

**THE NARRATIVES OF INFRASTRUCTURE: THE SIMULTANEOUS
BUILDING OF SPACES THROUGH CIVIL ENGINEERING AND
LITERARY THEORY**

by

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A Thesis

Submitted to the Faculty of Purdue University

In Partial Fulfillment of the Requirements for the degree of

Master of Arts



Department of English

West Lafayette, Indiana

May 2021

THE PURDUE UNIVERSITY GRADUATE SCHOOL
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Dedicated to my friends at Abonmarche, who draw the world.

ACKNOWLEDGMENTS

Thank you first and foremost to Patrick for your patience and support. I am so happy to spend every day with you. Thank you to my professors and to the Department of English at Purdue University for this opportunity. I can't tell you all how grateful I am and how much I enjoyed this experience. Thank you to my mom for always telling me to write everything down. Thank you to my dad for saying that "sometime, you've got to learn to love fluid mechanics." I think about you both every time I come upon something difficult and choose to persevere.

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ABSTRACT

The issues facing scientists, engineers, and analysts of culture, particularly issues of climate change, resource usage, and space, are becoming increasingly complex. They cannot be solved through one academic discourse. My project proposes a blended discourse from the academic disciplines of civil engineering and literary theory. Using this discourse of Simultaneity, we can analyze the technical and cultural narratives which create the spaces in which we live. I begin with a common touchpoint of flows. Flows are used within literary theory to explain the formation of cultural spaces and are used within civil engineering to design and analyze physical spaces. Then, I conduct literary analyses of Wallace Stegner's *Angle of Repose*, Ivan Doig's *Bucking the Sun*, and Jack Kerouac's *On the Road* to illuminate technical metaphors which shape a text, the similarities within the processes of changing cultural and physical spaces, and the similarities in novel narrative structure to the physical shape of engineered infrastructure. In this way, I show that constructing a blended discourse is possible and that by creating this discourse, we can explain a space's state of existence from both a technical and a cultural perspective. Furthermore, we enable literature to speak from both a literary, cultural angle and from a technical, engineering angle. Thus, we engage in cross-disciplinary study to more adequately explain the phenomenon of experiencing where we place our bodies while our minds are at work. In the future, as suggested within this thesis, this blended discourse of Simultaneity can give us a methodical way of building spaces which are both technically feasible and culturally sound.

CHAPTER 1: PARALLEL DISCIPLINES AND THE *COMPLEX EXPERIENCED SPACE*

Introduction

A story which forms a culture is shaped in part by the physical infrastructures referenced within the story. A physical infrastructure is shaped in part by the stories of the culture in which the infrastructure is conceived. Civil engineering mediates between story and infrastructure by providing the process through which both story and structure can be changed. The issues facing engineers, scientists, and students of culture in the 21st century, particularly issues of climate, resource usage, and space, are becoming increasingly complex. The solutions are not simple and cannot be found or implemented as long as they remain within one academic discipline. For example, we cannot productively solve, or perhaps even productively discuss, problems of climate vulnerability in coastal or arid regions without developing new ways to protect shorelines, rezone coastal properties, or construct resilient structures. We cannot convince those who live in coastal regions of the imperativeness of adopting new safety measures or climate supportive practices without engaging explanation and narrative. Nor can we transform patterns of behavior without attending to the stories that have generated these conditions of existence. Thus, we must create a new discourse which enables us to accurately encompass more than one way of problem-solving. In this thesis, I will show that creating a blended discourse of civil engineering and English literature by beginning with parallels within their disciplinary structures of problem-solving is possible. Furthermore, I will illustrate how physical and cultural spaces are constructed in parallel and simultaneously through civil engineering and English literature and show that through this blended discourse, we uncover new ways of revealing the structures and problems which are present in a literary text.

The full implications of this blended discourse are not present within the text of this thesis. This is because while cross-disciplinary study is not new, this particular combination of disciplines, in this particular structure and for these particular reasons, has not been studied in this precise manner. I acknowledge that this thesis is thus in a process of discovery and I expect to expand this idea in future work. In this thesis, I begin by establishing my idea's connection to very general conceptions of narrative, space, and time. Then, in this general narrative-time-space continuum, I concentrate on utilizing the concept of fluidity as a common touchpoint between civil

engineering design and literary theory. After developing the theoretical potential for the concept of fluidity, I briefly outline to whom this idea of a blended discourse is ultimately addressed and begin to suggest potential actionable outcomes using this blended discourse. I then expand upon this analysis in subsequent chapters and in the conclusion. I also define physical space and cultural space within this thesis, what I mean by the construction of these spaces, and how we, as individual people, experience these spaces. From these explanations, and from timelines drawn from civil engineering and literary theory, I draw a generalized timeline composed of three segments. This timeline structures the remainder of the thesis. Briefly, the segments of this timeline are Mapping and Mechanics, Design and Construction, and Possibility. The intent of this timeline is to provide a framework for analyzing the simultaneous existence of narratives which form physical space and cultural space and to illustrate that the interdisciplinary exchange between stories and infrastructure is ongoing.

I then turn to a literary analysis of three novels using this timeline: Wallace Stegner's *Angle of Repose*, Ivan Doig's *Bucking the Sun*, and Jack Kerouac's *On the Road*. Through an analysis of these three novels, I illustrate a method to simultaneously understand the construction of physical and cultural spaces as well as begin to explore how such a blended discourse enables literature to speak in conjunction with an engineering perspective. Finally, I draw some conclusions from implementing this blended literature-engineering discourse, a discourse of Simultaneity, which I have outlined and briefly explicate some possibilities for engaging in this type of research. I also take some time to outline some of the limitations inherently present in this type of discourse and provide some clarification on what actionability I am actually thinking this type of work suggests. While I will also discuss implications for bringing this discourse outside of academia, I acknowledge that this is inherently difficult and such transitions are still in progress.

A General Conception of the Narrative-Space-Time Continuum

In this section I discuss my approach to the terms narrative, time, and space. I use the word "approach" instead of the word "define" because I want to emphasize that I am not attempting to use these three words in a way that is somehow fundamentally different than how we colloquially refer to them; that is, I am not seeking to question physics or push the bounds of narratology. Rather, I begin with the idea that the narratives we tell about the spaces we experience, overtime, influence what types of infrastructures and spaces are eventually built. Likewise, the type of

infrastructures that are constructed influence lifestyles as they are lived through time and the narratives that we tell about these lives. Thus, the actual process of the design and construction of infrastructure, not just the finished project, has the potential to affect our experience living in the world.¹ Because civil engineering is the discipline which studies infrastructure and provides the method through which infrastructure is constructed, I have identified it as the *free space*² between narrative and infrastructure; that is, the space through which narratives and infrastructures are allowed to change into each other. I use the term *free space* to evoke a sense of possibility; that is, while both cultural ideas and physical construction are present within civil engineering design, the project process is just that, a *process*, and no project is complete until it is finished. It is through this process of civil engineering that narratives become infrastructure and it is because of the process of civil engineering that we recount narratives about infrastructure. Globally, this process is in a continuous state of flux; that is, people are constantly telling stories, living with infrastructures, and changing these infrastructures. Both infrastructures and narratives exist at the same moment and at any moment, an infrastructure or a narrative may be changing. I have illustrated this concept in Figure 1 by using a reversible reaction arrow borrowed from chemistry³. Both substances are present at the same time. The process is continually changing one substance into the other, back and forth. I have placed “Civil Engineering” over the double reaction arrow to indicate that it is the process which causes the transformations.

1. Briefly, I acknowledge that I am assuming a linearity of time which is no longer the sole conception of time in either the realm of science or in literary theory. For example, Louise Erdrich’s *The Plague of Doves*, a work of Indigenous literature, suggests the non-linearity of time. In physics, the theory of special relativity illustrates that while the speed of light may be held constant, time is actually a variable and thus does not progress without influence in the sort of linear fashion in which we colloquially imagine. I take this liberty because I intend for this blended discourse to be applied to project which have a lifetime which is small compared to the entire timeline of the universe. Thus, I briefly assume linearity in the same way that we draw a tangent line at a constant slope on a circle. I recognize that even this explanation is inadequate, but I reiterate, this is a work in progress.

2. I also use the term *free space* to bound the project between the point where it begins when the contract is signed and where it ends, when the project owner is now responsible for operations and maintenance, or the *Project Inception* and the *Project Completion*. In this way, we can look at the civil engineering process, the segment of time in which change is planned and created, without prematurely examining a space before or after this process takes place. I do this to limit the scope of the thesis and to reiterate that this blended discourse is set up to combine civil engineering and literary theory, not every idea ever.

3. The Encyclopedia Britannica provides a brief explanation of reversible reactions and reversible reaction arrows: <https://www.britannica.com/science/chemical-equation>.

$$\text{Stories} \xRightarrow{\text{Civil Engineering}} \text{Infrastructures}$$

Figure 1: Story, Engineering, and Infrastructure

Because civil engineering is the process which creates infrastructures, and because processes take place through time, infrastructures are created through time within constraints unique to each, individual, infrastructural project. Thus, each infrastructural project, which changes a space, bounds 1) the point where a person or group of people decide to change their ideas into physical reality, 2) the physical change a space undergoes, and 3) the possibilities which the changed space enables. Timelines are thus instruments of formation and studying timelines lends an element of fluidity to the study of space. Merging the disciplines of literary theory and civil engineering through the superimposition of discipline specific timelines illustrates the simultaneous building of spaces through civil engineering and literary theory because infrastructural projects and narrative develop in parallel through time.

According to the Aristotelian tradition, a narrative has a Beginning, a Middle and an End, thus providing a timeline for the production of narrative within the Western tradition⁴. The Beginning is chosen for a particular narrative; thus, it may be in the present, it may be in the past, or it may be in the world-built future. The Middle is a series of imitated actions that constitute the narrative and the End is the last event within the narrative. Thus, literary theory shows us that narrative develops based on a timeline with a Beginning, Middle, and an End, just like the progression of a civil engineering project. I have illustrated this concept in Figure 2.

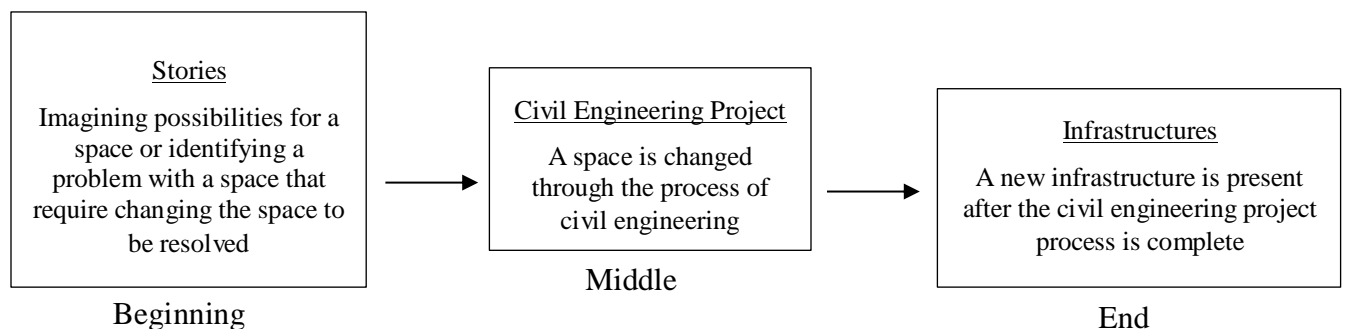


Figure 2: Concept of an Infrastructural Project Timeline for a Physical Space

4. Aristotle, *Poetics*, trans. Gerald Else (Ann Arbor: The University of Michigan Press, 1967), 27-28, 30.

This concept of parallel development and continuous, simultaneous exchange is the foundation for the possibility of creating a blended discourse, and so, it is critical to understand the parallels between these timelines. In later sections of this thesis, I will elaborate upon this idea of parallel structure, but the first step is establishing that the parallel exists because of the simultaneous development of narrative and project as I have identified in Figure 2.

In drawing our attention to a singular, specific, physical space, I isolate our analysis of that physical space within a moment in time (Figure 2). There are narratives which exist before this segment of time that have created this space. There are narratives which exist after this segment of time, which may have been changed by the project which I have analyzed in this specified segment of time (Figure 2). Thus, at the Beginning of a project which will change a space, there already exist characteristics of that space. As a civil engineering, or infrastructure, project develops, designers juggle geologic narrative timelines, human narrative timelines, political narrative timelines, and plan and specification production timelines. For example, a single infrastructure project, such as the Fort Peck Dam near Glasgow, Montana, engages the geologic timeline of the Missouri River, the historical period timeline of the Great Depression and the Works Progress Administration (WPA), the human life timeline of each worker, and the segment of time it took to design and construct the dam itself. As designers create the plans and specifications for a project, they consider the physical properties, or *technical narratives*, of the space, which have been defined by geologic timelines. They also consider the social properties of the space, or *cultural narratives*, which are defined by past land use practices, land ownership practices, and the owners' or current occupants' goals for creating change within that space.

These narratives are identified by asking questions such as: What is already here? What is the physical shape and size of the space? What materials are present at this site? Who is asking for change in this space, and why? How will, how can, this project change this space? What will the lives of workers, landowners, or employees in government agencies be like after this space is constructed? The way these questions are answered and incorporated into the final, physical form of the project affects the cultural impacts caused by the project and the cultural possibilities brought about by the project. Furthermore, these sample questions are not meant to be exhaustive, but rather to bring to light some of the narratives which have contributed to the formation of a space up until the moment in time when we begin to examine that space. Thus, we can identify

both the *technical narratives* and *cultural narratives* that have shaped a space at the beginning of a project.

Identifying that both *technical narratives* and *cultural narratives* contribute to the shape of a space at the beginning of a project is the first segment of the timeline that blends literary theory and civil engineering: Beginning: *Mapping and Mechanics*. The remaining two segments: 2) Change: *Design and Construction* and 3) Possibility: *Project Use and Infrastructural Aesthetic* describe how a project changes a space and what possibilities are enabled by a blended discourse. Thus, the foundation of a blended discourse is a blended timeline.

In this section, I have stated that physical and cultural spaces develop in parallel within the narrative-time-space continuum. This continuum explains the continuous transition between stories and infrastructure—they are both changed through civil engineering. Within this continuum, we can look at one particular engineering project and see what has happened in the past to contribute to the state of a particular space before creating an engineering project to change it, examine how a space is actually changed, and examine the impacts of the new project once the change is complete. Thus, examining a single segment of the narrative-time-space continuum allows us to begin to combine the discourses of the disciplines using a generalized timeline drawn from Aristotelian theory and civil engineering practice. I also presented very general conceptions of *narrative*, *space*, and *time*, which I will explain in more detail later in this Chapter. In the next section, I will more clearly establish the connection between existing discourses by focusing on a point of fixity—the idea of *flows*.

Flows are a point of discourse intersection

Combining literary theory timelines and civil engineering timelines requires a point of intersection of the discourses less tenuous than those I have described above. Through the concept of *flows*, we can articulate both the *technical narratives* that are used in civil engineering to design a physical space and the *literary narratives* that are used to describe the culture of a space within one timeline. In this way, I return to the idea of parallel development of the disciplines by showing that both discourses already engage with the concept of flows in developing and analyzing spaces. Thus, physical spaces and cultural spaces *flow together*. In a section of *Anti-Oedipus* called “A Material Psychiatry”, Gilles Deleuze and Félix Guattari generated the idea that “[d]esire is the set of passive syntheses that engineer partial objects, flows, and bodies, and that function as units of

production.”⁵ Literary theory uses this idea that objects of desire are produced partially as a result of the cultural space in which they are conceived; desiring-production produces social reality.⁶ In *A Thousand Years of Non-Linear History*, Manuel DeLanda has engaged the concept of flows by examining the matter-energy development in urban spaces and geologic spaces. He writes, “the difference between self-organized and planned cities is not merely one of form, but of the decision-making processes behind the genesis and subsequent development of that form,”⁷ thereby illustrating a fluid connection between cultural “decision-making processes” and the physicality of a constructed space.

Civil engineers, constructors of twenty-first century physical spaces, are more than familiar with the concepts of flows and fluidity. Engineers talk of traffic flows, stress flows, hydraulic flows. The flows involved in a project, such as the volume of traffic, the vectors of stresses, or volume of water per unit of time, contribute to developing the final manifestation of a project. For example, the size of a wastewater treatment plant is determined in part by the average amount of water used by a person in a day, called an Average Annual Daily Flow (AADF). To determine peak flow rates, these Average Annual Daily Flows are multiplied by a Multiplier (M), which is a different number depending on the period of usage the designer would like to know.⁸ These flows thus provide a set of constraints which bound the possible physical solutions of treatment plant design, just as DeLanda has identified that decision-making processes shape urban spaces and as Deleuze and Guattari generated the idea that social production is like a flow. Thus, the concept of fluidity is embedded within infrastructure design and it is on this concept of fluidity that I will begin to more fully develop my argument. As we engage with the fluidity of infrastructure development and fluidity as it is discussed in literary theory, we can use this as a point of fixity to ground this new discourse in the actual practice of both disciplines. Grounding a blended discourse in actual practice improves the ethos of this discourse and enables the outcomes of the blended discourse to be both relevant and actionable.

5. Gilles Deleuze and Félix Guattari, *Anti-Oedipus: Capitalism and Schizophrenia* (New York: Penguin Group, 2009), 26.

6. Gilles Deleuze and Félix Guattari, *Anti-Oedipus: Capitalism and Schizophrenia* (New York: Penguin Group, 2009), 29-30, 35.

7. Manuel DeLanda, *A Thousand Years of Non-Linear History* (New York: Zone Books, 2000), 30.

8. Michael Lindeburg, PE, *Civil Engineering Reference Manual, Sixteenth Edition* (Belmont: Professional Publications, Inc., 2018), 26-23, 26-24.

Outcomes, Audience, and Structure

Infrastructure is public. In the United States, running water, waste control, and transportation are almost exclusively publicly funded and maintained by municipalities, regional water districts, conservancy districts, and similar organizations. The utilities that are not publicly funded are given heavy public oversight. Consequently, the *narratives of infrastructure*, or the unique combination of *technical narratives* and *cultural narratives* that contribute to the creation and change of a space are read by public entities. The *cultural narratives* told about a physical space such as an engineering project, often told through literature, affect the way the project is perceived by the public. The *technical narratives* of a physical space, such as the type of soil that is present on a site, affect the way a project can be built. Additionally, public meetings and public input are a critical part of the civil engineering process for nearly all publicly funded infrastructure projects, yet, the public simply does not often participate. The developing academic fields of Infrastructure Studies and Infrastructuralism seek to bring infrastructure, often hidden to the public eye, to the forefront of our literary attention; I will engage with specific persons working in these fields later in this Chapter. By merging the disciplines of literature and civil engineering through understanding engineering while working in the literary realm, we can create stories which spur public participation in already existing forums and encourage people to take a stronger interest in the infrastructure which creates the spaces in which they live. Potential benefits of public participation include the creation of better, more culturally relevant spaces; that is, spaces that people use and develop and are more likely to enjoy using. Public engagement is often missed or misaligned because funding for and regulations of projects such as roads, trails, or public transportation often comes from sources outside a community and only a small group of people actually interact with the funding and regulatory agencies. Because funding and regulation, two factors which critically affect the final form of infrastructure are often disconnected from the community itself, we need more compelling narratives to engage a community in the development of infrastructure.

By engaging the concept of *flow* to corral technical and cultural narrative timelines, we can understand the connections between spaces we physically and culturally experience. In doing so, we can create new and dynamic, simultaneously technical and cultural narratives which can both spur public participation in already existing venues and encourage people to take a stronger interest in the infrastructure which creates the space in which they live. For example, one of the possible

venues that already exists are public transportation documents, such as the Categorical Exclusion Documents or Environmental Impact Assessments for the Indiana Department of Transportation (INDOT) in the United States. In the sphere of public engagement with civil engineering through initiatives such as State Transportation Improvement Programs (STIP), which solicit and require public input,⁹ explaining the impacts of potential state transportation projects, making the public aware of future transportation projects, and educating the public about these programs that require public input in an engaging way, something we as writers and English majors are adept at doing, can improve public participation.

In “The Smell of Infrastructure: Notes Toward an Archive”, Bruce Robbins writes, “[a]long with the line separating those who do and don’t have easily affordable access to clean water, the line between those who have and who don’t have a proper sewage disposal system is arguably the most important political line in the world today.”¹⁰ In stating this, Robbins accentuates the critical effect that infrastructures have on our way of being in the world. While Robbins acknowledges that not everyone needs to know infrastructural issues extensively, proposing effective change does require¹¹ some knowledge of the technical constructed nature of infrastructure. By engaging on a common point of connection between our calls for equity and our physical construction of infrastructure, we can build these bridges between engineering, English, academia, and the public by enveloping technical principles within stories and timelines related to our cultural experiences of living in the world. Thus, combining narrative with engineering is chiefly beneficial as a means of cultural communication and transformation.

