



**MINNESOTA DEMOLITION SURVEY:
PHASE TWO REPORT**

Prepared for:

Forintek Canada Corp.

By:

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February, 2004

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Executive Summary

Although there is a great deal of anecdotal evidence about the reasons for building demolition, there is little in the nature of statistical data, at least for North America. Nevertheless, there is an increasing tendency to make assumptions or claims about the relative durability of different structural materials. In an attempt to bring some facts to bear on this issue, the Athena Institute has undertaken a major survey of buildings demolished in St. Paul, Minnesota, for the period 2000 to mid-2003.

Covering 227 commercial and residential properties, the survey focuses on the age of the buildings, the main structural materials, and the reasons for demolition. When the building condition was cited as a reason, the survey probed for details about specifics (e.g., state of maintenance, structural problems).

Of the 227 buildings, 70% were in the 51-100+ age category, with 51% in the 76 and over bracket. The remaining 30% were all less than 50 years old, with 6% in the 0-25 category. The four biggest reasons for building demolition were “Area redevelopment” (35%), “Building’s physical condition” (31%), “Not suitable for anticipated use” (22%) and “Fire damage” (7%).

Lack of maintenance was cited as the specific problem for 54 of the 70 buildings where physical condition was given as the reason for demolition. In only eight cases was a specific problem with structural or other materials or systems cited. All but two (one of which was of unknown age) were in the 75 and over age categories, and all eight had foundation problems along with other concerns.

Wood buildings accounted for two-thirds of the buildings in the survey, which is not surprising given the geographic region. Of the demolished wood buildings, 85% were in the 51 and over age categories, with 49% in the 76-100 category and 18% more than 100 years old. In contrast, 63% of the structural concrete and 80% of the structural steel buildings were in the 50 and under age categories. Moreover, concrete and steel totally dominate the ‘Area Redevelopment’ and ‘Not Suitable for Anticipated Use’ reasons for demolition.

In general, we think these results challenge some of the emerging conventional wisdom about durability, for example, the perception that durability is primarily a function of the structural materials. The results highlight urban and site planning as well as aspects of building construction and maintenance as ways to increase building longevity. Finally, the study tends to confirm the view of many that we should do more to develop building systems that are flexible and that can be readily deconstructed for reuse in different locations if future land use is in question for economic or other reasons.

Minnesota Demolition Survey: Phase Two Report

1 Introduction

The Athena Institute was asked by Forintek Canada Corp. to undertake a demolition survey based on the recommendations of an earlier exploratory study that identified this work as a way to assess the durability of structural materials. The overall objective of the two-phased project was to determine if there is a correlation between structural material and reason for demolition. The task in Phase Two was to perform the survey and analyze the results based on the following Phase One recommendations:

1. Primarily utilize city demolition permit records to establish what buildings have been demolished; secondarily utilize demolition firms to establish this information.
2. Develop a dataset of approximately three hundred buildings including year building was demolished, type of building, structural material and reason for demolition.
3. Possible reasons for demolition should include area redevelopment, changing land values, building's physical condition, building too expensive to maintain, building too expensive to update to bring to code (access, fire, etc.), socially undesirable use and other.
4. If building's physical condition is indicated to be the primary reason for demolition, a more specific reason should be ascertained from the following options: outdated appearance, lack of maintenance, specific problem with structural or other material or system (please describe) and other (please describe).

1.1 Study scope and approach

The focus of Phase Two was to collect data about building demolition using the City of St. Paul demolition permit database, compile the results and present the findings.

1.2 Report structure

The remainder of this report is structured as follows.

Section 2 reviews the methodology of the survey.

Section 3 provides the results, including a detailed graphical representation of the data.

Section 4 discusses the results and provides an analysis of the data as it relates to the durability of different structural materials.

Appendix A includes sample survey letters.

Appendix B includes the four question survey card that was used to collect data.

2 Methodology

This section outlines the methodology that was used in data collection.

2.1 Identifying data set

Two options were identified in Phase One to find out what buildings had been demolished in the Minneapolis/St. Paul area: utilizing city demolition permit records or contacting individual demolition firms and developers in the area to find out what buildings they had demolished. The first option was selected because city permits provide a complete record of buildings demolished within a defined geographical area and contain detailed information to use for further inquiry. For each demolition permit issued, the City tracks information about owners and demolition contractors.

The City of St. Paul's records were obtained for 2000, 2001, 2002, and a portion of 2003. The City's database includes both residential and commercial properties, including garages. For the purposes of this study, the garages were excluded, leaving a total of 302 records.

2.2 Data collection

Building owners were contacted both by letter and telephone in several steps:

1. A mailing was sent to every owner with an introductory letter (see Appendix A), a two-page description of the Athena Institute, a two-sided survey card (see Appendix B) and a postage paid return envelope. Owners with more than one property in the database were sent survey cards for each property.
2. A second mailing was sent to every owner that did not respond to the first mailing. The second mailing contained a letter (see Appendix A), the two sided survey card and a postage paid return envelope. Owners with more than one property in the database were sent survey cards for each property.
3. Owners that did not return the survey card were contacted by telephone. Attempts were made to contact owners by telephone beginning several weeks after the first mailing was sent. The telephone researcher used the same questions contained in the survey card.
4. If the mailings were returned without delivery, address forwarding notices and internet research were used to find current addresses for the owners, and the mailings were resent.
5. If the telephone numbers in the demolition permit database were incorrect, the internet was used to find current telephone numbers.

Since the City of St. Paul is the owner of a significant number of the buildings contained in the demolition permit records, the information about those buildings was gathered using a different process. In Phase One we contacted a City representative who indicated that he would provide information about City buildings contained in the demolition permit records. He was contacted during Phase Two by both letter and telephone, and was sent a detailed spreadsheet to facilitate getting the survey answers. For ease of answering for the large number of buildings, the survey answers for the City were given by telephone.

Through this process, the following information was gathered for as many demolition records as possible:

- Age of demolished building (in 25 year increments)
- Structural material of demolished building
- Reason for demolition

An Excel spreadsheet was used to track data collection.

3 Results of the Survey

The following sections provide a detailed description of the survey dataset. The entire dataset is included in the Minnesota Demolition Survey CD-ROM that accompanies this report.

3.1 Survey response rate

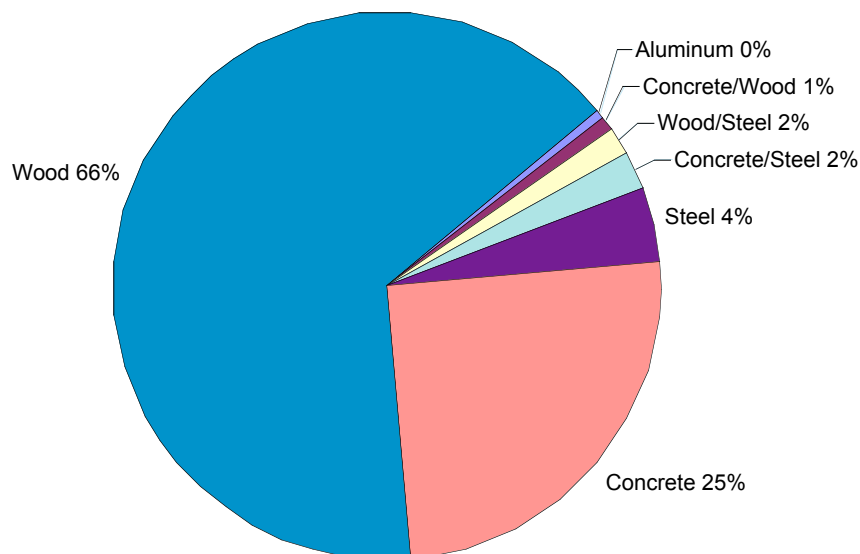
The City of St. Paul demolition permit database contained 302 records of demolition permits for non-garage commercial and residential properties. From the original 302 records, survey information was collected for 226 buildings. Three of the properties were then excluded from the results because demolition did not occur, no structure existed on the property or incomplete data was provided. In addition, during the process of conducting the survey, we discovered that several of the permit records actually represented more than one structure, leading to the inclusion of four buildings that were not originally accounted for in the permit database. In total, the Institute collected survey information for a total of 227 buildings for a survey response rate of 75%. One hundred and five of the buildings were commercial and the remainder were residential.

