of a fast track project would result in higher contingencies but which would be offset by greater profitability of the project and the reduced costs of interim financing.

The general contractor was forced to prepare a Critical Path Method (CPM) schedule, confirming the 18 month construction period. CPM updates would be reviewed by the developer and architect on a monthly basis and monthly progress payments were made contingent upon its submittal. In addition, CPM sorts of critical construction activities were used to show conformance with the schedule or show cause for delays or claims for time extensions.

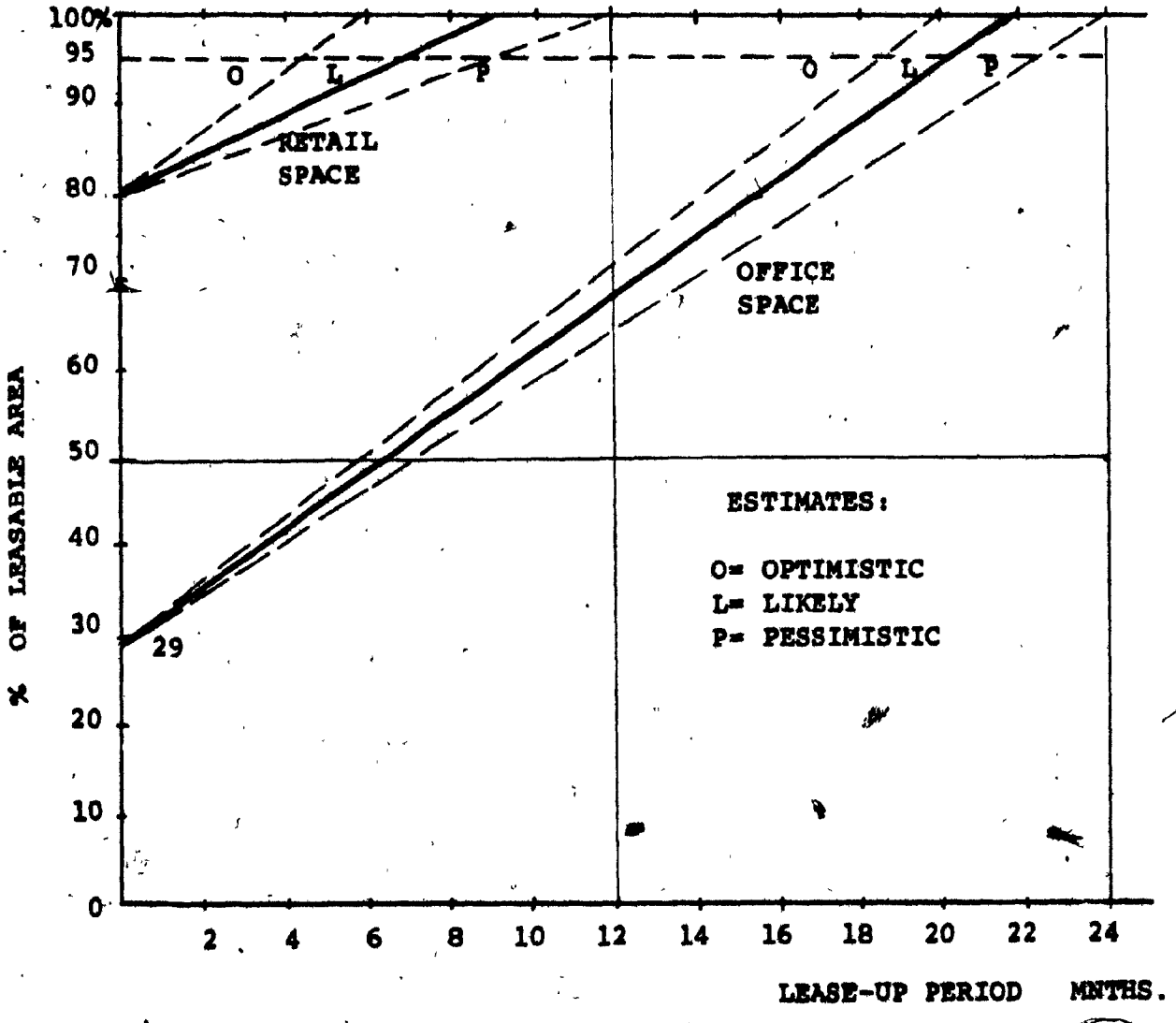
The overall project schedule, as reflected in the proforma and which was followed by the developer, is shown in fig. 4.6. The projected milestone dates ("likely" estimates) are listed below.

June 15/78	Detailed planning commenced
Sept. 15/78	Design drawings complete
Oct. 15/78	Development permit issued and working drawings begin
Jan. 31/79	Tenants vacate existing buildings and demolition begins
Mar. 01/79	Excavation begins (Start of Construction Phase)
June 01/80	Tenant improvements undertaken
Sept. 01/80	Substantial completion - opening date

A lease-up schedule was used in the proforma to calculate costs of bridge financing, income schedule and O & M cost of vacant areas during the lease-up period. Fig. 4.7 shows the optimistic, likely and pessimistic time estimates of the lease-up period.



PROJECT SCHEDULE
Fig. 4.6



LEASE-UP SCHEDULE
Fig. 4.7

4.1.3 Project Budgets

Project development costs, estimated by the developer during the feasibility phase were periodically updated as the design concept evolved. The final project cost estimates were performed at the end of 1979 and reflect "current dollar" expenditures in which escalation allowances have been included.

Construction cost estimates were derived from historical data within the developer's organization and compared against the design consultants estimate and the estimates of a cost consultant. In order to use historical data, allowances were made for local conditions and the escalation of labour and material costs with time. The developer's construction cost estimates are presented in Table 4.2 and include for the "likely" estimates used in the risk analysis of section 4.3. The total project development costs are shown in Table 4.3.

It should be emphasized that the involvement of a cost consultant is a fairly standard practice in commercial developments when construction costs exceed $10 million. The value and importance of this expert information at an approximate 0.1% fee lies in the reasonably accurate estimates which result from this process, thereby reducing risk and financing problems.

Although construction costs in this commercial development amounted to only 55% of the total development costs, a 10% construction cost accuracy (read: cost overrun) was felt to be passable in terms of the projects proforma. Similarly, the involvement of cost consultants would provide some assurance but not guarantee the 10% accuracy within the last month design period. The significance of a 10% construction cost overrun in terms of project profitability is explored in section 4.4, "Sensitivity Analysis".

CONSTRUCTION COSTS (likely estimate)				
Expense Category	Tower 498,233 ft² Gross $/ft²	Construction Cost $	% of Office Tower Cost	% of Total Project Cost
A. OFFICE TOWER & RETAIL				
1. Sitework	0.31	155,200	0.8	0.7
2. Excavation	0.41	202,200	1.1	0.9
3. Structure	9.21	4,589,500	24.1	19.9
4. Misc. Metals	0.25	125,600	.7	0.5
5. Roofing	0.23	112,300	.6	0.5
6. Exterior Walls	6.54	3,257,800	17.1	14.1
7. Interior Finishes	4.09	2,037,400	10.7	8.8
8. Electrical	3.27	1,626,900	8.5	7.0
9. Mechanical	7.12	3,546,800	18.6	15.3
10. Conveying Systems	3.69	1,838,200	9.6	8.0
11. Specialties	0.20	100,100	0.5	0.4
12. Miscellaneous	0.76	377,900	2.0	1.6
13. General Conditions	2.21	1,101,900	5.8	4.8
TOTAL	$38.29/ft²	$19,071,800	100.0%	82.5%
B. PARKING AND PEDWAYS				
Parking 126,200 ft²	$22.50	2,839,500	-	12.3
Pedways 15,900 ft²	75.00	1,192,500	-	5.2
C. Building Total 632,833 ft²	$36.51/ft²	$23,103,800	-	100.0%

CONSTRUCTION COST BREAKDOWN - LIKELY.
Table 4.2

TOTAL PROJECT DEVELOPMENT COST

Table 4.3

DEVELOPMENT BUDGET IN CURRENT DOLLARS

Items Subject				Percentage % (likely)	Optimistic	Likely	Pessimistic	Expected Value
1. Land								
51,100 ft² @ market value of 175/ft² ($140/ft² book value) capitalized				21	$ 8,942,500	$ 8,942,500	$ 8,942,500	$ 8,942,500
2. Demolition of Existing Structures				--	90,000	100,000	150,000	
3. Construction (Likely)								
(a) Retail	65,467 ft² @ $30		$ 1,964,010					
	7,500 ft² @ $35		262,500					
	19,994 ft² @ $52		1,039,685					
(b) Office	405,272 ft² gross @ $39		15,805,605					
(c) Parking	126,200 ft² gross @ $22.50		2,839,500					
(d) Pedways	15,900 ft² gross @ $75		1,192,500					
TOTAL	640,333 ft²	Likely	$23,103,800	55	21,948,610	23,103,800	25,414,800	
4. Architecture & Engineering								
5% of construction cost				2	1,097,430	1,155,190	1,270,190	
5. Development Fee								
2% of construction cost				1	438,972	462,076	508,284	(Items 2-13)
6. Property Taxes								
During construction period				6	237,500	250,000	275,000	$32,568,750
7. Legal Fees								
Allowance				-	140,000	150,000	160,000	
8. Leasing Fees								
Retail	72,967 ft² @ $1.50		109,500					
Office	347,474 ft² @ $2.00		695,000					
		Likely	$ 804,500	2	764,275	804,500	884,950	
9. Financing and Appraisal Fees								
Both interim and permanent				1	427,500	450,000	495,000	
10. Tenant Allowances								
Retail	72,967 ft² @ $6.00		437,800					
Office	347,474 ft² @ $3.00		1,042,400					
		Likely =	$ 1,480,200	3	1,408,090	1,480,200	1,628,000	
11. Interim Financing Costs (Items 2 to 9)								
Optunistic	= 25,144,287 x 0.5 x 10.5% x 16/12 mo.			-	1,760,100			
Likely	= 26,475,572 x 0.5 x 11.0% x 18/12 mo.			5		2,184,235		
Pessimistic	= 29,158,123 x 0.5 x 12.5% x 20/12 mo.			-			3,037,304	
12. Carrying Costs During Lease-Up				2	117,301	1,172,539	2,920,130	
13. Contingency								
5% of construction costs				2	1,097,430	1,155,190	1,270,709	
TOTAL DEVELOPMENT COST				100	$36,469,708	$41,410,230	$46,956,867	$46,003,378

When reviewing the percentage breakdown of the total development cost, it is recognized that the construction cost represents the single largest component (55%), while land costs amount to a significant 21%. Taxes and interim financing costs during construction and lease-up period constitute 11% of the total project development costs.

Project development costs, as shown in Table 4.3 were used to determine equity and financing requirements as well as overall profitability. Estimates by the developer of these items, again are represented by "likely" estimates. Data for "pessimistic" and "optimistic" estimates are also included and used in the risk analysis described in section 4.5.

Interim financing, item no. 11 of table 4.3, has been calculated for a straight line schedule over the entire construction period. This approximation also affects cash flow schedule but has been accepted as a reasonably accurate estimate of the interim financing costs.

The cash flow schedule also includes the consultants fees. They are assumed to be dispersed, with some inaccuracy, over the construction period in a linear fashion.

Lease-up expenses, item no. 12 of Table 4.3, have been further detailed in Table 4.4. Estimates are assumed for likely, pessimistic and optimistic scenarios to supplement the "likely" data which had been provided.

TRIPLE NET LEASE - LEASE-UP EXPENSES - 24 MONTH PERIOD

Total Office Space 347,474 ft² net Total Retail Space 72,969 ft² net	Optimistic 20 Months		Likely 22 Months		Pessimistic 24 Months	
	Net Lease Income	O & M Expenses	Net Lease Income	O & M Expenses	Net Lease Income	O & M Expenses
1. Maximum Exposure of Interim Financing Costs:						
O = $32,000,000, 20 mo, 10.5%	-	$5,600,000	-	-	-	-
L = $32,000,000, 22 mo, 11.0%	-	-	-	$6,433,333	-	-
P = $32,000,000, 24 mo, 12.5%	-	-	-	-	-	$8,000,000
2. Pre-Leased Income:						
Office: 29% = 100,000 ft², 24 mo, $9.00/yr/ft²	1,800,000	-	1,800,000	-	1,800,000	-
Retail: 80% = 58,373 ft², 24 mo, $13.50/yr/ft²	1,576,071	-	1,576,071	-	1,576,071	-
3. Lease-up Income:						
Office: 71% = 247,474 ft²						
O = 247,474 ft², 20 mo, $9.00/ft²/yr, 50%	1,856,055	-	-	-	-	-
L = 247,474 ft², 22 mo, $8.75/ft²/yr, 50%	-	-	1,984,948	-	-	-
P = 247,474 ft², 24 mo, $8.50/ft²/yr, 50%	-	-	-	-	2,103,529	-
Complementary Period to (24 mo) Full Lease						
O = 247,474 ft², 4 mo, $9.00/ft²/yr, 100%	371,211	-	-	-	-	-
L = 247,474 ft², 2 mo, $8.75/ft²/yr, 100%	-	-	180,449	-	-	-
P = 247,474 ft², 0 mo, $8.50/ft²/yr, 100%	-	-	-	-	0	-
Retail: 20% = 14,593 ft²						
O = 14,593 ft², 6 mo, $15.00/ft²/yr, 50%	54,723	-	-	-	-	-
L = 14,593 ft², 9 mo, $13.50/ft²/yr, 50%	-	-	73,877	-	-	-
P = 14,593 ft², 12 mo, $12.00/ft²/yr, 50%	-	-	-	-	87,557	-
Complementary Period to (24 mo) Full Lease						
O = 14,593 ft², 18 mo, $15.00/ft²/yr, 100%	328,342	-	-	-	-	-
L = 14,593 ft², 15 mo, $13.50/ft²/yr, 100%	-	-	246,257	-	-	-
P = 14,593 ft², 12 mo, $12.00/ft²/yr, 100%	-	-	-	-	175,116	-
4. Lease-Up Expenses:						
Office:						
O = 247,474 ft², 20 mo, $2.40/ft²/yr, 50%	-	494,948	-	-	-	-
L = 247,474 ft², 22 mo, $2.50/ft²/yr, 50%	-	-	-	567,127	-	-
P = 247,474 ft², 24 mo, $2.60/ft²/yr, 50%	-	-	-	-	-	643,432
Retail:						
O = 14,593 ft², 6 mo, $2.40/ft²/yr, 50%	-	8,755	-	-	-	-
L = 14,593 ft², 9 mo, $2.50/ft²/yr, 50%	-	-	-	13,681	-	-
P = 14,593 ft², 12 mo, $2.60/ft²/yr, 50%	-	-	-	-	-	18,971
Total Income:	$5,986,402		$5,861,602		$5,742,273	
Total Expenses:		$6,103,703		$7,038,141		$8,662,403
Net Lease-Up Carrying Costs Over 24 Month Period		$ 117,301		$1,172,539		$2,920,130

LEASE-UP PERIOD CASH FLOWS
Table 4.4

The lease-up period immediately following end of construction period, is a low income period in which taxes, mortgage payments and O & M costs are incurred by the developer. Both income and expenses during this period have been shown in Table 4.4. A mortgage of $32 million has been assumed for the analysis in this chapter. This mortgage amount does not reflect the actual or final financing arrangement obtained by the developer for this project.

Lease-up costs, of Table 4.4 have been computed in actual or current dollars. The pre-leased percentage of leasable space for miscellaneous tenants and "anchor" tenant at the start of the lease-up was projected at 30% and 80% respectively for office and retail space.

An abstract of an anchor tenant lease agreement has been shown on the following page.

ABSTRACT OF ANCHOR TENANT LEASE AGREEMENT

1. Lease agreement to start September 1, 1980 (opening date of construction completion.

2. Sixty (60) day prior to opening date, permission to fit-up and occupy premises free of charge.

3. Lease agreement for five year terms on triple net basis.

4. Option of two (2) successive five (5) year renewals at rental rates, equivalent to those in similar office areas at that time.

5. Rental rate (triple net) not to be lower than $\$8.90/ft^2$ for net leasable office space; $\$25.00/ft^2$ for net leasable retail space.

6. Guarantee of 30 parking spaces at current rate of $80/month.

7. Option to rent additional floor below floors at or before opening date.

8. Initial 10 year lease for office space on the top four floors.

9. Initial 10 year lease for 6,500 ft^2 retail space.

10. Developer to provide $\$3/ft^2$ cash allowance for tenant fit up work payable at commencement of lease.

11. At the tenants' option, the developer to provide financing costs of tenant improvements which exceed $\$3/ft^2$ allowance and such amount repayable as rent with interest at same rate as "senior permament financing" and amortized over the prime term of lease, or ten years, whichever is shorter.

12. Notwithstanding the minimum established lease rates of item 5, the net rental rate payable under both leases will be the actual average rental rate achieved in the high rise portion of the office tower under all other leases after adjustment to a full floor basis.

13. If a rate cannot be determined as of the lease commencing date, an estimate will be agreed upon, with later adjustments to a full building rental basis.

14. Expansion privilege to have first right of refusal to lease any space in building which is either vertically or horizontally continguous to the major tenant premises, and which becomes available during the currency of their lease.

15. Leasing terms for all tenancies immediately adjacent or below major tenant shall not exceed five years.

As a result of large unpredictable increases of O & M costs over relatively long periods of time, especially cost escalations, the triple net lease as described in Chapter 2, has been adopted by many developers across North America. Such is the case for this project, both for office and retail space. O & M costs and any increases in them are passed onto the tenants and risk or Net Operating Income (NOI) variations, as a result of unpredictable long term escalations, are largely estimated for the developer. The standard five year term, renegotiable triple net lease has been adopted for this project. A possible variation, not used in the project is: three (3) year terms. The latter is increasingly considered and "capped" triple net leases are sometimes negotiated with large tenants. In the "capped" triple net leases, limited overall or specific cost escalations (e.g. energy) could be included.

As is commonly the case, the developer assumes the proportionate amount of O & M costs for unleased or vacant space, during the lease-up period.

4.1.4 Traditional Investment Analysis

The final proforma, as put together by the developer, is based on the traditional approach to investment analysis and is limited to the "base year" cash flow, before taxes and debt service.

This traditional approach is shown in Table 4.5 and data is derived from the "likely" estimates presented in Tables 4.3 and 4.4.

The traditional investment analysis is based on the first full operating year. A normal vacancy rate of 5% has been assumed and included as an annual operating expense ($201,800).

PROFORMA - BASE YEAR ANALYSIS TRIPLE NET LEASES

Account	Annual - $/yr: Net Leasable Area Ft^2	Annual - $/yr: Lease Rate $/Ft^2/yr$	Annual - $/yr: Vacancy Rate %	Cash Flow: Sub-Totals $/yr	Cash Flow: Totals $/yr	Expenses: Vacancy $/yr	Expenses: O & M $/yr
I REVENUES							
A. Office Areas							
Anchor Tenant	40,422	9.00	-	363,800			
Balance of Space	307,052	8.75	-	2,686,700			
TOTAL	347,474	-	5		3,050,500	152,500	
B. Retail Areas							
1. Concourse Level							
Restaurant	10,440	10.50	-	109,600			
Balance of Space	11,342	15.50	-	175,800			
	21,782	-	-		285,400		
2. Street Level							
Lounge	1,600	10.50	-	16,800			
Fashion Dept. Store	8,225	11.00	-	90,500			
Trust Co.	6,640	25.00	-	166,500			
Balance of Space	5,470	18.00	-	98,500			
	21,935	-	-		372,300		
3. Mezzanine							
Fashion Dept. Store	17,350	11.00	-	190,900			
Balance of Space	4,400	12.50	-	55,000			
	21,750	-	-		245,900		
4. Pedway Retail	7,500	11.00	-		82,500		
TOTAL	72,967	-	5			49,300	
C. Parking Area							
355 cars @ $80/mth	-	-	-	340,800	340,800		
D. Gross Revenues	-	-	-	-	4,376,400		
II EXPENSES							
Total Vacancy						201,800	201,800
Parking Operations						-	75,000
Property Management (4% of total revenues)						-	175,000
Repair Reserve						-	65,000
Miscellaneous Costs						-	13,200
E. Gross Operating Costs						-	530,000
III CASH FLOW BEFORE DEBT SERVICE					3,846,400		

BASE YEAR INCOME AND EXPENSES
Table 4.5

The traditional proforma shows a NOI, before taxes and debt service of $3,846,000/yr. Based on a $32,000,000 mortgage and a $41,500,000 overall project cost, the developer's equity equals $9,500,000. The Return On Investment (ROI) or yield is 24.8% on equity investment, before taxes and debt service. In the traditional investment analysis no allowance is made for the time value of money.

If a capitalization rate (CR) of 12% is assumed for major banks at a prevailing 11% interest rate for prime lending, the project Economic Value (EV) would be estimated as:

$$EV = \frac{\text{NOI base year}}{CR}$$

$$EV = \frac{\$3,846,400}{0.12}$$

$$EV = \$32,053,333.$$

which is well below the $41,410,230 total project development costs.

Comments by financial executives and economists regarding the above discrepancy, indicate that the use of the above method for estimating project economic value has become rather obsolete as a measure of real estate lending by banking institutions due to the variable influences of recent escalations of interest and inflation rates. However, it remains a measure for "steady state" financial investments.

