Transformed Materials
A Material Research Center in Milan, Italy

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Submitted to the Department of Architecture in Partial Fulfillment of the requirements for the Degree of Master of Architecture at the Massachusetts Institute of Technology, February 2002.

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Abstract

[Transformed Materials] is an exploration into today’s design methodologies of architecture production. The emergence of architectural form is questioned in relation to the temporal state of design intent and the physical material construct. At a time when there is an increased awareness of the current state of technology, material innovation and methods of fabrication, there are new speculations of what materiality is and can be. This thesis will propose an architecture that emerges through an exploration of the material concept that directly informs and expresses the fundamental ideas of the project.

Building methods have changed widely over time, and are co-responsible for creating a dialog between functional requirements, technological invention, and material implication that reflects the current cultural state. Today’s architectural products have in a sense reverted back to thin surfaces. Current cultural issues such as socioeconomic, environmental impact, transportability, efficiency, lightness, storability, technology, and mass production, have over time created a state of “thinness”. This project tries to offset the current trend of building by accepting the norms of architectural products, and reinventing their role within a contemporary language that explores more deeply the material qualities and properties associated with it.

This thesis will use steel as the primary building material. Steel is a material that has become standardized in how it is shaped and formed, thus its ability to produce an architecture has been reduced purely to a dogmatic approach of engineered solutions or preconceived results. Steel, is artificial by nature; if we suspend our preconceptions of steel, could the material be designed such that its role is critical in defining space, structure and program in a tectonic system?

The area of research and examination will be focused on the design of a Material Research Center (mRC), located in Milan, Italy. Industrial by nature, the program will facilitate experimentation of concepts that will inform the making of architecture.

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Opposite: Model of Ceiling Surface
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Even the most pure forms of purpose are nourished by ideas - like formal transparency and graspability - which in fact are derived from artistic experience.

- Theodor Adorno, Functionalism Today
Introduction

This project represents ideas that have formed my particular view of architecture, that I find of increasing importance in coming to an understanding of complex issues that surround architectural design. We, as architects are seemingly always looking for ways in which to detach and reattach ourselves to our surroundings and modes of thinking. This project tries to raise particular topics and interests in how to formulate ideas of architecture. Each generation has responded differently to this question, in a way that relates to their particular time. At a time when there is an increased awareness of the current state of technology, material innovation and methods of fabrication, there are new speculations of what materiality is and can be. This materiality as it relates to architecture, is one of a kind of resurfacing and restructuring architectural environments. There was a time in primitive architecture that the making and assembly of materials defined the quality of the space, as well as the spatial and tectonic expression. Buildings systems seemed to have a correlation between form, function and beauty. These components worked in such a fashion that one informed the other until the desired result was brought forth. This thesis proposes in general a rethinking of architectural elements that responds to a desire for critical reevaluation of the current modes of production in such a way that a more responsive architecture can emerge in terms of its materiality.

Dual modes of Operation

Architecture is a multidisciplinary event whose purpose is to respond to a network of shifting needs and activities. It seem as though, if ideas and conceptions are singular in nature, architecture does not have the ability to respond to complex issues, that relish in the conception of design as a mediation of informed ideas. Component design that is so prevalent today reflects societal trends of manufacturing elements that respond to a specific singular need. It seems to me, that there is a need to invest time in challenging the essence of our daily constructs. Current constructs operate with a singular purpose, and are often ill informed of site with no relationship to a holistic design. Dual modes of operation proposes that by an increased knowledge and awareness of relationships between parts, can architecture be informed to operate as a kind of transitional agent to reveal a new relationship, which is greater than its singular purpose. A blending of assemblies may provide a materiality that can not be simply identified as any one element – a mutation of structure, construction, cladding, furniture, and art may be injected in such that the artifact may be indescribable in today’s component design.
Architectural technology is the way in which human beings create metaphorical ideas that place them in nature through the manipulation of habitable form that redirects natural force.

- Lance LaVine, Mechanics and Meaning in Architecture, 2001

The Essence of Technology:


3. Martin Heidegger, "The question concerning technology".

"When design and technology are too widely separated, design becomes disengaged from its means of making architecture and disconnected from the world and its informing environmental insights. Technology here does not mean the mechanistic icons and artifacts of current construction techniques. It is best defined as knowledge gained in the making, the accumulated insights into architecture learned from the experience of its processes and its place".

Technology as Tacit Knowledge Technology, from its root meaning of _techne logos_, can be taken to mean "knowledge gained in the making," through craft, the process, and production. This common definition of tacit knowledge learned through tactile and empirical experience. In this view, design and technology are intimately connected through a unified conception of architecture derived from knowledge of construction, context, and environmental resources.

How does technology engage itself into today's architectural discourse? It seems that the root of technology lay within its essence. "Technology is not equivalent to the essence of technology". By today's standards, technology may seem as the application of power machinery to production. This application may be technological, but is in no means technology. The essence of technology is ultimately a way of revealing. The concept of revealing is so fundamental in our time, such that we can not escape it. Its lies within a framework of ordering between man and nature – a challenging of being. In discussing technology two statements are true: "technology is a means to an end, and technology is human activity". "Wherever ends are pursued and means are employed", there exists a cause and effect. – _causality_.

