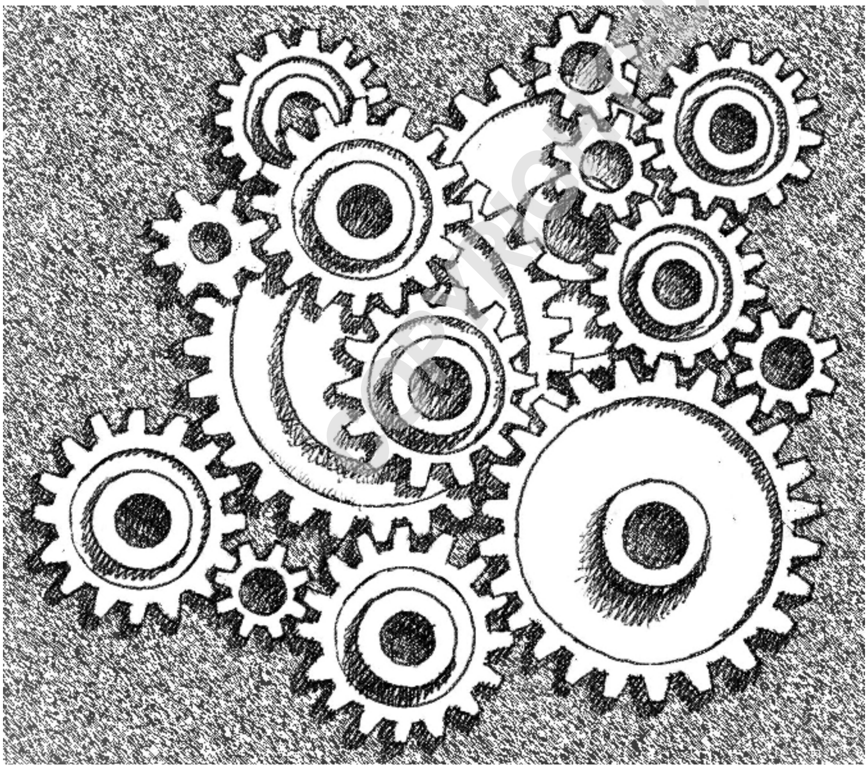
CHAPTER 1

The Process of Sustainable Engineering Design



CREATING A NEW PARADIGM FOR DESIGN

Traditional site engineering design concentrated solely on building infrastructure. Today, engineers are an integral part of complex design teams. Our role has expanded to include the strategies that help determine a project's design concepts at the outset. Such strategies include adopting and adapting the ideas and priorities of others

INTEGRATING DISCIPLINES: ARCHITECTS AND ENGINEERS

ERIN CUBBISON, GENSLER

In the last several years, architects and planners have increasingly delved into topics outside their typical skill sets. Now that design projects must meet specific energy reductions or water savings, for example, there is greater collaboration between designers and other disciplines—especially engineering. As engineers move upstream in the design process, they can offer more design options at lower costs.

The American Institute of Architects (AIA) has solidified this shift toward performance-based design and the increased integration of disciplines early in the design process through its proposal for integrated design and delivery (see Figure 1-1). Integrated design and delivery typically refers to the collaborative, information-sharing process of project design and delivery carried out by a team of owners, designers, consultants, builders, fabricators, and users. Figure 1-1 shows how current practices place the emphasis (time, effort, and fee) on the construction phase but should instead emphasize the design phase in order for collaboration to take place. In addition to improving the project's level of sustainability, this can also increase overall project quality and value, while reducing risk.

The architects and planners at Gensler have taken the idea a step further by adding two phases for consideration by the project team: a strategy phase and a use phase. This addresses the entire real estate life cycle, from business and real estate strategy through the occupancy and use of completed buildings and facilities. Strategy and use involve activities such as portfolio analysis, commissioning, and post-occupancy evaluation. By extending the

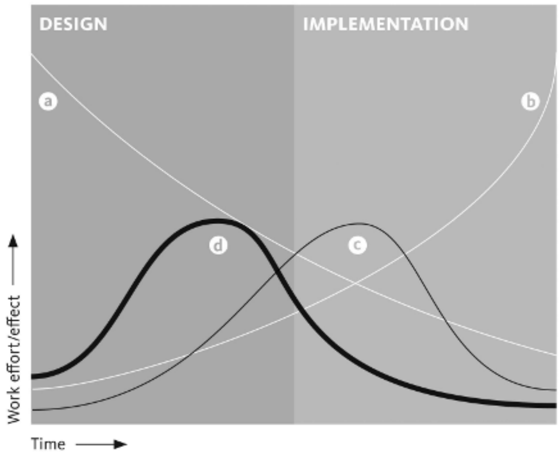


Figure 1-1 AIA integrated design model. Gensler.

during the design process as well as developing maintenance guidelines for keeping an integrated, "living" design operating properly throughout its life span.

An engineer's ability to make the biggest impact on a project comes at its beginning, when assumptions are laid out, goals are established, and limitations are imposed. Working within an integrative design process is the most effective way to meet a project's many (often competing) objectives while helping to ensure the most sustainable project possible. Engineers are much better equipped to succeed in their

focus of integrated delivery, the teams responsible for dispatching specific projects understand the need to ensure that the knowledge gained at each stage is captured for the future, not only for individual projects but also for the broader initiatives of the organization whose strategic goals and plans they serve. The strategy phase is particularly important because it allows for critical evaluations and decisions to be fully integrated with design work. As illustrated by Figure 1-2, if the project team can begin the design process in the strategy phase, then it can reduce risk even further. This provides the opportunity for even deeper sustainability efforts and a higher quality of work.

For more information on this subject please see www.sherwoodinstitute.org/resources.

