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Synchronic and Diachronic Labor: Deconstructing Eladio Dieste's Ruled Surfaces

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Abstract

Eladio Dieste was a Uruguayan engineer whose practice prioritized the choreography of on-site labor during the second half of the twentieth century. Dieste's structural innovations in reinforced masonry are admired for their geometric audacity, material economy, and experiential effects. This paper discusses the work and pedagogy from an ongoing architecture class, which focuses on the deconstruction and construction of one of Dieste's innovations, ruled surface brick walls – double curvature surfaces defined by a series of vertical lines (Fig. 1). One of the most underexamined aspects of Dieste's oeuvre is its link to labor. This scholarly blind spot is the foundation of the labor-based pedagogy defined in *Synchronic and Diachronic Labor*.

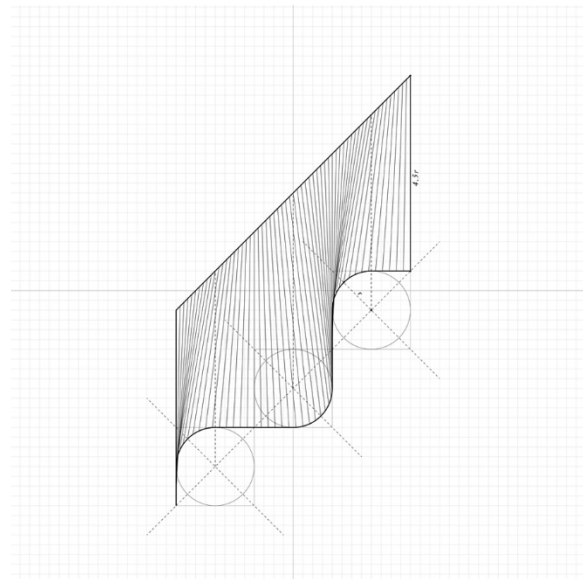


Fig. 1. Ruled Surface Drawing

Introduction

Labor is central to the discipline and profession of architecture, and has been the subject of philosophical, economic, and societal concerns for centuries. In this paper, labor is the organization of human force that enables the time-based material production of a building or structure. Additionally, labor is referred to as forms of production that leave no visible trace of their effects, such as, mental labor and other forms of immaterial production. In all of its forms, labor is a time-based condition. In order to consider notions of *time*, it is important to distinguish between *synchronic* and *diachronic* labor. Synchronic forms of labor connect people working in the same moment towards a shared goal, often resulting in a single object. Diachronic forms of labor connect efforts across time, forming relationships between distant objects in different places.¹ Labor of this kind is evident in the material legacy of construction techniques that emerge across time and cultures. Diachronic labor is part of an ongoing technological project. The fluid interaction between people, tools, and place is at the center of this form of labor. This paper is interested in the pedagogical effects of studying the role of labor in Eladio Dieste's practice through an architecture class called *Dieste Building Shop*. The paper is organized by a set of intersecting pairs: *Labor and Work*, *Technics and Technology*, *Machines and Translation*. The relationship between these pairs and the work of Eladio Dieste form the pedagogical core of *Dieste Building Shop*. The time-based implications of *synchronic* and *diachronic* labor reinforce this core.

For three consecutive years, thirty-five students ranging from second-year undergraduates to second-year graduate students have collaborated on the construction of three single-wythe walls made with the same bricks. Every semester, students start with the deconstruction and material cataloguing of the wall built by the previous group of students. After choreographing and graphically documenting the deconstruction of the wall, students design formwork systems that define the double curvature geometry of the “new” wall. Scaled representations – drawings or models – do not precede the construction of the walls. The precise placement of strings, vertically tensioned at different angles inside a wooden framework dictate the construction of each new structure. The assembly of strings and wood is the formwork or *encofrado*. Each adjustable *encofrado* enables the construction of several ruled surface walls.

