

of the buildings - EC-1, BAU-1 and BAU-2 (the satisfaction with fans was low in EC-2 because the building did not have any). The most cited reasons to turn on a fan in EC-1, BAU-1 and BAU-2 were 'to feel cooler' and to 'increase air movement' while the reason to turn off a fan was to 'reduce air movement' and because 'a co-worker requested it.' These are all as one might expect, and the majority of the occupants in EC-1, BAU-1 and BAU-2 said they were very sure of having the desired effect when they interacted with fans.

DISCUSSION

The occupant feedback surveys revealed that one of the energy conscious buildings (EC-1) was performing well (i.e., it had a satisfaction percentage of above 70% in 8 out of ten categories.) Overall, in all of the buildings occupants were primarily dissatisfied with the acoustics and office layout, which is common across the entire CBE database. Acoustic dissatisfaction is an important area that needs to be carefully evaluated since it is often seen as a potential barrier for natural ventilation. One of the arguments against having natural ventilation in a city like Ahmedabad is that operable windows would bring in outdoor noise. However, the survey results show that occupants were more dissatisfied with sound privacy than noise levels, which has more to do with the open plan layout. In terms of the sources of noise that bothered workers, people talking on phone and overhearing private conversations were the most frequently cited sources of acoustic dissatisfaction, rather than outdoor noise.

Another result worth noting is that all the buildings ranked low in the air movement satisfaction category compared to the CBE database, and the lack of air movement was repeatedly cited as the reason for thermal discomfort. Occupants were also dissatisfied with the ability to control air movement and opined that they needed more of it. This dissatisfaction prevailed mainly in zones that did not have fans, which means more attention needs to be given to providing sources of air movement in these buildings. Amongst those who had fans, the main reasons to turn on a fan were to feel cooler and increase air movement. Moreover, when asked about the confidence of having the desired effect on turning on a fan, the majority of the occupants voted that they were confident about this effect. This shows that occupants perceive fans as fast-acting and they rely on it for achieving comfort in a short span of time. Windows on the other hand were opened to let in fresh air in addition to feel cooler and increase air movement. There was a consistent opinion about the reasons to close a window, i.e. when the outdoor got warmer than the indoors. The key take-away from this result is that the occupants preferred to have air movement and when there was a combination of windows and fans in use, they worked well in providing it.

The results also revealed an interesting aspect of occupant satisfaction in EC and BAU buildings. Given that BAU-2 performed better than EC-2, this indicates that one cannot necessarily conclude that a building designed for better energy efficiency will result in better occupant satisfaction as well. In addition to needing to pay more attention to air movement and other indoor environmental factors, there could possibly be latent factors such as interior layout, work culture, and connection to the outdoor views that are important (all of these were better in BAU-2).

This study is a pilot for further research where surveys will be conducted across buildings in different climates of India. Although spatial mapping of thermal comfort and temperature is a powerful method of diagnostics, we were not yet able to generalize about the impact of relevant building design issues due to the uneven distribution of the number of responses (i.e., zones where occupants voted to be dissatisfied with thermal comfort had very few votes.) The scaled up study will consider ways by which we will ensure a minimum number of responses from each zone.

CONCLUSIONS

Indoor Environmental Quality (IEQ) parameters were evaluated in two energy-conscious (EC) and two 'business-as-usual' (BAU) buildings in Ahmedabad. The EC building that utilized more passive architectural approaches performed well in most of the categories compared to the buildings in the CBE database, the other three buildings had multiple categories of concern. Overall, the occupants expressed maximum dissatisfaction with sound and visual privacy. They were mostly satisfied with thermal comfort

except in one BAU building. Those who were dissatisfied most frequently cited 'air movement being too low' as the reason for dissatisfaction. In buildings that had fans, it was perceived to be a fast acting way of providing comfort. Fans were operated mostly due to thermal and air movement needs while windows were operated due to indoor air quality and acoustic reasons in addition to the two former reasons.

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