



pro-active adaptation
andy brandt [architectural masters thesis]
improving infrastructure

PRO-ACTIVE ADAPTATION:
IMPROVING INFRASTRUCTURE

by

Andrew MacMillan Brandt

A thesis submitted in partial fulfillment
of the requirements for the degree

of

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April, 2009

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ABSTRACT

Life on this planet adapts reactively through necessity; as environmental context changes, so do the inhabitants. Due to our level of creative analysis and critical thought, humans have the ability of anticipation. By recognizing patterns, trends, and correlating probabilities, we can anticipate a changing environment. In order to maintain a healthy world to live in, humanity needs to embrace ***pro-active adaptation: altering behavior in response to inevitable change in environmental conditions.***



THE SUCCESS OF HUMANITY AS A SPECIES IS DEPENDENT ON OUR ABILITY TO ACT AND REACT – TO RECOGNIZE AND ANALYZE SITUATIONS AND RESPOND TO THEM IN AN APPROPRIATE MANNER.”⁰¹



Environmental Systems

It is foolish to expect life as we know it to continue indefinitely in the same manner as its current state. Time does not halt. Our natural environment is never static and circumstances will always change. To maintain stability, the natural world ebbs and flows: when food is plentiful herds expand; when food is scarce animal groups are thinned. In the natural world consumption can never exceed supply and if demands change or are redirected, supplies must accommodate. Different plant variations have found ways to adapt to diverse climate regions, and as climates change certain plants may die off and be replaced by other, more appropriate solutions. Nature finds a way to maintain balance. It is a system that contains all life and all life contributes to the system. The further the pendulum swings from center and stability, the harsher the counter, and nature will establish equilibrium regardless. On a minor level, if a food source becomes unavailable, animals diversify and acquire a new source. If circumstances become extreme, nature has no qualms about wiping the slate clean and starting over.

For western human culture, stability is typically viewed as being synonymous with permanence. It carries with it the connotation that stability is static and rigid; so steadfast that nothing can budge it. Furthermore, this is a mindset and a state of being rather than a way of behaving.

In the natural world, stability retains the premise of durability and endurance, but approaches it in a different light. Instead of strength as brute force, nature is more attuned with agility. Instead of facing opposing force with more force, organic nature considers attributes like absorption and deflection: consider palm trees in recent tropical storms. The buildings along the coast were hard and steadfast – and were destroyed. Many trees however were left standing while surrounded by devastation. This idea goes back to the well known phrase, ‘what does not bend breaks’. While buildings may be built of harder materials, such as stone and metal, trees and other vegetation don’t necessarily have to be stronger and prevent impact, but only absorb and deflect the impact.

Storks and other birds have the impressive ability of sleeping standing up – on one leg. Highly trained athletes, martial artists, and circus performers like those in Cirque du Soleil can achieve even more dynamic feats based upon the same principal. It is not brute strength. It is the ability of finesse, self-control, balance – stability.

The problem, and conveniently the solution, resides in how we define our terms. Stability is still durability and endurance, but the achievement of those ideals needs to come from a different source. With the world in constant motion, with the contextual environment in which we live our lives ever fluctuating, true stability comes with moving within the system instead of putting in more energy to oppose it. This idea is nothing new. “The organism is not robust because it has been built in such a rigid manner that it does not buckle under stress. Its robustness stems from a physiology that is adaptive. It stays the same, not because it cannot change but because it compensates for change around it.”⁰² Humans already have the ability to think and act in this manner, but it is truly past the time in which humankind, as a unified culture, must embrace a different way of life. A new way is not required as the world around us can provide numerous old methods that have been proven successful over thousands of years.

Stability in nature is not concerned with an individual component or organism that is part of the whole, but rather the importance of the whole system itself. Plant and animal populations ebb and flow, seasons change as the earth makes its orbit, day turns to night and climates vary. With all the variables that are constantly rearranging, nature maintains a stable system, even if the context of that system itself must change. If a climate shift turns a wetland slowly into a prairie, the system can no longer be a stable wetland; that infrastructure is no longer relevant. The system must now become a stable prairie and its components need to reflect that change. The elements will adjust and the environment may become new, but the pendulum will always find the middle, even if ‘middle’ needs to be a new location.

Through this explanation of systems and stability, the subject of context continually occurs. In ‘context’ a certain decision will not hold the same outcome depending on the environment in which it transpires. Sun Tzu addresses this concept in *The Art of War*, where he outlines the importance of the moment. In conflict there is a right and a wrong solution, but situations overall are more complicated than that. Timing is just as critical as the act; the ‘when’ compounded with the ‘what’. A wrong decision at the wrong time is of course failure, but additionally the right decision at the wrong time is also failure. The context in which we do things greatly impacts the outcome.⁰³ Real world examples delve into a broad range of circumstances and cultural

differences. At times, looking a person in the eye when they are talking shows attentiveness and therefore respect, yet in a different setting looking a person directly in the eye is an incredibly rude gesture. Driving a car in the 1930s is dramatically different from today as the infrastructure has completely changed. The same action is not always the same action, based on the context and the environment in which it occurs. Moving to an architectural scenario, the idealized 'American Dream' of the 1950s is no longer applicable to the present. Having one parent working a standard, regular job cannot comfortably sustain a family of four. Due to economic shifts in the ratio between cost of living and income, a two car garage along a tree lined avenue with a white picket fence is not feasible for average people of this country. Additionally, with an ever increasing population, our land use cannot permit that same type of behavior and consumption. The context in which we live is ever changing and therefore the same decision made before will not always be the right one later.


Narrow thoughts and a belief of "this is the way we build because we've always built this way" no longer pertains. An example can be seen in the pervasive material of brick. Originally walls made of brick had to be several feet thick. As technological advancements were made and steel allowed for taller, faster, cheaper construction with a great reduction in materials, the manner in which architecture was approached changed. However the aesthetic quality of brick was widely retained and it became a façade. Now the process has continued even further, creating thin veneer of what used to be brick. A brick wall is never a solid brick wall any more, and to make things worse a brick wall isn't even necessarily real brick. There is a lack of authenticity by trying to allude to an old system without being willing to operate within its confines. This shows the wrong application of a material choice due to a changing and evolving context. Through a reluctance to change, an old solution is no longer utilized in its original framework, but rather attempting to force that old solution into a new context in which it is not applicable. Brick can be a very appropriate material – when it is used in the context in which it was developed and applied.

Building typology acts as another example. A Mediterranean style home with courtyards, open verandas, and bare materials works quite well in warmer climates. Transplant the same structure from Italy and place it in the center of Canada, and suddenly the successfulness of the initial design is greatly diminished. The outdoor spaces cannot be used in the winter, cool refreshing stone is now bitterly cold and snow loading may become an issue. The same idea under a different context changes significantly.


THE DESIGN OF BUILDINGS IN NATURAL SETTINGS, WHETHER URBAN OR RURAL, MUST BE RESPONSIVE TO THE EARTH OUT OF WHICH THEY ARISE AND THE SKY AGAINST WHICH THEY ARE SEEN.⁰⁴

The natural world in which we all live is comprised of numerous climates with unique distinctions. Through these components, environments in which we inhabit are formed. An important distinction to make is that these environments are never defined once and forever static. Instead natural cycles and environments are constantly changing, fluctuating, and adapting; their cumulative components moving within a moving context. The notion of permanence in nature is not based on static and unwavering authority, but rather permanence refers to stability in a balanced overarching system. While the components that comprise a natural environment may increase or decrease in significance, switch rolls, or be replaced altogether, the overall system is stable and retains longevity. Singular permanence does not overshadow the collective. These alterations occur due to the context of a given environment. As an ecosystem evolves, the context of that place is affected, and organisms must shift with the system. Context is thereby invariably linked with time. Linking to architectural terms, a building should relate to both the hard and soft site that it is located; to the physical land and weather as well as the demographics of its inhabitants and atmosphere. In essence, architecture should reinforce an identity of place, a commonly held view. Context expands upon that notion by stating that 'place' does not remain the same. Demographics of people shift and grow, vegetation is displaced based on other built developments, and climates vary. Both built and natural environments follow this same pattern: that one singular location can change greatly over the course of time and while that physical point remains the same, the world moves around it.

a•dapt (v.) – malleable, versatile, acclimate, adjust, harmonize, reshape



ARCHITECTURE THAT IS DESIGNED FOR ADAPTATION RECOGNIZES THAT THE FUTURE IS NOT [STATIC], THAT CHANGE IS INEVITABLE, BUT THAT A FRAMEWORK IS AN IMPORTANT ELEMENT IN ALLOWING THAT CHANGE TO HAPPEN. ADAPTABLE BUILDINGS ARE INTENDED TO RESPOND READILY TO DIFFERENT FUNCTIONS [AND] PATTERNS OF USE.⁰⁵



Socially, economically, politically, and culturally, the world in which we live is impacted by these 'soft' conditions. Precipitation, humidity, temperature, the amount of sunlight during a day, even the difference between day and night are all distinctions that change 'hard' conditions. With an ever changing context, moving with the environment becomes essential.

For a biological example of adapting to a changing context, we shall turn to the common ant. Within the colony there are scouts that must head out in the search for food. While there is only a small percentage of the colony that scout at a time, any of the ants retain the ability to go out and find food sources. As the scouts head out to find food, they lay a pheromone trail so that they may find their way home. If food is found then the trail is strengthened and other members of the colony follow it out to the food. Interestingly, the search for food is an ongoing process regardless of the current supply and the understanding of the surrounding landscape. For even if a source is found, it might not be the closest or even the most abundant. Additionally, it doesn't matter how many times the surrounding area has been scoured for food because the context is changing and a new source could easily appear where there was previously nothing.⁰⁶

What humans can take away from this example by the ways of biomimicry is understanding that no matter how bountiful a resource may be, there is always the possibility of a better or more effective alternative. Building upon that concept, it is also important to note that no matter how bountiful and effective and close or smart or viable or progressive a resource may be, it is always finite. And being finite, another source will eventually be required. Since that conclusion is inevitable, it logically follows that it is in the best interest of the group to continue pursuing alternatives.

Human Dissonance

What distinguishes humans from animals? The basic difference is our mental capacity. Stemming from our intellect is the fact that humanity retains the ability for critical thought, analytical reasoning, and creative design. It is through those three qualities that mankind was able to develop advanced technologies, and over the years became the dominant species of this planet. The development of tools and the basic principle of 'work smarter not harder' enabled our survival and progression. As the top of the food chain, we have permeated every corner of our world and can inhabit virtually any environmental condition. Adaptation has allowed for us to survive at the highest level of existence. However there is a very important distinction that must be made on this matter. It is necessary to understand the directionality of this term 'adapt', and which side is the possessor.

Humanity has reached a point where we do not incorporate ourselves into the larger environment in which we live. Instead, we have subjected the environment to our own behavior. "Though it seems perfectly sensible to echo our biological ancestors, we have been traveling in just the opposite direction, driven to gain our independence. Our journey began ten thousand years ago with the Agricultural Revolution, when we broke free from the vicissitudes of hunting and gathering and learned to stock our own pantries."⁰⁷ Instead of living with nature, we have forced nature to live for us. From the beginnings of irrigation in Mesopotamia, mankind has removed itself further and further from natural cycles by means of controlling the natural world and bending the environment to suit our needs. "Instead of trying to optimize nature's abundance, we automatically try to get it out of the way. For many of us used to a culture of control, nature in its untamed state is neither a familiar nor a welcoming place."⁰⁸ Through the years this behavior has taken a dramatic toll on the stability of ecosystems and resources. No other living organism has the same capacity as humans to impact the natural environment and degrade the places in which we live. Not only is our behavior highly influential (and currently destructive) but with over 6.7 billion people, even the smallest alteration to our world must be compounded greatly due to our massive population.

Ironically human behavior acts contrary to the essential understanding of how the natural world operates. Initially humans were able to adapt to nearly all living conditions, and through technological developments have surpassed any opposition. By being uncontested at the top of the ladder we have felt no need to make further advancements in order to fit within our environments. Instead, we have become obstinate and seek to maintain current lifestyles when there are simply not enough resources to sustain such behavior. Rather than reunite with natural systems and cycles, humans have preferred, and retain the power, to do as we please, essentially bending natural resources to our will. We take from a system and consume without considering the necessity of replenishment.



NOW THAT WE CAN DO ANYTHING, WHAT WILL WE DO?⁰⁹



Interestingly, we have become lethargic and arrogant in our confidence. By initially being able to adapt to any climate, humans have been able to maintain control over the environment. True adaptation revolves around altering the self, based on the changing environmental conditions, instead of retaining the power and ability to control and thus remain within static habits.

A 47-year study from the Oxford University has shown that a population of great tits (similar to a finch) is laying their eggs in accordance with the changing climate. As the climate is warming caterpillars are emerging sooner in the spring, thus the bird population is adapting to this new condition in its environment.¹⁰ Humans however build our way further into deserts with air conditioned buildings and wonder why there is no water. We do not consider context of our environment, but instead move forward and out in the same manner as everywhere else.

In addition to humans control over nature, a significant factor for remaining separated has been necessity, or rather the lack thereof. Mankind has grown increasingly lethargic in our position of power due to the fact that we have remained completely unchallenged. There has yet to be any external threat to our dominance and consequently no reason to truly be more efficient with our resources and more responsible in our consumption. Disciplined runners can train themselves to certainly push themselves and strive for a higher standard, but their true potential is challenged when another runner is there. Athletes can tap into an extra reservoir of energy and ability in circumstances of competition. The same can be said about the current approach to American life style; we could be doing better, but do we really have to? And to be clear, 'better' refers to smarter, healthier, well rounded and more efficient, instead of bigger, stronger, and more powerful.

As creatures of habit, humans often exhibit desires for predictability, repetition and patterns in daily life. From the way we prepare for a day or the daily commute, forming habits creates a sense of stability and safety; there is a residual sense of control. In many regards, maintaining habits enables a person to be more efficient with menial tasks so that more focus can be allocated to demanding thought processes and problem solving. Take the morning routine as an example. Through simple exploration and perhaps unconscious analysis, people find the most optimal process for getting ready. A set number of tasks must be completed: taking a shower, brushing their teeth, shaving or applying makeup, eating breakfast, preparing a lunch, reading the morning paper or periodical, and of course getting dressed. The order of operation for these tasks is somewhat flexible, while certain tasks are more rigid. For example it would make no sense to get dressed and then go take a shower or brush your teeth before eating. Aside from those two instances, finding an optimal routine – or developing a habit – lets the body work in auto pilot, relying on muscle memory more than cognitive deliberation. This way a person can focus on the upcoming exam, presentation or meeting, or simply having more time to wake up. Yet, within this process there is allowance for variation. The clothes a person wears day to day often change, or perhaps the breakfast consumed is different.

It is important to establish that habit is very beneficial and useful to humans in daily life. However it is just as important to note that habit has its limitations. The situation greatly depends on the context in which habit is utilized. As with the above example, having a morning routine enables a person to wake up more gradually and focus his or her attention on more pressing matters. Yet, if people do not utilize habit in this manner and instead just float by in a daze, not only do they miss out on what is occurring in the world around them, but they additionally develop a static and rigid mentality. Eventually a disinterest to explore and embrace variance becomes an *unwillingness* to adapt. Consider road construction. Since most people in America still

drive to work it is very plausible to encounter road construction or a collision at some point in the years of commute. For a rigid mentality, deviating from the normal course can be quite jarring and stressful. Yet, if an individual is used to taking multiple routes, or is at least aware of viable alternatives, the added variable to their commute is less of a concern. To advance the situation, what if their car doesn't even start in the morning? Not much of an issue if a bus, a bike, or simply walking is an option. You can certainly utilize the most economic and efficient of the options as part of a regular habit, but it is still important to be able to switch over to an alternative when conditions modify.

The exact same scenario can be applied to architecture and the way we not only build buildings, but additionally the way in which we inhabit them. Interestingly, 'habit' possesses strong etymological roots with *habitat*. While *habitat* more specifically addresses 'dwelling', both contain definitions synonymous with 'seize, take, have, hold' and more specifically to *possess*.¹¹ Both words focus inward on the individual or 'self'. To develop buildings in the same fashion, regardless of time or place, begins to show habit in a very unproductive manner. There is no single way in which buildings are constructed. Furthermore there is no single way in which a specific building can be inhabited. Train depots become restaurants, factories become museums, and warehouses become condos. It is important, when addressing adaptability, to maintain an awake and alert mind, to not fall into a stasis routine. Refusing to twist a situation on its head and to look at a circumstance with fresh eyes leads to a mediocre existence that becomes increasingly difficult to wake up from.

Linking strongly with habit, attachment deals with the possession of either thoughts and ideals, or physical objects. The significant component to that concept is the potential loss of control and the inherent fear that stems from it. The more ingrained the habit, consequently the stronger the attachment to that habit, and thus the more potent the fear of loss. Whether you look at more recent cultural examples such as the Jedi Order of George Lucas' Star Wars, or the more historical roots in Eastern Philosophy, the issue of attachment is pervasive within human culture. The act of letting go is an on going struggle we face, and the greater the attachment, the harder it becomes to pull away from an idea and accept new progression.

Take the notion of 'home' as an example. Moving where you live is an incredibly taxing event. Initially it might be assumed that this stress would correlate to someone being too static in their mentality, and additionally always living in the same place. If only they were more used to the act of moving, making it a more regular occurrence, it would be normalized and therefore less stressful or frightening. While that hypothesis is still a variable in the circumstance, it only reaches for the root of the problem – attachment. Moving more frequently

lessens the potential level of attachment because it reduces the duration and possibility of meaningful memories and emotions. Yet duration only lessens the possibility, it cannot prevent fond memories from occurring. Additionally, moving too frequently can remove all sense of identity and only create an even stronger longing for 'home'. Should a person come across a place that becomes exceptionally memorable, the prospect of leaving that place subsequently infers that the individual will no longer experience those joyous events that made the place so memorable – in essence a home.

At the same point however, the building didn't necessarily contribute to the attachment, but rather was simply a location, a vessel, for events and the interaction of people. There might be specific elements to a building, be it the layout of the kitchen, to the way a couch sat in a room, or the way the front porch looked out onto the sunset. On a certain level it is the job of the architect to provide for those occurrences; to take the natural orientation of the landscape and cater to experience. Certain built features can be replicated in essence – a west facing exterior space for example – but it will never quite be the same as the previous experience, nor should it. There needs to be retention of identity in a place. The responsible architect should not abandon their code of standards and contribute to 'Anywhere, USA' by making everything the same. Rather the resultant solution is an obligation to make every place and moment special; raise the bar instead of settling for the common denominator. The individual experiencing space needs to be willing to explore, but it is the architect who must provide that opportunity and encourage – even demand – such behavior.

Maybe the new place of residence won't be better, per se, but perhaps it can simply be different and not worse. The idea being that moving forward in time deals with the contextual circumstance. One building served its purpose at a certain moment, and that cohesion was appreciated by the occupant. However as circumstances change, a static building doesn't change with it. A person finds a better job, a family grows, a business' success blossoms or the objective of a company is re-evaluated. In all of these circumstances a change has occurred and the original building solution doesn't always properly address the new problem.

EMPOWERED AS SUCH, WE HAVE A RESPONSIBILITY TO ADDRESS THE NEW SET OF QUESTIONS THAT GO ALONG WITH THAT POWER. AT THE SAME TIME, WE ACKNOWLEDGE THE HUBRIS AND INHERENT PARADOX OF THE NEW POSITION WE FIND OURSELVES IN: *WE ARE DESIGNING NATURE AND WE ARE SUBJECT TO HER LAWS AND POWERS.*¹²

Whatever the activity, humanity is attempting to live a life without limits within a limited world. Yet, “we humans regard limits as a universal dare, something to be overcome so we can continue our expansion.”¹³ The resulting situation is a conflict of reality. Anything we consume is a derivative of some resource. Additionally all resources are developed from a material and processed through the application of energy. With that definition in mind, everything we use from food and clothing, to fuel and technology has a limited and finite source that we can draw from. Even renewable resources are finite at a base level. There are only so many trees that can be cut down and processed at any given moment. The catch is that time must be allotted for the plant to renew. Animals must be given the opportunity (time+space) to procreate. If this allowance is not made, then the resource fails to be renewable.

IF THE PRESENT GROWTH TRENDS IN WORLD POPULATION, INDUSTRIALIZATION, POLLUTION, FOOD PRODUCTION, AND RESOURCE DEPLETION CONTINUE UNCHANGED, THE LIMITS TO GROWTH ON THIS PLANET WILL BE REACHED SOMETIME WITHIN THE NEXT ONE HUNDRED YEARS. THE MOST PROBABLE RESULT WILL BE A SUDDEN AND UNCONTROLLABLE DECLINE IN BOTH POPULATION AND INDUSTRIAL CAPACITY.¹⁴

The excerpt from Donella and Dennis Meadows' *The Limits to Growth* was published in 1972. According to their projections, if there is no drastic action taken in the next fifty years to change our current way of life, situations will become quite bleak.

Responsible consumption of resources comes from maintaining an effective ratio of product to source use, which can be achieved through reduction of materials or the reduction of energy. One option is to simply consume fewer resources, both per capita and overall. To do so either dramatically reduces a standard of living, or more likely, creates a demand for a replacement resource – some alternative to fill the void. Another option is to increase the efficiency of a given resource – doing more with less – and an expansion of that concept is to extend the period in which a product is useful, thus reducing the necessary rate of acquisition. This method looks into William McDonough's Cradle to Cradle idea where nothing is waste. Expanding further is Bruce Mau's concept of 'waste equals food', which creates a more complex version of McDonough's where the waste byproduct of one resource helps satiate another demand or provides alleviation on the processing of another resource.

