Atrium in residential buildings – a design to enhance social interaction in urban areas in Nordic climates

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Abstract. The design concept of conditioned atria gains increasing popularity in commercial and service buildings all over the world, but is still not a common building design in the residential sector. This study used a psychological framework to examine if building design with enclosed heated atria in apartment buildings can enhance sense of community and social interactions in Nordic climates. A survey was conducted to understand the experience and perception of residents living in one of the few examples of existing apartment buildings with heated atrium in Sweden in comparison to a "traditional" apartment building designed without an atrium. The questionnaire was comprised of six parts: (i) socio-demographic aspects; (ii) information about the apartment; (iii) social activities within the building; (iv) social interaction with neighbours; (v) information about principles in life; and (vi) sense of community linked to their homes.

The results showed significant differences in social factors between the residents of the two buildings (atrium and non-atrium buildings), which could not be explained solely by differences in preferences and principles in life. A large proportion of the differences in social aspects between the buildings could be explained by the building design, as the common and semi-private areas within the atrium building provide opportunities to establish social interactions. The atrium building was found to have higher frequency of interactions and sense of community, which are both parts of social sustainability.

Keywords: Atrium, Residential Building, Social Interactions.

1   Introduction

Two-thirds of the world population is expected to live in cities by 2050. In Sweden, this level of urbanization was already reached during the 60s. Since then, urbanization has increased steadily; currently more than 85% of Swedes live in cities. Such rapid urban growth induces both challenges and opportunities. High population density in cities may benefit, e.g. from interconnection of many social circles forming vast information networks.

A social network refers to a set of individuals, the relationships among them (social ties), which facilitates by social interactions. In his theory on the spread of information in social networks known as "The Strength of Weak Ties", Granovetter [1] discussed the effect of social ties on flows of ideas, influences and information between individuals. He distinguished between strong and weak social ties. He claimed that weak ties are more likely to connect different social circles and to be the source of non-redundant information, whereas strong ties provide redundant information. Strong ties are often characterized as ties among close friends, whereas weak social ties are occasional, e.g. between casual friendship and neighbours.

Neighbourhoods offer different type of localities for social interactions: public areas, semi-private areas and private areas. Public spaces were reported to effect social interaction regarding access to pedestrian [2] and main streets [3], just to name a few. Semi-private spaces like terrace house's front yards and front balconies were reported to encourage social life and sense of community in residential neighbourhoods [4, 5]. In private spaces like residential buildings, factors such as proximity of apartments in multi-storey buildings, its orientation towards other apartments, position and quality of common place within the building were found to affect the social interactions among dwellers [6]. However, indoor common areas within multi-story apartment buildings are usually not designed in a way that becomes an integral part of the residents' day-to-day activities.

In this context, a courtyard or atrium design within residential buildings may benefit from all of the above three localities: a common space in the "middle" of the residential building (courtyard or atrium) used by all residents. Apartments as private spaces orientated towards the atrium and connected by indoor corridors within the atrium space. Indoor balconies (integrated in the indoor corridors) facing the courtyard acting as a semi-private spaces. They are part of the apartment area but one cannot avoid its neighbours (see example in Fig. 1).

In Nordic climates, an open courtyard within residential buildings may not entail large benefits as a place for social interaction within the building due to shorter daylight hours and poorer outdoor thermal comfort during the cold season. A design with heated enclosed courtyard, so called atrium, may be utilized to a greater extent throughout the year. With a proper design, it may also have lower energy demand for space heating due to lower ratio of thermal envelope to floor area [7]. However, such design in residential buildings is still uncommon in the Nordic regions.

2   Aim

This study used a psychological framework to examine if building design with heated atria in apartment buildings can enhance sense of community and social interactions in Nordic climates. A survey was conducted to understand the experience and perception of residents living in one of the few examples of existing apartment buildings with heated atrium located in northern Sweden (Fig. 1). The results were compared to the experience and perception of residents living in apartment building with a "traditional" design, i.e. without an atrium.

