Surveys of occupants of new apartment buildings in the United States of America

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ABSTRACT

A large developer of multifamily residential projects in the USA gives a standard survey to occupants of newly constructed buildings. The survey includes a numerical rating of the "sound proofing" of the apartment, along with a free-response question regarding any acoustical issues. Although not necessarily representative of older multifamily housing stock in the USA, the surveyed projects are from a variety of geographical regions and markets, and include both concrete and wood structural systems with a range of acoustical performance. So far over 950 responses in 16 buildings have been analyzed. The responses characterize the types of acoustical issues that are most commonly reported, and are analyzed with respect to the assembly design and market expectations.

INTRODUCTION

This paper describes some results from a survey of occupants in newly constructed multifamily residential projects in the United States. The survey was administered by the developer of the properties to gauge the satisfaction of the tenants. The survey included questions on the sound isolation of the apartments. The questionnaire was not a scientific survey, but it does allow a standardized method for occupants to respond to their perception of the sound isolation in their apartments.

The survey included a free-response question, which allowed insight into the categories of sound that were most disturbing to the occupants. In most cases, acoustical test results were not available for comparison. Therefore, this data is not suitable for use in developing dose-response curves.

SURVEY

Building Descriptions

A total of 16 projects are reported here, all of which were completed recently (within the past 5 years) by the same developer. The projects are located in major cities throughout the United States.

Three major structural systems are represented. Buildings described as “wood-framed” are low-rise, mixed-use projects, with 4-5 floors of wood joist-framed apartments over a concrete podium courtyard, with retail on the ground level and subterranean parking. The wood joists could be solid timber, open-web wood trusses, or engineered wood joists. The walls in these buildings are framed with wood studs.

One building had a steel structure, with steel trusses supported by load-bearing steel stud walls. The remaining buildings had poured concrete slabs, generally around 200 mm thick, with light-gauge steel stud walls.

Survey Question

The survey was developed and administered on-line by the developer, and includes the same questions for each project. The survey is mostly concerned with non-acoustical aspects like pets, parking, package delivery, cellular signal, etc. However, one question was “On a scale of one to five, five being the best sound proofing ever, how would you rate the sound proofing in your apartment home?”

The survey was delivered to all occupants, but since the occupancy rate was not recorded, the exact number of recipients is not known. An average of 59.5 tenants per building responded to the survey (952 total), which is approximately 22 percent of the total number of units.

The overall average rating was 3.4, with a range of 3.0–3.9. The ratings for each building are shown in Figure 1.

