PEOPLE, FLOUR, WATER, SALT

Bread and Community in Urban Public Space

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

ABSTRACT

People, Flour, Water, Salt is a proposal for re-thinking the ways in which we connect to and learn from one another in urban public space. Bread is a staple food and cultural artifact, and its production exemplifies the changing dynamics between people, cities, and land across cultures, regions, and time. By focusing on bread as a means to develop community relationships at the micro scale (the person-to-person interactions), we can also begin to examine its effects across various types and scales of exchanges. The process of bread-making then, which begins at the level of enzymes and bacteria, quickly expands to occupy a place of significance at the macro scale, and demands consideration and care for the future of our cities and environments.

This thesis proposes the implementation of communal bake ovens in the urban environment to support the development of diverse communities through public and productive space centred around the numerous and varied conceptions of bread. The relationships fostered through shared knowledge, culture, and food in these public spaces serve to mitigate the social isolation and decreased agency that new, immigrant, and low-income populations often experience. Through the introduction of an urban flour mill, the project also challenges the physical and psychological detachment between people and wheat that resulted from the framework of industrialized flour originating in the 19th century, and re-establishes the prominence of local food systems. Following an examination of the historical impact of the growth of wheat and production of bread on the design and organization of cities, the thesis suggests ways in which these processes can inform the shape and character of the city today. Calgary, a city with a growing immigrant population and a rich historical and ongoing relationship with wheat production in Canada, forms the site of the architectural intervention.

The design proposal explores the dichotomy between the technical and intuitive natures of bread, and its translation to architectural form through the consideration of materiality, visibility, the physiologies of bread and wheat, microclimates, and the unique thermal gradients of the communal ovens. The built forms and productive landscapes of a larger network of bread in Calgary aim to not only shape the physical environments of the communities in which they reside, but to generate a new narrative surrounding the production and role of bread in a diverse and growing city.

ACKNOWLEDGEMENTS

To my supervisor, Anne Bordeleau, thank you for the energy and enthusiasm that you brought to the work right from the beginning, and your wholehearted support of bread as a topic for an architectural thesis. Thank you also for encouraging me to push the design and for placing value in expression through writing. Your guidance was instrumental in getting me to a place where I am proud of the work.

To my committee member and TRD I professor, Jane Hutton, thank you for giving me the confidence to explore a topic that would have otherwise remained unseen. On the first day of studio, I lamented, "I wish I could just make my thesis about bread," to which you responded, "Why couldn't you?" Thank you for your consistent excitement and insightful critiques throughout.

I so greatly appreciate the grace and understanding that were afforded to me by Rick Andrighetti, Janna Levitt, and Jonathan Tyrrell at a very difficult point in the thesis. Thank you for the thoughtful conversation and your interest in the work. An additional thanks to Rick for your review of the final document.

Thank you to my friends and fellow grad students, especially my studiomates in Room 2023, for the much-needed distraction and encouragement along the way.

Thank you to my family, for the never-ending support of every endeavour I undertake, and for a love of bread that rivals my own. To my parents, thank you for teaching me what it means to work hard, and how to show strength in hard times.

Finally, to Ryan, I could not have done this without you, and I'm forever grateful that we're on the same team.

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INTRODUCTION

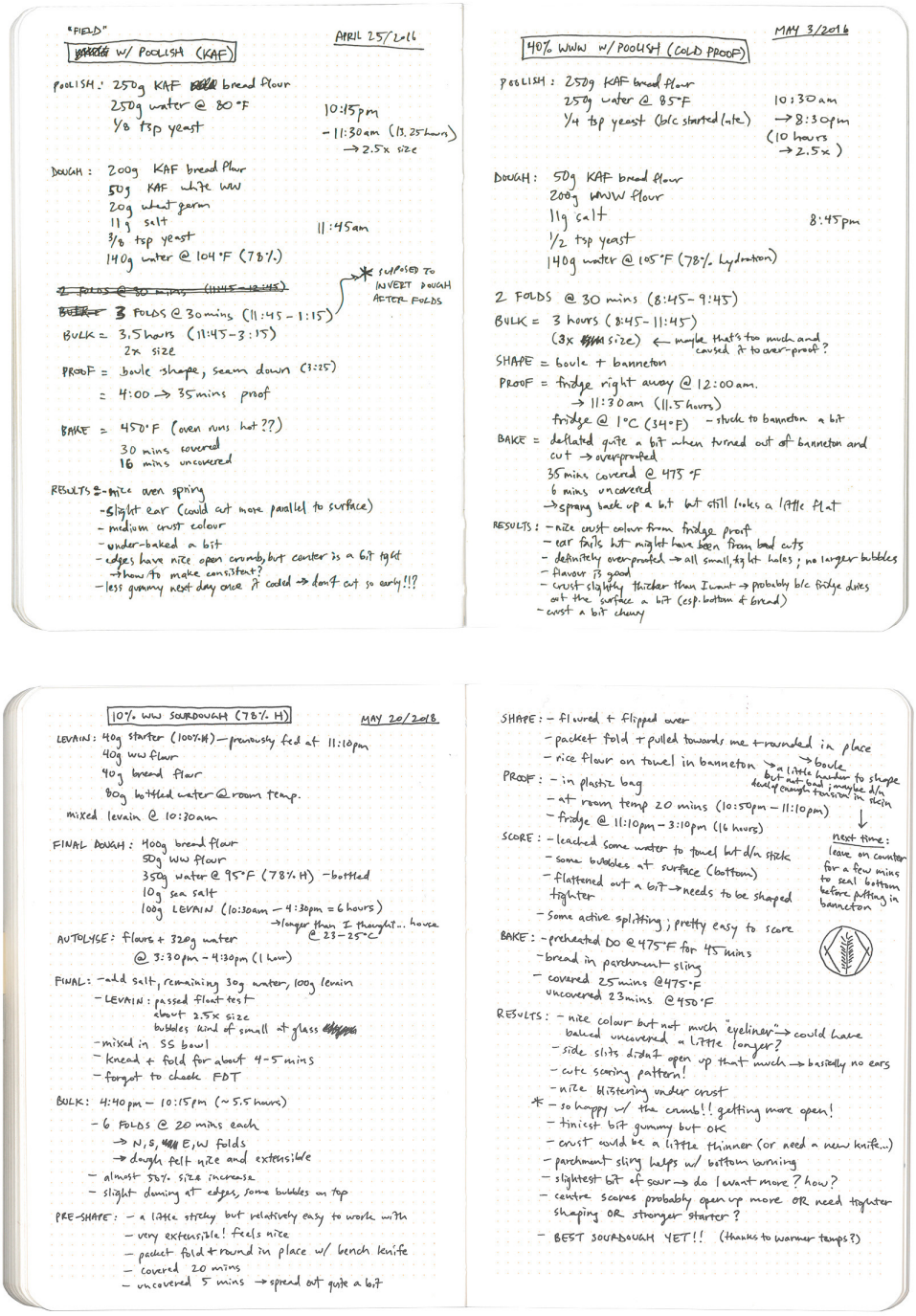
My personal interest in bread began in 2014 when I decided to bake my first loaf. The results were satisfactory – an edible, though quite flat, light rye bread topped with various seeds (*fig. 0.1*) – but I purchased a book by Ken Forkish titled *Flour Water Salt Yeast: The Fundamentals of Artisan Bread and Pizza* to develop a better understanding of what exactly was happening, or had to happen, between the time I gathered my ingredients and the time they came out of the oven. It struck me that the list of ingredients required to make a loaf of bread was really that short – ignoring, of course, the ingredient of *time*, which I would come to learn about – and that it could be even shorter with the switch from commercial yeast to a sourdough starter. This small number of variables may seem limiting, but in fact allows for an almost infinite number of manipulations to achieve specific, though sometimes unpredictable, results: denser, more open crumb, darker crust, more or less sour, soft and pillowy or hearty and chewy. They allow you to adapt to or take advantage of seasonal changes, varying protein contents of different flours, additional ingredients, and the reality of your schedule. There is both a scientific underpinning and a highly creative and experimental aspect to baking bread (*fig. 0.2*), and the result is something that begs to be shown off as a triumph and, more importantly, to be shared.

fig. 0.1 First bread baked in May 2014 and recently baked loaves in February 2019.

My attraction to food goes beyond the sheer enjoyment of eating it and has always involved conceptions about the importance of sharing it and of creating and understanding connections to it and around it. It provides the opportunity to not only learn about the physical manifestation of the food itself – the appearance, the taste, the recipe – but to learn about the person preparing the food and their own emotional and cultural associations to it. The word "bread" means so many different things to so many different people, and this allows it to serve as a proxy for talking and learning about culture on the one hand, and understanding the environmental and health implications of our industrialized systems on the other.

As the population of cities grows and becomes increasingly diverse, and agricultural landscapes suffer from the effects of climate change and a globalized market, can turning our attention to bread allow us to engage with and reflect changing demographics and mitigate social isolation, while also supporting local food systems and improving food security in the city?

This thesis seeks to address these increasingly critical questions through research divided into three sections – *People, Flour,* and *Water*. This is followed by an exploration of architectural possibilities – *Salt* – and, finally, a design proposal (*fig. 0.3*).



"FIELD"

W/ POOLISH (KAF)

APRIL 25/2016

POOLISH: 250g KAF bread flour
250g water @ 80°F
1/8 tsp yeast

10:15pm
- 11:30am (13.25 hours)
→ 2.5x size

DOUGH: 200g KAF bread flour
50g KAF white WW
20g wheat germ
11g salt
3/8 tsp yeast
140g water @ 104°F (78%)

11:45am

~~2 FOLDS @ 30 mins (11:45 - 12:45)~~

~~BETTER~~ 3 FOLDS @ 30 mins (11:45 - 1:15)

* SUPPOSED TO INVERT DOUGH AFTER FOLDS

BULK = 3.5 hours (11:45 - 3:15)
2x size

PROOF = boule shape, seam down (3:25)
= 4:00 → 35 mins proof

BAKE = 450°F (oven runs hot??)
30 mins covered
16 mins uncovered

RESULTS: - nice oven spring
- slight ear (could cut more parallel to surface)
- medium crust colour
- under-baked a bit
- edges have nice open crumb, but center is a bit tight
→ how to make consistent?
- less gummy next day once it cooled → don't cut so early!!?

MAY 3/2016

40% WWW W/ POOLISH (COLD PROOF)

POOLISH: 250g KAF bread flour
250g water @ 85°F
1/4 tsp yeast (b/c started late)

10:30am
→ 8:30pm
(10 hours
→ 2.5x)

DOUGH: 50g KAF bread flour
200g WWW flour
11g salt
1/2 tsp yeast
140g water @ 105°F (78% hydration)

8:45pm

2 FOLDS @ 30 mins (8:45 - 9:45)

BULK = 3 hours (8:45 - 11:45)
(3x size) ← maybe that's too much and caused it to over-proof?

SHAPE = boule + banneton

PROOF = fridge right away @ 12:00am.
→ 11:30am (11.5 hours)
fridge @ 1°C (34°F) - stuck to banneton a bit

BAKE = deflated quite a bit when turned out of banneton and cut → overproofed
35 mins covered @ 475°F
6 mins uncovered
→ sprang back up a bit but still looks a little flat

RESULTS: - nice crust colour from fridge proof
- ear fails but might have been from bad cuts
- definitely overproofed → all small, tight holes; no larger bubbles
- flavour is good
- crust slightly thicker than I want → probably b/c fridge dries out the surface a bit (esp. bottom of bread)
- crust a bit chewy

10% WW SOURDOUGH (78% H)

MAY 20/2018

LEVAIN: 40g starter (100% H) - previously fed at 11:10pm
40g ww flour
40g bread flour
80g bottled water @ room temp.
mixed levain @ 10:30am

FINAL DOUGH: 400g bread flour
50g WW flour
350g water @ 95°F (78% H) - bottled
10g sea salt
100g LEVAIN (10:30am - 4:30pm = 6 hours)
→ longer than I thought... house @ 23-25°C

AUTOLYSE: flours + 320g water
@ 3:30pm - 4:30pm (1 hour)

FINAL: - add salt, remaining 30g water, 100g levain
- LEVAIN: passed float test
about 2.5x size
bubbles kind of small at glass
- mixed in SS bowl
- knead + fold for about 4-5 mins
- forgot to check FDT

BULK: 4:40pm - 10:15pm (~5.5 hours)
- 6 FOLDS @ 20 mins each
→ N, S, E, W folds
→ dough felt nice and extensible
- almost 50% size increase
- slight doming at edges, some bubbles on top

PRE-SHAPE: - a little sticky but relatively easy to work with
- very extensible! feels nice
- packet fold + round in place w/ bench knife
- covered 20 mins
- uncovered 5 mins → spread out quite a bit

SHAPE: - flured + flipped over
- packet fold + pulled towards me + rounded in place
- rice flour on towel in banneton → a little harder to shape but not bad, maybe d/n dough enough tension in skin → boule

PROOF: - in plastic bag
- at room temp 20 mins (10:50pm - 11:10pm)
- fridge @ 11:10pm - 3:10pm (16 hours)

next time: leave on counter for a few mins to seal bottom before putting in banneton

SCORE: - leached some water to towel but d/n stick
- some bubbles at surface (bottom)
- flattened out a bit → needs to be shaped tighter
- some active splitting; pretty easy to score

BAKE: - preheated DO @ 475°F for 45 mins
- bread in parchment sling
- covered 25 mins @ 475°F
uncovered 23 mins @ 450°F

RESULTS: - nice colour but not much "eyeliner" → could have baked uncovered a little longer?
- side slits didn't open up that much → basically no ears
- cute scoring pattern!
- nice blistering under crust
* - so happy w/ the crumb!! getting more open!
- tiniest bit gummy but OK
- crust could be a little thinner (or need a new knife...)
- parchment sling helps w/ bottom burning
- slightest bit of sour → do I want more? how?
- centre scores probably open up more OR need tighter shaping OR stronger starter?
- BEST SOURDOUGH YET!! (thanks to warmer temps?)

fig. 0.2 **Scans of my bread notebook.**

I use this notebook to keep track of almost every loaf of bread I bake, with the goal of constant experimentation and improvement. I take notes on the recipe, timing, techniques, and results, but also on possible modifications for the next loaf.

fig. 0.3 Thesis organization and contexts.

Part One: People situates bread in its social and cultural context. Recipes for bread are often written with the ingredients listed in descending order by weight (e.g., flour, water, salt, then yeast), emphasizing the importance of the first ingredient: flour. In the composition of this thesis, *people* takes the top position, highlighting the value of their role not just in the physical making of bread (in contrast with entirely mechanical production), but also in the varied priorities, concerns, ideas, and cultures that each of us can bring to bread and our everyday experience of it. This section demonstrates the potential of bread and communal ovens in creating an inclusive space of making and cultural exchange that supports the goals of strengthened communities and food security in the city.

Part Two: Flour examines the effects of the industrialization of flour and bread on our agricultural environments, and analyzes the changes that are taking place in urban and ecological landscapes due to the renewed concerns surrounding local food and the possibilities inherent in wheat varieties.

Part Three: Water tracks the historical impact of bread on the design and organization of cities and their adjacent landscapes, and analyzes the ways in which bread permeates economic, political, and social realms across time. Following this, it proposes a set of built and natural programmes in Calgary that collectively generate a culturally and economically diverse network centred on bread.

Part Four: Salt more directly explores the architectural aspects of the project, focusing on materiality, the thermal presence of the communal ovens, the physiologies of bread and wheat, and the recognition and manipulation of microclimates as a design tool. In bread-making, salt is responsible for enhancing flavour, strengthening gluten, and, to a lesser extent, controlling the rate of fermentation. This key support function can be translated to architecture's role within the thesis: to reflect and convey the project's concerns in physical space, and to make the ideas tangible and accessible.

The final section, a design proposal for an architecture and urban public space centred around bread in Calgary, encompasses the research and architectural considerations that precede it. The communal ovens, urban flour mill, changing natural landscape of wheat, and all their associated programme are, in effect, the *yeast* in this recipe, lifting up and supporting the aspirations and implementation of the thesis, and giving bread a life and presence in the city.

ENERGIES

capacity of different materials and forms to store or transmit energies inherent in the project

IDEAS/FORCES

potential of the project to be an index for larger ideas and forces that stem from concerns surrounding bread

PEOPLE
OBJECTS

energies and ideas/forces affect how people and objects move through the project

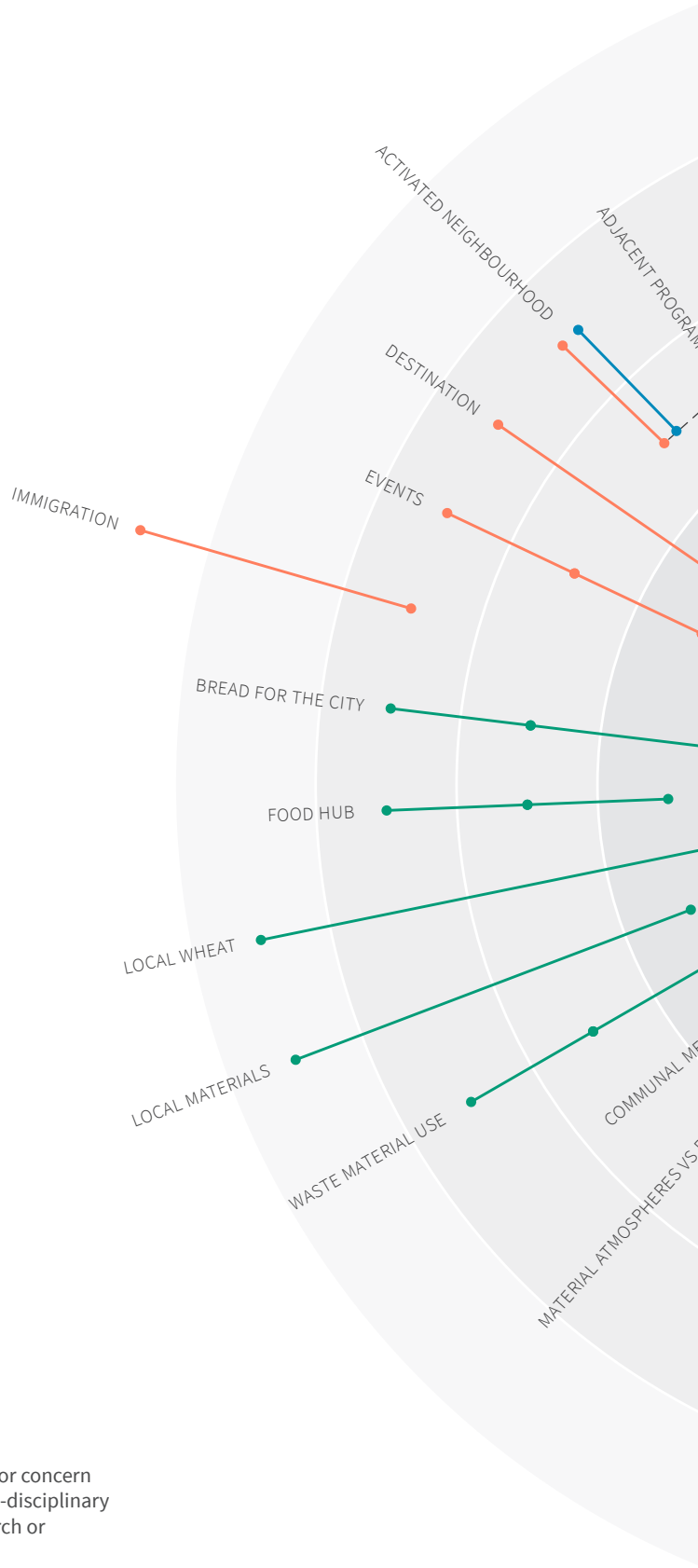
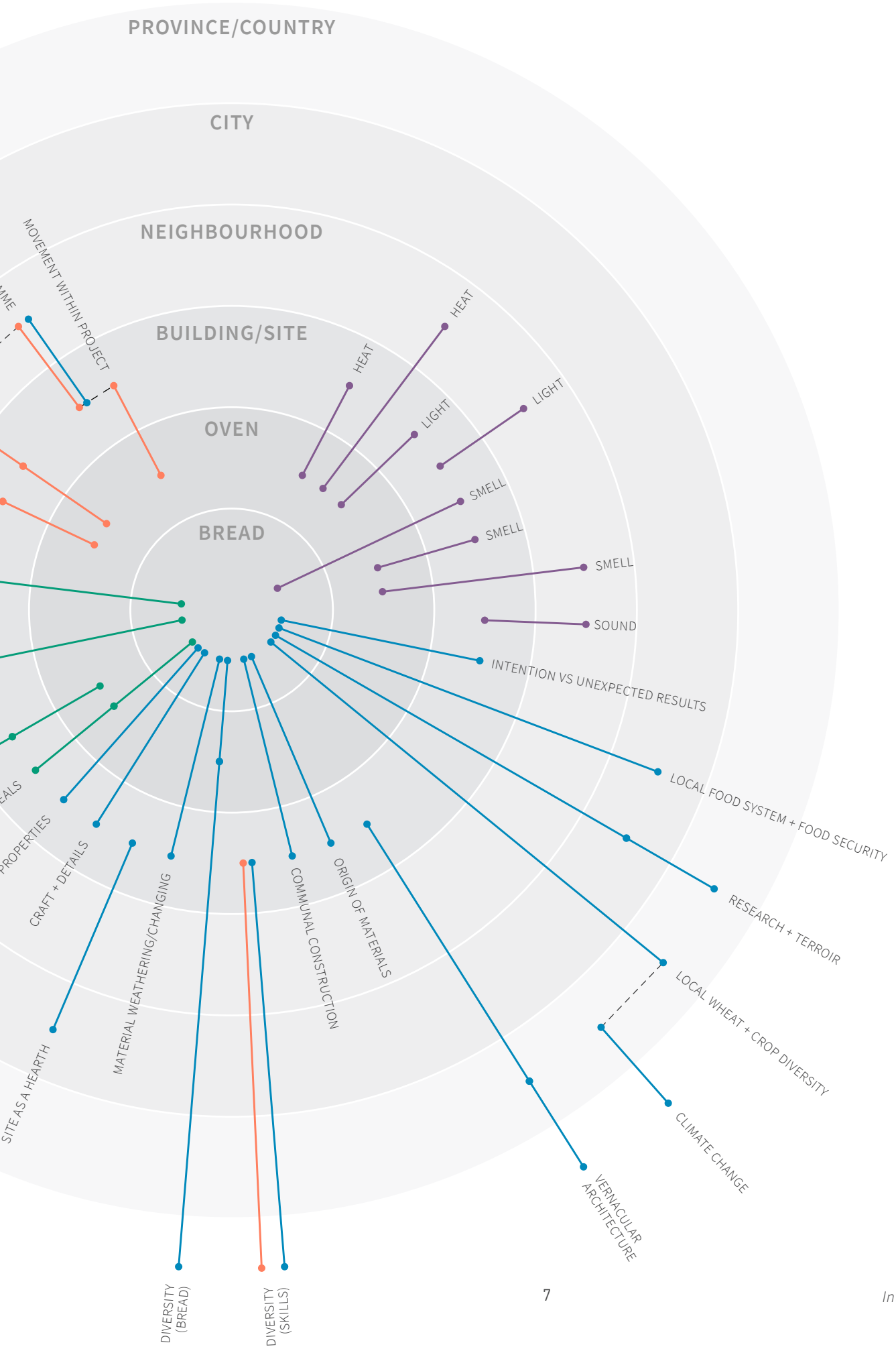


fig. 0.4 **Connections across scales and possible matters of concern stemming from bread.**

Though the thesis could not possibly explore every relationship or concern represented here, this diagram shows the multi-scalar and cross-disciplinary nature of bread, and points to possible avenues of further research or intervention.


PROVINCE/COUNTRY
CITY
NEIGHBOURHOOD
BUILDING/SITE
OVEN
BREAD
MOVEMENT WITHIN PROJECT
HEAT
HEAT
LIGHT
LIGHT
SMELL
SMELL
SMELL
SOUND
INTENTION VS UNEXPECTED RESULTS
LOCAL FOOD SYSTEM + FOOD SECURITY
RESEARCH + TERROIR
LOCAL WHEAT + CROP DIVERSITY
CLIMATE CHANGE
VERNACULAR ARCHITECTURE
ORIGIN OF MATERIALS
COMMUNAL CONSTRUCTION
MATERIAL WEATHERING/CHANGING
CRAFT + DETAILS
PROPERTIES
SITE AS A HEARTH
DIVERSITY (BREAD)
DIVERSITY (SKILLS)

part one

PEOPLE

PEOPLE

RESHAPING URBAN PUBLIC SPACE

Participation in the public realm has transformed over the course of human existence. The ancient Greek *politeia* and Roman *res publica* placed a focus on the political life of citizens, and a presence in these realms meant pursuing an active role in the political actions of the city-state. While philosophers such as Hannah Arendt lament the loss of this iteration of public or urban space, and the architecture that comes with it,[1] more contemporary theorists such as Nancy Fraser argue that this represents a normative and outdated view of what public space should or could be.[2] The public realm in ancient societies was exclusive – only a small group of privileged males were deemed worthy of accommodation – hence women, the poor, and slaves were not permitted to participate.

In Europe, the late-Renaissance saw participation in city life open up to more varied social and economic classes. As Richard Sennett explains, the idea of the "public" then "meant not only a region of social life located apart from the realm of family and close friends, but also that this public realm of acquaintances and strangers included a relatively wide diversity of people."[3] This forced public spaces, like the urban market, to evolve to cater to and account for a diversifying population.[4] Recognition of the needs and desires of various groups began to change the experience of urban centres.

In Fraser's view, public space has not been 'lost,' its definition has simply shifted to begin to encompass a wider range of "subaltern counterpublics," including women, people of various cultures, ethnicities, and religions, and LGBTQ communities.[5] This inclusion has in many cases resulted more from revolutionary action than liberal thought on the part of those who have dominated public space for centuries, but insistence on equality and recognition has demanded changes in both

physical and social provisioning (*fig. 1.1*). Margaret Crawford suggests the incremental effects of the presence of these groups:

> Residents with new histories, cultures, and demands appear in the city and disrupt the given categories of social life and urban space. Expressed through the specific needs of everyday life, their urban experiences increasingly become the focus of their struggle to redefine the conditions belonging to society. Once mobilized, social identities become political demands, spaces and sites for political transformation, with the potential to reshape cities.[6]

This reshaping of the city can take the form of an increased number of social programs, variability in and representation of culture through architecture, and accessibility at both the urban and building scale.

Diversity in interactions with others also provides a psychological benefit through the exposure to a wide variety of opinions and cultures, and is key to one's personal and intellectual development.[7] Our identities are created, as the philosopher Charles Taylor describes it, "dialogically" – through discourse with others, but also through the "languages" of art, action, and mutual care[8] – and have the potential to constantly shift in large or small ways as we occupy and learn from different parts of the public realm. When this dialog is cut off, as is often true with the tacit agreement to silence amongst strangers in contemporary cities,[9] developing connections with those around you is seemingly impossible, and social isolation is immanent.

fig. 1.1 Pride Parades are a celebration of identity in public space.

More and more people are moving to urban centers, and while residents are physically closer than ever to their neighbours, this feeling of social isolation is pervasive. This trend seems to be true for many types of people, but the risk factor is considerably higher for immigrants, seniors, and low-income populations. For these individuals, lack of inclusive social or cultural programming can be debilitating, and continued social isolation can have significant negative impacts on mental and physical health.[10]

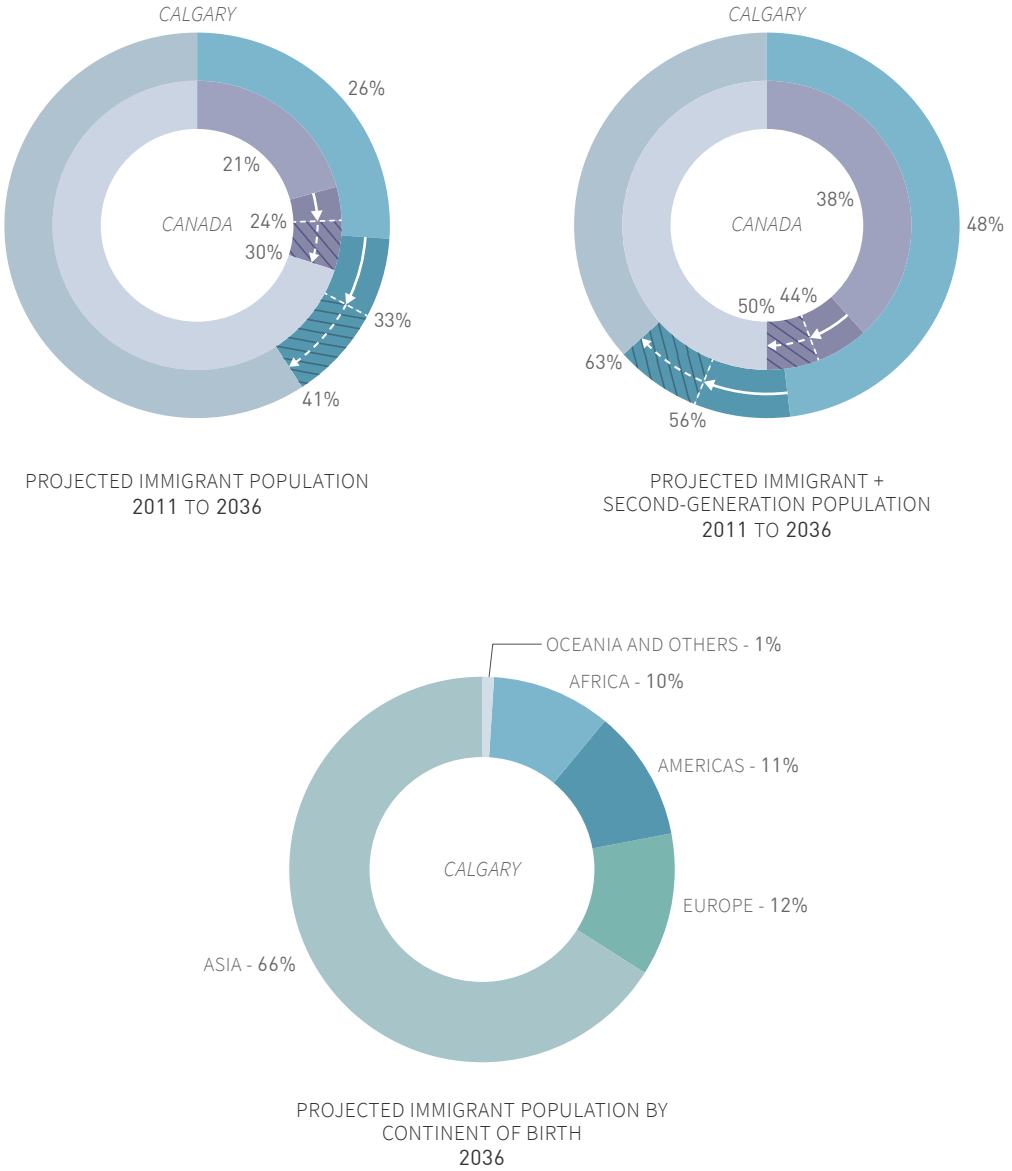


fig. 1.2 Projected immigrant population growth and origins in Calgary and Canada from 2011 to 2036.

DEMOGRAPHICS AND GROWTH IN CALGARY

Canada will see a high influx of immigrants over the next several decades, with the immigrant population percentage rising to between 25% and 30% in 2036, compared to 20.7% in 2011.[11] Calgary is among the major Canadian cities anticipating a significant increase – from 26% in 2011 to as high as approximately 41% of the city's population by 2036 *(fig. 1.2)*.[12] This growing and diversifying city thus forms the site for the implementation of the urban public space devoted to bread that is the focus of this thesis. How will these new populations establish relationships to their communities and maintain their cultural identities, while also providing for their families and participating in the economic growth of the city?

This projected population growth is coming at a time when Calgary has the second-highest unemployment rate of Census metropolitan areas in Canada at 7.7% in March of 2019 – behind only St. John's in Newfoundland at 7.8%, and above the national average of 5.8%.[13] According to the 2016 Census, 8.9% of Calgarians were below the Low Income Measure (LIM-AT) line. Though this is lower than the national average of 11.2%, the incidence rates are generally higher for women and recent immigrants.[14] Immigrant populations represented between 43% and 45% of those with low-income status in the city in 2016,[15] despite the total number of immigrants only accounting for approximately 29% of Calgary's population the same year.[16]

The instances of low income and poverty appear to be more concentrated in certain areas of the city than others. A study completed by the United Way of Calgary and Area in 2011 examined Calgary's neighbourhoods with more specificity, and shows high levels of poverty in the inner city and towards the east end of the city (*fig. 1.3*). These areas are also experiencing higher levels of social isolation (*fig 1.4*), which is tied to living alone, changed marital status, immigrant or Aboriginal identity, and living with a disability.[17] How can existing populations that suffer from the effects of poverty and decreased agency develop social capital in their communities and the skills and relationships needed to emerge from their current conditions?[18]

Food, and more specifically, bread, can play a role in addressing these critical issues.

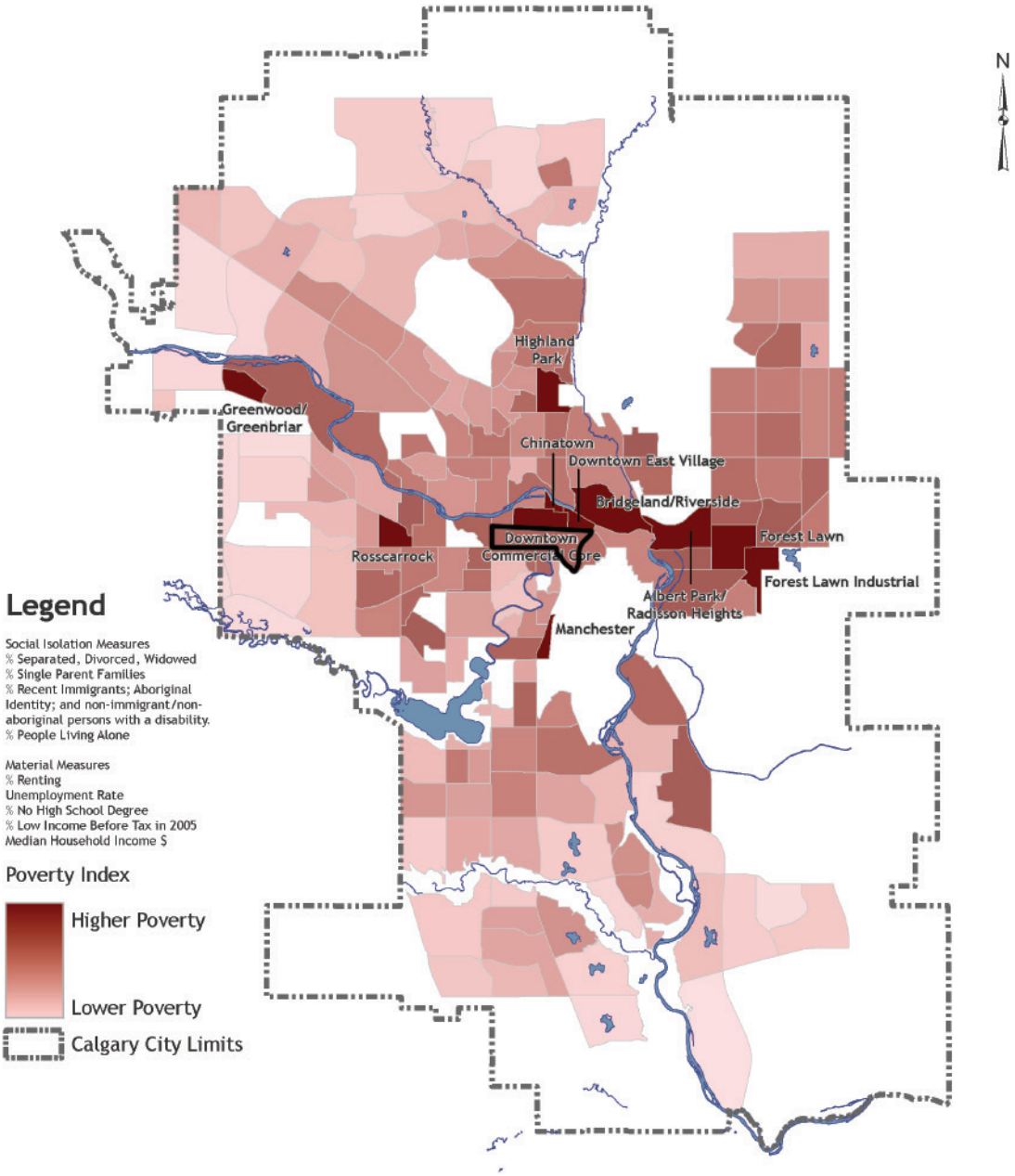


fig. 1.3 **Calgary poverty index map by neighbourhood; produced by the United Way of Calgary and Area.** The Beltline neighbourhood is outlined in black. See *Part Three: Water* for further information.

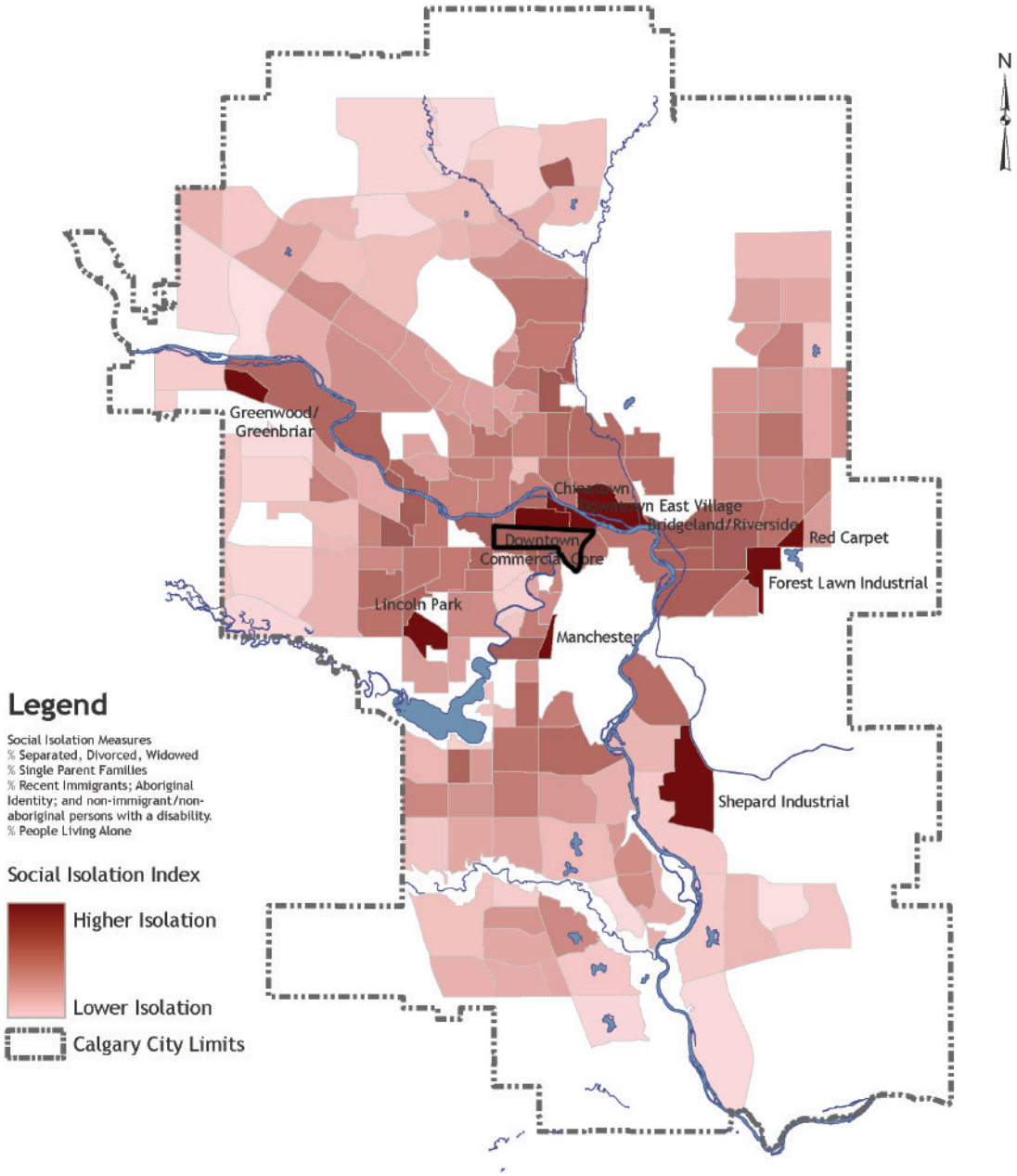


fig. 1.4 **Calgary social isolation index map by neighbourhood; produced by the United Way of Calgary and Area.** The Beltline neighbourhood is outlined in black. See *Part Three: Water* for further information.

PRODUCTIVE PUBLIC SPACES

Productive public spaces have the capacity to propagate meaningful change in our current social climate. There is value to be gained from open dialogue and collective action with those who present differences from our own experience of the world. Cooperation through making – through the physical practice of baking bread – promotes more informal interactions with others that incrementally strengthen the connections within our communities.[19] Food, prepared and eaten in the company of others, is a uniting, relational, and equalizing force.

Community Food Centres in ten locations across Canada, including one on First Nations land in New Brunswick, focus on food education, healthy food choices, and cooking and gardening skills in low-income communities. In Calgary, The Alex Community Food Centre (*fig. 1.5*) in the Forest Lawn neighbourhood has had positive effects on the mental and physical health of its participants, and in 2017, it held over 200 food skills classes and distributed over 12000 meals to community members.[20]

The Depanneur, a food event space in Toronto, is "an ongoing, evolving experiment, prototype and proof-of-concept exploring food's role in building community, creating opportunity and celebrating diversity."[21] They hold regular cooking workshops and family-style dinners, and rent their kitchen space out to local food entrepreneurs. In 2016, they started the Newcomer Kitchen, a non-profit organization that invites Syrian refugee women to cook meals in the Depanneur kitchen and sell them to local residents, splitting the earnings amongst each other (*fig. 1.6*).

fig. 1.5 The Alex Community Food Centre in Calgary.

fig. 1.6 The Newcomer Kitchen at The Depanneur in Toronto.

fig. 1.7 The Hot Bread Kitchen in New York City.

A similar model exists in New York City, where the Hot Bread Kitchen hires low-income or immigrant women for their intensive six-month 'Bakers in Training' program (*fig. 1.7*). The women learn to bake bread from a variety of cultures, and take classes in English, math, and science, preparing them for work after graduation. The breads are then sold at the bakery's storefront and to restaurants around the city, and this supports the continuation of the program and the wages paid to the women.[22]

The necessary intersectional approach of these food programs creates inclusive spaces in the city, and generates an extensive network of dignified food access and education. Putting food at the center of their initiatives not only improves the health of their communities, it also provides a venue to explore shared interests and a means to address other community issues. Bread can generate these same opportunities, while also connecting to local food systems and large-scale environmental concerns.

BREAD AND COMMUNAL BAKING

Bread is, in many ways, a simple food. With a limited number of ingredients and a basic set of steps, an almost endless number of breads can be made that take on specific forms and flavours for different cultures (*fig. 1.8*). Flour, water, salt, and, most times, yeast, come together to create a food item that is not just a staple food, but one that is deeply embedded in the histories and daily lives of many groups of people. Bread is a cultural artifact.

Over its long history, bread has acquired a multitude of religious and symbolic meanings. In Ancient Greece, Demeter was the goddess of agriculture, grain, and bread,[23] while Ancient Romans prayed to the equivalent goddess Ceres, as well as the oven goddess Fornax.[24] In certain Arabic dialects, the word for 'bread,' *aish*, is also the word for 'life', and it is forbidden to cut it with a knife.[25] The place of bread in Christianity is clear, with the rites of Communion offering it up as a representation of the body of Christ.

The ideas of wheat and bread as providers of life and health are also evident, with strong links to both rebirth and fertility; the leaven – a portion of pre-fermented dough used to make sourdough breads – is sometimes referred to as the 'mother'. Bread's ties to economy have also led to colloquialisms where 'dough' means 'money,' and "bread and butter" is one's source of livelihood. The phrase "the best thing since sliced bread" has come to represent innovations in technology or a recognition of excellence.