3   Methodology

3.1   Case studies

The atrium-design building was constructed during 2006 in the northern part of Sweden and it is one of the few examples of existing apartment buildings with heated atrium in Sweden. It comprises of two identical five-storey apartment buildings joined by an enclosed linear atrium in-between. The two buildings have a total floor area of 3830 m^2 accommodating 32 apartments with two, three, and four rooms. The entrance to each apartment is through an indoor balcony facing the atrium. All balconies on each floor are connected by suspended corridors. Although each indoor balcony can be regarded as a property of the apartment owner, neighbours can still pass through, for example, on the way to their own apartments. A staircase and an elevator are located in the middle of the atrium and serve both buildings by connecting all corridors. The atrium space is heated during the cold season and can be used by the residents for different activities throughout the year, regardless of the outdoor weather conditions.

   The design of the atrium building includes indoor areas with different social characteristic. The apartment areas act as private spaces orientated towards each other. The indoor balconies and indoor corridors acting as semi-private spaces facing the courtyard, i.e. they are part of the private area (apartments) but one cannot avoid its neighbours. The atrium courtyard acts as a common space located in the "middle" of the residential building for the use of all residents, as illustrated in Fig. 1.
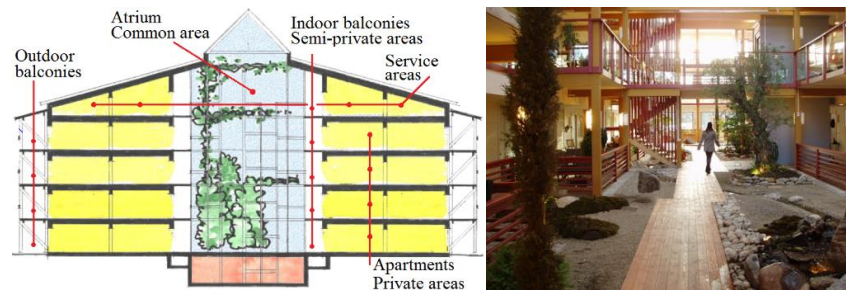
Fig. 1. The atrium building with its different type of areas (left figure) and an indoor photo of the atrium (right figure).

The atrium-design building was compared to a building with a "traditional" design with similar ownership type (condominiums), since the type of ownership could affect sense of community [8]. The "traditional" design building is a single apartment building located in the same city district area as the atrium-design building. It was constructed during 2011and consists of 30 apartments divided between four staircases with two or three apartments on each floor. Each apartment has access to private outdoor balcony. The staircases are heated during the cold season and each includes an elevator.

3.2   Questionnaire survey of apartment owners

A survey was conducted to understand the experience and perception of residents living in an atrium-design building in comparison to a "traditional" apartment building designed without an atrium. A questionnaire was delivered to all apartments in both the atrium and "traditional" design buildings. (62 households in total) during two days in February 2015. The questionnaire were delivered personally to each apartment owner (one per apartment) or alternatively by the mailbox, along with a prepaid return envelope, if the residents were not at home at the time. The choice of individual giving the answers for each apartment was left up to the respondents. The response rate was 81% (26 of 32) and 87% (26 of 32) for the atrium and "traditional" design buildings, respectively.

The questionnaire (appendix A) was comprised of six parts: (i) socio-demographic aspects; (ii) information about the apartment; (iii) involvement in social activities within the building (frequency and type); (iv) social interaction with neighbours (frequency and type); (v) information about principles in life; and (vi) sense of community linked to their homes. At the end of the questionnaire form, the respondents could add optional comments and supplementary information.

The measure of the sense of community used in this Study was a shorter version of McMillan and Chavis [9] scale that was created and validated by Peterson, Speer and McMillan [10]. The scale consists of eight questions that aim to assess dimensions in the experience of the neighbourhood based on the four subdivisions: fulfilment of needs, group membership, influence, and emotional ties.

Questions about guiding principles in life measure if sense of community could be affected by social-altruistic values. Respondents were asked to grade 16 values representing four guiding principles in Life from Schwartz's Value Inventory Scale [11]. These include self-transcendence values like universalism (e.g. social justice, peace on earth, consciousness and equality) and benevolence (e.g. loyalty, responsibility, helpful and forgiving), and opposing values like power (e.g. social power, authority, care for status and wealth) and achievement (e.g. success, skills, influence and ambition). The 16 values were previously used in Swedish context [12].

