RESEARCH ARTICLE

J. For. 116(5):429–436
doi: 10.1093/jofore/fvy025
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social sciences

What Does the Public Believe About Tall Wood Buildings? An Exploratory Study in the US Pacific Northwest

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Little is known about what the public thinks of tall wood buildings (TWBs), which are structures made primarily from wood that are at least five stories tall. Understanding end-user beliefs can help the industry address public preferences and concerns. An online panel of 502 residents in the Portland, Oregon, and Seattle, Washington, metropolitan areas showed that only 19 percent were familiar with TWBs. The largest percentages of respondents believed that, compared with concrete and steel buildings, TWBs are more aesthetically pleasing, create a positive living environment, and use materials that regrow. However, they also believed that TWBs have greater fire risk and need more maintenance. Sizable percentages of respondents said they did not know about various durability, performance, aesthetic, and environmental attributes of TWBs. There were few meaningful differences between respondents who reported being familiar and unfamiliar with TWBs, but those who were familiar evaluated TWBs slightly more positively.

Keywords: mass timber construction, wooden multistory buildings, wooden high-rise buildings, sustainable built environment, public beliefs

Tall wood buildings (TWBs) are structures made primarily from wood that are at least five stories tall (Bowyer et al. 2016). This terminology is used in North America, whereas many other parts of the world often refer to these buildings as mass (e.g., massive, heavy) timber construction (Kremer and Symmons 2016). TWBs may help make the urban and built environment a more sustainable space by providing an alternative to steel and concrete construction (Milaj et al. 2017).

Although using wood as a primary material in tall buildings is receiving considerable attention in professional circles (e.g., among engineers and architects) and studies have investigated the knowledge, preferences, and attitudes of these groups (e.g., Kozak and Cohen 1999; O'Connor et al. 2004; Knowles et al. 2011; Laguarda-Mallo and Espinoza 2015; Hemström et al. 2017), relatively limited research has systematically explored beliefs of the general public regarding TWBs. Information about public beliefs can be used by developers, architects, engineers, and the wood products industry to develop targeted communications and address potential end-user concerns that might be barriers to demand. This article describes a study of urban residents in the Pacific Northwest (USA) regarding their beliefs about the structural, environmental, and aesthetic aspects of TWBs.

Research Context

Although the concept of TWBs is not new, there is renewed and growing interest in these buildings. With innovations in engineered wood products (e.g., cross-laminated timber [CLT]) and building design,

Received January 8, 2018; accepted May 15, 2018; published online August 24, 2018.

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Acknowledgements: *The authors acknowledge financial support from Oregon Forest Resources Institute. The authors acknowledge financial support from Oregon Forest Resources Institute, 317 SW Sixth Ave., Suite 400, Portland, Oregon, United States 97204, for conducting research. We also want to acknowledge LPDP/Indonesia Endowment Fund for Education, Ali Wardhana Building 2nd floor, Lapangan Banteng Timur Street No. 1, Jakarta, Indonesia 10710, for financial support of the first author and Grupo Argos S.A., Cra. 43A #1A Sur Medellin, Colombia for financial support of the second author.*

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it is now possible to construct wood buildings over 40 stories tall (Bowyer et al. 2016). More than two dozen TWBs (seven to eighteen stories) have been built in Europe, North America, and Australia in the last six years (Rethinkwood 2017).

The increasing use of wood in high-rise buildings is supported by positive economic and environmental outcomes. A recent study about mass timber manufacturing in Oregon and Washington, for example, found this industry has the potential to create 2,000 to 6,100 direct jobs, resulting in $124 to $371 million per year of labor income in Oregon (Oregon BEST, 2017). With respect to environmental impacts, studies have shown that wood effectively sequesters and stores carbon, and the net fossil fuel footprint of using wood in buildings can be less than concrete and steel (Milaj et al. 2017). Moreover, architects and structural engineers associate wood buildings with being warm, comfortable, attractive, functional, and environmentally friendly (O'Connor et al. 2004; Kozak and Cohen 1999). Xia et al. (2014), however, found that the largest perceived obstacles among experts in the construction industry to using timber frames in multistory buildings were potential maintenance costs and fire risk.

