

NATURAL LIGHTING OF DEEP ARCHITECTURAL SPACE: THE PERCEPTION OF NEW ZEALAND ARCHITECTS

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Abstract

The paper considers aspects of a survey carried out amongst a group of registered New Zealand architects in order to establish their knowledge and experience in using core-daylighting systems and methods (Barrett, 2003). Core-daylighting comprises systems and methods for bringing natural light into deep architectural space where conventional methods (such as windows and skylights) cannot readily be used. Examples of these methods are: atria (Matusiak, 1998), sun tracking heliostats, sun and light pipes, light scoops, Fresnel lenses, anidolic zenithal systems, prismatic daylight systems, light shelves, tapping mirrors, light reflectors and louvres (Littlefair, 1991, 1996 & 2000), lightwells, internal courts (Lam, 1986), fibre optic cable (Kay, 1999), and other systems for light re-direction.

The survey was carried out using a questionnaire as described below (Survey Methods). The findings were analysed, resulting in a clear indication that the respondents were not especially experienced or knowledgeable, and a majority felt this to be an area of their skill base in need of development. Whilst the survey was strictly intended to gather quantitative material, respondents were invited to comment freely as they progressed through to completion of the questionnaire. This paper draws on this qualitative data as an insight into several areas, including the attitudes of respondents towards their clients when

making decisions about designing buildings for natural daylighting.

Keywords:

Deep architectural space; core-daylighting; natural lighting; consultation.

Introduction

The architectural profession worldwide seems ambivalent on making best use of daylight in buildings. Encouragingly, however, the matter is increasingly brought forward for discussion by and amongst architects, with some authors such as Cook (1997) suggesting that gaining knowledge about innovative daylighting design could become a matter of professional survival. Writing in the influential RIBA Journal, Cook suggests that practitioners who fail to keep themselves informed on the issue may eventually find themselves unable to offer the full range of services and expertise expected by their clients.

Other authors take a less pedantic view as to how 'expert' the architect must be, and Evans (1981) cites Louis Khan's Kimbell Art Museum

as an example of the use of daylighting for mood rather than utility. This approach also characterises the work of the contemporary American architect, Steven Holl, where the creation of an ambience seems more important than achieving starkly correct levels of illumination.

This is one side of the debate. The architect taking an exclusively 'poetic' approach to the use of daylight. The other side takes a more pragmatic view, in which the optimising of daylight is seen as a practical means to improving conditions within a building. Ander (1995) sums this up succinctly in a statement which neatly contains the whole *raison d'être* for core-daylighting:

"Because low-angle daylight can be better utilized, the use of this (core-daylighting) equipment is able to extend the hours within a day, as well as the months within a year, so that natural light can effectively replace or complement electric lighting".

This paper is not a catalogue of systems and methods for achieving core-daylighting, and in much the same way that the survey respondents were given no visual clues, but rather were forced to call upon their own empirical knowledge and experience, so it applies to the current reader. The reader wishing to delve more into the systems and methods may wish to refer to an earlier paper by the author (Barrett, 2007). Though possibly the most comprehensive catalogues of actual systems and methods for achieving core-daylighting (and other innovative natural lighting ideas) are those published by the United Kingdom's Building Research Establishment (Littlefair, 1996 & 2000).

Survey Methods

The survey group comprised approximately 33% of all practising architects accredited in 2002 by the New Zealand Architects Education and Registration Board, a total of 493 respondents (399 males and 94 females). Of the 493 architects approached, a total of 215 chose to take part in the survey (166 males and 49 females).

The collection of data from participants used two methods via a questionnaire, and these were specific to each of the questions. Questions 1 and 2 were ordinal (on a scale from '0 to 10'), and questions 2 to 6 were categoric ('yes/no', or specific nominations from listed possibilities). In addition, respondents were invited to make comments to each question, and it is this qualitative commentary that provides the substance for this paper. The original survey set out with the intention of noting any 'gender' and/or 'age' influences on responses, and whilst not being hugely influential, there are some points of interest as will be seen.

The Questions

The importance of natural lighting towards human health, wellbeing, behaviour and performance, is generally accepted by the scientific and medical (including behavioural psychology) communities (Gallagher, 1994 & 1999; Day, 1990; Cherulink, 1993), and, as indicated by the survey outcomes (Barrett, 2003), is not disputed by the respondent group of architects. For example, in question 1 of the survey (Do you believe the health and wellbeing of a building's occupants is influenced by the presence of daylight within the building?), 96% of respondents marked at the very high end of the 1 to 10 scale (8 or higher). However, as if to

set the scene for the qualitative aspect of the survey, and to acknowledge the importance of being allowed to make general comments, a number of respondents made qualifying comments relating to this survey question, to the effect that other aspects were equally or more important than natural lighting – aspects such as outlook to the exterior (views) and ventilation.

Do you believe the health and wellbeing of a building's occupants is influenced by the presence of daylight within the building?

Not at all 1 2 3 4 5 6 7 8 9 10 Significantly

The responses were recorded on a scale of 1 to 10 as shown above. All female respondents indicated 6 or higher on the scale, with 63.3% of the group indicating 10. The figures were similar for males, with 57.2% nominating 10, and only 2 of the 166 respondents dropping below the 6 line (both indicated 3 on the scale).

The survey indicates that the majority of architects taking part (97.9% of females, and 95.8% of males) selected at the 'significantly' (8 - 9 - 10) end of the scale. Of the 215 combined total of both male and female respondents, only 8 architects (3.7% of the total) selected lower than 8 on the scale.

