

The neighborhood bench, designed with the neighborhood: A participatory design-build project

by

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A REPORT

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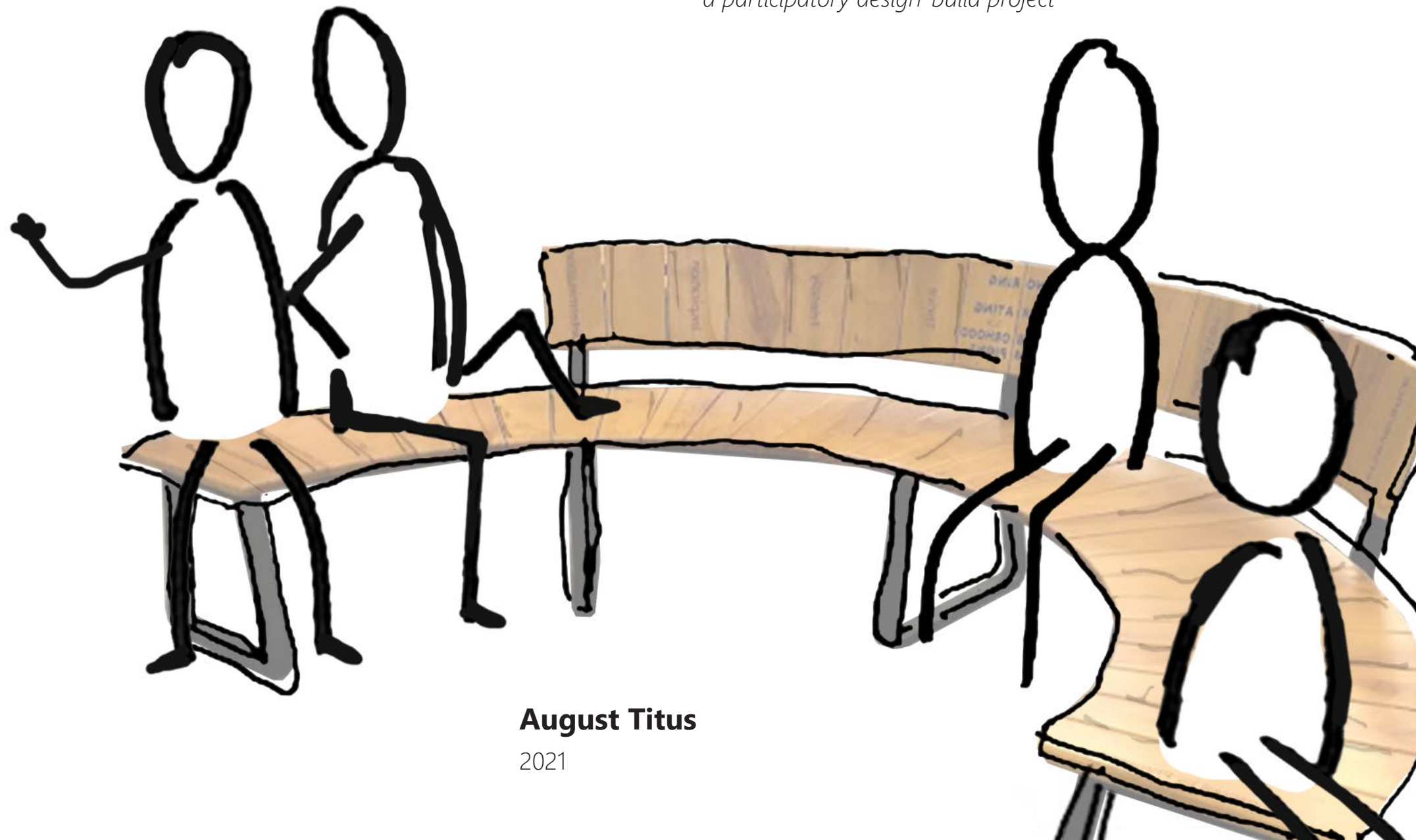
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Abstract

The placement of street furniture, especially benches, can help shape and activate public space. Outdoor benches and other street furniture can contribute to a neighborhood's "urban identity" (van Uffelen 2010). However, mass production of street furniture over the past century has led to a basic, near universal design style for benches (Olin 2017). Yet, a bench, like public art, can be designed to tell a story and reflect a neighborhood's unique character and visual identity. Thus, this project asks, how can a participatory design-build process inform the design and fabrication of a custom bench for a neighborhood? To inform the development of the participatory design-build process, the Ivanhoe neighborhood, in Kansas City, Missouri, was selected as the focus site. In working with a focus group of neighborhood residents, three participatory workshops were held to inform the design of a custom bench to be located in Jim Nutter Park. The workshops were collaborative sessions where participants expressed their thoughts and stories about their neighborhood; provided guidance and feedback and on preliminary design concepts; and expressed opinions about design details including overall size, materials, and colors. Guided by this feedback, a custom bench was fully designed and fabricated to reflect the focus groups' ideas. Reflecting on the overall process, a replicable participatory design-build guide was then developed for use by other designers, artisans, and craftspeople in future custom bench projects.

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The placement of street furniture, especially benches, can help shape and activate public space. Outdoor benches and other street furniture can contribute to a neighborhood’s “urban identity” (van Uffelen 2010). However, mass production of street furniture over the past century has led to a basic, near universal design style for benches (Olin 2017). Yet, a bench, like public art, can be designed to tell a story and reflect a neighborhood’s unique character and visual identity. Thus, this project asks, how can a participatory design-build process inform the design and fabrication of a custom bench for a neighborhood? To inform the development of the participatory design-build process, the Ivanhoe neighborhood, in Kansas City, Missouri, was selected as the focus site. In working with a focus group of neighborhood

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Preface

During the fall 2020 semester, I participated in a collaborative studio project. The focus site was Martin Luther King Jr. Square Park in Kansas City, Missouri. The site is located just south of the Ivanhoe neighborhood. During project reviews, local stakeholders were invited to participate. One of those stakeholders was Mrs. Nailah M’biti, Chief Real Estate Development Officer for the Ivanhoe Neighborhood Council. As my masters report project took shape, I reached out to her to see if I could work with the Ivanhoe community. She kindly agreed, and suggested Jim Nutter Park as a site in the neighborhood that could benefit from a custom bench.



chapter

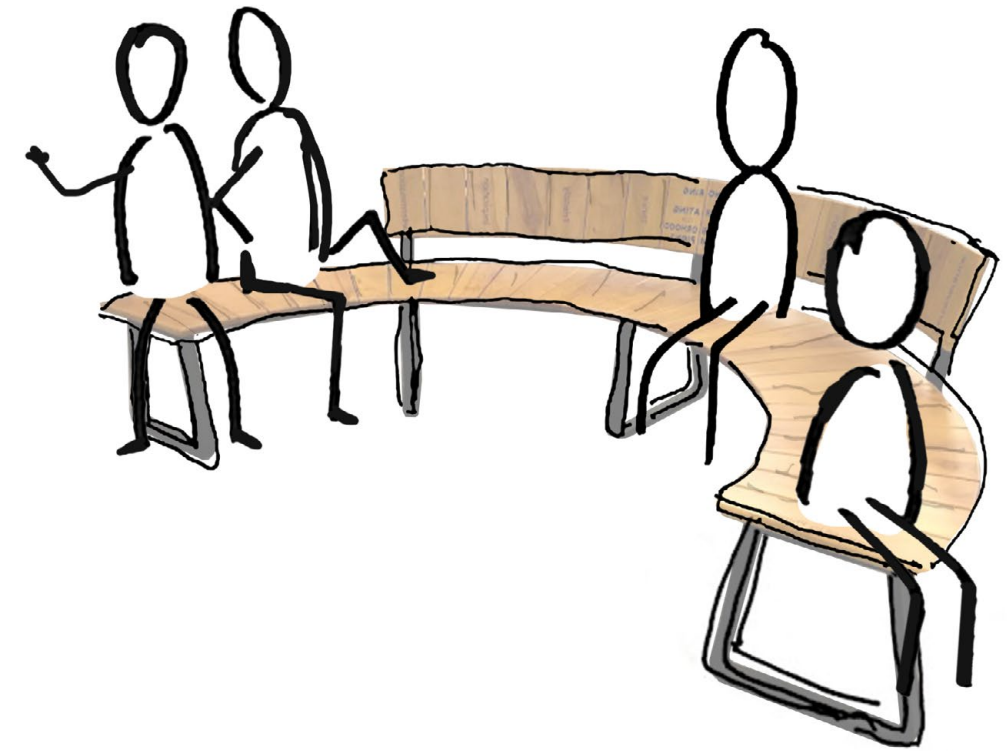
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introduction

Why a Bench?

In cities, outdoor benches and other street furniture are of greater importance than most people realize. Street furniture, also referred to as street furnishings or outdoor furniture, are objects such as benches, moveable chairs, lighting fixtures, waste bins, bike racks, and bollards that are typically found in public space. Street furniture helps shape and activate outdoor space, much like how furniture inside a house transforms rooms into homes. The functionality and importance of outdoor benches cannot be understated. They provide a place to rest, an edge to perch, and a place to gather with friends. Outdoor benches and other street furniture help to create a neighborhood's "urban identity" (van Uffelen 2010). The material, style, and color of these pieces are characteristics that help build an urban, visual identity.

Since the 20th century, the variety of design styles and materials found in outdoor benches has decreased significantly within public spaces, tending towards "simple," similar designs like wooden slats and metal leg supports (Olin 2017). The standard park bench over



"I sensed that places to sit - particularly benches - were entwined with the spatial structure and social/psychological character and success of public spaces. And yet they performed their parts quietly, in several ways that were neither noticed nor understood."

- Laurie Olin, in *Be Seated*, page 94



Figure 1.1

the years became a version of a traditional English park bench, and as a result the ubiquitous style of benches is barely worthy of attention (Olin 2017). Mass production of similar styles of site furnishings has created a generic character across public spaces. Many benches are bought for the lowest price and ease of maintenance. They are then placed without regard for social interaction or human comfort. Some benches are actually made purposefully uncomfortable to prevent people from sleeping on them (Bynon and Rishbeth 2015). However, street furniture, especially benches, can help create a unique visual identity for urban areas (van Uffelen 2010).

This project seeks to develop a replicable participatory design-build process to create a custom bench, apply the process working with the Ivanhoe neighborhood, and fabricate a custom bench. This project, in a small but important way, gives people who live in a neighborhood the ability to make decisions on what an aspect of their neighborhood should look like.

Goals of Study

- Develop a participatory design process that leads to the fabrication of a custom bench.
- Fabricate the bench with materials that are durable and that reflect the character of the neighborhood.
- Ensure the overall process is replicable by other designers or artisans to create unique outdoor furnishings in other communities.
- Install the custom bench on a site within the neighborhood.

Research Question

How can a participatory design-build process inform the design and fabrication of a custom bench for a neighborhood?

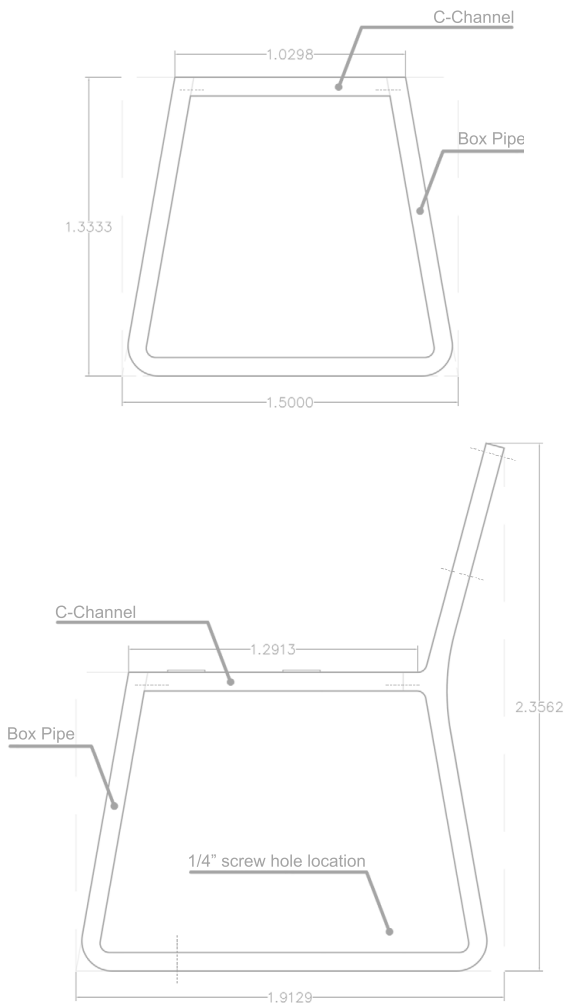


Figure 1.2 Bench leg dimensions and material makeup.

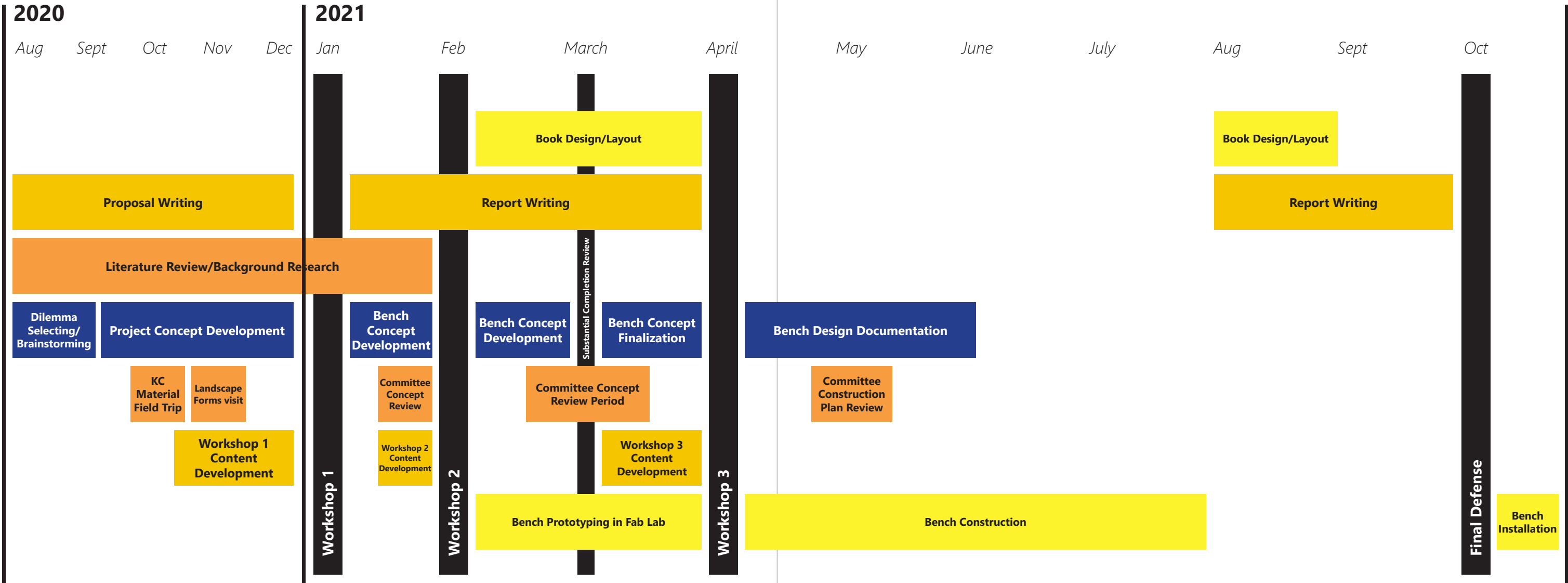


Overview of Report

This report presents a participatory design process for the design and fabrication of a custom bench. Chapter 2, Background, discusses participatory design, including its main principals and example methods, the history and current state of street furniture, and a review of relevant materials for outdoor furniture. Chapter 3, Methods, details the participatory design methods used for this research project. Chapter 4, Participatory Design Process, discusses the participatory design workshops that occurred and what the findings from each were. Chapter 5 presents the prototyping and fabrication process for the custom bench. Chapter 6 is a guide for other designers, artists, and craftspeople to recreate a participatory design-build custom bench project. Chapter 7 contains reflections on the entire process, along with suggestions for future research.

Figure 1.3 Bench in plan view with centerline

Project Timeline





chapter

2

background

Background

Literature Review

Participatory Design

Participatory design, also called co-design, can be defined as “people not trained in design” collaborating with designers to utilize both group’s creativity during the design and development process (Stappers and Sanders 2008). Since the 1970’s, research projects in the participatory design field have primarily emerged from the Scandinavian countries: Denmark, Norway, and Sweden (Bødker 1996, Stappers and Sanders 2008). Those studies, however, were focused on computer applications in the workplace, using workers as the participants (Bødker 1996). Since those studies, the focus area of participatory design projects have expanded to other disciplines and the definition of participatory design shifted. Some people consider participatory design to be the “collective creativity of collaborating designers” (Stappers and Sanders 2008). Others argue participatory design is about sharing the ability to make decisions among all participants in the

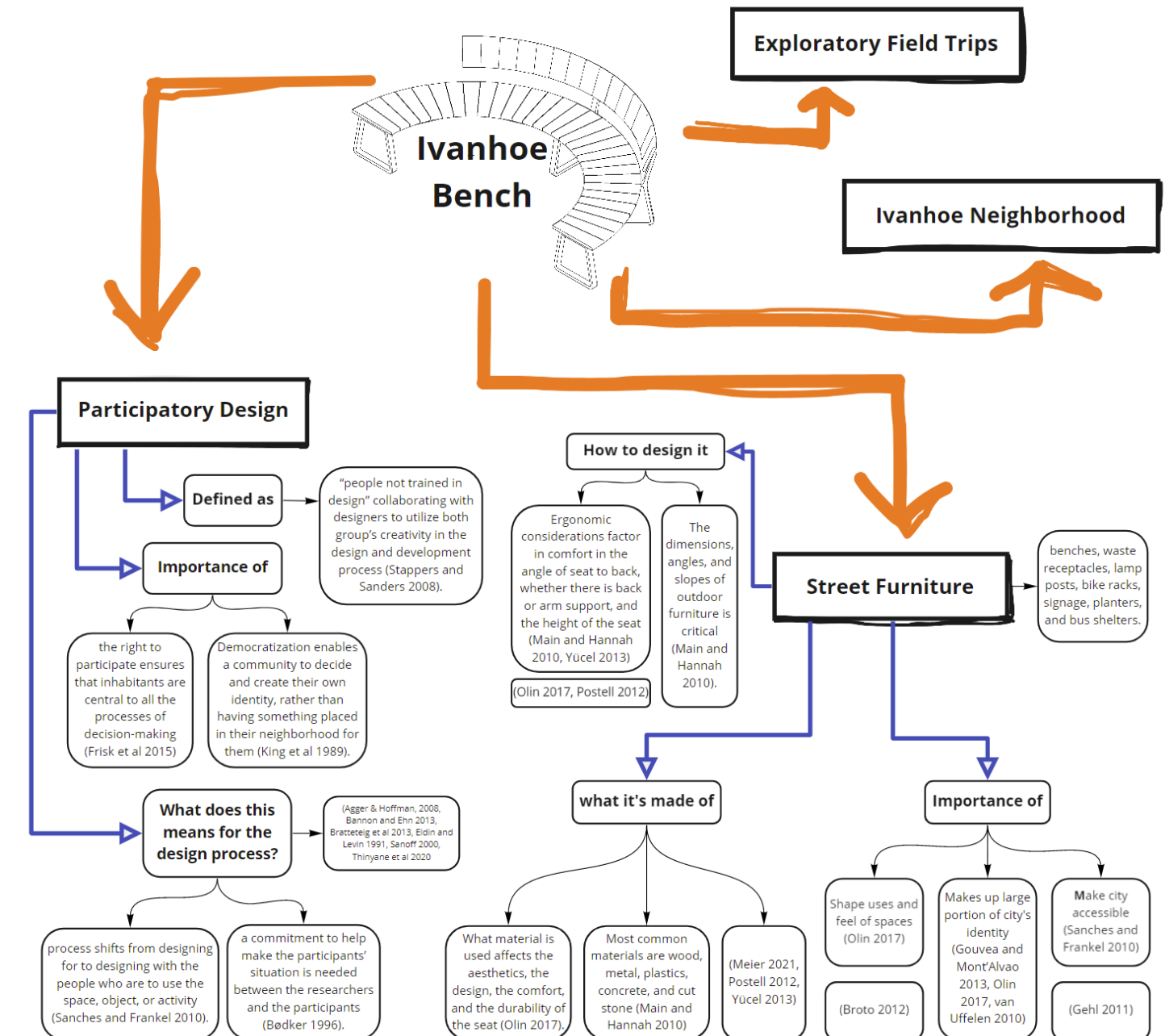


Figure 2.1 Literature Map

Goals of Participatory Design

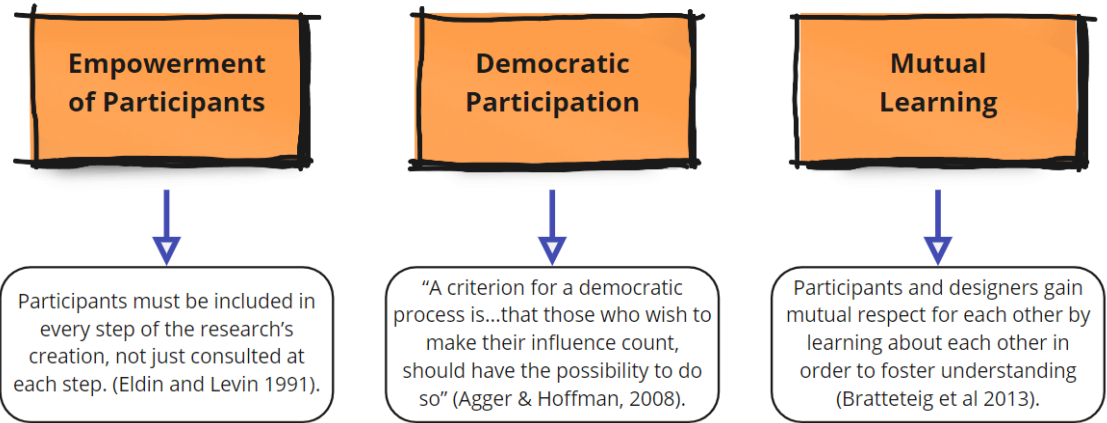


Figure 2.2 Goals of Participatory Design

process. Regardless of discipline, a participatory process is how participants, especially users and creators, work together to change, create, and tinker new and existing systems to better fit the end user’s needs (Bannon and Ehn 2013).

What does this mean for the design process? Designers partaking in participatory design must be willing to deal with issues related to power dynamics in the design process (Bratteteig et al 2013). The designer’s role is to facilitate conversation and to share and explain the design proposals with the non-designer participants while sharing the decision-making power with participants (Sanches and Frankel 2010). There is a shift in thinking that has to occur for designers, away from a mentality of designing for, to designing with those who will use the space, object, or activity (Sanches and Frankel 2010). During the development of initial projects using participatory design, intentional cooperation between

the researchers and participants became an important factor. A commitment to help make the participants’ situation better is needed between the researchers and the participants (Bødker 1996). “Although the researchers get research results out of this, the people with whom they work are equally entitled to get something out of the project” (Bødker 1996). The researcher should provide tools that the participants can use to create and express their ideas during the process (Sanches and Frankel 2010). As Stappers and Sanders state, “All people are creative but not all people become designers.” In general, there are four different levels of creativity seen in people during participatory design: “doing, adapting, making and creating”(2008).

In participatory design, participants must be included in every step of the process, not just consulted at the end. This strategy and pillar of participatory design is called empowering participation (Eldin and Levin 1991). Sanoff,

commenting on empowering participation, states that not “everyone in the community or organization is to be involved in every phase of the research process” (2000). Being respectful of different points of views, cultural backgrounds, and experience while giving each person equal voice is difficult. However, diverse knowledge and points of view are vital to gathering information and decision making in the participatory design process (Bratteteig et al. 2013).

Foundational to participatory design is mutual learning (Bannon and Ehn 2013, Bratteteig et al 2013, Thinyane et al 2020). Participants will all have their own expertise and line of reasoning. According to Bratteteig et al., the only way for participants to gain mutual respect for each other, especially between participants of different categories like researcher, designer, and user, is to have them learn about each other to foster understanding (2013). Particularly when participants are multidisciplinary, it is crucial to allow participants to become familiar with each participant’s expertise. Once familiarized, participants can recognize well-founded arguments when making shared decisions (Bratteteig et al 2013).

Why does this matter? Lefebvre claims that there are two rights of the people who live in cities: the right to occupy urban space, and the right to participate and contribute actively to the construction and design of the space (Frisk et al 2015). Generally, city planners, designers, and politicians are the ones who make decisions for public spaces and those items within, not those who live in a

place, thus deciding the visual identity of places (Sanches and Frankel 2010). The right to occupy the space within cities involves “the right to occupy, access, represent, characterize and create spaces based on everyday needs of the inhabitants. On the other hand, the right to participate ensures that inhabitants are central to all the processes of decision-making concerning the production of urban spaces (Frisk et al 2015). In addition, the people who live in a place are considered local experts and understand the function of spaces, the activities that take place within, know the community needs, and know the local history (Sanches and Frankel 2010).

Democratization enables a community to decide and create their own identity, rather than having something placed in their neighborhood for them (King et al 1989). “A criterion for a democratic process is – in a representative understanding of democracy – that those who wish to make their influence count, should have the possibility to do so” (Agger & Hoffman, 2008). This means more than sending out questionnaires, posting flyers, or handing out informational brochures about the changes and designs for an urban space, which is usually overlooked by the designer (Frisk et al 2015).

There are many methods by which to construct a participatory design process. See figure 2.3 for examples. Which methods are appropriate depends on the goals of the research and/or the problem to be solved. Participatory design methods can be categorized as: **awareness methods**, that help inform potential participants of the

Category	Method	Description
Awareness Methods	Exhibits	Set up in public spaces to inform people of project so they can decide to participate.
	News Media	News releases can inform people through newspapers, online forums, radio, or TV news stations.
	Walking Tours	Walking through the place of study to facilitate learning of environmental issues on site.
Indirect Methods	Surveys	These methods gather information from a sample of the population. Attitudes and opinions can also be gathered and gives "easily quantified, rapid results." These tend to reflect the position in the questions written by the researchers.
	Questionnaires	
Group Interaction Methods	Workshops	Participants learn from each other during exploration of the problem during workshops. These events can encompass many other types of participatory methods.
	Focus Groups	With a facilitator guiding the discussion, generally six to ten participants discuss the selected topic.
	Charettes	Interested groups attend interactive meetings to solve one problem, sometimes over a series of days.
	Design-in	Participants and designers work together plans, models, and photographs in an interactive design approach.
Open-Ended Methods	Community Meetings	Allows for the presentation of information to large groups of people at a time.
	Participatory Cable Television	An interactive television program where people can phone-in design ideas and these are discussed on the program. Could be shifted to modern times with a streaming service. Was used for the Roanoke Design 79 series.
	Planning Ballot	Option for participation by mail, can reach more people who cannot attend meetings.
Brainstorming Methods	Gallery	Each participant has a large note pad on an easel and is given time to write down all their ideas on the given problem, people then circulate, then go back to their own boards to rewrite. Notes can also be passed, which effective with those who do not wish to speak in front of people.
	Pin Card	Participants write ideas down on note card. Note cards are passed around and notes added by each new participant.
	Nominal Group Technique	Notes are pooled in middle of participants after a five-minute period to write down all ideas. Ideas are voted on and ranked in order of preference.
	Cranford Slip Writing	For large groups, where each participant is given 20 individual slips of paper for one idea to be written on each. The slips are collected and then organized by researchers.
	Delphi Method	After idea collection has occurred, which can be done anonymously by survey, the ideas are then ranked by each participant. The process keeps going until consensus is reached.