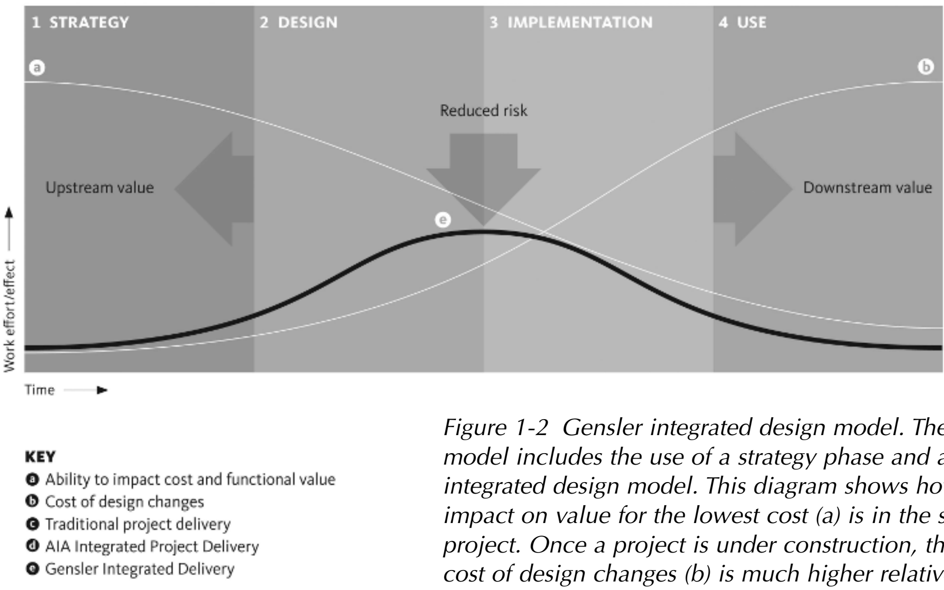


Figure 1-2 Gensler integrated design model. The Gensler integrated design model includes the use of a strategy phase and a use phase within the AIA integrated design model. This diagram shows how the ability to have the largest impact on value for the lowest cost (a) is in the strategy and design phases of a project. Once a project is under construction, the situation is reversed, and the cost of design changes (b) is much higher relative to their potential impacts. In Figure 1-1, (c) represents traditional project delivery while (d) demonstrates how integrated project delivery improves by moving the bulk of the work upstream into the design phase of the project. The Gensler integrated design model (e) shows a gentler curve that reduces risk and improves benefits by beginning in the strategy phase and continuing through occupancy. This allows critical decisions to be fully integrated with design, bridging the gap between strategy and implementation while ensuring that those strategies are put successfully to use by a site's occupants. Gensler.

areas of specialty when they have the opportunity to help shape such factors, be they increased water savings, decreased materials usage, or earthwork balancing. Without the chance to create integrated solutions, engineers are essentially left to solve technical problems created by the design.

A successful design process has a much greater chance of yielding an integrated design that creates synergies between the various elements and design disciplines. This synergy—creating a whole that is greater than the sum of its parts—is a cornerstone of sustainable design. Without a site engineer at the table from the outset to coordinate with the architect, landscape architect, and engineers from other disciplines, many of the sustainable elements that engineers help realize become more difficult to achieve.

The environmental and energy performance of our buildings and built environment is of increasing concern in the design process; it is therefore critical that engineers offer their technical expertise in the early phases. While this occasionally creates a longer, more complex design process, it reduces a project's overall costs by providing significant improvements in design. In a successful integrative design process, the higher up-front costs of design will be offset by savings on construction, reduced maintenance, and improved operations and performance over the lifetime of the project. However, such benefits must be clearly demonstrated to the client from the outset. Throughout this book, successful engineering strategies are described in order to show how incorporating engineers early on—and throughout the design process—can make a project more successful.

THE SUSTAINABLE DESIGN TEAM: AN ENGINEER'S PERSPECTIVE

As a project advances, different professionals contribute their expertise in different ways and at different times. Effectively integrating the members of a design team is essential for a successful process. It also creates an atmosphere of familiarity that allows for more collaboration and higher levels of achievement in design each time professional teams reconvene. Figure 1-3 illustrates the consultant team's structure on a master planning project in Brazil and how its members interacted throughout the process.

Each of these design team members interfaces in unique ways. A list of the typical team members and how each interacts with the site engineer follows:

Sustainability consultant: Often in-house at one of the design team members. Helps design clear priorities for the whole project and encourages synergies to engender success in reaching sustainability metrics. Works with engineers to reduce demand for water, energy, and source materials; integrate green space; and reduce carbon footprint.

Ecologist: Conducts baseline surveys of existing ecosystems and partners with site engineer and design team members to determine areas of constraints and opportunities for development. Helps establish development priorities that promote ecological benefits and diminish environmental impact.