One potential bias that was identified before the survey was conducted was that certain owners would be more willing to provide detailed information to researchers than others. For instance, since the City of St. Paul was the owner of a significant number of the buildings contained in the demolition permit records, and was willing to provide survey information, there could be a bias towards a specific type of structure or demolition reason. However, we subsequently concluded that the potential for bias was at least minimized because only 35% of the 227 buildings were city owned, with the remaining 65% privately owned.

3.2 Structural material

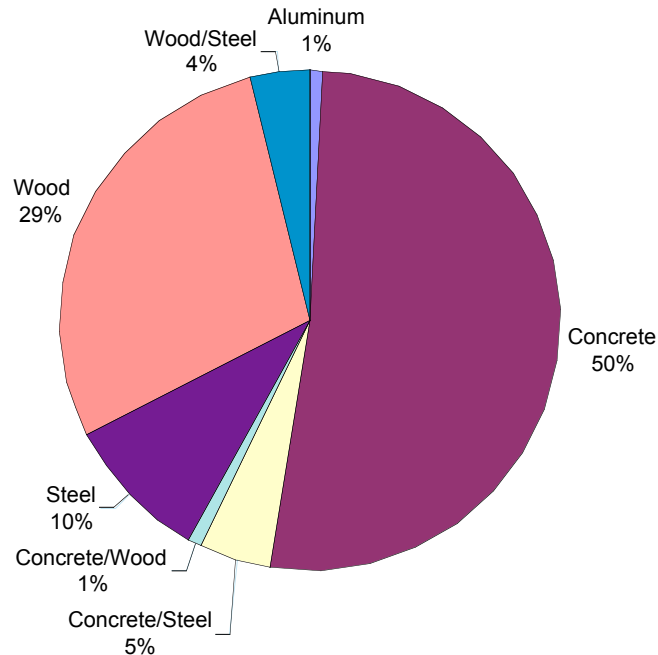
The survey asked “*What was the main structural material of the building?*” The three choices for respondents were concrete, steel and wood. Several respondents answered with more than one structural material, and two respondents added materials. Figure 1 illustrates the percentage of demolished buildings with each structural material. We should note that the aluminium category in Figure 1 contains one structure and constitutes 0.44% of the total structures, not “0%” as shown in the figure because of rounding.

Figure 1: *Percentage of demolished buildings by main structural material*



The dominance of wood as a structural material is to be expected in this region, given the large number of residential buildings in the total sample. The corresponding structural material percentages for commercial buildings only are shown in Figure 2.

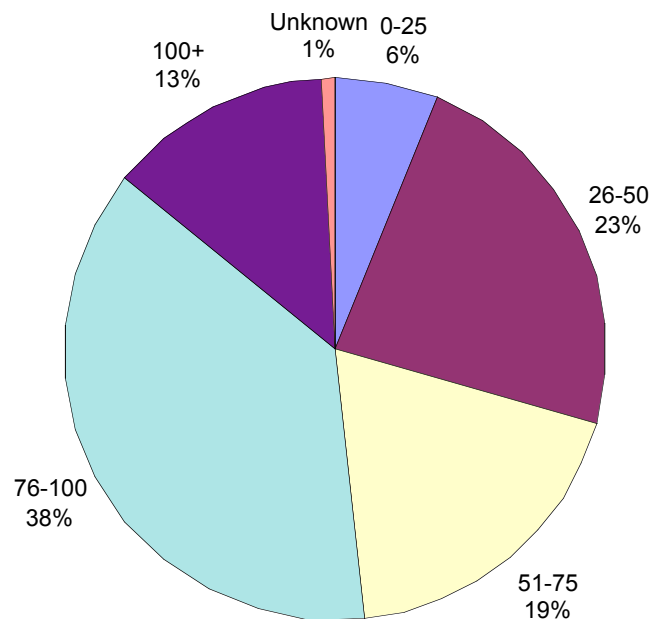
Figure 2: *Percentage of demolished commercial buildings by main structural material*



3.3 Building age

The survey asked “*What was the approximate age of the building (if known)?*” Respondents were given five choices: 0-25, 26-50, 51-75, 76-100, and 100+ years. The responses are illustrated in Figure 3.

Figure 3: *Percentage of demolished buildings by age in years*



3.4 Age by structural material

Figures 4-6 below show the responses to age question by structural material. Figure 7 then illustrates a comparison of the percentage of buildings in each age group by structural material. Twelve responses for buildings indicating more than one structural material were excluded from these figures.

Figure 4: *Percentage of demolished wood buildings by age in years (148 buildings)*

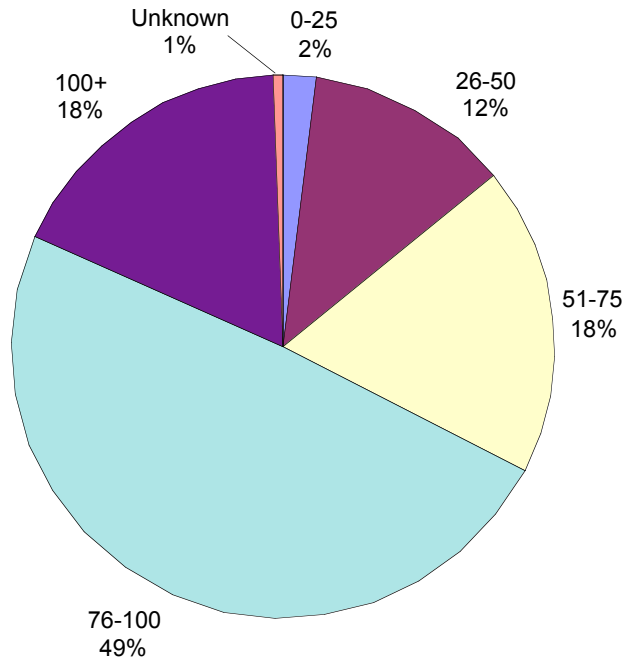


Figure 5: *Percentage of demolished concrete buildings by age in years (57 buildings)*

