

CORNELL UNIVERSITY GRADUATE SCHOOL

APPROVAL OF RESEARCH PAPER

Name of candidate: WYETH AUGUSTINE-MARCEIL
First Name Middle Name Family Name

Graduate Field: CITY AND REGIONAL PLANNING

Degree: M.R.P.

Title of Research Paper:

WHICH BUILDINGS ARE "WORTH" DISASSEMBLING? AN ANALYSIS OF AMERICAN DECONSTRUCTION ORDINANCES

COMMITTEE SIGNATURES:

Chairperson:  Date: May 17, 2023

Member: Felix Heisel Date: May 17, 2023

Member: _____ Date: _____

Member: _____ Date: _____

Member: _____ Date: _____

LICENSE TO USE COPYRIGHTED MATERIAL

I do hereby give license to Cornell University and all its faculty and staff to use the above-mentioned copyrighted material in any manner consonant with, or pursuant to, the scholarly purposes of Cornell University, including lending such materials to students or others through its library services or through interlibrary services or through interlibrary loan, and delivering copies to sponsors of my research, but excluding any commercial use of such material. This license shall remain valid throughout the full duration of my copyright.

Wyeth Augustine-Marceil
(Student Signature)

WHICH BUILDINGS ARE “WORTH” DISASSEMBLING? AN ANALYSIS OF
AMERICAN DECONSTRUCTION ORDINANCES

A Research Paper

Presented to the Faculty of the Graduate School
of Cornell University

In Partial Fulfillment of the Requirements for the Degree of
Master of Regional Planning

by

Wyeth Augustine-Marceil

May 2023

© 2023 Wyeth Augustine-Marceil

ABSTRACT

Construction and demolition (C&D) waste represents the single largest waste stream in the United States. 90% of C&D waste is produced at a structure's end-of-life through conventional mechanical demolition, which renders materials valueless, effectively wasting their embodied carbon while also producing harmful airborne toxins. Alternatively, structural removal through *deconstruction* produces comparatively less waste and other negative externalities. As deconstruction has gained popularity in the US, four cities have produced ordinances that require some buildings to be deconstructed: Portland (2016), Milwaukee (2017), Palo Alto (2019), and San Antonio (2022). Through interviews with local representatives, analysis of ordinance language, and review of city progress reports, this research explores the origins of the ordinances, the thinking that shaped them, and their eventual outcomes. This work provides a survey of American ordinances, challenges prevailing assumptions, and provides recommendations for other municipalities considering deconstruction.

BIOGRAPHICAL SKETCH

Wyeth Augustine-Marceil is an industrial designer, urban planner, and sustainability advocate. Born to a psychologist, Joe, and an elementary school teacher, Kari, Wyeth was raised within an active renovation of an 1878 Italianate brick hotel building on Main Street of the 3,000-person village of Marshall, Wisconsin. Wyeth received a B.S. in industrial design from the University of Cincinnati and later designed several commercially successful consumer products. After gaining an understanding of the waste streams resulting from these same products, Wyeth chose to pursue a Master's of Regional Planning at Cornell University to develop new tools to manage, reconceptualize, and eliminate waste and contribute to a more sustainable future.

To my parents, Joe and Kari. From them, I learned to appreciate the overlooked.

To my brother, Alec. From him, I learned to always follow what I feel to be right.

To my partner, Liliana. From her, I learned how the small things can add up.

I love you all.

ACKNOWLEDGMENTS

I want most to acknowledge my advisor, Dr. Jennifer Minner, with whom I have worked closely over the course of my two years at Cornell. Dr. Minner welcomed me into the Just Places Lab and the Circularity, Reuse, and Zero Waste (CROWD) network, which have both been instrumental in the development of this work. Dr. Minner has supported and helped shape my interests and ideas. I owe much of my experience at Cornell to her.

Thank you to Felix Heisel for being my second reader and introducing me to many concepts of deconstruction through his work. I also thank Stephanie Phillips, Shawn Wood, Maybo Auyeung, Robert Bauman, and Dave Bennink for all agreeing to be interviewed and informing this paper by sharing their time, resources, and ideas.

TABLE OF CONTENTS

| | |
|--|-----|
| ABSTRACT | i |
| BIOGRAPHICAL SKETCH | ii |
| ACKNOWLEDGMENTS | iv |
| TABLE OF CONTENTS | v |
| LIST OF FIGURES | vi |
| LIST OF TABLES | vii |
| INTRODUCTION | 1 |
| LITERATURE REVIEW | 5 |
| METHODOLOGY | 11 |
| ANALYSIS | 13 |
| Portland, Oregon Deconstruction Ordinance | 19 |
| Milwaukee, Wisconsin Deconstruction Ordinance | 24 |
| Palo Alto, California Deconstruction Ordinance | 28 |
| San Antonio, Texas Deconstruction Ordinance | 32 |
| DISCUSSION | 37 |
| CONCLUSION | 48 |
| APPENDIX | 50 |
| BIBLIOGRAPHY | 81 |

LIST OF FIGURES

| | |
|---|----|
| Figure 1: Visualization of the year-built applicability thresholds | 2 |
| Figure 2: Distribution of structures by decade built in the United States..... | 3 |
| Figure 3: Comparison of embodied and operational carbon | 7 |
| Figure 4: Geographical distribution of US cities with deconstruction ordinances | 14 |
| Figure 5: Distribution of home values in US cities with deconstruction ordinances | 15 |
| Figure 6: Distribution of year structure built in US cities with deconstruction ordinances .. | 17 |
| Figure 7: Language similarity of deconstruction ordinances | 37 |
| Figure 8: Language similarity of proposed deconstruction ordinances..... | 38 |
| Figure 9: Waste hierarchy for treatment of buildings..... | 44 |

LIST OF TABLES

| | |
|---|----|
| Table 1: Population and household income in US cities with deconstruction ordinances | 14 |
| Table 2: Housing typology, population density and city area in US cities with deconstruction ordinances | 16 |
| Table 3: Median year structure built in US cities with deconstruction ordinances | 17 |
| Table 4: Policy overview of US deconstruction ordinances..... | 18 |
| Table 5: Summary of US deconstruction ordinances. | 36 |
| Table 6: Content analysis of the four US deconstruction ordinances..... | 40 |
| Table 7: US deconstruction ordinance coverage | 41 |

INTRODUCTION

Contemporary building construction and demolition practices contribute to more than 50% of global material extraction and at least 40% of the world's carbon dioxide emissions (European Commission, 2022). Typically, when a building is removed, it is mechanically demolished in a manner that renders most of the component materials economically valueless resulting in their eventual disposal in a landfill, further perpetuating the demand for newly extracted materials. In 2018, the United States alone produced 188.8 million tons of construction and demolition (C&D) waste from buildings; 90% of which was produced through demolition (U.S. EPA, 2022).

Issues with demolition go beyond the production of excessive amounts of waste. Demolition showers surrounding communities with toxic 'fugitive dust,' squanders carbon embodied within materials, erodes the character and quality of building stock, and disproportionately impacts low-income communities of color (Rypkema et al., 2021). As awareness of the problems of mechanical demolition grows, many American municipalities are setting climate and sustainability goals to reduce their environmental impact. Due to its outsized presence in the waste stream, many climate and sustainability plans recommend policies to address C&D waste. Cities including San Francisco, Seattle, Chicago, and Denver have implemented policies that require contractors to divert, at minimum, a set percentage of C&D waste produced through demolition from being landfilled. A few municipalities have taken policies to address C&D waste a step further, requiring that some buildings be *deconstructed* if they are to be removed. Deconstruction is an alternative to mechanical demolition that can be described as the careful process of disassembling a structure that minimizes the damage to component materials enabling them to be salvaged and reused. Though typically more expensive (Dantata et al., 2005; Paruszkiewicz et al., 2016), deconstruction is thought to be an environmentally preferable alternative to demolition as it has been demonstrated to produce higher material salvage-rates and minimize the spread of harmful fugitive dust (Allam and Nik-Bakht, 2023). Further, deconstruction creates comparatively more jobs, produces affordable used building materials, and

contributes to the shift toward a circular economy (Bertino et al., 2021). Within the United States, Portland, Oregon; Palo Alto, California; San Antonio, Texas and Milwaukee, Wisconsin have each passed deconstruction ordinances that require some buildings to be deconstructed rather than mechanically demolished. Vancouver, British Columbia passed the first deconstruction ordinance in Canada in 2019, and groups in other cities such as Baltimore, Maryland and Ithaca, New York are actively working to pass deconstruction ordinances of their own.

However, except for Palo Alto, all current deconstruction ordinances in North America include a year-built applicability clause, which narrows the scope of the regulations considerably. For example, Portland, Oregon, which is widely considered the municipal leader in deconstruction, requires structures built in the year 1940 and earlier to be deconstructed, yet newer buildings may still be mechanically demolished (City of Portland, 2016). Thus, if a Portland building constructed in 1941 were slated for removal, it could be mechanically demolished without penalty. Other municipalities have utilized Portland’s ordinance as a model and include similar year-built applicability clauses. As shown in Figure 1, San Antonio requires deconstruction for buildings built in or before 1945, Milwaukee 1929, and Vancouver 1910.

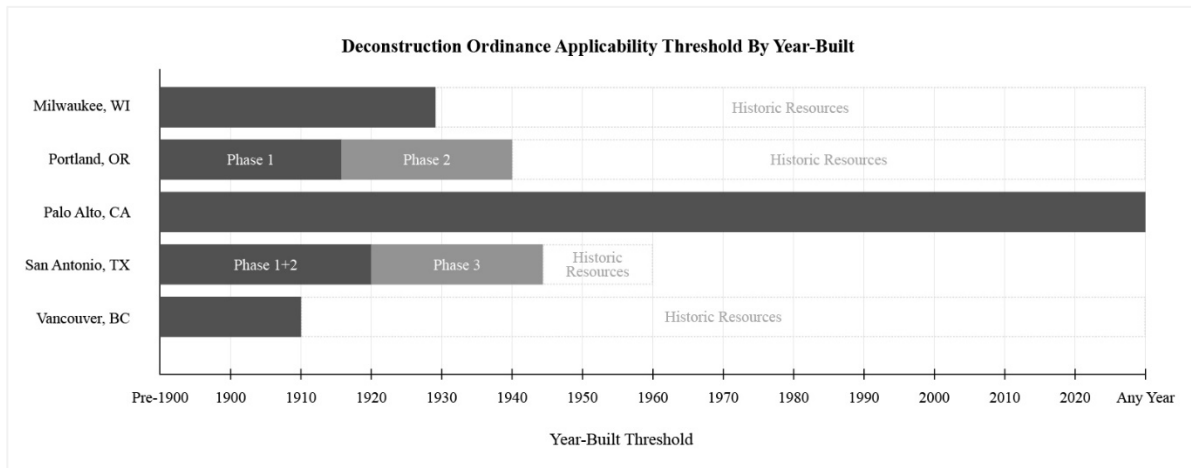


Figure 1: Visualization of the year-built applicability thresholds of five North American deconstruction ordinances. Four of five ordinances have thresholds based on the year a structure was built, while Palo Alto does not include such a threshold.

The primary justification for requiring deconstruction only for an area’s oldest buildings is that older buildings are more likely to produce a significant financial return through deconstruction

(Falk, 2002). Older construction typically used higher value materials, sometimes referred to as ‘heritage materials’ such as old growth lumber, which can be processed and sold to offset the comparatively high financial cost associated with deconstruction. More contemporary construction methods often use composite materials, low-grade lumber, and adhesives which each present challenges for deconstruction and have comparatively low market value (Falk, 2002).

While requiring deconstruction only for the oldest buildings may be logical financially, it may undermine many of the proposed benefits of widespread deconstruction. While salvaged contemporary building materials may not currently demand the same market as heritage materials, the deconstruction of newer buildings can still divert waste, preserve embodied carbon, mitigate the release of fugitive dust, and create jobs.

Of the deconstruction ordinances with year-built limitations, Portland (1940 or before) is the most aggressive. Considering the entire building stock of the United States, only 12.3% of structures would fall under the coverage as applied in Portland. Thus, even the most progressive deconstruction policy containing a year-built clause would fail to protect 87.7% of American buildings (some 122 million structures) from demolition (US Census Bureau, 2021).

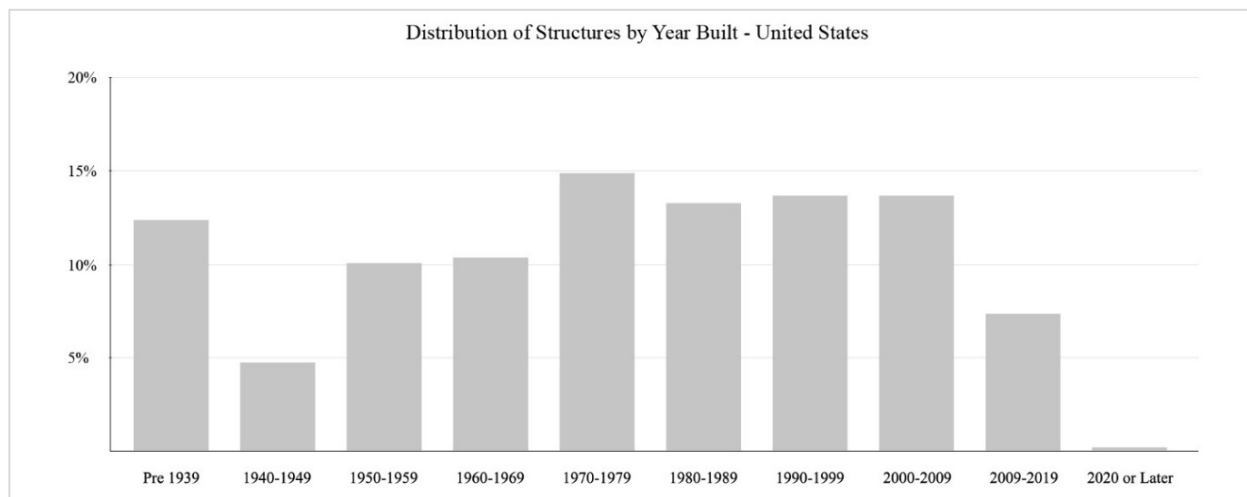


Figure 2: Distribution of structures by decade built for the United States. Source: American Community Survey 2021 (5-Year Estimates)

This raises the question of a potential mismatch between intent and outcomes of current and emerging deconstruction ordinances. If only intended to recirculate the diminishing supply of

heritage construction materials, these ordinances will largely accomplish their goal. However, if they are intended to divert the maximum amount of waste, maximize the preservation of embodied carbon, protect communities from demolition-generated pollution and create entry-level trades jobs, this author argues they are largely inadequate in their current form.

Of course, this author believes that some deconstruction is better than none. However, as deconstruction ordinances begin to proliferate across North America, now is a crucial juncture to uncover motivations, challenge assumptions and strengthen flagship policies. The few current deconstruction ordinances borrow heavily from each other, and it is reasonable to expect future ordinances will continue to do so, magnifying any potential discrepancies between intent and outcomes.

To better understand these flagship deconstruction ordinances, this paper includes a review of policy language, analysis of city progress reports, and interviews with key contributors from each US municipality with a deconstruction ordinance. This research seeks to uncover why deconstruction ordinances are self-limited in their scope, what factors contributed to specific policy decisions, and the potential for future revision. Further, this analysis is used to explore the case for the deconstruction of more buildings, regardless of age, use, or compositional materials. This paper will begin with a review of literature on deconstruction and demolition, continue with an analysis of the four American deconstruction ordinances, complemented with commentary provided through stakeholder interviews, and conclude with discussion of the findings.

LITERATURE REVIEW

The built environment is a critical frontier to reduce energy consumption and waste production that contribute to the emission of carbon and the changing of our climate. Many national and international authorities have identified construction and demolition waste as a pivotal stream in need of reduction to meet climate goals (Ellen Macarthur Foundation, 2021). Contemporary building construction and demolition practices contribute to more than 50% of global material extraction (European Commission, 2022), and account for 36% of all global waste production (United Nations Environment Programme, 2015). The industry's wasteful nature stems primarily from how structure end-of-life is typically managed (Benachio et al., 2020), with roughly 90% of C&D waste being produced through the demolition of buildings (US EPA, 2022). In the United States, mechanical demolition arose as the primary method of structural removal after World War II due to the proliferation of capable heavy machinery and federal policy aimed to renew America's urban cores (Ammon, 2016). Mechanical demolition has remained the norm since, largely due to the relative efficiency and low cost as compared to other removal methods (Purchase et al., 2021). More recently, scholars and governments alike have questioned whether the relatively low cost of mechanical demolition properly accounts for other factors (Ghisellini et al., 2018). The cost of mechanical demolition does not consider externalized factors identified in literature such as landfilling, embodied carbon, new extraction, community erasure, erosion of affordable housing stock, the demise of heritage materials and trades, and public health endangerment (Lawson, 2006; McCarthy and Glekas, 2019; Bezold et al., 2020; Ross, 2020). The fundamental pitfall of mechanical demolition is summarized nicely by Leigh and Patterson (2006), who contend that demolition "...changes assets (buildings) into liabilities (demolition debris)."

As proclivity to mechanically demolish anything that stood in the way of 'progress' grew, many strategies emerged in response. Among these strategies is the field of historic preservation, which experienced exponential popularity growth beginning in the 1950s in response to the mid-century loss of historic buildings (Ryberg-Webster and Kinahan, 2013). Preservationists have

developed numerous building treatments in an effort to stem mechanical demolition (Cook and Mays, 2017). Three of the four “Standards” for the treatment of historic properties (preservation, rehabilitation, restoration) are methods of maintaining a building largely as-is and in-situ (National Parks Service, 2022). Many municipalities have created historic preservation commissions capable of designating structures as historic resources, which oftentimes expressly forbids demolition (Ducker, 2013).

As an acceptance that not all buildings can, or perhaps should, be preserved indefinitely, scholars and municipalities have sought ways to address the externalized costs of mechanical demolition. Many municipalities have implemented regulatory controls such as requiring suppression methods for toxic ‘fugitive dust’ produced through mechanical demolition (Lauer, 2019), banning construction materials from landfills (Bertino et al., 2021), and requiring C&D waste diversion quotas (Jeffrey, 2011). On the construction side, there is a growing movement among architectural scholars to design buildings specifically to be disassembled at their end-of-life (Heisel et al., 2019). This emerging form of architectural design is called “design for disassembly” and has been implemented in numerous case studies but has yet to be implemented anywhere at significant scale (Rios et al., 2015).

To achieve climate goals, there is an emerging sentiment that waste diversion and design for disassembly alone do not go far enough (Crowther, 2016). C&D diversion requirements do little to prevent fugitive dust, dust suppression methods are inherently flawed, and C&D recycling facilities have low yield-rates. (Osmani, 2011, Farfel, et al., 2003). Even materials that are diverted at C&D recycling facilities are typically downcycled into aggregates, compost additives or burned for energy (Rios et al., 2015). Downcycling does little to stem new material extraction, and therefore should be de-emphasized as a sustainable solution. Rather, waste management should follow a hierarchical scale where ‘reuse’ is preferable to ‘recycle,’ which is preferable to ‘downcycle,’ which is preferable to ‘disposal’ (Bertino et al., 2021). And while design for disassembly is a promising practice in need of further exploration, it does little to address already standing buildings and the pressing need to address demolition practices.

Embodied Carbon

Disposing building materials effectively wastes the carbon that has already been emitted through material extraction, manufacturing, transportation, and fabrication (Hammond and Jones, 2008). The carbon produced to transform raw materials into a fully constructed home is referred to as ‘embodied carbon,’ which is crucial to consider when evaluating the sustainability of a structure. Unlike operational carbon (heating, cooling, lighting, etc.), which can be reduced during a building’s lifetime, embodied carbon is locked in place as soon as a building is completed and can never be recaptured (American Institute of Architects, 2021).

Embodied carbon is often overlooked when considering decarbonization of the built environment, and older structures are often derided for inefficient energy use (Hu, 2022). But the urgency of the climate crisis compels us to look at solutions that consider short- and long-term solutions to reduce carbon emissions. The Paris Agreement (2015) directs nations to pursue efforts “to limit the temperature increase to 1.5° C above pre-industrial levels” by 2030 or otherwise risk more severe climate change impacts. Thus, while replacing an older building with a newer ‘green building’ may improve operational efficiency, as shown in Figure 3, it may take decades for that operational efficiency to outweigh the loss of wasted embodied carbon (Heisel et al., 2022).

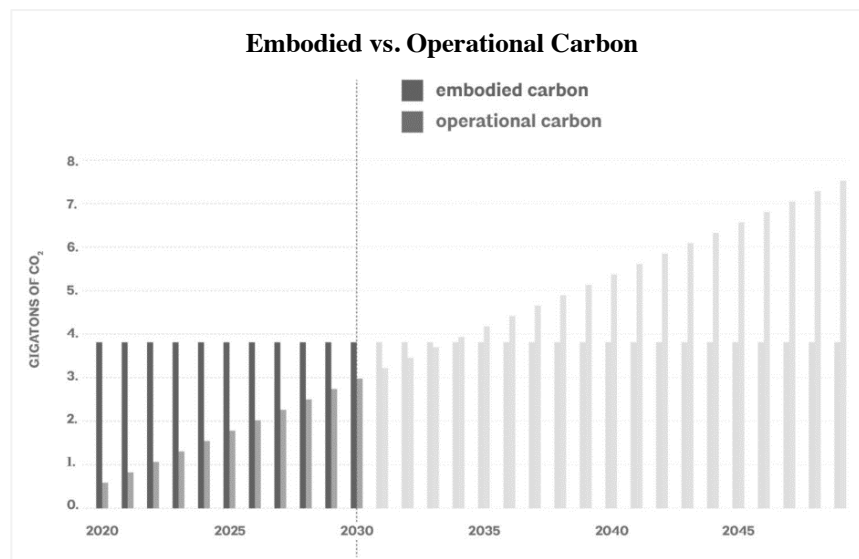


Figure 3: Comparison of embodied and operational carbon over time. Graphic created by Architecture 2030. Architecture 2030. (n.d.). Why the built environment? Architecture 2030. Retrieved April 30, 2023, from <https://architecture2030.org/why-the-building-sector/>

This is all to say that the preservation, reuse, and proper end-of-life care of structures is equally, if not more important than the effort to make buildings more operationally efficient. In most cases, preservation, whole building relocation, and adaptive reuse of existing buildings are all environmentally preferable alternatives to a new structure (Bertino et al., 2021). Each of these approaches extend the operational lifespan of buildings and thus the embodied carbon within (Langston, 2008; Danatzko and Sezen, 2011; Preservation Green Lab, 2011). While it is critical to improve the operational efficiency of the built environment, simply removing and replacing building stock is not a viable solution given the pressing nature of climate change. In other words, to quote Carl Elefante (2007), “The greenest building is...one that is already built.”