*“The resistant virtues of the structures that we are searching for depend on their form. It is because of their form that they are stable, not because of an awkward accumulation of matter. From an intellectual perspective, there is nothing more noble and elegant than resistance through form. When this is achieved, there will be nothing else that imposes aesthetic responsibility.”*²

Material economy is integral to this process and it is emphasized by resisting gravity through form. Before, during, and after construction, students read Dieste’s writings about the relationship between architecture, construction, and people. Through reading discussions, journal documentation, and collaborative construction, students engage the intellectual and physical dimensions of labor. *Synchronic* labor defines each fifteen-week semester. The ongoing scholarly project is *diachronic*, physically linking student labor across three years, and conceptually connecting it to historic structures on a different continent.

Historical Labor and Work

Philosophers and thinkers who are particularly interested in tying humanity to the production of things and thoughts have examined the distinction between work and labor. Most notably, in *The Human Condition* (1958), Hannah Arendt marks the difference between *work* and *labor* as the result of visible or invisible traces of production. For Arendt, *work* is the production of things that last; their material presence is felt in the world. Unlike *work*, *labor* leaves no material trace, the efforts of *labor* are invisible – labor is the unending cycle of biological reproduction. The distinction between *work* and *labor* is reinforced by her introduction of two hominization categories: *homo faber* and *animal laborans*.³ The former is tied to notions of *work* and material-based construction, while the latter is linked to *labor*. With these two categories, Arendt repositions previous distinctions made about mental and concrete labor, and the potential to intellectualize the production of things and thoughts. These are not semantic differences, but rather deep-rooted constructs that shape the western teaching and production of architecture. From Plato to Marx, the conflict between physical and mental exertion shows the historical schism between *design work* and *construction labor*. Plato’s political philosophy placed value upon physical labor, but always considered mental contemplation superior to physical activity. Following Plato, Aristotle viewed *labor* as a commodity that had value, but could not give value. Work was the activity and privilege of free people, while labor was synonymous with physical enslavement.⁴ The intellectual superiority ascribed to contemplative work was integral to the advancement of slavery and its ties to forced acts of construction throughout the western world. Even before the Renaissance, and Leon Battista Alberti’s authorial paradigm, on-site physical construction was considered an inferior, unintellectual activity.⁵ *Animal laborans* exerts the indispensable efforts for living, without ever becoming essential for living a thoughtful life, while *homo faber* produces value through reflexive mental practices.

The tension in this philosophical legacy was fuel for Marx's assertions about the role of the *proletariat* – industrial class of *Animal Laborans* – in the reconfiguration of political thought and material production. Contemporary architectural education and practice reflects the chronic separation between these material and immaterial worlds.

“In architecture, a building, a project, a model, a drawing, a text, or a book is usually referred to as *a work*, as in *the work of the architect*.”⁶ Pier Vittorio Aureli affirms the architectural implications of Arendt's seminal distinction by stating that *work* invokes the authorial context of architecture, while *labor* exceeds traditional outcomes – drawings, models, books – used to establish architecture as a representational discipline and profession. It is possible that a rigid distinction between *work* and *labor* is an over simplification of the complex systems that define contemporary capitalist production. What is important is not the direct application of these definitions, but rather their educational impact in the twenty-first century. If architectural labor, as Aureli points out, exceeds the traditional outcomes used to measure work, then how do we teach that “behind the production of something there is a much larger and wider agency than what is acknowledged in the public presentation of architectural work.”⁷ Labor transcends the manifestation of the poetics of craft, or *techne*, typically attributed only to *homo faber*.

One approach is to expand the repertoire of historical precedents and include practices that focus on the role of *labor*, or rather that do not make hierarchical distinctions between *homo faber* and *animal laborans*. Historically, such practices have a tendency to prioritize socio-technological issues above individual authorship. The preference for the intellectual merits of collaborative technical work is an essential factor in understanding the pedagogical implications of *labor*.