An option that must be carefully analyzed is to increase the access to, and availability of, a resource. On one hand the attempt is to increase the rate at which a renewable resource is replenished (i.e. planting more trees), which is already being done simply in an attempt to keep up with demand and consumption. On the other hand more of a finite resource is being consumed in a shorter duration, which in fact only makes the problem worse by reaching the inevitable decline sooner. Thus one interpretation goes in the opposite desired direction and the other is short sighted, attempting to make an intricate situation overtly simple.

Architecture is based on a system of materials, which are comprised of a culmination of energy and resources. While an argument might be made in the case of digital or virtual architecture, energy and resources may move from a hard definition to more of a soft one, but their existence is still prevalent due to concepts like embodied energy. For the remainder of this section, materials, energy and resources will be referred to as the abbreviated 'resources', with the understanding that this can be defined in literal or abstract terms, and refer to anything from bricks and stone to network servers and computer software.

All resources that might be potentially utilized in the development of architecture and its infrastructure are finite. While many sources are vast, from forests and our world's oceans there still remains a limit to what can be utilized. Even the sun is finite in the sense that, while we will probably not exist long enough to see it

supernova, there is a limit to which we can harness its energies (surface area for PV arrays). Therefore it is important to note that limitations can either come from the resource itself or our accessibility to it.

From that groundwork we can conclude a finite supply to any and all resources. With supply inevitably comes demand, as supply and demand are inversely proportional and related. A point of equilibrium exists between the two conditions where the demand for a resource is roughly balanced out by the available supply. However the two components do not form a direct correlation for this approach, meeting in the center. This approach to supply and demand is not from an economic and capitalistic stance where the objective is to maximize profits. Rather the objective is to retain stability and balance by maintaining a system that is in equilibrium as much as possible, which is based more on a steady supply of resources. The more stable the system, the more allowance it grants for exploration into alternatives and development of better systems based on contextual reference.

Since it is understood that all resources have a limitation, and in this discussion resources are equated with supply, it concludes that supplies are also limited and finite. Therefore it follows that the objective is to generate demand for alternate solutions in accessing and utilizing resources. In dealing with supply and demand, and consequently the inherent resources the system revolves around, there is an intrinsic balance. Differing from a capitalistic and economical approach, where the goal is to maximize profits, this approach of equilibrium is instead based upon the stability of supply rather than exploiting the demand.

How we move from point A to point B can be labeled, as Bruce Mau has coined, the 'movement economy'. This takes individual sub-markets like automotive, industrial rail, cruise liners, airplanes, and everything else and places it under one category, or economy. Currently, the most commanding of resources in our world is also the most irrelevant. Fossil fuels that drive the movement economy have been fought over for decades, and ironically we don't need it. "All energy is solar energy stored in different forms. Every two minutes the sun gives the earth more energy than is used annually worldwide. It is the only renewable resource with the capacity to provide all the energy we need on a global level."¹⁵ If mankind could only get away from current practices and realize there are better options sitting right in front of us. It's like two dogs fighting over one bone when there are two steaks sitting right behind them, if only the dogs would turn around.

As stated before, all methods of human life style rely on resources, and all resources are limited. Therefore alternatives will be always necessary. With the current state of events, "there is an urgent need to articulate

precisely what we are doing to ourselves and to our world.”¹⁶ In the accompanying chart, human behavior is shown through our off-gassing of carbon dioxide. If our actions continue at the current rate, we will see an environmental crisis within fifty years. The system that humans are forced to be a part of – nature – must be maintained if we wish to continue with some semblance of stability.

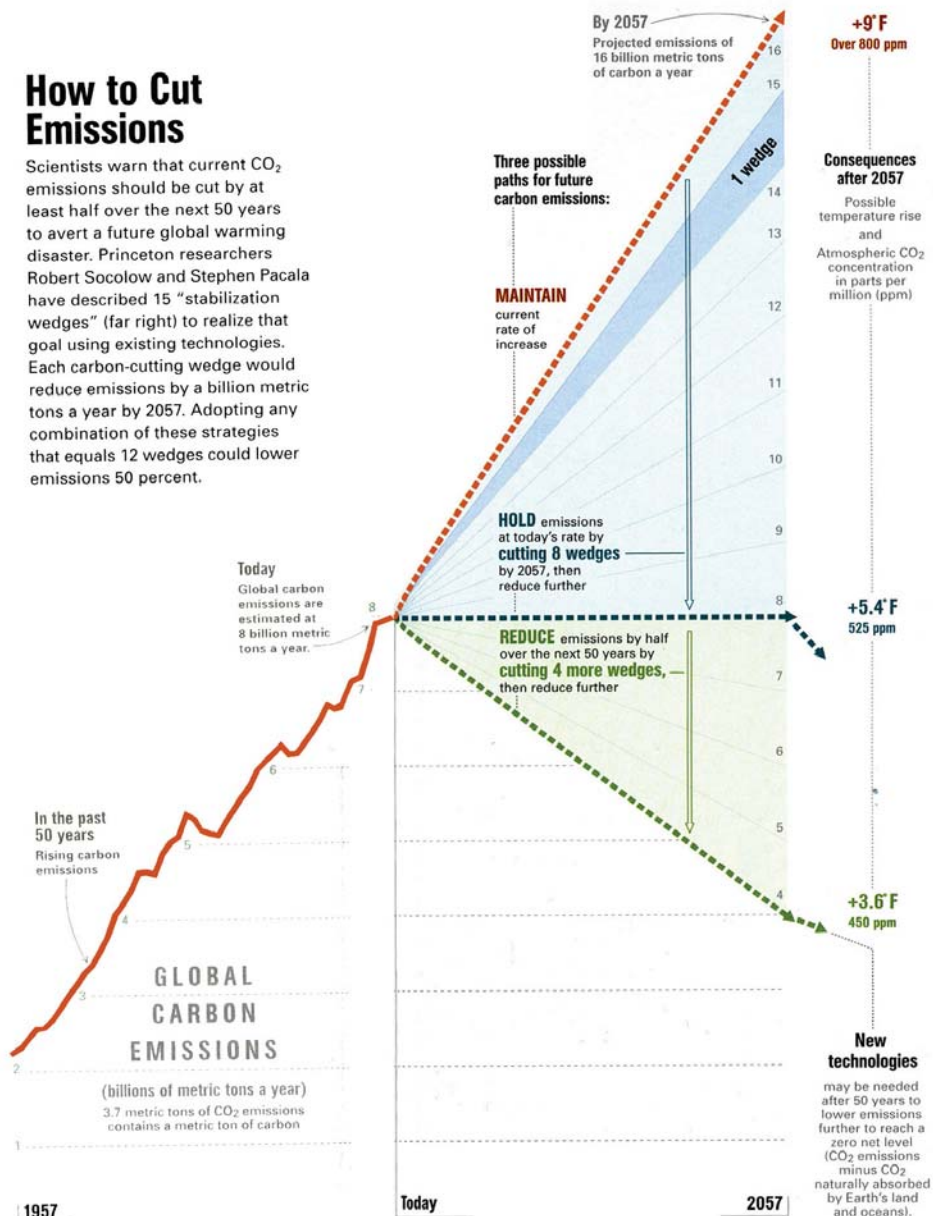
Human behavior it seems is bent on fighting an inevitable future. There cannot be reliance on truly finite resources as they will eventually run out. Or they will be too costly – either economically, to our wellbeing, or a slew of other factors, to continue old methods. And with an ever growing global population the efficiency of resource consumption means we can no longer do as we please. The restriction is no longer ‘what can we do’, but ‘what should we do’? In regards to our species’ long-term survival, it is absolutely imperative that we re-evaluate our current life styles, to no longer strive for opulence, but instead strive to live in equilibrium with the world that sustains us. The most complex challenge in doing so requires the “architect to temporarily set aside the traditional rules of a majority culture that govern the creation of most work” and push for what is needed, what is necessary, even when a majority is clamoring for what is wanted.¹⁷

Decision making on a large level (social, cultural, governmental) is typically made re-actively. A situation occurs, the parameters and variables are analyzed, options are compared and then the best course of actions is chosen based on the definitions the previous steps outlined. This process is in accordance with two different types of scenarios. On one hand there is no prior knowledge of an event and something just happens. These typically have a negative connotation: traffic pile-ups, or severe natural disasters like an earthquake. Hindsight is always 20/20, but there is rarely anything that could have been done regarding the situation. The other condition of re-active thinking is based on utilizing scientific evidence to support a hypothesis with some format of data or research. If there is not enough information to justify action, nothing is done until that information and support present themselves. To make a wild claim such as playing basketball causes gingivitis and everyone should avoid basketball holds no value if there is no proof of the correlation. People would have to experience an occurrence or know of such a case, in order to consider the connection. Until data is gathered, such a statement is completely illogical and holds no basis. This process goes for even plausible situations. To say that the penny holds no value and should be pulled out of circulation might seem logical, based purely on common sense, but the situation would still have to be evaluated in order to elevate the idea from merely an opinion.

To be pro-active requires many of the same conditions; there must be substantial proof or scientific evidence

How to Cut Emissions

Scientists warn that current CO₂ emissions should be cut by at least half over the next 50 years to avert a future global warming disaster. Princeton researchers Robert Socolow and Stephen Pacala have described 15 "stabilization wedges" (far right) to realize that goal using existing technologies. Each carbon-cutting wedge would reduce emissions by a billion metric tons a year by 2057. Adopting any combination of these strategies that equals 12 wedges could lower emissions 50 percent.



ONE WEDGE AT A TIME

Each strategy listed below would, by 2057, reduce annual carbon emissions by a billion metric tons.

- EFFICIENCY AND CONSERVATION**
 - Improve fuel economy of the two billion cars expected on the road by 2057 to 60 mpg from 30 mpg.
 - Reduce miles traveled annually per car from 10,000 to 5,000.
 - Increase efficiency in heating, cooling, lighting, and appliances by 25 percent.
 - Improve coal-fired power plant efficiency to 60 percent from 40 percent.
- CARBON CAPTURE AND STORAGE**
 - Introduce systems to capture CO₂ and store it underground at 800 large coal-fired plants or 1,600 natural-gas-fired plants.
 - Use capture systems at coal-derived hydrogen plants producing fuel for a billion cars.
 - Use capture systems in coal-derived synthetic fuel plants producing 30 million barrels a day.
- LOW-CARBON FUELS**
 - Replace 1,400 large coal-fired power plants with natural-gas-fired plants.
 - Displace coal by increasing production of nuclear power to three times today's capacity.
- RENEWABLES AND BIOSTORAGE**
 - Increase wind-generated power to 25 times current capacity.
 - Increase solar power to 700 times current capacity.
 - Increase wind power to 50 times current capacity to make hydrogen for fuel-cell cars.
 - Increase ethanol biofuel production to 50 times current capacity. About one-sixth of the world's cropland would be needed.
 - Stop all deforestation.
 - Expand conservation tillage to all cropland (normal plowing releases carbon by speeding decomposition of organic matter).
- New technologies**

may be needed after 50 years to lower emissions further to reach a zero net level (CO₂ emissions minus CO₂ naturally absorbed by Earth's land and oceans).

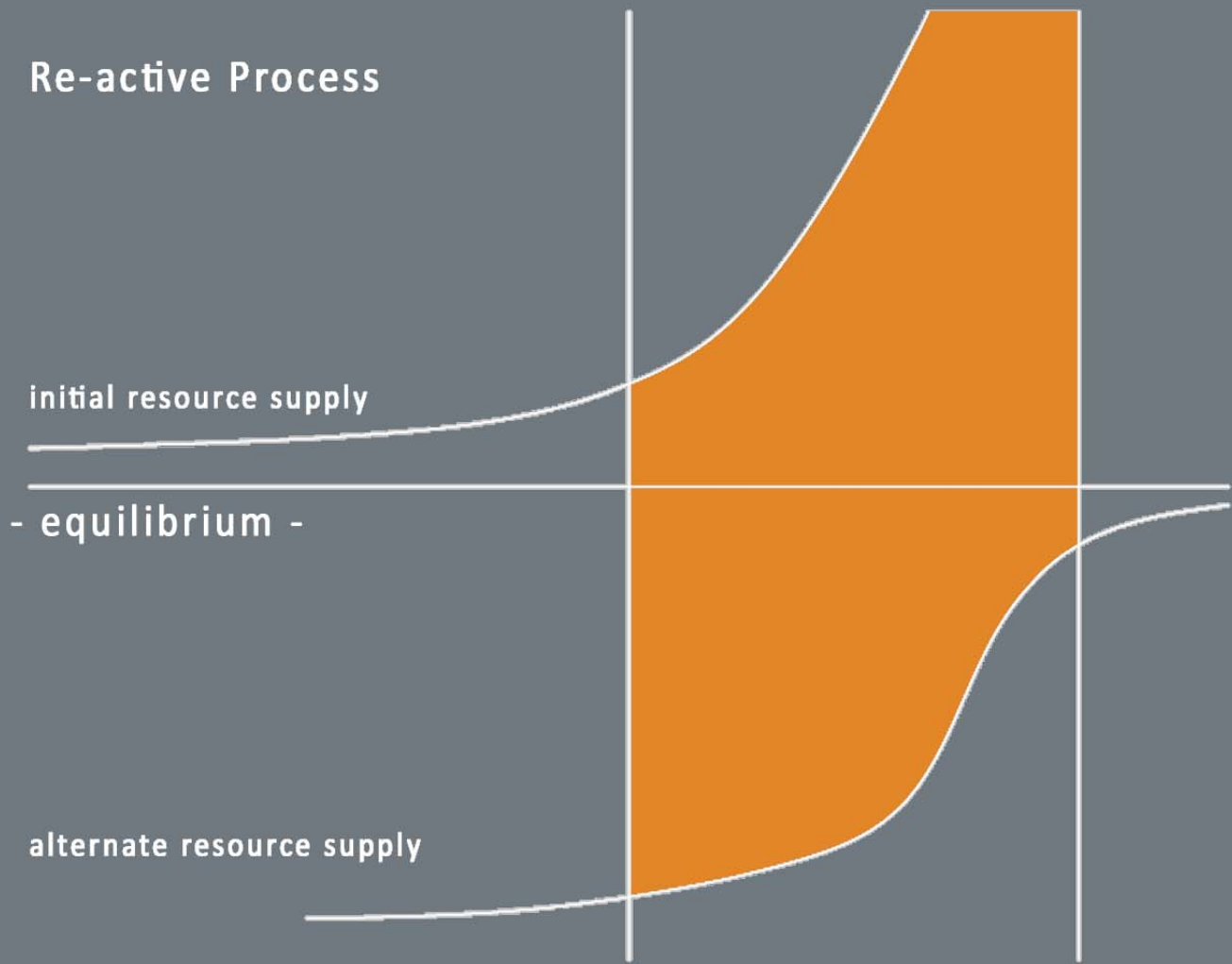
fig_01

– data that is quantifiable and measurable. However, in replacement of a past situation to reference, pro-active theory relies on correlation and probability. The weather report calls for a seventy percent chance of rain tomorrow, so you wear a jacket or take an umbrella. There is no proof that it will rain because, after all, it hasn't started yet, but based on weather systems and the correlating conditions that form a reliable pattern, a high probability is quite likely to occur. Returning to the currency example; to show that the penny has been losing value steadily and that fewer businesses are circulating the currency could lead into a plausible theory. While the penny has not lost its usefulness, a reliable projection based on past information and empirical evidence could lead to a pro-active decision: develop an alternative or replacement before the inevitable occurs.

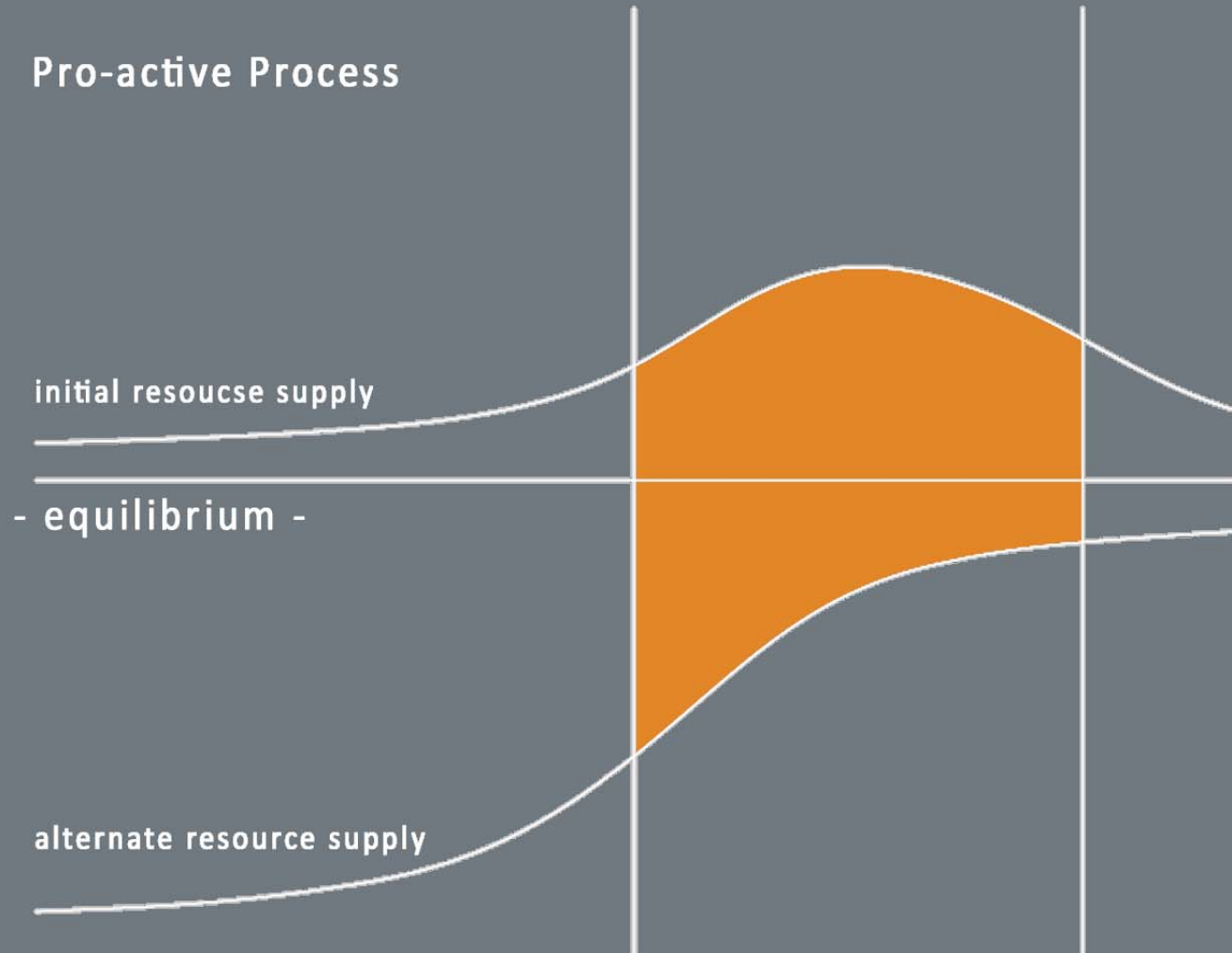
To be more direct and establish a very significant situation, consider the automobile. Here is a system that is heavily reliant on fossil fuels, the cost of which has steadily increased over the years as demand has increased and supply decreased. The personal automobile is built on a system that cannot be sustained indefinitely as the supply source is exceptionally limited and there is no way of producing more. Through definitions and criteria previously outlined, it is absolutely imperative that an alternative solution be put into effect. Waiting to obtain a new solution and adapt only prolongs the inevitable and makes a situation worse; *especially* when a system is known to be deteriorating. A cliff can be known without stepping over the edge.

In the following graphs, an initial resource supply is shown as it is consumed and decays away from equilibrium in the center. Under a re-active system, an alternative resource isn't fully developed until the first disappears. On the second graph, it is known that the initial resource will decline and as a result an alternate solution is being continually developed. The concluding situation is one where the area between the lines is closer to center, indicating a more efficient and stable system. An added benefit from a pro-active approach is from an economical standpoint. Like physics, to change the direction of an object in space, there is a direct correlation between the amount of movement and the required force. Here, 'money' replaces 'energy'. Thus, the sharper the curve, the more expensive the system becomes, with money as the acting force. Additionally, the farther out the system gets, the more money is wasted trying to get back to the center.

Re-active Process



Pro-active Process





WHAT WE THOUGHT WAS BOUNDLESS HAS LIMITS.
- ROBERT SHAPIRO¹⁸



Infrastructure

Heavy timber and stone were sufficient for a long expanse of time as they were durable building materials. The more durable a structure, the less maintenance required, and the longer it can last before needing to be replaced – very efficient design. Iron and later steel were critical components of the Industrial Revolution for creating greater spans, thus reducing the amount of materials required to build. Digital technologies allow for faster production and better accuracy, in addition to solutions and forms that were never before comprehensible. Finding ways to use waste products, either from demolition or processing, further reduces the need for precious resources. All of the infrastructure and supporting enterprises related to architecture additionally increase efficiency. This is exactly the role architecture can hold on culture and societal developments. In fact, as knowledge and understanding of materials, building processes, and various other advancements increase, architecture is directly affected. The overall driving force behind intelligence, and consequently technology, is efficiency. The advent of the railroad for example, allowed shipping of more goods, faster and more reliably than before. The field of architecture is now at a stage in development where people are working to improve the materials we currently have (glu-lam beams instead of heavy timber as an example). Sustainability not only works to be more efficient with the current supply of goods, but to live in healthier environments. The unifying concept through all of these examples of efficiency is that no matter what discoveries are made, or what kinds of improvements become available, there are always more advancements to be found. As resources are consumed, there are always methods to do more with less, find alternate solutions, and generally be more effective. Additionally, usage of space can always be tighter; we can always find ways to reduce our hard and soft footprint. Architectural practice should never be static or satisfied with where we currently are.