This study is thus addressed to a split audience: 1) English scholars interested in studying the constructions of place and 2) Civil Engineers who consider the ontological power that stories have to introduce new transformations in the narrative-time-space continuum. To the latter audience, I am speaking of those who are familiar with critical apparatus organizations such as the Rocky Mountain Institute (RMI) or the Center for Living Environments and Regeneration (CLEAR) and those engineers who seek to keep in mind the complex, interdisciplinary problem-

9. “State Transportation Improvement Program” (STIP), Indiana Department of Transportation, IN.gov, 2021, <https://www.in.gov/indot/2348.htm>

10. Bruce Robbins, “The Smell of Infrastructure: Notes Toward an Archive,” *boundary 2* 34, no.1 (2007): 33.

11. Robbins, 33.

solving methods which they recommend or which they have observed in their own practice. As a current student in the English Department at Purdue University, I write first to English scholars. As English scholars, we spend time identifying narratives and thinking of the ways in which we can change societal systems to make the world a more equitable place. Yet, we cannot forget that spaces are not constructed, or brought into reality based on our identification of oppressor/oppressed binary situations, broader conversations about systemic oppression, or demands for equity alone. Rather, a multiplicity of constraints arising from the technical, legal, and economic disciplines also contribute to the final formation of a space.

As a graduate of an ABET accredited engineering program and a working, although not yet licensed, civil engineer, I write also to civil engineers. I write to them to show that engineering knowledge is practically useful within the literary realm; that is, engineers do bring relevant knowledge to the metaphorical literary table. In this thesis, that knowledge is an understanding of the technical construction of major engineering projects that serve as the center points for the plots of three novels from the twentieth century which I have chosen: Wallace Stegner's *Angle of Repose*, Ivan Doig's *Bucking the Sun*, and Jack Kerouac's *On the Road*. Each of these novels features a prominent infrastructural project and enables us to engage with a different stage in the engineering development of an infrastructural project. Furthermore, each stage intersects with other timelines not always included within the engineering project timeline, including geology, the lifetimes of project users, or the economic timeline of the Great Depression.

Thus, I return again to the unified timeline, drawn from civil engineering and literary theory, which structures this thesis. As presented before and modified here, my proposed timeline contains three segments: 1) Shape — Mapping and Mechanics, 2) Change — Design and Construction, and 3) Possibility — Project Use and the Infrastructural Aesthetic. In Chapter 1: Shape — Mapping and Mechanics, I define and delineate a space's engineering characteristics and boundaries through a literary analysis of the technical metaphors present within Wallace Stegner's *Angle of Repose*. In this novel, Oliver Ward, a mining engineer, and his wife, Susan Burling Ward, a writer and illustrator, travel through the United States based on the locations of his mining jobs. As they do so, they map the cultural and physical spaces in which they live. The novel's title, *Angle of Repose*, frames the plot of the novel through the use of a technical metaphor that analogizes Oliver and Susan's marriage to an amount of soil falling into a pile. In Chapter 2 — Change: Design and Construction, I describe how a civil engineering methodology changes a physical space and draw

comparisons to changes in cultural spaces within the novel through a literary analysis of Ivan Doig's *Bucking the Sun*. In this novel, a family who owns a failing farm in Montana is transformed through the construction of the Fort Peck Dam. Because of the design and construction of the dam, their farm is flooded, they move to a different town, they gain new working skills, and they navigate interfamilial conflicts instigated by the changing of the physical space in which they live. In Chapter 3: Possibility — Project Use and the Infrastructural Aesthetic, I describe how civil engineering projects feature as both signifying and plot enable-ization components through a close reading of a section of Jack Kerouac's *On the Road*. I elaborate on how the presence of a particular civil engineering project, U.S. 6, symbolizes connectivity and enables the aesthetic possibility of a plot based in infrastructure within the novel.

Together, these three chapters connect the unified timeline (Beginning/Mapping and Mechanics, Middle/Design and Construction, and End/Project Use and Infrastructural Aesthetic) into the framework of literary analysis through the concept of flows. While I separate my thesis into three chapters, or segments, for organizational purposes, I reiterate that beyond this thesis, these segments are connected. Projects progress, and regress, through each stage as new information is found or a project owner changes their end goal for a project. Throughout this process, the project timeline is continually compared to geologic timelines, such as the tendency for certain types of rock to creep or settle, government timelines, such as the requirement of a 30-day public review period for environmental documents, or even corporate timelines, such as a company's billing cycle. Thus, understanding the process of civil engineering, as the project unfolds through its three narrative segments, is also a process of understanding fluidity. Multiple timelines, superimposed on one another and explored within the novels I have described above, are present in the singular moments which are chosen for analysis.

In this way, by engaging the civil engineering process within novels, we can explain a space's state of existence from both a technical and a literary perspective. In reading literature this way, we enable literature to speak from both a literary, theoretical, and cultural angle and from a technical, engineering angle. We engage in cross-disciplinary study to more adequately explain the phenomenon of experiencing where we place our bodies while our minds are at work; that is, in our personal, current *Complex Experienced Space*.

Understanding Spaces

This thesis analyzes the *Complex Experienced Spaces* present within *Angle of Repose*, *Bucking the Sun*, and *On the Road*. *Complex Experienced Space* is a phrase I have created for this thesis to describe the combined cultural and physical location of a body and mind within a point and time. The world we live in is constructed of both our physical position and the conventions of our mental relationships to each other and to physical spaces. It is important to comprehensively understand these spaces because these spaces are where we put our bodies while our minds work. The combined space we are in, consisting of both an *Experienced Physical Space* and an *Experienced Cultural Space*, contributes to our way of being in the world. Looking comprehensively at these combined spaces allows us to understand how a multiplicity of narratives contributes to 1) the construction of where we put our bodies, 2) how our minds engage with these spaces and 3) how our experiences are connected to a combination of narratives which is unique to us as individuals.

In this thesis, I use the term “space” colloquially; that is, we commonly refer to both a room and an atmosphere created by a group of people as a “space”. Thus, *physical spaces* are the geometric encapsulations which surround our bodies. I use this term generally; that is, I am not focusing on a particular type of constructed or non-constructed space (such as an office, dwelling, or National Park), but instead I am using the words *physical space* as a phrase to indicate our surroundings as bounded by our field of vision. I do not wish to overcomplicate this definition. Look around you—what are all the material things that pass your field of vision and where is the horizon where your vision ends? In this thesis, this is an *Experienced Physical Space*. Every individual, depending on their own personal background and the nature of their physical self, will experience a physical space differently. Furthermore, I want to clarify that in this thesis I am not discussing how ideology informs or influences our relationships with vision and space and representations of space. Thus, the term *Experienced Physical Space* is not intended to suggest any particular type of experience within a space, but rather is a name for the space itself.¹² The term does not reference an individual’s experiences, but instead represents a geometric height,

12. I use the example of soil and a foundation to illustrate why I make this distinction. Soil, such as sand, has material properties, but it does not emanate an ideology from itself. Rather, we use ideology to decide what to do with the soil. This is the difference between *Experienced Physical Space* and *Experienced Cultural Space*. The *technical narratives* creating the *Experienced Physical Space* are the soil properties. The *cultural narratives* that form our *Experienced Cultural Space* make us choose what to do with the soil based on those properties.

width, and depth —a volume —where a human body may be placed. This is important because it allows us to maintain the distinction between English literature and civil engineering before blending them together in a new discourse. Civil engineering is our way of analyzing a physical space whereas English literature is our way of analyzing a cultural space.

Similarly, in this thesis, *Experienced Cultural Spaces* are the interpersonal relationships and cultural norms which surround our mental space and influence the actions which we choose to take. Different cultural spaces afford different degrees of agency to the individual; that is, there are cultural spaces where an individual's behavior is highly dictated by convention and there are cultural spaces in which an individual wholly directs their own behavior. Again, I do not wish to overcomplicate this definition. Imagine a decision which you consider to be a 'big life decision' — who or what influences what you ultimately decide? In this thesis, this is an *Experienced Cultural Space*.

This combined study of a technical subject and literature is not without precedent. Architectural theory frequently discusses the connections between cultural experience and space. First, there is an inherent connection lying within the idea of the possibility of the creation of physical spaces. Civil engineering is the discipline through which by enabling the design and construction of physical spaces, architectural imagination is brought into physical reality. Similarly, literature is the means which we use to explore the ideas of what it is like to live in the world, to interact with others, and to imagine possibilities for new and different cultural worlds. Jean-Francois Lyotard has explored the role of scientific and narrative knowledge in the postmodern performative institution. He suggests that it is “ ‘imagination’ which allows one to either make a new move or change the rules of the [language] game.”¹³ Through imagining the combination of civil engineering (applied science) and literature (applied literary theory), we can better conceptualize the ways in which *Complex Experienced Spaces* are created.

In drawing a comparison to recent scholarship, this thesis places the individual within an *Experienced Physical Space* and an *Experienced Cultural Space* in a similar way to which Eric Kandel has placed the unconscious within the center of art and science. Chapters in Kandel's *The Age of Insight: The Quest to Understand the Unconscious in the Art, Mind, and Brain from Vienna*

13. Jean-Francois Lyotard, *The Postmodern Condition; A Report on Knowledge*, trans. Geoff Bennington and Brian Massumi (Minneapolis: University of Minnesota Press, 1984), 52.

1900 to the Present alternate between analyses of works of art and scientific explanations of how the brain works.¹⁴ Similarly, this thesis examines an individual's moment of experience within a space by uncovering the narratives contributing to the space's cultural and physical construction. Thus, through literary analyses of *Complex Experienced Spaces* of civil engineering projects, we gain further insight into our complex experience of living in the world.

Understanding *Complex Experienced Spaces*

As stated before, *Complex Experienced Spaces* are a combination of *Experienced Physical Spaces* and *Experienced Cultural Spaces*. Because these separate spaces develop in parallel, we can identify explicit similarities between the development of physical and cultural spaces.

14. Eric Kandel, *The Age of Insight: The Quest to Understand the Unconscious in the Art, Mind, and Brain from Vienna 1900 to the Present*, (New York: Random House, 2004).

Table 1 illustrates this concept of parallel development. I recognize that at this time my elaboration of parallels is somewhat simplistic; I anticipate that more complex parallels will be brought to light as this discourse becomes more complex. For now, I will reiterate the presence and simultaneity of these parallels by delving deeper into the “Contributing and Bounding Narratives” element of these spaces by looking at an example of a watershed.

Table 1: Parallel Development Between *Experienced Physical Spaces* and *Experienced Cultural Spaces*

Element of the Space	<i>Experienced Physical Spaces</i>	<i>Experienced Cultural Spaces</i>
Disciplinary Apparatus	Infrastructure	Works of English Literature
Discipline	Civil Engineering	Literary Studies
Contributing and Bounding Narratives	<i>Technical Narratives:</i> Soil Type, Required Loads, Material Properties, etc.	<i>Cultural Narratives:</i> Gender Roles, Class Restrictions, Racial Stereotypes, Etc.
Method of Change	Designing and Building a New Piece of Infrastructure (Civil Engineering Project)	Challenging Convention, Making Different Choices
Effects	Completed Projects Physically Change the Space	Changing the Cultural Space of the Future

Looking at the *Complex Experienced Space* of a watershed shows the simultaneous existence of an *Experienced Physical Space* formed by *technical narratives* and an *Experienced Cultural Space* formed by *cultural narratives*. Watersheds can be changed through methods of change, another element described on **Error! Reference source not found.**. Through this signifier of a watershed, we can understand the concept of a *bounding narrative*¹⁵ or a narrative that directs the decisions we make within an *Experienced Cultural Space* or the directions which waterdrops flow in the *Experienced Physical Space* of a watershed. Furthermore, I choose this signifier because it already is colloquially used to refer to both metaphorical and geomorphological formations. For example, “Watershed: An Independent Blog of Critical Theory by the Graduate Students of English at the University of Nebraska – Lincoln” recognizes the duality of this signifier by describing a watershed as both a “geographic feature that divides water into different systems” and “a crucial

15. Manuel DeLanda, “Markets, Anti-Markets, and Network Economies,” Collaboratory for Digital Discourse and Culture @ Virginia Tech, Virginia Polytechnic Institute and State University, <https://www.cddc.vt.edu/host/delanda/pages/markets.htm>

In a future version of this thesis, I anticipate connecting the idea of a *bounding narrative* to Manuel DeLanda’s work on “self-organizing spaces” or entities. This concept explores to what extent network economies organize themselves and to what extent they are organized by people. This concept is explained in this source.

event or occurrence recognized as causing a turning point or change.”¹⁶ Furthermore, metaphorically, in a person’s life, a *watershed moment* is one after which a person is never the same again. Because this term is already used within both disciplines, and because a watershed bounds flow within a particular area, I am choosing it as a point from which to elaborate on the possibility of a blended discourse.

First, I will relate the cultural, metaphorical definition likely already familiar to those in English academia to the physical, geological definition by explaining the geological definition with a specific example — the Saint Lawrence Divide. The United States Geological Survey defines a watershed as follows: “A watershed is an area of land that drains all the streams and rainfall to a common outlet; A watershed is a precipitation collector.”¹⁷ Watershed boundaries are lines which divide the direction which water flows and thereby outlines, or bounds, the entire area in which water flows to a single, defined outlet point. For example, the Saint Lawrence divide is a series of topographical high points, a ridge along the Valparaiso Moraine, that separates the water that flows into the Great Lakes from the water which flows to the Gulf of Mexico. In this way, the watershed exists as an already delineated space which dictates how the raindrops which should accidentally fall inside should behave. Similarly, our *Experienced Cultural Space* maps our own, personal watershed; when faced with a question, a choice, or a decision, our answers will be decided in part, if not in whole, based on the direction given to us by our *Experienced Cultural Space*. In this way, the restrictions of our *Experienced Cultural Space* bound the options we have when making a decision.

Both disciplines, literary theory and civil engineering, when creating and analyzing their parallel apparatuses of infrastructure and literary works, draw upon the identification of these cultural and physical boundaries. In a civil engineering project with a drainage component, an engineer will begin the project by *delineating the watershed*¹⁸, or determining the boundaries of

16. “About”, *Watershed Blog*, University of Nebraska – Lincoln, August 15, 2019, <https://www.watershedblog.com/about>.

17. “Watersheds and Drainage Basins”, Water Science School, USGS: Science for a Changing World, US Department of the Interior, December 8, 2020, https://www.usgs.gov/special-topic/water-science-school/science/watersheds-and-drainage-basins?qt-science_center_objects=0#qt-science_center_objects

18. “Delineating Watersheds: How to Delineate a Watershed,” National Resources Conservation Service: New Hampshire, February 22, 2021, https://www.nrcs.usda.gov/wps/portal/nrcs/detail/nh/technical/?cid=nrcs144p2_015680

from where the water that will cross the site is coming. This will help the engineer determine a total volume of runoff at a particular time and manage that runoff in accordance with a regulating organization's requirements and in accordance with the site's natural topography and soil properties. In literary analysis, we often examine a piece of infrastructure or a character by identifying the characteristics of the culture in which these infrastructures are created, or in which these characters live, and how the form of these infrastructures or characters' actions and feelings are influenced or limited by these cultural boundaries. Even in our own lives, while we cannot choose the culture in which we are born, or where the metaphorical waterdrop that is us falls, we are not left without choices. Just as physical infrastructures created within watersheds, such as pipes, culverts, or rain gardens direct the flow of water within a watershed, and if necessary, enable water to leave that watershed, our cultural choices are restricted by boundaries already in place, but by making different choices, we, or characters in literature, can break the boundaries of a particular place and create new outcomes for the future.

Furthermore, the boundaries between cultural watersheds and physical watersheds exist simultaneously. For example, through the reversal of the Chicago River in 1900, water that originally flowed from the City of Chicago through the Chicago River to Lake Michigan now outlets in the Gulf of Mexico. The construction of infrastructure — a changed riverbed, sluice gates, and moveable bridges changed the existing physical watershed's boundaries.¹⁹ While the project protected Lake Michigan, it radically transformed the landscape along the Chicago and Illinois rivers, down to the Gulf of Mexico, often for the worse.²⁰ Many farmers' land became less productive and today there is a dead zone in the Gulf of Mexico that is caused in part by this project. In this way, one project, a piece of physically constructed infrastructure, changed the boundaries of both a physical watershed and a cultural watershed; the physical watershed of the Chicago River was changed because the water was literally rerouted to a different outlet point. The cultural watershed boundaries were changed because the lives of each person whose land was affected had to reevaluate their lives based on new choices available to them. Constructed infrastructure changes watershed boundaries.

19. "Reversal of the Chicago River", American Society of Civil Engineers, December 8, 2020, <https://www.asce.org/project/reversal-of-the-chicago-river/>.

20. Carson Vaughan, "Floods, Carp, And Crap: The Environmental Impacts Of The Chicago River Reversal." *NPR*. NPR, October 14, 2019. <https://www.npr.org/local/309/2019/10/14/769630864/floods-carp-and-crap-the-environmental-impacts-of-the-chicago-river-reversal>.

Figure 3 provides a visual illustration of how physical watershed boundaries, cultural watershed boundaries, and constructed infrastructure. In Figure 3, the initial physical watershed boundaries follow the topography of the land; that is, high points along the ridgeline determine which direction water flows. In Figure 3, I have illustrated how this works on one particular watershed with arrows, which symbolize the path of water drops. In the inset, the highlighted section shows an unnaturally straight line —Lindberg Road has been constructed on the boundary of an existing watershed, and the crown of the road, illustrated by the straight line, has changed the watershed. Thus, the constructed infrastructure has changed the boundaries of what is possible — the direction which water will flow.

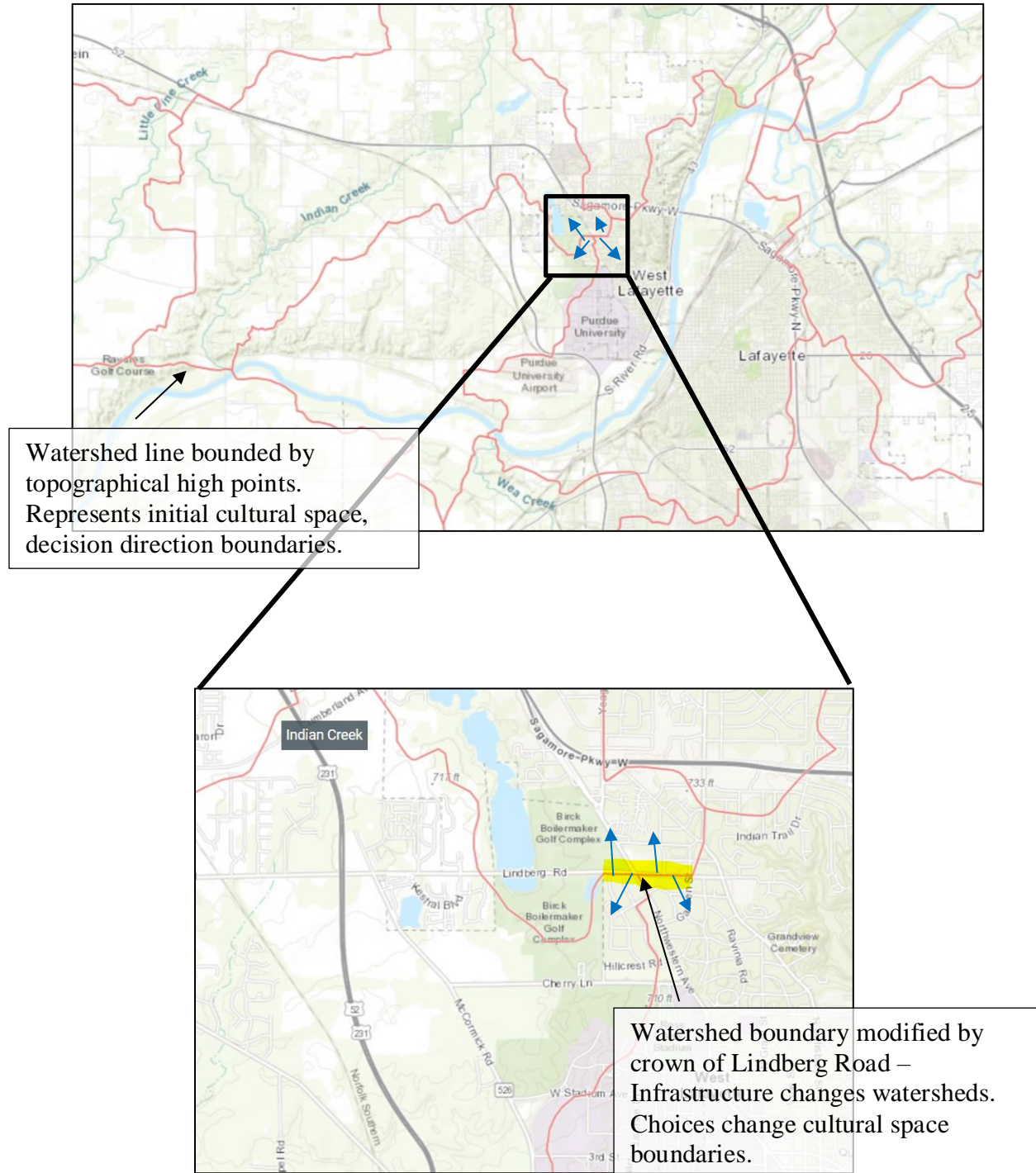


Figure 3: Watershed Illustration Showing Boundaries of *Experienced Cultural Spaces* and *Experienced Physical Spaces*

When characters make choices within the *Experienced Cultural Space* within their cultural watersheds, creating direction within boundaries placed by others who are not them, they recognize that there are choices and that they can build infrastructures to create the consequences of the choices they choose to make. In building infrastructures, we are encouraged to consider the impacts of our chosen directions and created infrastructures, both in physical and in cultural spaces. We also must consider the limiting potential of these created infrastructures, and instead of only asking the question – “How does this infrastructure meet a need now?”, to ask “What opportunities does this infrastructure give future generations?”. To remain within the watershed is to choose to balance our own goals within these boundaries of our *Experienced Cultural Space*. To choose to leave or change the boundaries of a watershed is to trade the existing boundaries for a different *Experienced Cultural Space* in which there are new rules and different boundaries which direct our decisions. Thus, throughout our lives, we experience a mix of constructed and pre-existing *Experienced Cultural Spaces* which function similarly to the *Experienced Physical Spaces* of a geomorphological watershed.