A Synthesis of static-aesthetic sensitivity, technical knowledge, and execution

It seems to be important at this time to define some of the properties and classifications of the visual environment. There needs to be a sense of clarity of what constitutes our daily constructs. "The word tectonic today may be used in a variety of fields and professions, such as biology and geology, as well as architecture. The Greek root tek, found in architecture and technology refers to giving visible shape through an exploration of basic human activities. Originally it was restricted with reference to the craft of the carpenter and the builder, who in ancient Greek was called tekton". The term tectonics was then derived, and was refer as the "poetry of building". The difficulty in defining tectonics today is that its essence on some level is intangible, and operates beyond the surface of actual reality. There is no singular expression, thus there needs to be a sense of nuance and subjectivity. This is the place were the architect can skillfully "reveal" sensibilities and provide a lens through which the visual is perceived. "Through tectonics the architect may make visible, in a strong statement, that intensified kind of experience of reality which is the artist's domain - in this case the experience of forces related to forms in a building. Thus structure, the intangible concept, is realized through construction and given visual expression through tectonics".

Past critics have described tectonics as a layered system, one that is identified by a frame and an opposing surface. What is tectonic, is the resulting resonance between the parts. This interpretation seems to simplify the resulting factor, and relies heavily on the final physical appearance of the object. In the essay of Eduard F. Sekler, tectonics was examined more closely in terms of its meaning. He concluded that there were in fact three closely related concepts that were relevant in architectural discourse: Structure Construction and Tectonics. From this perspective we can more accurately discuss its relationship in terms of "making" through informed knowledge.
Listed below are ways that Eduard F. Sekler deems useful in evaluating Structure and Construction in building:

**Criteria for Structural evaluation**

a. appropriateness
   Construction leads to a clear differentiation between pure tension and pure compression, and that the materials are chosen according to their best abilities to deal with these forces.

b. efficiency

**Criteria for Constructional evaluation**

a. handling of materials
b. process
c. technique

**Structure** "Structure refers to an ordered arrangement of constituent parts". In general, this concept refers to a system designed to resist the natural forces within a building. This is not a physical manifestation, but an implied concept of technical knowledge of how to possibly achieve a desired result. At this point, structure is an intangible concept, one that is in standing-reserve waiting.

**Construction** “Construction carries a connotation of something put together or assembled. The construction refers to the actual built artifact, which is a realization of a principle system”⁵. This term leads to how members or elements are fabricated, and ultimately joined. Here, the detail becomes a fundamental element, which is “brought forth” in its conception to define its purpose. This is also seen as the masterly execution of a principal system, which is in concrete realization.

**Tectonics** “When a structural concept has found its implementation through construction, the visual result will affect us through certain expressive qualities which clearly have something to do with the play of forces and the corresponding arrangement of parts in the building, yet cannot be described in terms of construction and structure alone”. For this, tectonics is the pervade of newly discovered qualities. Among these three concepts, tectonics is the only one that falls completely within the architect's hands – the architect is master of tectonic expression. It may also be needed to acknowledge empathy in relation to tectonics. Empathy operates on a psychological level, in which we are able to attribute our own feelings to an object, and on an unconscious level may inform us through the phenomenological cycle of our senses or through past experiences. Through the brilliance of structure, construction, light, space, place, and texture a static-aesthetic sensitivity can be achieved.

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There is a curious thickness about architecture's thinness today

- Ron Witte, Harvard University; Immaterial / Ultramaterial exhibition, 2001
It is the final effect of a given process. But it seems that materiality is more than just the result of a given process, by all means it should reflect a heightened awareness of surfaces that are felt, observed and understood.

The Matter of Material

There has been a recent change in architectural concerns to separate ourselves from the consciousness of reality through the visual alterations of an immaterial mode of perception. Numerous effects lend to a dichotomy between what is reality and what is an implied effect to change the visual implication of the material act. Thus, building matter has typically been reduced to surface appearances, purely judged on its visual composition.

In past, there were proponents of materials (the functionalists of truthfulness) that believed in a fundamental expression of the true nature of materials. "It was nonetheless difficult to find. A building must perform too many duties to obey a single logic of materials. The optimisation of a building structure can contradict the optimisation of its climatic boundary. Thus, from time immemorial, architecture has allowed itself liberties with respect to material consistency, has alternated between revealing and concealing, between truths and deceptions. The history of architecture has been written as a primer of signs and volumes. True to the Platonic precepts of form, and of matter's inferior role, it has directed its message at the eye of the beholder. As a result, architectural tracts have primarily dealt with systems of symbols, geometries, proportions and decorations; materials have received low priority in an architecture parlante. They were supposed to be the servants of form, allies of the structure, and only in exceptional cases could they as spoliation or rarities become bearers of meaning. This remains true for the prominent exposition of precious materials on representative facades: here too, it is generally the ornament, and seldom the material itself, which speaks"  

progressive / regressive tendencies
The aesthetic value of materials has a long tradition that has been discov-
<Dematerialization> Dematerialization refers to the absolute or relative reduction of the quantity of materials. In this context there are two distinctions, which are relevant to architecture. One is the consideration of socioeconomic and environmental issues in that lowering consumption of materials will conserve energy and resources. The other is related more to tectonics, where by a reduction of mass through construction, building components are clearly expressed as pertaining to their necessity. The Kunsthalle Bregenz by Peter Zumthor, is good example of contemporary architecture though which dematerialization is set forth into creating the sensuous presence of materials in defining a space. In either states, there is an inherit reduction in material, which could be best represented by today’s market of veneers and wall coverings. – Thinness?