However, increasing efficiency alone is not sufficient. Within the overarching concept, there still exists a rather subjective hierarchy of values. In a very capitalistic sense, buildings, both programmatically as well as materially, can always be accomplished faster and cheaper. That is an exceptionally narrow-minded and

greedy approach to efficiency if those are the only two priorities. The end product to the users will have poor quality, and deteriorate sooner. Instead, mankind has the responsibility to each other and more importantly to the world in which we live. Our built environment should be healthier than what is around us, not ridden with filth. The building materials we harvest and the land we use should be maintained responsibly. Higher efficiency should always be strived for, but on the level of responsibility before individual gain. A structure can certainly be more affordable and faster to construct, as long as physical and psychological health are higher concerns, in addition to environmental consciousness.

Cars running on fossil fuels are horribly pollutant and rely on an energy source that we can't sustain. Make engines more efficient is a positive start, but does that really solve the problem? Progressive behavior certainly helps, but the root of the issue is not addressed. Using less of a finite resource prolongs its application; however the inevitable end is not abated. The introduction of biofuels and hydrogen fuel cells are both short term solutions, while electric cars is the only sustainable solution given the proper energy source, but with all of these alternatives the overarching infrastructure is still in place. To truly address the root of the problem, changes need to be made to the system itself, not the components within the system.


THE WORLD WILL NOT EVOLVE PAST ITS CURRENT STATE OF
CRISIS BY USING THE SAME THINKING THAT CREATED THE
SITUATION.

- ALBERT EINSTEIN¹⁹


As it stands, cars sit unused 95 percent of the day.²⁰ Unused – and yet they demand an exorbitant amount of space, in addition to the high level of pollutants produced. The inefficiency of the system is astounding. What's more, the automotive system is finally failing instead of being forced to survive. With auto manufacturers filing for bankruptcy, it is absolutely evident that times are changing, context is shifting and the old system needs to be re-evaluated. What is also made clear is that the automotive industry failed to pro-actively adapt. It has been evident for decades that change was necessary, yet instead of working toward a better solution; there was more money to be made in the short term. General Motors even had the opportunity to be on the cutting edge with their development of the fully electric EV1 more than ten years ago. For reasons that are their own, GM pulled the car from the market.²¹ And all of a sudden the industry failing is a shocking surprise to the manufacturers. This has shown the difference between a short sprint for maximum return versus endurance to sustain a system for the long term. “Humans are condemned as the one species on the planet guilty of burdening it beyond what it can withstand; as such, we must shrink our presence, our systems, [and] our activities.”²² The way people move needs to adapt. Continually building, no matter how sound, on an unstable foundation will inherently be unstable.

While architects currently do not have direct control over America's movement economy, the infrastructure that dictates how people get from one location to another greatly impacts our built environment. However, architecture has potential to influence the other system. On the same interrelation of architecture reflecting culture and culture reflecting architecture, the movement of people can be cast in the same light. Architecture, after all, is built for experience of occupants moving in and around a structure. A single building is designed around movement and experience, and should respond to the human condition. But at the same time a building's design can alter, impact, and change that motion and the resulting perception of the experience.

The same can be said regarding the overall infrastructure of movement in a place. America's current system is based on the infatuation with the personal automobile. Cars and roads and parking lots dictate how we use our land and what our built environment eventually looks like. “Every hour of every day 50 acres of prime farmland are lost to development [...] Between 1970 and 1990 the population of the Chicago metro area grew by 4%, while the developed land increased by 46%.”²³ This links directly to the built infrastructure and suburban growth due to the personal automobile. It no longer becomes how we would like to use the land, but rather what is required to satiate our infrastructure. And all the while we've been ignoring the true issue of how we should live with the land.



IN EVERY ANIMAL... MORE FREQUENT AND SUSTAINED USE OF AN ORGAN STRENGTHENS THAT ORGAN... WHILE THE CONSTANT DISUSE OF AN ORGAN IMPERCEPTIBLY WEAKENS IT... AND ENDS IN ITS DISAPPEARANCE.²⁴



The asphalt and concrete infrastructure required to enable cars to function dictates the path that we can or cannot travel and where buildings can go in between. Furthermore, asphalt has an exceptional thermal massing quality that raises the temperature of a microclimate and can quickly reduce comfort levels. Imagine the difference of eating lunch out in a grass field on a hot summer day, and that of sitting in the middle of a vast asphalt parking lot. Filled with cars, that lot now has added reflectance and absorption of heat, thus increasing the intensity of the environment.

America's current movement infrastructure is broken. It is slow, costly, pollutant, unsustainable, generally uncomfortable, uses too much space, and overall degrading to our environment. *Inefficiency on every level.*

Simply looking at the numbers shows just how inefficient cars are, and how illogical it is to rely so heavily on them. Cars don't need to be abolished, but a better system is available to be the main infrastructure. In the animal kingdom, "the selective death of 'weaker' individuals is universally appreciated."²⁵ Thinning out the weak links is necessary for the group's survival, and right now automobiles should not be the primary mean of transportation.

Thankfully trends are forming to address this issue. Most European and East Asian countries are linked together with exceptionally efficient and reliable rail systems, and have had the infrastructure established for a number of years now. Using France and Japan as particular reference points, America is finally planning on developing its own passenger rail system. The main component behind pro-active adaptation is to recognize these occurring patterns and become involved with the process.

Just how fast, efficient and enviro-friendly will next-gen rail be compared to other options? The numbers below were gathered from federal and private sources for a 400-mile trip (the equivalent of traveling from Boston to Baltimore).



High-Speed Rail

Travel time: 2 hours, 54 minutes (maglev); 4 hours, 35 minutes (steel-wheel)

Energy used per passenger mile: 1130 Btu (maglev); 1200 Btu (steel-wheel)

CO₂ emissions per passenger mile: 0.47 pounds (maglev); 0.48 pounds (steel-wheel)



Amtrak (Diesel)

Travel time: 7 hours, 5 minutes

Energy used per passenger mile: 2709 Btu

CO₂ emissions per passenger mile: 0.46 pounds



Airplane

Travel time: 2 hours, 20 minutes (including 1 hour check-in time)

Energy used per passenger mile: 3264 Btu

CO₂ emissions per passenger mile: 1.06 pounds



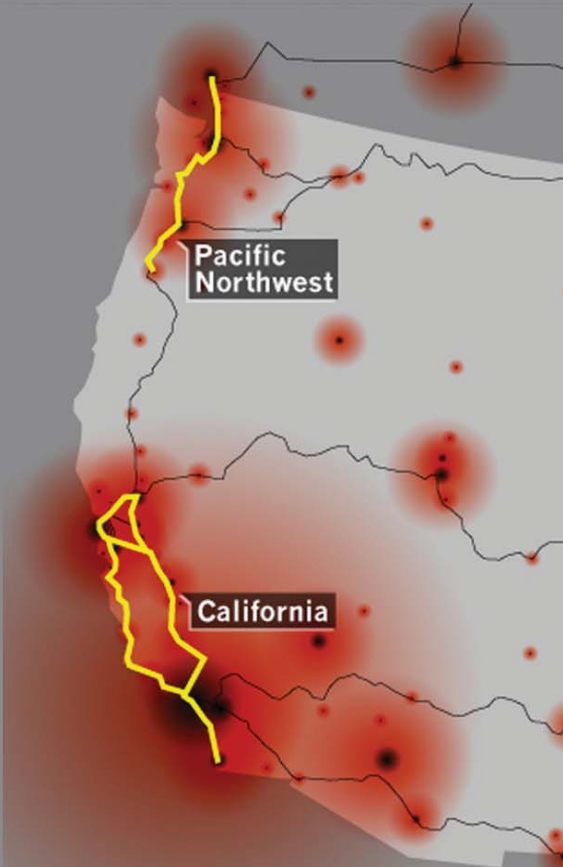
Car

Travel time: 7 hours, 6 minutes

Energy used per passenger mile: 3445 Btu

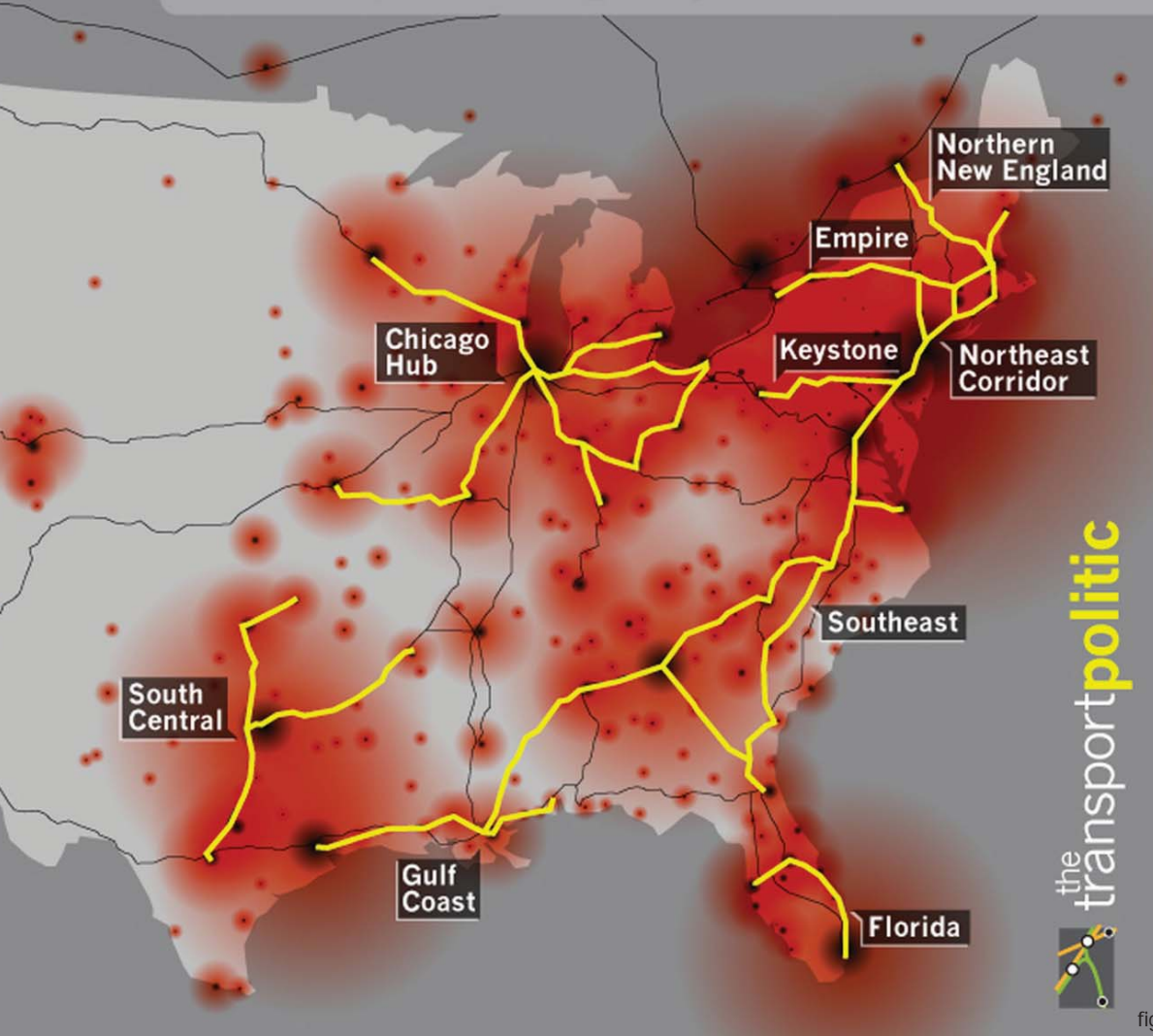
CO₂ emissions per passenger mile: 0.77 pounds

*Btu stands for British thermal unit. One gal. of gasoline yeilds ~1240 Btu.



- FRA High-Speed Rail Corridor
110-150 mph service
- Existing Amtrak Corridor
50-110 mph service

FRA-Proposed High-Speed Rail Network

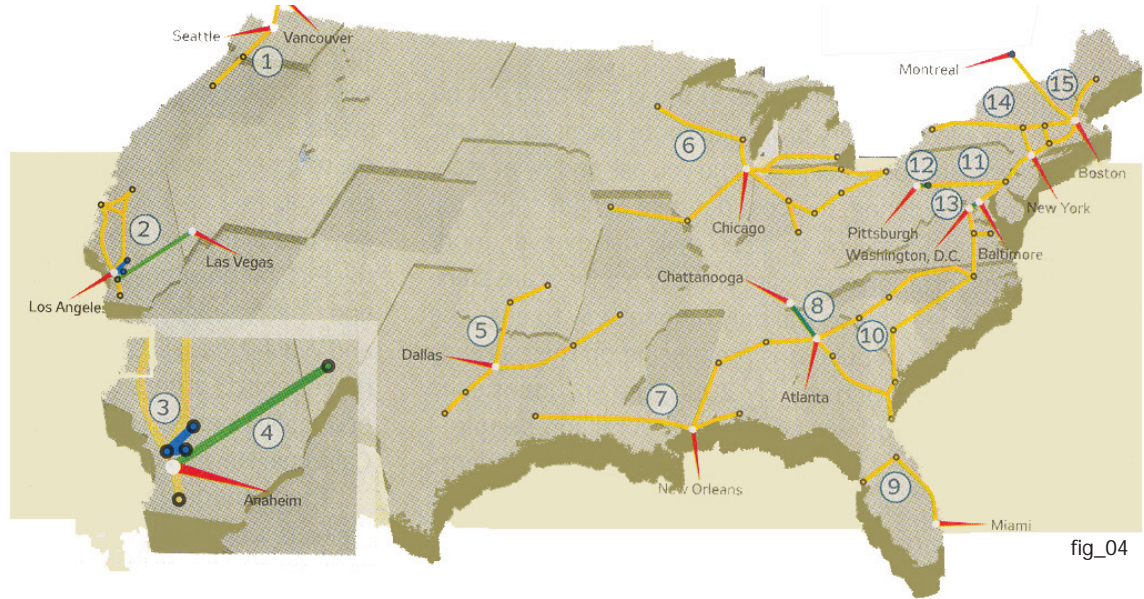


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PROPOSED NORTH AMERICAN HIGH-SPEED TRAIN PROJECTS

ROUTE KEY

- High-speed rail
- Maglev
- System to be determined



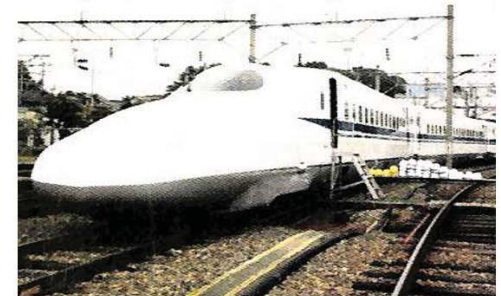
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Japan's experimental MLX01 maglev train holds the world speed record of 361 mph, which it reached during a run on the Yamanashi Maglev Test Line in 2003. The MLX01 uses super-conducting magnets that have to be cooled with liquid helium.



French TGVs are currently the fastest steel-wheel trains in operation, with cruising speeds of 199 mph. An experimental TGV set the steel-wheel record in 2007, reaching 357 mph.



In 1964, Japan's Shinkansen, or bullet train, became the first commercially operated high-speed train. Today the system carries more than 300 million passengers a year.

fig_05



OUR WORLD NOW FACES PROFOUND CHALLENGES, MANY BROUGHT ON
BY INNOVATION ITSELF.²⁶



Rebuilding

If humanity desires to be a regular member of nature's system we must play by Her rules, understand the limitation of resources, and be willing to adapt to the context in which we live. As it stands right now, we are killing ourselves. Humanity has pulled so far away from natural cycles that we must rely on artificial resources and destructive behavior in order to sustain our blind and selfish lifestyle. Our planet will rearrange itself as necessary in order to preserve an overarching system. At that point, nature's desire for self-preservation will override our own. "Reaching our limits, then, if we choose to admit them to ourselves, may be an opportunity for us to leap to a new phase of coping, in which we adapt to the Earth rather than the other way around."²⁷ If we do not find a way to become more symbiotic with nature soon our world will reach a tipping point where it is beyond saving.

"The twentieth century will be chiefly remembered by future generations not as an era of political conflicts or technical inventions, but as an age in which human society dared to think of the welfare of the whole human race as a practical objective." – Arnold J. Toynbee, English historian (1889-1975)²⁸

The main point behind Toynbee's comment is that a civilization is a collective and that people must work together to obtain a level of achievement. Additionally, the well being of that "civilization depends on its ability to respond creatively to challenges,"²⁹ and to make wise decisions when dealing with adversity. This will be the defining moment of the current generation.

The initial divergence of human behavior from environmental systems came from our intelligence, our ability to manipulate the system. We were smart enough to do as we pleased, but not smart enough to fully realize the ramification of our actions in the greater picture. If this is the trait, our mental capacity, that sets humans apart from animals it can and should be the trait that is the greatest benefit instead of the greatest hindrance. "Let's use our ingenuity to stay here; to become, once again, native to this planet."³⁰ To be on par with other organisms within an environment, we simply have to be willing to adapt as context changes instead of fighting inevitability. Yet humans are the most powerful creature on this planet and we should hold ourselves to a higher standard. Through our intelligence we can perceive changes and new conditions before they happen, which enables us to be *more* in tune with our environment, to be an even stronger fit into any microclimate.

Back in the 1960s John Habraken believed that "architecture required a new set of design principles that actively supported the probability of change."³¹ This is not a new issue. People have been attempting to realign our modern way of life since life was modern, and to continually ignore problems for whatever reason only compounds the issue. We have the ability to do the exact opposite.

Pro-active decision making stems from an ability to anticipate. Such futurists as Stephen Hawking and Buckminster Fuller used mathematical and scientific methods to determine probability and correlations between components of data in order to make projections on what was most likely to occur in a given situation. Anticipation, from a very structured application, comes from examining and understanding historical trends.³² There is nothing mystical or unusual about anticipation and being pro-active, as we do it constantly in our daily lives. A person uses soap while taking a shower. They are running out of soap. Without soap they will just get wet in the shower instead of clean. They plan to continue the bathing process, so they buy more soap before they run out – a simple act of anticipation. Dealing with larger, world problems the process is even more scientific and just as analytical.

ORGANISMS THAT LIVE IN CONSTANT ENVIRONMENTS GENERALLY HAVE A NARROW RANGE OF CONDITIONS FOR VIABILITY, WHEREAS THOSE THAT ENDURE MORE VARIED ENVIRONMENTS HAVE EVOLVED MECHANISMS TO TOLERATE WIDER RANGES.³³

Humans have already proven to be quite capable of inhabiting various living conditions and environments. But within the human race “the most fit organisms flourish and the less fit fail to contribute progeny to the next generation. This process selects a better-adapted subset of the population.”³⁴ People who refuse to adapt are not necessarily going to die off, but those who are more willing to adapt will certainly obtain the advantage. By constantly being flexible, people will be more attuned to changes occurring around them and provides for a greater harmony with the environment as context changes. “The more our world looks and functions like this natural world, the more likely we are to be accepted on this home that is our, but not ours alone.”³⁵ We can continue to force the Earth to adapt to us, with growing consequences, or we can learn the natural rhythm of our environment and move away from being isolated individuals.

SOMATIC ADAPTATIONS INCLUDE THE PHYSIOLOGICAL, BEHAVIORAL, ANATOMICAL, AND DEVELOPMENTAL CHANGES THAT TAKE PLACE WITHIN A GENERATION, ARE MADE IN RESPONSE TO ENVIRONMENTAL CHANGES, AND ARE DIRECTED TO THE ORGANISM'S IMMEDIATE BENEFIT.³⁶

A return to natural systems empirically concludes that since environmental context is constantly adjusting itself that we must follow suit and be capable of adaptation as well. The important thing to remember in this process is that this change isn't about generating something new and foreign. Rather the idea is to respond to precisely what is there, an environmental situation that already exists.³⁷ Furthermore, one solution to the same type of problem shouldn't look the same way in every application. An American rail system will not be the same as in France or Japan as the current infrastructure is quite different. Responding to environmental conditions requires taking cues from local signals and context.³⁸

Part of this response to the environment in which we live is understanding the limitations. Every system has rules and boundaries, from governmental laws to gravity and the laws of physics. Similarly, architecture must operate and function with restrictions such as code, zoning, and a general union of space and program. In our consumption of resources, we need to be just as aware of the limitations in order to work effectively within the system instead of trying to break the system down. There are ways to bend and adjust restrictions within all systems, but there are always consequences for pushing too far.

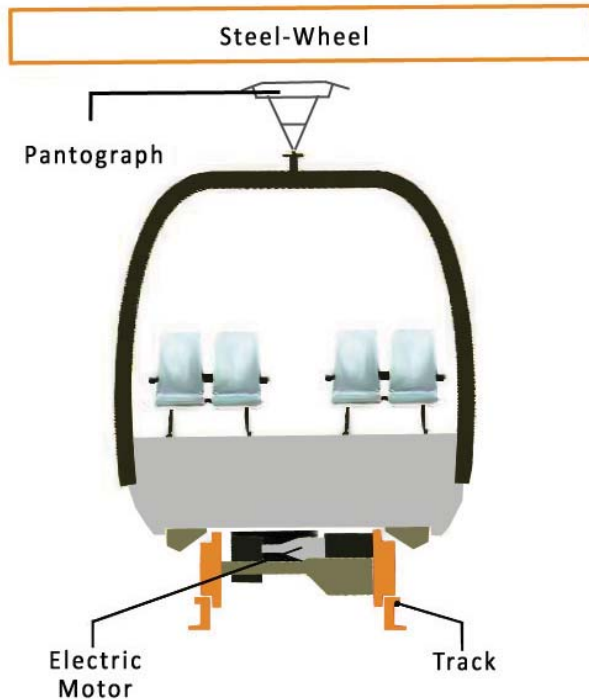


Project Proposal

To review the afore mentioned analysis, there are three main points being argued. It is first, and foremost important to understand the environmental context in which we live. The term 'somatic' additionally addresses the interrelation of how our behavior affects the system as well as how a body responds to the environment. From that understanding, in order to maintain a more stable system, humans can anticipate changes that are occurring and the potential impact they will have later on. To be truly pro-active, there must of course be action. The most critical component, after all the information is understood, is to *respond* to contextual change and *adapt*.