For TWBs to realize their full potential, a growing market that desires wood-based construction is required. To date, there has been only a small handful of studies of public beliefs and attitudes about TWBs. Studies have focused on perceived barriers to using wood in construction, with one study finding concern on the part of the building industry about user acceptance of this technology (Lehmann 2012). In research conducted in Australia, consumers were found to have concerns about wood buildings such as perceptions about their fire risk, durability (Kremer and Symmons 2016), termites, and susceptibility to rot (Parry-Husbands and Parker 2014). In a US study, respondents identified the primary barriers to TWBs as flammability, insects (e.g., termites), durability, strength, contribution to deforestation, and problems with moisture (Hammon 2016).

There are only two studies—both in Australia—that investigated positive perceptions the public may have about building with wood (e.g., Kremer and Symmons 2016; Parry-Husbands and Parker 2014). Wood was popular among Australian respondents, as they believed it to be aesthetically positive, "warm" or "homey," and environmentally friendly (Parry-Husbands and Parker 2014). However, only small percentages believed that constructing TWBs generates less carbon dioxide (CO_2) than building with concrete or steel (Kremer and Symmons 2016). One of the studies (Kremer and Symmons 2016) employed a convenience (nonrandom, nonprobability) sample, where 34 percent of respondents worked in the building industry. This may have influenced the results because of respondents' knowledge based on their occupation. Thus, there is an apparent need for additional research in other countries. This study reported here in the present article was designed to determine attitudes and perceptions regarding TWBs on the part of the general public in the US Pacific Northwest region.

When assessing public beliefs about a new technology, it is important to recognize that some respondents, particularly those unfamiliar with the technology, may respond based on superficial impressions or cues primed by questions asked in a questionnaire (e.g., Schuman and Presser 1980). Although such survey participants may still provide responses to questions, these cognitions are unlikely to be strong (i.e., "nonattitudes" or "uninformed beliefs") and so are likely to be malleable and responsive to information and communication efforts (Krosnick 1988).

Previous studies have found that many respondents were not familiar with topics related to TWBs. In the Kremer and Symmons (2016) study, 80 percent of respondents reported no prior knowledge of mass timber construction, whereas Hammon (2016) found that 45 percent of respondents were not at all familiar with "engineered wood products used for structure in buildings." Given these previous findings, it is anticipated that a substantial portion of respondents would not be familiar with TWBs. Therefore, a primary research goal was to compare respondents who self-reported having familiarity with TWBs to those who reported being unfamiliar. If differences arise, they could provide insights into what should be included in promotional communication and educational initiatives focused on development of a TWB market in the United States.

Research Questions

This article explores three research questions: (1) How familiar are Portland and Seattle metropolitan area residents with TWBs? (2) What are their beliefs about the durability, performance, aesthetics, interior living, and environmental attributes of TWBs? And (3), to what extent do these beliefs differ between residents who are familiar with TWBs and those who are unfamiliar?

Methods

This study was approved by a university institutional review board for research on human subjects. Initial open-ended pilot interviews were conducted in Corvallis, Oregon, to explore dimensions of public beliefs about TWBs and to identify terminology people use for describing their beliefs. The 27 interviews averaged 10 minutes in length. Although these interviews were with a convenience sample of residents intercepted in public locations, diverse sites were included (e.g., parks, supermarkets, parking lots, public libraries). This was intended to solicit maximum variation in responses. Interviewees had diverse demographic backgrounds and represented a range of ages and occupations.

These pilot interviews began with an initial question to gauge participants' familiarity with TWBs. Then participants were shown one photograph of a TWB, and the interviewer explained that the majority of the structural building components were made from wood (this was done to ensure that participants understood the nature of

Management and Policy Implications

This research will help the wood construction industry address public preferences and concerns about tall wood buildings (TWBs). Given the low familiarity with TWBs among respondents, they do not have strong a priori attitudes and, thus, are likely to be open to information and communication efforts. Positive assessments on aesthetic, environment, and sustainability values bode well for the demand of TWBs. Concerns, however, are related to fire risk, maintenance needs, and longevity. As research results on these issues continue to emerge, findings should be emphasized to potential end users.