Based on the $32,000,000 mortgage[1] the financing represents 77% of the total development costs. Thus the leverage ratio (LR) is:

---

(1) The actual mortgage amount and interest rates secured at the start of the project remained undisclosed. They were however claimed to be "advantageous" in early 1979. The annual report for 1979 and issued in 1980 indicated a mortgage of $30,000,000 at 10.625%. Financing under these conditions represents 72% of the total project development costs.

$$LR = \frac{\text{Total Project Cost}}{\text{Equity}} = \frac{41,410,230}{9,500,000} = 4.36$$

Deficiencies inherent in the traditional approach to investment analysis include:

- time value of money is ignored
- no allowance is made for potential differential inflation rates
- taxes and debt servicing are ignored
- reversion value is ignored
- no consideration is given to risk
- the ROI calculation assumes the investment will continue in perpetuity and no allowance is made for recapture of equity investment.

Program Input — TRIPLE-NET LEASES		Optimistic	Likely	Pessimistic	Mean 1)	Standard Deviation 2)
Section 1						
Table of Annual C.C.A. and undepreciated cash flows	yrs	20	20	20	20	-
Annual Summaries of Operations and cash flows	yrs	20	20	20	20	-
Section 2						
Land Costs	Item (1)	$ 8,992,500	$ 8,992,500	$ 8,992,500	$ 8,992,500	-
Site Improvements	Item (2)					
Building Costs	Item (3)					
Fees	Items (6,7,7.5,9)					
Interest Construction Loan	Item (11)					
Equipment, etc.	Item (10)					
Other (excluding item 12, lease-up costs)	Items (6,13)	27,609,907	31,295,191	35,094,237	31,280,818	2,401,353
Total Capitalized Cost		$36,352,407	$40,237,691	$44,036,737	$40,233,318	$2,401,353
Market value at time of completion						
- Building Item (3 to 13) x 110%		35,604,303	35,604,303	35,604,303	35,604,303	-
- Land Item (1 + 2) x 115%		10,398,875	10,398,875	10,398,875	10,398,875	-
Total Market Value		$46,003,378	$46,003,378	$46,003,378	46,703,378	-
Selling Expenses		6	6	6	6	-
Rate of Escalation (annually compounded)						
Land/Buildings 0-1 year	%	10.0/10.0	7.5/7.5	5.0/5.0	7.5/7.5	1.863/1.863
" 1-5 years	%	8.0/7.5	7.5/6.0	5.0/4.0	7.2/5.9	0.938/1.094
" 6-10 years	%	7.5/6.0	7.0/5.0	5.0/3.0	6.8/4.8	0.781/0.938
" 11+ years	%	7.5/5.0	7.0/2.5	5.0/2.0	6.8/2.5	0.781/0.313
Section 3						
Construction Period	mos.	16	18	20	18	1.25
Start of First Lease Income	mos.	16	18	20	18	1.25
Lease-up Time	Mos.	20	22	24	22	1.25
Annual Income/Month						
Office $/ft²/yr	367,878 ft²	9.00	8.75	8.50	8.75	0.16
Retail "	72,967 ft²	15.00	13.50	12.00	13.50	0.94
Garages 355 cars x $/month		80.00	80.00	80.00	80.00	-
Vacancy and bad debts	%	5	5	5	5	-
Rent Escalator	%/yr	10	7.5	5	7.5	1.36
Term of Rent Escalator	(yrs)	5	5	5	5	-
Section 3						
Construction Period	mos.	16	18	20	18	1.25
Start of First Lease Income	mos.	16	18	20	18	1.25
Lease-up Time	Mos.	20	22	24	22	1.25
Annual Income/Month						
Office $/ft²/yr	367,878 ft²	9.00	8.75	8.50	8.75	0.16
Retail "	72,967 ft²	15.00	13.50	12.00	13.50	0.94
Garages 355 cars x $/month		80.00	80.00	80.00	80.00	-
Vacancy and bad debts	%	5	5	5	5	-
Rent Escalator	%/yr	10	7.5	5	7.5	1.36
Term of Rent Escalator	(yrs)	5	5	5	5	-
Section 6						
Annual cash operating expenses for full occupancy at start of project, owners' share	%	100	100	100	100	-
Owner Shares Costs $/yr and Escalators %/yr						
Management — Head Office	$/yr	180,000	180,000	180,000	180,000	-
Escalator	%/yr	6	5	8	5	1.25
Other Admin. Expenses	$/yr	139,500	139,500	139,500	139,500	-
Escalator	%/yr	5	8	10	8	1.36
Section 5						
1st mortage payment after construction	mos.	20	22	24	22	1.25
Present value discount rate	%	13.0	13.0	13.0	13.0	-
Interest Rate Mortgage	%	10.5	11.0	12.5	11.17	0.625
Mortgage Amount	$	32,000,000	32,000,000	32,000,000	32,000,000	-
Amortization Period	(yrs)	30	30	30	30	-
Capital Cost Allowance (Buildings)	%	5	5	5	5	-
Taxable Income	%	50	50	50	50	-
Initial Building Cost for CCA (see input section 2)	$	27,609,907	31,295,191	35,094,237	31,280,818	2,401,353
No. of equal mortgage payments per year		12	12	12	12	-
Capitalization Rate	%	-	-	-	-	-

Notes 1) MEAN = $\frac{O + 4L + P}{6}$

2) Stand deviation = $\frac{O - P}{3.2}$

TRIPLE NET LEASES - PROGRAM INPUT

Table 4.6

4.2 DETERMINISTIC INVESTMENT ANALYSIS - (LIKELY)

The deterministic investment analysis corresponds to the Net Present Value (NPV) analysis as described in Chapter 3.

Additional information inputs are required for a NPV analysis. The additional data required for the analysis are identified in Table 4.6. Of particular importance are estimates of building and land value appreciation rates. Overall project profitability is quite sensitive to assumptions regarding these rates, as demonstrated in Section 4.4.

Similarly, rent escalation has been assumed at 7.5%/year and is negotiable after five year terms for triple net lease agreements. The rate corresponds to a $((1.075)^5 - 1 \times 100\% = 43.56\%$ increase of rents every five years. As noted in the lease agreement with the major tenant, the actual rates will be determined by the market. Only "management" and other administrative expenses section 4, Table 4.6 have been included in the annual expenses to the developer.

An after tax discount rate of 13% over the entire investment period of analysis of 5, 10 and 15 year investment horizons has been utilized in this analysis. This rate represents the minimum attractive rate of return (MARR) of similar real estate developments, after taxes and including an allowance for inflation. This rate does not necessarily reflect the rate required by the developer for this investment. Assuming a long-term inflation rate of 9%, the real after tax rate of return would correspond to 3.67%. The discount rate closely reflects the short-term government bond issue rate. It generally averages between one and two percent above the prevailing prime interest rate and reflects an investment of virtually no risk.

A taxable income rate was derived from the developer's annual report (Appendix A-2) and calculated from the "Consolidated Statement of Earnings" as 29.3% of "taxable income". The income tax rate shown therefore reflects the prevailing tax for the total corporate portfolio, rather than the corporate tax structure for this or other developments. The specific tax rate for this development has been entered as a constant 50%.

Based on the program inputs as shown in table 4.6 an investment analysis was performed with the CBEES program. Various performance measures are shown in tables 4.7 and 4.8. A cashflow profile for the triple net lease is depicted in figure 4.9.

Although no single representative project performance measure can represent all of the investors motivations, various investment or profitability criteria are usually considered. Investors are generally interested in the performance of:

- Internal rate of return (IRR)
- equity input
- equity reversion
- uniformity of cashflow
- tax shelter benefits
- appreciation potential
- payback period
- risk

For the deterministic investment analysis the most significant criteria used for comparison as determined by CBEES are:

- IRR
- Project NPV

The IRR is measured at 5, 10 and 15 year investment horizons after taxes and debt services. Equity reversion at the end of the investment periods is included in the CBEES program IRR computations.

It can be seen from table 4.8 that the IRR after taxes and debt service decreases with increased holding period from a healthy 25.374% in the 5th year to 16.238% in the 15th year.

When the IRR is less than the discount rate, the project approaches end of its economic life. Beyond this point the investment is considered less than viable, given the assumptions made about escalation and appreciation rates. The reason for the decline of IRR and project NPV or revenue earning potential of the development can generally be assigned to the decreasing annual CCA and tax shelter amount, while net revenues after taxes and debt service do not increase sufficiently to compensate for the reduced tax write-off.

A second important investment performance measure is the uniformity of cash flow as plotted in figure 4.8 and derived from table 4.8. The cash flow (column k) shows the dips and dimples as a result of the five year negotiated lease term. The cumulative discounted cash flow shows some regularity but is of lesser significance. The periodic decline of cash flows is a disturbing element for a single investment. The periodic decline is even more disturbing when consideration is given to the inflation rate. It is for such seasons that developers prefer three year negotiated leases in order to permit a more even cash flow throughout the initial period of the project life cycle.

Although not encountered in this investment, it is conceivable that a significant negative cash flow occurs, starting immediately after construction. In such projects bridge financing is required to cover mortgage payments and lease-up expenses of the project. The CBEES program assumes coverage by equity from the investor.

SECTION 8*

SUMMARY OF OPERATIONS, MORTGAGE PAYMENTS, TENANTS EXPENSES
CASH FLOWS AND DISCOUNTED CASH FLOWS YEARLY

YEAR	(A) NET REVENUES	(B) CASH OPER.EXP.	(C) NET OPER.REV.	(D) MORTGAGE PRINCIPAL	(E) MORTGAGE INTEREST
1	0.	0.	0.	0.	0.
2	1096824.	169481.	927343.	36419.	860161.
3	3200531.	359660.	2840872.	155829.	3430492.
4	4151654.	381673.	3769981.	173442.	3412888.
5	4147939.	405089.	3742850.	193845.	3393277.
6	4147939.	430881.	3717938.	214864.	3371458.
7	4147939.	456508.	3691432.	239149.	3347134.
8	4147939.	484715.	3663224.	266179.	3320143.
9	5051421.	514737.	4536684.	296264.	3290058.
10	5954903.	546699.	5408210.	329749.	3256573.
11	5954903.	580715.	5374189.	367019.	3219303.
12	5954903.	616939.	5337965.	408501.	3177821.
13	5954903.	655512.	5299391.	454672.	3131650.
14	7251969.	696594.	6555374.	506061.	3080261.
15	8549034.	740354.	7808680.	563258.	3023063.

YEAR	(F) TENANT'S OPER.EXP.	(G) PROJECT CCA	(H) DEDUCTIONS FOR TAXES	(I) TAXABLE INCOME	(J) INCOME TAX
1	0.	0.	0.	0.	0.
2	0.	782380.	1812022.	-715199.	-357599.
3	0.	1525641.	5315793.	-2115261.	-1057631.
4	926865.	1449359.	5243911.	-1092258.	-546129.
5	2385229.	1376891.	5175256.	-1027317.	-513658.
6	2579293.	1308846.	5109505.	-961565.	-480783.
7	2793521.	1244644.	5046324.	-898385.	-449192.
8	3030434.	1180512.	4985370.	-837430.	-418715.
9	3292903.	1121486.	4926281.	125140.	62570.
10	3584196.	1065412.	4868678.	1086225.	543113.
11	3908038.	1012141.	4812159.	1142744.	571372.
12	4268682.	961534.	4756293.	1198618.	599305.
13	4670975.	913457.	4700620.	1254284.	627142.
14	5120458.	867784.	4644640.	2607329.	1303665.
15	5623456.	824395.	4587812.	3961222.	1980611.

YEAR	(K) CASH FLOW	(L) CASH FLOW DISC.	(M) CUMULATED DISC. C.F.	(N) CASH FLOW INV.RATIO
1	0.	0.	0.	0.0000
2	328762.	279341.	279341.	.0399
3	197234.	130035.	409375.	.0238
4	616873.	524936.	934312.	.0969
5	677550.	381198.	1315510.	.0788
6	619955.	306512.	1622022.	.0705
7	561776.	244075.	1866097.	.0623
8	503048.	192066.	2058163.	.0544
9	970509.	317064.	2375227.	.1020
10	1361529.	402386.	2777613.	.1387
11	1224040.	316930.	3094543.	.1287
12	1160012.	263929.	3358472.	.1104
13	1093782.	218683.	3577155.	.1002
14	1781565.	306621.	3883776.	.1567
15	2358219.	364885.	4248661.	.1985

"LIKELY" CASHFLOWS

Table 4.7

SECTION 9

SUMMARY AND ECONOMIC EVALUATION OF PROJECT

	5 YEAR HORIZON	10 YEAR HORIZON	15 YEAR HORIZON
TOTAL PROJECT COST	$ 40237691.	$ 40237691.	$ 40237691.
MARKET VALUE AT HORIZON	$ 63258034.	$ 82609931.	$ 99142919.
SELLING EXPENSES	$ 3795002.	$ 4956596.	$ 5948575.
NET SELLING PRICE	$ 59455032.	$ 77653335.	$ 93194344.
MORTGAGE BALANCE	$ 31441265.	$ 30895061.	$ 27795551.
CASH REVERSION BEFORE TAXES	$ 28013767.	$ 47558274.	$ 65398793.
BOOK VALUE	$ 35103422.	$ 29188322.	$ 24606810.
CAPITAL GAIN OR LOSS	$ 19217341.	$ 37415644.	$ 52956653.
RECAPTURE OF DEPRECIATION	$ 5134269.	$ 11052369.	$ 15631681.
CAPITAL GAINS TAX	$ 4804335.	$ 9353911.	$ 13239163.
TAX ON RECAPTURE	$ 2567135.	$ 5526184.	$ 7815840.
CASH REVERSION AFTER TAXES	$ 28642297.	$ 32678179.	$ 44343789.
DISCOUNTED CASH REVERSION	$ 10813959.	$ 8966323.	$ 6375401.
CASH EQUITY INVESTMENT	$ 8237691.	$ 8237691.	$ 8237691.
SUMMARY MEASURES, AFTER TAXES AND AFTER MORTGAGE PAYMENTS			
INTERNAL RATE OF RETURN	25.374 %	18.778 %	16.238 %
PROJECT NET PRESENT VALUE	$ 4710925.	$ 4327388.	$ 3183468.
BENEFIT/COST RATIO	1.633	1.581	1.427
PAYBACK PERIOD, YEARS	12.	12.	12.
SUMMARY MEASURES, AFTER TAXES AND ASSUMING NO MORTGAGE!			
INTERNAL RATE OF RETURN	13.827 %	12.304 %	11.826 %
PROJECT NET PRESENT VALUE	$ 37393.	$ -1676957.	$ -3519868.
BENEFIT/COST RATIO	1.001	.954	.903
PAYBACK PERIOD, YEARS	11.	11.	11.

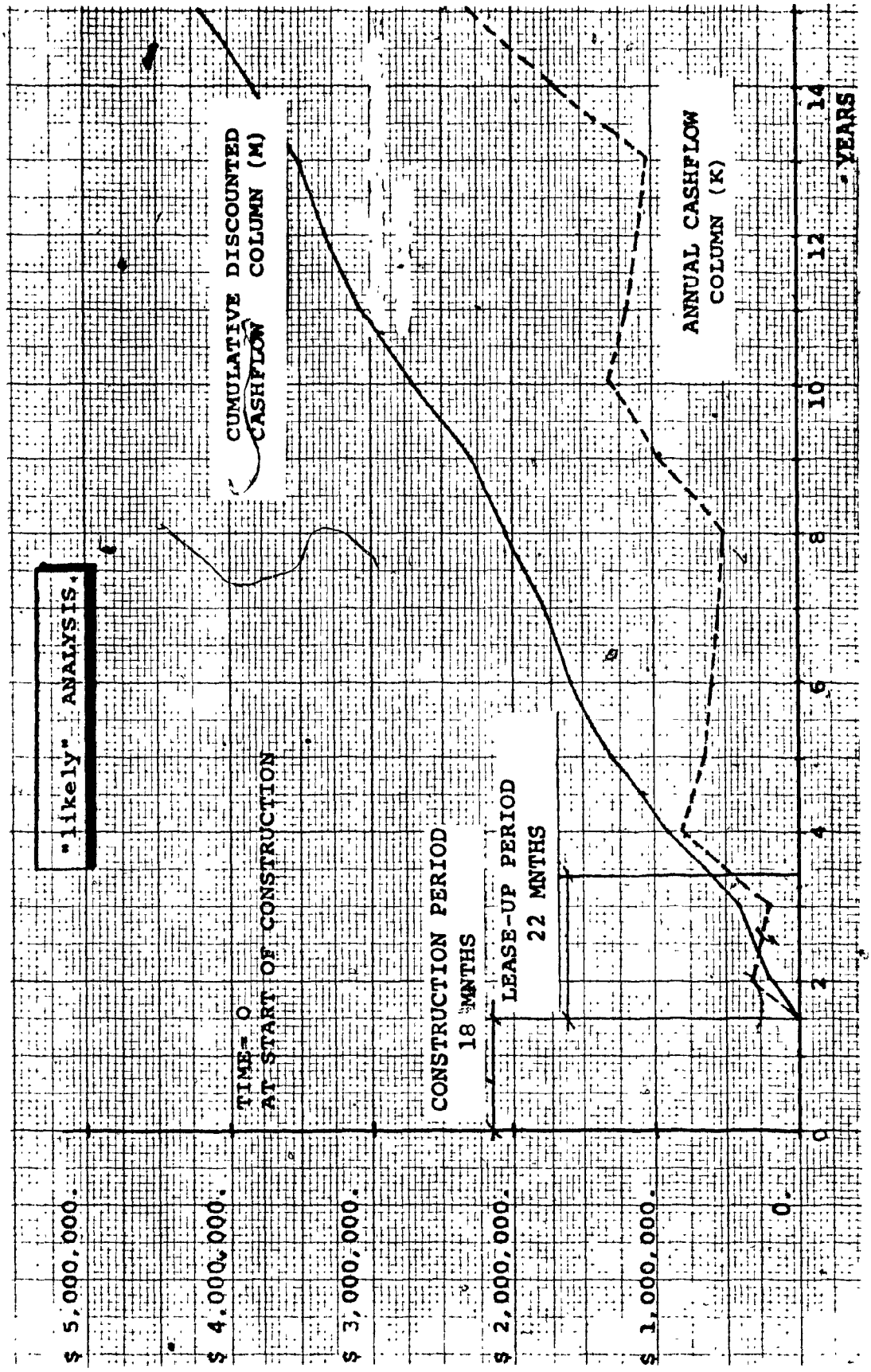
THE DISCOUNT RATE USED IN THE PRESENT VALUE CALCULATIONS IS: 13.000 /YR.

WHERE COST IS THE INITIAL CASH EQUITY INVESTMENT AND THE LATTER IS LESS THAN OR EQUAL TO ZERO, A ZERO (0) IS PRINTED FOR BENEFIT/COST RATIO

IF THE PAYBACK PERIOD IS GREATER THAN THE HORIZON REQUESTED A -9 IS PRINTED FOR PAYBACK

LIKELY - EVALUATION SUMMARY

Table 4.8



"LIKELY" - CASHFLOW - GRAPH

Fig. 4.8

The timing of cash flows is of significance to the investor. CBEES has been programmed for accrual accounting procedures with respect to cash flow. As a result, there are some built-in assumptions regarding the timing of income and expenditures. Cashflow columns A through J of table 4.7 therefore do not necessarily amount to the totals as shown in column K.

The traditional proforma of table 4.5 shows a base year cashflow of $3,846,000/yr. (before taxes and debt service). Conceivably this first full operating year should be based on year starting after 38 months, following the likely estimates of an 18 month construction period, and an additional 20 month lease-up period after construction.

In comparison, the CBEES summary of cashflows in table 4.7, column E, shows a $2,840,872.-annual income in the period 36 - 48 months following start of construction. In the subsequent year, income of $3,769,981.- is realized.

Although a 2 month discrepancy in time exists, the difference is rather significant and can possibly be reconciled by the following:

- "Repair reserve", $65,000.-/yr has not been included in CBEES program as a cashflow, a total of $260,000.- after 3 years.
- "Miscellaneous costs", $13,200/yr have not been included in the CBEES program, a total of $52,800.- after 3 years. These costs have been assigned to the tenants under triple net lease-agreements.
- "Property Management costs", at $175,000.- have been escalated at 5%/yr since start of construction. The extra cumulative costs at the end of the 47th month period (4 full years) is ($175,000.(1+0.05)^4 - $175,000.) = $37,714.-.

- The "other administrative expenses" in the CBEES program have been escalated at 8% /yr with an initial cost of $139,500.- estimated at start of construction.
  Thus the cumulative difference amounts to ($139,500.(1+0.08)^4 - $139,500.) = $50,288.-.
- Total cumulative cost difference, not including accruing, of the above items amounts to $400,802.- at the end of the 3rd year.
- Adjustments for the extra 2 month income for equal base year comparison and rent escalation effects should account for the remaining difference of $528,307.-.

The significance of real cashflow and escalation rates is emphasized by the difference in "base year" incomes between traditional and CBEES program investment models.

In summary the above comparison demonstrates clearly the need for real-world investment modeling and financial analysis in which escalation rates etc. are included. In addition, the deterministic analysis as performed by the CBEES program for likely input estimates provides the investor with some long term project profitability criteria in the form of IRR and NPV. The computerized approach, further permits the inclusion of time value of money taxes, debt service, equity reversion etc., as discussed before.

4.3 SENSITIVITY ANALYSIS

To demonstrate sevsitivity of input variables of the test case, the mean [1] input was used with the CBEES program for values as shown in table 4.6.