Can materials as they have in the past, perform as generators of architectural design. The investigation here is to focus on the role of materials in architecture, and to suggest a process that reveals a close connection between construction, fabrication, structure, tectonics and technology that is at the root of creating a material concept which is fundamental to the projects value in contemporary society. The interests in materials lay not only in the application of coverings as an additive measure, but how to engage materials within the scope of the design process.

The limits of materials as they relate to architecture are here being used as an active agent, such that they not only provide the needed performance specifications, but are moving away from a static representation to a dynamic process of transformably. Issues of technique, thinness, textiles, and fashion will be used as an entry point to rediscover the lost qualities of the architectural artifact, and will navigate towards creating value and meaning in the forms and surfaces that define space and building.

Is skin not, paradoxically, the most profound thing about us? A border defining within and without, a protective frontier, the envelope of the flesh, the body’s armor—skin separates and isolates. An interface of pains and pleasures (erogenous zones) skin is both armament and amor. Blushing, blanching, sweating like the eyes and the mouth, skin is also a medium of communication.

02.02

Steel / Context and Composition

By today’s standards, steel has become widely used in all aspects of the building industry. Since the introduction of industrial steel, its role has been subjective to a variety of conditions that places its use within a wide context. “At the broadest conceptual level, steel framed buildings can be considered as having two main parts: that which is the structural frame, or skeleton and that which is the cladding, or skin.” It is a fundamental architectural concern how the assembly or conception of the frame and skin will ultimately determine the building form. Compositionally, the architect must be fully engaged within the process of creating a resolution between the specialized parts of the building fabric.

External Envelopes

“External wall can be conceived of as light cladding or skins which wrap the structural frame within the buildings envelope, or infill the zones between the positions of vertical structure, or else stand free of the structure to expose it externally.” For the first three systems shown, the wall may be considered a secondary element that is free of the structural frame. This means there is a sense of independence between the compositional parts. Typically, these separate components are either directly fixed to the frame, or is attached with a subframe to create a closed system. The forth example shows the external wall as a structural wall. This type of building is one that is less seen today, but is predecessor of contemporary architecture. The load-bearing wall, has had a history of buildings in which certain restrictions limited what could be achieved through the materials at hand. As presented in such Greek projects as the Parthenon (448-432 BC) stone was not a material that was conducive to tension or long spans. Even so, the technological restrictions led to a compositional relationship between the structural performance of the material, and the overall building form.
Lightness deals with many different subjects that, somehow, are all interrelated by analogies in shape, structure, process, or the idea behind them. Likeness apparently transcends time, origin and professional specialization. Lightness can therefore be read in different ways, depending on one’s interest. Designers have taken many different approaches to the issue of lightness. For example, Buckminster Fuller viewed architecture as reaching its greatest potential in limiting the mass of a building and consequently its weight. Gottried Semper in his four “elements of architecture”, viewed architecture as responding to the human desire of raising the body off of the ground, subsequently separating the horizontal layers between ground and architecture - thus producing an architecture with a minimal connection to the earth. Lightness is a very ideological question, that could be a thesis in itself. What I propose is to loosely raise a conceptual framework of how one could conceive of lightness as it relates to architecture.

On one level, lightness can be considered the efficient use of materials, by selecting the appropriate method of construction. By designing with technological knowledge at hand, one can determine a structural proposal, in which the concentrated loads of a building can be limited, due to the materials strength and resiliency. This produces an architecture that is considered light due to its kind of dematerialization of getting more out of less.

Next, buildings can achieve a lightness through their visual and structural connection to the ground. “It is in the nature of skeletal framed buildings that the vertical loads are concentrated into small cross-sectional members and these loads are transferred to the ground. That is to say, in terms of load transfer, the frame needs only minimal contact with the ground plane. As a consequence, it is possible to either accentuate or suppress this fact in the overall massing of the building.”

11. Ibid., 6
The north elevation of the thesis project represents this idea of lightness. The expression of the frame-like quality is apparent by the dematerilization of exterior envelope as the building meets the ground. Here the transparence of the glass allows for the visual expression of the frame to supercide the idea of weight and permeance.

Buildings can be designed such that final act of construction presents itself as something that is considered light through its visual composition. How this is detailed will have a profound result in its meaning as an architectural expression.

"The quality of lightness in the fabric of a building can convey the frailty and temporariness. The aesthetic problem lies in the fact that the qualities of solidity and permanence have long been associated with architecture and were characteristics virtually inherent in traditional load-bearing masonry construction" 12.

Lightness today, and its relation to this thesis, poses a duality between what has been discussed. With the aspect of lightness in mind, the project's relationship to its site and context, is referential to ideas of an urbanist, industrials scale, and a human densification of parts that are disposable, and replaceable. The employment of a structural system was developed that responds to two distinct edges - one that is built of a heavy, corrugated steel plate wall. Its scale represents a kind of anti-lightness, and positions itself as a kind of urbanist machinery set within the city. This is further elaborated by its site, located on a disused railway, that represents permeance of the city infrastructure. The other edge is considered more temporal, thus its conceptualized as a light steel frame that houses the programmatic functions. The higher degree of transparency, and the subtleties expressed in the column connection, allude to a delicacy of the building being less obstructive on its public side.

