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ATRIA-Temperate Climate Responses.

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ABSTRACT. This paper reports on the continuing work in Auckland, New Zealand, to formulate design guidelines for architects operating in temperate climate zones to produce atria spaces associated with commercial buildings- particularly offices- which are energy efficient and architecturally plausible.
The apparent lack of recognition of the inherent characteristics of the atrium form has lead to the production of too many examples which , if not air-conditioned, are uncomfortably hot or cold; and if air conditioned are particularly large energy users.
It is argued that in temperate climate conditions the advantages of a non-air conditioned atrium are particularly attractive- and vital if adequate responses to Global Climate Change phenomena are to be adopted by the architectural community in the decades ahead. Work is progressing to finalise design nomographs for use by architects at the preliminary design stage, which is seen as the critical time in the process. The 'art' of the architect must prevail at this stage with fine tuning by computer analysis later in the design process. The complexity and often contradictory nature of the thermal design components in office space design is recognised. If energy efficient buildings are to result, then these components must be considered at the earliest stage or just energy efficient mechanical plant systems will result. Designer checklists are provided.

1 INTRODUCTION.

Climatic severity and the actual use of the building are important to determine the typical thermal responses of the proposed building- the basic question being asked is if the building is internal load dominated or external load dominated and for what period of time does each scenario

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apply. In temperate climates where the cut-off point between the two basic systems occurs, careful consideration of this issue is necessary. Does the office space typically need heating or cooling and for what proportion of the day/year does this happen.
To many, the term 'commercial building' includes all buildings of an overall commercial nature ranging from offices to retail spaces to hotels. All are 'commercial' but exhibit wide variations in energy performance. We must be more specific in temperate climate zones and forever come back to basic definitions-

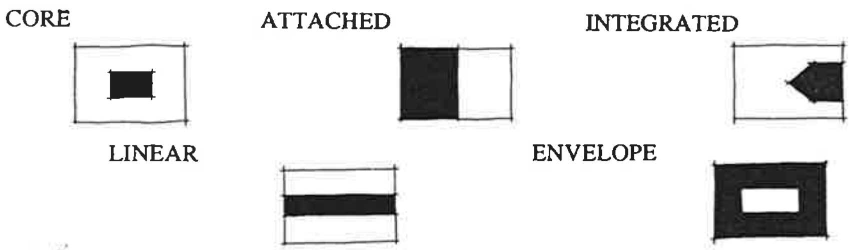
INTERNAL LOAD DOMINATED;
components; people, lighting, equipment;
strategy-reduce internal loads, lighting, cooling;
EXTERNAL LOAD DOMINATED;
components; conduction gains, conduction losses, infiltration, ventilation, solar gain;
strategy-reduce envelope losses, use solar gains, possibly use thermal mass.

In the New Zealand context this type difference is well exhibited by the NZERDC Report studying the Annual Energy Use for a range of building uses in two contrasting climate zones -
Auckland 37S° Hotels 550 MJ/s /annum, Offices 850 MJ/sqm /annum,
Christchurch 44S° Hotels930MJ/sq m /annum, Offices 370MJ/sqm /annum.
This shows that even allowing for possible variations in comfort standards the problem in Auckland offices, which are internally load dominated, is essentially a cooling one- quite at variance to other commercial building energy use profiles which tend to be externally load dominated. Throughout this paper, the term 'commercial building' is taken to mean 'office building'.

2 TYPE/FUNCTION.

In temperate climates all five well defined basic type of atria have an application-

Figure 1.



Each of the above offer a range of possible connection between building interior and atrium space with the degree of buffering with each being constrained by aspects of economics, atrium use, site and climatic severity. The acceptable comfort range within the atrium has a major bearing on type, economics and overall thermal efficiency. If the temperature in the atrium is allowed to run free then the auxilary heating/cooling demands will be zero. Whereas if the atrium temperatures are to be kept at precise levels equating to those in air conditioned spaces, then the auxilary loads and associated costs increase dramatically. In temperate climates the possibility of zero auxilary energy load and letting the temperature in the atrium run free is a legitimate design aim and is necessary if the full energy saving potential of the atrium is to be realised. Recent monitoring of a variety of un-conditioned spaces indicate the following for the two climate zones of Auckland and Christchurch Fig2/3.