Once "sensitive" input variables are identified or ranked in order of impact, the investor can further investigate the accuracy of the input variables to which performance is most sensitive. The effect of increasing the accuracy of estimates for the most sensitive input variables has the effect of reducing overall investment risk.

To illustrate the sensitivity of performance, changes were made in the following input variables:

1. Construction Costs
2. Financing Interest Rate
3. Mortgage Amortization Period
4. Rental Rates
5. Rental Escalation Rates
6. Land and Building Appreciation Rate
7. Mortgage Amount (Leverage)
8. Construction period.

Program input and output have been summarized in Table 4.9. The sensitivity analyses have been performed for a ten year holding period. Investment performance is measured for:

- IRR
- Project NPV
- Cumulative discounted cash flow

---

1) Mean value program input for sensitivity analysis does not correspond to the corrected "mean" of section 4.5 for the sensitivity analysis:
   - lease-up costs (item 12 of traditional proforma) are included;
   - owners' share of operating costs during lease-up equals 75%
   - income tax rate is 30%
   - CCA initial building cost to correspond to capitalized project costs.

Close examination of the changes indicate a "non-linear" response of most variables. Sensitivity coefficients (SC) include the higher order relationship as derived in chapter 3 and small changes only, must be considered for maximum accuracy. Graphical representation of the above has been included in Fig. 4.9, 4.10 and 4.11 for: "IRR", "NPV" and "Cum. Disc. Cash Flow" respectively. The SC have been summarized and ranked in Fig. 4.12.

The review of Table 4.9 and the sensitivity analysis, for this project can be summarized as follows:

- sensitivity of variables is non-linear and SC represent a tangent at the point of origin (eg.: $x/x = IRR/IRR = 0$).

- different profitability measures affect SC differently. As an example: "Construction costs" (item 1) ranks as the most sensitive variable for IRR and NPV but has virtually no effect on "Cum. Disc. Cash Flow";

- similarly appreciation rates for land/building (item 6) affect "Project NPV" in major ways whereas impact on IRR is minimal and absolute zero for "Cum. Disc. Cash Flow";

- mortgage amount (item 3) has the greatest impact on "Cum. Disc. Cash Flow" while "IRR" and "Project NPV" are only marginally affected;

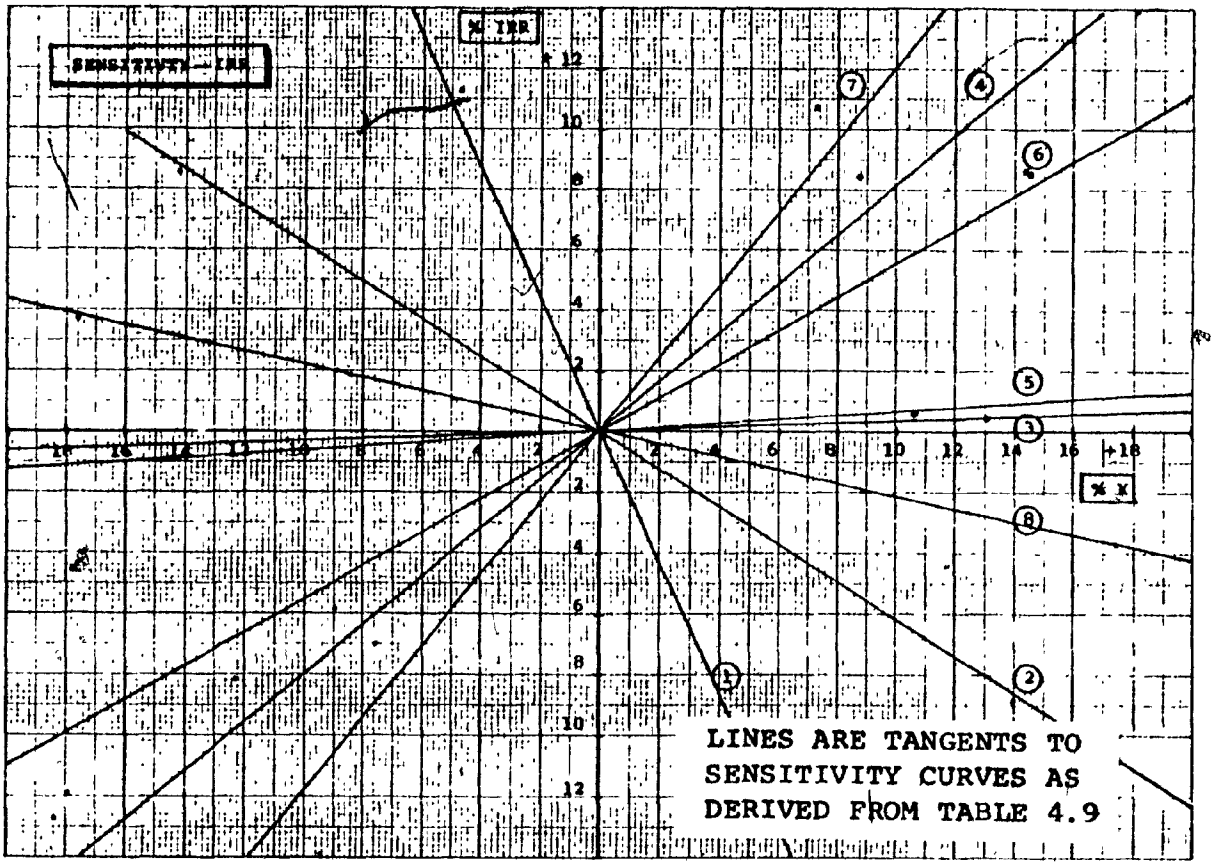
- construction period (item 8) sensitivity is greatest for "Cum Disc. Cashflow" while lesser impact on NPV and IRR can be noted.

The earlier statement in section 4.1, indicating reluctant acceptance of a 10% construction cost overrun in fact represents a 4 point drop in IRR or a 23% change from base. Thus it is questionable whether such an overrun in construction cost in fact would be acceptable to management and investors. The IRR would be reduced from 17.26% to 13.26% which could be below the minimum acceptable rate of Return (MARR) of the investors.

SENSITIVITY ANALYSIS										
INPUT VARIABLES				OUTPUT PROFITABILITY (10 YEAR HORIZON)						
Item	Variable	Change		Absolute Value			Relative Change Δ %			
	Program	Absolute Value	Change Δ%	IRR %	Project NPV $	Cum. Disc. Cashflow $	IRR	Project NPV	Cum. Disc. Cashflow
1	Construction Costs									
	+$6 million	36,368,750	+12.3	13.36	380,976	2,182,867	-22.6	-98.9	+10.9
	+$2 million	30,368,750	+6.1	15.13	2,056,909	2,075,213	-12.4	+4.9	+5.5
	Base Program Reference	32,368,750	0	17.26	3,732,832	1,967,563	0	0	0
	-$2 million	30,368,750	-6.1	19.79	5,301,444	1,806,085	+14.6	+42.0	-8.2
	-$6 million	28,368,750	-12.3	23.19	6,870,056	1,644,607	+34.3	+84.0	-16.4
2.	Mortgage Interest Rate									
	+6%	15.17	+40.6	13.36	320,235	-1,178,394	-22.6	-91.4	-
	+2%	13.17	+17.9	15.32	2,033,380	420,607	-11.3	-45.5	-97.9
	Base Program Reference	11.17	0	17.26	3,732,832	1,967,563	0	0	0
	-2%	9.17	-17.9	19.15	5,438,070	3,403,367	+10.9	+ 7.9	+174.6
	-4%	7.17	-40.6	20.98	7,026,337	4,802,722	+21.5	+88.2	+144.1
3.	Mortgage Amortization Period									
	-10 yrs.	20	-33.3	16.69	3,618,102	935,193	- 3.4	-8.4	-97.3
	- 5 yrs.	25	-16.7	17.03	3,623,109	1,468,204	- 1.3	- 2.1	-25.4
	Base Program Reference	30	0	17.26	3,732,832	1,967,563	0	0	0
	+ 5 yrs.	35	+16.7	17.37	3,793,698	2,244,374	+ 0.6	+ 1.6	+11.6
	+10 yrs.	40	+33.3	17.44	3,828,135	2,406,002	+ 1.0	+ 2.6	+42.6
4.	Rental Rate Office/Retail									
	-$2/yr/ft^2	6.75/11.50	-22.8/-14.8	14.62	421,021	-325,883	-15.3	-61.9	-
	-$1/yr/ft^2	7.75/12.50	-11.4/- 7.4	15.93	2,376,926	820,838	- 7.7	-31.0	-95.8
	Base Program Reference	8.75/13.50	0	17.26	3,732,832	1,967,563	0	0	0
	+$1/yr/ft^2	9.75/14.50	+11.4/+ 7.4	18.58	5,088,732	3,114,289	+10.8	+31.0	+58.3
	+$2/yr/ft^2	10.75/15.50	+22.8/+14.8	19.90	6,844,643	4,838,133	+15.3	+61.9	+145.9
5.	Rent Escalation									
	-2.5%/yr	5.0	-33.3	17.03	3,519,013	1,763,602	- 1.2	- 5.7	-10.4
	-1.0%/yr	6.3	-13.3	17.17	3,644,926	1,883,676	- 0.5	- 2.4	- 4.3
	Base Program Reference	7.5	0	17.26	3,732,832	1,967,563	0	0	0
	+1.0%/yr	8.3	+13.3	17.34	3,820,070	2,050,636	+ 0.5	+ 2.4	+ 4.4
	+2.5%/yr	10.0	+33.3	17.48	3,967,381	2,191,485	+ 1.3	+ 6.3	+11.1
6.	Land/Bldg. Appreciation Rate									
	-5.0%/yr	2.5/2.5	-66.7	7.38	-3,110,134	1,967,563	-57.2	-	0
	-2.5%/yr	5.0/5.0	-33.3	12.92	-99,391	1,967,563	-25.1	-	0
	Base Program Reference	7.5/7.5	0	17.26	3,732,832	1,967,563	0	0	0
	+2.5%/yr	10.0/10.0	+33.3	20.61	7,922,822	1,967,563	+19.4	+112.2	0
	+5.0%/yr	12.5/12.5	+66.7	20.24	10,190,084	1,967,563	+66.4	+280.2	0
7.	Mortgage Amount									
	-$6 million	26,000,000	-18.8	16.37	1,881,077	3,977,263	-15.6	-49.6	+102.2
	-$3 million	29,000,000	- 9.4	15.70	2,806,954	2,972,703	- 9.0	-24.8	+51.1
	Base Program Reference	32,000,000	0	17.26	3,732,832	1,967,563	0	0	0
	+$3 million	35,000,000	+ 9.4	19.58	4,658,709	962,423	+13.4	+24.8	-95.1
	+$6 million	38,000,000	+18.8	23.63	5,584,587	-42,717	+36.9	+49.6	-
8.	Construction Period									
	14 months	14	-22.2	18.13	4,489,902	2,936,383	+5.2	+20.3	+49.2
	16 months	16	-11.1	17.69	4,106,292	2,446,164	+2.5	+10.0	+24.3
	Base Program Reference	18	0	17.26	3,732,832	1,967,563	0	0	0
	20 months	20	+11.1	16.83	3,367,872	1,498,680	-2.5	-9.8	-23.8
	22 months	22	+22.2	16.42	3,012,666	1,060,798	-4.9	-19.3	-47.1

SENSITIVITY OF VARIABLES

Table 4.9



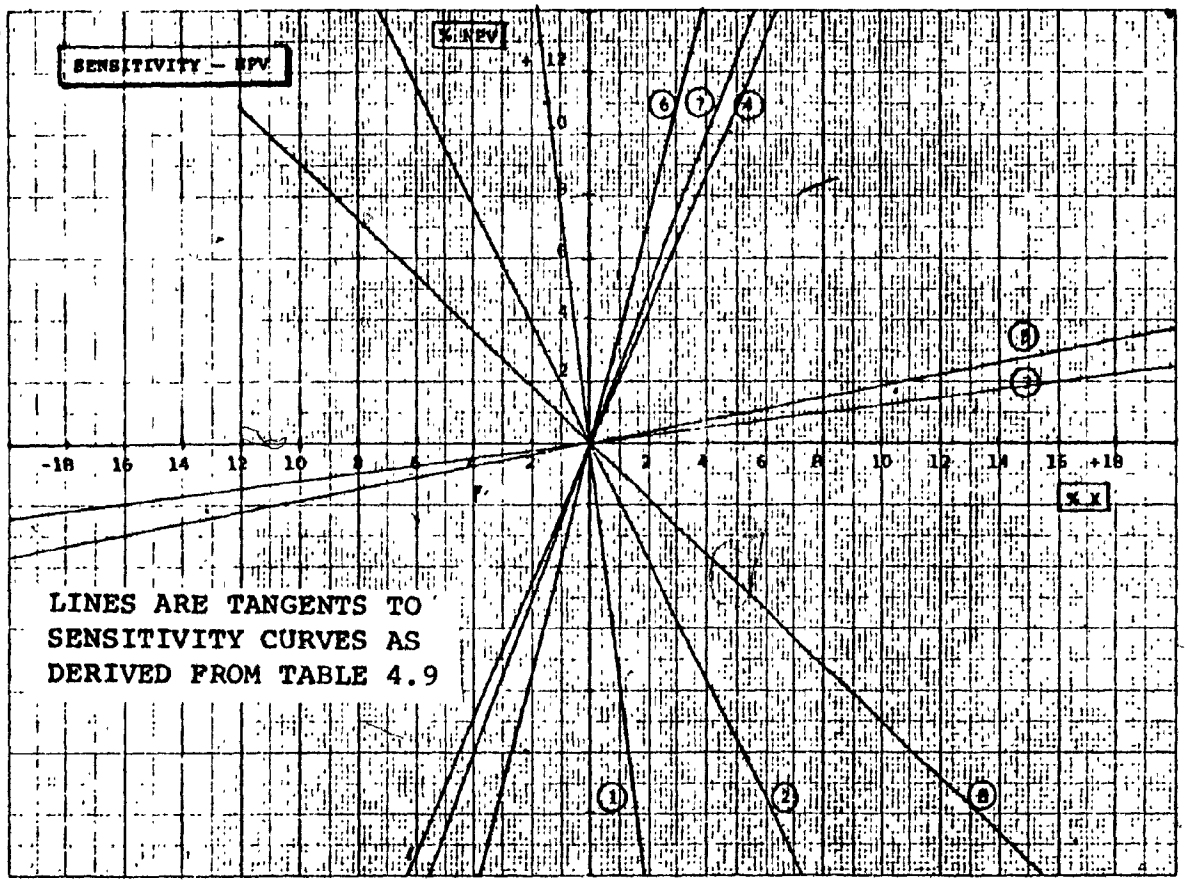
X = INPUT VARIABLE

1=CONSTRUCTION COSTS
2=MORTGAGE INTEREST RATES
3=MORTGAGE AMORTIZATION PERIOD
4=RENTAL RATE (OFFICE)
5=RENT ESCALATION
6=LAND/BLDG APPRECIATION RATES
7=MORTGAGE AMOUNT
8=CONSTRUCTION PERIOD

SENSITIVITY - IRR - GRAPHED

(10 Year)

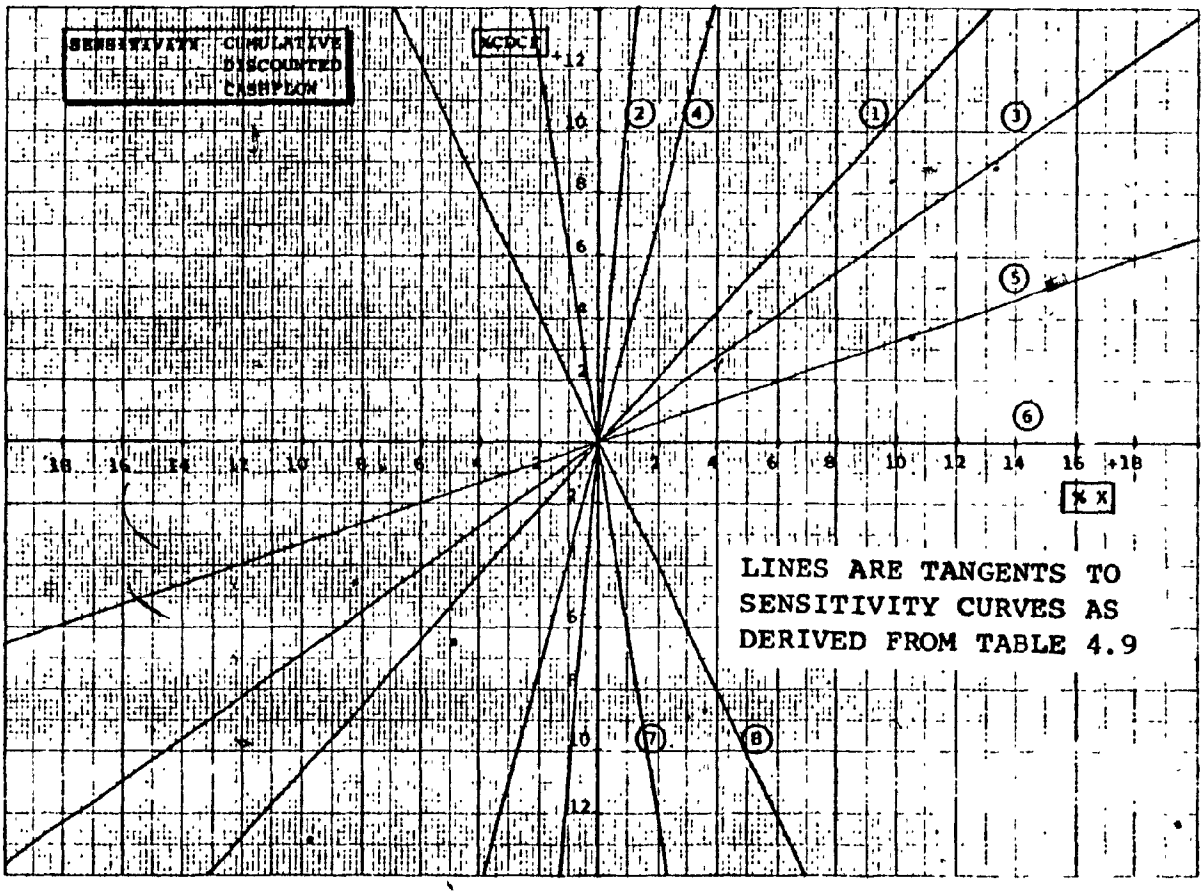
Fig. 4.9



SENSITIVITY - PROJECT NPV - GRAPHED

(10 Year)

Fig. 4.10



X = INPUT VARIABLE

1=CONSTRUCTION COSTS
2=MORTGAGE INTEREST RATES
3=MORTGAGE AMORTIZATION PERIOD
4=RENTAL RATE (OFFICE)
5=RENT ESCALATION
6=LAND/BLDG APPRECIATION RATES
7=MORTGAGE AMOUNT
8=CONSTRUCTION PERIOD

SENSITIVITY - CUM. DISC. CASH FLOW - GRAPHED

(10 Year)

Fig. 4.11

SUMMARY OF SENSITIVITY COEFFICIENTS							
INPUT		SENSITIVITY COEFFICIENTS			RANKING CRITERION		
Item	Variable	IRR	NPV	Cumm. Disc. Cashflow	IRR	NPV	Cumm. Disc. Cashflow
1	Construction Costs	-2.08	-7.20	+0.08	1	1	7
2	Mortgage Interest Rate	-0.64	-2.50	+11.80	5	4	1
3	Amortization Period	+0.04	+0.09	+0.50	8	8	5
4	Rental Rate (Office)	+0.98	+2.40	+4.00	3	5	3
5	Rent Escalation	+0.05	+0.19	+0.33	7	7	6
6	Land/Bldg. Appreciation	+0.58	+4.00	0	6	2	8
7	Mortgage Amount	+1.45	+2.90	-11.20	2	3	2
8	Construction period	-0.86	-0.91	-1.64	4	6	4

The expression for sensitivity coefficient. SC :

$$SC = \left(\frac{\Delta IRR}{IRR} \Big/ \frac{\Delta X}{X} \right) \quad \text{or} \quad \left(\frac{\Delta NPV}{NPV} \Big/ \frac{\Delta X}{X} \right)$$

$$SC = \left(\frac{\% \ IRR}{\% \ X} \right) \quad \text{or} \quad \left(\frac{\% \ NPV}{\% \ X} \right)$$

SENSITIVITY COEFFICIENTS

(10 Year)

Fig. 4.12

4.4 OPTIMIZATION - (GROSS LEASE)

The process of optimization is aimed at maximization of the project profitability by manipulating variables which relate to energy consumptions. Variables treated deal with the enclosure design and their impact on annual energy consumption. These variables were chosen as a result of the high interest which exists in the building industry for energy conservation and economical methods to achieve it.

Since a dependency exist between enclosure treatment and energy consumption, their relationship was determined using the Meriwether Energy Systems Analysis computer program. The original building enclosure and energy consumption items were used as a deterministic base value which relates in turn to the base IRR and NPV project profitability.

The building enclosure changes involved glazing and wall insulation changes while corresponding annual energy costs were obtained from the "Merriwether" computer program. Corresponding building enclosure costs changes were estimated and energy costs obtained from the separate program. They were then entered into the CBEES program to obtain the resulting IRR and NPV. The highest obtainable IRR or NPV represents the project optimum for the particular combination of input parameters.