Questions about social interaction with neighbours include three aspects: (i) questions about services, like babysitting, lending out tools or food, help in emergency, etc. The services are examples of neighbouring behaviour in a study of Perkins and Long [8]; (ii) question about frequency and locations of interaction, e.g. staircase, corridors, balconies, courtyard, apartments; (iii) questions about how well are the correspondents acquainted with their neighbours.

The measure of involvement in social activities within the buildings consisted of five questions designed to capture what was considered as relevant behaviour for engagement and activities in tenant-owner rights. Involvement in society has been related to the sense of community [10], but because this study was interested in the community within the building, new questions were created to be more relevant in this context. The questions asked respondents to indicate their frequency of participation in various activities and events in their own residential buildings like meetings, community tasks or other social activities.

4 Results

4.1 Socio-demographic

Table 1 list the socio-demographic parameters of the atrium and "traditional" design buildings. There are three main socio-demographic differences between the buildings. First, more than 50% of the households in the atrium-design building are single-family households, in comparison to 11% in the "traditional" design building. Second, the average age of the respondents in the atrium-design building is also significant higher. Last, the occupancy time of the respondents in the atrium-design building is higher. These three above-mentioned socio-demographic differences were used as control factors for the analysis of variables related to sense of community (see Fig. 2), social factors (see Fig. 3), frequency of meetings (see Fig. 4) and principle of life(see Fig. 5).

Table 1. Description of demographic factors of the atrium and "traditional" design buildings and calculated differences with χ^2 test and t-tests.

	"Traditional" design n=26	Atrium design n=26	χ^2 (df=1)
Gender: man/woman	10/16	11/12	0.44
Previous connection with the area	11	13	3.1
Single family household	3	14	11.34***
Post-secondary education	21	24	2.88
Household with children	8	1	6.28*
Working / Studying	20	14	0.47
	Mean (SD)	Mean (SD)	t (df=49)
Age	45 (17.61)	64 (11.19)	-4.63***
Number of years in the house	2.5 (1.46)	6.8 (2.87)	-5.66***
Size of the apartment	3.3 (0.8)	2.9 (0.57)	2.19*

*p<.05; ***p<.001

4.2 Sense of community

Fig. 2 illustrates the differences in variables related to sense of community. For all the variables, values reported by the respondents of the atrium-design building were higher in comparison to the "traditional" design building. A variance analysis shows a significant difference ($p<0.001$) between the two buildings regarding the overall 'sense of community', 'membership of the group', 'influence', 'emotional ties', and the 'importance of sense of community'. No significance difference was found between the two buildings regarding 'fulfilling the needs'.
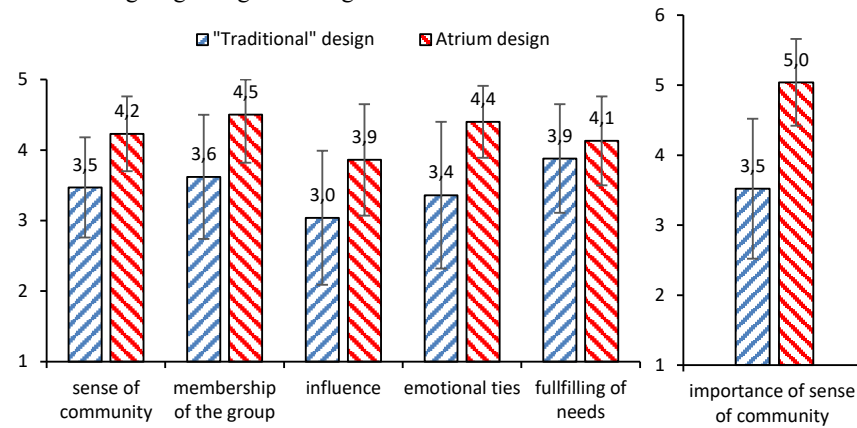

Fig. 2. Differences in variables related to sense of community. The 'importance of sense of community' have six-scale question. The columns represent mean values and the bars represent standard deviation.