The (re)Emergence of Deconstruction

In response to the mounting evidence of the destructive nature of mechanical demolition, a diverse coalition of professions and advocates have called for a more sustainable built environment. Architects, preservationists, municipal solid waste experts, circular economy experts, public health advocates, housing rights groups and others form a growing coalition seeking alternatives to demolition (Shooshtarian et al., 2020). Many scholars have identified *deconstruction* as an environmentally preferable alternative to demolition (Allam and Nik-Bakht, 2023). Deconstruction can be defined as a careful process of disassembling a structure that minimizes the damage to component materials enabling them to be salvaged and reused. Deconstruction has been shown to reduce the amount of fugitive dust produced, salvage a higher proportion of materials for reuse and recycling, and create more jobs as compared to traditional mechanical demolition (Chini, 2001). Deconstruction is hardly a new practice, in fact, the reuse of building materials, deconstructed and taken from previous constructions no longer in use, is quite common throughout human history (Hein and Houck, 2008). For example, in Europe, the scarcity of suitable timber in the middle ages led to the regular reuse of beams and other members from one building to the next (Crowther, 1999). And another example exists in traditional Japanese

architecture which was designed with flexibility for easeful expansion, remodeling, removal, and reconstruction of buildings (Kikutake, 1995). Further, deconstruction for reuse was commonplace in post-colonial America until the Housing Act of 1937 initiated a decades-long razing craze that flattened disproportionately poor, Black neighborhoods throughout the country in the name of progress (Ammon, 2016). While forms of deconstruction have been practiced across cultures throughout human history, the increasing efficiency and cost effectiveness of contemporary demolition practices has rendered the practice into obscurity in nearly every part of the world. However, as the disastrous impacts of demolition become more salient, a growing movement back toward deconstruction is gaining traction. Contemporarily, deconstruction is seen by circular economy scholars as a key step toward a circular building material economy, whereby materials from removed buildings are reused for the same purpose in new construction, thereby eliminating waste and the need for new material extraction (López Ruiz et al., 2020). A deconstruction movement in the US has been percolating for decades, largely in the form of one-off case studies and environmentally minded non-profits, but that is beginning to change.

The Formalization of Deconstruction

Recently, several US municipalities have shifted the regulatory landscape by enacting deconstruction ordinances that require some buildings be deconstructed rather than mechanically demolished. These cities are Portland, Oregon (2016); Milwaukee, Wisconsin (2017); Palo Alto, California (2019); San Antonio, Texas (2022); as well as Vancouver, Canada (2020). The passage of these ordinances has spurred numerous other municipalities to consider actions to support deconstruction, and efforts are underway in Baltimore, Maryland; Pittsburgh, Pennsylvania; Ithaca, New York; Seattle, Washington; San Francisco, California; and Hennepin County, Minnesota among others (CR0WD, 2021). Of the policies in place, only Palo Alto's ordinance requires the deconstruction for all full structural removals regardless of age, use, and material composition (City of Palo Alto, 2019). All other municipalities apply deconstruction requirements

only for the oldest or historically designated residential buildings (City of Portland, 2016; City of Milwaukee, 2017; City of San Antonio, 2022).

While the scholarship on deconstruction is relatively rich, scholarship on deconstruction ordinances in the United States is extremely limited as of this moment, with only a handful of case studies and overviews available. The Delta Institute (2018) published a guide to deconstruction that provides a snapshot of some C&D related policies, Rypkema et al. (2021) published a deconstruction study for the City of San Antonio, Armstrong and LaMore (2018) developed a similar guide with only brief summaries of language of seven municipal actions, and most recently CROWD (2023) published a deconstruction policy guide, to which this author contributed. Currently, there is no known scholarship that performs a comparative analysis for enacted US deconstruction ordinances. This paper will attempt to do so.

METHODOLOGY

This analysis attempts to shed light on the origins, intents, and outcomes of the four deconstruction ordinances that have been enacted in the US as of this writing. While Vancouver, British Columbia passed a deconstruction ordinance in 2018, due to inconsistency in demographic and building stock data between the US and Canada, the Canadian city will not be included in this analysis.

This analysis will begin by utilizing city-level US Census and American Community Survey data to provide an initial survey of the characteristics of the four US cities with deconstruction ordinances. Demographic and building stock data will inform a brief comparative analysis of relevant features that may influence deconstruction in each municipality.

The bulk of this chapter will delve into city-specific analyses that aim to illustrate the context, contributors, and decisions that shaped each municipality's deconstruction ordinance. Each city-specific analysis is informed by a review of municipal ordinances, supporting documents, local journalism, and in-depth interviews with key decision-makers from each city. One representative from each municipality and one independent deconstruction expert were interviewed for this research. Interviewees are as follows: Former City of Portland Construction Waste Expert, Shawn Wood (now Embodied Carbon Advisor for the EPA); City of Milwaukee Alderman Robert Bauman; City of Palo Alto Environmental Program Manager, Maybo Auyeung; City of San Antonio Deconstruction and Circular Economy Program Manager, Stephanie Phillips; and Director of the Building Deconstruction Institute, Dave Bennink. Interviews were conducted by the author in the Spring of 2023 over videoconference and ranged from 30 to 90 minutes in length. Each interviewee agreed to being recorded and quoted directly exclusively for the purpose of this paper. Additionally, each participant was provided a draft of this paper for review before it was finalized.

Following the city-specific analyses, a discussion section attempts to summarize the findings and provide guidance for future deconstruction policy. The discussion section utilizes

both analogue and artificial intelligence-supported methods of content analysis to compare each city's approach to deconstruction. Also included is the introduction of an initial framework intended to provide a hierarchy of building practices and discussion of where deconstruction fits into a broader conversation around sustainability in the built environment.

It is also important to note that this author has engaged in a form of 'participant observation' through regular participation in the Cornell Just Places Lab under Professor Dr. Jennifer Minner and the Ithaca-based Circularity, Reuse and Zero Waste Development (CROWD) network, a deconstruction advocacy group. In conjunction with these groups, this author has contributed to deconstruction advocacy in New York State through contributions to policy guides, participation in conferences, and creation of resources related to deconstruction.

ANALYSIS

As of writing, there are four US cities with policy in place one could reasonably consider to be a deconstruction ordinance. There are several other American municipalities that employ other policy approaches to support deconstruction (Pittsburgh, Pennsylvania; Hennepin County, Minnesota; Nashville, Tennessee), many more that require minimum rates of C&D materials to be diverted from landfill, typically through recycling (Madison, Wisconsin; Cook County, Illinois; San Francisco, California among them) and more still that are known to be actively working on a deconstruction ordinance of their own (Ithaca, New York; Baltimore, Maryland; Seattle, Washington). Additionally, Vancouver, British Columbia enacted a deconstruction ordinance in 2018, and several other BC municipalities (Port Moody, Surrey, Burnaby, Victoria) have implemented ‘green demolition bylaws’ that require large monetary deposits and lofty diversion goals to compel developers to reconsider how they remove buildings (Lanthier, 2023). However, for the purpose of this analysis, focus is narrowed to the four deconstruction ordinances currently in place within the United States.

City Overview

The four US cities that have passed a deconstruction ordinance are Portland, Oregon (2016), Milwaukee, Wisconsin (2017), Palo Alto, California (2019), and San Antonio, Texas (2022). These four cities form a somewhat odd deconstruction cohort, Portland and Palo Alto are perhaps usual suspects, but the shrinking rust-belt city of Milwaukee and sprawling central-Texas city of San Antonio may come as a surprise. As shown in Figure 4, The four cities are widely spread geographically across the Great Lakes, Sun Belt and West Coast.

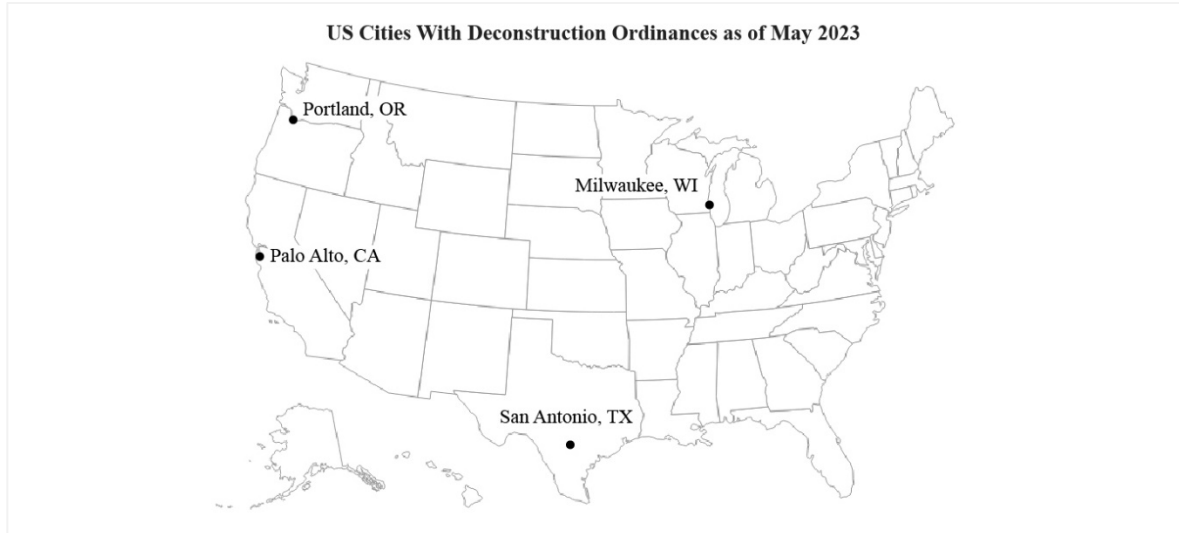


Figure 4: Geographical distribution of the four US cities with deconstruction ordinances.

Demographically, the cities are also quite varied, Table 1 demonstrates this variation. By population, Portland and Milwaukee are both mid-sized US cities, while San Antonio is the seventh largest city in the US, and Palo Alto, with 68,624 people, is comparatively exceedingly small, though located in densely populated Silicon Valley. Palo Alto, Portland and San Antonio have grown considerably between 2010 and 2020, likely contributing to pressures on the local housing stock and changes to the built environment. This is perhaps most pronounced in San Antonio, as between 2020 and 2021, no American city added more people (US Census Bureau, 2022). Conversely, Milwaukee lost approximately 3% of its population between 2010 and 2020, likely contributing to the city’s growing stock of vacant structures.

| | Milwaukee, Wisconsin | Palo Alto, California | Portland, Oregon | San Antonio, Texas |
|---------------------------------|----------------------|-----------------------|------------------|--------------------|
| Total Population (2020) | 578,198 | 68,624 | 647,176 | 1,434,540 |
| % Change 2010 to 2020 | -2.96% | +6.47% | +11.77% | +8.08% |
| Median Household Income | \$45,318 | \$194,782 | \$78,476 | \$55,084 |
| % of US Median Household Income | 65.7% | 282.2% | 113.7% | 79.8% |

Table 1: Population and household income figures for the four US cities with deconstruction ordinances. Source: American Community Survey 2021 (5-Year Estimates)

When looking at income, further variations arise. Milwaukee and San Antonio each have median household incomes (MHI) well below the national figure of \$69,021 (US Census Bureau, 2021). Portland is comparatively affluent with a median MHI of \$78,476 and Palo Alto is among the wealthiest cities in the US with a staggering median MHI of \$194,782, more the 280% of the national MHI. Unsurprisingly, city MHI has a direct correlation with home values (Figure 5). The relatively low-income cities of San Antonio and Milwaukee have home values clustered below \$300,000, while Portland home values cluster between \$300,000-750,000. In Palo Alto, however, more than 75% of homes are valued over \$2M, with median home prices reaching \$3.2M in 2022 (Zillow, 2023).

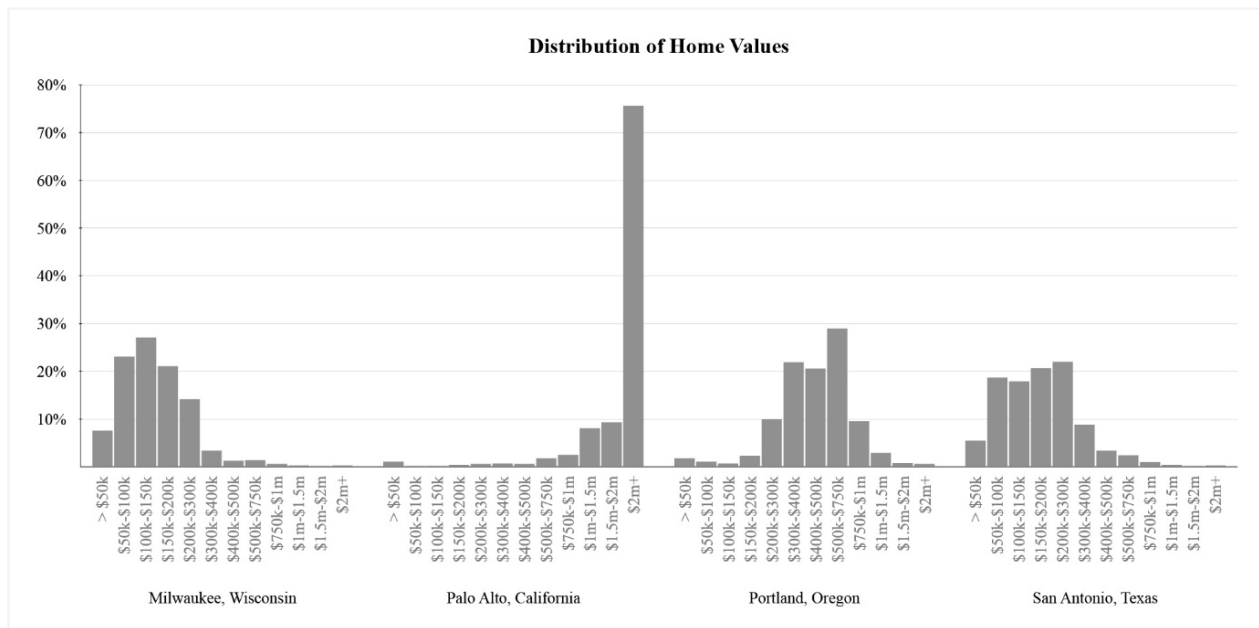


Figure 5: Distribution of home values in the four US cities with deconstruction ordinances. Source: American Community Survey 2021 (5-Year Estimates)

Development patterns contribute greatly to housing typology, thus the type of buildings that will eventually be removed in each place. In terms of municipal footprint, Milwaukee, Portland, and Palo Alto each have constraints on their expansion; Milwaukee the “Iron Ring” of suburbs (Miller, 2016), Portland an urban growth boundary (Oregon Metro, 2020), and Palo Alto by nature of its location in the heavily developed Silicon Valley. San Antonio, on the other hand,

is still today actively exploring growth through annexation, growing by 77 square miles between 2000 and 2013 (City of San Antonio, 2016).

| | Milwaukee, Wisconsin | Palo Alto, California | Portland, Oregon | San Antonio, Texas |
|--------------------------------------|-------------------------|--------------------------|---------------------|-----------------------|
| Housing Units: | 257,267 | 28,560 | 296,479 | 585,402 |
| 1, Detached | 39.4% | 56.7% | 54.1% | 60.1% |
| 1, Attached | 4.4% | 5.3% | 4.6% | 2.5% |
| 2 | 22.2% | 1.0% | 3.6% | 2.1% |
| 3 or 4 | 7.4% | 5.1% | 5.1% | 5.5% |
| 5 to 9 | 5.9% | 7.2% | 4.5% | 8.0% |
| 10 to 19 | 4.1% | 6.2% | 5.4% | 8.7% |
| 20 to 49 | 6.6% | 6.9% | 6.9% | 5.0% |
| 50 or More | 9.6% | 11.3% | 14.4% | 6.7% |
| Population Density (Per Sq. Mile) | 6,011.4 | 2,853.3 | 4,849.3 | 2,878.0 |
| Area (Square Miles) | 96.2 | 24.1 | 133.5 | 498.4 |

Table 2: Housing typology, population density and city area of the four US cities with deconstruction ordinances. Source: American Community Survey 2021 (5-Year Estimates)

The sprawling nature of San Antonio encourages single-family development, which accounts for more than 60% of the city’s housing stock, as demonstrated in Table 2. Despite having firm growth boundaries, the majority of both Palo Alto and Portland’s housing units are also single-family, detached homes. Each of the four cities has relatively few large-scale apartment buildings, with such structures comprising less than 15% of all units in each municipality. Milwaukee’s comparatively substantial number of duplex units (22.2% of city units) is by far the largest proportion of duplexes in the US (Diekemper, 2022). Milwaukee’s preponderance of duplexes is a result of the city’s rapid pre-war industrial growth, as immigrants sought out affordable housing that allowed homeowners to earn income from renters or accommodate extended families (Hubka and Kenny, 2000). This growth, primarily between 1890 and 1930, spurred on an accelerated home building period that still accounts for more than 35% of all structures still standing in Milwaukee, shown in Figure 6. While Milwaukee has the largest proportion of pre-1939 structures, Portland, with 27.7%, also has a large share of structures at least

this old. Palo Alto’s largest building boom occurred between 1950 and 1959, during which ‘ready money,’ made available through G.I. housing and education loans flooded into the formerly sleepy town, turning former agricultural land into twisting suburbs of single-family homes (Sussman, 1994). Twenty-seven percent of the Palo Alto’s current housing stock was constructed in the 1950s, before ‘residentialists’ organized to slow development and introduce restrictive building policies that continue to plague the city (Sussman, 1994). Consistent with the development of the rest of the Sun Belt, San Antonio has a comparatively new building stock, with less than 11% having been built before 1950, which may limit the effectiveness of a deconstruction ordinance with a year-built applicability clause.

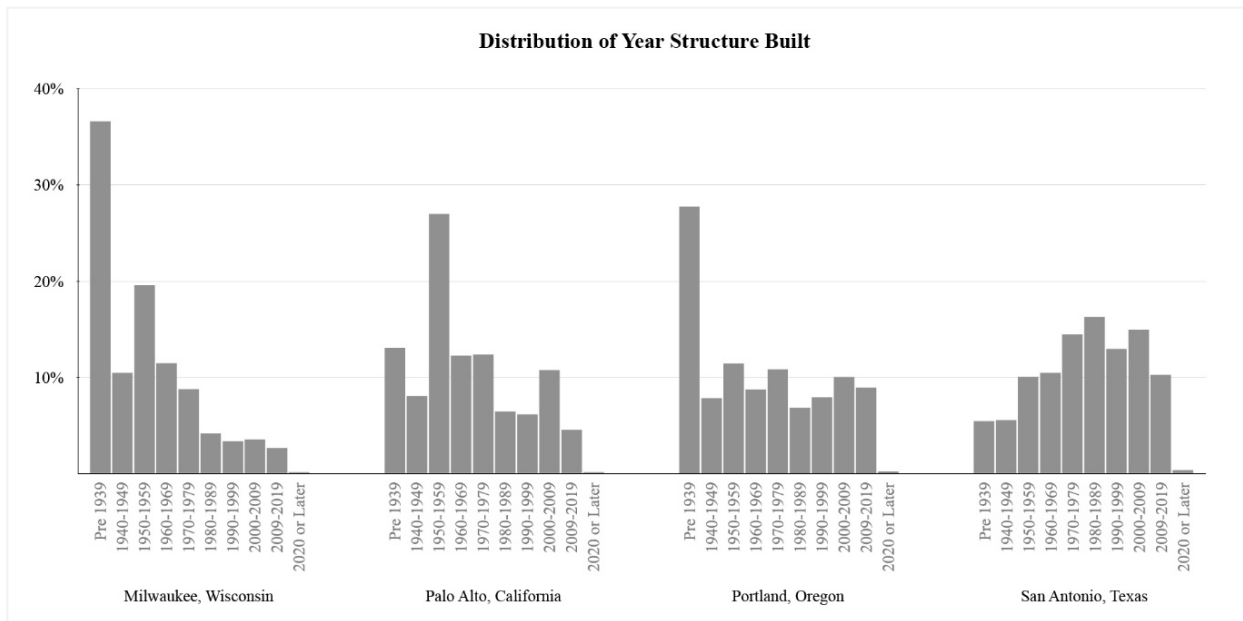


Figure 6: Distribution of year structure built by decade for the four US cities with deconstruction ordinances. The ‘year structure built’ figure only includes data for housing units, not commercial buildings. Source: American Community Survey 2021 (5-Year Estimates)

| | Milwaukee, Wisconsin | Palo Alto, California | Portland, Oregon | San Antonio, Texas |
|-----------------------------|----------------------|-----------------------|------------------|--------------------|
| Median Year Structure Built | 1952 | 1962 | 1964 | 1983 |

Table 3: Median year structure built for each of the four US cities with deconstruction ordinances. Source: American Community Survey 2021 (5-Year Estimates)

Overview of Deconstruction Ordinances

Table 4 below provides a snapshot of the four US deconstruction ordinances. Three of the four ordinances include a year-built applicability clause that narrows the scope of the ordinance to the oldest buildings in the jurisdiction, while Palo Alto does not limit applicability based on structure age. Portland, Milwaukee, and San Antonio also apply the deconstruction ordinance only to residential structures, whereas Palo Alto’s ordinance covers both residential and commercial structures. All four cities apply deconstruction only to full building removals and do not apply such requirements to partial removals or renovations. Of note, each municipality houses their deconstruction initiative within a different department. Portland’s deconstruction program is overseen by the Bureau of Planning and Sustainability; Milwaukee, the Department of Neighborhood Services; Palo Alto, the Zero Waste arm of the Public Works Department; and San Antonio, the Office of Historic Preservation.

| Municipality | Department Housed In | Year Enacted | Applicability Overview |
|-----------------------|---------------------------------------|---------------|---|
| Portland, Oregon | Bureau of Planning and Sustainability | Phase 1: 2016 | Phase 1: Full removal of all single-dwelling structures (houses and duplexes) built in 1916 or earlier, designated historic resources. |
| | | Phase 2: 2020 | Phase 2: Full removal of all single-dwelling structures (houses and duplexes) built in 1940 or earlier, designated historic resources. |
| Milwaukee, Wisconsin | Department of Neighborhood Services | 2017 | Full removal of all primary dwelling structures built in 1929 or earlier, designated historic structures, and structures in historic districts. (Currently stayed) |
| Palo Alto, California | Public Works Department (Zero Waste) | 2020 | All full removals of residential and commercial structures. |
| San Antonio, Texas | Office of Historic Preservation | Phase 1: 2022 | Phase 1: All city-executed full removals of residential structures with four (4) units or less built in 1920 or earlier, designated historic resources built 1945 or earlier. |
| | | Phase 2: 2023 | Phase 2: All full removals of residential structures with four (4) units or less built in 1920 or earlier, designated historic resources built 1945 or earlier. |
| | | Phase 3: 2025 | Phase 3: All full removals of residential structures with eight (8) units or less built in 1945 or earlier, designated historic resources built 1960 or earlier. |

Table 4: Policy overview of the four US deconstruction ordinances.

City Analyses

The following city-specific analyses uncover origins, intents, successes, challenges, and potential for revision or expansion of the four deconstruction ordinances within the United States. These analyses are informed by publicly available information published by the municipalities, local journalism, and individual interviews with key contributors to each city's ordinance. The analyses will begin with the first deconstruction ordinance (Portland) and introduce the others in chronological order to properly situate them in relation to one another.

