RESOURCEFUL BY NATURE

By Randolph R. Croxton, FAIA

Founded in 1970 by a group of law students and attorneys, the Natural Resources Defense Council (NRDC) helped write some of America’s bedrock environmental laws. Today’s NRDC has a staff of more than 300 lawyers, scientists and policy experts, supported by 1.3 million members and online activists. They collectively work to curb global warming in six national and international offices. NRDC’s mission is to create a clean energy future, revive the world’s oceans, prevent pollution, defend endangered wildlife and foster sustainable communities.

In 1988, NRDC began renovating a former light industrial loft space in New York’s Flatiron district to house its main office. The goal was to put its environmental principles into practice by designing an office that dramatically cuts energy use and demonstrates to architects, builders and businesses that “green building” concepts can create more humanistic and productive workspaces. To ensure that the office would be a model for others, NRDC insisted on using only commercially available materials and technologies.

In an age of deskbound computers, no Internet and primarily face-to-face interaction, the NRDC Headquarters office that opened in 1989 at 40 West 20th Street was a healthier and higher productivity model (soon to be called “green” design) that still cut conventional energy consumption in half. Twenty-four years later, NRDC turned to the same architecture firm to create an enterprise-wide reinvention of its work environment in the context of the Internet, iPad, smart phones and GoToMeeting.

The scope of the project anticipated the expansion and renovation of NRDC’s six offices. Performance challenges included additional levels of resourcefulness in energy and water consumption, building materials, space per unit of productivity, and a new resourceful life-of-project operational strategy that can accommodate expansion and reconfiguration with minimum staff downtime and minimum disruption/contamination of building systems. The highest return on the construction dollar, human productivity in the designed space, was advanced through 100% daylight and views, three tiers of visual connectivity (balancing privacy and collaboration), advanced indoor air quality and multiple work modes. This case study profiles the test bed for the project rollout: the eighth floor prototype of the NRDC’s New York offices, which is the physical concept of the Strategic Plan to be incorporated throughout the remaining floors of the organization’s 60,000 ft² headquarters and the offices from Chicago to Beijing. The project achieved the highest LEED Platinum rating for a Commercial Interior under LEED-CI v2.0 by scoring well in eight key metrics.
NRDC challenged the team to go beyond these traditional metrics in all design strategies that could elevate performance. The core programmatic process of the client/architect team was a collaborative series of work sessions. The sessions ranged from a self-critical analysis of NRDC’s existing facilities to a visioning session that identified operational procedures, to emerging environmental issues that would impart mission-specific attributes, which had to be validated by the underlying science or peer-recognized standards of practice.

**Top 10 Design Values**

The results of the work sessions were expressed in the Strategic Plan as a set of Top 10 Design Values, delivering qualitative and quantitative attributes, which had to be validated by the underlying science or peer-recognized standards of practice.

**KEY SUSTAINABLE FEATURES**

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**Water Conservation**
Toilets 1.28 gallons/flush, touchless sensor operated
Urinals 0.125 gallons/flush, touchless sensor operated
Faucet 0.5 gallons/minute, touchless sensor operated, solar panel to recharge sensor battery

**Recycled materials**
Insulated Panels 85% recycled content
Doors 70% recycled content
Cabinets/Woodwork 100% recycled content
Paneling 100% recycled content
Ceiling Tile 70% recycled content
Gypsum Board 98% recycled content
Toilet Parts 100% recycled content
Lobby Bench, Pantry Bar Counter, Pantry Tables 100% reclaimed wood

**Lighting Controls**
Lighting advanced daylighting

**Daylighting**
U-Value 0.27
Visible Transmittance 0.64
Shading Coefficient 0.31

**Window Blinds**
Each window has two sets, top set solid slats, bottom set perforated slats to reduce glare but maintain views, blinds are white for enhanced daylighting, 56% recycled content

**Faucet**
Sensor operated

**Toilet Parts**
Sensor operated

**HVAC**
40.3% better than ASHRAE/IESNA Standard 90.1-2004

**Light Power Density**
2004

**Water Efficiency**
46% better than EPAct (96,820 gallons/year saved)

**Construction Waste Management**
96% diversion from landfill
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3 **Resourceful:** A broad category that includes the traditional categories of energy and water conservation as well as renewable energy. Additional strategies were a 72% reduction in total materials per permanent scientist/attorney work area and a projected 96% reduction in life-of-project construction waste stream related to renovation/reconfiguration achieved by Design for Disassembly. (Every work surface and wall except the building core, elevators, bathrooms, etc., is an assembly/disassembly item; no internal fixed drywall, sparkle, paint surfaces, etc.)

4 **Long Life/Loose Fit:** The key to long-term flexibility, minimum disruption of ongoing operations and quick response to future opportunity. The design response is reflected in a universal standard for the open workstation’s “shell” for professionals and staff, which has tel/data and power infrastructure that is unaffected by flexible upgrade/downgrade of components to achieve single, double, or, in some cases, triple occupancy modes. (See Floor Plan.)

Below Original decorative window railings refinished. Local gardens beyond are beginning to sprout.