Younger architects of both genders in the 20-29 age group tended to be more categorical than others in selecting the highest number on the scale, though being a group relatively low in number the significance is unlikely to be truly indicative. In evaluating the responses to this question, with 96.3% of combined respondents indicating 8 or higher on the scale, the belief appears to be very strongly

held amongst the architects surveyed that the health and wellbeing of a building's occupants is significantly influenced by the presence of daylight within the building. This conclusion, however, needs to be considered alongside a range of comments made by respondents as discussed below. There were 18 comments to this question by male respondents, and 10 by female. The comments fell into four main categories:

Contact with the exterior

In considering the wellbeing of the occupants, 5 males and 4 females mentioned the equal importance of factors such as a view to the outside, and a general awareness of exterior conditions such as the weather. One male respondent suggested that an 'awareness of daylight' (as opposed to having direct access to daylight) was very important. Three respondents (2 male, 1 female) believed sunlight to be as important as daylight for the wellbeing of occupants.

One of the female participants summarised her response in general to question 1 as follows:

Absolutely - but it's not just 'light' that affects people; it's being able to see the sky and the weather that is important where people are living or working.

With another female respondent further reinforcing that aspect:

Outlook (and view) is more important.

And a male respondent suggesting that daylight is just one part of a more holistic combination:

Emotional wellbeing is based on a number of factors. Daylighting and the visual link with nature is very much part of it.

The use of the building or space

This category attracted only one direct comment from the female respondents, but figured more highly amongst the males with 9 comments being made. The comments made the point that the use the space is put to had a strong bearing on whether the absence or presence of daylight was an issue. In this, a distinction became apparent between (a) buildings or spaces in which daylight is not essential (some recreational spaces, utility and service type rooms), and (b) those in which daylight should be positively excluded (nightclubs, cinemas, darkrooms). One male respondent considered that multi-purpose rooms such as auditoriums could be compromised if daylight was over-abundant:

Dependant on occupancy, e.g. multipurpose auditorium spaces can suffer flexibility with too much natural light.

At the time of conducting the survey (2002), it was relatively common practice in New Zealand to design residential apartments with no direct natural lighting to the bedrooms, with borrowed light across other living spaces being utilised. This practice was criticised by one respondent, and alluded to by others. (The New Zealand Building Code has since been modified to circumvent this practice; NZBC, 2004).

Duration of occupancy (time spent in non-daylit space)

One female and two males commented that the length of time spent in a non-daylit space was a consideration. One of these respondents specifically quantified this, by suggesting (based on his observations) in a workplace situation, that stress would ensue when more than two

hours was spent deprived of natural light. This situation is acknowledged, for example in Berlin, Germany, where statutory regulations prohibit daytime occupancy of workplaces for more than 3 hours where daylight is absent (personal discussion with Werner Osterhaus, Head of School of Architecture, Victoria University of Wellington, 5 November 2001).

Sole use of artificial light is acceptable

Three male respondents commented that artificial light is always an acceptable substitute for daylight. None of the three qualified this statement by suggesting that 'in some instances' it might be. One male respondent considered that 'artificial light can be designed better' (sic):

I have no information that suggests that artificial light is not a suitable substitute. Sunlight, however is beneficial.

Although it has been shown that the majority of respondents considered the presence of daylight to be crucial towards ensuring the health and wellbeing of building users, clearly there are also various mediating factors to be taken into account. The professional responsibility of the architect in this matter is therefore quite complex, requiring considered decision making, taking into account widely diverging issues such as duration of occupancy, and the use to which the building is put. This leads into the next survey question, in which the extent of client consultation is examined. Clearly, if on the one hand the presence of daylight is agreed to be important, whereas on the other the issue is seen to be complicated by a range of other considerations, then the architect's role, and his/her working relationship with the client also needs to be critically evaluated.

When you prepare designs for clients do you consult them on which spaces require natural daylight?

The responses were recorded on the following scale of 1 to 10

Never 1 2 3 4 5 6 7 8 9 10 **Always**

There was a broader spread of nomination across the scale for this second question, although as for question 1 the majority (though smaller) indicated at the higher end. Of the combined total of 215 respondents 18.1% selected below 5 on the scale, with 81.9% above that figure. Of the female respondents, 67.3% selected at the 'always' (8 - 9 - 10) end of the scale, with 69.3% of the males doing the same. However, both male and female respondents were less categorical in selecting 10 than they had been for the first question (46.4% for males, and 48.9% for females).

As with the first question, architects of both genders in the younger age groups (20-29 and 30-34) tended towards the higher end of the scale, though once again their relatively low numbers make the findings somewhat unreliable.

In marked contrast to the first question, however, nominations at the lower (1 - 4) end of the scale were higher, with 12.2% of females and 15.1% of the male architects suggesting they would not as a general rule consult with their clients on the issue. To balance this, however, the written comments made by respondents are particularly revealing as to why consultation was not considered to be a high priority.

There were 40 written comments to this question

by male respondents, and 17 by female, and the comments fell into three main categories, with more one-off statements being made than for question 1. The first category was nominated by the largest number of respondents:

As the architect I make the decision for my client

The precise wording of the respondents' comments were not always stated in quite this way, with a brusque "I know better" being one example, and "normally intuitive" being another. In general terms, however, the message was given by 25 of the male, and 11 of the female respondents, that they believed themselves to be professionally capable of making the decision without reference to their client:

I see it primarily as my decision as a designer. Consultation specifically about daylight only occurs if I feel I need to do something out of the ordinary to achieve the daylighting I require in a space.

Several respondents (5 male and 3 female) qualified their responses by suggesting that they were more likely to discuss spaces with their clients where daylight was not, or could not be provided, or where it was specifically not required.

Two male respondents stated that they would discuss the issue 'obliquely', or as part of general discussion about the effect they were aiming for in the overall design, or of the various benefits and possibilities:

Assuming you are referring to habitable space. I take for granted that most spaces will have access to daylight. I always consult where this is not possible; i.e. about how I propose to deal with spaces that have limited or no access to daylight.