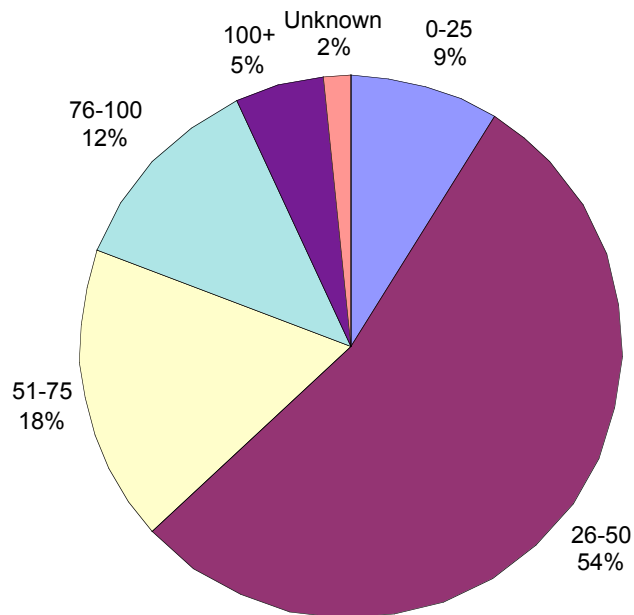


Figure 6: *Percentage of demolished steel buildings by age in years (10 buildings)*

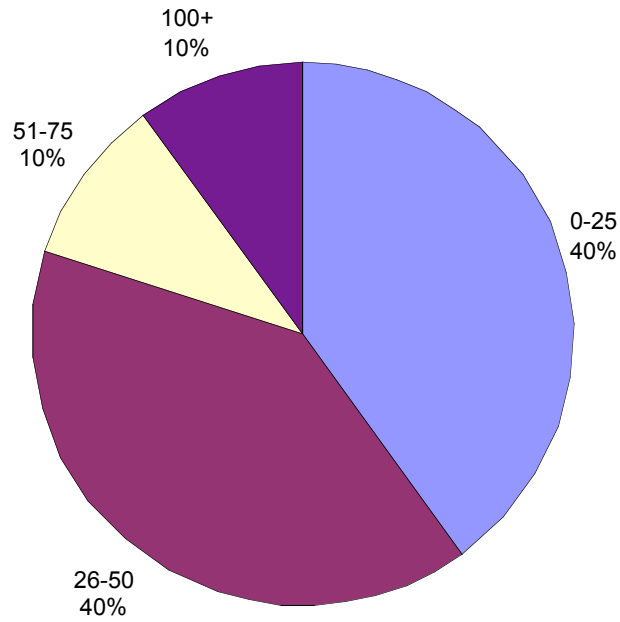
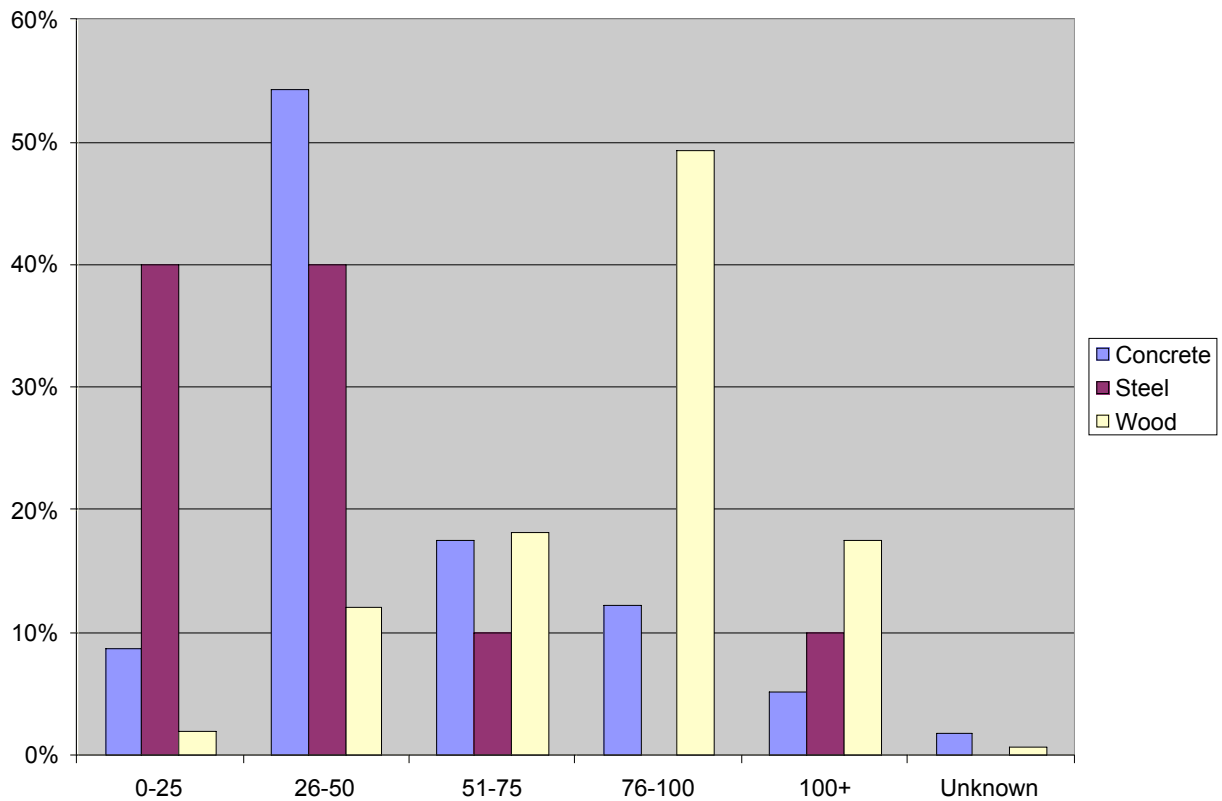
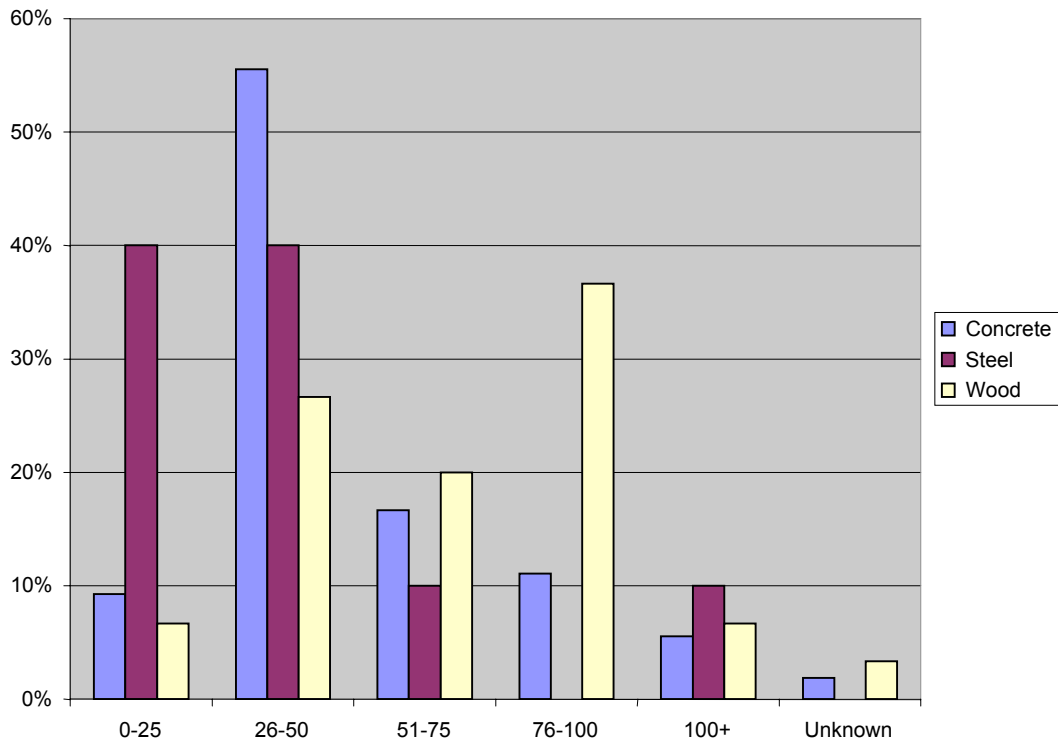


Figure 7: *Comparison of percentage of demolished buildings in each age group by structural material*



The profile is similar for the commercial buildings only, as illustrated in Figure 8.