The description for Corten steel was found at [www.delfilardi.com](http://www.delfilardi.com).

Del Filardi is an award winning sculptor whom works are built of corten steel.

13. **Color and Corten**

Whether steel is exposed externally or internally, they're typically methods applied that will help resist corrosion, which could damage the structural integrity of the material. The most common methods are coating the steel with paint or other metals. These are accepted by industry, but are not my interest in exploring the surface potential of the raw material.

Corten Steel, as employed here in this project, has a very different natural condition that affects its appearance. "Corten is US Steel's trade name for a corrosive resistant low-alloy steel that forms a protective coating of rust (hydrated iron oxide) when exposed in many natural atmospheres. The appearance of weathering steel is due to natural processes. The weathering characterization is a reminder that the material can change in appearance over time due to the environment. The rust layer on weathering steel becomes protective when the fine discrete crystallites of early rust recrystallize into a relatively intact barrier layer of rust. The formation of the protective layer requires alternating wetting and drying cycles: the wetting to generate the rust, and the drying to allow it to recrystallize. The appearance of weathering steel depends on the extent to which recrystallization has occurred and thus indicates the extent to which the barrier layer is formed. The early rust forms in discrete crystallites that are fine, red and diffusely reflecting, like hematite. The wetting and drying process will formulate different degrees of recrystallized oxide and will have varied appearance." 13.

Corten steel is a material that expresses its process of production through its raw industrial surface. This surface once erected on site, can weather and alter the surface qualities of the material that is conducive to the environment and the specific anomalies that occur on site.
For centuries, architects have developed specific systems that regulate the process of design. “What, if any, is the organizational influence of technique upon a specific work of art or in our case architecture? Less obvious is the answer to a question discussed innumerable times: what, if any, is the organizational influence of technique upon a specific work of art? In other words, how important is professional skill and its specific use for a defined aim; but also how much does it matter that technique is a means toward something else, and at the same time carries the significance of its own history as an instrument?”

Is it possible to think of technique as a tangible source to draw conclusions, in other words can technique itself be a source of material? We employ technique everyday in architecture; a connection to a beam can be considered a developed technique, and these techniques have become standardized. But, we rarely consider these connections as a method or viewpoint to design from.

If we consider technique as material for invention then two conclusions can be made. One is that, “techno-scientific thought and industrial production have gradually established themselves as an increasingly prominent and direct component of architecture during the past century.” A newfound freedom in technological advances has altered architectural production and with new materials and fabrication methods developed, there has been a profound impact on the building industry.

Secondly, technique is seen as constructional technique, as a method of assembly that has traditions and values based upon history and innovative approaches. Certainly techniques can create a compositional technique in which the resolution and precision of parts can inform the expressive quality about its constructability. But production of materials today no longer means giving specific form to a material.
Materials are premanufactured on assembly lines that are not created with the experience of construction in mind, but are formed by the rules of production and market values. As a point of reference, this thesis has positioned itself within a historical context. As mentioned early, materials and techniques have assumed a critical role in making architecture. In terms of Gothic architecture, “One must admit that the organic unity of the techniques used to build Gothic cathedrals was incomparably higher, more refined, consistent, and technologically significant than the construction modes we confront today. Gothic architects transformed materials into architectural fact; we assemble products” 16(fig. 1). At a time when integration is so prominent to making intelligent buildings, there is a deliberate separation between the technique of producing a product in relation to its structure, construction, and ultimately its tectonic role as a compositional element that has a specific meaning. This is a perplexing question, in view of what can be achieved. In subsequent chapters, I will raise particular topics that involve the modern state of materials, and how one might be able to engage the conflict of building surfaces, and begin to conceptualize a reintegration of materials and ideas.
Is "thinness" desirable? This question is approached very differently by many people. The perceptions of a "thin" architecture has very different ideological and personal roots in what it means to make architecture. On one level there has been a consumer trend towards producing materials that are thin and light. These materials are driven by resources available, cost, and market competition that reflect a post-industrial era of mass production. Current cultural issues such as transportability, efficiency, environmental impact, technological invention, socioeconomic factors, and storability have furthered the result of this particular condition. In light of this, materials are no longer pure, natural forms, but are engineered products that are artificial in their composition. This has an huge impact on how we building today. Buildings are designed as layered systems, by arranging these thin products into the desired composition. As mentioned early in terms of techique (see 02.03), materials no longer have to respond to a set of conditions that inform the result of what’s made. The correlation between idea, material and form is lost.

Material thinness could be seen as inspiration, and used to exploit new inventions within its context. Thus an invested interest in working within this language towards a material invention could pose a universal relationship of our place and time. The concept of thinness may provide an entry into the process of architectural form through a cultural, technological, and material paradigm.
<textura – to weave. 1. original woven fabric 2. the arrangement of particles or constituent parts of any material as wood, metal, etc. as it affects the appearance or feel of the surface, structure, composition, grain 3. the structural quality of a work of art, resulting from the artist use of material.
Architecture and textiles? The important relation between woven textiles and architecture may not be apparent at first. "In primitive dwellings, the vertical enclosure was often formed of crude mats with interlaced grasses and branches. Over time these mat-dividers gave way to textile fabrics manufactured from synthetic cords and threads". Durable backdrops were latter used for enclosures, though tapestries were still hung vertically as wall hangings. This symbolic transformation gave reference to past constructions, yet were still the defined spatial character of the room. "Later, as these textile hangings gave way to stucco, gypsum, metal paneling, and glazed tile, the artistic character of the new wall dressings for a long time emulated the textile style of their predecessors".  