I see it primarily as my decision as a designer.

Consultation specifically about daylight only occurs if I feel I need to do something out of the ordinary to achieve the daylighting I require in a space.

Type of Clientele

Several respondents made the distinction between commercial/corporate clients, and those for domestic residential projects. Two male respondents pointed out that corporate clients, who tended not to be the end users of the building, were especially difficult to engage on the subject of daylighting and building design. This was compounded by the fact that for this type of commission it was usually quite difficult for the architect to gain access to the actual occupants/users to obtain information and to discuss design options. This communication was usually carried out at owner or management level:

There is always a great difficulty with corporate clients who do not use the spaces themselves.

Use of the Space

A distinction was drawn by 1 female and 2 male respondents between habitable and non-habitable spaces, believing that consultation on daylight provision was generally not required for spaces where people neither lived nor worked. Amongst such spaces were listed stores, plantrooms, service rooms, utility spaces, toilets and corridors.

The fact that some activities specifically demanded the exclusion of daylight from rooms was mentioned by 1 female and 5 male respondents. Examples included archives, sensitive storage, darkrooms, and some heritage spaces.

Other Comments

One male respondent made the distinction between 'sunlight' (in which the direct rays of the sun penetrated to the interior spaces), and 'daylight' (in which natural light, but not the direct rays of the sun, penetrated to the interior spaces). He pointed out that the former was more commonly discussed as an issue with his client.

The amount of time spent in the space was considered by one male respondent to be a factor in determining the extent of consultation with the client:

I try to provide natural daylight to most occupiable rooms where people are in there for 15 min or more at a time.

Consideration of the nature and quality of daylight was mentioned as an important consideration by two respondents:

Always in commercial work. Don't ask so much in residential as answers are more standard, but quality of light questioned; i.e. am, midday, pm.

The quality (orientation) source of daylight is also important. Low amenity apartments becoming people warehouses and worth your study.

Many of the participating architects were quite adamant it was their responsibility to decide whether or not specific rooms would be naturally lit. Some believed this to be part of the expertise they were able to offer clients. On balance this is probably not an unreasonable attitude, particularly when tempered by caution when in doubt.

Significantly, a number of architects stated that the overall aim of the design (what they hoped to achieve) was indeed a matter for consultation

with the client, but that the daylight question was only one of a number of contributing factors towards that end result.

The distinction drawn by respondents between habitable and non-habitable space seems on the surface a reasonable one, however there is potential for bad design decision making unless careful evaluation of even the most utilitarian spaces is carried out. The role of daylighting should always be considered, if for no other reason than energy conservation and economics. Those spaces identified by respondents as having specific reasons for the exclusion of daylight (archives, etc) clearly have issues which go well beyond the preferred method of illumination, and which encompass the whole spectrum of environmental design (temperature and humidity control, etc.).

Possibly the most central issue raised is that of failure to design for natural light where it is clearly an expectation of the client, and a few respondents stated they would consult with their clients when such a situation arose. Though not stated by a large number of the participants, it is perhaps not an unreasonable expectation that all architects would consult in this situation:

Don't always consult with clients, but they are always made aware if natural daylight is unavailable or difficult to provide in whichever room is affected.

This, and the dilemma posed by the inability to provide natural light in crucial areas leads on to the next question, which examines the levels of usage and knowledge of core-daylighting methods.

Question 3: On Core Daylighting Systems Which of the following core-daylighting systems have you (a) used, or are (b) knowledgeable about?

The first two questions were intended as a 'warm-up' to the topic of daylighting in architecture before going on to address the main issue underlying the research project, to gauge levels of knowledge and understanding of the various core-daylighting and light redirection systems and methods. In question 3, therefore, the architects were asked to tick those systems they either had used or were knowledgeable about. The systems were simply listed as follows, with no accompanying illustrations, which might otherwise have triggered an empirical understanding of the system where no prior knowledge had formerly existed.

The following list of 18 core-daylighting 'systems' was presented to the respondents, and they were asked to identify the extent of both use and knowledge of each.

- light pipe (e.g. 'Solar Tube')
- built up rooflight
- roof window (opening)
- skylight (non-opening)
- atrium
- lightwell
- internal courtyard
- light reflection from exterior
- light shelf
- light reflector
- louvres
- heliostat (solar tracking mirror)
- fresnel lenses
- anidolic zenithal system
- prismatic daylighting system
- optical daylighting system

- light guiding glass system
- other daylight redirection systems - please specify

The subsequent analysis of responses has indicated a clear dividing line within the list, based on whether respondents see a system as being of a conventional nature (well known amongst the respondent group), or of an unconventional nature (less well known amongst the group). Systems from 'light pipe (e.g. 'Solar Tube') to 'louvres' fall into the more well known category, with those from 'heliostat' to 'light guiding glass systems' being less so. This is borne out in written comments, with a suggestion by some respondents that the latter systems were more 'hi-tech' than the former. In analysing the responses, therefore, those systems listed down to 'louvres' are recorded as conventional, and from 'heliostats' to 'light guiding glass systems' as unconventional. Analysis of the questionnaire was broken down as follows:

- 1) Systems Used (Conventional)
- 2) Systems Used (Unconventional)
- 3) Systems Known (Conventional)
- 4) Systems Known (Unconventional)

The list started with systems that were ticked by around 93% of respondents (roof lights, light pipes, lightwells, internal courts), through to those where very few of the architects indicated any knowledge (heliostats, fresnel lenses, fibre optics for daylight transmission, special light guiding glazings and films, optical daylight systems, etc). In spite of this lack of knowledge, it was encouraging to receive comments from several respondents indicating their own use of innovative light re-direction methods, including the use of pooled water on flat roofs for reflecting

light, photo-electric/polarised light shutters, and glass blocks in floor constructions. Of the 'conventional' systems, skylights, rooflights and roof windows were by far the most commonly used, with 97% of males and 89.8% of females having used skylights, for example. The least used systems in this category were 'light shelves' and 'light reflectors', with 16.3% of male respondents, and only 6.1% of females having used 'reflectors'. The extent to which this latter system was known to respondents, however, was much higher, at 40.4% for the males and 34.7% for the females. These two systems are the possible exceptions within this grouping, being more unconventional in their nature than the others.