Figure 2.3 Participatory Methods Chart
Adapted from Community Participation
Methods in Design and Planning by
Henry Sanoff, AIA pages 68-86.

process and garner interest for participation; **indirect methods**, that provide rapid, quantifiable information; **group interaction methods**, convening interested groups together, most commonly in the form of a workshop; **open-ended methods**, to inform large groups of people at the same time; and **brainstorming methods**, to generate ideas within groups of participants (Sanoff 2000).

As a design process, participatory design typically involves more effort and work than a typical designer-centric design process. The added efforts of sharing power and democratizing the design process means a shift in thinking for the designer. The participatory design process empowers participants to make decisions that help shape their built environment.

Street Furniture

Street furniture, also called site furnishings or outdoor furniture, includes elements like benches, waste receptacles, lamp posts, bike racks, signs, planters, and bus shelters. These small details can make or break the potential of a space (Gehl 2011). For example, if seating is placed in a way that exposes the person using it, people are unlikely to sit there. However, if the seating is placed on the edge of a space, in a niche for privacy, or with something behind it, people are much more likely to sit (Gehl 2011). Immovable features such as benches and planter walls shape an outdoor space's uses, feel, and identity (Olin 2017, Gouvea and Mont'Alvao 2013, van Uffelen 2010). They are the "bones of public landscapes" (Olin 2017, 16). These features can be "distinctive" to a

place and when they are custom or unique, not "off-the-shelf," they can help give a space "particularity" (Broto 2012, Olin 2017). Laurie Olin, landscape architect, in his book *Be Seated*, discusses how current industry standards for street furniture cause a loss of identity:

This proliferation of all-too-familiar industrial products has also contributed to a loss of particularity and local character. Just as the ubiquity of international corporate stores, highway design, and entertainment has led to a widespread loss of identity across America and elsewhere, bottom-line considerations are encouraging a mind-numbing uniformity in contemporary landscape design. While there is no guarantee of effective resistance to this phenomenon, the custom design of furnishings, when combined with a sensitivity to context and local conditions, can contribute significantly to community identity and a "sense of place."

- Laurie Olin, in *Be Seated*, page 16

Street furniture constitutes a significant portion of a city's identity (Gouvea and Mont'Alvao 2013, van Uffelen 2010). The concept of a city's accessibility is also deeply linked to street furniture (Sanches and Frankel 2010). Street furnishings do this job quietly (Olin 2017). These furnishing pieces are so commonplace in cities that people have become accustomed to having them. However, without street furniture, daily life would become more difficult. These features and elements make it "easier to get around" and "accessible to everybody." Signage allows people to

orient themselves, and get their bearings, while benches allow people places to gather, rest, eat, and talk. Other important pieces of street furniture are bus shelters, bike racks, and streetlights, which help support the everyday activities of people as they move around a city (Sanches and Frankel 2010). Though the significant role street furniture plays in everyday life often goes unnoticed, they are a quintessential part of urban living.

Design Considerations for Outdoor Seating

There are many design decisions and functional considerations to make when designing or selecting outdoor seating. Such considerations include material choices, dimensions, shape, size, form, angle, and comfort (Olin 2017, Main and Hannah 2010, Postell 2012). Decisions about form must also include consideration of the size and shape. Ergonomic considerations such as the angle of seat and back, support in the shape of armrests or backrests, and the height of the seat all contribute to the comfort of a bench. While indoor seating is allowed padding, outdoor furniture is usually made of hard surfaces to provide durability. Therefore, the dimensions, angles, and slopes of outdoor seating is critical (Main and Hannah 2010). The materiality of outdoor seating determines its durability, how stable or flexible the seat will be, and the temperature of the material (Main and Hannah 2010, Olin 2017).

Form is an important decision to make when thinking about the outdoor seating's function and location on the site. Linear benches and seat walls are good for accommodating many people side-by-side, but they

are not useful for a group of people who want to have a conversation (Olin 2017). When benches are oriented to a view, or along the edge of a space, and the focus is intended to be outward, linear seating is a good choice (Olin 2017). Conversely, when the benches form an "L," "C," or "U"-shape, conversation and community can be fostered (Olin 2017).

Another consideration for an outdoor bench is precipitation (Main and Hannah 2010, Olin 2017). Outdoor seating needs to have a way for water to runoff the seating surface, small holes, gaps, or perforations can allow water to drain away. These openings also help "prevent heat buildup from the sun." Bench slats can also effect comfort too: a bench with large slats is less comfortable than one with smaller slats, but large slats can withstand people sitting on the bench's back better (Yücel 2013). Smaller slats are able to sit along a curve and are more flexible than larger slats.

The required comfort level and ergonomics of a piece of outdoor furniture is determined by its intended use. A bench at an outdoor shopping mall, where people are momentarily resting, may not need to be as comfortable as a bench where people will stay seated longer, like at a park (Yücel 2013). Benches with backs are generally more comfortable than those without (Main and Hannah 2010). Armrests and backs also provide assistance to the elderly, providing support when standing up from a seated position. Armrests can also be placed on a bench to deter users from sleeping on the bench (Yücel 2013).

According to Postell (2012), a seat that supports a person should “enable” the following conditions:

- “Body movement
- Support the weight of the body as evenly as possible
- Maintain the natural curvature of the spine when standing while being seated (lumbar lordosis)
- Avoid inward compression of the lower vertebrae of the spine (kyphosis)
- Minimize uncomfortable pressure points” (20)

The angle of the back to the seat and the dimensions of both seat depth and back height will dictate several of these points. Main and Hannah go into further detail: “The typical seat with a back is about 17-18 inches above the ground near the front and slopes down toward the back

3 to 10 degrees” and “the back of the seat should reach at least 30 inches” (85). Yücel claims that “for benches, the recommended height of the seating surface is 42.5cm [16.73 inches], with a width of 35-40cm [13.78-15.75 inches] and the back rest extending for 50cm [19.69 inches].” The space for each person desired to sit should be 60cm or 24 inches per person (Yücel 2013). Back rests, if included, should be 32.5-37.5cm or 12.80-14.76 inches in height with an angle between backrest and seating surface of 95°-100° (Yücel 2013).

Other design strategies to consider include things such as: a flat seat or bucket is easier to get out of for elderly users than sloped one; seating that is reclined should be a little lower to the ground to allow the user’s feet to touch

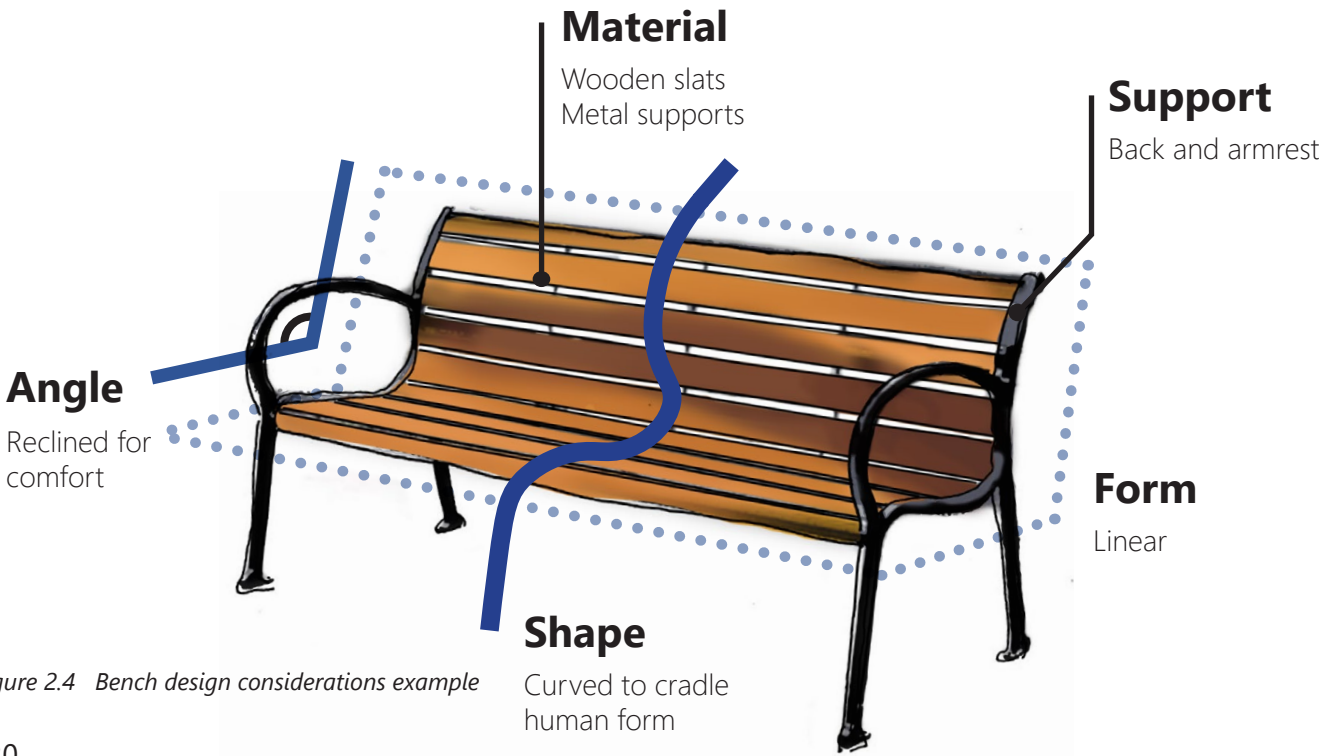


Figure 2.4 Bench design considerations example

the ground; and unanchored seating can tip on uneven surfaces and most designs avoid light cantilevered seats due to tipping concerns (Main and Hannah 2010).

Materials

What material is chosen for an outdoor seating piece greatly affects the durability, the possibilities of design, the comfort, and the aesthetics of the seat (Olin 2017). The design life of these materials should be 10-20 years or more. Destructive and abusive users, environmental threats, and the wear and tear of normal use are all factors outdoor furniture’s materials must be able to withstand (Main and Hannah 2010). Desirable characteristics for materials include:

- resistance to fading or degrading due to UV rays from the sun
- resistance to the effects of extreme humidity and precipitation
- resistance to the effects of temperature extremes, including freezing
- resistance to impacts, nicks, and scratches
- resistance to insects
- surfaces that are without splinters or sharp edges
- colors that maintain their integrity and do not leach or stain surrounding surfaces (Main and Hannah 2010).

Ventilation, drainage for water, usage frequency, cost of maintenance, cost of implementation, possibility for recycled or eco-friendly materials to be used, and

vandalism are other limitations and considerations for design and material selection (Yücel 2013). Burning, carving, and spray paint graffiti are the main types of vandalization to occur to street furniture and some materials are better suited to resisting being vandalized than others (Yücel 2013).

Another factor to consider are the materials and finishes compatibility with one another, physically, chemically, and thermally. Some common compatibility problems can be the cracking or peeling of a finish when used over expanding and shrinking wood, a shade sail fabric having holes cut into it by a sharp-edged support strut, or reactive metals that corrode each other (Main and Hannah 2010).

The most commonly used materials in outdoor furniture are “coated metals, stainless steel, exterior hardwoods, a few plastics, cast aggregates [concrete], and cut stone” (Main and Hannah 2010). The most universally popular of those options is wood and metal (Olin 2017, Yücel 2013). “Metal is used primarily because of its perceived strength, durability, and low maintenance. Wood is used for its warmth and naturalness. Stone is used for its earthiness and to match architectural materials” (Main and Hannah 2010). Another reason for materiality choices is their relationship to the temperature. Every material will “conduct” the warmth of the sun or the chill of the winter’s breeze differently. Metal can become either extremely cold or extremely hot, depending on the weather. Stone can also become frigid in winter conditions (Olin 2017). Wood generally tends to hold less extreme of temperatures than

metal and stone.

Concern for comfort in all seasons, regardless of geographic location; lower costs; and the challenges of cutting, working, and shaping stone and metal have led to the nearly universal choice of wood as a desirable material for outdoor public seating. The popularity of metal for frames and structure derives simply from its strength in rather small dimensions and its malleability regarding the forms and shapes that industrial processes can produce

- Laurie Olin, in *Be Seated*, pages 143 & 145)

The two categories of wood that can be used in exterior seating are hardwoods and softwoods. Softwoods are generally not used due to the harvesting old growth trees falling out of practice. Hardwoods are often exotic but local options exist too, like black locust (Main and Hannah 2010). Commonly used exotic hardwoods in the construction of wooden outdoor furniture are wood species such as teak, jarrah, or ipe (Postell 2012, Main and Hannah 2010). There are pitfalls to using exotic hardwoods: i.e. international shipping costs both financially and environmentally, unethical logging practices, species endangerment and habitat destruction (Meier 2021).

Using wood as a material is popular because of wood's thermal regulating properties of staying warmer in cold weather and cooler in hot weather, in respect to metal. Some downsides can be that wood will dry slower in relation to metal after a rainfall and requires more

maintenance and upkeep. More maintenance is required if the wooden parts of the furniture have a finish applied. Finishes can protect the wood color from fading, to an extent, but then causes annual maintenance for the furnishing. Do not put a finish on wood if you want the product to be no maintenance. If you put a finish on, expect annual maintenance to redo the finish (Main and Hannah 2010). Another factor to keep in mind is that wood moves, warps, and cracks through the seasons as moisture causes expansion and contraction (Main and Hannah 2010). Wood can be inexpensive and aesthetically pleasing, but it is easy to carve into, burn, and makes an excellent canvas for spray paint (Yücel 2013).

Wood species selection should try to use the local tree species and consider the climate of furniture location and frequency of use of the furniture (Yücel 2013).

Steel, stainless steel, aluminum, and cast iron are all metals that are used in outdoor furniture (Main and Hannah 2010). Brass and bronze can be used, but are generally used in more sculptural pieces. "The popularity of metal for frames and structure derives simply from its strength in rather small dimensions and its malleability regarding the forms and shapes that industrial processes can produce" (Olin 2017). Powder-coated metal gained popularity in the 70's & 80's due to the new forms and unfading colors previously unavailable in wood (Main and Hannah). Steel is one of the most common metals used in outdoor furniture due to a variety of factors: versatility, wide availability, ease of fabrication, high strength, and

durability (Main and Hannah 2010, Yücel 2013). It is durable, resistant to corrosion and impact and requires no maintenance" (Yücel 2013). Steel is also the most resistant material to vandalism, which is valuable in the public realm. Steel meshes and bars have the added bonus of adding ventilation to speed up drying after a rain on top of resistance to slashing, burning, and spray paint. Due to steel's durability and recyclability, steel is cheap in terms of life-cycle costs, but expensive up front (Yücel 2013). Other factors to consider are that steel rusts if not properly treated or if the surface coating it is chipped or torn, and can become incredibly hot or cold due to the climate (Main and Hannah 2010).

Concrete is an ancient material that can be shaped in forms to a wide array of design options. The strength of concrete is drawn from its mass and thickness, causing furniture made from this material to be heavy (Main and Hannah 2010). Due to the heavy weight of concrete, furniture made from this material generally does not need to be mounted (Yücel 2013). The malleability of concrete allows it to be pre-cast or poured into forms on-site. One downside of pre-cast forms is the weight increases shipping costs (Main and Hannah 2010). Concrete is also resistant to most types of vandalization, with the exception of spray paint. This material does not drain rainwater well or ventilate well, which can cause seating to be unusable long after a rainstorm (Yücel 2013). Extra design considerations to the slope of the seating surface is necessary than say a wooden bench with gaps between the slats. There is also the consideration of warmth while in sunlight but leeching

cold in winter or shade. While incredibly malleable as a material, the design of the concrete form should reflect the neighborhood architecture as existing furniture made of concrete can often seem outdated (Yücel 2013).

Similar to concrete, stone is also heavy and durable (Yücel 2013). "Granite, marble, slate, sandstone, and limestone are among those most commonly used in site furniture" (Main and Hannah 2010, 220). Aesthetic possibilities are limited and dependent on the stone type (Yücel 2013). Projects made out of stone are almost always a custom job, as there are few standard furniture pieces made of stone (Main and Hannah 2010). The same resistance to scratching, burning, and vandalism applies to stone as well. However, stone is susceptible to spray paint. This material also does not drain water well or dry fast after a rain (Yücel 2013). Dark stone can soak up sunlight and warmth in the winter, but other stones can be extremely cold (Olin 2017).

While not as commonly used as wood or metal for site furnishings, plastics still have good usages (Main and Hannah 2010). Plastics tend to be light but strong but most suffer UV damage (Olin 2017). Polyethylene, polycarbonate, acrylic resin, and fiberglass have all been used to create furniture, with differing strengths for each and different abilities to be recycled (Main and Hannah 2010). Recycled plastics can be a low-maintenance, durable option that tends to last longer than wood. Fading and wear from UV light can occur and plastics are susceptible to all kinds of vandalism, including carving, burning, and painting (Yücel 2013).

Ivanhoe Neighborhood
at a glance:

Physical Size:

1.14 square miles

Population:

5,216 residents (as of 2019)
Source: City-Data

Demographics:

(as of 2019) Source: City-Data

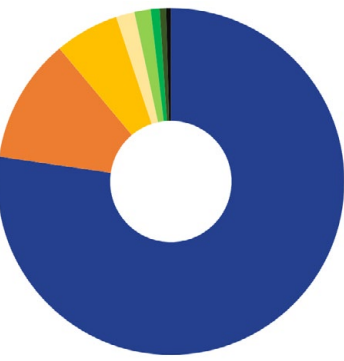


Figure 2.5 Ivanhoe neighborhood demographics breakdown

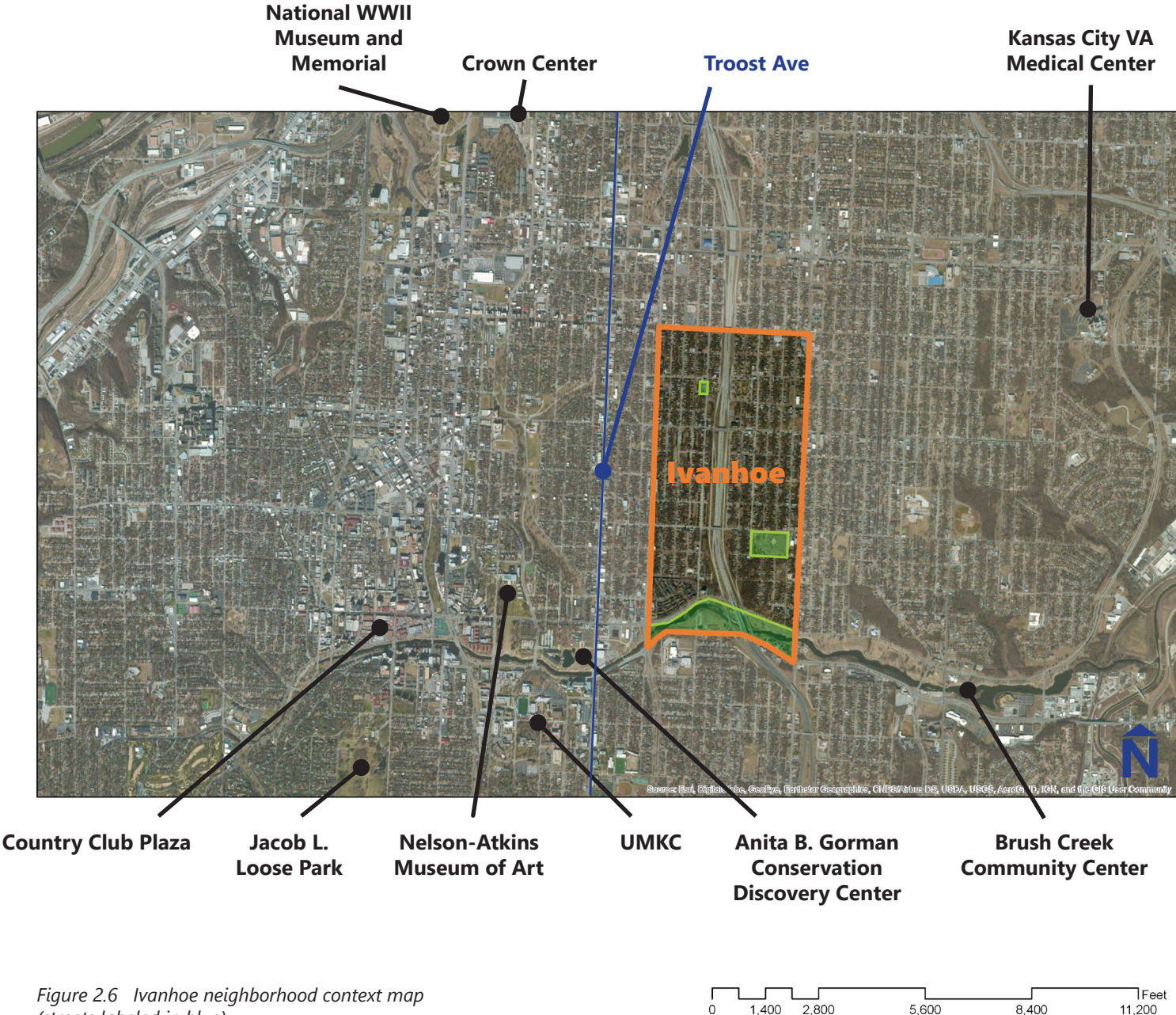
Finding Ivanhoe

During the fall studio of 2020, the focus area was a park along the southern edge of the Ivanhoe neighborhood. Neighborhood leaders attended reviews for the project. I reached out to Mrs. Nailah M'biti to see if the neighborhood would be interested in a custom bench.

Ivanhoe Neighborhood History

The Ivanhoe neighborhood in Kansas City, Missouri is said to be “one of Kansas City’s most dynamic examples of sustained progress as a successful neighborhood association and community development corporation” (Local Initiatives 2020). The neighborhood is located east of Troost Avenue, a historic redlining dividing line. To the west of the neighborhood is the Country Club Plaza and the Nelson-Atkins Museum of Art. To the north is the downtown area with Crown Center and Union Station. The neighborhood also sits along the Brush Creek Corridor.

In the 1890s, the neighborhood was founded by German immigrants. Into the 1930s, Ivanhoe consisted primarily of working-class white families (Urban Neighborhood Initiative 2020 and Swaminathan 2017). A major demographic shift started in 1954 after the *Brown vs. Topeka Board of Education* decision and Kansas City schools were integrated (Urban Neighborhood Initiative 2020 and Swaminathan 2017). White residents fled to the suburbs because of block-busting practices in the real-estate industry (Swaminathan 2017). The Ivanhoe



Ivanhoe Neighborhood at a glance:

Median Family Income:

\$41,027 Source: City-Data

Median House Value:

\$44,459 Source: City-Data

Unemployment:

11.34% Source: City-Data

Residents Below Poverty Level:

30.54% Source: City-Data

Median Age:

39.60 years old Source: City-Data

neighborhood was 96% African American by the 2000 census (Swaminathan 2017).

Another major shift started in 1951 when an arterial road was to connect residents of the southeastern suburbs to the downtown area that would bisect the neighborhood. The highway, named after local black politician Bruce R. Watkins, did not open until 2001 due to several lawsuits and the process of land acquisition. Due to environmental concerns from the neighborhood, the highway eventually became a parkway with landscaped sides (Swaminathan 2017).

In 1967, the Ivanhoe Neighborhood Council was formed and then further reorganized in 1997 with a mission to “build a clean, beautiful, safe, and thriving neighborhood” (Local Initiatives 2020). In the 80’s and 90’s, vacant houses, illegal dumping areas, drug houses, and gun violence pervaded the Ivanhoe neighborhood, accompanied by falling property values and a decreasing population (Urban Neighborhood Initiative 2020 and Swaminathan 2017). The turnaround of the neighborhood began with Alan Young and his wife Yolanda in 1997. First organizing prayer vigils, the couple then founded the Ivanhoe neighborhood association, and helped the neighborhood recover (Swaminathan 2017). “A strategic plan to revive Ivanhoe to thrive once again was developed; funding has followed and today Ivanhoe is widely considered one of the strongest neighborhood associations in the city” (Urban



Figure 2.7 Map of Ivanhoe Neighborhood
(streets labeled in blue)

Neighborhood Initiative 2020). With an Aldi that opened in 2014, a weekly farmers market, and an urban farm, Ivanhoe is no longer considered a food desert. Gone is the reputation of a trash dumping area and a place with drug houses (Swaminathan 2017). Margaret May, a resident who has been picking up trash in the neighborhood for years, said: "I often say, 'We've come a long way, baby, but we still have a long way to go.'" (Swaminathan 2017).

Site of Bench

During a conversation with Nailah M'biti, the Chief Real Estate Development Officer from the Ivanhoe Neighborhood Council, it was determined that Jim Nutter Park would be a beneficial location for the bench. The 0.7 acre park is publicly accessible, but is privately owned by the Ivanhoe Neighborhood Council. It is located immediately south of the Ivanhoe Neighborhood Council building at 3700 Woodland Ave, Kansas City, MO. Within the park, Mrs. M'biti suggested a spot under a shade tree facing the lawn. The bench will have a view of each part of the park. The park contains an inclusive playground, a swing set, a picnic shelter, raised garden beds, and a round walking path. Jim Nutter Park is a well-used amenity within the Ivanhoe neighborhood.