17. Harry Francis Mallgrave, "Gotfried Semper Architect of the Nineteenth Century". (Yale University Press, 1996) 122

18. Ibid., 134
wrapped, smooth, fluid, transparent, layered, material, border, sleeve, exposed, texture, fold, facing, pattern, decorative, fabric, ornament, veiled, fluted, fastened, patch, stiff, cosmetic, worn, reveal, covered, hung, formal, symmetry, cut, foot, fussy, elegant, measure, size, image, model, sketch, design, style, seam, stitch, coat.

Fashionable Sensibilities

The metaphor of architecture as clothing has always existed as a dialog of expression. But traces of a greater connection can be seen throughout history. "The goal of modern architecture could be likened to a change in clothing: to shed the overly-fussy, decorated dress of the 19th century and to don a plain coat of pure white." There exists a commonality between building and clothing, that can be seen not only in conceptual thought and techniques, but in expressing identity. The terms we use to describe clothing, have been adopted as architectural design ideas. The above terms can be easily assimilated to the garment industry and building industry in describing appearances. In fact we could argue that we actually wear buildings, or that our clothing represents a kind of visual, bodily protection.

Clothing as Architecture?

In Islamic countries, garments known as chador's, are worn by women that are designed to cover the body. The chador is made of a large semi-circle piece of black cloth that is held in place at the chin, leaving a small portion of her face and feet visible. This surface of clothing represents an extended skin, tent, or architecture. "The Persian chador is derived from the Turkish word chadir, which in Turkish means tent." The surface of the chador carries with it connotations of a transportable covering, that is engaged with visual, historical, and political representations. The surface essentially describes an extended boundary or skin that delineates between public and private.

Then isn't true that both buildings and garments are created through a conduit of knowledge, that is then constructed by hand, "to enclose and yet display the human body in all its physical, cultural and psychological dimensions. Each is an extension of that body. Each touches and is touched, seen and felt."
22. Issey Miyake has studied fashion and textile design in Japan for many years. His innovative approach to fabric design is revolutionary to the field of fashion, and related industries. The designs reflect a integration of modes of production, techniques, and a sense of constructability that is unique to its surface qualities.

Architecture as Clothing?

Some of the attention given to buildings today are attained though their richness in layering, transparency, materials, curves and fluidity, which so reminds us of clothing. Thinking of architecture as clothing can reintroduce a set of sensory experiences. How we feel and move through architecture, our relation and occupation inform a dialog. Could it be that Empathy is what is important here? Much of what effects us is material in nature – its touch and feel. Though architecture’s tangibility and intangibility we gain insight to sensory qualities and visual perceptions. The garment industry has an advantage in terms of its material. Materials are not secondary in making its form, they are essential in defining the character – the means to an end. Practicing fashion designers, such as Issey Miyake have developed a process of making that has taken the techniques of woven materials to a level of expression that transcends the boundaries of fashion design 22. Techniques, such as pleats and folds create a deviation of the material that evokes depth and volume with the thin surface.
Value System

In the past, architects have draw conclusions as to what has meaning and value in architecture, and how one should expresses those ideas. Below are two past examples, in which ideas of form conveyed larger ideas of time, place and represented specific meaning. The third section represents some contemporary ideas that this thesis tries to relate too.

[1] Roman/Gothic Periods

Form and ornamentation was in response to symbols of wealth and power (see fig. 5)

[2] Nineteenth Century

Form was founded in the new age of freedom, hope, and mass production with the following concepts:

Industrial production
Advancement of materials and methods in building industry, (steel)
“Pure” forms
Image of the machine, w/ mechanical precision and rhythms, but also through the very idea of self-reference.
Functionalism
(see fig. 6)

[3] Contemporary Architecture

Process - Architecture finds its foundation in constructing a method for correlating specific problems and organizing them in meaningful ways. In the basic sense, this architecture is based on a learned tradition and finds
value in the history of society, cultures, building methods, and where invention is a result of a reconfiguration / rethinking of the elements that are used in creating surfaces and enclosures. It’s a system that is not autonomous in its thinking where the development is separated from historically references as a bases for reflection and invention. Meaning is constructed through a rereading of elements, details, fabrication methods, and tectonics that responds to varied scales.

*Image/Perception* - image is a way to represent and communicate numerous notions in an artist vision. Today’s methods in respect to architecture have tended to dissolve to a market driven system that evokes meaning, and thus communication. Can architecture connect larger issues of contemporary society without relying on kitsch?

*Precision* - Precision means the every piece of the project, however small, must be entirely legible, revealing not its own independence but the necessity behind both its existence and its connections with other elements, as well as the reasons why each of those elements was selected. Precision is not a synonym for rigidity; instead, it is the instrument necessary for exploring and establishing the limits of ambiguity in a project. Precision clarifies relationships and moves away from obscurity. It also allows one to create space and silence around reflections on the project that listen to the internal voices, and to define and resolve its knots and problems that tend towards the original act of joining.