Bread's status and place in culture makes it clear, however, that sliced and white is not the only form of bread that exists. As Canada

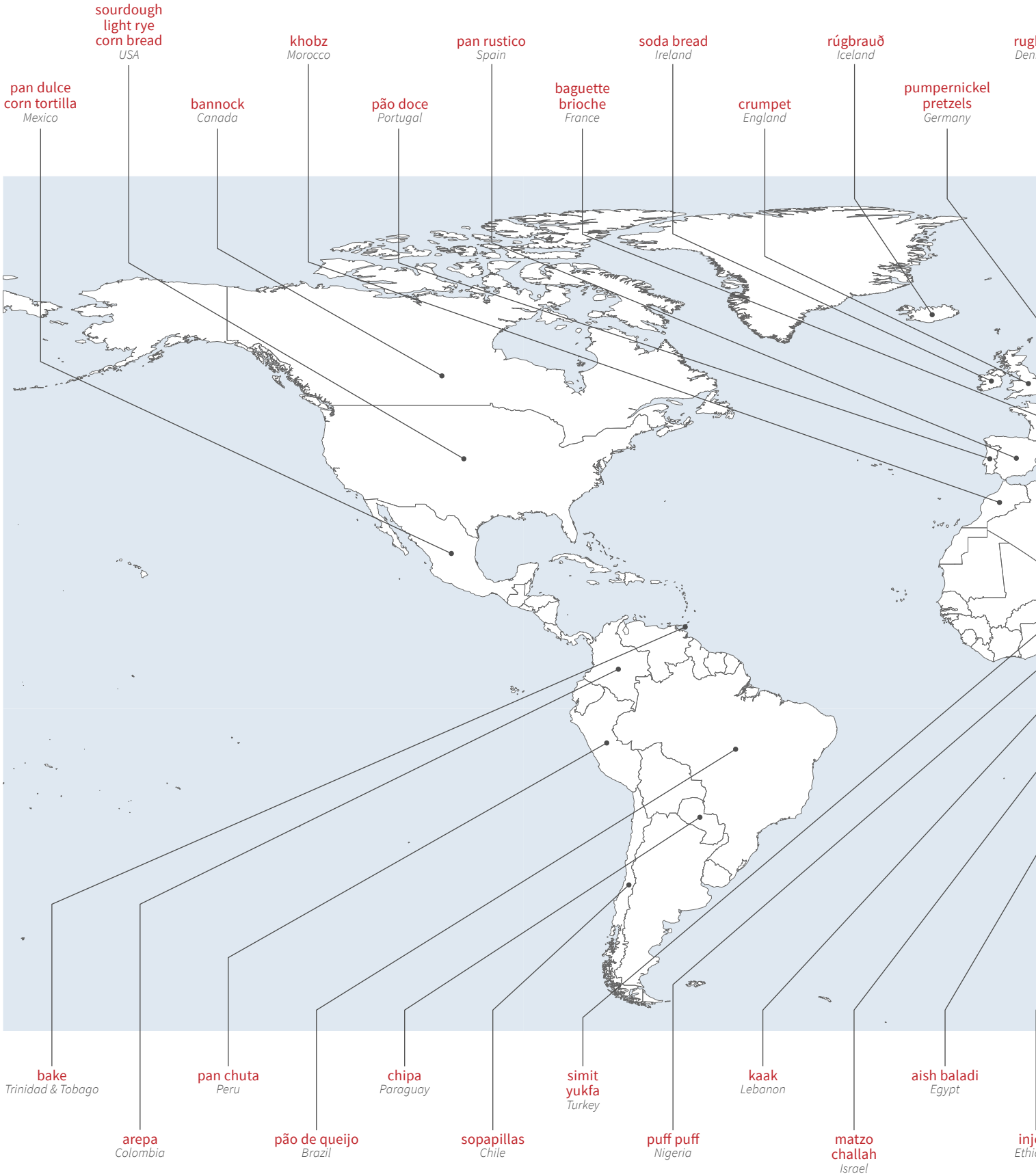
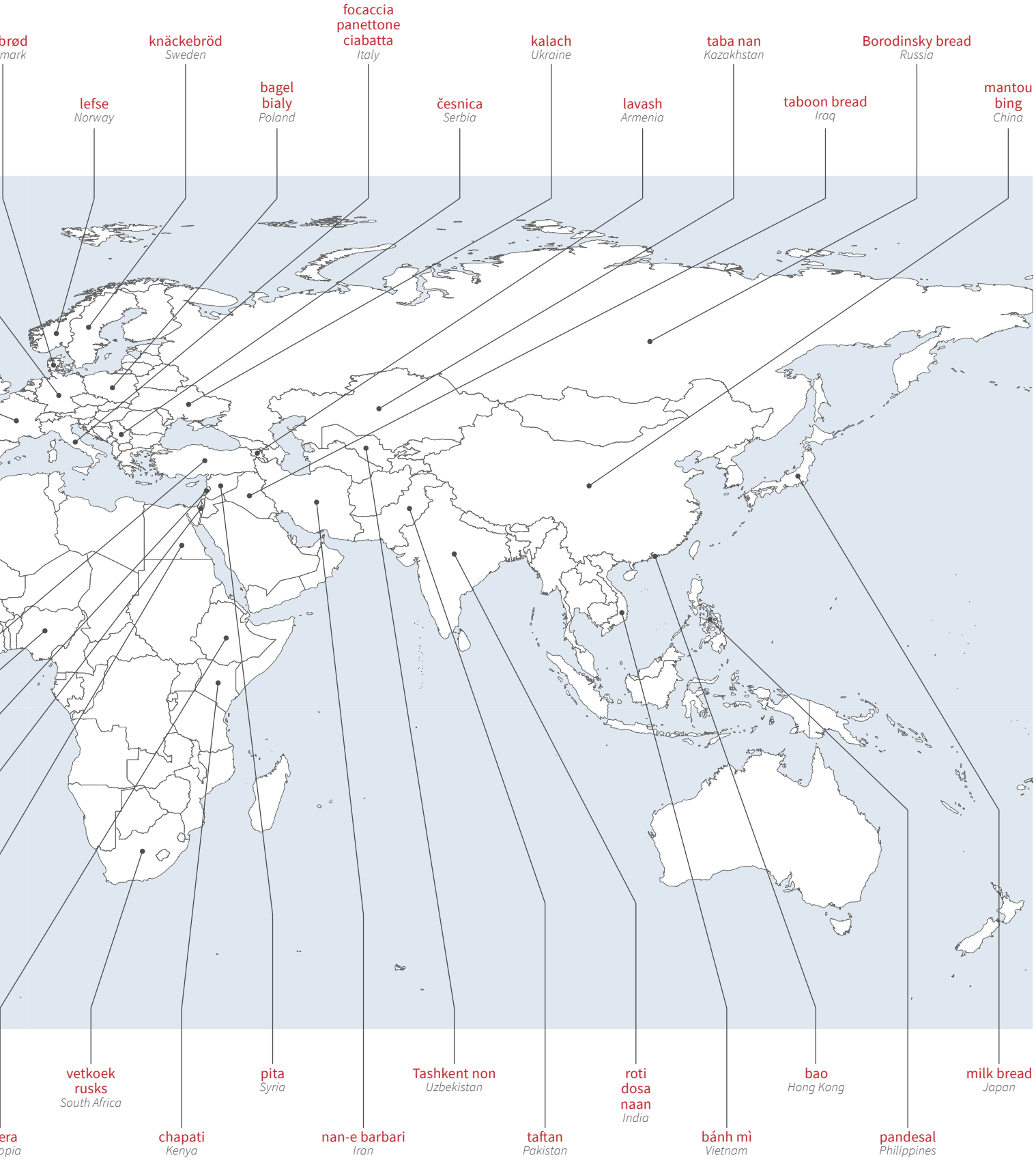


fig. 1.8 **World map of bread.**

This map is far from exhaustive. Many bread types also overlap between countries in the same region.


brød
mark
knäckebröd
Sweden
focaccia
panettone
ciabatta
Italy
kalach
Ukraine
taba nan
Kazakhstan
Borodinsky bread
Russia
lefse
Norway
bagel
bialy
Poland
česnica
Serbia
lavash
Armenia
taboon bread
Iraq
mantou
bing
China
vetkoek
rusks
South Africa
pita
Syria
Tashkent non
Uzbekistan
roti
dosa
naan
India
bao
Hong Kong
milk bread
Japan
era
opia
chapati
Kenya
nan-e barbari
Iran
taftan
Pakistan
bánh mì
Vietnam
pandesal
Philippines

continues to be a centre for immigration from all over the world, and works to combat the issues of poverty across the country, the communal baking and sharing of bread can be a way to improve the social experience and depth of cultural understanding in its cities. It offers opportunities for learning about other cultures and their rituals, customs, values, and related foods (*fig. 1.10*). Equally as important, it is a medium for interacting and working together with others towards a common goal, and developing new skills and connections that can benefit fellow community members. These baking and food skills extend beyond their use at the site itself to encourage people to cook in their own homes, and can empower others to start new businesses that diversify the economic landscape of the city.

A space designed for these goals and for the communal baking of bread must be public, visible, and accessible to all (*fig. 1.9*). While bread-making can be done anywhere that has an oven (or a fire) and a surface to work on, its dual nature of being both a technical or biological process and one that is highly adaptable or intuitive allows for the creation of a place that is specific to its changing needs for space, temperature, and time. This architectural intervention must integrate the wood-fired communal ovens into its design, giving them prominence and emphasizing their role of gathering people together on the site. The character of these ovens is such they are highly perceptible; people are drawn to them. There is the sight and smell of smoke, the pulse of activity, the feeling of warmth, and the aromas of freshly-baked bread.

fig. 1.9 **A communal bake oven event at Regent Park in Toronto.**

The oven opening is at the coloured tile wall. It is built into a structure with storage and basic facilities inside, and faces a covered public plaza in the park.

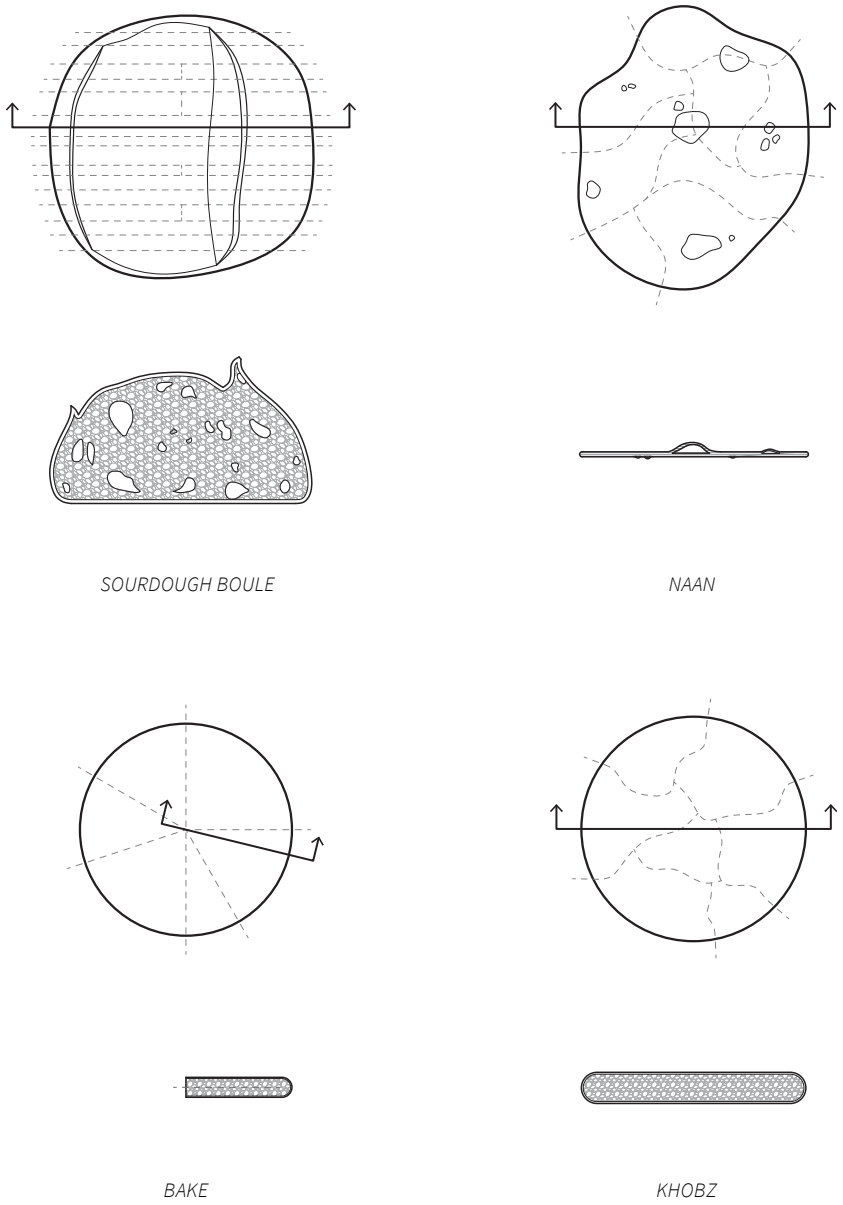


fig. 1.10 **Different breads and their sections.**

The ways that bread is cut or torn and shared often relates to specific rituals and associated foods for different cultures. The section (crumb) of the bread can also reveal a lot about its ingredients and the way it was prepared.

The impetus for the use of these spaces to produce good bread is obvious, but shared experiences that promote the development of a sense of community, increased knowledge, and a greater cultural understanding are the by-products for those willing to participate.

A definition by psychologists David McMillan and David Chavis for what people typically refer to as a "sense of community" proposes that the community must support four elements: "membership", "influence", "integration and fulfillment of needs", and "shared emotional connection."[26] Each of these elements can be addressed by a public space that has the preparation and sharing of food at its core. Participation in the baking of bread with others provides you with a specific and necessary role ("membership"), and allows you to contribute to the health and economic stability of the community ("influence"). It fulfills the more basic need for food ("integration and fulfillment of needs"), but also allows for the development of diverse relationships and shared experiences ("shared emotional connection").

Michael Brill, an architectural theorist, argues that we should be cautious to distinguish between "community life" and "public life" in our design intentions, noting that "Public life is sociability with a diversity of strangers; Community life is sociability with people you know somewhat."[27] He continues on to say,

> But what do we lose when we don't cultivate our Public life, this important form of social relationships with a diversity of strangers? We lose an important factor in the growth of individuals, in a culture that values individualism. … Because Public life is life with strangers in places outside the home and locale, it frees individuals from the social control of tight-knit groups, providing an alternative venue for alternative social learning. … As this process happens, Public life becomes more attractive, more informative, more theatrical.[28]

However, with the type of interactions that are possible in a space centered around bread, public life could develop into a richer form of community life, without the stifling of individualism that Brill is suggesting. Knowing the people in your community – their skills, their needs, their stories – seems to be just as valuable as, and not mutually exclusive to, exposing yourself to people you may have unfounded prejudice towards, or whose cultures you know little about. This more informed version of public life is a way to address these problems on a more fundamental level, leading to a community where commonalities are established, but individual contributions and opinions are still valued.

Peter Reinhart, in his seminal baking book *The Bread Baker's Apprentice*, explains the role of the craft guild apprenticeship in supporting empowerment through the acquisition of knowledge, and in creating a space for shared experiences and lessons about life outside of the craft.[29] In both the Newcomer Kitchen and the Hot Bread Kitchen,

participants are joining a sort of guild of other women who want to find a safe space in their communities to teach and learn, express their culture and expose themselves to other cultures, and develop connections to the community as a whole.

The transference of knowledge at the proposed communal ovens is perhaps less formal, and surely less exclusive, than in the guild apprenticeships of the past, but the focus on common ground and empowerment through the baking of bread is retained and celebrated.[30] All populations are welcome to participate and learn, and as a result of this personal development, both private life and community life are enriched.

FIRE

The use of communal ovens has almost entirely disappeared from cities in the present day, except for a few places including Morocco[31] (*fig. 1.11*) and some small European towns.[32] This is due to a number of possible reasons, but the ubiquity of supermarket bread, and therefore the lack of need to bake your own, and the modernization of the home oven are likely contributors.

Individual home ovens are not a purely modern construction. The first way that bread would have been baked was to put the dough on a stone heated by fire, and the first ovens were an evolution of this, where the hot stone or ground was covered with a clay or terracotta pot and surrounded with more hot coals.[33] This would have been a fairly simple set-up, small enough to sit within or just outside of the home, but the cost of wood could have been prohibitive for many families.

fig. 1.11 **Wood-fired communal oven in Morocco.**

These ovens are typically built directly into a wall of the bakery. A wood pile can be seen to the left of the oven, and both baked and unbaked bread is in the foreground.

For cities where there were no home ovens, or for people who could not maintain their own, there existed communal ovens. These ovens were fired and used on a specific day of the week, which the people of the city or town would have planned around. Prepared dough was brought by families to the oven, and the bakers, after being paid a small fee, would load the bread into the ovens and watch over them as they baked. Food and fire were attractors for human activity; the ovens "brought people together in a much more fundamental way than other things they may have had in common, like classes."[34] In order to distinguish the bread of one family from the next, specific patterns or initials were carved into the dough by slashing ("scoring") it with a knife (*fig. 1.12*), or bread stamps were used to create an impression that remained on the baked loaf. In Mesopotamia and ancient Egypt, bread was commonly baked in moulds that either created a specific design on the surface or formed the loaf into a particular shape, but this was less common in other parts of the world.[35]

Firing these large ovens took time, and with the invention of the modern electric and gas ovens, those who still wanted to prepare bread in their own homes simply had to "preheat the oven to 350°F" and return when the oven was hot enough for baking. This saved time and still allowed for homemade bread to be baked, but the social and cultural aspects of the community oven and the act of gathering attributed to these places were lost.

The idea of gathering around fire is, of course, not new. Tending to a fire often meant battling with wind, rain, and resources. Its preservation, whether exposed to the elements or sheltered within architecture, marked the space around it as a place for gathering – for cooking and for storytelling. For Gottfried Semper, the hearth was a socializing force: "Around the hearth the first groups assembled; around it the first alliances formed… Throughout all phases of society the hearth formed that sacred focus around which the whole took order and shape."[36] It was, for him, the most important element of architecture, and all other elements – roof, enclosure, and mound – were organized around it to protect it from the harshness of nature (*fig. 1.13*).[37] Centuries before this, Vitruvius attributed the civilizing of societies to the discovery of fire, and placed the origins of architecture in the first shelters and huts that were constructed to protect it.[38]

The fire and the hearth have long been both social and spiritual symbols for various cultures (*fig. 1.14*). Their presence in both hot and cold climates suggests that provision of heat was not necessarily their primary purpose.[39] The preparation of food was evidently another critical function, but the relationship of fire to ideas of permanence, life, and death, and the social aspects of gathering and ritual, retained fire's symbolic importance beyond its sensory or purely functional existence. For many societies, the public hearth occupied a prominent location in the city and was seen as a community amenity. It was more important

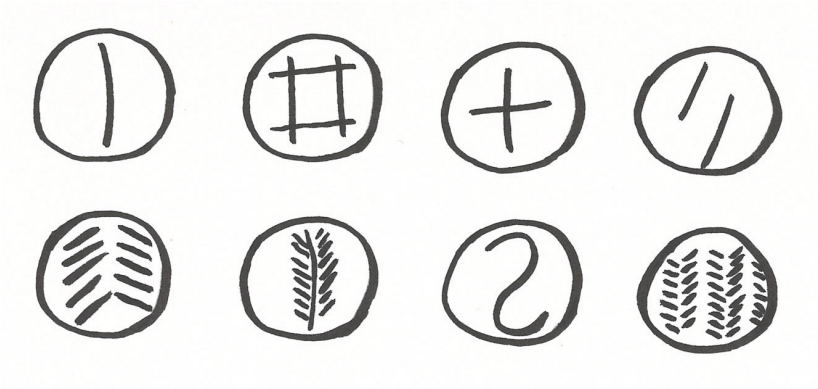


fig. 1.12 Typical bread scoring patterns.

fig. 1.13 **Robie House by Frank Lloyd Wright (Chicago, 1910).**

The massive fireplace occupies a central place in the house, separating the living and dining rooms.

fig. 1.14 **Iraqi mudhif.**

The mudhif is a traditional gathering place whose focal point is a hearth where coffee is prepared and served.

than the private hearth of individual homes, and the flame had to remain burning at all times.[40]

Technological advances in heating and cooking led to the multiplication and dispersal of fire throughout the home and the city. The role of the communal hearth was broken up into mechanical heating systems, individual stoves and ovens, and electric lighting. It was, according to Luis Fernandez-Galiano, "dislodged, and then ousted altogether, from the central place it occupied in architectural space."[41] Though this dispersal can be seen as a "progressive erosion of [its] symbolic value,"[42] the image of fire still holds a place in our collective notions of social and cultural space, interaction, and sustenance. Lisa Heschong describes this physical and psychological association:

> Perhaps the human fascination with fire stems from the totality of its sensory stimulation. The fire gives a flickering and glowing light, ever moving, ever changing. It crackles and hisses and fills the room with the smells of smoke and wood and perhaps even food. It penetrates us with its warmth. Every sense is stimulated and all of their associated modes of perception, such as memory and an awareness of time are also brought into play, focused on the one experience of the fire. Together they create such an intense feeling of reality, of the "here and newness" of the moment, that the fire becomes completely captivating.[43]

The communal ovens collect fire once again, and, given a place in the public domain, their thermal qualities create spaces that are rooted in social and cultural purpose, and that can be amplified by architecture. As actual hearths for the public space they exist within, and metaphorical hearths for the neighbourhood and the city, they have, in their role as a place of gathering and knowledge, the potential to perpetuate greater environmental and sociological changes.

fig. 1.15 The captivating sensory qualities of fire.

fig. 1.16 **A spectrum of oven types.**

The barrel vault brick oven, cob dome oven, and tandoor oven (highlighted in white) are the focus of this thesis due to their high potential for communal use and the variability that exists between them.

fig. 1.17 **Barrel vault brick oven.**

This is the largest of the three oven types. It requires more time to heat, but has the highest baking capacity.

fig. 1.18 **Tandoor oven.**

Many variations of tandoor ovens exist, but all require that the bread be baked directly on the oven walls (or ceiling).

fig. 1.19 **Cob dome oven.**

Cob ovens are low-cost and can be built in a single weekend, often with local or found materials.

COMMUNAL OVENS FOR THE CITY

Early in the morning, the head baker and his apprentices gather the wood, already reserved in a storage area, and load smaller logs and branches into the large barrel vault of the brick oven (*fig. 1.17*). A fire is started, and larger logs are slowly added to increase the size and strength of the fire. The fire is tended to over the next several hours, ensuring that enough heat is stored in the brick and stone mass of the oven. The smell of smoke begins to drift through the city, while families finish their dough preparations in their homes, shaping the loaves, dusting them with flour, and placing them onto trays. The fire has now diminished to a pile of hot coals, and the baker sweeps these coals out of the oven and allows the oven to cool to the correct bread-baking temperature. He tests this by throwing small handfuls of flour into the oven and counting the number of seconds until the flour begins to brown, while the baking apprentices watch intently, taking mental notes about this technique. The families of the community start to make their way towards the oven, trays in hand, and join the hum of activity forming around the brick structure. The baker is paid, and just before the loaves are slid into the oven, the owners quickly slash a design onto the dough – a cross, a square, initials, a wheat sheaf – to identify it as their own. The bread will be ready in less than an hour, so some choose to walk around town, gathering other groceries and supplies that they need, while others wait outside the bakery, discussing anything from politics, to community events, to gossip. When the loaves are finished baking and have cooled slightly, they go back into the bakery to pick up their edible works. As they admire the finished loaves made by other families, the conversation switches to bread: "How much water did you use?", "The colour on that crust is amazing!", "Are those walnuts I see?". Recipes and techniques are discussed, and as people part ways to return to their homes, ideas about next week's loaves are fermenting in their minds. Meanwhile, the oven has now cooled slightly, and the next crop of bakers and cooks arrive, ready to slide their pastries, meats, and stews into the oven, and to converse with friends and strangers while they wait.

These interactions vary from culture to culture, and from oven to oven. In India and other parts of south, west, and central Asia, tandoor ovens are often used for baking naan and other flatbreads (*fig. 1.18*). In parts of China, they are also used to cook a variety of meat-filled buns. These ovens are cylindrical in form, and a fire placed inside the oven heats up the inner walls that are typically made of clay or mud. A variation of the tandoor oven was used as early as Mesopotamian times.[44] The oven is smaller than the large brick ovens of some European countries, so the heating time is shorter, and the fast-baking nature of the thin flatbreads requires constant attention. Dough is stretched over a round pillow and slapped against the inner walls of the tandoor, and then carefully removed with a hook and stacked in a pile once they are

finished baking. When the oven cools slightly, meat and vegetables can be threaded onto metal skewers and placed into or over the oven. As the meat and vegetables cook, fats, oils, and seasonings drip onto the fire, creating smoke and imparting additional flavours to the foods. While the simplicity in form and materials make this an easy oven type to build for the average home, larger versions are also common in markets and on the commercial streets of smaller towns.

Another common wood-fired oven type is the cob oven (*fig. 1.19*). These ovens are made from a mixture of clay, sand, water, and straw that is formed into a dome and often placed on a masonry base. Their traditional construction makes use of materials found in the immediate surroundings, and thus embodies a connection to place and to other built form. Cob ovens can be very simple and inexpensive to build, and variations of it are found worldwide, taking on slightly different forms and sometimes incorporating sculptural elements.

	Barrel Vault Brick Oven	*Cob Dome Oven*	*Tandoor Oven*
Locations	Morocco, Europe (especially Italy)	variations worldwide	Southern, Central, Western Asia
Materials	brick, firebrick, concrete, insulation	cob (clay + straw), stone, sand, firebrick, plaster	clay, concrete/mud
Primary bread types	hearth breads (best), flatbreads (good)	hearth breads (good), flatbreads (best)	flatbreads (best)
Heat generation method	fire lit on hearth burns to saturate oven with heat; coals are removed to bake hearth breads	fire lit on hearth burns to saturate oven with heat; embers or low fire can be retained to bake some flatbreads	fire lit at base of oven saturates walls with heat; embers are retained for additional heat
Location of heat	- conduction: direct heat from hearth - convection: air passing over hot walls/hearth - radiation: heat from surfaces	- conduction: direct heat from hearth - convection: air passing over hot walls/hearth - radiation: heat from retained fire/embers	- conduction: direct heat from walls - convection: air passing over hot walls (minimal) - radiation: heat from retained fire/embers
Time of heat retention (downward curve)	24+ hours	12+ hours	2+ hours
Tools required for use	bread/pizza peel (long) or oven loader, rake/brush for coals	bread/pizza peel (shorter), rake/brush for coals	naan pillow (gaddi), naan hook, skewers
Temperature range	heats up to 900°F (480°C) hearth breads: 400-550°F flatbreads: 400-700°F	heats up to 900°F (480°C) hearth breads: 400-550°F flatbreads: 400-700°F	heats up to 900°F (480°C) flatbreads: 450-650°F
Retained heat cooking	roasting, braising: 300-500°F	roasting, braising: 300-500°F	meat/vegetables on skewers: 400-550°F

fig. 1.20 Summary of communal oven properties.

While the traditional model of the communal oven was a place where families would bring their unbaked dough and have a professional bake it for them – a model that, while efficient, meant that conversations about bread with others in the city were limited to hypothetical instruction – the types of interactions that are inherent in and emphasized by a place with the preparation of food at its core demonstrates the potential of this public amenity in modern and growing cities. A new communal oven could expand its use to embed a larger role for community members, encouraging collective participation in the actual baking, preparation, and distribution of the bread, as well as providing a place to share a meal with others. Workshops that demonstrate how to build and use cob ovens can also encourage the use of these ovens in both smaller-scale personal and larger-scale community endeavours.

In Toronto, a network of public bake ovens in parks and at markets across the city show some of the possibilities of urban spaces enriched by the images of food, fire, and social engagement (*fig. 1.21*). The first wood-fired bread oven was built in Dufferin Grove Park in 1995 by a group of volunteers led by community and park activist Jutta Mason. Their spread throughout the city was propelled by the success of this oven in connection with local events, including festivals, public pizza days, Friday Night Suppers, and baking for the weekly farmer's market.[45] While the support structures – available water, storage space, and prep areas – are lacking to make some of these ovens a significant and usable feature of their communities, their success in others points to the potential role of architecture and association with other programming and public spaces in supporting their continued use (*fig. 1.22*). The bake ovens started out as a grass-roots initiative by Toronto residents looking to improve and diversify the activities in their communities. Increasing regulations and a new Outdoor Oven policy put in place in 2011, however, have made it increasingly difficult to construct new ovens and make use of existing ones.[46]

Jutta Mason argues that a local and "piecemeal" approach to the bake ovens is the most successful, and cautions that "Planning and design by professionals too often create obstacles to the commons. … Builders collaborating directly with bakers leads to the most workable and by far the cheapest ovens."[47] This thesis does not propose that a top-down approach be taken for the implementation of communal ovens in the city, as a large architectural project might suggest, but that creating a place where the benefits of the ovens are publicly displayed can provide agency and support for bottom-up, community-specific interventions centred around bread to propagate themselves throughout the city. The participation of formerly-excluded or marginalized social, cultural, and economic groups in these public spaces can then lead to demands for change that ultimately impact both the city and its surrounding environments.

fig. 1.21 **Location of wood-fired community bake ovens in Toronto.**

The ovens indicated to be "privately-owned" are still used for community events, but cannot be booked for use by members of the public like other ovens in the city.

R.V. Burgess Park has the first public tandoor oven in North America as a result of the efforts of the Thorncliffe Park Women's Committee. The oven is used regularly during the weekly summer market and other community events.

The oven at Wychwood Barns is typically used as a part of The Stop Community Food Centre farmers' market and other food programming.

fig. 1.22 **Bake oven events in Toronto.**

ENDNOTES

1 Arendt saw architecture and public space as vessels for political action – evidenced by places like the Roman Forum – and perhaps attributed the "striking decline" of monumental architecture to the increasing presence of "social," as opposed to political, action in the public realm. See Hannah Arendt, *The Human Condition* (Chicago: The University of Chicago Press, 1958), 39.

2 Nancy Fraser, "Rethinking the Public Sphere: A Contribution to the Critique of Actually Existing Democracy," *Social Text,* no. 25/26 (1990): 66.

3 Richard Sennett, *The Fall of Public Man* (New York: Knopf, 1977), 17.

4 Ibid., 18.

5 Fraser explains her use of this term, saying "I propose to call these *subaltern counterpublics* in order to signal that they are parallel discursive arenas where members of subordinated social groups invent and circulate counterdiscourses, which in turn permit them to formulate oppositional interpretations of their identities, interests, and needs." See Fraser, "Rethinking the Public Sphere," 67.

6 Margaret Crawford, "Blurring the Boundaries: Public and Private Space," in *Everyday Urbanism,* eds. John Leighton Chase, Margaret Crawford, and John Kaliski (New York: The Monacelli Press, 2008), 35.

7 Amy Gutmann, "Introduction", in *Multiculturalism and "The Politics of Recognition,"* ed. Amy Gutmann (Princeton, New Jersey: Princeton University Press, 1992), 9.

8 Charles Taylor, *Multiculturalism and "The Politics of Recognition,"* ed. Amy Gutmann (Princeton, New Jersey: Princeton University Press, 1992), 32.

9 Sennett, *The Fall of Public Man,* 27.

10 "Good Food is Just the Beginning: 2016 Impact Report," Community Food Centres Canada, accessed September 28, 2018, https://goodfoodbeginning.cfccanada.ca/.

11 Jean-Dominique Morency, Éric C. Malenfant and Samuel MacIsaac, "Immigration and Diversity: Population Projections for Canada and its Regions, 2011 to 2036," *Statistics Canada*, last modified January 25, 2017, https://www.statcan.gc.ca/pub/91-551-x/91-551-x2017001-eng.htm.

12 These projections place Calgary behind only Toronto and Vancouver in total immigrant population percentage, but higher than both of these cities in terms of percentage increases. Ibid.

13 Statistics Canada, "Labour force characteristics by census metropolitan area, three-month moving average, seasonally adjusted and unadjusted, last 5 months," Statistics Canada Table 14-10-0294-01, accessed April 24, 2019, https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1410029401.

14 Janet Eremenko, *Poverty in Calgary: A picture of the incidence and experience of low income in Calgary and area* (Calgary, Alberta: Vibrant Communities Calgary, 2018), 3-4. http://enoughforall.ca/wp-content//uploads/2018/05/Poverty-Snapshot-2018.pdf.

15 Ibid., 7. See report for detailed low-income status population percentages.

16 Statistics Canada, "Census Profile, 2016 Census: Calgary [Census metropolitan area], Alberta and Alberta [Province]," Statistics Canada Catalogue no. 98-316-X2016001, accessed February 7, 2019, https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E.

17 Michael Classens and Loreen Gilmour, *Mapping Poverty in Calgary* (Calgary, Alberta: United Way of Calgary and Area, 2011), 10-11, 14-15.

18 The United Way of Calgary study found that "emerging literature suggests that 'social capital' – defined as people's sense of belonging and connectedness to each other and to the community – is increasingly being identified as a crucial contributor to moving out of poverty, along with availability of life opportunities and health outcomes." See Classens and Gilmour, *Mapping Poverty in Calgary,* 4.

19 Richard Sennett, *Together: The Rituals, Pleasures and Politics of Cooperation* (New Haven, Connecticut: Yale University Press, 2012), 205.

20 "The Alex Community Food Centre: 2017 Impact Summary," Community Food Centres

Canada, accessed February 4, 2019, https://thealexcfc.ca/wp-content/uploads/2018/02/The-Alex-CFC-Impact-Summary-2017.pdf.

21 "About," The Depanneur, accessed November 9, 2017, https://thedepanneur.ca/about/.

22 "Culinary Training Program," Hot Bread Kitchen, accessed November 9, 2017, https://hotbreadkitchen.org/culinary-training/.

23 Heinrich Eduard Jacob, *Six Thousand Years of Bread: Its Holy and Unholy History*, trans. Clara Winston and Richard Winston (Westport, Connecticut: Greenwood Press, 1970), 53.

24 Ibid., 77.

25 *Cooked: Air,* Web, directed by Ryan Miller (USA: Jigsaw Productions, 2016).

26 David W. McMillan and David M. Chavis, "Sense of Community: A Definition and Theory," *Journal of Community Psychology* 14, no. 1 (1986): 9.

27 Michael Brill, "Problems with Mistaking Community Life for Public Life," *Places* 14, no. 2 (2001): 48. Brill was also a professor at the University at Buffalo School of Architecture and Planning.

28 Ibid., 53-54.

29 Peter Reinhart, *The Bread Baker's Apprentice: Mastering the Art of Extraordinary Bread* (Berkeley, California: Ten Speed Press, 2001), 2.

30 "Empowerment" is defined by psychologists Marc Zimmerman and Julian Rappaport as "the connection between a sense of personal competence, [and] a desire for, and a willingness to take action in the public domain." See Marc A. Zimmerman and Julian Rappaport, "Citizen Participation, Perceived Control, and Psychological Empowerment," *American Journal of Community Psychology* 16, no. 5 (1988): 725. http://onlinelibrary.wiley.com/doi/10.1007/BF00930023/abstract. Developing a greater sense of empowerment appears, in combination with social capital, to positively contribute to overcoming some of the barriers to moving out of poverty.

31 Miller, *Cooked: Air*.

32 Petra Hagen Hodgson and Rolf Toyka, *The Architect, the Cook and Good Taste*, trans. Michael Robinson (Berlin: Birkhauser, 2007), 11.

33 Jordan W. Barry and Michael H. Turkell, interview with Francisco Migoya and Nathan Myhrvold, "Episode 1: Pre-ferment," *Modernist BreadCrumbs,* podcast audio, October 4, 2017, https://heritageradionetwork.org/podcast/pre-ferment/.

34 Ibid.

35 William Rubel, *Bread: A Global History,* Edible, ed. Andrew F. Smith (London: Reaktion Books, 2011), 26.

36 Gottfried Semper, *The Four Elements of Architecture and Other Writings,* trans. Harry F. Mallgrave and Wolfgang Herrmann (Cambridge, England: Cambridge University Press, 1989), 102.

37 Ibid.

38 Luis Fernández-Galiano, *Fire and Memory: On Architecture and Energy,* trans. Gina Cariño (Cambridge, Massachusetts: MIT Press, 2000), 9.

39 Rem Koolhaas, AMO, and Harvard Graduate School of Design, *Fireplace,* Elements of Architecture, ed. James Westcott (Venice, Italy: Marsilio Editorio, 2014), 24.

40 Ibid., 28.

41 Fernández-Galiano, *Fire and Memory*, 214.

42 Ibid., 213-214.

43 Lisa Heschong, *Thermal Delight in Architecture* (Cambridge, Massachusetts: MIT Press, 1979), 29.

44 Rubel, *Bread: A Global History*, 25.

45 A second oven was also built in Dufferin Grove Park in 2000. See "Dufferin Grove Park Oven's History," *Public Bakeovens,* last modified August 24, 2015, http://www.publicbakeovens.ca/wiki/wiki.php?n=DufferinGrovePark.History.

46 Jutta Mason, *Cooking with Fire in Public Parks: 1993-2013 at Dufferin Grove Park* (Toronto: CELOS - Centre for Local Research into Public Space, 2013), 53-56. http://www.publicbakeovens.ca/wiki/uploads/PublicBakeovens/cooking_fire_WEB.pdf.

47 Ibid., 57.

part two

FLOUR

FLOUR

WHITE FLOUR VS BIODIVERSITY

Despite the variety in form, taste, use, and symbolic meaning that can be found in bread types worldwide, sifted pale white flour has long been the ingredient of choice. Bread, and more specifically white bread, has been a symbol of wealth for millennia. White flour was historically very wasteful – pre-industrial milling and sifting technologies removed more than 50% of the grain to produce it – and was therefore only affordable for the wealthy.[1] Smaller loaves were of a higher status, and breads enriched with eggs, milk, oil, fruits, or olives were a true luxury. There are examples of types of bread that have deeper cultural associations and have therefore subverted the stigmatization of dark-coloured loaves, such as the rye breads of northern Europe and Germany and the teff flour injera of Ethiopia (*fig. 2.1*), but the general preference towards light and soft breads was prevalent worldwide.[2]

The long-standing preference for soft white airy bread culminates in the industrialization of flour in 19th century and, subsequently, the creation of Wonder Bread. The invention of the steel roller mill and its widespread use by the 1880s drastically increased the speed at which wheat could be processed, and, most importantly, was able to remove the shelf-life-inhibiting germ and dark-coloured bran from the wheat kernel, leaving behind the pale starchy endosperm (*fig. 2.2*).[3] Flour was now white, transportable, quick to produce, and cheap – the ultimate goal over the course of bread's existence in human life. These changes forced the older, slower, and, in the eyes of this new age of industrialization, ineffective stone mills to close down, and consolidated the milling industry into large factory buildings (*fig. 2.3*).[4] Towns that built their economy around the operation of these stone mills would have had to look for alternate sources of income, and the local mill was no longer a

fig. 2.1 German rye bread and Ethiopian injera.

fig. 2.2 Anatomy of a wheat kernel.

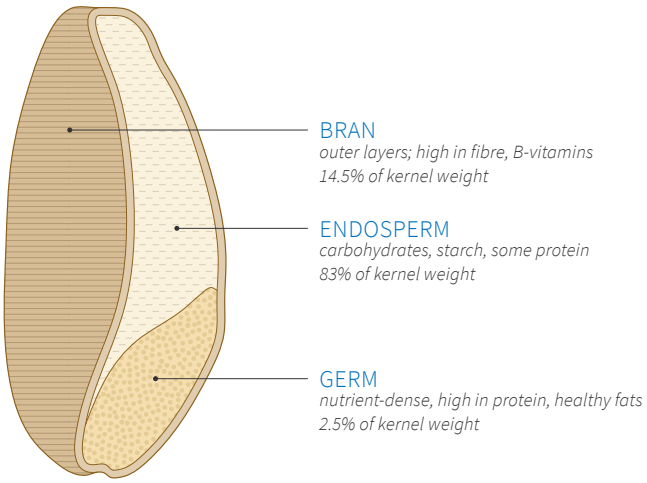


fig. 2.3 Industrial flour mills at Honeywell Flour Mills in Nigeria.

node around which to build a community.

Roller mill technology also influenced the breeding selection for wheats. The harder the outer bran of the wheat, the easier it is to separate and remove in the industrial milling process. Hence, hard red wheats were preferred over soft white wheats, and were bred to further increase the hardness of the bran.[5] This, in turn, made whole grain flour even more coarse and bitter, and therefore less desirable by bread production companies and the general public, further solidifying white flour's control over the market.

The desire for specific industrialization-friendly characteristics in wheat has resulted in a loss of wheat biodiversity, since any varieties that do not meet the criteria for easy processing into white flour no longer have value in a capitalist and profit-driven economy. The most significant of these breeding "advancements" was made possible by Norman Borlaug in the 1940s during the Green Revolution, when typical wheat varieties were crossed with dwarf wheat varieties to create the high-yielding semi-dwarf wheats that are grown in monocultures all over the world today.[6] These breeding selections not only changed the visual appearance of a field of wheat – different strains can have different colours, heights, and head shapes – but also the ecologies of the wheat fields and their ability to adapt to varying climates and diseases (*fig. 2.4*).

This capacity for adaptation is seen in what are called *landrace crops*. These varieties can thrive within a wide range of climatic conditions, soil qualities, and rainfall amounts due to the genetic variability present in their seeds.[7] This is especially significant in places like Canada, where there are extreme climate differences from once season to the next, and the Middle East, where the dry and hot climate can make it difficult for many wheat varieties to grow.

In Canada, the Red Fife variety, a landrace wheat, was first planted by a farmer named David Fife in Ontario in 1842, and its performance in cold weather, resistance to rust, and high yields made it a fast favourite of Canadian farmers. It became the standard wheat grown in Canada between 1860 and 1900.[8] It was an excellent baking and milling wheat, and its spread throughout Canada and the United States was facilitated by the roller mill technology that came a few decades after its first planting[9] – an irony considering its current state of relative non-existence. Stemming from the ambitions propelled by the Green Revolution, new varieties – with their shortened stature, increased yields, and love of chemical fertilizers – took precedence over Red Fife and other landrace wheats.[10] The lack of adaptability and resilience in these new strains, however, means that agricultural scientists must constantly breed for new varieties in order to combat new diseases and the constantly changing climate.

A focus on the cultivation of landrace crops, then, appears to be a way to respond to not only the broader environmental changes of the Anthropocene, but also the potential effects of political conflict. In Syria,

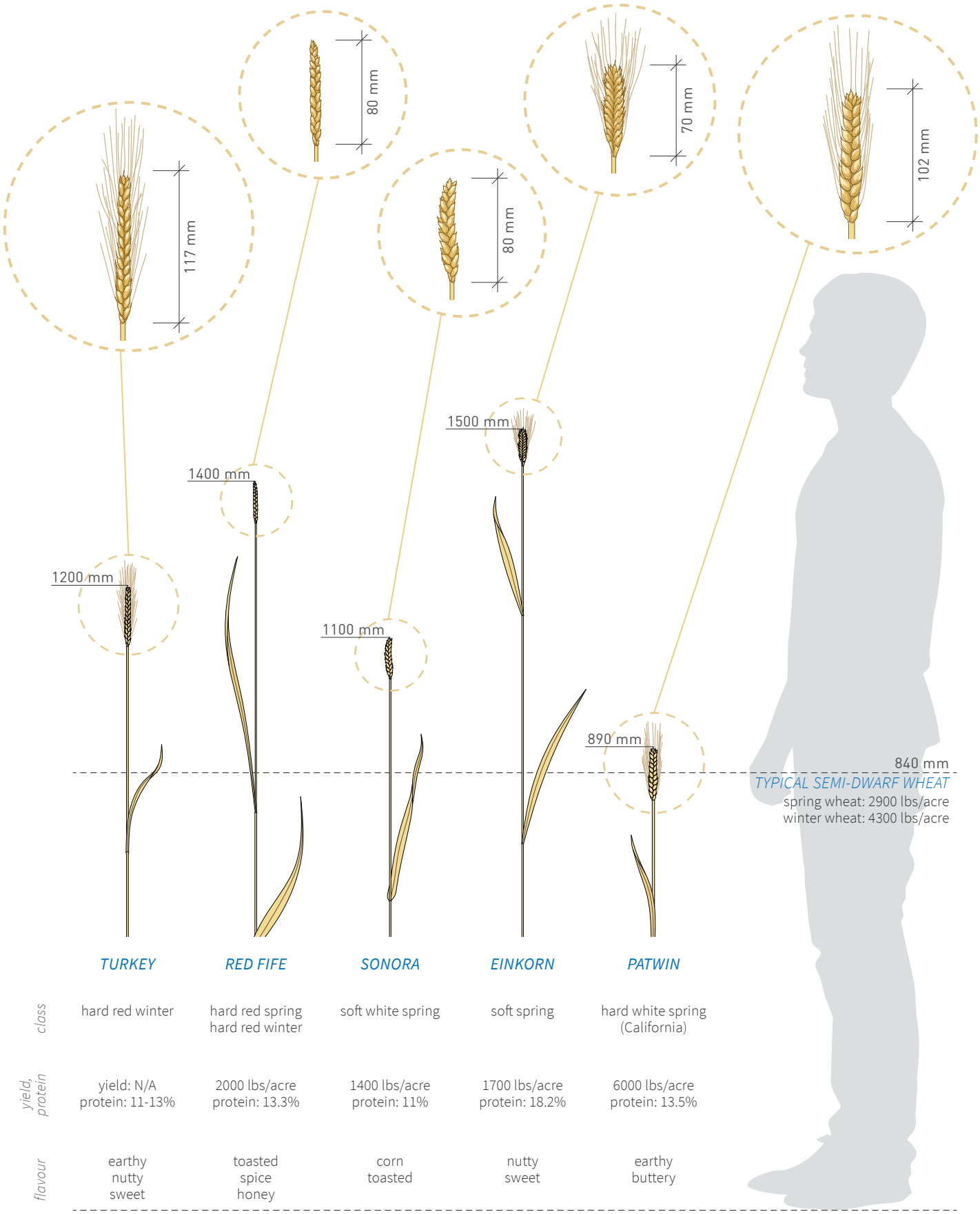


fig. 2.4 **Characteristics of different wheat varieties.**

The landrace wheats Turkey, Red Fife, Sonora, and Einkorn are only grown in small numbers today, as they have been replaced by higher yielding semi-dwarf wheat varieties. Patwin was released by the University of California in 2006 and, though it is also a semi-dwarf wheat, it was developed as a region-specific variety. (Wheat heights at 1:10 scale; wheat heads at 1:4 scale.)

fig. 2.5 The Svalbard Global Seed Vault currently has over 980 000 seed samples, and can store up to 4.5 million crop varieties.

the civil war forced scientists to abandon their seed bank in Aleppo in 2012, and withdraw wheat and other crop seeds from the Global Seed Vault in Svalbard for the first time in 2015 (*fig. 2.5*).[11] The crops were then planted in greenhouses in nearby Lebanon so that the seed stock could be replenished. These seeds were for drought- and heat-resistance varieties, many of them landrace crops,[12] and exemplify the importance of varieties that are suited to and have developed in a specific region over standardized varieties.

BEYOND WONDER BREAD

The breeding of wheat for industrial processing is not focused on nutritional content, but on increasing yield and decreasing the length of the growing season. In the 1940s, Wonder Bread was forced to add nutrients, in the form of various B vitamins, back into their breads, since any nutritional content that would have existed in the wheat was stripped away with the removal of the bran and germ.[13] The "brown bread movement" of the hippies in the 1960s was a political stand against these highly processed white breads, but this, as Michael Pollan says, "resulted in the production of some uncompromising and notably bricklike loaves of dark, seedy bread,"[14] and so the power of Wonder Bread still reigned supreme.[15]

There is another reason why sliced processed bread is so widespread: it is cheap. For the average consumer who is unaware of the true cost of food,[16] and especially for low-income populations, factory bread is an easy and inexpensive way to satisfy our collective desire for bread. If you compare the cost of a loaf of Wonder Bread at less than $2.50 to a loaf of "artisan" bread at anywhere between $5.00 and $10.00, and combine this with the lack of public information surrounding bread's

fig. 2.6 **Ingredient label of factory-produced bread.**

The list of ingredients for industrialized bread produced in Canada is shorter than that of the USA, but does not appear to fair better in terms of nutritional content or lack of preservatives.

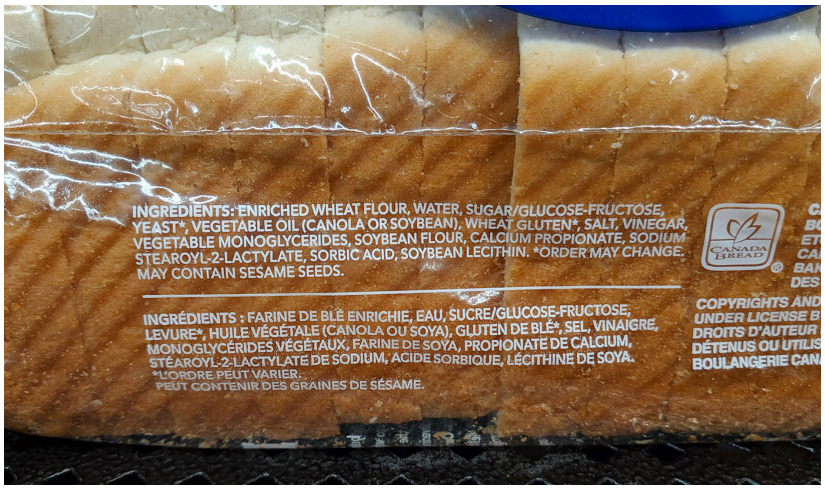


fig. 2.7 Wheat variety test plots at The Bread Lab.

fig. 2.8 Flours made from different wheat varieties present a range of colours, textures, tastes, and smells.

ingredients and production, it is no wonder that so many people choose to go to the supermarket rather than their local bakery – if one even exists.

Resistance to Wonder Bread – as a food product that contains almost 30 ingredients and has very little naturally-occurring nutritional content[17] – has re-emerged over the past couple decades (*fig. 2.6*). Bakers, consumers, and researchers are starting to turn their attention to whole grain breads and bread produced with a sourdough starter rather than commercial yeast, not only for their health benefits, but for the potential of the wheat to produce a variety of tastes, colours, and textures in the bread. New research into wheat varieties and experimentation in bread baking has put a focus on these parameters, and the previous conceptions about the taste of "brown breads" are fading.