Figure 8: *Comparison of percentage of demolished commercial buildings in each age group by structural material*



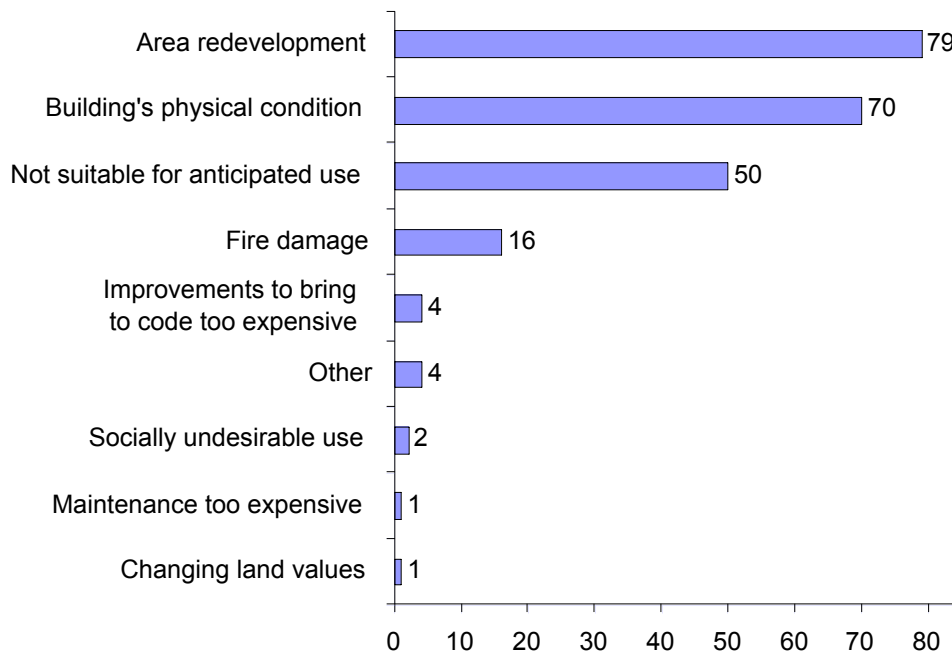
3.5 Reason for demolition

Owners were then asked “What was the main reason for demolition?” and given the following choices:

- area redevelopment
- changing land values
- building’s physical condition
- maintenance was too expensive
- socially undesirable use
- improvements needed to bring the building to code were too expensive
- other (please describe).

Upon review of the responses to this question, many of the ‘Other’ responses were found to be similar and could be categorized as either ‘Not suitable for anticipated use’ or ‘Fire damage’. These additional categories were therefore added to further subdivide the original ‘Other’ category. Figure 9 shows the number of responses in each category.

Figure 9: Number of demolished buildings by reason for demolition



3.6 Reason for demolition by structural material

Figures 10-12 below show the responses to “What was the main reason for demolition?” by structural material. Twelve responses for buildings indicating more than one structural material were excluded from these figures. Figure 13 provides a comparison of the percentage of buildings with each reason for demolition by structural material.

Figure 10: Percentage of demolished wood buildings by reason for demolition (148 buildings)

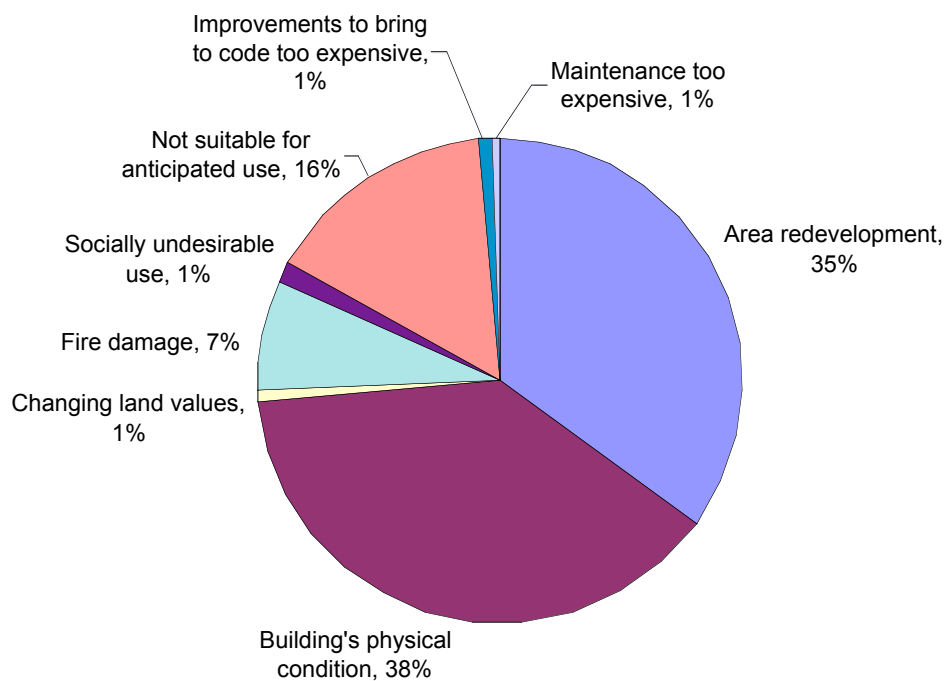


Figure 11: *Percentage of demolished concrete buildings by reason for demolition (57 buildings)*

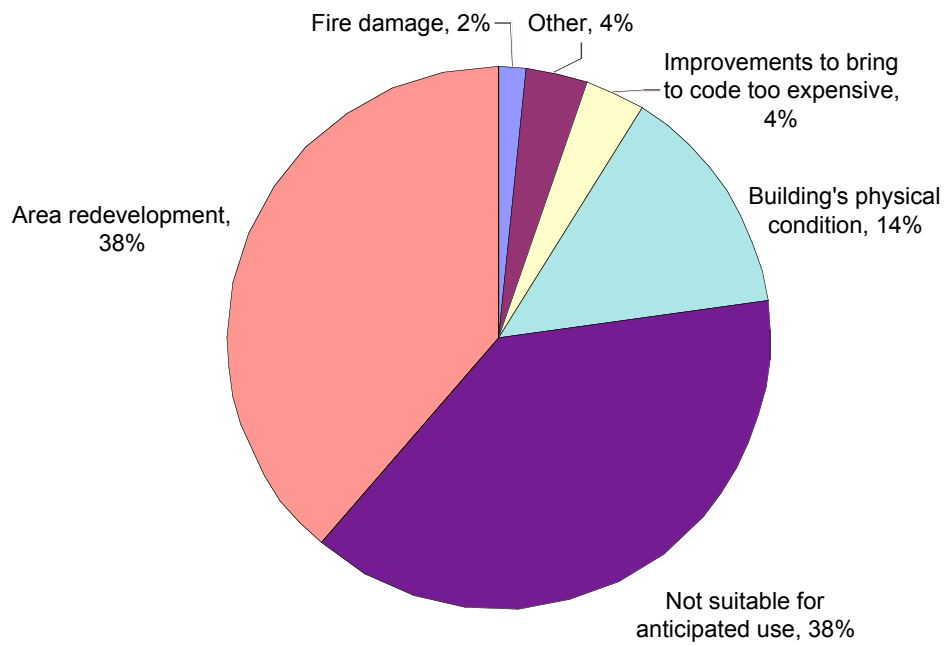


Figure 12: *Percentage of demolished steel buildings by reason for demolition (10 buildings)*