Through exploring these concepts of boundaries and watersheds, we can see the construction of *Complex Experienced Spaces*. The *Experienced Physical Space*, the physical watershed, is directly analogous to the *Experienced Cultural Space*; both have boundaries that define the behavior of what is inside and changing these boundaries affect the choices available to future generations. Watershed boundaries interrupt flows. They direct and manipulate flows. These boundaries are changeable through the construction of infrastructure, and at any point in time, a part of the watershed’s boundaries may exist due to natural, pre-existing topography or due to constructed infrastructure, such as the crown of a road. Consequently, examining a watershed is examining a *Complex Experienced Space* within a specific moment of time. Changing the watershed requires assessing what the boundaries are at that particular moment in time. Creating a change in the infrastructure requires that a project be bounded. A starting point must be defined and then we must choose how to balance the particular moment with the challenges presented by the characteristics of that space within that particular moment.

Noticing, Experiencing, and Proposing Change in *Experienced Physical Spaces*

I devote time to explaining a particular way of noticing *Experienced Physical Spaces* in order to center my work within the broader literary fields of Infrastructure Studies and

Infrastructuralism and to provide a way of describing engineered spaces without only talking about their effects. This is necessary because it gives us a way to discuss the complexity of changing the physical space and to begin to articulate immediately feasible solutions to change a physical space. In short, noticing *Experienced Physical Spaces* in the way I will outline enables us as English academics to talk about engineering changes without having to delve too deeply into engineering literature. This way of noticing *Experienced Physical Spaces* provides a bridge between civil engineering and English Literature.

Experienced Physical Spaces exist on a spectrum consisting of constructed and non-constructed spaces (Figure 4). The spectrum illustrates the complexity of changing the space; rebuilding an urban space presents different challenges than building in a non-constructed space. The spectrum also reminds us of continuity and fluidity because a space's location on the spectrum is unique to that space. Consequently, I have provided a few examples of constructed and non-constructed spaces and spaces in-between. Briefly, I want to note that there are no arrows on this spectrum because I do not wish to imply a progression between types of spaces; that is, neither constructed nor non-constructed spaces are "better" than the other. While we can draw conclusions on the positives and negatives of the outcomes of particular projects, and the opportunities which projects afford or take away from future generations, which have created spaces at various locations along the spectrum, the intent of the spectrum is rather to give us a way of articulating the amount of constructed-ness effort that went into creating a space. Additionally, while it is theoretically possible for a *Non-Experienced Physical Space* to exist, because this thesis focuses on human relationships with constructed spaces, I have chosen not to explore this possibility. Finally, it should go without saying that considering the entire history of the world and the myriad of cultures and conditions in which humanity has lived, it is beyond the scope of this thesis to definitively state whether a space could be wholly *Non-Experienced*. Thus, the spectrum is intended to be illustrative without being identificatory or exclusive. Engaging with the spectrum by considering a space's possible location on the spectrum shifts our thinking from noticing the aesthetic of the space towards discussing the civil engineering aspects of the space's construction.

4a: Chicago, IL



4c: Fossil Discovery Trail, Dinosaur National Monument, UT

Non-Constructed
SpacesConstructed
Spaces4b: Briarwood Apartments,
LaPorte, IN4d: Just off Native Lake Trail Mount
Massive Wilderness, COFigure 4: Spectrum of *Experienced Physical Spaces*

Changing constructed spaces engages the challenges of coordination and construction within urban spaces. Figure 4a shows two examples of constructed physical spaces, the skyline of Chicago and the shoreline of Lake Michigan. A viewer standing within the City experiencing the space would see some combination of urban infrastructure: skyscrapers, streets, hard-armored shorelines, engineered materials including steel, concrete, glass, or manicured greenspaces. Hidden elements of urban infrastructure, while mostly unseen, would still be immediately present. As I have mentioned before, the developing academic fields of Infrastructuralism and Infrastructure Studies seek to bring this hidden infrastructure to the forefront of our literary attention. Michael Rubenstein's *Public Works* closely engages the intersections of the post-colonialist space of Ireland and the publicness of electrical grids and water infrastructure as they are used within Irish Modernist writing.²¹ Rubenstein argues that he provides a "heuristic that yields new insights into a multiplicity of post-colonial literatures,"²² an idea which Caroline Levine has developed by drawing comparisons between structures of class and infrastructure. As characters in Adichie's *Americanah* "become accustomed to wealth, they lose their capacity to perceive both the structures of inequality and the infrastructures of ordinary life."²³ In these ways, Rubenstein and Levine critically articulate how infrastructure — designed and constructed by civil engineers — and societal systems can be analyzed together to more comprehensively explain our experience living in the world.

Interestingly, recent anthropological projects have also focused on increasing public awareness of this infrastructure. Shannon Mattern has meticulously catalogued recent projects designed to spark critical thought about infrastructure. She notes that while projects such as the Invisible 5, a "self-guided audio tour of Interstate 5 in California between Los Angeles and San Francisco,"²⁴ gets people to notice infrastructure, instigating action towards more equitable spaces

21. Michael Rubenstein, *Public Works, Infrastructure, Irish Modernism, and the Postcolonial*, (Notre Dame: University of Notre Dame Press, 2010), 2.

22. Rubenstein, 2.

23. Caroline Levine, "'The Strange Familiar': Structure, Infrastructure, and Adichie's *Americanah*", *Modern Fiction Studies* 61, no. 4 (2015): 600.

24. Shannon Mattern, "Infrastructural Tourism," *Places Journal*, July 2013, <https://placesjournal.org/article/infrastructural-tourism>.

does not always intuitively follow.²⁵ That this lack of clarity regarding how to produce action based on a new awareness of infrastructure exists is indicative of the importance of interdisciplinary work. After all, public meetings and public input are a critical part of the civil engineering process for nearly all publicly funded infrastructure projects, yet, the public does not often participate. By merging the disciplines of literature and civil engineering through understanding engineering while working in the literary realm, we can articulate the technical requirements of infrastructure in conjunction with the public nature of infrastructure in order to spur public participation in already existing forums and encourage people to take a stronger interest in the infrastructure which creates the space in which they live. This is because when we understand engineering processes, we can speak more concretely about elements of those processes. In seeking the ways in which *Experienced Physical Spaces* are constructed and have changed through time, we can connect our cultural position to understanding how we interact with those spaces. We can understand how the construction of physical spaces, such as the reversal of the Chicago River, interrupts our physical space of being in the world. We can understand the continuous interplay between stories and structures and by retelling this interplay in interesting, narrative forms, engage the public, thereby creating a cultural climate more likely to engage with changing physical infrastructures. To be more specific, in the case of the reversal of the Chicago River, there exists the story that the engineers told themselves to justify the construction of the river reversal, the stories given to the public to get buy-in for approving construction of the river, and the story dealing with the creation of a dead zone. In the wake of these stories, a following story which explain a thorough impetus for not doing this again is one which would include the technical characteristics of why the Chicago River was reversed—to protect Lake Michigan by not sending wastewater to Lake Michigan. Now, because we have better wastewater treatment technologies, it is possible to approach the question of protecting Lake Michigan from Chicago's wastewater with a different perspective. Now, we can suggest and implement alternative methods for dealing with the problem. Rather than rerouting wastewater, we can treat the wastewater, and releasing it into Lake Michigan is less of a problem and will become even less of a problem as wastewater treatment technology improves. Because we now have different methods for technically solving problems, we can criticize the old methods for solving the problems. Creating a story, then, which summarizes the original available technology and the negative consequences

25. Mattern.

of these technologies and also explains how newer technologies enable newly available solutions to problems, can be used to explain implementable solutions to problems such as the one I have described above. In this way, we can not only identify that the reversal of the Chicago River had/has negative consequences for both people and the environment brought about by this infrastructural project, but we can articulate ways to change, or re-approach this situation such that the technical problems of dealing with wastewater is still met without the negative social and environmental consequences caused by a solution which uses older treatment technologies.

Already, we are more familiar with public action in the realm of environmental protection. Figure 4d shows a space just off of Native Lake Trail in the Mount Massive Wilderness, Colorado. This area was designated a wilderness in 1980 as part of the Colorado Wilderness Act,²⁶ another Act in a series of Acts which have created the National Parks, National Monuments, and Wilderness areas over the past century. We are familiar with protests to protect the importance of science, such as the March for Science on Earth Day in 2017, conducted to express opposition to President Trump's climate denial.²⁷ In *Slow Violence and the Environmentalism of the Poor*, Rob Nixon encourages us as literary scholars to create narratives which spur action against the devastating environmental and societal consequences of toxic waste, megadams, and petro-imperialism, among other industries.²⁸ Nixon's work is compelling and pushes us to engage with a geological timeline — one much longer than our own lives, yet, still impacted by the choices we make. Engaging civil engineering within our study of literature shows one way that this is possible — by narrativizing the process of creating infrastructure, we can identify points where actions towards equitable infrastructure can be taken. In this way, we can identify the points where the flows of an engineering project timeline will intersect with the flows of other timelines (such as when changing the flow of a river interrupts the geomorphological timeline of the river) and choose to adjust the engineering timeline to make it more equitable. Thus, this thesis proposes to engage the process of infrastructure creation without inducing immediately negative reactions to the

26. Senate and House of Representatives of the United States of America Assembled. "Public Law 95-560: An Act to designate certain National Forest System lands in the States of Colorado, South Dakota, Missouri, South Carolina, and Louisiana for inclusion in the National Wilderness Preservation System, and for other purposes (Dec. 22, 1980).

27. Laura Smith-Spark and Jason Hanna, "March for Science: Protestors gather worldwide to support 'evidence'", CNN, April 22, 2017, <https://www.cnn.com/2017/04/22/health/global-march-for-science/index.html>.

28. Rob Nixon, *Slow Violence and the Environmentalism of the Poor*, (Cambridge: Harvard University Press, 2013), 3-8.

discipline of civil engineering or towards particular civil engineering projects. While projects will be used as examples, the primary focus of this thesis is to use a unified timeline which could accurately describe the process of almost any civil engineering project. For example, in Chapter 2 of this thesis, I extract a generalized *Design and Construction* process explanation from the Fort Peck Dam, rather than discuss in detail the actual implications of the dam as it exists in the real world.

Constructing Experienced Physical Spaces

In this thesis, I have chosen to consolidate the formal civil engineering sequencing into three enveloping categories: 1) Mapping and Mechanics, 2) Design and Construction, and 3) Project Use. The purpose of this consolidation is to reduce the complexity of the project process into workable chunks for a thesis of this size. In choosing this consolidation, I have sought to remain faithful to design processes with which engineers are likely already familiar, such as the five phased design sequence published by the American Institute of Architects (AIA) that structures the progression of project design.^{29,30} I recognize that reducing complex project timelines into such broad categories does pose a risk of generalization. Yet, while flattening the complex civil engineering process risks undermining the complexity of the discipline, it does enable us to corral other timelines, such as by including a river's natural migration within the delineation of a space at the beginning of the project. These timelines usually have the unfortunate tendency to remain tangential to the design process; but by using the concept of a project as the intersection of the flows of many timelines, we can incorporate this timeline into the project timeline because we look upstream and downstream from a point of stopped flow —the project itself. In this way, I illustrate the project with the simplest of narratives: 1) Beginning, 2) Middle, and 3) End. In this

29. Michael Lindeburg, PE, *Civil Engineering Reference Manual, Sixteenth Edition* (Belmont: Professional Publications Inc., 2018), 86-8.

30. Furthermore, engineering theories of design exist, but due to time limitations in writing this thesis, I have not explored them. In a further version of this thesis, I anticipate a section documenting the development of the theories of civil engineering education and design in order to more fully explain the developments between narratives and infrastructures by explaining the narratives that inform the process and the designers of these infrastructures. The following is an example of a study that explores theories of design practice:

Sharifah Osman, et al. "A Grounded-Theory Study of Civil Engineering Design Practice in Malaysia," *Journal of Civil Engineering Education* 146, no. 2 (2020), doi: 10.1061/(ASCE)EL.2643-9115.0000007.

thesis, this is done in three chapters: 1) Shape: Mapping and Mechanics, 2) Change: Design and Construction, and 3) Possibility: Project Use and the Infrastructural Aesthetic.

Mapping and Mechanics, the Beginning stage of a project, gives shape to the possibilities available to designers of a project by exploring the *technical narratives* that shape a project site. In this stage, the design team investigates the project site to determine the site's characteristics and identify potential challenges. The investigation is both physical and cultural. Generally, a topographic survey is completed, soil borings or rock cores are taken, and relevant permitting agencies are identified. Right-of-way or easement acquisition, required rezoning, compressible or liquefiable soils, site classification for seismic design, or steep slopes are also identified at this stage. The engineer will typically conduct a site visit to 'get a feel' for the site and notice anything that may have been left out of the technical investigations and topographic surveys. Gathering information shows the engineer what to expect from the site's inherent, or in-situ, properties and what to expect from the governing bodies that regulate development on the site. Thus, the *Mapping and Mechanics* stage gives Shape to a project by identifying what is already present at the site and providing a beginning for delineating the possibilities for changing the site.

Wallace Stegner's *Angle of Repose* is a literary work that addresses some of the elements I have outlined in this mapping stage. Stegner's novel investigates the simultaneous identification and delineation of the physical and cultural spaces of the American West, the American East, and his grandparents' marriage. The novel's setting alternates between the 1970s and 1880s as Lyman Ward navigates his own failed marriage and the damaged, but still intact, marriage of his grandparents. Ward analogizes his grandparents' marriage as a spilled bucket of soil; his grandmother, an aristocratic writer and illustrator, fails to appreciate her mining engineer husband's abilities and career. He, in turn, is uncooperative towards her and his coworkers, tearing the intimacy of their relationship. As his grandparents map the space of their marriage as they travel through the cultural and physical spaces of the American West and East on mining surveys, Lyman Ward maps his own relationships with his caregivers and estranged family. On one occasion, Lyman Ward's son visits him and the two discuss the stodgy, quiet personalities of Lyman's grandfather and his father. Lyman tells him about how Oliver Ward surveyed the Hearst mine, slept in a tent through a Dakota winter, and interacted with Buffalo Bill Cody and Horace Tabor. His son, only interested in "exciting" history, tells him that since he is writing a book of

Western history, he should add some “zing”³¹ to it. Lyman reemphasizes that he is not interested in Western history as a whole, but rather, his grandparents’ marriage, and how “two such unlike particles, clung together, and under what strains, rolling downhill into their future until they reached the angle of repose where I knew them.”³² It is in this passage that Lyman figures out why he is bothering to record and archive his grandmother’s letters.³³ For readers, because we see Lyman use the technical term *angle of repose* in direct correlation to this passage, we see the analogy of soil and particles and this technical property of soil, unique to his grandparents’ marriage, spelled out clearly. In this novel, he applies the technical meaning of an *angle of repose* to a cultural context. That is, if we understand what *angle of repose* means in a technical sense, we can understand how Lyman’s grandparents are behaving. If we understand the technical meaning of the term *angle of repose*, when we read the title of the novel and learn that it is about the story of the marriage of two individual’s, we can immediately guess that there will be some discussion of friction, that is, of social conflict between the two individuals, and there will be some element of rest and resignation. If we do not understand the technical meaning of the term *angle of repose*, our cultural interpretations of the novel are limited. The novel thus delineates the shape of particular cultural and physical spaces, namely, marriage, through the lens of soil mechanics.

Design and Construction, the Middle category in the project timeline, is the stage where the site is changed based on the boundaries and expectations defined in the previous stage. This change unfolds to progress towards a chosen end, or planned manifestation of the project. The end goal may be influenced by any number of factors including technical boundaries or cultural conventions which critically influence the objectives of infrastructure. Isolating this category allows us to suspend judgement of a project because we can focus on the narratives that have brought the project into being and are shaping the project. Understanding the process of infrastructure construction and incorporating it into our analysis of infrastructure within literature can help us look more closely at an infrastructural problem and not make assumptions about what the effects of that particular infrastructural project will be. Examining actual steps within *Design*

31. Wallace Stegner, *Angle of Repose*, (New York: Vintage, Reprint edition, 2014), 228.

32. Stegner, 228.

33. Stegner, 228.

and Construction further exposes the complexity of changing physical spaces and possible elements of interest with this process.

Ivan Doig's *Bucking the Sun* illustrates the process of changing the space of western Montana through the design and construction of the Fort Peck Dam. The novel takes place in 1933 during a period now rightfully criticized for its huge public expense, relatively unsuccessful mission of turning the desert west into fertile farmland, and damage to tribal populations.³⁴ The book tells the story of family dynamics in parallel with the construction of the Fort Peck Dam. Owen Duff, a field engineer, must manage the physical construction of the dam in tandem with balancing deadlines from the Federal Government and maintaining relationships with his family whose farmland will be drowned in the reservoir. His family navigates the cultural plots of having in-laws, starting businesses, and getting to know one another in uncertain economic conditions. In this way, *Bucking the Sun* uses the process of *Design and Construction* to show change in both people and in physical space. Doig's novel utilizes the human tendency to view projects only in connection to their individual current moment, ignoring that infrastructure is both inherently public and also directly interfaces with the natural environment. To the misunderstanding of his father and his wife, Owen Duff acknowledges the multiplicity of timelines on which he is working. He simultaneously acknowledges the magnitude of change which "his dam" is imposing on the landscape and that rivers are always changing in a geomorphological sense.³⁵ Furthermore, my analysis of this novel shows how merging civil engineering with literary studies can help us understand how both *technical narratives* and *cultural narratives* combine to create the space of a project. Because this category most obviously unfolds over a series of events and shows how both characters' *Experienced Physical Spaces* and *Experienced Cultural Spaces* are changed over time through a civil engineering project, it is aptly named the Change section of this thesis.

The final category for this thesis is Possibility: Project Use and the Infrastructural Aesthetic. As the aim of this category is to reveal the narratives created by infrastructure, this category aligns most readily with the study of English Literature. For this reason, I chose Jack Kerouac's *On the Road* as a representative "road novel". This section explores the possibility for new narratives to be brought into existence because of the construction of a particular type of infrastructure which

34. Mark Reisner, *Cadillac Desert: The American West and Its Disappearing Water, Revised Edition*, (New York: Penguin Books, 1993), 5-7.

35. Ivan Doig, *Bucking the Sun*, (New York: Scribner, 1997), 54, 81.

may or may not exist at a current moment in time. Both *Bucking the Sun* and *Angle of Repose*, novels which present events primarily in the nineteenth century, show cross country travel as occurring by train. By contrast, in *On the Road*, Sal Paradise, a writer and his unreliable friend Dean Moriarty drive across the United States and south into Mexico. Their travel path is enabled by highways, foreshadowing the construction of the Interstate highway system.