Eladio Dieste and the Job Captains

Dieste and Montañez S.A. was started in 1945 by Eladio Dieste and Eugenio Montañez. Both Dieste and Montañez were engineers who graduated from the Faculty of Engineering in Montevideo, Uruguay. Throughout their forty-year partnership – the firm continues today under different leadership – they developed four structural innovations in *cerámica armada* (structural ceramics) using steel-reinforced brick masonry. Working as a design engineering and construction firm, they built nearly one and a half million square meters of structural ceramics, in the form of gaussian vaults, self-supporting vaults, and ruled surfaces.⁸ Images of the audacious spans and phenomenal curvature of these structures have been recently published with increased frequency. In spite of a recent surge in interest, Dieste and Montañez's work remains rather unknown in the context of modernist scholarship, even in the regionalist setting of Latin America. There could be several reasons for this anonymity; small size of Uruguay, historical political turmoil, lack of self-promotion, etc. Without diminishing the inventiveness of Dieste's well-documented structural intuitions, the methodology of *Dieste Building Shop* claims that Dieste and Montañez's practice is overlooked because of its inextricable link to physical labor.

For almost four decades, Vittorio Vergalito, Edio Vito Pacheco, and Alberto Hernandez worked as job captains with Dieste and Montañez.⁹ Their role as job captains should not be underestimated. Each one of them was responsible for recruiting and coordinating the teams of local workers that labored on the construction of notable projects, such as, *La Iglesia del Cristo Obrero* (Church of Christ the Worker) in Atlántida, Uruguay. Vergalito's work in Atlántida was instrumental. He figured out how to translate the double curvature geometry of the walls into measurable, mechanical construction systems that were communicated to a team of on-site masons.

Eladio Dieste was explicit about his views on architecture and construction, “the builder is indispensable. In fact, the project for a building is not really complete if it does not consider how it will be built, and the ways in which a building can be built have a notable power of inspiration...all viable new structures are intimately related to construction methods, and these methods are visible in the finished building.”¹⁰ This statement may seem like an anachronistic view of labor or the ubiquitous call for architecture projects – especially academic work – to be more “real”. It is neither of those things. In *Art, People, and Technocracy*, Dieste implies a reconfiguration of *animal laborans* by paying close attention to construction systems and the people that engage with them. Without fetishizing representation, or the intellectual work of inventing unprecedented structural innovations, Dieste proposed a vision of architecture that was inseparable from its construction force. In his estimation, imagining that force – the synchronic efforts of workers – was indistinguishable from seeing the structures come to life.

Dieste Building Shop is a combination of history/theory seminar and building technology class. The combination puts students in close proximity to the theoretical underpinnings of Dieste’s practice and his attitude towards labor. The work of reading is an essential part of this course. Reading Dieste’s writings about the role of workers is a precondition to understanding the labor-centric aspects of Dieste’s thinking and it is a way to link intellectual work with subsequent forms of physical labor. Reading discussions and questions are recorded in individual student journals (Fig. 2). The journals are formally and informally reviewed on a biweekly basis. During formal reviews, students submit their journals to the instructor, while informal reviews consist of students exchanging journals with each other. Both types of reviews are ways of prompting discussions around issues that affect the trajectory of the course. The journals become a way to visibly trace physical labor and reflect on its implications. Each journal is an individual reflexive document and a collective record of the semester’s work.



Fig. 2. Dieste Building Shop - Student Journals

Time of Technics and Technology

The introduction of the paper describes the difference between *synchronic* and *diachronic* forms of labor. Ideas of *time* connect this precursory distinction with the historical difference between *work* and *labor* outlined in the first section of the paper. *Synchronic* and *diachronic*, *work* and *labor*, these two pairs intersect to generate another pair, *technics* and *technology*.

A lot has been written about the history of technology in the context of architectural pedagogy. It is self-evident that “technical life is inseparable from processes of hominization – inseparable, that is from the very processes by which a group of animals learned to think of themselves as human subjects.”¹¹ Simply put, this anthropological view asserts that life is lived through an external set of technical objects, whose relationship to humans establish *technics* as a conceptual category that is different than *technology*.¹² This categorization is reinforced, but certainly precedes Heidegger’s efforts to describe the poetics or essence of technology as a form of *techne*.¹³ While this distinction adds layers of specificity to the pedagogical implications of labor, its most significant contribution is associated with conceptions of *time*. In this case, *time* is a formulation of *technics*.

There are two primary ways of thinking about the pedagogical relationship between *time* and *technics*:

1. *Engagement with medium(s)*; the external objects or tools that define the internal conceptual space of *technics*.
2. *Transfer of knowledge*; the ontological effects of external objects or tools that define *technics* as an evolutionary condition, not a fixed category.