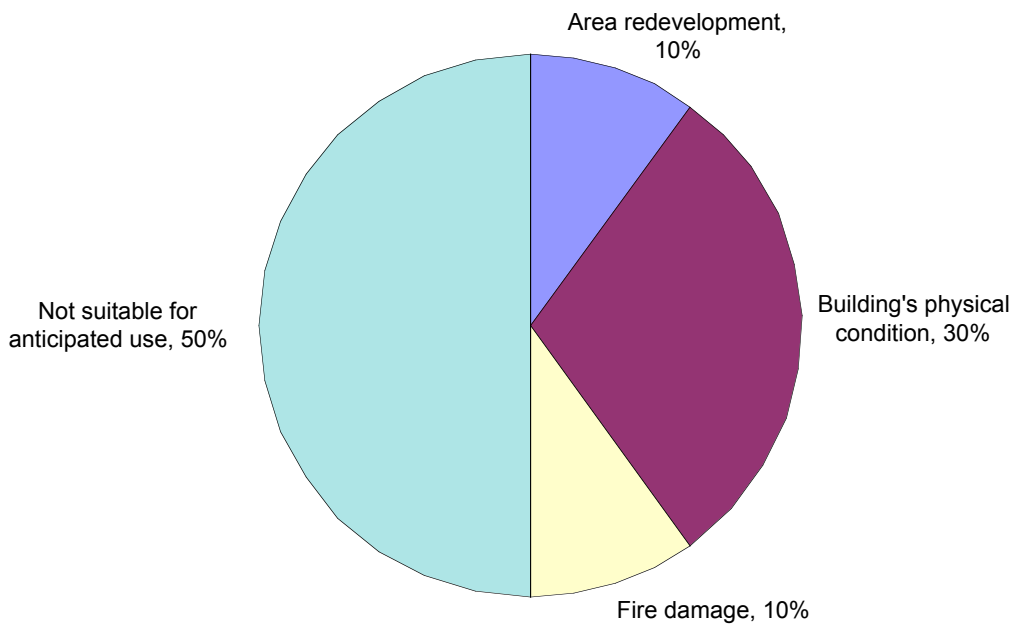
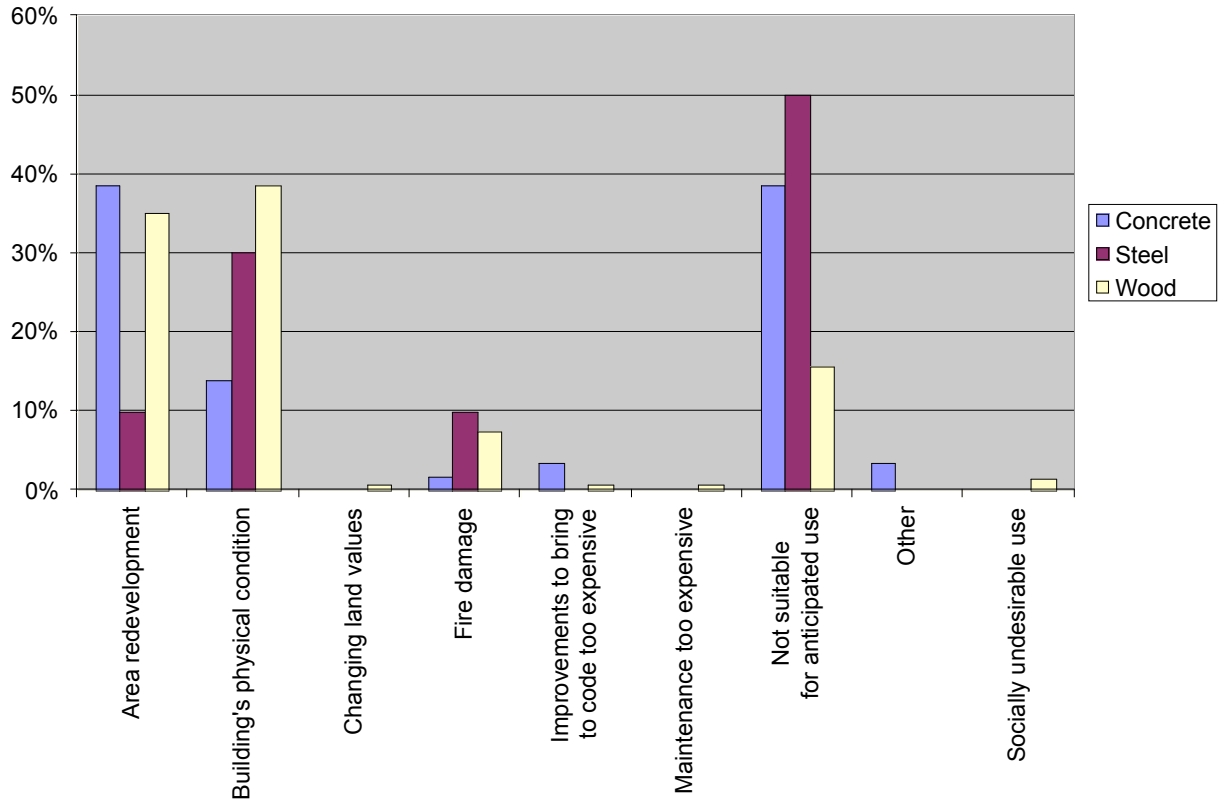
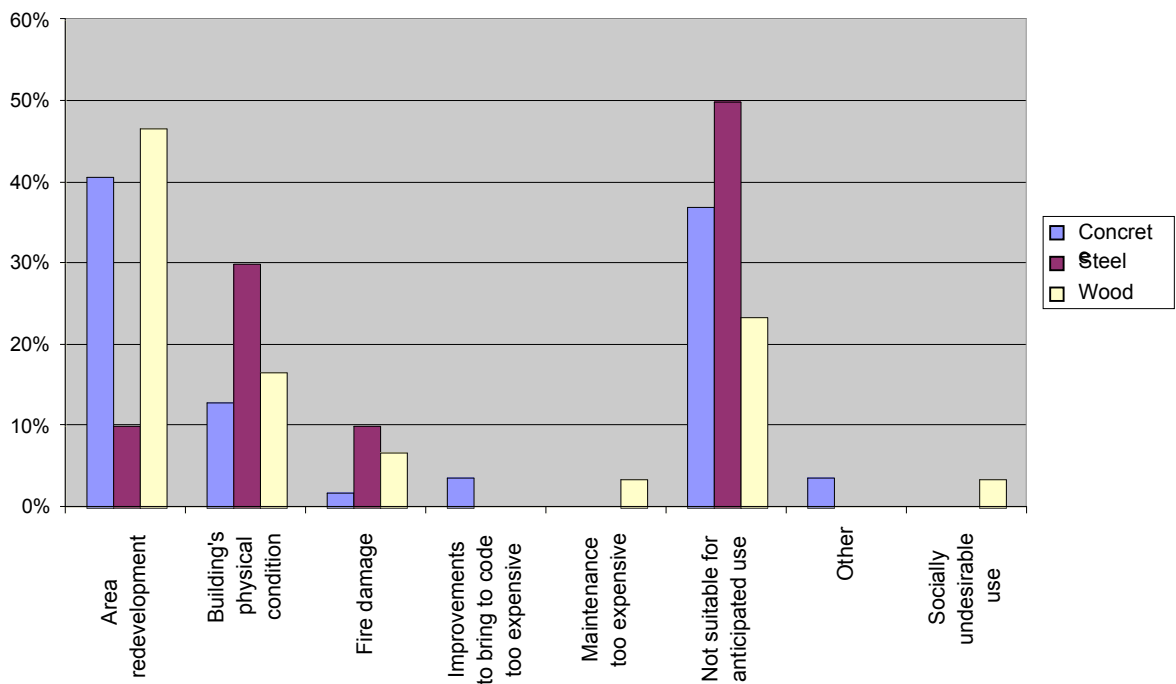