At Washington State University, The Bread Lab, which opened in 2011 and is led by renowned plant geneticist Dr. Stephen Jones, has a plant breeding program that "conducts research on thousands of lines of wheat, barley, buckwheat and other small grains to identify those that perform well for farmers, and that are most suitable for craft baking, cooking, malting, brewing, and distilling."[18] This focus on not only the taste and end-use of the grain but on the economic viability of the crops for farmers positions the research as a part of a long-term goal of implementation (*fig. 2.7*). The emergence of participatory and farmer-led research programs like this signifies the importance of collaboration in the cross-disciplinary subject that is food.[19]

BAKERS, MILLERS, AND FARMERS

The expanded field of wheat breeding promotes novel and distinct flavours in breads and other baked goods, as well as the ability to recreate recipes that may traditionally use or benefit from other types of flour (*fig. 2.8*). However, it also presents the challenge of learning how to bake with heritage grains and freshly milled flour. Working with these ingredients requires a reskilling of bakers, since non-commodified, fresh flours inherently present more variability – in protein content, water absorption, enzyme activity – than their industrialized counterparts.[20] Craft bakers are at the forefront of this resurgent baking style, and are learning how to once again work with a range of wheats. By collaborating with a bourgeoning group of small-scale millers, or attaining their own stone mills, they are pushing the limits and existing knowledge base beyond generic white flour.

While the focus of these craft bakeries is at the end-stage of a long process – the actual preparation and baking of bread with specific aspirations surrounding taste, texture, and appearance in mind – there is a clear acknowledgement that each of the other stages and groups of

fig. 2.9 Red Fife, spelt, and durum crackers from Evelyn's Crackers.

fig. 2.10 Both The Mill and Grist & Toll use Osttiroler grain mills imported from Austria to produce their flours.

people involved cannot simply be dissociated from the finished loaf, in the way that they are when looking at a loaf of industrially-produced bread. Through their experimentation and triumphs, they are spreading the word to the general population about wheat's vast potential and critical importance, and putting high-quality bread in our hands and minds once again.

In San Francisco, The Mill, started by Josey Baker in 2012, has an in-house stone mill that is used to grind their whole grain flours every day. The goal of freshness is obvious but, as Baker explains, it also supports more direct contact and maintains open discussion with the farmers growing the wheat.[21] This close relationship allows for constant experimentation with different grains, and the ability to adapt to the large-scale changes taking place while also innovating to propel new ones.

In Toronto, a similar focus on the potential inherent in heritage wheats led to the creation of Evelyn's Crackers in 2008. The owners, Dawn Woodward and Edmund Rek, work with Ontario farmers and millers in reviving the growth of Red Fife wheat in the province, and incorporate the whole grain Red Fife flour, as well as other local grains, into their crackers, cookies, and pastries (*fig. 2.9*). They are deeply invested in the local food economy, primarily selling their products at farmers markets around the city, and in the development of a regional agriculture.[22]

In its current state of recent re-emergence, it is clear that, as Samantha Martin-McAuliffe, an author and architectural historian, says,

> [Landrace farming] is smaller in scale than conventional agriculture, but importantly it is also a craft that requires a farmer to develop specific expertise in regional climates, crop rotation, zero-tillage, grain history, local cultures and food literacy. … Landrace farming is a slow yet evolving process, and it offers the possibility of recovering a diversified form of agriculture, one that values flavour and taste over compatibility with long-haul transport and economies of scale.[23]

This agricultural model requires not only a relationship between farmers, bakers, and millers, but also a connection to the communities they serve.

Access to a larger population and a variety of social groups is characteristic of urban locations, and Grist & Toll is, as their masthead says, an "urban flour mill" – the first one in the Greater Los Angeles area in almost 100 years.[24] Started by a baker named Nan Kohler and a screenwriter named Marti Noxon in 2013, and located in Pasadena, Grist & Toll freshly mills California grains to supply both local bakeries and curious home-bakers (*fig. 2.10*). They aspire to bring visibility back into the milling process, and recognize that education is a key component for not only understanding the path from field to bread, but in how to successfully work with the flours.[25] Through collaborations with local

fig. 2.11 **The Michael O'Malley Mobile Oven ("MOMO").**

MOMO was built between 2012 and 2013 and travels to events across southern California, including workshops and community bakes in various settings. The oven is a central component of the artist's interest in social practice, and comes after years of building both temporary and permanent ovens for interactive installations across the country.

fig. 2.12 Community Grains is committed to local food systems in California, and produces "Identity Preserved" pastas and flours.

culinary institutes and the Michael O'Malley Mobile Oven (*fig. 2.11*), they have taught several classes and hosted wood-fired baking events for the community.

Developing relationships at more than just the industry level is what grounds these places and the movement they are collectively working towards. The Bread Lab facility has expanded since its opening to include the King Arthur Flour Baking School, where anyone can register for workshops ranging from advanced sourdough and flatbreads to pasta and scones, and The Mill regularly hosts bread and pizza classes and fundraisers for local community efforts. This engagement in both large and small-scale endeavours pushes toward greater changes in the wheat landscape and plays an active role in the dissemination of knowledge about wheat and bread.

Sliced white bread is often villainized – and for good reason – but, in reality, factory-produced bread has provided food for many people who cannot afford to purchase a healthier option. The war is not against sliced bread specifically, but against the dichotomy that industrialization has created where the cost of real, fresh, healthy bread is prohibitive for many. The model of baking bread in a local communal setting presents an opportunity for reducing the barriers to high-quality bread. The costs of long-distance transportation are eliminated, and the process becomes transparent and accessible to all. The breads baked on site use fresh flour and higher percentages of whole grains, educating people on the merits of healthier eating and of a diverse agricultural landscape. Any leftover bread from community events or workshops can be donated to local food banks, or given away on site. Teaching the skills for baking your own bread, and providing a venue and the equipment to do it, also offers alternative options for those whose only choice is to buy nutrient-lacking bread from the supermarket. Valuing bread and flour as more than commodities – as social and cultural artifacts, and as foods that have a larger impact on our ecological systems – pushes back on the industrial model of growth and production, and allows us to re-examine our priorities when it comes to what we feed ourselves and our families.

LOCAL FOOD SYSTEMS

The changing perceptions and interest surrounding bread are coming at a time when the concept of *local food* is on the rise. There is a desire for food to be grown and purchased close to your home and in the correct season, to support farmers who are testing new models of agriculture, and to understand and be able to trace your food back to its origin. Wheat is undergoing this same sort of renaissance; bakers and consumers want to know what variety of wheat they are using or eating, and where, when, and how the wheat was grown (*fig. 2.12*). The

term *terroir*, a French word that is understood as "the amalgam of environment, technique and tradition that confers unique qualities to products tied to the land,"[26] is typically used to describe and promote wine from various regions, but the same concept is beginning to be applied to wheat. A wheat variety bred for and grown in the climate of Washington State will taste different than one bred for and grown in Ontario, or in Alberta, and the intention of the researchers and farmers who are committed to this work is to have people recognize and celebrate these differences. Bread made with these flours do not taste bland and do not all taste the same – they naturally taste earthy, nutty, sweet, toasted, spiced, grassy, or any combination of these flavours[27] – and the effects of different flours are immediately visible in the colour and texture of the crust and crumb itself.

Beyond the desires for taste and recognition, aspiring towards a local or regional food economy ultimately strengthens food security in the city. Food security – which can be defined as "a situation in which all community residents obtain a safe, culturally acceptable, nutritionally adequate diet through a sustainable food system that maximizes community self-reliance and social justice"[28] – inherently values cultural and social diversity, and the support of local businesses. These systems promote the multi-faceted relationship of cities and their adjacent farmland, while also reducing the burden on distant locations to provide for them (*fig. 2.13*). Not every place can grow vast fields of wheat or dense groves of mangoes, so the reliance on long-distance transport of certain products may always be a reality in our globalized world. For places that do have this ability though, committing to the cultivation of the land around them is key to future sustainability, the reduction of

fig. 2.13 **Flourist flour mill in Vancouver, British Columbia.**

Flourist is "Canada's only source for 100% traceable grains, beans, and freshly milled flours." By working exclusively with Canadian family farms, they aim to promote the high quality of Canadian crops and the importance of regional rather than industrialized farming and market practices. Their website also has a growing list of recipes and tips that provide both instruction on how to use their flours and encouragement to substitute new flour types in everyday use.

food waste, and counteracting the environmentally damaging effects of commodity chains.

The concerns about regional, sustainable agriculture and wheat taste and terroir challenge the embedded narrative of the supermarket, and propose a new set of assemblages that support a local food system (*fig. 2.14*). A case for this diversified infrastructure can be seen in New York City with the Greenmarket Regional Grains Project. In 2009, Greenmarket, who operates more than 50 farmers markets in the city, mandated that bakers must use at least 15% regional flour in their products.[29] By guaranteeing profits and support for farmers and creating a demand for allied small businesses, this model has led to the opening of several new mills and seed-cleaning facilities in the American northeast, and has significantly increased acreage for both new and heritage wheat varieties.[30]

The Regional Grains Project, as well as the other projects described above, show the role that changing perceptions about wheat can play in the larger built environment. Bread-eaters, bakers, millers, farmers, and scientists are all connected to each other, and to the larger agricultural landscape. The relationships of wheat to bread, bread to people, and people back to wheat are all tied together, and this, Martin-McAuliffe argues, "not only affects the quality of the bread we eat, but it also, importantly, has the potential to reshape our productive landscapes."[31] Seemingly small-scale initiatives, like the local communal oven or flour mill, can impact these large-scale changes by increasing awareness of the possibilities of wheat, and by once again creating a significant place for bread in the lives of community members, both on their plates and in the spaces around them.

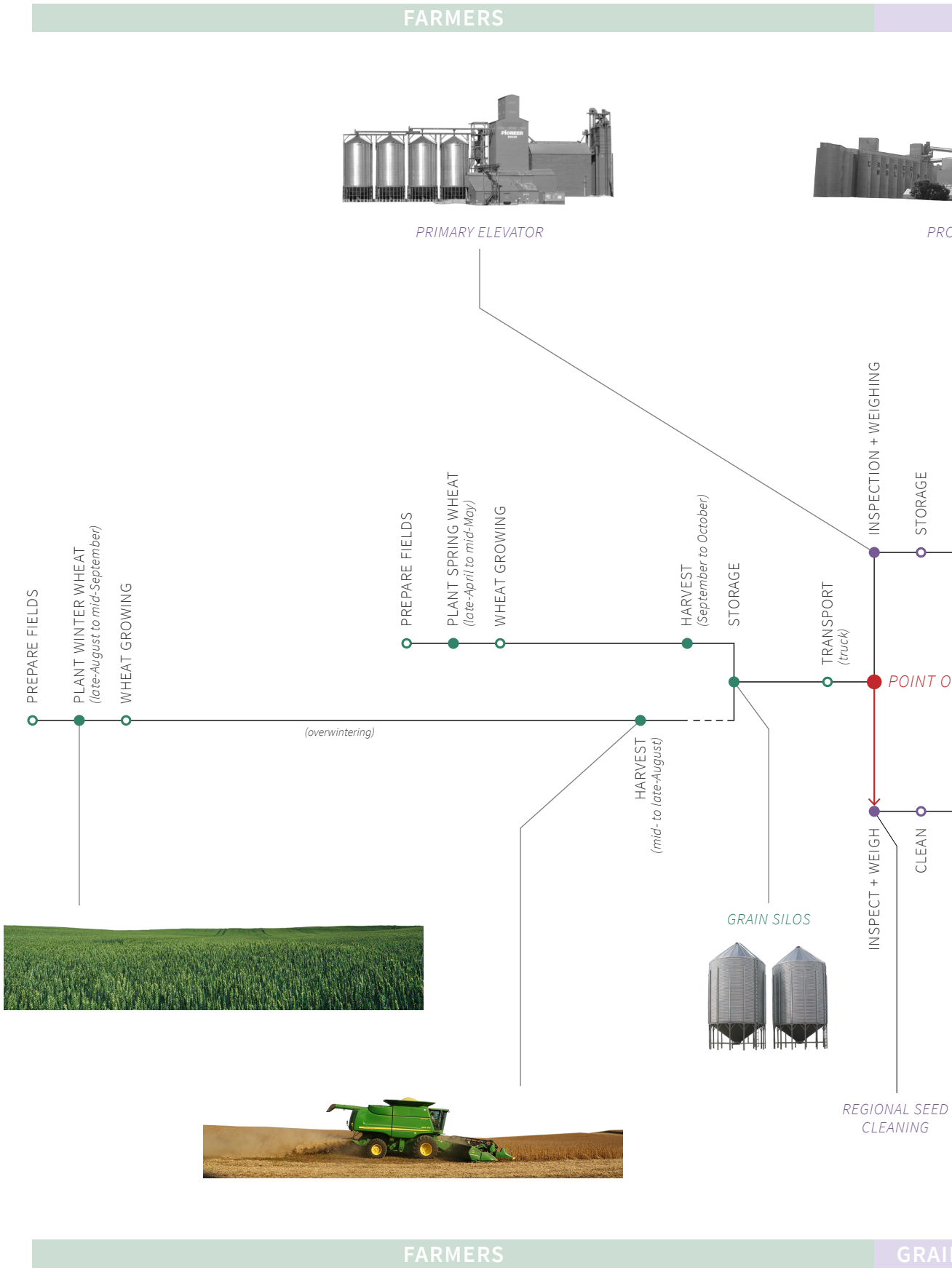
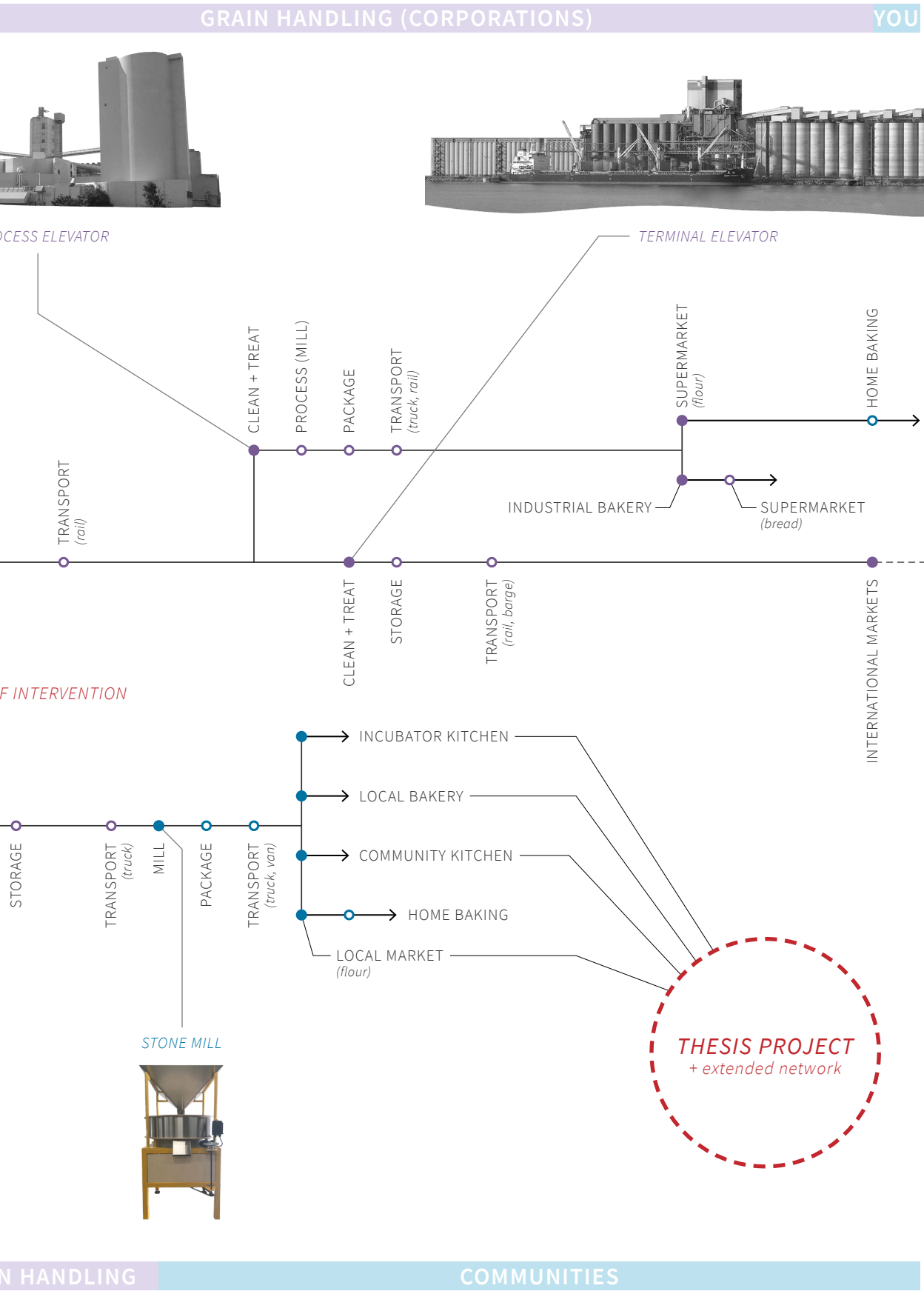


fig. 2.14 **Timeline from wheat to bread.**



This timeline represents two models of production from wheat to bread. The upper path follows the standards of industrial production, where bread and flour are handled by corporations and customer input is non-existent. The lower path challenges this system at the point of intervention. Grains are handled through a regional economy and processed locally into flour and bread with the participation of community members. This alternative model also generates a reciprocal relationship with farmers, and impacts the growth of wheat.

1 Rubel, *Bread: A Global History*, 16.

2 Ibid., 53.

3 Michael Pollan, *Cooked: A Natural History of Transformation* (New York: The Penguin Press, 2013), 226.

4 Ibid., 225.

5 Ibid., 226.

6 Borlaug won the Nobel Peace Prize in 1970 for his contributions to agricultural science and for giving many developing countries the ability to support themselves agriculturally, resulting in countless lives saved. Modern criticisms of these breeds, however, show an increased need for artificial fertilizers, susceptibility to insect infestations, and a lack of biodiversity. See Evan D. G. Fraser and Andrew Rimas, *Empires of Food: Feast, Famine, and the Rise and Fall of Civilizations* (New York, NY: Free Press, 2010), 215, 216.

7 Sharon Rempel, "Red Fife Wheat," *The Canadian Encyclopedia*, last modified March 4, 2015, http://www.thecanadianencyclopedia.ca/en/article/red-fife-wheat/.

8 Ibid.

9 A. H. Reginald Buller, *Essays on Wheat* (New York: The MacMillan Company, 1919), 30-31.

10 As a part of the Slow Food Ark of Taste program, the Red Fife Presidium (the first and only presidium in Canada) was created in 2003 to re-introduce Red Fife wheat into Canadian artisan markets. The Ark of Taste is "an international catalog of foods that are threatened by industrial agriculture, the standardization and large-scale distribution of global food markets, and environmental degradation." See "The Canadian Ark of Taste," Slow Food Canada, accessed August 29, 2018, http://arkoftaste.slowfood.ca/about-the-ark/the-canadian-ark-of-taste/.

11 Arwa Damon and Gul Tuysuz, "Arctic 'Doomsday Vault' Opens to Retrieve Vital Seeds for Syria," *CNN,* last modified October 19, 2015, http://www.cnn.com/2015/10/19/europe/svalbard-global-seed-vault-syria/index.html.

12 Ibid.

13 Pollan, *Cooked*, 228.

14 Ibid., 229.

15 Even historically, whole grain or seeded breads were only consumed by European elites who wanted to stimulate bowel movements, and not for their taste. See Rubel, *Bread: A Global History*, 52.

16 According to author and architect Carolyn Steel, "Food is the most devalued commodity in the industrialised West, because we have lost touch with what it means." From Carolyn Steel, *Hungry City: How Food Shapes our Lives* (London: Chatto & Windus, 2008), 51. We have detached ourselves so far from the actual growth and production of food that we are mostly unaware of the set of complex interactions that must take place to bring it to our plates. Placing greater monetary and psychological value on it can, in turn, place more value on sustainable systems and fair trade with local and global farmers and producers.

17 Beyond the necessary ingredients of flour, water, salt, and yeast, Pollan explains that Wonder Bread produced in the USA contains a number of additional ingredients whose roles include conditioning the dough, justifying health claims, preventing moulding, and masking the taste of the bitter bran (in whole wheat breads) and various chemical additives. See Pollan, *Cooked*, 233-234.

18 The Bread Lab, "About the Bread Lab," Washington State University, accessed September 21, 2017, http://thebreadlab.wsu.edu/about-the-bread-lab/.

19 Other notable breeding programs include the Bauta Family Initiative on Canadian Seed Security, which started in 2013 and is the first of its kind in Canada (see http://www.seedsecurity.ca/en/), and Row 7 Seed Company, which launched in 2018 and is a collaboration between breeders and the award-winning chef Dan Barber (see https://www.row7seeds.com/).

20 Amy Halloran, *The New Bread Basket: How the New Crop of Grain Growers, Plant Breeders, Millers, Maltsters, Bakers, Brewers, and Local Food Activists are Redefining our Daily Loaf* (White River Junction, Vermont: Chelsea Green Publishing, 2015), 103, 97.

21 "Whole/Wild/Wet/Slow/Bold," Josey Baker Bread, accessed November 9, 2017, http://www.joseybakerbread.com/wholewildwetslowbold.

22 "About," Evelyn's Crackers, accessed November 10, 2017, https://evelynscrackers.wordpress.com/about/.

23 Samantha L. Martin-McAuliffe, ed., *Food and Architecture: At the Table* (London; New York, NY: Bloomsbury Academic, 2016), 145.

24 Grist & Toll, accessed August 27, 2018, https://www.gristandtoll.com/.

25 Halloran, *The New Bread Basket*, 114, 117.

26 Nicola Camerlenghi, "Terroir and Architecture," in *Food and Architecture: At the Table*, ed. Samantha L. Martin-McAuliffe (London; New York, NY: Bloomsbury Academic, 2016), 25.

27 Catherine Meng, "Wheat Tasting December 2012," *Community Grains* (blog), last modified February 4, 2013, https://www.communitygrains.com/wheat-tasting-december-2012/.

28 Michael W. Hamm and Anne C. Bellows, "Community Food Security and Nutrition Educators," *Journal of Nutrition Education and Behaviour* 35, no. 1 (2003): 40. https://doi.org/10.1016/S1499-4046(06)60325-4.

29 GrowNYC, "About Greenmarket's Regional Grains Project," GrowNYC – Greenmarket, accessed August 29, 2018, https://www.grownyc.org/grains/about/.

30 Ibid. According to Greenmarket, "Although wheat acreage has more than doubled in size in recent years, demand still outstrips supply." See https://www.grownyc.org/grains/wheretobuy for a map of the farms, mills, and malt houses affiliated with Greenmarket.

31 Martin-McAuliffe, *Food and Architecture: At the Table*, 145.

part three

WATER

WATER

The current relationship between bread and the form of the city seems almost non-existent. Expansive monocultural wheat fields fill the leftover land outside of the city, physically and psychologically disconnected from urban centers (*fig. 3.1*). For the average person, bread is produced in massive quantities on a hidden factory line and purchased at the supermarket. Whether or not the wheat from the nearby fields actually went in to the bread you are consuming is almost impossible to know. City form is determined by zoning ordinances with pre-determined goals in mind, and bread is just another commodity that is trucked in and stocked onto shelves. However, it did not always exist in this subservient role. At its conception, bread was embedded in the construction of cities, and has had economic, political, religious, and sociological implications to the populations of the world throughout history. This has resulted in its impact on the organization and formation of cities, towns, and villages, the buildings and infrastructures required to serve their populations, and the transportation networks needed to link the urban areas and agricultural landscapes together. This long history evokes images of bread once again finding a place in cities today.

fig. 3.1 **Satellite view of Calgary and its surrounding area.**

The developed land of Calgary forms a hard edge against the mosaic of farmland to the north, east, and south of the city. The Rocky Mountains can be seen to the west.

BREAD CITY

The cultivation of einkorn and emmer – the earliest known forms of wheat (*fig. 3.2*) – in the Fertile Crescent as early as 8000 BCE[1] positions wheat amongst the first domesticated plant species, and key to the development of agriculture-based societies.[2] Advancements in agricultural production in this part of the world, primarily through the use of improved irrigation systems, allowed for the stockpiling of surplus grains, and led to the further development of cities like Uruk, established around 4000 BCE and considered by many archaeologists to be one of the first cities. Uruk was a "bread-based city";[3] the temple around which the city was built was central to the organization of labour, farming, and grain distribution, as was the case with many other ancient Mesopotamian and Egyptian cities.[4]

Urbanization, with bread as the driving force, quickly spread throughout Mesopotamia, with wheat later reaching India and parts of China by 5500 BCE, most of Europe by 3000 BCE, east Asia by 2500 BCE, and eventually North and South America during the 16th century CE.[5] It is difficult, however, to determine exactly what types of bread were eaten throughout history. Recipes were typically not written down and most bakers learned through apprenticeship,[6] but the movement of bread to other cultures and regions was likely a result of the fact that sourdough cultures, the standard method of leavening bread for thousands of years, are a shareable and easily transportable ingredient.[7] Their presence throughout history makes it conceivable that, as Michael Pollan suggests, the "microbes [present in sourdough] probably coevolved with us: Their culture depends upon our culture of bread making, and (until recently) vice versa."[8]

fig. 3.2 Einkorn – one of the first varieties of wheat.

fig. 3.3 Map of bakeries in Pompeii.

fig. 3.4 **A historically-used rotary quern (left) and iconic windmill (right).**

Milling technology evolved over time from hand-powered saddle and rotary querns, to animal-driven mills, to water mills and windmills that capitalized on the natural forces present in a given area. Each mill type would have required a different building form, and its location in relationship to the city and bakery would likely vary as well.

The recipe – often called the formula – for a loaf of bread is commonly listed in terms of weight measurements, and is expressed as a percentage of the total weight of flour in the recipe – the *baker's percentage*. For example, 100% flour, 75% water, 2.2% salt, 0.4% instant dried yeast, translates to 500g of flour, 375g of water, 11g of salt, and 2g of yeast. This disposition toward precision in the baking of bread may seem like a modern construct, but actually dates back to ancient Egypt, where workers were paid in loaves of bread, and so the recipe had to be standardized to be used a form of currency; bread was the first regulated food.[9] In ancient Rome, laws were put in place to dictate the size and cost of bread, as well as what could be put into it.[10] Mandatory grain distributions for certain Roman citizens[11] could have lead to the professionalization of bread-baking and the prevalence of bakeries, mills, and granaries in the city.[12]

The natural properties of wheat – the unsaturated omega-3 fats in the germ – make whole wheat flours prone to oxidization and therefore unable to travel long distances before starting to go bad. This fact, combined with the historical lack of sifting technology to be able to remove the germ from the flour, meant that every city needed its own mill, or several, to be able to sustain its population.[13] Excavations in Pompeii, a city that likely had a population of about 10,000 people at the time of the eruption of Mount Vesuvius in 79 CE, reveal a city with more than 110 mills in as many as 30 bakeries (*fig. 3.3*).[14]

The development of larger millstones and kneading machines, which were often powered by donkeys or horses, increased the output of these bakeries, but meant that animals that typically resided on farms outside of the city center now needed a place in the city as well, likely in nearby stables.[15] The later invention of water-driven mills, which could serve between 320 and 690 people – compared to the millstones of Pompeii which served 90[16] – strengthened the desire for cities to be located near water sources. Aqueducts were expensive, however, and where natural slopes from water sources were not available, mills made use of the waste water from other sources, as evidenced by excavations at the Baths of Caracalla in Rome.[17] Prior to this, milling and baking took place within the same building, but the efficiency of the water mills led to a separation of the two processes (*fig. 3.4*).[18] The use of water-powered mills continued worldwide into at least the 19th century, and is still used on a small scale in places like Morocco today.[19]

The regulation and prevalence of bread continues into the Middle Ages. From the 13th to the 19th century in England, a law called the "Assize of Bread and Ale" was in place that mandated a fixed price for a loaf of bread. As the price of wheat increased, the size of the loaf was reduced (and vice versa), but the price remained the same, maintaining the earnings per loaf for bakers.[20] Bakers and millers were often treated with suspicion, since it was difficult to know what went into a loaf of bread once it was purchased in its baked form.[21] The Assize

fig. 3.5 **Development along the St. Lawrence Seaway.**

The Thunder Bay grain terminal (top) connects the Great Lakes and Western Canada to the St. Lawrence Seaway.
Quebec City (bottom) developed adjacent to the river. The Port of Quebec exists a short distance to the north of this view and has another large grain terminal.

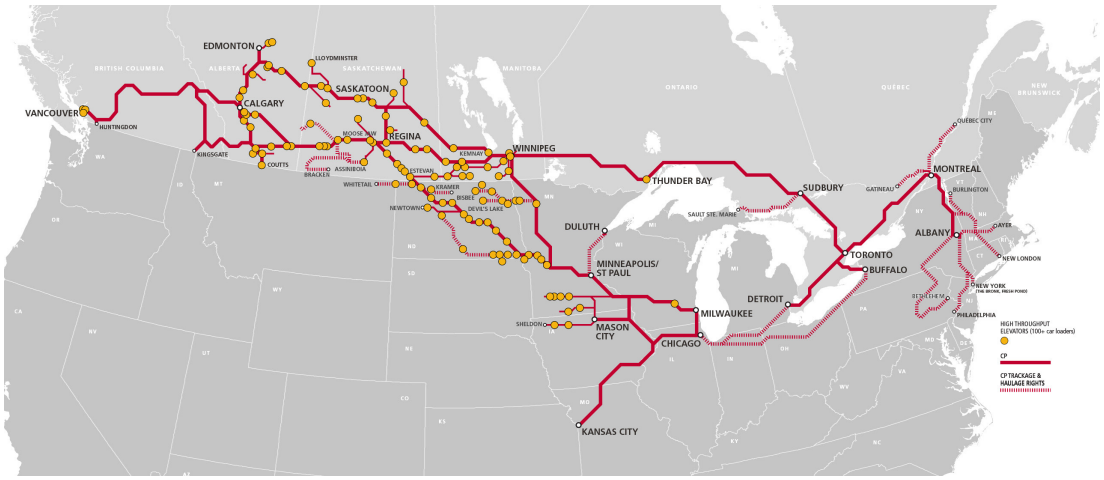


fig. 3.6 The Canadian Pacific Railway connects the wheat-growing regions of both Canada and the USA to major ports and other distribution networks.

of Bread, and the order by King Edward I in 1302 that bakers in the area could no longer sell bread from their homes or bakeries, but had to sell them in the city bread market,[22] were attempts at preserving the sanctity of bread as a staple food. This bread market was located on the aptly named Bread Street near the center of London.[23] In other cities, there was a concern for the potential fire risk that bakeries posed to the increasingly dense urban areas, so bread baking was pushed out to the edges. In Medieval Dublin, bakers and cooks were located on Cook Street outside of the north wall of the city and close to the river.[24] This placed the bakeries closer to not only the crucial bread ingredient – and fire-retardant capabilities – of water, but to the farmland that would have supplied wheat to the city.

The distance that grains had to travel from farms to bakeries and mills was a limiting factor for the size of pre-industrial cities. Grains are heavy, prone to rot and weevil infestation, and difficult to carry long distances on land.[25] Therefore, as Carolyn Steel suggests, "[a] day's journey by cart, a distance of around 20 miles [(32 kilometres)], was the practical limit for bringing in grain overland, which limited the width of the city's arable belt."[26] Proximity to a river – as a means for increased speed and volume of transportation – could increase the extent of this arable belt, but contemporary lack of shipping technology also increased the risk of water damage. Waterways were, nevertheless, an efficient means of transportation for grains, and triggered the construction of large infrastructural projects in North America.

The Erie Canal opened in 1825 and connected Buffalo and the Great Lakes to Albany and the Hudson River. The massive construction project – 83 locks over a distance of 363 miles (584 kilometres) – linked the fertile agricultural land of southern Ontario and western New York to the more densely populated east side of the state.[27] One of the first major promoters for the Erie Canal was Jesse Hawley, a flour merchant who, while serving time in debtor's prison from 1807 to 1808, wrote a series of essays detailing how the canal could be built and its imminent benefits to farming and industry.[28] After its opening, transportation costs dropped by 90%, and New York City quickly surpassed Philadelphia and Boston as the primary port city in the United States, with wheat and flour as its top exports.[29]

In Canada, the St. Lawrence Seaway (*fig. 3.5*), which opened in 1959, also serves as a major route for wheat exports – the other important exporters today being the Port of Vancouver and the Port of Prince Rupert in British Columbia. By 1966, shortly after its opening, approximately 50% of Canadian wheat moved through the St. Lawrence Seaway, with 90% of that destined for countries overseas.[30] The importance of this shipping route lead to the further development of the port cities along its path, including Montreal and Quebec City, and likely the addition of grain elevators and the small towns that were needed to support them.

fig. 3.7 Wooden grain elevator in Azure, Alberta.

fig. 3.8 Concrete grain elevator in Chicago, Illinois.

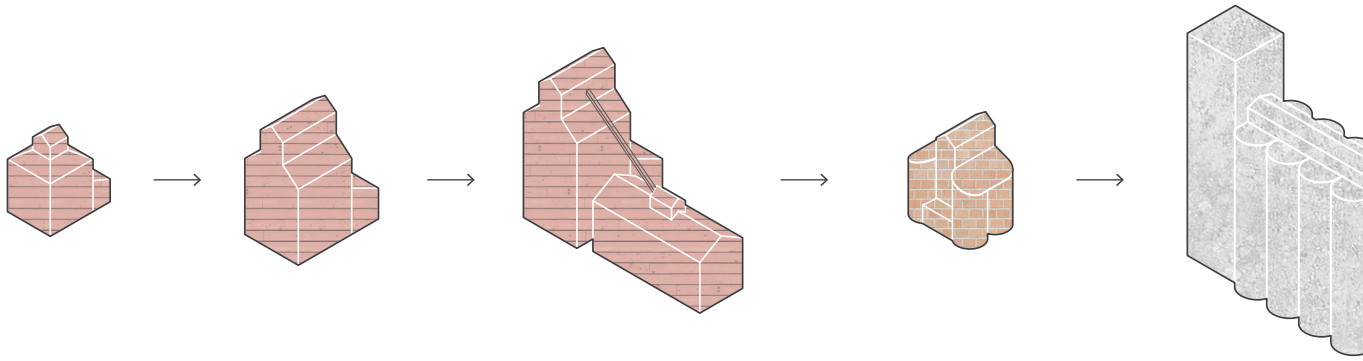
The Canadian Pacific Railway was constructed to link these areas to Western Canada, where wheat was, and still is, grown in abundance (*fig. 3.6*). Grain elevators could be found beside railway tracks as frequently as every 12 kilometers, and in 1933, there were as many as 5758 grain elevators in Canada.[31] They marked the location of Prairie towns – earning them the nickname of "Prairie sentinels" (*fig. 3.7*) – and multiple grain elevators in one community signalled a thriving local economy and fertile farm land.[32] The wheat industry was a clear economic generator, and the required adjacency of grain elevators to the railway would have influenced the site selection and distribution of new towns and villages.

Due to the industrialization of flour and consolidation of the processing of grains by large companies, many grain elevators have been abandoned or demolished. By 2009, the number of grain elevators in Canada had dropped below 400.[33] Industrialization has also resulted in the changing material, size, and form of grain elevators. The buildings were initially constructed out of wood, but as requirements for increased storage capacity and concerns about flammability and moisture control became more prominent, the materiality shifted to hollow clay tile, and finally to concrete (*fig. 3.9*). Changing building technologies also allowed the elevators to become much larger, and iconic pitched roofs quickly crumbled away to make room for rows of enormous cylindrical silos. Flour mills gave up on their stone milling past to embrace mechanization as well, following the formal and material evolution of their grain elevator partners.

These new forms are what caught the attention of international architects. In 1913, Walter Gropius published an article about the architecture of industrial buildings, extolling the virtues of the North American grain elevators and silos by emphasizing their monumentality and lack of traditional ornamentation (*fig. 3.8*).[34] Le Corbusier echoes these sentiments in his 1923 book *Towards A New Architecture*, calling grain elevators the "magnificent first-fruits of the new age," and praising them for their use of "primary forms" – cones, spheres, cylinders, and pyramids – which he saw as critical components for a modern architecture.[35] The users of these grain elevators were likely more concerned with functionality than with form or design in architectural terms, but this sense of monumentality and the importance of the buildings to the historical economic growth of Canada has retained them as symbols of Canadian agriculture.

fig. 3.9 **Formal and material evolution of the primary grain elevator.**

Primary grain elevators are typically the first stop for grains harvested by farmers. These elevators are smaller in scale and more numerous than process or terminal elevators (which appeared as a result of industrialization), and thus their development over time is more discernible.



WOOD PYRAMIDAL PLAN ELEVATOR

WOOD STANDARD PLAN ELEVATOR

WOOD STANDARD PLAN ELEVATOR WITH *WOOD* ANNEX

HOLLOW CLAY TILE/BRICK ELEVATOR AND BINS

CONCRETE ELEVATO BINS

Wooden grain elevators gradually increased in size as wheat production in Canada grew, and eventually additional storage annexes were built.

Hollow clay tile and brick elevators were only constructed in certain regions, but are seen as an intermediary step in the transition to concrete as the primary building material.

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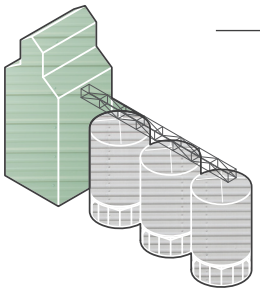
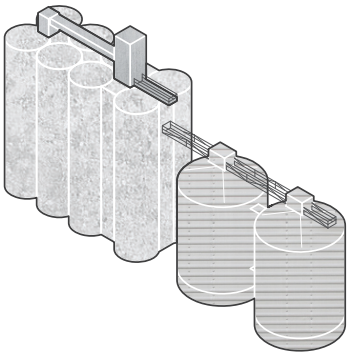
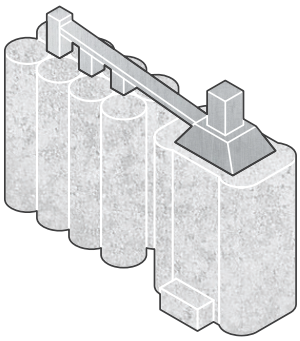


WOOD/METAL STANDARD PLAN ELEVATOR WITH *STEEL* BIN ANNEXES

CONCRETE ELEVATOR WITH *STEEL* BIN ANNEXES





CONCRETE ELEVATOR WITH *CONCRETE* BIN ANNEXES

Steel bin annexes were added to existing wooden elevators to increase their storage capacity. Some newer elevators mimicked the form of the older gabled ones, but were built with metal siding and structures rather than wood.

Modern grain elevators have expanded significantly in scale, and are built out of concrete with either steel or concrete bin annexes.

The commodification of flour and bread that changed the siting of the grain elevator has also impacted the relationship of the bakery to the city. While the scale of the bakeries in ancient Rome could characterize them as the factory bakeries of their day, they did still exist in the city centre, able to be seen, smelled, and acknowledged by the city's residents.[36] Constructed adjacent to the *horrea* (grain storage buildings), they created important civic areas centred around bread.[37] Late-20th century and modern factory bakeries do not offer this same possibility for recognition. They are slotted into generic factory buildings in industrial parks, and exist at the edges of cities to maximize their footprints and access to transportation networks and minimize their visibility; the bread goes directly from the factory to the supermarket in an entirely hidden industrialized chain.

The emergence of bakeries and mills like those described in the previous chapter, on the other hand, are creating new relationships by referencing old ones, and making the bread-baking process visible again. They wish to embed themselves in cities in the same way that the bakeries of the past did, and rely more directly on the communities and businesses around them. In the Middle East in the Middle Ages, bakeries, both privately-owned and those with communal ovens, were located near churches, gardens, and public baths, grouped together with other important urban spaces.[38] Now, in places like Beirut where the culture of street food is very strong, the baker, the butcher, and the *fawwal* (maker of stewed chickpeas and fava beans), exist in a symbiotic relationship that enriches urban street life and the food itself (*fig. 3.10*).[39] These types of adjacent and interdependent functions are part of what has solidified bread's physical place in cities throughout history, and are key to re-establishing its prominence.

fig. 3.10 Kaak is a Lebanese bread often coated in sesame seeds and filled with za'atar. Cart vendors pick up the bread from bakers, and sell them on the streets throughout Beirut.

CALGARY, ALBERTA

Calgary, the largest city in the province of Alberta, sits within the bountiful wheat-filled landscape of the Canadian Prairies. Alberta itself plants wheat on over 7.5 million acres (over 3 million hectares) of land, and is responsible for approximately 35% of all wheat production in Canada (*fig. 3.11*).[40] Canada, in turn, is a top exporter for wheat worldwide, behind only the United States of America and Russia.[41]

Though Calgary is now primarily known for its role in the oil and gas industry, its foundation and growth is owed to the expansion of the Canadian Pacific Railway (CPR) through the western provinces. It was established as a North West Mounted Police fort in 1875, with the railway constructed through the area in 1883, and finally incorporated as a town in 1884.[42] By the early 1900s, wheat cultivation in Alberta was still in its infancy,[43] but strong global wheat prices and a demand for cattle, combined with the aspirations of the CPR, led to investment in these agricultural industries and significant growth in the city.[44]

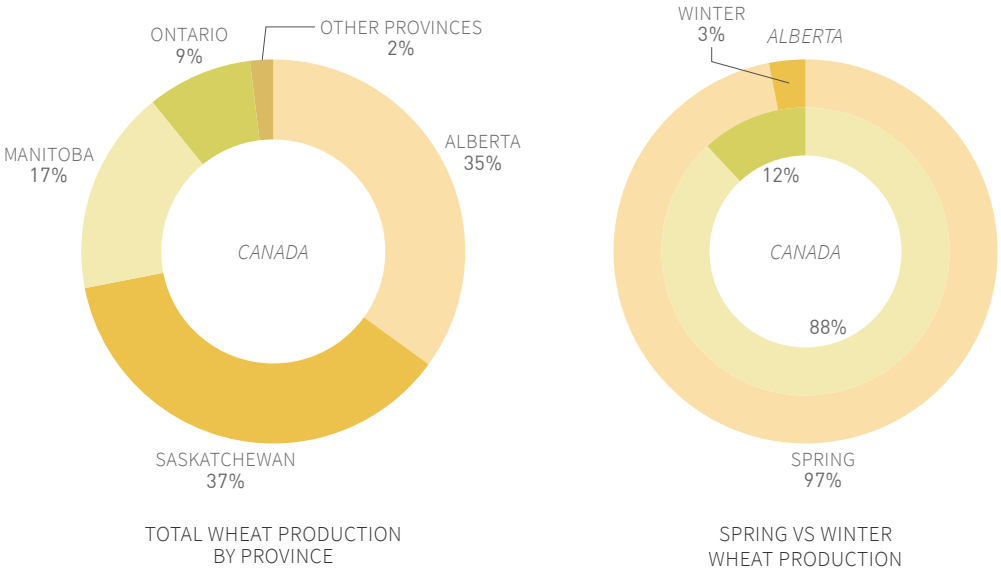


fig. 3.11 **Wheat production in Canada and Alberta (average from 2014-2018).**

The Prairie provinces account for approximately 89% of all wheat production in Canada, and 98% of spring wheat production. Due to the colder climate of the Prairies, spring wheat is more commonly planted than winter wheat, even though the yields are generally less. In Ontario, these numbers are reversed: 93% of wheat planted is winter wheat.

fig. 3.12 Postcard depicting the Calgary CPR station and railway gardens.

The railway station was the first space that visitors and newcomers to Calgary would have experienced, and was the social and economic centre of the town (*fig. 3.12*). The Grain Exchange Building, built in 1909 and located adjacent to the railway station, was one of two buildings at the time that were permitted to surpass the building height restriction of six storeys.[45] The proximity of this building to the railway station suggests the early importance of wheat to the city, and though the local industries shifted to focus on oil and ranching, the building remains as a testament to wheat's significance and possible future.

Oil was first discovered in Alberta in the Turner Valley, 60km south of Calgary, in 1914, and it quickly became the primary industry in Calgary. Following the two World Wars, planning strategies of zoning and urban renewal, propelled by the wealth from the oil industry, generated the sprawling single-family low-density suburban form that Calgary is known for today (*fig. 3.13*). Cars became the primary mode of transportation, investment in public transit declined, and the downtown area became an office and commercial district devoid of any desirable pedestrian experience (*fig. 3.14*). Much of the Inner City's building history was also erased for the sake of "progress," replacing the varied grain and density of the original building construction with "superblocks," further diminishing the possible diversity and experience of the street life.[46]

The old CPR station and railway gardens – the historical entry point to the city – were eventually replaced by one such superblock, consisting of indoor commercial and office space, an apartment building, and the Calgary Tower. As Beverly Sandalack, an urban design professor at the University of Calgary, laments, "The new buildings created a broad barrier between the downtown and the areas to the south, and the symbolism of the station and garden were lost along with the public nature of the building."[47]

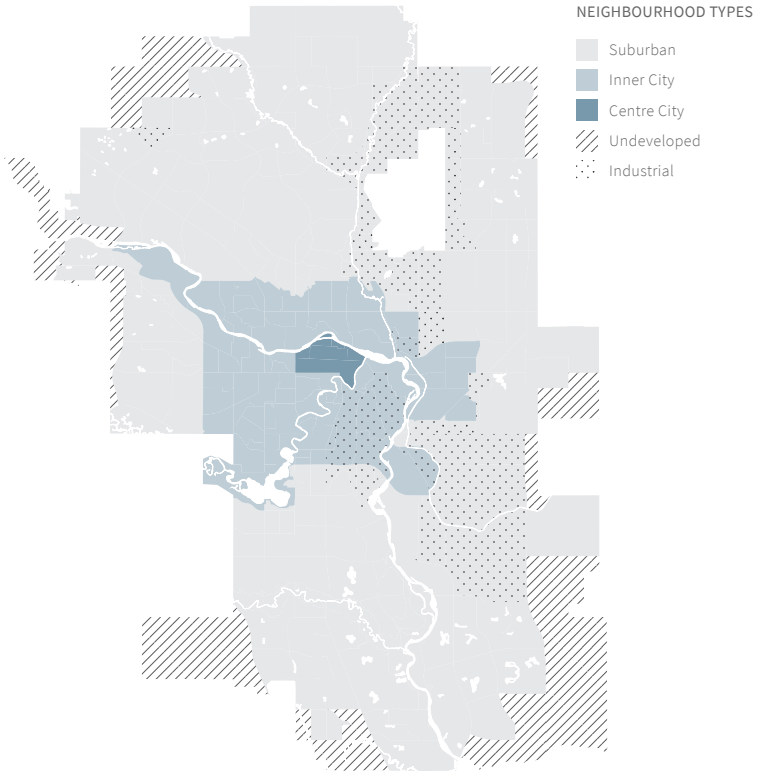


fig. 3.13 The distribution of neighbourhood types in Calgary shows a primarily suburban fabric.