Significant differences between the two groups' regarding 'sense of community' remained after adjustment for the control variables (variance analysis): age, number of occupancy years in the building, and single households. The variable 'influence' found to correlate to the demographic factor 'Number of years in the house' in both buildings, i.e. respondents with longer occupancy time in the building reported higher influence in the community in comparison to respondents with shorter occupancy time.

4.3 Social variables

Fig. 3 illustrates differences in social variables between the atrium and the "traditional" design buildings. The respondents of the atrium-design building reported higher grade of participation in common activities within the building, higher grade of familiarity with other neighbours, and higher grade of frequency of meetings with their neighbours. Slightly higher exchange of services with other neighbours was also reported in the atrium-designed building in comparison to the "traditional"-designed building. A variance analysis shows a significant difference ($p<0.001$) between the two buildings regarding all the above-mentioned social factors. The significance also remained after adjustments for the demographic factors.
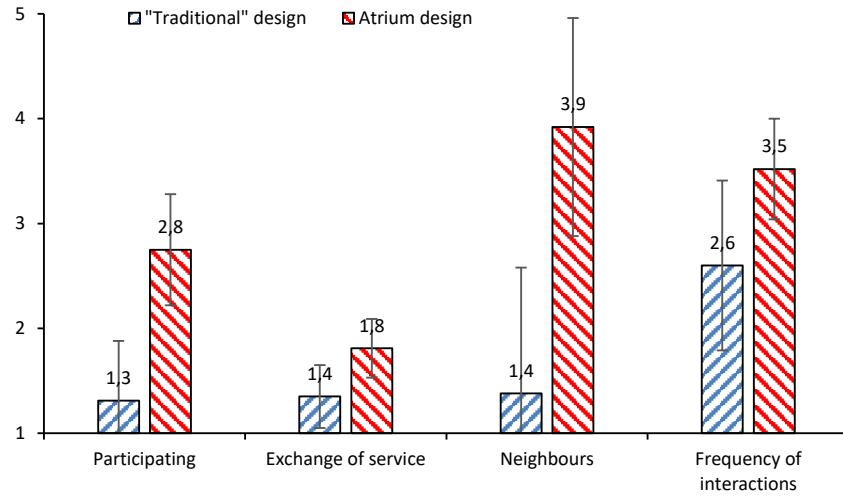
Fig. 3. Differences in social variables between the atrium and the "traditional" design buildings presented with mean value and standard deviation. The columns represent mean values and the bars represent standard deviation.

4.4   Frequency of meetings

Fig. 4 compare the frequency, in which the respondents meet other neighbours in different locations within both the atrium and "traditional" design buildings. The results shows that most of the meeting took place in the common and semi-private areas in both buildings, i.e. the entrance, staircases/corridors and in the case of the atrium-design building also in the indoor balconies and atrium space.

The results also shows that the atrium-design building on average has a higher frequency of meetings then in comparison to the "traditional" design building. A variance analysis shows a significant difference between the two buildings regarding frequency of meetings at the entrance ($t(36) = 2.88$, $p < .01$), at the indoor corridors ($t(50) = 3.77$, $p < .001$), in someone's apartment ($t(42) = 4.23$, $p < .001$) and in the common atrium ($T(50) = 3.20$, $p < .01$). High meeting frequency was reported also in the indoor balconies of the atrium design building. No significant difference, in meeting frequency, was found between the groups in the open-space around the buildings.

Fig. 4. Places the residents indicated they meet other neighbours and the frequency of meetings. Indoor balconies are only in the atrium-designed building. The columns represent mean values and the bars represent standard deviation.