Since energy costs are a insensitive paramenter in the "triple net lease" scenario, a "gross lease" was assumed to amplified its effect and the CBEES program input was modified to reflect the gross lease rental rates and annual O & M costs.

BASE YEAR O & M EXPENSES - GROSS LEASE			
Item	Category	Annual Costs $/YR	Specific $/ft^2/YR
1	Parking Operation	75,000	0.60 (1)
2	Property Management	180,000	0.43
3	Repair Reserve	65,000	0.15
4	Cleaning	401,600	0.95
5	Electrical System	22,900	0.05
6	Elevators	69,300	0.16
7	General Building Costs	108,600	0.26
9	Energy	374,200	0.89
10	Insurance	30,900	0.07
11	Real Estate Tax	632,800	1.48
	TOTAL ANNUAL COSTS	$2,099,800	$ 5.00 (2)

Notes: (1) Based on 126,000 ft^2

(2) Based on 420,441 ft^2

GROSS LEASE - BASE YEAR O & M EXPENSES

Table 4.10

A deterministic "mean" program was used and inputs are as shown in table 4.12.

A detailed base year O & M cost, obtained from the developer, is shown in table 4.11.

The inputs form the reference of building costs and annual energy cost changes. Project profitability for the gross lease scenario has been shown in tables 4.13 and 4.14. They are not necessarily comparable [1)] to the mean "triple net" program output of section 4.2. The violent flucuations of cashflow under a gross lease agreement are shown in figure 4.13. They provide a significant justification for the triple net lease agreements sought by most developers. Profitability criteria IRR and NPV for the gross lease are lower than the triple net lease scenario.

Program Input — GROSS LEASES		Optimistic	Likely	Pessimistic	Mean Value
Section 1					
Table of Annual C.C.A. and undepreciated cash flows	yrs	20	20	20	20
Annual Summaries of Operations and cash flows	yrs	20	20	20	20
Section 2					
Land Costs	* Items (1)	$ 8,962,500	$ 8,962,500	$ 8,962,500	$ 8,962,500
Site Improvements	Items (2)				
Building Costs	Items (3)				
Fees	Items (4,5,7,8,9)	27,527,208	32,467,730	38,014,367	32,568,730
Interest Construction Loan	Item (11)				
Equipment, etc.	Item (10)				
Other	Items (6,12,13)				
Total Capitalized Cost		$36,489,708	$41,430,230	$46,976,867	$41,531,230
Market value at time of completion					
- Building Items (3 to 13) x 110%		35,600,303	35,600,303	35,600,303	35,600,303
- Land Item (1 + 2) x 115%		10,398,875	10,398,875	10,398,875	10,398,875
Total Market Value		$46,003,378	$46,003,378	$46,003,378	46,003,378
Selling Expenses		6	6	6	6
Rate of Escalation (annually compounded)					
Land/Buildings 0-1 year	%	10.0/10.0	7.5/7.5	5.0/5.0	7.5/7.5
" 2-5 years	%	8.0/7.5	7.5/6.0	5.0/4.0	7.2/5.9
" 6-10 years	%	7.5/6.0	7.0/5.0	5.0/3.0	6.8/4.8
" 11+ years	%	7.5/5.0	7.0/2.5	5.0/2.0	6.8/2.5
Section 3					
Construction Period	mos.	16	18	20	18
Start of First Lease Income	mos.	16	18	20	18
Lease-up Time	Mos.	20	22	24	22
Annual Income/Mo/h					
Office $/ft²/yr	307,076 ft²	16.00	15.00	13.00	15.00
Retail "	72,967 ft²	25.00	24.00	23.00	24.00
Garages 359 cars x $/month		80.00	80.00	80.00	80.00
Vacancy and bad debts	%	5	5	5	5
Rent Escalator	%/yr	10	7.5	5	7.5
Term of Rent Escalator	(yrs)	5	5	5	5
Section 4					
Annual cost operating expenses for full occupancy at start of project, owners share	%	75	75	75	75
Owner Shares Costs $/yr and Escalators %/yr					
Superintendent	$75,000	5	8	10	8
Management - Head Office	$180,000	4	5	8	5
Hydro (Excluding Heating)	$22,500	4	5	6	5
Water	-	-	-	-	-
Total Energy Costs	$379,200	10	15	20	15
Painting & Decorating	-	-	-	-	-
Maintenance and Repairs	$65,000	4	5	6	5
Supplies	-	-	-	-	-
Services	$69,300	6	8	10	8
Misc. Operating Expense	$401,600	3	6	8	6
Other Admin. Expense	$139,300	5	8	10	8
Insurance	$58,900	4	5	6	5
Real Estate Taxes	$632,200	4	6	8	6
Other Taxes	-	-	-	-	-
Ground Rent'or Land Lease	-	-	-	-	-
Other	-	-	-	-	-
Base Year Total	$1,991,200				
Section 5					
1st mortage payment after construction	mos.	20	22	24	22
Present value discount rate	%	13.0	13.0	13.0	13.0
Interest Rate Mortgage	%	10.5	11.8	12.3	11.17
Mortgage Amount	$	32,000,000	32,000,000	32,000,000	32,000,000
Amortization Period	(yrs)	30	30	30	30
Capital Cost Allowance (Buildings)	%	5	5	5	5
Taxable Income	%	30	30	30	30
Initial Building Cost for CCA	$	27,527,208	32,467,730	38,014,367	32,568,730
No. of equal mortgage payments per year		12	12	12	12
Capitalization Rate	%	-	-	-	-

* REFERENCE OF ITEMS AS PER TABLE 4.3

GROSS LEASE - PROGRAM INPUT

Table 4.11

SECTION 8

SUMMARY OF OPERATIONS, MORTGAGE PAYMENTS, TENANTS EXPENSES
CASH FLOWS AND DISCOUNTED CASH FLOWS YEARLY

YEAR	(A) NET REVENUES	(B) CASH OPER.EXP.	(C) NET OPER.REV.	(D) MORTGAGE PRINCIPAL	(E) MORTGAGE INTEREST
1	0.	143042.	-143042.	0.	0.
2	1612048.	899604.	912645.	35161.	873170.
3	5458959.	1776381.	3682578.	150598.	3482724.
4	6957722.	2208473.	4759249.	167890.	3465433.
5	6938912.	2707008.	4231905.	187167.	3446156.
6	6938912.	2930514.	4008398.	208657.	3424666.
7	6938912.	3176527.	3762385.	232615.	3400708.
8	6938912.	3447746.	3491166.	259323.	3373999.
9	9828740.	3747237.	5281504.	289099.	3344224.
10	11118569.	4078475.	7040093.	322293.	3311030.
11	11118568.	4445416.	6673152.	359298.	3274024.
12	11118568.	4852552.	6266016.	400552.	3232770.
13	11118568.	5305000.	5813568.	446543.	3186779.
14	14471924.	5808584.	8663340.	497815.	3135507.
15	17825280.	6243564.	11581716.	554974.	3078348.

YEAR	(F) TENANT'S OPER.EXP.	(G) PROJECT VCA	(H) DEDUCTIONS FOR TAXES	(I) TAXABLE INCOME	(J) INCOME TAX
1	0.	0.	143042.	-143042.	-42913.
2	0.	814219.	2586792.	-774744.	-232423.
3	0.	1587727.	6846532.	-1387573.	-416272.
4	56214.	1508340.	7182246.	-214524.	-64357.
5	144189.	1432923.	7586087.	-647175.	-194152.
6	155803.	1361277.	7716457.	-777545.	-233263.
7	166628.	1293213.	7870448.	-931536.	-279461.
8	179125.	1228553.	8058298.	-1111386.	-333416.
9	192560.	1167125.	8258585.	770155.	231046.
10	207002.	1108769.	8498274.	2620294.	786088.
11	222527.	1053330.	8772770.	2345798.	703739.
12	239216.	1000664.	9085986.	2032582.	609775.
13	257157.	950631.	9442409.	1676159.	502848.
14	276444.	903099.	9847190.	1624734.	1387428.
15	297178.	857940.	10179857.	7645424.	2293627.

YEAR	(K) CASH FLOW	(L) CASH FLOW DISC.	(M) CUMULATED DISC. C.F.	(N) CASH FLOW INV.RATIO
1	-279844.	-260953.	-260953.	-.0294
2	-82766.	-68690.	-329644.	-.0087
3	305532.	206292.	-123351.	.0320
4	1221110.	787475.	664123.	.1259
5	788258.	442995.	1107118.	.0799
6	620606.	306913.	1414031.	.0617
7	421558.	183260.	1597291.	.0411
8	205115.	78478.	1675769.	.0195
9	1536431.	494531.	2170299.	.1429
10	2741069.	809293.	2979593.	.2482
11	2353238.	608290.	3588883.	.2071
12	2041498.	464505.	4053389.	.1741
13	1697611.	339457.	4392846.	.1400
14	3832342.	655764.	5048618.	.3049
15	5726579.	885321.	5933930.	.4382

MEAN - GROSS LEASE

SUMMARY OF OPERATIONS

Table 4.12

SECTION 9

SUMMARY AND ECONOMIC EVALUATION OF PROJECT

	5 YEAR HORIZON	10 YEAR HORIZON	15 YEAR HORIZON
TOTAL PROJECT COST	$ 41511250.	$ 41511250.	$ 41511250.
MARKET VALUE AT HORIZON	$ 62901996.	$ 81369083.	$ 97355749.
SELLING EXPENSES	$ 3774120.	$ 4882145.	$ 5841345.
NET SELLING PRICE	$ 59127877.	$ 76486938.	$ 91514404.
MORTGAGE BALANCE	$ 31459185.	$ 30147199.	$ 27888016.
CASH REVERSION BEFORE TAXES	$ 27668691.	$ 46339739.	$ 63626387.
BOOK VALUE	$ 36168041.	$ 38009105.	$ 25243437.
CAPITAL GAIN OR LOSS	$ 17616627.	$ 34975688.	$ 58003154.
RECAPTURE OF DEPRECIATION	$ 5343209.	$ 11502145.	$ 16267813.
CAPITAL GAINS TAX	$ 2642494.	$ 5246353.	$ 7500473.
TAX ON RECAPTURE	$ 1602963.	$ 3450644.	$ 4880344.
CASH REVERSION AFTER TAXES	$ 23423235.	$ 37642742.	$ 51245570.
DISCOUNTED CASH REVERSION	$ 12270820.	$ 10330817.	$ 7367777.
CASH EQUITY INVESTMENT	$ 9511250.	$ 9511250.	$ 9511250.
SUMMARY MEASURES, AFTER TAXES AND AFTER MORTGAGE PAYMENTS			
INTERNAL RATE OF RETURN	23.689 %	18.278 %	16.786 %
PROJECT NET PRESENT VALUE	$ 4811385.	$ 4769758.	$ 4709513.
BENEFIT/COST RATIO	1.506	1.555	1.548
PAYBACK PERIOD, YEARS	11.	11.	11.
SUMMARY MEASURES, AFTER TAXES AND ASSUMING NO MORTGAGE!			
INTERNAL RATE OF RETURN	13.174 %	12.688 %	12.478 %
PROJECT NET PRESENT VALUE	$ 249291.	$ -1828039.	$ -1748946.
BENEFIT/COST RATIO	1.027	.973	.954
PAYBACK PERIOD, YEARS	11.	11.	11.

THE DISCOUNT RATE USED IN THE PRESENT VALUE CALCULATIONS IS: 13.000 /YR.

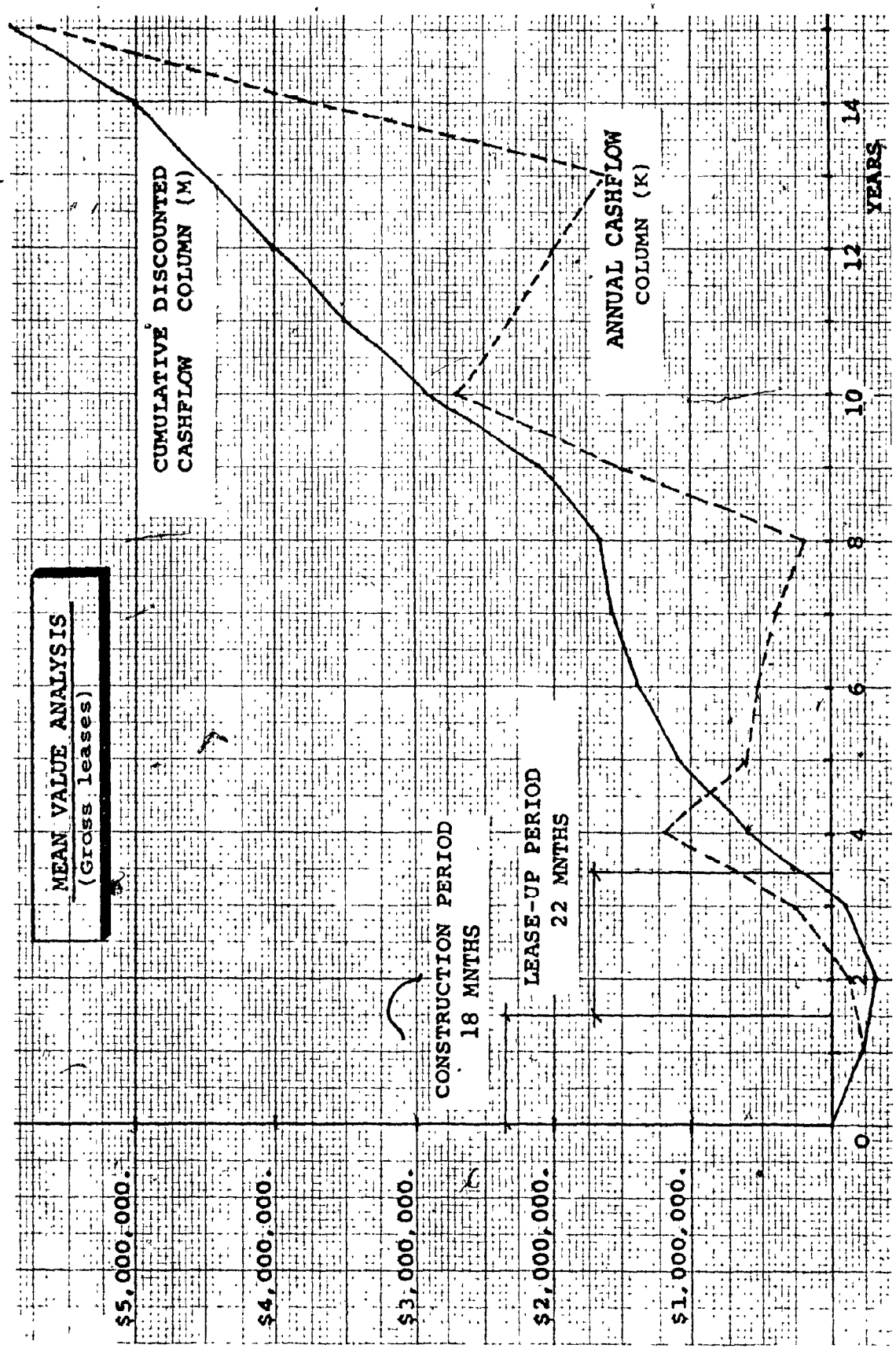
WHERE COST IS THE INITIAL CASH EQUITY INVESTMENT AND THE LATTER IS LESS THAN OR EQUAL TO ZERO. A ZERO (0) IS PRINTED FOR BENEFIT/COST RATIO

IF THE PAYBACK PERIOD IS GREATER THAN THE HORIZON REQUESTED A 99 IS PRINTED FOR PAYBACK

MEAN – GROSS LEASE

SUMMARY OF ECONOMIC MEASURES

Table 4.13



CASHFLOW - MEAN - GRAPHED

Fig. 4.14

4.4.1 BUILDING ENCLOSURE AND ENERGY COST RELATIONSHIP

The relationship between building enclosure treatment and annual energy costs is a complicated issue when the entire building complex is considered. A great number of "zones" would be required to include to various wall and window systems.

Due to budget constraints and in order to simplify the analysis, only the typical office floors of the office tower were considered for the energy conservation study. As a result, a total of 330,000 ft.^{2} of net leasable office out of a total 420,441 ft.^{2} combined office and retail area was studied. (see table 4.1)

The summary and relationship of building enclosure and energy consumption is depicted in Table 4.14. Wall cost estimates were obtained from the supplier of the original building wall system in 1979 dollars. Energy consumption data was obtained from several "Merriwether" [1] computer runs. (The funds for these runs were provided by Concordia University, Centre for Building studies, Montreal). Resulting annual energy costs were converted into 1979 dollar amounts based on local energy and utility cost data.

Building enclosure and energy cost changes relative to the base "mean" CBEES program were entered to obtain the resulting IRR and NPV output. The relationship between the input (dependent variables: wall system costs and energy cost) and output (IRR and NPV) have been summarized in Table 4.15.

---

1) Building energy computer program commercially available through Public Works - Government of Canada - Ottawa.

BUILDING DATA AND SYSTEM MATRIX				
GLAZING	Building Enclosure & Energy Consumption	Exterior Panel Insulation Thickness		
		2"	4"	6"
CLEAR DOUBLE	**Perimeter System**	1	2	3
	U-glass BTU/hr/ft²/°F	0.490	0.490	0.490
	U-panel BTU/hr/ft²/°F	0.114	0.060	0.040
	1) U-overall BTU/hr/ft²/°F	0.310	0.284	0.274
	Shading Coeff.	0.88	0.88	0.88
	2) Wall Costs $/ft²	18.35	18.60	18.65
	3) Heating MBH/yr	14,347,689	13,262,513	12,857,192
	4) Chiller ton-hrs/yr	395,833	396,805	397,354
	5) Lights & Power KWH/yr	6,078,194	6,082,449	6,082,764
	6) Specific Heating KWH/ft²/yr	16.99	15.71	15.22
	7) Specific Chiller KWH/ft²/yr	0.96	0.96	0.96
	Specific Lights & Power KWH/ft²/yr	18.42	18.43	18.43
	8) Specific Total KWH/ft²/yr	36.37	35.10	34.61
TINT DOUBLE	**Perimeter System**	4	5 Base	6
	U-glass BTU/hr/ft²/°F	0.430	0.430	0.430
	U-panel BTU/hr/ft²/°F	0.114	0.060	0.040
	U-overall BTU/hr/ft²/°F	0.278	0.252	0.243
	Shading Coeff.	0.58	0.58	0.58
	Wall Costs $/ft²	19.75	20.00	20.25
	Heating MBH/yr	13,069,438	11,973,793	11,551,677
	Chiller ton-hr/yr	369,733	370,196	372,732
	Lights & Power KWH/yr	6,000,211	5,980,829	5,998,737
	Specific Heating KWH/ft²/yr	15.48	14.18	13.68
	Specific Chiller KWH/ft²/yr	0.90	0.90	0.90
	Specific Lights & Power KWH/ft²/yr	18.18	18.12	18.18
	Specific Total KWH/ft²/yr	34.56	33.20	32.76
REFLECTIVE DOUBLE	**Perimeter System**	7	8	9
	U-glass BTU/hr/ft²/°F	0.430	0.430	0.430
	U-panel BTU/hr/ft²/°F	0.114	0.060	0.040
	U-overall BTU/hr/ft²/°F	0.278	0.252	0.243
	Shading Coeff.	0.38	0.38	0.38
	Wall Costs $/ft²	20.75	21.00	21.25
	Heating MBH/yr	NOT	11,962,564	11,557,419
	Chiller ton-hr/yr	OBTAINED	320,998	322,131
	Lights & Power KWH/yr		5,838,550	5,841,845
	Specific Heating KWH/ft²/yr		14.16	13.68
	Specific Chiller KWH/ft²/yr		0.78	0.78
	Specific Lights & Power KWH/ft²/yr		17.69	17.70
	Specific Total KWH/ft²/yr		32.63	32.16
CLEAR TRIPLE	**Perimeter System**	10	11	12
	U-glass BTU/hr/ft²/°F	0.310	0.310	0.310
	U-panel BTU/hr/ft²/°F	0.114	0.060	0.040
	U-overall BTU/hr/ft²/°F	0.216	0.190	0.180
	Shading Coeff.	0.71	0.71	0.71
	Wall Costs $/ft²	20.75	21.00	21.25
	Heating MBH/yr	10,427,775	9,343,613	8,938,405
	Chiller ton-hr/yr	390,641	391,710	392,140
	Lights & Power KWH/yr	6,057,884	6,062,181	6,064,173
	Specific Heating KWH/ft²/yr	12.35	11.06	10.58
	Specific Chiller KWH/ft²/yr	0.95	0.95	0.95
	Specific Lights & Power KWH/ft²/yr	18.36	18.37	18.38
	Specific Total KWH/ft²/yr	31.65	30.38	29.91

Notes:
1) U-overall = 0.52 U-glass + 0.48 U-panel
2) Gross Panel & Glass Area = 157,944 ft²
3) Heating, net required (Merriwether)
4) Chiller, net required (Merriwether)
5) Lights & Power, net required (Merriwether)
   Lights & Auxiliary Power Use: 3.15 w/ft²
6) Net Leasable Area: 330,000 ft². Overall boiler and pumping efficiency: 0.75.
7) Average Chiller Efficiency: 0.8 KWH/ton ref-hr
8) Base Year: 10,320 degree-days/yr below 65°F

1 KWH = 3,413 BTU

OFFICE TOWER - ENERGY DATA

Table 4.14

Attention is drawn to the following items:

- Specific energy consumption of approximately 33KWH/ft^2/yr is representative of office buildings in severe winter climates as experienced in mid-Western Canada. A base year weather tape for 10,320 degree-days/yr (below 65°F) was used for this location;

- Basic fuel source is natural gas which locally sold in 1979 for extremely low price of $1.143/MCF. The annual heating costs affects project profitability hardly at all, even at an average 15%/yr energy escalations.