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the following questions). Subsequent questions covered familiarity with TWBs, perceptions of using wood as the main material in tall buildings, possible benefits of using wood in tall buildings, challenges and barriers of TWBs, and types of buildings that might be made of wood. Each question had follow-up, probing questions to elicit more detailed answers.

Major themes in responses from the pilot interviews included positive attributes of TWBs such as attractive appearance, being environmentally friendly, generating fewer greenhouse gas emissions, and containing renewable materials. However, there were also concerns about TWBs, such as the amount of wood required, possible contributions to deforestation, unsustainable management of forest resources, fire risk, structural strength, durability, stability, and safety. These themes, coupled with questions used in past research (e.g., Hammon 2016; Kremer and Symmons 2016; Parry-Husbands and Parker 2014), were then used to design a quantitative questionnaire administered online.

The first item in this questionnaire asked if respondents had heard or read anything about constructing buildings that are five or more stories (floors) tall using wood as the primary structural material (TWBs), and they could respond yes, no, or unsure. Given the novelty of TWBs, it was important to go beyond verbal descriptions of these buildings, as has been done in previous research (Hammon 2016; Kremer and Symmons 2016). Therefore, after the initial question, a photograph of a TWB showing exposed wood as the primary building material was included. The questionnaire asked if the type of building depicted was what the respondents had in mind when responding. The following questions elicited respondents' agreement with 20 statements about using wood as the primary structural material in tall buildings and how living in a TWB would compare to a tall building made from concrete and steel. Responses were provided on a five-point scale (1 = "strongly disagree" to 5 = "strongly agree") with a "do not know" option to differentiate between people who did not know about the topic and those who had neutral responses (i.e., "neither disagree nor agree"). The questionnaire ended with demographic questions about gender and age. This questionnaire was pretested with a convenience sample of 20 people from the local community who had diverse demographic backgrounds. Results and debriefing with respondents showed that some questions needed to be simplified and some technical language removed or explained.

General population mail surveys today generate quite low response rates, making their value for capturing a representative sample questionable (Vaske 2008). Therefore, an online panel was used for obtaining data from the target population. Members voluntarily join these panels and are sometimes paid for completing questionnaires online. Respondents are not told the topic of the study before they access the questionnaire. Such panels can be cost effective and generate data rapidly (Brandon et al. 2014). There are, however, some challenges with internet panels, such as accurately estimating sample representation and sampling error, difficulty ensuring a perfectly random sample (i.e., they usually involve nonprobability samples), and the low tolerance of some panel members for long questionnaires (Brandon et al. 2014). Some respondents also have a tendency to skip questions or provide identical answers to all items in a set of scale questions to complete questionnaires quickly (i.e., "straight-lining;" Kaminska et al. 2010). To address these limitations, the number of questionnaire items was restricted to ensure a completion time of less than 10–15 minutes. The questionnaire also required respondents to answer "attention filter" items that required particular responses (e.g., "this is an attention filter, select 'strongly disagree' with this statement" and a question asking what the questionnaire is about). Respondents who failed these attention filters were excluded from the dataset.

The target number of respondents (500) was based on budget availability and minimizing potential coverage, measurement, and sampling errors (Vaske 2008). A soft launch was conducted on May 4, 2017, with 50 Qualtrics Panel members (i.e., 10 percent of the target sample) in the Portland and Seattle metropolitan areas. These areas were targeted because they are considered to be manufacturing hubs for the emerging CLT market in the United States (Oregon BEST 2017). Responses were scrutinized carefully to identify potentially problematic issues, such as straight-lining and extremely short response times, to ensure that respondents carefully read and responded to each question. Based on results of this soft launch, the questionnaire was modified slightly by adding additional attention filters and rearranging some scale questions to help minimize straight-lining responses.

