Window seat or aisle?

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Introduction

Window seat or aisle? On planes I take the aisle; in buildings. the window. It's the same reason in both cases: personal control.

From a users' perspective, perception of personal control is the single most important factor underlying comfort. It is also linked more indirectly with many other things like productivity, stress, ill-health, safety and security. This is so for people using planes, cars, computer software, most kinds of tools and technical devices and, especially so in buildings. [Reference 1]

There is a growing body of knowledge on usability and its design implications [Reference 2], but usability in buildings is a subject on which the literature can be tantalisingly coy. This is because buildings are different in two important respects.

- They form *contexts* within which activities take place. Contexts have a nasty habit of changing - often unexpectedly.
- Buildings are more than the sum of their parts, so that *emergent* properties dominate - this can be to the good, if eg. they are aesthetically pleasing, but bad if chronically dysfunctional. Emergence then also affects context, producing vicious and - less often - virtuous results.

Unpredictable context changes, linked to growing complexity, create special problems for designing for user needs. Emergence, eg of undesirable "system" effects such as overheating, have consequences which obviously affect users and occupiers much more than designers or developers. The combined effects of context and emergence have led to the growing prominence of user problems which first came to widespread attention in the 1980s with sick building syndrome. If we want to avoid users and occupiers carrying unnecessary costs - which is now at the heart of the "productivity" issue in buildings [Reference 3] - then we need to pay more attention to possible consequences in design and briefing processes.

Control and switching behaviour

The obvious reason why people want more control is to improve things for themselves. It is subtly less obvious that users often use coping strategies where they try to makes things *less uncomfortable* or *less dysfunctional.* This is where designers and users part company because their strategies differ. Designers tend to optimise with respect to known constraints, eg. to make things comfortable and functional. Users try to avoid worsening consequences.

Users hardly ever optimise. They spring in to action in response to random, external events - like the sudden noise of a pneumatic drill or police car siren in the street, or a sudden change from sunlight to gloom - or more perhaps in response to more predictable events, like twilight. They are likely to make the decision to use the switch or control only after the event has prompted them to do so (rather than in advance of it), and will often wait quite a long time until taking action (when they reach a "crisis of discomfort"). They also tend to over-compensate (like completely closing all the windows in a railway carriage when it rains to keep out a few spots of rain, in spite of subsequently creating a hotter and more humid environment for everyone inside). People will operate the element which is most conveniently to hand, not the one which is the most appropriate. They also often take the easiest and quickest option, rather than the best for their immediate benefit.

Worst from the users' perspective is when they want to make changes but are denied them because:

- there are no options open to them (ie no usable controls);
- the systems that are apparently available are unintelligible, do not have any perceived effect when operated or make things even worse when they are.

If an option is available, and having made the decision to switch, people will often as not leave the system in the switched state, rather than alter it back again later, at least until another crisis of discomfort is reached. This tendency to take the ON decision, but ignore the OFF, means that many buildings adopt inertial states in which their systems are left enabled or running unnecessarily. It is also one of the reasons why many automatic control systems - especially for lighting - seem to work so badly in practice [Reference 4]. Not only is this inefficient for energy consumption, but it can also quickly degrade comfort conditions.

Inefficient and uncomfortable inertial states are much more common in open-plan environments where it is frequently difficult or tedious for people to arrive at OFF decisions because of the complexity of the decision-making processes involved (eg: glare can come from a window a long way away from the workstation affected; sometimes even by reflection or through a glass partition), and aided and abetted by poor design and layout of controls.

The closer a control device is to the general occupant, the easier it should be to understand, the more straightforward the technology involved, and the more robust its construction and controls. Control devices used must give direct and unambiguous feedback. The device should almost plead with the occupant to be used, rather than put people off. Thus vertical sliding sashes, for instance, especially upper ones, must be easily reachable (especially for women who do not like to stand on chairs to open windows!), and have no tendency to trap fingers, damage nails or leave dirt on the hands (all of which discourage subsequent use).