In the 'unconventional' category, the indicated level of usage was extremely low, with 'prismatic daylighting system' attracting the highest figure for males, where 4.8% indicated they had used this method. The female architects scored very low in the 'unconventional' category, with not a single respondent indicating they had used any of the listed systems. In all, only 28 of the 166 male architects had used systems from this category, and it is here that the only really apparent age group variation seems to have occurred in the responses to this question. Of the 28 male respondents a total of 11 were in the age group 40-44. The indicated level of knowledge in the 'unconventional' category was somewhat more encouraging, with, for example, 27.7% of the males saying they had knowledge of 'heliostats', and 11.4% of them indicating 'fresnel lenses'. The females registered 4% for both of these systems.

There were four written comments by the female respondents, and 11 by males, and there were

three main issues raised:

Other Systems Used

This category, in which respondents offered 'other' core-daylighting systems which they had themselves used, attracted the highest number of comments for this question, with 7 males and 1 female responding.

A number of interesting systems were nominated, including the reflection of light using pooled water on flat roofs, glass blocks used in floor construction, photo-electric/polarised light shutters, and fibre optics. The latter is perhaps the most intriguing, particularly when considered alongside international endeavours, where the general consensus is that fibre optics systems are both exceedingly costly and of limited practical application (Kay, 1999). The limitation imposed by an anonymous questionnaire is very apparent in this instance, where the opportunity to follow up with the respondent could have proved of considerable interest. It should also be noted that the respondent did not clarify whether he was nominating 'use of' or 'knowledge of' fibre optics as a core-daylighting system.

More conventional methods are also included by respondents, and these are also very important being somewhat less costly, and capable of being readily included within normal construction and budgetary requirements. These include the simple device of carefully selected colour schemes to enhance light reflection, and the incorporation of 'borrowed lights':

Internal glazing / clearstorey glazing.

Sidelights / borrowed lights.

Internal wall treatment especially colour schemes.

Budgetary Considerations

One male respondent stated that he had specified the use of light shelves in a project, but that post-tender cost cutting had seen them removed.

Two similar remarks were made under 'Further Comments' (at the end of the questionnaire), where one respondent stated she had often wished to incorporate systems for more active sun control, but again had always been limited by the budget. The other pointed out the fact that cost is always a big determinant in the making of design decisions:

I have often wanted to use more active sun control techniques, but have always had them removed from the developed design stage as an unnecessary cost. This is even with the client acknowledging sun control would make a beneficial difference. So many problems in our industry boil down to cost.

Three respondents (2 female and 1 male) made specific comment regarding their lack of knowledge, especially in the more unconventional areas. Perhaps the most intriguing response was from a female architect who, although she was unsure as to the nature of some of the more unconventional systems, thought it was possible she may have used them:

I have limited knowledge about some core-daylighting systems but not enough to be confident designing them.

Not sure what the last 6 are (may have used them?).

Other Comments

As with most of the questions, several respondents made comments which could equally have been made in response to one or more of the

other questions. An illustration of this occurred in this case where an issue commented widely upon in question 1 was again raised. A female respondent mentioned outlook and awareness of exterior conditions, and commented that 'workrooms' could be quite adequately lit using artificial means, and that occupant dissatisfaction was usually caused by factors other than lack of daylight, such as "isolation, detachment ... and lack of sky view".

It's not just 'light' that affects people; it's being able to see the sky and the weather that is important where people are living or working.

Workrooms can be lit perfectly adequately by artificial light. When you ask workers for comments they don't necessarily talk about light levels - they may talk about isolation, detachment, not being valued by management, and when further questioned they identify lack of sky view as a core part of their dissatisfaction. Therefore hi tech indirect lighting methods such as bracketed in Q3 (respondent bracketed all systems from 'light shelf' down to 'other') would not meet that sort of client comment/brief.

In retrospect the questionnaire has limitations when it comes to evaluating the actual depth of knowledge amongst the respondents. For example, an indication of knowledge of 'heliostats' could at one extreme mean the respondent has complete understanding of the principles involved and may have seen examples of heliostats in use, to the other extreme where the respondent has a vague recollection of reading about heliostats at some time in the past.

The observation was made by several respondents at various points in the questionnaire that the survey was somewhat remiss in the

lack of explanation for some of the less well known core-daylighting systems. Given that the aim of the survey was to establish the extent of awareness, however, then this is perhaps a defensible approach.

Having established some idea of the extent of awareness of core-daylighting systems amongst architects, the next question asks participants to make a series of judgements on 'difficult' projects regarding the use of artificial light in lieu of daylight.

Imagine a difficult project where you are forced to use artificial lighting as the sole means of illumination for some of the interior spaces - tick those spaces where this would be acceptable.

This question was divided into two categories, residential or non-residential.

Residential

- dining area
- living area
- bedroom
- bathroom
- kitchen
- hallway
- other residential - please specify:

Non-residential

- individual office
- open-plan office space
- restaurant
- wine bar
- retail shop
- reception area to company office
- airport terminal
- factory floor

- hospital ward
- theatre
- public swimming pool
- church
- classroom
- gymnasium
- art gallery (exhibition room)
- other non-residential – please specify

In considering sole use of artificial light in residential spaces, respondents were very clear in nominating two areas above all others where this would be acceptable, and these were 'bathrooms' and 'hallways'. For bathrooms 81.6% of the female respondents and 80.1% of the males, and for hallways 85.7% of females and 87.4% of the males, were comfortable in using solely artificial lighting.