With the analysis of the relationship between supply and demand, it is understood that the supply of various resources are finite. Our way of life, particularly the way we move, is limited. In order to be pro-active with change, the demand for a new system needs to be the catalyst. Current examples in business are as follows: If a developer is making a new suburb it will happen. If one design firm passes due to ethical qualms, rest assured another company will gladly step in and make money. If a car manufacturer refuses to make SUVs along the same grounds, another company will be more than happy to absorb the available revenue. This is the same system (acknowledging context) in which to operate, only instead of playing the supplier role, the idea is to rethink relationships and function on the side of the demander.

Since the greatest impact on the structuring of our built environment is the way people move, the final proposal is to develop a facility that impacts our movement infrastructure. The automotive industry has proven to be a broken system. Analysis has shown that mass transit, particularly rail, is exceptionally more efficient. Rail demands fewer resources to maintain, and thereby a potentially more sustainable system. However, resources must be acquired to develop the infrastructure. "Instead of disposing of waste, think about how to use it as an input. The goal is no waste generation at all. Apply the intelligence of nature to human needs. Waste = food."³⁹ In order to uphold the 'waste equals food' mantra, the old system of cars will



Electric Power

Overhead lines supply steel-wheel trains with 12 to 25 kilovolts of power, which is transmitted via an articulated arm known as a pantograph.

Motor

High-speed trains use AC traction motors and mechanical transmissions similar to those found in most electric trains.

Track

Wheel flanges lock trains to the rails. High-speed trains must run on tracks with wide curves or employ a hydraulic tilting mechanism.

be used to fuel the new system of rail. Additionally, this process has to happen now, before absolutely necessity, so that the new infrastructure is in place for pro-active adaptation to occur.

Schnitzer Steel Inc. of Portland will be the chosen business to operate this new facility.

fig_06

“ THOUGH ENVIRONMENTAL POLICY MAKERS HAVE FOCUSED ON THE GROWING GLUT OF GARBAGE AND POLLUTION, MOST OF THE ENVIRONMENTAL DAMAGE IS DONE BEFORE MATERIALS EVER REACH THE CONSUMER. JUST FOUR PRIMARY MATERIALS INDUSTRIES – PAPER, PLASTICS, CHEMICALS, AND METALS – ACCOUNT FOR 71 PERCENT OF THE TOXIC EMISSIONS FROM MANUFACTURING IN THE UNITED STATES, ACCORDING TO THE RESEARCHERS. FIVE MATERIALS – PAPER, STEEL, ALUMINUM, PLASTICS, AND CONTAINER GLASS – ACCOUNT FOR 31 PERCENT OF US MANUFACTURING ENERGY USE.”⁴⁰

significance of steel

[material]

As a material, steel has had a dramatic impact on the way we build since the Industrial Revolution. Being relevant in both compression and tension, steel has enabled both immense and dynamic feats to be constructed. Due to the smelting process and melting the material down, steel can be crafted into any possible shape that we can create a mold for. Additionally, due to the ability to remelt steel it can be continually reused and refined instead of being thrown out.

[business]

Steel and the supporting manufacturing processes comprise a significant majority of Portland's industrial sector. There is a strong market for the material as well as access.

Schnitzer as influence

[business influence]

Started in 1906 as a single man operation buying and reselling steel, Schnitzer Steel Inc. has since grown to a nationwide corporation with strong international ties. As of 2007 Schnitzer has also become a member of the Forbes 1000 with an annual revenue of \$2.57 billion. This means that as a company, Schnitzer has tremendous clout and influence within the steel industry, allied company relations, and the ability to make a tremendous impact.⁴¹

[environmental commitment]

From ocean reefs and river ways around docks, to meadows and wetlands, Schnitzer Steel is committed to maintaining and promoting a healthy environment. Countless man hours have been donated to restoration projects in addition to regular business practices. Whenever possible the company utilizes environmentally conscience methods.⁴²

[community involvement]

A member of the Portland community for over one hundred years, Schnitzer steel has been a strong, ongoing supporter of the arts with the Arlene Schnitzer Concert Hall being a cornerstone for music and culture.

adaptability

[diversifying economies] - business

From a business standpoint, Schnitzer certainly understands the importance of diversification in order to stay productive, efficient, and on top of their industry. Having difficulties with international shipping, in 1963 the company simply expanded to incorporate Lasco Shipping – their own freightliners. Since then, Schnitzer has expanded at a tremendous rate through joint business ventures and a willing to adapt to fit other markets. The new proposed facility will further this ideal by shifting a business involved with the manufacturing economy into the movement economy. Schnitzer is currently utilizes automobiles as resources, but has yet to fully move into the movement economy itself.

[developing infrastructure] – culture

As the automobile was made affordable and widely available in America, restrictions of movement were lessened. People now had the freedom to explore and make quicker trips away from the home. Soon suburbia was developed since cities were deteriorating and people could still commute into work without terrible difficulty. Unfortunately since then Americans have been told that they want to have their own little slice of the country – and they can because their car grants them complete freedom to go where they want, when they want. As a young country of abundance, America hasn't been restricted by space like older parts of the world. Land, coupled with the personal automobile, enabled our built environment to expand exponentially. Yet we are slowly discovering that our horizon is limited.

Public transportation is dramatically more efficient than a fleet of individual cars. Mass transit produces dramatically less pollution per person than cars, requiring less fuel overall and releasing less CO2 into the atmosphere. Additionally mass transit requires significant less space to operate. Vehicles demand ridiculous amounts of space to park at home, at work, and at all other destinations. On top of that, cars on average spend 90% of their time sitting unused. The main snag is the lack of infrastructure, and it is the classic problem of the can opener and the can. No one will ride a bus or train system if it is infrequent or inadequate, yet an immense system cannot be financed if no one rides it. A major cost for public transportation is the distance that needs to be covered; requiring more busses / trains, more tracks, and more fuel. This makes it harder to reach all the places need to go and make an effective system. The biggest component to then

contest with is density. We don't necessarily need to build smaller by any means, only smarter.

[wasted time] - space

Under manufacturing economies in particular, as well as the whole world at large, it is important that 'waste=food'. As in nature, all waste material from both plant and animal are used by another component of that system as a food or energy source. In order to return to, and be a member of, this system architectural solutions should consider how waste can become useful. This does not apply to physical materials alone, but also the efficiency use of space. Furthermore time can be a wasted commodity, as any moment a building is unoccupied and empty it is a waste of both time and space.

To maximize efficiency and minimize waste, the proposed facility will be designed to incorporate adaptability over a regular time cycle by having spaces that are capable of multiple functions throughout the day.



Case Studies

[Igus]

Since the Industrial Revolution large manufacturing plants and material processing centers have utilized large, open-plan layouts to be capable of adapting to new and different equipment or the reconfiguration of equipment to address different needs and products. Currently this approach continues as “contemporary industrial buildings take this form to allow for changes in the production-line process as manufacturers respond to new product demands or the introduction of new machinery and processes.”⁴³ Expanding further on that concept, the Igus factory in Cologne, Germany has been designed by Nicholas Grimshaw and Partners to incorporate even more flexibility than before. The factory for the family-owned business specializes in injection-molding tools. These components have a wide range of application, each with a specific use, which consequently demands adjustments in the production process. Depending on what is specifically being made, the interior of the factory was designed to accommodate change. As such, a very flexible approach to production was developed “by changing the process frequently to increase efficiency.”⁴⁴

To enable this shifting program, the design firm created column-free bays 223 foot square with a modular building system. Now with an open space available, Grimshaw turned to the program occurring in that space. The interior aluminum cladding is easily demountable allowing individual panels or even whole walls to be change, adjusted, or completely relocated anywhere. Additionally administration and office facilities were built into elevated steel pods that too can be rearranged as necessary. To do so, the architect utilized existing means and applied air-supported, theatre/film scene-shifting trolleys, successfully reapplying a current infrastructure to a new use.⁴⁵

The driving philosophy behind this factory project was that “adaptable architecture is necessary where more complex building types must respond to change.” This is especially applicable to buildings with unpredictable or varied functions.⁴⁶ What is also important to remember is that this concept doesn’t apply to just factories

and warehouses. Art exhibitions, medical facilities, learning environments, research, and entertainment industries are all applicable recipients of this type of model, but in reality flexible architecture can and should be considered for all projects. As it was established before, the context in which we live is constantly adjusting, so in many ways all of our buildings can have unpredictable or varied uses. While one adaptable building might cost more than a single use building initially, it is still more effective than two separate single use buildings and additionally retains a longer lifespan as the facility can be applied to something new. This approach provides a key strategy in the obtainment of sustainability since the better a building can adapt and the longer it serves an appropriate use, it doesn't need to be replaced with new materials and resources.⁴⁷



fig_07



fig_08

[Ford Rouge River]

Established in 1917, the Ford Rouge River plant near Dearborn, Michigan was a national icon of achievement and pride. Always moving forward with the times and adjusting to the context in which it was contained, the factory even established a 'disassembly line' during the depression, "a striking illustration of 'waste equals food' and an early step toward the reuse of industrial materials".⁴⁸ Since then, the Rouge River facility fell into disrepair as industry took over in full swing. Automated systems slowly reduced the need for manual labor, while at the same time polluting the environment and degrading the surrounding region. Chairman Bill Ford had the easy road before him with the option of simply leaving the destroyed land behind and finding a new, clean location to start a better facility. Instead, the company was committed to maintaining the existing site and to invest in the company's history, the employees, the next generation and especially the environment.⁴⁹ In 1999 the decision was made to invest in a \$2 billion renovation to give the 600 acre production facility the improvements it desperately required.

Environmental and sustainable strategies were of utmost importance in the redesign. An important question asked was, 'would you feel comfortable having your family visit, to have your children play in the fields and around the creek during a company picnic?' The project outlook not only took the next generation of families and residents in mind, but also that of local wildlife. Because of that awareness cleaning up the soil wasn't enough, instead they developed proactive terms like 'creating healthy soil'.⁵⁰ From a moral and ethical standpoint, being responsible stewards, establishing a healthy work environment, and establishing a long term sustainable solution greatly outweighed the typical short sighted approach of cutting costs at the immediate moment.

Manufacturing and industrial production didn't have to be so degrading and detrimental to the natural and work environment. The Rouge River plant strove to create and encourage 'clean industrial' on a large



THIS IS NOT ENVIRONMENTAL PHILANTHROPY; IT IS SOUND BUSINESS, WHICH FOR THE FIRST TIME, BALANCES THE BUSINESS NEEDS OF AUTO MANUFACTURING WITH ECOLOGICAL AND SOCIAL CONCERNS IN THE REDESIGN OF A BROWNFIELD SITE.

– FORD CHAIRMAN BILL FORD ⁵¹

scale. As a component to this goal, the Rouge River facility helped promote Ford's International Standards of Organization (ISO) environmental certifications. Taking this standard further, Ford used its status as a powerful and influential company to mandate that of their suppliers also possess ISO certification and to "undertake a proactive investigation of environmental interests and concerns rather than relying on regulators to moderate it."⁵² In the current market of supply and demand, if a business doesn't provide the supply for a demand, regardless of how obscene or irrational it might be, rest assured someone else will come in to make the available profit. On the manufacturing side Ford worked the same system, but on the other side – creating a demand and forcing others to help supply a positive change.

Part of the renovation improvements include an innovative air delivery system, abundant natural day lighting, and improved exterior shading integrated with local vines. The most significant component was the development of the world's largest green roof covering 454,000 sq ft, providing habitat for, instead of displacing, numerous birds, an increased thermal membrane, and an extended life due to UV protection.⁵³ Additionally the green roof manages stormwater runoff and was a component of the Phytoremediation system that employs local plants to cleanse the soil of contaminants.⁵⁴

[Project Data]

Project Name: Ford Motor Company's River Rouge Plant

Year: 2003

Owner: The Ford Motor Company

Location: Dearborn, MI, USA

Building Type: Industrial

Greenroof Type: Extensive, Test/Research

Greenroof System: Custom

Roof Size: 454,000 sq.ft.

Roof Slope: 1.5%

Access: Accessible, Private



fig_09

[Designers/Manufacturers of Record]

Architects: William McDonough + Partners

Vegetated Mats: Xero Flor

Environmental Consultant: ARCADIS

Construction Manager: Walbridge Aldinger

Research Support: Michigan State University, Department of Crop & Soil Science and Department of Horticulture

Stormwater Consultant: Cahill Associates

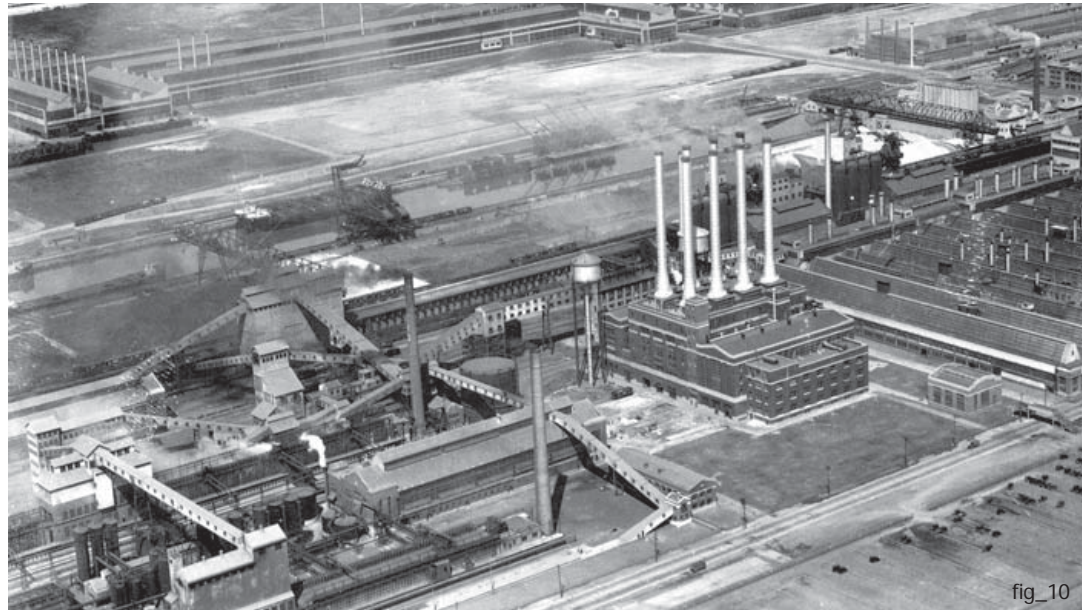
Vegetation Consultant: Wildtype Native Plants

Plant Suppliers: Hortech, Inc. and Walters Gardens, Inc.

Waterproofing: Siplast

Roof Membrane Installer: Christen, Detroit

Drainage: Colbond, Inc.⁵⁵



fig_10



fig_11



fig_12

[SSI]

Part of understanding programmatic requirements involves knowing what technical equipment is necessary for processing. This machinery largely dictates the amount of space required as well as an understanding of the potential energy draw of this facility.

Shredding Systems Inc (SSI) is a leading industry provider that has specialized shredding devices for any kind of material. Based in Wilsonville, Oregon, this company has not only developed a successful and widespread business, but additionally has done so on the very basis of recycling. Due to the close proximity, SSI could be a valuable asset to the overall programmatic process and not simply a reference. The machinery by itself is exceptionally quiet and efficiently shreds, rather than simply compress, difficult or culmination of materials thus preparing them for processing and reuse. Shredding is especially beneficial when dealing with automobiles because non-metal objects are easier to remove, thus increasing the quality of materials produced. Furthermore, feeding smaller pieces of steel into the furnace helps to speed up the remelting process, creating more efficient use of time and money.⁵⁶

While a wide range of shredders are available for multiple functions, PRI-MAX™ provides the highest processing capacity. Depending on materials and model type, this shredder is capable of processing up to 150 tons per hour, with a volume reduction of 80%. It is able to handle construction and demolition debris, solid metals and other large scrap. Furthermore, the machinery is designed to last longer with lower operational and maintenance costs. The accompanying chart expands on dimensions and capabilities:

Model	<i>PR-560</i>	<i>PR-590</i>	<i>PR-770</i>	<i>PR-2000</i>	<i>PR-4000</i>	<i>PR-6000</i>
Production rate	1-10 tons/hr	5-20 tons/hr	10-40 tons/hr	10-30 tons/hr	30-80 tons/hr	60-150 tons/hr
# of shafts	1	1	2	1	2	2
Diesel Power	50/120HP	120HP	250HP	260HP	540HP	700HP
Electric Power	50/100HP	100HP	200HP	200HP	400HP	500HP
<i>Infeed opening</i>						
Length	67"	108"	112"	146"	146"	224"
Width	51"	56"	81"	83"	79"	94"
Height	50"	50"	30"	36"	28"	43"
Capacity	3.4 yd3	6.1 yd3	5.3 yd3	5.2 yd3	6.4 yd3	13.1 yd3
Active cutting zone Length	64"	105"	73"	94"	94"	129"
Width	32"	32"	57"	39"	69"	82"
Area	14 ft2	23 ft2	30 ft2	25 ft2	45 ft2	73 ft2
Cutting table Cutter thickness	4"	4"	3"	3"	3"	3"
Cutting sweep diameter	29"	29"	27"	35.5"	35.5"	43"
Cutting table weight	19,000 lbs.	25,000 lbs.	19,500 lbs.	24,000 lbs.	36,000 lbs.	62,000 lbs.

This tough, durable equipment is also safe, quiet and easy to operate. Mobility options are also available, allowing for adjustments within the processing facility.⁵⁷

If the resulting pieces of material need to be refined further, the Quad™ shredder is designed to deal with tires, metal and electronic scrap. The accompanying chart expands on dimensions and capabilities.⁵⁸

Model	HP Range	Cutting Chamber*	Hopper Opening
<i>Q55</i>	50-60HP / (38-45kW)	36" x 40"	56" x 51"
<i>Q70</i>	80-100HP / (60-75kW)	44" x 52"	72" x 67"
<i>Q85</i>	120-150HP / (90-113kW)	54" x 52"	81" x 79"
<i>Q100</i>	250-400HP / (188-300kW)	62" x 63"	86" x 87"
<i>Q140</i>	400-600HP / (300-450kW)	82" x 75"	113" x 108"
<i>Q160</i>	600-1,000HP / (450-750kW)	101" x 101"	133" x 120"

Further discussion would be necessary to establish the details on the processing capabilities, but it is important to note that SSI shredders are available in both hydraulic and electric models. Electric versions contain a little less power, but are easier to maintain and operate, plus they are cheaper and more energy efficient. Hydraulic models are recommended for tougher and more difficult materials, as well as the higher probability of unknown materials being mixed into the processing.⁵⁹

The employees of SSI are always looking for a new challenge, so if a larger, custom device is required, they are certainly willing to work towards a design solution.



fig_13



fig_14



fig_15



fig_16

[Electric Arc Furnace]

An Electric Arc Furnace (EAF) is especially useful when dealing with scrap metal. The materials typically used are light-gauge steel (especially cars) layered with heavy melt (large beams) with direct reduction iron (DRI) used to maintain a chemical balance and consistency. Scrap to be melted down is carefully arranged in large baskets and loaded into the furnace. To be more energy efficient, baskets move to a scrap pre-heater which utilizes the furnace heat to the next batch of scrap and recover energy.

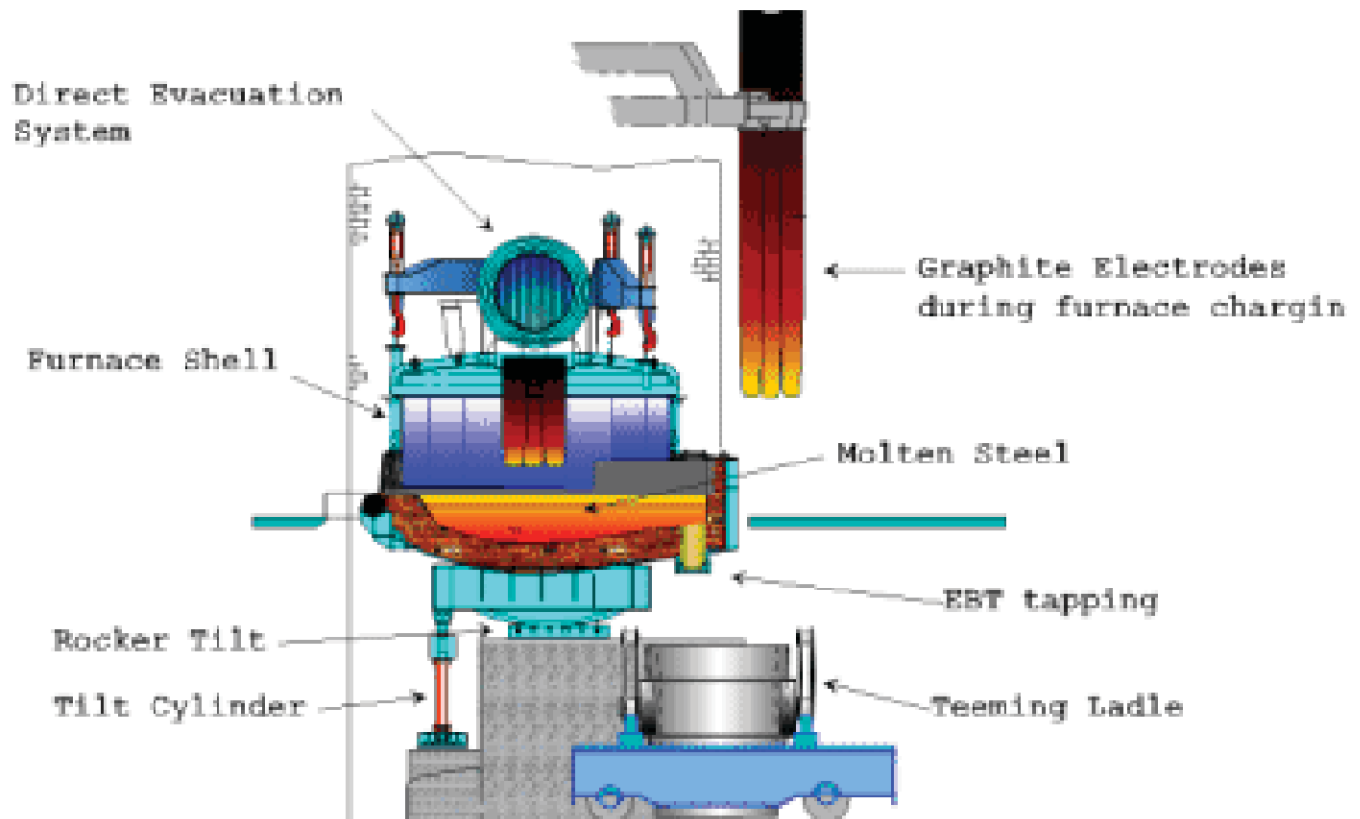
The entire furnace is on a rotator connection that enables it to tilt to the side and pour out the resulting molten metal. A small portion of metal is left in the bottom of the EAF in order to help the next batch, effectively reducing energy consumption and generally speed the process. A drawback to this process is that it makes charging the next batch somewhat dangerous as solid scrap added to the furnace displaces the liquid at the bottom upward which can ignite any dust or grease on the added scrap. However there are ways of containing resulting fireballs, an efficient option is to pre-heat the next batch continually and charge the metal with the excess heat from the forge.