Portland, Oregon's Deconstruction Ordinance

After the 2008 financial crisis, Portland's growing appeal began placing considerable development pressures on the city's real estate market. From 2000 to 2020, Portland's population grew by 120,000 (US Census Bureau, 2023), accelerating the building cycle and leading to an explosion of residential demolitions. Many viable homes were being demolished and replaced by new construction several times larger and more expensive. In response, motivated by "...the rapid loss of unique affordable housing citywide as well as the new construction that took its place" (United Neighborhoods for Reform, 2014) Portland residents organized to form the United Neighborhoods for Reform (UNR). In the fall of 2014, UNR produced a "Demolition/Development Resolution" that urged City policymakers to stem the growth of demolitions and explore the formalization of deconstruction in Portland (United Neighborhoods for Reform, 2014). Facing mounting public pressure, City officials obliged and placed former City of Portland Construction Waste Expert (now an Embodied Carbon Advisor for the EPA) Shawn Wood, in charge of an effort to study demolition in Portland. Wood was interviewed for this paper, all below quotes can be attributed to him.

In April 2015, The City of Portland's Bureau of Planning and Sustainability (BPS) convened a Deconstruction Advisory Group (DAG), composed of community advocates, planners, architects, historic preservationists, developers, contractors, and other professions to discuss

policies related to deconstruction as an alternative to conventional demolition (Paruszkiewicz et al., 2016). Though there was a nascent deconstruction ecosystem already operating locally, the Portland DAG evaluated local contractor capability, market capacity, building stock inventory, and the economics of deconstruction to evaluate the potential of requiring deconstruction.

Hoping to slow the removal of buildings, change in neighborhood character, and the spread of toxic dust, UNR advocated for the compulsory deconstruction of *all* buildings. At the time, around 350 buildings were being demolished annually, and concern arose that the local deconstruction ecosystem would be unable to deconstruct, process and sell the materials of so many structures. To address these concerns, BPS explored ways to slowly introduce progressively more deconstruction projects into the ecosystem. BPS explored requiring deconstruction only for buildings constructed with certain materials or for projects located in particular neighborhoods, but each posed their own issues. Eventually, BPS decided that a year-built threshold would function as the best method to slowly introduce deconstruction. According to Wood, the idea of using building age as a threshold originated from a ‘green demolition’ bylaw passed in Vancouver, British Columbia which required higher C&D diversion rates depending on the age of the structure being removed (City of Vancouver, n.d.). Wood felt that the building age threshold is an effective “gas pedal” because older buildings are thought to contain more valuable materials and are typically easier to deconstruct than newer constructed buildings:

When it comes to houses, age matters in terms of both the value of the materials, and how easy it is to actually deconstruct the building. Our older houses have old-growth lumber that is a lot more valuable. If you go to the other end of the spectrum, modern houses have second, third growth, lumber. It does not have a whole lot of value, and you have the introduction of adhesives that make it physically challenging to separate materials.

Though there was some protest, DAG members agreed that a year-built threshold was an agreeable approach. Uncertainty arose again when deciding on which year would serve as the threshold. Wood conducted an evaluation of demolition permits and gauged contractor preparedness and market capacity and recommended the year 1917 to serve as the threshold. 1917

was selected because it would apply only to buildings more than 100 years old, which represented a bold, but reasonable proportion of expected removals.

... [looking at] our permit data, in 2013, 2012, 2011, [buildings] 1916 and older are very consistently represented as one-third of house demolition permits in Portland. So even though we were seeing an increase in overall number of demolitions, percentage wise, [1916] was always a third...So not [requiring deconstruction] for everything, and not for just this token amount...it would be aggressive but reasonable if we did it for one third.

The year-built threshold resonated with historic preservation advocates concerned with the diminishing stock of heritage buildings and materials. Further, specific protections were included in DAG's recommendations to protect historic resources from mechanical demolition.

"We also had [the clause] 'or historic,' which was a 'bone' for historic preservationists. It does not matter how old it is, if it is historic, and you get permission to take it down, you have to deconstruct, so [preservationists] liked that."

DAG's recommendations were eventually submitted to the City, and on July 6, 2016, Portland City Council adopted the first North American ordinance, including code language, which requires certain projects seeking a demolition permit to be fully deconstructed as opposed to mechanically demolished (City of Portland, n.d.). DNS, the neighborhood group that initiated the movement toward deconstruction, agreed to the year-built applicability clause, but with one condition: the ordinance would eventually have to apply to more buildings. Perhaps the most clever aspect of the year-built threshold is its flexibility. As Portland's deconstruction program matured, so did the corresponding ecosystem, eventually to the extent that in 2019, City Council passed an amendment to extend the year-built threshold from 1917 to 1940. The amendment expanded the ordinance considerably, from applying to one-third of removals to two-thirds with the stroke of a pen.

[It was] almost as simple as scratching out 1916, and putting in 1940...And so, the beauty of that year-built threshold is, you can mess around with that number. That is the gas pedal.

Portland's Ordinance Outcomes

The weight of enacting the first deconstruction ordinance in North America was not lost on Wood. A failed deconstruction ordinance in Portland may have preemptively undermined future efforts elsewhere.

If you are the first city in North America that is going to require deconstruction, you want to be as successful as possible.

Fortunately, Portland's deconstruction ordinance has largely accomplished what it intended to do. As of 2020, 67% of all full-building removals in Portland are mandated deconstructions, amounting to around 600 deconstructions since the ordinance was first passed. Through these 600 deconstructions, the City estimates that 6 million lbs. of lumber has been salvaged and a total benefit of 4,560 metric tons of carbon dioxide equivalent (CO₂eq) has been preserved (Wood, 2023). The number of certified deconstruction contractors has exploded from two in 2016 to 16 in 2023, and three new salvage retail stores have opened (City of Portland, 2023). The cost of deconstruction has decreased, and thanks to complementary policies (requiring hand-removal of painted materials and wetting demolition sites to suppress dust), the cost of mechanical demolition has increased, leading many property owners to deconstruct buildings that are not covered by the ordinance.

Though the local deconstruction ecosystem appears to be operating effectively, when asked about again amending the ordinance to apply to more structures, Wood was concerned that the market would be unable to absorb more construction materials as things stand.

If you require deconstruction, [for buildings] 1965 or older, you are just going to have more materials that are less valuable and harder to move. If those materials do not have a market, we could make people disassemble a house by hand, but if they cannot sell a material, it is eventually going to end up in a drop box and the same place that the [demolition debris] ended up.

Looking forward, if the City has hopes of further expanding the deconstruction ordinance, Wood feels that demand-side policy would be necessary to maintain equilibrium within the used material market.

There is only so much demand for [used materials] and there is only so much salvage retailers can do to try and increase demand. Portland could use a slight injection on the demand side. Policy-wise, you either incentivize or require a certain amount of salvage material in new construction. There just has to be a proportionate move on the demand side to support [expanding the ordinance] beyond houses built 1940.

Wood is also careful to note that amending the year-built “gas pedal” is one of several methods to expand deconstruction to more projects. For example, Portland’s ordinance only applies to full removals of single dwelling homes, and does not address accessory structures (garages, accessory dwelling units), commercial buildings or remodeling projects. Wood speculates that there may even be more waste produced in remodels than in full removals.

There are 300 house demolition permits a year. There are thousands of remodel permits a year. So, one could argue that there is more material available through remodels than demolitions. But...there is political and neighborhood support for deconstruction, nobody really cares about what happens inside somebody's house.

Portland’s leading example and Wood’s willingness to contribute time to other inquisitive municipalities has positioned the City as the American municipal leader in deconstruction. While with the City of Portland, Wood worked directly with numerous other cities which has clearly shaped the approach of many enacted and proposed ordinances in the US and Canada. The influence of Portland will be discussed further in this paper.

Milwaukee, Wisconsin's Deconstruction Ordinance

While Portland's deconstruction ordinance has become the standard, Milwaukee's experience serves as a cautionary tale that deconstruction ordinances are not one-size-fits-all. In contrast to Portland's growing population, Milwaukee has seen consistent population decline since reaching its peak in 1960. Today, Milwaukee's population is 22% smaller than it once was, which has resulted in a huge oversupply of vacant structures. As of 2018, there were 2,940 registered vacant houses in the City of Milwaukee (Causey, 2018), around 435 of which are owned by the City itself as a result of tax foreclosure (Redsten, 2021). Like many other shrinking Rust Belt cities, the City of Milwaukee has formalized the process of removing large numbers of vacant and 'blighted' structures in an effort to stabilize struggling neighborhoods (City of Milwaukee, 2009). From 2010 to 2017, the Milwaukee Department of Neighborhood Services (DNS) averaged 150 demolitions a year (Olen, 2019).

Milwaukee Alderman Robert Bauman, who sits on the City's Historic Preservation Commission, is a vocal skeptic of widespread vacant structure demolition and has instead proposed several alternatives, including for the City to rehabilitate vacant buildings to bolster the City's affordable housing stock (Jannene, 2021). Alderman Bauman was interviewed for this paper, all below quotes can be attributed to him. In 2017, encouraged by the recently passed ordinance in Portland, Alderman Bauman sought to moderate demolitions in the City by enacting a deconstruction ordinance in Milwaukee. Bauman hoped a deconstruction ordinance could create new entry-level construction jobs, create financial savings for the City by reducing C&D tipping fees, and promote environmental sustainability by reusing materials. In contrast to Portland, the City of Milwaukee owns most of the buildings slated for removal, and almost all are concentrated in a few divested neighborhoods on the North Side of the City.

...if you look at the breakdown of abandoned and foreclosed properties, or even the properties with raze orders, they are concentrated in three aldermanic districts: the Fifteenth, the Sixth, which is the 'famous' 53206 ZIP code...and the Seventh. They are overwhelmingly African American and they are overwhelmingly low-income.

When buildings are removed in these districts, the land is rarely redeveloped. The ‘famous’ ZIP code Alderman Bauman refers to, 53206, is already home to one third of the City’s 2,940 vacant lots (Causey, 2018). When a deconstruction ordinance was first introduced, Alders in these districts were skeptical of the idea for fear of additional barriers to removing neglected structures, which constitutes a very visible form of political action. As compared to the exceedingly efficient process of mechanical demolition, deconstruction presented a potential headache.

...the Alders from those districts were interested primarily in getting rid of ‘eyesores’ by whatever means necessary, and as quickly as possible. This, of course, made deconstruction a heavy lift for them, because it meant a slower process: It meant fooling around with RFPs, and trying to [generate] bids for this work, and trying to find a contract. And so, they were...highly skeptical.

After rounds of negotiation, Alderman Bauman eventually found the prospect of job-creation, especially trades jobs for people with barriers to employment, resonated with skeptical Alders, and he eventually developed significant political support. On November 7th, 2017, Milwaukee’s deconstruction ordinance passed the Common Council unanimously and went into effect January 1st, 2018 (City of Milwaukee, 2017).

Milwaukee’s deconstruction ordinance is a near carbon-copy of Portland’s. Except for a few tweaks of department names, dates, and other minor modifications, much of Milwaukee’s ordinance replicates Portland’s verbatim. This, of course, is not uncommon in policymaking, but it does further underscore the influence the City of Portland has had on municipal deconstruction. Milwaukee did make one change of interest to this paper; while Milwaukee did include a year-built applicability clause, they opted for a slightly more ambitious threshold of 1929. The year 1929 was selected to capture most City-executed removals, but also because a substantial proportion of the old-growth lumber in Milwaukee exists within buildings constructed before the Great Depression. In contrast to Portland, where a year-built threshold was utilized to moderate the volume of deconstruction projects, Milwaukee utilized the year-built threshold to moderate the type of materials diverted.

Post World War II, you suddenly had all these new materials: drywall, gypsum board, plywood. They even started changing the dimensions of structural lumber! You get into modern construction methods, modern materials, which we just didn't want to deal with, yet.

Aside from modest alterations, Milwaukee's closely followed Portland's approach to deconstruction except in a dramatically different real estate market.

Milwaukee's Ordinance Outcomes

Typically, when a home is removed in Portland, it is replaced by a larger, more expensive one. A slightly higher dollar cost for deconstruction is negligible compared to the cost of a large, newly constructed building or can easily be passed onto future occupants. The economics of deconstruction is feasible in Portland partially because of the inflated costs of real estate. By contrast, in Milwaukee, when a structure is removed, it is more than likely that it will be replaced with a vacant lot. Defraying added costs of deconstruction then relies on the ability to consistently sell reclaimed materials or to receive tax deductions through the donation of salvaged materials to a non-profit organization. But because the City, who executes most deconstructions, cannot receive the tax incentives from donations, the additional cost of deconstruction is difficult to offset.

After the ordinance went into effect on January 1, 2018, the City began to post RFPs for private contractors to deconstruct high priority City-owned structures. For several reasons, the bids the City received were hugely divergent and substantially higher than the cost to mechanically demolish the same structure.

The downside, of course, is the cost per unit was higher [using deconstruction] ...and how much higher is the subject of some debate, but therein lies part of the problem. We would get widely divergent estimates on our bids for deconstruction, sometimes double the cost, sometimes three times the cost of mechanical [demolition].

While deconstruction is typically more expensive than mechanical demolition, the bids received by the City of Milwaukee rendered deconstruction impracticable. There have been several reasons identified for the exorbitant bids, foremost amongst them are two City policies intended

to promote equity in City contracts. The Residents Preference Program (RPP) and Emerging Business Enterprise (EBE) program both aim to equitably award City contracts to support local businesses, entrepreneurs from underrepresented groups and people with barriers to employment (City of Milwaukee, n.d.). Several already-existing deconstruction contractors, including the longest-operating deconstruction contractor in the area do not qualify under RPP and EBE and are therefore unable to bid on City RFPs. To fill the gap, the City attempted to support new businesses, but has seen limited success.

...what we have gotten is a lot of 'start up ventures' who, at the end of the day, could not deliver. [They] basically just abandoned their projects, walked away, got their equipment foreclosed on, or got the lease on their backhoe terminated, that kind of stuff. So repeated examples of contracts being let, the contractor trying to perform, failing to perform, and ending up with a half-deconstructed building or a site with a pile of lumber and the contractor is long gone.

Additionally, new regulations to responsibly manage lead-based paint during building removals added complexity for contractors further inflated deconstruction bids. While well-intended, RPP, EBE, and lead-based paint regulations have created additional hurdles that have hamstrung the implementation of deconstruction in Milwaukee. Bids to deconstruct City-owned structures surged to \$45,000 to \$60,000 per house, while mechanical demolition of the same house remained steady at \$15,000 to \$20,000 (Olen, 2019). The astronomical deconstruction bids have proven prohibitive, and very few City-owned deconstructions have been executed since the ordinance went into effect. City Council has since stayed the ordinance on five occasions, including most recently on March 21st, 2023. When asked about the future of deconstruction in Milwaukee, Alderman Bauman was pessimistic, to say the least.

We would be lucky to keep it on the books, and to stave off efforts to abolish the ordinance.

Palo Alto, California's Deconstruction Ordinance

Of the four US cities with a deconstruction ordinance, Palo Alto has by far the smallest population as well as the wealthiest. In terms of development, Palo Alto is constrained by a fairly small municipal boundary, the housing stock is majority detached single family dwellings, and the City has been noted for its resistance to large-scale development (Dougherty, 2020). The combination of wealth and restricted development has made Palo Alto into one of the most expensive real estate markets in the country, with median home prices of \$3.2M in 2022 (Zillow, 2023).

Palo Alto's interest in deconstruction stems from the City's aggressive commitment to 'zero-waste,' by which the City intends to "...virtually eliminate waste" (Palo Alto, 2023). City of Palo Alto Environmental Program Manager, Maybo Auyeung was interviewed for this paper, all below quotes can be attributed to her. The City of Palo Alto first published a Zero Waste Plan in 2007 and aimed to achieve a goal of 90% diversion from landfills by 2021 (Palo Alto, 2018). An update to the original plan, published in 2018, followed the City Council's 2016 adoption of the Sustainability/Climate Action Plan (S/CAP) which set a goal of 95% material diversion and 80% greenhouse gas reduction by 2030 (Palo Alto, 2018). Though mandatory C&D recycling had already achieved a 72% diversion rate for demolitions, "...there [was] so much construction activity that the [other] 28% of construction materials being landfilled still accounted for 44% of the total waste landfilled by Palo Alto" (Palo Alto, 2018). Thus, deconstruction and source separation of C&D materials was identified as the City's highest priority with the potential to divert 3,330 tons of waste annually (Palo Alto, 2018). Shortly after Palo Alto's 2018 Zero Waste Plan was published, the City began working on a deconstruction ordinance. Perhaps unsurprisingly, Shawn Wood of Portland was involved from the beginning.

We reached out to other cities and looked at how they have been implementing their programs. One of the cities that we spoke with multiple times was Shawn Wood from Portland.

While the City consulted with Portland, Palo Alto's deconstruction ordinance is a notable outlier. Palo Alto is the only municipality in North America to effectively ban mechanical demolition. Palo Alto's deconstruction ordinance covers all full building removals regardless of use, material composition, or year built. It should be noted that this includes commercial buildings, not just primary dwelling structures as is the case in the three other cities. Except for accessory dwelling units (ADUs), detached garages and structurally unsound buildings, every building removed in Palo Alto must be deconstructed. Like Portland, when a structure in Palo Alto is removed, it is typically replaced by a larger, more expensive new construction building. Given the wealth of the homeownership population in the area, the additional cost incurred through deconstruction is negligible.

Palo Alto's decision to require deconstruction for all building removals stems from the zero-waste influence on the ordinance. While other municipalities discuss myriad benefits of deconstruction, Palo Alto's ordinance is focused on waste diversion. From a zero-waste perspective, the difference in 'quality' of materials carries little significance; an old-growth lumber ceiling joist and a contemporary, laminated ceiling joist consume the same volume in a landfill. In addition to achieving zero-waste goals, AuYeung and the City wanted to simplify the permitting process by applying the ordinance to all removals.

[As compared to Portland] we wanted to make more projects fall under the compliance group. We looked at the history of permits, and we estimate 100 residential projects a year and about 15 commercial projects. We think that we have enough staff capacity to support this many jobs...Another thing that I briefly mentioned earlier, we want to keep it consistent. We want to have one set of requirements for all projects that are covered.

Palo Alto's Ordinance Outcomes

Palo Alto's deconstruction ordinance was passed in August of 2019 with an effective date of July 1st, 2020. While the City prepared for the new administrative challenge, it could not have anticipated the onset of the Covid-19 pandemic. The pandemic disrupted business as usual in Palo Alto, resulting in the number of deconstruction projects dropping from an anticipated 115 to only

44 applications. However, the shortfall of projects worked in favor of the nascent deconstruction program, as the City only issued 18 permits and was allowed time to adjust the new program.

...turns out Covid happens, and we had a lot less than that estimated project numbers, but that gave us extra resources to really work with every single project.

This ramp up period proved especially valuable as building removals bounced back significantly the following year, The City's Development Center received 74 whole structure removal permit applications, issued 60 deconstruction permits, and 57 buildings were ultimately removed (City of Palo Alto, 2022). For the 57 structures that were removed, the City reported an overall diversion rate (reuse and recycling) of 92%, with 7% of that being salvaged for reuse and the remainder recycled (City of Palo Alto, 2022). From a diversion perspective, Palo Alto's approach appears to be the most effective of any of the four deconstruction ordinances, even still, Palo Alto has plans to expand the ordinance to cover more projects and divert more waste. Next on the City's priority list may be to include diversion standards for renovations, which are a considerable source of waste.

Palo Alto is a relatively 'well-off' city. When I was doing site visits...you see really, really good new appliances, kitchens. I think it has to do with the market, too. People tend to fix up the place to sell it, and then once the new owner comes in, they want to knock everything down. So, we want to make sure that these newer appliances, fixtures, and cabinets have a second chance.

The City of Palo Alto made a sizable financial commitment to their deconstruction program. Working exclusively with waste contract company, GreenWaste, Palo Alto invested \$243,000 upfront for infrastructure adjustment and will pay \$567,000 for each year GreenWaste operates the C&D diversion program (City of Palo Alto, 2019). This exclusive agreement includes a clause that "...all deconstruction and construction projects are required to utilize GreenWaste...for the collection of all materials if using containers at project sites" (City of Palo Alto, 2023). Palo Alto's deconstruction program also requires projects to perform a salvage survey

which can only be conducted by a third party approved by the City. Currently there is only one organization approved to conduct salvage surveys. Palo Alto has few contractors partly because the local reuse ecosystem is underdeveloped. Like Portland, the local reuse market is unable to absorb all materials resulting from deconstruction, but this issue is even more pronounced in Palo Alto, as little of the salvaged materials is recirculated locally. Instead, they are most often donated to two reuse centers on the other side of the San Francisco Bay.

The [salvaged] material usually goes to Oakland. So, still in the Bay Area. We don't have a reuse center in Palo Alto or in surrounding cities. Most things get delivered to 'The ReUse People,' or to 'Habitat For Humanity,' Those are the two big, more commonly seen reuse organizations that receive material from these projects.

While The ReUse People and Habitat For Humanity are two reputable organizations that can ensure reusable materials find new homes, for unwanted construction materials to be exported from the extremely wealthy Palo Alto to the comparatively impoverished Oakland, presents a potentially fraught dynamic. When asked about the potential of a reuse store in Palo Alto, AuYeung was doubtful.

I don't think we have the real estate for that. It is very expensive to have real estate in Palo Alto or surrounding areas.

Palo Alto's deconstruction program has demonstrated the potential for requiring deconstruction for all buildings and produced exceptional material diversion rates. Palo Alto's program has been successful, however, a dearth of local reuse compromises the shift toward a more circular economy, instead perpetuating something closer to a charitable giving model that transfers the material burden to another place. For Palo Alto's approach to be replicable, a local reuse marketplace must exist to close the loop.

San Antonio, Texas's Deconstruction Ordinance

In September of 2022, San Antonio, Texas became the largest city to pass a deconstruction ordinance. As of writing, San Antonio is also the most recent American municipality to pass a deconstruction ordinance. Movement toward a deconstruction ordinance began when several legacy neighborhoods began to experience accelerating rates of demolitions of naturally occurring affordable housing to make way for more expensive and intensive housing developments (e.g., a single-family home demolished for four luxury townhomes). Demolitions concentrated in low-income areas adjoining downtown, but especially in City Council Districts 1, 2, and 5, which disproportionately house residents that are low income, people of color, and linguistically diverse. City of San Antonio Deconstruction and Circular Economy Program Manager, Stephanie Phillips was interviewed for this paper, all below quotes can be attributed to her.

District 1 oversees downtown San Antonio, and a lot of its older residential districts, so a lot of the districts that are either historic districts or eligible historic districts, and those that have most of our naturally occurring affordable housing stock and older housing stock.

In 2017 and 2018, the area experienced a dramatic uptick in residential demolitions that spurred residents to organize for action. The City Council member for District 1 obliged and submitted a council consideration request to the Office of Historic Preservation (OHP) to explore the City's policies and operations related to demolition and explore alternatives.