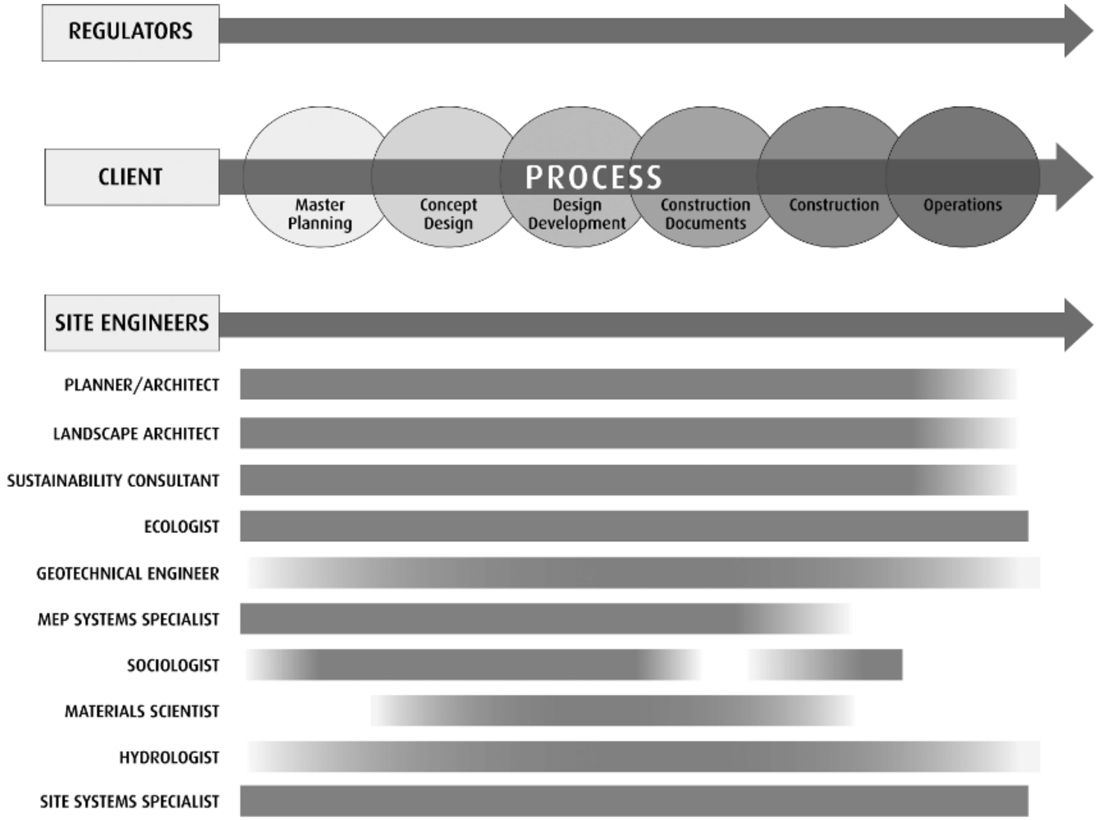


Figure 1-3 The design team through the life of a sustainable planning project in northeast Brazil. For this project, Sherwood Design Engineers acted as both sustainability consultant and site engineer. © Sherwood Design Engineers.

Planner/architect: Designs site master plan and/or buildings. Works with engineer on site design to determine optimal placement, sizing, and integration of buildings at the site. Works with engineers on water and energy balance models to develop appropriate strategies for meeting project demands. Coordinates design between disciplines among all designers and ensures that built infrastructure will perform as designed. Oversees the development of a sustainability plan to ensure the project meets ongoing goals of energy savings, water reuse, sustainable waste practices, and so on.

Landscape architect: Helps engineers improve site aesthetics by incorporating an overarching design philosophy into the site that manifests in physical form through hardscape and softscape organization, vegetation management, stormwater facility placement, and so on. Assists engineers in minimizing damage to soils, trees, and native plants during construction. Chooses appropriate site plantings and landscaping. Works with engineers to integrate landscaping with on-site water systems. Coordinates landscaping maintenance of green infrastructure on-site (swales, green parking lots, rain gardens, wetlands, etc.).

Geotechnical engineer: Analyzes underground rock and/or soil characteristics to provide recommendations for subsurface engineering related to planned roads, buildings, and site infrastructure. Determines soil types that will support infiltration and various types of landscaping. Consults with engineers on land-forming strategies.

Mechanical, electrical, and plumbing (MEP) systems specialist: Designs energy and electrical systems, including heating, ventilation, and air-conditioning (HVAC). Works with engineer and architect to integrate energy systems into the building design and perform accurate energy modeling to ensure systems are sized and placed correctly. Coordinates with site designer and engineer to minimize infrastructure, including piping, trenching, and wiring, when placing utility corridors on-site.

Hydrologist: Often a part of the site engineering team, works with engineers to determine local groundwater levels and qualities, determine potential stormwater runoff and stream flow, develop watershed master plans, establish water balance models, and review strategies for capture and reuse of water on-site. Helps engineer develop water treatment and delivery strategies that minimize piping, culverts, and other hardscape in favor of swales, rain gardens, infiltration basins, and/or wetlands.

DESIGN DRIVERS FOR SUSTAINABLE INFRASTRUCTURE SYSTEMS

Although the specifics of the design process Sherwood Design Engineers employs vary from project to project, there are a number of components that tend to remain central to our work. Typically, this process includes some, if not all, of the following elements:

- Identifying and understanding the project drivers
- Setting goals
- Establishing desired outcomes and metrics for success
- Creating frameworks and action plans that organize the approach
- Identifying concrete, measurable design strategies to achieve the above items

For more information on related topics please see www.sherwoodinstitute.org/ideas.

Project Drivers

Project drivers define the fundamental requirements of a project (such as budget or timeline) that in turn help to establish the design criteria. Conventional project drivers continue to be supplemented or replaced by additional, more integrated drivers, often defined by environmental and infrastructure constraints, increased regulatory controls, or the desire to conform to a green rating system.

For the development project mentioned above located in a very dry part of Brazil, this included a detailed look at the interrelationship between the site's hydrology and vegetation to inform an ecological succession strategy that phased with the project's horizontal infrastructure development. The project driver in this case was its role in a larger reforestation and protection strategy of the much deteriorated Atlantic Forest.

Another common set of drivers include those related to increased regulatory controls. From water and energy efficiency requirements to stormwater quantity and quality requirements, we have seen much stricter controls placed on our design solutions. "Business as usual" for designers is changing rapidly. In recent years there have been shifts in the planning process to account for new requirements from municipalities. Building codes, water policies, emissions standards, labor laws, material use, and carbon accounting are all being revised—and designers must keep pace.

An increasingly important set of drivers involve meeting the requirements of rating systems. Whether these are green rating systems such as Leadership in Energy and Environmental Design (LEED) or the Building Research Establishment Environmental Assessment Method (BREEAM), goal-based systems such as One Planet Living and the Living Building Challenge, performance-based systems such as SmartCode and the benchmarks established by the American Society of Landscape Architects' (ASLA) Sustainable Sites Initiative, or education-based systems such as the Energy Star program, designers are being called upon to integrate them into their design solutions. This has led many design firms to either bring this additional expertise in-house or add sustainability consultants or other specialists to their team.