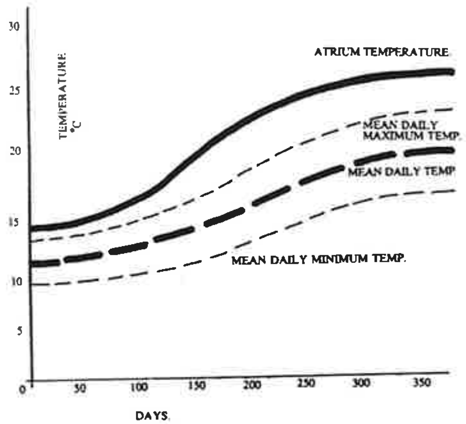


FIGURE 2 AUCKLAND ATRIUM.

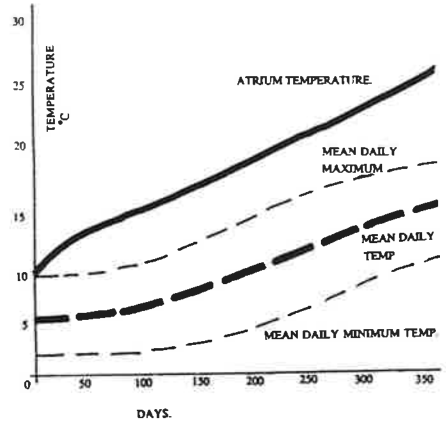


FIGURE 3 CHRISTCHURCH ATRIUM.

Considering the internal climate of the atrium, the above two graphs show -assuming reasonable design control- two things; the relative latitude available to the designer in the milder climate of Auckland and the relatively higher importance of atrium cooling techniques in the milder climate.
Also when the connection back to the surrounding office space is considered- Fig 4/5- the results are similar with need for heat loss reduction techniques- insulation, double glazing- to the Christchurch office space.
The allowable thermal climate conditions in both the atrium and the office space is a critical design decision. A wider range of thermal conditions is generally accepted in spaces that have a good connection to nature and avail the occupant of better control of their environment.

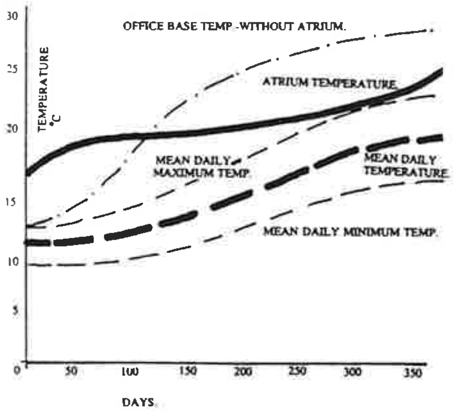


FIGURE 4 AUCKLAND OFFICES.

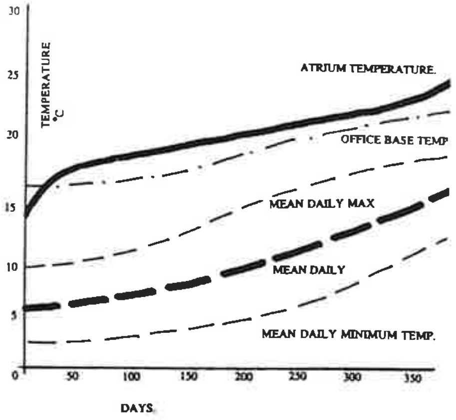


FIGURE 5 CHRISTCHURCH OFFICES.

3 TEMPERATE CLIMATE CRITERIA.

Without the extremes of climate common in other regions, architects operating in temperate climate conditions such as in New Zealand must exhibit care by not adapting the atrium form without carefully assessing the inherent advantages and disadvantages. Generally as the climate becomes less extreme the energy saving justifications of atria become less significant with many of the over heating potentials becoming more dominant if the atria is poorly considered.