In this chapter, I will look speculatively at the actual merging of infrastructure and literature using the phrase *infrastructural aesthetic*. In *On the Road*, we are able to see the structure of infrastructure embedded within the narrative of a novel. Generally speaking, and similar to other pop culture media such as the YA novel *Amy and Roger's Epic Detour* by Morgan Matson, Pixar's *Cars*, Tom Cochrane's "Life is a Highway", or Whitesnake's "Here I Go Again", the novel embodies the aesthetic of the road. In this chapter, I show that not only do the words of the novel tell the story of the characters' travels on the road, but the structure of the novel matches the structure of a highway. That is, there are moments of high speed and moments of total pause; this pattern mirrors the phenomenon of driving and then stopping periodically as is done on a cross-country driving trip. Thus, in *On the Road*, by revealing structures created through civil engineering as they are revealed in parallel within literary novels, we enable literature to speak from an engineering angle. That is, having engineering knowledge illuminates new elements of the novel. Finally, by briefly looking at *On the Road* in conjunction with more recent narratives of highways in the professional civil engineering realm, we can see how the way we speak about highways has developed over the twentieth and twenty-first centuries and is now beginning to intersect with conversations about race, gender, and class. Due to the time limitations in writing this thesis, I do not delve too deeply into these discussions, but I do want to mention that these conversations are occurring and the ideas presented in this thesis, as they become more fully developed, could find a home in such a blended discourse as this one.

Understanding the Fluidity of *Experienced Physical Spaces* and *Experienced Cultural Spaces*

Our experience of being in the world, and the interplay between narrative and infrastructure, moves fluidly through time. Analyzing a singular book allows us to see a singular narrative, or a singular collection of narratives. Through studying literary theory, we can understand how literature shows us the experience of creating a cultural space. In this way, we can become aware

of our *Experienced Cultural Space*. Through the discipline of civil engineering, we balance geologic timelines, human timelines, and historical design philosophy timelines into an individual project timeline to build physical spaces. By presenting a project as a narrative with a beginning, a middle, and an end — a flow — and by looking at a project at a specific segment of time — stopping the flow — we can understand how all the surrounding and following narratives are influenced by the project. Much as Stewart Brand has posited in *How Buildings Learn: What Happens after They're Built*, infrastructure is in a consistent state of flux.³⁶ Creating equitable infrastructural change, then, demands that we acknowledge both the physical and cultural processes by which spaces are created. Creating equitable infrastructural change demands that we acknowledge fluidity.

Incorporating the concept of fluidity thus brings the ideas of narrative and projects in parallel with one another. As *cultural narratives* and *technical narratives* influence the design of spaces, these spaces influence the design of stories. The flows which we experience contribute to the formation of both our *Experienced Cultural Space* and our *Experienced Physical Space*. Thus, an individual at any given moment, living simultaneously within their personal *Experienced Physical Space* and their *Experienced Cultural Space*, is subjected to the influence of a variety of flows. Because the individual experiences the effects of these flows, the flows can be said to be “acting on the person.”

In light of this statement, I will make one final comparison showing the close similarities between civil engineering and literary theory. In **Error! Reference source not found.**, I have provided an illustration of the idea that cultural flows and physical flows are acting on a person. The person is represented by a block and the effects of the flows creating the experienced spaces are shown as arrows pulling on the person. With this concept, we are reminded of Edward Soja's idea of the *Thirdspace*. Soja describes two spaces in the City of Los Angeles as where “everything is seen as a simultaneously historical-social-spatial palimpsest, Thirdspace sites in which inextricably intertwined temporal, social, and spatial relations are being constantly reinscribed, erased, and reinscribed again.”³⁷ In **Error! Reference source not found.**, I take Soja's idea and

36. Stewart Brand, *How Buildings Learn: What Happens after They're Built*, (New York: Penguin Books, 1995), 2.

37. Edward Soja, *Thirdspace, Journeys to Los Angeles and Other Real-and-Imagined Places*, (Malden: Blackwell Publishers, Inc., 1996), 18.

showing how being in such a space may affect a person—that is, how the spaces, sites, reconceptualized as flows using my idea of time from earlier in this paper, can be shown to be acting upon a person.

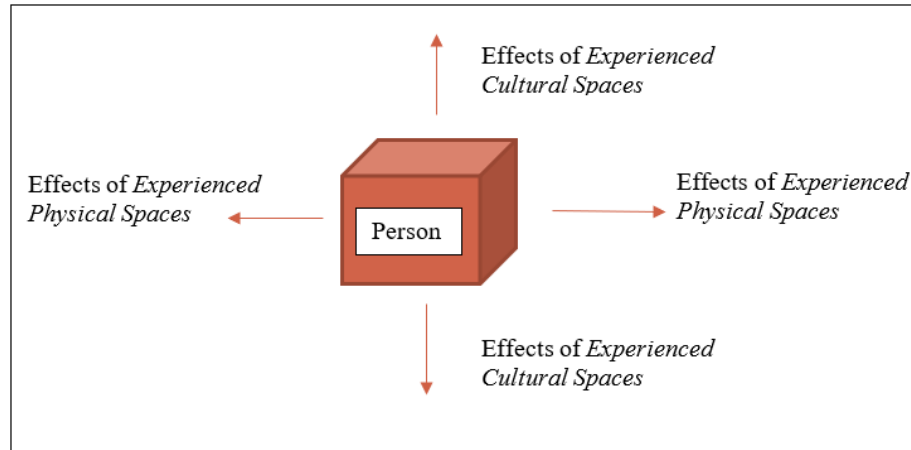


Figure 5: Conceptualization of the *Flows of Experienced Spaces* Acting on a Person

I choose to represent Experienced Spaces using **Error! Reference source not found.** because it mimics the representative stress blocks used in engineering to illustrate the stresses on a representative block of material. In **Error! Reference source not found.**, the Greek letters Sigma and Tau represent *stresses*, or the forces acting over the area of a particular plane of the *stress block*. Rotating the *stress block* to a particular orientation, unique for each type of material and the stresses applied, will enable calculation of the maximum combination of stresses a material can take before failure.

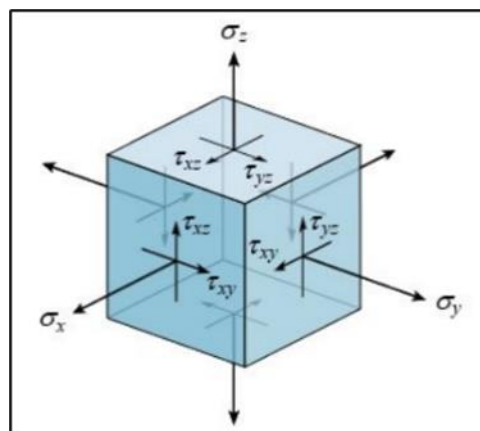


Figure 6: Engineering Stress Block

Similarly, examining our own behavior through the lens of *Experienced Physical Spaces* and *Experienced Cultural Spaces*, can help us understand what is contributing to our state of being in a particular moment. By understanding this connection between literary theory and civil engineering through technologizing Soja's *Thirdspace*, we can understand the process of how this complicated, interconnected, or to use Soja's word, "trialectic"³⁸ space is changed. In this way, we can see the big knowledge connections suggested by Soja's intersecting spaces between civil engineering and literary theory — not only are they practically connected through the practice of project development, but they are connected within the realm of knowledge and creating knowledge as well. I recognize that the magnitude of this claim is much too large in reference to this size of this thesis and I do not wish to make claims which are too large or which I cannot prove. Thus, then, this section is meant to serve only as an implication of a possibility of cross-disciplinary work which I do in this thesis, not as the argument itself.

My argument, to return to the beginning, is that by drawing upon the parallel structures of the disciplines of civil engineering and English literature through the common theoretical touchpoints of timelines, flow as articulated by Deleuze and Guattari, de Landa, and Soja, and the boundaries of metaphorical and physical watersheds, we can more comprehensively articulate the narratives of infrastructure. Then, by articulating both the *technical narratives* and the *cultural narratives* which contribute to the construction of, and interpretation of, physical spaces, we can more clearly identify areas for change. We can narrow in on the isolated timeline of an infrastructural project by creating a generalized project timeline and analyzing literature to see how that timeline is represented within literature. This timeline, which follows the Aristotelian tradition of Beginning, Middle, and End is Shape: Mapping and Mechanics, Change: Design and Construction, and Possibility: Infrastructural Aesthetic. It is through this timeline that we can momentarily freeze the flows of a *Complex Experienced Space* and look, segmentally, at what narratives have brought that space into existence and what narratives that space may inspire. Then, when we think about the larger connections between how these experienced spaces act upon the

38. Soja, 8.

individual, we can see that both civil engineering and literary theory, and the way we analyze them, can reveal more about our state of being than theorists have previously identified. Finally, we can understand that both *technical narratives* and *cultural narratives* form a space simultaneously.

This, I think, is why we talk about experience; because articulating our experience reveals our state of being. Experience brings to us what we know, and in the moment we experience it, we are reminded of what we feel we felt. When we understand how both the physical and cultural spaces that we are experiencing were created, and understand how to change them, we can really get a handle on what is going on. Once we have acknowledged this, it is easier to move forward with creating more comprehensive narratives that more adequately explain how spaces are made. This is especially useful in the realm of public infrastructure, even those infrastructures like buildings which are often owned by a private developer but the public still walks in, this is pretty much public for most practical purposes. We can explain a space's state of existence from both a technical and a literary perspective and enable literature to speak from both a literary, theoretical, cultural angle and from a technical, engineering angle. Through this observation of parallel structure and common touchpoints, moving towards creating a new, blended discourse, we can describe the *narratives of infrastructure*, or the simultaneous building of spaces through civil engineering and literary theory. When we understand more comprehensively how spaces are made, we can improve cultural communication and more easily identify points for changing infrastructure and making more equitable spaces, which is, after all, kind of what we're after.

CHAPTER 2: MAPPING AND MECHANICS IN WALLACE STEGNER'S *ANGLE OF REPOSE*

Introduction

A *deed* uses words to describe a plot of land. A *boundary survey* delineates the borders of a plot of land. A *topographic survey* is a drawing that shows all the features of a plot of land. *Contour lines* on the topographic survey show the elevation of the ground within the boundaries of the deed. Rocks *weather* because of wind and water. Particles of rock are transported by water and wind, mix with other particles, embrace organic matter, and become *soil*. Soil spills and rests at an *angle of repose*. Soil forms the earth that is the physical base of a space. The surveyed elevation points create contours which delineate the shape of the space. The survey shows the trees, the mailboxes, the asphalt — the materials that already exist in the space before the specifics of spatial change are decided. The soil, trees, contours, grasses, ground cover that form the space define the present state of an *Experienced Physical Space*. This is the Shape of a space.

In this chapter, I analyze Wallace Stegner's *Angle of Repose* by examining the novel through the lens of two technical metaphors. These metaphors are representative of the first stage in the unified timeline I have proposed for constructing a blended discourse. This first stage, *Mapping and Mechanics*, is the stage of the timeline where engineers identify what is already present in the physical space which is a potential engineering project.³⁹ In analyzing literature, this is the stage where we identify the cultural boundaries imposed upon characters and identify what we expect to see as plots develop based on the characteristics of this culturally bounded space. This action of identifying cultural characteristics and exploring the limitations they place on characters is nothing new in the analysis of literature; what is new about identifying these actions as *Mapping and Mechanics* is that by borrowing terms from the discipline of civil engineering, we explicitly make a connection with the discipline of civil engineering and so begin to create a blended discourse. Illustrating the transferability of terms is a key step in articulating the blended discourse which I am proposing with this thesis.

39. In making this statement, I acknowledge that the true “beginning” of a project is more difficult to pin down, because changing a physical space actually begins in the cultural space. For this reason, when I refer to “Beginning” in this thesis, I am referring to that point where the ‘reaction’ — the project — begins to switch from story to infrastructure through the process of engineering (See **Error! Reference source not found.** in Chapter 1).

Furthermore, exploring a literary novel through the lens of these terms borrowed from civil engineering provides a starting point for creating narratives instigating the public's interest in infrastructure. Examining technical metaphors within literature by bringing engineering concepts to the forefront of literature creates a shared beginning point for discussion. When creating narratives about infrastructure, if we begin with the *technical narratives* surrounding a piece of infrastructure, that is, if we start our *cultural narrative* story with the technical reasons for why a piece of infrastructure is constructed the way it is, and what challenges we expect to see when changing it, we do not require our audience to buy into a particular metaphysical worldview before engaging with questions of infrastructural change. Instead, we can begin the narrative with an immediately contextual representation of the project.

Drawing upon the theorists which I have mentioned in the first section of this thesis shows a few key allusions to shape and form. In *Anti-Oedipus*, Deleuze and Guattari write of a “body without organs,” or a type of surface onto which social production and desiring production flows act. The body without organs then appropriates these flows, “the unproductive, the unconsumable, serves as a surface for the recording of the entire process of production of desire, so that desiring-machines seem to emanate from it.”⁴⁰ In *A Thousand Years of Non-Linear History*, Manuel DeLanda uses the concept of *mineralization* to connect geologic and social behavior. He describes the fossil record as mineralizing the history embedded within soft tissue because it preserves the shape of endoskeletons. Additionally, when humans began to build brick buildings and stone walls to restrict the movement of people, that was the construction of an exoskeleton.⁴¹ Both Deleuze and Guattari's allusion to a surface and DeLanda's allusions to endo-and exo-skeletons illustrate that Shape is already used within literary theory. The solidification of formations in a phenomenological sense points us toward studying actual physical forms. This is an incremental progression, from conceptualizing a shape which consolidates and regurgitates the flow ideas, to using the concept of structured mineralization to connect the fossil record and human buildings, to studying how flows contribute to the initial form of a place before that place is changed through the methodical process of civil engineering. When telling the *narratives of infrastructure*, the first

40. Gilles Deleuze and Felix Guattari, *Anti-Oedipus: Capitalism and Schizophrenia* (New York: Penguin Group, 2009), 10-11.

41. Manuel DeLanda, *A Thousand Years of Non-Linear History*, (New York: Zone Books, 2000), 27.

step is to identify what is already present. What is the situation at the beginning of a particular infrastructural narrative?

The Shape of a *Complex Experienced Space* is uncovered through *Mapping and Mechanics*. Through *Mapping and Mechanics*, we demarcate the ways in which *cultural narratives* and *technical narratives* bound a space (*Mapping*) and explain what we expect to happen based on the cultural and physical spaces in which the narrative takes place (*Mechanics*). In this way, the spaces within the text may be described as *Complex Experienced Spaces*. When we use *Mapping and Mechanics* to explore the Shape, or the present state, of a *Complex Experienced Space* within a work of literature, we engage a new way of conducting cross-disciplinary literary study and of identifying a beginning point before moving forward with recommendations to change a particular space.

Wallace Stegner's novel, *Angle of Repose*, explores the *Complex Experienced Spaces* of marriage and the late nineteenth century American West and East. The terminally ill narrator, Lyman Ward, has retired to his grandparents' cabin where he is consolidating his grandmother's writings into a book. In doing so, he reflects on his life and his memories of his grandparents. Susan Burling Ward, Lyman's grandmother, was an aristocratic writer and illustrator who symbolically embodies the American East. Oliver Ward is a taciturn, self-made mining engineer symbolizing the American West.⁴² Lyman Ward immerses readers into two technical metaphors which structure the novel and reveal the role of *Mapping and Mechanics* in building *Complex Experienced Spaces*: 1) surveying and 2) soil mechanics. In doing so, he incorporates several narratives which act as flows that influence the Shape of the *Experienced Cultural Spaces* and *Experienced Physical Spaces* which Susan and Oliver Ward encounter.

In this chapter, I will explore *Mapping* within the technical metaphor of surveying. Lyman compares the different boundaries of the cultural spaces between his marriage and his grandparents' marriage and how these boundaries have affected the outcomes of their marriages. Specifically, Lyman's grandmother was uncomfortable with the life she experienced traveling through the West, yet despite this discontent, because their marriage existed within the space of Victorian norms, their marriage persisted. Lyman directly contrasts this with the more relaxed sexual norms of the 1970s and his wife, also discontented, leaves him for his surgeon. I will unpack this further within this chapter, but for now, I want to mention that this is an example of how *Mapping* works by

42. William Dubois, "The Last Word: The Well-Made Novel", *The New York Times*, August, 1971.

providing a means with which to delineate the boundaries created by the *Experienced Cultural Spaces* in which these marriages take place.

Secondly, Lyman Ward analogizes his grandparents as soil particles⁴³ and the story of their marriage as how these soil particles fall and eventually come to rest. This analogy of falling soil particles immerses readers within the technical metaphor of *soil mechanics*. In civil engineering, *mechanics* explains the behavior of a particular material based on repeated empirical tests or theoretical models. In *soil mechanics*, the *angle of repose* is a term used to describe the natural angle at which different types of soil rest (Figure 7).⁴⁴

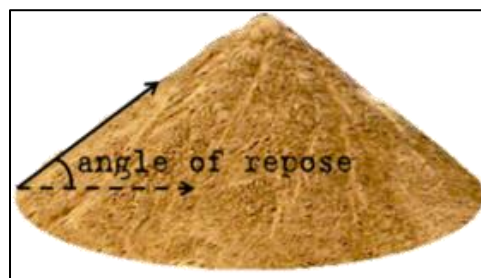


Figure 7: Angle of Repose

Although general values are derived and are used in practice, the *angle of repose* is unique to each type of soil —each particular combination of weathered rock and organics. By using this metaphor, Stegner allows readers to see both the allusion of a ‘falling marriage’ and points to the fact that his grandparents are unique individuals, and their marriage is unique, and so in falling they discover their own personal, cultural *angle of repose*.

Mapping: Surveying and Culture

Identifying the boundaries created by physical setting reveals the shape of Susan Burling Ward and Oliver Ward’s story. Within the space of American land inhabitation, the words in property descriptions, formally called *deeds*, legally delineate the physical space and temporally

43. Wallace Stegner, *Angle of Repose*, (New York: Vintage, Reprint edition, 2004), 228.

44. Michael Lindeburg, PE, *Civil Engineering Reference Manual, Sixteenth Edition* (Belmont: Professional Publications, Inc., 2018), 80-4.

suggest the cultural space of a plot of land. The land deed documents a boundary survey which records, in words, the mathematical measurements that legally delineate the boundaries of land ownership. The unit of measure used within the deed (feet in newer deeds or rods and chains in older deeds) places the mathematical descriptions temporally within the historical and cultural moment in which the deed was written. Delineation unfolds over time. As surveyors delineate the boundaries of a property, they traverse that property. As engineers draw the results of the survey on the computer, they virtually re-traverse those boundaries and lend to them an element of officiality and temporal permanency. Thus, surveying is a process which delineates the Shape of the land. As the survey unfolds, the boundaries of the land become known.

Furthermore, in colloquial American culture, owning the physical space of the land often suggests that the cultural space within the physical space is owned concurrently. Barring restrictions by local governments, owners have the agency to make changes to their space of land. This is a central problem in Louise Erdrich's novel, *Tracks*, because as the Pillager family loses their ownership of the physical space of their land, they also lose the ability to hold the land as part of their familial history and instead it is exploited for resources.⁴⁵ After Fleur Pillager and her family are unable to pay the fees to retain the deed to their land, their land is sold to those who will use it for timber production. Fleur leaves the land as the lumberjacks arrive, manipulating the forest in a final display of power.⁴⁶ Thus, within the American system of land ownership, the holder of the land deed is assumed to have both cultural and physical ownership of a space of land. Building upon this idea, a land deed, creatively worded beyond the typical standard language of a surveying document,⁴⁷ could encompass both the cultural and physical reality of a *Complex Experienced Space*. Thus, surveying is a form of delineating the boundaries of this space.

Within *Angle of Repose*, Oliver Ward's approach to his work as a mining engineer exemplifies this connection of delineating dual physical and cultural ownership. Upon arriving in Leadville, Colorado, Oliver and Susana meet other surveyors, mining engineers, and their wives. Some engineers, such as Oliver, are surveying mines for private investment, and other characters are surveying areas for the United States Geological Survey or the Public Domain. Through a

45. Louise Erdrich, *Tracks*, (New York: HarperCollins, 2004), 222-223.

46. Erdrich, 222-223.

47. See Appendix A.

conversation between Oliver and two other engineers, Stegner addresses the multiplicity of cultural objectives embedded in the physical work of mine surveying.⁴⁸

At a party, another engineer's wife, named Helen, jokingly probes the engineers and surveyors about the legalities of telling mine owners what they want to hear. She says, "Mr. Janin [another engineer] pretends to think they are paid by investors to tell investors what investors want to hear. But how does a government scientist remain honest?"⁴⁹ Her question implies the problem of government surveyors recommending land for private purchase if it appears to be profitable, rather than remaining in the public domain. The atmosphere in the room is light, and the other engineers dance around answering the question. Stegner illustrates Oliver's personality with a follow-up question, " 'You know', said Oliver unexpectedly from his seat against the wall, 'I'd kind of like to hear you *answer* that question of Mrs. Jackson's'. It was the wrong note."⁵⁰

This quote of Oliver's shows how the cultural boundaries between private and public ownership can be in conflict within the same physical space of a mine. In this scene, the mine becomes like a body without organs; the mine becomes a space in which cultural questions of ownership, profitability, public good, and honesty are allowed to interact until they reach a space of resolution. Yet it is critical to acknowledge that the mine itself is not actually a blank slate, because it is the *technical narratives*, the physical characteristics of the mine which influence the development of these *cultural narratives*. Thus, through this example, we can see how the simultaneous existence of *technical narratives* and *cultural narratives* contribute to the Shape of the space that is the mine when Oliver and the other engineers are discussing it and by exploring these narratives, the possibilities for what the land that is the future mine can do are exposed. In this way, the potential area for a mine is a *Complex Experience Space*.