- Electrical power was supplied in 1979 at $0.0242/KWH based on large use of approximately 5. x 10^6 KWH/yr and with allowance for an extra 500KW peak demand during a 4 month summer operation (centrifugal chillers);

- Overall and specific energy costs amount to approximately $0.52/ft^2/yr for the 1979 base year, well below the national averages identified in Chapter 2;

- Chillers and fan systems have been programmed for "economizer cycle" or free cooling option;

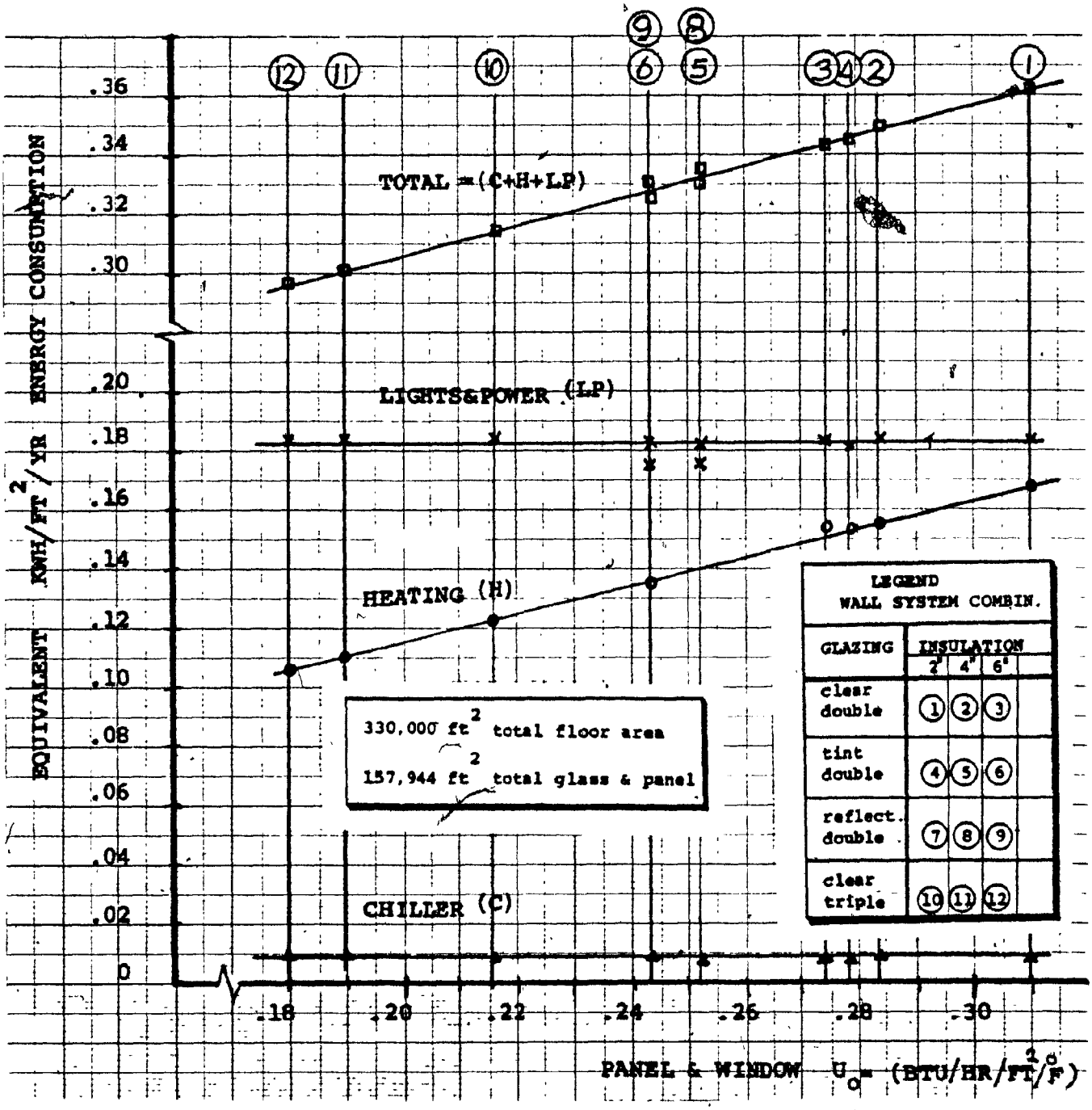
- Fan operation and lights throughout the building have been programmed for shut down after office hours with time allowance for office cleaning operations;

- Although an extremely efficient lighting layout was obtained in the design of the building, lighting accounts for approximately 55% of this average office building energy consumption;

GLAZING	Energy & Profitability Data		Exterior Panel Insulation Thickness 2"	4"	6"
	Perimeter System		1	2	3
CLEAR DOUBLE	Project Cost Change	$	- 260,607	- 221,121	- 181,636
	Office Tower Heating Costs	$/yr	21,865	20,212	19,594
	Office Tower Chiller Operation	$/yr	7,663	7,682	7,693
	Office Tower Lights & Power	$/yr	147,092	147,195	147,203
	Office Tower Total Energy Costs	$/yr	176,620	175,089	174,490
	Specific Energy Costs	$/ft²/yr	0.53	0.53	0.53
	Project Energy Cost Change	$/yr	+ 6,469	+ 4,938	+ 4,339
	Profitability:				
	IRR 5 year	%	23.99	23.95	23.92
	IRR 10 year	%	18.46	18.44	18.41
	IRR 15 year	%	16.93	16.91	16.89
	Project NPV 5 year	$	4,849,040	4,844,488	4,838,234
	Project NPV 10 year	$	4,844,193	4,836,015	4,829,371
	Project NPV 15 year	$	4,804,851	4,795,522	4,781,543
	Perimeter System		4	5 Base	6
TINT DOUBLE	Project Cost Change	$	- 39,486	0	+ 39,486
	Office Tower Heating Costs	$/yr	19,917	18,248	17,605
	Office Tower Chiller Operation	$/yr	7,158	7,167	7,216
	Office Tower Lights & Power	$/yr	145,205	144,736	145,169
	Office Tower Total Energy Cost	$/yr	172,280	170,151	169,990
	Specific Energy Costs	$/ft²/yr	0.52	0.52	0.52
	Project Energy Cost Change	$/yr	+ 2,129	0	- 161
	Profitability:				
	IRR 5 year	%	23.73	23.69	23.64
	IRR 10 year	%	18.30	18.28	18.25
	IRR 15 year	%	16.80	16.79	16.76
	Project NPV 5 year	$	4,814,684	4,811,385	4,803,964
	Project NPV 10 year	$	4,774,573	4,769,758	4,753,872
	Project NPV 15 year	$	4,713,289	4,709,513	4,687,461
	Perimeter System		7	8	9
REFLECTIVE DOUBLE	Project Cost Change	$	+ 118,458	+ 157,944	+ 197,430
	Office Tower Heating Costs	$/yr		18,231	17,614
	Office Tower Chiller Operation	$/yr		6,215	6,236
	Office Tower Lights & Power	$/yr	NOT	141,293	141,373
	Office Tower Total Energy Costs	$/yr	OBTAINED	165,739	165,223
	Specific Energy Costs	$/ft²/yr		0.50	0.50
	Project Energy Cost Change	$/yr		- 4,412	- 4,928
	Profitability:				
	IRR 5 year	%	-	23.50	23.45
	IRR 10 year	%	-	18.17	18.14
	IRR 15 year	%	-	16.70	16.68
	Project NPV 5 year	$	-	4,780,680	4,771,773
	Project NPV 10 year	$	-	4,721,515	4,706,151
	Project NPV 15 year	$	-	4,652,813	4,633,186
	Perimeter System		10	11	12
CLEAR TRIPLE	Project Cost Change	$	+ 118,458	+ 157,944	+ 197,430
	Office Tower Heating Costs	$/yr	15,892	14,240	13,622
	Office Tower Chiller Operation	$/yr	7,563	7,583	7,592
	Office Tower Lights & Power	$/yr	146,601	146,704	146,753
	Office Tower Total Energy Costs	$/yr	170,056	168,527	167,967
	Specific Energy Costs	$/ft²/yr	0.52	0.51	- 0.51
	Project Energy Cost Change	$/yr	- 95	- 1,624	- 2,184
	Profitability:				
	IRR 5 year	%	23.54	23.50	23.46
	IRR 10 year	%	18.18	18.16	18.13
	IRR 15 year	%	16.70	16.68	16.66
	Project NPV 5 year	$	4,788,309	4,783,753	4,777,168
	Project NPV 10 year	$	4,719,916	4,711,724	4,698,082
	Project NPV 15 year	$	4,639,751	4,603,403	4,612,055

INPUT VARIABLES - PROFITABILITY

Table 4.15



U_o - vs. KWH/FT²/YR

Fig 4.14

- It should be noted that retail area power consumptions remained constant throughout the optimization analysis;

- Although no 6" insulated wall panel presently exists, information for a standard 5" insulated wall panel data was extrapolated for the required input;

- The office tower area has been subjected to optimization and represents approximately 78.5% of total leasable area; and

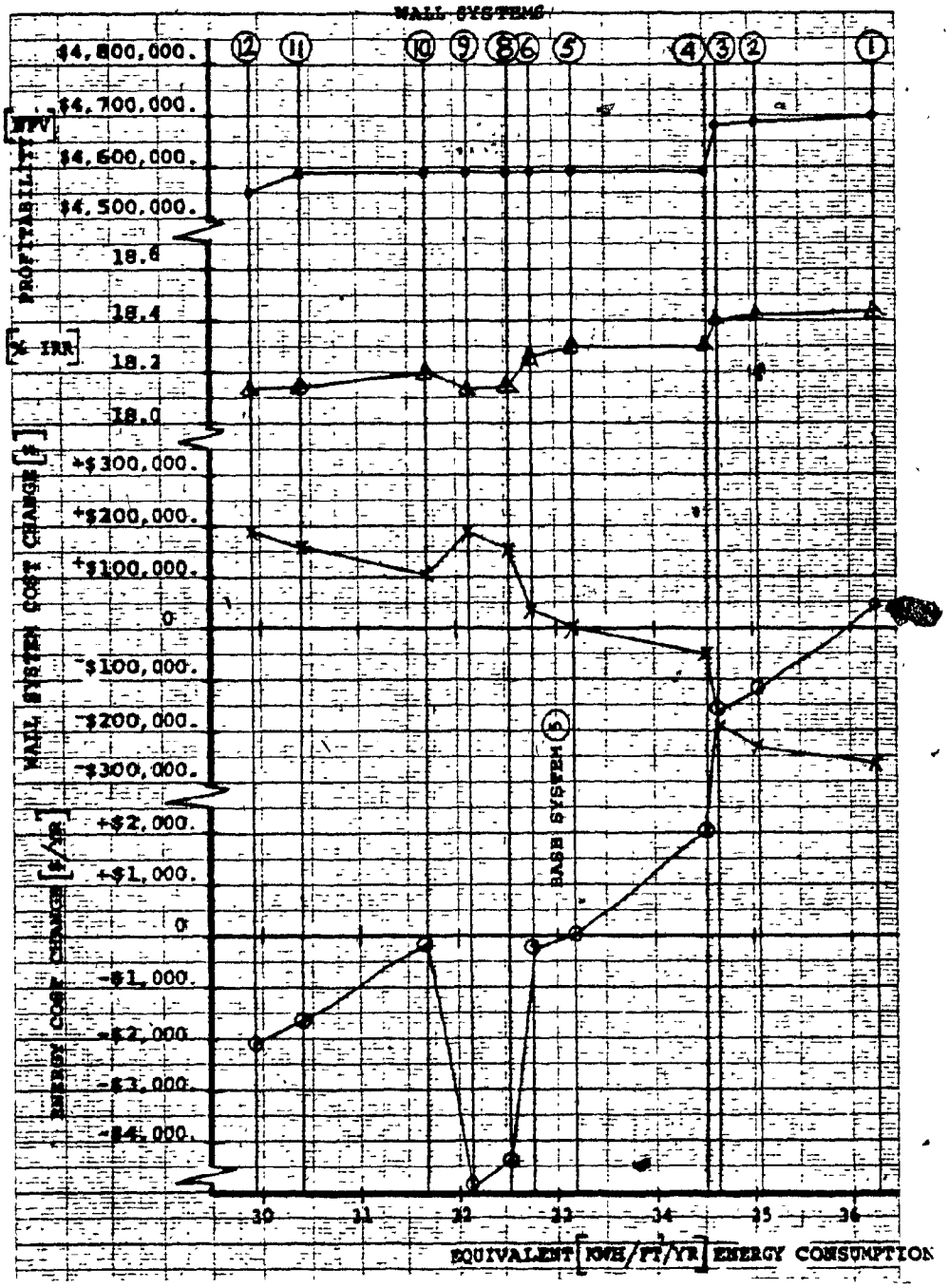
- A graphical representation of wall system U_o factors and their effect on average KWH/ft^2/yr energy consumption has been shown in figure 4.14. Wall system numbering corresponds to the matrix of Table 4.14. From this graph it can be seen that only the heating appears to be effected by the variation of wall system thermal resistance. The specific cooling requirements remain virtually uneffected despite the use of tinted or reflective glazing.

4.4.2 OPTIMIZATION

The relationship between project profitability on one hand, and changes of perimeter wall system and energy consumption on the other are summarized in figure 4.15.

Response of project profitability, to these input changes is rather mild, but could be explained based on the relatively small cost changes in relation to the total project development cost. Certainly surprising, and contrary to popular belief is the fact that maximum project profitability is realized with the worst wall insulation system and maximum energy consumption (perimeter system 1). Similarly surprising is the fact that the lowest profitability is obtained for the best insulated wall system (perimeter system 12)

In summary, the energy conserving investor could come out a loser, based on the above assumptions and analysis. Higher than 15%/yr energy cost escalations could change this trend but this has not been investigated in additional program runs. Given the above results, investors would not be motivated to reduce energy costs for their buildings. Only a Federal or Provincial legislation such as a building code would assure efficient building enclosure systems and national conservation of energy.



330,000 ft² total floor area

157,944 ft² total glass & panel

LEGEND WALL SYSTEM COMBIN.			
GLAZING	INSULATION 2"	4"	6"
clear double	(1)	(2)	(3)
tint double	(4)	(5)	(6)
reflect. double	(7)	(8)	(9)
clear triple	(10)	(11)	(12)

OPTIMIZATION

Fig. 4.15

4.5 RISK ANALYSIS - PROBABILISTIC APPROACH

In this section, the probalistic investment analysis as discussed insection 3.5, will be applied to the "mean" input data. The "mean" values as shown in table 4.6 have been entered in to the CBEES program to form the basis of the probalistic investment analysis.

The "mean" program input and output is shown in Appendix - D. When comparing the investment performance of the "mean" program with the "likely" program, a slightly lower profitability is noticed for the "mean" investment analysis. This has been summarized below

Evaluation:	Investment Horizon		
	5 Year	10 Year	15 Year
"Likely"			
IRR	25.374%	18.778%	16.238%
Project NPV	$4,710,925	$4,327,380	$3,183,488
"Mean"			
IRR	25.001%	18.405%	15.969%
	$4,533,773	$3,990,761	$2,881,929

It follows that the "likely" estimates are of an optimistic nature, relative to the "mean". This comes about because of the skewed nature of the component input distributions relative to the mean. An approximate 10 to 15% discrepency exist between the "likely" and "mean" project profitability.

For comparison, the mean cashflow distribution has been shown in figure 4.16.

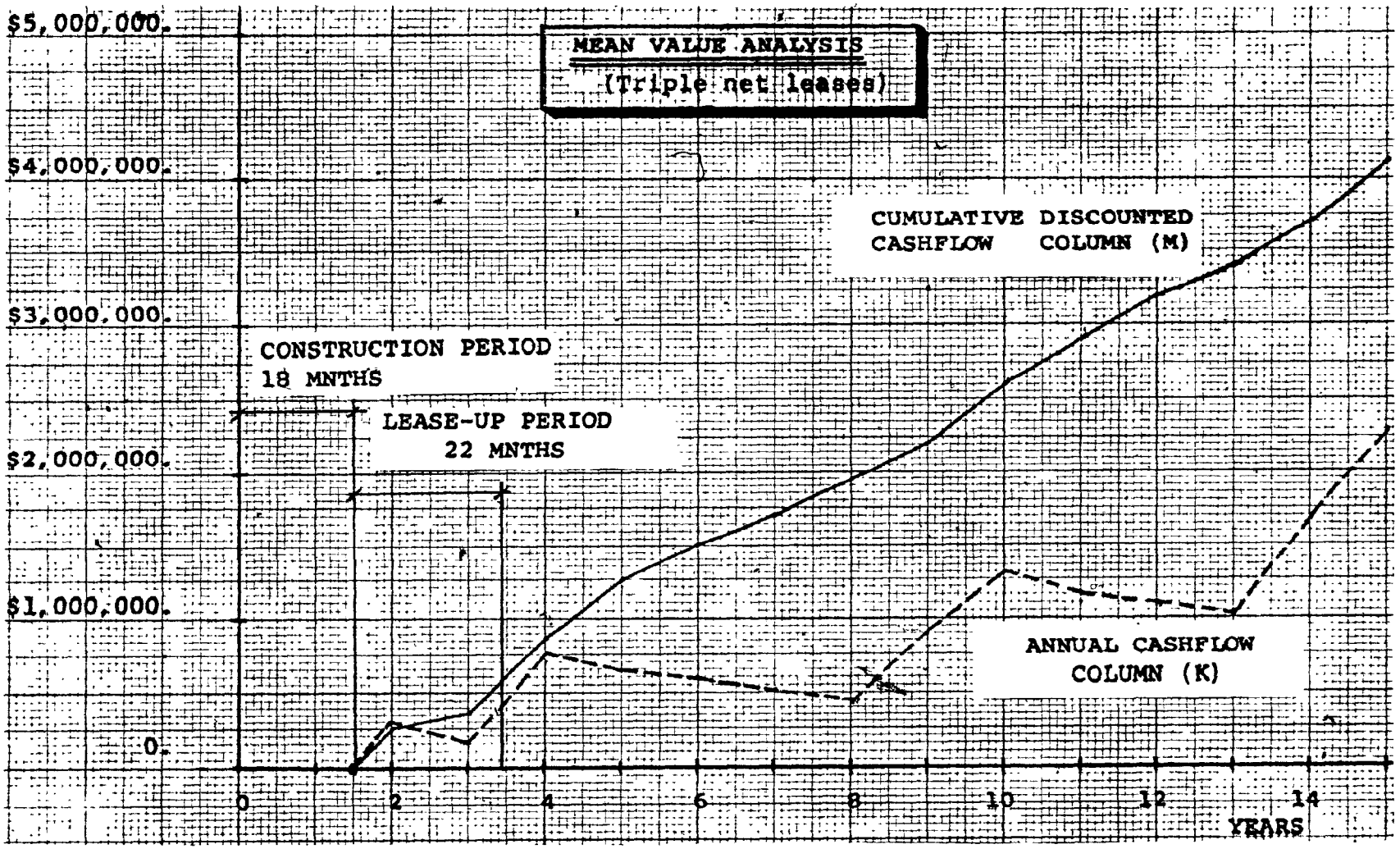

MEAN VALUE ANALYSIS
(Triple net leases)
$5,000,000.
$4,000,000.
$3,000,000.
$2,000,000.
$1,000,000.
0.
MEAN - CASH FLOWS
CUMULATIVE DISCOUNTED CASHFLOW COLUMN (M)
CONSTRUCTION PERIOD
18 MNTHS
LEASE-UP PERIOD
22 MNTHS
ANNUAL CASHFLOW
COLUMN (K)
0
2
4
6
8
10
12
14
YEARS

Fig. 4.16

SECTION 9

SUMMARY AND ECONOMIC EVALUATION OF PROJECT

	5 YEAR HORIZON	10 YEAR HORIZON	15 YEAR HORIZON
TOTAL PROJECT COST	$ 40223318.	$ 40223318.	$ 40223318.
MARKET VALUE AT HORIZON	$ 62901996.	$ 81389083.	$ 97355749.
SELLING EXPENSES	$ 3774120.	$ 4883345.	$ 5841345.
NET SELLING PRICE	$ 59127877.	$ 76486938.	$ 91514404.
MORTGAGE BALANCE	$ 31459189.	$ 30147199.	$ 27898016.
CASH REVERSION BEFORE TAXES	$ 27668691.	$ 46339739.	$ 63626387.
BOOK VALUE	$ 35901407.	$ 29176025.	$ 24596818.
CAPITAL GAIN OR LOSS	$ 19804559.	$ 35263620.	$ 51291086.
RECAPTURE OF DEPRECIATION	$ 5181011.	$ 11047298.	$ 19624502.
CAPITAL GAINS TAX	$ 4726140.	$ 9069905.	$ 12822771.
TAX ON RECAPTURE	$ 2969056.	$ 5323646.	$ 7812251.
CASH REVERSION AFTER TAXES	$ 20376596.	$ 31790188.	$ 42991365.
DISCOUNTED CASH REVERSION	$ 10674765.	$ 8713642.	$ 6181087.
CASH EQUITY INVESTMENT	$ 8223318.	$ 8223318.	$ 8223318.