Often, decisions must be made that improve one aspect of a project but impact another negatively; for such situations, a clear understanding of a project's key values is important so the decisions will favor the project's highest priorities. Developing a framework for sustainable design can help designers prioritize a project's core values in order to make the hard choices so often required.

Establishing Project Values and Setting Goals

Every project starts with a vision and a set of objectives. It is the design team's responsibility, in coordination with the client, to establish project values that can be used to define clear goals for the design effort. These values are sometimes lofty and hard to interpret. At the headquarters of a nonprofit, Sherwood was recently asked to create a "replicable" project—one that had elements that could be re-created on green buildings throughout the world. The project value established was the creation of a model coming from a desire to contribute to the advancement of green building.

Project values get translated into goals that are more tangible and can be used to drive the design process. Quantitative goals are advantageous because they allow a project to measure its success in various ways. This is not always easy to do and, if these goals are not clearly formulated, a design team can be left scrambling, trying to figure out the best way to then measure progress. (A goal of "conservation of biodiversity," for example, might prove elusive and difficult to measure.) Projects often implement a variety of goals, some of which are qualitative and others that are quantitative. For quantitative goals, it is important to define the metric that will be used to determine achievement.

Project goals can be met in different ways. For instance, on an urban project, the goal of reducing vehicle trips may be met by increasing the number of residential units in the urban core so fewer people have to commute, or by expanding access to public transportation so fewer commuters have to drive. Project goals can be as detailed as the achievement of a certain LEED credit, or as general as a positive impact on global warming. For a recent green streets project in Florida, the project stakeholders identified the following goals to support the widely held triple bottom-line values related to project achievement:

- Community
  - Improve site aesthetics.
  - Increase pedestrian connectivity.
  - Expand multiuse functionality.
- Environment
  - Improve energy efficiency.
  - Reduce carbon emissions.
  - Increase water efficiency.
  - Reduce stormwater runoff.
  - Improve stormwater quality.
  - Expand local material use.
- Economics
  - Increase marketability.
  - Stay within budget limits.
  - Optimize maintenance requirements.
  - Increase systems durability.

Defining Desired Outcomes and Metrics

Various industry standards have been developed to help designers reach measurable outcomes for all scales of projects. Some systems use predefined, widely accepted metrics. Others are narrow in focus and are not all-encompassing when it comes to analyzing a project's commitment to sustainability. These systems often provide a defined format for projects to compare to a baseline to determine how they measure up against other projects. One of the most widely used standards in the United States is the U.S. Green Building Council's (USGBC) LEED rating system. There are many other standards in use internationally.

The benefits of pursuing LEED (or another similar rating system) are that it provides third-party verification, brand recognition, marketing cachet, and even investment opportunity. Whether utilizing a rating system or not, resource-efficiency analysis is a great way to measure progress and show results. For many projects, this may mean analyzing the key site resources in the following ways:

- *Water:* Compare the site's expected water demands with a baseline case and strive for a water balance that focuses on low-use and renewable sources.

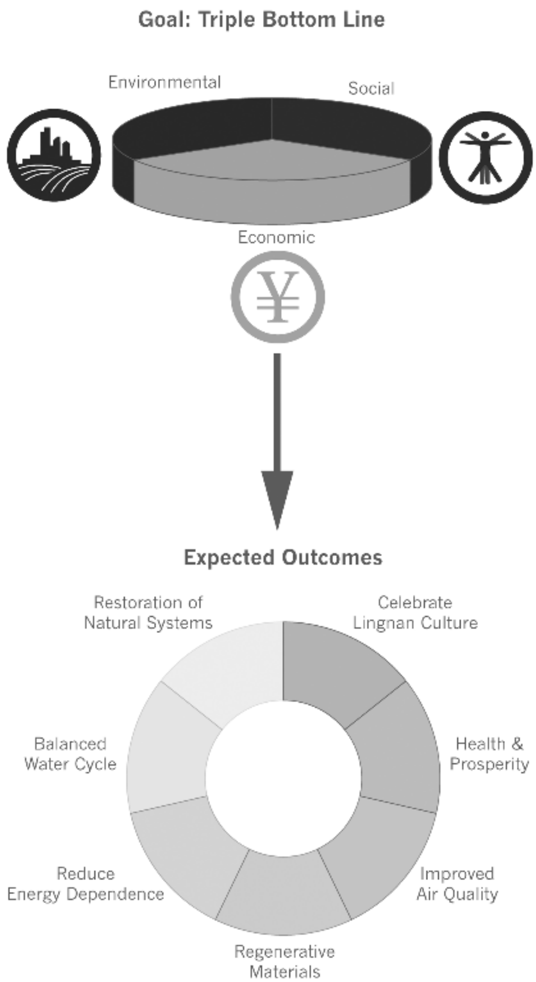


Figure 1-4 Design drivers for the Baietan master plan in Guangzhou, China. In this project, the major goals of environmental, social, and economic improvement to the city were connected to a variety of outcomes. The anticipated outcomes exist on a scale from the more quantitative, like water and energy use, to others that are more qualitative in nature, like health and prosperity or celebrating local culture. Each of these outcomes is then supported by a variety of action plans. These action plans usually support several of the desired project outcomes. © Skidmore, Owings & Merrill LLP 2009 with Sherwood Design Engineers. All rights reserved.

- *Energy:* Compare the project's final energy requirements with a baseline case and strive for net zero energy use.
- *Carbon:* Compare the project's carbon footprint through the design, construction, and occupancy phases with a baseline case and strive to be carbon negative.
- *Materials:* Complete a life-cycle analysis for the project and specify materials with long life cycles. Local resources should also be evaluated.