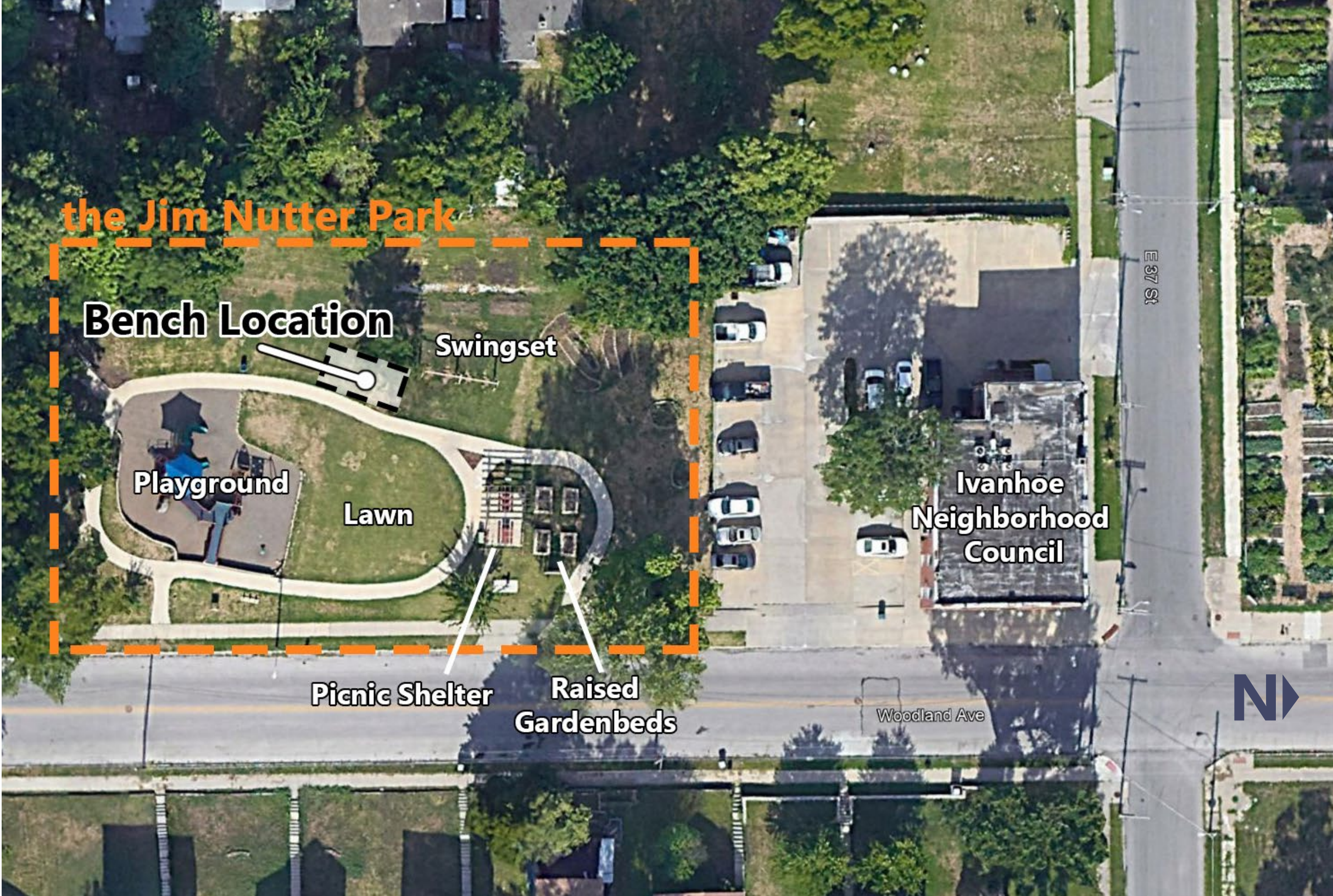


Figure 2.8 Jim Nutter Park amenities and context map



Figure 2.9 Jim Nutter Park's pergola, swing set and raised planter beds.



Figure 2.10 The pergola in Jim Nutter park with picnic tables underneath



Figure 2.11 Swing set next to future bench location in park



Figure 2.12 Playground in Jim Nutter Park that faces lawn, swing set, pergola, and Ivanhoe Neighborhood Council building

Exploratory Field Trips

In order to gain awareness about custom street furniture fabrication and potential local fabrication materials, two site visits were conducted. The first visit was to a street furniture manufacturer that has a custom furnishing studio within the company and the second was to several material sourcing locations in the Kansas City metro area.

Landscape Forms

The purpose of the visit to Landscape Forms, a street furniture manufacturer headquartered in Kalamazoo, MI, was to see and learn about their studio’s process for designing and fabricating custom furniture. I was invited by Richard Heriford, the founder and former CEO of Landscape Forms, when he heard of the subject of my project from the LARCP department head, Stephanie Rolley. The in-person visit took place on November 9, 2020, social distancing and masking were required due to the Covid-19 protocols of Landscape Forms.

A standard catalogue product is not always suitable for every design and custom elements are often desired. Local contractors may not be capable or are suitable for a custom furnishings job. Thus, there is a market for high quality, custom fabricated site furnishings, and why Landscape Forms started Studio 431. Studio 431 handles custom site furnishings, from benches, to bus stop shelters, to planter retaining walls, to sculptures with swings attached. The offices for Studio 431 are directly adjacent

to their fabrication space inside the main headquarters of Landscape Forms and this enables the team to be incredibly well connected during the fabrication of the pieces. The structural engineer, or team lead, can step out their office door and onto the shop floor where a project is being built. Studio 431 offers not only fabrication services, but collaborative design services as well, including engineering, project management, and procurement assistance (Studio 431).

Tucked along a side of the production floor, is an area with workbenches and every tool needed, including welders, and sturdy overhead cranes to move projects to and from the work area. Adjacent to the production area were the administrative offices labeled Studio 431. Two employees were welding together planter boxes for a large retaining wall during my visit.

After a tour of the metal fabricating facilities, a prototyping area, and the Studio 431 department, I was able to speak



Figure 2.13 August at Landscape Form’s Outdoor Showroom in Kalamazoo, MI

to several employees about the company’s specific process for custom site furnishings. I learned what tools they used, what their general process is, and that the sooner a designer can collaborate with the people actually fabricating the piece, the better. One memorable lesson from the visit, was that the more knowledge a designer has of the fabrication process, and how things are actually built, the better the design will be. However, since not every designer has an encyclopedic knowledge of all wood joints or metal bending techniques, collaborators with that knowledge can help to create beautifully designed, masterfully crafted projects.

Overall, the visited showed me how high-end custom fabrication occurs when a team of experts collaborates with a designer. While the experience was inspiring, my project would be at a much smaller operation scale since I will do all design and fabrication myself.



Figure 2.14 Rock Quarry company Sturgis’s outdoor showroom, one location of field trip

Material Availability trip to Kansas City, MO

The other field trip taken was to Kansas City, MO, to see what materials were available in the region and to gain design inspiration. The trip was led by Tim Duggan, principal of Phronesis, a landscape architecture firm in Kansas City.

The places visited included the Wood Lot, a metal scrap yard, and a quarry showroom lot. The Wood Lot is a local KC business that reuses wood material sourced from many places. They also refurbish old furniture and build custom furniture out of reused materials. The metal scrapyard had a lot of options for material. The quarry showroom had many types of landscaping rock and gravel. The main takeaway from the trip was that designers have to be very flexible and know exactly what is available to reuse in order to reuse materials.

Visiting these different material sources helped the decision-making process to not use local material. It would be difficult logistically for working with the neighborhood since I was not in the same location as these places.



chapter

3

methodology

Methodology

Approach

This project used an action research, community-based participatory approach.

Workshops were the chosen participatory method because of their flexible format, which can include many methods within the format. Workshops do not have to be as intensive as other methods like charettes.

Participants were recruited with the help of community coordinator, Mrs. Nailah M'biti. Once the participants emailed me expressing their interest in participating, a consent form was sent to them prior to the first workshop.

Project Roadmap:

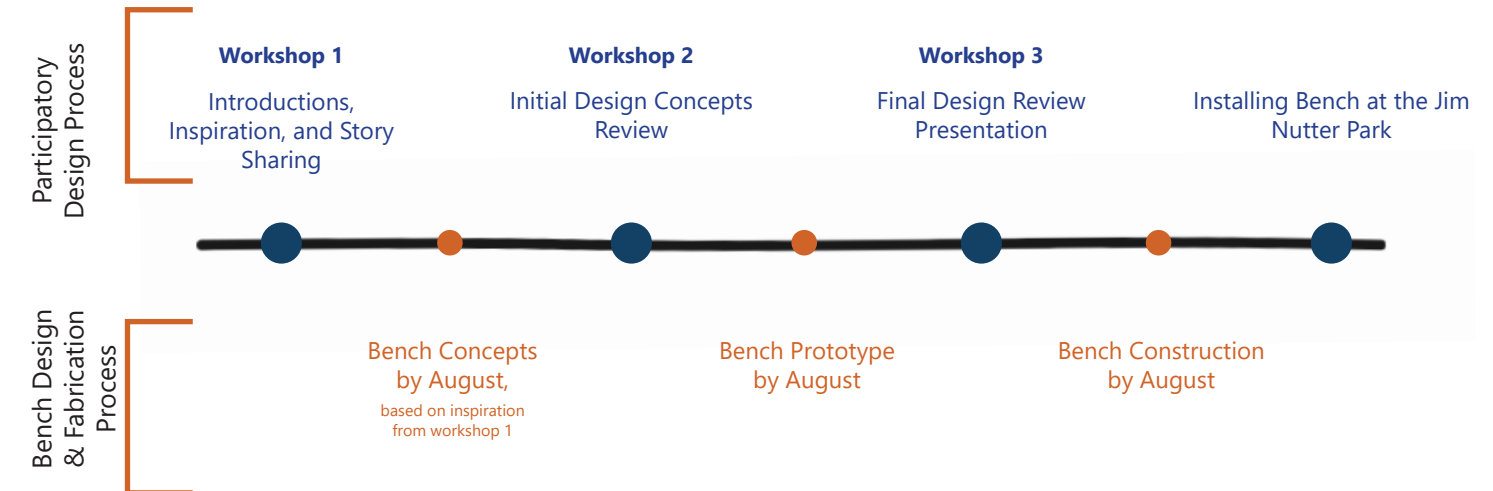


Figure 3.1 Project Timeline as shown in the workshops

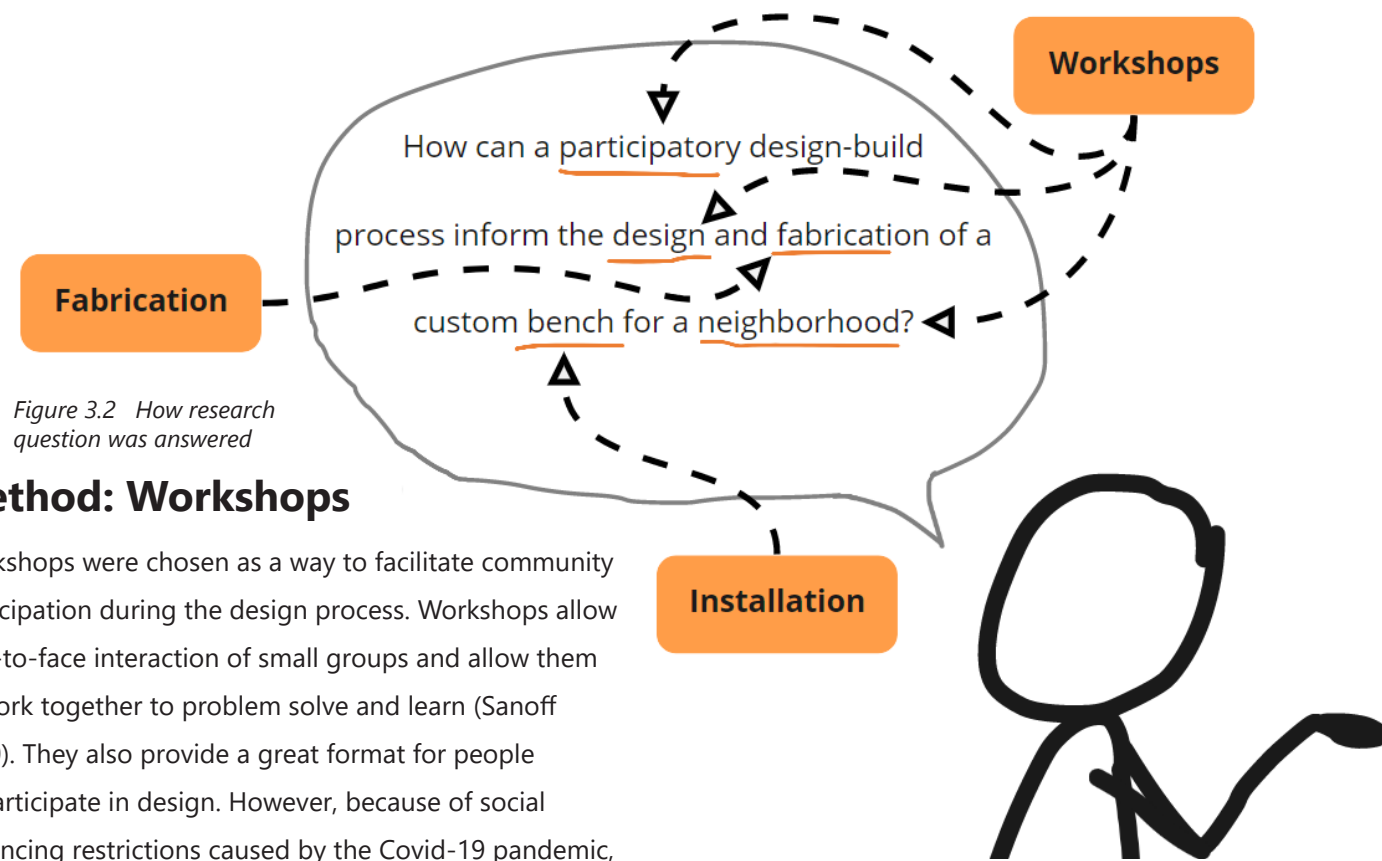


Figure 3.2 How research question was answered

Method: Workshops

Workshops were chosen as a way to facilitate community participation during the design process. Workshops allow face-to-face interaction of small groups and allow them to work together to problem solve and learn (Sanoff 2000). They also provide a great format for people to participate in design. However, because of social distancing restrictions caused by the Covid-19 pandemic, the workshops would need to be conducted remotely via Zoom.

Being mindful of the project time frame and time limitations of the participants, the design process was split into blocks of activities that could occur simultaneously. These blocks fit into three workshops, leaving time in between for me to design concepts. I also selected the workshop format because I had prior experience implementing that method.

The appropriate number of participants desired for each workshop was 8-11 participants, which would allow for deep, meaningful discussion. Participants were identified

using Snowball Sampling, starting with a community leader. A flyer was sent out to the community through the community coordinator, Mrs. Nailah M'biti. The flyer explained the project and included my contact information. If any neighbors emailed me expressing interest, I emailed them the consent form to fill out prior to the first workshop. Once the consent form was received, I sent the participants a link to access the Zoom workshop. Criteria for participation were that participants must be age 18 or older, have access to the Internet and Zoom, and live within the Ivanhoe neighborhood in Kansas City, Missouri, or adjacent neighborhoods. Participants were recruited with email and word of mouth. The participants were

self-enrolled in the process by agreeing to participate by contacting me.

Workshop 1: Storytelling

Purpose

To inspire initial design concepts for the custom bench, the focus of Workshop 1 was to learn more about the Ivanhoe neighborhood and community. According to Sanches and Frankel, the people who live in a place are local experts and understand the function of spaces, the activities that take place within, know the community needs, and know the local history (2010). To discover what makes Ivanhoe unique, a facilitated discussion was used to learn the story of the Ivanhoe neighborhood from the neighbors' perspective.

Procedure

The duration of the workshop was one hour. The facilitated discussion included ice breaker questions, story question prompts, a collage activity, and a live word cloud.

The ice breaker questions were designed to get participants comfortable with speaking in the online Zoom meeting platform. Ice breaker questions included:

1. Tell a bit about yourself
2. Where did you grow up?
3. How long have you lived in the neighborhood?

These questions allowed participants to get to know each other if they had not previously interacted.

The next phase of the workshop included story question prompts. These questions were to prompt the participants

to tell stories about what their neighborhood is like from their point of view. Questions asked included:

1. What does your neighborhood mean to you?
2. What do you like the best about your neighborhood?
3. What are you proudest of in your community?
4. How would you describe the culture of your community?
5. What is your favorite program your neighborhood hosts?
6. What is your favorite local event to go to?
7. What activities happen in different seasons?
8. What is your favorite story about someone from your neighborhood?
9. What are your hopes for the future of your neighborhood?
10. Who do you think would use the bench in the Jim Nutter Park?

The goal of asking these questions was to gain knowledge that only a local would know, insight that could not be found in a news article or a Google search.

The third section included a collage activity that was designed to achieve the same goal as the question prompts, but in a non-verbal expression of information. The online tool Miro was used for this activity because the entire workshop was digital. Prior to the workshop I added pictures on the Miro board that the participants could use for the collage. The pictures included images of outdoor activities, urban buildings, outdoor furniture, Kansas City

and Ivanhoe cultural icons, and nature. These images were selected to provide a starting point for the participants to create a collage from. The participants could also add their own images if they wanted to. The idea was for the participants to arrange the pictures on the Miro board, which would simulate creating physical collage, which would normally include magazines, scissors, and glue. Miro also allowed users to draw, put text, and add shapes to the board. The prompt for the board was, “What do you think of when you think about your neighborhood?” Underneath the prompt, they were given instructions to “Grab pictures from the left, add words, draw over, and upload your own pictures to create a collage of your neighborhood.”

The final section involved using Mentimeter, an online live word cloud tool. The participants were given the prompt, “What does your neighborhood mean to you?” To answer the question, they typed words and phrases into Mentimeter. The software transformed the words into a word cloud. The overall group looked at the results and the participants were asked to comment on what others stated. The word cloud was anonymous and the goal was to allow participants to share sentiments anonymously, while being able to build on other entries.

Workshop 2: Concepts

Purpose

Workshop 2 occurred six weeks after the first workshop. The purpose of the second workshop was to build the participant’s knowledge of bench design and to

have a discussion about multiple design concepts that I developed after Workshop 1. Workshop 2 included activities for both verbal and visual feedback. The end goal of the second workshop was to have a strong idea of the working bench design and why the neighbors preferred certain parts of the design, so that I could start fabricating a prototype. It was also to ensure that any changes made during prototyping kept within the design intent of the participants established during the workshop.

Procedure

The duration of the workshop was one hour. Engagement activities included the bench preference activity, concept story sharing, example concept presentation, and a discussion at the end where idea generation occurred.

The bench preference activity was designed to allow participants to form their own ideas of their ideal bench, and what features of a bench they preferred. The goal was to give the participants a notion of their ideal bench separate from the concepts that I had prepared. There were different design criteria to consider for the bench design, such as size, materials, form, and other features, such as armrests and backrests, that were shown. In order to build the participant’s opinions of bench features, the participants were asked, using visual aids, what specific they preference (see figures 4.3-5).

The idea of concept story sharing was to allow participants to critique and give feedback on the design narrative before being shown the design concepts. Each narrative

that was attached to each concept was put into paragraph form, without any accompanying visuals and read aloud to the participants. This separated the feedback about the narrative from the feedback about the physical features of the design concept.

The presentation consisted of three concepts that were developed based on the findings of Workshop 1 (see figures 4.6-11). After briefly presenting each concept, time was allowed for discussion and further idea generation.

Workshop 3: Finishing Touches

Purpose

The purpose of the third workshop was to present the final design, to discuss changes that occurred during prototyping, and to get their thoughts on the remaining design details that needed to be addressed (see figure 4.16).

Procedure

The last workshop was one hour long over Zoom. The final design was presented to the participants and feedback was given. Different color options for powder coating the metal legs were shown in the form of digital renderings. The chosen colors would look good with both the seat’s wood color and with colors at the park site (see figure 4.16). Additionally, an idea generated in Workshop 2 was to engrave the names of neighbors who had contributed significantly to the neighborhood into the backrest of

the bench to honor them. The last part of the workshop was dedicated to determining who would be honored, and what font type and size should be used. Options for the font were given in the form of digital renderings (see figure 4.17).

Method: Fabricate & Install Bench

Purpose

The purpose of physically building the bench was to grow my fabrication skills and to be able to give back to the community. Bødker argues that “Although the researchers get research results out of this, the people with whom they work are equally entitled to get something out of the project” (1996).

Procedure

This fabrication process would not have been possible without the numerous resources available to me within the College of Architecture, Planning, and Design’s Fabrication Laboratory. I had access to knowledgeable craftsmen that worked in the FabLab who were able to walk me through any questions I had. I was able to use practice materials and scrap pieces that are part of the student access to the Fab Lab. Metal fabrication utilized specialized tools such as a MIG welder, CNC plasma cutter, and Di-Acro bender. Wood fabrication required the use of a CNC router. All of these tools provided an accuracy and precision far greater than basic tools would provide and thus allowed for a greater complexity in design.



chapter

4

participatory
design process

Participatory Design Process

This chapter includes the findings from the three participatory design workshops.

Workshop 1: Storytelling

The first workshop for the Ivanhoe Bench Project took place on January 12, 2021 via Zoom. There were five participants that represented a wide age range: Mrs. Bessie Mays, Mrs. Nailah M'biti, Mrs. Jackie Hunter, Mr. Rico Alvarez, and Mr. Bill King. The workshop was led by myself and it lasted for about an hour. At the start of the workshop, I introduced the project and my goal for the project: to collaboratively design a bench with the neighbors, that embodies the unique identity of the Ivanhoe neighborhood. A project timeline was shown to illustrate the proposed steps of the overall design and fabrication process. The first activity included four icebreaker questions to ease participants into talking on a Zoom call.

The second activity was the story question prompts. Each participant was given time to verbally answer each question.

What are you proudest of:

*"The proudest I am of my neighborhood is...We are doing more **rebuilding**. In our neighborhood this is a wonderful sight to see, since the freeway came through the neighborhood and did a little tearing up, we are now on the rebound. We are rebuilding, we are working on keeping our neighborhood cleaner."*
- Mrs. Mays

*"I think the thing that I'm most proudest of with respect to Ivanhoe is the **tenacity** of the residents to stay about...to make sure that our association [Ivanhoe Neighborhood Council] continues the work that it started." – Mrs. M'biti*

*"When talking about where you live, a lot of times when we say we're from Ivanhoe, people get **excited** like 'Oh, you're from Ivanhoe! I've heard this about Ivanhoe or that about Ivanhoe!' and its good things not bad things." – Mrs. Hunter*

*"I'm really proud of the **generational connection**. Right, a lot of the young people that live in Ivanhoe still have a connection to a lot of the seniors that live here." – Mr. King*



Workshop 1 at a glance:

Goal:

Learn the story of the neighborhood from the neighbors

Activities:

- Ice Breaker Questions
- Story Question Prompts
- Collage Activity (did not occur due to technical difficulties)

Outcomes:

- key word adjectives from neighbors describing their neighborhood
- idea of sense of pride and feeling of community the neighbors have



What do you like best about your neighborhood:

"I like the fact that it did transition, right. I think Ivanhoe gives a lot of **hope** to a lot of neighborhoods around Kansas City of transitioning from some place that is was violent at one point to a place that...is actually a really nice, calm place to live. You get the occasional stir, but I definitely feel safe here. So I think the **safety** is one of the things that I like best about my neighborhood." – Mr. King

How would you describe the culture of your community?

"But really, so for me, I think the culture of the Ivanhoe community is that there is this **sense of pride** and this **sense of identity**. And that it's something that, you know, not necessarily everybody buys into, but that is important as the foundation of who we are." – Mrs. M'biti

"We have a variety of different ethnic group in our neighborhood. And we tried to make them **welcome**. And we are letting our neighbors know that we are friendly neighborhood, and we're going to **take care of one another**." – Mrs. Mays

What is your favorite local event to go to?

"My favorite event, specifically from Ivanhoe, is Night Out Against Crime, which happens at Ivanhoe Park. ...Essentially Night Out Against Crime is a **large block party** is what it is like the hot dogs and music everywhere and people playing basketball and different activities for young kids.... but there was always there's always just this **great sense of community**" – Mr. King

"I enjoy the Saturday cleanups we have once a month for the majority of the spring and summer. We have **cleanup events** every Saturday or once a month. And it's really cool to see how everyone kind of takes responsibility for the upkeep of the neighborhood itself." – Mr. Alvarez

"My favorite local event to go to is...the **Beautification and Crime Committee Meeting** once a month. And I also enjoy inviting everybody to the table: police officers, city officials; so we can talk about what's going on in Ivanhoe, and how we can improve Ivanhoe, what activity happened in different season." – Mrs. Mays

There was a Miro collage activity planned, to allow participants to visually express the same information as the question prompts, but the activity was not able to be completed. There was an unfamiliarity with the Miro user platform and the participants who were familiar were not able to use the Miro board because they were using Zoom from their phones, causing the activity to be almost

impossible to complete. The workshop was concluded with the participants given the option to do the activity later. Only one participant completed the activity afterward and the activity was not used for bench concept design.

Outcomes

Looking back at the original goal of the workshops, to collaboratively design a bench with the neighbors that embodies the unique identity of the Ivanhoe neighborhood, the first steps were successful. While the design of the physical bench at this point had not yet started, I had begun to uncover what makes Ivanhoe unique, through the neighbors' own descriptions of the neighborhood.

A summary of what I learned: Ivanhoe is an incredibly tight-knit community. The people care for each other, people of different ethnic backgrounds and different ages. Ivanhoe is an incredibly hardworking community. They fought to combat the decline of their community, broke themselves out of a downward spiral, and changed trajectories through perseverance. The local events that were highlighted by the neighbors were things that reminded them of their friendly community that cares for the residents within.

With the help of the workshop participants, I had a sense of the neighborhood's story. I now had a concrete picture of the lens of identity from the neighbors. I used these stories that were shared to create the narrative of the concepts shown in Workshop 2.

Figure 4.1 Design Pieces as explained in Workshop 1 to participants

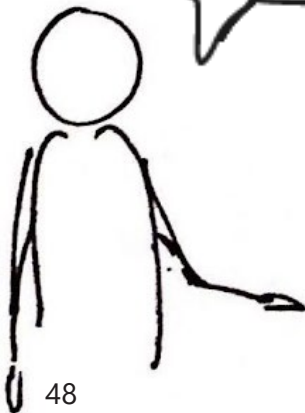
What are you proudest of in your community?

"I'm really proud of the generational connection. Right, a lot of the young people that live in Ivanhoe still have a connection to a lot of the seniors that live here."



What is your favorite program your neighborhood hosts?

"I enjoy the Saturday cleanups we have once a month for the majority of the spring and summer. We have cleanup events every Saturday or once a month. And it's really cool to see how everyone kind of takes responsibility for the upkeep of the neighborhood itself."