The final questionnaire was administered from May 10 to 21, 2017, to members of the Qualtrics Panel who were 18 years of age or older and resided in one of the targeted counties (Clackamas, Columbia, Multnomah, Washington, Yamhill, Clark, and Skamania [Portland metropolitan region]; and King, Snohomish, and Pierce [Seattle metropolitan region]). Partial responses were not recorded, so an exact response rate cannot be calculated. It is seldom possible to accurately calculate response rates for these online panels (see Brandon et al. 2014 for reasons). However, 502 respondents from 6,850 invitations amounts to a 7.3 percent completion rate.

Results

Respondent Profile

The proportions of respondents from each location (i.e., Portland and Seattle metropolitan regions) and each gender category were almost identical to the population as described by the US Census, but respondents were slightly younger in age (Table 1). As a result, relationships between age and all of the dependent variables in this article were examined. Responses for only five of the 22 (23 percent) variables in this article statistically differed by age at $p < 0.05$, and no consistent patterns were observed in these few differences. Statistical significance is influenced by sample size, so effect sizes should be examined (Vaske 2008). Of the five variables that were related to age, the effect sizes ranged from $r = 0.09$ to 0.12 and averaged 0.11. Using guidelines from Cohen (1988) and Vaske (2008), these results suggest that any possible relationships between age and the other variables are either insignificant, "small," or "minimal." In addition, responses for only seven of the 22 variables (32 percent) differed by gender, and again, the effect sizes were minimal or small (from r_{pb} [point-biserial correlation] = 0.10 to 0.13, average = 0.11). There were no consistent patterns in these differences. The data, therefore, were not weighted by census information, as it is unlikely that weighting would have substantially altered the results.

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Table 1. Respondent characteristics and US Census information for counties in the study.

Characteristics	Sample counts (*n*)	Sample (%)	Census (%)*
Location			
Seattle metropolitan region (Washington)	293	58	61
Portland metropolitan region (Oregon)	209	42	39
Gender			
Female	253	50	50
Male	234	47	50
Transgender	7	1	NA
Do not identify	8	2	NA
Age (in years)			
18–29	180	36	22
30–39	153	30	21
40–49	81	16	18
50–59	48	10	18
60–69	34	7	14
70–80	6	1	7

* From the US Census Bureau 2016 American Community Survey (ACS) estimates for counties in the study area. Age and gender are combined across both the Seattle and Portland metropolitan regions. NA = not available, as these categories are not included in the ACS.

Slightly more respondents were from the Seattle metropolitan area than the Portland region (Table 1). The gender proportions were almost equal between women and men. The mean age of respondents was 36 years, with 66 percent of respondents being 40 years of age or younger. Of the bivariate statistical tests (e.g., chi-square [χ^2] tests, independent samples *t*-tests) of relationships between metropolitan region and the other variables in this article, 24 percent revealed statistically significant (i.e., $p \leq 0.05$) differences between Seattle and Portland area residents. However, the effect sizes (e.g., Cramer's *V*, phi [ϕ], r_{pb}) were only 0.13 to 0.27 and averaged 0.16, which is considered "small" (Cohen 1988) or "minimal" (Vaske 2008). There were also no consistent or clear patterns in the differences for variables that varied between regions. Therefore, data for the entire sample were aggregated.

Familiarity with TWBs

Respondents were classified as "familiar" with TWBs if they answered yes to these two questions: (a) if they had ever heard or read anything about TWBs, and (b) whether the photograph of a TWB shown in the questionnaire was the type of building they were thinking of when responding. Only 19 percent of respondents were classified as familiar with TWBs by answering yes to both questions (Table 2).

Table 2. Respondent familiarity with TWBs.

Familiar with TWBs	Frequency	Percent
No	269	54
Unsure	138	27
Yes	95	19

Beliefs about the Durability and Performance of TWBs

Tall wood buildings have perceived by a majority of respondents to have greater fire risk, require more upkeep and maintenance, and not last as long compared with tall buildings made from steel or concrete (Table 3). More than 20 percent of respondents, however, said they did not know about relative performance in terms of structural stability (e.g., which type sways more in an earthquake, is weaker, or is stronger in an earthquake), durability, and requirements for insulation. For two variables (maintenance needs and fire risk), there were statistically significant differences based on familiarity with TWBs; those familiar with TWBs were less likely to agree that TWBs have more maintenance needs and fire risk. The Cramer's *V* effect sizes for these variables, however, were "small" (Cohen 1988) or "minimal" (Vaske 2008).