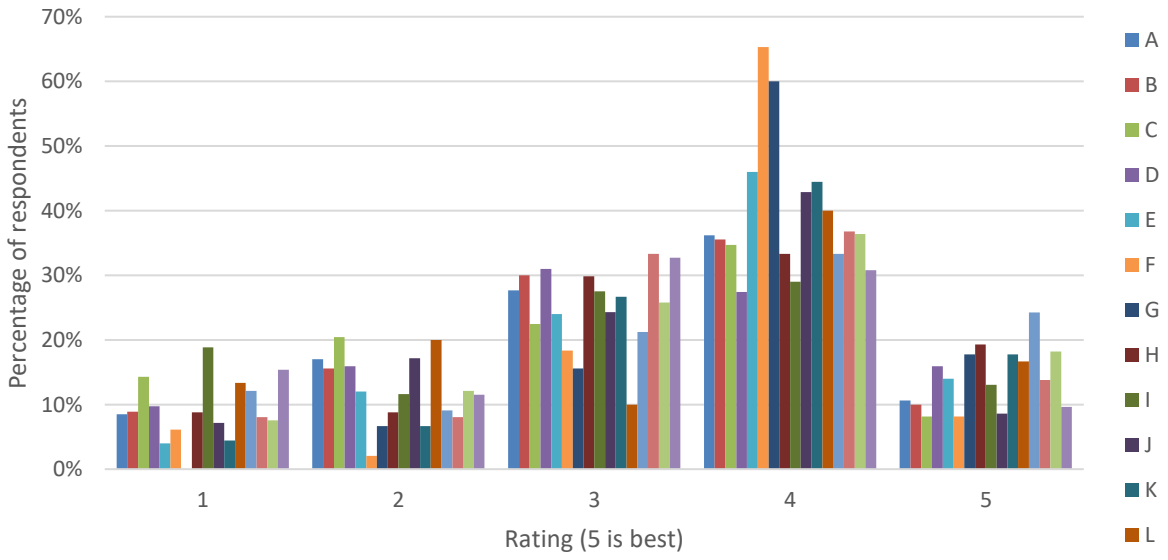

Figure 1: Tenant ratings of "sound proofing" by building

The building structural system did not have a significant effect on the overall rating. Figure 2 shows box-and-whisker plots the average rating (left) and the individual ratings (right) for the buildings grouped by structural type. Note that was only one steel building included in the evaluation. Comparing both the average rating and the rating distribution show no significant differences between the structural types in terms of the overall rating.

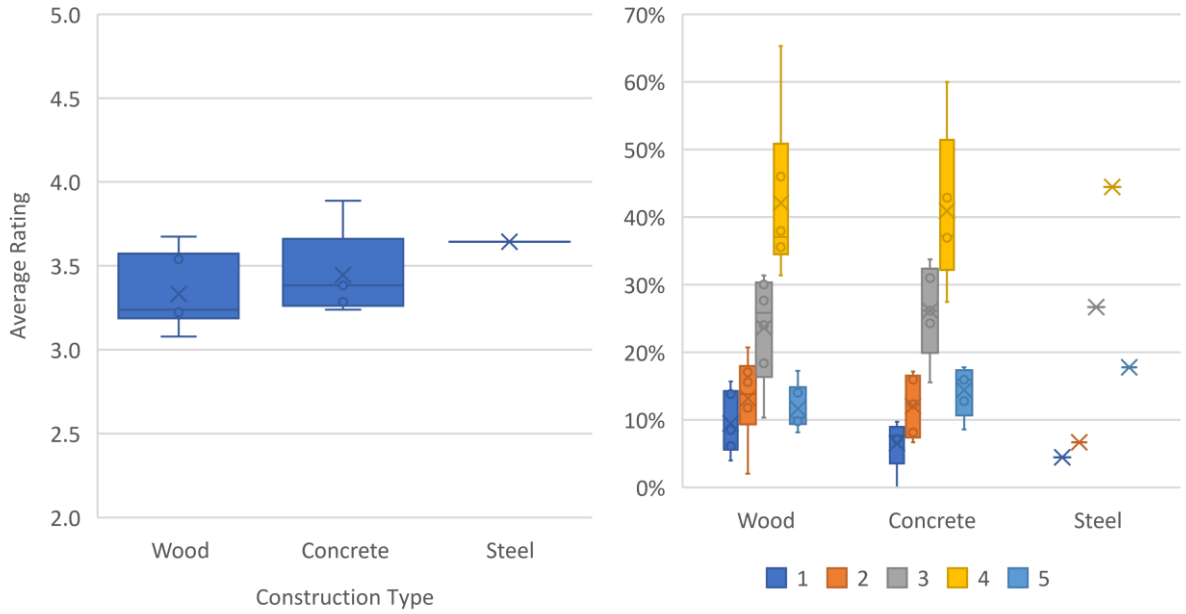

Figure 2: Ratings as a function of building structural type. Left, average rating; right, percentage of each rating (5 is best).

NOISE SOURCE CATEGORIZATION

If the respondent rated the “sound proofing” as 3 or less, there was a further prompt: “Uh oh…You rated the sound proofing three or less thumbs up, please elaborate. Tell us what noises you hear.” Typical responses include, “You can hear walking upstairs” and “Doors slamming. Street noise.”