Boundary surveys begin and end at a Point of Beginning —a point with a known elevation and location with reference to a point of fixed elevation. I choose not to italicize Point of Beginning here because it is a formal, surveying term and not my own invented term. The Point of Beginning, or fixed elevation and location is often at a Monument or Benchmark (Figure 8). All of the subsequent measurements are taken from this point and all locations on the property are measured

48. Stegner, 276.

49. Stegner, 281.

50. Stegner, 281.

from the boundary of the property; thus, the Point of Beginning and the boundaries of the property provide the basis of measurement within an *Experienced Physical Space*.



Figure 8: GPS and Vertical Control Survey Marker

In the *Complex Experienced Spaces* in which we live, boundaries are both physical and cultural, and just like in surveying, we delineate these boundaries through the plots of narratives by starting at a Point of Beginning.

Furthermore, Oliver's comment reveals that he is solely acting within an engineering *Experienced Cultural Space*; that is, his actions and reports are wholly based on the *technical narratives* which he reads while surveying the mine. His reports adhere only to these *technical narratives* without regard for the norms arising from the cultural spaces of the readers of his reports, which could include investors or the government. In this way, Oliver's reports are also a surface over which the *technical narratives* from his observations and the *cultural narratives* from his engineering approach and his audience's desires flow. These reports are thus a space where flows overlap and the ways in which they overlap affect whether Oliver will be kept on a project or removed to another project.⁵¹ In this way, we begin to see how the *Experienced Cultural Space* of one individual can affect the *Experienced Cultural Space* of another individual, a concept on which I will elaborate further later in this Chapter.

When Susan marries Oliver, she leaves both the *Experienced Cultural Space* and the *Experienced Physical Space* of the East and must redefine the boundaries of her experience. She continues her career as a writer and an illustrator which she established in the East; however,

51. Stegner, 382-383.

because she is married to an engineer and lives within the West, the stories she tells changes. She incorporates technical terms such as “drifts, stopes, tipples, pumps, ores, assays, mining law, claim jumpers, underground surveying, and other matters”⁵² into her writing which is published in the *Century* and the *Atlantic* and read by Eastern readers. As the boundaries of her *Experienced Physical Space* change in tandem with the boundaries of her *Experienced Cultural Space*, Susan continually redefines her relationship to these boundaries that shape her life. She compares new boundaries to her original, New England aristocratic starting point; as William Dubois has noted in a 1971 New York Times review of the novel, Susan is “the eternal bluestocking with minor pen-and-brush talents who never reconciles her craving for Paris and Conversation.”⁵³ Susan thus continually maps her present *Experienced Cultural Space* in strict reference to the space at which she began. In this way, she becomes a surveyor of *Experienced Cultural Spaces*.

Throughout the novel, Susan accepts the landscape in which she lives, but resists the “West as a transience and social crudity.”⁵⁴ The meaning that she gives these spaces can be articulated incrementally. When Oliver considers working in Potosi, Susan resists; in the cultural boundaries of the life she left, moving to a remote, high altitude mining location for professional development is not even available for consideration.⁵⁵ Even so, as she struggles with embracing and pushing away the Western cultural space because she views these spaces as less “civilized” than those of the East, she knows that much of her income is based on her portrayal of these spaces. By the end of the novel, Susan has accepted that she will live in the West. In a letter to her friend, she describes that despite the tensions which have developed between her and Oliver due to the transitory nature of his career, and the space of the West in which it takes place, her career too has taken place in the West. Furthermore, this is where her marriage is and so she must solve the problems of her marriage within the Western cultural space.⁵⁶ The meaning she ascribes to the Western cultural space, then, develops into one of confinement. This is contrary to the meaning which Oliver ascribes to the West because the West enables the expansion of his career.

52. Stegner, 13.

53. William Dubois, “The Last Word: The Well-Made Novel”, *The New York Times*, August, 1971.

54. Stegner, 299, 419.

55. Stegner, 183.

56. Stegner, 589.

While Susan's method of surveying relies on *cultural narratives*, Oliver's method of surveying relies on the *technical narratives* within the physical spaces in which he works. In the creation of a blended discourse, Oliver represents the engineering side of the discourse. Because of the nature of his profession, he must physically place his body in the location where he is surveying; thus, this transiency directs his life and bounds his experience. For Oliver, his goal of becoming an engineer serves as the Point of Beginning to which he continually compares his experiences. Oliver surveys numerous physical spaces: mines in New Almaden, California, the Sutro drainage tunnel in Nevada, undeveloped areas in Leadville, Colorado and Michoacán in Mexico to determine if they are suitable for mines, and the area for a drainage ditch outside of Boise, Idaho.⁵⁷ His opportunities are bounded by Susan's reactions to living in each space. Oliver's constancy in is *Experienced Cultural Space* as a professional engineer redefines the boundaries of his *Experienced Physical Space* as he moves from location to location, whereas Susan's transiency in *Experienced Physical Spaces* redefines the boundaries of her *Experienced Cultural Space*.

In this way, Susan and Oliver, viewed together, act as reciprocals of one another. As they continually redefine their experiences to their individual Points of Beginning, the boundaries placed on each other by their individual experiences shape their experience of each other. It is in this space of continual, back and forth delineation in which their lives lived within the bounds of their marriage takes place. Thus, they map their individual *Experienced Physical Spaces* and *Experienced Cultural Spaces* within their boundaries to each other—all within the *Complex Experienced Space* of their marriage. I have illustrated this concept in **Error! Reference source not found.** The surveying that each of them does, Oliver of physical spaces and Susan of cultural spaces, draws the boundaries of their marriage. Their physical location is always dependent on Oliver's current job, and the "happiness" of their marriage is often dependent on Susan's level of satisfaction with their current location and the cultural opportunities available to her that are similar to those in the East. In short, **Error! Reference source not found.** shows how their particular opportunities and experiences have been enables, or restricted, because of the *Complex Experienced Space* of their marriage.

57. Stegner, 44, 83, 232, 355.

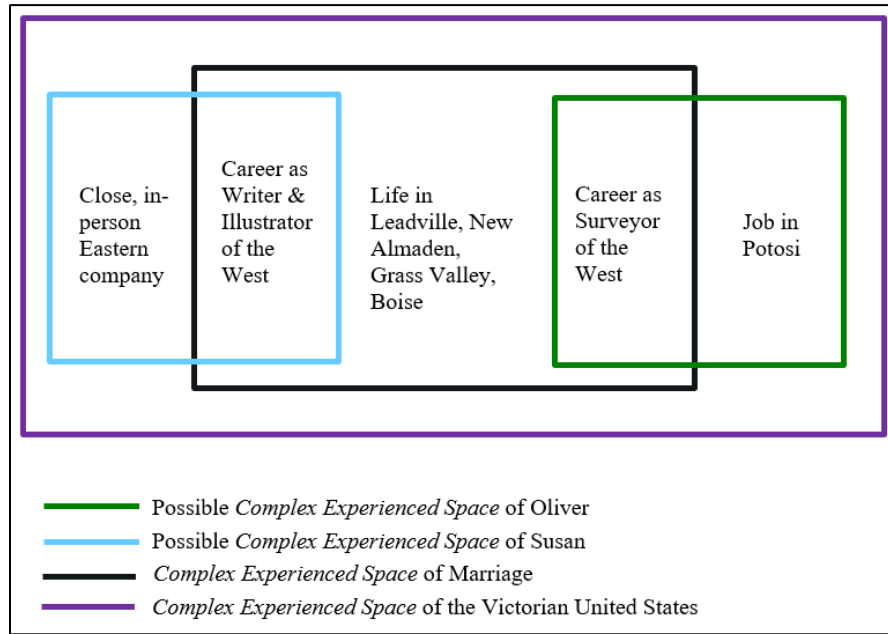


Figure 9: The *Complex Experienced Space* of Susan and Oliver's Marriage

Susan's mapping of *Experienced Cultural Spaces* and Oliver's profession of mapping *Experienced Physical Spaces*, and their differences in Points of Beginning illustrates that their experiences of being in the world, both physical and cultural, are bound by their *Complex Experienced Space* of marriage. Through their lives, they continually redefine and delineate these boundaries with respect to one another and within the broader *Complex Experienced Space* of the Victorian United States. Susan's cultural delineations seek to bound her experience within her idea of living a life of conversation and literature in the East; Oliver, by contrast, measures the physical world to reach his objective of becoming a mining engineer. Because Oliver's position requires them to physically relocate to areas culturally incompatible with Susan's ideals, their *Complex Experienced Space* is one which contains conflict.

Resolution is ever forthcoming; thus illustrating that surveying the boundaries of our experience is a continual process. Identifying boundaries shows us the actions available to us, but unlike a technical, formal, boundary survey which definitively states the legal boundaries of a property at a snapshot in time, we continually trace new boundaries in our lives. To invoke a surveying phrase, the boundaries of our *Complex Experienced Spaces* "do not close." While a legally recorded boundary survey is valid until a property is subdivided or sold (usually after a time of a few months, years, or decades), the boundaries of our individual *Complex Experienced*

Spaces are valid as long as we choose for them to be. The time increment is infinitesimally small and we live our lives within the continuous fluctuations of the boundaries of our *Complex Experienced Space*. In this way, using the metaphor of surveying reveals how delineating boundaries illustrates the connections between physical and cultural spaces. By naming a fixed Point of Beginning in either type of space and regimentally measuring out our distance from that Point of Beginning, and by taking stock of the textures, objects, and materials on the sites of our lives, we slow down enough to identify the boundaries of our *Complex Experienced Space*. Once we know what is present on the site of our lives, we can begin to predict what will happen and what our reactions to these actions will be.

Examining the *Complex Experienced Space* of marriage thus enables the transition from *Mapping* to *Mechanics*. The novel's title, *Angle of Repose*, refers to a mechanical characteristic of soil to rest at a unique angle depending on the soil type. As I mentioned before, Lyman Ward, the novel's narrator, analogizes his grandparents, Susan and Oliver Ward, as soil particles and compares his marriage to theirs. Each of these marriages contains conflict between the spouses; that is, a "falling," to use a word embedded within the technical metaphor. Each marriage "falls" according to the *Mechanics* of the *Experienced Cultural Space* in which it is conceived.

Mechanics: Expectations and Behavior

In civil engineering, *Mapping* identifies the boundaries and features of a site. *Mechanics* explains the behavior of those features. For example, the discipline of *soil mechanics* tells engineers how much weight a type of soil can support or how long it will take the soil to settle once a structure is built. Thus, analyzing the *Mechanics* of an *Experienced Physical Space* by looking at the *technical narratives* of that space enables civil engineers to develop expectations of that *Experienced Physical Space*. Likewise, as literary theorists and students of English literature, we examine the *cultural narratives* that shape *Experienced Cultural Spaces* in order to understand how these spaces are working. Approaching understanding an *Experienced Cultural Space* by using the *Mechanics* of that *Experienced Cultural Space* enables us to predict what may happen within that *Experienced Cultural Space*. Using the technical lens of *Mechanics*, or understanding that we are identifying systems, can help us identify the systems that are contributing to a space which we wish to change.

Angle of Repose tells the story of not one, but two marriages in not one, but two, *Experienced Cultural Spaces*: 1) Susan and Oliver Ward's marriage within the *Experienced Cultural Space* of the Victorian Age and 2) Lyman Ward and his wife, Ellen's, marriage within the *Experienced Cultural Space* of the 1970s California. In one way, the marriages are similar, both Susan and Ellen experience years of discontent⁵⁸ the actions they take based because of this discontent vary. Despite the possibility of infidelity, Susan and Oliver remain married, never forgiving each other, for the remainder of their lives, whereas Ellen leaves Lyman and the end of the novel poses the possibility for reconciliation.⁵⁹ Through the last pages of the novel, Lyman muses on many different possible meanings for *angle of repose*. The novel's last words, narrated by Lyman Ward who has just woken up from dreaming, read "I lie wondering if I am man enough to be a bigger man than my grandfather."⁶⁰ Reading the novel through the technical, metaphorical lens of *soil mechanics* illustrates that *angle of repose* references a place of rest after a long, long fall. In this way, an awareness of *Mechanics* can shape our reading of the novel.

Thus, the anthropomorphic representation of soil particles with the bodies of the characters of Lyman and Ellen and Oliver and Susan illustrates the combination of civil engineering and literary theory. This representation applies a technical principle drawn from geomechanics to the non-materialistic space of a relationship between persons. Furthermore, the novel's title, *Angle of Repose*, situates readers within the most basic element of physical spatial creation: the soil. In civil engineering the purpose of understanding *soil mechanics*, rock mechanics, and conducting site investigations is to reveal what is unseen within the earth before building any structure in order to understand the potential implications for the project based on the space in which the project is to be built. Similarly, in explaining his own marriage and his marriage of his grandparents, Lyman draws his assumptions about what will happen based on the mechanics of the *Experienced Cultural Space* in which the marriages fall, that is, begin to fail and eventually resolve. For example, as Lyman describes the moment of infidelity between Susan Ward and another man, he expounds on the differences between her infidelity and his wife's infidelity. He writes, "It is easier these days than it was in Grandmother's time, faster, more direct. Ellen Ward's seduction took only weeks

58. Stegner, 44, 83, 232, 355.

59. Stegner, 631-632.

60. Stegner, 631-632.

and was total. Susan Ward's if it really was seduction, took eleven years, and may never have translated impulse into act. I know none of the intimate circumstances; I only guess backward from the circumstances."⁶¹ In this quote, Lyman compares the *Experienced Cultural Spaces* of Victorian marriage and marriage in 1970s California. When the marriages fall, they fall according to what is allowed in each cultural space; that is, according to the *cultural narratives* defining the *Mechanics* of their *Experienced Cultural Space*. Furthermore, Lyman recognizes the contributions of personality as a *cultural narrative* contributing to an *Experienced Cultural Space*. When he recognizes the differences between his responses and his grandfather's; that is, his suggestion of the possibility of forgiving his wife, a possibility which Oliver Ward was unable to consider because he was a stubborn engineer, illustrates the multiplicity of narratives contributing to an *Experienced Cultural Space*.

Thus, within the novel, *Angle of Repose*, beginning with the rock of the ideals of Victorian ideas of marriage, Susan and Oliver have been weathered through abrasions of infidelity with their own cultural boundaries and transported through space and time, across the American continent, into Mexico, and back again. At the end of their narrative, they are two soil particles, resting together into a pile. Yet, critically, this illustrates that the narrative is not yet over, Lyman takes the knowledge from the narrative of his grandparents' marriage and uses it in his own. This further illustrates the continuity of *Complex Experienced Spaces*; while we experience these spaces as individuals, they exist in a state of continuity.

Finally, I return to the engineering definition of *angle of repose* in order to emphasize the fundamental importance of understanding the *Mechanics* of a space. In civil engineering, the *angle of repose* is also the angle of static friction, or the internal friction angle.⁶² This angle is used to calculate the strength of a soil, or the amount of shear stress a type of soil can handle before it slides.⁶³ While this angle is unique each type of soil, generalized values have been calculated so that engineers can quickly estimate the friction angle —and how much weight a site's soil could hold —based on the type of soil found on a site. Project such as the Leaning Tower of Pisa, which

61. Stegner, 563.

62. Donald P. Coduto, *Geotechnical Engineering: Principles and Practices*, (Upper Saddle River: Pearson Education Inc., 2011), 25.

63. Michael Lindeburg, PE, *Civil Engineering Reference Manual, Sixteenth Edition* (Belmont: Professional Publications, Inc., 2018), 35-26.

is leaning because the soil underneath is consolidating, illustrate the importance of conducting soil investigations.⁶⁴ Thus, understanding the technical use behind *angle of repose* reiterates the technical importance of understanding the mechanics of the soil materials initially present in an *Experienced Physical Space*. Likewise, understanding the *Mechanics* of an *Experienced Cultural Space*, are critical to understanding what will actually happen within that space.

Secondary Criticism

In the future, more deeply exploring secondary criticism to further ground this section of my proposed blended discourse within literary studies is necessary. Beyond the personal narratives of Oliver and Susan, Stegner's *Angle of Repose* tells a narrative of the literal building of the physical space of the modern American West. Briefly, I want to address the obvious colonialist implications of this type of statement — the physical space which I have been referring to as the American West already existed and was already inhabited before Oliver Ward and other engineers arrived and began surveying. Elizabeth Cook-Lynn, a member of the Sioux Creek Tribe, has reminded us of this critical point in her collection of essays titled *Why I Can't Read Wallace Stegner*, which explores the colonialist nature of the works of Wallace Stegner, among other Western writers. Cook-Lynn states that works by authors such as Stegner present a false view of the Indigenous people of the Americas because they ignore their present survival in favor of false regret and a “cloak of respectability.”⁶⁵ By contrast, C.L. Rawlins highlights Stegner's admission of the European genocide of Indigenous cultures and his own lack of knowledge of Indigenous people⁶⁶ and an investigation into the text illustrates that Stegner is aware of the colonialist nature of the interactions of Europeans in the Americas. Specifically, in Mexico, when Oliver is standing next to the owner of the mine he has been hired to survey. Susan notices “how blond [Oliver] was...he looked the part of the invading Nordic capitalist.”⁶⁷ Even though the novel was written

64. Coduto, 25.

65. Elizabeth Cook-Lynn, *Why I Can't Read Wallace Stegner and Other Essays: A Tribal Voice*, (Madison: University of Wisconsin Press, 1996), 31.

66. C.L. Rawlins, “Why I Can't Read Wallace Stegner and Other Essays: A Tribal Voice (review),” *Western American Literature* 32, no. 3 (1997): 293-296, doi: 10.1353/wal.1997.0012

67. Stegner, 361.

in 1971 before post-colonial critique as a literary field really got underway, Stegner's writing notices the capitalist tendencies within this type of Western engineering narrative. In one scene, Shelly, Lyman's younger secretary who does much of his typing for him, looks back on the huge irrigation ditch that Oliver wanted to build in Idaho and comments with the perspective of someone living in the 1970s, "[a]ll that big dream of his was dubious ecology, and sort of greedy when you look at it, just another piece of American continent-busting."⁶⁸ These quotes suggest that postcolonial critique of *Angle of Repose* is likely to yield productive work, even though I have not had time to engage with it within this thesis.

Furthermore, it is critical to note that the method of *Mapping* which I have identified is unique to analyzing spaces within the Western system of land ownership. *Mechanics*, by contrast, is more universal; that is, while a particular type of soil may be more common in a particular physical area that houses a certain culture, the theorems which explain how these soil particles interact is less dependent upon these cultures. While the way knowledge is deployed for power is contextual and varies across cultures, the facts of how a soil behaves is inherent to the soil type, rather than the culture that is intending to use the soil. This statement, and exploration thereof, definitely demands more analysis and I anticipate I will conduct such an analysis in a future expansion of this work.

Conclusion

Thus, *Mapping and Mechanics* is a way of defining boundaries and uncovering expectations. In transforming these terms from the discipline of Civil Engineering to Literary Studies, we gain a contextual way of articulating the current Shape of the space and what we expect to happen based on this particular Shape. Describing a *Complex Experienced Space* using this context created from a blended discourse establishes a common starting ground between civil engineering and literary theory. In this way, when creating narratives about infrastructure, we can begin with narratives drawn from the project itself, rather than outside the project, within the established elements of each, individual discipline. *Mapping and Mechanics* is thus a way of beginning productive, cross-disciplinary conversation through the co-opting and sharing of terms. Returning back to the idea of a unified timeline in the changing of *Complex Experienced Spaces*, using this method of

68. Stegner, 575.

Mapping by comparing current boundaries to a previous point of fixity, and by suggesting expectations through *Mechanics* lets us shape the beginning of creating a *narrative of infrastructure*.

CHAPTER 3: DESIGN AND CONSTRUCTION IN IVAN DOIG'S *BUCKING THE SUN*

Introduction

A *plan set* is an assembly of drawings which document in words and pictures a project and all its components; a vision for spatial change. A *specification book* is an assembly of pages containing the words that detail the legal obligations of the *Project Owner*, the *Project Engineer*, and the *Contractor*. The *Contractor* must read and adhere to the *technical specifications*, also contained within the *specification book*, which spell out in words the materials and government codes, brand names, strengths, and sizes of every project component. Together, the *plan set* and *specification book* are the project *Design*. The *Contractor* creates a *bid* after reviewing the *Design* to determine the cost, time, and manpower required to construct the project. The public agency and the public review the *bid* and provide comments. The *Contractor* wins the project, agrees to the legal obligations, submits a schedule, and *mobilizes equipment*. Earth is moved, engineered materials are arranged, utilities are connected. The *Project Owner* asks questions and suggests changes; the *Project Engineer* develops solutions and approves substitutions; the *Contractor* arranges materials. This is the *Construction* of a project. Together, this is the development of the Change of a space.