Tapping the batch is the point in the process where electrodes are applied to the scrap. Low voltage is used initially until the electrodes bore down to the heavy melt layer. The electric arcs are now protected by the scrap metal and higher voltages can be used without damaging the shell of the furnace. Oxygen can additionally be injected into the process to speed the combusting of the steel and accelerate the scrap meltdown. Furnaces can be as large as 400-tonne, but a medium 90-tonne can melt a batch in roughly 60-70 minutes.

The major benefit to using an EAF over conventional blast furnaces and other methods is the large reduction of energy required per unit weight of steel. New steel can be crafted from 100% recycled stock and the

process is exceptionally flexible as EAFs can be rapidly started and stopped, unlike blast furnaces that must be maintained constantly, enabling production to shift and adapt to demand. EAFs additionally enable the operation of mini-mills and smaller, localized facilities. While some plants have the capacity to generate as many as 3,000,000 tons annually, a typical range is between 200,000 and 400,000 tons.

Environmental concerns for operating an EAF are reduced to dust and off-gas production, cooling water demand and a high electricity demand. Yet these concerns can be addressed with relatively straightforward sustainability practices.



fig_17



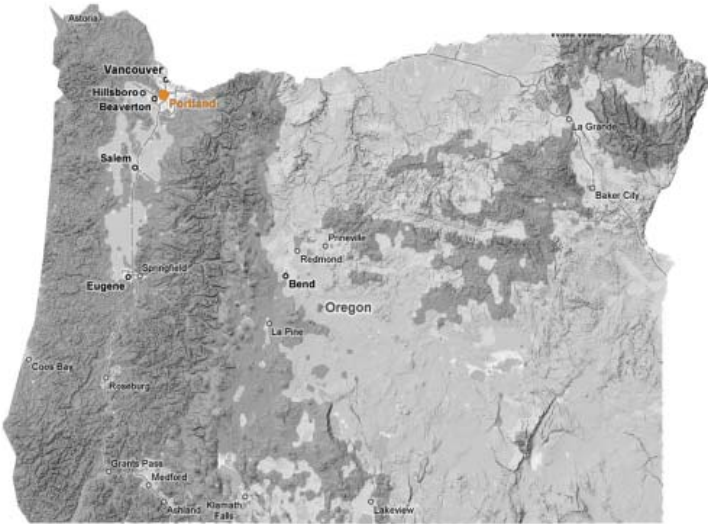
fig_18



fig_19



Site Analysis



LAT: 45.5 N
 LONG: 122.7 W

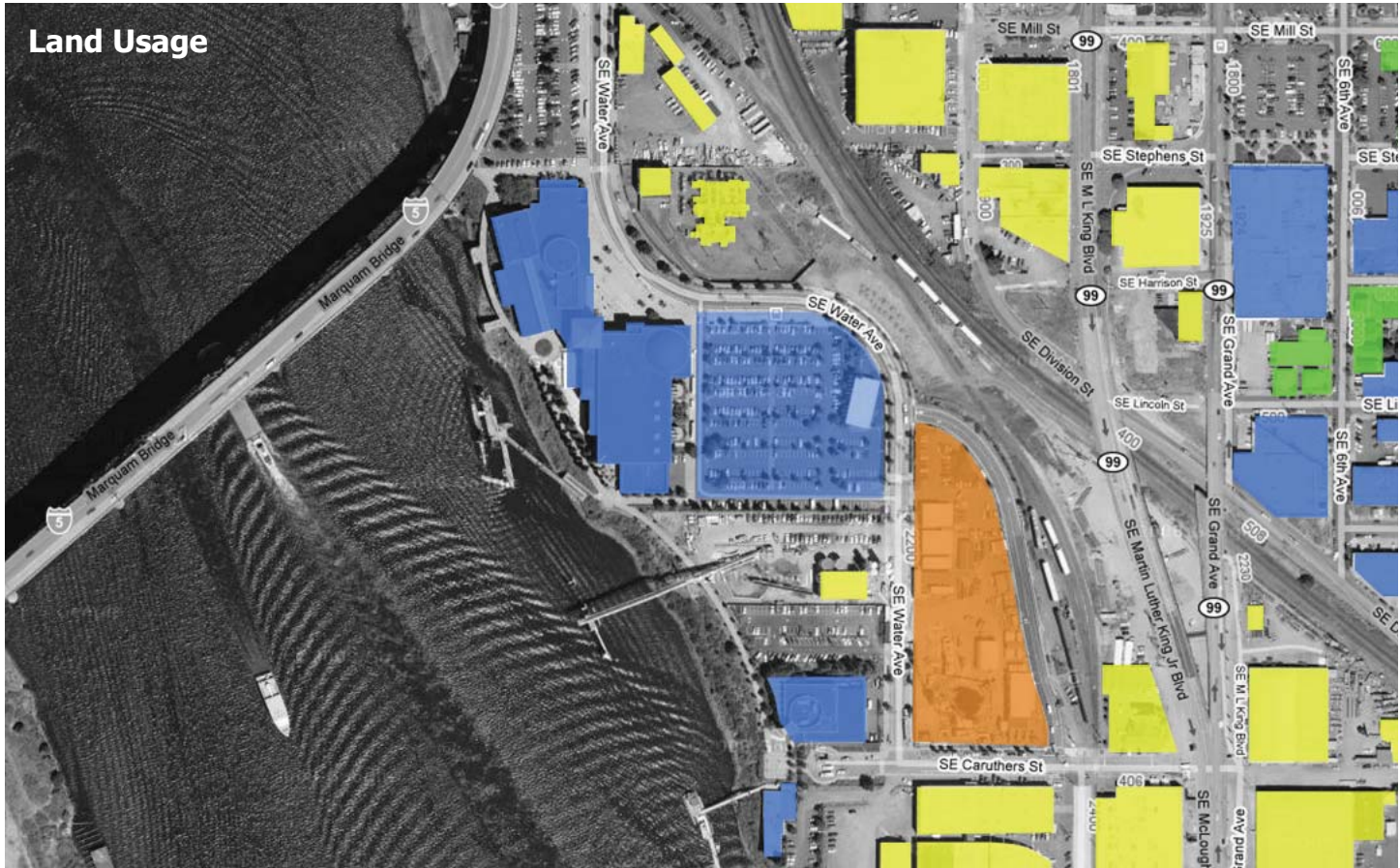




fig_21

■ site outline

Land Usage



- orange site outline
- blue commercial
- yellow industrial
- green residential

Circulation



- site outline
- automobile
- rail
- pedestrian

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
avg. max. temp (°F)	42	51	52	56	66	71	80	80	77	62	52	45
avg. min. temp (°F)	33	37	36	39	48	49	54	57	50	44	38	35
avg. precipitation (in)	5.95	2.77	4.35	2.82	1.80	1.37	0.22	1.19	0.66	1.75	5.33	9.65
avg. wind speed (mph)	11	8	6	6	4	4	3	3	4	5	7	8
avg. wind gust (mph)	26	24	22	22	18	21	23	18	22	24	25	23
sum heating degree days (65 base)	838	587	636	521	259	180	17	22	83	367	600	760
sum cooling degree days (65 base)	0	0	0	0	31	145	86	137	44	0	0	0
annual precipitation (in)	37.86											
annual heating degree days	4870											
annual cooling degree days	443											

fig_22

[Demographics]

Portland resides in the Multnomah County and the following data comes from the 2000 census.

79.2% of the population is white

34% of the population is between 25 and 44 years of age⁶⁰

85.6% of the population has at least a high school diploma⁶¹

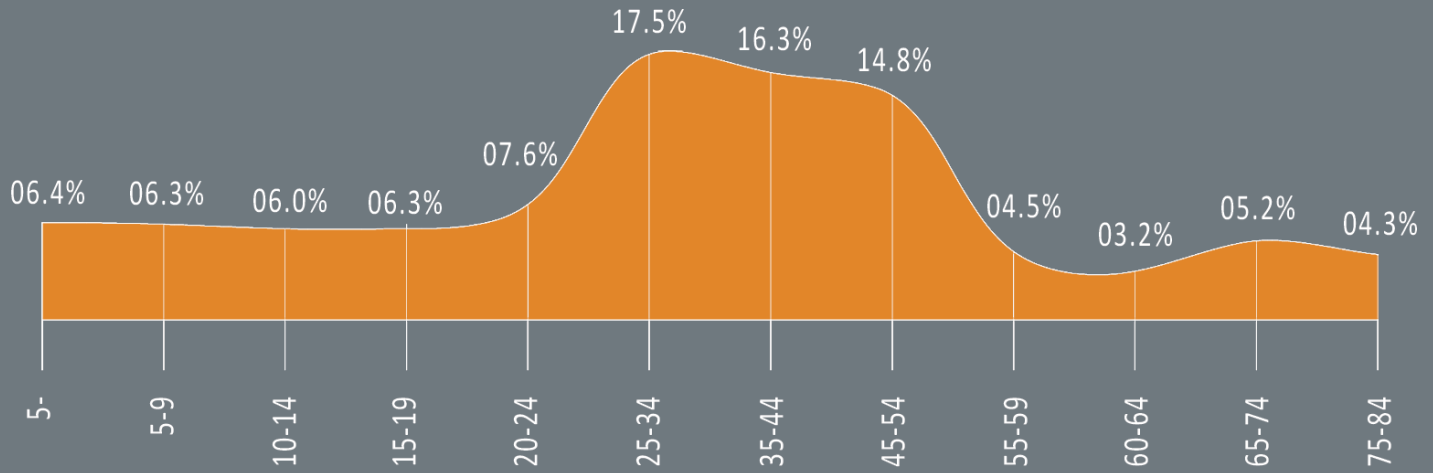
With a population of 660,500 and an unemployment rate of 4.4%,

77.6% drove to work, 65.6% commuting alone – roughly 473,000 vehicles daily

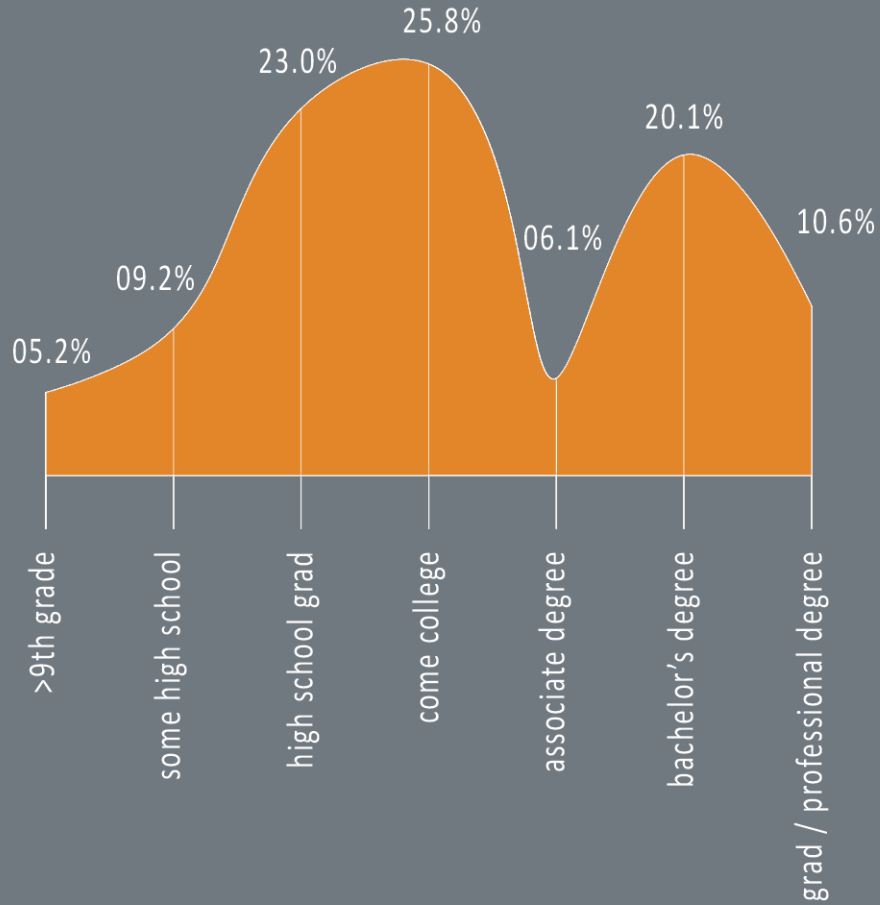
Only 18% walked, biked, or took public transportation.⁶²

The demographic area to the east of the proposed site (around Hawthorne and Division) is predominantly politically liberal, involved in the creative and fine arts, physically active, and lower-middle / middle class economically.

Age Distribution



Education Level



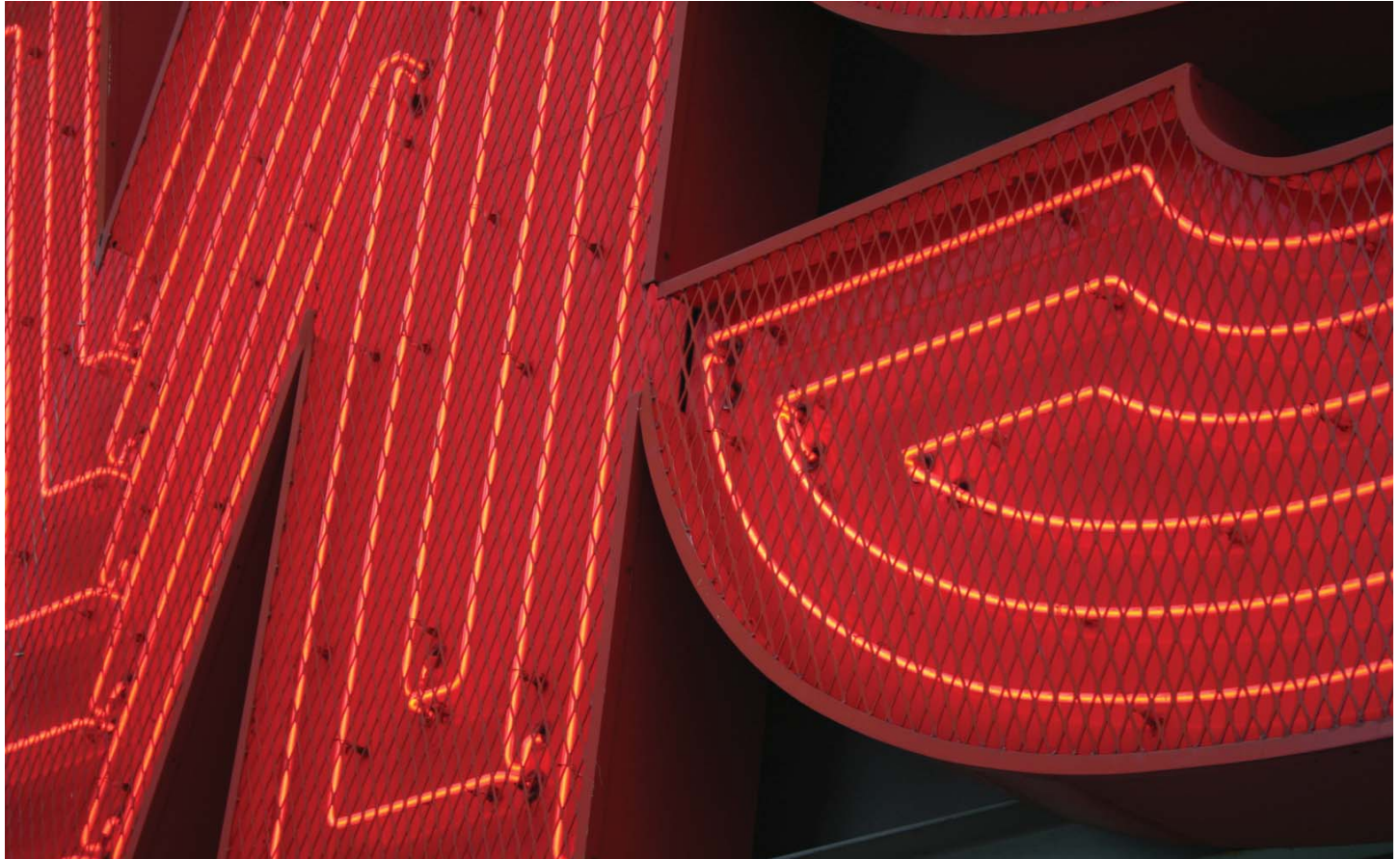




















LIFE CAN'T PUT ITS FACTORY ON THE EDGE OF TOWN;
IT HAS TO LIVE WHERE IT WORKS.⁶³



Programming

Industrial

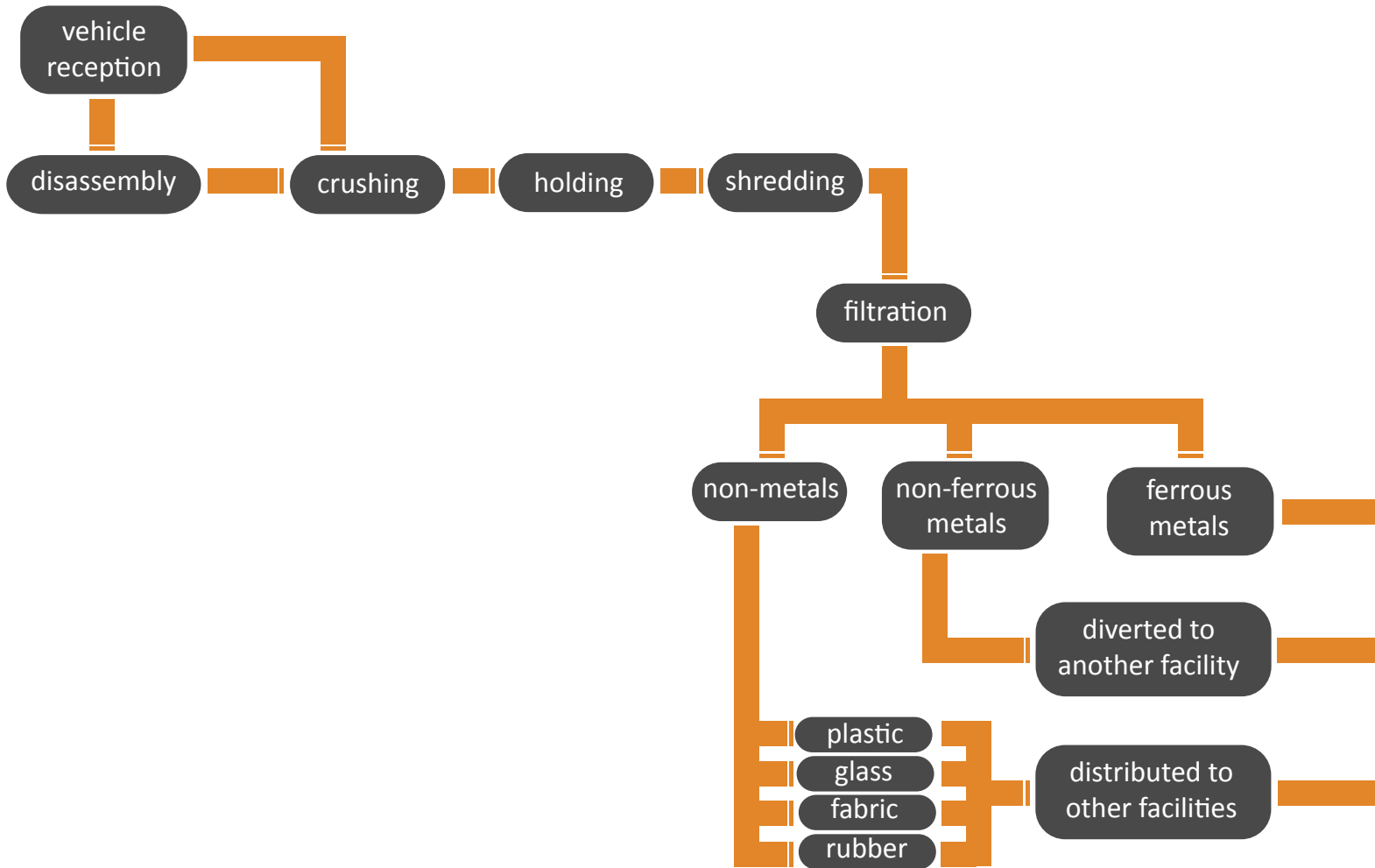
vehicle reception	2700
vehicle holding	3100
vehicle disassembly	3600
vehicle shredding	2200
material filtration	3600
material storage	600
forge	1100
fabrication	1100
product storage	5000
distribution	2700
employee area	1100
	26,800