The 'living area' was clearly at the opposite end of the acceptability spectrum, with only 4.1% of female architects and 3% of their male counterparts prepared to use solely artificial lighting. The 'dining area' was somewhat more acceptable to respondents, with 26.5% of the females and 34.9% of the males nominating this space. The 'bedroom' figured somewhere in between, with 14.3% of females and 12.7% of the males indicating them as being acceptable.

'Other residential' attracted an average of 34.5% of respondents, and this category included such respondent nominated areas as utility rooms, stores, garages, and games and entertainment rooms.

In the non-residential category the nominations were somewhat more evenly spread, and there were more spaces which respondents felt could be solely artificially lit. Around 8 of the listed space types fell at the high end of

acceptability, with 2 at the low end. As might have been anticipated, areas such as 'theatres' and 'art galleries' were acceptable to the highest numbers. For theatres the figures were 81.6% for females and 83.7% for males, and for art galleries, 81.6% and 77.1% respectively.

Other spaces at the high end included 'retail shops', with nominations from 77.6% of the females and 78.9% of the males, 'wine bars', with 73.5% of the females and 78.3% of the males, and 'restaurants', with 59.2% of the females and 68.7% of the males.

Two spaces in particular were identified at the low end of acceptability. The 'hospital ward' attracted 8.2% of the female respondents and 12.7% of males, with the figures for the 'classroom' being 10.2% and 10.8% respectively. Some respondents qualified their nomination for 'classroom', referring to rooms such as lecture theatres as being artificially lit by preference or choice.

Respondents identified a number of spaces in the 'other non-residential' category, which came in overall at the low end of acceptability, with nomination by an average of 7.4% of the respondents. The list of those spaces where lack of daylight was considered acceptable included libraries, meeting rooms, prison cells, archives spaces, warehouses, service rooms and toilet areas. Also, several respondents identified a range of spaces such as nightclubs, casinos and other spaces which are used predominantly at night.

For this question there were 11 written comments by the female respondents, and 39 by males, and there were three main categories of comment:

Other Residential

This category, in which respondents offered 'other residential' spaces in which absence of daylight was acceptable, resulted in the nomination of more traditional spaces such as laundries, utility rooms and garages, though a sign of the times was apparent in the nomination of wine cellars, home entertainment rooms, home theatres and home gymnasias by several respondents. Also acceptable to one male respondent was a room used exclusively for formal dining.

Other Non-Residential

In the 'non-residential' category a range of spaces was nominated as listed above. In addition to this, considerations such as the duration of occupancy were raised in the comments. One respondent identified 'transitional spaces', in which little time was spent, with another suggesting that internally focussed temporarily used rooms were in the range of acceptability. The same respondent also considered it unusual for situations to arise in which total reliance on artificial lighting was necessary. Another respondent who commented on the duration of occupancy factor, also added that "time of day" and "opportunities for relief" should be taken into account.

Transitional space where no-one has to spend their working day.

For internally focussed temporarily used spaces it is more acceptable. It is rarely necessary to totally rely on artificial lighting

Indicative, perhaps, of traditionally persisting attitudes towards incarceration, two male respondents considered it quite acceptable to totally exclude daylight from prison cells.

The identification of spaces used exclusively at night was made by a number of the respondents, and in addition to the more obvious choices such as nightclubs and casinos, other spaces requiring "fantasy and special effects" were also nominated.

Commercial kitchens were considered to be within the range of acceptability by one male respondent, and other nominations included libraries, and specialised medical areas, such as operating theatres and x-ray suites, where it was clearly necessary to positively exclude daylight.

Clarification Comments

There were frequent instances in which respondents felt it necessary to clarify or qualify aspects of their nominations on the questionnaire form. In one case, for example, the respondent had indicated that it was acceptable to have non-daylit 'art galleries', but he also wrote a qualifying comment indicating that this was dependent on the nature of the exhibits. In another case the respondent indicated that whilst 'classrooms' should be naturally lit, the same was not true for 'lecture theatres'. Another respondent felt that "some types" of classroom could be solely artificially lit.

Reluctant or conditional acceptance was occasionally indicated by respondents. For example, one female architect would accept no daylighting to 'retail shops', 'reception areas', 'dining areas', 'individual offices' and 'gymnasias', but only reluctantly.

'Restaurants' and 'wine bars' were acceptable to another respondent, but only if they operated at night.

Other Comments

There were a number of one-off comments, with one respondent suggesting he would resign the commission if a client requested exclusion of daylight in any residential situation:

If they wanted (only) artificial light in the above (residential) would tell them to get another architect.

There was a comment alluding to the generality of the questionnaire, with the respondent stating that "some spaces in the list would be acceptable, but too general a question".

One female respondent made a somewhat derogatory (though possibly quite telling) remark about Frank Lloyd Wright's attitude towards building users and occupants, suggesting that he paid no heed to the importance of view to the exterior when he designed the Johnson Wax Building. The same respondent included a range of other issues that should be taken into account in evaluating the choice of illumination method. These included (i) the level of involvement in an activity being experienced by the occupants, as for example with theatre-goers, shoppers and diners, (ii) time of the day, and (iii) duration of occupancy:

Artificial illumination only' would be acceptable in a space where - people are strongly focussed on other things (eating, shopping, theatre) - it's night outside (restaurant etc) - people are not spending hours every day there (shop, gallery, etc) (pity the staff though - hopefully they have a view out from the staffroom or workroom) - where the floor plan is very large, e.g. factory floor, so that the sense of outside would be very remote. But F L Wright managed to get daylight into the Johnson Wax Building and the staff loved it, so he said (he wouldn't let them have a view because windows didn't conform with his overall aesthetic: so much for valuing staff).