SUMMARY MEASURES, AFTER TAXES
AND AFTER MORTGAGE PAYMENTS

INTERNAL RATE OF RETURN	25.001 %	18.409 %	15.969 %
PROJECT NET PRESENT VALUE	$ 4533773.	$ 3990761.	$ 2881929.
BENEFIT/COST RATIO	1.610	1.537	1.388
PAYBACK PERIOD, YEARS	12.	12.	12.

SUMMARY MEASURES, AFTER TAXES
AND ASSUMING NO MORTGAGE:

INTERNAL RATE OF RETURN	12.679 %	12.246 %	11.804 %
PROJECT NET PRESENT VALUE	$ -28320.	$ -1807036.	$ -3968926.
BENEFIT/COST RATIO	.999	.950	.902
PAYBACK PERIOD, YEARS	11.	11.	11.

THE DISCOUNT RATE USED IN THE PRESENT VALUE CALCULATIONS IS: 13.000 /YR.

WHERE COST IS THE INITIAL CASH EQUITY INVESTMENT
AND THE LATTER IS LESS THAN OR EQUAL TO ZERO, A
ZERO (0) IS PRINTED FOR BENEFIT/COST RATIO

IF THE PAYBACK PERIOD IS GREATER THAN THE
HORIZON REQUESTED A 99 IS PRINTED FOR PAYBACK

PROJECT PROFITABILITY
MEAN - CBEES - 3 NET LEASES

Table 4.16

4.5.1 MEASURE OF RISK - STANDARD DEVIATION:

The objective of this section is to quantify risk, as measured by standard deviation for the IRR and NPV project profitability. The CBEES investment program with "mean value" input data of section 4.5. forms the basis of such computation.

From the Central Limit Theorem, the mean value of IRR or NPV represents a point for which there is a 50% chance that the actual outcome is below and above this value.

For purposes of this proje[redacted] case example, a risk analysis was performed for a 15 year investment period. Standard deviations for 5 and 10 year investment periods are consequently smaller and subject to poportionally lesser risk. Mean values of profitability for the triple-net lease scenario showed:

$$\overline{NPV}_o = + \$2,881,929.$$

$$\overline{IRR}_o = 15.969\%$$

Standard deviations for both: NPV_o and IRR_o are derived, using the theory and methodology of Chapter 3. A subroutine computer program was developed at Concordia University, Centre of Building Studies to perform these computations subsequent to the CBEES program output.

It must be remembered that constant factors and multipliers for taxes, debt service and expenses are void of standard deviations as they are treated with certainty.

Using the above methodology, the subroutine program permitted calculation of the variance for each of the components. The standard deviation for NPV simply represents the square root of the cummulative total of the variance for NPV.

In order to obtain the standard deviation for $\overline{IRR}$, two additional CBEES programs were run to obtain σ_{NPV_1}, and σ_{NPV_2} values for discount rates r_1=17% and r_2=15%. These discount rates represent approximately 1% above and below the IRR_o=15.969%.

Comparison of the NPV and IRR profitability criteria and measure of risk for a 15 yr investment horizon, after taxes and debt service shows:

Mean value: $\overline{NPV}$ = + \$2,881,929.

Measure of Risk: σ_{NPV} = \$3,993,094.

Mean value: $\overline{IRR}$ = 15.969%

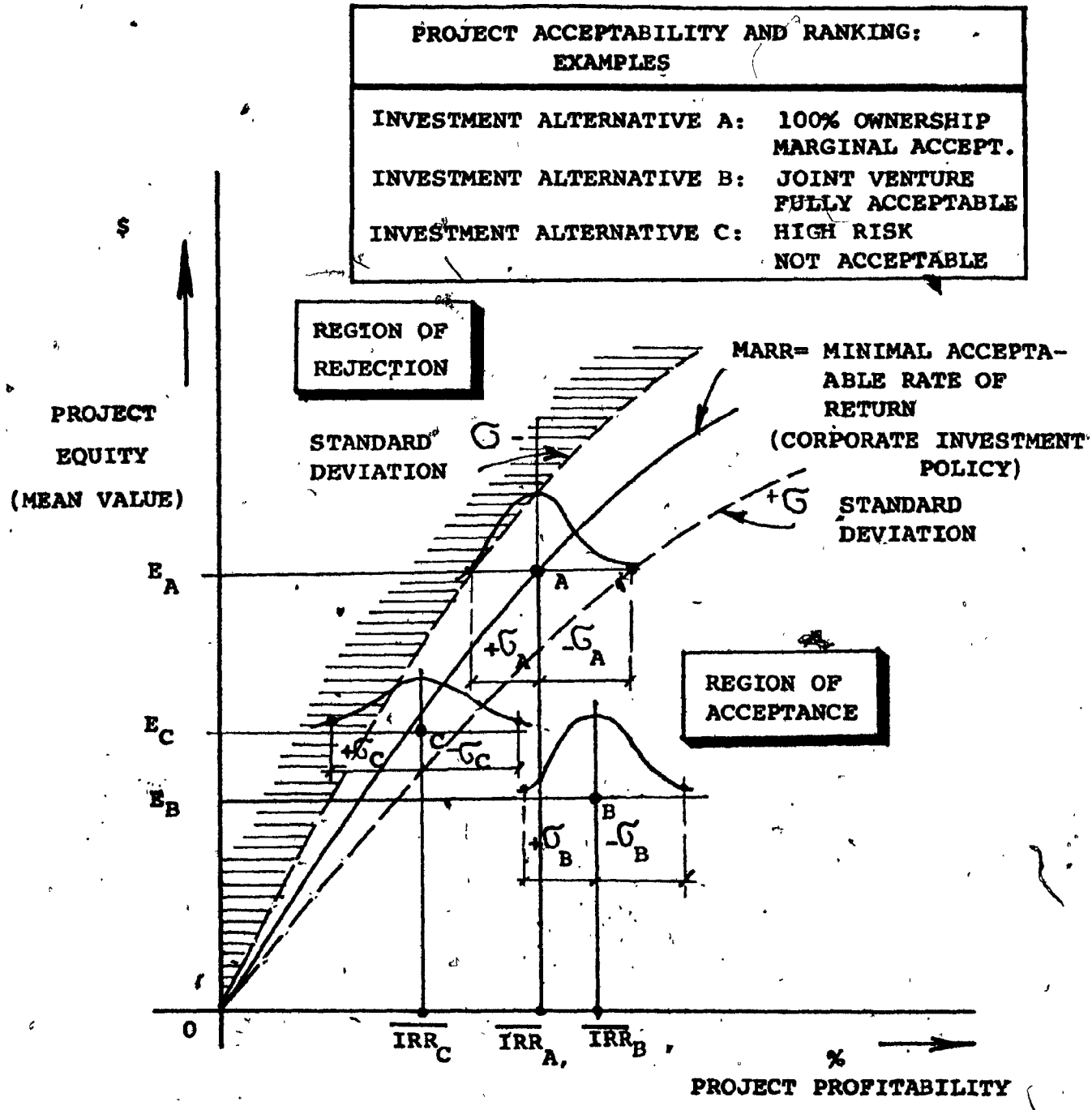
Measure of risk: σ_{IRR} = 4.96%

Program output is summarized below:

Triple NET - mean value risk analysis

ITEM	CBEES OUTPUT			Subroutine program output		
	Discount Rate	NPV 15 Yr	IRR 15 Yr	Variance σ^2	Standard Deviation NPV	IRR
	%	$	%	$(\$)^2$	$	%
0	13 *	+2,881,929	15,969	1.59440×10^{13}	3,993,094	4.96
1	15	+ 810,721	15.969	1.50991×10^{13}	3,885,756	-
2	17	- 748,035	15.969	1.47515×10^{13}	3,840,768	-
3	15.969	0	15.969	-	-	-

* BASE PROGRAM



QUANTIFICATION OF RISK

Fig. 4.17

The standard deviation and variance for each of the components entered in the subroutine program are shown in Table 4.17. The total standard deviation of NPV is $3,993,094 and is obtained from the summary of variances for each of the components 1.59448×10^{13}, before taxes and debt service of $18,578,397. The contribution of risk towards the total project can be measured as a percentage of variance (% σ^2). As can be seen from Table 4.17 and Fig. 4.18, the major contribution of risk is attributable to the equity input requirement (64.38%). With varying total project development costs and a constant mortgage assumed, the required equity as measured by standard deviation or variance is the largest component. Office rental (24.86%) during the 15 year investment period is the second most significant contributer to investment risk, followed by equity reversion through landsale at 8.00%.

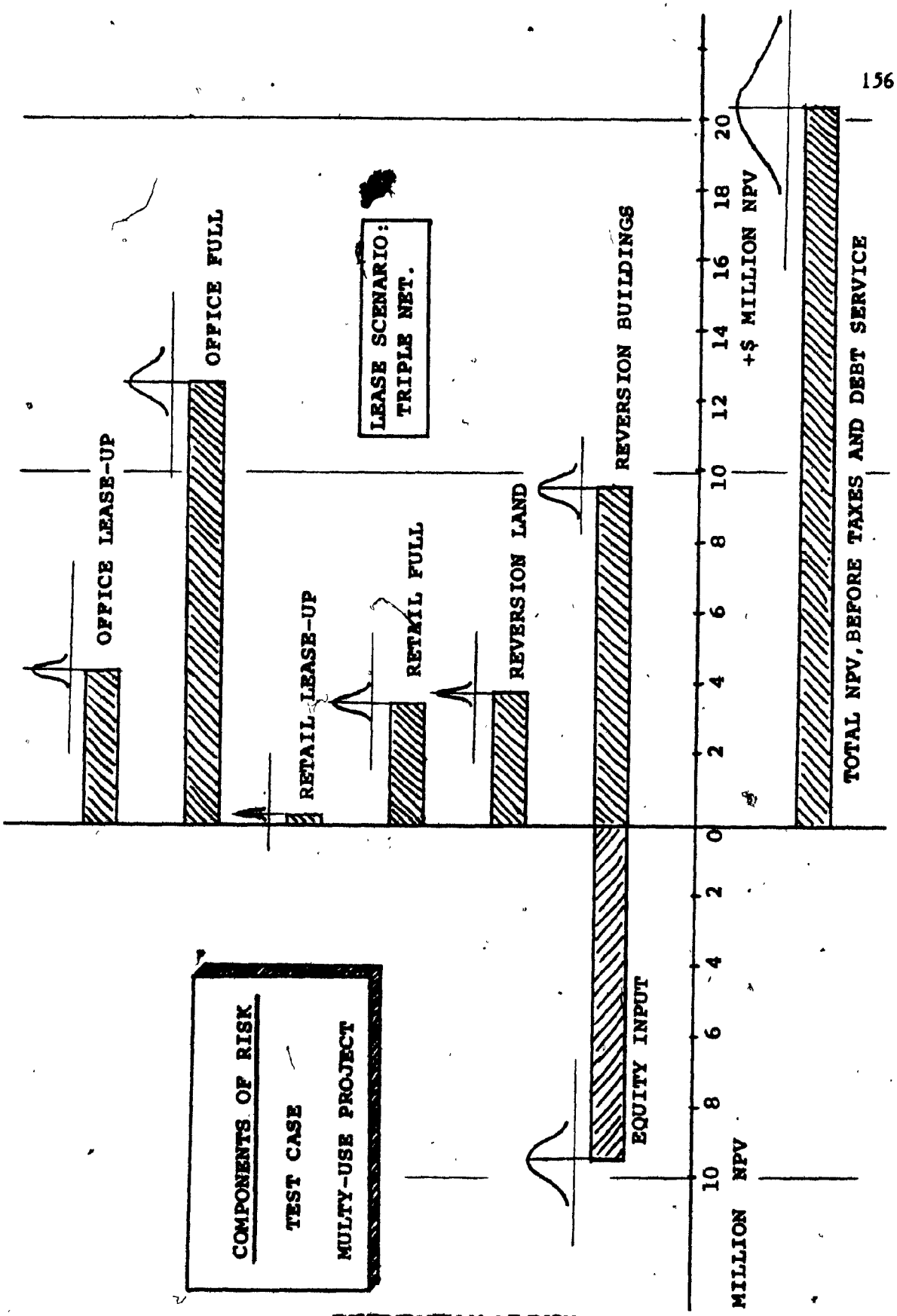
The importance and contribution of the risk analysis is the ability to separate the components as they contribute to the overall investment risk. Risk as generated by equity input can be reduced by lease-back financing. Reduction of risk by the rental income component explains the triple net leases sought by the developer.

As stated in the initial objectives of this thesis, identification and quantification of real estate development risk makes it possible for the developer to concentrate on major risk components and mobilize resources to reduce risk.

COMPONENTS OF RISK

Table 4.17

NPV - RISK ANALYSIS, r=13 %, 15 YEAR INVESTMENT PERIOD					
ITEM	COMPONENT	$\overline{NPV}$	σ_{NPV}	σ^2_{NPV}	% σ^2_{NPV}
1	EQUITY INPUT, TOTAL	-$9,511,250	3,277,237.	1.07403×10^{13}	64.38
2	OFFICE LEASE-UP	+ 431,804	21,237	4.51043×10^{8}	0.00
3	OFFICE FULL	+10,599,800	1,990,997	3.96407×10^{12}	23.76
4	RETAIL LEASE-UP	+ 121,803	10,097	1.01955×10^{8}	0.00
5	RETAIL FULL	+ 3,434,200	704,244	4.95960×10^{11}	2.97
6	REVERSION LAND	+ 3,820,800	454,066	2.06176×10^{11}	1.24
7	REVERSION BUILDING	+ 9,681,240	1,129,480	1.27573×10^{12}	7.65
TOTAL - SUBROUTINE PROGRAM BEFORE TAXES & DEBT SERVICE		18,578,397.	(3,993,094)	1.59448×10^{13}	100.00
TOTAL - CBEES PROGRAM AFTER TAXES AND DEBT SERVICE		+$2,881,929.	-	-	-



DISTRIBUTION OF RISK

Fig. 4.18

In summary of the above, it is evident that project profitability, measured by IRR is more significant than NPV. The IRR is analogous to an investment yield, independent of varying discount rates. Investment alternatives of different equity magnitude can readily be compared and ranked on the basis of IRR only. Similarly the σ IRR as a measure of investment risk is uneffected by discount rates which vary with time. A change in discount rate during the investment period requires re-evaluation of the investment analysis and projects of greater or lesser magnitude cannot readily be compared. The IRR therefore represents the most usefull single pofitability criteria for the commercial real estate developer or investor.

The "mean value" investment program and risk analysis as demonstrated in this section permits a simplified and readily useable mean value and standard deviation computation, based on PERT probability estimates of project parameters. Investment risk can be determined, based on 5% percentile, optimistic and pessimistic estimates in addition to the "likely" estimate for which a normal probability distribution is assumed. The risk analysis can be used by the developers to further identify the major components of risk which make up the overall standard deviation.

A simplified risk analysis, as demonstrated in this paper, will aid the commercial real estate developer in analytical investment decision making and furthermore provide an insight as to where risk is generated in the development. Subsequently the source of risk can be reduced, which is the general objective of commercial real estate developments.

CHAPTER 5

SUMMARY

5.0 SUMMARY

This paper has attempted to provide a comprehensive overview of the commercial real estate development process. Particular emphasis has been placed on bridging an apparent knowledge gap which exists amongst Architects and Engineers regarding investment objectives of commercial real estate developments.

The motivations and objecives of a real estate developer at the feasibility stage of a project have been accounted for and aspects of business risk have been identified throughout the project life cycle. In addition, a perspective and reference of the development process viewed from the investor's position is provided to the reader.

The manner in which a project can be analyzed, using time value of money concepts and all relevant cash flows for the different phases in the project life cycle was treated. Also examined was the issue of sensitivity analysis.

A contribution was made with respect to a simplified method of risk analysis, using a mean and variance or PERT approach. The goal of this approach was to provide the analyst with a "quick and dirty" method for measuring project NPV and IRR; their range and relative likelyhood of each outcome within this range. Existing software such as CBEES, plus additional calculations permitted this simplified risk analysis. Such an approach avoids a costly Monte Carlo simulation and the enormous input information for distribution requirements, demanded by such a method.

Various assumptions have been made in the "Russell-Smits" approach to risk analysis, such as a fixed time model and zero correlation between components in the NPV equation. It is therefore suggested that further analysis be performed to validate the approximation theory in order to establish a magnitude of accuracy. A comparison with a Monte Carlo gaming program is suggested.

The contribution of the case study is to provide an insight of the real estate investment analysis, its overall profitability, contribution of risk for each of its major input parameters, and overall investment risk.

The sensitivity of the development to various controllable and uncontrollable parameters was investigated with respect to overall project profitability while measured in IRR and NPV.

Optimization of building perimeter wall systems and energy consumption parameters were investigated for project IRR and NPV.

In order to establish confidence for developer and consultants in the above described investment analysis, a need for feedback on project performance would be essential. A range of commercial development analysis and feedback information could narrow the range of probabilistic estimates made in this paper. The benefit of feedback information would manifest itself in a "feel" for profitability criteria such as IRR and NPV and the amount of risk as determined by standard deviations for project IRR and NPV.

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APPENDIX A

Annual Statements

Of a Canadian

Real Estate Development Corporation

CONSOLIDATED BALANCE SHEETS

Year Ending December 31	1979	1978	1977	1976	1975
(Figures in $1,000 x)					
1. Assets					
Cash	$ —	$ 684	$ 820	$ 885	$ 1,600
Funds on deposit with Trustee	—	—	—	20,719	—
Accounts, loans & mortages receivable	78,367	36,143	30,966	32,833	27,355
Inventories	66,762	59,502	66,479	73,519	71,327
Land held for sale and development	156,949	125,975	86,732	74,831	70,946
Rental properties; hotel; other property, plant and equipment	546,840	477,870	422,962	332,604	299,036
Other assets and deferred charges	17,441	21,662	13,644	10,520	11,231
	866,359	721,036	621,603	545,913	481,695
2. Liabilities					
Bank indebtedness—short term, secured	51,346	31,716	36,900	37,513	38,350
Accounts payable & accrued liabilities	39,462	41,501	42,683	32,673	35,203
Advances relating to land & housing	69,646	42,036	40,787	37,654	32,860
Long-term debt, per Schedule 1	618,584	534,046	434,771	344,192	285,191
Deferred income taxes	47,422	36,749	33,048	35,278	34,633
Minority interests	—	—	—	754	619
Total Liabilities	826,460	686,048	588,189	488,064	426,856
3. Shareholders' Equity					
Capital stock:					
First Preference Shares	—	—	—	7,903	7,905
Second Preference Shares	—	—	—	200	200
Class A and B Common Shares	—	—	—	31,934	31,932
	18,805	18,354	16,044	40,037	40,037
Retained earnings & contributed surplus, per statement	21,094	16,634	17,370	17,812	14,802
Total shareholders' equity	39,899	34,988	33,414	57,849	54,839
4. Contingent liabilities and Commitments	866,359	721,036	621,603	545,913	481,695

CONSOLIDATED STATEMENT OF EARNINGS

Year Ending December 31	1979	1978	1977	1976	1975
(Figures in $1,000 x)					
1. **Revenues**					
Rental properties, hotel operations and sales of housing & land	244,696	209,169	169,804	173,601	139,969
2. **Expenses**					
Cost of sales & rental properties	152,527	147,413	125,961	126,236	97,644
Financing interests	50,313	37,224	25,475	23,216	18,077
General and administration	20,617	15,390	11,790	10,923	6,895
Depreciation and amortization	7,365	6,110	5,263	5,063	3,843
TOTAL	230,822	206,137	168,489	165,438	126,459
3. **Gross Income (1-2)**	13,874	3,032	1,315	8,163	13,510
4. **Other Gains**					
Disposal of Property	1,101	725	—	—	—
Minority interests	—	—	—	135	128
TOTAL INCOME	14,975	3,757	1,315	8,298	13,638
5. **Income Tax**	10,174	3,234	(1,174)	2,438	6,070 ~~7,814~~
Earnings before Extraordinary Items	4,801	523	2,489	5,590	7,568
6. **Extraordinary Items**					
Gains or (losses)	1,800	—	680	(1,363)	—
NET EARNINGS	6,601	523	3,169	4,227	7,568
7. **Earnings per Common Share**					
Before extraordinary items	$ 1.09	$ —	$ 0.28	$ 0.73	$ 1.02
After extraordinary items	$ 1.55	$ —	$ 0.38	$ 0.53	$ 1.02

CONSOLIDATED STATEMENT OF RETAINED EARNINGS

Year Ending December 31	1979	1978	1977	1976	1975
(Figures in $1,000 x)					
1. Retained Earnings					
Balance at beginning of year	16,634	17,771	16,644	14,007	7,693
Prior year adjustments	—	(401)	—	—	—
Nets earnings for year	6,601	523	3,169	4,227	7,568
TOTAL	23,235	17,893	19,813	18,234	15,261
2. Dividends					
Class A and B Common	785	368	635	638	637
First preference	—	—	525	553	553
Second preference	6	6	6	6	6
Series A preference	532	532	28	—	—
Cost of reorganization	—	—	258	—	—
Premium on conversion	353	353	1,766	—	—
Transfer from contributed surplus	—	—	(795)	(795)	(795)
Tax paid on windup of subsidiaries	—	—	—	—	38
Shares for cancellation	465	—	—	—	—
TOTAL	2,141	1,259	2,443	422	459
3. Balance at End of Year	21,094	16,634	17,370	17,812	14,802