4.5   Guiding principles of life

Fig. 5 compare the four guiding principles of life used in this study: universalism, benevolence, achievement and power. Residents in both the atrium and "traditional" design buildings tend to have slightly higher self-transcendence values (universalism and Benevolence), but a variance analysis shows no significant difference between the two buildings regarding all the above-mentioned guiding principles of life.
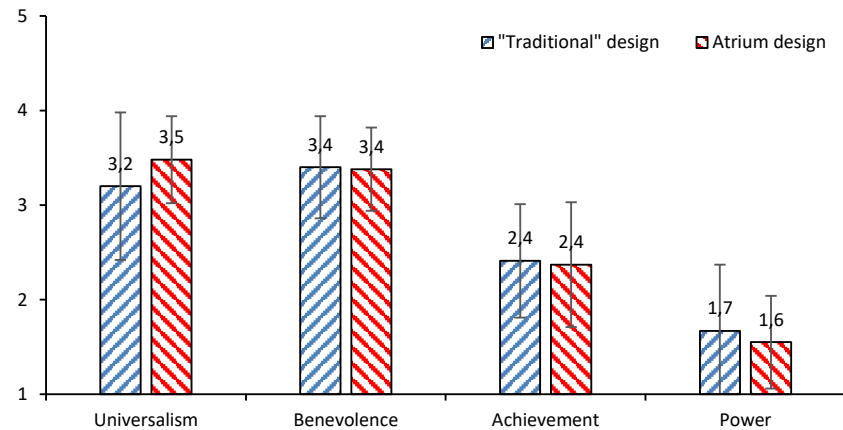

Fig. 5. Differences in guiding principles of life between the atrium and the "traditional" design buildings. The columns represent mean values and the bars represent standard deviation.

5   Discussion

A previous study, examining the same atrium-design building, showed that atrium designed in apartment buildings in Nordic climates have a potential to reduce the annual energy use for space heating [7]. In this study, a psychological framework was used to examine if building design with heated atria in apartment buildings can enhance also sense of community and social interactions in Nordic climates. The study compare between the perception of residents of two apartment buildings with different designs located in the same city district in northern Sweden; one building with an heated atrium, and the other without.

The results showed significant differences in social factors between the residents of the atrium and the "traditional" design buildings. Residents in the atrium-design building reported higher frequency of interactions. Most of the interactions among the residents found to occur in the common and semi-private areas within and around the buildings. According to Gehl [5] common and semi-private areas are the places in which most of the spontaneous interactions occur. Spontaneous interactions facilitates weak ties that may develop to strong ties. Weak ties contribute to the development of social networks by flow of information among different circles or social groups [1]. Such flow of information may even contribute to higher creativity.

The residents living in the atrium-design building found also to know their neighbours better, and are more active in the common activities organized within the building in comparison to the residents in the "traditional" design building. This in turn can facilitates a sense of community within the building. A sense of community is a catalyst for behaviours such as organized participation and emotional ties to the neighbourhood [13], and is an important part of social sustainability.

A sense of community, in this study, was measured by four categories; membership of the group, influence (i.e., ability to express themselves and affect the community within the building), emotional linkage (i.e., extent and quality of interaction between members of the building), and fulfilled needs (i.e., whether needs are perceived as satisfying in their current accommodation). The residents of the atrium-design building reported higher values in all first three categories.

An explanation may be that the needs of the residents are fulfilled in both groups, but those living in the "traditional"-design building are not familiar with the social benefits of the atrium. This can be supported by the 'lower importance of sense of community' (**Fig. 2**) reported by the residents of the "traditional" design building, i.e. how important it was to be part of the neighbours community.

Significant differences between the groups' sense of community remained after checking for the variables age, number of years of accommodation and single occupancy. Respondents with longer occupancy time in the building reported higher influence in the community in comparison to respondents with shorter occupancy time.

No differences were found concerning principle of life between the residents of the two buildings. Therefore, it is possible to conclude that large proportion of the differences in social aspects between the buildings could be explained by building design, i.e. the atrium as a facilitator for social interactions.

6   Conclusions

A heated atrium in apartment buildings in Nordic climates, with appropriate design that includes common, semi-private and private areas, seems to have a potential to facilitate social interactions, engage residents in common activities and provide them with a sense of community, which is an important part of social sustainability.

Residents in the atrium-design building reported higher frequency of interactions with their neighbours. They know their neighbours better, and are more active in the common activities organized within the building. They have stronger connection with their neighbours, and feels higher ability to affect the community within the building, in comparison to the residents in the examined "traditional" design building.

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