Figure 13: Comparison of percentage of demolished buildings by structural material related to reason for demolition



Again, the profile of demolition reasons by structural material is very similar for the commercial buildings only, as shown in Figure 14.

Figure 14: Comparison of percentage of demolished commercial buildings by structural material related to reason for demolition



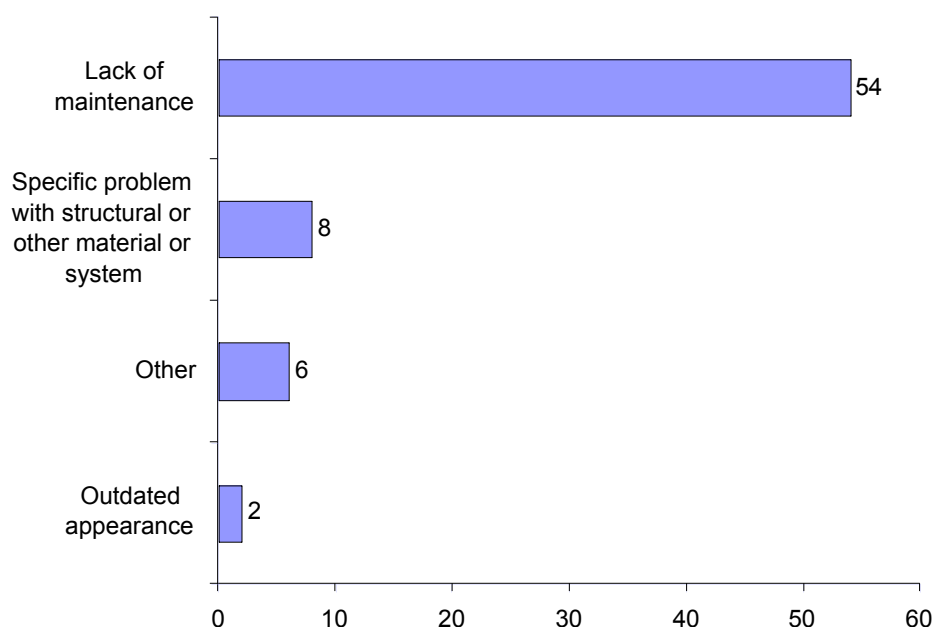
3.7 Building's physical condition

If the respondent chose building's physical condition in the previous question, the owner was asked to 'indicate more specifically what the primary factor regarding the building's physical condition was that led to demolition.' The choices were:

- outdated appearance
- lack of maintenance
- specific problem with structural or other material or system (please describe)
- other (please describe).

Owners were asked this question about 70 of the buildings, based on their response to the previous questions. Figure 15 shows the results.

Figure 15: Number of demolished buildings indicating specific reason for demolition related to building's physical condition



3.8 Building's physical condition by structural material

Figures 16 and 17 show the responses to the request to 'indicate more specifically what the primary factor regarding the building's physical condition was that led to demolition' by structural material, and Figures 18 and 19 show the comparisons of all structural materials by percentage of response, with and without the residential component of the sample.

Of the 70 responses to this question, 57 were for wood buildings, 8 for concrete, 3 for steel and 2 for buildings with more than one structural material. The latter were excluded from the figures below. No figure is shown for the 3 steel buildings because all three were demolished for "other" reasons that were described to include mold problems, bad location and building condition was beyond repair.

Figure 16: *Percentage of specific reason for demolition related to building's physical condition for wood buildings (57 buildings)*

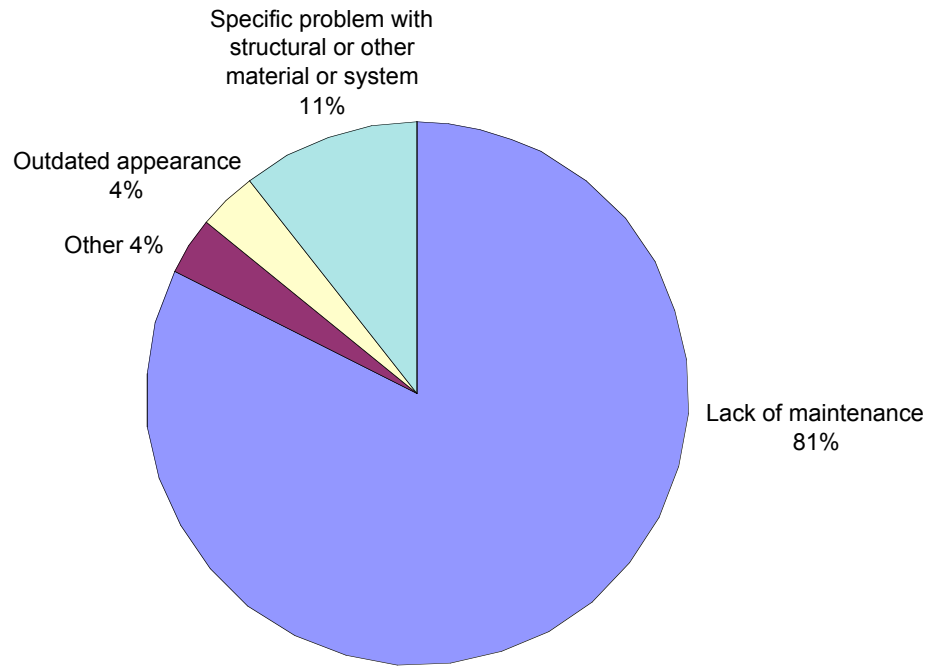


Figure 17: *Percentage of specific reason for demolition related to building's physical condition for concrete buildings (8 buildings)*