Judging by the number of written comments to this question, respondents clearly felt the need to do more than simply nominate individual spaces which they felt could be non-daylit. There were a few spaces on which the majority were in agreement, such as 'theatres' at the high end of acceptability, and 'hospital wards' at the low end. There were other spaces, however, where the architects felt it was important to qualify their nomination, and to list some of the mediating factors to be considered. One frequently mentioned factor, for example, being length of time spent in the space.

Possibly the most unexpected nomination in the residential area, given the contemporary focus on the 'kitchen' as a social, entertaining and gathering place within the home, was the relatively high number nominating this as being acceptable without natural light. For female respondents the figure was 26.5%, and for males 27.7%. Again, however, the occasional generality of the questionnaire needs to be taken into account when evaluating responses. It may well be, for example, that the respondents were basing their judgement on the contrasting lifestyles of young professional couples or singles living in inner city apartments, as compared with that of more traditional family groups in larger suburban family dwellings.

The 'unexpected' equivalent in the non-residential category was the 'church', which was nominated at a relatively high level of acceptability with more than one in four of the respondent architects believing it was acceptable for churches to be non-daylit (26.5% of the female respondents, and 25.3% of the males). This challenges a long established tradition of religious building design in which

natural light has been considered absolutely central to fulfilment of the building's purpose. Examples include Le Corbusier's chapel at Ronchamp, and several of Louis Kahn's religious buildings. Also of more recent vintage would be the Chapel of St Ignatius by American architect Steven Holl. Each example being testimony to its architect's philosophy that daylight is as much a material as the glass, wood, steel and concrete of the building's fabric.

With four questions completed, and the general level of respondent awareness and attitude towards the issues of daylight and core-daylighting having been established, the final two questions aim to gauge firstly how respondents feel about the state of the art amongst their colleagues, and secondly how keen they are as individuals to be more knowledgeable about the subject.

Do you believe New Zealand architects are as knowledgeable as they might be in the use of core-daylighting systems?

Respondents were simply asked to indicate 'yes', 'no', or 'don't know'.

Although a majority of the architects answered 'no', there was a substantial gender variation which was far more noticeable than with any of the other five questions. Of the females, 83.7% felt that the levels of knowledge were not what they might be, with 68.1% of the males agreeing (a 15.6% gender variation). Allowing for the 7.2% of males who were unsure, a total of 24.7% of their group believed the profession to be knowledgeable. In comparison, 14.3% of the females felt this way.

There were 22 written comments to this question,

6 from females and 16 from the males, and the comments generally fell into 4 main categories as outlined below:

Don't Know / Not Sure

Of the total of 22 comments, 10 were in this category, with respondents indicating they were simply unable to answer the question. One male architect possibly summed up the apparent all round reactions by simply stating "I have no idea what other architects know or don't know".

Limited Knowledge

Three respondents believed there to be a limited level of knowledge amongst practitioners in New Zealand, one describing it as "rudimentary", and another as "mid range knowledge".

Systems Unknown to Respondents

Three of the comments were made with reference to the respondents' own personal levels of knowledge, one stating that her answers to question 3 (systems used or known) were clearly indicative of her personal lack of knowledge; she had indicated the use or knowledge of 'conventional' core-daylighting systems down to 'louvres', with none of the 'unconventional' systems nominated.

Not a Major Issue in New Zealand

Two respondents considered that in New Zealand there was not the same need for core-daylighting expertise as there was internationally, with one suggesting that it was uncommon for projects to occur of a nature and scale which might justify such measures.

Other Comments

One female respondent considered that architects were well aware of the issues

relating to daylight and building design, but were prevented from addressing them by the limitations of the brief.

A male respondent, who had indicated 'no' in answer to the question, qualified this by saying that for lifestyle reasons in residential situations the idea of using core-daylighting was unacceptable. His point was not entirely clear, however it could perhaps be construed to mean that no special measures should be taken beyond the more traditional methods of bringing daylight into residential spaces.

Both comments undoubtedly relate back to question 3, and concerns expressed by several respondents over limitations imposed by cost.

In spite of the gender imbalance, as noted above, the belief is held by a majority of all respondents (71.6%) that practitioners in this country are not as knowledgeable as they might be on the issue of core-daylighting. Leading on from this, the final question asks respondents if they would like to become personally more knowledgeable and thus, by implication, see the situation change within the architectural profession in New Zealand.

Would you personally like to be more knowledgeable in the use of core-daylighting systems?

Respondents were again asked to indicate 'yes', 'no', or 'don't know'.

Unlike the previous question the genders were evenly balanced in their responses to question 6. The majority of respondents were clear in their wish to know more about core-daylighting systems, with the female affirmative response

at 83.7% and the males at 82%. Allowing for a small number of 'don't knows', the figures for those architects not wishing to improve their knowledge were 14.3% for the females and 14.5% for the males.

There were 9 written comments to this question, 3 from females and 6 from the male architects. The comments essentially fell into just one category, with most respondents simply qualifying their answer to the question.

One of the females had no desire for more (as she described it) "hi-tech info", with one of the males nominating 'yes' but stating he was in "no rush". Two of the respondents indicated they would research the issue if and when the need for core-daylighting arose on any projects in the future.

Whilst the majority of the surveyed architects have indicated they would like to be more knowledgeable on the issue of core-daylighting, the tenor of the comments suggests it is certainly not a high priority in their minds. It is perhaps quite reasonable to take the attitude "I will research as required", as this approach is central to the offering of any professional service, where no individual practitioner could reasonably be expected to be fully expert in all fields of their discipline. Whereas the client would be right to anticipate efficiency in the sourcing of the information, or of recommended onward referral to another professional, expert in the particular field.