*Dematerialization* - “Dematerialization refers to the absolute or relative reduction of the quantity of materials”. In this context there are two distinctions, which are relevant to architecture. One is the consideration of socioeconomic and environmental issues in that lowering consumption of materials will conserve energy and resources.
The other is related more to tectonics, where by a reduction of mass through construction, building components are clearly expressed as pertaining to their necessity. In either states, there is an inherit reduction in material, which could be best represented by today’s market of veneers and wall coverings. – Thinness

Textiles – This thesis tries to find value in past systems of assemblies that have fallen to the wayside of the current state of architectural practice. Ancient textiles have show relationships between given cultures that responded to very particular needs in providing shelter. The woven textile provided a system of fabrication that created a very unique tectonic system, which defined space. It was a system that spoke of methods, art, skill, efficiency, but most interestingly it provides ornamentation through the process of making that gave it a sense of presence.

Territorial Enclosures – The wall is just a built artifact as the building itself. Walls and wall systems are composed of layer elements that are utilized to perform very specific functions. As the wall becomes exposed there is an ability to re-read or redefine its meaning. The wall can be seen as creating occupiable space within, and yet has the ability to define space. The boundaries of exterior space and interior space can be erased, while searching for qualities that place the primacy of perception over theory.

Material Ornamentation – Whether ornamentation is considered appropriate, or ornamentation is seen as a crime, architecture due to its tangibility, is forced to evolve from the conception to the built form, and in doing so, must resolve is some kind of built articulation that becomes imbedded within the project. Most recently, with the rise of Modernism, the elimination of ornamentation created a dressing for architecture that defined its “pure form”.
This pure form concealed the reference of what "makes" architecture. Its own essence of what it's made of, or how it's assembled, is deliberately eradicated as a relevant source of expression. It now seems appropriate to define ornamentation through the materials themselves, at the level of details, and at the scale of the building. In doing so, surfaces can be hyper activated to cast light on form, function and beauty in new terms of ornamentation.
To deviate by design from the standardized uses of this material is not a matter of turning away from the norm but of turning into the material more deeply to explore the full palette of its properties.

- Kennedy & Violich Architects
Material Research Center

The Materials Research Center is a place for the research and exploration of materials and their applications. The building is to be used as a public and private resource for the city of Milan. Its prominent location will provide a center along this industrial edge, that will create a transition between the dense housing and the large surrounding industrial businesses.

The Bethlehem Steel factory in Pennsylvania (fig 7-11) was used as a precedent study.
fig. 8 Bethlehem Steel Plant - Exterior

fig. 9 Bethlehem Steel Plant - Stacks

fig. 10 Bethlehem Steel Plant - Interior

fig. 11 Bethlehem Steel Plant - Products manufactured
Program

Program Components:

1. Orientation Center

<table>
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<tr>
<th>Component</th>
<th>Area (sq.ft.)</th>
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<td>Main Entrance</td>
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<td>Reception</td>
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<td>Administration</td>
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<td>Auditorium</td>
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<tr>
<td>Conference Rm.</td>
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<tr>
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2. Training / Production Facility

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<td>CNC Router Rm.</td>
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<tr>
<td>Vacuum former</td>
<td>300</td>
</tr>
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<td>Wood Shop</td>
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<tr>
<td>Glass Shop w/</td>
<td>3000</td>
</tr>
<tr>
<td>Hot Wall/Fire Wall</td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>-</td>
</tr>
<tr>
<td>Library</td>
<td>2500</td>
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<tr>
<td>Auditorium</td>
<td>3600</td>
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<td>Product assembly Space</td>
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<tr>
<td>Exterior Work Space</td>
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<tr>
<td><strong>Total area</strong></td>
<td><strong>24000</strong></td>
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<tr>
<td><strong>Product Manufacturing Facility</strong></td>
<td></td>
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<tr>
<td>-----------------------------------</td>
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<tr>
<td>Steel Production</td>
<td>10000 sq.ft.</td>
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<td>Milling / Fabrication</td>
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<td>Molds</td>
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<td>Glass Production</td>
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<td>Melting vats</td>
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<td>Loading</td>
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<td>Train Platform</td>
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<tr>
<td><strong>Total Net Area</strong></td>
<td>55900 sq.ft.</td>
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A modern city with an ancient history  

"Milan is a city that has always been considered the economic and moral Capital of Italy, the leader in practically all business sectors, in the world of professionals and technological innovation. The current day Milan has its roots planted in a past that has bestowed on us a patrimony of art and culture; which isn’t rare for towns in Italy, but not all of them have so much to offer.

The world famous "L’ultima cena" by Da Vinci, the Opera House- La Scala, the numerous museums and art galleries: many of Milan’s treasures are hidden to the less attentive eyes of its inhabitants, but it’s all there, waiting to be discovered. Milan also has a rich calendar of events to cater for all tastes, be it cultural, recreational or sports; the city certainly has something to offer for everyone. Milan is situated in the North of Italy, in the middle of the vast area of the Padana plains, in a truly strategic position for the paths that lead to the heart of Europe. Nowadays, Milan can be considered on the edge between the Northern and Southern part of the world.