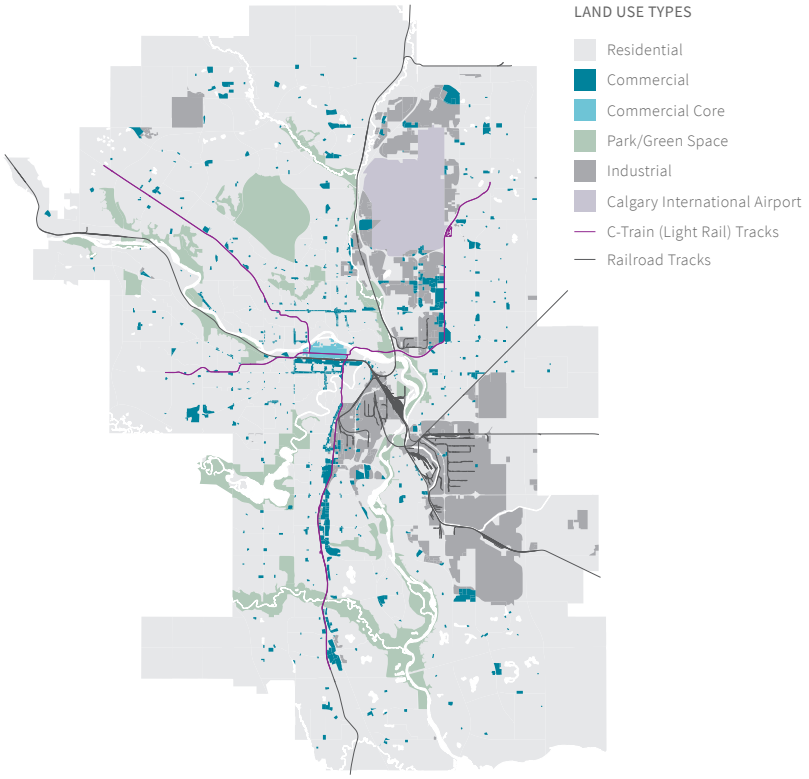


fig. 3.14 Land use divisions in Calgary.

The City of Calgary is beginning to recognize the importance of investment in public spaces. Revitalization and development plans for riverfront green spaces, the "Main Street" program, expansion to the CTrain (Calgary's light rail transit system), and increased density in various neighbourhoods, especially in the Inner City, are working towards goals of a more pedestrian-oriented and mixed-use city.

The Beltline, south of the downtown area, has the highest population and is one of the most densely populated neighbourhoods in Calgary. It is bounded by the railway tracks to the north, the Stampede grounds to the east, the active retail-focused 17th Avenue SW to the south, and 14 Street SW to the west. It contains a mix of cultural, commercial, residential, and park spaces, and is currently a focal point for new construction projects in the city. It has a relatively high percentage of immigrant population compared to other neighbourhoods in Calgary: 30% immigrant and 5% non-permanent residents in 2016 (*fig. 3.15*).[48] This likely due to the variety of housing types and assistance programs, and its proximity to the downtown core and public transit.

These numbers are likely to increase as more people immigrate to Canada and choose to make Calgary their home. Calgary will need to continue to develop the social and cultural programs and spaces that support this growth and diversity. The communal ovens and mill proposed by this thesis aim to address this future, with the Beltline neighbourhood targeted as the initial seed for change.

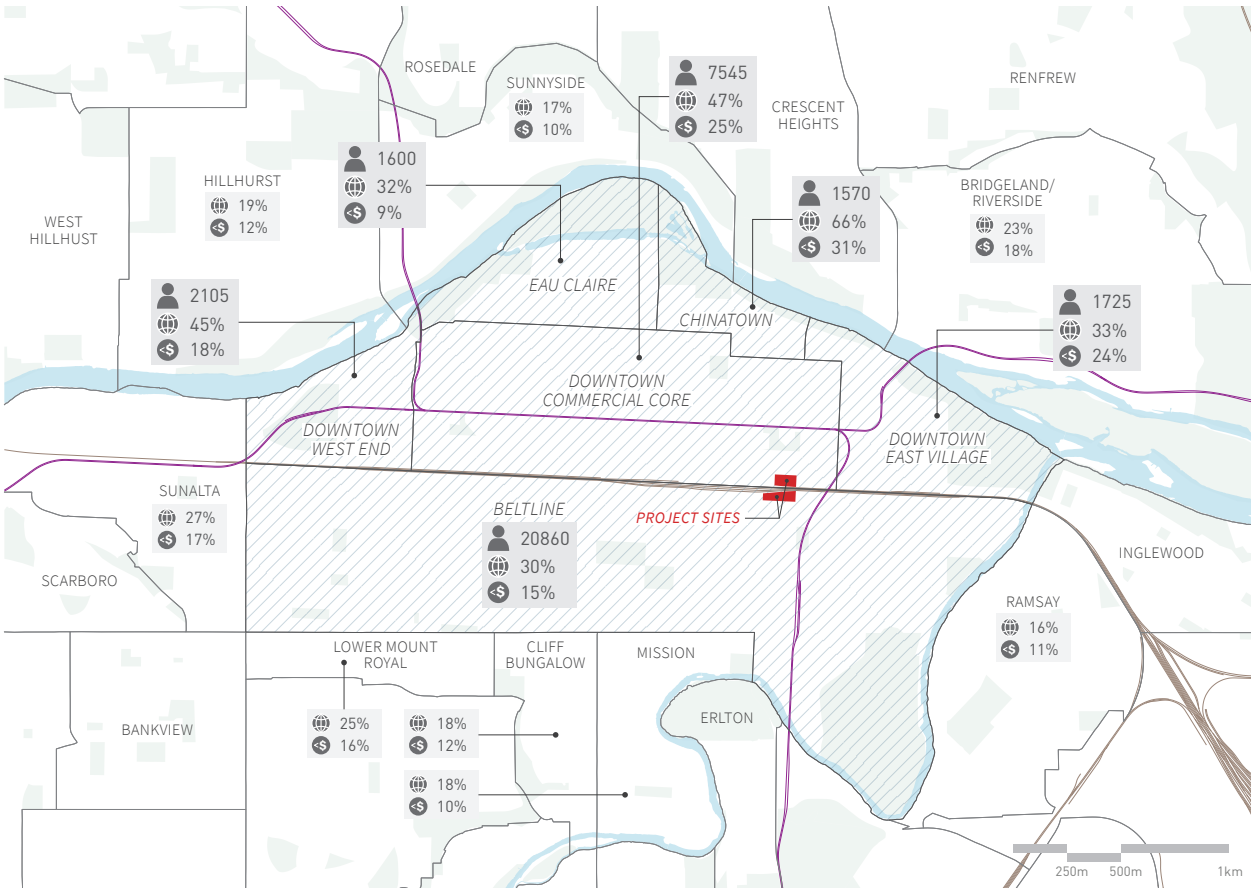


fig. 3.15 **Total population, immigrant population percentage, and percentage with low-income status for Calgary's Centre City and surrounding neighbourhoods.**

The Centre City neighbourhoods (shown hatched) have significantly higher immigrant and low-income population percentages than the surrounding neighbourhoods. While Northeast Calgary is also home to a large immigrant community, the high population density, central location, and adjacency to other communities in need make the Beltline particularly suitable for the primary thesis intervention.

A NETWORK OF BREAD

The story of bread and its historical impact on the city point to the ways in which it can reacquire a higher level of importance in cities like Calgary today. Moving forward with new technologies and information, but also acknowledging its past, communities can once again celebrate the culture and role of bread in the city, and reap the benefits that come from this care and physical presence. Creating an urban *network of bread* involves not just the opening of local bakeries and communal ovens, but also the larger infrastructure needed to support greater changes to the system.

Mills are a part of this larger system, but so are the intermediary facilities between the farm and the mill, bakery, or communal kitchen. As Amy Halloran, a food and agriculture writer, advises, "Regional farming needs the stepping-stone facilities for processing, handling, and distribution that make the national and international food systems function."[49] For grains, this includes seed-cleaning, research institutes like the Bread Lab, seed incubators or greenhouses, malthouses and breweries that also focus on local grains, grain markets, and storage. Each of these programmes can occupy different areas of the urban and rural landscapes, serving specific neighbourhoods or whole cities, and cater to varying levels of engagement with the local grain movement. They collectively establish a significant place for bread in the city, and a requirement to incorporate their functions into future city planning.

Sufficient storage plays an important role in the use of local grains and freshly milled flour. Wheat is typically harvested in September and October in the more northern climate of the Prairies, but bread is consumed year-round. While whole kernels can be stored for an extended period when kept in the correct conditions – cool and dry – freshly milled flours have a much shorter shelf-life, especially compared to their industrialized counterparts. For the use of fresh regional flour to be feasible, grain storage must be located nearby and be easily accessible. Flour, then, can be treated with the same care as any other perishable local produce.

The rise in bakeries investing in their own stone mills to address this concern for freshness led to the formation of the New American Stone Mills company in 2015 by Andrew Heyn, owner and baker at Elmore Mountain Bread in Vermont (*fig. 3.16*). Their mills are hand-made in Vermont, with barre granite stones from local quarries.[50] The company represents a commitment to "local" at all levels of the bread-making process, and the need for varying scales and types of businesses to help propel local systems forward.

Urban grain storage, mills, and communal ovens can also generate related economic growth for the city. Kitchen incubators, where commercially certified and inspected kitchen space is rented out to small businesses to produce their goods (*fig. 3.17*), can tap into the resources

fig. 3.16 **A 26” mill made by New American Stone Mills (left) and a granite millstone (right).**

The company also produces mills with 40” or 48” stones that have higher flour outputs.
The iconic primary forms of these small-scale mills may have appealed to Le Corbusier in a similar way to the industrialized behemoths that he observed.

fig. 3.17 **Forage Kitchen is a kitchen incubator in Oakland, California.**

In addition to commercial kitchen equipment, supplementary programmes help to ensure the success and relevance of kitchen incubators. Forage Kitchen has an event space and storefront cafe, while other incubators may have co-working spaces, business support and mentorship, or market and grocery store access. Many programs choose to focus their efforts on immigrants, women, and people of colour.

provided by the network. The relatively low-cost and low risk setting encourages a diversity of food businesses and provides a possible means for the economic participation of new immigrants, as well as access to larger markets. These businesses can later open their own storefronts in other neighbourhoods of the city or create demand for more local markets to sell their products, driving further changes to the urban and suburban fabrics.

There is also the opportunity to connect with existing food access organizations in the city. Baking or culinary schools and public cooking workshops can reinforce education surrounding wheat and local food systems. Food banks can start Community Supported Bread (CSB) programs that use volunteer help to provide for those that have physical or other barriers to participation at the communal ovens.[51] Each of these initiatives contribute not only to economic development and food security in the city, but also to a more culturally and socially diverse experience.

In combination with the communal ovens and the existing agricultural land outside of the city, the proliferation of these bread-focused programmes sets up the potential benefits of a presence of wheat in urban areas. Wheat in the city is not entirely unprecedented in the modern era. In 1982, the conceptual artist Agnes Denes planted a two-acre field of wheat in the Battery Park landfill in New York City as a part of an installation called "Wheatfield – A Confrontation" (*fig. 3.18*). The seeds were sown in May, and 1000 pounds of wheat were harvested in August of the same year. The wheat was planted on land that far outweighed the value of the crop that was harvested, and this, as Denes explains,

> created a powerful paradox. Wheatfield was a symbol, a universal concept; it represented food, energy, commerce, world trade, and economics. It referred to mismanagement, waste, world hunger and ecological concerns. It called attention to our misplaced priorities.[52]

These questions continue to be relevant today as we struggle to feed the world's rising population, and the concerns surrounding ecological sustainability are increasingly paramount.

A second iteration of "Wheatfield" was created to coincide with the Universal Exposition in Milan in 2015, whose theme was "Feeding the Planet, Energy for Life." 5 hectares (approximately 12 acres) were planted with the help of the public, and later harvested by both tourists and locals as a part of a harvest celebration (*fig. 3.19*). A combination of historical and modern harvesting techniques were used, and visitors took home a bundle of wheat and a bag of seeds.[53] The project created a novel and changing, albeit temporary, urban park for the locals, and reinforced the role of food education and community engagement in the landscapes that feed us.

fig. 3.18 Agnes Denes standing in the wheat field of her New York City installation.

Planting seeds

Wheat growing

Experience of space

Mature wheat

Harvesting

Distribution

fig. 3.19 **Agnes Denes' 2015 iteration of "Wheatfield" in Porta Nuova, Milan was larger in scale and more interactive for the public.**

fig. 3.20 **Maine Grains, a flour mill and seed cleaner in Skowhegan, Maine.**

The silos and dust suppression system are removed from their rural and industrial settings, respectively, and their meanings are altered in the context of a project focused on community growth and connections to the region's grain economy.

In Calgary, a research facility or grain market on an adjacent site could promote the education of wheat varieties to the public, and, through the actual planting of these varieties, create small but impactful experiential moments through a transforming natural landscape in the city. The infrastructures that will be necessary for Calgary to realize its urban farming ambitions will also serve to support these planted areas.[54] Though the spaces are not intended for harvesting wheat at the scale of the rural farm, they can connect farmers, scientists, and residents more directly, and propel the goals of a local system for bread forward.

The programmes for a new network of bread can also create recognizable landmarks that signal their location in the city (*fig. 3.20*). Just as the grain elevator once marked active communities on the Prairie landscape, new forms can create visual associations with these places of culture, diversity, social interaction, and knowledge. The smells of wood being burned for the communal ovens and of freshly baked bread also re-enter the city, creating invisible trails for citizens and powerful memories of place. Silos challenge the typical imagery of urban life, smoke from the ovens rise above local parks, and fields of wheat sway and rustle in the wind near city sidewalks.

The presence of these forms and their inherent connectivity can influence future urban planning, inform the use of public space, and re-establish the interdependence of urban and agricultural land. Their physical, atmospheric, and social impacts exist across a range of scales, and are integral to the reintegration of bread into our cities.

ENDNOTES

1 Francisco Migoya and Nathan Myhrvold, *Modernist Bread, vol. 2, Ingredients* (Bellevue, Washington: The Cooking Lab, 2017), 90. The Fertile Crescent region includes modern-day Iraq, Israel, Syria, Lebanon, Jordan, and parts of Egypt, Turkey, and Iran.

2 Agricultural land was crucial to the functioning of cities, and was seen as equally significant to the more urban architectural forms and streetscapes. The concept of land as a commodity, as something to be owned and controlled, began quite early, with Sumerian elites owning swaths of farmland outside of the city, which they then leased out to farmers. See Steel, *Hungry City,* 16, 18. This propensity for control over nature has continued into the present day, but the perception of agricultural land as having equal importance to urban land, at least for city-dwellers, has generally disappeared.

3 Rubel, *Bread: A Global History*, 22-23, 11.

4 Steel, *Hungry City*, 76.

5 Migoya and Myhrvold, *Modernist Bread, vol. 2, Ingredients,* 90.

6 Barry and Turkell, interview with Migoya and Myhrvold, "Episode 1: Pre-Ferment."

7 Rubel, *Bread: A Global History*, 17.

8 Pollan, *Cooked*, 196.

9 Barry and Turkell, interview with Migoya and Myhrvold, "Episode 1: Pre-Ferment."

10 Ibid.

11 Jan Theo Bakker, *The Mills-Bakeries of Ostia: Description and Interpretation*, eds. H. W. Pleket and Meijer, F J A M (Amsterdam: J.C. Gieben, 1999), 13-14. These grain rations were, however, only given to a "privileged group of free adult males" (see Steel, *Hungry City,* 77) – unsurprising considering the large population and economic disparity of Rome at the time.

12 Barry and Turkell, interview with Migoya and Myhrvold, "Episode 1: Pre-Ferment."

13 Pollan, *Cooked*, 224.

14 Bakker, *The Mills-Bakeries of Ostia*, 11-13.

15 Ibid., 5, 7.

16 Ibid., 111.

17 Ibid., 9-10.

18 Ibid., 4.

19 Barry and Turkell, interview with Migoya and Myhrvold, "Episode 1: Pre-Ferment."

20 Rubel, *Bread: A Global History*, 46.

21 Pollan, *Cooked*, 223.

22 John Noorthouck, "Bread Street Ward," in *A New History of London Including Westminster and Southwark* (London: R Baldwin, 1773), 558-560. http://www.british-history.ac.uk/no-series/new-history-london/pp558-560.

23 Ibid.

24 Máirtín Mac Con Iomaire, "The Gastro-Topography and Built Heritage of Dublin, Ireland," in *Food and Architecture: At the Table*, edited by Samantha L. Martin-McAuliffe (London; New York, NY: Bloomsbury Academic, 2016), 73.

25 Steel, *Hungry City,* 67.

26 Ibid., 70.

27 "History and Culture," Erie Canalway National Heritage Corridor, accessed September 3, 2018, https://eriecanalway.org/learn/history-culture/.

28 Halloran, *The New Bread Basket,* 25-26.

29 Ibid., 29.

30 Leon P. Sydor, "The St Lawrence Seaway: National Shares in Seaway Wheat Benefits," *The Canadian Journal of Economics* 4, no. 4 (1971): 544-545, http://www.jstor.org/stable/133552.

31 Jane Ross, "Grain Elevators," *The Canadian Encyclopedia*, last modified April 24, 2015, http://www.thecanadianencyclopedia.ca/en/article/grain-elevators/.

32 Patricia Vervoort, ""Towers of Silence": The Rise and Fall of the Grain Elevator as a Canadian Symbol," *Histoire Sociale/Social History* 39, no. 77 (2006): 182.

33 2009 saw the lowest number of grain elevators in Canada at 386, but increased to 424 elevators in 2018. These new grain elevators were almost certainly of concrete construction, as are many of the remaining elevator stock. See "Total number and capacity of all grain elevators by crop year, 1962 to current crop year," Canadian Grain Commission, accessed August 1, 2018, https://www.grainscanada.gc.ca/application/GEICOWeb/GEICOHistoricalSummariesReport-en.

34 Vervoort, *"Towers of Silence": The Rise and Fall of the Grain Elevator as a Canadian Symbol*, 189.

35 Le Corbusier, *Towards A New Architecture* (New York: Dover Publications, 1986), 31, 29.

36 See Bakker, *The Mills-Bakeries of Ostia*, 114-115 for plan of Ostia with locations of bakeries, grain storage, and millstones indicated.

37 Ancient civilizations recognized the critical role of a substantial and accessible grain supply. The large horrea and extensive temple granaries exemplified the idea that "[g]rain was more than just food … it was wealth," and adequate supplies stifled political unrest, at least to a point. See Steel, *Hungry City,* 77. Lack of grain storage in the modern world can have equally detrimental effects. In 2012 in India, millions of tons of wheat rotted in the open air, left there for almost a year because the country's warehouses were already at capacity. See Nirmala George, "India's Wheat Left to Rot due to Lack of Storage," *The Toronto Star,* May 10, 2012. https://www.thestar.com/news/world/2012/05/10/indias_wheat_left_to_rot_due_to_lack_of_storage.html.

38 Annia Ciezadlo, "Bread of Beirut," *Granta* 120, August 2, 2012, https://granta.com/bread-of-beirut/.

39 Ibid.

40 Wheat production percentages are based on the average values for spring and winter wheat from 2014-2018. These values do not include durum wheat production. See Statistics Canada, "Estimated areas, yield, production, average farm price and total farm value of principal field crops, in metric and imperial units," Statistics Canada Table 32-10-0359-01, accessed April 27, 2019, https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3210035901.

41 "Market Information – Supply & Demand," *International Grains Council,* accessed September 7, 2018, http://www.igc.int/en/markets/marketinfo-sd.aspx.

42 Beverly A. Sandalack, *The Calgary Project: Urban Form/Urban Life* (Calgary, Alberta: University of Calgary Press, 2006), 6-7.

43 Buller, *Essays on Wheat*, 35.

44 The population grew from 4000 in 1900 to 50000 by the start of World War I in 1914 due to the promise of agriculture on the Prairies. See Sandalack, *The Calgary Project,* 11.

45 Sandalack, *The Calgary Project,* 20.

46 Ibid., 125.

47 Ibid., 114.

48 The Calgary Community Profiles compile demographic and household information obtained from the 2016 Census of Canada. See "Community Profiles," The City of Calgary, accessed April 28, 2019, http://www.calgary.ca/CSPS/CNS/Pages/Research-and-strategy/Community-profiles/Community-Profiles.aspx.

49 Halloran, *The New Bread Basket,* 56.

50 "About," New American Stone Mills, accessed September 4, 2018, https://www.newamericanstonemills.com/about-us/. The company was created in collaboration with Fulton Forde of Boulted Bread in North Carolina, but is now operated solely by Heyn.

51 Community Supported Bread (CSB) programs follow the model of Community Supported Agriculture (CSA) programs that are on the rise for city-dwellers who want consistent and easy access to local food. In CSBs, community members make a commitment to purchasing a desired number of bread shares (typically one every week, two weeks, or month) from a local bakery for a certain number of months (often 3-6 at a time). This upfront funding guarantees initial capital and income for the bakery, and allows them to invest in better equipment and higher quality ingredients. It also creates a strong mutually-beneficial relationship between bakers and community members.

52 Agnes Denes, "Wheatfield – A Confrontation: Battery Park Landfill, Downtown Manhattan," Agnes Denes, accessed September 1, 2018, http://www.agnesdenesstudio.com/works7.html.

53 Shuhei Senda, "Agnes Denes Plants a 5 Hectare Wheatfield Amongst Milan's Porta Nuova Skyscrapers," Designboom, last modified July 15, 2015, https://www.designboom.com/art/agnes-denes-wheatfield-fondazione-nicola-trussardi-07-15-2015/.

54 Calgary's 2012 *Food Action Plan* includes goals for the local growth and production of food and increasing support for urban farming initiatives. In 2017, a set of Land Use Bylaw Amendments were passed that include accommodation for various indoor and outdoor urban agriculture projects. See "Land Use Bylaw amendments: food growing, processing and distribution," The City of Calgary, accessed April 28, 2019, http://www.calgary.ca/PDA/pd/Pages/Calgary-Land-Use-bylaw-1P2007/Land-Use-Bylaw-Amendments-food.aspx.

part four

SALT

SALT

Bread-making and architecture share an exciting characteristic in that they both sit at the intersection of technical or pragmatic processes, and playful or intuitive sense. The approach to making a loaf of bread or to designing a space can tend toward one side or the other, but most often seem to coexist in a balance.

An architect, for example, must analyze occupant loads and energy requirements in the design of a building, but must also intuit the way that people might move or occupy its spaces, or what the building's form might express to its users. A baker, similarly, starts out with intentions for the flavour and form of the bread, but aims to develop an acute sense of the visual, tactile, and olfactory clues about the bread's progress and be able to adapt to changing conditions.

An architecture with bread at its core must reflect this dichotomy of pragmatism and intuition, exploring materiality, narrative, heat, and bread's physiology in its conception. The aspirations for the future of bread and wheat that have been discussed in the preceding chapters can also point to related concerns in the future of architecture, such as the use of local or sustainable materials, the role of heat, light, and smell, and the building's impact within the community and city.

TEN CONSIDERATIONS FOR DESIGN

The following design considerations draw on the ideas of both the technical and experiential implications of material, formal, and programmatic design choices. They address the realistic use or function of these elements within the building, but also their perception in a project about diverse communities and the importance of bread. These considerations are applicable across a range of design scales, and the prominence of one over another would undoubtedly vary based on context and community needs.

1. Brick and bread
2. Calgary’s material history and future
3. Building strategies for Calgary’s climate
4. The thermal space of architecture
5. The thermal space of baking
6. Bread is alive
7. Wheat is alive
8. Narrative
9. Craft and community
10. Microclimates

1. Brick and bread

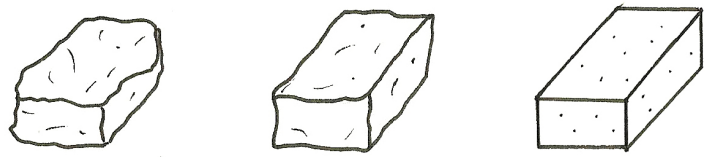


fig. 4.1 Evolution of the brick: hand-formed mud brick to moulded mud and straw brick to fired clay brick.

Of the commonly used building materials, brick is one that has perhaps the most direct connection to bread. Its method of production, its embedded terroir and presence around the world, and even its perception amongst the general population bear striking similarities to that of bread. As James Campbell, an architect and architectural historian, says, "Brick is at once the simplest and the most versatile of materials, the most ubiquitous and the least regarded, all too familiar yet strangely neglected."[1] This perception of brick and bread as humble and unassuming parts of everyday life make the realities of their variability and their potential for innovation all the more interesting.

The use of brick as a building material is almost as old as bread itself, with mud bricks being invented in Mesopotamia between 10000 and 8000 BCE.[2] These bricks were a mixture of mud and water that were formed by hand and left to dry in the sun, and were followed by the more technically-advanced and uniformly-shaped moulded bricks around 5000 BCE.[3] The invention of the fired brick around 3500 BCE brought a new permanence to these structures, and the manufacturing principles remain quite similar to this day (*fig. 4.1*).[4]

The basic production method for fired bricks is quite similar to that of bread. A set of typical ingredients (clay, sand, iron oxide, magnesia, and lime) are mixed with water, formed into the desired shape and size, and then fired in a kiln. Industrialization, just like for bread, allows for the final product to be standardized. Through the development of formulas and timelines, these processes can consistently produce specific desired colours, surface textures, and compressive strengths. Bricks created through pre-industrial or smaller-scale manufacturing, on the other hand, more clearly exemplify the qualities and differences of regional production. If the clay used in a specific region is high in iron, the resulting bricks will be more red or pink in colour, while clays with higher amounts of lime and lower iron contents will tend towards cream or beige.[5] The temperature and amount of oxygen let into the kiln while firing also impacts the final colour, with higher temperatures and lower amounts of oxygen both resulting in darker hues.[6] The physical characteristics of bricks, therefore, can be visibly tied to the environmental conditions of a place and to the methods of production by a group of people (*fig. 4.2*).

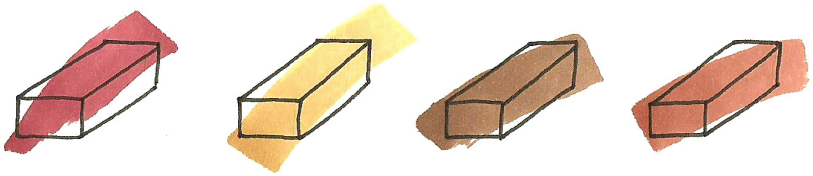


fig. 4.2 The colour of bricks can vary greatly from place to place.

Variations in brick bonds, patterning, and ornamentation worldwide also show the potential of the material to be a part of the architectural style associated with a place (*fig. 4.3*). Its use in both monumental and everyday architectures throughout history positions it, like bread, as a material to which many people can draw connections to; it is a material that crosses cultural and social boundaries.

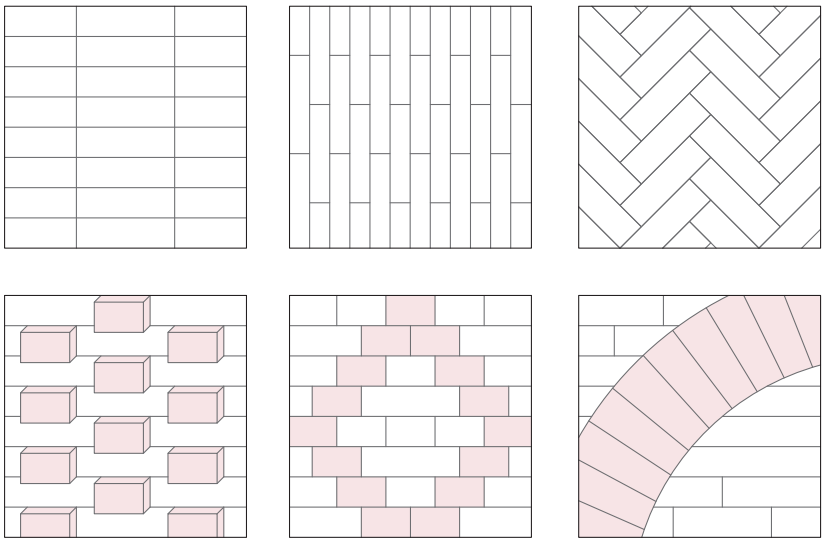


fig. 4.3 Examples of brick patterning and ornamentation.

2. Calgary's material history and future

After a fire in 1886 destroyed a significant portion of Calgary's wooden building stock, the town began to rebuild its downtown in sandstone and brick.[7] Much of southwestern Alberta, including Calgary, sits upon the Paskapoo Formation, a geological layer containing significant deposits of sandstone. As many as nineteen quarries, located in and around Calgary, were established and in use over the next 30 years, up until their closure by 1915.[8] These quarries provided material for the construction of numerous sandstone buildings in the early 20th century, including the Grain Exchange Building (*fig. 4.4*), the Palliser Hotel, the old City Hall, and the now-demolished CPR station, and earned Calgary the nickname of "Sandstone City."

The brick industry also experienced a significant upturn, taking advantage of the shale that exists between the layers of Paskapoo sandstone.[9] The Calgary Pressed Brick and Sandstone Company, also known as Brickburn, was started in 1905 and operated until 1931 within Calgary's current city limits.[10] It is likely that this factory produced bricks for many of the buildings that were constructed in the downtown core, as well as the Beltline's "warehouse district" south of the railroad tracks (*fig. 4.5*).[11]

While the production of brick is no longer as local as it once was, its use can reflect the history of Calgary's industries and embed itself in the colour and material palette of the Beltline. The reds of the Beltline's existing brick, and yellows and beiges of its sandstone, serve to stand out against the modern steel, glass, and concrete constructions.

The concerns for local material use extending from and relating to the value of local wheat can, nonetheless, still be emphasized within the project. Alberta's forests contain three main types of trees – lodgepole pine, trembling aspen, and white spruce (*fig. 4.6*) – and each of these can be used to produce wood products with different physical qualities (colour, smell, patterning, reflectivity) and typical forms (sheet goods, dimension lumber, structurally engineered wood). Emphasizing these unique characteristics places value in their use, and connects the building to its nearby natural environments. A new project for the neighbourhood, then, can evoke the stories and streetscapes of the past, while also addressing issues of sustainability and the new role of bread and community for the city's future.

fig. 4.4 Calgary's Grain Exchange Building is built from locally-quarried sandstone.

fig. 4.5 A typical brick building (built 1912) located in the Beltline's "warehouse district" along 10th and 11th Avenues.

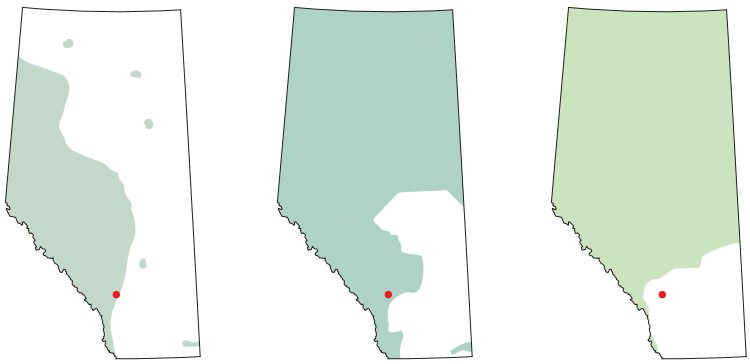


fig. 4.6 **Tree growth extents of Alberta's most common tree types.**

Calgary's location is indicated by the red dot.

3. Building strategies for Calgary's climate

Calgary experiences cold winters and mild to warm summers, and its climate is often moderated by the Rocky Mountains a short distance to the west (*fig. 4.7*). Its high elevation (1045 m) results in a relatively dry climate, with most of its precipitation coming in the early summer months in the form of rain.[12] Calgary is the sunniest large city in Canada, and has an average of 333 days with sunshine per year and more than 52% of daylight hours in sun.

Winter temperatures in Calgary are often impacted by wind chill, as Southern Alberta is one of the windiest regions in Canada. This results in almost one-third of the days between December and February experiencing wind chill temperatures colder than -20°C, and three to six of those days per month that feel colder than -30°C. The Calgary winds, however, can also have the opposite effect. Warm and moist Chinook winds flow eastward from the Pacific Ocean, release their moisture in the form of precipitation as they move over the Rocky Mountain range, and travel across Southern Alberta as warm, dry air masses. These winds can cause temperatures to rise as much as 20-30°C within a couple of hours, and can keep the temperatures elevated for a few hours to a few days.[13]

By examining these climatic conditions, it is apparent that the thermal strategies for a new building in Calgary primarily involve addressing its low winter temperatures. A well-insulated (high R or RSI value) building enclosure is necessary, and technologies such as radiant floor heating can be used to regulate the interior environment. For supplemental air flow and thermal control, a heat recovery ventilator (HRV) system can capitalize on the heat released by the interior ovens, re-using it as necessary throughout the building. During the seasons with milder temperatures, when this additional heat source is less critical for the interior spaces, the warm air retained through the HRV system can be redirected to the exterior, generating focused and intentional warm microclimates close to the building.

The project should be sited to benefit from Calgary's plentiful year-round sunlight. South-facing glazing, used in a direct-gain system in combination with interior concrete or brick thermal mass, can help to passively heat the building (*fig. 4.8*). Solar heat gain can be controlled in the summer using roof overhangs, integrated blinds, or ceramic frit glazing as required. The building can generate some of its own energy on site with the placement of photovoltaic panels on its rooftop.

South-facing thermal mass walls on the exterior of the building can also absorb solar radiation and release heat throughout the day (*fig. 4.9*). By moderating the fluctuations in temperature for these outdoor spaces, the project can extend its use in spring and fall, and during Calgary's cool summer evenings. These various strategies can allow the building to have both an interior and an exterior life, despite its location in a relatively cold climate.

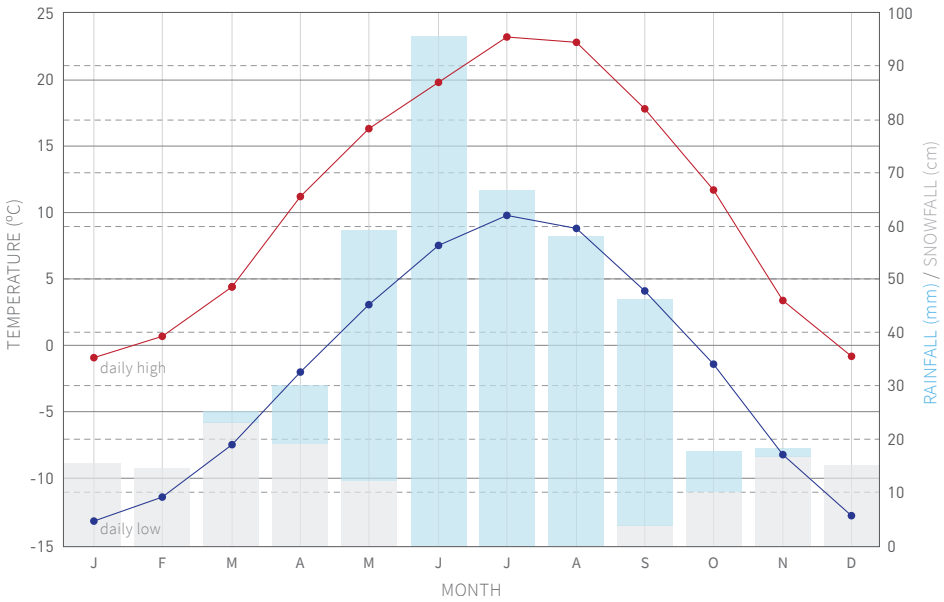


fig. 4.7 Climate data for Calgary.

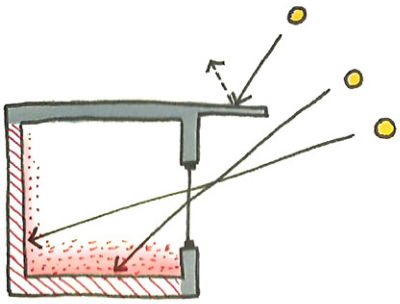


fig. 4.8 Walls and floors in a direct-gain system.

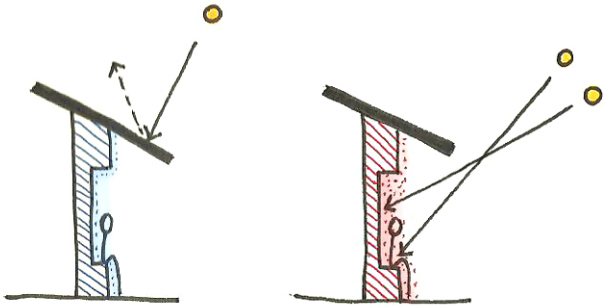


fig. 4.9 **The warming and cooling effects of exterior thermal mass.**

Though the spread of heat from these exterior thermal mass surfaces may be relatively small, especially in very cold temperatures, the intuitive sense of the warmth that comes from brick or concrete on a sunny day could be enough to impact people's movement and gathering on site.

4. The thermal space of architecture

Reyner Banham's story of the tent and the campfire demonstrates two opposing responses to the question of thermal comfort for humans (*fig. 4.10*). One response – the shelter – is in line with what people have primarily chosen to do for thousands of years: separate ourselves from natural weather conditions. The other – the open-air fire – appears by contrast to be a primitive and temporary solution to the problem. Luis Fernandez-Galiano suggests, though, that one response should not necessarily take priority over the other, as "[both] present themselves in most cultures and both deserve to be called architecture. Indeed, the thermal space of the bonfire is no less architectural than the visual space of the hut."[14]

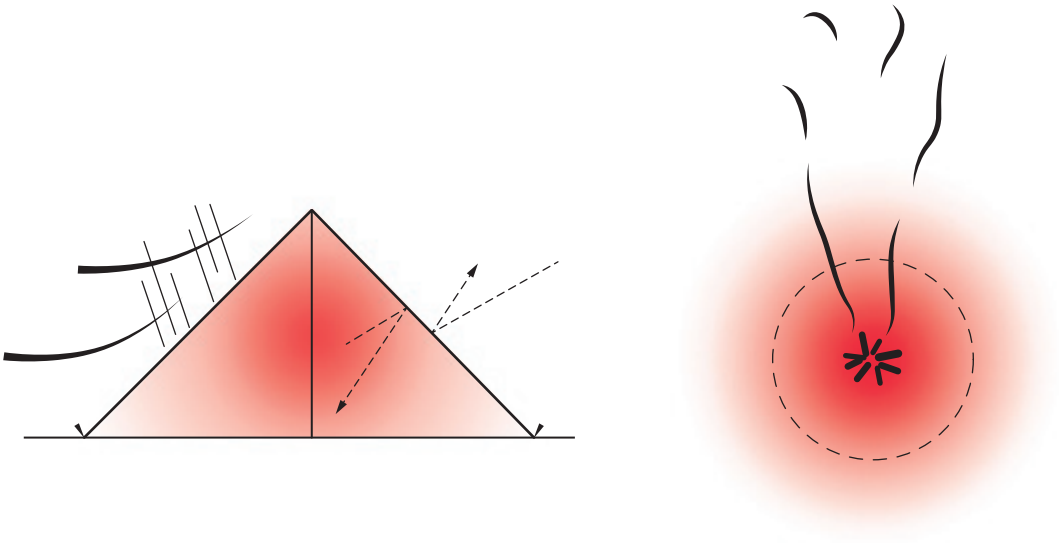


fig. 4.10 **Thermal space in Reyner Banham's tent and campfire.**

In Banham's parable, a tribe arrives at a site with available timber, and must decide whether to build a simple shelter ("the structural solution") or a fire ("the power-operated solution"). The chosen methodology will likely follow the past cultural practices of the tribe, and this has resulted in the tendency to build more permanent structures.[15] Banham further defines these contrasting approaches, saying, "societies who do not build substantial structures tend to group their activities around some central focus – a water hole, a shade tree, a fire, a great teacher – and inhabit a space whose external boundaries are vague, adjustable according to functional need, and rarely regular."[16] Understanding architectural space as a potentially fluctuating medium can lead to design that offers a greater range of experience and more varied physical and psychological responses.

Other contemporary architects have chosen to explore this position as well. Sean Lally describes the role that architecture plays on a given site beyond just the spaces contained within its walls; it creates microclimates that generate variable exterior environments, and that create relationships between those resulting spaces and the more carefully planned interior ones.[17] Heat exhaust from mechanical systems, areas in shadow, wind tunneling or barriers, and sun reflections all influence the environments surrounding a building. Lally, however, argues that these are simply accidental conditions without deliberate architectural or spatial benefit.[18] Hence, an opportunity lies in the intentional design of form and selection of materials to create microclimates that can influence the experience, movement, and assembly of people on site (*fig. 4.11*). These spaces will undoubtedly be constantly in flux, as day-to-day weather, sunlight, levels of activity, and other factors will impact the presence and intensity of the microclimates. Choosing to regard them as another building material or tool for design, however, can, as Lally proposes, "[allow] architecture to explore new territories of design, aesthetic proclivities, and social interaction,"[19] and extend the use of exterior spaces to other seasons and times of day.

Philippe Rahm's work has a similar focus, and seeks to create a "meteorological architecture" that conceives of a building as "an open-ended, shifting weather system embracing different climates and atmospheric qualities to be occupied and used according to our needs and desires, the time of day, and the season."[20] This interest leads him to closely examine the thermodynamic principles of radiation, conduction, and convection, and propose ways in which different climatic conditions can be tuned to different programmatic functions, and vice-versa (*fig. 4.12*). For both Lally and Rahm, a re-evaluation of our desire for thermal homogeneity in our built environment – and, similarly, of the demand that we be able to occupy all parts of a building at any time and for any activity – is necessary for both future sustainability and architectural innovation.

Historically, the amount of energy, and consequently the cost, that would have been required to heat an entire home to a uniform temperature would have been prohibitive. As a result, there was an acceptance of a greater range of thermal comfort, and a willingness to compress or move one's activities into a thermally-appropriate space as required. Heat retention and finding ways to make heat sources multi-functional was – and in many cold climates, still is – critical for daily life. The thermal mass assemblies that have been in use by various cultures for centuries are precedents for the efficient, purposeful, and versatile use of heat (*fig. 4.13*).

fig. 4.11 **Seasonal expansion diagram for Sean Lally's project 'Wanderings.'**

By intentionally designing around microclimates (especially heat), spaces can extend their use into other seasons and times of day.

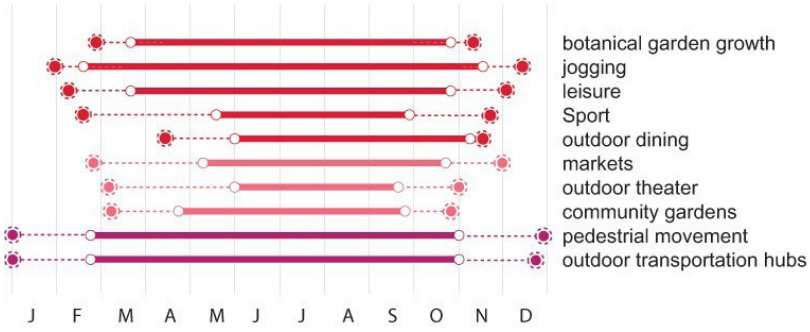
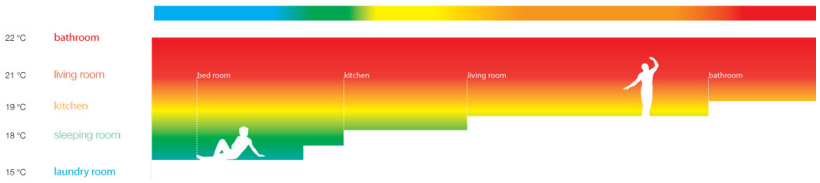


fig. 4.12 Philippe Rahm's 'Convective Apartments' project proposes a programme distribution based on thermal requirements.



The Russian stove (left) and Chinese kang (right) have thermal mass that stores heat generated by cooking fires. The platforms are then used for sleeping, as they will remain warm throughout the night.

An inglenook is a small seating area surrounding a fireplace that is typically enclosed on three sides and has a lower ceiling. The small volume amplifies the heat, and thermal mass is sometimes added.

fig. 4.13 **Assemblies that amplify or retain thermal energy are in use around the world.**

5. The thermal space of baking

The Russian stove, kang bed, and inglenook share a critical element in common with the proposed communal bake ovens: fire, and the heat generated by it. These forms, which take advantage of their thermal mass or thermal gradients to generate spaces with an increased range (both distance and time) of thermal comfort, are clues to the ways in which the wood-fired communal ovens can expand their functionality and assume a space-making role within the project. The intent for their frequent use on the site provides the project with a unique opportunity to create microclimates centred around the ovens and their activities. While in the case of the ovens, the primary function requires that heat retention in the baking chamber is maximized, some heat loss is unavoidable. This "loss" for the purpose of baking can be seen as a "gain" for the experience of people within that thermal space.

The amount of heat that radiates from these nodes varies for each oven type, and is dependent on the oven's form and the method of baking. The following descriptions elaborate on the heating and baking process of the three main communal oven types – the barrel vault brick oven, the cob dome oven, and the tandoor oven.[21] The sample baking schedules align these heat gradients to specific times of day and show how these new and temporal thermal spaces can be tied into other activities on site (*figs. 4.14 – 4.19*).

Note:
The gradients as drawn in *figs. 4.14*, *4.16*, and *4.18* are approximations generated through the heat transfer simulation program Energy2D.[22] The models account for the insulation values and thermal properties of the materials that make up the ovens, as well as the outside air temperature, but do not account for changes in wind direction or velocity. The results are used here for qualitative rather than quantitative analysis, and helped to gain an intuitive sense of the ways in which the form and material of the ovens impact the flow of heat around them.

The steps for making bread in the sample baking schedules as drawn in *figs. 4.15*, *4.17*, and *4.19* are simplified as follows:

1. Collect ingredients
2. Mix + knead
3. Bulk fermentation
4. Divide + pre-shape
5. Rest dough
6. Final shape
7. Proofing
8. Bake
9. Cool
10. Eat + storage

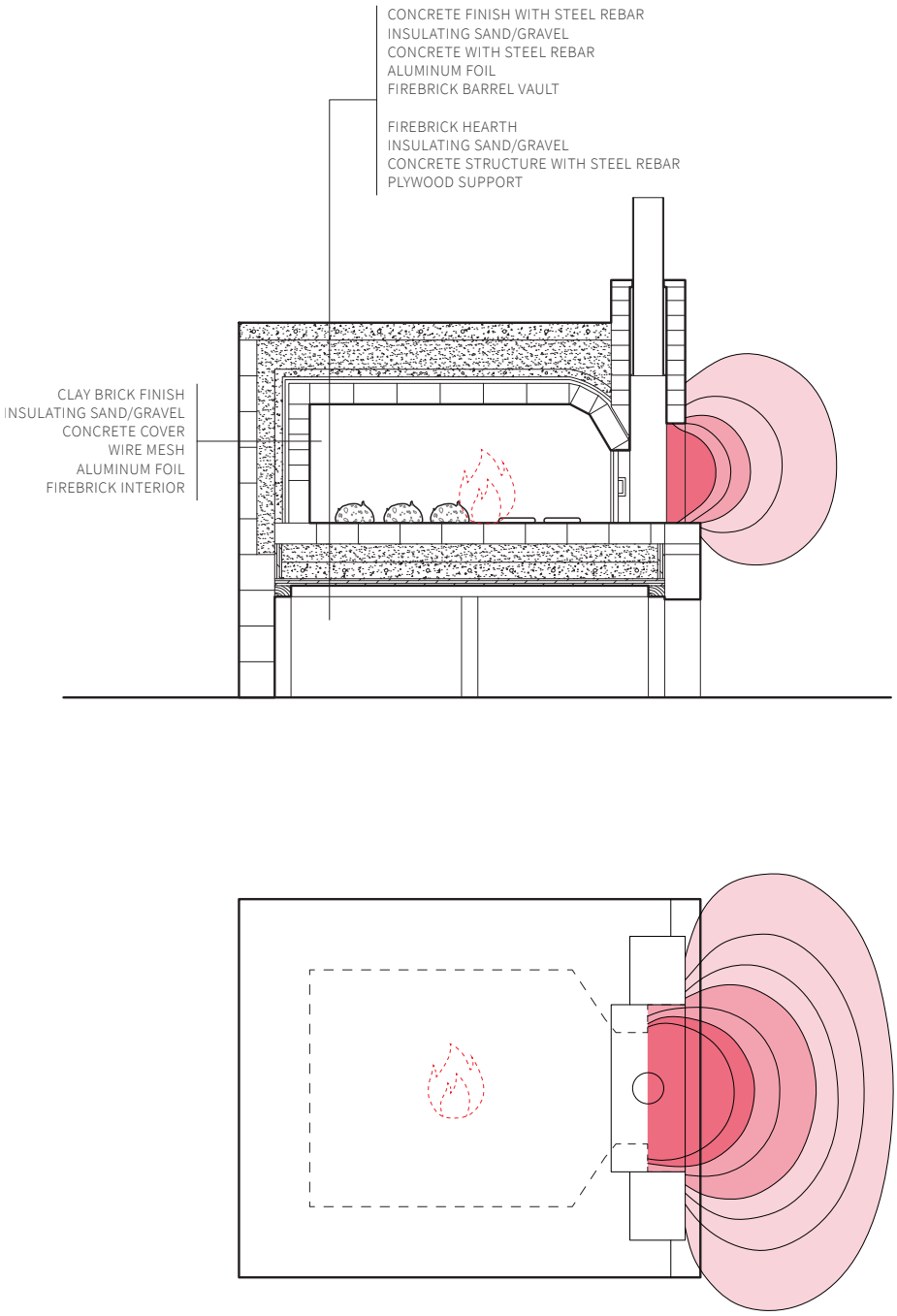


fig. 4.14 **Barrel vault brick oven heat gradient – section and plan.**

See *Appendix* for photos of oven physical models.