While working on the sustainability plan for a recent park project, Sherwood developed the following sustainable infrastructure systems metrics:

- Ecology
  - Annual aquifer recharge of 55 acre-feet
  - Water quality treatment of all runoff
  - 25 acres of habitat restoration

- Water
    - 75 percent water reuse for irrigation
    - 95 percent recycled water for fountains
    - 35 percent water reuse for restrooms
- Energy
    - Carbon neutrality for park operations
    - 75 percent on-site renewable power generation
    - 50 percent energy reduction from baseline for parking garage

Every project will have specific needs and require a customized approach to establishing the proper metrics for evaluating the progress and success of the project goals.

Creating Frameworks and Action Plans

Frameworks and action plans are methods by which the designer can organize the various strategies and means of achievement. These systems are not requirements of most projects but can be imperative when trying to tackle complex objectives with many interwoven parts and integrated strategies.

For the project mentioned in Brazil, Sherwood developed a comprehensive sustainability plan using the pillars of sustainability framework, which is explained more fully in chapter 2. Briefly, the five pillars of water, energy, community, ecology, and materials are all important to a project's success. But it may not be possible to address all of them equally. For this project, "community" was given a high priority because the analysis, which used the United Nations Human Development Index, revealed that the local community scored below some of the poorest and most war-torn countries in Africa. It became clear to the client that investments in renewable energy or decreasing carbon would not be sustainable without first improving conditions in the local community.

As part of the sustainability plan, Sherwood coordinated with local leaders to develop programs that would offer immediate educational and job-training opportunities to the community in order to lay a foundation for future community development. It was decided that additional money spent up front in this sector was a better investment in sustainability than alternative options, such as expanding wind power generation capacity to decrease the carbon footprint.

Design Strategies

Once the structure driving a project has been defined and agreed upon, the next step is to establish appropriate design strategies to meet those goals.

In order to establish design strategies, it is important to respond to a project's context. The same goal will be met in different ways depending on whether the project is in a dense urban area, a rural development, or a delicate ecosystem. Managing stormwater through passive means in an urban area might involve developing a net-work of rain gardens above underground cisterns. In a rural development, the same goal might be met with bioswales and wetlands, while a reforestation program might be called for in an undeveloped area.

Design strategies become integrated when the entire design team is aware of the criteria and works toward a complementary set of solutions. On the LEED Platinum Chartwell School in Monterey, California, one desired outcome was a reduction in embodied energy for the materials involved. This resulted in a variety of strategies: the use of salvaged materials from nearby sites, the specification of materials with recycled content throughout the project, and a building system that allows for the planned deconstruction of the buildings many years in the future. From the architect to the structural engineer and site designer, the consultant team worked to incorporate strategies in support of the desired outcome.

IMPLEMENTING THE PROCESS

The collaborative process is rooted in a belief in teamwork, in developing a solid understanding of project goals, and in all parties doing their best to realize those goals. Meeting with the other design team members as often as is practical and staying coordinated through regular communication allows the team to achieve these

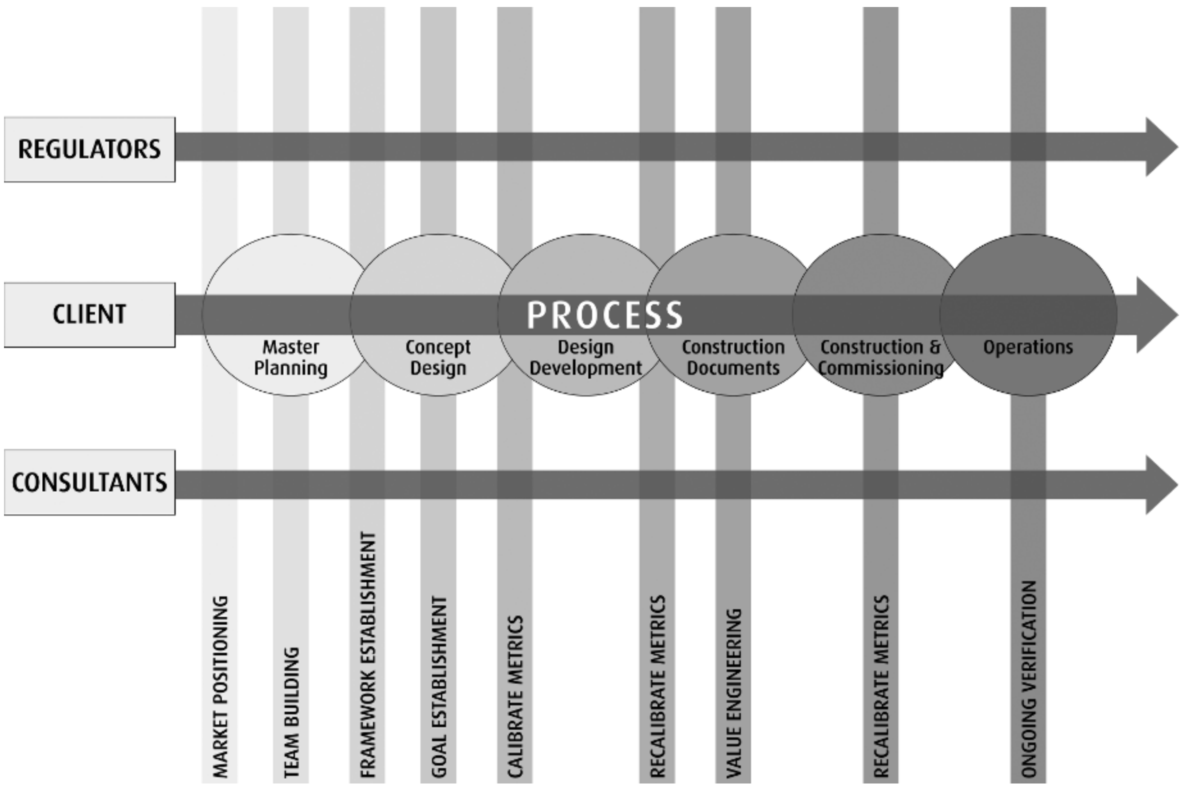


Figure 1-5 Vertical bars in this process diagram indicate where the sustainability drivers are introduced during a specific project. In this case, most critical is the introduction and calibration of metrics. © Sherwood Design Engineers.