It is a gateway to the companies that are seeking to enter the national and European business market. It is also a portal for a large number of immigrants that arrive from emerging countries searching for job opportunities and hoping for a better future. And for numerous others, for example, those whom intend to continue their studies in the many avant-garde scientific and educational structures that the city has to offer. Milan is a city in which many different chains of thought intertwine: universities, research centres and Institutes: structures and people that aim to transmit the knowledge and know-how needed to face the challenges that the future holds for us.
In years gone by the Lombardy Metropolis was the Capital of the industrial revolution; today its entrepreneurial vocation has been confirmed in many sectors: communications, telematics technology, finance and the many other services it offers. Milan is truly one of the few “complete” Italian cities, able to reconcile economic and social realities. It is active in many fields of culture and research. It is a busy and advanced Metropolis that attracts millions of people every year, offering a multitude of opportunities in the fields of education, employment, entertainment and tourism. The city has emerged as Italy’s major center for commerce, finance, and publishing and, recently, as the Italian capital of the media, design, fashion and advanced service sectors.

Today Milan gives the impression of being a very chaotic city with a lot of traffic, and full of people who are always in a hurry. However, you just have to leave the main streets to see that Milan has a fascinating past, and its present physionomy is the result of its history. The first known inhabitants of Milan date back to the Bronze Age, but the first sign of it being an actual settlement of a reasonable size comes from the 4th century B.C.. This settlement is generally attributed to the Celts, or more precisely the Gauls. It seems that the name Milan -possibly meaning place in the middle - also dates back to the Celts, although it was later converted to Mediolanum. Milan is a very central place, lying at the centre of the Padana Plain, the largest plain in Northern Italy.

At the beginning of the 3rd century B.C. Milan was conquered by the Romans, and then became an autonomous province (a Municipium) under the control of Rome. It’s importance grew considerably during the Imperial Age. Thanks to its geographical position it became a point on the road going to the North of the Italian Peninsula, and also an important military
station in order to fend off the Barbarians from Northern Europe. It was an Imperial residence in the 3rd century A.D., and halfway through the 4th century it became the most important city in Europe, after Rome. Christianity spread rapidly through Mediolanum, and this made it one of the most important centres of the Christian religion. To this day, in the city’s historical centre, you can still see some Roman remains, especially in Piazza Cordusio.

Milan’s importance lessened with the decline of the Roman Empire, as did its centrality which ended with the invasion of the Longobardi in the 4th century. Its rebirth began after the start of the Carolingian domination in the 8th century A.D.. The Ambrosian rite was born at this time, and still exists today in the rites of the Roman Catholic Church. This demonstrates Milan’s importance as a religious centre.

In the meantime, merchant life was developing, and led towards the period of the signoria, who gradually acquired autonomy from the Empire, first with Ottone Visconti, and then with Matteo and Azzone. During this period Milan continued it’s geographical expansion with a new city wall (this wall corresponds to the Navigli circle in modern Milan). This new wall around the city included the six new entrance gates - today the memory, and in some cases, the remains, are still there, and annex some of the immediately surrounding hamlets into the city’s outskirts. At some point in the 14th century, Milan acquired a canal system. This was both for defensive use - ditches around the walls - and for agricultural use. It was the birth of the Navigli (Canal) system, which still defines the city’s physiognomy today. In the 15th century power passed from the Visconti signoria to the Sforza signoria, with Francesco Sforza who became Duke of Milan.
A period of prosperity began at this time, along with the development of the crafts, merchant and agricultural sectors. Architectural features of this time include the Ospedale Maggiore (today this is the seat of the State University), the Lazzaretto (which holds the Rotonda della Besana where shows are held, and which is an open air cinema in the Summer), the Castello Sforzesco, which today is classed as a monument and holds many art collections, and various constructions by Bramante and Filarete.

In the 16th century, Milan found itself at the centre of a conflict between France and the House of Hapsburg. During this dark period of it’s history, the Sforza family came and went, the continual battles weakened the city, which was finally reduced to a province under Spanish rule. Notwithstanding all of this, the Milanese’s pervaciousness enabled the city to obtain its own autonomous government and a restricted circle of noble families who controlled the economic and demographic expansion. One important figure of this time left his mark, that was Carlo Borromeo. He was the archbishop who consolidated the Ambrosian rite, and became a saint in the 17th century. The creation of the Ambrosian Library (which today also holds the Art Gallery Pinacoteca Ambrosiana) is due to his successor, Federico Borromeo. At the beginning of the 17th century the Black Death greatly reduced the city’s population and caused another decline of the city, especially from the economic point of view. The main architectural sign of the 17th century is the construction of the new walls - The Spanish Walls - which today surround Milan’s historical centre.

At the beginning of the 18th century power passed from the Spanish to the House of Hapsburg. Milan began a new phase of expansion, characterised by fiscal and ecclesiastical reform, which culminated in exceptionally rich
cultural activity around 1770. II Caffè (an Enlightenment newspaper), and Giuseppe Piermarini’s architecture, which included the restoration of several important buildings, as well building the Villa Reale at Monza, are examples of the cultural expansion of this period. The Library and the Brera Accademy were also born at this time. Milan fell under French control with Napoleon Bonaparte, and underwent a large demographic increase. It became the capital of the Cisalpine Republic and reaffirmed its cultural and economic importance. Napoleon’s architectural and urbanistic program brought about the building of the “cerchia dei bastoni”, also known as the ring road, a system of roads which today surrounds Milan’s historical centre. New roads were built, based on Paris’ road system, and these roads are still used today.