BARREL VAULT BRICK OVEN

In order to store a sufficient amount of heat in the thermal mass of the oven for retained heat baking, a fire is burned on the hearth for between two and five hours, depending on the size of the oven and the quantity of bread to be baked (Steps 1 and 2). During this time, the oven door is left either partially or fully open to allow enough oxygen to access the fire and keep it burning. This timeframe would have the highest and most consistent amount of heat radiating out of the oven, and the smells of burning wood.

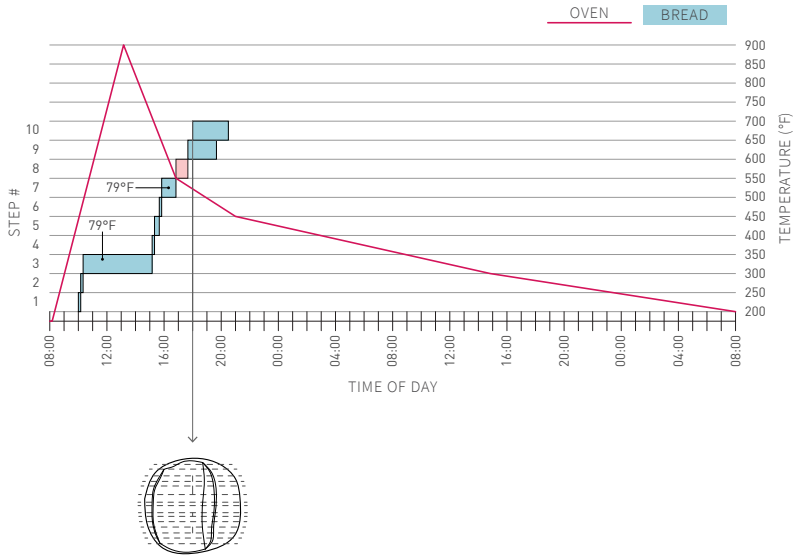
The fire is left to burn down to coals, which are then scraped out of the oven (Steps 3 and 4).

The oven must now cool slightly and equalize to bread-baking temperatures, around 550°F (Step 5). This can either be done with the door on (up to 2 hours, minimal heat radiating from opening) or off (up to 1 hour, steady heat radiation) depending on when the oven is to be used.

Bread is now baked with the oven door closed to maximize heat retention in the baking chamber (Step 6). Due to the amount of insulation outside of the hearth and barrel vault, minimal amounts of heat would escape from the oven enclosure, likely not perceptible to people nearby. While baking, heat is only released from the oven when bread is loaded or unloaded. The scent of baking bread now permeates the air as well.

When the oven's temperature has dropped below what is required for bread, other food items, including pastries, meats, and stews, can be baked in the oven on its downward heating curve (Step 7).

Finally, the oven is allowed to slowly cool down when not in use (Step 8).



- oven fired in the morning at 8:00 am
- "same-day" dough prepared in the morning/ early afternoon
- dough shaped in afternoon
- baked bread ready for dinner at 6:00 pm
- potential for low temperature baking/ roasting the next morning

fig. 4.15 **Sample baking schedule for the barrel vault brick oven.**

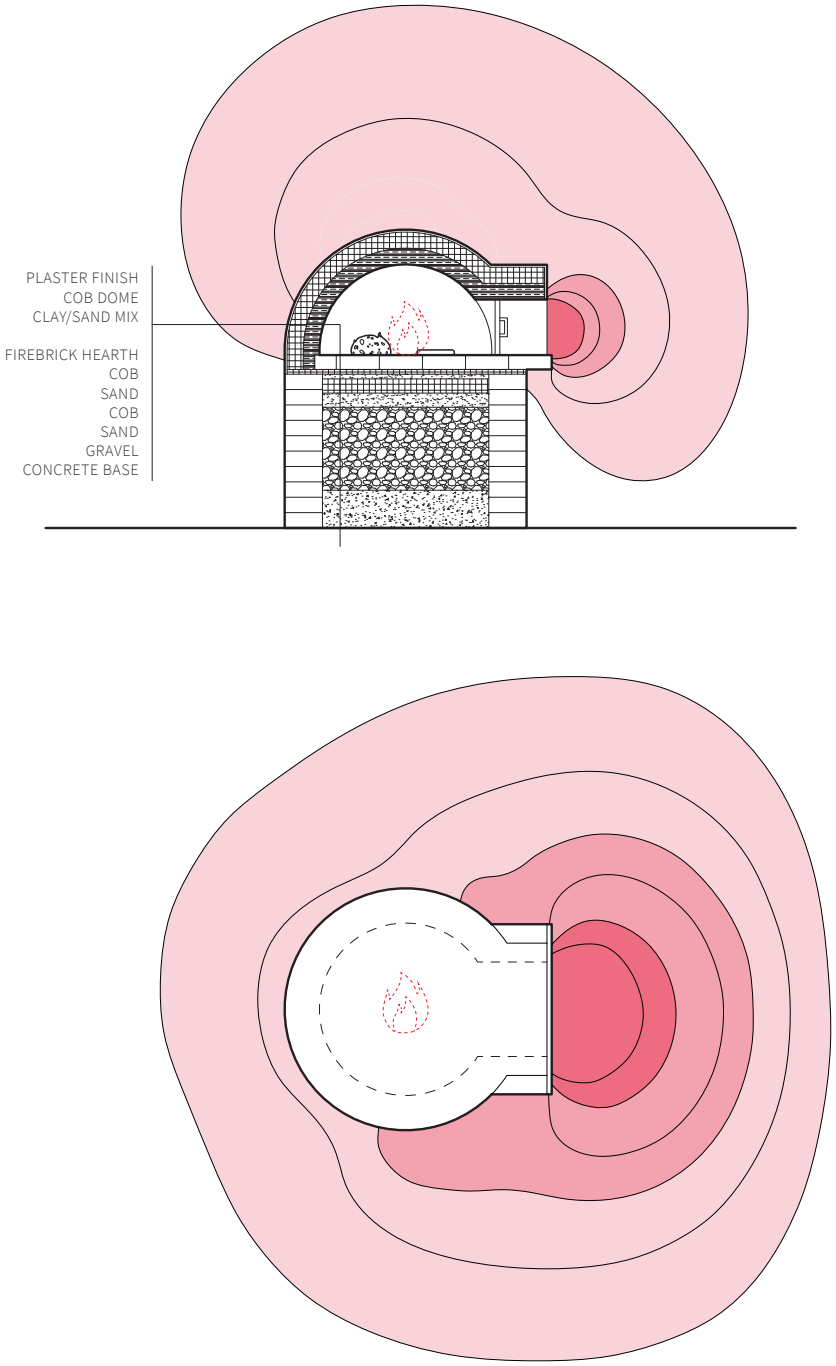


fig. 4.16 **Cob dome oven heat gradient – section and plan.**

See *Appendix* for photos of oven physical models.

COB DOME OVEN

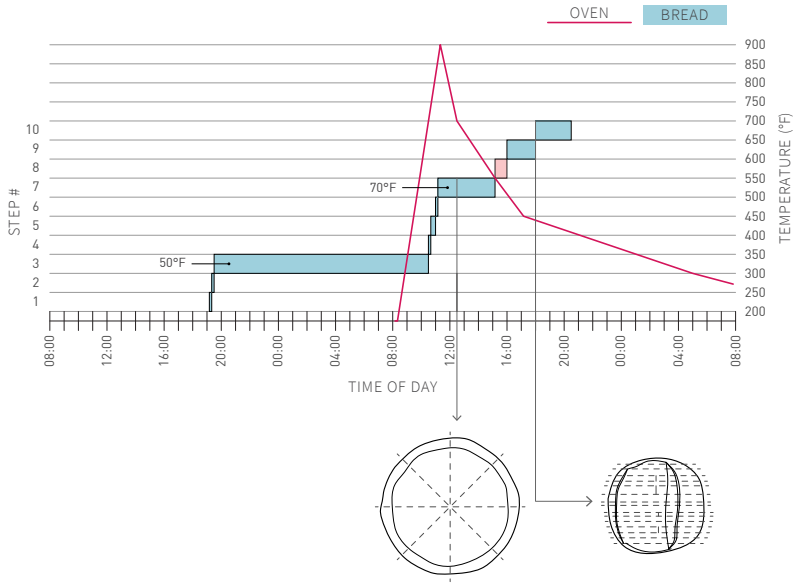
The steps for firing and baking in the cob dome oven are very similar to the barrel vault brick oven. Due to a reduced thickness of thermal mass and insulation, however, the timeframes for firing and heat retention are reduced.

1. Build up wood pile for fire in oven.
2. Light fire and allow it to burn for 1-3 hours to saturate the oven with heat. Keep oven door partially or fully open. Add additional wood as needed.

3A. Pizza/Flatbread: Push fire to the side and maintain a low fire. Brush baking area. Bake pizzas and flatbread in open oven at 700°F.

3B. Other breads: Allow fire to burn down to coals.

4. Scrape out coals into fireproof container. Brush baking area.
5. Allow oven to cool and equalize to bread baking temperature (550°F) for 30 minutes to 1 hour. Door can be open or closed.
6. Bake bread with oven door closed. Add steam prior to loading bread if desired.
7. Bake other items on oven's downward heating curve.
8. Oven cool down.



- dough prepared in the evening before baking day (overnight bulk fermentation)
- oven fired in the morning at 8:00 am
- pizza ready for lunch at 12:30 pm
- dough shaped in the afternoon
- baked bread ready for dinner at 6:00 pm
- potential for lower temperature baking of desserts and pastries after bread

fig. 4.17 **Sample baking schedule for the cob dome oven.**

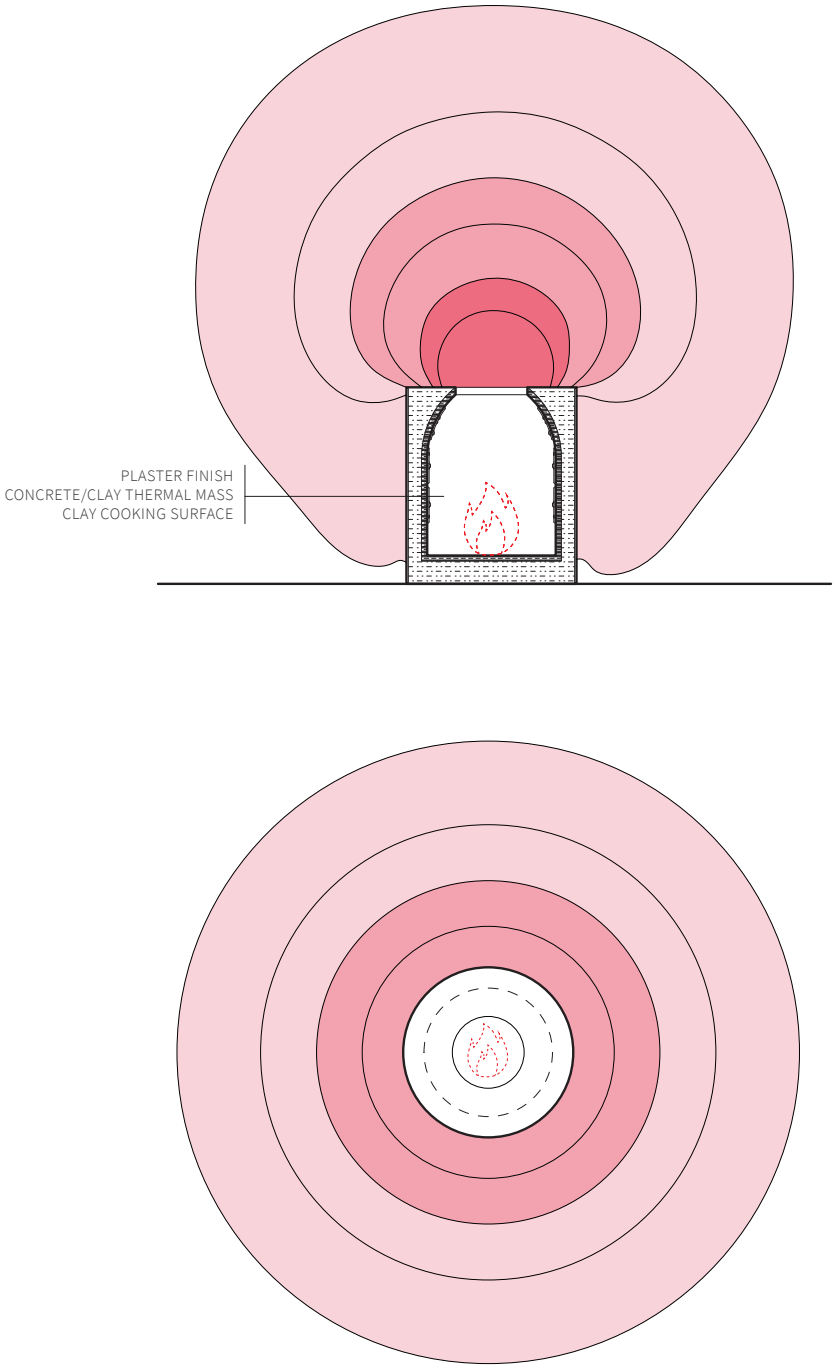


fig. 4.18 **Tandoor oven heat gradient – section and plan.**

See *Appendix* for photos of oven physical models.

TANDOOR OVEN

The spread of the heat gradient from the tandoor oven is larger and more consistent than the other oven forms. It is left open while it is in use because bread placed on the walls of the tandoor bake very quickly (within 1-2 minutes). This oven typically has the lowest amount of thermal mass and insulation, and therefore has the shortest firing time.

1. Build up wood or charcoal pile for fire in oven.
2. Light fire and allow it to burn for approximately 1 hour to saturate the tandoor walls with heat. Allow the fire to burn down to embers.
3. Allow oven to cool and equalize to bread baking (550°F-450°F) or other cooking (600°F-450°F) temperatures for 20-30 minutes.

4A. Bake naan and other flatbreads by adhering them to the walls of the tandoor with a gaddi pad (also called a naan pillow).

4B. Cook meat and vegetable skewers by placing them in the tandoor.

5. Oven cool down.

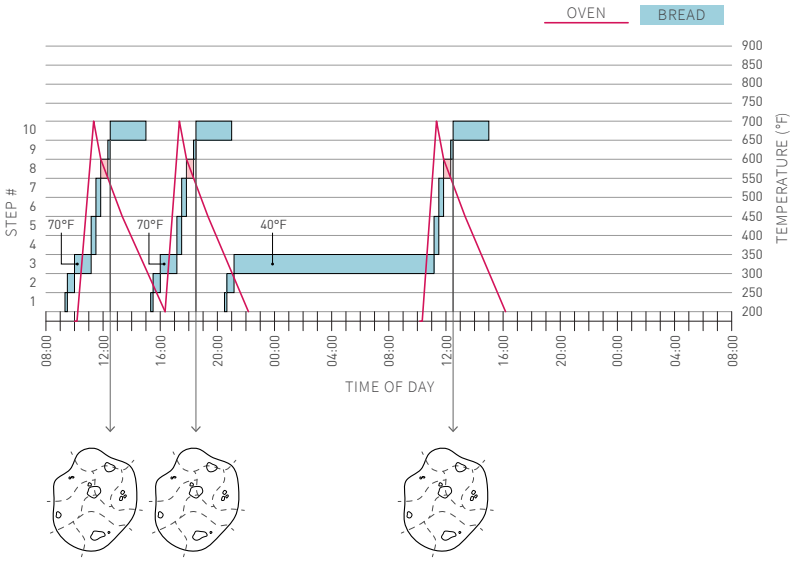


fig. 4.19 **Sample baking schedule for the tandoor oven.**

Option 1a:

- morning dough preparation and oven firing
- naan ready for lunch at 12:00 pm

Option 1b:

- afternoon dough preparation and oven firing
- naan ready for dinner at 6:00 pm

Option 2:

- dough prepared in the evening before baking day (overnight bulk fermentation)
- oven fired in morning at 10:00 am
- naan ready for lunch at 12:00 pm

Additional functional requirements for the ovens can also impact the physical and architectural space around them. For example, although the exterior of a cob oven is often coated with plaster to increase its resistance to water, it is ideal for the oven to be in a covered area to protect its more fragile material composition from damage. The open top and lack of a chimney in a tandoor oven means that the flow of air around the oven must not be impeded in order to allow sufficient dispersal of smoke. Barrel vault brick ovens, as discrete and enclosed entities with more advanced venting systems, can be more freely placed on the site or built into walls that make up the buildings themselves.

Understanding the schedules, requirements, and generated heat of the ovens is critical to seeing the thermal gradients as "material[s] to build with."[23] It opens up opportunities for manipulating and amplifying their resultant thermal spaces, and gives further power to their influence on the architecture. The qualitative and formal differences of these spaces produce a variety of experiential moments on the site that can impact how people move and gather in various seasons. The act of gathering around the ovens also contributes its own warmth as heat is naturally released from people's bodies. The new thermal spaces, therefore, permit gathering, and gathering further expands the thermal spaces. As a result, the site is constantly in flux and is animated in response to bread's role in the lives of the site's users.

6. Bread is alive

Bread – a food coerced out of the natural process of fermentation – is very much alive. Much like other living organisms, it responds to its environment, reacting to conditions like temperature and humidity, and alters its own growth and internal ecosystem accordingly. Temperature, in particular, directly relates to fermentation time (*fig. 4.20*). Professional bakeries use temperature- and humidity-controlled proofing rooms to create specific conditions, but most home-bakers do not have access to this type of equipment and must develop an intuitive sense of how to optimize their environments for the type of bread they want.

A brief overview of the process of fermentation in bread is necessary in order to understand its needs and why one might want to manipulate its surroundings:

Leavened breads acquire the ability to rise with the addition of yeast, either natural as in sourdough breads, or commercial. The yeast multiplies through mitosis by feeding on sugars found in the starch molecules of flour, and converts these sugars into carbon dioxide and alcohol (ethanol).[24] These gaseous by-products of yeast's multiplication are trapped within the dough by its gluten network, which causes the bread to rise. This network is formed when flour is mixed with water and the two proteins in flour, glutenin and gliadin, interlock to create a web-like structure. Mixing, kneading, and folding dough organizes and stretches these gluten strands, increasing its capacity to hold gases.[25]

Commercial yeast (the single strain *Saccharomyces cerevisiae*) has been formulated to multiply quickly and consistently. With every increase or decrease in dough temperature of 17°F (9.5°C), the fermentation time is approximately halved or doubled, respectively, to a point (*fig. 4.21*).[26] Sourdough cultures, which contain many different strains of yeast and bacteria, thrive at similar temperatures, but multiply much more slowly than their commercial counterparts – hence the priority given to commercial yeast in industrial bread production.

fig. 4.20 An active sourdough starter, kept at a warm temperature, quickly begins to form gas bubbles.

Though manipulating temperature – and as a result, time – appears to be solely driven by the goal of yeast multiplication and making bread rise, the true benefit comes when considering the process that is ultimately responsible for bread-baking: enzyme activity. Enzymes are proteins that act as catalysts for biological reactions, and this activity happens at a much slower pace than yeast mitosis under the same conditions. In the case of bread, this reaction involves breaking down the complex starch molecules found in flour into simple sugars that can then be fermented.[27] These sugars – primarily glucose and maltose – become available to yeast as food, but also contribute to the flavour of the bread and the browning of the crust during baking. In industrial bakeries, where fermentation times can be as little as 90 minutes, the enzymes are not given enough time to maximize the potential tastes inherent in the flour, and thus the final product is devoid of interesting or complex flavours.

Sourdough breads adopt unique characteristics from their extended fermentation times. Secondary to the fermentation from wild yeast activity, there is also bacterial fermentation that takes place. Lactobacillus and acetobacillus bacteria feed on the sugars released by the enzymes to produce lactic and acetic acids that flavour the bread. Warmer temperatures promote lactic acid production, which comes through as milky and buttery flavours, while cooler temperatures promote acetic acid production, which results in a more sour or vinegary taste.[28] The confluence of these organic reactions and exterior variables is responsible for the complex array of flavours and aromas in sourdough bread.

Temperature Ranges and their Effects on Yeast

< -4°F (-20°C)	Yeast is unable to ferment.
< 40°F (4°C)	Yeast goes dormant.
< 68°F (20°C)	Yeast growth rate is significantly reduced.
68°F – 81°F (20°C – 27°C)	Ideal range for yeast multiplication.
79°F (26°C)	Optimal temperature for yeast multiplication.
81°F – 100°F (27°C – 38°C)	Ideal range for fermentation.
95°F (35°C)	Optimal temperature for fermentation.
> 104°F (40°C)	Yeast growth rate is significantly reduced.
> 140°F (60°C)	Yeast dies.

fig. 4.21 **Temperature ranges and their effects on yeast.**

The "optimal" temperatures as indicated above are from the perspective of yeast's ecology, and are not necessarily the ideal conditions for human desires surrounding the flavour or timing of the bread. Knowing these temperature ranges, however, allows us to alter the dough's environment to suit our intentions.

All of this makes bread sound very technical – and it can be – but it is also very forgiving and resilient, and open to changes in its environment and schedule. On cold winter days, I will often move my fermenting dough to a sunny spot or on top of the fridge or stove where it is warmer. If I need to slow down the process in the summer to fit my schedule, I will move the dough to the basement or to a shaded room. Putting unbaked bread in the fridge is a good way to essentially press pause on its growth, while still developing flavour due to the enzyme activity. Practice has improved my perception or sense of when to make these adjustments, but continuing to be observant and humble will undeniably lead to better bread.

A building with baking as its foundation must recognize that bread takes up space. It has certain "preferences" that do not always align with the environment around it, and the building must be able to compensate for non-optimal conditions, ideally without additional energy inputs. Simple design choices that leverage the architecture or its natural environment for the purposes of bread-making can create bread-focused microclimates at the scale of the community building, impacting its design and the place of bread within it (*fig. 4.22*). These decisions can also create desirable conditions for people using the same spaces, such as warmth from sun access or thermal mass in the winter, or coolness from shading in the summer. This knowledge of adaptation can then be disseminated beyond the site and applied as needed in the home.

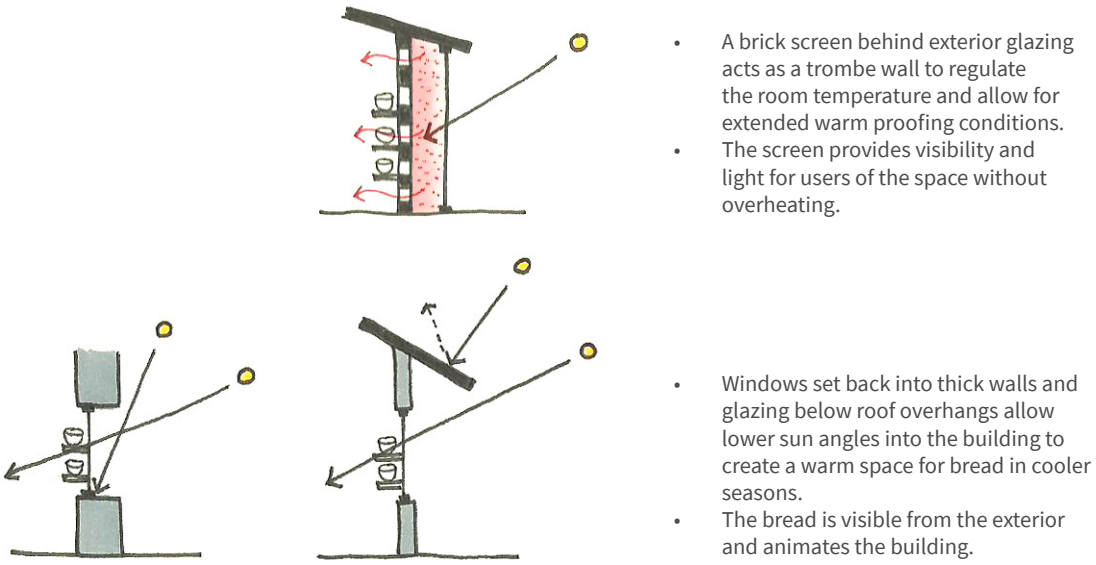


fig. 4.22 **Possible design elements that benefit both bread and people.**

7. Wheat is alive

Part Two: Flour identified the exciting variety in flavour, nutrition, and workability that exists for different breeds of wheat, as well as the ecological benefits of planting a diverse agricultural landscape. Wheat and other grains (such as oats, rye, teff, and the pseudocereal buckwheat) can present significant variability in height, colour, shape, and the timing and length of their growing seasons depending on the strain. When these grains are brought into the city as a part of the larger "network of bread," their differences can be leveraged not only for their educational value and taste, but for their aesthetic and experiential qualities. Most of us have likely only "experienced" wheat from far above (perhaps in a plane, travelling over the Prairies) or at high speeds (driving through the countryside). Siting wheat in an urban context for the purposes above, on the other hand, allows you to experience it more directly and at a slower pace. You get to see the wheat up close, but also smell it and hear it as it moves.

These experiences cannot, however, exist without addressing the practical requirements of growing a plant. Sustainable practices, for example, require the use of crop rotation systems to reduce weeds, disease, and nutrient depletion, thereby reducing the reliance on pesticides and chemical fertilizers. Crop rotations can be planned as a single-field or multi-field system, and often include sequences of cereals (wheat, rye, oats, canola), pulses (chickpeas, lentils), or perennial legumes (alfalfa, field peas, red clover) (*fig. 4.23*). The sequence must consider different seeding times, tolerances, and nutrient requirements in order to be most effective.[29]

fig. 4.23 **Simplified crop rotation systems.**

Crop rotations would impact the appearance, experience, and activities of the site from year to year.

Wheat itself varies in its seeding dates depending on which broad category of wheat is planted. Spring wheat, the most commonly planted type of wheat in the Prairies, is seeded in late April to mid-May, and typically harvested in September and October.[30] Winter wheat, which is more common in Ontario but is slowly gaining popularity in the Western provinces, is seeded in late August to mid-September, left to overwinter, and then harvested in mid-August the following year. These differences would impact the timelines of experience and appearance in the city.

The urban wheat plantings proposed in this thesis are not intended for rural-scale harvest, but rather serve a research, didactic, or experiential role (*fig. 4.24*). The use and scale of harvesting equipment must then be reconsidered for its new context. At the smallest scale, planting and harvesting the wheat can be done by hand by community members as a part of city events that mark these important agricultural seasons (see *Water, fig. 3.19*). This connects city-dwellers to and promotes an understanding of the same events happening at a much larger scale outside of the city. For harvesting at mid-sized scales, small combines can be used that provide another reference point for actual farming operations. These urban-scaled combines are perhaps stored in one or several locations around the city, and are shared amongst several sites so that equipment storage is minimized.

fig. 4.24 **Turenscape's projects present a multitude of ways to experience and interact with a landscape.**

The projects below are Yongning River Park (top left), Chengtoushan Archaeological Park (top right), and Shenyang Architectural University Campus (bottom). A similar approach can be taken for the planting of wheat in the city.

8. Narrative

A key prerequisite for returning bread to the city and to the people – for dismantling, or at least reworking, the commodity framework – is removing the veil that factory bread hides behind (*fig. 4.25*). By making the processes behind the production of bread and farming of wheat visible, we can educate the public about larger issues of health, cultural diversity, and environmental sustainability, and initiate discussions that challenge the existing systems and demand change.

It is easy to romanticize bread-making. The images of transformation, of fire, and of handmade bread are evocative and alluring. Making the process visible, however, is not just about showing its beauty. It is also about bringing a sense of reality to it – about demystifying it – so that we, both individually and collectively, can decide how, where, and when to participate or intervene. Much of what happens behind the scenes is pragmatic in nature, and requires a certain level of efficiency, but having the entire process on display provides greater opportunity for experimentation and innovation from a greater number of people (*fig. 4.27*). By seeing what goes into a loaf of bread, and the physical work of those involved in the process, we inherently assign more value to the final product and can begin to demand more from it. The concerns for flour and bread diversity, cultural representation, and the establishment of local food systems shifts our focus, and alters our conception of what a "modern" bakery or mill should or could look like.

fig. 4.25 Industrial-scale hidden bread production (left) vs local bakery visibility (Tartine Manufactory, right).

In addressing the future role of bread in the city there is also value in representing forms that are outside of the typical urban milieu. A complete picture of bread-baking includes not just the components that are responsible for its final transformation, but the buildings, places, and networks that collectively contribute to its creation. Though not all of these elements may regain a physical place in the city, their forms, materials, and historical symbolism can become a part of the story of the site or assume new meaning in their shifted context (*fig. 4.26*).

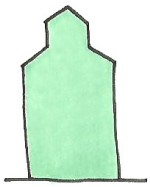
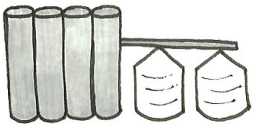
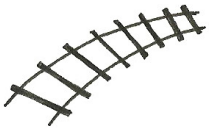
	FORMER MEANING	*NEW MEANING*
 *farm building*	collective work/labour outside the city	collective making within the city
 *wheat fields*	monoculture, inaccessible, background	variable, didactic, experiential
 *grain elevator (old)*	beacon of civilization in vast landscape	beacon of community, culture, and bread
 *grain elevator (new)*	aspirations for an industrial future	challenging the industrial present
 *railroad*	new frontiers and markets	supplemental system
 *chimney*	fire, warmth, food, aroma, gathering (family)	fire, warmth, food, aroma, gathering (inclusive community)

fig. 4.26 **Shifting meanings of formal archetypes.**

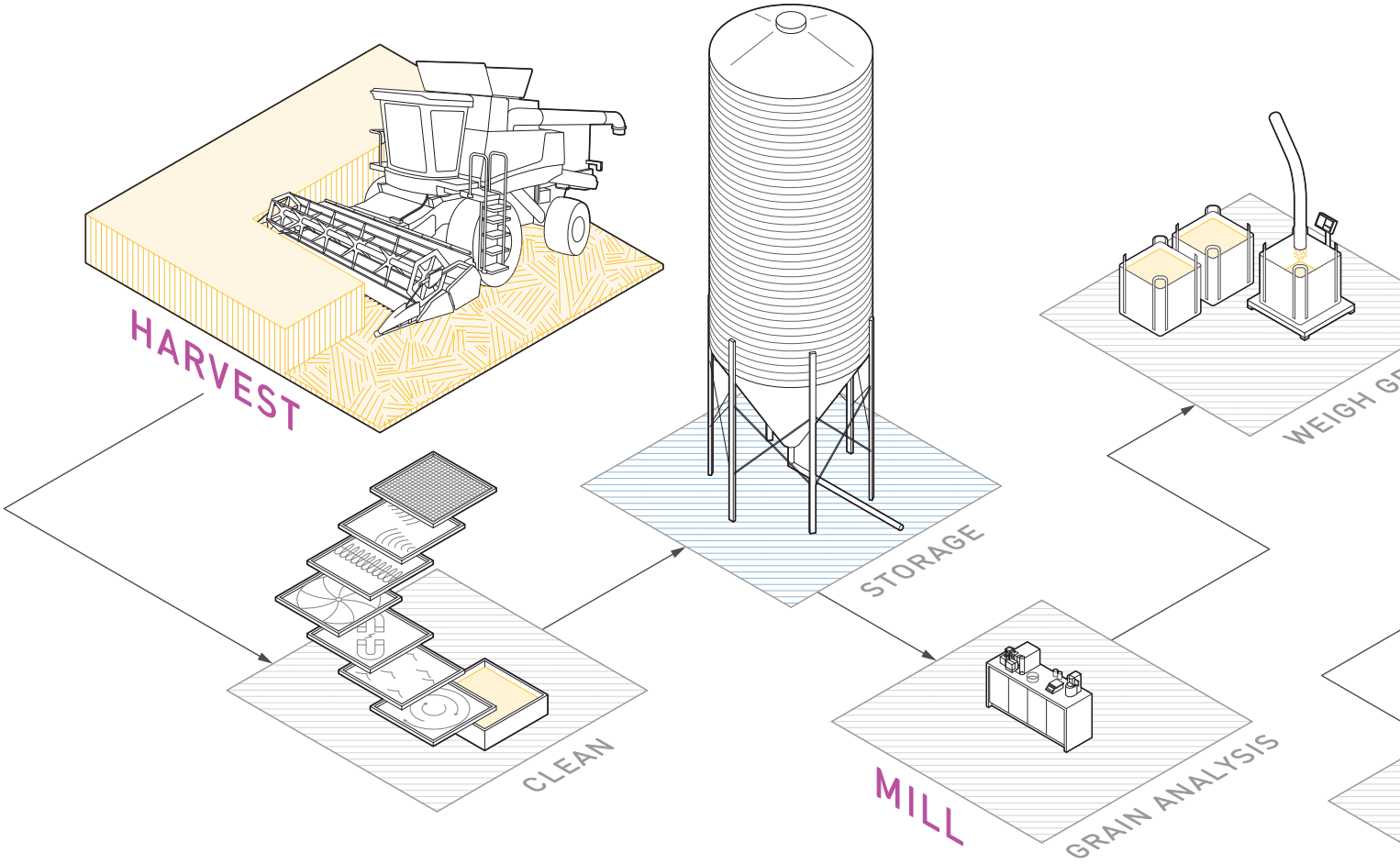
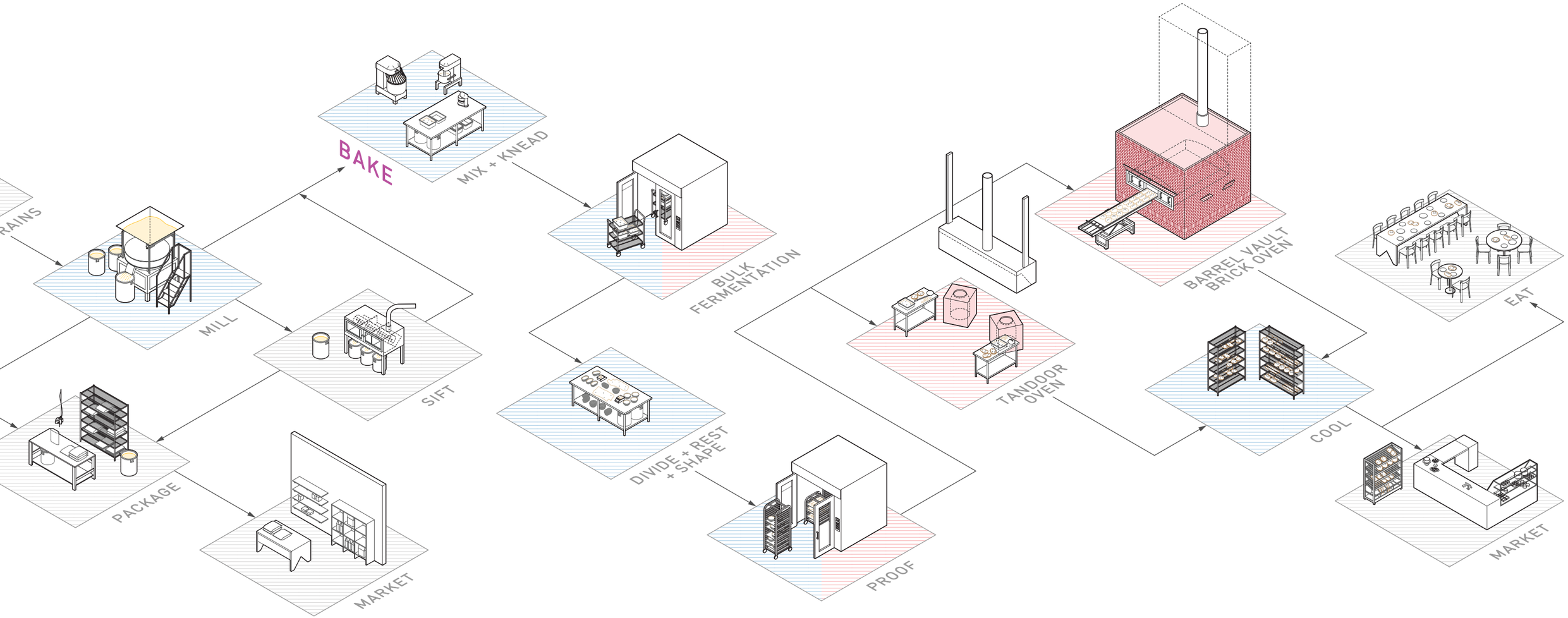


fig. 4.27 **Visibility of the bread-making process from field to bread.**

While the majority of the harvest would occur outside of the city, and seed cleaning perhaps at another local facility, each of the other steps in the bread-making process should be visible on the site.

Red and blue hatched bases indicate temperature requirements for specific activities (warm vs cool), which would impact the place of the process within the building and the design of the space around it.


RAINS
MILL
SIFT
BAKE
MIX + KNEAD
BULK FERMENTATION
DIVIDE + REST + SHAPE
PROOF
TANDOOR OVEN
BARREL VAULT BRICK OVEN
COOL
EAT
MARKET
PACKAGE
MARKET

9. Craft and community

The intent of this thesis project is to put bread, at each of its stages, back into the hands – literally and figuratively – of people. Bread, made by hand, is an extremely tactile and sensory endeavor. You can feel the strength and texture of the dough change as you knead. You can see it rising as the yeast does its seemingly magic work. You can smell this fermentation taking place and immerse yourself in the enticing aromas of the oven when it bakes the dough into its final form. You can hear the crackling of the crust as the bread cools, or of the fire as the oven is heated. And, of course, you can taste the wonderful flavours of the bread, all the more rewarding when each of your other senses were engaged throughout the process.

Even in a small commercial bakery setting, where machines are typically used to knead larger volumes of dough, the handling of the dough and shaping by hand into loaves can connect the baker to their senses, and are integral to understanding bread-making as an intuitive but also teachable and ever-evolving craft.

In a project devoted to bread-making – to the intricacies of growing, milling, baking, and dining as a community – can the idea of "craft" be tangible in the building itself? A connection to the hands and to the body can be visible in elements where special care or detail has been put into their creation. This could include intentionally designed brick patterning (*fig. 4.28*), handmade façade elements (*fig. 4.29*), novel connection details, or finishes that stray from the standard set. The value assigned to bread and to its greater impact is extended to the experience and aesthetic of the building.

Collaboration with the community at large can also establish a stronger relationship to the building. The "craft" elements have the potential to be specific to a place or to a group of people within a community, either through their visual character or by involving the community directly in their production (*fig. 4.30*). This can include the work of local craftspeople, or by planning events where the general public participates in making certain elements. Smaller-scale projects can be designed to rely on the communal construction of components such as brick screens, furniture, and the ovens themselves (*fig. 4.31*). Even if they are not involved in the physical construction, gathering the voices of community members at certain stages of planning and design can provide agency to these groups, and a connection to and care for the building and ovens from the outset.

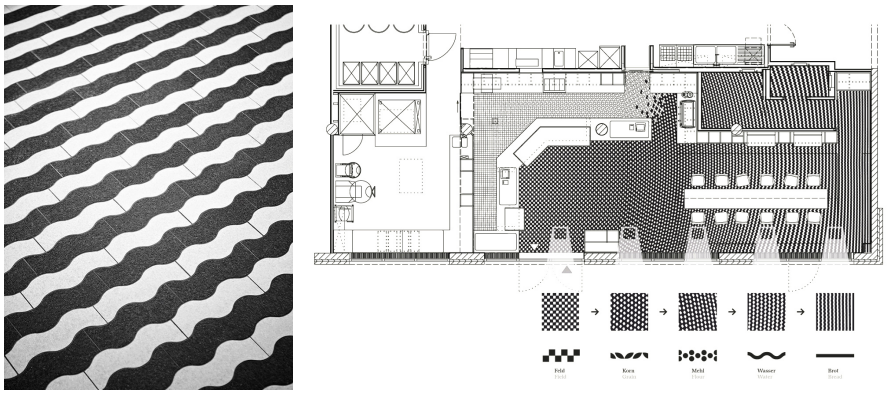


fig. 4.28 **Das Brot. at the Autostad by Designliga.**

Carefully designed floor tilework at this bakery represents the transformation of grains from field to bread.

fig. 4.29 **"A Factory As It Might Be" by Assemble.**

The artists in residence created extruded ceramic shingles to clad the facade of the architectural installation.

fig. 4.30 **Angdong Hospital Project by Rural Urban Framework.**

The simplicity and variability of the screen makes it easy to imagine a scenario where community members help to create the modules.

fig. 4.31 **Fjelstervang Udeforsamlingshus by Spektrum Arkitekter.**

This community hub was built by inhabitants and volunteers of a small village to serve their collective needs.

10. Microclimates

Drawing on Sean Lally's penchant for microclimates, and adapting them to the specificities of bread and an architecture around bread as described in the considerations above, we can begin to establish a set of *ingredients* for the making of space. By simplifying these complex and interconnected conditions – both inherently present on the site (wind, snow, sun) and intentionally designed (warmth, wheat) – we can explore the ways in which they naturally overlap and intersect, or can be purposefully amplified, excluded, and moderated by the architecture. When combined, these ingredients generate the microclimates that impact one's experience and perception of the building and site, and its seasonal variability and use (*fig. 4.32*).

It is likely that there are many more possible design factors for this project that have not been explored here. For the scope and intention of this thesis, however, these considerations collectively work towards a design approach where:

- wheat and bread animate the site through changing natural forms and programmatic implications,
- the communal ovens extend the use of exterior space and impact movement and gathering on site, and
- the material and formal choices tie the building to Calgary and to its growing and changing population.

The project, as a result, aims to cater both to bread and to civic empowerment and experience.

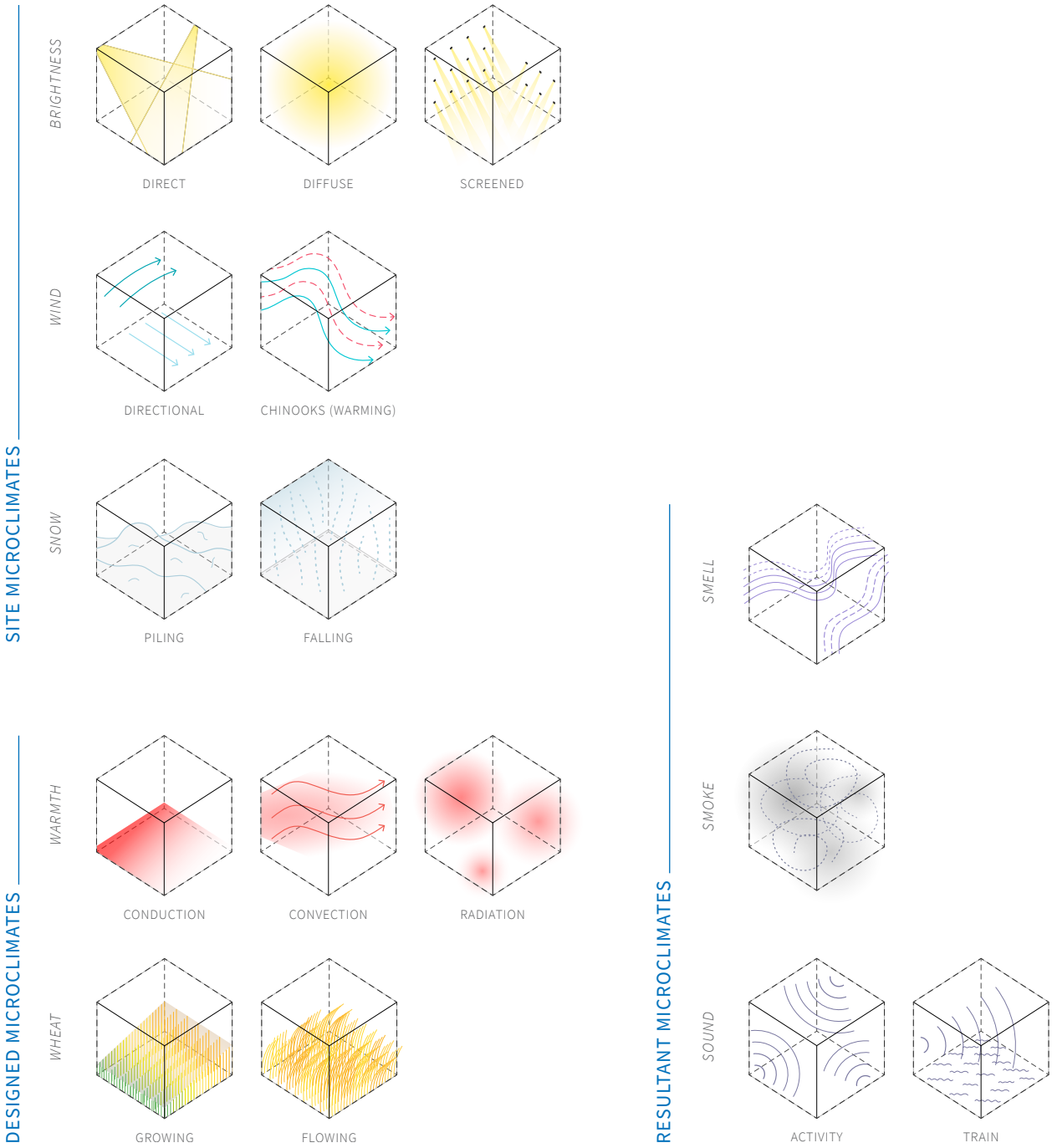


fig. 4.32 **Catalogue of microclimate components.**

The individual components can overlap, exclude, or amplify each other to form microclimates that then impact the movement, gathering, and experience of people within the project.

ENDNOTES

1 James W.P. Campbell and Will Pryce, *Brick: A World History* (New York: Thames & Hudson, 2003), 13.

2 Ibid.

3 Moulded bricks, which underwent significant development in Egypt, saw advancements in material composition and structural integrity due to the addition of straw and the fact that they were more uniform and straight-sided. Ibid., 26-29.