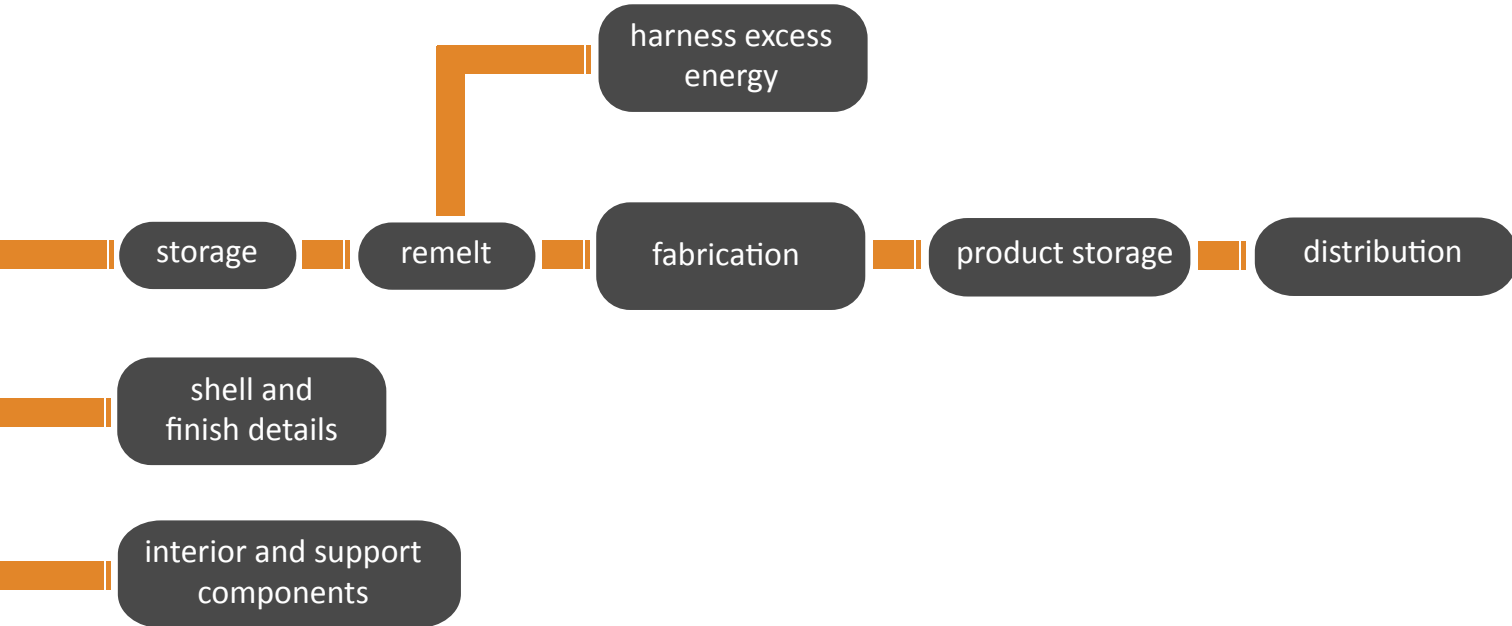
Private

offices	950
design center	1450
conference room	1000
bathroom	480
	3880

Public

venue space	2800	34,440 subtotal sf
catering	480	x15% circulation
bathroom	480	
	3760	39,600 total sf





Code Review

GENERAL PROJECT INFORMATION

Project: Recycling and Arts Center
Location: Portland, Oregon
Client: Schnitzer Steel
Applicable Code: IBC 2006

OCCUPANCY REQUIREMENTS

302.1 General

Structures or portions of structures shall be classified with respect to occupancy in one or more other groups listed below. A room or space that is intended to be occupied at different times for different purposes shall comply with all the requirements that are applicable to each of the purposes for which the room or space will be occupied.

303.1 Assembly Group A

Assembly Group A occupancy includes, among others, the use of building or structure, or a portion thereof, for the gathering together of persons for purposes such as civic, social or religious functions; recreation, food or drink consumption; or awaiting transportation.

[A-2]

Assembly uses intended for food and/or drink consumption including, but not limited to, the following:

banquet halls / night clubs / restaurants / taverns and bars

[A-3]

Assembly uses intended for worship, recreation or amusement and other assembly uses not classified elsewhere in Group A including, but not limited to, the following:

Art galleries / community halls / exhibition halls / waiting areas in transportation terminals

304.1 Business Group B

Business Group B occupancy includes, among others, the use of a building for structure, or a portion thereof, for office, professional or service-type transaction, including storage of records and accounts. Business occupancies shall include, but not be limited to, the following:

Electronic data processing / laboratories: testing and research / motor vehicle show rooms / professional services (architects, attorneys, dentists, physicians, engineers, etc.) / training and skill development not within a school or academic program

306.1 Factory Industrial Group F

Factory Industrial Group F occupancy includes, among others, the use of a building or structure, or a portion thereof, for assembling, disassembling, fabricating, finishing, manufacturing, packaging, repair or processing operations that are not classified as Group H hazardous or Group S storage occupancy.

306.2 Factory Industrial F-1 Moderate-hazard Occupancy

Factory industrial uses which are not classified as Factory Industrial F-2 Low Hazard shall be classified as F-1 Moderate Hazard and shall include, but not be limited to, the following:

Bicycles / business machines / electric generation plants / machinery / metals / refuse incineration

306.3 Factory Industrial F-1 Low-hazard Occupancy

Factory industrial uses that involve the fabrication or manufacturing of noncombustible materials which during finishing packing or processing do not involve a significant fire hazard shall be classified as F-2 occupancies and shall include, but not be limited to, the following:

Foundries / metal production (fabrication and assembly)

311.1 Storage Group S

Storage Group S occupancy includes, among others, the use of a building or structure, or a portion thereof, for storage that is not classified as a hazardous occupancy.

311.3 Low-Hazard storage, Group S-2

Includes, among others, buildings used for the storage of noncombustible materials such as products on wood pallets or in paper cartons with or without single thickness divisions; or in paper wrappings. Such products are permitted to have a negligible amount of plastic trim, such as knobs, handles, or film wrapping. Storage uses shall include, but not be limited to, storage of the following:

Dry cell batteries / electrical motors / glass / metal parts / metals / parking garages (open or closed)

[TABLE 503] ALLOWABLE HEIGHT AND BUILDING AREAS

<i>Occupancy</i>	<i>Type I (A)</i>	<i>Type I (B)</i>	<i>Type II (A)</i>	<i>Type II (B)</i>
A-2	UL / UL	11 stories / UL	3 stories / 15,500 sf	2 / 9,500
A-3	UL / UL	11 / UL	3 / 15,500	2 / 9,500
B	UL / UL	11 / UL	5 / 37,500	4 / 23,000
F-1	UL / UL	11 / UL	4 / 25,000	2 / 15,500
F-2	UL / UL	11 / UL	5 / 37,500	3 / 23,000

503.1.1 Special Industrial Occupancies

Buildings and structures designed to house special industrial processes that require large areas and unusual heights to accommodate craneways or special machinery and equipment, including, among others, rolling mills; structural metal fabrication shops and foundries; or the production and distribution of electric, gas or steam power, shall be exempt from the height and area limitations of Table 503.

504.2 Automatic Sprinkler System Increase

Where a building is equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1, the value specified in table 503 for maximum height is increased by 20 feet and the maximum number of stories is increased by one story. These increases are permitted in addition to the area increase in accordance with Sections 506.2 and 506.3. For Group R buildings equipped throughout with an approved automatic sprinkler system in accordance with section 903.3.1.2, the value specified in Table 503 for

maximum height is increased by 20 feet and the maximum number of stories is increased by one story, but shall not exceed four stories or 60 feet respectively.

[TABLE 601] FIRE-RESISTANCE RATINGS REQUIREMENTS FOR BUILDING ELEMENTS (hours)

<i>Building element</i>	<i>Type I (A)</i>	<i>Type I (B)</i>	<i>Type II (A)</i>	<i>Type II (B)</i>
Structural frame	3	2	1	0
Bearing walls:				
Exterior	3	2	1	0
Interior	3	2	1	0
Nonbearing walls and partitions:				
Interior	0	0	0	0
Floor construction	2	2	1	0
Roof construction	1.5	1	1	0

[TABLE 706.3.9] BARRIER RATING BETWEEN FIRE AREAS

<i>Occupancy group</i>	<i>fire-resistance rating (hours)</i>
H-1, H-2	4
F-1, H-3, S-1	3
A, B, F-2, H-4, H-5, I, M, R, S-2	2
U	1

[TABLE 1004.1.1] MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

<i>Function of Space</i>	<i>Floor Area in sf per Occupant</i>
Storage areas	300 gross
Assembly w/o fixed seats	
Concentrated (chairs not fixed)	7 net
Standing space	5 net
Unconcentrated (tables and chairs)	15 net
Business areas	100 gross
Industrial areas	100 gross
Kitchens, commercial	200 gross
Parking garages	200 gross
Warehouses	500 gross

1005.1 Minimum required egress width

The means of egress width shall not be less than required by this section. The total width of means of egress in inches shall not be less than the total occupant load served by the means of egress multiplied by the factors in Table 1005.1 and not less than specified elsewhere in this code. Multiple means of egress shall be sized such that the loss of any one means of egress shall not reduce the available capacity to less than fifty (50) percent of the required capacity. The maximum capacity required from any story of a building shall be maintained to the termination of the means of egress.

1008.1.1 Size of doors

The minimum width of each door opening shall be sufficient for the occupant load thereof and shall provide clear width of not less than 32 inches. The maximum width of a swinging door leaf shall be 48 inches nominal. The height of the door shall not be less than 80 inches.

[TABLE 1015.1] EXIT ACCESS TRAVEL DISTANCE

<i>Occupancy</i>	<i>Un-sprinkled [ft]:</i>	<i>Sprinkled [ft]:</i>
A-2 / A-3	200	250
B	200	300
F-1 / F-2	200	250
S-2	300	400

[TABLE 1018.1] MINIMUM NUMBER OF EXITS FOR OCCUPANT LOAD

<i>Occupants:</i>	<i>Min. Exits:</i>
1-500	2
501-1,000	3
>1,000	4

MINIMUM NUMBER OF REQUIRED PLUMBING FIXTURES [TABLE 2902.1]

<i>Occupancy:</i>	<i>WC:</i>		<i>Lavatories:</i>		<i>Fntns:</i>	<i>Other:</i>
	<i>Male:</i>	<i>Female:</i>	<i>Male:</i>	<i>Female:</i>		
A-2 / A-3	1/40	1/40	1/75	1/75	1/500	1 service sink
B	1/25	1/25	1/40	1/40	1/100	1 service sink
F-1 / F-2	1/100	1/100	1/100	1/100	1/400	1 service sink
S-2	1/100	1/100	1/100	1/100	1/1000	1 service sink

Zoning

EG2g [map 3230]

General Employment 2 + River General (Greenway) overlay⁶⁴

Info – 503.823.7526

General Employment zones

The General Employment zones implement the Mixed Employment map designation of the Comprehensive Plan. The zones allow a wide range of employment opportunities without potential conflicts from interspersed residential uses. The emphasis of the zones is on industrial and industrially-related uses. Other commercial uses are also allowed to support a wide range of services and employment opportunities. The development standards for each zone are intended to allow new development which is similar in character to existing development. The intent is to promote viable and attractive industrial/commercial areas.

General Employment 2

EG2 areas have larger lots and an irregular or large block pattern. The area is less developed, with sites having medium and low building coverages and buildings which are usually set back from the street. EG2 zoned lands will generally be on larger areas than those zoned EG1.

River General (Greenway) overlay⁶⁵ [20.05]

- (2) Significant natural and scenic areas, viewpoints and vistas shall be preserved.
- (4) The quality of the air, water and land resources in and adjacent to the Greenway shall be preserved in the development, change of use or intensification of use of land within the Greenway Management Zone.
- (5) Areas of annual flooding, flood plains and wetlands shall be preserved in their natural state to the maximum possible extent to protect water retention, overflow and other natural functions.
- (8) The proposed development, change or intensification of use is compatible with existing uses on the site and the surrounding area.
- (13) Except for water related and water dependent buildings and structures buildings and structures shall be located 30 feet or more upland from the ordinary high water line, unless it can be shown that the parcel size makes meeting this requirement impossible, or significant natural features would be lost if the standard is met. [25 feet from top of bank in some places]
- (16) The development, change or intensification of use shall provide the maximum possible landscaped area, open space or vegetation between the activity and the river.



What follows is the final facility designed for Schnitzer Steel to shred, melt and change cars into rail lines.



[Circulation and Material Processing]

Cars are currently viewed as social status possessions. The perceived image of owning a sleek / fast / powerful and individual machine supercede efficiency / longevity / and practical function. Personal and selfish desires have been labeled as freedoms and hold more influence than science and logic. The blatant disparity in these values has prevented America from continuing to be a truly innovative and progressive world leader.

The proposed facility will redefine the role of the personal automobile - from materialistic consumable goods to that of processable resources.

01 System Entrance

Old cars are brought in on truck bed or train, where a track crane unloads the cars onto a conveyor belt. At times of high influx, an overflow storage is also located in the first bay.

02 Disassembly Yard

Reversing the original construction process, each car goes through four stations where auxiliary components are stripped away: primarily glass / engine block / tires / seats. Bins advance each material once full.

03 Shredding

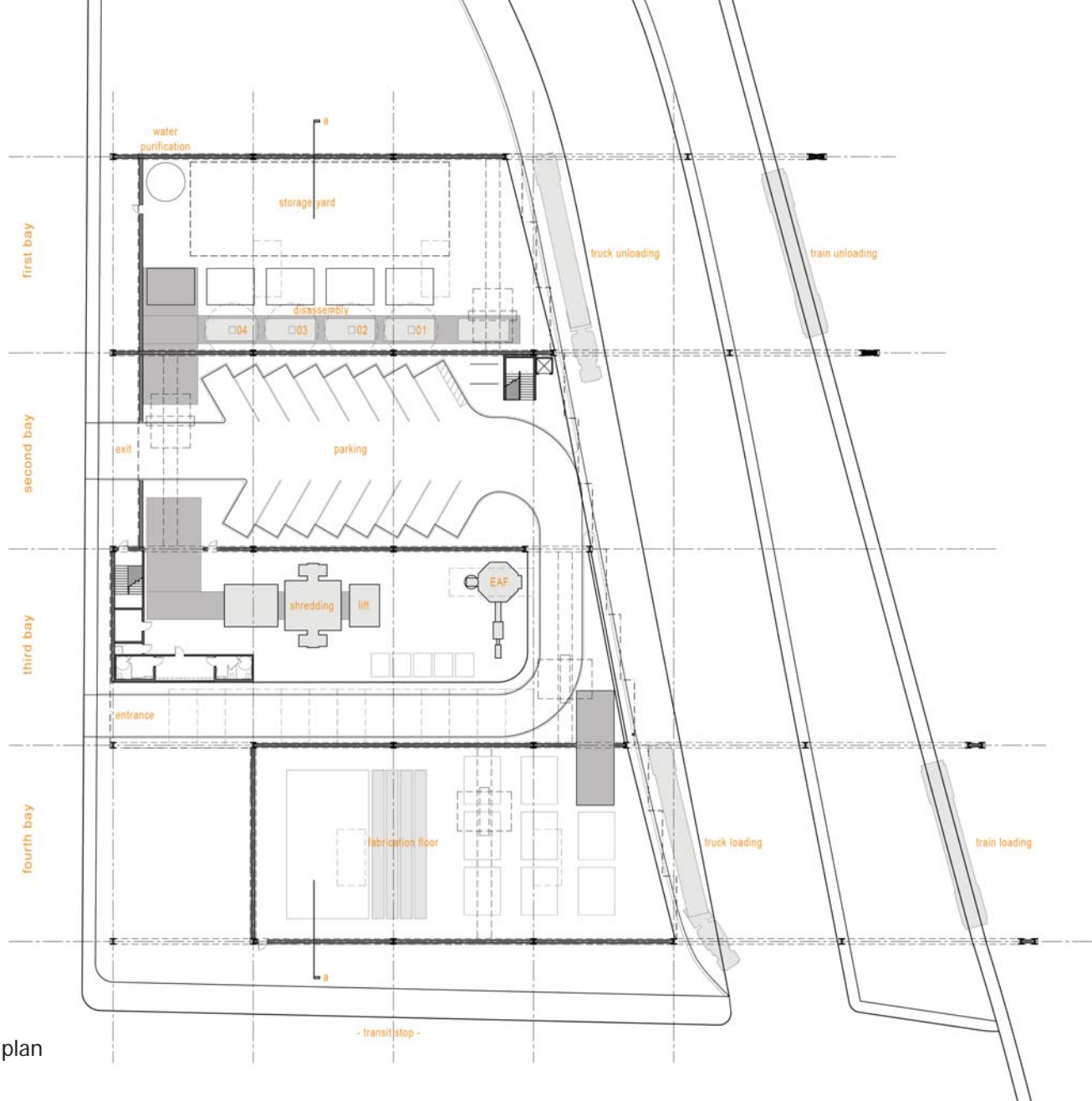
In accordance with Shnitzer Steel's current process, cars go through a dual pre-shredder where the vehicle is 'aired' before descending into a hammermill. The hammermill continues to crush the car until pieces are small enough to fall through the holes below.

Sorting

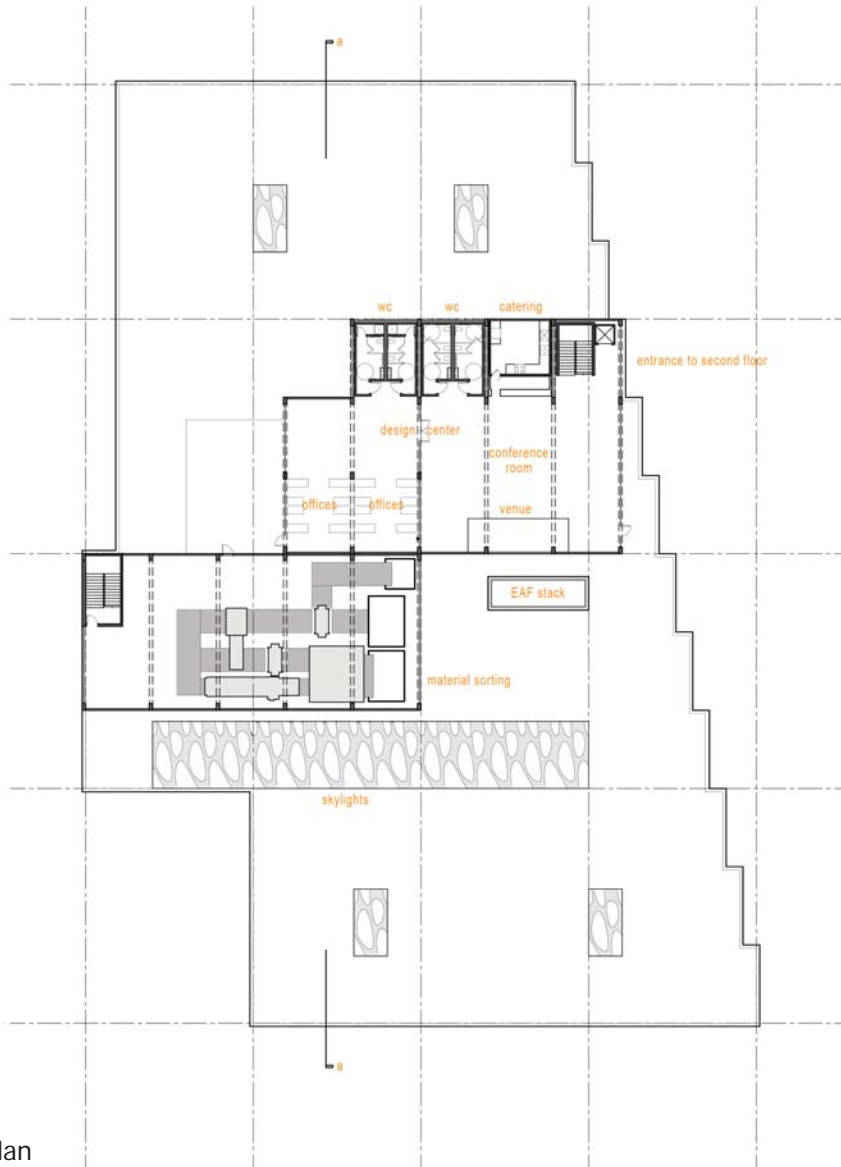
The resulting bits of material are then sent upstairs for sorting. Usable ferrous metal (containing iron - ie steel) is pulled out with a magnet drum and sent to the forge. All other components are separated and distributed to their own bins by going through an industrial vacuum, eddy current separator, and finally induction sorting.

04 EAF

Ferrous metal is melted down in the Electric Arc Furnace. The molten steel is then sent to the fourth bay for fabrication as steel rails to expand the mass transit infrastructure. Any slag produced (typically seen as a waste product) is used as track ballasting under rail lines.