"...Essentially Night Out Against Crime is a large block party is what it is like the hot dogs and music everywhere and people playing basketball and different activities for young kids.... but there was always there's always just this great sense of community"

Workshop 2: Concepts

Workshop 2 occurred on February 23, 2020, via Zoom, and lasted an hour. There were four participants: Mrs. M'biti, Mrs. Hunter, who were both at the first workshop, and Participant A, Participant B. The second workshop focused on establishing the size, function, and materials of the bench. The activities were designed to allow participants to form their own ideas of their ideal bench and what parts they preferred. The goal was to give the participants a way to discover their preferences for bench design before explaining the concepts, so they had a better understanding of what they were wanting in the concepts. In the bench preference activity, the different parts of a bench's design were broken down into focus areas (see figures 4.3-5). The participants all said that they liked benches with backs and that they liked sitting on wood better. I purposely avoided talking about color when talking about materials and form as color would be discussed in Workshop 3. I then showed the participants the story behind each design concept before showing them the bench concepts. This was to allow critiques of the design narrative before seeing the visual behind each concept. The participants did not have anything to change to the narratives. Then the participants were shown the three design concepts (see figures 4.6, 8, and 9). The participants immediately liked the curved bench of

Figure 4.2 Participant feedback in Workshop 1



Workshop 2 at a glance:

Goals:

- Give participants a sense of their bench design preferences
- get feedback on concepts
- get ideas from participants

Activities:

- Bench Preference Activity
- Concept Story Sharing
- Example Concept Presentation
- Discussion

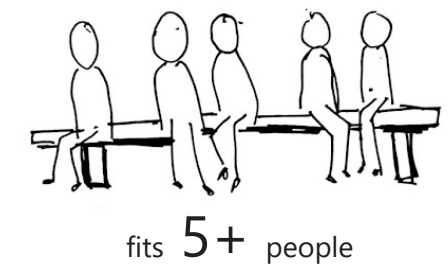
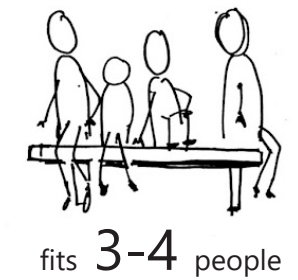
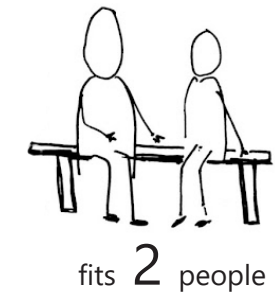
Outcomes:

- general characteristics final bench designs needs
- ideas from participants

Concept 2, because of the conversation opportunities it fostered. The participants expressed interest in armrests for their preferred bench design. However, the concept they liked, Concept 2, had backless portions without armrests so bench users could sit in either direction (see figure 4.8) It was then suggested by one participant that names could be engraved into the bench back of Concept 2, the s-curve bench. The names would be a way to honor neighbors who have contributed greatly to the neighborhood. The participants wanted to keep the engraved adjectives describing the neighborhood, based on feedback in the first workshop, that was a design suggestion in Concept 2, and find a way to fit both adjectives and names on the back of the bench.

"I will say just as a user of public space sometimes that occasionally, a five plus bench is nice, because I do feel like sometimes if I'm going to sit on a bench, and it's a stranger there, sometimes I'll feel you know, two people that don't know each other might sit on a larger bench and then start a conversation where sometimes I wouldn't necessarily sit directly next to a stranger on a two person bench, you know, so yeah, but three to four i think is always good because the whole family can sit there but five plus can maybe provide opportunities for more people to communicate or something" - Participant A

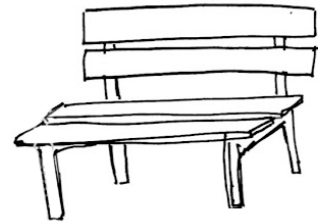
Scale



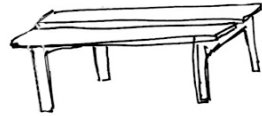
How big do you think the bench should be?

Figure 4.3 Bench size preference activity from Workshop 2

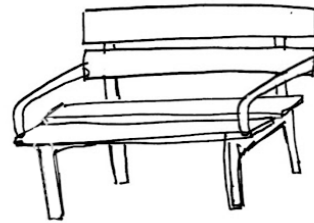
Function



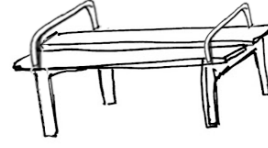
Bench with a Back



Bench with no Back



Bench with a Back
and armrests



Bench with no back
and armrests

What features would you prefer to have in a bench?

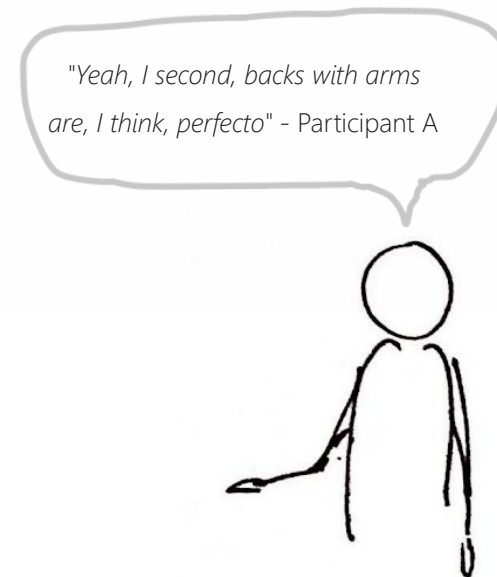
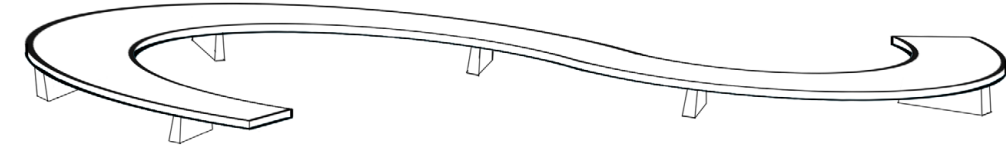
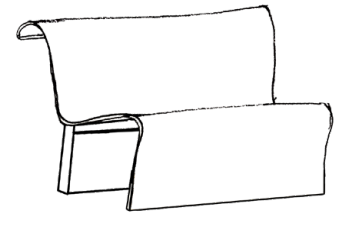
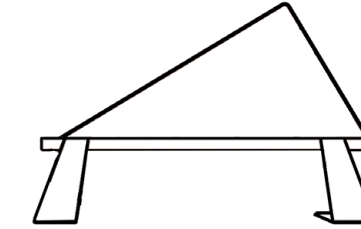
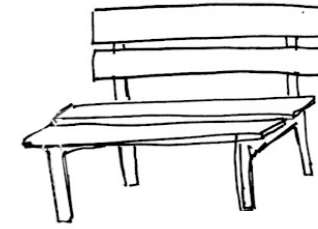


Figure 4.4 Bench features activity with feedback

Form



What type of form do you prefer? Traditional? Funky? Curvy?
Is there a shape you don't see here that you prefer?

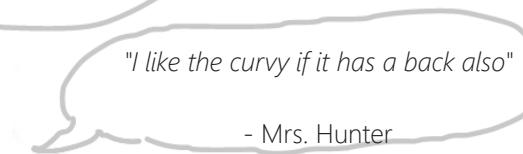
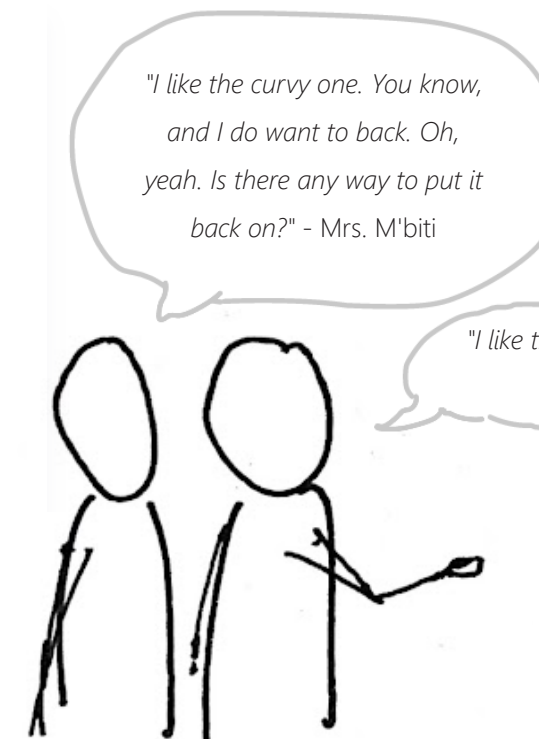


Figure 4.5 Bench form activity with feedback

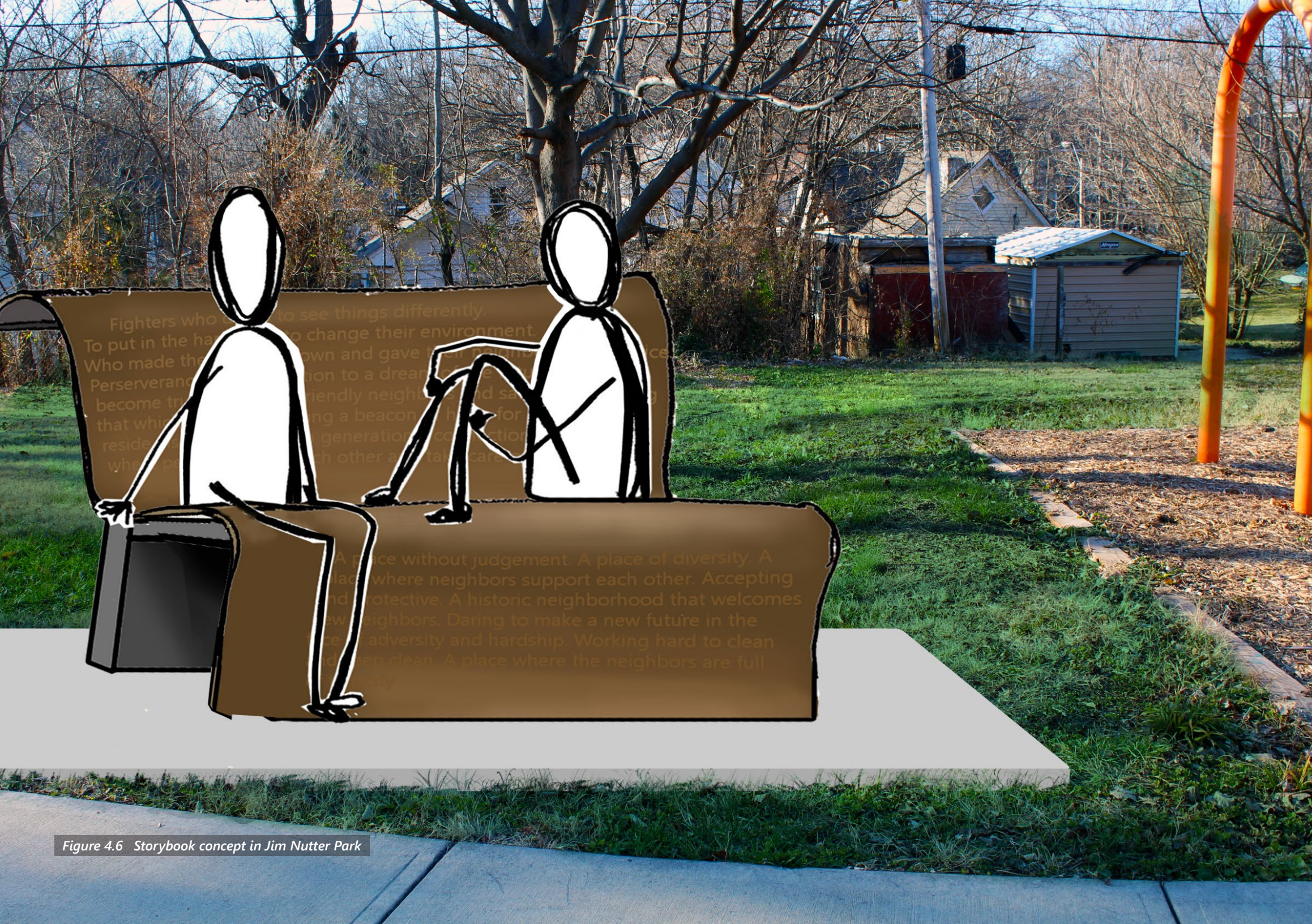


Figure 4.6 Storybook concept in Jim Nutter Park

Design Concept 1: Story Book

Made of engraved bronze with slightly raised letters, the bench is made to look like a sheet of paper. On the sheet is the story of Ivanhoe. The bronze will eventually turn shiny after many people sit on the bench. This act symbolizes change can be made over time with effort. This idea is a reflection of the neighborhood's progress.

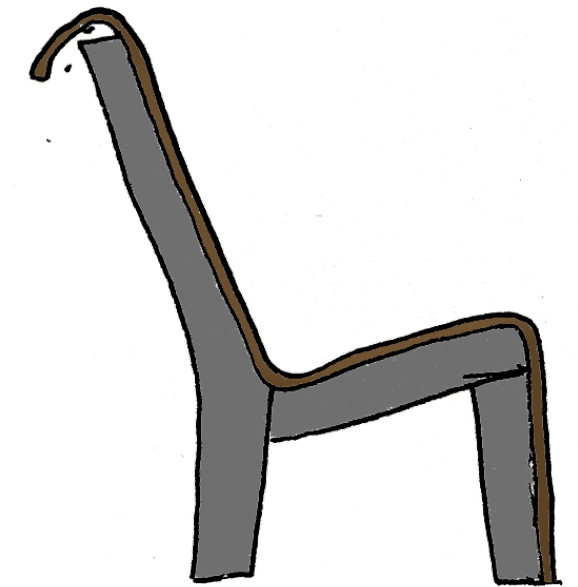


Figure 4.7 Storybook concept sideview

Design Concept 2: Connecting with the Neighborhood

The two curves allow for two different conversations to happen at the same time. During the first workshop, the friendliness and connectedness of the neighbors was mentioned several times over. An inward curve helps facilitate conversation. Along the back of the bench are engraved words inspired by the words said in the first workshop. The backless areas are positioned so that people may face either direction. The words on the back of the bench are "rebuild," "connection," "friendly," "dedication," "perseverance," "safety," "thrive," and "hope."

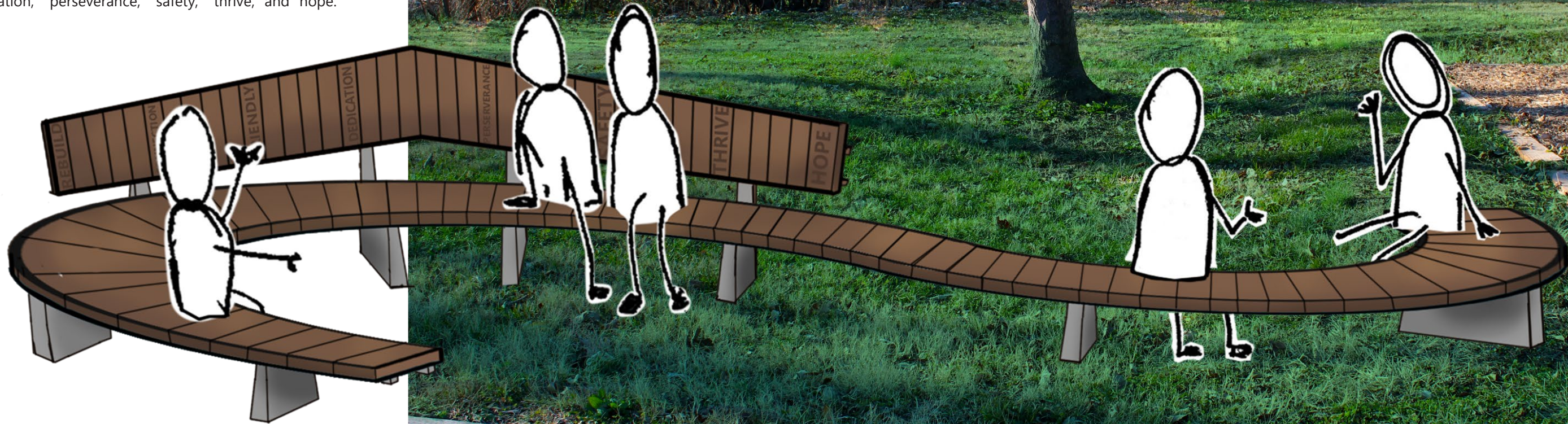


Figure 4.8 Connecting with Neighborhood Concept in Jim Nutter Park

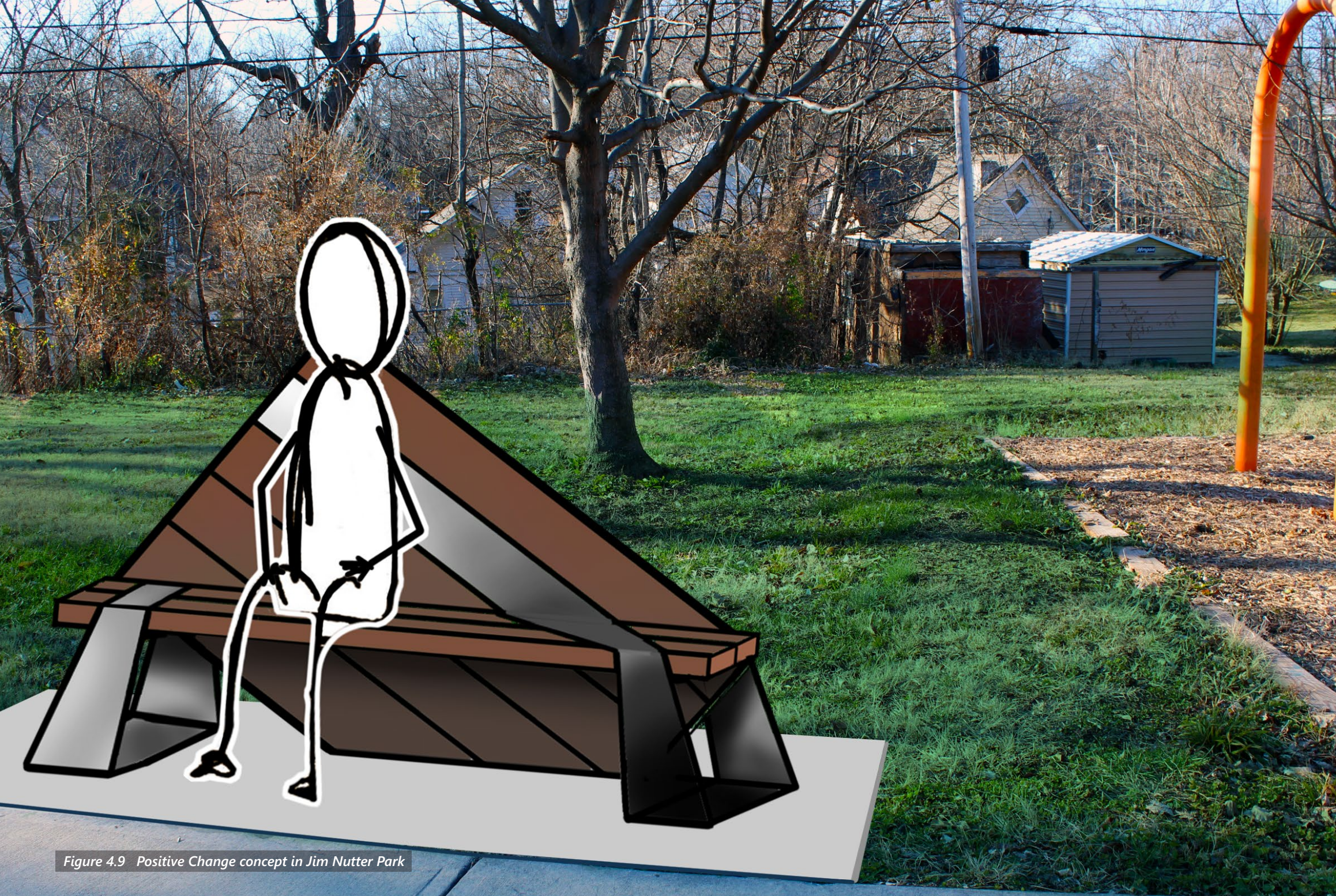


Figure 4.9 Positive Change concept in Jim Nutter Park

Design Concept 3: Positive Change

The wood slat bench has a metal strip that runs in an upwards trajectory from the legs across the back. The metal strip starts out tarnished and painted a dark color, then transitions into a shiny chrome. This idea represents the hard work the neighborhood went through, going from a place with drug houses and high crime, to a place where residents feel safe and full of hope.

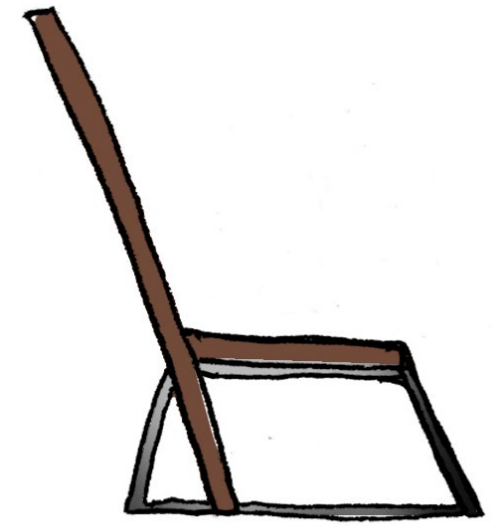


Figure 4.10 Positive Change side profile

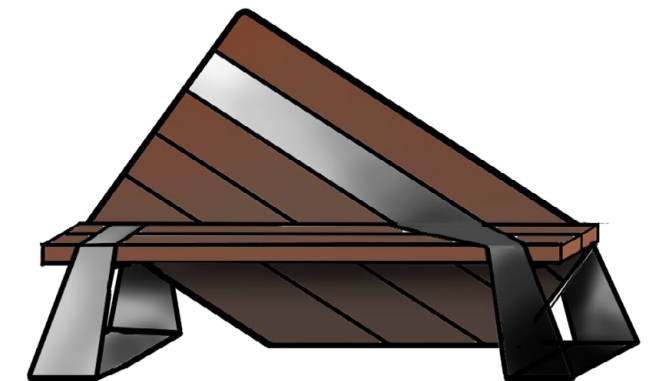
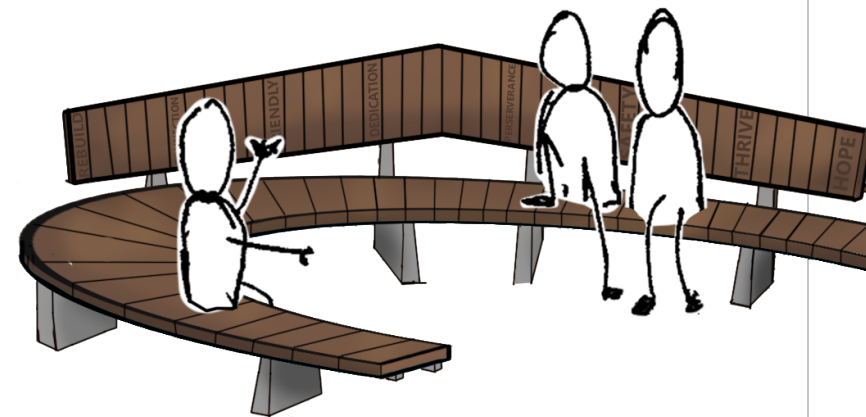


Figure 4.11 Positive Change concept

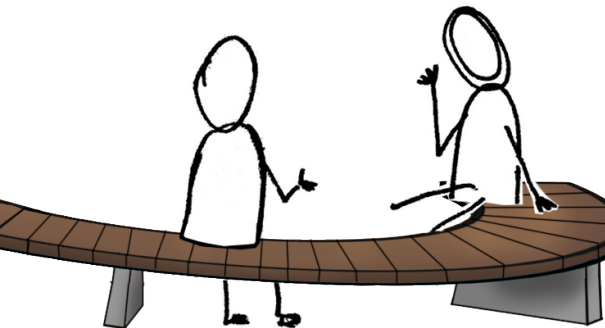
"I like the fact that when you have just a few words there, it can help spur the conversation as opposed to something that somebody can read in full and not necessarily have to converse with somebody else about"



"Curvy, curvy, curvy!"

"It's like going to actually be bringing people together and starting conversations."

"The curvy one is awesome! Yeah, that!"



"I love that. Yeah, I like the curvy. I like how the back looks on it, too."

Discussion

At the end of the second workshop there was an open discussion and participants freely generated ideas. The idea that was most favored was to put the names of individuals who greatly contributed to the neighborhood onto the bench:

"What if there was like, the names of like, important people from the neighborhood or people that have made big, you know, sacrifices and done a lot for the neighborhood artists from the neighborhood? You know, like, maybe it could be kind of cool to type history in it or something like that?" - Participant A

It was mentioned by another participant that the names honoring individual neighbors would be a new way to commemorate the neighborhood after losing their mural.

"I think that would be good. I don't know if you remember the mural that was on the side of the furniture store at the corner of prospect and 39th Street. And then when there was then when that store was sold, of course, they painted it. So we lost that as a talking point, so to speak. But I like the suggestion, because there are definitely some seniors who have dedicated quite a bit of time, you know, especially I would say, in the late 90s, through maybe 2015. You know, and even some who are still active today." - Mrs. M'biti

Figure 4.12 Feedback from participants on bench concepts

Outcomes

Concept 2: Connecting with the Neighborhood was chosen as the design concept to move forward with. The participants also expressed interest in the form of Concept 3’s leg shape. The neighborhood gained a new way to commemorate the neighborhood and honor those who contributed greatly. Names of honorees are to be engraved into the final bench’s back. Adjectives describing then neighborhood are also to be engraved in the back.

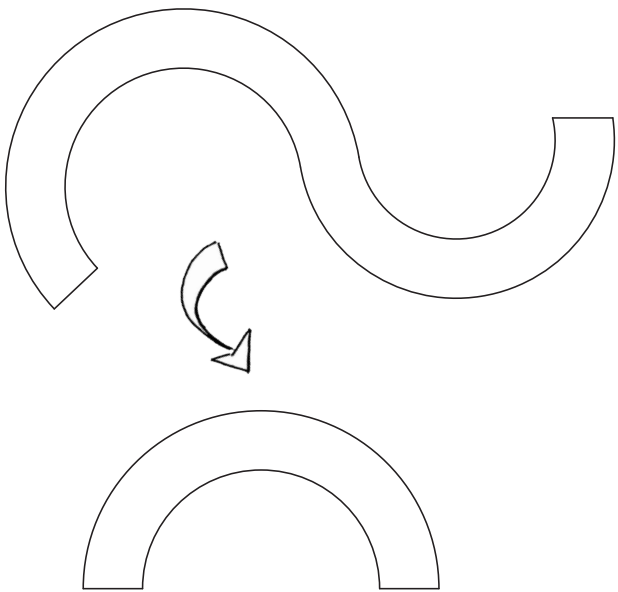


Figure 4.13 Design changes to Connecting Concept during prototyping phase

Design Changes after Workshop 2

The design concept that the participants gravitated towards to the most was Design Concept 2: Connecting with the Neighborhood. However, logistically the bench needed to be smaller, while still maintaining the core design intent. Another challenge was to create a way for names to be added to the bench over time. Taking feedback into consideration, the bench was modified from an “s” shape to a “c” shape to make the design buildable within time and resource constraints. The design of the legs from the Concept 3: Positive Change was desirable, so it was kept and modified to work with Concept 2. The legs would need to be fabricated using box pipe, which was readily available in the college’s Fabrication Lab.