Beliefs about the Aesthetic Qualities and Interior Living Environment of TWBs

A majority of respondents agreed that TWBs are more visually pleasing and provide indoor environments that are more positive and healthier than buildings made of steel and concrete (Table 4). More than 20 percent of respondents, however, said they did not know whether TWBs would be healthier, more comfortable, less noisy, or provide better indoor air quality. The only difference based on familiarity with TWBs was for the item, "TWBs would provide a more comfortable environment," where respondents who were familiar with TWBs were more likely to agree. Although this difference was statistically noteworthy, the Cramer's *V* effect size was relatively "small" (Cohen 1988) or "minimal" (Vaske 2008).

Beliefs about Environmental Attributes of TWBs

A majority of respondents agreed that TWBs use materials that regrow, are more environmentally friendly in source materials, create less air pollution, and use less fossil fuels than tall buildings made from concrete and steel (Table 5). However, the majority was also concerned that TWBs would contribute to deforestation. In addition, more than 20 percent of respondents did not know whether TWBs use less fossil fuels or create less air pollution than tall buildings made from concrete and steel. For these two items, there were statistically significant differences based on familiarity with TWBs, with those familiar with TWBs more likely to agree that TWBs are superior in terms of these environmental benefits. Again, however, the Cramer's *V* effect sizes were "small" (Cohen 1988) or "minimal" (Vaske 2008).

Discussion

Although only a few studies have been conducted examining end-user perceptions of TWBs, Hammon's (2016) nationwide study in the United States was somewhat similar. The current study built on Hammon's research by including a photograph of a TWB to confirm respondent understanding of the topic. Additionally, based on the pilot interviews, the questionnaire included more aspects that the public considers relevant to assessing TWBs, such as aspects related to the indoor environment and their environmental sustainability. Finally, respondents were explicitly asked to consider how TWBs compare to traditional construction methods, which gives a more grounded context for their responses.

Results showed that Portland and Seattle metropolitan respondents were generally unfamiliar with TWBs. The high degree of unfamiliarity may present a hurdle in the development of the TWB market and corresponding demand for

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Table 3. Respondent beliefs about the durability and performance of TWBs compared with tall buildings made from steel or concrete.

TWBs		Familiar with TWBs (Percent, %)						
		Yes	No	Unsure	Total	χ^2 value	*p*-value	Cramer's *V* effect size
Have more fire risk						13.90	0.031	0.12
	Agree	63	81	80	77			
	Neither*	16	6	6	8			
	Disagree	12	6	8	8			
	Don't know	10	7	7	8			
Need more upkeep						10.90	0.092	0.11
	Agree	54	63	59	60			
	Neither	14	12	10	12			
	Disagree	16	6	11	9			
	Don't know	17	20	20	19			
Need more maintenance						14.82	0.022	0.13
	Agree	50	62	65	60			
	Neither	14	9	12	11			
	Disagree	19	7	10	10			
	Don't know	18	22	14	19			
Do not last as long						6.23	0.398	0.08
	Agree	53	57	64	58			
	Neither	13	12	10	12			
	Disagree	22	15	15	16			
	Don't know	13	17	12	15			
Sway more in an earthquake						7.48	0.279	0.09
	Agree	48	44	48	46			
	Neither	15	10	10	11			
	Disagree	15	13	9	12			
	Don't know	22	34	33	31			
Are weaker						7.74	0.258	0.09
	Agree	41	44	41	42			
	Neither	19	12	16	14			
	Disagree	25	19	20	21			
	Don't know	15	25	23	23			
Need more insulation						7.88	0.247	0.09
	Agree	39	36	44	38			
	Neither	19	14	16	16			
	Disagree	28	26	22	25			
	Don't know	14	24	19	21			
Are stronger in an earthquake						11.51	0.074	0.11
	Agree	28	22	20	22			
	Neither	11	11	15	12			
	Disagree	43	36	32	36			
	Don't know	18	32	33	30			
Are more durable						8.97	0.175	0.10
	Agree	18	13	14	14			
	Neither	26	16	20	19			
	Disagree	38	47	41	43			
	Don't know	18	25	25	24			