Based on a review of the complaints, we manually sorted the complaints into the categories and subcategories shown in Table 1. Because the question was free response, this required interpretation in some cases, such as when the complaint was that they could hear the upstairs neighbor but did not specify impact or airborne noise. Usually, however, the descriptions were sufficient to categorize the source. Multiple categories per entry were allowed, so that the reported percentage in each category should not be combined.

The percentage of respondents who mentioned a source in each category is shown in Figure 3. For calculating the percentage of respondents who complained about footfall noise from above, only units with neighbors above should be considered. For example, in a 5-story building, about 20% of the units are on the top floor and therefore only 80% of the units have an upstairs neighbor. In this manner, the percentage of units with an upstairs neighbor was estimated for each building using the number of stories, and the percentage of respondents reporting footfall noise complaints was adjusted appropriately.

Table 1: Categories of disturbing noise

Category	**Subcategories**
Exterior Noise	Traffic, pedestrians (outside the project) Train Courtyard/amenity space (other tenants) Construction
Impact Noise (footfall)	
Airborne Noise	Music or voice From entry corridor
Other	Door slams Washing machine (units) Dogs Fitness center (weight drops) Plumbing noise Building systems (elevator, garage gate, etc.)

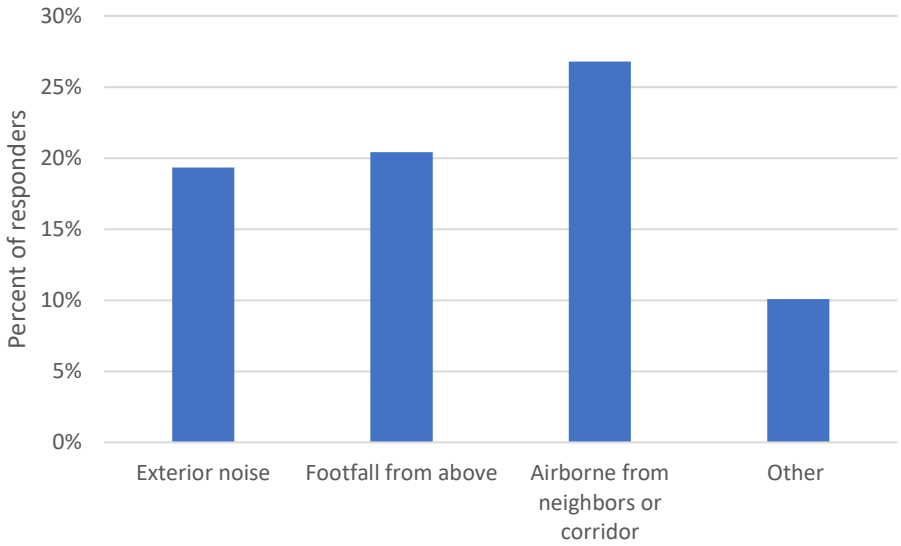

Figure 3: Percentage of responders who mentioned a noise source by category

The percentage of complaints in each category as a function of building structural type is shown in Figure 4. There are clearly more complaints of footfall in the wood buildings than the concrete buildings. For the other categories, there is no clear pattern visible.