4 Ibid., 13.

5 Ibid., 16.

6 *Technical Notes on Brick Construction: Manufacturing of Brick* (Reston, Virginia: The Brick Industry Association, 2006), 5, accessed Jan 18, 2019, https://www.gobrick.com/docs/default-source/read-research-documents/technicalnotes/9-manufacturing-of-brick.pdf.

7 Sandalack, *The Calgary Project,* 17.

8 "Sandstone Quarries," The City of Calgary, accessed February 7, 2019, http://www.calgary.ca/CS/CPB/Pages/Projects-and-initiatives/Historic-City-Hall/SandstoneQuarries.aspx.

9 Canadian Geoscience Education Network, "Geoscape – Calgary: Sandstone City," Canadian Federation of Earth Sciences, accessed February 7, 2019, https://www.cgenarchive.org/calgary-sandstone.html.

10 Glenbow Museum, *Calgary Pressed Brick and Sandstone Company plant, Brickburn, Alberta (Image No. NA-5392-5)*, 1916-1920, Glenbow Museum, Calgary, Alberta, http://ww2.glenbow.org/search/archivesPhotosResults.aspx?TN=IMAGEBAN&AC=QBE_QUERY&RF=WebResults&QF0=File+number&QI0=NA-5392-5.

11 Other bricks could have come from the Redcliff Pressed Brick Company, which opened in 1912 and is located 300km southeast of Calgary in Redcliff, Alberta.

12 The following climate data for Calgary was retrieved from Environment and Climate Change Canada, "Canadian Climate Normals 1981-2010 Station Data – Calgary Int'l A," Government of Canada, accessed February 1, 2019, http://climate.weather.gc.ca/climate_normals/index_e.html.

13 Calgary experiences about 25 Chinook days from December to February each year. See John Gibson, "How chinook winds bring warmth to southern Alberta," *CBC News,* February 14, 2017, https://www.cbc.ca/news/canada/calgary/calgary-chinook-valentines-day-record-high-torneby-environment-canada-1.3982463.

14 Fernández-Galiano, *Fire and Memory*, 8.

15 Reyner Banham, *The Architecture of the Well-Tempered Environment,* 2nd ed. (Chicago: The University of Chicago Press, 1984), 19.

16 Ibid., 19-20.

17 Sean Lally, *The Air From Other Planets: A Brief History of Architecture to Come* (Zürich: Lars Müller Publishers, 2014), 11.

18 Ibid., 57.

19 Ibid., 65.

20 Gilles Clément and Philippe Rahm, *Environ(ne)ment: Approaches for Tomorrow,* ed. Giovanna Borasi (Montreal: Canadian Centre for Architecture, 2006), 155.

21 Information regarding oven firing and cooling times is based on anecdotal information retrieved from the Forno Bravo Wood Fired Ovens community forum (https://community.fornobravo.com). Variations in the construction, size, and purpose of the ovens make it impossible to provide exact timeframes, hence a range of heating and cooling times are given.

22 Charles Xie, "Energy 2D: Interactive Heat Transfer Simulations for Everyone," The Concord Consortium, accessed December 8, 2017, http://energy.concord.org/energy2d/.

23 Lally, *The Air From Other Planets*, 36.

24 Reinhart, *The Bread Baker's Apprentice,* 62.

25 Ken Forkish, *Flour Water Salt Yeast: The Fundamentals of Artisan Bread and Pizza* (Berkeley, California: Ten Speed Press, 2012), 51.

26 Reinhart, *The Bread Baker's Apprentice,* 87-88.

27 The primary enzymes at work in bread are amylase (which break down complex starch molecules) and, to a lesser extent, protease (which break up small amounts of gluten to make the dough more workable). See Emily Buehler, "Enzymes: The Little Molecules That Bake Bread," *Scientific American,* last modified September 28, 2012, https://blogs.scientificamerican.com/guest-blog/enzymes-the-little-molecules-that-bake-bread/.

28 Forkish, *Flour Water Salt Yeast,* 123, 127.

29 B. Frick and E. Johnson, "Crop Rotations for Organic Systems," Dalhousie University, accessed February 4, 2019, https://www.dal.ca/faculty/agriculture/oacc/en-home/resources/pest-management/weed-management/organic-weed-mgmt-resources/weeds-crop-rotation.html.

30 Alberta crop reports were used as a reference for harvest dates. The reports note significant differences in harvest dates from the north to the south regions of the province. See "Alberta Crop Report," Government of Alberta – Ministry of Agriculture and Forestry, accessed March 28, 2019, https://open.alberta.ca/dataset/2830245.

part five

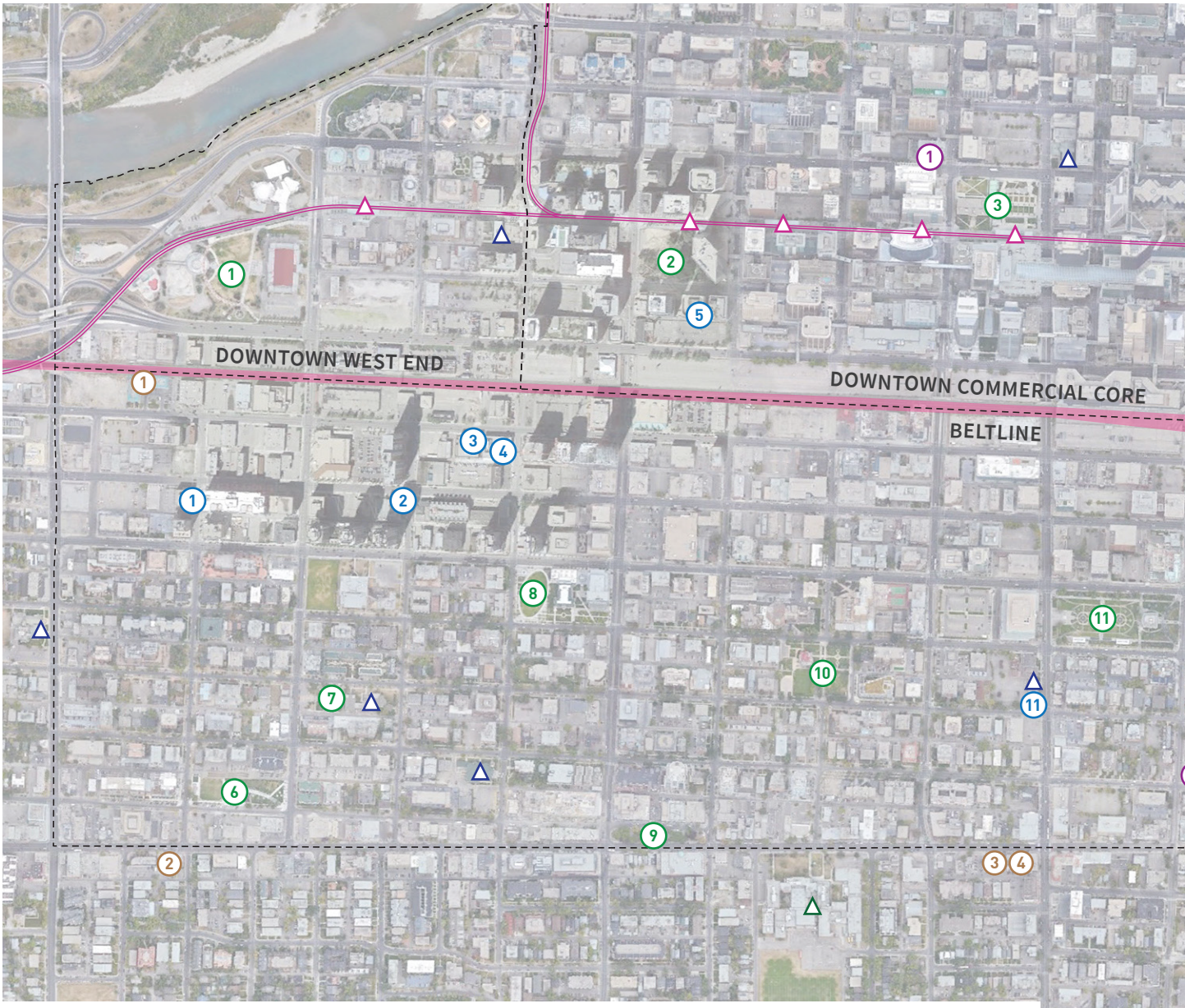
DESIGN PROPOSAL

DESIGN PROPOSAL

SITE ANALYSIS

The chosen site sits at the northernmost edge of the Beltline neighbourhood in Calgary's Centre City, and exists at the intersection of a diverse set of conditions (*fig. 5.1*). Its proximity to the densely built Downtown Commercial Core, growing East Village, and neighbourhoods with high immigrant population percentages (*see Water, fig. 3.15*) position it as an ideal site for the goals of inclusivity, accessibility, and challenging urban form, as described in the previous chapters. Its location and role in the city fulfills the promise of the old railway station as an entry point into the city for new populations.

The primary project site is on the south side of the Canadian Pacific Railway tracks that run east-west through this part of the city (*fig. 5.2*). The CPR tracks still see heavy usage, with approximately 22 - 27 freight trains passing through the area in a 24-hour period (per email correspondence with the CPR Community Connect department), many of them carrying wheat across the country. A secondary site on the north side of the tracks allows the proposal to bridge the Beltline and Downtown neighbourhoods across the railway. Both sites are currently parking lots, but a significant amount of parking exists in a structure one block to the west, as well as further west along the railroad tracks and southeast towards the Stampede grounds. The loss of these two sites as parking lots is unlikely to impact the sufficient amount of parking in the area.



FOOD ACCESS

1 Good Food Box depot
2 Stephen Avenue Farmers' Market
3 Salvation Army
4 Mustard Seed
5 Inn From The Cold
6 Jesus Loves You Society
7 St. Mary's Cathedral

SOCIAL SERVICES

1 Canadian Red Cross
2 Calgary Catholic Immigration Society
3 Alberta Supports Centre
4 Calgary Urban Project Society (CUPS)
5 Creative Community Living Activities
6 Calgary Immigrant Women's Foundation
7 YWCA Calgary
8 Career Connection Employment Centre
9 Calgary Homeless Foundation
10 Safe Communities Opportunity and Resource Centre
11 Calgary International Learning Centre
12 Mustard Seed Wellness Centre
13 Kids Up Front Calgary
14 Safe House Youth Shelter
15 Calgary Alpha House

BREAD

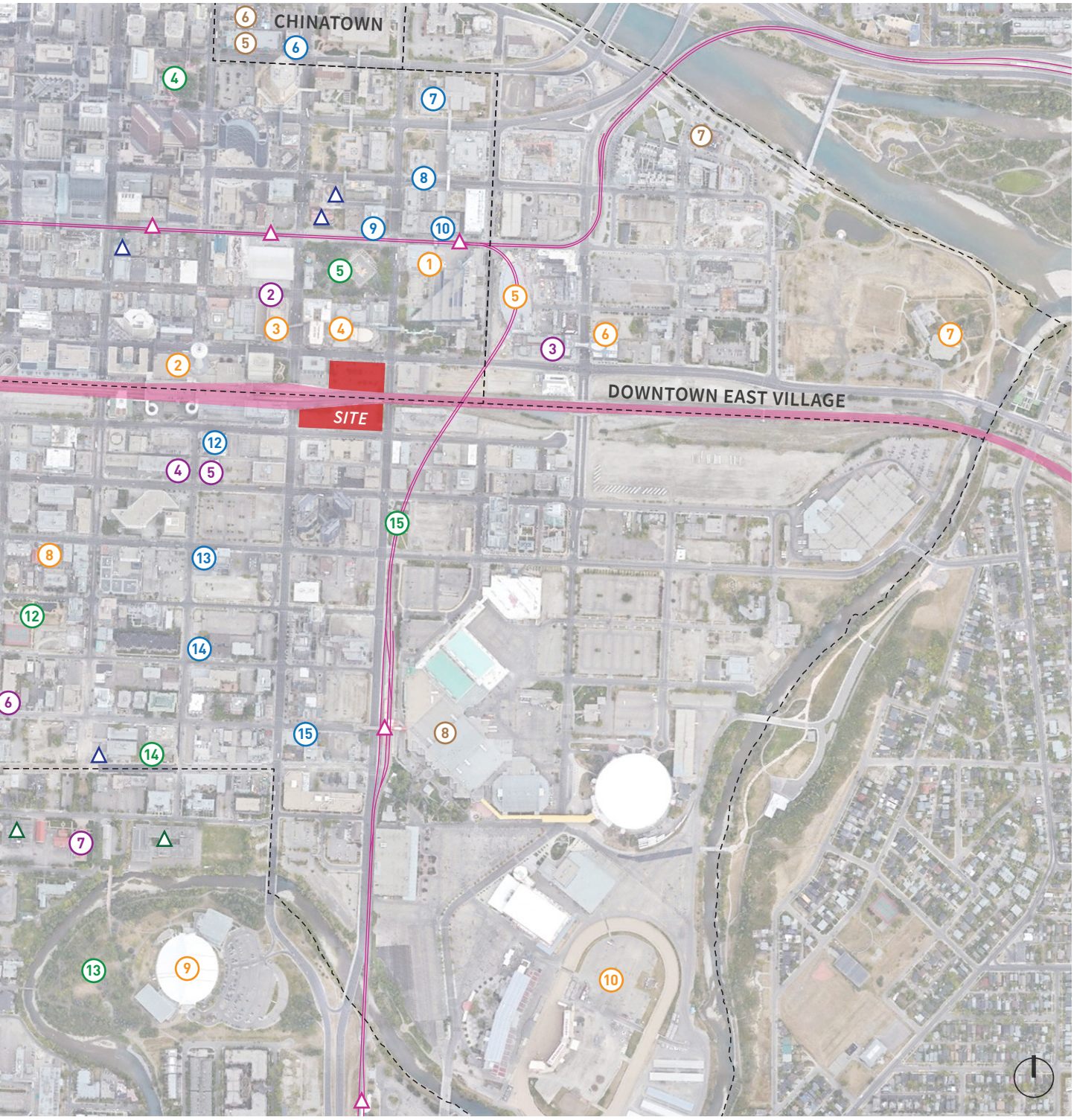
1 Korean Bakery (Korean)
2 Rustic Sourdough Bakery & Deli (European)
3 Saj Bakery (Lebanese)
4 European Bakery & Deli (Eastern European)
5 Rainbow Bakery (Chinese)
6 Diamond Bakery (Chinese)
7 Sidewalk Citizen Bakery (multiple)
8 Grain Academy & Museum

PARK/GREEN SPACE

1 Shaw Millennium Park
2 Century Gardens
3 Harley Hotchkiss Gardens
4 James Short Park
5 Olympic Plaza
6 Thomson Family Park
7 Connaught Park
8 Barb Scott Park
9 Tomkins Park
10 The Lougheed House
11 Central Memorial Park
12 Haultain Park
13 Lindsay Park
14 Humpy Hollow Park
15 East Victoria Park

CULTURE/RECREATION

1 Calgary City Hall
2 Calgary Tower
3 Glenbow Museum
4 Theatre Calgary
5 Central Library
6 Studio Bell (National Music
7 Fort Calgary
8 Beltline Aquatic & Fitness C
9 Repsol Sport Centre
10 Stampede Park



Centre)

entre

RELIGIOUS BUILDING

SCHOOL

LRT STOP

LRT TRACKS

RAILWAY CORRIDOR

NEIGHBOURHOOD BOUNDARY

fig. 5.1 **Beltline programme and context analysis.**

A number of food access organizations and social services exist in the Centre City neighbourhoods that could use the site as a part of additional programming. The high volume of these supports also points to the prevalence of people in need.

The site provides another large "green" space and cultural/recreational programme for the people in this area.

Religious buildings and schools can also make use of the site for events or educational purposes.

fig. 5.2 **Site aerial view.**

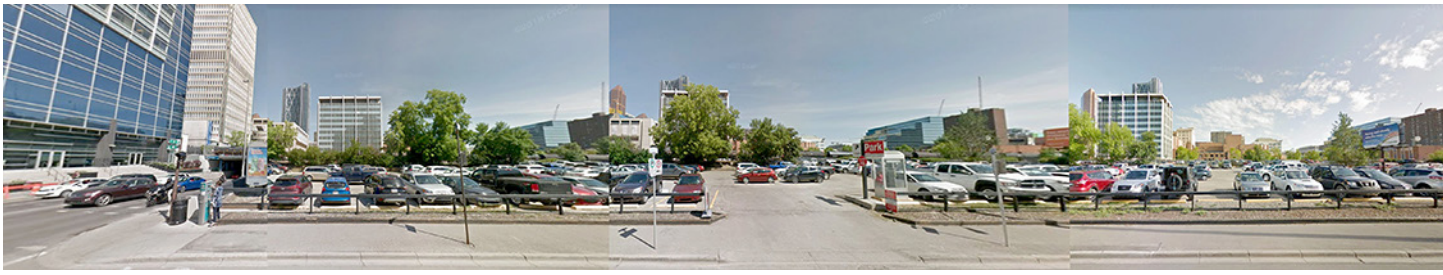


fig. 5.3 **Site context model, looking north. Project is at centre.**

fig. 5.4 **Site context model, looking south. Project is at centre.**

The majority of the area's tall buildings exist to the north and west of the site (towards the Downtown Core), while the building heights taper down to the east (towards the Elbow River) and south (further into the Beltline) (*figs. 5.3-5.4*). New condominium construction projects planned for both the East Village and Beltline neighbourhoods will alter this composition, but the Downtown Core will remain the tallest area of the city.

fig. 5.5 **Existing site elevation collage, looking north.**

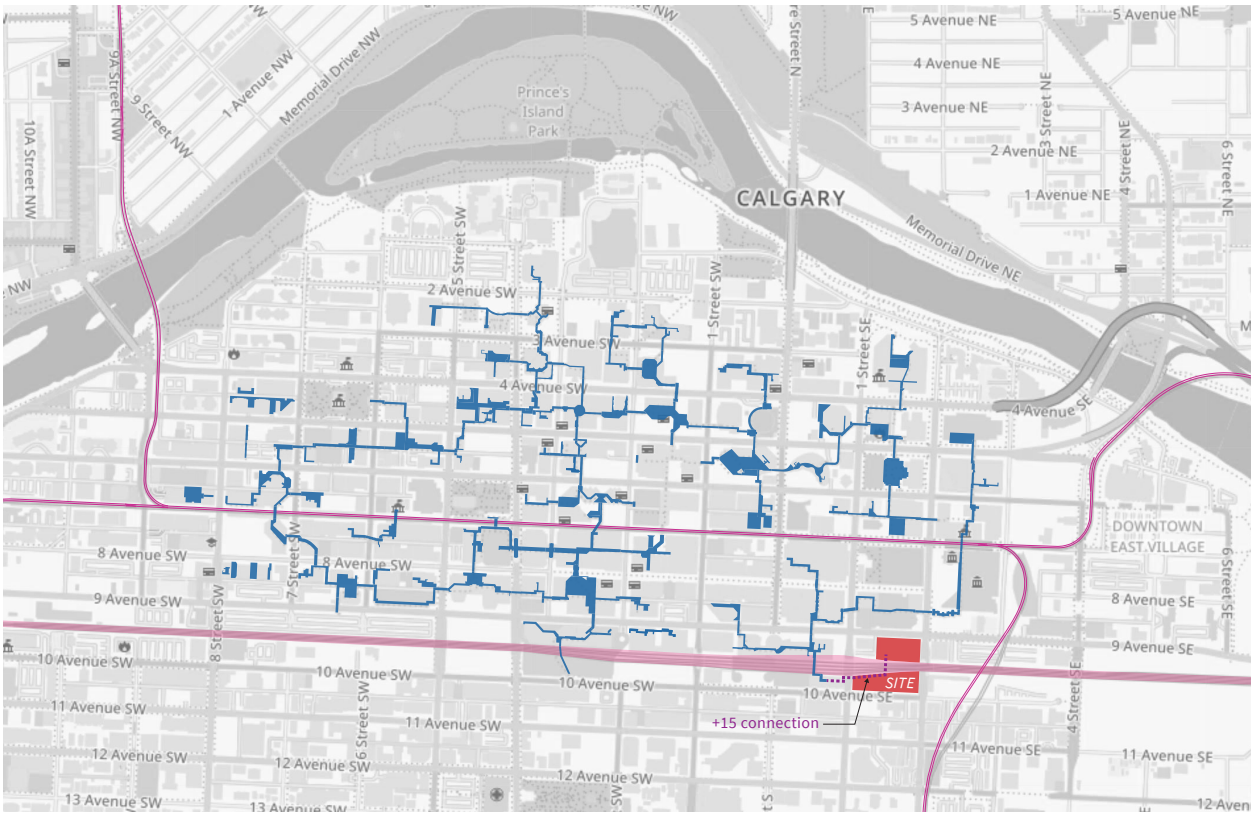


fig. 5.6 **Map of +15 network in downtown Calgary, with connection to project site.**

The sites are easily accessible by public transportation, with several bus routes and two CTrain stops located nearby, as well as the newly implemented Bus Rapid Transit (BRT) MAX Purple line. The 'Plus 15 (+15)' – Calgary's pedestrian network that links much of the Downtown Core through raised interior walkways – passes through the office tower directly west of the site, and provides another point of connection for the project (*fig. 5.6*).

DESIGN SUMMARY

fig. 5.7 **Project parti drawing.**

The form and organization of the project is drawn from the archetypes of the factory and the farm – two opposing models that are, nevertheless, both a part of the primary system of bread-making around the world. The standards of these entities are, however, challenged through their implementation on the site. The "factory" is morphed into a place where the operations are visible to the public and open to community involvement, while the "farm" finds a new place in the city and is scaled to human activity. The project, then, is simultaneously *both* factory and farm, and *neither* (*fig. 5.7*).

Starting from these two formal approaches that have different but equal value on the site, the public, community, and exterior programmes are laid out (*fig. 5.8*). "Public" is differentiated from "community" here in the programme's intention. Both are, of course, open to everyone in the city, but the spaces denoted as "public" aim to showcase a model for changes to the commercial bread-as-commodity system, as well as generate revenue to support the use of the site.

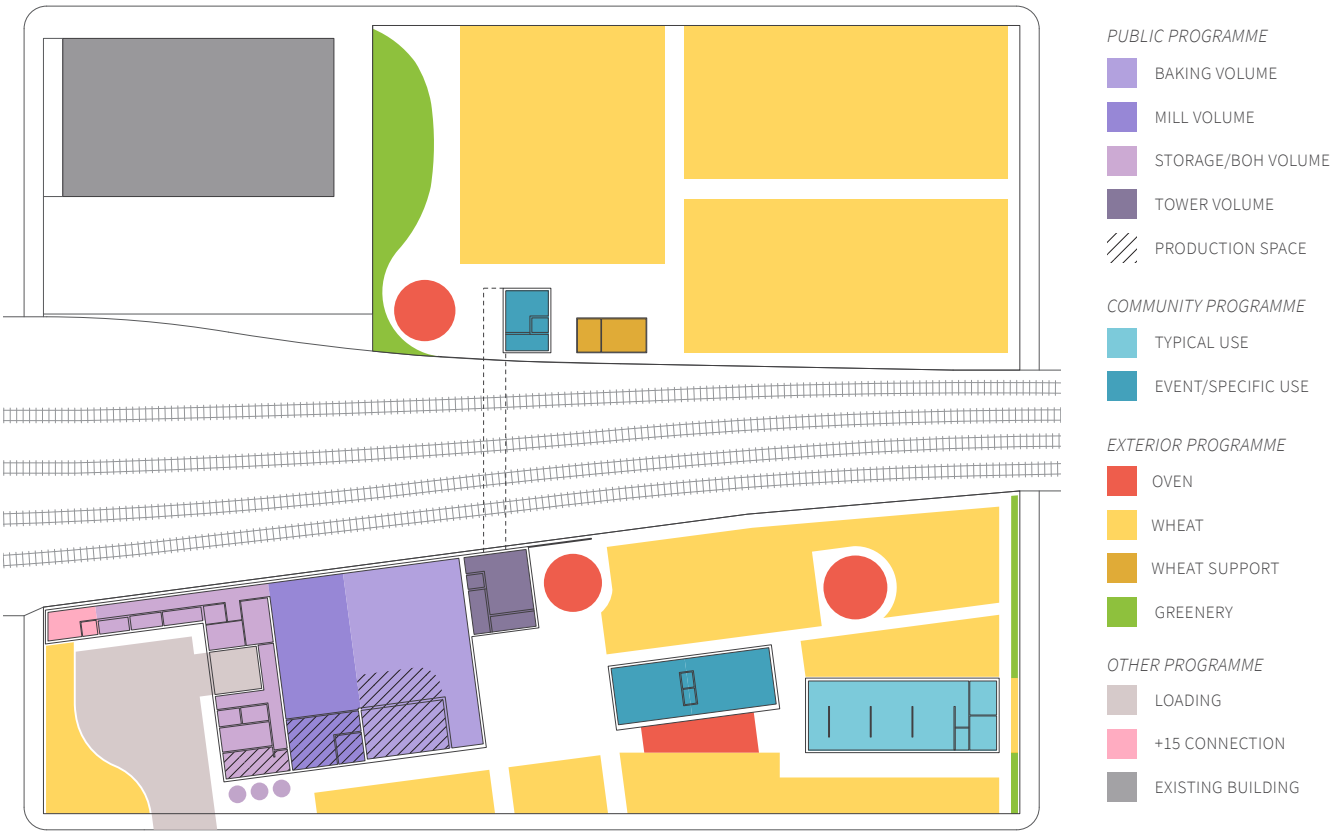


fig. 5.8 **Programme diagram.**

The design addresses a set of objectives that are drawn from the research and outlined in the initial thesis questions:

OBJECTIVE	*DESIGN APPROACH*
Communal ovens as generators of community and spaces for gathering	• The three outdoor communal ovens can be seen as individual "characters" that are distributed throughout the site and that generate unique social forms and collaborative spaces. By placing the ovens outside, they are accessible to anyone at any time. • Workspaces and storage in adjacent buildings make the ovens more functional, and extend the space of gathering and participation for community members and the public.
Engage with and reflect social and cultural diversity	• The different communal ovens allow for a range of bread types to be baked, and present opportunities to learn from and engage with other people and cultures. • The site and building are accessible (location, barrier-free design), ensuring that no social group is excluded. • The project can partner with existing support services in the Centre City neighbourhoods to extend the reach, effectiveness, and diversity of their programs.
Visibility of bread-making process	• Placing the spaces for milling and baking at the front of the production building creates visibility for these processes. This both educates the public and allows for intervention and innovation. • A range of public commercial and community programmes allow for varying levels of participation in bread-baking and in the broader changes surrounding bread in the city.
Multi-sensory, human-scaled experience	• Wheat fields are scaled down and planted to create a varied and direct experience of wheat and its growth. • The interior and exterior ovens create unique microclimates involving heat, smell, and sound.
Support local food systems and improve food security in the city	• Regional and sustainable flour and bread production is achieved through the project's small-scale community-focused operations. • A market on site allows farmers and local businesses to sell their products, thereby strengthening the local economy.
Challenge urban form	• Silos, wheat, chimneys, and smoke challenge our preconceptions of urban form and experience, and create recognizable forms throughout the city.
Physical and material connection to Calgary	• The building connects to the existing +15 pedestrian network, and provides an overpass across the railway. • Brick is the primary building material for the project and its varied colours and uses tie into Calgary's historical building stock.

fig. 5.9 **Approaching the site, walking west.**

CENTRE CITY BAKEHOUSE AND MILL

The project is generally organized following the parti diagram. The more public and production spaces (factory) exist on the west half of the site, while the smaller scale community spaces and the majority of the wheat fields (farm) are on the east half. A central brick plaza connects the various programmes.

The production building is arranged according to three main volumes: the baking volume, the mill volume, and the back-of-house or storage volume. At the front of each of these volumes is the primary programme associated with them, providing visibility into these production spaces from the street and keeping the building constantly animated.

The smaller community buildings sit amongst the fields of wheat, and are closely connected to the exterior ovens.

The exterior communal ovens are distributed throughout the site, and the spaces around them are designed to emphasize and support their use. Wheat fields are planted not as monolithic entities, but with small and large paths throughout that allow for varying degrees of closeness and a range of experiences.

GROUND LEVEL

1 Elevator to +15 Network
2 Waste Bins
3 Waste Room
4 Market Storage
5 Loading Dock
6 Walk-in Freezer
7 Walk-in Fridge
8 Kitchen Storage
9 Mill Storage
10 Grain Silos
11 Mill Room
12 Kitchen + Dough Room
13 Interior Oven Workspace
14 Flex Market
15 Permanent Market
16 Dining Area
17 Tool Rental and Bulk Ingredients
18 Bridge to North Site Above
19 Outdoor Cob Dome Oven
20 Brick Plaza
21 Event Kitchen
22 Workshop
23 Outdoor Barrel Vault Brick Oven
24 Community Kitchens
25 Dining Hall
26 Outdoor Tandoor Oven

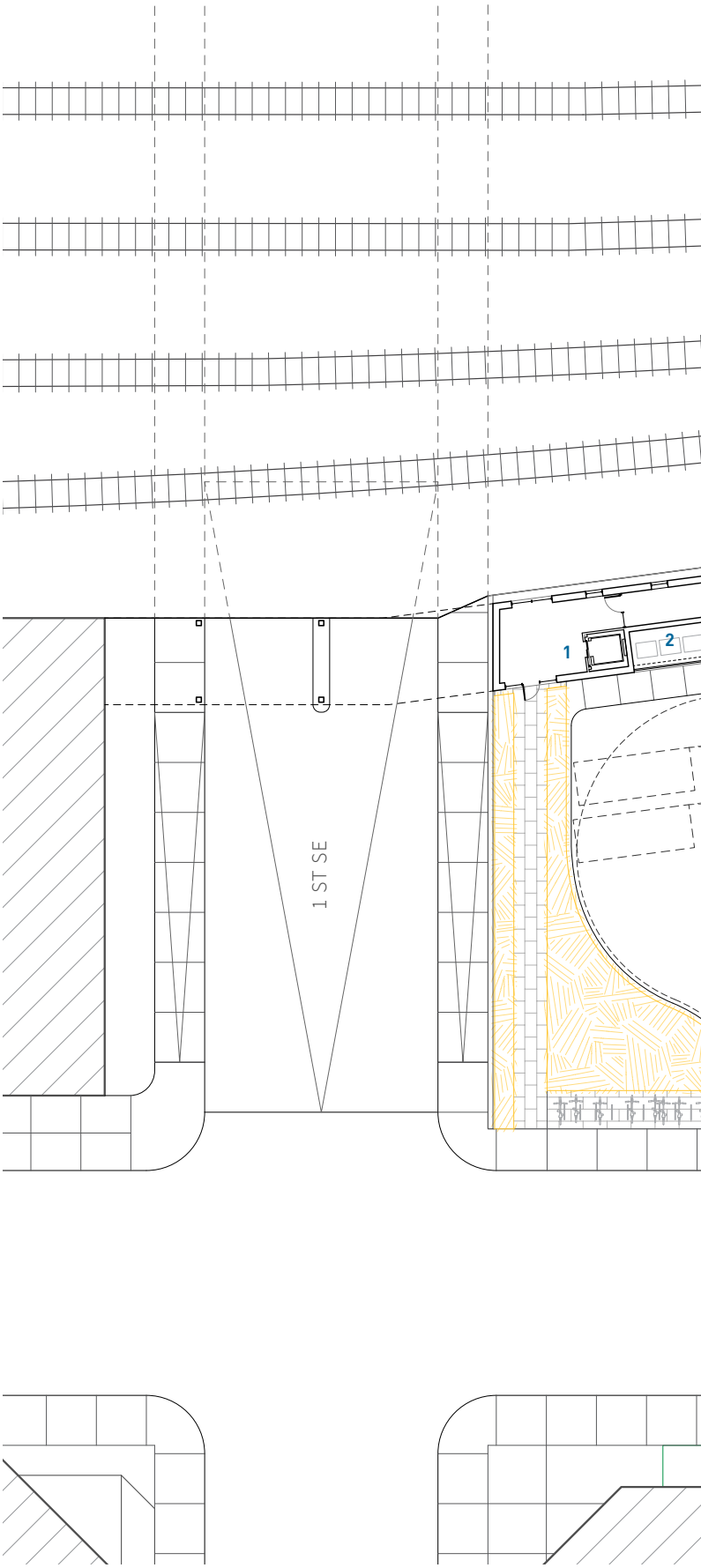
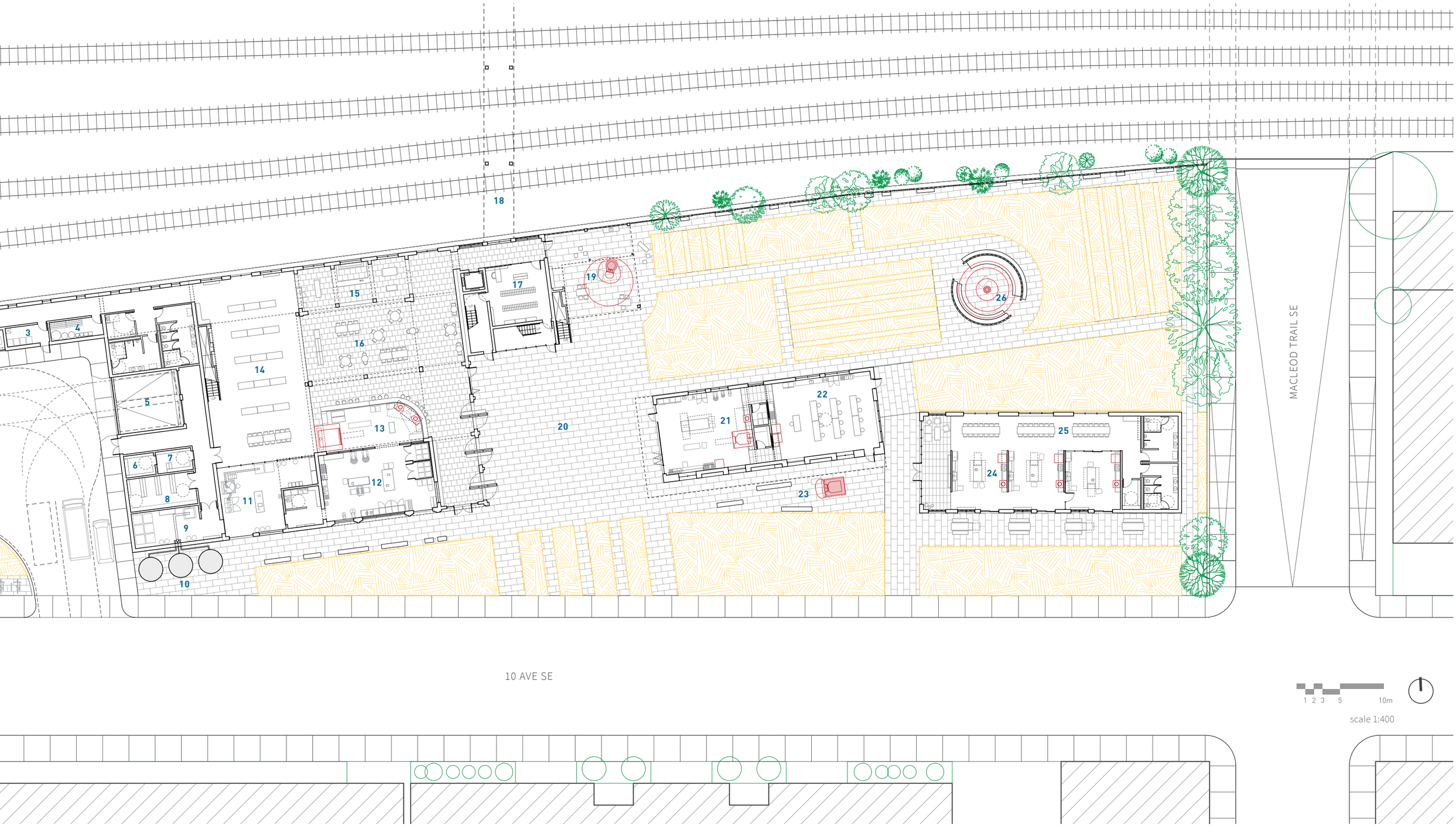


fig. 5.10 **Ground level floor plan.**


18
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26
MACLEOD TRAIL SE
10 AVE SE
1 2 3 5 10m
scale 1:400

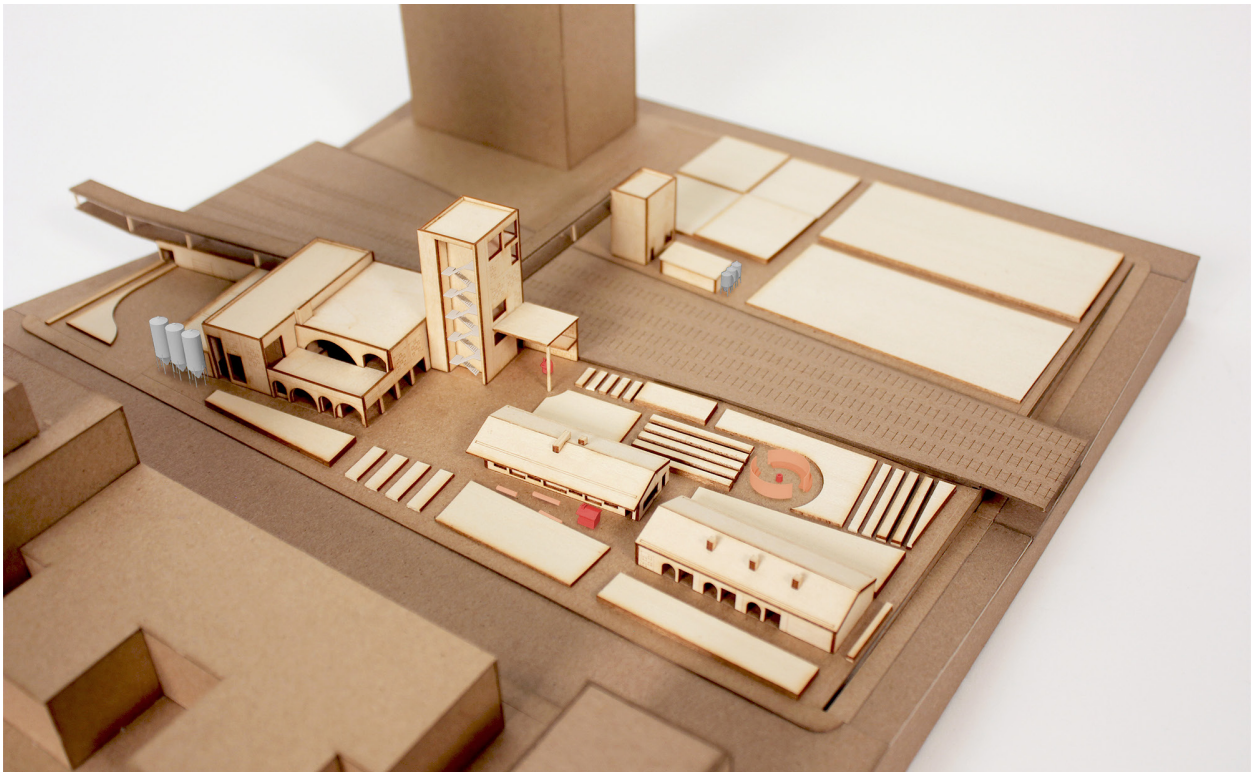


fig. 5.11 **Site model, looking north-west.**

See *Appendix* for additional site model photos.

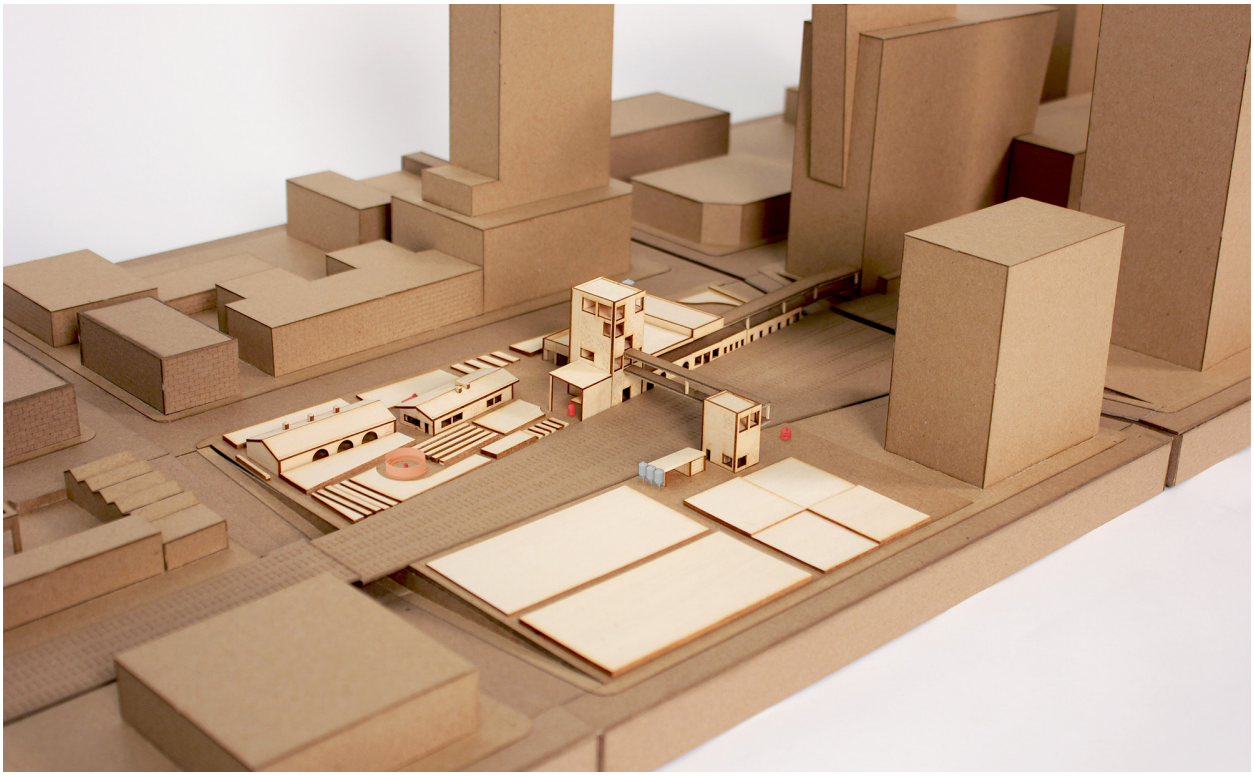


fig. 5.12 **Site model, looking south-west.**

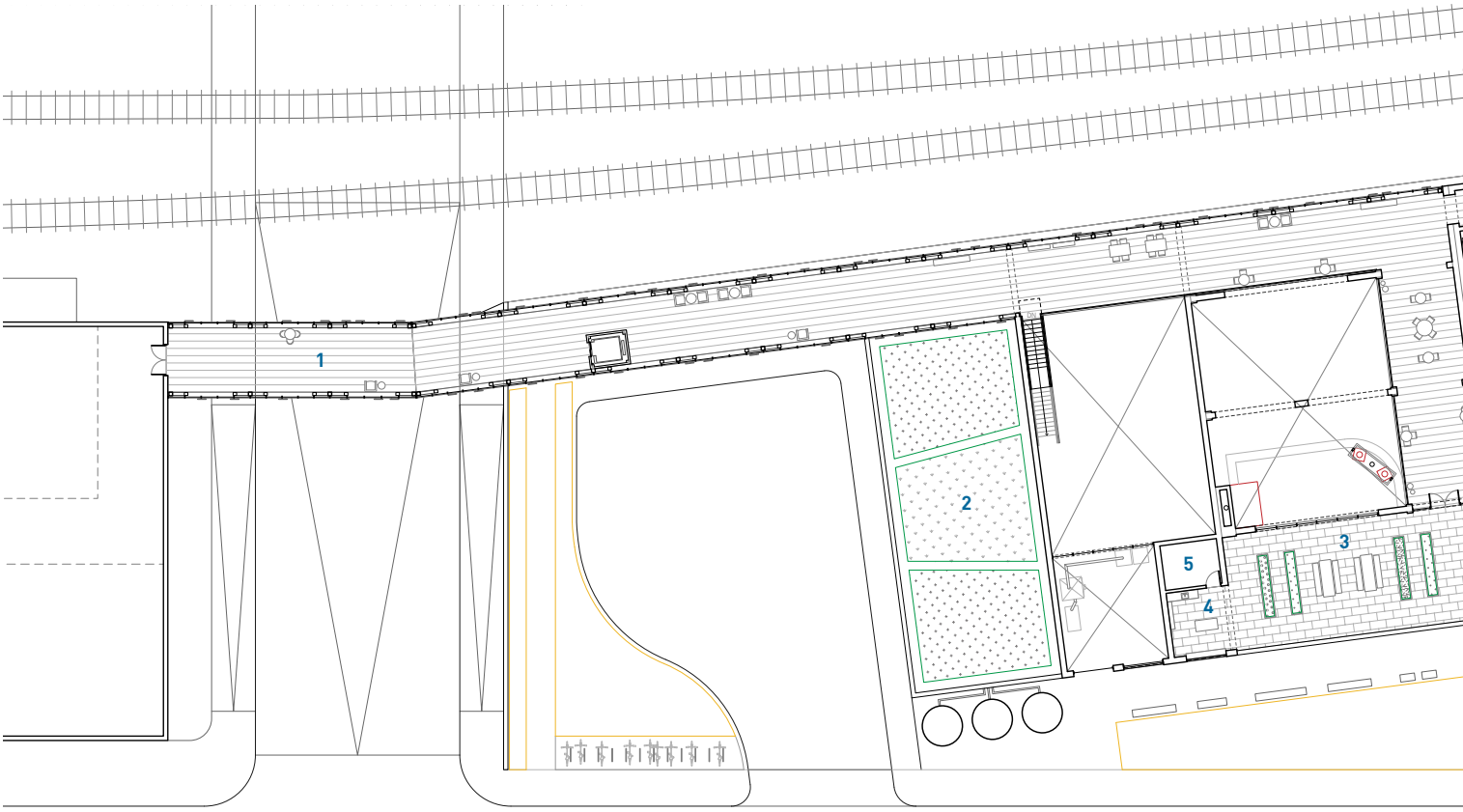


fig. 5.13 **Second level floor plan.**

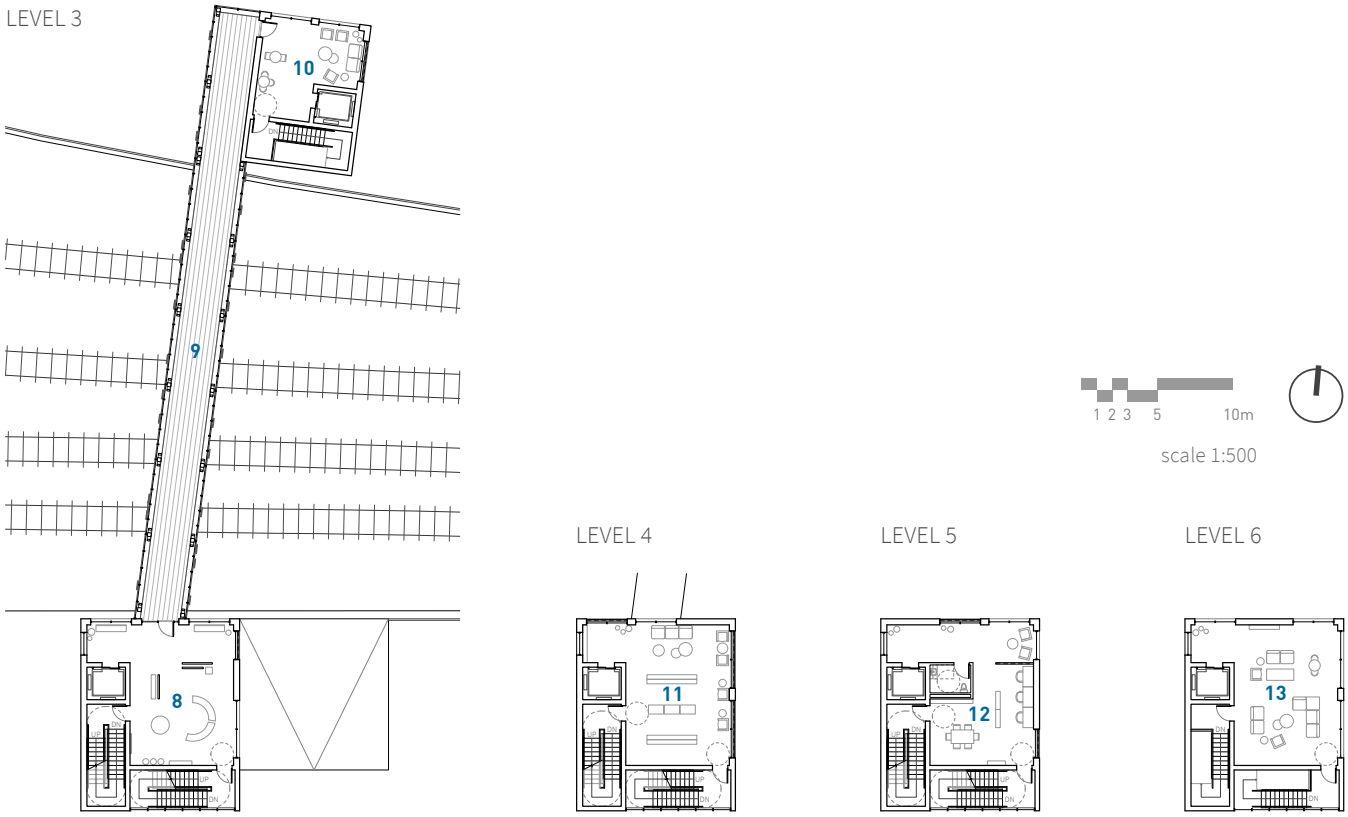
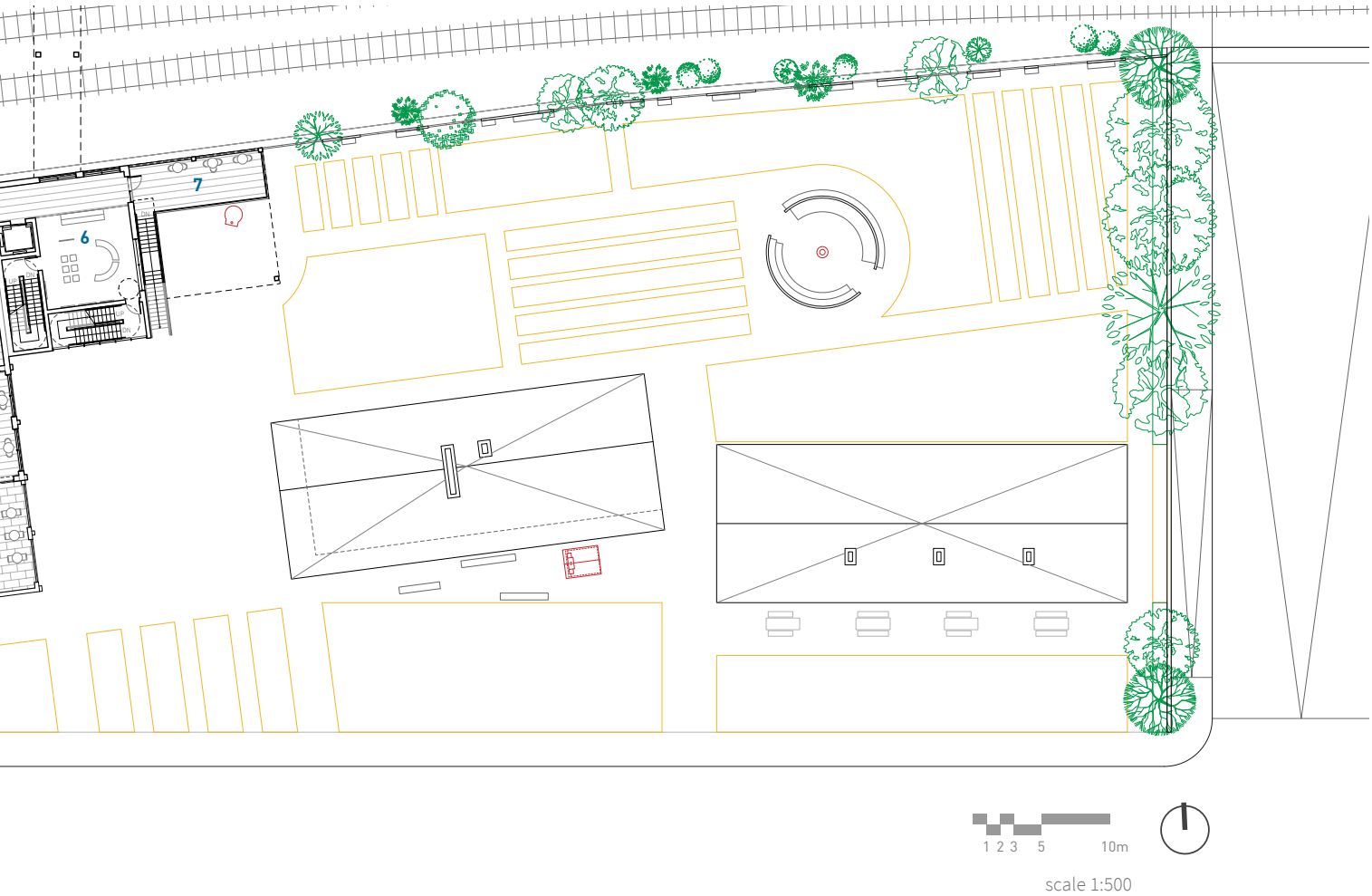


fig. 5.14 **Tower level floor plans.**



SECOND LEVEL

1 +15 Walkway Connection
2 Inaccessible Green Roof
3 Accessible Roof
4 Roof Workspace
5 Roof Storage
6 Exhibition Space
7 Exterior Deck Above Cob Oven

The second level provides a connection to the +15 network, as well as additional seating space. The accessible roof can be used for events, and is another level at which to view the wheat fields and activities on site.