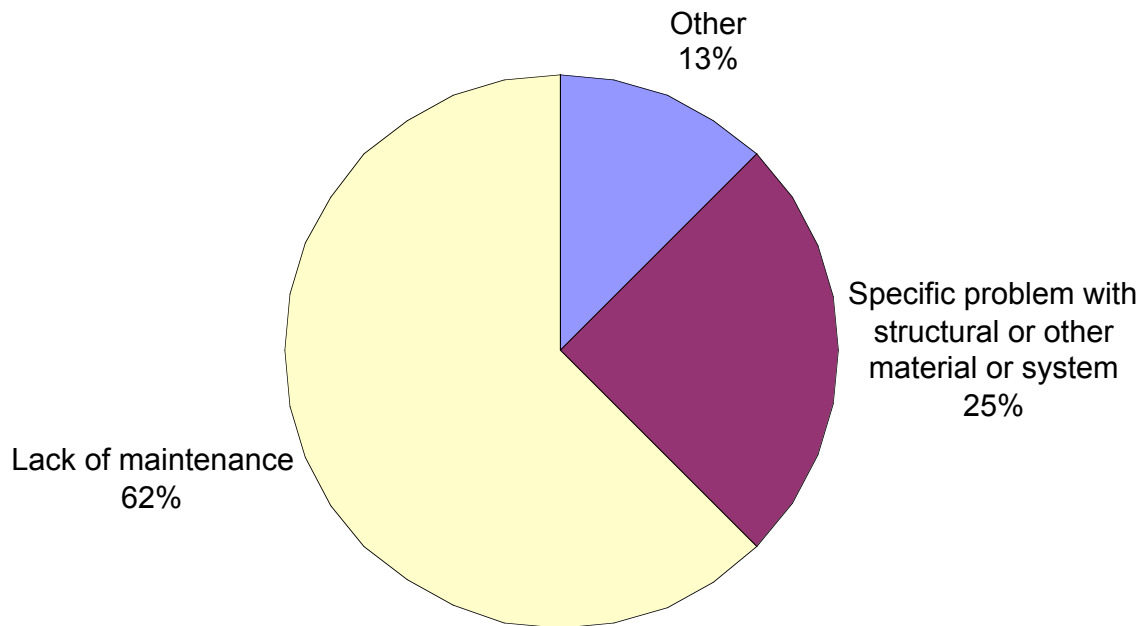


Figure 18: Comparison of percentage of specific reason for demolition related to building's physical condition for all structural materials

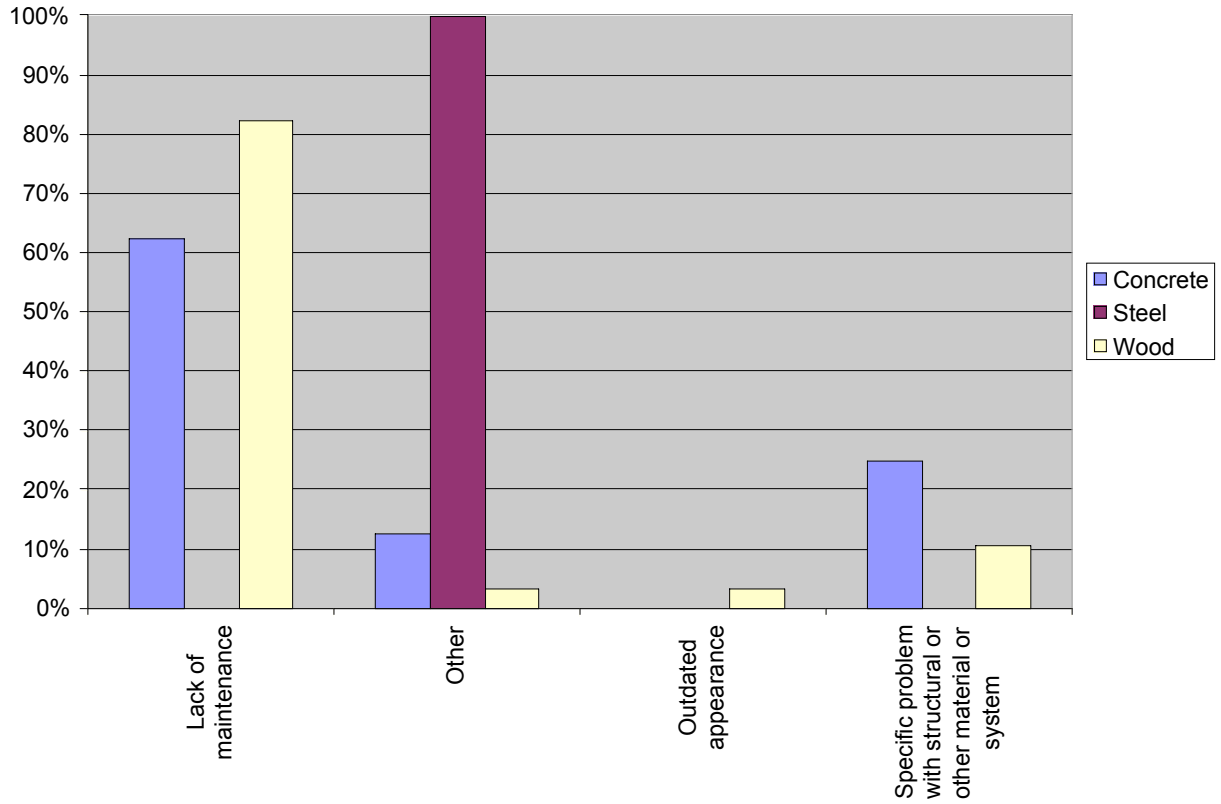
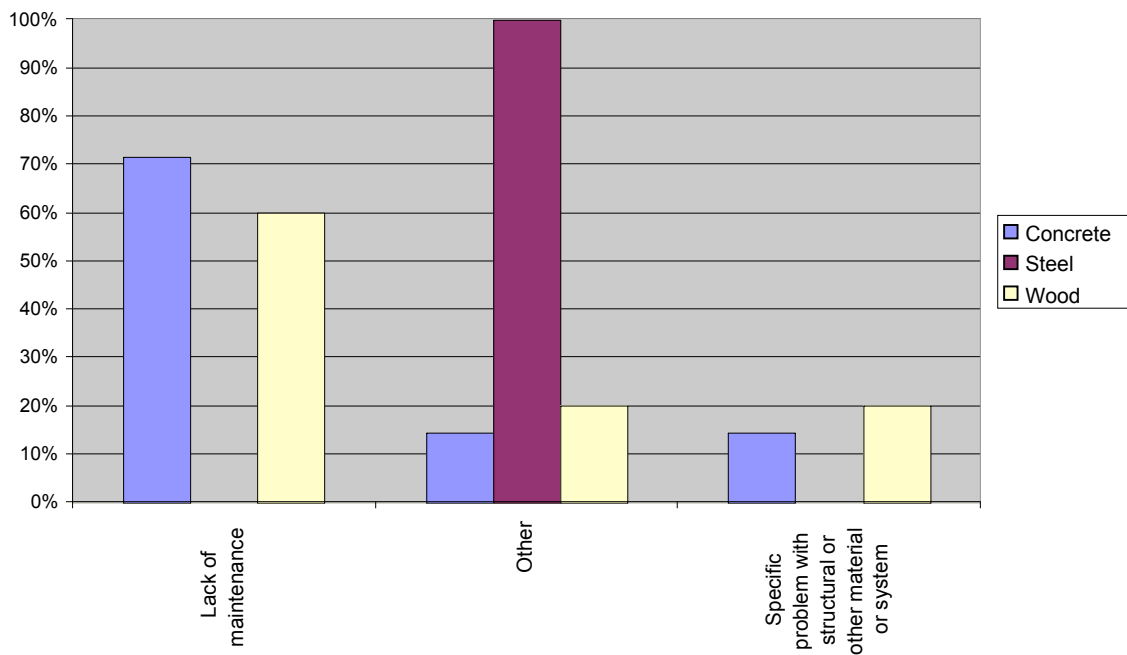


Figure 19: Comparison of percentage of specific reason for demolition related to building's physical condition for all structural materials in commercial buildings



3.9 Specific structural problems

Of the total sample, owners of 8 buildings indicated that the reason for demolition was building's physical condition and further, that there was a specific problem with the structural material.