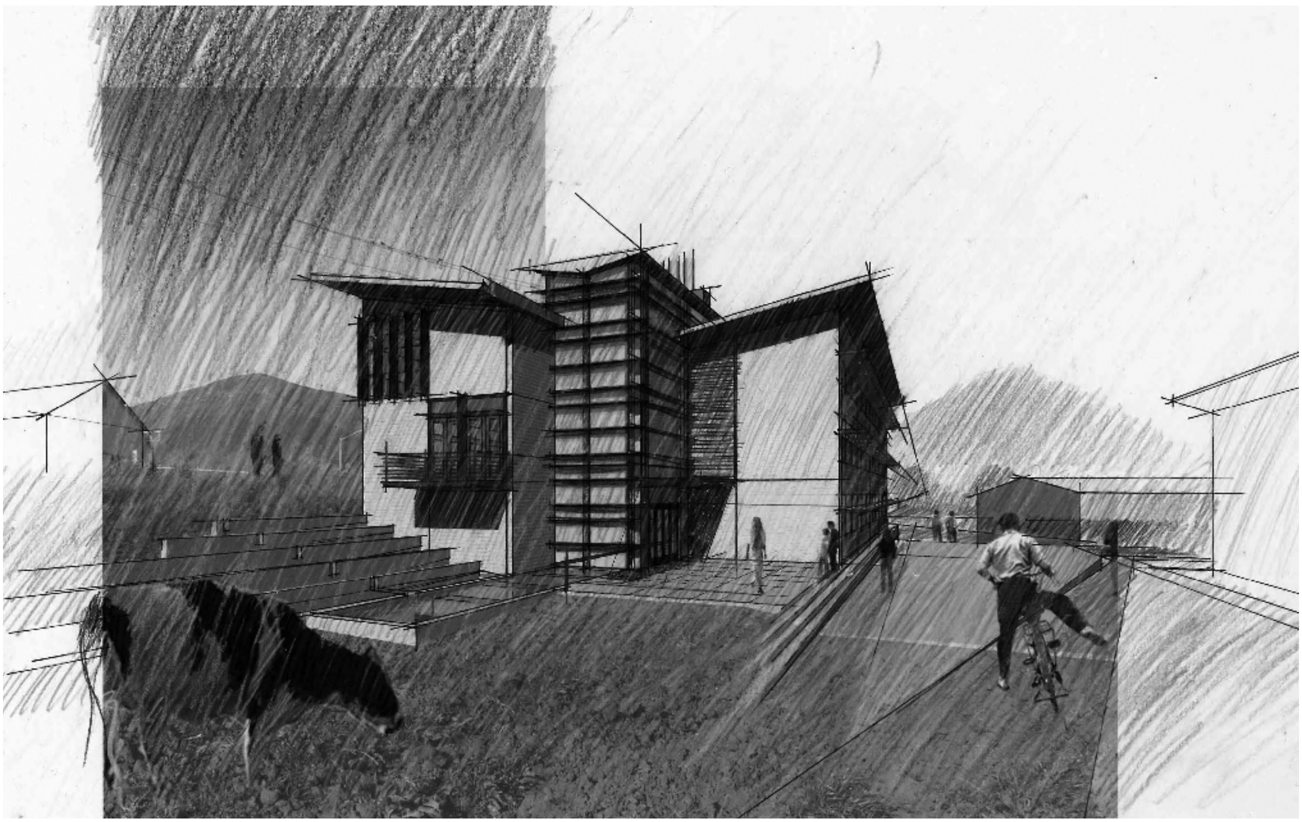
goals while staying on schedule and on budget. Sherwood's process, of course, varies slightly from project to project; below are two detailed examples (see pages 16–18) of that process, including a green streets project in San Francisco, California, and a green community project on Florida's Gulf Coast.

The overall process that design teams go through during the course of a project is standard across the industry. It begins with defining the concept, developing designs, and preparing construction documents. What makes the collaborative process unique are the design steps taken within each of these phases.

As part of the sustainability plan for the project in Brazil mentioned earlier, Sherwood laid out the following project schedule and key milestones for the client. Determining the market position and the framework was critical to establishing our goals. Once goals were set, they were tracked using metrics through the life of the project. Below is an outline of some of the steps of the engineering process:

1. Project planning
    - Perform initial research to identify climate conditions; energy source and costs; water source and costs; and environmental constraints and opportunities.

Figure 1-6 This concept sketch from a charrette for a sustainable technology park captures a combination of design strategies and shows their integration through graphic expression. EHDD Architecture.



- Identify key components (at a charrette) of sustainable opportunities specific to site and region.
- Provide case studies relevant to the site.

2. Concept design
   - Establish a framework.
   - Conduct a design/client team sustainable systems workshop, including all designers and client representatives, to present opportunities, understand site-specific limitations and opportunities, and gain consensus on project goals and design criteria.
   - Provide and quantify comprehensive strategies for achieving established goals.
   - Develop metrics and benchmarks to determine whether goals are being met.
3. Design development
   - Integrate and track goals with the master plan program; as the plan changes, identify when goals are being compromised and recommend alternatives to preserve them.
   - Revise design to meet priorities through collaborative iteration with other stakeholders.
   - Recalibrate metrics, if necessary, to accommodate any design changes as the project develops.
   - Create sustainability guidelines that fully integrate with the project design guidelines, moving from design to operations.
4. Construction documentation
   - Recalibrate metrics, if necessary, to accommodate design changes associated with value engineering.
   - Collaborate with the project team on the detailing of unique elements critical to project goals and/or integrated systems.
5. Construction and commissioning
   - Develop a sustainable systems construction manual.
   - Use project specifications as a means to require sustainable construction practices.
   - Develop a materials use plan to minimize construction waste.
   - Commission site infrastructure, including drainage systems.
6. Operations
   - Develop an operations and maintenance manual for new or innovative design solutions.
   - Develop a plan for ongoing carbon management and greening project operations.