Both categories can operate *synchronically* and *diachronically*. However, it is important to consider how each category tacitly supports traditional views of *work* and *labor*. Students labor synchronically – in the same moment towards a common goal – through forms of media all the time. Media-based *diachronic work* that stretches across time, producing a range of distinct, yet intellectually connected objects is much more unusual. This type of *diachronic work* is usually limited to studios or representational courses that stretch across an entire semester. Without disregarding the obvious *synchronic* sharing of ideas, it is evident that *diachronic work* is typically associated with the *transfer of knowledge*. In architectural education, it is common that this type of work is considered instrumental or simply used to achieve predictable outcomes. Working diachronically is analogous to working through *technics*. To become enmeshed in diverse, potentially conflicting histories, which can manifest their contemporaneity through specific mediums is the challenge of *diachronic labor*. The difficulties of this challenge are evident when *technics* is understood as a system that “usually has embodied in it characteristics suiting it for survival in a particular time and place.”¹⁴

How does student work stretch across multiple semesters and years to form deep connections through the study of *technics*? The assumption that all contemporary curricula are based on *diachronic transfers of knowledge* is naïve. There are, of course, internal and external forces that affect curricula and displace concerns about the modes of transfer that affect the relationship between *technics* and *technology*. In *Dieste Building Shop*, this relationship is designed to highlight methods of *diachronic transfers of knowledge*.

Deconstruction with Many Hands

“Western culture has built a cultural system where works of the intellect, regardless of their material complexity, are expected to be ideated by an individual author and the expression of just one mind.”¹⁵ This implies that all objects must be designed prior to being made – design work precedes, in both value and time, the labor of construction. The tension between this historical separation and contemporary collaborative media is marked by what Mario Carpo refers to as “the style of many hands”.¹⁶ If Carpo’s term implies the *synchronic* bias of contemporary tools, and their ability to dissolve perceptions of singular authorship, then how can acts of deconstruction become *diachronic*?

The same set of six-hundred bricks has been used to build and deconstruct three ruled surface walls in as many years. While reading about Dieste’s practice, student teams design the deconstruction of the wall built by students in the previous version of *Dieste Building Shop* (Fig. 3). The deconstruction of the wall is performed synchronically during class time. Through the measured choreography of bodies, tools, and material cataloguing, each student implicates themselves in the efforts of previous semesters.

Physically and conceptually linking student hands across multiple semesters is *diachronic*. As part of this process, students record the existing wall through a series of point-based vertical sections that produce an error-filled impression of the wall as it is being deconstructed (Fig. 3). Students make images of the labor of deconstruction. This is a way of using media to affect the *transfer of knowledge* based on designing *diachronic labor*. The two methods for laboring diachronically are self-evident, but worth reinforcing:

1. Students work with objects (walls) built across time by other students. Multiple students, multiple walls, multiple semesters, same bricks.
2. Students build one of Eladio Dieste’s structural innovations, a ruled surface (double curvature) wall, connecting students to buildings in another context, built in the past.

The notion of ideas existing apart from their technical formation is a precondition of the traditional dominance of *work over labor*. “The kind of people that are captivated by a machine-driven society of the future and theorize about it are usually not people that do things...someone has to design the prototypes and processes.”¹⁷



Fig. 3. *Dieste Building Shop - Wall Deconstruction*

Machines and Translations at Work

Machines have always made their presence felt in architectural history and theory discourse. Without invoking the contemporary implications of electronic machines, it is possible to consider that “a machine can be defined as a human-made, artificial construction, which essentially functions by virtue of mechanical operations.”¹⁸ Machine participation on the production of work and the labor of construction has been widely acknowledged in contemporary education and practice. Their participatory nature is central to Nicholas Negroponte’s argument about authorship; “as soon as a designer furnishes a machine for finding methods of solutions, the authorship of the results becomes ambiguous.”¹⁹

Contemporary interest in autonomous, robotic labor and the architectural ramifications of artificial intelligence are important to this authorial ambiguity. If contemporary labor concerns are about relocating physical labor over to machines, what are the historical alternatives that combine machine and human labor? Architects claim that the reconfiguration of physical labor is about concerns for the people performing dangerous, dirty, and dull labor.