Like Portland, San Antonio OHP began by convening a deconstruction advisory council (DAC) comprised of representatives of real estate, demolition and deconstruction, sustainability, housing, preservation, public health, architecture, and academia. Additionally, OHP commissioned a study of the local demolition trends and the potential of a deconstruction ordinance in San Antonio. 'Treasure in the Walls' is an extensive report completed by PlaceEconomics, a private firm that specializes in the economic impact of historic preservation (Rypkema et al., 2023). The document is a comprehensive review of deconstruction's potential implications on the material marketplace, economy, environment, workforce, and public health of

San Antonio. The report included an analysis of the areas that were being inundated with demolitions and found a series of inequitable development patterns.

We analyze[d] at least 10 years of demolition data dating back to 2009, and we...geographically mapped [demolitions] to show where they were concentrated in residential neighborhoods. [The concentrations] are basically the same as the 'red lining' map. We were able to find that demolitions are disproportionately occurring in places where there is legacy pollution. There are more public health issues, like a higher concentration of...illnesses that affect the respiratory system.

Phillips noted that in San Antonio, if a single-family residence was razed and replaced by another, the market property value of that parcel typically increases approximately 70-100%, with some values increasing more than 350%. Further, the City has found that approximately 60-70% of small-scale residential structures (fourplex or smaller) are demolished for a new income-producing development, while 20% are demolished for vacant lots.

Over the course of several years of advocacy, OHP's messaging de-emphasized more typical arguments for deconstruction, such as sustainability and waste prevention, and instead focused on workforce development, public health, and the retention of cultural and built heritage. Arguments related to public health, workforce development and material availability resonated especially in San Antonio because deconstruction was being explored while in the height of the Covid pandemic. Public health was the among most discussed topics in the country, unemployment reached historic highs, and supply-chain issues dramatically inflated construction materials costs; deconstruction offered a timely solution.

We were constantly emphasizing [different] benefits of deconstruction. So, not just focusing on the waste which can be really abstract to people right, but focusing on the ways that the policy would affect people directly.

OHP's approach led to the passage of a deconstruction ordinance in San Antonio. On September 8, 2022, San Antonio City Council adopted a deconstruction ordinance on a 10-1 vote. Councilmembers were passionately in favor of the ordinance, citing a wide range of benefits the deconstruction would usher in. The ordinance itself speaks to the myriad of proposed benefits of deconstruction including: public safety, health, and general welfare associated with building

removal, the increase the availability of high-quality and reclaimed building materials for local reuse, equity of access to building materials for use in affordable housing preservation and production, neighborhood continuity, retention of historic building materials in the communities from which they originated, development of a local workforce in construction, heritage trades, and deconstruction, and achieve citywide sustainability goals (City of San Antonio, 2022).

While San Antonio provided new avenues for messaging of the benefits of deconstruction, the actual substance of the ordinance follows Portland's example closely, except for a different approach to phasing. Rather than Portland's approach of requiring an amendment to expand the ordinance, San Antonio built three phases into the original ordinance. Phase 1 began with first requiring City-executed deconstructions for residential structures with four units or less constructed before 1921 and residential historic resources built before 1946. Phase 2 expanded the same criteria to all projects, and Phase 3, which goes into effect in 2025, updates the year-built threshold to 1946 for all structures and 1961 for historic resources. The specific year-built thresholds were informed by a similar process of combining deconstruction data with expert knowledge as seen in Portland and Milwaukee.

Because we are historic preservationists, age-date is always a big part of our work. The 1945 date came from Council feedback. One of our council members is an architect, and [suggested] after World War II when...construction methods dramatically shifted. 1920 has always been something that we've communicated from day one. It's just an easy cut-off date; something that is over 100 years old and something that our development community was supportive of. Phase 3 will expand into 1960, and that was also a very strategic date, [as] pre-1960 is how we define 'older housing stock' in the context of affordable housing in San Antonio.

Like Portland, San Antonio aimed to use the year-built threshold as a gas-pedal to regulate the number of deconstructions to allow contractors and the market to build capacity to match.

Similarly to Portland, we wanted to take bite-size pieces out of the residential demolitions and convert them into deconstructions. So, we wanted to make sure that we were not overwhelming our industry and our economy right away with hundreds of deconstructions. We determined before we adopted our ordinance that Phase 2 would cover maybe 28% of demolitions which seemed manageable. It wasn't quite at a third. It wasn't super low. Then comes Phase 3 in 2025, we're going to jump to [cover] 40% of residential demolition.

When asked about potentially expanding the ordinance to apply to commercial buildings, Phillips was hopeful but tentative.

We initially were considering including commercial [buildings] in our ordinance, but that was a ‘no-go’ for our development community. We also got a lot of feedback from our active deconstruction contractors, that there is a very real reality that commercial structures are more complicated to fully deconstruct. I think that there is potential for [expanding the ordinance], but it would basically kick off an entirely new policy initiative.

When asked about expanding the ordinance to include more recent construction, Phillips felt that to require deconstruction for more or even all buildings would require further study.

At this point we have not really talked about [covering newer construction]. I think we would have to see a workforce that can take apart those buildings because they are built differently, you are getting into glues, mastics, staples, and things that make it a little bit more cumbersome to take down. We need to see how that plays out with our workforce and the end-uses locally for that to happen, but never say never. My dream is to make demolition obsolete, but we might explore incentives before we explore regulations for that.

Phillips added that San Antonio may explore other policy mechanisms to slow building removal and instead promote more sustainable building practices.

...a trend that is happening nationwide and internationally is that we should stop tearing buildings down, period. So, in the next few years we might be exploring things that tie to how buildings come down...that may indirectly...shift that industry without it being tied into our deconstruction ordinance.

Perhaps the most novel aspect of San Antonio’s deconstruction program is the adaptive reuse of a portion of the former Kelly Air Force Base to create a deconstruction and trades hub. The ‘Material Innovation Center’ will host heritage trades workshops, operate a tool library, and offer storage space as well as a “last stop before the landfill” for unwanted materials from deconstruction projects. By teaching trades skills and offering an outlet for materials, the Material

Innovation Center represents an important closing of the loop for the deconstruction movement in San Antonio.

As of writing, the City’s deconstruction ordinance has only been in effect for five months, so there is little measurable data on the status of the program thus far, however Phillips shared that as of March 2023, there were 13 projects in various stages of the permitting queue, including two actively undergoing deconstruction.

| Ordinance Summary Table | | | | | |
|--------------------------------|--|---|---|--|--|
| | Ordinance Origins | Primary Reasons for Support | Outcomes | Merits | Lessons |
| Portland | Community advocacy to slow the rise of demolitions and neighborhood change. | Local political pressure, heritage materials, public health, waste. | Phase 1 applied Deconstruction to ~33% of demolitions, then Phase 2 scaled up to ~67%. Deconstruction costs have gone down, demolition Costs have gone up. | Successful first example of deconstruction ordinance, deconstructs the most buildings anywhere in US. Using policy to tip scale in favor of deconstruction even when not required. | Ideally suited for deconstruction to be successful, other municipalities may need different approaches. |
| Milwaukee | Alderman concerned with waste produced by vacant city-executed demolitions. | Job creation, heritage materials. | Unable to generate reasonable bids for city-executed projects. Stayed since passage. | Raises issues with mass building removals in shrinking cities. | Serves as an example of challenges for deconstruction in shrinking cities. |
| Palo Alto | Zero waste and sustainability goal to divert 95% of all materials from landfill. | Waste diversion. | Went into effect just before Covid, but now applying deconstruction to all full removals. | Demonstration that a municipality can require deconstruction for all buildings. | Directing unwanted goods to a lower-income area is potentially problematic. Local reuse is important for a transition to a circular economy. |
| San Antonio | Community advocacy to slow the rise of demolitions in low-income neighborhoods. | Local political pressure, public health, equity, heritage materials, waste. | Passed 10-1 with included expansion in 2025. Too soon for outcomes. | Most comprehensive approach, with City-support for material storage, use and training. | Focus on historic preservation may undermine potential to divert maximum materials from landfill. |

Table 5: Summary of origins and outcomes of each US deconstruction ordinance.

DISCUSSION

The Influence of Portland

As the first North American city with a deconstruction ordinance, it comes as little surprise that other cities would draw inspiration from Portland’s approach. Still, it is worth highlighting the influence Portland, and notably former City of Portland Construction Waste Expert, Shawn Wood, has had in the policy choices of other cities that have followed with ordinances of their own. When specifically looking at applicability, two of the three other American cities utilize Portland’s year-built approach, although with different years serving as the threshold. Further, the two proposed deconstruction ordinances available to this author (Baltimore, Maryland and Ithaca, New York) also include provisions for a year-built applicability threshold.

Municipalities borrowing language and approaches from successful policy examples is common and carries potential advantages, such as a use of a common vocabulary, consistency of rules and potential for comparison. Still, as this research aims to shed light on the emergence of municipal deconstruction ordinances, it is useful to illustrate just how much other cities have borrowed from Portland’s example. Anecdotally, Shawn Wood has had contact with each US municipality with an ordinance. But to visualize this influence, an artificial intelligence (AI) content detection platform, Copyleaks, was utilized to measure the similarity between the language used in Portland’s ordinance and the ordinances that followed (Figure 7).

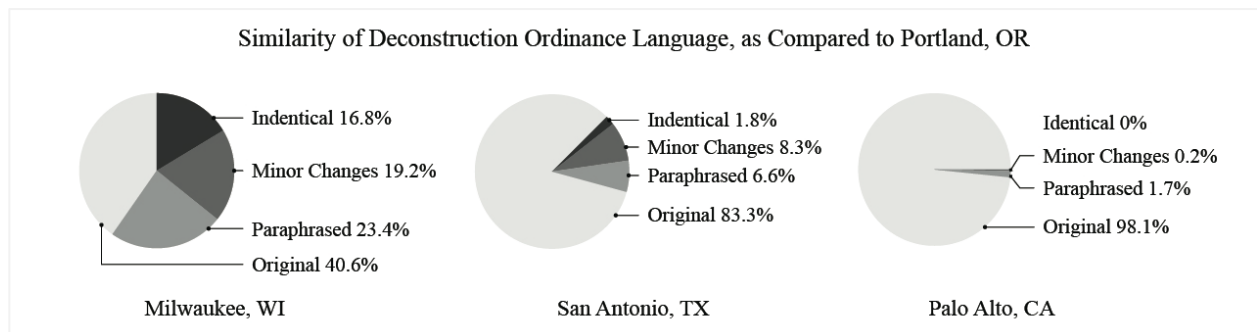


Figure 7: Language similarity of Milwaukee, San Antonio, and Palo Alto’s deconstruction ordinances as compared to the first US ordinance passed in Portland. Copyleaks AI content detection was used for the analysis.

Of the three ordinances passed since Portland’s, Milwaukee borrowed most heavily, with nearly 60% of ordinance language being pulled from the Portland deconstruction ordinance, including 16.8% verbatim. Evidence of San Antonio borrowing language is present as well, through to a different degree than Milwaukee, and Palo Alto’s unique approach is demonstrated again to be a clear outlier with 98.1% original content.

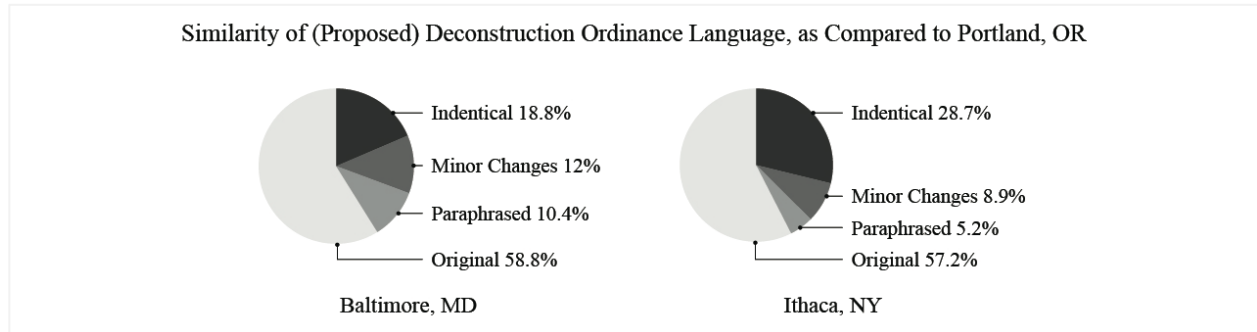


Figure 8: Language similarity of Baltimore and Ithaca’s proposed deconstruction ordinances as compared to the first US ordinance passed in Portland. Copyleaks AI content detection was used for the analysis.

The two draft deconstruction ordinances readily available to this author also demonstrate substantial influence from Portland’s approach. An online version of a deconstruction ordinance proposed in Baltimore, known as ‘REcovering Baltimore’s Underutilized Inventory of Lots and Dwellings’ (REBUILD) Act borrows roughly 40% of its language from Portland’s Ordinance, and a model deconstruction ordinance published by the Circularity Reuse and Zero Waste Development (CROWD) network in Ithaca, New York borrows more language directly from Portland than any other text surveyed. It should be noted that this author contributed to the CROWD document.

By all accounts, Portland’s deconstruction program has been a success. It is important to note, however, that Portland was uniquely positioned for deconstruction to be successful. The city is famously progressive, was experiencing high real estate pressures, and already had several established deconstruction contractors and used building material retailers in place. Additionally, the deconstruction ordinance in Portland arose from community action which gave it built-in public support. Conversely, Milwaukee has low real estate pressures, few deconstruction

contractors, and generally less action around sustainability issues. The result of Milwaukee attempting to implement Portland’s approach to deconstruction directly was a failed program. Other municipalities considering deconstruction should take heed from the case of Milwaukee, and understand that deconstruction cannot be a one-size-fits-all approach.

Overemphasis of Heritage in Deconstruction

In 2014, Portland-based United Neighborhoods for Reform (UNR) posted its first document, a ‘Demolition/Development Resolution,’ that eventually led to the City of Portland passing the first deconstruction ordinance in North America. UNR’s resolution explicitly outlined Portland residents’ concern for the “preservation of...historical heritage and character” (UNR, 2014). Shawn Wood, who orchestrated Portland’s ordinance, alluded to the influence historic preservation advocates had through the policy-making process, which included a provision for mandatory deconstruction of designated historic resources, and the emphasis on heritage materials in the ‘purpose’ section of the ordinance (City of Portland, 2016). This thread of historic preservation and heritage materials has been carried through to other cities and is presented as a benefit of deconstruction in both Milwaukee, where the primary author, Alderman Robert Bauman is a self-described “longtime historic preservation advocate” (Bauman, n.d.) and San Antonio, where the deconstruction program housed within the City’s Office of Historic Preservation.

Of course, if deconstruction can further the aims of historic preservation through the recirculation of heritage materials, this author is supportive. However, the widely held presupposition that heritage materials are vastly more precious, and thus more important to divert than contemporary materials is ultimately harmful to the broader goals of deconstruction. Beyond the reclamation of heritage materials, the broader goals of deconstruction include protecting communities and the environment from toxic dust, salvaging materials—of all types—to be recirculated thus preserving their embodied carbon, maximizing diversion of material from landfill, and creating pathways to trades jobs. Narrowing deconstruction to only the oldest

buildings may undermine the full potential of these goals. As mentioned above, even if Portland’s deconstruction ordinance was implemented in every US jurisdiction, 87.7% of American buildings would not be protected from demolition. Further, year-built applicability thresholds incidentally perpetuate a false binary that some buildings and materials are valuable, and others worthless.

Evaluating the content of each city’s deconstruction ordinance, all four cities agree that the prevention of waste, protection of public health, reuse of materials, and preservation of embodied carbon are benefits of deconstruction (Table 6). However, as the only city to require deconstruction for residential *and* commercial buildings regardless of age, Palo Alto’s deconstruction ordinance makes no mention of heritage materials or historic preservation. Instead, Palo Alto’s ordinance is focused on the four proposed benefits upon which each city agrees. By employing a zero-waste perspective, Palo Alto’s approach is likely more effective in diverting C&D waste, curbing fugitive dust, and salvaging materials—both new and contemporary—for reuse.

| | Waste | Public Health | Material Reuse | Embodied Carbon | Jobs | Heritage Materials | Historic Preservation | Affordable Materials | Affordable Housing | Taxpayer Savings |
|--------------------|-------|---------------|----------------|-----------------|------|--------------------|-----------------------|----------------------|--------------------|------------------|
| Portland (2016) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| Milwaukee (2017) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| Palo Alto (2019) | ✓ | ✓ | ✓ | ✓ | | | | | | |
| San Antonio (2022) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |

Table 6: Content analysis of the four US deconstruction ordinances. A box is marked if the term was used at least once in the city’s ordinance.

Deconstruction For All

In the opinion of this author, the explicit goal of the deconstruction movement should be to effectively put an end to mechanical demolition. If deconstruction is reserved only for the buildings deemed to be ‘worth it,’ the potential of deconstruction is diluted. Virtually every building, regardless of age, contains materials suitable for reuse and certainly materials suitable for recycling. The year-built applicability threshold is a clever policy mechanism that enables cities

to slowly ‘open the tap’ on deconstruction without overwhelming nascent ecosystems. But if utilized, year-built thresholds should be viewed as the first step in a longer arc toward replacing all demolition with deconstruction.

Portland and San Antonio selected their year-built thresholds by evaluating the characteristics of buildings being removed and the capacity of the local deconstruction ecosystem (both for-profit and non-profit entities). As shown in Table 7, currently, Portland’s ordinance covers roughly 70% of residential full-building removals and San Antonio expects to cover roughly 30% (Rypkema et al., 2021). As deconstruction ecosystems mature, it is crucial to continue to evaluate the long-term projections of building removals by evaluating the entirety of the building stock, not just the buildings that have been removed in the past. Looking at each city’s entire building stock, only 27.5% of Portland’s buildings would be covered under the deconstruction ordinance, while only 5.2% of San Antonio’s buildings would require deconstruction.

| | Milwaukee, Wisconsin | Palo Alto, California | Portland, Oregon | San Antonio, Texas |
|--|----------------------|-----------------------|------------------|--------------------|
| Median Structure Built Date | 1952 | 1962 | 1964 | 1983 |
| Current Year-Built Threshold | 1929 | N/A | 1940 | 1920 |
| Estimated Annual Full Building Removals | 107 (city-executed) | 114 | 367 | 475 |
| Full Building Removals Covered Under Original Ordinance | No Data | 114 (100%) | 128 (34.9%) | 54 (11.4%) |
| Phase 2 Coverage | -- | -- | 256 (69.7%) | 144 (30.3%) |
| Phase 3 Coverage | -- | -- | -- | 161 (33.9%) |
| Full Removals Not Covered by Current Ordinance | -- | 0% | 30.2% | 69.7% |
| Total City Building Stock Not Covered by Current Ordinance | > 63.6% | 0% | 72.5% | > 94.8% |

Table 7: Ordinance coverage for each of the four US deconstruction ordinances. Source: Municipal ordinances and American Community Survey 2021 (5-Year Estimates)

Deconstruction expert and Director of the Building Deconstruction Institute, Dave Bennink has deconstructed over five thousand projects and was interviewed for this research. According to Bennink, contrary to some prevailing beliefs, not only are newer buildings typically viable candidates for deconstruction, but they may also come with some advantages as compared to older buildings. Bennink has found that, due to federal bans, homes constructed after 1970 are much less likely to contain toxic materials, such as asbestos and lead paint, which poses challenges for deconstruction, disposal, and reuse. Additionally, newer homes are more likely to have salvageable appliances, heating and cooling systems, and fixtures. Further, heritage cabinetry construction is integrated directly into the walls of a structure, making it difficult to reuse, but contemporary cabinetry is typically built as boxes that can be removed and easily reused elsewhere. Bennink has also introduced novel methods to salvage whole sections of wood-framed walls for reuse in whole form in new sheds, garages, or potentially new homes. This method preserves the embodied carbon, materials and value of the wall as opposed to stripping it to its less valuable component materials. Bennink refers to this process as “panelization,” and the method lies somewhere between deconstruction and whole building relocation. According to Bennick, walls with modern 2x4” framing and drywall construction lend themselves better to panelization than do old-growth lumber framing and lath, which is comparatively much heavier. While contemporary construction homes do pose different challenges to deconstruction than do heritage construction homes, they still contain an immense amount of embodied carbon as well as reusable and recyclable materials that should be considered with similar care. Bennink’s panelization approach is just one innovative solution to the different challenges of deconstruction posed by contemporary construction methods, suggesting that an assets-based approach would further uncover viability of requiring deconstruction for newer buildings.

Like more recently built residential buildings, commercial structures are often considered poor candidates for deconstruction due to their perceived low material value. As with newer residential structures, Palo Alto is the only municipality in the US to require deconstruction for these structures. Though commercial buildings account only for roughly 5% of all structures in the

US (Potter, 2020), their large scale and material composition still make them important candidates for deconstruction. Commercial buildings are typically constructed of concrete and steel, two of the most carbon intensive building materials (Sizirici et al., 2021), thus commercial buildings contain an immense amount of embodied carbon. Currently, even when commercial buildings are deconstructed, concrete and steel is typically recycled rather than reused. While steel can be recast into new steel products, concrete is usually downcycled into aggregates for roads or fill, failing to lower demand for new concrete production. Several efforts have explored the reuse of concrete sections for new construction (Gorgolewski, 2008; K pfer and Fivet, 2021), demonstrating the potential to preserve one of the largest sources of carbon emissions in the building sector (Br tting et al., 2019). For both residential and commercial buildings, concrete is the largest material stream by tonnage (US EPA, 2018), with much of it coming from the building foundation. Retaining a building’s foundation in place for new construction may be an additional method to retain the store of embodied carbon (Hertlein and Walton, 2000; Laefer and Farrell, 2015). Again, these emerging strategies demonstrate the potential for disassembly of structures typically considered unsuitable for deconstruction.

Additional building projects to be considered by deconstruction advocates include partial building removals and interior renovations. Though full building removal generates more attention and public resistance, partial building removal and renovations account for a sizeable proportion of C&D waste (Cheng and Ma, 2013). Both Shawn Wood, formerly with the City of Portland, and Maybo Auyeung of the City of Palo Alto intimated that their deconstruction ordinances may soon expand to these categories. Interior renovations yield copious quantities of materials, such as appliances and cabinetry that are especially suited for reuse. Given changes in interior design preference, interior renovations will continue to represent another waste stream that could be addressed through deconstruction and salvage policy.

Deconstruction, In Context

When imagining a sustainable built environment, deconstruction should be considered a last resort. For all its benefits, deconstruction, salvage, and reuse is only a step toward a more sustainable built environment, and not a silver bullet. Building removal through deconstruction still produces an immense amount of waste and materials diverted from landfill through recycling are almost exclusively downcycled, which does little to slow material extraction. We must reconceptualize buildings as uniquely precious compositions of materials that will always be more valuable than the sum of their parts.