Ivan Doig's novel, *Bucking the Sun*, describes the *Design and Construction* process of the Fort Peck Dam near Glasgow, Montana through the perspective of the Duff family. The Duff family is employed in the industries surrounding the dam's construction. Owen Duff, the novel's main character, is the construction engineer on the dam and is responsible for managing daily construction activities and communicating with the design engineers in Kansas City. His parents and two brothers, previously living on their family farm located a hundred miles upstream, relocate to Glasgow, Montana because their land will be flooded by the river behind the dam. There, they redefine the boundaries of their experiences by taking construction jobs, setting up new businesses, getting married, and falling in and out of trouble. The novel's familial, or *cultural narrative* climax and plot development up to the climax mirrors the physical construction and technical climax of the dam.

Ivan Doig illustrates the *Complex Experienced Space* of Glasgow, Montana through parallel *cultural narratives* and *technical narratives* that fit within the concepts of *Design* and

Construction. In this section, I define *Design* as responding to a need posed by a lack by methodically developing an actionable solution. For example, the novel poses the development of the Fort Peck Dam project as the Roosevelt administration's response to low employment during the Great Depression.⁶⁹ In civil engineering, *Design* is completed after the *Mapping and Mechanics* phase; based on the needs of the client and the current state of the site, potential solutions for Change are identified. I define *Construction* as bringing this defined solution into material reality through expending energy and communicating and coordinating with involved persons. I acknowledge that these definitions are still too general; in a future version of articulating this blended discourse, I anticipate breaking *Design and Construction* down into incremental steps and drawing more thorough connections between these processes and the plot of *Bucking the Sun*. For the present, however, I will remain with a high-level view of these definitions and use them to explain some characteristics of change within *Complex Experienced Spaces*. Analyzing the parallels between *technical narratives* and *cultural narratives* illustrates that by examining this segment of my unified timeline, we can create a plan to rearrange the narratives shaping a *Complex Experienced Space*; that is, create Change within this space. Furthermore, by coopting the terms *Design* and *Construction* into a blended discourse such as I have proposed, we begin to procedurally incorporate an already existing, methodical way of creating physical changes in infrastructure into the ways in which we discuss cultural change for infrastructure.

This is particularly useful when creating narratives about infrastructure to encourage public involvement. Using knowledge about *Design* and *Construction* encourages incremental, feasible suggestions for spatial change. Understanding the *Design and Construction* process; that is, being aware of typical periods when 30%, 60%, or 90% design documents are available for public comment, or developing a knowledge of the hourly time required to develop *Plans* and *Specifications* for projects of various types reveals the complexity of infrastructural projects. By developing an understanding of this process and the time it takes to actualize infrastructural change, we can suggest smaller, perhaps more feasible, projects as steps in the way towards larger, systemic change. The changes brought about by these projects will accumulate into larger, systemic changes towards more equitable and ecologically sustainable spaces. In suggesting this, I am not intending to downplay the urgency of creating more equitable and ecologically sustainable spaces, but rather to provide a starting point for immediately pursuing that goal. This idea fits within an already

69. Ivan Doig, *Bucking the Sun*, (New York: Simon & Schuster Inc., 1996), 23-24.

existing conversation taking place in both academia and popular literature that engages the intersections of architecture and literary theory.

For example, Leslie Kern's article in *The Guardian* titled " 'Upward-thrusting buildings ejaculating into the sky' - do cities have to be so sexist?"⁷⁰ asks us to consider why cities are designed as masculine spaces to the extent that buildings literally take a phallic shape. She posits questions about what would create a more Feminist city. Questions such as these provide a framework for culturally changing the way we conceptualize *Experienced Physical Spaces*. However, to affect timely, material change towards these larger goals, we as English academics and students of theory also need to be asking about changes that can be physically brought into existence on the level of individual projects, whether those projects be evaluating a potential new water source for a community or working within a single city to provide more options for transportation beyond the automobile. Developing a basic understanding of the *Design and Construction* process, and an awareness of the characteristics of this process, and using this understanding in literary analysis can help us understand the parallel constructions of *Experienced Cultural Spaces* and *Experienced Physical Spaces*. Because *Design and Construction* are where possibilities unfold into reality, examining the *Design and Construction* process shows the temporal middle of the *narratives of infrastructure*.

Furthermore, examining the construction of cultural spaces as it parallels the *Design and Construction* of physical spaces enables us to look beyond identificatory statements calling for change. We can look beyond the beginning or the end of a project; that is, beyond the effects of a project once it is built or the reasons for building it in the first place. Specifically, *Design and Construction* unfold over time; they are not instantaneous. When we take the time to see the process, we can better grasp the magnitude of the project and the interest surrounding the project itself. When we understand both the *technical narratives* and *cultural narratives* which define a *Complex Experienced Space*, we can more comprehensively identify ways to change a particular *Complex Experienced Space* and therefore, our experience being in the world. I acknowledge that this idea is not yet fully developed, but I do want to emphasize that it is important to understand

70. Kern, Leslie. "Upward-Thrusting Buildings Ejaculating into the Sky' – Do Cities Have to Be so Sexist?" *The Guardian*. Guardian News and Media, July 6, 2020.
<https://www.theguardian.com/artanddesign/2020/jul/06/upward-thrusting-buildings-ejaculating-cities-sexist-leslie-kern-phallic-feminist-city-toxic-masculinity>.

the complexity and intricacy with which change in infrastructure is created. I believe that understanding this complexity can help us as academics work towards immediately feasible change for developing more equitable spaces.

Bucking the Sun takes place from 1933-1938, during the Great Depression and near the end of a period of large, publicly funded irrigation projects designed to provide employment to displaced farmers during the Dust Bowl and to change the shape of the American West by improving irrigation, flood control, and hydraulic power.⁷¹ This period alluded to with Oliver Ward's Big Ditch in *Angle of Repose* and analyzed extensively in Mark Reisner's *Cadillac Desert*, has in recent decades been rightfully criticized for its huge public expense, relatively unsuccessful mission of turning the desert west into fertile farmland, and damage to tribal populations. In light of this and other twentieth century issues with inequitable infrastructure, I do want to acknowledge that the general trends of civil engineering education have been towards sustainability.⁷²

Effectively planning and articulating Change within a *Complex Experienced Space* requires beginning at a contextual starting point. In Chapter 2 I identified a potential starting point as having examined the *Mapping and Mechanics* of a site; that is, identifying the *technical narratives* and *cultural narratives* contributing to the current Shape of a space. In Doig's novel, the construction of the Fort Peck Dam will change both the *Complex Experienced Space* of the Duff family and how they respond to these changes as individuals and as a group.

Bucking the Sun addresses the timelines which intersect before, after, and during the timeline of infrastructure construction. These timelines include geologic timelines, labor relations timelines, design timelines, construction timelines, and economic timelines. Ivan Doig acknowledges the presence of these timelines within the novel; specifically, balancing user needs upstream and downstream along the river and managing Depression-era labor narratives are discussed by characters within the novel.⁷³ I have illustrated this concept with Figure 10. In Figure 10, I show three separate narrative timelines as intersecting the *narrative of infrastructure* timeline

71. Mark Reisner, *Cadillac Desert: The American West and its Disappearing Water*, (New York: Penguin, 1993), 5-7.

72. This comparison is based on my personal, anecdotal experience compared to the anecdotal experience of engineers who have graduated a generation before me, say in the late 1980s – early 1990s. Emphasis on LEED Certifications (1998) and Envision Sustainability Professional (ENV-SP) certifications (2010), developed later as the civil engineering position continues to emphasize specialization, professionalization, and sustainability.

73. Doig, 79.

segment that is the project of the Fort Peck Dam. Because of the complexity of this idea, and the length of geologic timeline of the Missouri River in comparison to the other narrative timelines, I was unable to make this timeline to scale. On the side before the dam, the geologic timeline is on top, as it is the primary force contributing to the shape of the river. With the imposition of the dam, the US Federal Government WPA's planning supersedes the geologic timeline of the river. This is why it is moved to the top after the Project Use phase. Furthermore, because the point of the project is to finish it and labor relations take place during the construction, labor relations are under the timeline of the Federal Government. The lengths of the timelines carry significance too; the geologic timeline is shown to be the longest. I have placed labor relations in the middle because that timeline existed after the formation of the river but before the formation of the WPA.

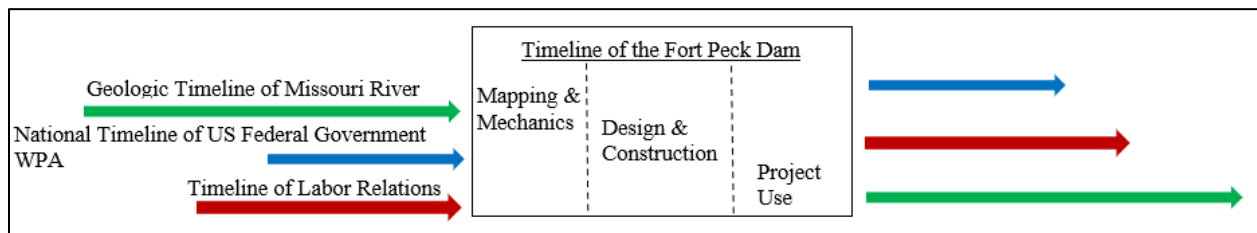


Figure 10: Timelines within the *Complex Experienced Space* of the Fort Peck Dam

In Figure 10, the initial narrative timelines feed into the *Mapping and Mechanics* segment before the *Design and Construction* timeline begins. Within the *Design and Construction* segment, the space undergoes Change. I have illustrated the results of Change by rearranging the timelines that emerge within the *Project Use* segment. Thus, it is within the *Design and Construction* segment that timelines are re-prioritized, or modified, according to the planned outcomes of the project. Through planning, and then bringing these plans into material action, the *Complex Experienced Space* is changed.

Design: Planning and Change

In Chapter 1, I established that *flows* are the common point between English literature and civil engineering. In this section, I establish that *Design* is the process of planning the direction of flows by responding to the stated needs of the situation and developing a plan to determine an actionable solution to meet this need. In this way, *Design* is the point in the unified timeline in

which Change is articulated through the rearrangement of existing timelines. In a *Complex Experienced Space*, this means that the questions of how the *cultural narratives* creating the *Experienced Cultural Space* intersect with the *technical narratives* creating the *Experienced Physical Space* can be asked. Solutions can be developed based on the answers to these questions. While *Mapping and Mechanics* presents what is present, *Design* is planning what Change is possible. I articulate three characteristics of design: 1) having an objective, 2) having a method, and 3) fitting in with an existing community. In stating this, I use generalizations, but using these generalizations provides a place to begin understanding how *Design* is used in constructing a blended discourse.

Owen Duff, the primary protagonist within *Bucking the Sun*, illustrates the critical role engineers play in the Change of *Complex Experience Spaces*. By choosing to analyze Owen Duff, I am not discounting the roles of other characters in the novel, but rather am beginning to create a blended discourse by examining the role of a character embedded within one “side” of the blended discourse. By breaking down the way in which he views the project of the Fort Peck Dam, we can gain greater insight into the engineering “side” of the discourse. Owen works for the U.S. Army Corps of Engineers and as a field engineer, his job is to communicate with the engineers in Kansas City and translate the designs drawn up in the *Plans* into daily volumes of earth that must be moved.⁷⁴ Owen mediates between the *Experienced Cultural Spaces* of the U.S. Army Corps of Engineers, the Federal Government’s plans for irrigation, and the construction site of the dam. The work he does based on the objectives identified within the *Experienced Cultural Spaces* of which he is a part physically changes the *Experienced Physical Spaces* of the Missouri River and Glasgow, Montana. Owen characterizes the fact that the project is changing the Missouri River as something exciting, he proclaims, “[t]his is an even-steven process really... Using the river’s own water and riverbed to regulate it.”⁷⁵ Analyzing this shows us two things: 1) Owen as an engineer is not understanding the dam project to be imposing upon the river, but rather to be a way of working with the river’s natural flow and 2) by knowing this, we gain greater insight into Owen’s frame of mind. We can understand that he is seeking — and radically failing according to today’s standards of sustainability — to work with the river in order to accomplish the social objectives of

74. Doig, 43-44.

75. Doig, 55.

his time. In this way, Owen is manipulating a *technical narrative*, a geomorphological timeline, in order to meet a goal set by a *cultural narrative*, the timeline of the Works Progress Administration.

Owen Duff's position as a civil engineer, a designer and constructor of *Experienced Physical Spaces*, shapes the way he views the *Complex Experienced Space* of the Fort Peck Dam by giving him a sense of ownership over the ability to change the *Experienced Physical Space*. To illustrate this idea, Doig uses possessive pronouns to define the relationship between Owen and the dam. Specifically, when Owen's wife, Charlene, arrives from Bozeman, Owen takes her to see the construction site. He eagerly points out different components of the project site, gesturing to the "the immense hull timbers could be seen waiting, asking to be envisioned into *his* 170-foot-long vessels, the white fleet of the Missouri River" (emphasis mine).⁷⁶ Charlene, by contrast, stares bewilderedly, and tells him "[i]t's just that for somebody who isn't you, it's so-so hard to put together."⁷⁷

Owen's excitement and proclamations illustrate the advantage we gain from bringing in engineering knowledge to understanding the change within a *Complex Experienced Space*. Owen's ability to understand and his responsibility to partially control the way the *Experienced Physical Space* of the Missouri River is changing in response to the ideas represented by the *Experienced Cultural Spaces* of the goals of the Federal Government's Works Progress Administration and the Army Corps of Engineers gives him a sense of fascination with the *Design and Construction* of the dam. Because he understands how the project he is working on will change the geomorphological space of the Missouri River, he understands a broader context of his work beyond the immediate context of the project and the project's goals. For Owen, this brings him a sense of excitement and ownership, as indicated by the excitement and possessive pronouns with which Owen shows Charlene the dam and with which talks about the dam.

Furthermore, here is a point where the project could have been changed to create more equitable outcomes. Owen's case illustrates that Change towards creating better contexts happens early in the *Design* process, before a solution is even established. Despite Owen's articulation of recognizing that he is using the river's bed to regulate the flow of the river by rearranging the bed, he fails to recognize the long-term ecological consequences of such a decision. Thus, in planning

76. Doig, 54.

77. Doig, 55

the Change of the river, by more deeply understanding the geomorphological contexts of the river, he could have created more ecologically friendly methods of design. Decades later, modeling tools such as Bentley OpenFlows FLOOD⁷⁸ or the U.S. Army Corps of Engineers' Hydrologic Engineering Center's River Analysis Software (HEC-RAS)⁷⁹ can model many possible scenarios quickly and efficiently. Because of technical innovation, it is possible to quickly model many different possible solutions to choose an option that does not harshly rearrange timelines such as I have illustrated in **Error! Reference source not found.**, that is, one which preserves the possibilities for natural geomorphological change and also meet additional goals articulated by other *cultural narratives*. Furthermore, it is important to note that generating these equitable solutions happens early in the *Design* process; thus, the intended objectives of *cultural narratives* and their intersections with the *technical narratives* that shape a project must be articulated early in the project process.

Beyond this immediate context, understanding the engineering ideas behind infrastructural projects that seek to meet cultural goals, and conveying these ideas to a broader public, can lend a sense of reassurance to those who are concerned about infrastructure. By including technical explanations in our narratives calling for more equitable spaces, we can create a greater sense of security and ownership and empower citizens to understand and articulate possible solutions for the problems which affect their daily lives. Engineering knowledge, when directly connected to infrastructural goals, is power, because it enables the quantification of both the time and economic costs of constructing a piece of infrastructure and creating Change within a *Complex Experienced Space*. Through clear articulation of the quantification and scheduling components of a project's *Design*, it is possible to see how Changes in an *Experienced Cultural Space* translate into changes in an *Experienced Physical Space*. It is possible to track progress and imagine how the Change will actually happen, and with action and knowledge of action can come a sense of reassurance.

Returning to *Bucking the Sun*, the differences in the responses between Owen and Charlene illustrates a situation of a knowledge disconnect between *Experienced Physical Space* and *Experienced Cultural Spaces*. That is, while our experience living in the world is affected both by

78. "OpenFlows FLOOD: Flood Risk Assessment and Mitigation," Bentley Systems Inc., 2021, <https://www.bentley.com/en/products/product-line/hydraulics-and-hydrology-software/openflows-flood>.

79. "HEC-RAS," US Army Corps of Engineers Hydraulic Engineering Center, accessed March 18, 2021, <https://www.hec.usace.army.mil/software/hecras/>.

cultural and physical spaces, the ability to plan the Change within these spaces — to *Design* the new physical spaces — may not always be within our grasp. Understanding the way *Experienced Physical Spaces* are designed thus can empower people to understand and create more deeply the *Complex Experienced Spaces* in which they live. Within a blended discourse, the actionability of this is to continue to improve our understanding of *technical narratives* and the procedures of *Design* and incorporate them into our narratives which we use to spur public participation in the development of infrastructure.

The mirrored cultural and physical plots within *Bucking the Sun* illustrate the simultaneous development of Change as it occurs within *Experienced Physical Spaces* and *Experienced Cultural Spaces*. Because of their physical displacement; that is, because the Duff's family farm will be flooded after the dam is built and they must relocate to the space where the dam is being built, they must also reorient themselves to new cultural boundaries. They leave their solitary farm and are brought into close proximity with members of the government, engineers, and laborers from other places in the United States and also from Scotland. Nancy Cook, Professor at the University of Montana, praised Doig's portrayal of class conflict and class differentiation within *Bucking the Sun* by stating that the book, "gently reminds us that the American West was a classed society, where, in this case, the federal government offered laboring classes busy work to keep them passive. Doig gives us a range of perspective on the politics of boomtowns, revealing how the West accommodates both the entrepreneur and the Communist party member."⁸⁰ Furthermore, she describes the state of Doig's characters after losing their land and getting jobs as construction workers on the dam "[w]ithout their land, Doig's characters cast about for a future, for a sense of whom and where each will be in the world."⁸¹ In this way, Cook's review acknowledges the uncertainty faced by the characters in the novel. Because characters' *Experienced Physical Spaces* have changed, they must redefine the boundaries of their *Experienced Cultural Spaces*. The events of the novel recount the process of these changes and I will briefly explore these changes later in this section.

Reading Nancy Cook's review in conjunction with the novel highlights a new location for creating equitable change by re-emphasizing points of quantification as points for creating more

80. Nancy Cook, "Bucking the Sun by Ivan Doig", *Western American Literature*, 417.

81. Cook, 416.

equitable spaces. Two such spaces are: 1) naming and including diverse project stakeholders in the design process⁸² and 2) labor contracts for bidding on projects. In considering the labor for projects, by adhering to safety standards and fair labor laws, as is often required in public projects, we can encourage equitable labor policies.⁸³ Thus, understanding construction methods and creating a design that can be safely constructed can contribute to the level of equitability in the space of a project. In this way, we can see how studying a novel and finding representations of class disparities can direct us back to the *Design* process and identify points in the project where it is possible to design a project such that both the outcome and the actual process of its construction is more equitable. Once again, this stage of the project is before any construction work ever begins; consequently, when creating narratives that encourage the *Design* of more equitable spaces, doing so early in the *Design* of a potential project can create equitable spaces from the beginning of a project *Design*.

Ivan Doig describes each family member's reorientation to their new *Complex Experienced Space* differently. He describes the incremental developments in the family's disagreements, continual judgment of one another as dividing the members of the family, and Owen's consistent attention to technical developments. In each case, he highlights characters' thought processes as they re-evaluate their cultural space and act accordingly. For Owen, the dam is a daily technical challenge; he must convert the total volume of soil to be moved into daily work volumes.⁸⁴ As mentioned before, Owen's position as an engineer grants him a sense of control over the Change process of the *Complex Experience Space*. His mother, Meg, while unhappy about being uprooted from her home, understands that leaving the family's failing farm and working on the dam is an incremental step towards a more financially stable life.⁸⁵ Meg's attentiveness to financial stability

82. For example, Environmental Justice, including providing the opportunity for tribal and community organizations to comment on project designs, is required for Indiana Department of Transportation Projects (INDOT). Creating a greater awareness of these processes within communities and organizations and emphasizing why these processes matter and how suggestions can be incorporated into design can encourage public participation in the design process. INDOT's Environmental Justice policy can be found here: <https://www.in.gov/indot/2523.htm>

83. For example, projects funded by the Indiana Finance Authority-State Revolving Fund require adherence to the Davis-Bacon and related Acts, which require that laborers be paid the prevailing wage, usually a union wage. Including such requirements on other projects can help ensure laborers are paid fair wages. Provisions for this type of project can be found here: <https://www.in.gov/ifa/srf/applications-guidance-and-documents/>

84. Doig, 43-44.

85. Doig, 79.

illustrates her *Design* of the *Experienced Cultural Space* of her family; her attitude allows her to engage with *Complex Experienced Space* in which she is located in such a way that despite her lack of control over the *Experienced Physical Space* which she is in, she still finds a way to direct and look forward into the new *Experienced Cultural Space*.