Owners were asked to describe the problems, and the individual answers are included in Table 1.

Table 1: *Description of structural material problems*

	Structural Material	Age	Description of Problem
1	Concrete	76-100	Inadequate foundation for fieldstone/concrete structure; arson
2	Concrete	Unknown	Various problems: needed new roof; joists were bad; cracked walls; costly to fix
3	Wood	76-100	Ground settling caused foundation & wall systems to fail
4	Wood	51-75	Bad flat roof; water leaking through foundation
5	Wood	76-100	Foundation failure; exterior deterioration; too many remodelings to rehabilitate
6	Wood	76-100	Bad foundation; too many remodelings to rehabilitate
7	Wood	76-100	Floor and rim joist rotten; concrete basement wall broken
8	Wood	76-100	Poured foundation crumbling

3.10 Results summary

Of the 227 buildings in the survey, 70% were in the 51-100+ age category, with 51% in the 76 and over bracket. The remaining 30% were all less than 50 years old, with 6% in the 0-25 category. The four biggest reasons for building demolition were "Area redevelopment" (35%), "Building's physical condition" (31%), "Not suitable for anticipated use" (22%) and "Fire damage" (7%).

Lack of maintenance was cited as the specific problem for 54 of the 70 buildings where physical condition was given as the reason for demolition. In only eight cases was a specific problem with structural or other materials or systems cited. All but two (one of which was of unknown age) were in the 75 and over age categories, and all eight had foundation problems along with other concerns.

Wood buildings accounted for two-thirds of the buildings in the survey, which is not surprising given the geographic region. What may be surprising, however, is that 85% of the demolished wood buildings were in the 51 and over age categories, with 49% in the 76-100 category and 18% more than 100 years old. In contrast, 63% of the structural concrete and 80% of the structural steel buildings were in the 50 and under age categories. Moreover, concrete and steel totally dominate the 'Area Redevelopment' and 'Not Suitable for Anticipated Use' reasons for demolition.

When residential building results are dropped, wood buildings account for only 29% of the remaining commercial buildings, with concrete becoming the dominant structural material at 50%. However, the commercial building age profiles by material and the reasons for demolition remain very similar for the commercial buildings. The same is true for the physical condition results.

4 Conclusions

The findings of the survey support that there are a number of reasons for building demolition that are unrelated to structural material. Further, this small sample overwhelmingly shows that only a very small percentage of buildings are actually demolished for reasons related to their structural material; rather, most buildings demolished for their physical condition are demolished due to lack of maintenance. These findings directly inform green building issues, particularly the concept of durability.

Perceptions about building durability are often related to structural material. A building made out of wood and a building made out of steel have perceived differences in durability, defined in this case as length of life. This study contradicts that perception because the service life of buildings is much more often related to a host of other issues, many concerning land use. The findings not only challenge some of the emerging conventional wisdom about durability but also, perhaps more importantly, highlight aspects of building construction and maintenance as areas of concern if we want to increase building longevity.

In green building, there is a disconnect between the concept of durability and the practice of making buildings that last. This disconnect leads green building project teams and designers into uninformed definitions of words like “durable” and “long lasting.” In a worse case scenario, this can lead to buildings that are capable of lasting for centuries that end up being demolished within twenty years.

We can not know what will happen in the long term future nor prejudge the desires of future generations. And yet the opportunity exists to make buildings as flexible and adaptable as possible. In the least, if a building’s expected life span can be estimated during design, this information provides a solid roadmap during the decision making process to choose appropriate building techniques. For example, if the life span of a building on a college campus is projected to be 200 years, it may be designed and constructed differently than a strip mall that is expected to last twenty years.

As more and more people are building green, it becomes increasingly important to understand what issues should be examined during a building’s planning phase to ensure an appropriately located, designed and built structure. The study tends to confirm the view that we should do more to develop building systems that are flexible and that can be readily deconstructed for reuse in different locations if future land use is in question for economic or other reasons. It also confirms the need to further develop our definition of terms like “durable” so we can better apply knowledge gained to a sustainable future.

Appendix A: Letters to Owners

First mailing

Dear Sir or Madam,

The ATHENA Institute, a non-profit materials institute, is currently doing a research study about the durability of structural materials. By doing this study we hope to ascertain the role materials play in the demolition of structures. For our work we are attempting to determine the structural material of demolished buildings and the reasons for their demolition.

We obtained your name from the City of St. Paul demolition permit database as the owner or past owner of a property at [Property Address Here]. We would appreciate a few minutes of your time to answer several questions about the structural material of the building that was demolished and reasons for its demolition. The information we are collecting will help those in the building industry understand durability of materials which can assist in planning the life span of structures.

The enclosed card contains several questions about your property. We thank you in advance for completing the card and returning it to the ATHENA Institute in the pre-stamped envelope. Your input is very valuable to our research.

The ATHENA Institute is a non-profit research organization that works in the United States and Canada. To let you know about our work, we have enclosed a brochure about our organization. For more information about the ATHENA Institute, please visit our website at www.athenasmi.ca.

Please feel free to contact me with any questions regarding this survey.

Sincerely,

Scot W. Horst
Executive Director

Second mailing

Dear Sir or Madam,

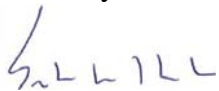
We recently sent you information about The ATHENA Institute, a non-profit sustainable materials institute. We are doing a research study about the durability of structural materials and need your help by answering a short four question survey. By doing this study we hope to ascertain the role materials play in the demolition of structures.

We obtained your name from the City of St. Paul demolition permit database as the owner or past owner of a property at [Property Address Here]. We would appreciate a few minutes of your time to answer the questions found on the enclosed card about the structural material of the building that was demolished and reasons for its demolition. Also enclosed is a pre-addressed, stamped envelope for the return of the card.

Your input is very valuable to our research, and we thank you in advance for completing and returning the card.

Please feel free to contact me with any questions regarding this survey.

Sincerely,

A handwritten signature in blue ink, appearing to read "Scot W. Horst".

Scot W. Horst
Executive Director

Appendix B: Survey

Side One

Thank you for taking the time to provide us with information about the building at «Property Address».

1. What was the approximate age of the building? (if known)
 - 0-25 26-50
 - 51-75 76-100
 - 100+ years
2. What was the main structural material of the building?
 - concrete
 - steel
 - wood
3. What was the main reason for demolition? (Please choose one)
 - area redevelopment
 - changing land values
 - building's physical condition
 - maintenance was too expensive
 - socially undesirable use
 - improvements needed to bring the building to code were too expensive
 - other _____
(please describe)

OVER



Side Two

4. If you chose the building's physical condition as the main reason for demolition, please indicate more specifically what the primary factor regarding the building's physical condition was that led to demolition:
 - outdated appearance
 - lack of maintenance
 - specific problem with structural or other material or system
_____ (please describe)
 - other _____ (please describe)

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THANK YOU!