Windows

Windows are a prominent example of a context-dependent building element which are increasingly being designed and specified as if they were context-free (they are often chosen out of catalogues, for instance, with little attention given to the detailed manner in which they operate). Users expect that windows should be controllable, give views out, allow available daylight in most of the time thus keeping down the demand for artificial light, give fast - if not instantaneous - response to personal comfort requests for fresh air or cooling, look good, and give weather-proofing and thermal and acoustic performance of a high standard. All of these, except perhaps aesthetics (an emergent property) are context-dependent. It is hard to think of other technologies (of any type) which have to undertake so many simultaneous functions which both set boundary conditions and mediate interactions (between inside and outside). Many potentially clash with each other as the prevailing context changes (like the need to keep daytime traffic noise out but allow fresh air in, for instance).

The normal inertial state for windows in office buildings is CLOSED. At night-time, all windows will tend to be locked shut by the security staff or the cleaners. They will usually remain closed until altered by occupants during the day. In many open-plan office spaces, the opening of even a single window may cause conflict - either because of genuine differences in comfort needs between people, or because of disagreements whose origins may be outside environmental controls, but which spill over and affect their use (often irrationally so, and sometimes bewildering so to the outside observer) or just because operation is difficult (there may be a desk in front of the window) and the result too crude (for example, the window opens too far or in the wrong way and draughts occur).

The ideal window for users will be openable on demand during the day as normal, but with a separate upper part which may also be automatically or manually opened during the evening or night to satisfy cooling demands. This upper element should adjust or shut again when the cooling requirement has been met, so that the building is not left too cool (as can happen when windows are opened overnight in hot weather and conditions change for the worse during the night). The "night-time" element could be an upper hopper and the day-time element a vertical sash, or, perhaps better, a motorised upper sash (for automatic night-time use) with a local over-ride control for day-time adjustment and perhaps also an alternative manual option for day-time as well. A window which approaches this specification has been operating at Marston Book Services, Milton Park, Abingdon. Its performance is reported in [Reference 5] and design features in [Reference 6].

Users like sash windows because:

- they allow a wide range of adjustment, from a tiny crack to half open;
- people understand what they are for, how to use them and how they work;
- users can monitor their state and performance easily (you can see that they are open from a distance);
- they give instant, perceivable responses and feedback;
- they are relatively easy (but not the best) to clean and maintain;

- they can be combined straightforwardly with many other internal and external control blinds and devices for solar and glare control;
- they fit the vertical plane of the building;
- they have many glazing options;
- they can be fitted with supplementary controls for sun and glare.

Drawbacks are often greater for the designer and specifier than the users, hence their increasing rarity. They include:

- perceived higher maintenance costs, especially for wooden systems;
- inefficient mechanisms, making windows difficult to open, particularly with aluminium systems with slender elements and most modern systems without intermediate glazing bars which provide useful hand-holds;
- higher cost;
- difficult to see when they are properly shut;
- poor airtightness.

Implications for design

Here are some user-biased considerations for windows or window systems in naturally-ventilated and/or mixed-mode buildings.

- Ideally there should be openable high, medium and low elements, but two elements - upper and lower - are usually simpler and more affordable.
- The lower sash should be the major "daytime" component- that is it would be adjusted by occupants frequently on demand mostly for localised fresh air - because this is how people normally perceive and use them.
- The upper sash should be the major "night-time" component - with the capability to be either motorised or manually-operated or, preferably, both, rather like a motor-car sunroof. This would be adjusted by occupants on demand during the day, and operate under automatic, semi-automatic or manual control during the night (and other unoccupied periods). Given that the windows are restrained while open, this will be relatively secure, especially if only the upper part is open. The system could also be calibrated locally so that some areas are more fully ventilated and/or cooled than others. Sometimes acoustic screens and acoustic treatment may be required.
- Refinements for control of solar gain, glare and noise should not be part of the basic system itself but should be considered as context-dependent add-ons. These are often difficult to solve with one universal technology and can be highly local, especially affecting the people who do not sit directly next to the window, but are remotely affected by glare and draught, for example.
- The system should be compatible with standard security and cleaning procedures, because these people often set the state of the building for subsequent daytime operation.
- The system should allow window-opening under automatic BMS-type control in response to outside conditions. Automatic opening and closing should normally happen when the building is unoccupied. Occupants often object to automated operation when they are present; particularly of elements which are close to them.
- All automatic operations should be capable of being over-ridden locally.
- The system should not confuse occupants as to how it should be set. For instance, at night after a hot summer's day occupants should expect that upper windows will be relatively wide open and in a cooling mode. In the morning, they will probably partially close the windows to obtain the best conditions. On cooler summer nights, the windows may be in a ventilating mode, and occupants will expect to open windows progressively during the day.