The point has been made by Matusiak (2000) that it is not possible for all architects to be experts in core-daylighting, but rather that they acknowledge and understand the difficulties, and then seek appropriate professional help. This

suggests that the level of understanding held by architects, if not required to be comprehensive, should at least be sufficient to allow for informed dialogue with the acknowledged expert.

As a final part of the questionnaire respondents were invited to make further comments, and these are outlined below.

Respondents' Further Comments

A total of 70 'Further Comments' were made by the architects participating in the survey, 15 from the females and 55 from the males. As with comments specific to the six questions, the final remarks also fell into a number of categories as follows:

Examples of Projects

Ten respondents cited examples of their own projects which they felt had either incorporated some form of core-daylighting, or would have benefited from having done so.

One of the female respondents who had worked on the National Library in Wellington, pointed out the need to address the dual issues of human needs and comfort, as well as the protection of light sensitive material contained in the building. Of particular interest in this quoted example is the fact that the needs of the occupants appear to have been acknowledged by the building owners, with the construction of a glazed rooftop cafeteria.

One project I was involved with which presented major lighting issues was the National Library in Wellington. Huge areas under the building (actually underground) provide storage. Many people work here all day. All resources in the building were considered to be light sensitive. In order to provide daylight to office space, whilst eliminating direct daylight, deep specifically designed window

recesses were integrated into the cladding system. To provide relief from unlit work space a glass pyramid was built on top of the building to house a cafeteria.

On the one hand the importance and quality of natural light is acknowledged, where on the other, its deleterious effects are quite justifiably feared.

This dilemma, along with the facility to control the nature and quality of light in sensitive situations is often mentioned by users of a range of similar building types, in particular museums and art galleries:

... gallery spaces within the museum that have no daylight are so much easier to control and the exhibits look so much better as a result - really the aim of the exercise.

(Personal e-mail correspondence with the curator of the Waikato Museum: 20 July 2001)

Another female respondent had used solar tubes for lighting ground floor internal en-suites in a rest home, and she included a sketched freehand cross section of the building to illustrate (the equivalent rooms at the upper level were designed with roof windows).

A suggestion involving some interesting lateral thinking was made by another of the female respondents, although she pointed out that most of her work was on too small a scale to warrant the incorporation of core-daylighting. The idea involved the security aspect of prison design, which she felt might well be a spinoff from the use of core-daylighting systems.

With one exception it appears to be the case with most of the quoted examples that skylights, or some other form of overhead aperture system,

was the preferred method used for daylighting internal spaces. Whilst perfectly acceptable and effective, such systems obviously pose a limitation on building height and on the number of storeys capable of receiving natural light. It was interesting to note, therefore, that one of the male respondents had also used louvres for redirecting daylight, and that he did so on a regular basis when designing new homes.

Most of my new home designs use skylight or external louvre systems to manipulate light inside and out.

Higher Priority Issues

As noted by a number of the architects in their comments to Question 1, many felt that a range of other issues were equally if not more important than core-daylighting. In all, 18 of the 55 comments in this final section expressed this view.

Foremost amongst the other considerations was having a view to the exterior, a point made by 9 respondents, though some also included ventilation and other issues in the same comment.

Not only daylight but the 'long view' a window affords/enhances one's pleasure of being in a space. So you are looking not just at lighting but emotional wellbeing.

The importance of aspect was strongly made in particular by one of the male respondents who felt that "The psychology of visual aspect is often of greater importance than whether the lighting is all natural ... external vistas are important, for orientation as well as visual connection to the "world outside".

By implication core-daylighting applies exclusively to internal spaces, and several respondents

recognised that another important issue also comes up with this type of planning, that of ventilation. One of the female architects believed that natural light and natural ventilation were interconnected, and that both had implications for health and wellbeing. One of the male respondents felt that ventilation was actually more important than natural light.

That it is potentially dangerous to investigate any architectural issue in isolation from others is obvious. A discussion on daylighting is no exception to this, and one respondent summed this up by suggesting that a more important issue was to establish what people's needs or wants might be, and she felt that issues such as productivity and teamwork were influenced by a whole range of factors.

Along similar lines, a number of respondents felt that a sense of compromise was important, rather than total focus on achieving natural lighting, possibly at the expense of other issues. Two architects considered that integration of natural and artificial lighting systems needed to be considered, whilst another, in specific reference to "spiritual space" stressed the importance of control on quality and quantity of daylight to ensure that the desired effect was achieved.

Integration of light systems with partial natural light - control of solar penetration with shading and dispersal techniques.

... Combination of natural and artificial lighting is more often the more cost effective solution, rather than one or the other.

a number of categories mentioned require a fairly specific response; for example, natural light into a spiritual space I consider desirable. This needs to be carefully controlled however. Degree of natural light,

orientation, and desirability of, are all fundamental to a design solution.

Not a Major Issue in New Zealand

As with comments for question 5, in which two respondents felt that the need for core-daylighting expertise was not as strong in New Zealand as it was internationally, three of the respondents made similar remarks in this section.

One female architect felt that in the USA and Europe less natural light was available, due in part to higher building densities, thus providing stronger justification for the use of sophisticated daylighting systems.

Another of the female respondents, whilst acknowledging the value of having an understanding of such issues, also felt there was little or no demand for such skills.

The third respondent, a male, also made reference to the lack of demand for expertise in the field of core-daylighting, and he suggested that the prevailing New Zealand town planning provisions ensured that housing densities would continue to be kept low.

Although it is necessary to be aware of core daylighting systems, there really is not a large demand for them in most cases. NZ's Town Planning provisions for low density housing doesn't really necessitate using/requiring them.

Budget Considerations

As for question 3, once again a number of respondents raised the issue of cost as a prohibitive factor in the debate about core-daylighting.