* Neither agree or disagree.

a suite of mass timber products. On the other hand, limited familiarity also means that people may not possess strong a priori beliefs and may be open to communications and information from sources they deem to be credible. The large percentage of respondents who reported that they either "don't know" or "neither agree nor disagree" with the individual questionnaire items is evidence of this. For many items, more than 40 percent of respondents gave such answers, and this was especially notable among those who were not familiar with TWBs.

Both positive and negative beliefs provide information for marketing, communications, and development. From a positive perspective, a large majority of respondents believed that TWBs are visually pleasing and would be pleasant living environments. This is clearly an area where TWBs can be differentiated from other structures in the eyes of consumers and end users.

Overall, respondents also saw TWBs as more environmentally friendly than buildings made from other materials. These issues can be a focus for marketing. The fact that the majority of respondents believed that TWBs contribute to "deforestation" could signal confusion about terminology, lack of awareness of requirements to replant after harvest, or both. Either presents an opportunity for greater clarification of how forest harvest practices differ around the world. Concerns about forest capacity and capability are worthwhile and important to address. Although building TWBs could increase wood consumption, there remains sufficient room for growth of wood production in terms of forest capacity and health, especially in the Pacific Northwest (Oregon BEST 2017). Ongoing research is studying

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Table 4. Respondent beliefs about aesthetic qualities and interior living environments of TWBs compared with tall buildings made from steel or concrete.

TWBs		Familiar with TWBs (Percent, %)						
		Yes	No	Unsure	Total	χ^2 value	*p*-value	Cramer's *V* effect size
More visually pleasing						7.53	0.274	0.08
	Agree	83	78	75	78			
	Neither*	8	13	17	13			
	Disagree	7	5	4	5			
	Don't know	1	4	4	3			
More positive indoor living environment						12.36	0.054	0.11
	Agree	74	60	58	62			
	Neither	11	20	18	18			
	Disagree	6	5	4	5			
	Don't know	10	15	20	15			
Healthier						9.84	0.132	0.10
	Agree	57	50	49	51			
	Neither	24	25	17	23			
	Disagree	6	5	9	7			
	Don't know	13	20	25	20			
Better indoor air quality						4.52	0.607	0.07
	Agree	54	45	50	48			
	Neither	20	24	23	23			
	Disagree	6	6	8	7			
	Don't know	20	25	19	23			
More comfortable						25.58	<0.001	0.16
	Agree	61	43	45	47			
	Neither	22	16	26	20			
	Disagree	8	15	9	12			
	Don't know	8	26	20	21			
Less noisy places to live						11.22	0.082	0.10
	Agree	36	33	33	34			
	Neither	32	19	23	22			
	Disagree	20	24	21	23			
	Don't know	13	25	23	22			

* Neither agree or disagree.

how to improve CLT production methods, including using low-grade lumber, wood waste, and juvenile wood (e.g., Lawrence 2017). If these practices expand in the marketplace, it could bolster the sustainability story of TWBs.

Concerns about fire risk were notable among all segments of the sample. The forest and building sectors have a challenge ahead to convince consumers that TWBs can be safe in the event of fire or earthquakes. Past and ongoing research provides relevant information regarding positive fire and earthquake performance. Cross-laminated timber, for example, has inherent fire-resistance and can maintain significant structural capacity because of the cross-sectional thickness of timber members that char slowly and at a predictable rate (Karacebeyli and Douglas 2013). The use of CLT panels for floors and walls in TWBs creates fire-rated compartmentalization that reduces the spread of fire beyond its point of origin (Oregon BEST 2017). As TWBs evolve, emphasis should be placed on communicating the actual relative fire risk and the steps taken to lower such risks.