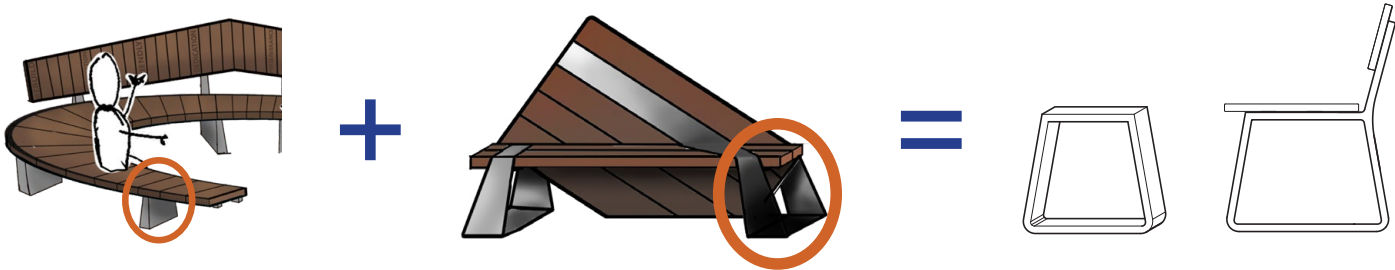


Figure 4.14 Design changes to the legs for feasible fabrication combining two concepts.



Figure 4.15 Final Concept for Ivanhoe Neighborhood Bench



Workshop 3 at a glance:

Objectives:

- Update participants on bench design progress
- Get feedback on design and prototype
- Get ideas from participants

Activities:

- Design Changes Explanation
- Design Decisions
- Discussion

Outcomes:

- Specific characteristics for final bench decided
- ideas from participants

Workshop 3: Finishing Touches

Workshop 3 focused on smaller design details and gaining feedback from the neighbors on those options. The overall form of the bench had been chosen, but through building the prototype, was cut back in scale to just a single semicircle, instead of an s-shape. There were five participants: Mrs. M'biti, who was at the previous two workshops, Mrs. Mays, who was at the first workshop, Participant A, who was at the second workshop, and two new participants, Participants C & D.

For the words to be carved onto the bench back, layout and font examples were shown. The overall consensus was "whatever is easiest to read" because of the neighborhoods elderly population. There were also pictures shown of the wood chosen and the reasons of why were explained, the wood being osage orange/hedge apple because of its incredible rot resistance, interesting color, and for its native status. Orange is also part of the neighborhood colors, appearing on the Neighborhood Council Building and in social media flyers. The wood for the bench came from a farm in Madison, Kansas. Examples of the color of metal were also shown, with both weathered and new wood colors. The colors chosen for the examples were all colors that complimented the orange-yellow wood color. The consensus was for black because of its timeless nature and the fact that black matches everything. Black would not go out of style.

The last part of the workshop was used to discuss who would be honored on the bench, with a preliminary list

With New Wood

Black



Emerald Green



Navy Blue



With Weathered Wood

Black



Emerald Green



Navy Blue



Figure 4.16 Metal color activity from workshop 3. Colors were picked that complimented the yellow-orange wood color.

"I think that the black metal looks the best probably because it'll count it'll contrast more simply make the orange of the wood stick out"

- Participant A

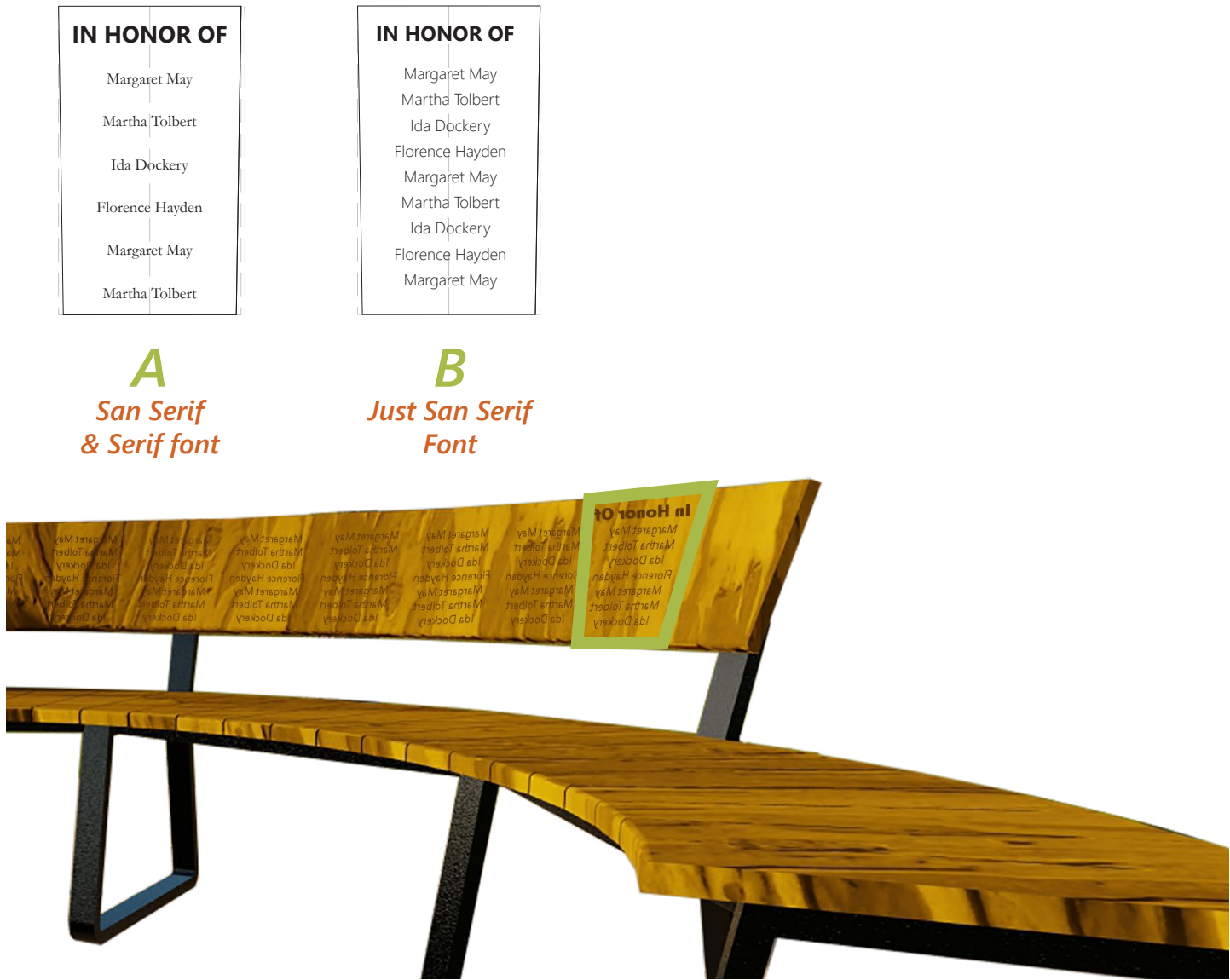
"Well, I'm gonna go with the black. I think the black would be okay...it's not a bad color" - Mrs. Mays

"Yeah, I like the black as well". - Mrs. M'biti

forming by the end of the workshop. The neighbors ultimately decided that this list was a starting point and that they needed more input from the rest of the community before carving could begin. The adjectives for the neighborhood that will be carved vertically on the bench back were also edited by the neighbors.



Figure 4.17 Activities to help participants choose a font type and words to honor neighbors.





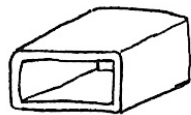
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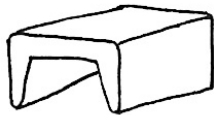
design build

Key Terms

Box Pipe: Rectangular steel tubing, comes in different dimensions and thicknesses



C-Channel: C-shaped metal pieces, comes in different dimensions and thicknesses



C-joint: C-shaped, metal, connecting piece



CNC Router: short for Computerized Numerical Control Router, a mechanically controlled drill bit that carves material in a pattern given to it by a computer

Galvanization: process through which metal pieces are dipped into a molten zinc compound, used to protect pieces from rust

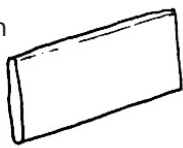
Jig: crafted object used to hold pieces in a certain position for fabrication, can be made from many materials, for this project, scrap lumber was used

Milling: the process of taking lumber from a rough, uneven form to useable pieces, usually a certain even thickness with 90-degree corners

Plasma CNC, CNC Plasma Cutter: short for Computerized Numerical Control Plasma Cutter, a mechanically controlled plasma torch used to cut through metal in a pattern given to it by a computer

Powder Coating: process of using electrostatic to adhere colored powder to a piece, protects from rust

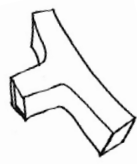
Strap: Thin, long pieces of metal that can be bent easily, comes in different dimensions and thicknesses



Tack Weld: Small weld, similar to a hot glue dot, to hold pieces together before structurally welding all pieces together

Tapping, Retapping: cutting threads (spiral) into a metal piece to create a nut or place for a bolt to screw into

T-joint: T-shaped, metal, connecting piece



Thread: the spiraled end of a bolt or screw, also the spiral inside of a metal nut.



Design Build Process

Introduction

In this chapter, the fabrication for both the bench prototype and the bench are documented. Many problems were encountered and solved, and many lessons were learned. This was the first time I had ever done metal fabrication, and this was a challenging project to start with. My advice to anyone starting out: don't try to fabricate something that is essentially a 3-Dimensional, upside-down cone. This project would not have been possible without the help of my two committee members, Kendra Kirchmer and Kirby Barrett. They both helped me with the construction planning process immensely. This project would not have been possible without both a CNC Router and CNC Plasma Cutter. The form was difficult to achieve due to the many curves required to be executed with precision. The finished product is a comfortable fit that has curves in multiple directions.

Fabrication Timeline

WORKSHOP 2	2.23.21
DESIGN FINALIZED	3.9.21
BEGIN PROTOTYPE	3.13.21
WOOD PURCHASING	3.24.21
WORKSHOP 3	4.1.21
BEGIN LEG FABRICATION	4.8.21
FINISH PROTOTYPE	4.10.21
LEGS COMPLETED	4.26.21
METAL SEAT SUPPORTS COMPLETED	4.29.21
BEGIN MILLING WOOD	4.30.21
MAKING LAYERCake	5.4.21
BACK SUPPORTS COMPLETED	5.22.21
CUTTING SEAT WEDGES	6.1.21
METAL GALVANIZATION	6.4.21
CNC TESTS	6.15.21
CNC WORDS	6.18.21
METAL POWDER COATING	6.21.21
LASER BURNING WORDS	6.22.21
SANDING	6.24.21
FINISHING	6.30.21
ASSEMBLY	7.13.21

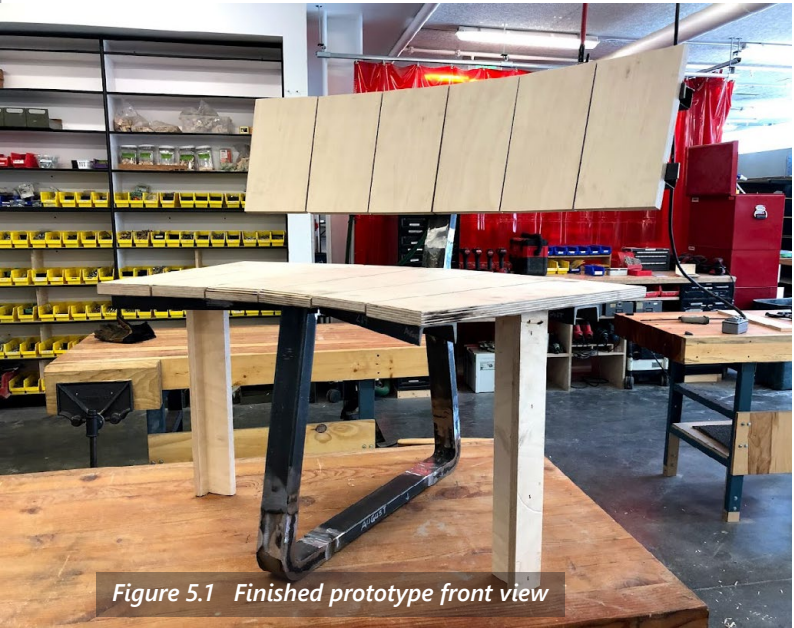


Figure 5.1 Finished prototype front view

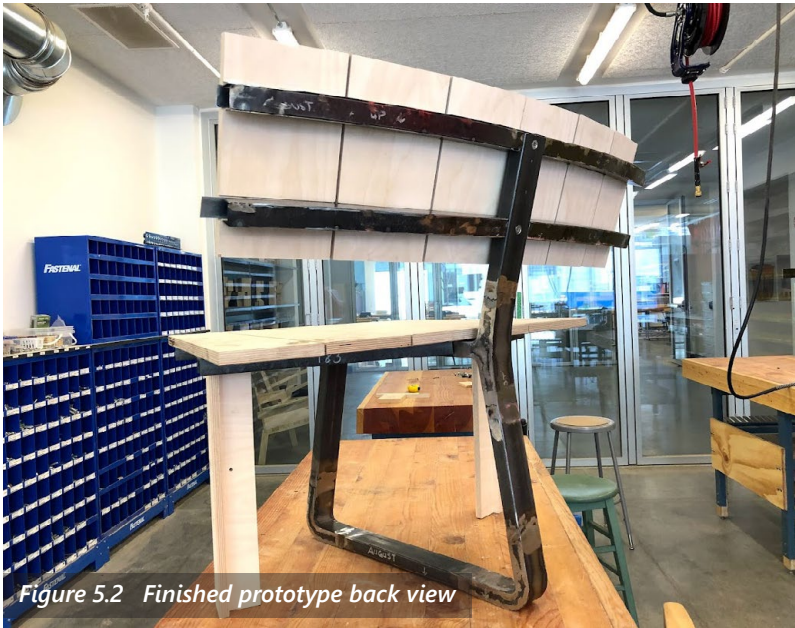


Figure 5.2 Finished prototype back view

Building The Prototype

After Workshop 2 helped determine the design features, I began working on a prototype to learn how to actually fabricate the bench. Having never attempted metal fabrication before, this was quite the learning curve for me! Once I learned how to weld and what box pipe was, the prototyping process was underway.



Figure 5.3 Taped footprint

Masking tape was used on my living room floor to determine what dimensions were comfortable, with the help of my roommate and classmate, Haley Weinberg, pictured.



Figure 5.4 Test curve diameter pieces

One inch metal strap helped test the radius of the bending dies available in the FabLab. The inner radius that looked the best for the curved corner pieces was 1/2 inch. The outer radius that matched was 1 1/2 inches.



Figure 5.5 C-joint after welding

After several errors cutting out the correct c-shaped wall pieces, I was able to weld together the corner pieces. 2" steel strap was bent and used for the vertical pieces seen here. After it was welded together, I used a high speed sander to grind down the welds.



Figure 5.6 Pieces of leg

I first tried lining up the corners and box pipe onto a full scale 2D printout I had made of the legs. I realized that it was hard to align the pieces straight. I developed a different plan for the back attachment that included a t-joint to incorporate the back support into the leg. I learned what metal gauges are and how welding together different metal thicknesses is more difficult because you can blow a hole through the thinner material, due to too much heat, much easier.



Figure 5.7 Leg before making jig

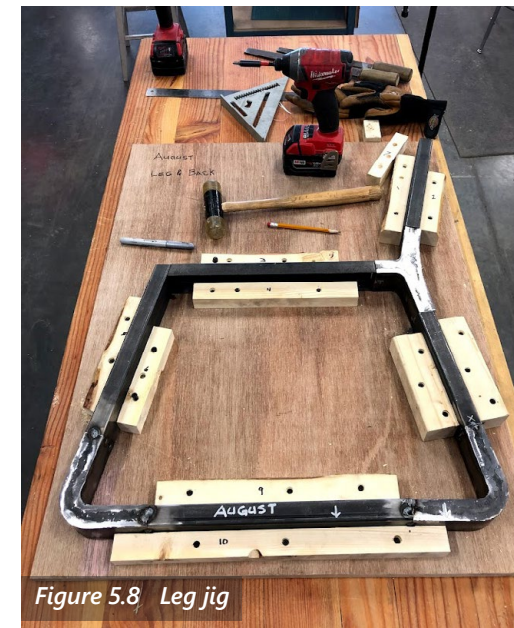


Figure 5.8 Leg jig

After trying to manually align the pieces for the leg unsuccessfully, I made this jig so all the pieces could be slid into place.



Figure 5.9 Seat support pieces

The seat supports were constructed out of 1x2" 11 gauge c-channel. Screw holes were pre-drilled in these supports before attaching, as well as holes for a bolt to secure the supports to the leg. This is where I learned about tolerances and why it is important leave wiggle room somewhere in the design for movement.



Figure 5.10 Attaching support pieces



Figure 5.11 Completed seat

The seat boards were cut on the table saw using two different jigs, one for each cut angle. The board shape was figured out in AutoCAD. The wedge shapes, when arranged correctly, form a 6' semicircle. The boards were screwed in from underneath to hide the fasteners.



Figure 5.12 Cover attachment

In order to hide more fasteners, I made a cover for the back support. The gap shown above in figure 5.12 goes over the leg and a bolt can be screwed through into a nut that is welded into the piece that the boards are fastened to.



Figure 5.13 Weld nuts on back support



Figure 5.14 3D model of welding jig for back support pieces

I tried to make the back supports out of flat strap welded into a C shape. I realized that would not work when I went to attach the back boards. The back support pieces would need to curve in two directions to account for the angle of the back. I modeled this jig in Rhino based on the 3D model I had previously made.

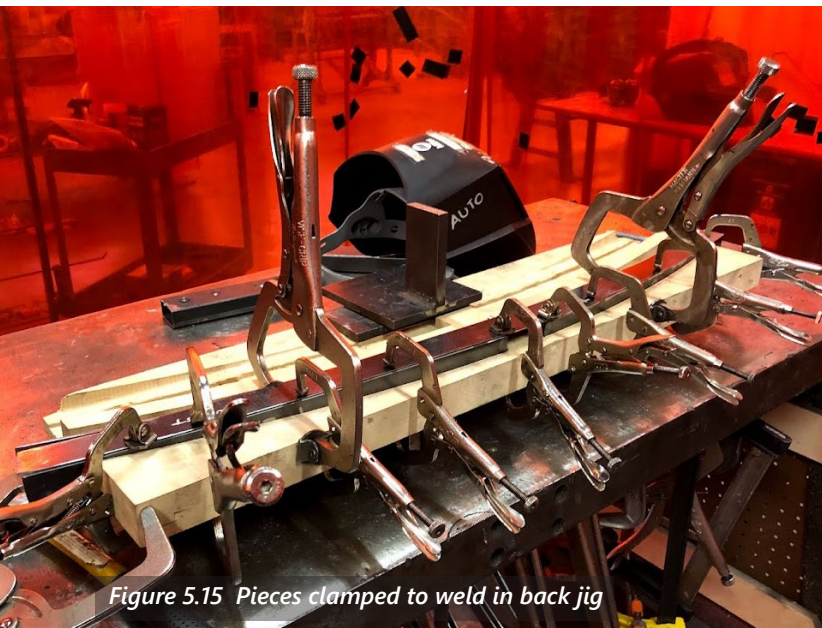


Figure 5.15 Pieces clamped to weld in back jig

Here is the aforementioned jig for the back support pieces. Lots of clamps were needed to force the metal pieces to bend in two different directions and fit together. The pieces had to be CNC plasma cut to get correct shape per the Rhino model of the bench. The jig they sit in was made on the big CNC machine for wood that the FabLab has and is made of MDF board.

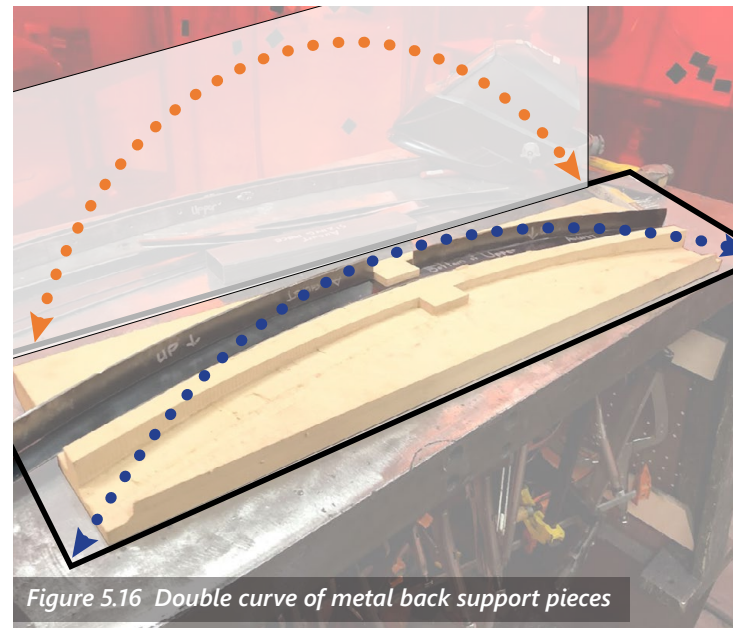


Figure 5.16 Double curve of metal back support pieces

The metal pieces supporting the backrest are doubly-curved, on both the x- and y-axis. Figure 5.16 illustrates this double curve. This is necessary because the backrest piece itself is a cone shape, and thus needs to bend in two different directions at once.

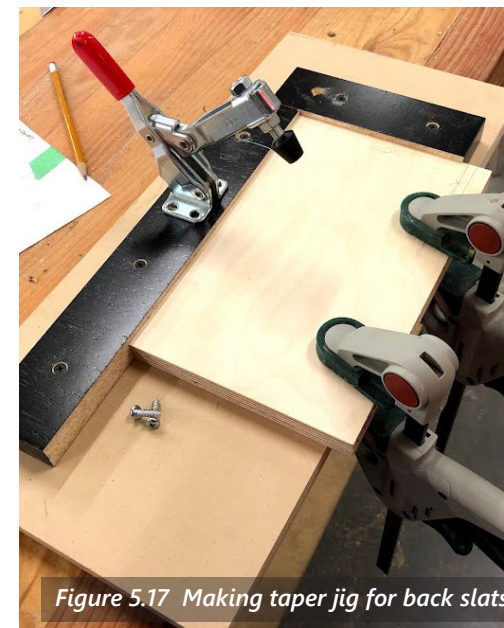


Figure 5.17 Making taper jig for back slats

The back boards were challenging to figure out. Several iterations of different wedge shapes occurred before I modeled the wedge shape in Rhino to get the correct shape. The question of how to attach them to a doubly curved support had to be answered.



Figure 5.18 Attaching back slats

After several attempts, a curved groove was carved into the backside of the boards so they could sit "flat" to the supports when fastened.

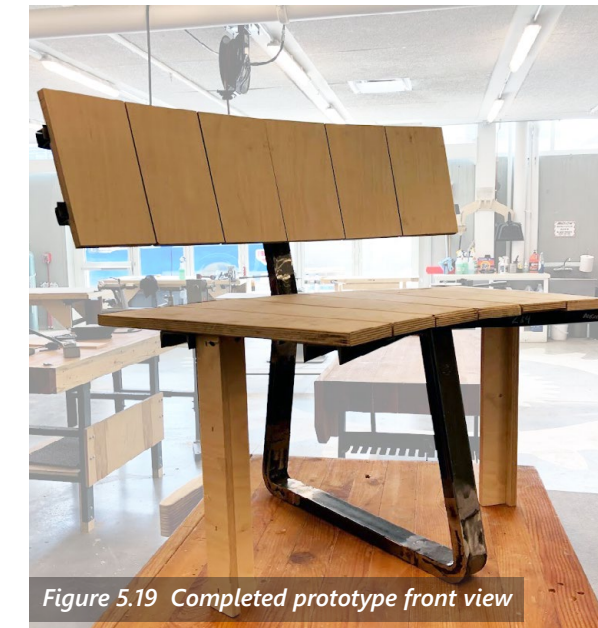


Figure 5.19 Completed prototype front view

Here is front view of the finished prototype, with wooden supports added so it wouldn't tip over.

Fabrication

Developing the prototype was an invaluable step in the design-fabrication process. By prototyping, I was able to establish all the angles for the wedge-shaped boards, develop all the attachment joints, and create the jigs required for the final bench. I learned how pieces would fit together, how large certain holes need to be for pieces to align correctly, and where to clamp pieces down in jigs for welding. Having finished the prototype, it was time to move on to fabricating the full-scale bench.

The full-scale bench had five legs, three legs with back supports and two without. The metal backrest support pieces were 7 feet long and required a large jig to create the double-curved geometry. There were 30 seat slat wedge-shaped boards to cut and 16 backrest slats. Words were engraved into half of the backrest slats. The final bench fabrication took me four months to complete.