Bottom Reclaimed New York wood reworked for table at the pantry.
5 Teaming Culture: Key to creative and innovative NRDC culture. Design response includes unassigned multi-functional Team Rooms, informal “Living Room” sitting/gathering space, as well as a 100% perimeter “commons” access to light and air—a social corridor. All-in-all, the space facilitates spontaneous and cross-disciplinary interaction. A core feature is seated eye-level privacy with standing full view of the north or south half of floor plate.

6 Mixed Mode Functionality: Unassigned acoustically private spaces that have four key functional modes (see Adaptable Design). The Team Rooms facilitated the consensus to break away from enclosed offices for professionals, as long as they were supplemented with remote functioning (virtual workplace) when away from the office. This feature was also key to providing a population density “flux” capability to accommodate summer interns, fellows and future growth.

7 Indoor Air Quality: Moving beyond the VOC criteria of LEED-CI v2.0, a screening protocol addresses a broader spectrum of building materials injurious to human health. Some examples are below.

**Example Building Materials Hazardous to Human Health**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Hazard</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethylene dichloride</td>
<td>Carcinogenic, Neurotoxicant</td>
<td>Plastic Welding Adhesive</td>
</tr>
<tr>
<td>1, 2 Dichlorobenzene</td>
<td>Endocrine Toxicant, Neurotoxicant</td>
<td>Plastic Foam Insulation</td>
</tr>
<tr>
<td>Crystalline Silica</td>
<td>Lung Disease, Neurotoxicant</td>
<td>Joint Compound</td>
</tr>
<tr>
<td>Dimethylphthalate</td>
<td>Carcinogenic, Neurotoxicant</td>
<td>Pressure-tired wood</td>
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</tbody>
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In the upper right corner (NE) and the lower left corner (SW) of the floor are the informal and formal shared conference rooms on the “Social Corridor” loop, while the four shared team rooms with acoustical privacy are centered in the plan.

Social Corridor along north elevation provides unbroken walkway around the entire floor and also passes tangent to the south façade. Note the reflection of sunlight from the building to the north, a common attribute of urban settings.
8 Thermal Comfort: First requirements were to meet LEED framework. Going beyond those metrics, the social circulation spaces (i.e., perimeter wall and interconnected stairway) will have the most thermal variability and natural light, which works well in a social space where you want sunlight while also achieving a thermal/glare “buffer.”

9 Renovation “Detox”: The elimination of destructive demolition and reconstruction and spackle/painting/sanding (crystalline silica in pre-existing core walls, respirable particles, etc.) improves the environmental quality of this floor. In addition, the entire building population benefits because air pressure differentials (elevator stack effect, etc.) distribute particulates and vapors throughout the building. The change agent is the screwwriter, not the sledgehammer!

10 Breaking the Shell: For NRDC, moving away from private offices as a default for professionals was informed by more than just the requirements for design for disassembly. Rather than small, enclosed air pockets of rooms (which are more vulnerable to a spill or error in paint selection over a weekend), there is a massive and diffusing “commons” of light and air that provides an inherently safer work environment. Importantly, the quantified reduction in “materiality” (the sum total of visible and invisible materials and systems necessary to achieve functionality per person) was dramatic. (See Suburban Model vs. Nature’s Model.)

The Metrics Challenge

One area needing improvement was that of measuring sustainability. For instance, by finding ways to increase the net density of NRDC’s population, the per capita consumption of energy, materials and capital was reduced and yet it is not fully reflected in the BTUs per square foot metric. The reason is that more people are accommodated per floor. Another challenge is a higher utilization factor (early morning, late evening) at NRDC than is typical in this building type, which also is not accommodated in the traditional building type with kBTUs per square foot model. This gets back to one of Buckminster Fuller’s favorite questions: “How many..."'

A NATURAL SETTING

Full spectrum light as applied to the design of NRDC refers to the maximum use of and access to natural daylight throughout the interior. Artificial light cannot reproduce the full electromagnetic spectrum of sunlight that our eyes have evolved to capture. And, most importantly, it does not impart the biological rhythms (circadian rhythms) and seasonal variation in length of day. Our responses to the dynamic characteristics of natural light (direction of the source, vertical height, color, duration) and the interaction with passing clouds, weather change, surrounding buildings and the sun’s dramatic rising and setting are all conscious and subconscious connections to not just physical orientation (where we are) but also to temporal orientation (when we are). The greatest misconception in the integration of daylight is the glass-to-the-floor concept of more is better. The integration of daylight is the glass-to-the-floor concept of more is better. The integration of daylight is the glass-to-the-floor concept of more is better. The integration of daylight is the glass-to-the-floor concept of more is better.

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Climate. To accomplish this, the energy consumption per square foot can be expressed as per average operational hour, and a climate factor could be applied to level a Monte Carlo, building to a building in Gainesville, Fla. In the case of NRDC, the supporting physical infrastructure and energy required per occupant in a given climate is the leveling metric being developed for each location. Therefore:

\[ \text{(average energy/person/hour)} \times (\text{climate factor}) = \text{measurable metric} \]

The long-term sustainability benefits of design for disassembly also will vary depending on “churn rate,” or frequency of change within an organization. Therefore, if no history exists (as in the case of NRDC), it requires detailed and extended post-occupancy reporting to establish the equivalent of an energy payback and life-cycle cost analysis.