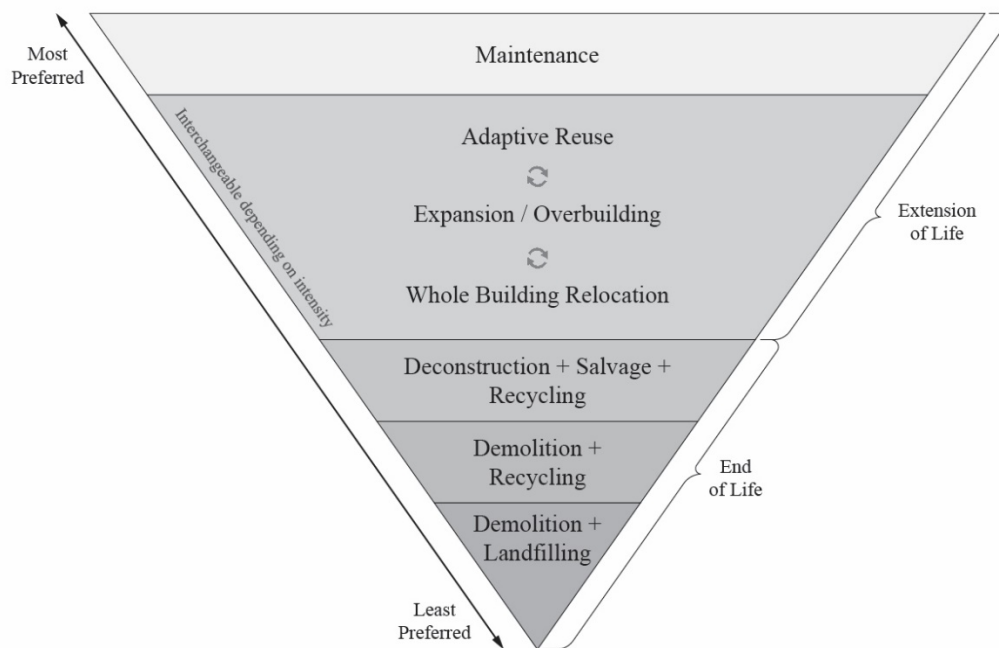


Figure 9: Waste hierarchy for treatment of buildings. Developed in collaboration with Dr. Jennifer Minner and the Cornell Just Places Lab.

Along with Dr. Jennifer Minner and the Cornell Just Places Lab, a hierarchy for building treatments was created to properly situate deconstruction in relation to other building practices. This hierarchy draws from other zero waste hierarchies and frameworks developed by Crowther

(2001). The hierarchy can be understood as the most preferable (thus ideally most common) practice on the top and the least preferable (ideally least common) practice on the bottom.

Following this waste hierarchy for treatment of buildings, as many buildings as possible should be maintained as-in and in-situ for as long as possible. Maintenance of existing structures is the most effective, economical, and sustainable building practice available. Understanding that places, people, and needs changed, the next three treatments, adaptive reuse, expansion/overbuilding, and whole building relocation aim to extend the life of the building. Adaptive reuse and expansion/overbuilding maintain much of a building only adapting its size, use and form to host new and different activities, while structural relocation offers a relatively low-waste and low-carbon option that retains the compositional value of a building, only located in a new place. These three building treatments are shown to be interchangeable, as they can each take varying forms of intensity, which may alter their position in the hierarchy. Finally, and only after the first four treatments can be considered impossible, should one consider removal through disbanding the composition of materials. Deconstruction is an alternative to mechanical demolition, but not to maintenance, adaptive reuse, or relocation. Deconstruction can eke out some value by salvaging materials for reuse and employing tradespeople, but disbanding an assembled structure is still a net-negative action. Below deconstruction on the hierarchy is demolition + recycling and demolition + landfilling which each change assets into liabilities.

Deconstruction is a net-negative that should not be posited as a virtuous act to justify the unnecessary removal of structures, especially when replacing still-functional single-family homes with more expensive ones, which is often the case in Portland and Palo Alto. In addition to supporting deconstruction, municipalities interested in fostering more sustainable building

practices should consider actions to support actions to extend the lifespan of already existing buildings, such as affirmative maintenance, adaptive reuse, and structural relocation.

Deconstruction + Reuse

The goal of deconstruction should be to maximize the reuse of materials for their original purpose. By exchanging new materials for reused materials in construction, demand for material extraction is tempered, multiplying the benefits of reuse. The promise of deconstruction is highly dependent on a robust demand for reclaimed materials. Without an outlet, unwanted salvaged materials pose a burden and risk being downcycled or disposed of entirely. Reinvesting the wealth embodied in existing materials back into the communities from which they originated has enormous economic, environmental, cultural, and social potential (Build Reuse, n.d.). Reuse at a local scale should be prioritized to minimize transport costs, retain material wealth within communities, and retain vernacular materials and styles locally. Any municipality considering mandating deconstruction should consider integrating support for local reuse to close the material loop. This could come in the form of support for local reuse material marketplaces, requirement quotas or incentives for reused materials in new construction, permitting salvaged materials to serve structural functions, or creating a storage and innovation hub such as San Antonio's Materials Innovation Center.

Shrinking cities and Deconstruction

Deconstruction has been relatively uncontroversial in Portland, Palo Alto and San Antonio partially because removed structures are often replaced by significantly more expensive projects, meaning any additional cost incurred through deconstruction has a comparatively minimal impact on the new owners' bottom line. In shrinking cities, such as Milwaukee, Detroit, or Baltimore

where the city itself has become a large property owner through tax-foreclosure, the city must often foot the bill for deconstruction. As seen in the case of Milwaukee, added cost can unravel a deconstruction initiative. Shrinking cities must consider alternative approaches to deconstruction, as the market forces in Portland and Palo Alto will not hold true. Alternate approaches could include scaling back building removals, instead of prioritizing renovation of city-owned structures. For example, through an American Rescue Plan (ARPA) Grant, the City of Milwaukee has done exactly that, committing \$15 million to renovate and reoccupy a minimum of 150 vacant foreclosed City-owned houses with the aim of provide home-ownership opportunities for City residents (City of Milwaukee, 2022).

CONCLUSION

As local governments seek strategies to manage demolitions, meet sustainability goals, and protect public health, requiring the deconstruction of buildings has become an increasingly popular method. As opposed to mechanical demolition, deconstruction has been shown to produce less waste, create more jobs, preserve embodied carbon, and suppress the spread of harmful fugitive dust. While deconstruction is still less preferable than maintaining, renovating, or even relocating an existing structure, it is a much preferable alternative to mechanical demolition.

Four US cities have passed ordinances that require some buildings to be deconstructed, with several more in process. The first deconstruction ordinance was passed in Portland, Oregon in 2016 after residents protested a wave of demolitions that altered neighborhood character, produced substantial amounts of waste, and showered surrounding areas with demolition dust. Hoping to not overwhelm the local deconstruction ecosystem and driven by a preference for heritage materials, Portland took a prudent approach by including a year-built applicability threshold that applied deconstruction to only the oldest and historically designated buildings in the city. Two of the three following deconstruction ordinances have been heavily influenced by Portland's approach and also included a year-built applicability clause. Other ordinances in progress appear to be taking the same approach. This paper argues that the influence of historic preservation on deconstruction has incidentally perpetuated an overemphasis on the importance of heritage materials that dilutes the potential of widespread deconstruction. While heritage materials should be preserved, current approaches to deconstruction by-and-large overlook the potential of deconstruction for newer buildings, leaving much of the building stock vulnerable to demolition. Palo Alto has required deconstruction for all full building removals and groups like the Building Deconstruction Institute have provided examples of how innovative approaches can produce value through the deconstruction of undervalued contemporary construction.

This paper asserts that the ultimate goal of the deconstruction movement should be to totally supplant mechanical demolition. Deconstruction ordinances are a powerful tool to displace mechanical demolition, and phased approaches are likely judicious, but should include provisions to eventually apply to all structures and coordinate with other related efforts to create a more sustainable built environment. Other methods to stem mechanical demolition should include maintenance, renovation, or relocation of existing structures so buildings are not wasted, and investment and policy supports for increased local reuse of building materials to close the supply and demand loop.

By challenging early prevailing assumptions, this paper seeks to make deconstruction a progressively more viable approach for increasingly more municipalities. The four US deconstruction ordinances are assuredly a net positive as compared to status quo, but the movement toward a more sustainable built environment is nascent and will continue to require considerable study, practice, and maintenance.

APPENDIX

Portland Deconstruction Ordinance

ORDINANCE No. 187876

Adopt requirements for deconstruction of the city's oldest and most historic houses and duplexes (Ordinance; add Code Chapter 17.106)

The City of Portland Ordains:

Section 1. The Council finds:

1. On February 12, 2015, City Council directed the Bureau of Planning and Sustainability to develop strategies for increasing deconstruction activity.
2. On April 15, 2015, the Bureau of Planning and Sustainability convened a Deconstruction Advisory Group comprised of deconstruction experts, builders, developers, neighborhood groups and historic preservationists; this group met 16 times to provide advice on strategies and incentives for advancing deconstruction activities.
3. On June 3, 2015, City Council adopted Resolution 37127, which directed the Bureau of Planning and Sustainability to establish a deconstruction grant program with funding from the Solid Waste Management Fund Reserves and to report back in January 2016 with recommendations for next steps.
4. On September 8, 2015 the Bureau of Planning and Sustainability launched the deconstruction grant program and has funded 11 projects to date, resulting in innovative approaches, new participants, and increased awareness of the benefits of deconstruction.
5. On February 17, 2016, City Council adopted Resolution 37190 which directed the Bureau of Planning and Sustainability to develop code language for Council consideration to require deconstruction for the city's oldest and most historic houses and duplexes.
6. Bureau of Planning and Sustainability applied (Ordinance 187474) and received notice of award from the Oregon Department of Environmental Quality (DEQ) for \$50,000 in funding to supplement the existing deconstruction grant program.
7. A review draft of the deconstruction code language was available for a four-week public comment period.
8. With the assistance of a local workforce development consultant, the Bureau of Planning and Sustainability convened a group of stakeholders to develop a training and certification plan for deconstruction workforce and contractor.

NOW, THEREFORE, the Council directs:

- a. City Code Title 17 is amended to add a new Chapter 17.106, Deconstruction of Buildings Law attached as Exhibit A.
- b. The City Code amendment adding Chapter 17.106 shall be effective on and after October 31, 2016 to allow adequate time for the development of administrative rules, procedures, database programming, and training/certification of deconstruction workforce and contractors.
- c. The Bureau of Planning and Sustainability shall report back to City Council within the first six and twelve months of the deconstruction program's effective date, addressing program status and making recommendations on whether or not to modify, maintain, or expand the program with a goal of including houses and duplexes built before 1941 by the year 2019.
- d. Develop administrative rules, procedures and forms associated with adopted code language.

Passed by the Council: JUL 06 2016

Mayor Charlie Hales
Prepared by: Shawn Wood
Date Prepared: May 25, 2016

Mary Hull Caballero
Auditor of the City of Portland
By *Gayla Jennings*
Deputy

EXHIBIT A**Chapter 17.106 Deconstruction of Buildings Law**

17.106.005 Short Title

17.106.010 Purpose

17.106.020 Definitions

17.106.030 Authority of Director to Adopt Rules

17.106.040 Regulations

17.106.050 Enforcement and Penalties

17.106.060 Right of Appeal

17.106.005 Short Title

Chapter 17.106 of the Portland City Code shall be known as the Deconstruction of Buildings Law.

17.106.010 Purpose

This Chapter provides deconstruction requirements for the removal of Portland's older and more historic primary dwelling structures. The Deconstruction of Buildings Law seeks to:

- A. Maximize the salvage of valuable building materials for reuse;
- B. Reduce carbon emissions associated with demolition;
- C. Reduce the amount of demolition waste disposed of in landfills; and
- D. Minimize the adverse impacts associated with building removal.

17.106.020 Definitions

The terms used in Chapter 17.106 are defined as provided in this section:

- A. "Certified Deconstruction Contractor" means a contractor licensed with the Oregon Construction Contractors Board (CCB) that has successfully completed a deconstruction certification program

recognized by the Bureau of Planning and Sustainability. A firm will be considered certified if at least one person currently employed by the firm is certified.

- B. "Deconstruction" means the systematic dismantling of a structure, typically in the opposite order it was constructed, in order to maximize the salvage of materials for reuse, in preference over salvaging materials for recycling, energy recovery, or sending the materials to the landfill.
- C. "Director" means, the Director of the Bureau of Planning and Sustainability or his or her authorized designee.
- D. "Primary Dwelling Structure" means one and two-family structures (detached and attached) based on current permitted occupancy at the time of demolition permit application. Primary Dwelling Structures do not include accessory structures such as garages or accessory dwelling units.
- E. "Recycling" means the processing of waste materials into new products or material feed stock for products. Materials that can be recycled include but are not limited to concrete, metal piping, and asphalt roofing shingles.
- F. "Responsible Party" means any owner or person in control of a primary dwelling structure, or their authorized agent.
- G. "Reuse" means the utilization of a product or material that was previously installed for the same or similar function to extend its life cycle. Materials salvageable for reuse include but are not limited to cabinets, doors, hardware, fixtures, flooring, siding, and framing lumber.

17.106.030 Authority of Director

- A. The Director is hereby authorized to administer and enforce the provisions of this Chapter.
- B. The Director is authorized to adopt rules, procedures, and forms to implement the provisions of this Chapter.
 - 1. Any rule adopted pursuant to this Section shall require a public review process. Not less than 10 nor more than 30 days before such public review process, notice shall be given by publication in

a newspaper of general circulation. Such notice shall include the place, time and purpose of the public review process and the location at which copies of the full set of the proposed rules may be obtained.

2. During the public review, the Director shall hear testimony or receive written comment concerning the proposed rules. The Director shall review the recommendations, taking into consideration the comments received during the public review process, and shall either adopt the proposed rules, modify or reject them. Unless otherwise stated, all rules shall be effective upon adoption by the Director and shall be filed in the Office of the Director and with the City Auditor's Portland Policy Documents repository.
- C. The Director may temporarily suspend or modify the requirements of this Chapter based on a determination that such requirements are temporarily infeasible due to economic or technical circumstances. The Director's determination to temporarily suspend or modify shall be filed as a report with the City Council. The Director's determination shall be effective after the Council has accepted the report.

17.106.040 Regulations

- A. Scope. The deconstruction requirements of this Chapter apply to demolition permit applications under Chapter 24.55 of the City Code for:
1. Primary dwelling structures that were built in 1916 or earlier according to building permit records on file with the Bureau of Development Services, or if no such permit records exist, then County tax assessor information; or
 2. Primary dwelling structures that have been designated as a historic resource subject to the demolition review or demolition delay review provisions of Title 33.
- B. Requirements. Primary dwelling structures must be deconstructed in accordance with the provisions of this Chapter and associated administrative rules. Salvaged material may be sold, donated, or reused on site.
1. Demolition Permit Application. An application for a demolition permit under Chapter 24.55 for any primary dwelling structure shall not be considered complete unless it is accompanied by a completed Pre-Deconstruction Form provided by the Director.

2. Certified Deconstruction Contractor. Deconstruction work must be performed by a Certified Deconstruction Contractor. A Certified Deconstruction Contractor shall be assigned to the project throughout the course of deconstruction. Certified Deconstruction Contractors must comply with the requirements of this Chapter and the administrative rules. The Bureau of Planning and Sustainability will maintain on file and available to the public a list of current Certified Deconstruction Contractors.
3. Site Posting. On the first day of active deconstruction a yard sign provided by the Director when the permit is issued must be posted at the site. The sign must indicate that the structure is being deconstructed and must provide City of Portland contact information for questions or concerns.
 - a. The sign must remain in place throughout the course of deconstruction.
 - b. The sign must be placed on each street frontage of the site.
 - c. Signs must be posted within 5 feet of a street lot line and must be visible to pedestrians and motorists. Signs may not be posted in a public right-of-way. Signs are not required along street frontages that are not improved and allow no motor vehicle access.
4. Heavy Machinery. Heavy machinery may be used in deconstruction to assist in the salvage of materials for reuse or to remove material not required to be salvaged for reuse. Heavy machinery may not be used in deconstruction to remove or dismantle components of buildings in ways that render building components unsuitable for salvage. For purposes of this Chapter 17.106, heavy machinery includes, but is not limited to, track hoes, excavators, skid steer loaders, or forklifts.
5. Documentation. Certified Deconstruction Contractors must maintain receipts for donation, sale, recycling, and disposal of all materials for any deconstruction project. Materials intended for reuse on site must be documented with photographs. The Director may ask that a Certified Deconstruction Contractor produce the receipts or photographs for inspection any time until the demolition permit is approved to be finalized.
6. Demolition Permit Final. A completed Post-Deconstruction Form and all documentation required in Subsection 5 above must be submitted to the Bureau of Planning and Sustainability before the Bureau of Development Services may approve a demolition permit as finalized.

- C. **Additional Regulations.** Compliance with Chapter 17.106 does not exempt the demolition of buildings from any other requirements of the City Code, such as in Title 11 Trees, Title 24 Building Regulations, or Title 33 Planning and Zoning.
- D. **Exemptions.** The following are exempt from the requirements of Chapter 17.106:
1. A building permit to move a structure as provided under Chapter 24.25.
 2. Any primary dwelling structure that has been determined by the Bureau of Development Services to be dangerous and is required to be abated by demolition as provided in Section 29.40.030.
 3. Any primary dwelling structure that the Director has determined is unsuitable for deconstruction because:
 - a. The structure is structurally unsafe or is otherwise hazardous to human life; or
 - b. Most of the material in the structure is not suitable for reuse.
- E. **Request for an Exemption.** An applicant may request an exemption from the requirements of this Chapter under Subsection 17.106.040 D. by submitting a written request for exemption, together with supporting evidence, when submitting a demolition permit application.
- F. **Determination of an Exemption.** The Director will make the final determination of exemption based on evidence submitted by the applicant as well as an inspection to confirm conditions and unsuitability. The demolition permit will not be issued until the final determination is made on the exemption request. Should the applicant disagree with the final determination the determination may be appealed by the applicant under Subsection 17.106.060 B.

17.106.050 Enforcement and Penalties

- A. The Director may impose penalties on any responsible party who fails to comply with the requirements of this Chapter or who has misrepresented any material fact in a document or evidence required to be prepared or submitted by this Chapter.
1. A first violation of this Chapter may be subject to a penalty of up to \$500.
 2. A second violation of this Chapter by the same person may be subject to a penalty of up to \$1,000.

3. Third and subsequent violations of this Chapter by the same person may be subject to a penalty of up to \$1,500.
 4. Penalties may be imposed on a per month, per day, per incident, or such other basis as the Director may determine as appropriate based upon criteria in Subsection E below.
 5. Any person receiving a notice of violation shall, within 10 days of issuance of the notice, either pay to the City the stated amount of the penalty or request an appeal as provided in Section 17.106.060.
- B. Heavy Machinery.
1. Improper use of heavy machinery in violation of this Chapter may be subject to a penalty of up to \$10,000.
 2. Any person receiving a notice of violation shall, within 10 days of issuance of the notice, either pay to the City the stated amount of the penalty or request an appeal as provided in Section 17.106.060.
- C. Additional Enforcement Actions for Certified Deconstruction Contractors. The Director may impose the following additional remedies for Certified Deconstruction Contractors.
1. A first violation of this Chapter may result in removal from the list of approved Certified Deconstruction Contractors for up to 6 months.
 2. A second violation of this Chapter may result in removal from the list of approved Certified Deconstruction Contractors for up to 12 months.
 3. Third and subsequent violations may result in revocation of certification whereby a contractor may not apply for recertification for a period of 18 months.
 4. Temporary removal from the list of approved Certified Deconstruction Contractors will expire immediately following the term of removal and will not require further action from the Director.
- D. Stop Work Orders. When necessary to obtain compliance with this Chapter, the Director may issue a stop work order requiring that all work, except work directly related to elimination of the violation, be immediately and completely stopped. If the Director issues a stop work order, activity subject to the order may not be resumed until such time as the Director gives specific approval in writing. The stop work order will be in writing and posted at a conspicuous location at the site. When an emergency condition exists, a stop work order may be issued orally, followed by a written

stop work order. It is unlawful for any person to remove, obscure, mutilate or otherwise damage a stop work order. Any person subject to a stop work order may seek administrative review of the order and may appeal the Director's administrative determination as provided in Subsection 17.106.060 B.

- E. The Director will consider the following criteria in determining the amount of penalties or remedies to impose under this Section:
1. The nature and extent of the person's involvement in the violation;
 2. Whether the person was seeking any benefits, economic or otherwise, through the violation;
 4. Whether other similar prior violations have occurred with that person;
 5. Whether the violation was isolated and temporary, or repeated and continuous;
 6. The length of time from any prior violations;
 7. The magnitude and seriousness of the violation;
 8. The costs of investigation and remedying the violation;
 9. Other relevant, applicable evidence bearing on the nature and seriousness of the violation.
- F. If the Director assesses an enforcement penalty as described in this Section, the Director will file a statement with the City Auditor that identifies the property, the amount of the penalty, and the date from which the charges are to begin. The Auditor will then:
1. Notify the property owner of the assessment of enforcement penalties;
 2. Record a property lien in the Docket of City Liens;
 3. Bill the property owner monthly for the full amount of enforcement penalties owing, plus additional charges to cover administrative costs of the City Auditor; and
 4. Maintain lien records until the lien and all associated interest, penalties, and costs are paid in full; and the Director certifies that all violations listed in the original or any subsequent notice of violation have been corrected.
- G. Inspections. The Director may conduct inspections whenever necessary to enforce any provisions of this Chapter, to determine compliance with this Chapter or whenever the Director has reasonable cause to believe there exists any violation of this Chapter. If the responsible party is at the site when the inspection is occurring, the Director will first present proper credentials to the responsible party and request entry.

17.106.060 Right of Appeal

- A. Whenever the responsible party has been given a written notice or order pursuant to this Chapter or has been directed to make any correction, pay a penalty or to perform any act and the responsible party believes the finding of the notice or order was in error, the responsible party may have the notice or order reviewed by the Director. If a review is sought, the responsible party will submit a written request to the Director within 10 days of the date of the notice or order. Such review will be conducted by the Director. The responsible party requesting such review will be given the opportunity to present evidence to the Director. Following a review, the Director will issue a written determination. Nothing in this Section shall limit the authority of the Director to initiate a code enforcement proceeding under Title 22.
- B. A responsible party may appeal the Director's written determination to the Code Hearings Officer in accordance with Portland City Code Chapter 22.10. The filing of an appeal request will remain the effective date of a penalty until the appeal is determined by the Code Hearings Officer. If, pursuant to said appeal hearing, payment of a penalty is ordered, such payment must be received by the Director or postmarked within 15 calendar days after the order becomes final.
-

Milwaukee, Wisconsin Deconstruction Ordinance

City of Milwaukee

Office of the City Clerk

200 E. Wells Street

Milwaukee, Wisconsin 53202

Certified Copy of Ordinance

FILE NO: 170188

Title:

A substitute ordinance relating to deconstruction of residential buildings.

Body:

The Mayor and Common Council of the City of Milwaukee do ordain as follows:

Part 1. Section 200-19-2 of the code is amended to read:

200-19. Penalties.