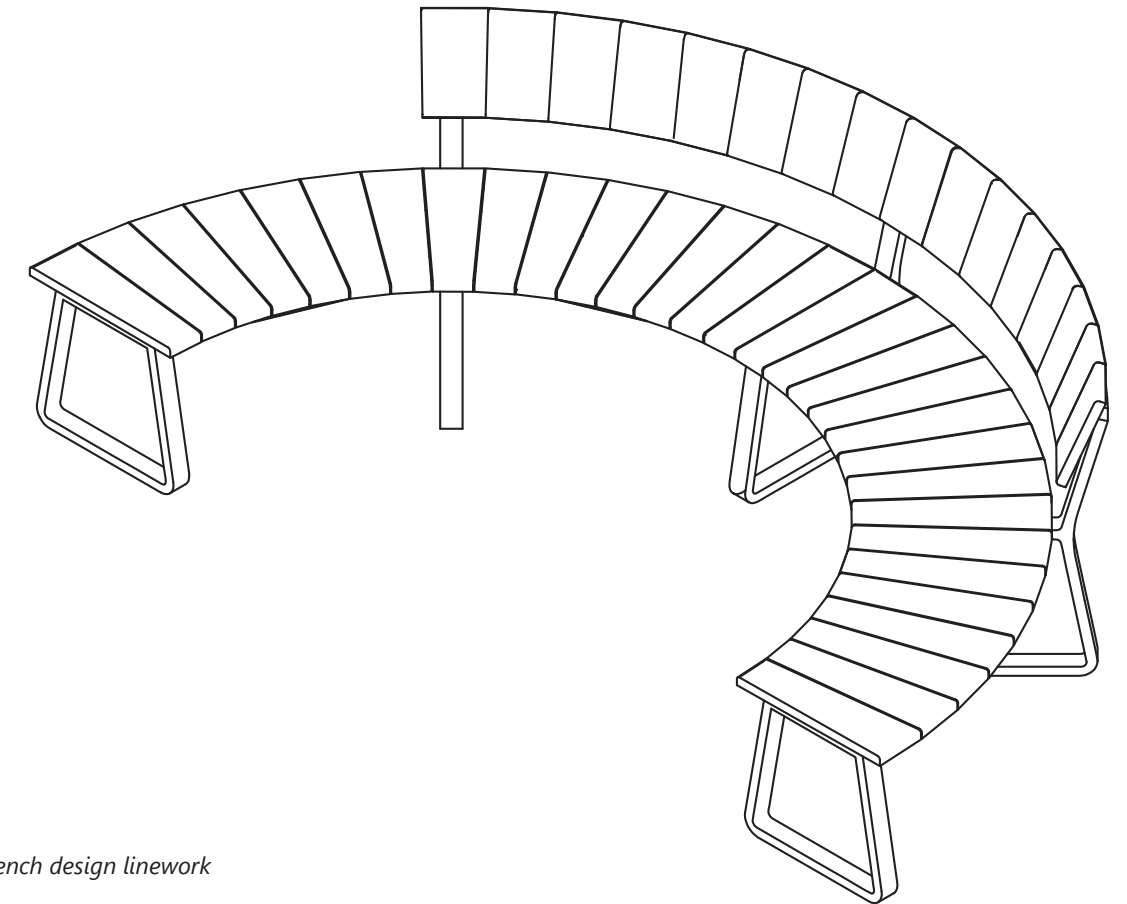
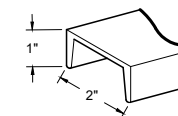


Figure 5.20 Final bench design linework



84



85

Begin Leg Fabrication



Figure 5.23 Walls for C-joints on CNC plasma bed

Cutting out the walls of the curved C-joint in the legs and T-joint on the plasma CNC.



Figure 5.24 Clean C- & T-joints walls

Shown below are the walls all cleaned and removed from the CNC plasma bed. There are 20 walls needed for the 5 legs, as each C-joint takes two walls and there are two C-joints in each leg.

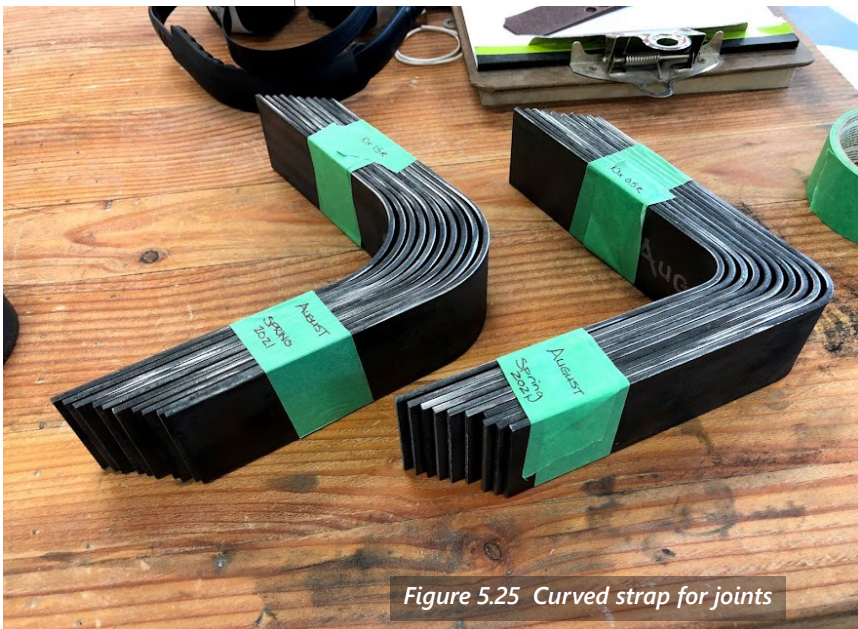


Figure 5.25 Curved strap for joints

Bending the inner and outer radius for all of the C-joints.



Figure 5.26 Bending strap

The Acro bender was used to form the 2" strap into the C-joints and T-joints.



Figure 5.27 Tacked together C-joints

All 10 of the C-joints tacked together, ready to be welded.



Figure 5.28 C-joints



Figure 5.29 Welds on C-joint half ground down

After being welded, as shown above, each C-joint was ground flat with a high speed sander.



Figure 5.30 Ground flat C-joints

When both sides were ground flat, the extra 2" strap was trimmed flush with a horizontal bandsaw.



Figure 5.31 Welded T-joint

The three T-joints were welded together after being tacked.



Figure 5.32 Ground flat T-joints



Figure 5.33 Laying out joints to find length of straight pieces

To determine what lengths were needed of box pipe, the C- and T-joints were aligned on a full- scale print out of the legs. Each joint piece was trimmed at a different length and labeled with a letter to indicate which direction the piece needed to be placed in the jig later.



Figure 5.34 All pieces cut for large legs

Holes were pre-drilled in the box pipe and c-channel pieces. Different sized holes were drilled for screw attachment and venting. The vent holes were necessary for the galvanization and powder coating process.

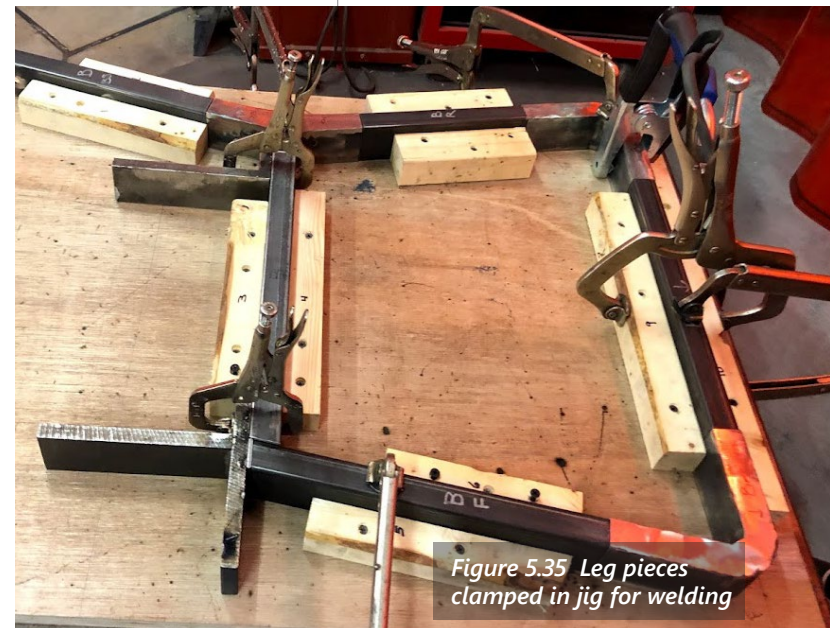


Figure 5.35 Leg pieces clamped in jig for welding

After all the holes were drilled, the pieces for a leg were clamped into the jig, and then tack welded. All three legs-with-back-support were done consecutively.



Figure 5.36 Checking pieces' measurements in jig before welding



Figure 5.37 Three legs tacked together

Legs Completed



Figure 5.38 Cap for T-joint tacked on

Caps were needed to seal the open end against water and insects at the ends of the T-joints. A 1" strap was tacked in between to cover the end of the T-joint, between the T-joint and C-channel.



Figure 5.39 Cap on front of leg

A cap was also needed for the end of box pipe that was on the front of the leg to keep out water.

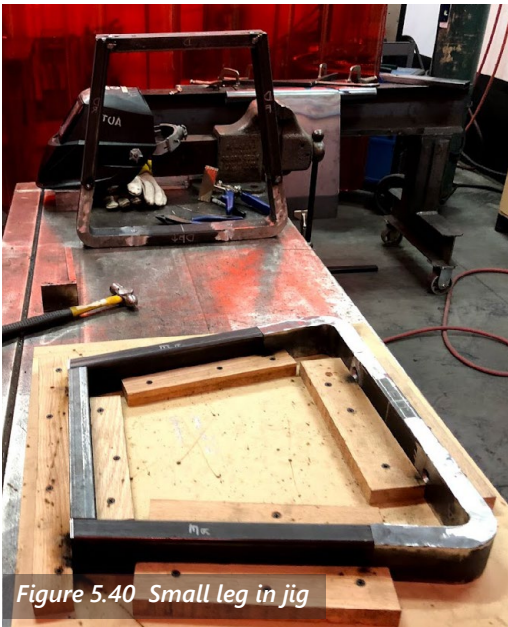


Figure 5.40 Small leg in jig

The two smaller legs had their own jig for welding.

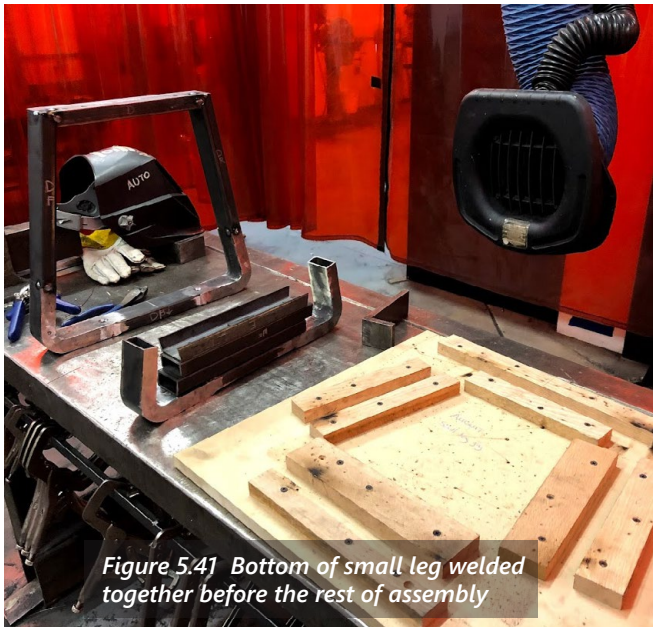


Figure 5.41 Bottom of small leg welded together before the rest of assembly

Because of their smaller overall width, the two C-joints had to be welded to the bottom box pipe and ground flat so holes could be drilled. The holes needed to align with the wider legs that have the back supports.



Figure 5.42 All legs tacked together

All legs tacked together.

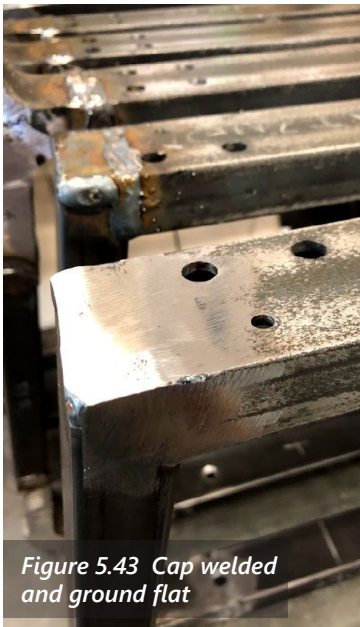


Figure 5.43 Cap welded and ground flat

After all the legs were welded together, all seams were ground flat with a high speed sander to allow the seat boards to sit on top.

Metal Seat Supports Completed



Figure 5.44 Punches for drilling holes in seat supports

Each C-channel seat support was cut at a unique angle due to the curved form of the bench.



Figure 5.45 C-channel seat support pieces

Holes were predrilled for screws and bolts, marked here with Sharpie.



Figure 5.46 Notch and holes in seat supports for attachment to legs

Notches were cut out from the end of the supports, following the angle of the cut edge, so the ends would sit flush with the top of the legs. Larger holes were drilled for the bolt attachment to the legs.



Figure 5.47 Test fit of legs and seat supports

To ensure bolt holes were drilled large enough and notches cut deep enough, a test fit was assembled with the legs and seat slat supports.



Figure 5.48 Jig for welding back supports

For the full-scale bench, a larger version of the prototype jig used to weld together the back support pieces was needed. The jig, nicknamed the Layercake, was made from three sheets of MDF and cut on the CNC.

Starting Metal Backrest Supports and Screw Cover Pieces

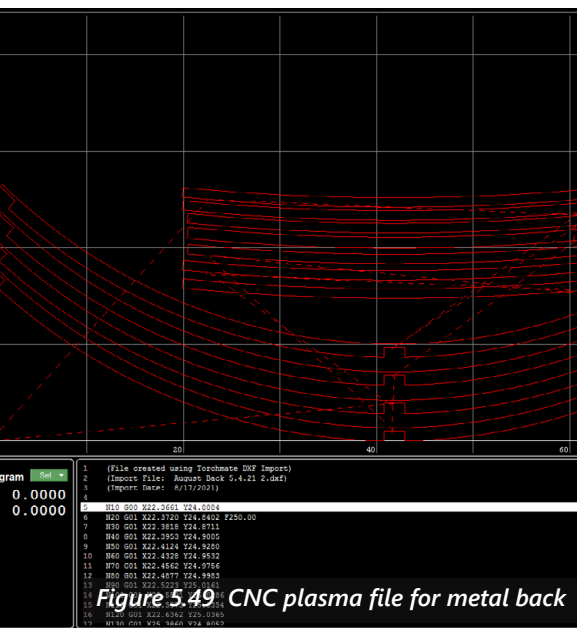


Figure 5.49 CNC plasma file for metal back

Figure 5.49 shows what the CNC plasma cutter file setup looks like. The computer controlled arm with the attached plasma torch will follow the path in the file.



Figure 5.50 Cleaning up back supports

After plasma cutting, each piece had to be cleaned to remove a large amount of slag, which are the rough, jagged, raised pieces left on the cut edges.



Figure 5.51 Clamping pieces in jig

The pieces were clamped into the Layercake jig, to curve the pieces. The jig allowed the pieces to be shaped into the specific multi-dimensional curve needed to support the bench backrest wooden slats.



Figure 5.52 Closeup of ends of supports

The middle of the Layercake had a bump out to simulate the space needed for the leg's rectangular back support. This allowed metal pieces to be shaped and welded around where the legs would eventually go.



Figure 5.53 Test fitting the curve of pieces

Test fit for the first back support piece to ensure the screw holes lined up with the legs. While curves make fabrication more complicated, they look so nice.



Figure 5.54 Back covers before being modified

To cover the screws attaching the wooden slats to the metal support pieces of the backrest, a metal cover was designed. The original plan was to have the back cover pieces be a "C" shape but then the backrest support pieces, that the wooden slats screwed into, did not fit. Both pieces were modified to be "L" shapes to better fit together.



Figure 5.55 Test fit for weld nut

Test fit for CNC plasma cutting a hole to fit a weld nut in.



Figure 5.56 Tacking weld nuts in place

I used a scrap piece of plywood to support the weld nut for the first tack weld. The bolts being used to attach the backrest to the legs were not long enough to have the weld nut sit on top of the curved strap, which is why I had to recess the weld nut into the strap. Having the nut sit flush also made the fabrication of the wooden slats for the backrest easier, as I would not have to carve a groove to fit the weld nut into.

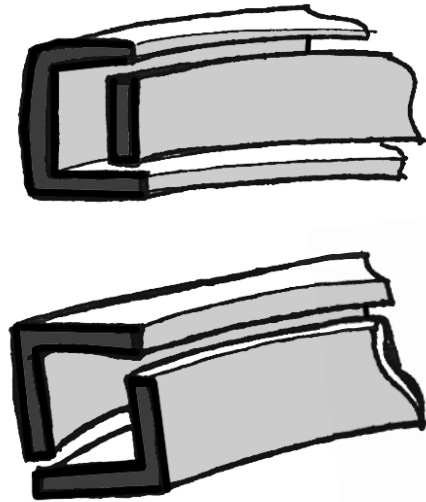


Figure 5.57 C-shaped back cover (top) to an L-shaped cover (bottom).



Figure 5.58 Test fitting back support strap piece

The test fit of the curved back support piece, made of 1" strap, revealed that the strap would not sit inside the C-shaped back cover, which was problematic because the covers would not fit otherwise. The pieces were then reconfigured into two L-shapes, see figure 5.57.



Figure 5.59 New 'L' shape in jig

The strap piece being welded to a new bottom piece to form an "L" shape. This new shape is stronger and easier to fit together.

Metal Galvanization



Figure 5.60 Discoloring from reinforcing weld's heat

A reinforcing weld was added to the inside corners of the C-channel at the top of the leg, reinforcing the joint between it and the sides of the legs. Evidence of the heat transfer, created during the weld, left a discolored area on top right corner of the legs.



Figure 5.61 Rounding over sharp edges before and after

Once all the back support pieces were complete, all corners on the legs and back supports were rounded over, to create a more polished edge and to eliminate all jagged, sharp edges. To ensure the process was consistent, all rounding was done at the same time. Each "roundover" was done very carefully with a high speed sander.



Figure 5.62 Round over edge



Figure 5.63 Metal pieces after being galvanized

Once all the metal pieces were welded, ground flat, all edges smoothed over, and all holes drilled, the parts were sent to be galvanized at Valmont, a galvanizing plant in Salina, KS. The galvanizing process dips the metal pieces in a molten zinc solution that, when hardened, protects the metal from rusting. Since the bench is going outside, galvanizing the metal gives the metal pieces a greater longevity in the elements.



Figure 5.64 Aluminum plugs

Aluminum plugs were created to fill in the vent holes that had been drilled into each leg after the pieces were galvanized. The vent holes are required for hot air to escape as the pieces are dipped into a tub of liquid zinc compound. If vent holes are not placed correctly or forgotten, the pieces can explode due to heat buildup during the dipping process. Once the galvanization process has been completed, the vent holes are no longer necessary, and can be filled with an aluminum plug (aluminum is rust resistant).



Figure 5.65 Aluminum plugs inserted into gap



Figure 5.66 Holes filled during galvanization

During galvanization, most holes, originally drilled for screw connections, unexpectedly became filled.



Figure 5.67 Re-drilling holes after galvanizing

All filled holes were re-drilled and the larger holes for the bolts were slightly enlarged to ensure the parts would properly fit together.

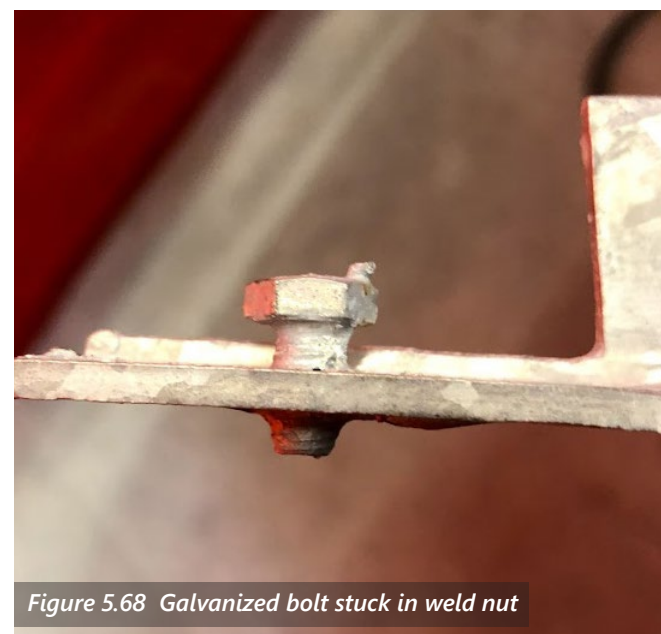


Figure 5.68 Galvanized bolt stuck in weld nut

To protect the weld nut threads, the spiral on the inside, of the back support pieces, a protective bolt was placed inside each. Silicon can also be used to protect the threads. If the bolts had not been there, the weld nuts would have filled with zinc during galvanization and the back support pieces would not be able to attach to the rest of the bench. However, after galvanizing, the protective bolts were now stuck to the support pieces, see figure 5.68. Three of six bolts snapped while being of removed. Two were re-tapped—cutting threads back into the metal—without issue, but one had to be filled with new weld and then re-tapped.

Metal Powder Coating



Figure 5.69 Test fitting galvanized pieces

A test fit was done to ensure all the pieces still fit together after galvanization. A few of the bolt holes on the seat support pieces needed to be enlarged to ensure the pieces to fit together again.



Figure 5.70 Powder coated pieces

Once all the galvanized pieces were painstakingly cleaned up, it was time to powder coat! The color chosen during Workshop 3 was a textured black, which would hide some of the surface inconsistencies caused by the galvanization process. Zinc sticks thicker in areas that have been welded.



Figure 5.71 Test fitting powder coated pieces

The powder coated pieces were carefully assembled to ensure everything fit together.

Wood Purchasing

Begin Milling Wood

Cutting Seat Wedges



Figure 5.72 Rough sawn lumber

All 57 rough sawn osage orange boards were organized by thickness and by length. The thicknesses ranged from 1 1/8" to 5/4." The wood was sourced from a farmer in Madison, KS, which is a 2 hour drive from the FabLab in Manhattan, KS.



Figure 5.73 Milled lumber

All boards had to be milled down to 1" thickness. After using the planar to get the boards to the correct thickness, the jointer was used to give each board one square edge.



Figure 5.74 Taper jig

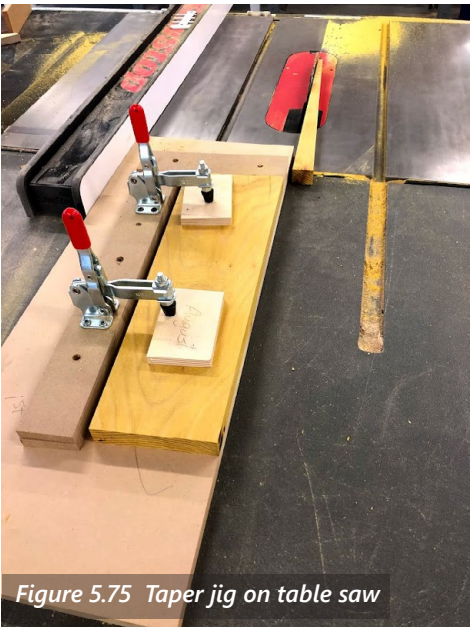


Figure 5.75 Taper jig on table saw

Taper jigs, created during prototyping, were used for cutting the wedge shapes out of the boards. The seat boards had two jigs, one for the first cut's angle and the second jig for the second cut's angle. All the seat boards were cut to the same wedge shape. The back boards also had two jigs to cut the wedge shape, just with different angles from the seat boards.



Figure 5.76 Boards cut into wedge shapes

To create the semicircle seat, 30 wedge shaped boards were needed.



Figure 5.77 Wedge shape of boards

CNC Carving Word Tests

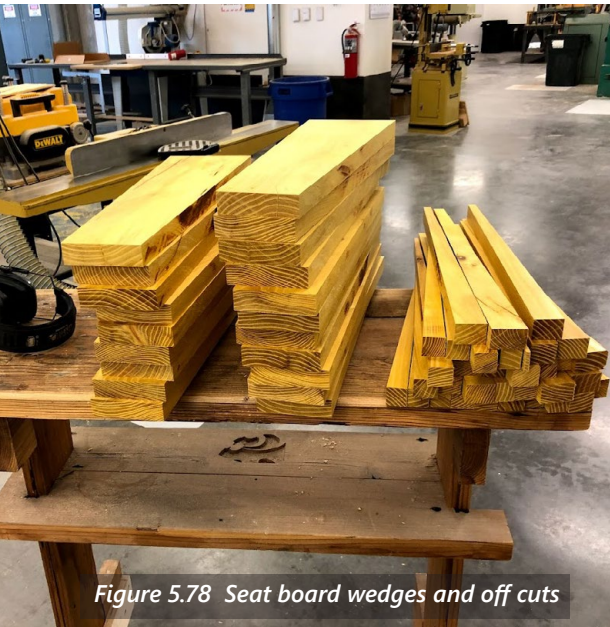


Figure 5.78 Seat board wedges and off cuts



Figure 5.79 August cutting boards using taper jig



Figure 5.80 Laying out wedges

Boards were cut on the table saw using the jigs for the taper.

I laid all the boards out to see the full semi-circle for the first time, and to pick which side of each board would become the top. Only the edges of the top of the boards received a larger roundover created with a router later.



Figure 5.81 Test board after carving the words



Figure 5.82 Test board after laser etching words



Figure 5.83 Test board after putting on finish

A board that I messed up while planing (it ended up too thin) served as a test piece for carving the words into back slat boards. Different font choice, letter sizes, and burning techniques were tested. I also did a practice with finish coatings to see how the boards would look. The burning technique chosen was using a laser cutter to etch the words into the wood. On a softer piece of wood, laser etching will take off 1/16th of an inch, but since osage orange is an incredibly dense wood, the etching process simply burned on the words without taking off any material.

Laser Etching Words



Figure 5.84 Carving words into back boards with CNC

The backrest boards all had two channels that you can see a corner of (the two end board’s channels did not go all the way through) to allow the boards to sit “flat” on the curved back supports.



Figure 5.85 Before and after laser etching

The words were carved with a v-bit on the FabLab’s CNC. Here you can see the before and after laser etching (the bottom board says ‘determination’).



Figure 5.86 Left middle back board before finish

In the middle of the backrest, the words “honoring and celebrating our neighborhood champions” are carved. As the backrest consists of 16 wooden slats, the words had to be split between two boards. Figure 5.86 shows the left board.

Applying Finish



Figure 5.87 Putting finish on boards

Three coats of clear satin, oil-based, spar urethane finish was applied to all the boards to protect them against water and UV rays. The boards were lightly sanded in between each coat and any drips were cleaned off.