- It should not conflict with the use and operation of blinds, which will often be used in office buildings to avoid VDU glare.
- The inertial night-time state of the blinds - internal or external - should be UP in warm weather, but perhaps DOWN in cold weather when heat may need to be retained.
- The system should be designed to encourage a change in habitual behaviours of occupants, so that default settings always favour the optimum use of outside conditions. This means that the defaults will be context-dependent, and change from one set of circumstances to another. These defaults will differ according to the complexity of the control technology on the skin of the building.

Implications for strategy

Providing people with more control is a major strategic issue for design because perceptions of control are linked to health and productivity [References 3,7,8]. The best way of doing this is usually through controllable windows which meet the kinds of criteria suggested earlier. There are other options as well. In closed-controlled air-conditioned spaces with unopenable windows, an efficient and proactive help desk may be able to compensate, provided that background conditions are stable, predictable and normally fall within reasonable comfort envelopes. Problems arise when occupants are not compensated for things that they perceive to have been taken from them, and they have no recourse to change things for the better for themselves. Often sadly this occurs with help desk systems outside normal hours - frequently the desks are moved during core time only!

The worst circumstances for occupants are buildings which are unmanageably complex (so that many provided functions may not be working properly or at all) and have a high level of management - and technological - dependency (so that there is nothing the occupants can do about it for themselves) but the highlevels of management required are not present. In these situations, people will be even more sensitive to control issues, which takes us back to where they prefer to sit in control-poor environments. Window or aisle?

References

[1] BORDASS W., BROMLEY K. and LEAMAN A., BRE Information Paper - Comfort, control and energy efficiency in offices, BRE, February,1995

[2] Examples from this burgeoning area are NIELSEN, J., Usability Engineering, Academic Press, 1993 (see also www.useit.com) , WINOGRAD T. (ed), Bringing Design to Software, New York: ACM Press, 1996 and NORMAN, D. The Psychology of Everyday Things, New York: Basic Books, 1988 (Retitled "The Design of Everyday Things" for the second edition).

[3] LEAMAN A. and BORDASS W., Probe 15: Productivity: the killer variables , Building Services, The CIBSE Journal, 1998, June, pps. 41-43 (edited version) and in an expanded version on the authors' website

http://www.usablebuildings.co.uk/Publications.html

[4] HEASMAN, T., BORDASS, W. STEWART, T. and FARKAS, N., Scoping Study of Occupant Use of Lighting Controls, Systems Concepts Ltd, 1994, January

[5] STANDEVEN M., COHEN R., BORDASS W. and LEAMAN A., Probe 16: Marston Book Services, Building Services, The CIBSE Journal, 1998, August, pps. 27-32

[6] LLOYD-JONES D., Windows of Change, Building Services: the CIBSE Journal, January 1994

[7] BORDASS W., LEAMAN A. and WILLIS S., Control strategies for building services: the role of the user, CIB Conference on Buildings and the Environment, BRE, 16-20 May, 1994

[8] LEAMAN A. and BORDASS W., Strategies for Better Occupant Satisfaction, in ROOLEY, R. (ed), Indoor Air Quality and the Workplace, Cambridge: Mid-Career College Press, 1997, July, pp. 97-113

[9] Energy Efficiency Best Practice Programme, General Information Report 48: Passive Refurbishment at the Open University, March 1998, available free from Brecsu.

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More information about usability, manageability and related topics may be found on

www.usablebuildings.co.uk

the joint website of Building Use Studies and William Bordass Associates.

The windows in the design studio refurbishment at the Open University's Harold Wilson building were designed to avoid air-conditioning and provide good user control. In spite of this there are still significant differences in occupant comfort between window and aisle seats [Reference 9]

The Colt Window System [Reference 6], shown here at Marston Book Services, is well-liked by occupants. Their operation in the wider context of building services and energy performance in reported in more detail in Reference 5.