I have often wanted to use more active sun control

techniques, but have always had them removed from the developed design stage as an unnecessary cost. This is even with the client acknowledging sun control would make a beneficial difference. So many problems in our industry boil down to cost.

Conclusions

The survey set out to establish the state of the art amongst New Zealand architects in relation to knowledge and awareness of core-daylighting. It remains to draw a conclusion from the findings, though in doing so, the nature of the questionnaire design is firstly discussed briefly.

The quantitative aspects of the questionnaire are, by definition, measurable, and the tables are the result of this. In contrast, the qualitative aspects, resulting from comments made by the respondents, are less readily analysed, though their contribution is equally important.

It could be argued that an element of quantitative processing of the comments was in fact possible, for example where a known number of respondents all added the note "views to the outside" when answering question 1. However, the question did not ask respondents to nominate other issues which they believed might influence the wellbeing of building users, but simply whether or not they believed daylight to be important in this regard. The situation would certainly have warranted quantitative analysis had the question been phrased along the lines "List those environmental considerations which you believe can influence the health and wellbeing of a building's occupants?" In this case all respondents could be assumed to have looked at a range of considerations, rather than some choosing to do so, and a measurable set

of responses would have been achieved.

In designing the questionnaire, thought was given to this dual aspect, as to whether or not a mix of qualitative and quantitative data could be successfully dealt with. The decision, that indeed it could, was influenced by the unique nature of the respondent group's profession. The practice of architecture, per se, involves a balance of the 'scientific' and the 'artistic', and architects deal in widely diverging areas; on the one hand in aspects such as human performance, comfort and emotion, and on the other, practicalities such as cost, technical performance of their buildings and regulatory compliance. In dealing with any project the architect brings to bear a fine sense of judgement over all of these considerations. The conclusion to this paper therefore attempts to do the same, and to balance the qualitative and quantitative aspects of the issue.

Taken as a whole, the survey indicates a reasonable level of interest in the issues raised. These issues range from general discussion on the importance of natural light for human function, through the question of client consultation, and into the specifics of designing for daylight, and the use and knowledge of systems and methods. Interest, however, does not necessarily translate into action, and there seems to be some opinion amongst the group which sees the issue as important, but not necessarily of high priority. This is exemplified by the respondent who in response to question 6, ("Would you personally like to be more knowledgeable in the use of core-daylighting systems?"), answered "yes, but no hurry".

In considering why this might be the case, other

comments by respondents provide some insight. For example, there is a perception that New Zealand (with its small population of 4 million spread thinly around the country), unlike many other countries, has little or no high density building development, and that we are not therefore deprived of natural light due to overcrowding. Realistically this perception is probably more true for residential than it is for commercial projects, where arguably some central city development, particularly much of that carried out during the 1980s, would clearly have benefited from a more proactive and sensitive approach to daylight design. Although the survey was not designed to be categorical on the point, it would seem from many of the comments that a fairly high number of the architects worked primarily on residential projects, with a consequent over-emphasis in that area.

In the process of relegating core-daylighting to low priority, other issues featured as being equally or more important in the minds of a number of respondents. The provision of views to the exterior, along with well designed natural ventilation, were two of the most frequently quoted of these issues. This could perhaps be summed up as the need to ensure a careful balance of the numerous issues inherent in the process of designing architecture, with no one single aspect taking predominance over others.

The low priority viewpoint was not universally stated, with a number of respondents strongly advocating the use of natural light wherever and whenever possible. It was interesting to note that a few architects nominated actual projects they had worked on, some of which had used specific core-daylighting methods, and others where the architect felt the design

would have been improved if such methods had been included. As to the question, "why not included?" there were perhaps three principal reasons that emerged from the survey.

Firstly, the issue of cost, and the fact that 'luxuries' such as light shelves would be amongst the first deletions where post-tender cost savings were required.

Secondly, the difficulty of engaging client interest in the issue, especially where they were not the end users of the building. This factor is possibly also largely cost driven, though it is also indicative of mindset, where the basic and traditional solution to lack of natural light is simply to install artificial.

The third, and most telling in terms of the aims of the survey, was the self admission by a number of respondents that they personally lacked the confidence, knowledge and skills required to design for core-daylighting. Some respondents felt this also to be true for most of their New Zealand practitioner colleagues.

This viewpoint was clearly demonstrated by the survey findings, particularly in relation to question 3, where the extent of use and knowledge was shown to be restricted largely to the more conventional core-daylighting systems.

The survey seems to indicate that there is no great pressure on New Zealand architects to address the issue of core-daylighting. In fact a reasonable number of the respondents seemed quite unaware that the issue even existed beyond basic conventional methods such as skylights.

If such a pressure were to emerge, it would presumably be the result of greater overcrowding

in our cities, and of clients clamouring for solutions. Human nature being what it is, little will be done until the need is present. Global warming, and, in particular, increasing levels of UV in New Zealand, may eventually be considered sufficient reason to develop appropriate design skills. A well considered core-daylighting solution in a kindergarten, for example, could protect young children from too much exposure to UV during the height of summer, whilst allowing them good access to daylight. Also, well designed internal spaces could become attractive and multi-dimensional in mid-winter if core-daylighting was addressed more proactively as a design option. Since undertaking the survey in 2002 (Barrett, 2003), the debate on sustainability in buildings, carbon emissions and global climate change, has taken off apace, and it would be interesting to follow up with the same survey now in 2008. One significant development since the survey was carried out is undoubtedly the increased receptivity of clients, and greater willingness on their part to commit to spending money on what had until comparatively recently been considered add-on luxuries. In parallel with this, architects are also now required to be far more open to these needs, and to having the necessary skills and knowledge to implement them into their buildings. A frequently quoted comment in the 2002 survey went along the lines " ... not a major issue in New Zealand". It is to be hoped that the short few years that have passed since that time have turned this attitude around.

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