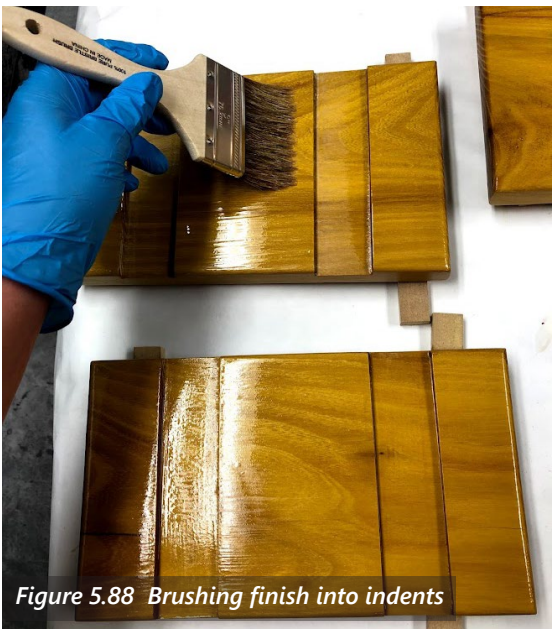


Figure 5.88 Brushing finish into indents



Figure 5.89 Finish drying outside in sunlight



Figure 5.90 Using 1/8" spacers to position seat slats

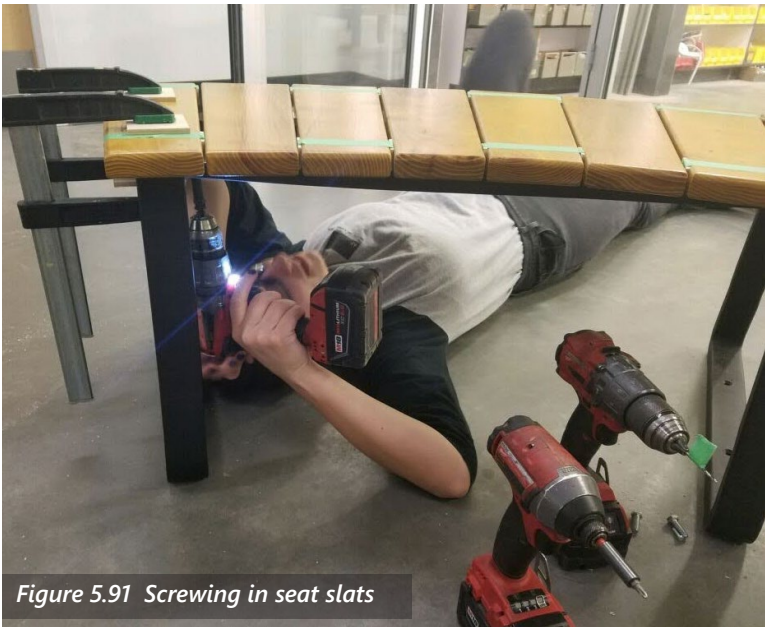


Figure 5.91 Screwing in seat slats



Figure 5.92 Numbering on underside of slats

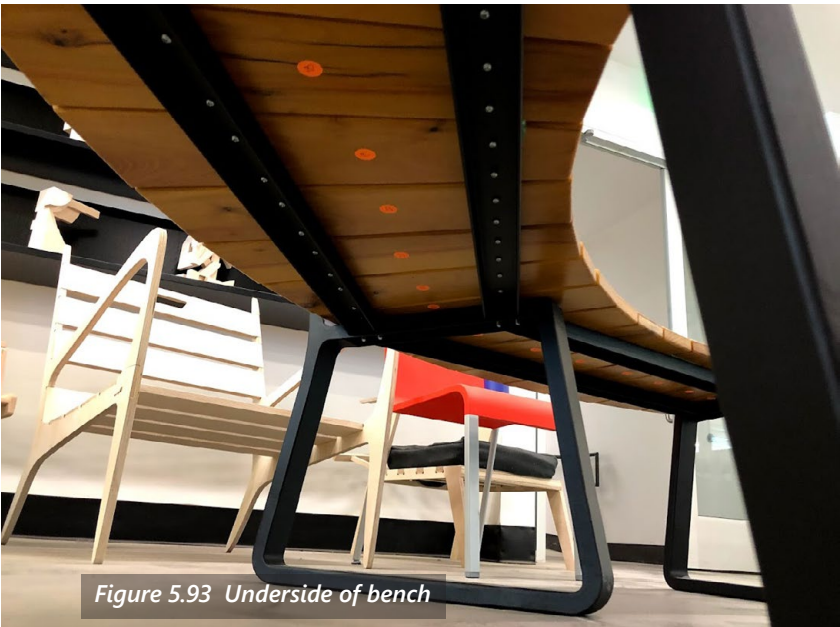


Figure 5.93 Underside of bench

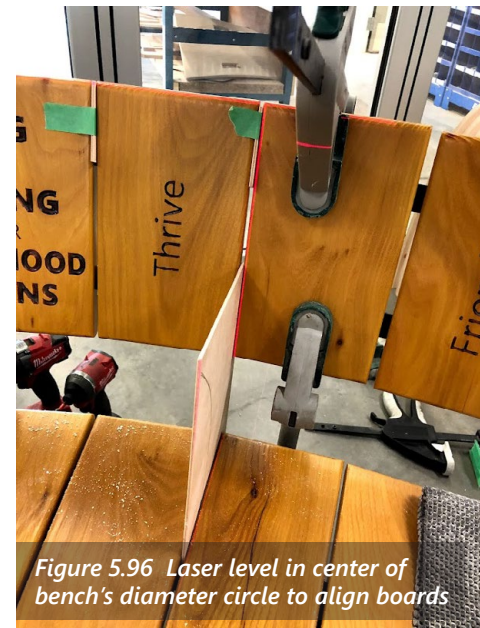
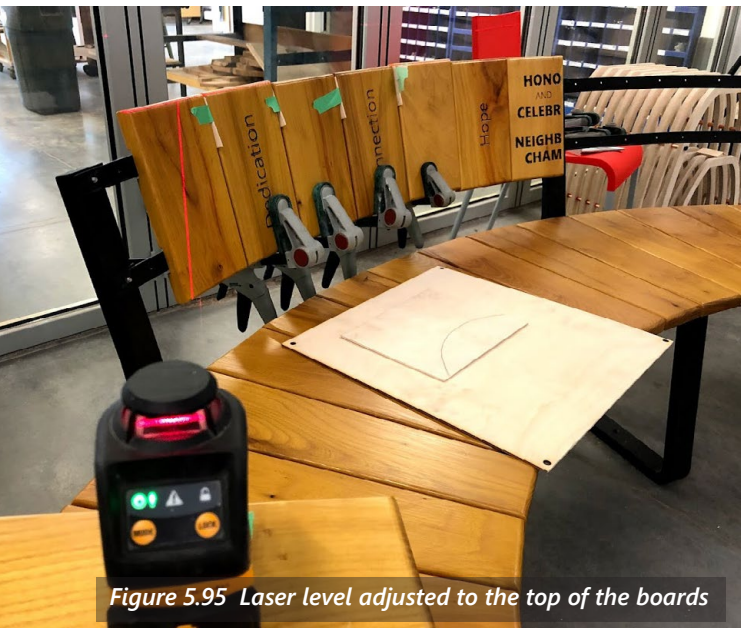


Figure 5.94 Seat slats fastened to the metal supports

When screwing the seat slats to the metal supports underneath, spacing was paramount to achieve a neat look. To space all the slats evenly, spacer boards were made of plywood that was 1/8" thick. These spacers were taped in between each slat to ensure an even gap. The seat slats were aligned with the front bottom edge of the bench's legs and screwed in. The first two boards on each section were clamped down and screwed in from underneath. The entire section was then taken to a workbench and flipped upside down. The remaining boards were then lined back up and screwed in.

On the underside of the bench, all boards were numbered after initial placement (before being screwed in) to ensure the color of the boards looked aesthetically pleasing. There were lighter and darker boards and the goal was to create a nice transition between lighter and darker boards, as all the boards were slightly different shades.

The bench with all the seat boards fastened.



A laser level was needed to ensure the backrest slat boards were level. The level was placed so that the gap between the seat boards continued vertically into the backrest. A 1/8" thick scrap piece of plywood was also used to help space out the boards.

Once all the backrest boards were attached, the entire back piece was removed to put on the metal screw covers for the backrest.



Figure 5.100 Metal back fastener covers in place

Once the metal screw covers (see figure 5.100) for the backrest were installed, with the help of three other people, the fabrication process was complete and the Ivanhoe Neighborhood Bench was done!



Figure 5.101 Completed and fastened back boards with words

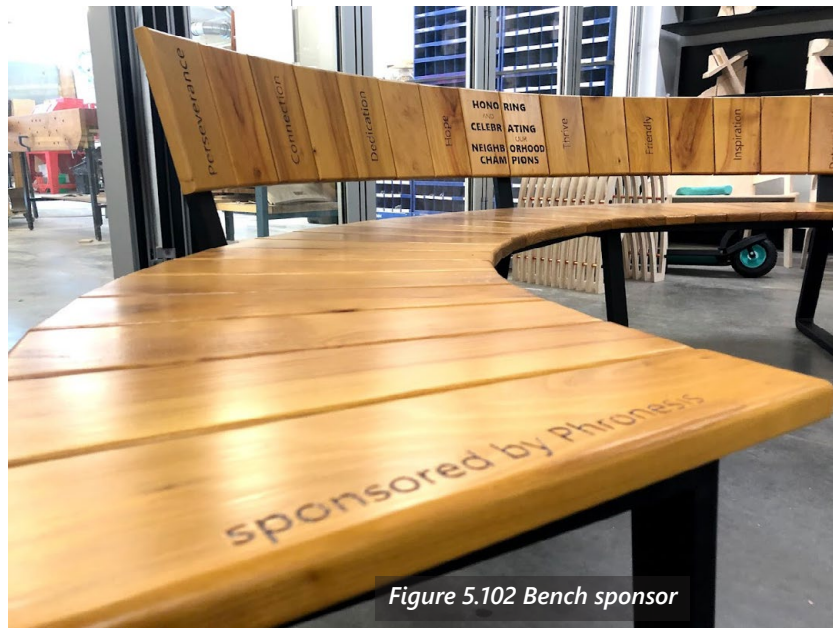


Figure 5.102 Bench sponsor



Figure 5.103 Completed bench



chapter

6

guide

A Guide to Developing a Participatory Design-Build Process for the Creation of a Custom Bench

Introduction to the Guide

This guide was developed after completing and reflecting on the Ivanhoe Neighborhood Bench project. This chapter includes a step-by-step process to create a participatory design-build project for a bench. While the steps do not entirely follow what I did, they account for the pitfalls I ran into, add considerations I had not known about, and include questions to help you plan your own project.

There are two different approaches that could occur when developing a participatory design-build project. The first approach, Alternative A, shows how designers can create a design, with feedback from participants. This approach was modeled after my experience in the creation of the Ivanhoe Neighborhood Bench, which responded to social distancing requirements, imposed by Covid-19 in the fall of 2020. The second possible approach, Alternative B, is the more participatory process as the participants are designing the concepts themselves with guidance from the Design Lead.

This guide is intended to be used by designers, landscape architects, artisans, craftspeople, or anyone who wants to create a custom bench collaboratively with others. This guide will help to establish the project team, structure the participatory activities, set a budget, and identify resources, while providing considerations for the custom bench design, fabrication, and installation processes.

Steps of Process

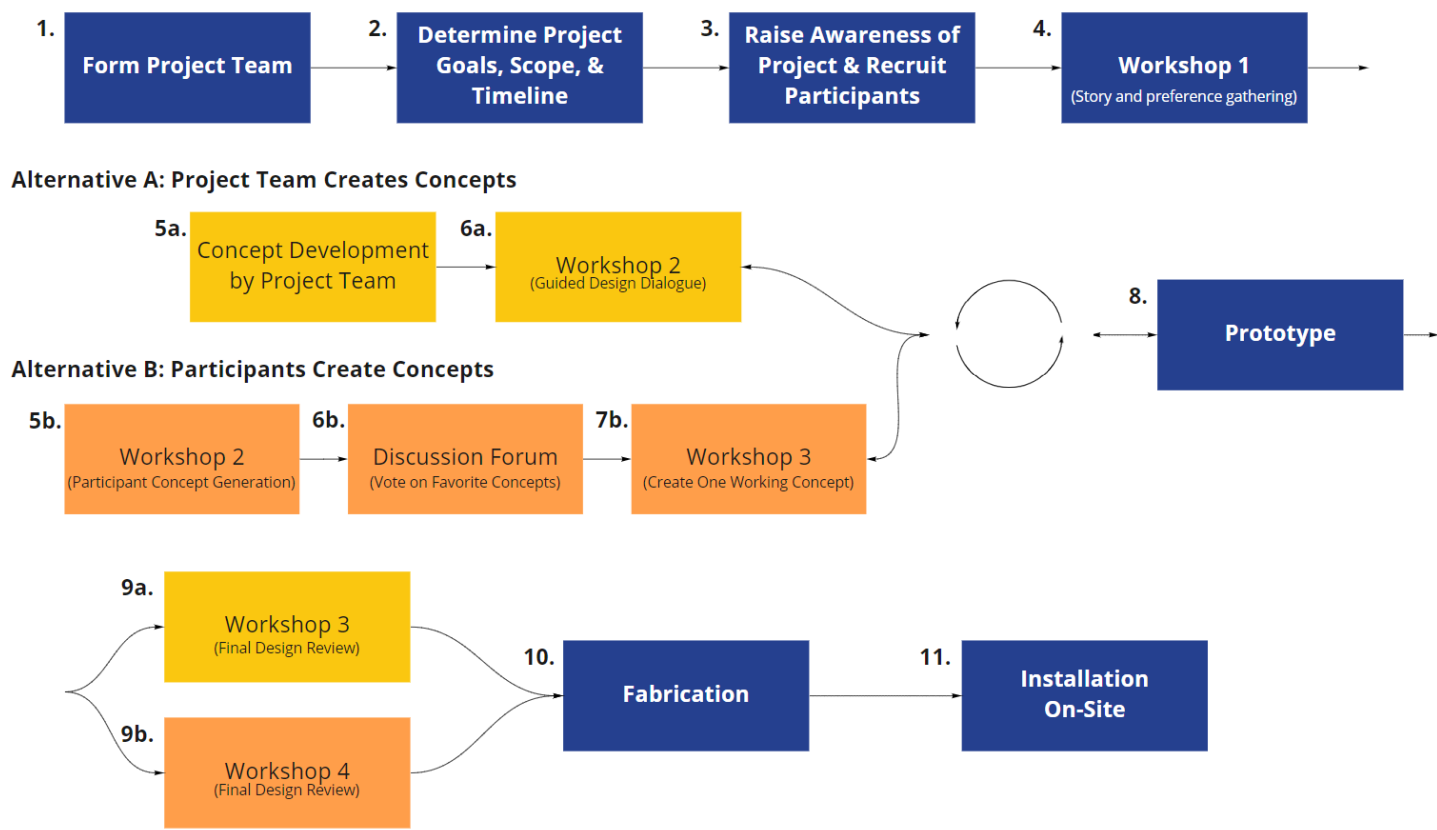


Figure 6.1 Diagram of steps within the participatory design-build process guide.

Steps of Process

When starting a custom bench project, there are many administrative, logistical, and technical considerations that need to be made. A suggested resource for further reference is *Site Furnishings: A Complete Guide To The Planning, Selection, And Use Of Landscape Furniture And Amenities* by Main and Hannah.

There are, depending on how concepts are generated, a series of 3-4 proposed workshops for the process. Workshops are flexible, programmable meetings that allow discussion and problem solving to occur. This is necessary in the participatory design process to allow participants to be included and to see how their suggestions are being implemented into the final design.

1. Form Project Team

Purpose: to form a group of experienced people to work together to spearhead the entirety of the participatory design-build process.

First, a dedicated team must be formed. Though duties can be shared, it will be important to identify a point person for design, community coordination, and fabrication. This team organizes the entire process from start to finish. The Design Lead should be knowledgeable about the design process, preferably of site furnishings. At a minimum, they must be able to coordinate workshops and work through design concepts. The Local Coordinator provides knowledge of the neighborhood, promotes the project, and helps navigate working with the community. The

Fabrication Lead needs to be knowledgeable about the materials being used, the fabrication techniques of those materials, and teach others their fabrication knowledge. All duties could be shared, but a dedicated leader for each role is strongly encouraged.

Design Lead:

- Lead the design process.
- Plan and prepare material for the workshops.
- Provide design budget framework.

Local Coordinator:

- Recruit participants.
- Generate publicity for project.
- Assist Design Lead at workshops.
- Determine the number of participants desired for the project with Project Team.
- Recruit volunteer workers if that is the chosen fabrication method.
- Provide project budget and fundraising.

Fabrication Lead:

- Identify where fabrication will occur, and what tools and resources are available.
- Ensure designs are buildable with the resources available.
- Provide insight and educate participants on appropriate fabrication methods.
- Provide fabrication and installation budget.

2. Determine Project Goals, Scope, and Timeline

Purpose: to create goals that will guide the overall project, determine key aspects of the project scope, and establish a timeline for the project.

Creating project goals at the beginning can help steer the process in the right direction. Goals can be created within the Project Team and revisited with the participants at the workshops. Using the Assessment Worksheet, page 54, will help the Project Team determine what goals it hopes to accomplish during the entire participatory process. The goals should be revisited periodically throughout the process and changed to reflect new project directions, if necessary.

Using the Assessment Worksheet, establish the project scope for the bench. Early establishment is essential for proper planning. The size and location of the bench are both vital decisions to make early in the planning process. The size of the bench impacts the overall cost and time needed to fabricate it, as well as where the bench can be placed. The location may impact the design of the bench, as the bench design can respond to aspects of the surroundings including view, topography, and shade. For further insight, consult the Design Considerations Worksheet.

Using the Assessment Worksheet, determine the budget, resources, and tools available for the project. The budget must be established early because the cost of materials and fabrication services can be expensive. A determination

of what resources are available will greatly impact the potential scope of the project, as certain tools may be vital to the fabrication process.

Another consideration is the timeframe for the project. How long do you have before the bench needs to be installed? Depending on how long fabrication takes and how organized the team is, the project could take anywhere from two months to six months, from start to finish.

The number of participants desired is another aspect to consider. Participants in the workshops can be divided into groups for discussion and activities. The overall number of participants can be flexible depending on the Project Team’s capabilities. If the number of participants grows beyond the Project Team’s ability to manage, more team members may be required to help, or the participants split into multiple synchronous workshops.

Design Lead and Local Coordinator:

Decide the location of the bench either by project team choice, with the participants during a workshop, or at a community meeting with the neighborhood. Establish the budget for the project and if sponsorships/fundraising will be necessary.

Fabrication Lead:

Assess what fabrication tools and facilities are available. Keep in mind that participants may have some experience, tools, home workshops, and/or access to resources.

3. Raise Awareness of Project & Recruit Participants

Purpose: to inform potential participants and generate interest about the project.

For people to want to participate, they must learn about the project. Advertising on neighborhood social media pages, going to community meetings, news releases, and setting up informational exhibits are ways to inform people about the upcoming project and pique their interest in participating (Sanoff 2000). It is suggested to ask participants when they sign-up, if they have experience in construction or resources that could be used as part of the project. There should be a sign-in sheet at every participant meeting to keep a record of attendees.

Local Coordinator:

Create advertising materials about the project that state how participants can sign-up, what the project entails, and details about when and where each workshop will occur.

4. Workshop 1: Storytelling and Bench Preferences

Purpose: To inspire initial bench design concepts.

The second purpose is for both the community participants and the Project Team to learn from and about each other, which is called mutual learning, one of the pillars of participatory design (Bratteteig et al 2013). Participants and Project Team also learn about the neighborhood from those who live there.

The third purpose is for the Project Team to gather information on what type of bench the participants are wanting and which features the design should include.

Suggested Activities:

- Story Question Prompts
- Collage Activity
- Gallery
- Brainstorming

Design Lead:

Lead the workshop and ensure every participant has a chance to speak. Ensure no one participant dominates the conversation. Develop workshop activities.

Local Coordinator:

Promote the workshop. Assist the Design Lead with running the workshop. Work with the Design Lead to develop workshop activities.

Fabrication Lead:

Answer fabrication questions that arise during workshop. Explain how material choices may impact the fabrication process during the preference activity.

Alternate A (Project Team Creates Concepts):

5a. Concept Development by Project Team

Purpose: to generate bench design concepts based on feedback from the participants.

The Project Team creates concepts based on feedback from Workshop 1, where stories about the community were collected and preferences for bench design discussed. Referred to the Design Considerations Worksheet for ideas to be aware of during concept creation. While creating bench concepts, the Project Teams should ensure that designs stay reasonably within the budget and fabrication capacity available to the project. However, budgetary flexibility could be necessary as a design may be deemed worthy of finding additional funding sources by participants.

6a. Workshop 2: Guided Design Dialogue

Purpose: to discuss multiple design concepts created by the Project Team. Be able to create a prototype (scale model, full scale construction, etc., depends on complexity) from the design developed at the end of the workshop.

The Design Lead organizes and leads a design workshop with participants to collaboratively create a final design concept, building on the initial preferences and concepts established by the Project Team. By the end of the charrette/workshop, bench concept should be refined and detailed enough for a prototype in some form to be built.

Suggested Activities:

- Bench Preference Activity
- Concept Story Sharing
- Example Concept Presentation
- Discussion

Design Lead:

Lead the workshop and ensure every participant has a chance to speak. Ensure no one participant dominates the conversation.

Local Coordinator:

Promote the workshop to participants. Assist the Design Lead with running the workshop.

Fabrication Lead:

Advise participants throughout the concept generation activities and provide feedback on concepts about the feasibility of fabrication. Guide concept designs towards designs that are feasible given the facility, tools, budget, and experience available to the project.

Alternative B (Participants Create Design Concepts):

5b. Workshop 2: Guided Design Dialogue with Participants

Purpose: to allow participants to generate their own bench concepts in a guided format.

The guided design dialogue will take place in a workshop setting, generating concepts with participants. For quick model making, participants could use LEGOs or clay. Rough prototyping could also occur using paper or cardboard materials. Group sketching and brainstorming should be utilized throughout the workshop. The parameters for the size of bench should be established with the participants

at the beginning of the workshop, so the concepts do not exceed the budget and resources predetermined for the project. Each concept should have a physical form but also an idea behind it, tying it to the feedback from activities in Workshop 1.

Depending on the results from Workshop 2, there may need to be an additional concept generation, design, or review session to produce stronger concepts.

Suggested Activities:

- Model making using LEGO or clay
- Rough prototyping
- Group Sketching
- Discussion
- Cranford Slip Writing

Design Lead:

Lead the workshop and ensure every participant has a chance to speak. Ensure no one participant dominates the conversation. Guide participants through a design creation session.

Local Coordinator:

Promote the workshop. Assist the Design Lead with running the workshop.

Fabrication Lead:

Advise participants throughout the concept generation activities and provide feedback on participant's concepts about the feasibility of fabrication. Guide concept designs towards designs that are feasible given the facility, tools,

budget, and experience available to the project.

6b. Discussion Forum: Vote on Favorite Concepts

Purpose: to get more participants involved and to get feedback on design concepts.

To involve more of the neighborhood, a discussion forum could be used as a way to see which concepts the neighbors like best. The Project Team would be responsible for creating and maintaining the forum. This could occur using a variety of mediums. One way is social media sites, using built in voting features such as Instagram stories or other online voting tools. Another way is in person at a predetermined location such as a town hall meeting using various voting methods. During voting, participants can be prompted to comment on what specific parts of the design they liked most.

A consultant could also be hired to create and maintain the forum if the management of it becomes overwhelming to the Project Team.

Design Lead and Local Coordinator:

Ensure commentary remains civil and helpful. Set up a way of voting either online or in person.

7b. Workshop 3: Create One Working Concept

Purpose: to create a bench design with participants that is clear and detailed enough to begin prototyping.

In this workshop, the participants and Project Team

work together using all the concepts and feedback to collaboratively create one final design.

Suggested Activities:

- Concept Sharing
- Online Forum results summary
- Design Discussion

Design Lead:

Lead the workshop and ensure every participant has a chance to speak. Ensure no one participant dominates the conversation.

Local Coordinator:

Promote the workshop. Assist the Design Lead with running the workshop.

Fabrication Lead:

Ensure that the final concept design is within the capacity of the facility, tools, budget, and experience available to the project.

8. Prototype

Purpose: to solidify the methods of fabrication, to test complicated joints and forms.

Prototyping, in some form, is necessary to give a visual reference for non-designers as to what the design will look like. Options for prototyping could be a rough cardboard model, an architectural scale model, a half-scale built section of the bench, or a full-scale built section of the bench.

To figure out the construction method of a complicated

design, a prototype may be necessary to test connections and identify structural issues. Building a small portion of the bench, or a particular joint, may be necessary to learn the best way to fabricate that part. This part of the step may not be necessary if the proposed design is simple and straightforward, allowing for fairly standard construction methods. Though, if there is any uncertainty on how something is going to work or be built, a prototype can help resolve confusion.

The prototyping step may become an iterative cycle back to steps 6b or 7b, the concept design stage, to modify the design to resolve problems or limitations of fabrication.

Design Lead:

Creates any documents and/or drawings that are needed to guide fabrication of the prototype, such as a formal construction document set, a series of dimensioned sketches, or a digital model of the bench. The Design Lead needs to be available for redesign in the event prototyping leads to major design changes. This person works with the Fabrication Lead to solve design problems in fabrication and to modify the design as needed. Coordinates between fabrication team and participants to ensure design integrity is maintained.

Local Coordinator:

If local volunteers are involved in fabricating the prototype, this person is responsible for coordinating volunteer sign ups and disseminating information.

Fabrication Lead:

Manages the fabrication of the prototype. The Fabrication Lead may or may not be the person doing the actual fabrication. They should coordinate with those who fabricate the bench prototypes if they are not fabricating themselves. If volunteers are involved with the fabrication of prototypes, the Fabrication Lead is responsible for assigning tasks and ensuring the safety of volunteers around tools.

9a. & 9b. Workshop 3 or 4: Final Design Approval

Purpose: to present the final design, to discuss any design changes that occurred during prototyping, and to get participants thoughts on any remaining design details that needed to be addressed. This workshop wraps up the design process so final fabrication may begin.

During the prototyping process, changes to the design may have been made. Sometimes significant changes to the initial design must be made, and new design questions arise in order for the bench to be built successfully. If major changes occur, another review with participants is suggested. This is to finalize the design before final fabrication.

Suggested Activities:

- Final Design Presentation
- Design Changes Presentation
- Design Decisions discussion

Design Lead:

Lead the workshop and ensure every participant has a chance to speak. Ensure no one participant dominates the conversation. Present final concepts for approval.

Local Coordinator:

Promote the workshop. Assist the Design Lead with running the workshop.

Fabrication Lead:

Ensure that concept designs are feasible given the facility, tools, budget, and experience available to the project.

10. Fabrication

Purpose: to build the final bench design concept.

The fabrication of the bench can occur with volunteers, with participants from the design process, with a local craftsman, or be hired out to a company/contractor, depending on available resources and budget. If people fabricating the bench are learning as they go, the time required to fabricate will be longer than that of experienced craftsmen. If working with inexperienced craftsmen, ensure someone with experience can assist to ensure safety, design integrity, craftsmanship, and quality. Be sure to wear proper personal protection equipment for the tools being used, run all power tools as intended, and keep hands away from blades.

Fabrication can be a lengthy process that not all participants will be able to or want to help with. To keep participants updated with the progress of fabrication, it is suggested that the Project Team establish a

communication method and time interval of updates. This could be social media posts, monthly updates at community meetings, or website posts.

Design Lead:

Creates any documents and/or drawings that are needed to guide fabrication of the prototype, such as a formal construction document set, a series of dimensioned sketches, or a digital model of the bench. The Design Lead needs to be available for redesign in the event prototyping leads to major design changes. This person works with the Fabrication Lead to solve design problems in fabrication and to modify the design as needed.