Innovative Design

The chronic underuse of enclosed or private office space is the norm in the United States (60% vacant) and, if anything, was even higher in the case of NRDC, given its requirements for work in the field and the increasing ability to work remotely. The necessity for a private office for writing and analytical tasks has always been a given (don’t go there) in office planning for NRDC. However, Ashok...
Gupta, NRDC’s Director of Energy Policy, stepped forward in the work sessions to say that he and his group would be the first “colonists” of the eighth floor prototype.

The design process was a “clean sheet of paper” exercise in how to move much further, much faster by leveraging technological advancements (iPad, smart phones, GoToMeeting, etc.). Looking at a typical time and use profile, it became clear that the combination of a much smaller and open work space (60 ft² vs. 120 ft²) combined with enhanced connectivity to work remotely and, when needed, the ability to take any office calls or redirect office calls to any work point on the floor plate could create a more resourceful and flexible physical infrastructure for NRDC. However, the greatest benefit is proving to be the enhanced collaborative and team-centered work modes.

This quantitative enhancement would not result in long-term productivity and teaming culture advantage unless the qualitative attributes identified in the “Top 10 Design Values” work sessions could be included. The most common frustration expressed with all forms of open plan is balancing the sense of visual privacy and sense of “my domain” with connectivity to colleagues, open space and community when desired.

Workstations
The three-tiered layering of solid, translucent and transparent form throughout the work spaces offers seated visual privacy with a right-angle corner to turn into for fully blocked peripheral vision. Translucent panels allow light to reach all desktops.

All solid bases (desktop to floor) are modular for functional retrofitting as required. Upper zone transparency allows direct views to the upper zone “commons” portion of the windows by all professionals and staff in Team Rooms or workstations.

Mechanical Systems
Circulation, horizontal and vertical, is organized to pass by the exterior wall with comfortable variability in temperature and naturally changing sunlight quality. This is the essence of a social and dynamic space. It allows for a lower ambient temperature setting for heating and cooling than at the more variable perimeter edge, which is a source of complaints that drive greater energy consumption than necessary.

The mechanical system, a high-efficiency direct expansion (DX) unit and fully integrated BMS with water-side economizer cycle, couples with nature to capture free cooling throughout the winter and shoulder seasons. A 5.55 kW rooftop photovoltaic array was constrained in NRDC’s urban location by surrounding structures shading the roof. However, the remainder of the roof is being developed as a green roof, urban agricultural garden and apiary (see Roof Plan).

A continuing built-in frustration is that the base building’s central boiler uses fuel oil and is a number...
of years away from a changeover, and the basement is too space-constrained for ice storage technology at this point. Both issues are on the long-term agenda for sustainable technology upgrades.

**LESSONS LEARNED**

Waterless urinals, used in multiple previous renovations over the years, have been monitored for operational function/efficiency and were ruled out by NRDC as environmentally superior. The volumes of storm water carried by sidewalks in NYC are not just what falls on the sidewalk, but also the large amounts of rainwater that sheet down the face of the buildings, adding significantly to the storm water management potentials of this strategy.

**Conclusion**

The NRDC project team accomplished three transformational design tasks:

1. Set aside the private office as a default standard for the scientists and attorneys of NRDC, by using Internet, telephony and personal video interconnectivity and privacy options within the "commons." This increased net density by more than 30%.

2. Provide every occupant with direct visual access to nature while preserving a sense of a personal domain.

3. Create a "social circulation" pathway at the building perimeter for interaction that is sunlit, ther-mally variable and interconnected to formal and informal conference rooms and adjacent floors.

Three areas of enhanced performance and quality, not currently embodied in architectural/engineering practice, were central to the NRDC effort:

1. Measures/metrics of performance in energy and materials. Moving from kBtus per square foot by building type to a more nuanced metric of climate/duration leveling may have an obvious advantage; however, having transparency about the total consumption of materials to meet mission is a new challenge. Just as some projects list cost as confidential, some projects may choose to handle the materiality of their solution in the same manner. If we are to learn how to do more with less, we need these metrics.

2. Full spectrum screening of materials used. While VOCs are considered a qualitative screening issue, an array of carcinogenic, neurotoxic, endocrine disruptive, etc., substances in building materials remain invisible. This is an enormous opportunity for qualitative enhancement.

3. Maximum daylight commons. Daylighting remains an underused and "no cost" asset typically characterized as useful in only the outer 15 ft of the typical floor. Deep daylighting strategies extend subtle, but essential, qualities of full spectrum light into the heart of the building.

All of these areas are extensions of the foundational high performance strategies of best practice: the envelope upgrade, the HVAC equipment efficiencies, the water conserving fixtures, the daylight dimming, the free cooling, etc.

They are but hints of the massive challenges of continuous improvement and innovation that will be required as we strive for the ultimate high performance threshold: sustainability.

**ABOUT THE AUTHOR**

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