2. In addition to other applicable enforcement procedures and pursuant to the authority of s. 66.0113, Wis. Stats., the department may issue citations pursuant to the citation procedure set forth in s. 50-25 to any person violating any provision of ss. 200-11, 200-20-2, 200-21.5, 200-22-5, 200-24, 200-42, 200-51.7, 200-53, 200-61, ch. 207, ch. 214, ss. 218-2, 218-6, 218-9-6, >>218-10,<< 222-11-2, 222-13-1, 222-19-1, ch. 223, ss. 225-2-1, 225-3-4, 225-3-5-a, ch. 236, ch. 240, s. 244-3, ch. 246, s. 252-1, ch. 261, ch. 275, ch. 289, ch. 290, ch. 295 or s. 320-21-11.

Part 2. Section 218-10 of the code is created to read:

218-10. Deconstruction of Residential Buildings. 1. PURPOSES. This section provides deconstruction requirements for the removal of Milwaukee's older and more historic primary dwelling structures. In particular, through the enactment and enforcement of this section, the common council seeks to:

- a. Maximize the salvage of valuable building materials, especially old-growth structural lumber, for reuse, thereby supporting the city's goal of being a sustainable community.
- b. Reduce the amount of demolition waste disposed of in landfills, thereby saving city and taxpayer dollars, extending the lives of existing landfills and reducing the need to create new landfills.
- c. Create employment opportunities for city residents, as the deconstruction process is much more labor-intensive than demolition, which relies on the use of heavy mechanical equipment.
- d. Reduce carbon emissions associated with demolition activity by preserving the embodied carbon and energy of existing building materials and avoiding the creation of greenhouse gasses associated with producing new materials.

- e. Minimize the adverse impacts associated with building removal by increasing the likelihood of discovering materials containing lead and asbestos for safe removal and disposal.
- f. Reduce the releasing of dust and other hazardous or potentially hazardous airborne substances associated with mechanical demolition of structures.
- g. Preserve Milwaukee's historic architectural features and building materials.

2. DEFINITIONS. In this section:

- a. "Certified deconstruction contractor" means a contractor that has successfully completed a deconstruction certification program either conducted by the department or approved by the commissioner, and where the contractor appears on a list of certified deconstruction contractors maintained by the commissioner and posted on or accessible from the department's website. A firm shall be considered certified if at least one person currently employed by the firm is certified.
- b. "Deconstruction" means the systematic dismantling of a structure, or portion thereof, to maximize the salvage of materials for reuse, in preference over salvaging materials for recycling, energy recovery, or sending the materials to the landfill.
- c. "Primary dwelling structure" means a residential structure containing one to 4 dwelling units based on current permitted occupancy at the time of demolition permit application. This term does not include an accessory building such as a garage or shed.
- d. "Recycling" means the processing of waste materials into new products or material feed stock for products. Materials that can be recycled include, but are not limited to, concrete, metal piping, and asphalt roofing shingles.
- e. "Responsible party" means any owner or person in control of a primary dwelling structure, or that owner or person's authorized agent.
- f. "Reuse" means the use of a product or material that was previously installed for the same or similar function to extend its life cycle. Materials salvageable for reuse include but are not limited to cabinets, doors, windows, hardware, fixtures, flooring, siding, and framing lumber.

3. AUTHORITY AND DUTIES OF COMMISSIONER. a. The commissioner shall administer and enforce the provisions of this section.

b. The commissioner shall adopt rules, procedures, and forms to implement the provisions of this section, and post the same, or links to the same, on the department's website, provided:

b-1. Any rule adopted pursuant to this paragraph shall pertain to certification of deconstruction contractors, to certification-program training, or to deconstruction method or practice, and shall require a public review process. Not less than 10 nor more than 30 days before such public review

process, notice shall be given by publication in a newspaper of general circulation. The notice shall include the place, time and purpose of the public review process and the location at which copies of the full set of the proposed rules may be obtained.

b-2. During the public review, the commissioner shall hear testimony or receive written comment concerning the proposed rules. The commissioner shall review the recommendations, taking into consideration the comments received during the public review process, and shall either adopt the proposed rules, modify or reject them. Unless otherwise stated, all rules shall be effective upon adoption by the commissioner and shall be filed in the office of the commissioner and with the legislative reference bureau, and shall be posted on or accessible from the department's website.

c. The commissioner shall develop, and the department shall conduct, a deconstruction certification training program to teach deconstruction method and practice principles generally recognized in the deconstruction industry. A firm shall apply to the commissioner for certification-program training on a form provided by the commissioner, and, subject to the provisions of this section, shall be listed as a certified deconstruction contractor following successful completion of the program and certification by the commissioner.

d. A contractor may apply to the commissioner, on a form provided by the commissioner, for recognition of deconstruction training certification based on successful completion of a training program other than the department-conducted program. The commissioner shall consider course teaching and certification requirements and generally recognized training and certification principles in the deconstruction industry in determining whether to recognize the alternative certification program. The commissioner may require an interview or testing in making a determination. The commissioner shall inform the contractor of the commissioner's determination regarding recognition of alternative certification in writing.

e. The commissioner shall maintain and post on the department's website a listing, or a link to a listing, of certified deconstruction contractors.

f. The commissioner shall provide reports on the implementation of this section to the common council's zoning, neighborhoods and development committee at least annually. Beginning in 2018, each report shall be submitted to the committee no later than June 30 of each year. These reports shall include, but not be limited to, information on contractors certified for deconstruction, responsive deconstruction bidders, bid amounts, jobs created, buildings deconstructed, and the recovery and marketing of reclaimed materials.

4. REGULATIONS. a. Scope. The deconstruction requirements of this section apply to any demolition permit application under this chapter for any of the following:

a-1. A primary dwelling structure that was built in 1929 or earlier according to building permit records on file with the department or, if no such permit records exist, according to records of the commissioner of assessments or the Milwaukee county register of deeds.

a-2. A primary dwelling structure that has been designated as an historic structure by the common council under s. 320-21.

a-3. A primary dwelling structure located in an historic district designated by the common council under s. 320-21.

b. Requirements. b-1. General. Primary dwelling structures shall be deconstructed in accordance with the provisions of this section and associated administrative rules. Salvaged material may be sold, donated, or reused on- or off-site. Every deconstruction project shall achieve a documented 85% landfill diversion rate by weight, unless:

b-1-a. Otherwise approved by the commissioner in writing for the particular structure based on economic or practical infeasibility as determined by the commissioner after consideration and inspection; or

b-1-b. Otherwise allowed by administrative rule adopted by the commissioner under this section.

b-2. Demolition Permit Application. An application for a demolition permit under this chapter for any primary dwelling structure shall not be considered complete unless it is accompanied by a completed pre-deconstruction form provided by the commissioner, including a list of targeted salvageable materials and final destinations or by a commissioner-approved exemption issued under this section.

b-3. Certified Deconstruction Contractor. Deconstruction shall only be performed by a certified deconstruction contractor listed on the department's website. At least one certified employee of the contractor shall be present on the job site when activities related to deconstruction are underway. The department shall maintain and make available to the public, and post on the department's website, a list, or a link to a list, of currently-certified deconstruction contractors.

b-4. Site Posting. Prior to commencement of deconstruction activity, a yard sign approved and provided by the commissioner shall be posted on each street frontage of the site. The sign shall:

b-4-a. Indicate that the structure is being deconstructed

b-4-b. Provide department of neighborhood services contact information for questions or concerns.

b-4-c. Remain in place throughout the course of deconstruction.

b-4-d. Be posted within 5 feet of a street lot line, be visible to pedestrians and motorists, and not be posted in a public right-of-way.

b-5. Heavy Machinery. Heavy machinery may be used in deconstruction to assist in the salvage of materials for reuse or to remove material not required to be salvaged for reuse. Heavy machinery may not be used in deconstruction to remove or dismantle components of buildings in ways that render building components unsuitable for salvage. For purposes of this section, heavy machinery includes,

but is not limited to, track hoes, excavators, skid steer loaders, and forklifts.

b-6. Documentation. The demolition permit holder shall maintain receipts for donation, sale, recycling, and disposal of all materials for any deconstruction project. Materials intended for reuse on site, and materials disposed of and concerning which no receipt for disposal is obtainable, shall be documented with photographs. The commissioner may ask that the permit holder produce the receipts or photographs for inspection any time until the demolition permit is closed.

b-7. Closing of Demolition Permit. A completed post-deconstruction form and all documentation required in subd. 6. shall be submitted to the department before a department inspector may approve a demolition permit as closed.

c. Exemptions. The following are exempt from the requirements of this section:

c-1. The moving of a building, provided it occurs in accordance with s. 218-2.

c-2. Any primary dwelling structure that the commissioner has determined is unsuitable for deconstruction because either of the following is true:

c-2-a. The structure is structurally unsafe or is otherwise hazardous to the health, safety or welfare of the public and too unsafe or hazardous for deconstruction.

c-2-b. Most, or a substantial portion, of the material in the structure is not suitable for reuse.

d. Request for an Exemption. An applicant may request an exemption from the requirements of this section under par. c by submitting a written request for exemption, together with supporting evidence, when submitting a demolition permit application. Where the city, as the owner of the primary dwelling structure, seeks an exemption, the commissioner shall approve and sign a city-exemption form to document satisfaction of the exemption requirements of par. c.

e. Determination of an Exemption. The commissioner shall make the final determination of exemption based on evidence submitted by the applicant as well as an inspection to confirm conditions and unsuitability. The demolition permit shall not be issued until the final determination is made on the exemption request. If the applicant disagrees with the final determination, the determination may be appealed by the applicant under sub. 6.

5. ENFORCEMENT AND PENALTIES. a. General. a-1. A first violation of this section may be subject to a penalty of up to \$1,000.

a-2. A second violation of this section committed by the same person or firm may be subject to a penalty of up to \$2,000.

a-3. Third and subsequent violations of this section by the same person or firm may be subject to a penalty of up to \$3,000.

a-4. Penalties may be imposed on a per-month, per-day or per-incident basis, or such other basis as the commissioner may determine appropriate based upon the criteria in par. f.

a-5. Any person receiving a notice of violation shall, within 10 days of issuance of the notice, either pay to the city the stated penalty amount or appeal the penalty under sub. 6.

b. Heavy Machinery. b-1. Improper use of heavy machinery in violation of this section may be subject to a penalty of up to \$20,000.

b-2. Any person receiving a notice of violation shall, within 10 days of issuance of the notice, either pay to the city the stated penalty amount or appeal the penalty under sub. 6.

c. Additional Enforcement Actions for Certified Deconstruction Contractors. The commissioner may impose the following additional remedies on a certified deconstruction contractor:

c-1. A first violation of this section may result in removal from the list of certified deconstruction contractors for up to 6 months.

c-2. A second violation of this section may result in removal from the list of certified deconstruction contractors for up to 12 months.

c-3. A third or subsequent violation of this section may result in removal from the list of certified deconstruction contractors for an indefinite period. The contractor may not apply for reinstatement to the list of certified deconstruction contractors for a period of 18 months.

d. Temporary Removal. Temporary removal from the list of certified deconstruction contractors shall expire immediately following the end of the term of removal, and shall not require further action by the commissioner except for re-listing of the contractor on the department's website.

e. Stop Work Orders. When necessary to obtain compliance with this section, the commissioner may issue a stop work order requiring that all work, except work directly related to elimination of the violation, be immediately and completely stopped. If the commissioner issues a stop work order, activity subject to the order may not be resumed until such time as the commissioner gives specific approval in writing. The stop work order will be in writing and posted at a conspicuous location at the site. When an emergency condition exists, a stop work order may be issued orally, followed by a written stop work order. It is unlawful for any person to remove, obscure, mutilate or otherwise damage a stop work order.

f. Criteria. The commissioner shall use the following criteria in determining the type and magnitude of penalties or remedies to impose under this subsection:

f-1. The nature and extent of the person's involvement in the violation.

- f-2. Whether the person was seeking any benefits, economic or otherwise, through the violation.
 - f-3. Whether the person has committed similar violations in the past.
 - f-4. The length of time since any prior violations.
 - f-5. Whether the violation was isolated and temporary, or repeated and continuous.
 - f-6. The magnitude and seriousness of the violation.
 - f-7. The costs of investigating and remedying the violation.
 - f-8. Other relevant, applicable evidence bearing on the nature and seriousness of the violation.
 - g. Inspections. The commissioner may conduct inspections whenever necessary to enforce any provisions of this section, to determine compliance with this section or whenever the commissioner has reasonable cause to believe there exists any violation of this section. If the responsible party is at the site when the inspection is occurring, the commissioner will first present proper credentials to the responsible party and request entry.
6. RIGHT OF APPEAL. Whenever the responsible party has been given a written notice, order or determination pursuant to this section, or has been directed to make any correction, pay a penalty or to perform any act, and the responsible party believes the finding of the notice, order or determination was in error, the responsible party may have the notice, order or determination reviewed by the commissioner. If a review is sought, the responsible party will submit a written request to the commissioner within 10 days of the date of the notice, order or determination. Such review will be conducted by the commissioner. The responsible party requesting such review will be given the opportunity to present evidence to the commissioner. Following a review, the commissioner shall issue a written decision. The responsible party may appeal the commissioner's decision to the administrative review appeals board under s. 320-11.

Part 3. This ordinance is effective January 1, 2018.



I, James R. Owczarski, City Clerk, do hereby certify that the foregoing is a true and correct copy of a(n) Ordinance Passed by the COMMON COUNCIL of the City of Milwaukee, Wisconsin on November 7, 2017, published on November 27, 2017, effective January 1, 2018.

James R. Owczarski

James R. Owczarski

November 22, 2017

Date Certified

Palo Alto Deconstruction Ordinance

Chapter 5.24

DECONSTRUCTION AND CONSTRUCTION MATERIALS MANAGEMENT

Sections:

- 5.24.010 Purpose.
- 5.24.020 Definitions.
- 5.24.030 Applicability.
- 5.24.040 Salvage survey and reuse required.
- 5.24.050 Deconstruction and source separation of materials.
- 5.24.060 Material collection.
- 5.24.070 No unauthorized containers.
- 5.24.080 Exclusions.
- 5.24.090 Administration by City Manager.
- 5.24.100 Enforcement and penalties.

5.24.010 Purpose.

The accumulation, collection, removal and disposal of waste associated with construction, deconstruction and demolition activities must be controlled for the protection of the public health, safety and welfare, and the natural environment. State law addresses this need through the California Integrated Waste Management Act of 1989 and the California Green Building Code, which requires local governments to require fifty percent of construction debris be diverted from the landfill, and Senate Bill 1374, which requires annual reporting to the state on progress made in the diversion of construction related materials, including information on programs and ordinances implemented and quantitative data, where available. Required minimum diversion rates by project type are covered under the California Green Building Code and the city's local amendments in Title 16, Building Regulations, of this code. In 2016, the city adopted sustainability, waste diversion and climate action goals of eighty percent reduction in greenhouse gases and ninety-five percent diversion of materials from landfills by 2030. The city may adopt, implement, and enforce requirements, rules and regulations for local reuse and recycling of materials that are more stringent or comprehensive than California law, and this chapter establishes local requirements to further both state law and the city's adopted policies.

This chapter's goals are to implement best practice methods for separation, handling, and delivery of deconstruction and construction site materials to maximize the salvage of building materials for reuse, to reduce the amount of construction and deconstruction related materials disposed in landfills and to establish deconstruction and source separation requirements. The requirements of this chapter are in addition to, the requirement in Chapter 16.14 of this code to achieve a specified diversion of materials generated from an applicable construction project.

(Ord. 5472 § 2 (part), 2019)

5.24.020 Definitions.

For purposes of this chapter, terms defined in Chapter 5.20 shall have the same meanings in this chapter. The following terms shall have the ascribed definition for the purposes of applying the criteria of this chapter and other chapters as referenced.

- (1) "Approved facility" means a reuse, recycling, composting, or materials recovery facility which the director has determined can accept diverted materials, has obtained all applicable federal, state and local permits, and is in full compliance with all applicable regulations for reuse, recycling, composting, and/or materials recovery.
- (2) "Applicant" means (a) any individual, firm, limited liability company, association, partnership, political subdivision, government agency, municipality, industry, public or private corporation, or any other entity whatsoever who applies to the city for, or who is issued, the applicable permits to undertake a construction, remodeling, or demolition project within Palo Alto, and (b) the owner of the real property that is subject to the permit.
- (3) "Construction and demolition debris" or "construction and deconstruction materials" means (a) discarded materials generally considered to be non-water soluble and non-hazardous in nature (as defined by California Code of Regulations, Title 22, § 66261.3 et seq.), including but not limited to, metal, glass, brick, concrete, porcelain, ceramics, asphalt, pipe, gypsum wallboard, and lumber from the construction or destruction of a structure as part of a construction or demolition project or from the renovation of a structure and/or landscaping, including rocks, soil, trees, and other vegetative matter that normally results from land clearing, landscaping and development operations for a construction project; and (b) remnants of new materials, including but not limited to, cardboard, paper, plastic, wood, glass and metal from any construction, renovation and/or landscape project.
- (4) "Contractor" means any person or entity holding, or required to hold, a contractor's license under the laws of the State of California, and who performs any construction, deconstruction, demolition, remodeling, renovation, or landscaping service relating to buildings or accessory structures in the city.

(5) "Covered project" means any project that is required to comply with the provisions of this chapter, as described in Section 5.24.030.

(6) "Deconstruction" means the systematic and careful dismantling of a structure, typically in the opposite order it was constructed, in order to maximize the salvage of materials and parts for reuse and recycling.

(7) "Demolition" means the partial or complete destroying, tearing down, dismantling or wrecking of any building or structure.

(8) "Diversion" means any activity, including recycling, source reduction, reuse, deconstruction, or salvaging of materials, which causes materials to be diverted from disposal in landfills and instead puts the material to use as the same or different usable product.

(9) "Recycling" means the process of collecting, sorting, cleansing, treating, and reconstituting materials that would otherwise become solid waste, and returning them to the economic mainstream in the form of raw material for new or reconstituted products which meet the quality standards necessary to be used in the marketplace. This term does not include transformation as that term is defined in Public Resources Code section 40180.

(10) "Reuse" means further or repeated use of materials or items, including sale or donation of items, but not including recycling.

(11) "Reuse organization" means an organization approved by the city to provide salvage surveys and accept materials or items for reuse.

(12) "Salvage" means the controlled removal of items and material from a building, construction, or demolition site for the purpose of on- or off-site reuse, or storage for later reuse. Examples of items that may be salvaged include air conditioning and heating systems, columns, balustrades, fountains, gazebos, molding, mantels, pavers, planters, quoins, stair treads, trim, wall caps, bath tubs, bricks, cabinetry, carpet, doors, ceiling fans, lighting fixtures, electrical panel boxes, fencing, fireplaces, flooring materials of wood, marble, stone or tile, furnaces, plate glass, wall mirrors, door knobs, door brackets, door hinges, marble, iron work, metal balconies, structural steel, plumbing fixtures, refrigerators, rock, roofing materials, siding materials, sinks, stairs, stone, stoves, toilets, windows, wood fencing, lumber and plywood.

(13) "Source separated single recyclable materials" means recyclable materials that are separated from other recyclable materials or solid waste and placed in separate containers according to type or category of materials and directly marketed as a single commodity.

(Ord. 5472 § 2 (part), 2019)

5.24.030 Applicability.

This chapter shall be applicable to all residential and commercial projects that include a whole structure demolition requiring a demolition permit. However, this chapter shall not apply to those projects comprised solely of the demolition of an accessory dwelling unit, or to any project for which the completed demolition permit application was submitted to the city prior to July 1, 2020.

(Ord. 5472 § 2 (part), 2019)

5.24.040 Salvage survey and reuse required.

(a) All applicants and other persons who undertake a covered project shall complete a salvage survey provided by a reuse organization or other third party approved by the city, prior to the issuance of a demolition permit. The survey shall itemize the materials and items eligible for salvage and reuse and the estimated weights.

(b) Upon completion of the deconstruction and source separation of materials, the applicant or person responsible for the covered project shall ensure the items listed on the salvage survey are delivered to, collected by or received by, and certified by a reuse organization or other third party approved by the city, and shall submit to the city proof of delivery of salvage items in accordance with city regulations.

(Ord. 5472 § 2 (part), 2019)

5.24.050 Deconstruction and source separation of materials.

(a) All applicants and other persons who undertake a covered project where materials can be recycled or composted shall deconstruct buildings and structures in a manner to divert the maximum feasible amount of materials and debris from disposal in landfills. All construction and deconstruction materials shall be source separated. Materials to be source separated for recycling include, but are not limited to, steel, glass, brick, concrete, asphalt, roofing material, pipe, gypsum, sheetrock, lumber, wood, pallets, rocks, sand, soil, clean cardboard, paper, plastic, carpet, wood and metal scraps. Materials to be composted include, but are not limited to, trees, shrubs, plant cuttings, food scraps, and other material as designated by the city.

(b) All persons undertaking a covered project shall submit proof of reuse, recycling and composting in accordance with city regulations.

(c) The city, or its collector at city's direction, shall be authorized to inspect, upon reasonable notice, and audit individual waste streams generated at covered projects to determine compliance with this section.

(Ord. 5472 § 2 (part), 2019)

5.24.060 Material collection.

Projects using a container provided by the city's collector pursuant to the provisions of Chapter 5.20 shall be deemed to have complied with the requirement to take construction and deconstruction related waste and source separated materials to an approved facility. Persons using any other method of collection shall dispose of such debris at an approved facility in accordance with city regulations.

(Ord. 5472 § 2 (part), 2019)

5.24.070 No unauthorized containers.

No person other than the city's collector may place containers within Palo Alto.

(Ord. 5472 § 2 (part), 2019)

5.24.080 Exclusions.

The provisions of this chapter shall not apply to the following:

- (a) **Dangerous Structures.** Any building or structure that has been determined to be dangerous, structurally unsafe or otherwise hazardous to human life, and is required to be abated by demolition.
- (b) **No Suitable Materials.** Any building or structure that does not have materials that are suitable for reuse, recycling, or compost, as determined by the Director of Public Works. Materials unsuitable for reuse, recycling, or compost include insulation, painted or treated wood, rubber, and non-recyclable plastics.
- (c) **De Minimis Exception.** The Director of Public Works may waive any of the requirements of this chapter if documentation satisfactory to the director is provided to establish that the materials are not reusable, recyclable or compostable, the materials are incidental in quantity, or providing appropriate containers at the particular site would be unduly difficult.

(Ord. 5472 § 2 (part), 2019)

5.24.090 Administration by City Manager.

(a) The City Manager shall adopt written rules and regulations, not inconsistent with this chapter, as may be necessary for the proper administration and enforcement of this chapter.

(b) The City Manager shall resolve all disputes concerning the administration or enforcement of this chapter, and his or her decision shall be final.

(Ord. 5472 § 2 (part), 2019)

5.24.100 Enforcement and penalties.

(a) The Director of Public Works shall have primary responsibility for enforcement of this chapter. The Director of Public Works is authorized to take any and all other actions reasonable and necessary to enforce this chapter.