Likewise, Owen's brothers, Neil and Bruce seek new opportunities and engage in entrepreneurship after they leave the farm and come to the site of the dam, illustrating the idea that *Design* is in part the creation of possibilities within a given set of constraints. Neil purchases a truck, bringing in an economic element to the *Experienced Cultural Space* directly related to the *Experienced Physical Space* of the dam. Doig writes, "Neil had it figured cold. That loads of whatever kind...were going to have to be brought into Fort Peck...and he might as well be the trucker of some of those loads."⁸⁶ Bruce becomes a river diver and seizes an exciting and economic opportunity that would not have been available to him had he remained on the farm. While he expresses feelings of nervousness, he finally musters up the courage and tells the barge boss that he wants the job, and he gets it.⁸⁷ Thus, for both of Owen's brothers, Neil and Bruce, a change in their *Experienced Physical Space* affords them new opportunities for gaining employment. In this way, their *Experienced Physical Space* has changed the boundaries of their *Experienced Cultural Space*. This is because they live in a *Complex Experienced Space* which simultaneously consists of both overlapping physical and cultural spaces. Meg, Neil, and Bruce's story illustrate the elements of possibilities of *Design*. Rather than understanding *Design* as the process towards an end, we can re-conceptualize *Design* as presenting possibilities. As Neil, Bruce, and Meg have seen a situation as an opportunity for possibility and *Designed* in reaction to this possibility, so in their cases, they see *Design* as many possibilities.

Finally, *Design* creates a project to fit in with existing communities, but often, there are tensions within those communities in the way they view the interaction of the timelines contributing to a project (Figure 10). For example, while speaking with his father, Hugh, in a bar, Owen describes the process of relocating the sediment in the Missouri River to create the dam. He explains the process of building the dam as just another step in a process which has dated back to the glaciers. He says, " 'So, see what a river does, any river, is geologically temporary. Rivers are

86. Doig, 88.

87. Doig, 130.

always changing, so here we're just—'; 'These are not glacier times!' Hugh thundered.”⁸⁸ Hugh's comment returns us to the idea of narrative timelines — while Owen highlights changing the timelines and sees the timeline of the river as one continuous situation and this justification allows him to feel like he is controlling the river, Hugh sees a clear separation in timelines; he states his objection to the project based on how the project has changed his individual, personal live. To understand why this is important, I turn again to Rob Nixon – he states, “the insidious workings of slow violence derive largely from the unequal attention given to spectacular and unspectacular time.”⁸⁹ This is critical because it shows that we need a way to put things on the same narrative timeline so we understand *cultural narratives* and *technical narratives* to be occurring simultaneously. One way to do this is by corralling and representing all the narrative timelines that will be affected by a particular project and asking how the project will rearrange these timelines. By focusing on an individual project and engaging the process of civil engineering in our narratives calling for ecological attention, we can provide scaled suggestions at the individual project level. This is one possible way we can, in the words of Nixon, “plot and give figurative shape to formless threats whose fatal repercussions are dispersed across space and time.”⁹⁰ Talking about a singular project and presenting the timelines that come in and out of this particular project (Figure 10), is one way of articulating the possibilities for both destruction and construction by that specific project.

In this way, Ivan Doig shows how several individuals within the same family respond differently to the same change in physical space. *Design*, as I have been describing it and as it happens often within the civil engineering industry, particularly in the public works sector, is a planned response to a need. Through examining *Bucking the Sun*, we can see how several characteristics of *Design* are illustrated within the plot of the novel. Understanding Owen's ability and fascination with shaping an *Experienced Physical Space* can help us understand how knowledge of both the *Design* of physical spaces and cultural spaces can lend fascination and empower us to suggest workable changes and follow the progress of the construction of spaces. Through clear articulation of the quantification and scheduling of a project, we can see the points where a project could potentially

88. Doig, 81.

89. Nixon, 6.

90. Nixon, 10.

change to become more equitable. This idea is further illustrated as Meg, Bruce, and Neil respond to a change in their *Complex Experienced Space* by taking advantage of new opportunities which arise from this Change. In this way, we can understand *Design* as possibility. Finally, we can return to the idea of the timeline by seeing how Hugh and Owen both understand the timelines differently. In this way, we can see how it is critical to both understand how projects affect timelines beyond just the immediate needs of the project. We can also see how points for defining project objectives, and the timelines the project will influence, are critical for creating equitable projects and must be identified and incorporated early in the *Design* process. In this way, *Design* represents the earliest stages of the Change process.

Construction: Creating Physical Change

While Owen's fascination and sense of control resulting from his understanding of both the *technical narratives* and *cultural narratives* surrounding the Fort Peck Dam give him a comprehensive grasp of the *Design* stage, there is still an element of disconnect between planning and actual construction. Doig describes Owen's thoughts on one of his first days on site, "[h]e knew the Fort Peck plan in its every inch and angle, yet even he almost could not believe that the dam was now underway, *this way*, with the echoes of axes and the timber yells of men.. Blueprints showed none of this."⁹¹ In this way, Doig highlights the contrast between creating a plan on paper and bringing it into physical reality. In short, the *Construction* process involves physically moving earth and materials and brings into material reality the plans suggested by *Design*.

In this section, I will highlight a few characteristics of the civil engineering *Construction* process as they are represented within *Bucking the Sun*. Through careful communication, the consumption of energy, and the balancing of priorities, planned Change is brought into reality within a *Complex Experienced Space*. Careful communication is required because those who have created the *plans and specifications* are not usually the people who actually change the blueprints into material reality. Energy is required for creating Change in both *Experienced Physical Spaces* and *Experienced Cultural Spaces*, because Change involves the reorganization of the timelines which are connected to those spaces. Finally, the way priorities are balanced during *Construction* also influences the final outcome of a project.

91. Doig, 35.

Careful communication is required because one element of the *Construction* process is dealing with the unexpected. In *Bucking the Sun*, characters deal with the unexpected in both the *Experienced Physical Space* and the *Experienced Cultural Space* of the Fort Peck Dam construction site. For example, in the *Experienced Cultural Space*, Darius, Owen's uncle, arrives from Scotland in the middle of the novel. He left Scotland because of union labor disputes and brings this conflict with him to Glasgow, Montana. Darius's arrival is a point where the plot changes, he is a hinge around which the remainder of the plot develops. When Owen has an affair with his brother's wife, Rosellen, Darius catches them in the act. Later, Rosellen commits double suicide murder and kills herself and Darius. As readers, we see that Rosellen and Owen are having an affair just before the Fort Peck Dam partially collapses.⁹² The parallel is that problems in the family culminate in the murder-suicide and the problems with the construction of the dam culminate in the partial collapse of the dam. It is in this moment that Doig fully merges the physical plots with the cultural plots, illustrating how a *Complex Experienced Space* works — it is the combination of an *Experienced Cultural Space* and an *Experienced Physical Space* and Doig has illustrated their simultaneous development through the parallel narratives.

Construction is the stage of Change where energy is consumed in creating Change. Quantifying this energy indicates specific locations where the *Construction* of a space can be made more equitable or ecologically sustainable. The energy used in creating *Experienced Physical Spaces* is visible and easily quantifiable, but the energy used in creating *Experienced Cultural Spaces* is less so. Yet, we admit it exists; much work recently has been put into articulating and quantifying emotional labor. In *Bucking the Sun*, Doig on more than one occasion expresses awe at the amount of energy expended during construction. Owen enumerates pile drivers, diversion tunnels, railroads built to bring in stone, and the construction of barges that have hydraulic construction equipment to pump hydraulic fill.⁹³ Looking at the amount of energy expended during construction allows us to see the dissipative nature of a project designed to change space. Not only does the project change the landscape and culture within the immediate *Complex Experienced Space*, but it also influences jobs and supply chains far away from this space. In this way, it becomes clear how *Construction* breaks down a larger goal into smaller activities, quantifying and

92. Doig, 354, 374.

93. Doig, 74, 88, 123.

breaking down the feasibility of the *Design*. *Construction* is thus the expending of energy, the use of on-the-spot thinking, and dealing with unexpected events and the consequences of those events.⁹⁴

Balancing actual activity with a planned schedule is the component of *Construction* where a *Design*'s feasibility is tested. For example, in one scene, Doig elaborates the amount of power used to construct the dam. The colonel of the Army Corps of Engineers does not like the amount of power that is being used, but Owen "held to the argument that it was either meet his power specs or cut back on the dam schedule, and the colonel inveterately held to the sacredness of the schedule."⁹⁵ In this quote, we see a point of identification, of reevaluation. It does not look like the strategy will work, so there is an opportunity to either add more energy or to reevaluate and change the goal, which in this case is the schedule. This is a moment of evaluating the actual feasibility of a *Design*. It is a moment where lofty goals are possible, but improbable unless more energy is applied and that is what happens here. By noticing this, we are encouraged to think about how plans translate into reality; that is, once we have created a plan, how can that plan translate into material reality.

In these ways, Doig has illustrated the simultaneous existence of the characteristics of *Construction* within *Experienced Cultural Spaces* and *Experienced Physical Spaces*. Examinations of infrastructure within the *cultural space* has already been examined within the realm of representations. Ian J. Kerr, in writing about representations of Indian railways, has explored the representation of the transfer between the British ran railway system and the ways in which the railroads physically united India and were represented within the cultural space of the

94. In undergrad, I attended an ASCE presentation given at Rose-Hulman Institute of Technology hosted by the student chapter. I do not remember the speaker's name, but I remember one quote from him, which I paraphrase here: "In government work, you have two months to solve a problem. In consulting, you have two weeks. In construction, you have two hours". I include this quote in my thesis because it characterizes the compression of time between articulating big ideas for systemic change (such as at the governmental level), planning change and creating actionable solutions, and actually bringing those solutions into material reality. This is important because it illustrates that much of the 'thinking' work happens before construction begins; once a project is under construction, it's too late for the public – or anyone else – to really make comments that could significantly affect a final design. Thus, in creating equitable spaces, it is critical that we engage early stage of the design process, rather than only commenting on the project after construction is complete, although post-project analysis is critical for understanding the mindset through which we approach future projects.

95. Doig 123.

Indian move towards independence.⁹⁶ In this way, Kerr focuses on a piece of constructed infrastructure and both the physical and the cultural implications of this constructed infrastructure, illustrating the back and forth transfer between the physically constructed realm and the culturally constructed realm, an exchange which I have shown to be present in *Bucking the Sun*. Through this thesis chapter, I have shown a related concept in studying the parallels of process within a physically constructed space as fictionalized within a literary novel. It is here that we return to the idea of possibility and the importance of *Design and Construction*; in planning based on known facts, *Designing* in response to a need and towards a planned outcome, and *Constructing* towards a decided outcome, consuming energy and addressing problems as they arise, we create change within *Complex Experienced Space*. In approaching these problems from the broad structure of a civil engineering project, we are able to name and categorize our actions. We also clearly identify our points of response and decisions we make towards Change.

Conclusion

Edward Said's concept of the *contrapuntal* helps illustrate how the language of *Design and Construction* can be used to analyze literature and create narratives toward equitable and ecologically sustainable spaces. Said uses the *contrapuntal*, or a set of "intertwined and overlapping histories"⁹⁷ to create a "simultaneous awareness of both the metropolitan history which is narrated and of those other histories against which (and together with which) the dominating discourse acts."⁹⁸ According to Said, in analyzing post-colonial cultures contrapuntally, we "must take into account all sorts of spatial or geographical and rhetorical practices – inflections, limits, constraints, intrusions, inclusions, prohibition – all of them tending to elucidate a complex and uneven topography."⁹⁹ The discourses of English literature and civil engineering have developed concurrently, each discourse dominating in its respective "disciplinary

96. Ian J. Kerr, "Representation and Representations of the Railways of Colonial and Post-Colonial South Asia," *Modern Asian Studies* 37, no. 2 (2003): 326. <http://www.jstor.org/stable/3876573>.

97. Edward Said, *Culture and Imperialism*, (New York: Alfred A. Knopf, 1993), 18.

98. Said, 51.

99. Said, 318.

silos,”¹⁰⁰ and it is in part because of this concurrent but silo-like development that competing narratives have emerged.

While I have primarily discussed public documents as potential spaces in which to implement a blended discourse of civil engineering and literary theory, Corey Taylor, Richard House, and Mark Minster have already identified the competing, intertwined narratives of sustainability as they appear in undergraduate education. Taylor, House, and Minster, as part of a group of professors at a small engineering school, created a living-learning community to introduce first year engineering students to a framework of sustainability.¹⁰¹ They discuss the difficulties of creating this community including: 1) identifying the differences between technological and ecological sustainability 2) teaching across “disciplinary silos” and most importantly, 3) developing a way to cross these disciplinary lines. They argue for countering the typical ROI-focused undergraduate narrative

by telling an equally persuasive story about sustainability and higher-education in the twenty-first century. This story has to acknowledge the lucrative careers that await most engineers, while exposing average starting salary as a poor measure of success. In its place HERE [the living-learning community] must emphasize the values of environmental stewardship, social and ethical responsibility toward underserved populations, and the intrinsic worth of mitigating economic hardships and inequalities in the United States and throughout the world. Unlike the current narrative — which places profit so far above people and planet as to say in essence *people and the planet do not matter* — our counter-narrative puts profit below the exigencies of environmental and ethical concern.¹⁰²

One possible way to create a counternarrative is to incorporate the use of a blended discourse that explicitly delineates the simultaneous existence of competing narratives that influence a particular project. That is, by beginning with the concept that we live in a *Complex Experienced Space* that is subjected to continual Change caused by both *cultural narratives* and *technical narratives* in such a way that the exchange between story and infrastructure is always happening, it is possible to emphasize that both types of narratives are unfolding simultaneously. When we use the language

100. Corey Taylor, Richard House, and Mark Minster, “Student Expectations, Disciplinary Boundaries, and Competing Narratives in a First-Year Sustainability Cohort,” in *Narratives of Educating for Sustainability in Unsustainable Environments*, ed. Jane Haladay and Scott Hicks, (Lansing: Michigan State University Press, 2017), 125.

101. Taylor, House, and Minster, 115.

102. Taylor, House, and Minster, 129-130.

and identifying characteristics of *Design and Construction* as drawn from civil engineering to analyze English literature, we can show the parallel development of *Experienced Cultural Spaces* and *Experienced Physical Spaces* in a way that contextualizes engineering projects in a new way. It becomes more obvious that these narratives are inseparable. They develop and occur at the same time.

Returning to the unified timeline which I have proposed as a starting point of this blended discourse, the language of *Design and Construction* describes the temporal middle of the narratives of infrastructure. Analyzing Ivan Doig's *Bucking the Sun* by pulling out characteristics of *Design and Construction* illustrates the *Simultaneity* with which *technical narratives* and *cultural narratives* contribute to Change within a *Complex Experienced Space*. Using this language allows us to briefly pause and observe the *Change* as it is occurring, rendering us capable of analyzing *Complex Experienced Spaces* on a different level than commenting on context. By engaging in this type of analysis, we gain greater insight into how the *narrative of infrastructure* rearranges the *cultural narratives* and *technical narratives* which existed before this space was constructed. In doing so, we are able to gain a more comprehensive understanding of the process of Change which shapes both infrastructure and stories.

CHAPTER 4: CONCLUSIONS AND POSSIBILITY – INFRASTRUCTURAL AESTHETIC IN JACK KEROUAC'S *ON THE ROAD* AND LIMITATIONS OF THIS THESIS

Introduction

The *way* is a method of directional convenience for transporting oneself from one space to another. A *path* or *trail* is a *way* to transport oneself on foot. A *road* is a *way* to transport oneself by automobile. The *road* exists between and beyond physical spaces, trans-borders, and is a physical space in and of itself. The *shoulder* is the one foot of gravel on the side of the road. The *daylighted ditch* is the drainage ditch parallel with the road that carries the water from the road and the oils and soils which have been caught up with it. *Pavement markings* provide semantic instructions for drivers navigating the *road*. *Free flow speed*, the speed that cars go when left unattended, is usually 74-mph.¹⁰³ *Exits* are spaces for entering and leaving the *road*. *Radii* define the curves of the *road*. Together, these elements create the aesthetic of the road. The *infrastructural aesthetic*, created by *Project Use*, suggests the *Possibility of an Experienced Physical Space*.

In the final chapter of this thesis, I begin to posit what a fully blended discourse may look like, describe more fully the limitations of the discourse as described in this thesis, and draw conclusions from both the thesis and limitations thereof. In the last section, I introduced the term *Simultaneity* — the idea that *cultural narratives* and *technical narratives* Change a space at the same time — and perhaps no novel illustrates the simultaneous existence of these narratives than Jack Kerouac's *On the Road*. I show that *cultural narratives* and *technical narratives* exist simultaneously by drawing comparisons between the novelistic structure and material form of Jack Kerouac's *On the Road*. Then, by conducting a close reading of a selected passage, I show that the structure of the novel mirrors the structure of a highway. In doing so, I begin with Manuel DeLanda's idea that "much as history has infiltrated physics, so we must now allow physics to infiltrate human history."¹⁰⁴ My proposal of a blended discourse engages this idea because I am incorporating physics applied (engineering) within literature (often used to explore the cultural impacts of history). I begin by addressing the aesthetic suggested by the novel's title, *On the Road*,

103. Michael Lindeburg, PE, *Civil Engineering Reference Manual, Sixteenth Edition* (Belmont: Professional Publications, Inc., 2018), 73-4.

104. Manuel DeLanda, *A Thousand Years of Non-Linear History*, (New York: Zone Books, 2000), 15.

and briefly unpack how this title centers the novel within the historical moment of the conception of the Interstate Highway System and existing scholarship. Then, I examine the similarities between the material construction of the novel and the physicality of a road and conduct a close reading of a passage to show how Kerouac's writing captures the creative experience of being on the road. Finally, I synthesize these observations to show how bringing technical knowledge from civil engineering illuminates the *infrastructural aesthetic* with which the novel is structured and also illustrates elements of *Possibility* for creating more equitable and sustainable infrastructures.

This chapter enables us to engage with the final segment of the unified project timeline that I have suggested for blending the discourses of civil engineering and English literature: Project Use. Because the infrastructure examined in this segment consists of completed projects, this segment aligns most readily with the existing fields of Infrastructure Studies and Infrastructuralism. Furthermore, this section draws most heavily on existing scholarship and is probably the section that, when further developing this thesis, will most readily lend itself to the task. Because this section has the potential to be expanded in much more depth and touches upon a breadth of already existing scholarship, I acknowledge that this is a work in progress.

Context of Infrastructure Studies and Materiality of the Novel

On the Road has already been studied within the contexts of Infrastructure Studies and Infrastructuralism. Specifically, Tara Chittenden has engaged both "Bakhtin's theory of the chronotope and Deleuze's description of the fold to investigate the arrangements of time and space in *On the Road* which produce street corners as the locus of social and cultural identities."¹⁰⁵ That is, "personal development is triggered for Sal/Kerouac through ephemeral encounters with individuals inhabiting geographically diverse street corners; their fates become folded together, if only for a short time."¹⁰⁶ Chittenden's work begins to illustrate the *Simultaneity* of *cultural narratives* and *technical narratives*; through a journey enabled by the technical assembly of a

105. Tara Chittenden. "A Fold in the Road: Kerouac and the Temporal-Spatial Construction of the Street Corner as Place in *On the Road*", *Journeys* 15, no. 2 (2014): 86-103, doi:10.3167/jys.2014.150205.

In citing Chittenden, I acknowledge that a breadth of research has been done on the spatial road aesthetic within *On the Road* and that because of time limitations, I was not able to grasp and incorporate all these ideas. There is a lot more work I need to do in this section.

106. Chittenden, 90.

highway, Kerouac's characters encounter the *cultural narratives* of class, race, and gender which shape the society in which they live.