CONSOLIDATED STATEMENT OF CHANGES IN FINANCIAL POSITION

Year Ending December 31	1979	1978	1977	1976	1975
(Figures in $1,000 x)					
1. **Source of Cash**					
Operations	24,098	11,817	9,481	13,652	17,467
Proceeds of issue of long-term debt	156,674	90,222	156,131	72,961	31,618
Proceeds of project fund	—	—	20,719	—	—
Proceeds of capital stock issued	1,559	2,310	8,171	—	1,079
Other	2,370	—	19,460	—	—
TOTAL	184,701	104,349	213,962	86,613	50,164
2. **Use of Cash**					
Rental properties, hotels, properties, plants, equipment	77,135	47,976	79,134	39,797	25,941
Funds deposited with Trustee	—	—	—	20,719	—
Increased investment in land	30,974	28,099	11,901	3,884	13,442
Increase in inventories	7,260	—	—	2,192	11,043
Repayment of long-term debt	44,526	19,947	78,441	16,094	9,590
Dividends	1,323	906	1,214	1,217	1,216
Capital Stock Redeemed	1,573	989	37,110	—	—
Acquisition of Business	—	1,338	5,593	—	—
Other - Net	1,596	46	—	2,588	3,665
TOTAL	164,387	99,301	213,393	86,491	64,897
3. **Decrease in Bank Indebtedness** Net of Cash	20,314	5,048	569	122	(14,733)

CONSOLIDATED SCHEDULE OF LONG-TERM DEBT

December 31,	Average Interest Rates At Dec. 31, 1979	1979	(in thousands) 1978	1977	1976	1975
Debt Applicable To:						
Rental Properties:						
6-1/4% to 17% mortgages, loans & bonds	9.36%	$218,304	$175,823	$163,877	$128,741	$127,999
Amount due under financing arrangement	9.9%	38,000	38,000	38,000	38,000	38,000
Bank loans	16.16	25,012	6,409	48,431	4.513	9,174
General Mortgage Bonds	11.00	21,800	22,400	23,000	—	—
First Mortgage Sinking Fund Bonds	11.18	135,245	135,608	49,883	50,000	—
Construction Loans	—	—	—	—	1,570	—
Hotels:						
Bank Loan	9.60	64,163	65,219	58,507	45,229	46,411
Construction Loan	—	—	—	—	2,198	—
First Mortgage Sinking Fund Bonds	11.18	12,468	12,500	—	—	—
Land Held for Sale and Development:						
5% to 13% mortgage loans	10.56	35,890	25,936	16,966	21,050	13,778
Bank Loan	15.18	25,163	12,294	1,092	—	—
Other:						
Share Purchase Bank Loan	9.75	30,499	30,499	29,510	—	—
Other Bank Loan	16.25	5,833	5,336	—	—	—
Convertible notes payable	6.63	1,908	2,544	3,180	6,359	6,359
Swiss Bank Notes	—	—	—	—	43,754	40,754
Sundry loans and notes secured by specific mortgages receivable, machinery & property	14.66	4,299	1,478	2,325	2,773	2,716
	10.85%	$618,584	$534,046	$434,771	$344,192	$285,191

NOTES:

(i) Long term debts due December 31, 1979 are as follows:

	Instalment Payments	Balance Due At Maturity	Total
		(in thousands)	
1980	$ 18,672	$ 26,689	$ 45,361
1981	15,400	17,809	33,209
1982	10,049	45,763	55,812
1983	10,424	75,448	85,872
1984	11,171	37,570	48,741
subsequent to 1984	—	—	349,589
			$618,584

APPENDIX B

CBEES - COMPUTER PROGRAM

DESCRIPTIONS

DUE TO COPYRIGHT MATERIAL APPENDIX B IS OMITTED FOR FILMING

APPENDIX C

RISK ANALYSIS - "EXAMPLE"

EXAMPLE:

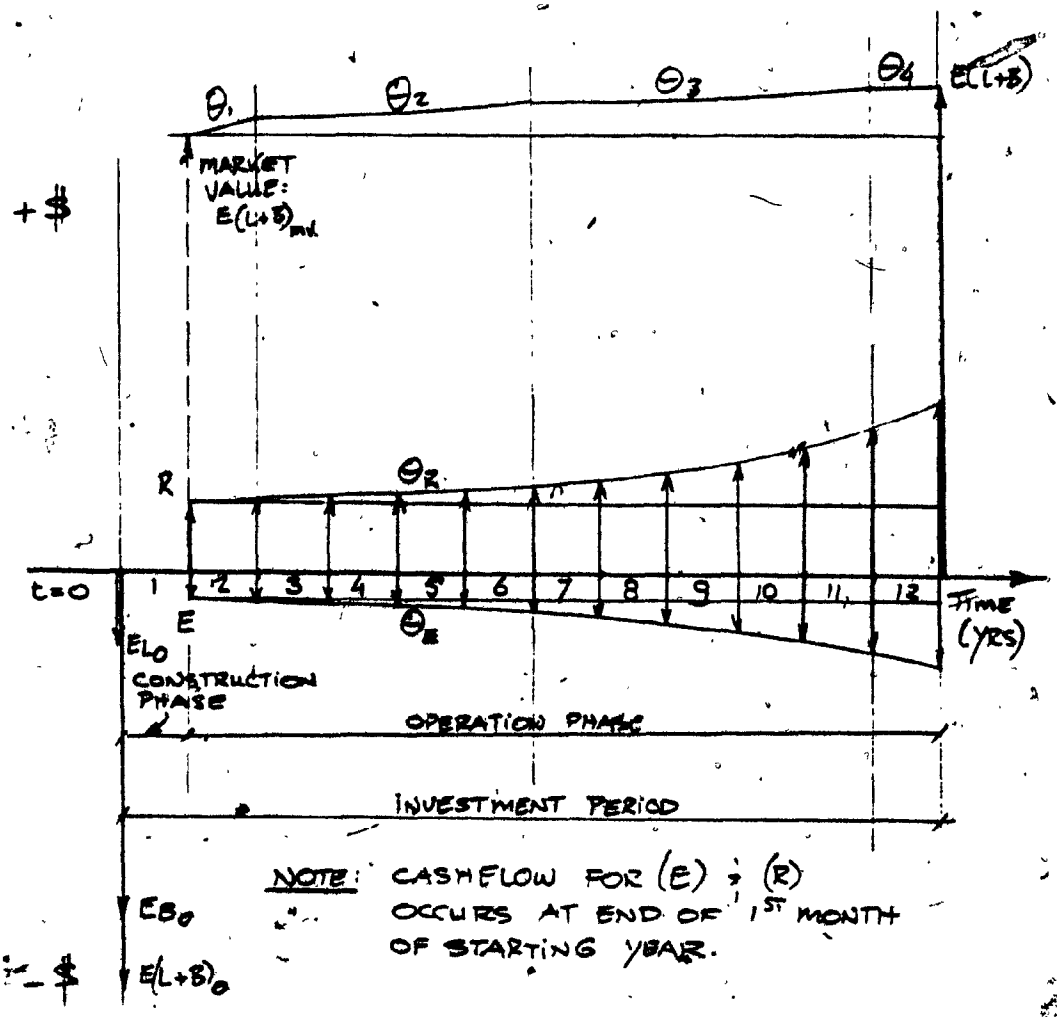
When the annual discount rate r_0=19%, and the inflation rate θ=10%/yr, determine the profitability and the measure of risk for the investment as graphically depicted below:

Determine the following profitability and risk criteria.

1) Mean value of NPV and standard deviation of NPV.

2) Mean value of IRR and standard deviation of IRR.

3) Profitability and risk components in terms of NPV.



PROGRAM INPUT PARAMETERS													
CASH FLOW ITEM	BASE YEAR VALUES						TIME MODEL PARAMETERS						
	SYMBOL X	OPTIM. X_a	LIKELY X_m	PESSIM. X_b	MEAN[1] $\bar{X}$	STD. DEV.[2] σ_x	START t_1	FINISH t_2	OPTIM. θ_a (%/yr)	LIKELY θ_m (%/yr)	PESSIM. θ_b (%/yr)	MEAN[1] $\bar{\theta}$ (%/yr)	STD DEV.[2] σ_θ
Equity Input													
Land $	EL_o	-180	-200	-220	-200	12.5	0	-	-	-	-	-	-
Building $	EB_o	-900	-1000	-1100	-1000	62.5	0	-	-	-	-	-	-
Total Equity $	$E(L+B)_o$	-1080	-1200	-1320	-1200	75.0	0	-	-	-	-	-	-
Reversion													
Market Value $ (+ 10%)	$E(L+B)_{MV}$	+1188	+1320	+1452	+1320	82.5	1		-	-	-	-	-
Equity Appreciation (%/yr)		-	-	-	-	-	1	2	0.20	0.15	0.10	0.15	0.0313
Equity Appreciation (%/yr)		-	-	-	-	-	3	6	0.18	0.12	0.06	0.12	0.0375
Equity Appreciation (%/yr)		-	-	-	-	-	7	11	0.15	0.10	0.05	0.10	0.0313
Equity Appreciation (%/yr)		-	-	-	-	-	12	12+	0.14	0.08	0.02	0.08	0.0375
Revenue ($/yr)	R	+220	+200	+180	+200	12.5	13 mos	144 m	0.12	0.10	0.08	0.10	0.0125
Expenses ($/yr)	E	-60	-75	-90	-75	9.375	13 mos	144 m	0.08	0.12	0.16	0.12	0.0250

NOTES:

1) $\bar{\theta}, \bar{X} = \frac{a + 4m + b}{6}$ 2) $\sigma_x = \frac{b - a}{3.2}$

SOLUTION:

1) Results obtained from a subroutine computer program, developped by CONCORDIA UNIVERSITY, BUILDING ENGINEERING DEPARTMENT, are sumarized and tabulated as follows:

NPV—ANALYSIS r_0=19% θ_0=10%/yr.					
COMPONENTS		$\overline{NPV}$	σ_{NPV}	σ^2_{NPV}	% σ^2
1 EQUITY BUILDING	$	- 1,000.00	62.5	3,906.3	6.07
2 EQUITY LAND	$	- 200.00	12.5	156.3	0.24
3 REVENUE	$	+ 1,279.27	157.4	24,770.3	38.52
4 EXPENSES	$	- 479.73	118,5	14,053.9	21.85
5 REVERSION BUILDING	$	+ 381.20	143.5	20,601.1	32.03
6 REVERSION LAND	$	+ 76.24	28.7	823.7	1.28
7 TOTAL NPV	$	+ 56.99	(253.6)	64,311.8	100.00

2)

The computation of the implicit function of IRR and the σ_{IRR} by means of program NPV output, requires determination of NPV=0 in which case IRR=r.

A linear correlation for NPV and discount rate r is assumed for small variations at the point NPV=0

Program output for r_2=20% showed a negative NPV and was compared with base program value for which r_1=19%

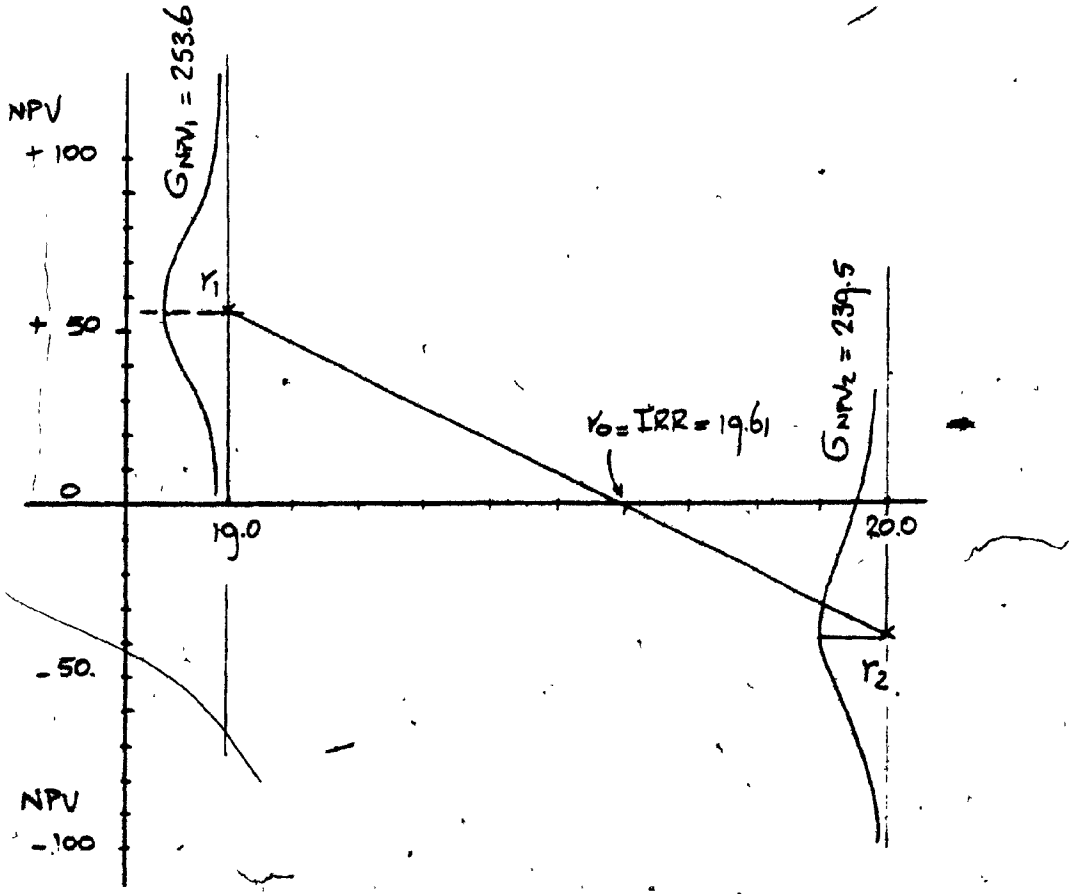
Summary of outputs:

ITEM	DISCOUNT RATE	INFLATION RATE	$\overline{NPV}$	σ_{NPV}	σ^2_{NPV}
1	19%	10%	+56.99	253.6	64,311.8
2	20%	10%	-36.92	239.5	57,369.1

Therefore,

$$IRR_o = \left(\frac{NPV_1}{NPV_1 - NPV_2}\right)(r_2 - r_1) + r_1$$

$$IRR_o = \left(\frac{+56.99}{56.99 + 36.92}\right)(0.20 - 0.19) + 0.19 = \underline{0.1961} \quad (19.61\%)$$



the $\overline{IRR}$ can be dtermined by substitution of values of r and NPV into formula 3.39 (page 85)

For correlation coefficient $\rho_{NPV1,\ NPV2}=1$, the mean value of IRR is:

$$\overline{IRR} = IRR_o + \left[\tfrac{1}{2}\frac{d^2IRR}{d(NPV_1)^2}\sigma^2_{NPV1}\right] + \left[\tfrac{1}{2}\frac{d^2IRR}{d(NPV_2)^2}\sigma_{NPV2}\right] + \left[\frac{d^2(IRR)}{d(NPV_1)\ d(NPV_2)}\rho_{NPV1,NPV2}\ \sigma_{NPV1}\ \sigma_{NPV2}\right]$$

$$\overline{IRR} = 0.1961 + \left[\tfrac{1}{2}.\ 2\ \frac{(0.20 - 0.19)(-36.92)}{(56.99 + 36.92)^3}\ .\ 64,3118\right] +$$

$$+\left[\tfrac{1}{2}\ .(\ 2\ )\frac{(+\ 56.99)(\ 0.20 - 0.19)}{(56.99 + 36.92)^3}\ .\ 57,369.1\right] +$$

$$+\left[-\ \frac{(\ 56.99 - 36.92)(\ 0.20 - 0.19)}{(56.99 - 36.92)^3}\ .\ (\ 1\ )(253.6)(239.5)\right]$$

OR: $\overline{IRR} = 0.1594$

$\overline{IRR} = .\ 15.94\ \%$

The variance of IRR, according to formula 3.40 (page 85) is computed as shown below:

$$\sigma^2_{IRR} = \text{Var}(IRR) = \left(\frac{dIRR}{dNPV_1}\right)^2 \sigma^2_{NPV1} + \left(\frac{dIRR}{dNPV_2}\right)^2 \sigma^2_{NPV_2} +$$

$$+ 2\left(\frac{d\,IRR\; d\,IRR}{d\,NPV_1\, d\,NPV_2}\right) \rho_{NPV1,NPV2} \cdot \sigma_{NPV1} \sigma_{NPV2}$$

$$\sigma^2_{IRR} = \left[\left(\frac{(0.20-0.19)(+36.92)}{(56.99+36.92)^2}\right)^2 (64,311.8)\right] + \left[\left(\frac{(56.99)(0.20-0.19)}{(56.99+36.92)^2}\right)^2 (57,369)\right] +$$

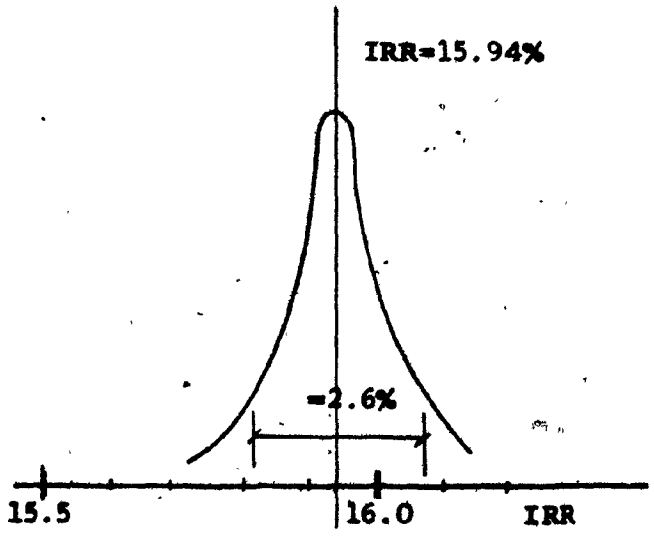
$$+2\left[\left(\frac{(0.20-0.19)(+36.92)}{(56.99+36.99)^2}\right)\left(\frac{(56.99)(0.20-0.19)}{(56.99+36.92)^2}\right)\right].1\,(253.6)(239.5)$$

$$\sigma^2_{IRR} = 6.809 \times 10^{-4}$$

Standard Deviation $\sigma_{IRR} = \sqrt{\sigma^2_{IRR}}$

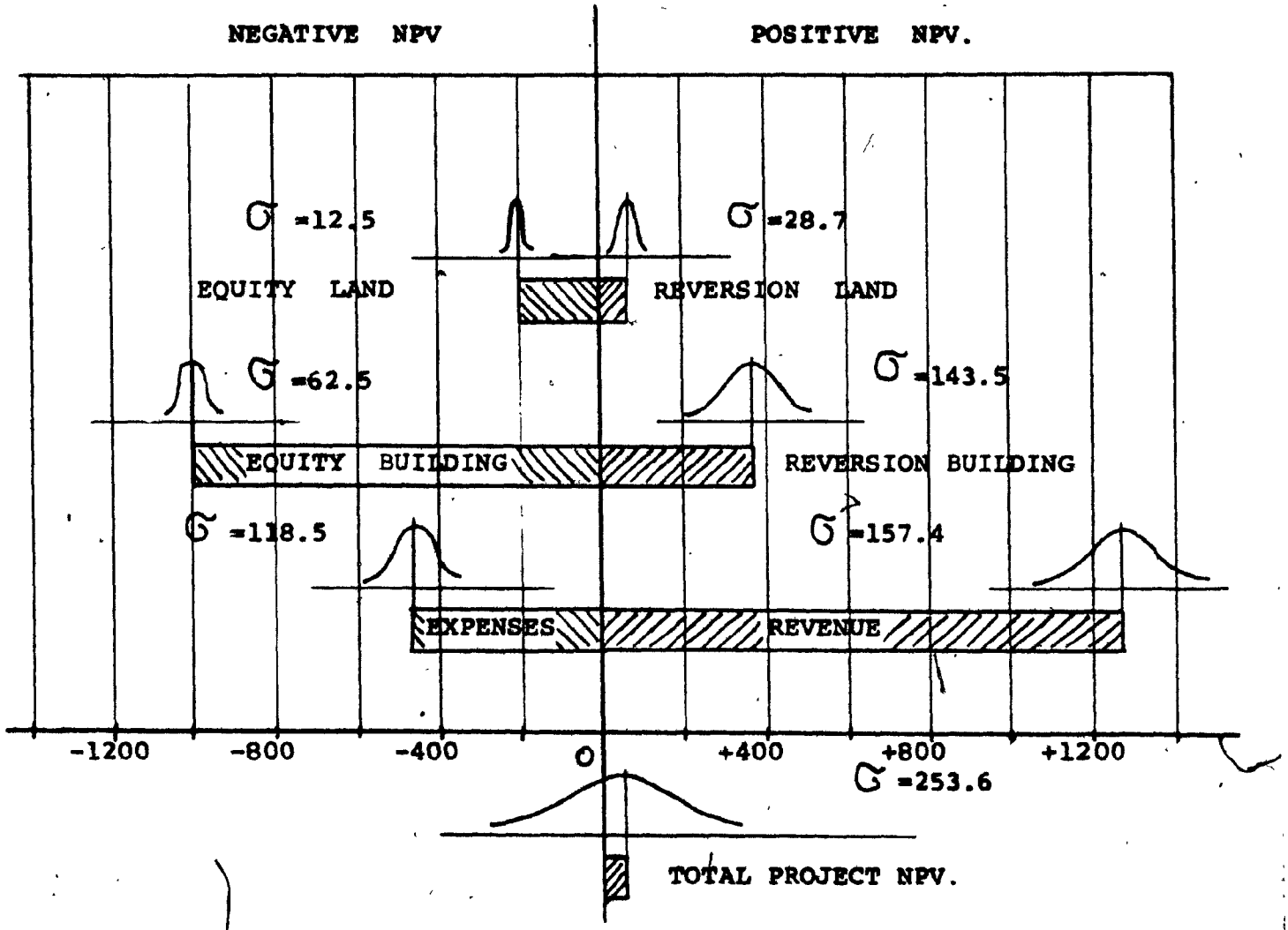
$$\sigma_{IRR} = 0.2609 \times 10^{-2}$$

$$\underline{\sigma_{IRR} = 2.61\ \%}$$



3)

Components of project profitability and risk are graphically represented in the following diagram



From the above diagram it can be seen, that the major portion of risk, relative to absolute NPV component value is contributed by reversion of equity capital of the building, closely followed by expenses and revenue during the operation and maintenance phase.