TOWER LEVELS

8 Exhibition Space
9 Bridge to North Site
10 Observation Level
11 Cookbook Library
12 Office
13 Observation Level

The tower is modelled after the dimensions of a typical wooden grain elevator, and contains additional community and operational programmes. A cookbook library contains cuisines from all cultures, and the exhibition spaces can display information about the site or curated works from the community. A bridge to the north site is accessible from Level 3, and observation decks exist at Levels 3 (north site) and 6, providing another vantage point for the site and a clear view east along the railway.

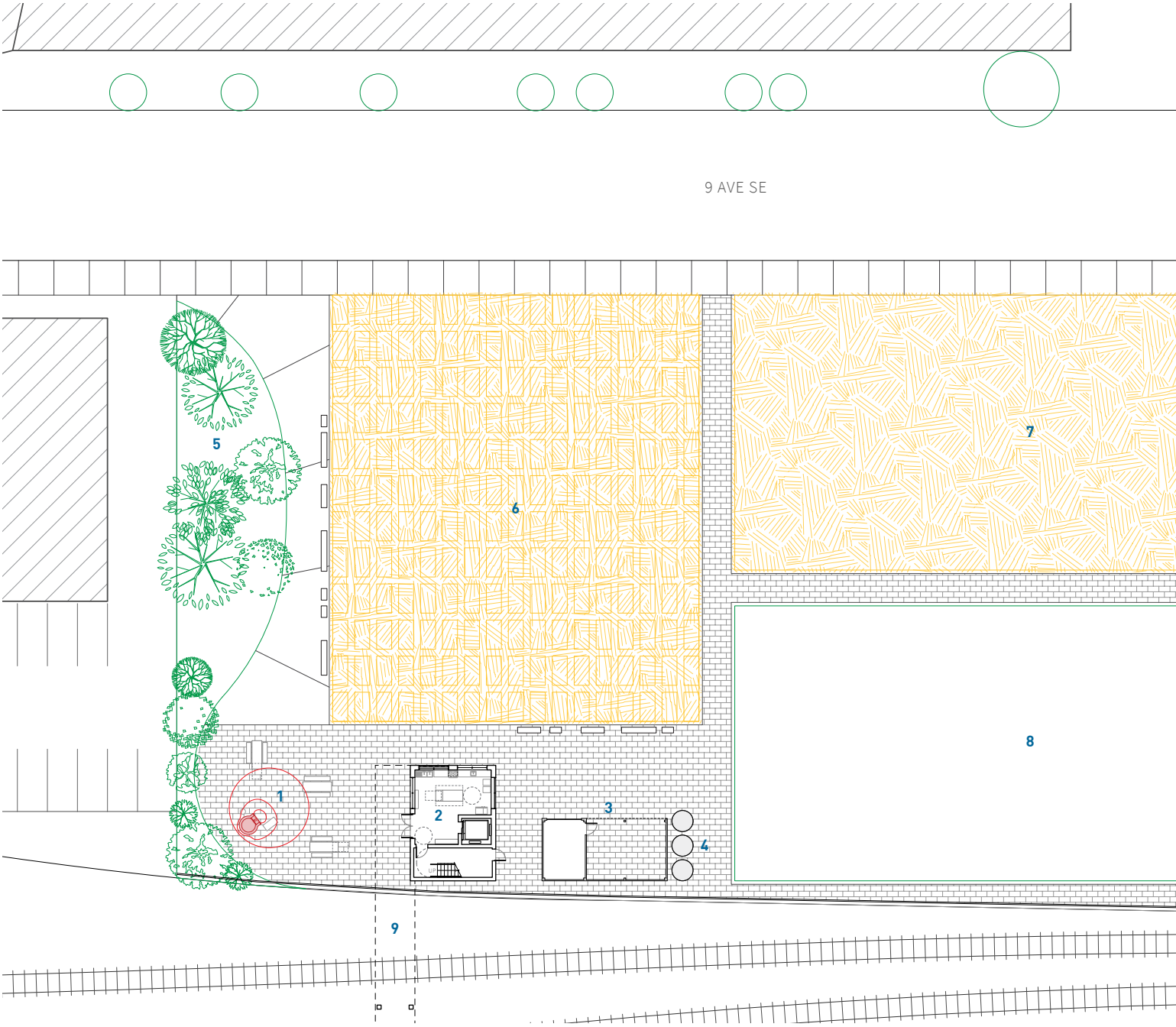


fig. 5.15 **North site – ground level floor plan.**

NORTH SITE

1 Outdoor Brick Dome Oven
2 Oven Kitchen
3 Equipment Storage Shed
4 Grain Silos
5 Existing Park
6 Wheat Test Plots
7 Wheat Field
8 Crop Rotation Field
9 Bridge to Main Site Above

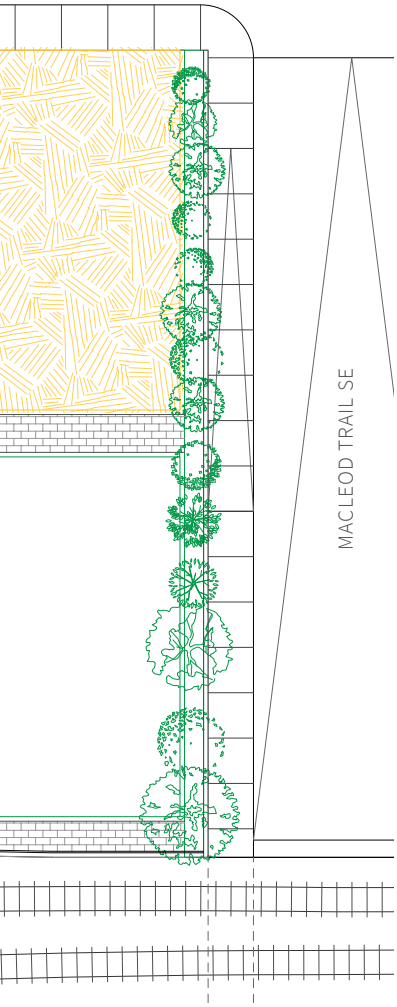


fig. 5.16 **The north site is primarily occupied by wheat.**

Curved glulam columns in the railway overpass mimic forms on the main site and iterate on the structure of typical +15 bridges in the city.

scale 1:500

The north site is focused on larger plantings of wheat, and creates a more dramatic intervention of wheat fields into the urban context, with the railway as a backdrop. The test plots feed back into research happening at a larger scale outside of the city. A storage shed houses equipment used for harvesting and maintenance.

An additional communal oven with a simple kitchen and prep space also exists on the site, and is a model for the propagation of smaller-scale projects.

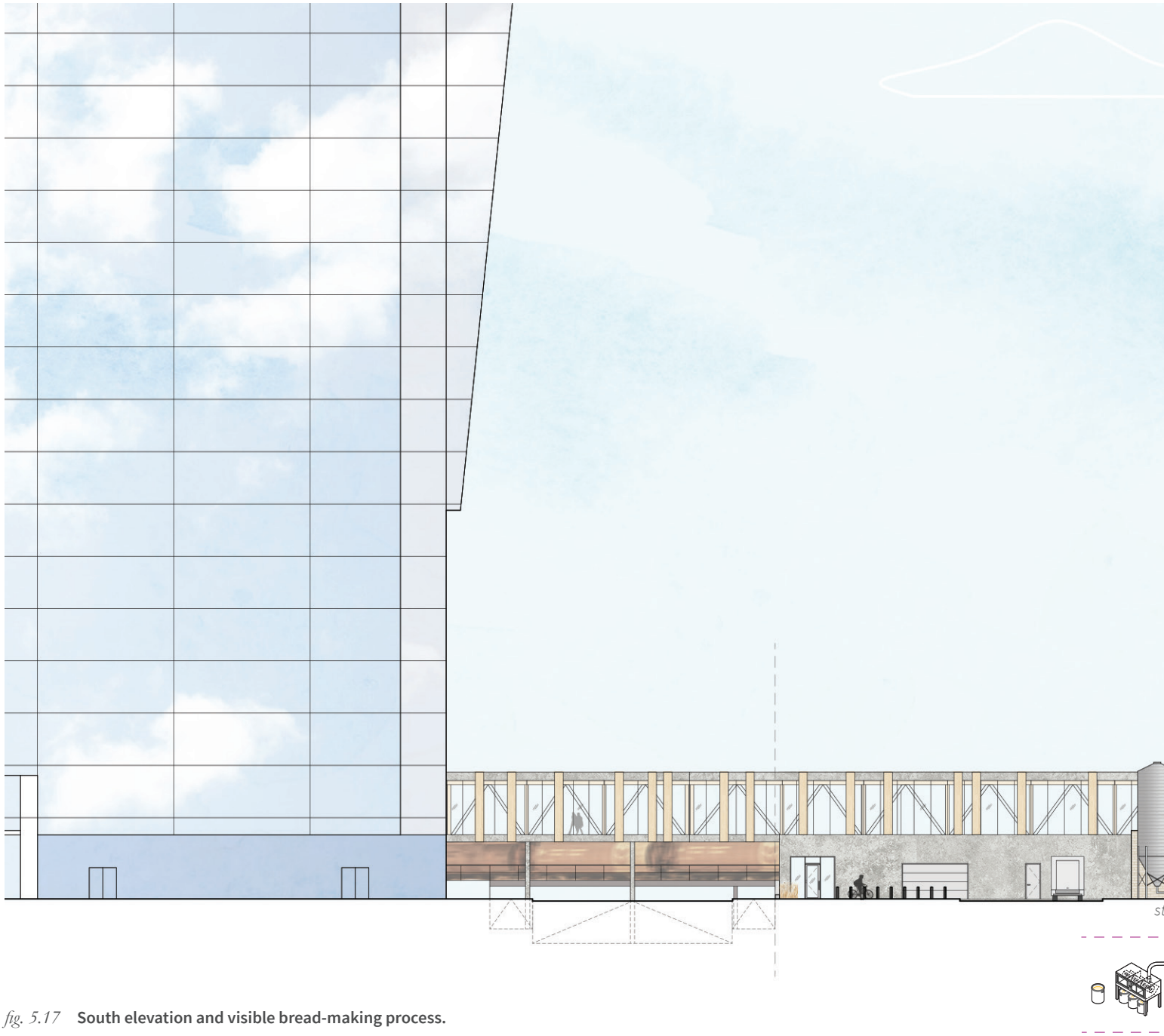
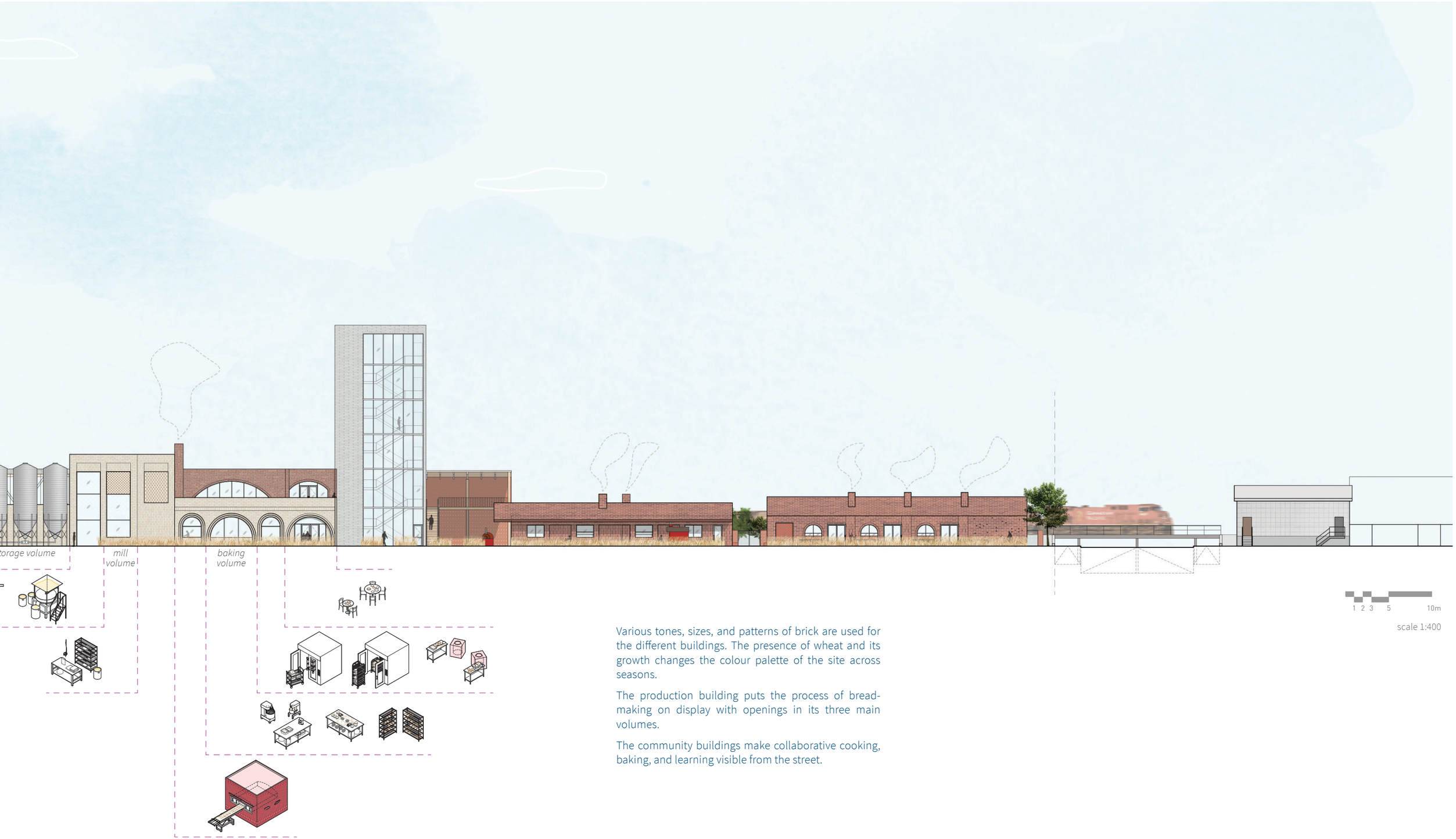


fig. 5.17 **South elevation and visible bread-making process.**

See *Salt, fig. 4.27* for a visualization of the full bread-making process.



Various tones, sizes, and patterns of brick are used for the different buildings. The presence of wheat and its growth changes the colour palette of the site across seasons.

The production building puts the process of bread-making on display with openings in its three main volumes.

The community buildings make collaborative cooking, baking, and learning visible from the street.

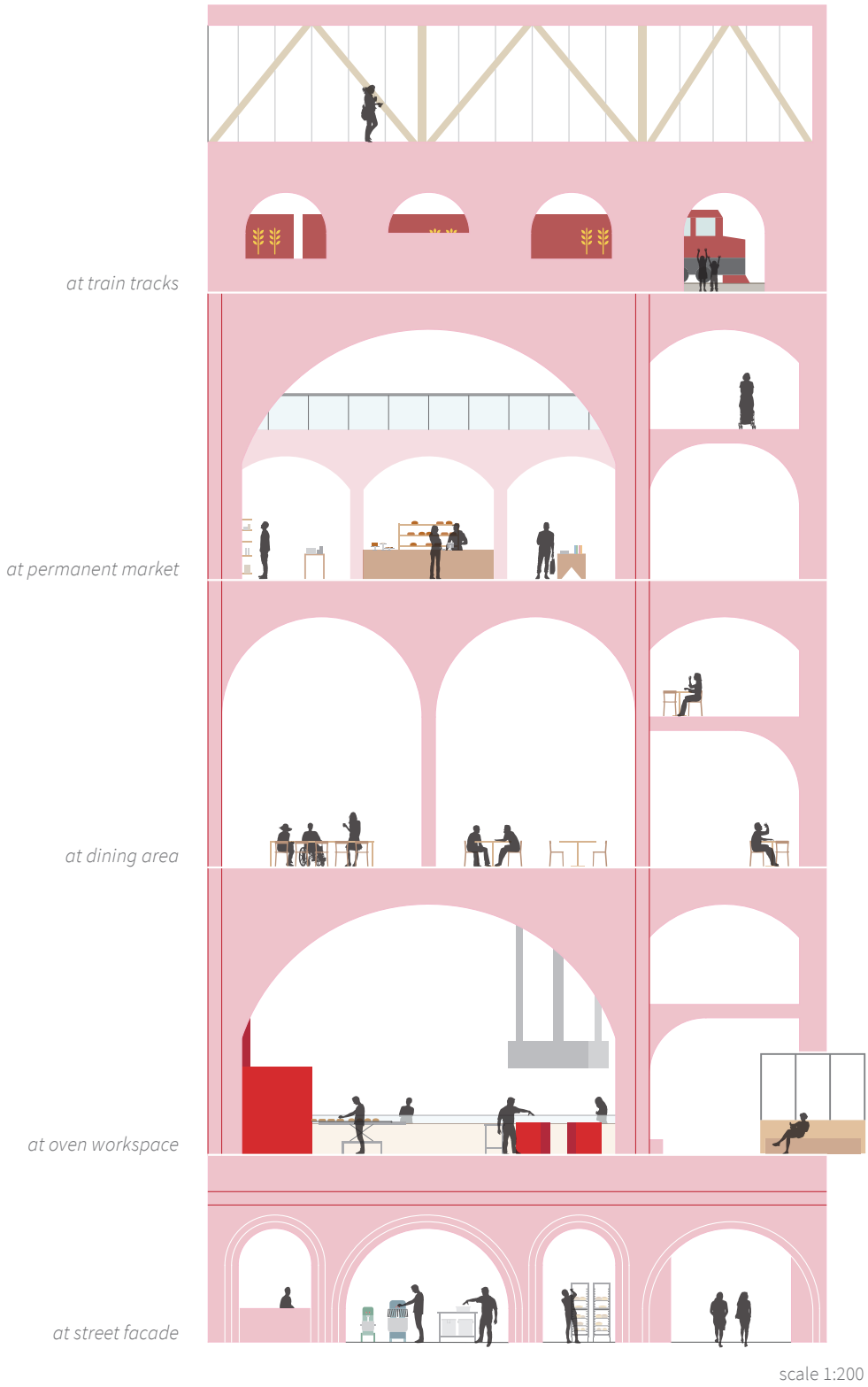
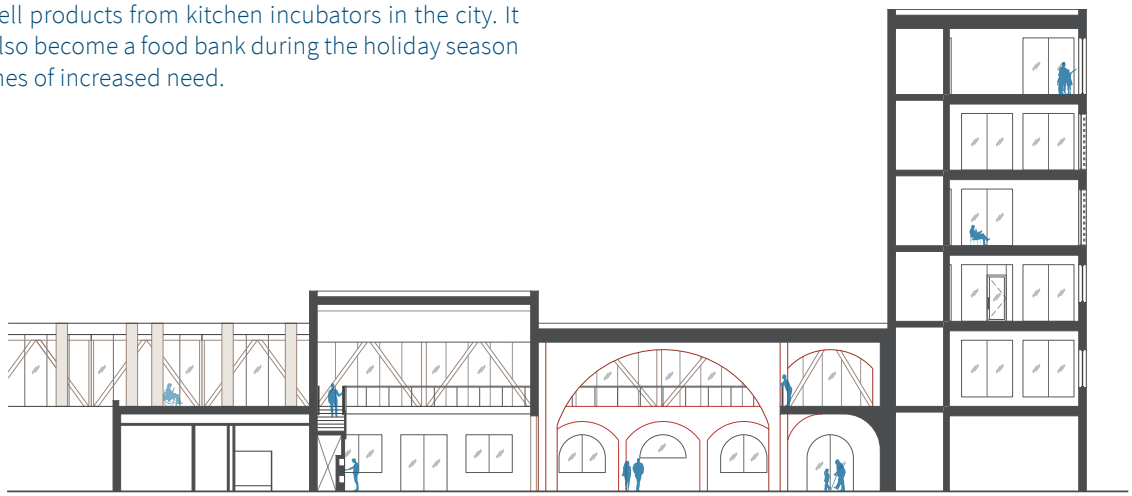


fig. 5.18 **Sections at arches moving north through the baking volume.**

The baking volume is divided into its programmatic functions by the varying brick arches. The openness of the arches maintains visibility across spaces and to the bread-making process.

The mill and bakery are economic drivers on the site. The mill provides flour for the communal kitchen, but also to nearby bakeries and home bakers through the permanent market. The permanent market also sells unmilled grains, home baking equipment, and baked goods produced on site.

The flex market provides space for farmers' markets and can sell products from kitchen incubators in the city. It can also become a food bank during the holiday season or times of increased need.



scale 1:400

fig. 5.19 **Section through the storage, mill, baking, and tower volumes.**

fig. 5.20 **Mill volume – the mill's iconic forms and functional needs are on display behind glazing.**

fig. 5.21 **Experience at the cob dome oven.**

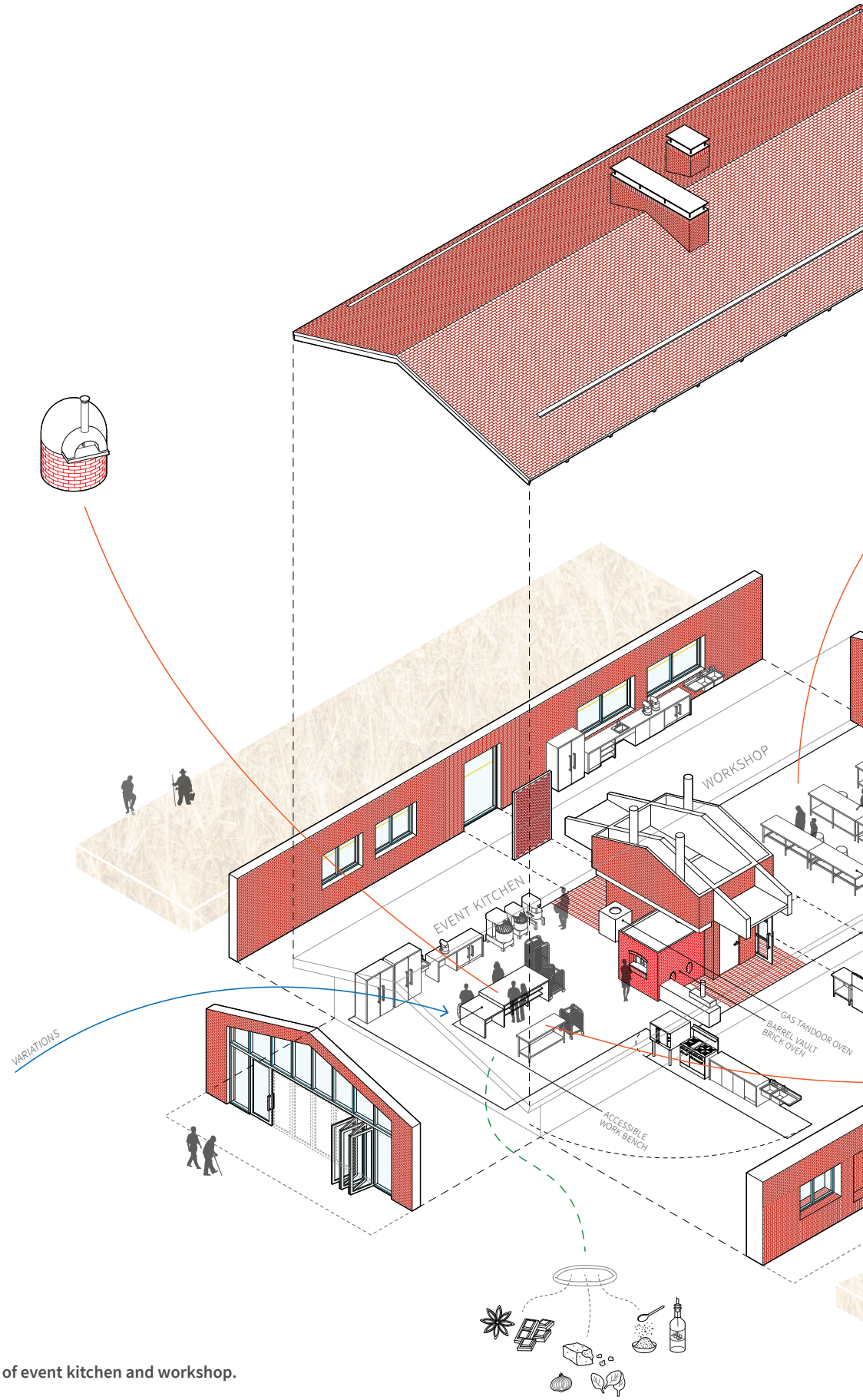
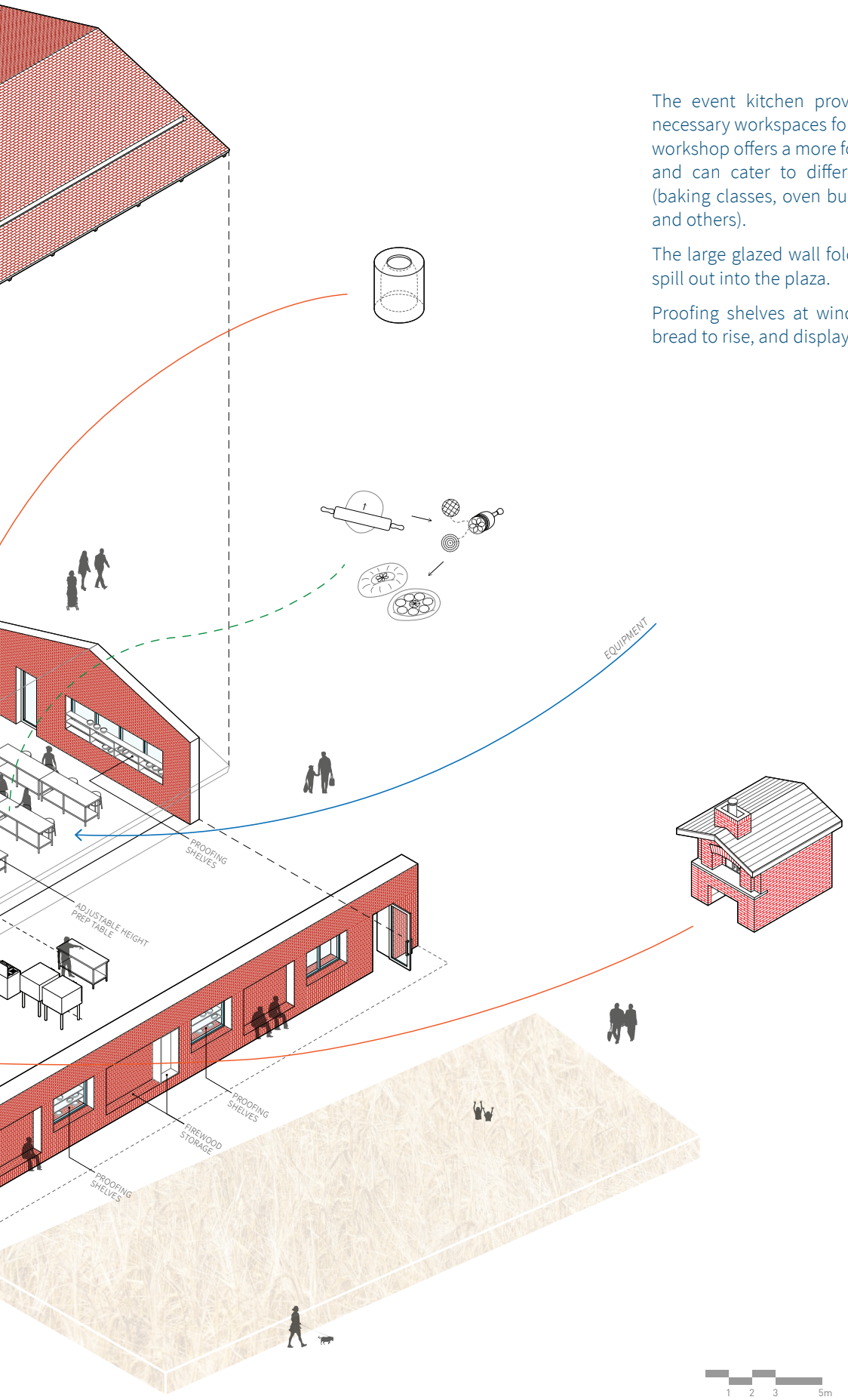


fig. 5.22 **Exploded axonometric of event kitchen and workshop.**

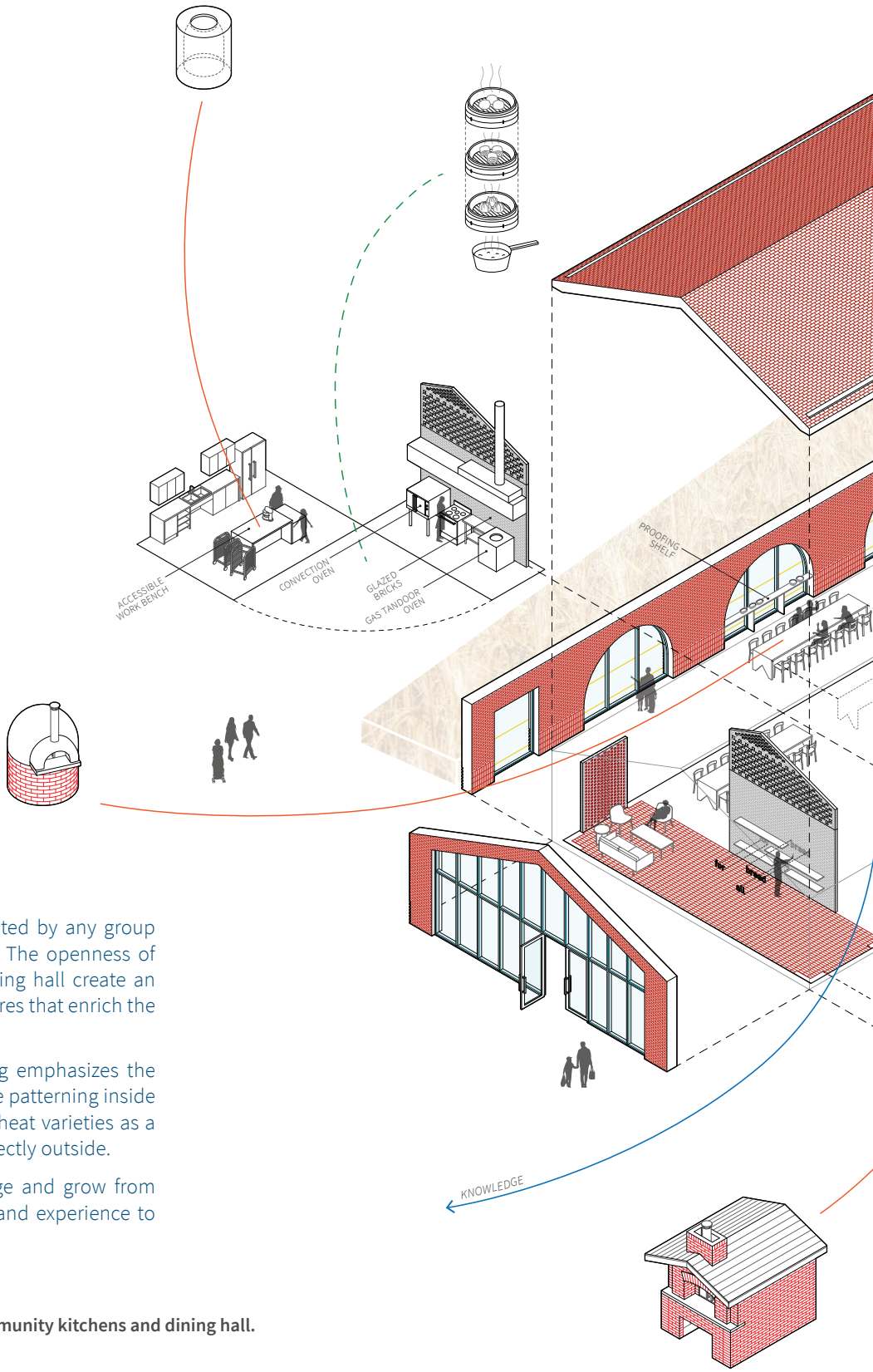


The event kitchen provides direct support and the necessary workspaces for larger community events The workshop offers a more formalized learning experience, and can cater to different skill levels and interests (baking classes, oven building, business management, and others).

The large glazed wall folds open and allows activity to spill out into the plaza.

Proofing shelves at windows create warm spaces for bread to rise, and display their progress to the street.

fig. 5.23 **Experience at barrel vault brick oven.**

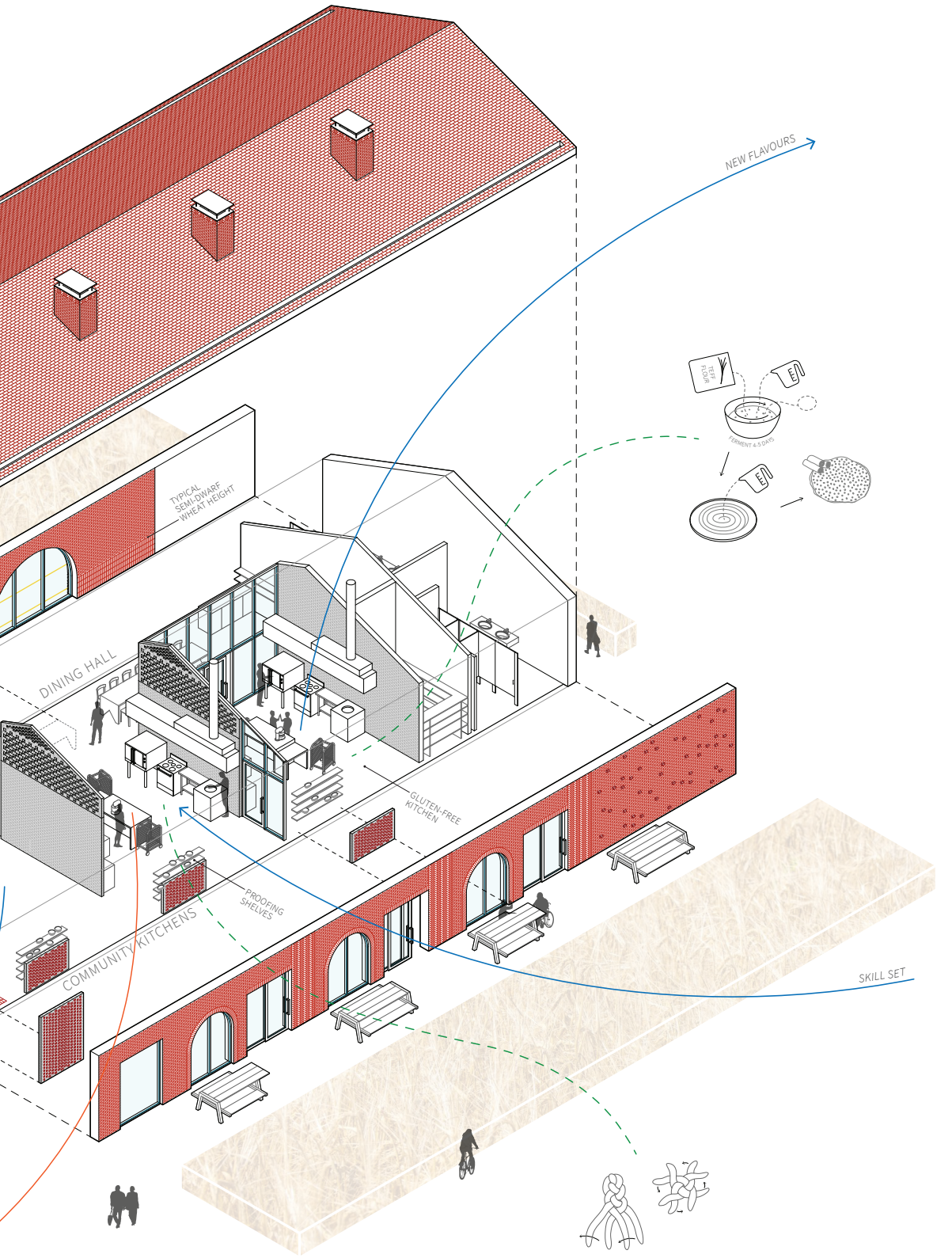


The community kitchens can be rented by any group for their baking and cooking needs. The openness of the kitchens and the communal dining hall create an interplay of smells, sounds, and cultures that enrich the experience of the project.

Brick patterning outside the building emphasizes the location of the chimneys above, while patterning inside indicates the height of semi-dwarf wheat varieties as a comparison to the wheat growing directly outside.