The main architectural criteria for the design of atrium- connected office spaces not requiring auxilary energy to achieve acceptable comfort conditions, include-

DESIGN FACTOR	TYPE	NOTES
Building use-internal loads	High-people, computers,etc.	Internal loads may result in cooling needs.
	Low	External climate may become dominant.
Climate zone	Extreme temperate	Better need for atria.
	Mild temperate	Internal loads dominate with stable comfort needs easily met.
Atrium comfort	Small variations	Precise control- particularly solar and ventilation.
	Wide range	Truly passive atrium form is possible.
Office comfort	Small variations	Precise individual controls for fine tuning
	Wide range	Passive non- involvement will be possible.

Atrium configuration	Core	Mild climates with careful design of external wall.
	Attached	Minimal impact on office interior.
	Integrated	Better integration possible.
	Linear	More severe climates good connections.
	Envelope	Ultimate buffering form.
Nature of top skin to sky	Filter	Glare,solar gain and control possible-and needed in high-load applications.
	Clear	Over-heating/over-cooling potential high, therefore mass and ventilation important.
Orientation	Dominant external wall orientation is important to allow optimum solar control and ventilation inducement.	
Atrium width, height,volume	Large	Close to ambient, with a range of thermal conditions.
	Large shallow	Roof skin important with good daylight potential to office spaces.
	Deep	Reduced potential.
	Small shallow	Minimal impact.
Wall surface	Large solid area	Greater buffering potential.
	Small solid area	Less daylight reflectance.
	High reflectivity	Daylight to deep atrium areas possible.
	Low reflectivity	Reduced daylight potential.
Connection to offices, thermal and daylight	Direct	Maximum potential.
	Dilute	May be desirable if atrium thermal con-ditions fluctuate widely.
Natural ventilation	High	Always desirable
	Low	Dangerous but appropriate in high humidity,low load situations.
Insulation	High R value	Extreme climate locations.
	Low R value	Warm temperate high internal load situations.
Mass	High	Extreme climate
	Low	Most temperate climate atrium uses.
Atrium glazed area	High	High glare, solar gain and heat loss potential.
	Low	Passive solution which may be adequate.

4 CONCLUSIONS.

Whilst the above are presented as available design options, it must be realised that many are inherently contradictory in their impact. For instance, shading- increases lighting loads, diminishes cooling loads and increases heating loads. There must always be an analytical back up to test intuitive decisions taken at the earlier stages. However with so many atrium thermal disasters appearing in particularly temperate climates, an awareness of the design factors involved must produce a better more sustainable architecture. The well-conceived atrium has a place on the architectural palette of temperate climate designers. A truly 'regional' architecture will develop appropriate forms of atria associated with varying building uses.

5 REFERENCES.

Baker N.1988 .The Atrium Environment, Building Technical File No 21,U.K.

Bednar M J.1983. The New Atrium, McGraw-Hill.

Breuer D.1988. Energy Efficient Passive Solar Commercial Building Design. NZERDC 173, Wellington.

BOMA 1989. Optimising Energy Conservation, Seminar, Auckland.

Bryn I. Atria IEA Monitoring and Evaluation of 16 Buildings SINTES, Technical University of Norway, Trondhein.

Gentilli J.1971. Climates of Australia and New Zealand, World Survey of Climatology. Volume 13.

IPCC 1990 Working group 1 Report, Scientific Assessment of Climate Change.

NZERDC 1985. Commercial Sector Energy Use. Report 115. Wellington.

Robertson G.1990. Energy Efficient Commercial Buildings-A Realistic Market Objective. Proceedings ANZScA/ADTRA Conference, Sydney.

Robertson G. 1990. The Marketing of Energy Efficient Commercial Building Design. Proceedings C I B Symposium, Singapore.

Robertson G.1990. Survey of 150 Auckland CBD Buildings. University of Auckland.

U.S.A. D O E. 1983. Passive Solar Commercial Building Programme Case Studies. DOE/CE 0042.

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