In the 19th century Milan fell under Austrian power again. This was not popular with the educated middle classes or, later, with the people in general. In 1848, during the Five Days of Milan, there was a popular insurrection which was curbed with violence. However a few years later, the changed political scene in the Italian Peninsula brought about the proclamation of the Kingdom of Italy (1861).

Since the Unity of Italy, right up to the present day, Milan’s development has been continuous, this has led to it being described as the moral capital of Italy. Milan has undergone a huge increase in size, that has sometimes seemed to be almost out of control. It has given the city new outskirts, which are sometimes crime ridden and badly designed.

The centre of Milan, as we know it today, dates back to the beginning of the 20th century, when many areas outside Milan’s centre were designed and rebuilt. The first workers’ houses date back to this time, then in the Fascist period, “minimalist” houses were born, these fill the immediate outskirts, on
great, tree-lined avenues.

After the war, following the massive immigration into Milan from the South of Italy, the so-called "dormitory districts" were built. These were huge apartment blocks with hardly any shops or services nearby. They were built with little funding and soon fell into disrepair.

The big economic revival has made Milan into a rich and interesting city from many points of view. The "moral capital" of Italy, is without doubt very different from all the cities of art dotted around the country. It is the centre of economic activity in Italy. The Stock Exchange is based here. Milan's fame is also boosted by its role in the world of fashion, by the presence of many industries, the diffusion of the high-tech service sector, and by its cultural innovation.

Most of the Italian press is also based in Milan. One of the major TV networks - the largest private network in Italy - has its headquarters at the gates of Milan. It has become an internationally renowned city for its economic activity, and many students and business men from all over the world come here to study and work. Milan's size has remained reasonably contained, without its hinterland it has one and a half million inhabitants, these become four million if you count all the areas covered by the underground."
The site is located in the Porta Vittoria area of Milan (fig. 10-12). The site for this project is a disused freight rail yard (part of Milan's old railroad system) that is ordered by blocks of different housing types and industrial buildings. It's located in the nineteenth-century gridded portion of Milan, outside the historical center. Milan unfolds in circles ringed by a patchwork grid that finally sprawls raggedly into the landscape (from dense core to light periphery), the site finds itself in the middle of this transition. The site is a thin strip of land, that runs parallel to the train lines; just east from the abandoned Vittoria train station. The existing Porta Vittoria station has been disused for some years; its subterranean areas are being used for the construction of the Garibaldi Vittoria Passante and specifically for the "new" Vittoria Station, which will be the most important eastern station of the underground railway system. This system will create a underground transportation network that will link the city with its own internal occupancy, and provide nonstop service from trains passing through the city to outbound destinations.

The existing Porta Vittoria Station is planned to be demolished in early 2002. In 2001, the Milan City Council (Comune di Milano) held an international competition to design the new European Library of Information and Culture (BEIC) on the site of the station. This was the incentive of the Council to develop a building that would be a great resource for the city of Milan, as well as providing urban upgrading in an area that has been disengaged with the city fabric.
fig. 10 Map of Milan showing highlighted site location.

fig. 16

fig. 17
03.05

Product

Site Plan
Interior view of public corridor
Exterior surface of steel plate wall
Folded structural steel plate wall

Interior view of public corridor
Fig. 18
Image of woven fabric - manipulations of the fabrication technique creates anomalies in the surface of the material.

Above / Opposite:
The steel plates separate to create openings in the surface.
Fig. 19
Image of Bethlehem Steel Plant

Above:
Elevation of the Product Manufacturing Facility

Above:
Ventilation Stack of the Product Manufacturing Facility
Ventilation Stack

The ventilation stack is an industrial artifact, that reflects the age of the machine in architecture. With such a rich and romantic past, this contemporary design also reflects the process of steel production in a sculptural device that emerges from the interior of the building. The stack provides housing for the mechanical systems required in the building as well as providing a structural tube created by the folded steel plates.
Suspended Metal Ceiling:
The hung ceiling provides acoustical absorption in the steel facility, and allow to light to be diffused as it enter the space by filtering through the joints and openings created by the folded panels.
Openings in the ceiling system allows light to be filtered through.
Section 3: Orientation Center / Training Production Facility
Folded / tapered steel plate column

Above:
View of the Orientation Center
The folded steel plate wall creates a density in the wall surface that increases its structural integrity and operates as a storage wall.
Column Study:
The column is constructed of welded steel plates. The form of the columns changes due to the position of the observer.
Exterior Perspective:
View from train tracks
Interior Perspective:
View of Product Manufacturing Facility

Interior Perspective:
View of Orientation Center
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bibliography


I would like to thank John Fernandez for his constant support and encouragement throughout my time spent at MIT. You gave me the opportunity to experiment in class, as well as with many fascinating independent projects during breaks. Working with you has intensified my interests to explore architecture, and has pushed me to question and think more critically about such issues. I can’t thank you enough.

I have had the great pleasure to work and learn from Michael McKinnell. You have been a tremendous help and inspiration in the office and at school. Thank you so much for constantly going above and beyond in extending your time and support in my career.

Finally, I would like to thank Kelly, for her support, love, and friendship. Thank you for joining me in my pursuit of this degree, without it - none of this thesis could have happened.