APPENDIX D

CBEES Program

"Mean" - Triple Net

******** C B E E S ********

THIS COMPUTER PROGRAMME HAS BEEN DEVELOPED BY THE CANADIAN DIVISION OF THE PORTLAND CEMENT ASSOCIATION IN COOPERATION WITH THE FACULTY OF ADMINISTRATIVE STUDIES OF YORK UNIVERSITY, TORONTO, ONTARIO, TO HELP PROVIDE IN-DEPTH COST ANALYSIS OF PROPOSED BUILDING PROJECTS.

SECTION 1

PROJECT DESCRIPTION AND GENERAL INFORMATION

NAME OF PROJECT: RUN 4 MEAN DEVIATION 2 3 NET LEASE
LOCATION OF PROJECT: SCENARIO J.J.SMITS
TYPE OF CONSTRUCTION: MULTY-USE COMPLEX 30 STOREY BLDG
GROSS AREA: 624433. SQ.FT. RENTABLE AREA: 420441. SQ.FT.

THE FOLLOWING PRINTOUT SECTIONS ARE REQUESTED

SECTION 2: PROJECT COST AND MARKET VALUE DATA
SECTION 3: REVENUE AND TIME REQUIREMENTS DATA
SECTION 4: CASH OPERATING EXPENSE DATA
SECTION 5: MORTGAGE FINANCING DATA
SECTION 6: CAPITAL COST ALLOWANCE AND REPLACEMENT SCHEDULES
SECTION 7: INCOME TAX RATES
SECTION 8: SUMMARY OF OPERATIONS AND CASH FLOWS, YEARLY
SECTION 9: ECONOMIC EVALUATION OF PROJECT

THE FOLLOWING PRINTOUT SECTION OPTIONS WERE USED

SECTION 6: TABLE OF ANNUAL C.C.A. AND UNDEPRECIATED CASH FLOWS ARE FOR . . . . . 20 YEARS

SECTION 8: ANNUAL SUMMARIES OF OPERATIONS AND CASH FLOWS ARE FOR . . . . . 20 YEARS

CASH FLOWS DEFINED AS AFTER TAXES AND AFTER MORTGAGE INTEREST AND PRINCIPAL PAYMENTS

CASH EQUITY INVESTMENT PLUS ACCUMULATED MORTGAGE PRINCIPAL PAYMENTS IS USED IN THE CASH FLOW TO INVESTMENT RATIO

SECTION 9: THE HORIZONS COVERED BY THE ECONOMIC EVALUATION ARE:
5 YEARS 10 YEARS 15 YEARS

THE FOLLOWING INPUT OPTIONS WERE USED

RENTAL REVENUES ARE BASED ON THE NUMBER AND RENTAL RATES OF EACH TYPE OF RENTAL UNIT

THE AMOUNT OF MORTGAGE FINANCING WAS ENTERED IN KNOWN AMOUNTS

THE MAXIMUM C.C.A. RATE IS TAKEN EACH YEAR AND ANY LOSSES ARE TREATED IN PART AS TAX SAVINGS

SECTION 2

CAPITALIZED COST OF PROJECT, MARKET VALUE, AND RELATED DATA

ESTIMATED PROJECT COSTS (TO BE CAPITALIZED)

LAND	$ 8962500.
SITE IMPROVEMENTS	$ 0.
BUILDING CONSTRUCTION AND GENERAL EQUIPMENT	$ 0.
FEES (BOND, LEGAL, CLOSING, ETC.)	$ 0.
INTEREST ON CONSTRUCTION LOAN	$ 0.
FURNISHINGS, APPLIANCES, ETC.	$ 0.
OTHER	$ 31260818.
TOTAL	$ 40223318.

ESTIMATED OTHER COSTS OF PROJECT
(TO BE TREATED AS NON-RECURRING EXPENSES)

FEES	$ 0.
INTEREST ON CONSTRUCTION LOAN	$ 0.
LANDSCAPING	$ 0.
OTHER	$ 0.
TOTAL	$ 0.

MARKET VALUE OF PROJECT AT TIME OF COMPLETION
(GROSS AMOUNT RECEIVED IF PROJECT WERE SOLD)

MARKET VALUE OF BUILDING AND APPURTENENCES	$ 35604503.
MARKET VALUE OF LAND	$ 10398875.
TOTAL MARKET VALUE	$ 46003378.

COSTS ASSOCIATED WITH SALE OF COMPLETE PROJECT

SELLING EXPENSES (% TOTAL MARKET VALUE)	6.00
TAXES (NOT RELATED TO CAPITAL GAIN OR RECAPTURE ON SALE)	$ 0.

RATE OF INCREASE OR DECREASE IN MARKET VALUE AFTER PROJECT COMPLETION

TIME PERIOD	OTHER THAN LAND /YR	LAND /YR
0 - 1 YEAR	7.50	7.50
2 - 5 YEARS	5.90	7.20
6 - 10 YEARS	4.80	6.80
11+ YEARS	2.50	6.80

CASH EQUITY INVESTMENT AT COMPLETION $ 8223318.

TOTAL COST OF PROJECT, LESS LAND $ 30.093 SQ.FT.

TOTAL PROJECT COST, INCLUDING LAND $ 64.416 SQ.FT.

SECTION B

RENTAL REVENUE DATA AND TIME REQUIREMENTS FOR CONSTRUCTION AND RENTAL OF THE PROJECT

LENGTH OF TIME REQUIRED FOR CONSTRUCTION 18 MONTHS

LENGTH OF TIME FROM START OF CONSTRUCTION UNTIL FIRST RENTAL REVENUES START 18 MONTHS

NUMBER OF QUARTER YEARS FROM FIRST RENTAL REVENUES UNTIL FULL OCCUPANCY IS ACHIEVED 8 QUARTERS

TOTAL NUMBER OF DIFFERENT TYPES OF UNITS FOR WHICH RENTAL REVENUES ARE GIVEN 3

ANNUAL REVENUES OTHER THAN THOSE COVERED BY DETAILED BREAKDOWN $ 0.

ESCALATOR FOR ANNUAL REVENUES OTHER THAN THOSE COVERED BY DETAILED BREAKDOWN 0.00 /YR

DATA ON INDIVIDUAL UNITS

FOR EACH TYPE OF UNIT THE ORDER OF THE DATA ITEMS IS AS FOLLOWS:

FIRST ROW UNDER EACH UNIT TYPE

1. NUMBER OF UNITS OR RENTABLE AREA PER UNIT
2. RENT PER UNIT OR PER SQ.FT.
3. NUMBER OF MONTHS USED AS THE BASIS FOR RENTAL RATES
4. VACANCY AND BAD DEBT RATE %
5. RENT ESCALATOR %/YR
6. TERM OF RENT ESCALATOR, YEARS

SECOND ROW UNDER EACH TYPE OF UNIT

PERCENT RENTED DURING EACH OF THE QUARTER YEARS STARTING AT FIRST RENTAL AND PRIOR TO FULL OCCUPANCY FOR THE PROJECT

OFFICE

347474. $ 8.75 12 5.0 7.5 5
29.0 39.0 48.0 58.0 67.0 77.0 88.0 98.0

RETAIL

72967. $ 15.50 12 5.0 7.5 5
53.0 67.0 94.0 99.0 99.0 99.0 99.0 99.0

GARAGE

[illegible]. $ [illegible] 12 5.0 7.5 5
99.0 99.0 99.0 99.0 99.0 99.0 99.0 99.0

GROSS AREA 624483.SQ.FT. RENTABLE AREA 420441.SQ.FT.

GROSS POSSIBLE ANNUAL RENTAL REVENUES $ 4386252.
NET ANNUAL RENTAL REVENUES $ 4147939.

NET ANNUAL REVENUE $ 6.643 PER SQ.FT. GROSS AREA

NET ANNUAL REVENUE $ 9.866 PER SQ.FT. RENTABLE AREA

NET MONTHLY REVENUE $ .994 PER SQ.FT. GROSS AREA

NET MONTHLY REVENUE $ 1.822 PER SQ.FT. RENTABLE AREA

SECTION 4

ANNUAL CASH OPERATING EXPENSES FOR FULL OCCUPANCY
BASED ON WAGES AND PRICES AT START OF PROJECT

CASH OPERATING EXPENSE CATEGORY	OWNER $/YR	TENANT $/YR	ESCALATOR %/YR
SUPERINTENDENT	0.	79000.	7.
MANAGEMENT-HEAD OFFICE	180000.	0.	5.
HYDRO (EXCLUDING HEATING)	0.	82900.	5.
WATER	0.	0.	0.
HEATING FUEL	0.	374200.	15.
PAINTING AND DECORATING	0.	0.	0.
MAINTENANCE AND REPAIRS	0.	69000.	7.
SUPPLIES	0.	0.	0.
SERVICES	0.	69300.	8.
MISC. OPERATING EXPENSE	0.	401600.	5.
OTHER ADMIN. EXPENSE	139500.	108600.	8.
INSURANCE	0.	30900.	5.
REAL ESTATE TAXES	0.	632800.	5.
OTHER TAXES	0.	0.	0.
GROUND RENT OR LAND LEASE	0.	0.	0.
OTHER	0.	0.	0.

TOTAL ANNUAL CASH OPERATING EXPENSES EXCLUDING CCA, INCOME TAX, MORTGAGE PAYMENTS AND GROUND RENT	$ 819500.
TOTAL ANNUAL CASH OPERATING EXPENSE PER SQ.FT. OF RENTABLE AREA	$ .7599
TOTAL ANNUAL CASH OPERATING EXPENSE PER SQ.FT. OF GROSS AREA	$ .5117
RATIO OF ANNUAL CASH OPERATING EXPENSES TO ANNUAL GROSS POSSIBLE RENTAL REVENUES	7.32 %
RATIO OF ANNUAL CASH OPERATING EXPENSES TO ANNUAL NET RENTAL REVENUES	7.70 %

SECTION 5

FINANCING, INTEREST RATE AND DISCOUNT RATE DATA

DISCOUNT RATE USED IN PRESENT VALUE CALCULATIONS:	13.00 /YR.
NUMBER OF MORTGAGES AVAILABLE FOR FINANCING:	1 MORTGAGES
COST, OTHER CONSIDERATIONS, ASSOCIATED WITH FINANCING	$ 0.

THE AMOUNT OF MORTGAGE FINANCING WAS GIVEN FOR EACH MORTGAGE

	1 MORTGAGE
MORTGAGE AMOUNT	$ 32000000.
INTEREST RATE	11.17 /YR.
AMORTIZATION PERIOD	30. YEARS
NO OF EQUAL PAYMENTS	12. PER YEAR
MONTHS) AFTER CONSTRUCTION STARTS, UNTIL FIRST PAYMENT	22. MOS.
MONTHLY MORTGAGE PAYMENT	$ 302777.
ANNUAL DEBT SERVICE	$ 3633322.
LOAN COVERAGE	1.094
MORTGAGE CONSTANT	11.354

TOTAL COST OF PROJECT	$ 40223318.
PLUS OTHER CONSIDERATIONS EQUAL	$ 40223318.
TOTAL AMOUNT OF MORTGAGE FINANCING	$ 32000000.
INITIAL CASH INVESTMENT OR WINDFALL GAIN IF NEGATIVE	$ 8223318.

SECTION 6

CAPITAL COST ALLOWANCE, REPLACEMENT AND
UNDEPRECIATED BOOK VALUE TABLES

1 ASSET CATEGORY	2 INITIAL COST	3 CCA RATE-%	4 REPLACE YEARS	5 ESCALATOR /YR	6 SALVAGE VALUE
BUILDING	$31280818.	5.00	0	0.00 %	0.

NOTE: ASSETS THAT ARE NOT TO BE REPLACED HAVE A
ZERO IN THE REPLACE COLUMN(4)

ANNUAL CAPITAL COST ALLOWANCES FOR ASSET CATEGORIES
ANNUAL TOTAL CCA AND BOOK VALUES

YEAR	BUILDING
1	1564041.
2	1485839.
3	1411547.
4	1340970.
5	1273921.
6	1210225.
7	1149714.
8	1092228.
9	1037617.
10	985736.
11	936449.
12	889627.
13	845145.
14	802888.
15	762744.

ANNUAL CAPITAL COST ALLOWANCES FOR ASSET CATEGORIES
ANNUAL TOTAL CCA AND BOOK VALUES

YEAR	TOTAL DEPR.	BOOK VALUE
1	1564041.	31280818.
2	1485839.	29716777.
3	1411547.	28230938.
4	1340970.	26819191.
5	1273921.	25476422.
6	1210225.	24204501.
7	1149714.	22994276.
8	1092228.	21844356.
9	1037617.	20752334.
10	985736.	19714717.
11	936449.	18728981.
12	889627.	17792332.
13	845145.	16902906.
14	802888.	16057765.
15	762744.	15254872.

SECTION 7

INCOME TAX RATE DATA

AVERAGE TAX RATES
FOR YEARS FOLLOWING START OF CONSTRUCTION

1	2	3	4	5
50.0	50.0	50.0	50.0	50.0

THE TAX RATE BEYOND THE FIFTH YEAR FROM THE START OF CONSTRUCTION IS ASSUMED TO BE THE SAME AS THAT LISTED FOR THE FIFTH YEAR

SECTION 8

SUMMARY OF OPERATIONS, MORTGAGE PAYMENTS, TENANTS EXPENSES CASH FLOWS AND DISCOUNTED CASH FLOWS YEARLY

YEAR	(A) NET REVENUES	(B) CASH OPER.EXP.	(C) NET OPER.REV.	(D) MORTGAGE PRINCIPAL	(E) MORTGAGE INTEREST
1	0.	0.	0.	0.	0.
2	1096824.	169751.	927073.	39161.	873170.
3	3200981.	360795.	2839736.	150598.	3482724.
4	4131694.	383464.	3748180.	167890.	3465433.
5	4147939.	407600.	3740339.	187167.	3446156.
6	4147939.	433302.	3714638.	208857.	3424466.
7	4147939.	460673.	3687267.	232615.	3400708.
8	4147939.	489825.	3658119.	259323.	3373998.
9	5091421.	520877.	4530544.	289099.	3344224.
10	5954903.	553957.	5400947.	322293.	3311030.
11	5954903.	589201.	5365703.	359298.	3274024.
12	5954903.	626754.	5328150.	400352.	3232770.
13	5954903.	666771.	5288132.	446543.	3186779.
14	7251969.	709420.	6542549.	497815.	3135907.
15	8549034.	754877.	7794157.	554974.	3078348.

YEAR	(F) TENANTS OPER.EXP.	(G) PROJECT CCA	(H) DEDUCTIONS FOR TAXES	(I) TAXABLE INCOME	(J) INCOME TAX
1	0.	0.	0.	0.	0.
2	0.	782020.	1824942.	-728118.	-864089.
3	0.	1924940.	5368460.	-2167928.	-1083964.
4	926065.	1448693.	5297990.	-1149936.	-572968.
5	2385229.	1376256.	5230014.	-1082079.	-541037.
6	2579293.	1307445.	5165419.	-1017473.	-508737.
7	2798521.	1242073.	5103453.	-955514.	-477757.
8	3030434.	1179969.	5043793.	-895854.	-447927.
9	3292903.	1120971.	4986072.	65350.	32675.
10	3564196.	1064922.	4929909.	1024994.	512497.
11	3908038.	1011676.	4874901.	1080002.	540001.
12	4266682.	961092.	4820616.	1134287.	567144.
13	4670975.	913031.	4766598.	1188315.	594158.
14	5120456.	867386.	4712913.	2539636.	1269828.
15	5623456.	824017.	4657242.	3891792.	1945896.

YEAR	(K) CASH FLOW	(L) CASH FLOW DISC.	(M) CUMULATED DISC. C.F.	(N) CASH FLOW INV.RATIO
1	0.	0.	0.	0.0000
2	322124.	274266.	274266.	.0392
3	172160.	111652.	385918.	.0208
4	794890.	510669.	896787.	.0949
5	655387.	368736.	1265523.	.0764
6	597577.	295455.	1560974.	.0682
7	539146.	234150.	1795124.	.0601
8	480120.	183319.	1978547.	.0522
9	947235.	309262.	2287809.	.1001
10	1337834.	395412.	2683221.	.1372
11	1199900.	310682.	2993903.	.1191
12	1135337.	258317.	3252220.	.1088
13	1066489.	213628.	3465848.	.0986
14	1795564.	302055.	3767903.	.1556
15	2331405.	360747.	4128650.	.1979

SECTION 9

SUMMARY AND ECONOMIC EVALUATION OF PROJECT

	5 YEAR HORIZON	10 YEAR HORIZON	15 YEAR HORIZON
TOTAL PROJECT COST	$ 40223319.	$ 40223319.	$ 40223319.
MARKET VALUE AT HORIZON	$ 62801996.	$ 81369083.	$ 97355749.
SELLING EXPENSES	$ 3774120.	$ 4882145.	$ 5841349.
NET SELLING PRICE	$ 59127877.	$ 76486938.	$ 91514404.
MORTGAGE BALANCE	$ 31499189.	$ 30147199.	$ 27888016.
CASH REVERSION BEFORE TAXES	$ 27628691.	$ 46339739.	$ 63626387.
BOOK VALUE	$ 35091407.	$ 29176025.	$ 24998816.
CAPITAL GAIN OR LOSS	$ 19904599.	$ 36263620.	$ 51291086.
RECAPTURE OF DEPRECIATION	$ 5131911.	$ 11047293.	$ 15624502.
CAPITAL GAINS TAX	$ 4726140.	$ 9069905.	$ 12822771.
TAX ON RECAPTURE	$ 2565956.	$ 5523646.	$ 7812251.
CASH REVERSION AFTER TAXES	$ 20376596.	$ 31750188.	$ 42991365.
DISCOUNTED CASH REVERSION	$ 10674765.	$ 8713642.	$ 6101087.
CASH EQUITY INVESTMENT	$ 8223318.	$ 8223318.	$ 8223318.
SUMMARY MEASURES, AFTER TAXES AND AFTER MORTGAGE PAYMENTS			
INTERNAL RATE OF RETURN	25.001 %	18.405 %	15.469 %
PROJECT NET PRESENT VALUE	$ 4833773.	$ 3990761.	$ 2881929.
BENEFIT/COST RATIO	1.610	1.537	1.388
PAYBACK PERIOD, YEARS	12.	12.	12.
SUMMARY MEASURES, AFTER TAXES AND ASSUMING NO MORTGAGE:			
INTERNAL RATE OF RETURN	12.979 %	12.246 %	11.804 %
PROJECT NET PRESENT VALUE	$ -28320.	$ -1807036.	$ -3568926.
BENEFIT/COST RATIO	.999	.950	.902
PAYBACK PERIOD, YEARS	11.	11.	11.

THE DISCOUNT RATE USED IN THE PRESENT VALUE CALCULATIONS IS: 13.000 /YR.

WHERE COST IS THE INITIAL CASH EQUITY INVESTMENT AND THE LATTER IS LESS THAN OR EQUAL TO ZERO, A ZERO (0) IS PRINTED FOR BENEFIT/COST RATIO

IF THE PAYBACK PERIOD IS GREATER THAN THE HORIZON REQUESTED A 99 IS PRINTED FOR PAYBACK

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THIS COMPUTER PROGRAM HAS BEEN DEVELOPED BY THE
CANADIAN DIVISION OF THE PORTLAND CEMENT ASSOCIATION
IN COOPERATION WITH THE FACULTY OF ADMINISTRATIVE
STUDIES, YORK UNIVERSITY, TORONTO, ONTARIO, TO
PROVIDE ASSISTANCE IN MAKING AN ECONOMIC EVALUATION
OF PROPOSED BUILDING PROJECTS. WHILE THE PORTLAND
CEMENT ASSOCIATION AND YORK UNIVERSITY HAVE TAKEN
EVERY PRECAUTION TO ASSURE THE CORRECTNESS
OF THE ANALYTICAL CALCULATIONS AS THEY PERTAIN TO
THIS PROGRAM, THE RESPONSIBILITY FOR INPUT DATA AND
APPLYING JUDGEMENT TO EVALUATE OUTPUT REMAINS WITH
THE USER OF THIS PROGRAM. ACCORDINGLY, THE PORTLAND
CEMENT ASSOCIATION AND YORK UNIVERSITY DO AND MUST
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OMMISSIONS WHICH MAY OCCUR IN CONNECTION WITH
USING THIS PROGRAM.

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