Both community buildings encourage and grow from flows of information, culture, skills, and experience to and from the site.

fig. 5.24 **Exploded axonometric of community kitchens and dining hall.**


NEW FLAVOURS
TEFF FLOUR
FERMENT 4-5 DAYS
TYPICAL SEMI-DWARF WHEAT HEIGHT
DINING HALL
GLUTEN-FREE KITCHEN
PROOFING SHELVES
COMMUNITY KITCHENS
SKILL SET

1 2 3 5m

fig. 5.25 **Experience at tandoor oven.**

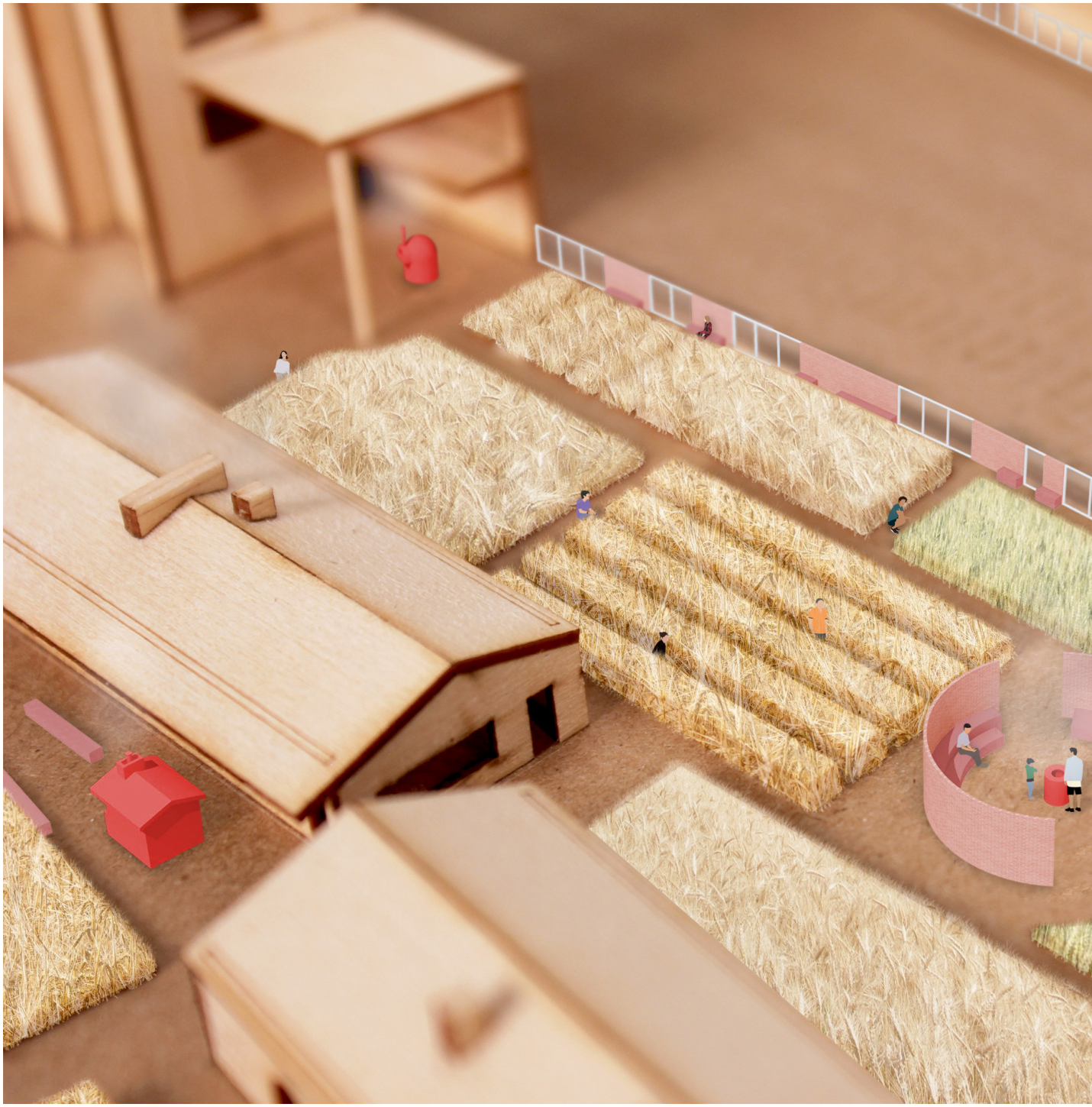
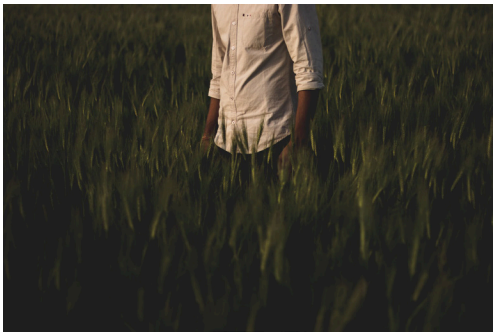
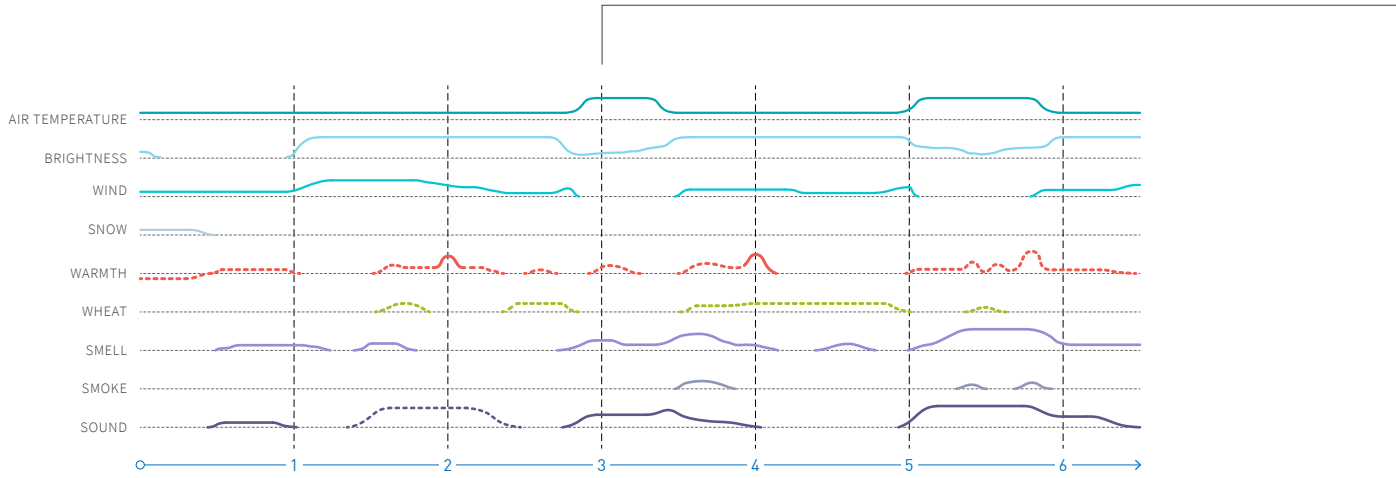


fig. 5.26 **Experience of the wheat fields.**

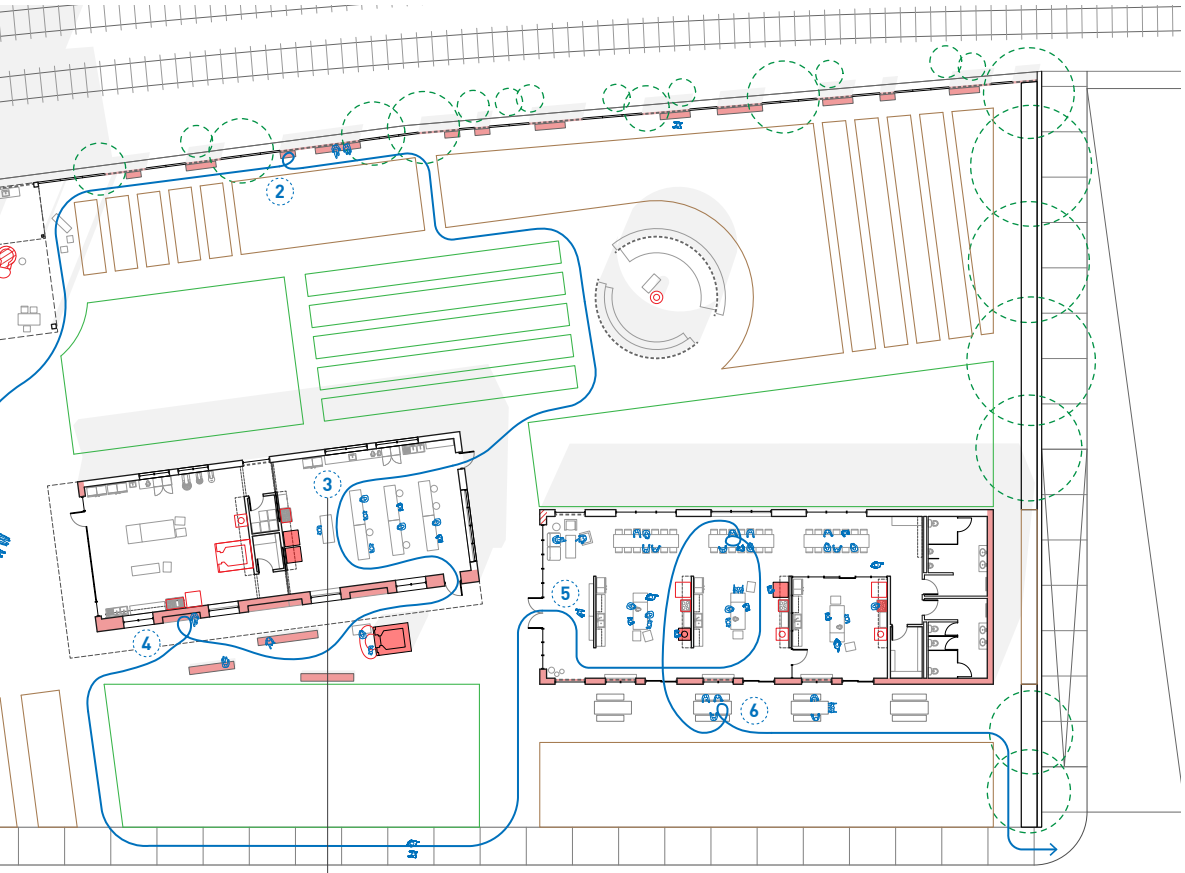


USE OF SITE AND POSSIBLE PATH OF EXPERIENCE



INTENSITY OF MICROCLIMATES ALONG PATH

fig. 5.27 **Spring – seasonal use of site and experience of microclimates.**

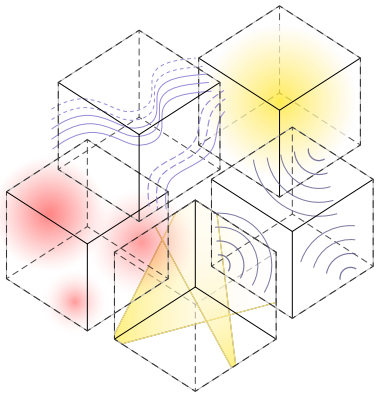


OVENS

- *in use*
- *cooling*
- *not in use*

THERMAL MASS

- *releasing heat*
- *storing heat*
- *inactive*

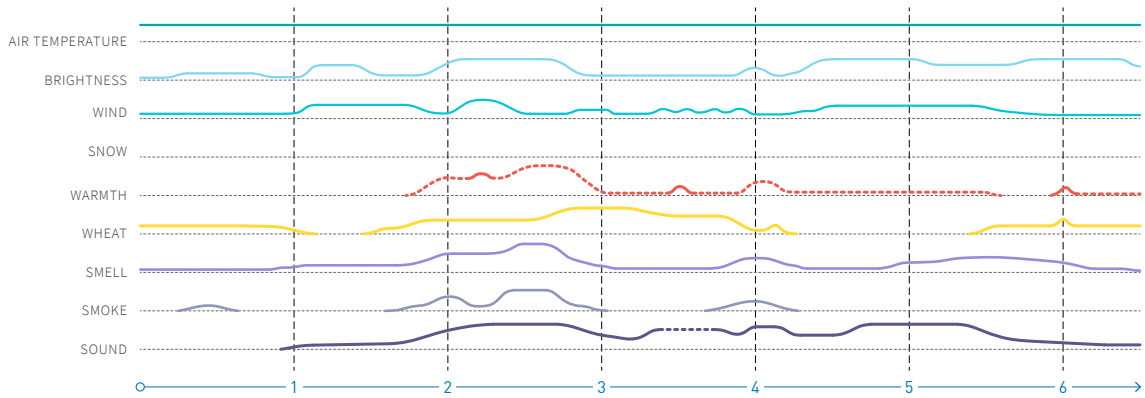


SAMPLE OF MICROCLIMATE CONVERGENCE

SPRING
Sunday afternoon
typical community use

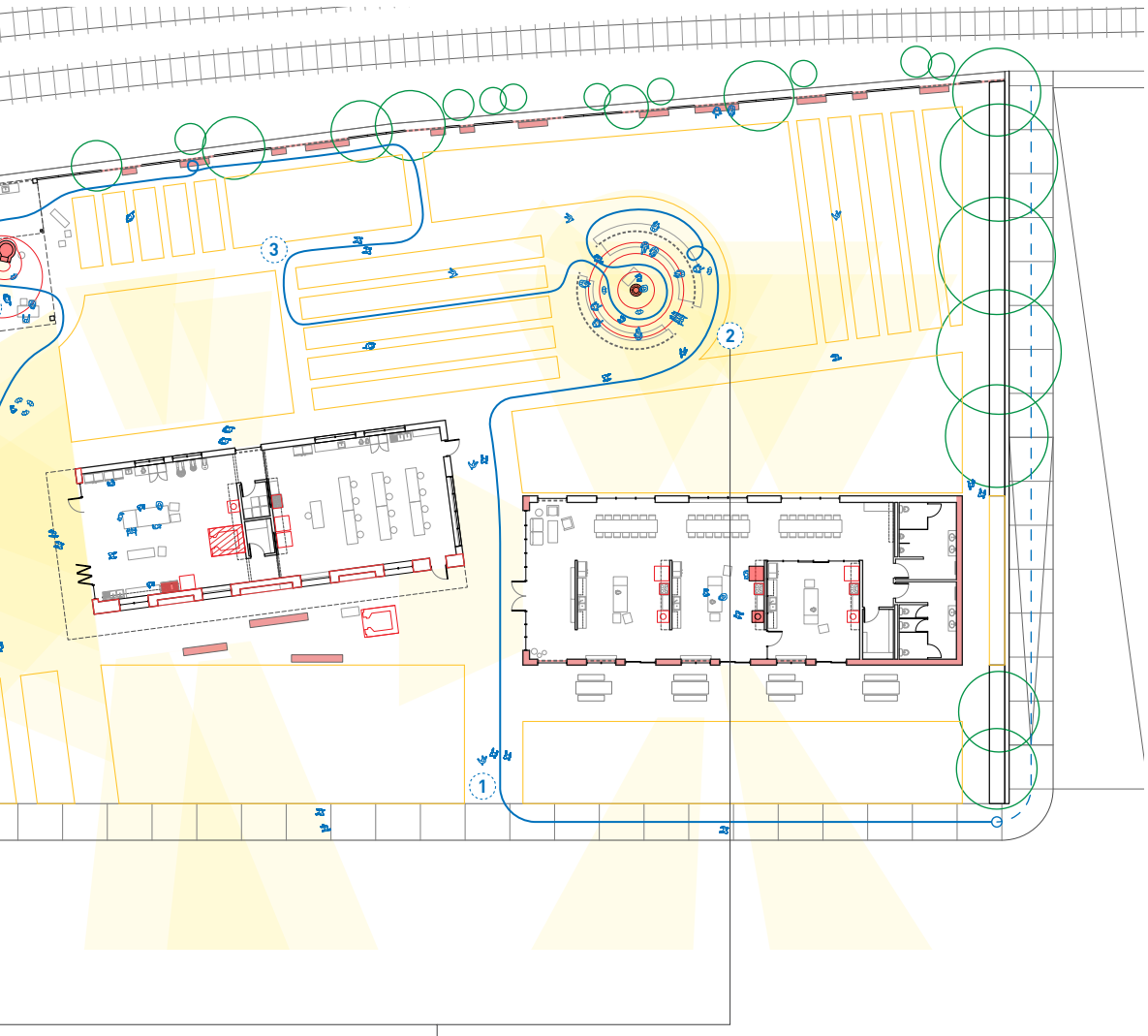
- activity is primarily inside, especially at community kitchens and baking volume, and in sun-exposed outdoor spaces
- use of flex market is limited due to most fresh produce being out of season
- barrel vault brick oven is being used in the sun
- most wheat fields are bare, some have small growth of winter wheat planted the previous fall

USE OF SITE AND POSSIBLE PATH OF EXPERIENCE



INTENSITY OF MICROCLIMATES ALONG PATH

fig. 5.28 **Summer – seasonal use of site and experience of microclimates.**

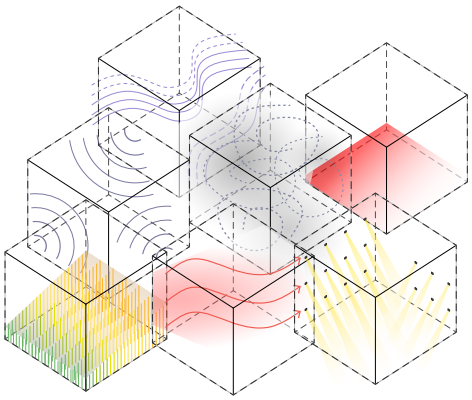


OVENS

- *in use*
- *cooling*
- *not in use*

THERMAL MASS

- *releasing heat*
- *storing heat*
- *inactive*

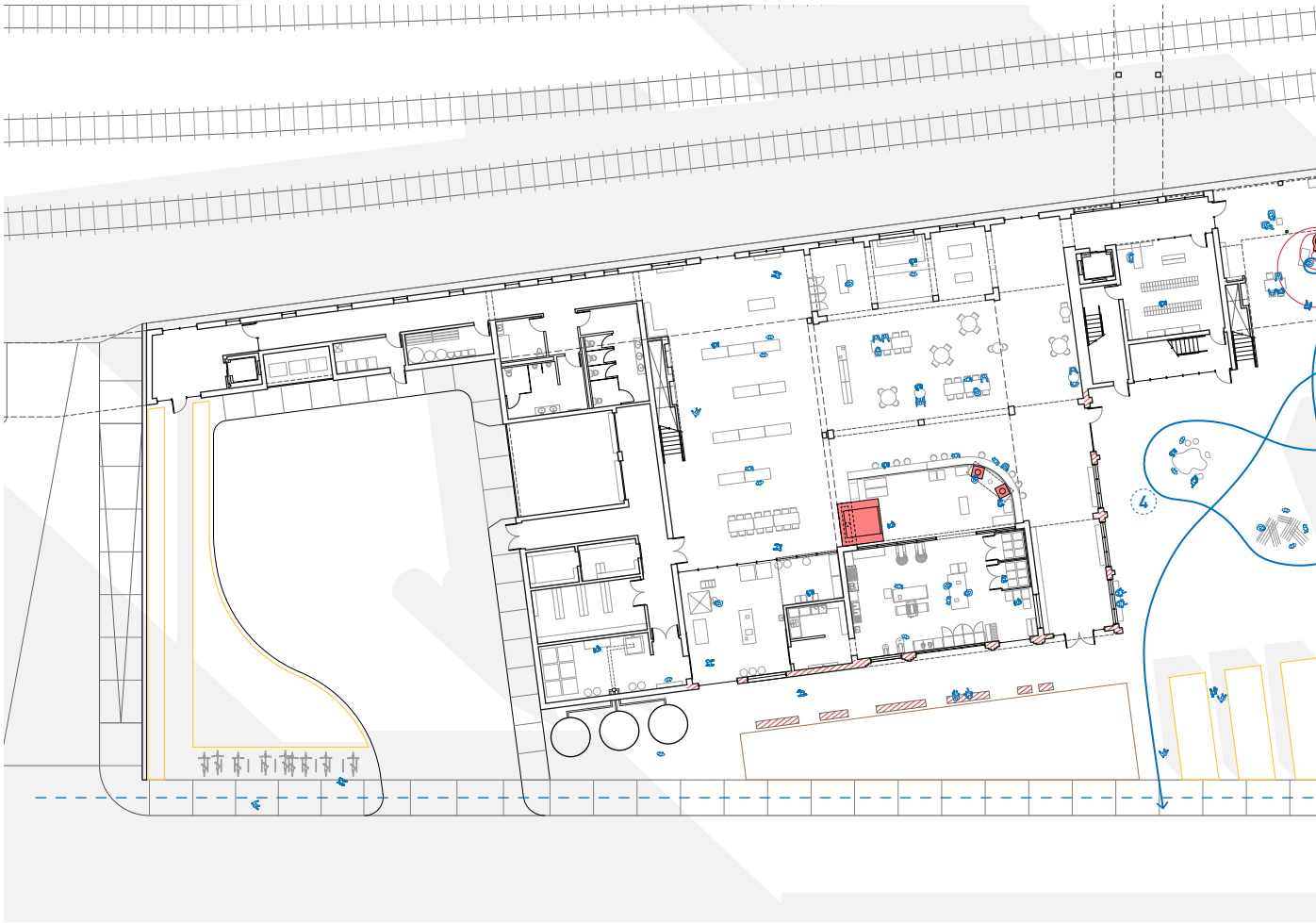


SAMPLE OF MICROCLIMATE CONVERGENCE

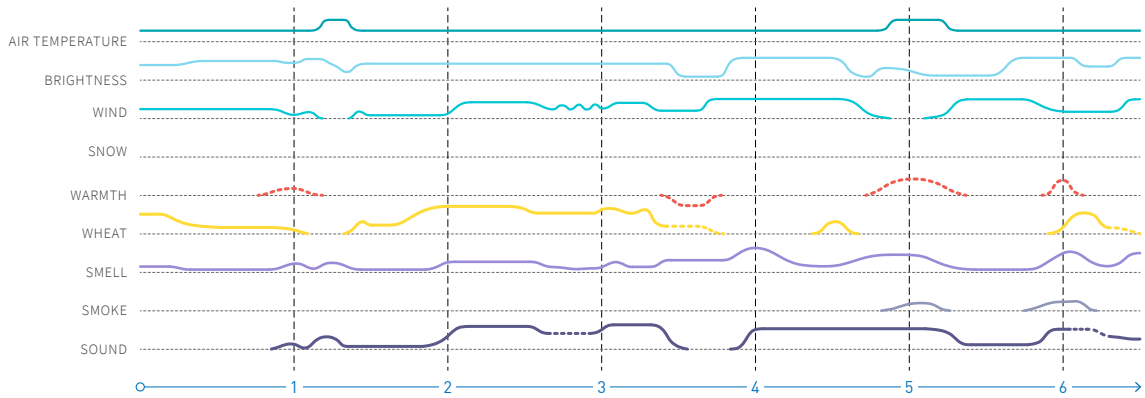
SUMMER

Thursday evening community event

- activity is spread throughout public spaces, and concentrated at ovens and plaza
- flex market used as additional indoor event space
- larger heat gradients of cob and tandoor ovens provide warmth for cool evenings
- all wheat fields are planted and most have shifted to a golden colour with varying heights

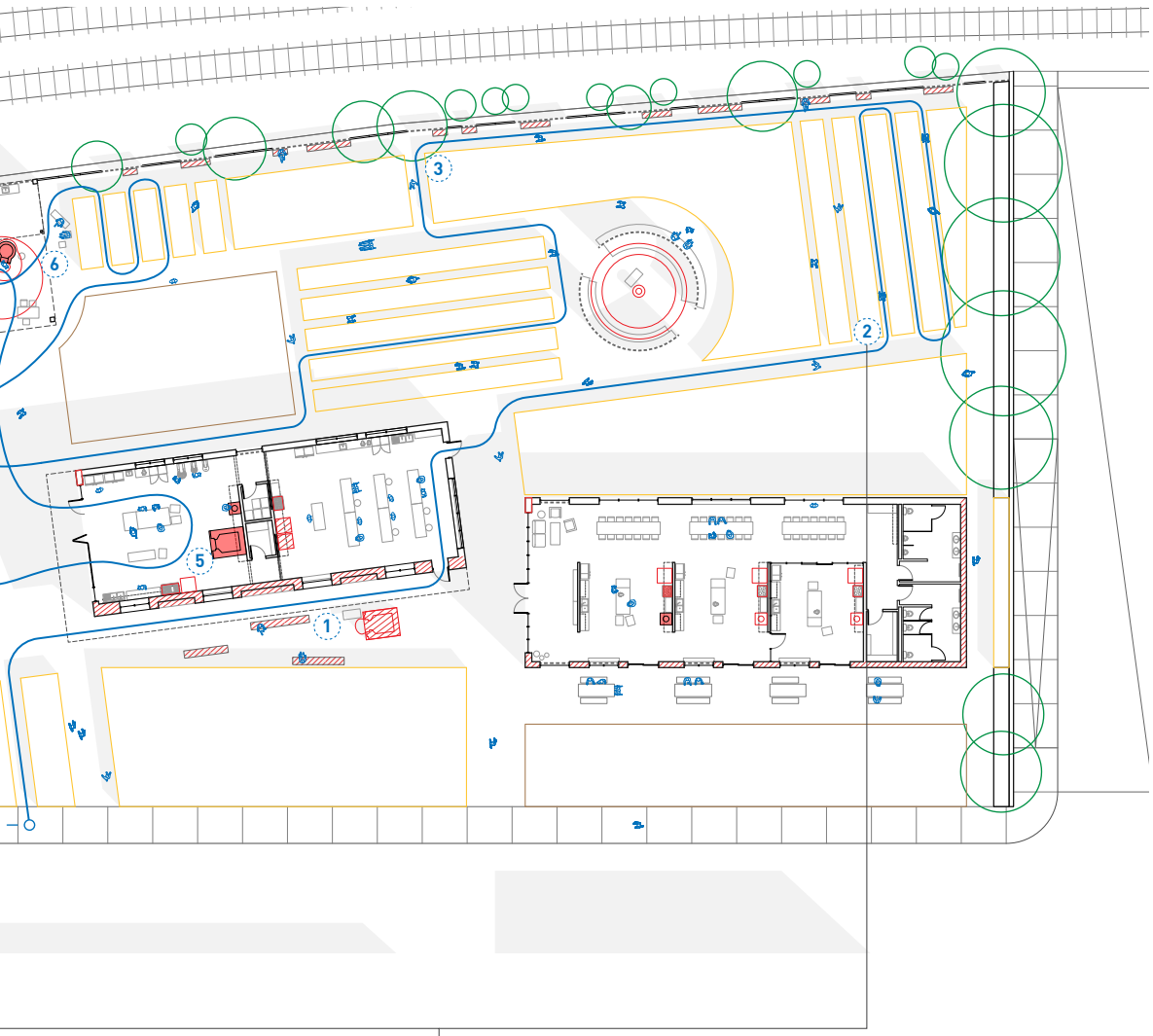


USE OF SITE AND POSSIBLE PATH OF EXPERIENCE



INTENSITY OF MICROCLIMATES ALONG PATH

fig. 5.29 **Fall – seasonal use of site and experience of microclimates.**

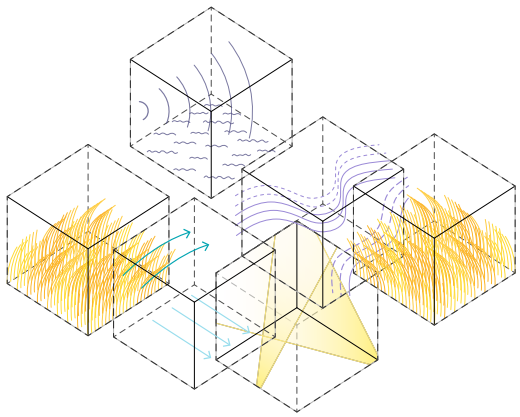


OVENS

- *in use*
- *cooling*
- *not in use*

THERMAL MASS

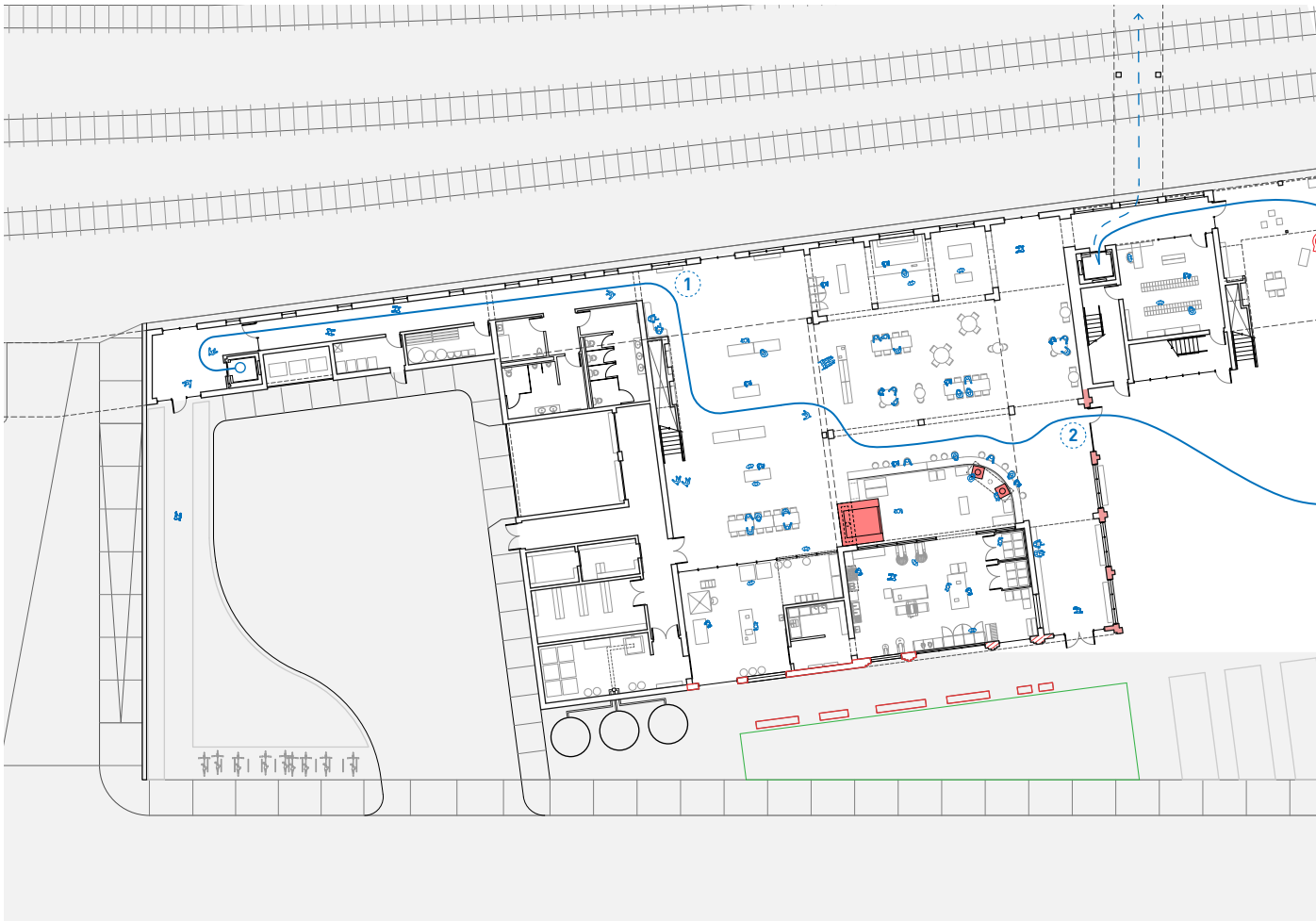
- *releasing heat*
- *storing heat*
- *inactive*



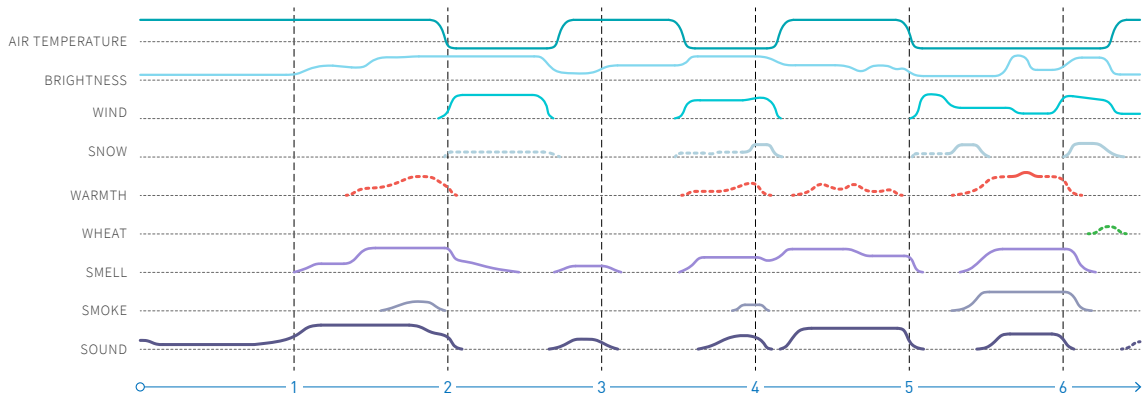
SAMPLE OF MICROCLIMATE CONVERGENCE

FALL
Tuesday morning
class field trip + day-to-day use

- smaller groups are spread throughout the site to learn about its components
- increased flex market usage for farmers' market produce
- the use of the cob oven is being demonstrated because it is the simplest oven to build
- wheat fields are mature and some areas have been harvested

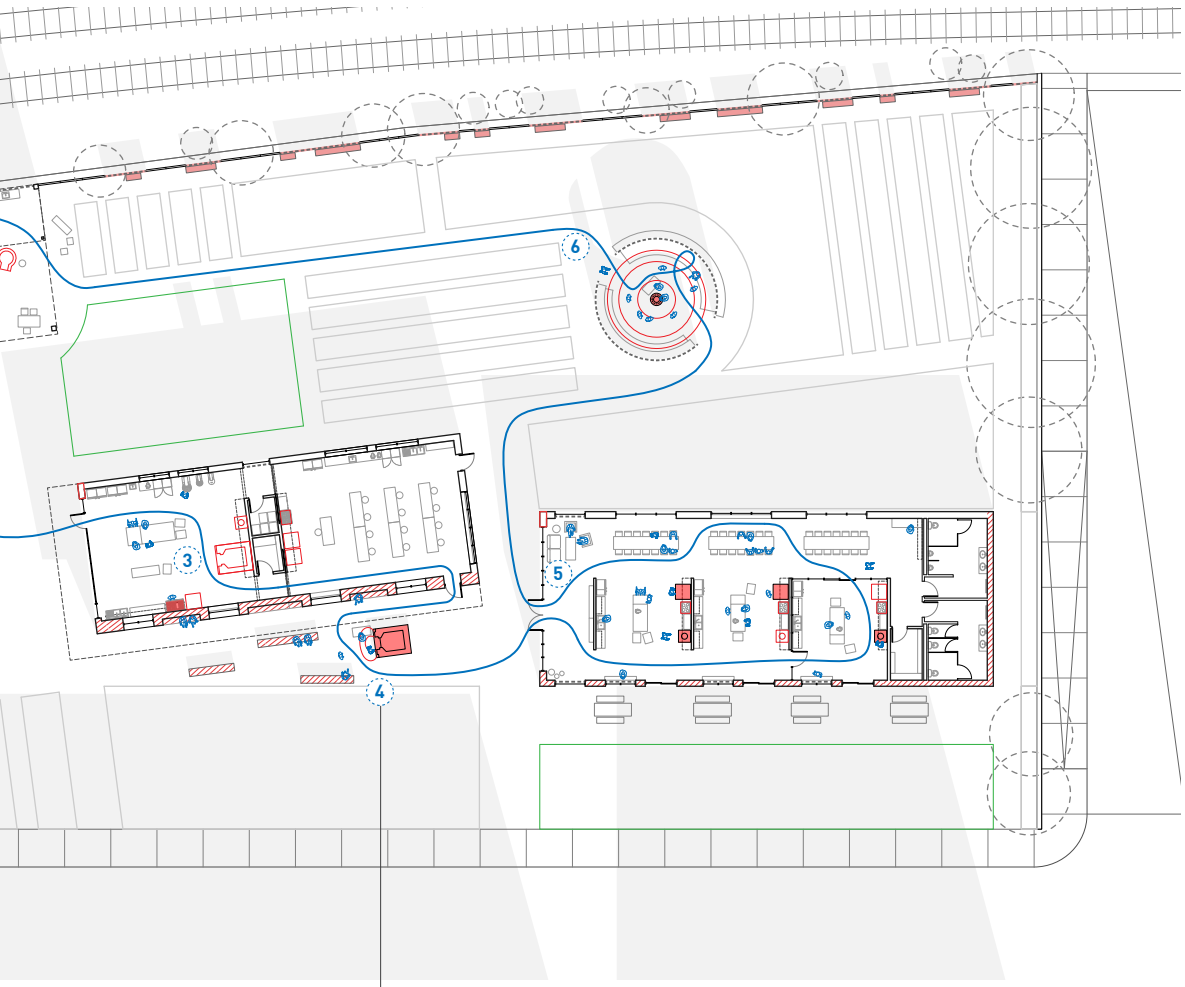


USE OF SITE AND POSSIBLE PATH OF EXPERIENCE



INTENSITY OF MICROCLIMATES ALONG PATH

fig. 5.30 **Winter – seasonal use of site and experience of microclimates.**

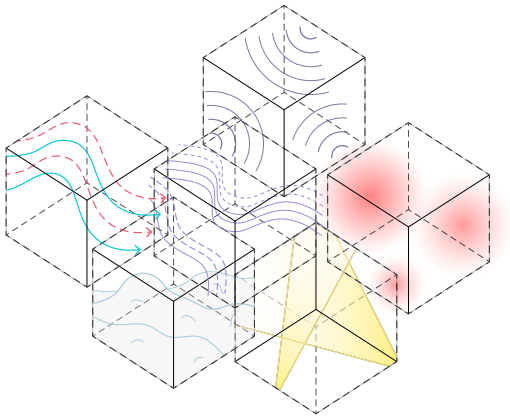


OVENS

- *in use*
- *cooling*
- *not in use*

THERMAL MASS

- *releasing heat*
- *storing heat*
- *inactive*



SAMPLE OF MICROCLIMATE CONVERGENCE

WINTER
Saturday noon
cold-weather use

- activity is focused inside due to cold outside temperatures
- flex market used to sell products from kitchen incubators
- tandoor oven is in use due to large heat gradient, shorter firing/cooking times
- barrel vault brick oven is in use due to thermal mass and sun exposure
- wheat fields are covered in snow, some have small growth underneath from planted winter wheat

fig. 5.31 **Approaching the site, walking east.**

CONCLUSION

The design proposal could have focused on any one of the individual pieces that make up the project that is ultimately presented in this thesis; the urban mill, the market and bakery, the community kitchens, the event kitchen, or simply an oven in a park with a workspace, could be successful and impactful in the diverse and growing city that is Calgary. The choice to create a project that encompasses each of these components stems from an understanding that the broader proposal is an anomaly in the context of industrial food production. Thus, by creating a microcosm of bread-related programmes in a dense, visible, and accessible part of the city, the site demonstrates how these pieces can work together at the urban scale and support greater changes to existing food systems.

The *Centre City Bakehouse and Mill* seems far-removed from the small community-initiated oven-in-a-park model in Toronto that was one of the initial inspirations for the research. A project of this scale would likely require some support (financial and operational) from the City of Calgary, but by putting the benefits and potentials of the site on display, the project can act as a seed and connection point for future interventions that enrich urban life as a whole. The dispersal and multiplication of certain programmes – especially the communal ovens – throughout the city allows for the creation of spaces that address the needs of specific communities.

Further development of the thesis work would turn its attention towards these smaller-scale projects that form a part of the network laid out by the initial site. Within these community-specific projects lies the opportunity to emphasize particular design considerations: innovations in brick detailing and patterning, communal or modular construction that fits within lower budgets, or formal decisions that create recognizable landmarks for a neighbourhood can be explored in greater depth and

with input from the communities they intend to serve. Integration into existing community centres, religious buildings, schools, and parks presents another way in which the communal ovens can generate unique social forms and spaces.

Additional questions remain: What does the urban network of bread require in places that do not or cannot grow wheat in their surrounding regions? What components or experiences are emphasized instead, and how is information about agricultural systems presented? How does the design change in warmer climates, where the heat from the ovens may be seen as a detriment to the experience of exterior space rather than a benefit? How do the sites and networks evolve with changes to bread-making or agricultural and food science? Can the heat generated by the communal ovens be captured more completely and be directed for specific uses? For a project that branches into many fields of research and involves many different groups of people, the list of possible questions and future explorations is seemingly endless.

This thesis set out to use bread as a medium for generating and empowering alternative ways of relating to and interacting with one another. Rather than suggest that the design proposal be the definitive solution for Calgary or any other city, it illustrates the varied concerns and multitude of approaches that can go into the making of urban public space. The project aspires to transform an entire system of food production on the one hand, but, importantly, is grounded in the increasingly critical need to provide inclusive social and cultural spaces in cities on the other. For me, it is also an example of the innumerable design opportunities and distinct magic that can arise from a thorough and expansive analysis of often pragmatic processes – in this case, the growth of wheat and the making of bread – through the recognition of their value and place amongst the people that work together to bring them to life.

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APPENDIX

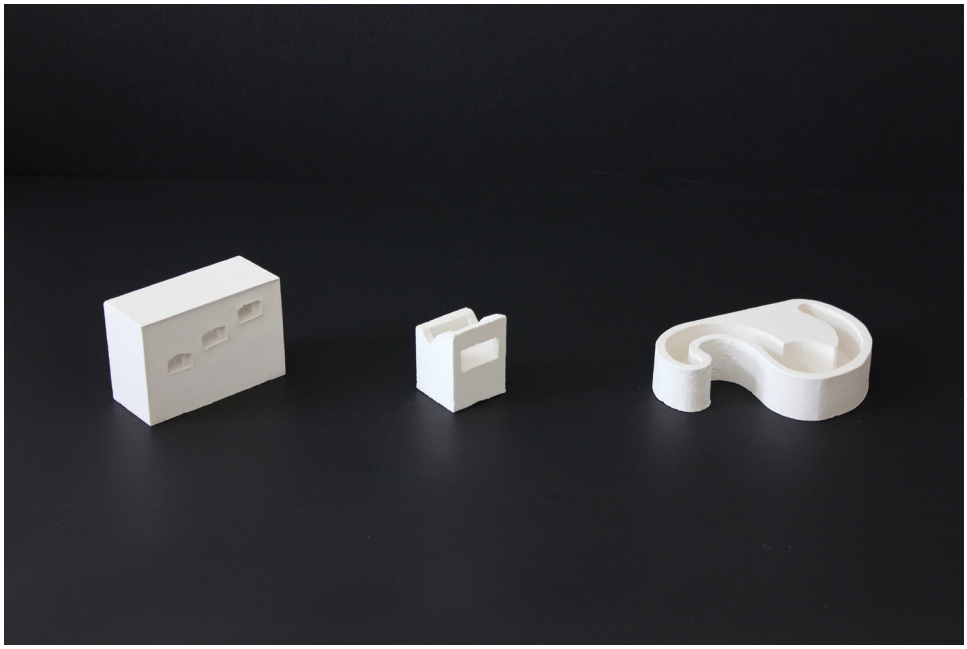
fig. 6.1 **Sectional communal oven models.**

Initial research about oven types led to the discovery of geothermal ovens (far right), which have the potential to be used in a communal setting. Dough is placed in a pot with a lid, wrapped to create a sealed environment, and then buried in the ground to “bake” for 24 hours using naturally-occuring geothermal energy. These ovens are only in use in Iceland, however, and so were excluded from the thesis.

fig. 6.2 Barrel vault brick oven sectional and simplified model.

fig. 6.3 Cob dome oven sectional and simplified model.

fig. 6.4 Tandoor oven sectional and simplified model.



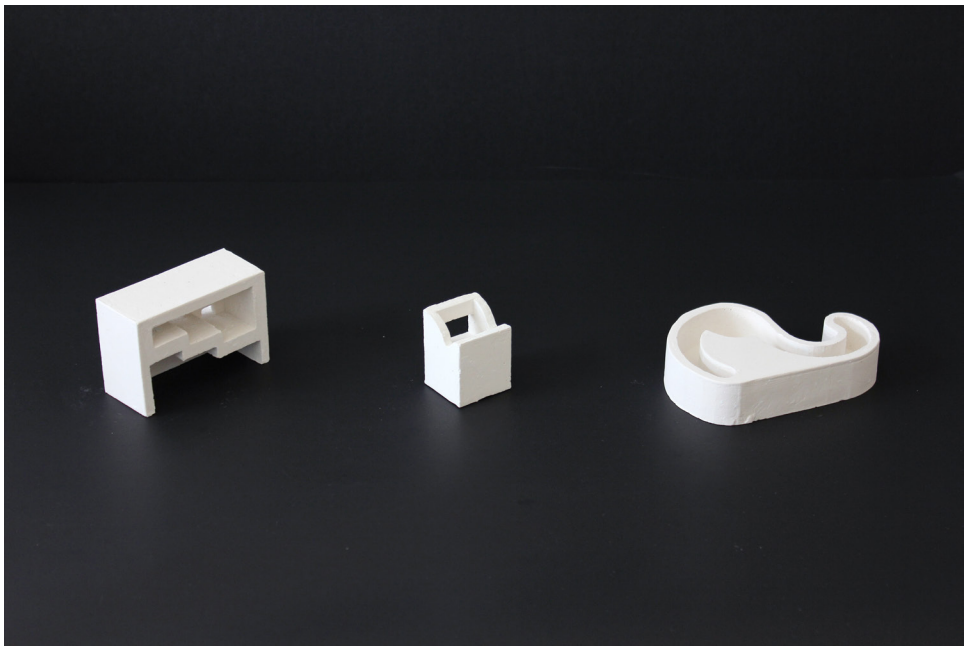


fig. 6.5 **Experimental oven type models.**

Early thesis work included a re-imagining of the three main oven types. I posed the question, “What could the ovens look like if thermal efficiency was not the primary priority?”. The ovens above explore the possibilities of baking at different temperatures within the same oven, baking multiple bread types at once, and allowing for many bakers and observers to use the space of the oven at the same time – all goals centred on communal use and experience.

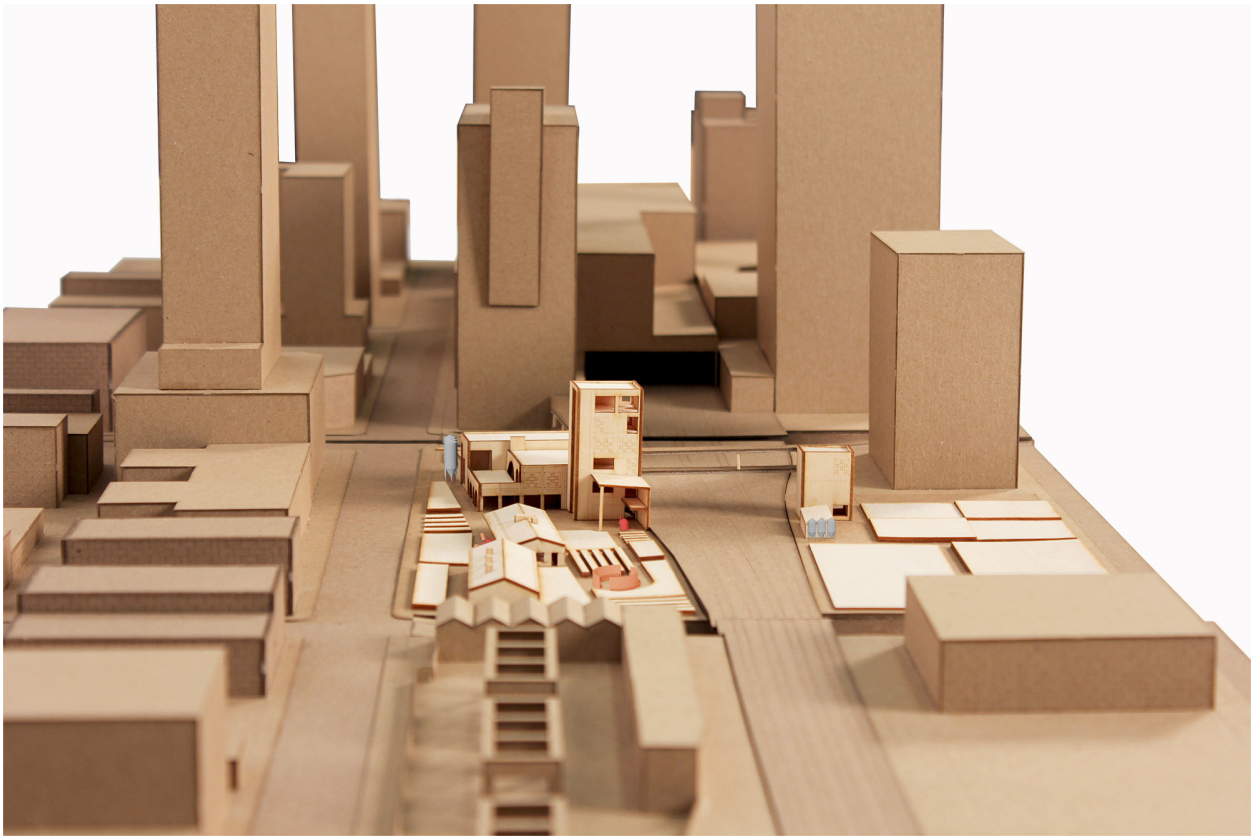


fig. 6.6 Site model, looking west.

fig. 6.7 Site model, looking north-west.

fig. 6.8 Site model – central brick plaza.

fig. 6.9 Site model, looking east at railway overpass.

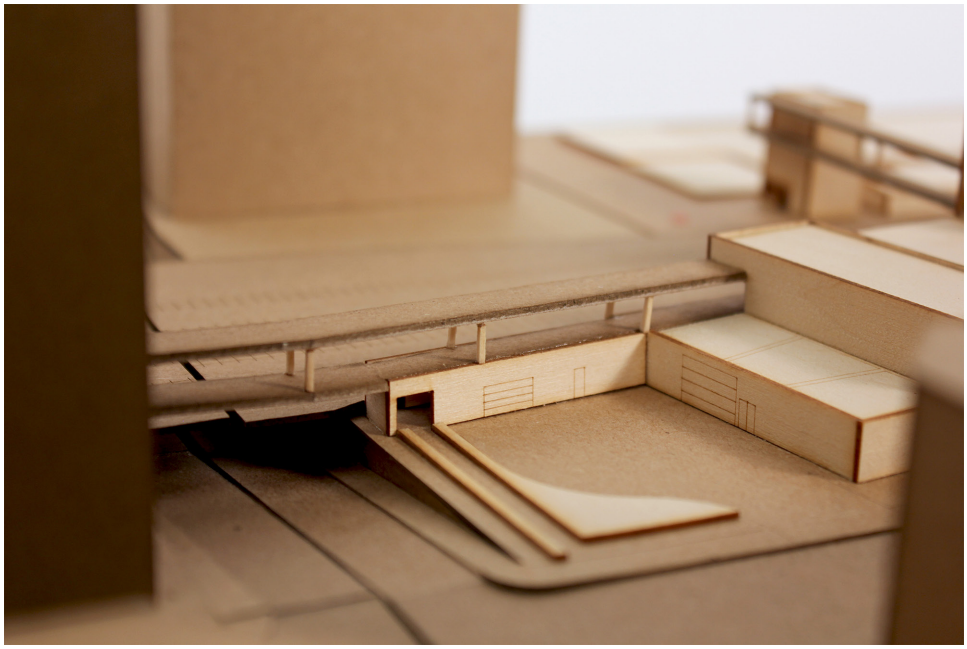


fig. 6.10 Site model – loading area and +15 connection bridge.