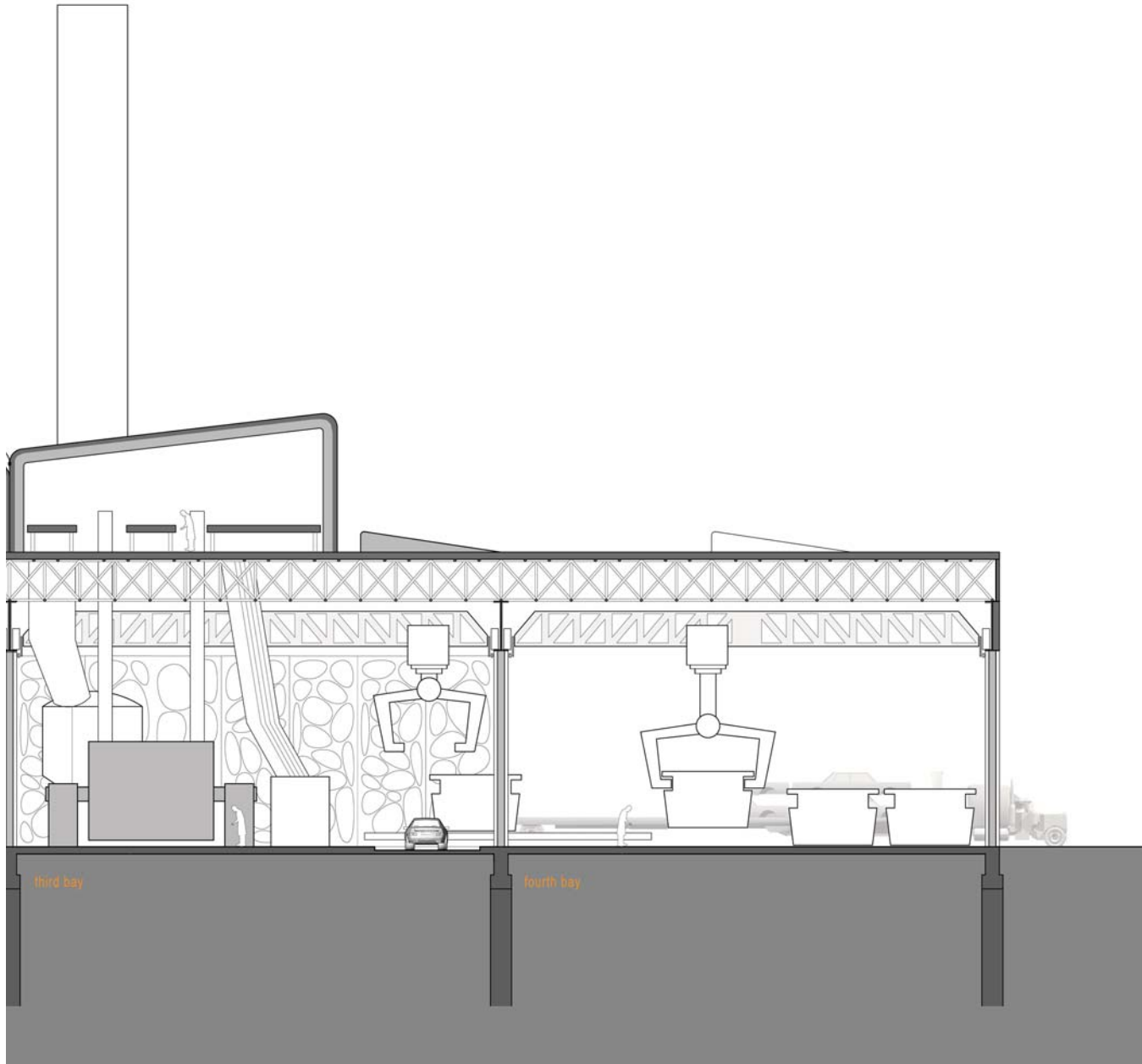
first floor plan



second floor plan

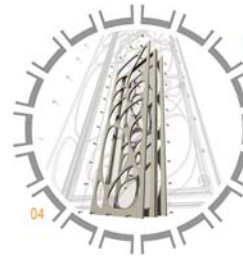
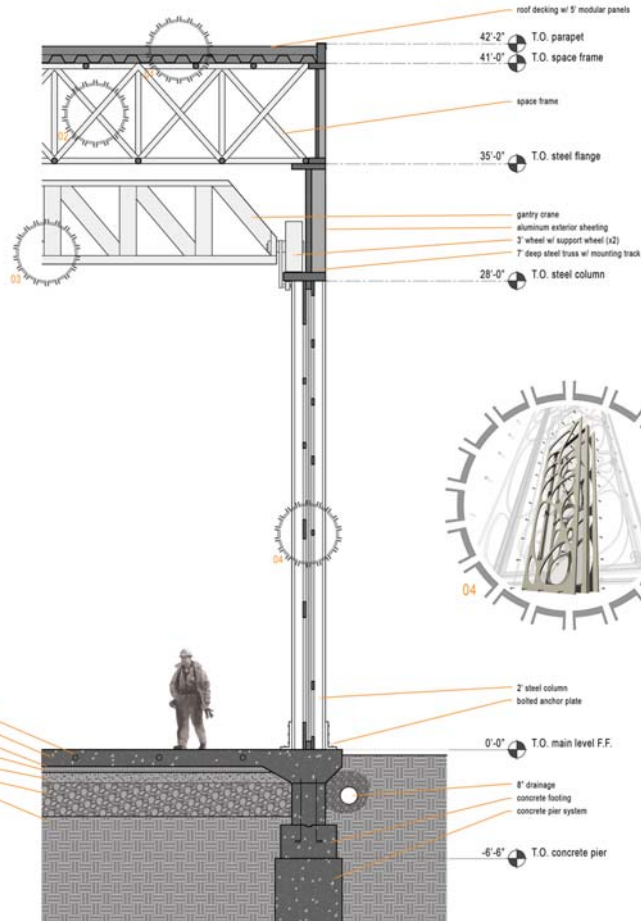
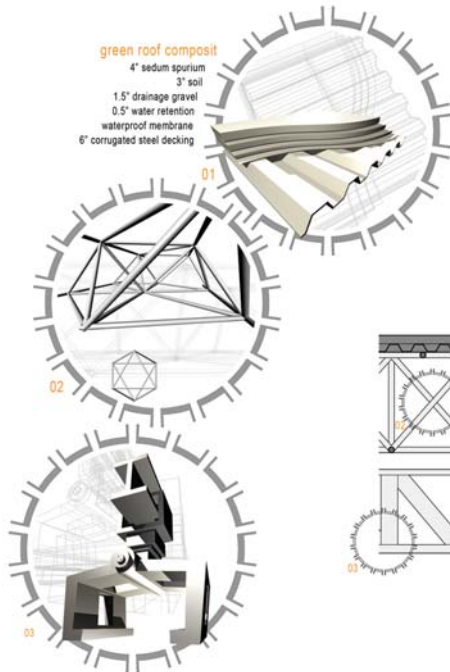


building section a



third bay

fourth bay



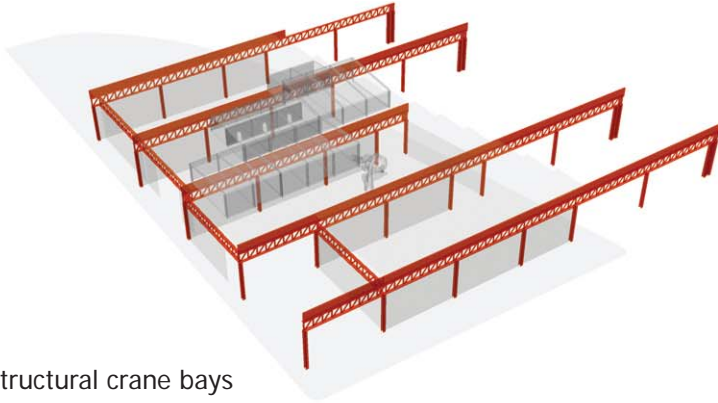
modular wall panel assembly

dual 2" cnc cut steel plates are bolted to either side of a 4" frame, housing insulated japanese glass. spider clamps are used in the center of the 10'x28' frame to maintain an open and seamless appearance

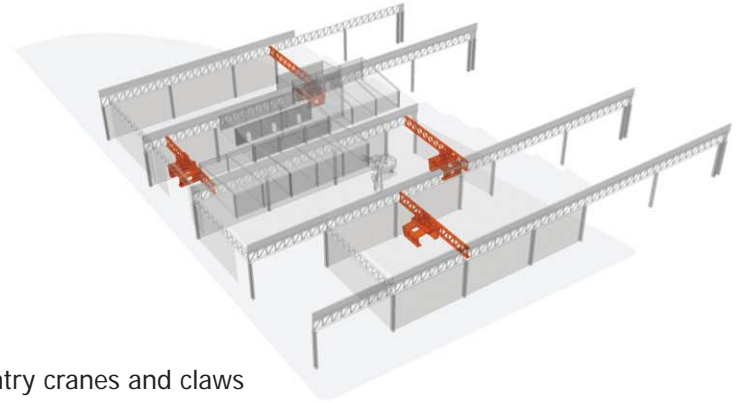
the five unique panels can be flipped, rotated, and reconfigured altering perceived density making spaces more / less visible and parametrically adjusting to seasonal lighting conditions

radiant heating 5' o.c.
 concrete slab on grade
 polyethylene moisture barrier
 2" underlaid rigid insulation
 2" sand
 6" gravel
 compacted dense soil

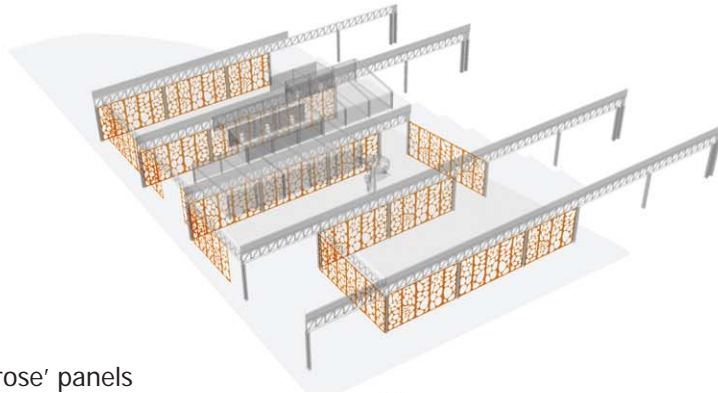
wall section



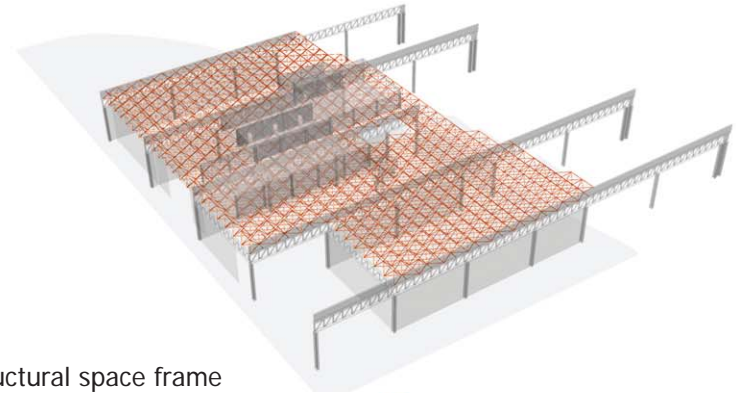
structural crane bays



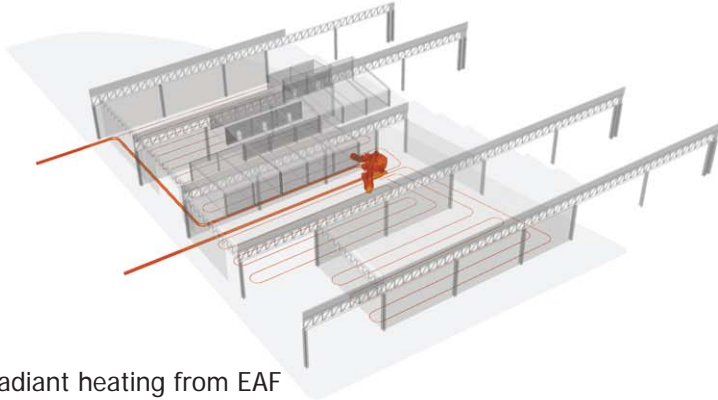
gantry cranes and claws



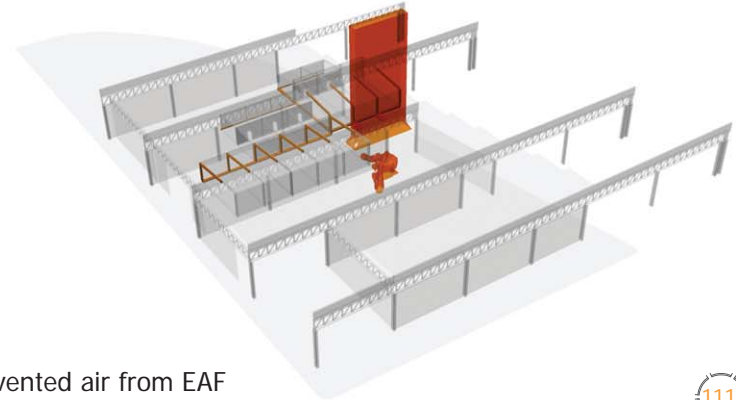
'rose' panels



structural space frame



radiant heating from EAF



re-vented air from EAF

[Modular]

(*adj*) composed of standardized units or sections for easy construction and flexible arrangement

(*n*) a self-contained unit that can be combined or interchanged with others like it to create different shapes or designs

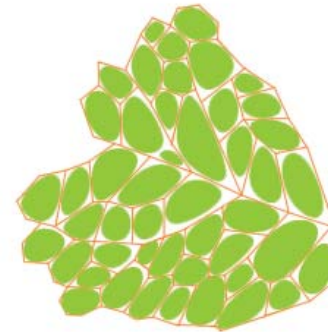
[Grid]

(*n*) a pattern of regularly occurring conditions, used as a basic system of co-ordinates for organizational purposes

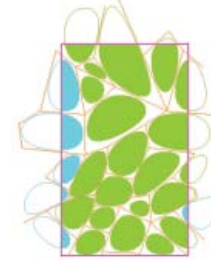
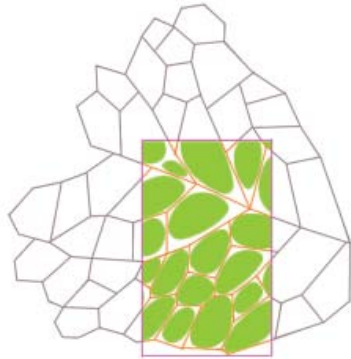
It is typically assumed that grids are square. However, that does not always have to be the case. Any shape can be used for modularity and an organizational grid – as long as it generates a regularly occurring pattern. Furthermore that pattern can be perceptually complicated – again, as long as the same conditions occur at a controlled interval. Through tessellation, the manipulation of a regular grid can create intricate subdivisions that work within the framework. Depending on the scale of the grid, this approach can create the impression of unique customization, while divulging a pattern at the same time. A gentle tension results from the dichotomous nature of this system as both conditions work within each other.



In order to reinforce a link to nature, the paneling system throughout this project was derived through a process involving biomimicry. Since Portland is known as the Rose City, the structure of a rose leaf became the clear decision - combining both nature and site.

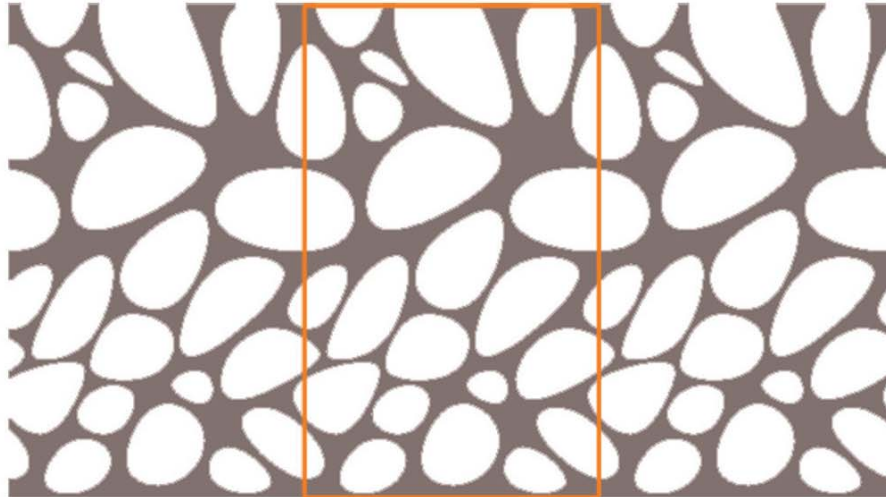


Using the grid for control points, a curved form is generated by snapping to the corners. In order to retain substantial void space between the curved shapes, four control points works best (pentagons are acceptable on occasion). Therefore it is important to simplify the leaf structure when deriving the initial grid.



From the available information, a panel is outlined based on proportions - maintaining an adequate relationship between solid and void space and ensuring the green pieces don't get too large for the eventual scale.

The panel is then manipulated with tessellation to create a single 'unit'. Through tessellation, a seemingly complex design retains a uniform pattern, thus enabling a unit to be both intricate and modular.



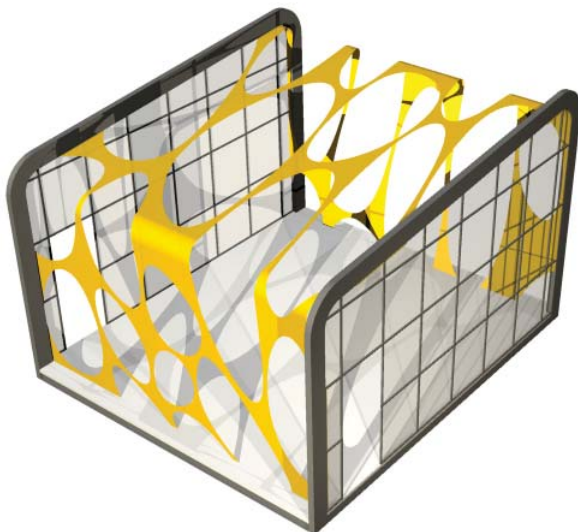
The rounded shapes are used to cut holes out of a large sheet, with the resulting organic panel able to be copied over and over as a modular unit.