(b) Violation of any provision of this chapter shall be subject to the provisions and penalties set forth in Title 6 of the Municipal Code unless otherwise specified.

(c) The remedies and penalties provided in this section are cumulative and not exclusive.

(Ord. 5472 § 2 (part), 2019)

San Antonio, Texas Deconstruction Ordinance

AL
9/08/2022
Item No. XX

FINAL DRAFT

ORDINANCE

**AMENDING CHAPTER 12 ENTITLED “VACANT STRUCTURES”
OF THE CITY CODE TO ADOPT DECONSTRUCTION
REGULATIONS FOR RESIDENTIAL AND ACCESSORY
STRUCTURES WITHIN THE CITY OF SAN ANTONIO AND
ESTABLISHING PENALTIES.**

* * * * *

WHEREAS, over the past 10 years, more than \$16 million worth of salvageable building materials were sent to local landfills, amounting to nearly 170,000 tons of irrecoverable resources, and more than 1,500 pre-1960 houses in San Antonio were demolished; and

WHEREAS, more than 500 buildings are demolished in San Antonio every year, an increase of 68% since 2012; and

WHEREAS, deconstruction is proven to mitigate the release of particulates into the air by carefully dismantling materials by hand versus crushing them with machines and releasing dust into and onto the surrounding air, ground, and structures; and

WHEREAS, the proposed deconstruction ordinance is designed to provide deconstruction requirements to safeguard the public safety, health, and general welfare associated with building removal, including the reduction of airborne toxic pollutants, carbon emissions, water consumption, and the dumping of refuse and demolition waste as well as to promote a circular economy; and

WHEREAS, maintaining, stabilizing, and preserving older and historic buildings, including naturally occurring affordable housing, is most successful when reclaimed and salvaged materials are locally accessible; and

WHEREAS, the proposed deconstruction of select small-scale housing stock would result in an increase in the availability, accessibility, and affordability of locally-available, high-quality **building materials sourced from San Antonio’s “urban forest,”** facilitating inclusion of new participants in the local salvage exchange market, including those traditionally excluded; and

WHEREAS, an increased local availability of building materials and robust exchange networks represent valuable pre-disaster mitigation strategies that improve community health and resilience; and

WHEREAS, the economic and workforce potential of deconstruction is on average six times that of demolition, generating new local opportunities in deconstruction, warehousing, retailing, trades, and value-added manufacturing sectors; and

WHEREAS, the proposed deconstruction ordinance aligns with City priorities outlined in the Climate Action and Adaptation Plan (CAAP), Strategic Housing Implementation Plan (SHIP), Recycling and Resource Recovery Plan, and Ready to Work Program; and

FINAL DRAFT

WHEREAS, the City's Office of Historic Preservation (OHP) will administer the deconstruction ordinance through the existing demolition permitting process, which will apply to residential and accessory structures based on the construction date and building type; and

WHEREAS, OHP staff briefed the Community Health, Environment, and Culture Committee on February 8, 2022, the former Planning and Community Development Committee and Arts, Culture, and Heritage Committee in 2019 and 2020; and

WHEREAS, OHP staff recently presented the proposed Deconstruction Ordinance to the Planning and Community Development Committee, which unanimously voted to advance the recommended ordinance to City Council A Session; **NOW THEREFORE**:

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF SAN ANTONIO:

SECTION 1. Chapter 12 of the City Code of San Antonio, Texas, is amended by adding the language that is underlined to the existing title, and by adding Article II. Deconstruction, to the existing text as set forth in this Ordinance. Chapter 12 of the City Code of San Antonio, Texas, is amended as follows:

CHAPTER 12 – VACANT BUILDINGS AND DECONSTRUCTION

Article II. DECONSTRUCTION.

This article of the City of San Antonio City Code is the Deconstruction Code.

Sec. 12-20. Purpose and Scope.

- (a) *Purpose.* This article shall be construed to secure its expressed intent, which is to provide demolition and deconstruction requirements to safeguard the public safety, health, and general welfare associated with building removal, including the reduction of airborne toxic pollutants, carbon emissions, water consumption, and the dumping of refuse and demolition waste. In addition, this article seeks to increase the availability of high-quality and reclaimed building materials for local reuse; improve equity of access to building materials for use in affordable housing preservation and production; encourage neighborhood continuity; retain historic building materials in the communities from which they originated; develop and sustain a local workforce in construction, heritage trades, and deconstruction; and achieve citywide sustainability goals and mitigation strategies outlined in the City's adopted Climate Action and Adaptation Plan (CAAP), including the development of a local circular economy. The purpose of this article is not to create or to establish a standard for a building product, material or aesthetic method in construction, renovation, maintenance, or other alteration of a residential or commercial building.
- (b) *Scope.* This article provides the procedures to be followed by all persons engaged in the removal of residential and accessory structures within the territorial limits of the City of San Antonio, Texas that meet the criteria for deconstruction established herein.

FINAL DRAFT

Sec. 12-21. Definitions.

The following definitions shall apply in the interpretation and enforcement of this article.

Accessory structure means a building, structure, or use on the same lot with, and of a nature customarily incidental and subordinate to, the principal building or use. Examples include garages carriage houses, accessory dwelling units, or tool sheds.

Certified Deconstruction Contractor means any person doing work within the building trades or construction professions that has successfully completed a deconstruction certification program as administered through the City of San Antonio Office of Historic Preservation.

City means the City of San Antonio, Texas.

Deconstruction means the systematic dismantling of a structure, typically in the opposite order it was constructed, from roof to foundation, in order to maximize the salvage of materials for reuse, in preference over salvaging materials for recycling, energy recovery, or sending the materials to the landfill.

Demolition means the complete or partial removal of a structure from a site.

Director means the director of the Office of Historic Preservation for the City of San Antonio, Bexar County, Texas, and his/her designee.

Multi-unit structure means a residential structures with two (2) or more residential attached dwelling units including, but not limited to, duplexes, apartments, townhomes, and condominiums.

Period of Deconstruction means the period beginning on the date the City issues a demolition permit with deconstruction requirements and ending on the date the City approves the Post-Deconstruction Form, which shall be a maximum of sixty (60) calendar days or as specifically provided in the permit requirements of the subject application, whichever period is greater.

Post-Deconstruction Form means an inventory of actual materials salvaged for reuse or donation, as well as materials discarded or landfilled, to be completed and submitted after deconstruction is fully complete to initiate permit closure by the Director.

Pre-Deconstruction Form or *Salvage Plan* means an inventory of materials to be salvaged for reuse or donation as part of an application to deconstruct.

Recycling means the processing of waste materials into new products or material feedstock for products. Materials that can be recycled include, but are not limited to, concrete, metal piping, and asphalt roofing shingles.

Re-use means the utilization of a product or material that was previously installed for the same or similar function to extend its life cycle. Materials salvageable for reuse include, but are not limited to, cabinets, doors, hardware, fixtures, flooring, siding, and framing lumber.

Single-family structure means a dwelling unit for one family.

FINAL DRAFT

Structure means a walled or roofed building that was constructed to provide occupied or unoccupied shelter or enclosure.

Sec. 12-22. Applicability and Administration.

This article applies to any request for demolition of residential and accessory structures within the territorial limits of the City of San Antonio that meet the criteria for deconstruction as established in this article.

- (a) *Criteria.* Any application for demolition of a structure that is determined by the Director to meet the criteria for deconstruction shall consider the construction date and original use of the structure. The Director, at his or her discretion, may refer the applicability of criteria to a property to the Historic and Design Review Commission (HDRC) for a recommendation before determination is made.
 - (1) **Construction Date.** The construction date of a structure shall be informed by available primary sources including, but not limited to, Sanborn Maps, deed records, appraisal district data, and/or other applicable research methods.
 - (2) **Original Use.** The original use of the property shall be determined by the Director after a visual assessment of construction type and reference to the 1968 City Plan. The current zoning or use of the property does not determine whether the requirements of this section apply.
- (b) *Phasing.* This article shall take effect in phases as set forth below.
 - (1) Phase I shall take effect on October 1, 2022. Deconstruction requirements shall apply to demolition permit applications for City-executed demolitions for:
 - A. Residential single-family structures, multi-unit structures with four (4) units or less, and accessory structures that were constructed on or before December 31, 1920, regardless of zoning overlay; and
 - B. Residential single-family structures, multi-unit structures with four (4) units or less, and accessory structures that were constructed on or before December 31, 1945, and that have either: been locally designated as historic and carry a historic zoning overlay (H, HL, HS, or HE); or, are located within a Neighborhood Conservation District (NCD) and carry a NCD zoning overlay.
 - (2) Phase II shall take effect on January 1, 2023. Deconstruction requirements shall apply to demolition permit applications for:
 - A. Residential single-family structures, multi-unit structures four (4) units or less, and accessory structures that were constructed on or before December 31, 1920, regardless of zoning overlay; and

FINAL DRAFT

- B. Residential single-family structures, multi-unit structures four (4) units or less, and accessory structures that were constructed on or before December 31, 1945, and that have either: been locally designated as historic and carry a historic zoning overlay (H, HL, HS, or HE); or, are located within a Neighborhood Conservation District (NCD) and carry a NCD zoning overlay.
- (3) Phase III shall take effect on January 1, 2025. Deconstruction requirements shall apply to demolition permit applications for:
 - A. Residential single-family structures, multi-unit structures eight (8) units or less, and accessory structures that were constructed on or before December 31, 1945, regardless of zoning overlay; and
 - B. Residential single-family structures, multi-unit structures eight (8) units or less, and accessory structures that were constructed on or before December 31, 1960, and that have either: been locally designated as historic and carry a historic zoning overlay (H, HL, HS, or HE); or, that are located within a Neighborhood Conservation District (NCD) and carry a NCD zoning overlay.
- (c) The Director is authorized to administer and enforce the provisions of this article and adopt rules, procedures, and forms to implement the provisions of this article.
- (d) The Director may temporarily suspend or modify the requirements of this article based on a determination that such requirements are temporarily infeasible due to economic or technical circumstances. The Director shall temporarily suspend the requirements of this article if, at any time, there are less than three (3) Certified Deconstruction Contractors registered with the City.

Sec. 12-23. Demolition Permit and Deconstruction Requirements.

- (a) *Permit Required.* No person shall demolish a residential or accessory structure that is eligible for deconstruction under this article without first obtaining a demolition permit from the City.
 - (1) *Pre-Application Conference.* An applicant requesting to demolish a structure that meets the criteria for deconstruction, may meet with the Office of Historic Preservation to discuss the procedures and requirements pursuant to this Code. The required forms may be obtained from the Office of Historic Preservation prior to or at the time of application.
 - (2) *Applications.* All applications for demolition of a residential structure shall be referred to the Office of Historic Preservation for a determination of applicability for deconstruction. The Director shall determine, in writing, the construction date, original use, and applicability for deconstruction. If the provisions of this article **apply, the City shall notify the applicant of the Director's decision and** of the deconstruction requirements of the demolition permit within ten (10) business days after an application for demolition permit is filed with the **City's Development**

FINAL DRAFT

Services Department. The Director, at his or her discretion, may refer the applicability of criteria to a property to the Historic and Design Review Commission (HDRC) for a recommendation before determination is made. An appeal of **the Director's decision may** be made as set forth in section 12-25 of this article.

- (3) *Issuance of a Permit.* A demolition permit for deconstruction shall only be issued to a Certified Deconstruction Contractor who shall be responsible for the deconstruction activities of the subject application throughout the Period of Deconstruction.
- (b) *Deconstruction Requirements.* Upon issuance of a permit, a Certified Deconstruction Contractor shall adhere to the applicable deconstruction requirements and submit to the Office of Historic Preservation the following forms and documentation for review and approval before the post-work evaluation is performed.
 - (1) *Pre-Deconstruction Form.* The Certified Deconstruction Contractor of a structure subject to deconstruction under this article shall complete and submit a Pre-Deconstruction Form to the Office of Historic Preservation.
 - (2) *Post-Deconstruction Form.* The Certified Deconstruction Contractor of a structure subject to deconstruction under this article shall complete and submit a Post-Deconstruction Form to the Office of Historic Preservation within ten (10) calendar days after completion of the deconstruction work.
 - (3) *Documentation.* The Certified Deconstruction Contractor of a structure subject to deconstruction under this article shall submit documentation identifying the destination for all materials removed to the Office of Historic Preservation no more than ten (10) calendar days after completion of the deconstruction work as part of a complete Post-Deconstruction Form. The Office of Historic Preservation shall review and approve the documentation before conducting the post-work evaluation. The Certified Deconstruction Contractor shall be responsible for providing the Office of Historic Preservation Office copies of documentation requirements as provided by staff:
 - A. Photographs of deconstruction in progress, to be taken weekly at a minimum;
 - B. Itemized receipt of materials and quantities donated to a nonprofit or community organization;
 - C. Itemized receipt of materials and quantities sold;
 - D. Itemized list and photographs of salvaged material that will be re-used on site or at another site;
 - E. Transaction receipt or weight tickets for the disposal of hazardous material abated during the course of deconstruction; and

FINAL DRAFT

- F. Transaction receipts or weight tickets for all materials taken to a transfer facility, material recovery facility, and/or landfill.
- (4) *Site Posting.* The Office of Historic Preservation shall provide the Certified Deconstruction Contractor a sign(s) when the deconstruction permit is issued. The Certified Deconstruction Contractor shall post the sign(s) on site before the first day of deconstruction activity and it shall remain on site until the deconstruction is complete. The sign(s) shall indicate that the structure is being deconstructed and must provide City contact information for questions or concerns.
- A. The sign(s) must remain in place throughout the Period of Deconstruction;
- B. The sign(s) must be placed on each street frontage of the site; and
- C. The sign(s) must be posted within 5 (five) feet of a street lot line and must remain visible to pedestrians and motorists. Signs are not required along street frontages that are not improved or not named, and/or do not allow motor vehicle access.
- (5) *Building removal.* Building removal shall be performed by a Certified Deconstruction Contractor as follows:
- A. Building removal shall be completed within the Period of Deconstruction;
- B. Materials shall be removed by hand to the fullest extent possible while maintaining original sizes and dimensions;
- C. Nails, screws, or items used to secure materials in place shall be removed and prepared for re-use where feasible; and
- D. Removal and disposal of hazardous materials shall be in accordance with this article, and any other local, state, or federal laws, rules, or regulations.
- (6) *Salvageable Materials.* The property owner may re-use, sell, or donate salvage materials from a deconstruction site before the materials leave the site, provided that the distribution of the materials meets the documentation requirements under section 12-23 (b) of this article. The rules and procedures outlined in Chapter 16, Article XIII. – Garage Sales do not apply to active deconstruction sites.
- (7) *Site Storage.* Materials shall be stored and covered to protect them from exposure to rain and permeable ground contact during the Period of Deconstruction. Materials from the deconstructed building may only be safely stored on site during the Period of Deconstruction, provided that they are safely stacked and secured. The property owner shall remove all materials not sold, donated, or re-used from the deconstruction site by the deconstruction completion date and within the Period of Deconstruction.

FINAL DRAFT

- (8) *Deconstruction Review.* Before post-deconstruction review is approved by the Director, the Certified Deconstruction Contractor of a structure shall submit a Post-Deconstruction Form and all required documentation to the Office of Historic Preservation.
- (c) *Site Inspections.* Upon the written consent of the property owner of the subject application, the Director is authorized to conduct site inspections throughout the Period of Deconstruction to assure compliance with this article.
- (d) *Compliance.* Any demolition work that exceeds or violates the provisions of this article shall be subject to penalties set forth in section 12-26 of this article. Compliance with the provisions of this article does not exempt the demolition of buildings or structures from any other requirement.
 - (1) Certified Deconstruction Contractors shall follow all deconstruction, building related and licensing requirements, regulations, and laws.
 - (2) Failure to complete deconstruction, remove materials, and obtain approval of the Post-Deconstruction Form within the Period of Deconstruction shall result in the City completing the abatement of the property at cost of the property owner.
- (e) *Suspension or Revocation of Deconstruction Certification.* In the event a Certified Deconstruction Contractor fails or refuses to comply with requirements of this article, performs demolition work that exceeds or violates the deconstruction requirements of the demolition permit issued, or does not complete the deconstruction activities and documentation of a permit issued under this article, then the Director may suspend or revoke the deconstruction certification of such contractor, cancel all unexecuted permits issued to such contractor, and stop all work being done by such contractor, and withhold approval of further permits for deconstruction work until any or all incomplete or defective work of such contractor is fully completed by such contractor. Suspension or revocation of deconstruction contractor certification is accomplished by mailing to the holder of such certification a written notice by certified mail stating the permit or certification is suspended or revoked or by personally delivering to the holder thereof a written notice stating the permit or certification is suspended or revoked. An appeal of the **Director's** decision may be made as set forth in section 12-25 of this article.

Sec. 12-24. Exemptions.

- (a) *Exemptions.* Building conditions, damage, catastrophic events, or other factors may limit suitability for deconstruction and the amount of material that can be reasonably or safely salvaged. The following are exempt from the requirements of this article:
 - (1) A structure is unsuitable for deconstruction because:
 - A. The structure has been determined to be a clear and imminent danger to life, safety, or property under San Antonio City Code Chapter 6, Section 6-175 Emergency Demolitions; or

FINAL DRAFT

B. A large majority of material in the structure is not suitable for reuse as determined by the Director upon review of a request from exemption from the Certified Deconstruction Contractor assigned to the project.

- (b) *Determination of an Exemption.* The Director will decide exemptions based on evidence submitted as well as by an inspection of the conditions of the property to confirm unsuitability. Upon determining that the request for an exemption contains all the required information, the Office of Historic Preservation will contact the applicant within five (5) business days to request a site visit on a mutually agreed upon date and time. Within five (5) business days of the site visit, the Director will either approve, deny, in whole or in part, or request additional information. Receipt of requested additional information will be reviewed and a determination will be made within five (5) days of receipt. The Director, at his or her discretion, may refer the criteria for exemption to the Historic and Design Review Commission (HDRC) for a recommendation before determination is made. **The Director's decision may be appealed in accordance with section 12-25 of this article.**

Sec. 12-25. Appeals.

- (a) *Notice of Appeal.* An appeal of **the Director's decision** may be made by the property owner of the subject application. The property owner shall file a notice of appeal with the Office of Historic Preservation within ten (10) business days after the issuance of the **Director's decision. Upon receipt of** a notice of appeal, the Director shall transmit to the Board of Adjustment for the City of San Antonio all original documents and materials, or true copies thereof, constituting the record upon which the decision appealed from was based.
- (b) *Appeal Hearing.* The Board of Adjustment (BOA) shall decide the appeal within sixty (60) days after receipt of a notice of appeal. The property owner may appear at the appeal hearing in person or by agent or attorney. The BOA shall consider the same criteria as the Director. The BOA may reverse or affirm, in whole or in part, or modify the **Director's** decision by the concurring vote of seventy-five percent (75%) of the members.
- (c) *Building Standards Board.* Notwithstanding any other language in this section, demolition orders issued by the Building Standards Board (BSB) requiring compliance with this Article shall follow appeal procedures in accordance with Chapter 6, Article VIII, Section 6-173 of the City Code.

Sec. 12-26. Violations, penalties, and enforcement.

- (a) *Violations.* It shall be unlawful for a person to fail to adhere to any provision of this article. Each violation of a particular section of this article shall constitute a separate offense, and each day an offense continues shall be considered a new violation for purposes of enforcing this article.

FINAL DRAFT

(b) *Penalties.*

- (1) *Criminal.* A conviction for violation of any provision of this article shall constitute a Class C misdemeanor. A person convicted of a violation shall be fined an amount not to exceed five hundred (\$500) dollars per violation. A culpable mental state is not required to prove an offense under this article.
- (2) *Civil.* A person found liable for violation of any provision of this article shall be subject to a civil penalty in an amount not to exceed one thousand dollars (\$1000.00) per violation.
- (3) *Administrative.* The Director, at his or her discretion, is authorized to take any and all appropriate administrative actions against violators of this Chapter and upon a finding thereof, including but not limited to recommendations that registrations to conduct business within the City be revoked for a set length of time, revocations of certificates of deconstruction, and denial or revocation of present and future permits for a set length of time. Appeals of any administrative action taken will follow the process laid out in their respective chapters.

- (c) Nothing in this article shall limit the remedies available to the City as provided by law in seeking to enforce this Deconstruction Code. The Director shall have authority to designate trained personnel to issue notices of violation and to make accompanying affidavits to enforce this Code for the benefit of the public health, safety, and welfare.

SECTION 3. All other provisions of Chapter 12 of the City Code of San Antonio, Texas shall remain in full force and effect unless expressly amended by this Ordinance.

SECTION 4. Violations occurring after January 1, 2023, shall be punished as provided in the revised City Code Chapter 12. Violations prior to the effective date shall be punished under the former applicable Sections which shall remain in effect for that purpose.

SECTION 5. Should any Article, Section, Part, Paragraph, Sentence, Phrase, Clause, or Word of this Ordinance, for any reason be held illegal, inoperative, or invalid, or if any exception to or limitation upon any general provision herein contained be held to be unconstitutional or invalid or ineffective, the remainder shall, nevertheless, stand effective and valid as if it had been enacted and ordained without the portion held to be unconstitutional or invalid or ineffective.

SECTION 6. The City Clerk is directed to promptly publish public notice of this Ordinance in accordance with Article II, City Council, Section 17 Publication of Ordinance of the City Charter of San Antonio, Texas.

SECTION 7. The publishers of the City Code of San Antonio, Texas are authorized to amend said Code to reflect the changes adopted in this ordinance and to correct typographical errors and to index, format, and number paragraphs to conform to the existing code.

AL
9/08/2022
Item No. XX

FINAL DRAFT

SECTION 8. Penalties provided for in this revised City Code Chapter 12 shall be effective January 1, 2023, after publication by the City Clerk.

SECTION 9. This Ordinance shall become effective October 1, 2022.

PASSED AND APPROVED this 8th day of September 2022.