Local Coordinator:

If local volunteers are involved in fabricating the bench, this person is responsible for coordinating volunteer sign ups and disseminating information. The Local Coordinator is also responsible for completing regular fabrication updates to the participants/community.

Fabrication Lead:

Manages the fabrication of the bench. The Fabrication Lead may or may not be the person doing the actual fabrication. They should coordinate with those who fabricate the bench if they are not fabricating themselves. If volunteers are involved with the fabrication, the Fabrication Lead is responsible for assigning tasks, ensuring the safety of volunteers around tools, maintaining the design integrity, and ensuring the quality of craftsmanship.

11. Installation

Purpose: to deliver to and install bench on-site.

Refer to the Design Considerations Worksheet on page 56 for review of criteria to be mindful of when during installation. Any changes necessary to create the desired ground conditions are advised to occur before moving bench or pieces of bench to site. If the bench is not being attached to the ground, the site still may require some preparation. If working with a city government or private owner, ensure the appropriate people are made aware of the time and method of installation.

Design Lead:

Assists Fabrication Lead in duties of ensuring correct installation.

Local Coordinator:

If local volunteers are involved in installing the bench, this person is responsible for coordinating volunteer sign ups and information. If working with a parks department or private owner, coordinate an installation time and method that works with the landowners.

Fabrication Lead:

Point person for coordinating the physical installation of bench. If the project is hiring a team to install the bench, this person acts as project manager, ensuring proper installation by the contractor is completed.

Assessment Worksheet

This worksheet is meant to be a living document and revisited periodically to update throughout the entire process.

Establish Goals:

Project Goals

- Purpose of Bench (to be a memorial, to provide seating in a park or plaza, etc.):
- How many people should the bench accommodate?
- Will multiple benches be built?
- What is the location of bench? Include a small sketch and/or photo of intended site below.

Engagement Goals

- Who might be involved?
- How might you engage underrepresented groups?
- What are other groups you might want to also engage?

Assess Resources:

Budget

- What is the overall budget for this project and what is the funding source(s)?
- Is there a sponsor for the project?
- Does fundraising need to occur?

Fabrication and Materials

- What tools and facilities are available to use?
- How can you make use of participant/volunteer tools?
- How might you include participants/volunteers in the fabrication process?
- What materials might participants/volunteers work with to fabricate the design?
- What materials are available?
- Are there any donated and/or reclaimed materials (Materials bought at a salvage yard, scrap materials provided by the community)?

Timeline:

Consider how long each of the following tasks would take your team to complete. To find calendar dates for each deadline, work forwards from the desired project start date, or backwards from the desired end date. Consult with Fabrication Lead for time estimates if necessary.

Date	
Project Start Date	
Estimated Time Required	
Project planning	
Workshop planning/preparation	
Workshops	
Preliminary Design	
Final design	
Prototyping	
Fabrication	
Installation	
Date	
Project End Date	

Design Considerations Worksheet

After completing the Assessment Worksheet, the Project Team should discuss these considerations together. Continue to refer to the considerations throughout the design process.

Site Context

Site Conditions

- Are there any jurisdictional requirements such as permits or city ordinances? If so, how will they be addressed?
-
-
-
- What overhead, underground, and ground level utilities are on site? Sketch in provided box or create map if necessary. Contact Dig Safe (811) to locate underground utilities.



Spatial Characteristics of Bench Location

- What are the significant features of the site?

- What will the bench be oriented towards?

- Is there an opportunity and/or need to provide shade over the bench? If so, how?

- People tend to feel safer with their back to walls and other barriers, as well as sitting on the edges of a space (Gehl 2011). What are the opportunities for the bench to allow people to feel safer when sitting on it (next to a wall, building, or dense bush)?

- Are there trees or other plant that conflict with the bench location? How will you address these conflicts?

Ground Conditions

- What is the ground material surface of the bench site (existing concrete, grass lawn, gravel, etc.)?

- Does the ground surface need to be modified to provide the bench a stable foundation (concrete slab, concrete footings, etc)? If so, how?

The slope of the site is important to determine early in the project. If the slope is too steep (more than 5.0%), people may not be able to access the bench. To comply with the Americans with Disabilities Act (ADA), paths should be less than 5.0%. If the slope is too flat, water will not drain from the area and will form puddles. A slope of 2.0% is ideal for water drainage. On concrete, the minimum recommended slope to facilitate drainage is 0.5%.

- Does the ground slope need to be modified to an accessible slope percentage? If so, how?

Materials

Materials used for outdoor furniture must consider the affects of weather, sun, and use. Protection from water and the sun's UV rays are necessary to increase the longevity of the bench. Two commonly used materials are metal and wood, due to their wide availability and ease of fabrication.

Metal

Common types of metal used in outdoor furniture are mild steel, stainless steel, aluminum, and cast iron.

- Mild steel is the most commonly used metal. Steel is incredibly strong and is widely available in many forms. However, it does require a robust rust protection (Main and Hannah 2010).
- Stainless steel does not require rust protection as it is naturally rust resistant, but is a very expensive option, and special tools and techniques are necessary for fabrication (Main and Hannah 2010).
- Aluminum is a lightweight metal that is less costly than stainless steel but is weaker. While corrosion resistant, aluminum does form rust that is a white color and a protective finish may still be desired (Main and Hannah 2010).
- Cast iron requires a mold thus is better suited to forms that will be repeated. Cast iron forms are generally heavy. Rust protection is required (Main and Hannah 2010).

Wood

Choosing wood as a material for outdoor furniture can be complicated. The chosen species must be rot, decay, and insect resistance, while also resistant to the wood movement that causes cracking and warping. Wood brings a natural, warm element to a design. However, wood will fade to a gray color in the sun. Finishes can protect the wood from fading and decaying, but adds yearly maintenance. Exotic hardwoods are most commonly used in outdoor furniture, but domestic hardwoods and softwoods are also an option (Main and Hannah 2010).

Exotic Hardwoods

- Ipe and teak are ideally suited to outdoor uses due to their density and rot resistance (Main and Hannah 2010).
- Hardwoods generally do not require a protective finish (Main and Hannah 2010).
- However, these hardwoods are expensive due to shipping costs and extra care should be taken to ensure ethical logging practices were used (“Ipe” 2021).
- Due to the density of the wood, these species can be hard to work with and can dull blades of tools (“Ipe” 2021).

Domestic North American Hardwoods

- Osage orange and black locust are two options for local hardwoods. These species are also very durable and rot resistant. Osage orange is “considered to be one of the most decay resistant woods in North

America” (“Osage Orange” 2021).

- Hardwoods do not generally require a protective finish.
- There is a limited supply of these species and lumber can be hard to find (Main and Hannah 2010).
- Domestic hardwoods, like exotics, can be difficult to work with due to wood density and can dull tool blades (“Osage Orange” 2021).

Domestic North American Softwoods

- Western Red Cedar and redwood are softwoods that are suited to the outdoors (Main and Hannah 2010).
- These species are easier to work with than hardwoods and are less prone to cracking (Main and Hannah 2010).
- These species are rot resistant and can hold up without a protective finish, but are better suited to protected/sheltered areas. Other softwoods may require a protective finish to withstand exterior conditions (Main and Hannah 2010).
- Softwoods are prone to scratches and dents (Main and Hannah 2010).

- What materials are desired to be used?

- How are materials being protected from outdoor conditions?

All Materials

Materials shrink and swell in changing temperatures and humidity. Therefore, any joint between materials will need to allow some space for this swelling, or materials will start to bend, crack, or warp.

- What precautions might be taken to avoid bent, cracked, or warped material?

Additional Considerations

Design Complexity

The design must also fit the budget. Complex angles and curves can require specialized tools/expertise to execute the design intent. Generally, the greater the complexity of the design, the more costly the project will become.

Preventative Design

It is important to prevent water from collecting on the seating surface of a bench. Determine how water will escape the seat surface. There are several ways to prevent water pooling such as:

- Drain holes.
- Allowing space between surface elements.
- Sloping the seating surface to encourage water runoff.

- How might these additional considerations be addressed?

Installation

Planning for the installation of the bench will help prevent unforeseen challenges from arising. The questions below can serve as a guide to inform the installation process:

- Will any permits be required to install?

- How will underground utilities markers remain in place so the utilities remain undisturbed?

- How heavy is bench?

- Will the bench be attached to the ground? If so, how?

- How will the bench be moved from the fabrication space to the installation site?



chapter

7

conclusion

Conclusion

A Reflection of the Project & Process

Introduction

The process of designing and fabricating the Ivanhoe neighborhood bench taught me many things, including metal fabrication, new woodworking techniques, and extreme patience. Given what I have learned from this experience, there are several things I would do differently if I were to go back and restart the process from the beginning. However, the end result of this process is something I am proud of and something I hope the Ivanhoe neighborhood will enjoy for a long time to come.

Reflection on Each Goal

Goal 1: Develop a participatory design process that leads to the fabrication of a custom bench.

Looking back on the process of this project, there are several things I could have done better.

Project Team

Being the sole designer and fabricator was exhausting and

challenging. In hindsight, having a partner or team to share responsibilities would have both benefited and expedited the process. Designing, preparing for, and running the workshops, as well as designing and fabricating the bench are responsibilities that, given the option, I would share with others.

In my experience, there needs to be more than one person fabricating the bench. As I was the only fabricator, fabrication took much longer than initially anticipated (see figure 7.2 for a project time estimate).

Due to the distance between myself and the Ivanhoe neighborhood, having another person to coordinate workshops proved invaluable. Mrs. M'biti, the neighborhood coordinator I worked with on this project, helped find and recruit participants, as well as let people know when workshops were occurring.

Alternative Methods for Participatory Design Process

For the participatory design process, I wanted to include

more people from the neighborhood, and to have used additional methods to help those who could not attend online workshops participate. Methods such as community meetings and surveys could have increased participation alongside the existing workshops.

There are also methods that are much easier to complete when the workshops are done in person, rather than online. A model-making session for conceptual idea generation using LEGOs, clay, or cardboard would have added so much to the workshop. However, as we were utilizing Zoom, it would have been difficult to see what others were doing with their hands when making these models. It would also have been beneficial to the design process to have team drawing sessions with participants; however, people are generally not comfortable drawing with a computer mouse.

Lastly, more advertising of the project should have been done. Having more people know about the project

and get excited about it would have been beneficial. I only made a single flyer that was distributed, by the community coordinator, to potential participants for the first workshop. At a minimum, additional flyers should have been distributed before all participation opportunities to generate additional interest and participation. Appearing at the neighborhood’s monthly local community meetings and making a short presentation about the project could have also helped.

Social media posts not only could have made potential participants aware of the project, but could have also been used to give project updates. Any way to keep participants appraised of current progress, especially during fabrication, would have been a nice way to involve the participants in that part of the project.

Success

First, two potentials of the project need to be examined: the potential of a bench to acknowledge a neighborhood’s story and the potential to add to the visual identity of a place. The neighborhood story was the starting point for the design process and aspects were incorporated into the design concept. The final bench design now continues the neighborhood’s story, serving as a memory wall of honor for residents. The bench adds a new, but small, design element to the makeup of the neighborhood’s architectural character and visual identity. However, the bench design and materials were not derived from the neighborhood’s existing architectural features and materials.

Secondly, for the participatory design process, I had originally planned for 8-11 participants per workshop to form a good size for conversation and discussion, but no



Figure 7.1 Ivanhoe Neighborhood Bench

Fabrication Cost and Time Estimate		
Cost Estimate		
• Material Cost:		
Osage Orange (65.87 bf):	\$450	
Metal:	\$500	
• Fasteners:	\$70	
• Galvanization:	\$300	
• Powder Coating:	\$350	
Fabrication Total Cost:	\$1,670	
Installation Cost*:	\$600	
		Total: \$2,270
Time Estimate		
• Design:		
Workshops:	4 hrs	
Preparation:	10 hrs	
Design:	30 hrs	
Committee Review:	15 hrs	
Design Total:	59 hrs	
Prototyping:	100 hrs	
• Fabrication:		
Milling:	24 hrs	
Shaping Boards:	30 hrs	
Sanding/Finishing:	50 hrs	
Cutting Steel:	8 hrs	
Welding/Grinding:	180 hrs	
Assembly:	16 hrs	
Fabrication Total:	308 hrs	
		Total: 467 hrs
*Estimated cost as bench was not installed.		

Figure 7.2 Project Cost and Time Estimate

workshop had that many. However, there were at least four participants at each workshop, with new people at each, as well as repeated participants, so there was good discussion at the workshops. I, as the designer and fabricator, would say the process was successful in that there was a design process that people participated in that resulted in a built bench. I did not ask the participants themselves if they felt involved enough or if they had suggestions for the process.

Goal 2: Fabricate the bench with materials that are durable and that reflect the character of the neighborhood.

Material Selection

It was difficult to figure out what material would be best for outdoor durability, comfort, and cost, in particular, which wood species would be the most durable for its price.

Ipe, a tropical hardwood from South America, is frequently used in outdoor furniture, but comes with the ecological impact of long-distance shipping, and is expensive due to high demand and transport costs. I used a locally sourced, native wood species, but in an unconventional way. Osage orange is typically used as fence posts or for small objects like bow handles, but not for large furniture.

It was incredibly difficult to source enough Osage orange wood to use for fabrication. The local sawmills only had a few board feet on hand, if any at all. This forced me to find other sourcing options. In my search, I found an article

about a sawmill near Emporia, KS, who had done a project using Osage orange. When I called the sawmill, they did not have any on hand, but they gave me the number of a nearby farmer who might. When I called, the farmer fortunately had just cleared his brother-in-law's pasture of trees, most of which were Osage orange. As Osage orange is generally full of knots and twists, I was only able to get small boards a few inches longer than each seat slat (See figure 7.2 for a full cost estimate).

Material Durability

It's difficult to have a material be both durable and comfortable sometimes. Wood retains warmth best in the winter but may warp and could require yearly maintenance. Metal can be incredibly durable if protected correctly but can become incredibly hot in the summer and cold in the winter. The characteristics of these materials are a give and take. Sometimes the cost of making something durable is high or comes with additional maintenance costs, like galvanizing or adding a finish.

Deciding which finish to apply to the wood was a difficult task. There are many conflicting accounts of what finish works best. I eventually decided on one that was recommended by a person who works in the APDesign Fabrication Lab. He was not only able to explain the benefits but how to apply it.

Reflecting the Neighborhood Character:

There is a difficulty in having a material reflect the neighborhood correctly unless there is a strong use of that material in a way that is unique to the neighborhood.

In today's mass-produced society, it is difficult to find neighborhoods that are built with distinct character and unique materials. Many neighborhoods unfortunately utilize common patterns, colors, and details that make them blend together. This makes the process of finding said material for that neighborhood a much more difficult task.

Goal 3: Ensure the overall process is replicable by other designers or artisans to create unique outdoor furnishings in other communities.

Creating a truly replicable process was difficult because everyone's situation will be different. Everyone has access to different resources, time, and fabrication experience. Everyone's design skills and senses are different. People who are interested in creating a custom bench may read the guide but end up realizing that such a project beyond their capability or capacity. Many resources are needed to conduct a participatory design-build process. I was only able to build the bench I did because of the state-of-the-art facilities and knowledgeable personnel available to me within the College of Architecture, Planning, and Design.

Others with less resources and support may not be able to fabricate something as complex. The project would have been impossible without the support I received in the form of expertise in craftsmanship and tools. For resources, at the very least, a circular or miter saw is needed to cut boards to a certain length. One step beyond that, due to the nature of wood, a table saw, jointer, planar, router, and hand drill are necessary for the construction process.

All wood distorts over time, so no board is flat or has 90-degree corners until jointed and planed down. These tools, however, are not as effective without the knowledge of how to properly use them. The expertise required for such a project is equally, if not more, important than the tools.

Goal 4: Install the custom bench on a site within the neighborhood.

Installing a bench can be complicated. You must make sure you can transport the bench to the site where it will be installed. My first concern for the bench was weight, due to the density of wood and sheer size of the piece. Since the Ivanhoe bench weighs only 300lbs, it is well within the carrying capacity of any standard vehicle. The pieces also all fit inside a truck bed.

Another part of installation is knowing the site conditions. Since I am 125 miles away from the site, I could not easily stop by and observe conditions. How a bench is installed depends on what the ground slope is and surface composition. It can be hard, for one person, to capture details like slope and ground firmness without the proper tools and know-how.

Concrete footings and pads can be expensive. These costs can be even greater if you hire a contractor to pour them. Costs can be reduced by installing the bench with footings, which are small concrete pads slightly wider than the legs, to give it a solid foundation to sit on. However, if a full concrete pad is required or desired it may be necessary

to hire someone to pour the concrete and/or install the bench.

Craftsmanship

Tolerances

I learned an exorbitant amount regarding tolerances during the design and fabrication process for the bench. One thing I learned, as a designer, is to allow more time than you think, in order to deal with unknown issues that arise throughout the process. Another lesson any experienced fabricator or carpenter would tell you is 'build in tolerances!' Probably more than you think you'll need.

Tolerances are wiggle room that you add in because you are never going to be entirely mathematically precise, the material is never going to be entirely straight, and pieces do not always line up. Holes for bolt attachment should be drilled 3-5 sizes larger than the thread width, especially if you are powder-coating and galvanizing the metal, as long as the head of the bolt still fits over the hole. Leaving tolerance room also means building in space between pieces to allow wiggle room when fitting them together. Not all the boards on my bench are exactly spaced 1/8" apart as planned, most are, but some had to be set closer together due to minute errors while cutting the wedge shape. Tolerances are necessary to compensate for all your real-life measurement mistakes.

Fabrication Limitations

There were two major fabrication limitations: time and design feasibility. The design concept chosen in Workshop

2 included two semi-circles joined together and the overall size was incredibly large. The size of the design concept was beyond what could be feasibly constructed. While the idea of a conversation “circle” was kept, the design was scaled down to include just one semi-circle.

The original leg design going into prototyping was based on Concept 3. The legs were initially proposed to be thin and made out of sheet metal. However, for better stability and safety, box pipe was suggested, by my committee members, as an alternative. Because rounded corners on the legs were desired, a custom joint was made to fit the width of the box pipe. This joint added around 4 weeks of fabrication time, as 10 joints (2 for each leg) had to be made. Other, more minor, design changes were implemented during prototyping as I learned of various fabrication methods, opportunities, and challenges. However, the main core concept stayed the same. Further technical details were determined as the bench moved from a conceptual to a physical state.

Material thickness was another significant issue I failed to account for at first. Measurements will be wrong if you do not account for the thickness of all materials. Ideally, it is accounted for during conceptual design. I, however, encountered this issue while I was fabricating a prototype leg. I forgot to account for 1/16”-1/8” thick metal pieces which, if not accounted for later, could have compounded into large errors for properly sizing the final pieces. After realizing this, I also had to estimate how material thickness would change after the powder-coating and galvanizing processes, which both add thin layers onto the metal.

Another problem I experienced along the way was how to incorporate the participants into the fabrication process. Involving them in the fabrication of the piece could have helped form a sense of ownership. I had originally planned to have the participants help assemble the bench on-site, together, as the final step of the participatory process. However, the final design, and how it needed to be fabricated, made that impossible.

Instead, staying true to what the neighbors chose as the design was more important than having them help assemble the built bench on site. The neighborhood participants trusted that I would create the design we agreed on in Workshop 2, and I did not want to deviate from what we had discussed. During assembly in the shop, it became clear that an on-site assembly would be too time consuming and difficult to accomplish on-site. Every seat board had to be painstakingly lined up and screwed to the different sections of the seat supports. The back boards had to be lined up using a laser level and clamps. Then the whole backrest had to be taken off to install the metal back covers that hid the fasteners. This process took four skilled craftsman two hours to put on.

The participants could still help assemble the big sections together on-site, but that would entail only 16 bolts to fasten. Had the bench been a simpler design (not curved), assembling the bench pieces “IKEA-style” would have given a stronger sense of ownership of the bench to the community members.

Growing as a Designer

I learned several things about myself as a designer throughout this process. One is that I don’t ever want to design by myself again. I feel like a design will always be stronger with the input of an experienced team. I have also realized I am drawn more to curved forms and organic shapes. These are harder to draft and fabricate due to their more complex geometric shapes, adding more time to a project for both design and fabrication.

Research Design Process

The goal of developing a participatory process for the neighbors to participate in, that resulted in a custom bench, was achieved, with an asterisk. Any student who wants to do this process again would have to be able to start the participatory design phase much quicker than I did. Any student wishing to fabricate something so large with so many parts should probably plan on an extra semester for fabrication or choose to make a simpler and smaller design to build. Having a partner on the design-build project would also help.

Participatory Design

There were several positive aspects and different opportunities that came from having the workshops online. The workshops, particularly the first workshop about storytelling, were an opportunity for each participant to learn about their fellow participants. This concept, called mutual learning, is a crucial part of the participatory design process that entails gaining mutual respect by learning

about each other to foster understanding (Bratteteig et al 2013). The workshop format fostered constructive idea building where participants felt comfortable around each other.

Another feature that Zoom encourages is no cross talking, or people talking over each other. It is much harder to talk over someone else when your volume is dictated by someone else’s sound system. Being online also allowed people with tight time constraints to participate. One participant logged onto Zoom five minutes after he got off work. Safety concerns due to the Covid-19 pandemic were also alleviated by hosting the workshops online. Lastly, the online format allowed the sessions to be recorded, which would have been much more difficult in an in-person format.

Some challenges did occur during the process. There were times during the workshops when I had to make changes on the fly. The collage activity in Workshop 1 did not happen. It was originally intended to allow those who did not feel comfortable speaking a means to express themselves using visuals. If the workshop had occurred in person, the activity would have either been an actual physical collage or a clay modeling activity. The goal was to allow people to use their hands instead of their words. I think in the end, the bench turned out beautiful with the neighbors’ ideas and input, but it is hard to know if the design outcome would have been different with in-person meetings.

Another challenge I encountered during the workshops

was allowing everyone a chance to speak while trying to avoid people feeling forced to answer. While I did wait for everyone to answer before moving on with each question, some participants answers were just agreement with what was said before. I made sure to ask everyone their opinion, but not demand a unique answer, in hopes the questions did not force anyone outside of their comfort zones.

I believe the participatory design-build process with the Ivanhoe neighborhood is one of many ways the research question could be answered. The bench honors those of the neighborhood who contributed greatly while providing a gathering space for a tight-knit community. The number of participation could have been higher, and maybe would have been if not during a global pandemic. An opportunity to work with local artisans and craftsmen who work and/or live in the neighborhood would have been an excellent addition to the process.

The materials used in the bench do not necessarily reflect the neighborhood, since brick and limestone were not used. However, the wood species used was from a tree species that grows natively to the area. In that respect, the materials do reflect the region.

Limitations of the Project

One limitation of this project was participants access to Internet connections. The participation pool was smaller than if the workshops were able to be held in person.

One silver lining of the online workshops was that several participants were able to join immediately after getting off work. Another limitation of the online format was the

limit of tools that were able to be used due to participants unfamiliarity with them. One planned workshop activity was not able to be completed for this reason. Many participants used Zoom on their cell phones and were unable to open the collage activity that was to occur on Miro. There is a Miro app for phones, however, participants would have had to download the app prior to the workshop. The two participants using their phones for that workshop had not.

Application for Others

This guide will likely be used by design firms who want to include something unique for a neighborhood design. A bench design-build project inside a larger project could kickstart a community master plan.

Alternatively, in academia, a graduate student or researcher could use this as a starting point for a participatory-based research project. Teachers could also use this as a tool to include students, or students and their parents, in a project to build something collaboratively together as a learning experience.

The guide could inspire a person with the idea of building a bench in their neighborhood. The guide could also provide the realization that such a project is beyond the resources, capacity, or time for them to reasonably complete.



appendix

Appendix A - IRB Compliance #10328



TO: Dr. Jessica Canfield
Landscape Architecture/Regional and Community Planning
Seaton Hall

Proposal Number: 10328

FROM: Rick Scheidt, Chair


Committee on Research Involving Human Subjects

DATE: 12/03/2020

RE: Proposal Entitled, “LAR 897 Proposal Writing Community Building through Bench Design and Fabrication”

The Committee on Research Involving Human Subjects / Institutional Review Board (IRB) for Kansas State University has reviewed the proposal identified above and has determined that it is EXEMPT from further IRB review. This exemption applies only to the proposal - as written – and currently on file with the IRB. Any change potentially affecting human subjects must be approved by the IRB prior to implementation and may disqualify the proposal from exemption.

Based upon information provided to the IRB, this activity is exempt under the criteria set forth in the Federal Policy for the Protection of Human Subjects, **45 CFR §104(d), category: 2, subsection: ii.**

Certain research is exempt from the requirements of HHS/OHRP regulations. A determination that research is exempt does not imply that investigators have no ethical responsibilities to subjects in such research; it means only that the regulatory requirements related to IRB review, informed consent, and assurance of compliance do not apply to the research.

Any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Committee on Research Involving Human Subjects, the University Research Compliance Office, and if the subjects are KSU students, to the Director of the Student Health Center.

Appendix B - IRB Compliance #10284



TO: Dr. Jessica Canfield
Landscape Architecture/Regional and Community Planning
Seaton Hall

Proposal Number: 10284

FROM: Rick Scheidt, Chair


Committee on Research Involving Human Subjects

DATE: 10/29/2020

RE: Proposal Entitled, “LAR 897 Proposal Writing Community Building through Bench Design and Fabrication”

The Committee on Research Involving Human Subjects / Institutional Review Board (IRB) for Kansas State University has reviewed the proposal identified above and has determined that it is EXEMPT from further IRB review. This exemption applies only to the proposal - as written – and currently on file with the IRB. Any change potentially affecting human subjects must be approved by the IRB prior to implementation and may disqualify the proposal from exemption.

Based upon information provided to the IRB, this activity is exempt under the criteria set forth in the Federal Policy for the Protection of Human Subjects, **45 CFR §104(d), category: 2, subsection: ii.**

Certain research is exempt from the requirements of HHS/OHRP regulations. A determination that research is exempt does not imply that investigators have no ethical responsibilities to subjects in such research; it means only that the regulatory requirements related to IRB review, informed consent, and assurance of compliance do not apply to the research.

Any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Committee on Research Involving Human Subjects, the University Research Compliance Office, and if the subjects are KSU students, to the Director of the Student Health Center.

Citations

Images

Figure 2.5

Derived from:

"Ivanhoe Neighborhood in Kansas City, Missouri (MO) Detailed Profile." n.d. City-Data. Accessed September 26, 2021. <https://www.city-data.com/neighborhood/Ivanhoe-Kansas-City-MO.html>.

Figure 2.13

Blum, Michael. [August Titus sitting on a bench in Landscape Form's Outdoor Showroom]. 2020. Photograph.

Figure 5.79

Matlock, Mary. [August Titus using table saw to cut taper into boards]. 2021. Photograph.

Figure 5.91

Williams, David. [August Titus screwing boards to bench]. 2021. Photograph.

Text

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