Applying Integrative Design on Old Mint Plaza

Our work on San Francisco streetscapes ranges from residential streets to thoroughfares to urban plazas. Though each of our projects varies slightly, they all have consistent components: overarching goals, design strategies, and targeted outcomes. As part of an interdisciplinary team led by CMG Landscape Architecture, Sherwood was responsible for the reconstruction of an existing streetscape adjacent to the historic Old Mint building in downtown San Francisco. Conversion of the 19,000-square-foot block into a flagship stormwater park and public plaza has set future development standards for urban stormwater management techniques, infiltration best management practices (BMPs), and green street design on projects throughout the San Francisco Bay Area. Central to the project were the goals of creating a community amenity and having a net positive impact on San Francisco's combined sewer overflows. Figure 1-7 summarizes the results of this process for the Old Mint Plaza and outlines the project's key design goals, the strategies chosen, and the resulting benefits.

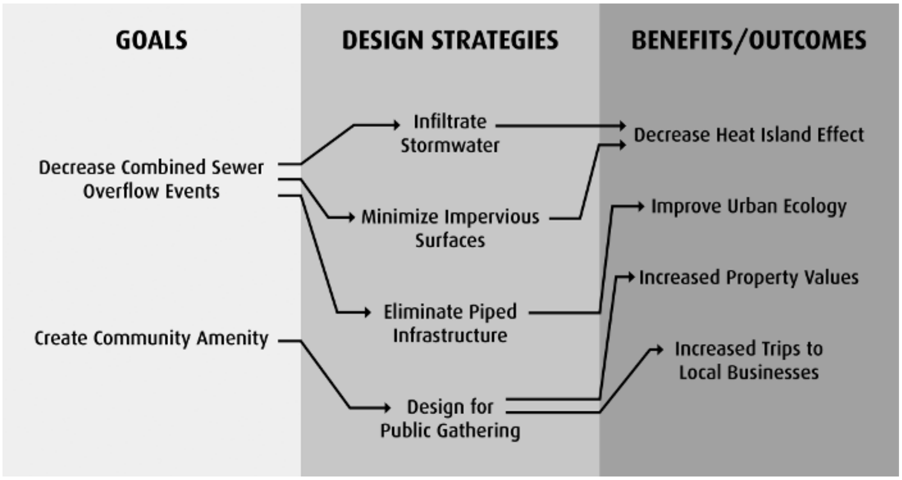


Figure 1-7 Applying integrative design at Old Mint Plaza, San Francisco. The Old Mint Plaza was able to achieve the city's overarching design goals and their associated synergistic benefits through the implementation of design strategies that were integrated within the consultant team's final design. © Sherwood Design Engineers.

Goal Setting at Aquatera, Florida

This large residential housing development on Florida's Gulf Coast was the area's first ecologically sensitive development of its size and nature. With the goal of meeting the county's requirements for improving the hydrological function of the site, the project's landscape architect came to Sherwood to explore landscape-based approaches to stormwater as part of its green streets initiative for the project.

On this type of development, the developer, home builder, and design team typically require buy-off over a multiple-year process that lends itself to value engineering and shortcuts in the field. Understanding the complexities of getting innovative ideas integrated into the project framework and actually built on this type of development, Sherwood proposed a unique method of applying a values inventory that had been developed with AECOM Design + Planning for a previous application in order to generate selection criteria and help prioritize design decisions. This process is detailed below and includes prioritizing project goals, scoring green strategies, and ranking these strategies based on the weighted goals. Because the proposed community center was slated to be a green building, the stakeholders rated the goals for it and for the overall development separately.