M A Y O R
Ron Nirenberg

ATTEST:

APPROVED AS TO FORM:

Debbie Racca-Sittre, City Clerk

Andrew Segovia, City Attorney

BIBLIOGRAPHY

- Allam, A. S., & Nik-Bakht, M. (2023). From demolition to deconstruction of the built environment: A synthesis of the literature. *Journal of Building Engineering*, 64, 105679. <https://doi.org/10.1016/j.jobe.2022.105679>
- Ammon, F. R. (2016). *Bulldozer: Demolition and clearance of the postwar landscape*. Yale University Press.
- Architecture 2030. (n.d.). *Why the built environment?* Architecture 2030. Retrieved April 30, 2023, from <https://architecture2030.org/why-the-building-sector/>
- Armstrong, B., & LaMore, R. (2018). *Guide to Local Ordinances: Deconstruction and the Management of C&D Material Waste*. Retrieved April 30, 2023, from https://domicology.msu.edu/upload/GuidetoLocalOrdinances_May2018.pdf.
- Bauman, R. (n.d.). *Alderman Bauman's Biography*. Alderman Bauman's biography. Retrieved April 30, 2023, from <https://city.milwaukee.gov/CommonCouncil/CouncilMembers/District4/AldermanBaumansBio>
- Benachio, G. L., Freitas, M. do, & Tavares, S. F. (2020). Circular economy in the construction industry: A Systematic Literature Review. *Journal of Cleaner Production*, 260, 121046. <https://doi.org/10.1016/j.jclepro.2020.121046>
- Bertino, G., Kisser, J., Zeilinger, J., Langergraber, G., Fischer, T., & Österreicher, D. (2021). Fundamentals of building deconstruction as a circular economy strategy for the reuse of construction materials. *Applied Sciences*, 11(3), 939. <https://doi.org/10.3390/app11030939>
- Bezold, C., Bauer, S. J., Buckley, J. P., Batterman, S., Haroon, H., & Fink, L. (2020). Demolition activity and elevated blood lead levels among children in Detroit, Michigan, 2014–2018. *International Journal of Environmental Research and Public Health*, 17(17), 6018. <https://doi.org/10.3390/ijerph17176018>
- Brütting, J., De Wolf, C., & Fivet, C. (2019). The reuse of load-bearing components. *IOP Conference Series: Earth and Environmental Science*, 225, 012025. <https://doi.org/10.1088/1755-1315/225/1/012025>
- Build Reuse. (n.d.). *Build reuse*. Build Reuse. Retrieved April 30, 2023, from <https://www.buildreuse.org/about>
- Causey, J. (2018). *53206 is Wisconsin's most incarcerated zip code. here are 4 more facts about the Milwaukee neighborhood*. Journal Sentinel. Retrieved April 30, 2023, from <https://www.jsonline.com/story/news/local/wisconsin/2018/12/07/53206-facts-milwaukees-troubled-zip-code/2237529002/>
- Cheng, J. C. P., & Ma, L. Y. H. (2013). A BIM-based system for demolition and renovation waste estimation and planning. *Waste Management*, 33(6), 1539–1551. <https://doi.org/10.1016/j.wasman.2013.01.001>
- Chini, A. (2001). *Deconstruction and Materials Reuse: Technology, Economic, and Policy*. Retrieved April 30, 2023, from https://www.iip.kit.edu/downloads/CIB_Publication_266.pdf.

- City of Milwaukee, A substitute ordinance relating to deconstruction of residential buildings (2017). Milwaukee, WI. Retrieved April 29, 2023, from <https://city.milwaukee.gov/ImageLibrary/Groups/dnsAuthors/Decon/DeconOrdinance170188.pdf>
- City of Milwaukee, Proposed Amendment to the Action Plan for Federal Funding for the Neighborhood Stabilization Program II (NSP 2) for the Redevelopment of Abandoned & Foreclosed Homes (2010). Retrieved April 30, 2023, from <https://city.milwaukee.gov/ImageLibrary/User/jsteve/NSP2-amendment-FINALDRAFTforwe.pdf>.
- City of Milwaukee. (n.d.). *Small business development*. RPP. Retrieved April 30, 2023, from <https://city.milwaukee.gov/Equity-and-Inclusion/RPP>
- City of Palo Alto, Zero Waste Plan (2018). Retrieved April 30, 2023, from <https://www.cityofpaloalto.org/files/assets/public/zero-waste/zero-waste-website-files/2018-zero-waste-plan.pdf>.
- City of Palo Alto, Deconstruction and Construction Materials Management (n.d.). Retrieved April 29, 2023, from https://codelibrary.amlegal.com/codes/paloalto/latest/paloalto_ca/0-0-0-65161.
- City of Palo Alto. (2019). *Zero Waste – New Deconstruction and Foodware Reduction Requirements*. Retrieved April 30, 2023, from <https://www.cityofpaloalto.org/files/assets/public/agendas-minutes-reports/reports/city-manager-reports-cmrs/year-archive/2019/10148.pdf?t=53734.77>.
- City of Palo Alto. (2021). *Deconstruction & Construction Materials Management*. City of Palo Alto, CA. Retrieved April 30, 2023, from <https://www.cityofpaloalto.org/Departments/Public-Works/Zero-Waste/Zero-Waste-Requirements-Guidelines/Deconstruction-Construction-Materials-Management#section-3>
- City of Palo Alto. (2022). *Update on the Fiscal Year 2022 Implementation of the Deconstruction and Construction Materials Management Ordinance*. Retrieved April 30, 2023, from <https://www.cityofpaloalto.org/files/assets/public/cmr-14836.pdf>.
- City of Palo Alto. (2023). *Zero waste*. City of Palo Alto, CA. Retrieved April 30, 2023, from <https://www.cityofpaloalto.org/Departments/Public-Works/Zero-Waste>
- City of Portland, Amendment to Deconstruction of Buildings Law (2019). Retrieved April 29, 2023, from <https://www.portland.gov/bps/decon/documents/adopted-amendment-language/download>.
- City of Portland, Chapter 17.106 Deconstruction of Buildings Law (2016). Portland, OR. Retrieved April 29, 2023, from <https://www.portland.gov/bps/decon/documents/deconstruction-ordinance/download>.
- City of Portland. (2023). *Certified Deconstruction Contractors*. Portland.gov. Retrieved April 30, 2023, from <https://www.portland.gov/bps/climate-action/decon/certified-deconstruction-contractors>
- City of San Antonio. (2022). *Amending Chapter 12 entitled “Vacant Structures” To Adopt Deconstruction Regulations for Residential and Accessory Structures Within the City of San Antonio and Establishing Penalties*. San Antonio, TX.

- City of San Antonio. (2016). *City of San Antonio annexation policy, program, and plan*. Retrieved April 30, 2023, from <https://www.sanantonio.gov/Portals/0/Files/Planning/Annexation/2020Edits/AnnexationPolicyDocuments2016.pdf?ver=2021-09-22-085721-030>.
- City of San Antonio. (n.d.). *Material innovation center*. San Antonio Reuse. Retrieved April 30, 2023, from <https://www.sareuse.com/mic>
- City of Vancouver. (n.d.). *Demolition permit with recycling and deconstruction requirements*. City of Vancouver. Retrieved April 30, 2023, from <https://vancouver.ca/home-property-development/demolition-permit-with-recycling-requirements.aspx>
- Cook, W., & Mayes, T. (2017). *Shifting the Paradigm from Demolition to Reuse: New Tools*. National Trust for Historic Preservation. Retrieved April 30, 2023, from <https://forum.savingplaces.org/blogs/special-contributor/2017/02/16/shifting-the-paradigm-from-demolition-to-reuse-new-tools>
- CR0WD. (2022). *CR0WDsource Deconstruction: A Guide For Local Government*. Retrieved April 29, 2023, from https://www.cr0wd.org/_files/ugd/52fa8e_aa6c6c9e141d4f79ad5b7fc9e46a0c62.pdf.
- CR0WD. (2023). *Toward Building Sustainable Communities and Circular Economies: A Local Government Policy Guide to Alternatives to Demolition through Deconstruction and Building Material Reuse*. Retrieved May 15, 2023, from https://www.cr0wd.org/_files/ugd/52fa8e_7132447b0ded417bbdc657b3ee7abfae.pdf
- Crowther, P. (1999). International science and technology conference. In *Historic trends in building disassembly*. Montreal. Retrieved April 30, 2023, from <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=0668b874547184705d88da799cbbddce6dab6632>.
- Crowther, P. (2001). Developing an Inclusive Model for Design for Disassembly. *Deconstruction and Materials Reuse: Technology, Economic, and Policy, CIB Publication 266*, 1–26.
- Crowther, P. (2016). Morphological analysis of the city for achieving design for disassembly. In A. Galiano-Garrigos & C. A. Brebbia (Eds.), *The sustainable city XI* (pp. 15–26). essay, WIT Press.
- Danatzko, J. M., & Sezen, H. (2011). Sustainable structural design methodologies. *Practice Periodical on Structural Design and Construction*, 16(4), 186–190. [https://doi.org/10.1061/\(asce\)sc.1943-5576.0000095](https://doi.org/10.1061/(asce)sc.1943-5576.0000095)
- Dantata, N., Touran, A., & Wang, J. (2005). An analysis of cost and duration for deconstruction and demolition of residential buildings in Massachusetts. *Resources, Conservation and Recycling*, 44(1), 1–15. <https://doi.org/10.1016/j.resconrec.2004.09.001>
- Delta Institute. (2018). *Deconstruction & building material reuse: a tool for local governments & economic development practitioners*. Retrieved April 30, 2023, from <https://delta-institute.org/wp-content/uploads/2018/05/Deconstruction-Go-Guide-6-13-18-.pdf>.
- Diekemper, N. (2022). *City of duplexes*. City Journal. Retrieved April 30, 2023, from <https://www.city-journal.org/article/city-of-duplexes#:~:text=Notably%2C%20Milwaukee%20boasts%20the%20highest,ranks%20third%2C%20at%2013.4%20percent>.

- Dougherty, C. (2020). *California, mired in a housing crisis, rejects an effort to ease it*. The New York Times. Retrieved April 30, 2023, from <https://www.nytimes.com/2020/01/30/business/economy/sb50-california-housing.html?searchResultPosition=4>
- Ducker, R. (2013). *Demolition and code enforcement involving historic districts and landmarks*. Coates' Canons NC Local Government Law. Retrieved April 30, 2023, from <https://canons.sog.unc.edu/2013/11/demolition-and-code-enforcement-involving-historic-districts-and-landmarks/>
- Elefante, Carl. (2007). "The Greenest Building Is... One That Is Already Built." *The Journal of the National Trust for Historic Preservation* 21, no. 4 (Summer): 26–38.
- Ellen MacArthur Foundation. (2021). *Completing the picture: How the circular economy tackles climate change*. How to Build a Circular Economy. Retrieved April 29, 2023, from <https://ellenmacarthurfoundation.org/completing-the-picture>
- European Commission. (2022). *Buildings and construction*. Internal Market, Industry, Entrepreneurship and SMEs. Retrieved April 29, 2023, from https://single-market-economy.ec.europa.eu/industry/sustainability/buildings-and-construction_en
- Falk, B. (2002). Wood-Framed Building Deconstruction A Source of Lumber for Construction? *Forest Products Journal*, 52(3). Retrieved April 29, 2023, from <https://www.fpl.fs.usda.gov/documnts/pdf2002/falk02a.pdf>.
- Farfel, M. R., Orlova, A. O., Lees, P. S., Rohde, C., Ashley, P. J., & Chisolm, J. J. (2003). A study of urban housing demolitions as sources of lead in ambient dust: Demolition practices and exterior dust fall. *Environmental Health Perspectives*, 111(9), 1228–1234. <https://doi.org/10.1289/ehp.5861>
- Ghisellini, P., Ripa, M., & Ulgiati, S. (2018). Exploring environmental and economic costs and benefits of a circular economy approach to the construction and demolition sector. A literature review. *Journal of Cleaner Production*, 178, 618–643. <https://doi.org/10.1016/j.jclepro.2017.11.207>
- Gorgolewski, M. (2008). Designing with reused building components: Some challenges. *Building Research & Information*, 36(2), 175–188. <https://doi.org/10.1080/09613210701559499>
- Hammond, G. P., & Jones, C. I. (2008). Embodied Energy and carbon in construction materials. *Proceedings of the Institution of Civil Engineers - Energy*, 161(2), 87–98. <https://doi.org/10.1680/ener.2008.161.2.87>
- Hein, M. F., & Houck, K. D. (2008). Construction challenges of adaptive reuse of historical buildings in Europe. *International Journal of Construction Education and Research*, 4(2), 115–131. <https://doi.org/10.1080/15578770802229466>
- Heisel, F., Hebel, D. E., & Sobek, W. (2019). Resource-respectful construction – the case of the Urban Mining and Recycling Unit (Umar). *IOP Conference Series: Earth and Environmental Science*, 225, 012049. <https://doi.org/10.1088/1755-1315/225/1/012049>
- Heisel, F., McGranahan, J., Ferdinando, J., & Dogan, T. (2022). High-resolution combined building stock and building energy modeling to evaluate whole-life carbon emissions and saving potentials at

- the building and urban scale. *Resources, Conservation and Recycling*, 177, 106000. <https://doi.org/10.1016/j.resconrec.2021.106000>
- Hertlein, B. H., & Walton, W. H. (2000). Assessment and reuse of Old Foundations. *Transportation Research Record: Journal of the Transportation Research Board*, 1736(1), 48–52. <https://doi.org/10.3141/1736-07>
- Hu, M. (2022). Embodied carbon emissions of the residential building stock in the United States and the effectiveness of mitigation strategies. *Climate*, 10(10), 135. <https://doi.org/10.3390/cli10100135>
- Hubka, T. C., & Kenny, J. T. (2000). The Workers' Cottage in Milwaukee's Polish Community: Housing and the Process of Americanization, 1870-1920. *Perspectives in Vernacular Architecture*, 8, 33–52. <https://doi.org/10.2307/3514406>
- Jannene, J. (2021). *Eyes on Milwaukee: Bauman's demolition moratorium killed*. Urban Milwaukee. Retrieved April 30, 2023, from <https://urbanmilwaukee.com/2021/06/08/eyes-on-milwaukee-baumans-demolition-moratorium-killed/>
- Jeffrey, C. (2011). *Construction and Demolition Waste Recycling A Literature Review*. Retrieved April 30, 2023, from <https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/sustainability/resources/publications-and-plans/waste/Final%20C%26D%20literature%20review.pdf>.
- Kikutake, K. 1995, 'On the Notion of Replaceability', *World Architecture*, vol. 33, p26-27.
- Küpfer C., Fivet, C. (2021) *Déconstruction Sélective - Construction Réversible: recueil pour diminuer les déchets et favoriser le réemploi dans la construction*. doi: 10.5281/zenodo.4314325
- Laefer, D. F., & Farrell, K.-A. (2015). A hybrid method for foundation reuse evaluation. *Environmental Geotechnics*, 2(4), 224–236. <https://doi.org/10.1680/envgeo.13.00034>
- Langston, C. A. (2008). The sustainability implications of building adaptive reuse. 1-10. Paper presented at The Chinese Research Institute of Construction Management (CRIOCM) International Symposium, Beijing , China
- Lanthier, N. (2023). *B.C. cities adopting stringent bylaws to divert building demolition waste from landfills*. The Globe and Mail. Retrieved April 30, 2023, from <https://www.theglobeandmail.com/business/industry-news/property-report/article-bc-cities-adopting-stringent-bylaws-to-divert-building-demolition/>
- Lauer, A. (2019). *Lead-Safe Demolition Working Group Report*. Retrieved April 30, 2023, from <http://d-scholarship.pitt.edu/37684/1/IOP%20-%20Lead%20Safe%20Demolition%20Report.pdf>.
- Lawson, B. (2006). Embodied Energy of Building Materials. *Environment Design Guide*, 1–5. <http://www.jstor.org/stable/26148351>
- Leigh, N. G., & Patterson, L. M. (2006). Deconstructing to redevelop: A sustainable alternative to mechanical demolition: The Economics of Density Development Finance and Pro Formas. *Journal of the American Planning Association*, 72(2), 217–225. <https://doi.org/10.1080/01944360608976740>

- López Ruiz, L. A., Roca Ramón, X., & Gassó Domingo, S. (2020). The circular economy in the construction and Demolition Waste Sector – a review and an integrative model approach. *Journal of Cleaner Production*, 248, 119238. <https://doi.org/10.1016/j.jclepro.2019.119238>
- McCarthy, T. M., & Glekas, E. E. (2019). Deconstructing heritage: Enabling a Dynamic Materials Practice. *Journal of Cultural Heritage Management and Sustainable Development*, 10(1), 16–28. <https://doi.org/10.1108/jchmsd-06-2019-0084>
- Miller, C. M. (2016). *Iron ring*. Encyclopedia of Milwaukee. Retrieved April 30, 2023, from <https://emke.uwm.edu/entry/iron-ring/>
- National Parks Service. (2022). *The secretary of the interior's standards for the treatment of Historic Properties*. National Parks Service. Retrieved April 30, 2023, from <https://www.nps.gov/orgs/1739/secretary-standards-treatment-historic-properties.htm>
- Olen, M. E. (2019). *Deconstruction: Reducing the costs to deconstruct blighted buildings* (thesis). Retrieved April 30, 2023, from <https://minds.wisconsin.edu/bitstream/handle/1793/79629/2019olenm.pdf?sequence=1&isAllowed=y>
- Oregon Metro. (2021). *Urban growth boundary*. Metro. Retrieved April 30, 2023, from <https://www.oregonmetro.gov/urban-growth-boundary>
- Osmani, M. (2011). Construction waste. *Waste*, 207–218. <https://doi.org/10.1016/b978-0-12-381475-3.10015-4>
- Paruszkiewicz, M., Liu, J., Hanes, R., Hoffman, E., & Hulseman, P. (2016). *The Economics of Residential Building Deconstruction in Portland, OR*. Retrieved April 30, 2023, from https://pdxscholar.library.pdx.edu/nerc_pub/1/
- Potter, B. (2020). *Every building in America - an analysis of the US Building Stock*. Every Building in America - an Analysis of the US Building Stock. Retrieved April 30, 2023, from <https://constructionphysics.substack.com/p/every-building-in-america-an-analysis>
- Preservation Green Lab. (2011). *The Greenest Building: Quantifying the Environmental Value of Building Reuse*. Retrieved April 30, 2023, from https://living-future.org/wp-content/uploads/2022/05/The_Greenest_Building.pdf
- Purchase, C. K., Al Zulayq, D. M., O'Brien, B. T., Kowalewski, M. J., Berenjian, A., Tarighaleslami, A. H., & Seifan, M. (2021). Circular economy of construction and Demolition Waste: A literature review on lessons, Challenges, and benefits. *Materials*, 15(1), 76. <https://doi.org/10.3390/ma15010076>
- Redsten, G. (2023). *City of Milwaukee will renovate and sell vacant, foreclosed homes*. Journal Sentinel. Retrieved April 30, 2023, from <https://www.jsonline.com/story/news/local/milwaukee/2023/04/24/milwaukee-vacant-foreclosed-homes-will-be-renovated-for-sale/70134914007/>
- Rios, F. C., Chong, W. K., & Grau, D. (2015). Design for disassembly and deconstruction - challenges and opportunities. *Procedia Engineering*, 118, 1296–1304. <https://doi.org/10.1016/j.proeng.2015.08.485>

- Ross, S. M. (2020). Re-evaluating heritage waste: Sustaining material values through deconstruction and reuse. *The Historic Environment: Policy & Practice*, 11(2-3), 382–408.
<https://doi.org/10.1080/17567505.2020.1723259>
- Ryberg-Webster, S., & Kinahan, K. L. (2013). Historic Preservation and urban revitalization in the twenty-first century. *Journal of Planning Literature*, 29(2), 119–139.
<https://doi.org/10.1177/0885412213510524>
- Rypkema, D., Grosicki, B., Swink, R., Cotton, K., Herr-Cardillo, S., Bruni, C., & Frystak, A. (2021, February). *Treasure in the Walls*. Retrieved April 29, 2023, from
<https://www.sanantonio.gov/Portals/0/Files/HistoricPreservation/Deconstruction/Treasure%20in%20the%20Walls.pdf>
- Shooshtarian, S., Caldera, S., Maqsood, T., & Ryley, T. (2020). Using recycled construction and demolition waste products: A review of stakeholders' perceptions, decisions, and motivations. *Recycling*, 5(4), 31. <https://doi.org/10.3390/recycling5040031>
- Sizirici, B., Fseha, Y., Cho, C.-S., Yildiz, I., & Byon, Y.-J. (2021). A review of carbon footprint reduction in construction industry, from design to operation. *Materials*, 14(20), 6094.
<https://doi.org/10.3390/ma14206094>
- Sussman, D. (1994). *The 1950s: So long, sleepy town*. Palo Alto Online: The 1950s: So long, sleepy town - Palo Alto: The First 100 Years. Retrieved April 30, 2023, from
https://www.paloaltoonline.com/news_features/centennial/1950SA.php#:~:text=People%20quickly%20began%20spending%20their,26%2C000%20new%20residents%20moved%20in.
- Sussman, D. (1994). *The tumultuous '60s*. Palo Alto Online: The tumultuous '60s - Palo Alto: The First 100 Years. Retrieved April 30, 2023, from
https://www.paloaltoonline.com/news_features/centennial/1960SA.php
- United Nations Environment Programme. (2015). *Global Waste Management Outlook*. Retrieved April 30, 2023, from <https://www.unep.org/resources/report/global-waste-management-outlook>.
- United Nations Framework Convention on Climate Change, The Paris Agreement (2015). Retrieved April 30, 2023, from https://unfccc.int/sites/default/files/english_paris_agreement.pdf.
- United Neighborhoods for Reform. (2014). Demolition/Development Resolution. Retrieved April 30, 2023, from <http://1.bp.blogspot.com/-WJsIEK7DMKI/VFZ9dx8kuDI/AAAAAAAAADFU/CIC-x1-QXOs/s1600/UNRDemolitionResolution.jpg>
- United Neighborhoods for Reform. (2014). *United Neighborhoods for Reform*. November 2014. Retrieved April 30, 2023, from <http://unitedneighborhoodsforreform.blogspot.com/2014/11/>
- US Census Bureau. (2023, April 3). *Fastest-growing cities are still in the west and South*. Census.gov. Retrieved April 30, 2023, from <https://www.census.gov/newsroom/press-releases/2022/fastest-growing-cities-population-estimates.html>
- U.S. Census Bureau. (2021). *2021 American Community Survey 5-year Estimates, Home Value* [Data file]. Retrieved from https://www.socialexplorer.com/tables/ACS2021_5yr/R13365913

- U.S. Census Bureau. (2021). *2021 American Community Survey 5-year Estimates, Median Household Income* [Data file]. Retrieved from https://www.sociaexplorer.com/tables/ACS2021_5yr/R13365908
- U.S. Census Bureau. (2021). *2021 American Community Survey 5-year Estimates, Population and Density* [Data file]. Retrieved from https://www.sociaexplorer.com/tables/ACS2021_5yr/R13365914
- U.S. Census Bureau. (2021). *2021 American Community Survey 5-year Estimates, Units in Structure* [Data file]. Retrieved from https://www.sociaexplorer.com/tables/ACS2021_5yr/R13365912
- U.S. Census Bureau. (2021). *2021 American Community Survey 5-year Estimates, Year Structure Built* [Data file]. Retrieved from https://www.sociaexplorer.com/tables/ACS2021_5yr/R13365903
- US Environmental Protection Agency, *Advancing Sustainable Materials Management: 2018 Fact Sheet* (2020). Retrieved April 29, 2023, from https://www.epa.gov/sites/default/files/2021-01/documents/2018_ff_fact_sheet_dec_2020_fnl_508.pdf.
- Wood, S. (2023). *Climate Action Plan Deconstruction and Reuse. U.S. Environmental Protection Agency Webinar*.
- Zillow. (2023). *Palo Alto Home Values*. Zillow. Retrieved April 30, 2023, from <https://www.zillow.com/home-values/26374/palo-alto-ca/>