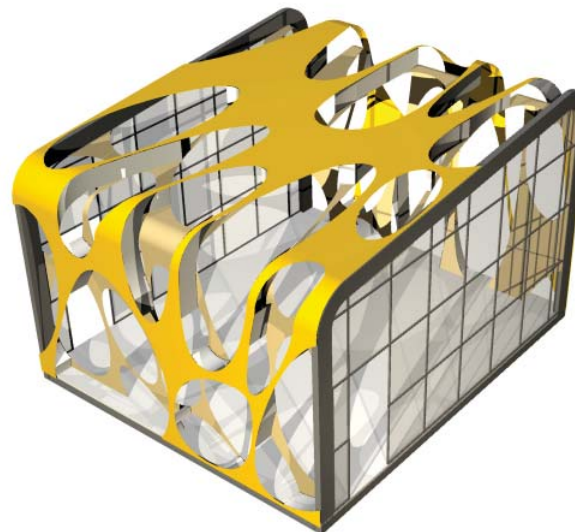
structural frame



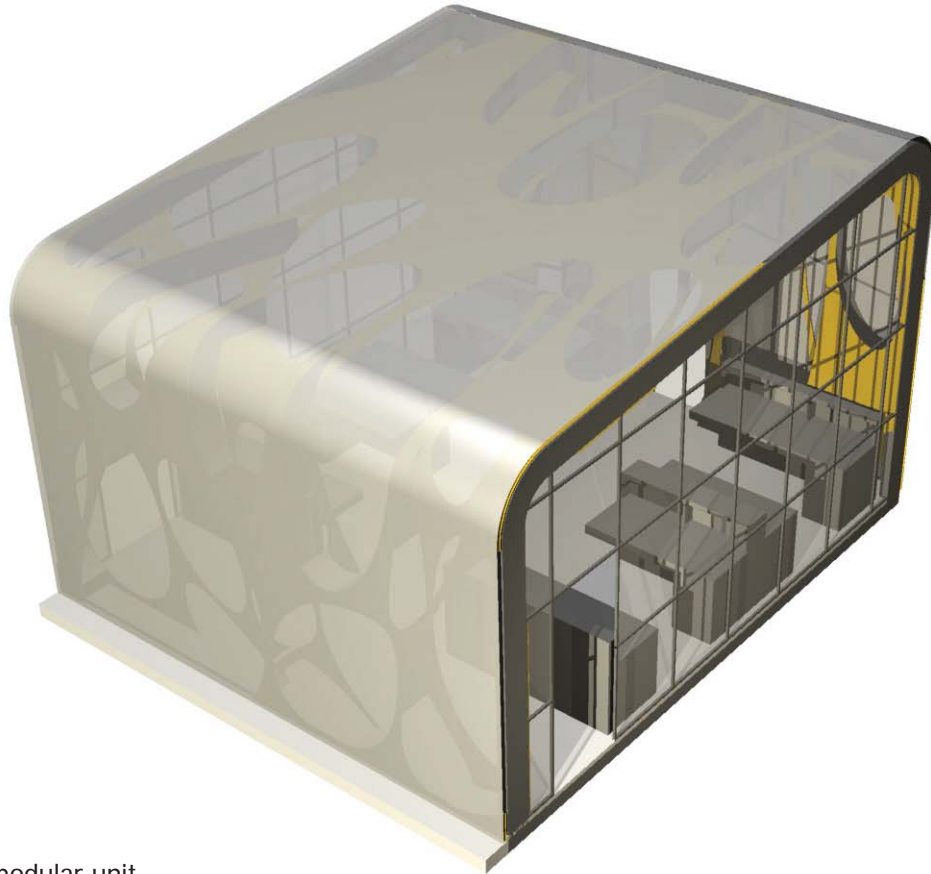
floor + glazing



inner metal paneling



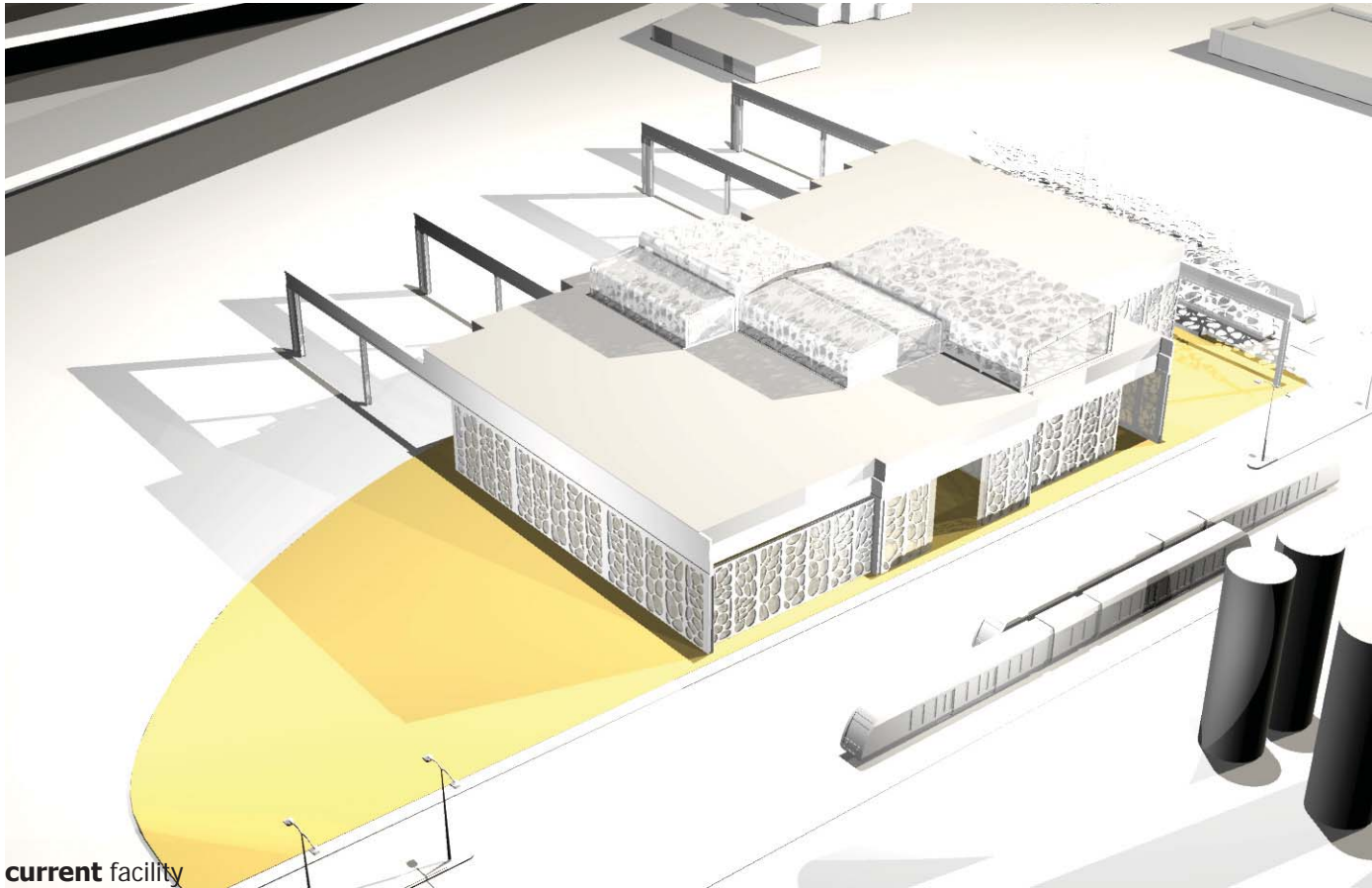
outer metal paneling



second floor modular unit

Two modular units were created, both 20 ft wide, one two-thirds a bay width and the other one-third the bay width (shown above). Single units can accommodate offices (shown), bathrooms, catering or vertical circulation. The design center was created by dismantling the fenestration and stringing multiple units together. As with the modular pattern described earlier, these units are tessellated and blur the boundary between units, effectively making the space feel less modular.

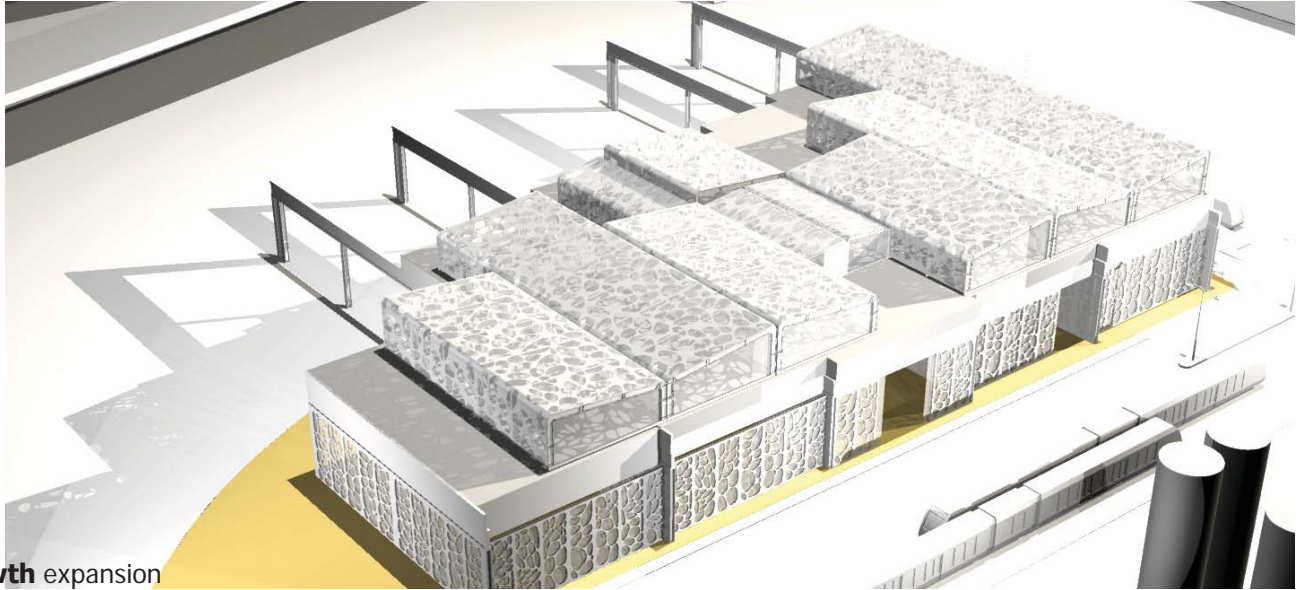
The exterior of each unit is wrapped in a transparent, self-cleaning ethyl tetrafluorethylen membrane (ETFE).



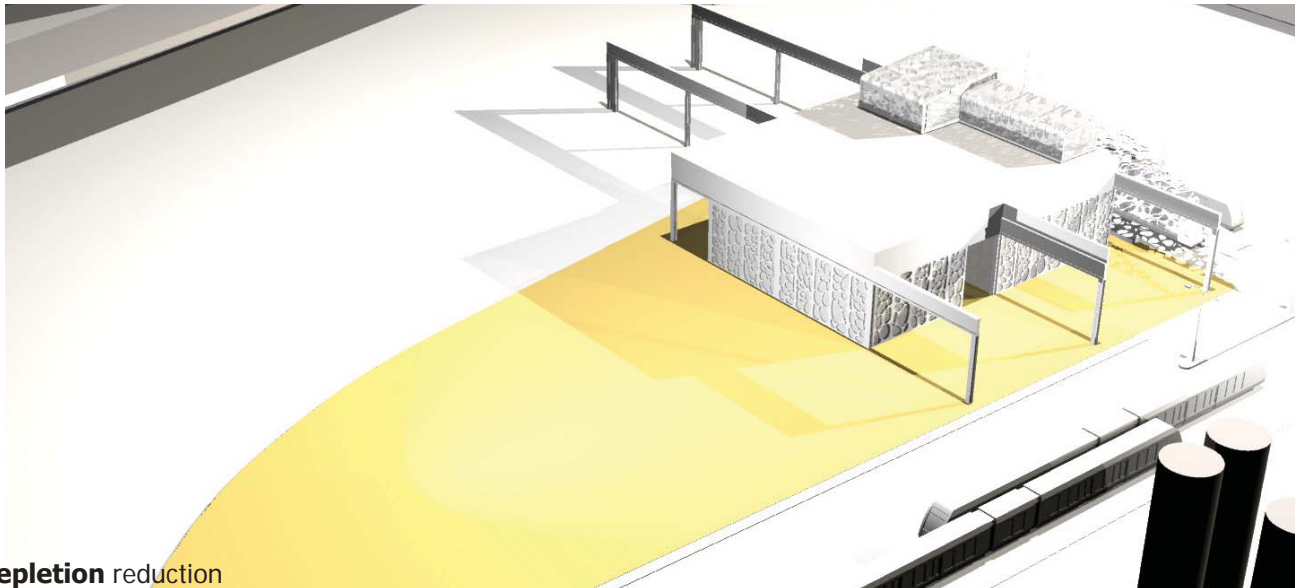
current facility

In dealing with adaptation, an important consideration to remember is anticipating success. As the shift from car to rail catches on, the facility needs to be able to expand to match the supply and demand. Subsequently, no resource is infinite, so the facility needs to be able to contract and reprocess different materials.

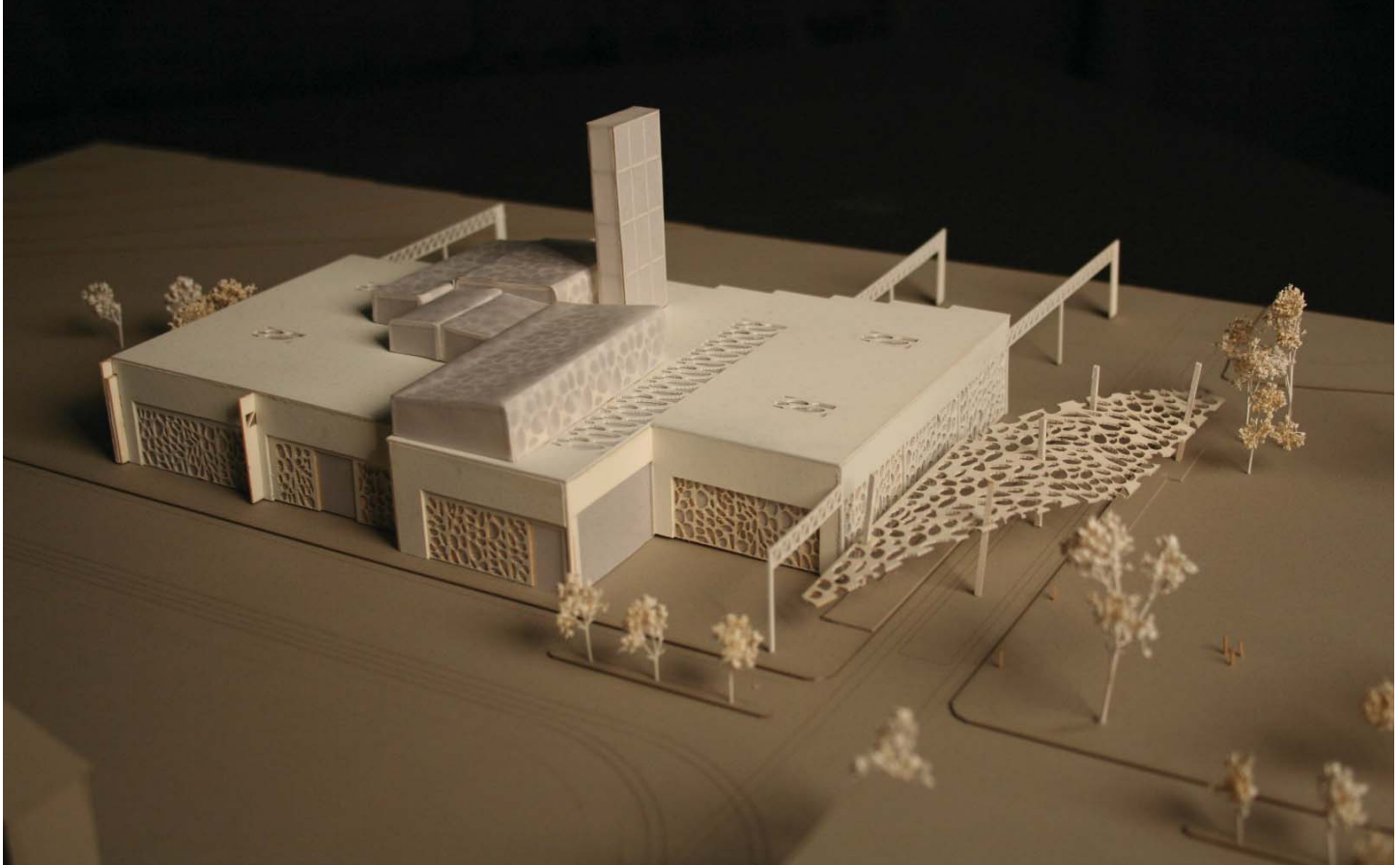
For these reasons, modularity plays an important role in enabling that adaptability.



initial growth expansion



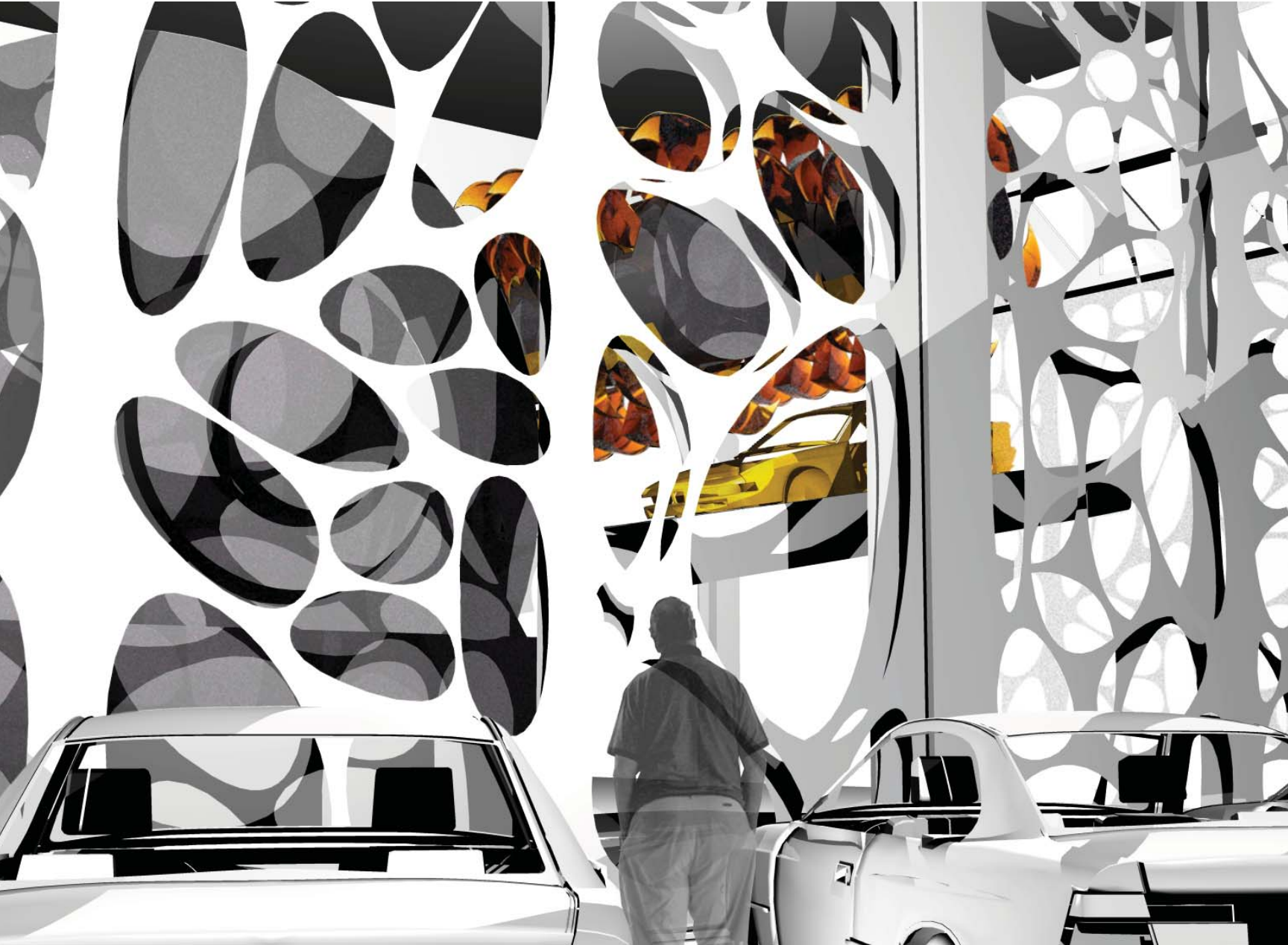
eventual depletion reduction



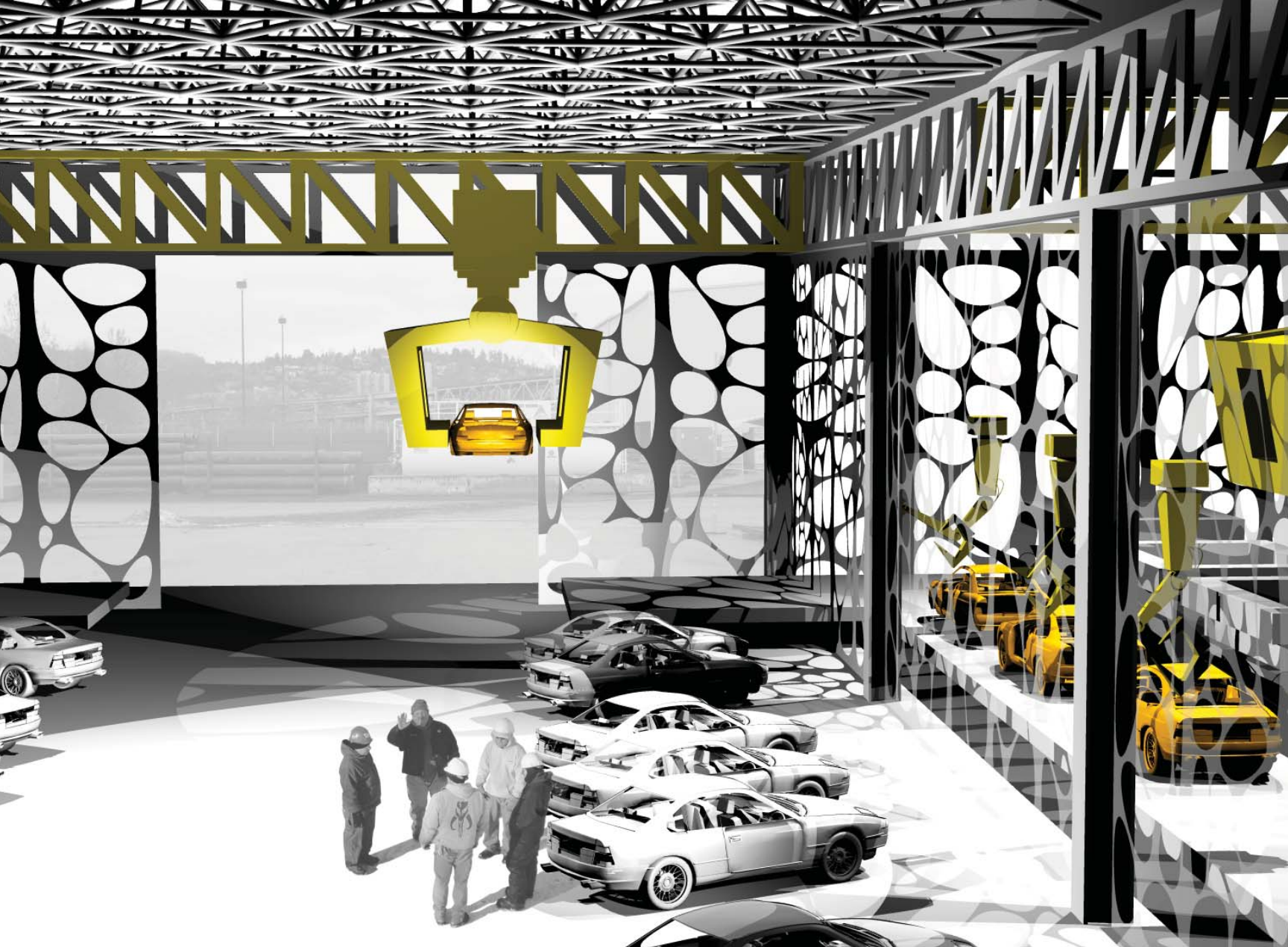
site model



lighting detail



parking / shredding





venue space

personal reflection

Looking back to where I started, there has been a lot of ground covered. The biggest challenge was simply trying to stay focused on one single, cohesive idea all while taking on a very real issue facing American society and culture. This project is not about cars or rail roads or even a way of life, but attempts to address the bigger picture – a way of thinking. I have seen a sign that reads, “Progress has gone far enough”. How terrifying is that? And I can assure you there are plenty of people that would agree with that statement. That kind of mentality goes beyond the bounds of ignorance, and is exactly what I will be combating for the rest of my life. We need to be better – we can be better than this. Humanity should always strive to be better, smarter, more efficient, more aware, and more responsible stewards of this planet.

As I see it, this thesis project is by no means an end or a conclusion. On the contrary, this is phase one. This is the beginning of something greater and all pervasive. So with that, I need to thank all the people who helped me along the way to get started. A special thanks must go to Jeremy Grotbo – for without whom, none of this would have been possible.



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Images

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