The large segment of respondents who were uncertain about earthquake risks also highlights a need for messaging. Mass timber buildings may show positive performance in the event of an earthquake (Karacebeyli and Douglas 2013), and new innovations continue to enhance this performance. For example, a rocking shear wall system has achieved lower post-earthquake repair costs and recovery time (Pei et al. 2017). This system is designed to be ductile and withstand tensile stress with negligible damage that can be easily repaired. Such features will be especially important to promote if public concerns are to be effectively overcome.

Respondents familiar with TWBs perceived there to be less fire risk and fewer maintenance concerns with these buildings compared with those who were unfamiliar with TWBs. In addition, those familiar with TWBs were more likely to agree these buildings provide a more comfortable living environment, create less air pollution, and consume fewer fossil fuels than concrete and steel buildings. Generally speaking, those who were familiar with TWBs had less negative perceptions and had some more positive beliefs about TWBs. Such findings suggest that increasing public knowledge about TWBs is key to positive market development.

To help address concerns about TWBs, forestry-related organizations can be partners in public education. A regional example is the Oregon Forest Resources Institute (OFRI), created by the Oregon Legislature in 1991 for the purpose of "enhancing collaboration among forest scientists, public agencies, community organizations, conservation groups and forest landowners; providing objective information about responsible forest management; and encouraging environmentally sound forest practices through training and other educational programs" (OFRI 2018).

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Table 5. Respondent beliefs about environmental attributes of TWBs compared with tall buildings made from steel or concrete.

TWBs		Familiar with TWBs (Percent, %) Yes	No	Unsure	Total	χ^2 value	*p*-value	Cramer's *V* effect size
Use materials that regrow						6.75	0.345	0.08
	Agree	79	79	70	76			
	Neither*	10	7	9	8			
	Disagree	5	5	7	6			
	Don't know	6	10	15	10			
Are more environmentally friendly in source materials						6.83	0.337	0.08
	Agree	67	57	56	59			
	Neither	8	11	11	11			
	Disagree	15	15	13	14			
	Don't know	10	17	20	17			
Contribute to deforestation						10.03	0.123	0.10
	Agree	45	62	62	59			
	Neither	16	12	9	12			
	Disagree	22	14	15	16			
	Don't know	17	12	15	14			
Create less air pollution						13.27	0.039	0.11
	Agree	67	51	59	56			
	Neither	14	13	16	14			
	Disagree	5	6	6	6			
	Don't know	14	29	20	24			
Use less fossil fuels						16.10	0.013	0.13
	Agree	60	46	50	50			
	Neither	11	13	14	13			
	Disagree	12	5	4	6			
	Don't know	18	36	32	32			

* Neither agree or disagree.

Limitations and Future Research

Despite the methodological differences between this study and previous research, results of studies on end-user perceptions of TWBs are somewhat similar. Given that most previous work is based on American (Hammon 2016) and Australian (Kremer and Symmons 2016; Parry-Husbands and Parker 2014) consumers, this may suggest some similarity in the way that western societies react to wood as a primary material in buildings. Future work focused on other locations and other potential beliefs associated with TWBs is clearly needed.

As with most survey research today, there was a challenge to obtain a representative sample of the target population. The online panel respondents were slightly younger than the population of the region, and it is reasonable to assume that panelists who chose to respond to the questionnaire were more interested in the topic than those who opted out. If this is the case, it might be that the population, as a whole, has even less familiarity with TWBs or strong opinions about them.

Finally, additional work is needed to develop a more in-depth understanding of whether different subgroups of the public (e.g., based on demographic characteristics, geographical regions, or cognitions other than familiarity with the topic) differ in their beliefs and preferences regarding wood-based living spaces. For example, other research has shown that consumers are not especially enamored with bio-based materials, but environmentally oriented subgroups may feel more positively than average consumers (Innventia 2016). Accordingly, identifying relevant market segments for TWBs will be critical to improving the efficiency of market development.

Supplementary Materials

Supplementary data are available at *Journal of Forestry* online.

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