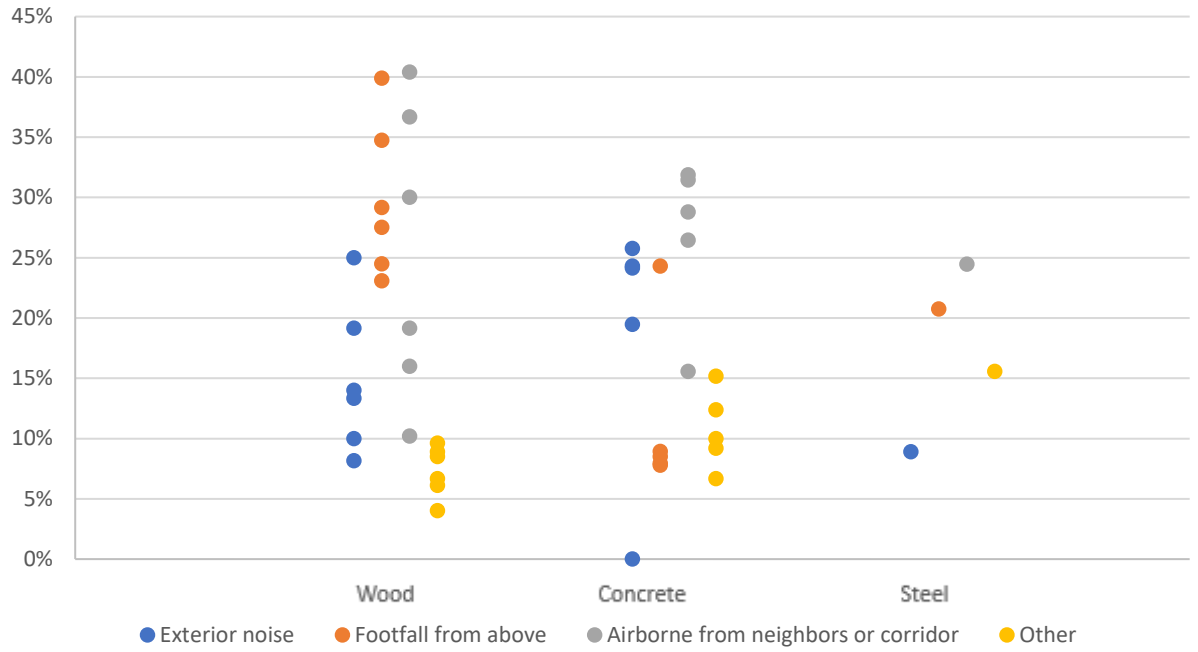

Figure 4: Percentage of respondents who mentioned a noise source as a function of building structure

SUMMARY

Although we cannot directly relate the occupant ratings of “sound proofing” to measures of annoyance that are often used in subjective studies, we might assume a rating of 2 or less (out of 5) corresponds to a judgement of poor sound insulation. The percentage of occupants that rated the isolation at this level ranged from 7 to 35 percent and averaged 21 percent. In terms of the acoustical classes defined in COST Action TU0901 [1], reproduced in Table 2, the sound isolation corresponds to Class D on average, and to Class E for many of the buildings.

These buildings are new, and although extensive testing has not been performed, the available information suggests that the buildings meet or exceed all acoustical building code requirements. This suggests that building code requirements in the Unites States are inadequate. Based on this data, the developer may evaluate changes to the acoustical design of the buildings.

Further analysis will focus on individual sources, such as correlating the exterior noise complaints with modeled noise levels or nearby nightclubs. It is also anticipated that surveys from additional buildings will become available.

Table 2: Description of sound quality of the classifications in COST Action TU0901 (Table 5.6 of Ref. 1)

Class	General	Sound insulation judged poor
A	A quiet atmosphere with a high level of protection against sound	less than 5%
B	Under normal circumstances a good protection without too much restriction to the behaviour of the occupants	around 5%
C	Protection against unbearable disturbance under normal behaviour of the occupants, bearing in mind their neighbours	around 10%
D	Regularly disturbance by noise, even in case of comparable behaviour of occupants, adjusted to neighbours	around 20%
E	Hardly any protection is offered against intruding sounds	around 35%
F	No protection is offered against intruding sounds	50% or more

ACKNOWLEDGEMENTS

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REFERENCES

[1] B. Rasmussen and M. Machimbarrena, “COST Action TU0901 - Building acoustics throughout Europe. Volume 1: Towards a common framework in building acoustics throughout Europe,” COST Office Action TU0901, 2014.