SHERWOOD Design Engineers

STAKEHOLDER RESPONSE: RATING AVERAGES

Strategy Division	Project Goal	Averages: Community Center (1=LOW; Total =100)	Averages: Overall Development (10=HIGH; Total = 130)	STAKEHOLDER 1 (Director of Product Design) CC	OD	STAKEHOLDER 2 (Manager, Land Acquisitions) CC	OD	STAKEHOLDER 3 (Associate VP, Sales & Marketing) CC	OD	STAKEHOLDER 4 (Vice President, Planning & Development) CC	OD	STAKEHOLDER 5 (Vice President, Sales & Marketing) CC	OD	STAKEHOLDER 6 (Director of Construction) CC	OD	STAKEHOLDER 7 (Manager, Planning & Development) CC	OD	STAKEHOLDER 8 CC	OD	STAKEHOLDER 9 (Director of Planning & Development) CC	OD	STAKEHOLDER 10 (Director of Construction) CC	OD
Adopt LEED NC																							
1	Adopt LEED NC	9.0		10		8		9		10		8		9		10		8		9		10	
COMMUNITY																							
2	Improve Home Site Aesthetics		7.7		2		5		8		10		7		9		10		10		8		9
3	Heighten Home Site's Sense of Uniqueness		6.6		2		7		5		10		7		7		10		7		4		8
4	Improve Development Amenities		7.3		10		4		7		10		6		7		10		8		4		10
5	Improve Development Aesthetics		7.9		10		6		8		10		8		7		10		8		4		10
6	Heighten Development's Sense of Uniqueness		8.4		10		7		9		10		8		9		10		7		6		10
7	Improve Road and Driveway Aesthetics		6.4		5		7		7		10		3		8		10		5		3		10
8	Increased Pedestrian Connectivity	6.8	5.8	7	7	7	3	6	8	5	1	8	9	8	8	5	1	7	7	8	8	10	10
9	Expand Multi-Use Functionality	6.4	5.4	2	2	8	2	7	7	7	6	8	6	6	6	7	6	5	6	8	8	10	10
ENVIRONMENT																							
10	Improve Energy Efficiency	7.2	8.0	10	10	3	8	7	10	8	8	9	9	8	7	8	8	7	7	5	5	10	10
11	Reduce Carbon Emissions	3.1	3.3	2	2	2	5	2	5	1	1	7	3	6	6	1	1	3	3	4	4	10	10
12	Minimize Embodied Energy	1.9	1.9	1	1	4	3	2	3	1	1	1	1	1	1	1	1	3	3	3	3	10	10
13	Increase Water Efficiency	6.2	6.7	10	10	2	6	8	8	7	7	4	4	7	7	7	7	5	5	6	6	10	10
14	Improve Water Recycling	3.6	3.0	2	2	7	1	7	6	1	1	6	8	4	4	1	1	3	3	1	1	10	10
15	Reduce Stormwater Runoff	3.7	3.8	2	2	4	5	5	5	4	4	3	3	4	1	4	4	4	4	3	6	10	10
16	Improve Stormwater Quality	2.7	3.1	1	1	3	2	7	4	1	4	2	2	4	3	1	4	4	4	1	4	10	10
17	Expand Local Material Use	3.0	2.7	2	2	2	1	2	2	5	4	1	1	3	3	5	4	1	1	6	6	8	8
ECONOMICS																							
18	Increase Marketability and Perceived Value to Potential Buyers	7.4	7.9	10	10	4	6	6	9	8	8	8	9	9	8	8	8	8	8	6	5	10	10
19	Stay within Budget Limits	7.0	5.7	10	10	5	7	7	7	8	4	7	7	6	1	8	4	7	6	5	5	10	10
20	Optimize Maintenance Requirements	6.7	5.1	10	10	7	8	7	5	6	3	4	4	7	1	6	3	5	4	8	8	10	10
21	Increase Systems Durability	6.0	5.1	10	10	6	7	7	5	5	5	3	3	7	1	5	5	5	4	6	6	10	10
CONTEXT																							
22	Maximize Practice of Locally Appropriate Construction	3.1	1.8	2	2	4	2	0	0	5	2	3	3	1	1	5	2	7	2	1	2	8	8
23	Create Positive Influence on Future Development	2.7	3.4	4	4	5	4	0	0	1	1	6	6	1	9	1	1	2	2	4	4	9	9
24	Reinforce Good Neighbor Policy		2.9		1		7		0		3		2		2		3		4		4		10
25	Advance Codes to Support Project Goals	2.3	2.3	1	1	7	7	0	0	1	1	2	2	1	1	1	1	2	2	6	6	10	10
26	Encourage Positive Influence on Lifestyle/Awareness	6.1	3.9	2	2	9	7	6	1	8	3	5	6	4	3	8	3	8	5	5	5	10	10
27	Expand Positive Influence on Environmental Stewardship	4.9	2.9	2	2	3	3	5	1	8	3	3	3	4	1	8	3	6	5	5	5	10	10
		100	129	100	130	100	130	100	130	100	130	100	130	100	130	100	130	100	130	100	130	195	262

Figure 1-8 Stakeholder response: rating averages. A stakeholder survey for a project allows the design team to prioritize and weight the client's goals. © Sherwood Design Engineers.

Prioritizing Project Goals

As per Figure 1-8, the stakeholders listed across the top were asked to rate each of the project goals listed down the left side for both the community center and the overall development. Each goal could be scored from 1 to 10, but the total points had to add up to a specific number, thereby requiring the stakeholders to prioritize goals. (One individual, at the far right, didn't follow these instructions and ranked virtually every goal a 10, for a total score of 262; his numbers had to be recalibrated.)

After everybody ranked the project goals, they were given a combined weighting factor, which indicated their overall importance to the team. In this case, the highest priority for the community center was to adopt the LEED for New Construction Rating System (LEED-NC), while the winning priority for the overall development was "heighten development's sense of uniqueness."

Scoring Green Strategies

In the next phase of the exercise, the design team scored a list of green strategies in terms of their impact—positive, negative, or neutral—on each of the project goals from the survey results. For instance, a materials strategy like "reusing local aggregate for landscaping" has no impact on the project aesthetics, because it is buried and invisible. But reusing that heavy material on-site does reduce the embodied energy of the project.

Ranking the Winners

The green strategies' scores were then multiplied by the weighted ranking given to each goal by the stakeholders. In this way, each of the green strategies was given a final ranking based on its overall impact on the project goals that were of high priority to the stakeholders.

For the Aquatera Project, the top five goals were as follows:

Community Center Goals
Overall Development Goals

1. Cisterns for rainwater collection on rooftops
   Stormwater capture parks/Outdoor event parks
2. Landscape irrigation via harvested rainwater
   Sustainable living maintenance manual
3. Sustainable living maintenance manual
   Visible stormwater feature/Art installation
4. Stormwater capture parks/Outdoor event parks
   Community nursery/Greenhouse
5. Locally appropriate plantings
   Locally appropriate plantings

This process yields a wealth of data about the project and clarifies why some strategies are getting prioritized. For instance, the second-ranked goal for the community center was "landscape irrigation via harvested rainwater." This strategy scored high for its positive impact on important goals like "increase water efficiency" (weighted 6.3) and "increase marketability to potential buyers" (weighted 7.4), while having no negative scores, even on economic goals (including "stay within budget limits"). The second-ranked goal for the overall development was "sustainable living maintenance manual," which scored high on two important goals—"heighten development's sense of uniqueness" (7.8) and "improve energy efficiency" (7.6)—while having only one negative: "stay within budget limits." The number one goal for the overall development, "stormwater capture parks," was a mixed bag. Despite slight negatives on energy and economic goals, it ranked positively for a large number of community, environmental, and contextual goals, and received the highest ranking.

This type of sophisticated analysis integrates values, goals, and strategies in a transparent, participatory way that allows a group of stakeholders to gain clear consensus on their programming priorities. As the landscape design moved forward, it focused on xeriscaping strategies wherever possible to minimize water use and lend a unique flavor not found within other projects of this scale in the area.