This altruism is contradicted by a lack of interest in teaching students about people performing physical labor and their historical presence on construction sites. Acknowledging the role of workers reveals an issue that is essential in Negroponte’s work – the translation from human to machine language.

Machines foreground two primary systems of translations, *direct* and *transfer*. These two systems are analogous to the two ways of thinking about *time* and *technics* outlined in the previous section of the paper. *Direct* translation systems generate a translation directly from an original language to another language with no intermediary form of representation. *Transfer* systems are typically more complex than direct translation because they integrate forms of syntactic analysis, which expand the content of the original language, avoiding direct one-to-one translations.²⁰ These two approaches to translation are not mutually exclusive. When overlaid onto Alberti’s authorial paradigm, the instrumentality of orthographic representation becomes a *direct* system of translation, while Negroponte’s *thinking machines* become types of *transfer systems*. This is an acknowledgement of the differences between each system; it is not a value-judgment.



Fig. 4. Dieste Building Shop - Ruled Surface Wall Construction

The role of machines in Eladio Dieste's work exists somewhere in the spectrum from *direct* to *transfer* systems of translation. It is important to point out that Dieste and Montañez's buildings were designed and constructed before the advent of computational tools. Every structure built from 1943 to 1996 was imagined and described using hand-mechanical orthographic drafting and analog numerical calculations. The double curvature geometries of ruled surfaces and gaussian vaults were constructed through the combination of formwork machines called *encofrados*. Encofrados were the intermediary transfer systems between numerical calculations and material construction. Knowledge of the machine's operating language was inseparable from the ideation of the buildings. Through the use of *encofrados*, traditional notions of unintellectual *labor* drifted into the realm of *work*, articulating the wider agency of architectural labor postulated by Pier Vittorio Aureli.

In *Dieste Building Shop*, the intermediary translation systems are a series of wood and string machines that describe the double curvature geometry of the ruled surfaces (Fig. 4). Instead of making representations of potential versions of the wall, students worked on the construction of *encofrados*. Each *encofrado* can produce multiple, non-identical versions of the wall. Non-identity is a product of mortar inconsistencies, hand error, number of bricks, placement, etc. The implications of designing the machines and laying the bricks is central to the *diachronic* condition of student labor. Through this process, formal complexity becomes independent from material precision. As long as the geometry of the wall is not undermined, the system of construction can absorb inconsistencies, which in most cases would read as construction errors. In Eladio Dieste's practice, these errors were absorbed and mitigated by the sophistication of the *encofrados* and the knowledge of the people working with these machines. If we recognize this type of knowledge as the *technics* of architectural *work*, then pedagogical models centered on the intellectual dimensions of *labor* may emerge.

Conclusion

There are many outcomes documented in three years of student work and discussed while reflecting on the pedagogical impacts of *Dieste Building Shop*. The three points outlined below are synthesized from observations made in student journals.

1. Authorship of processes over object ownership
2. Disassociate precision from complexity
3. Make it economical, not cheap

A seemingly innocuous question reoccurs in students' writings and connects these three points into an enduring polemic about labor: "What if every time we had to build something, we had to deconstruct something else first?" This question hinges on students' concern over the contemporary idea that the act of building is independent from any type of deconstruction. This independence is not liberating, nor is it true. Architecture usually follows some act of physical deconstruction. Academic evasion of this self-evident fact reinforces the intellectual distance between architecture and physical labor. The effects of this distance are discussed in this paper and unfolded through the distinction between synchronic and diachronic conceptions of time. Eladio Dieste's physical work lives in the space defined by this historical schism.

Labor-based pedagogies can establish diverse socio-cultural networks that are intrinsic to the advancement of technical knowledge. The three points outlined above, reassert that technology is the study of skill, not simply the product of skill. This pedagogical approach is not based on reviving anachronistic forms of construction or proposing a return of the *Master Builder*. *Dieste Building Shop* is a call to expand architectural history and theory discourse by studying the role of physical labor before we rush to erase it from our future.

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