On the Road was published in 1957, the year after Dwight D. Eisenhower signed the *Federal Highway Act of 1956* that formed the Interstate System.¹⁰⁷ Jason Vredenburg has read this novel in the context of the Interstate Superhighways, stating that the different routes in the novel “access to a relationship among self, others, and the landscape that is lost in the move toward smart roads and superhighways.”¹⁰⁸ Through this article Vredenburg compares Sal Paradise's interaction with others to the efficiency ethics of the Interstate Superhighways. I quote him at length:

In juxtaposing Sal Paradise's mode of travel against the emerging superhighway ethic, Kerouac's *On the Road* provides more than a snapshot of evolving social structures; it also offers an ideological analysis of an emerging national infrastructure. In celebrating travel as a way of fostering both community and intense personal experience—often grounded in the experience of the natural world — *On the Road* stands as an early critique of postwar culture, in which the prospects for such experience are increasingly eroded by an ethos of efficiency, productivity, and consumption.¹⁰⁹

Vredenburg's analysis illustrates the ways in which literature exposes the *cultural narratives* which contribute to infrastructure design. His work and Chittenden's, together, highlight the vibrant analysis that is already underway within the field of Infrastructuralism and Infrastructure Studies and therefore re-emphasize the vibrant potential of a blended discourse. Vredenburg's and Chittenden's work brings together *cultural narratives* from history, literary theory, and an immediacy of place. By introducing *technical narratives*, I add a new dimension to this conversation. As Melody Keomany has articulated, Sal “seeks to connect with [the land] through the medium of the road.”¹¹⁰ Studying the physical nature of this road that we add new depth to our analysis.

107. “History of the Interstate Highway System,” Federal Highway Administration, U.S. Department of Transportation, June 27, 2017, <https://www.fhwa.dot.gov/interstate/history.cfm>

108. Jason Vredenburg, ““Solitary Bartlebies”: Kerouac's *On the Road* and the Ideology of the Superhighway”, *Twentieth-Century Literature* 62, no. 2 (2016): 170–196., doi: 10.1215/0041462X-3616576

109. Vredenburg, 192-193.

110. Melanie Keomany, “The Raw Body of America: Landscape, Embodiment, and the Americas in Jack Kerouac's “On the Road” and “Tristessa,” *The International Journal of the Humanities* 9, no. 10 (2012): 237, doi: 10.18848/1447-9508/cgp/v09i10/43368.

Vrendenburg recounts Kerouac's own words describing how he wrote *On the Road*, "the writing went fast like the road was fast."¹¹¹ An alternate version of the novel, "The Original Scroll,"¹¹² presents the novel without paragraphs, on one, continuous, line. This version of the novel is literally shaped like an Interstate highway. The physical shape of the novel literally matches the physical shape of the interstate and prefigures the efficiency of the superhighways even as the experience it recounts is one of wandering. This reiterates the importance of studying the assembly of infrastructure, just as we study its impacts and the ideology behind it.

The "road trip" story that Jack Kerouac tells in *On the Road* is encouraged by *cultural narratives* of individualism and highway travel and is enabled by the *technical narratives* that produce the *Experienced Physical Space* of a highway capable of carrying large numbers of vehicles at high speeds. The title, *On the Road*, both references the dominant mode of travel for Americans beginning with the systems constructed starting the year the novel was published and references the actual material shape of the novel as a long, extended scroll. Together, these references to historical context, the physical object of the novel, and the experiences recounted within illustrate the *infrastructural aesthetic* of the road.

Close Reading and Creative Experience

In this section, I will conduct a close reading of a passage in *On the Road* to illustrate how this passage engages with the aesthetic of the road. As described by Chittenden and Vrendenburg, *On the Road* essentially features a road that is both nationwide and strikingly local and embodies the physical and cultural characteristics of highways both before the Interstates and after the Interstates. It is thus a novel that embodies the temporally liminal space of technical development; that is the switch from roads designed only for local travel to roads designed for efficient travel between cities. These new types of roads, the Interstate highways, funnel traffic in a continuous flow from city to city and from state to state. The limited access nature of the highway separates travelers from what they are passing and limits non-drivers' access to the drivers themselves. When we

111. Vrendenburg, 179.

112. "On the Road: The Original Scroll Reader's Guide," Penguin Random House, accessed, March 21, 2021, <https://www.penguinrandomhouse.com/books/532510/on-the-road-the-original-scroll-by-jack-kerouac/9780143105466/readers-guide/>

view interstates on the map, we often see the entire Interstate on a map. Consequently, it is easier to imagine ourselves in Boston, in Chicago, in Rapid City, in Seattle, than it is to imagine ourselves in the extreme locality given by local roads. Because this locality, as illustrated in Kerouac's *On the Road* has been lost, and because we now may drive for the experience of driving and not necessarily to get anywhere, the smashed asphalt that makes up the highway has been separated from its original purpose. To use a phrase from literary theory, the Signifier has been disconnected from its original Signified. The road no longer serves as a means to get somewhere, but is instead an experience in-and-of itself.

Kerouac recognizes the experience of road travel as an aesthetic experience. On the second trip Dean and Sal take to California, Sal describes Dean settling into the seat, “[a]nd he hunched over the wheel and gunned her; he was back in his element, everybody could see that. We were all delighted, we all realized we were leaving confusion and nonsense behind and performing our one and noble function of the time: *move*.”¹¹³ Sal/Kerouac, narrating this section, calls the reader's attention to how Dean embodies the *Complex Experienced Space* of the road. The word “element” in “his element”¹¹⁴ is both a common colloquial phrase and a direct indicator of the road itself. The technical design of the road, smooth curves and steady inclines, is what enables the movement. Cotton Seiler has defined the cultural space created by the road as an “apparatus of automobility...automobility comprises a ‘multilinear ensemble’ of commodities, bodies of knowledge, laws, techniques, institutions, environments, nodes of capital, sensibilities, and modes of perception.”¹¹⁵ Additionally Seiler has identified that Kerouac, among other writers in the 1950s, has defined the road as a potential site of masculine renewal and as the new form of pioneering; essentially, automobility was a critical component of the modern American subjectivity.¹¹⁶ In this way, Seiler has illustrated how the *Experienced Physical Space* of the road contributes to the *Experienced Cultural Space* of postwar America.

113. Jack Kerouac, *On the Road*, (New York: Penguin Books, 1957), 125

114. Kerouac, 125.

115. Cotton Seiler, *Republic of Drivers: A Cultural History of Automobility in America*, (Chicago: The University of Chicago Press, 2008), 8.

116. Seiler, 14, 82-83.

Furthermore, Kerouac does describe a *technical narrative* which gives Shape to the *Experienced Physical Space* of the road. He writes, “the purity of the road. The white line in the middle of the highway unrolled and hugged our left front tire as if glued to our groove.”¹¹⁷ This calls readers’ attention to an infrastructural element of the highway by calling out the *pavement marking*, an element of engineering that appears on *Plans* and in *Specifications*. In this way, Kerouac more deeply centers readers within a *technical narrative* which constructs the *Experienced Physical Space* of the road. By personifying this symbol (the line “hugs”), he makes the road at once an *Experienced Physical Space* and an *Experienced Cultural Space*, that is, a *Complex Experienced Space*. In this way, Kerouac illustrates that a particular assembly of technical parts causes a creative, aesthetic, cultural experience.

In this way, I use the example of the *road* to return to the original idea of this thesis, the two-way exchange between stories and infrastructure (**Error! Reference source not found.**). One way to change the way we travel is to change the way the highways are made (or fund other forms of transportation). In *Divided Highways: Building the Interstate Highways, Transforming American Life*, Tom Lewis points to specific technical ideas which characterize highway travel, often through improving its safety. For example, Lewis centers descriptions of these technical features, such as “clear zones, places with no obstructions where a car, were it to leave the road, would have room to stop without hitting an obstruction,” and “highway hardware — light poles, sign poles, and the like — to break on impact.”¹¹⁸ Donald Shoup’s 2011 book, *The High Cost of Free Parking*, originally published as an article in 1997¹¹⁹, traces the environmental, urban design, and mobility problems caused by the privileging of the automobile.¹²⁰ Finally, books such as Reid Ewing and Keith Bartholomew’s *Pedestrian- and Transit-Oriented Design* provide specific design guides for

117. Kerouac, 126.

118. Tom Lewis, *Divided Highways: Building the Interstate Highways, Transforming American Life*, (Ithaca, Cornell University Press, 2013), 292.

119. Donald Shoup, “The High Cost of Free Parking,” *Journal of Planning Education and Research* 17, no. 1 (1997): 3-20, doi: 10.1177/0739456X9701700102

120. Donald Shoup, *The High Cost of Free Parking*, (Florence, Taylor & Frances Group LLC, 2011).

giving technical solutions to physically change the problems placed by designing for automobiles.¹²¹

In this section, I have not even begun to scratch the surface on the depth of scholarship regarding the either the cultural impacts of the Interstate Highway System or the physical design of roads for automobiles. I do want to emphasize that enumerating the problems of the automobile was not my intent; my intent rather was to provide an example of an already existing connection between literature, technical design, and cultural consequences that illustrates the back-and-forth nature of stories and infrastructure as changed by engineering. Because much scholarly work on automobiles and automobile culture has already been completed, highway travel is a rich area of infrastructure studies in which to begin engaging a blended discourse within literary analysis. As Kerouac's *On the Road* illustrates, within the realm of literary analysis, the discourse can be used to show how identifying *technical narratives* can deepen our understanding of a novel because we are able to understand the assemblage of infrastructure and how a particular story is enabled by the physical form of a particular infrastructure. Furthermore, we can begin to understand an *infrastructural aesthetic*; that is, the *Complex Experienced Space* that is a type of infrastructure, by examining the historical context, the material representations, and technical requirements for that type of infrastructure. This brings me to the limitations for this thesis.

Limitations and Future Work

I open this "Limitations" section by acknowledging my position as someone who has only had a brief experience with both the fields of civil engineering and English Literature. As such, my knowledge is limited and my ideas, when improperly expressed or on occasion drawn from my own experience, are at a risk of becoming polemical and do occasionally diverge into that territory. As I am able to dedicate more time to this idea and develop it more clearly, I will further ground these ideas into the existing conversation and thus give credibility to this idea. For example, I will need to include Henri Lefebvre's *The Production of Space*, as he discusses social space, which is similar to *cultural space* as I have articulated within this thesis.¹²² Clearly, as discussed

121. Reid Ewing and Keith Bartholomew, *Pedestrian- and Transit-Oriented Design*, (Washington DC: Urban Land Institute, 2013).

122. Henri Lefebvre, *The Production of Space*, trans. Donald Nicholson-Smith, (Malden: Blackwell Publishing, 1991).

before, this thesis is limited by its size and by the time that was available to write it. It is also limited because in trying to express a large idea of the parallel construction of *Experienced Physical Spaces* and *Experienced Cultural Spaces*, how they are blended into *Complex Experienced Spaces*, and how we experience these spaces as the narratives that construct them act upon us, I have attempted to articulate an idea too large to really be fully articulated within a document this size. As I have stated throughout this paper, these ideas will become more and better researched as this idea develops further.

Regarding the discourse itself, another limitation is that this discourse, as I have begun to articulate here, is only applicable to civil engineering and English literature. Developing such a blended discourse for virtual spaces would require an in-depth study of computer science and/or computer or software engineering. While I think it would be incredibly interesting to read a paper that drew direct comparisons between all technical disciplines and all humanities disciplines in order to illustrate that the disciplines continuously inform each other and studying a discipline in the humanities is critical to our understanding in the technological disciplines, and vice versa, this is way too large of an idea to be articulated here, or probably anywhere. Thus, one limitation of this thesis is that many of the knowledge connections which it may suggest may never be able to be articulated; that is, the idea is too amorphous.

More practically, a blended discourse such as the one I have suggested is not useful unless it is possible to illustrate specifically how such a discourse may be deployed. While I have suggested potential actionable outcomes for deploying this discourse, there are actually several examples of this type of verbiage already beginning to be exemplified within Departments of Transportation's Facebook accounts. These include the Indiana Department of Transportation, the Iowa Department of Transportation, and the Montana Department of Transportation, which I personally follow. However, using this evidence would place this thesis within the realm of Rhetoric and Composition studies, and when I set out to write this thesis, I was more interested in the broader connections between engineering and literature that shape the spaces we experience. In the future, I think that extricating examples of this blended discourse from Department of Transportation social media accounts would make for an interesting paper because there are frequent instances where narrative and humor are used to explain technical concepts, such as bridges freezing before roads, and to influence subsequent public action, such as participating in the State's Transportation Improvement Program (STIP). Furthermore, these instances provide

concise, immediate examples of a blended discourse and would not require any explanation or general simplification of engineering or literary disciplinary procedures, as I have found necessary to do here.

Finally, I acknowledge that in this thesis I have used general definitions of *narrative*, *space*, and *time*, which I have only briefly begun to define. In refining this thesis, I will need to develop more specific definitions for each of these terms and potentially expand this thesis to encompass actual ideas of the fabric of the space-time continuum instead of the segmented, linear timelines which I have articulated here. Furthermore, it will likely become necessary to address *space* as an ideological concept, rather than as the separate physical volume and cultural boundaries which I have used in this thesis. I separate the two types of space in order to show how the design of both contribute separately to create the *Complex Experienced Spaces* which we live in throughout our lives. However, in doing this, I risk taking too much time to explain engineering, and not enough time to analyze literature, and then it is difficult to come up with actionable outcomes, which is the point of writing a thesis.

Conclusion

In this thesis, I have begun to 1) establish a blended discourse that combines civil engineering and English literature, 2) ground this discourse in existing civil engineering practice and connected it to concepts within literary theory, 3) illustrate how this discourse can be used to discuss engineering and literature simultaneously, and 4) suggest practical ways in which this discourse can be implemented to create more equitable or ecologically sustainable spaces, particularly through public input in infrastructural projects. The point of connection between civil engineering and English literature is that of *flows*. Deleuze and Guattari, two literary theorists have created the idea that objects of desire are presented as a result of social/cultural space in which they are conceived. Manuel DeLanda, a writer and philosopher, has identified that decision making processes contribute to the final development of the physical form of a city. When designing infrastructure — the physical form of a space — engineers incorporate different types of flows, including traffic flows, water or wastewater flows, stress flows, etc.

The foundation of this blended discourse is two-fold: 1) The parallel development between the disciplines, civil engineering and Literary Studies and 2) Civil engineering is the *free space* between story and structure. Briefly and broadly explained – the stories we tell about where we

live, landscapes, etc. influence what type of infrastructures get built and the type of infrastructures that get built influence our lifestyles and the stories we tell. Thus, the actual process of the design and construction of infrastructure, not just the finished project, has the potential to affect the human experience. Furthermore, the disciplinary apparatuses, pieces of infrastructure and works of literature, develop through parallel narratives, which I have called *technical narratives* and *cultural narratives*. *Technical Narratives* dictate the form of an *Experienced Physical Space*, or a volume in which a human body can be placed. *Cultural Narratives* define the formation of an *Experienced Cultural Space*, or the culture which creates the boundaries that shape our actions. Together, the *Experienced Physical Space* and *Experienced Cultural Space* combine to create the *Complex Experienced Space* in which we live. Both *technical narratives* and *cultural narratives* influence our experience of being in a *Complex Experienced Space*.

I have presented a unified timeline as a way to isolate and examine this touchpoint of flows. The timeline is drawn from both Aristotelian literary theory (a narrative has a Beginning, Middle, and End) and the civil engineering project process. The timeline has three stages, which are 1) Beginning: Shape — *Mapping and Mechanics*, 2) Middle: Change — *Design and Construction*, and 3) End — Possibility and Project Use. I have used this unified timeline to structure this thesis. In each chapter, I have drawn out elements of civil engineering knowledge from works of literature. I began with examining the Shape of a space, or establishing what is already present on a site or in a culture and what we expect to happen or what options are available to us based on the boundaries presented in this space. To do this, I examined technical metaphors within Wallace Stegner's *Angle of Repose*. Specifically, I examined how understanding the technical meaning of the phrase *angle of repose* enables us to understand the ways in which cultural boundaries shape characters' behaviors within the novels. Second, I examined how a space Changes, or the process of *Design and Construction*, by looking at how characteristics of technical *Design and Construction* are represented within Ivan Doig's *Bucking the Sun*, and how the mirrored technical and cultural climax of the novel illustrates the interconnected-existence of a *Complex Experienced Space*. Finally, I briefly examine Possibility and Project Use or the way the structure of Jack Kerouac's *On the Road* matches the structure of a physical highway and is already centered within scholarship that identifies the myriad of *cultural narratives* which shaped the *Experienced Cultural Space* of the postwar United States and automobile culture. The term I use for looking at these combined narratives, including the *technical narratives* which shape a particular type of

infrastructure, is *Infrastructural Aesthetic*. In this way, I begin to explore what possibilities an actually articulated fully blended discourse may afford us within the field of English literature and also re-ground this thesis in existing scholarship of the analysis of infrastructure within *On the Road*.

I separated *Experienced Physical Spaces* from *Experienced Cultural Spaces* in order to highlight the technical methods that are used to create spaces, but I do not want to diminish the importance that culture and theory have on shaping the outcomes of engineering projects. That is, I reiterate that *both* technical and cultural studies and actions are critical to creating equitable and ecologically sustainable spaces and that these studies and actions are always occurring simultaneously. I acknowledge again that this work is incredibly difficult. Corey Taylor, Richard House, and Mark Minster, creators of an undergraduate engineering program called Home for Environmentally Responsible Engineering (HERE), have articulated the difficulties of teaching engineering students to become “creative, flexible thinkers, able to map, even to navigate the deep waters of sustainability while coming to appreciate the interconnectedness of the world’s natural and human systems.”¹²³ Specifically, in today’s ROI-focused undergraduate atmosphere, Taylor, House, and Minster have articulated the necessity of challenging the dominant narrative that “places profit so far above people and planet as to say in essence *people and planet do not matter* — our counter narrative puts profit below the exigencies of environmental and ethical concern.”¹²⁴ (emphasis in the original). I believe that utilizing a blended discourse by explicitly identifying and narrativizing the ways in which spaces are created and changed because of the continuous back-and-forth double-reactive arrow nature of infrastructures and stories (Figure 1) can help illustrate the importance of understanding both cultural and technical discourses. Furthermore, a blended discourse requires the use of engineering knowledge to examine literature, thereby re-emphasizing the interconnectedness of the disciplines, albeit in an inverse way to what has previously been articulated. To be clear, I do not think implementing a blended discourse will “solve the problem,” but I do think it is a step in the right direction. As engineering informs our understanding of literature, so literature informs our understanding of engineering. This exchange is continuous and

123. Corey Taylor, Richard House, and Mark Minster, “Student Expectations, Disciplinary Boundaries, and Competing Narratives in a First-Year Sustainability Cohort,” in *Narratives of Educating for Sustainability in Unsustainable Environments*, ed. Jane Haladay and Scott Hicks, (Lansing: Michigan State University Press, 2017), 115.

124 Taylor, House, and Minster, 130.

ongoing; that is, the *narratives of infrastructure* are combinations of the simultaneous existence and rearrangement of *technical narratives* and *cultural narratives*. These stories create spaces. The stories we tell and the stories told by the physical spaces that already exist will shape the spaces that will be in the future. It is within these spaces that we get up, go to work, go to lunch, think about and meet our friends and our family, ponder the state of the universe, in short, where we live.

APPENDIX A: “EXHIBIT A”

Exhibit A – September 27, 2018

This short, experimental & imaginative piece is written in a blended format of a metes and bounds survey, a PLSS deed, and creative writing. This piece begins to explore the bland unspoken within land ownership in the small Midwest, and will someday be expanded in both in length and depth.

A deed is given the name ‘Exhibit A’ when it is included in a mortgage or other legal document.

Commencing at the North East corner of lot number one hundred and thirty-six in the Second Continuation of the 1896 gulping West Addition to the Town of Here, Midwest, thence southerly along the East side of said lot thirty-six feet, thence West to the West line of the lot of ground purchased by Jennifer and Scot Hopewell from Joan and Donald from James A. Morgan the hired man with the railroad connections from Ethel B. Olafsen from the Nation(s), thence North to the North west corner of said last named lot, thence East to the place of beginning where the sun centered the haze and cut the ice pooled in the isolated depression. Thence South variation four degrees, twelve and twenty hundredths chains to the North line of Washington the First President of the United States Street in the Town of Here, Midwest which held a parade in his honor each year on July the Fourth which travelled thence East sixty-six chains, thence North variation five-and-one-half degrees chains to the place of commencing, excepting therefore the following tracts of land – Commencing at a stone at the North West corner of the above described tract of land, thence South 6 poles and 4 links to the foot of a low, sweeping rocky bluff, thence with the meanderings of said bluff, South 77 degrees East 21 rods, thence South 68 degrees East 19 rods and 11 links to a stone at the foot of said bluff, since moved by to be placed within the yard of Mike to mark his mailbox, thence North 5 ½ degrees East 67 rods and 19 links to the South line of the Indiana River Railroad Company’s original grant of land, thence with the line of said Railroad South 74 degrees West 50 rods and 21 links to the place of commencing.

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