Case Study presented to
The United States Green Building Council
Seeking LEED® NC Version 2.1 Gold Certification
for the newly constructed museum
Building Details

OWNER .............................................. Grand Rapids Art Museum

LOCATION ........................................... 101 Monroe Center, Grand Rapids, Michigan 49503

BUILDING TYPE ................................... Fine Art Museum

BUILDING PROGRAM ............................... Indoor: Lobby, Circulation, Art Galleries, 285-seat Auditorium, Library, Dining Room, Kitchen, Book & Gift Shop, Art Storage, Offices, Conference Rooms, Restrooms, Other

Outdoor: Education, Garden, Loading Dock, Other

SCOPE .................................................. 125,000 sf

COST .................................................. $75 million

SETTING ............................................. Re-developed downtown city block (148,000sf) bounded by Monroe Avenue, Monroe Center, Ottawa Avenue and Louis Street, adjacent to Rosa Parks Circle

CONSTRUCTION ................................. 2004 - 2007

DEDICATION ....................................... October 5, 2007

AWARDS TO DATE ............................... Newsweek’s Six Most Important Buildings of 2007

SEEKING LEED® RATING ......................... Gold

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FOUR SALVAGED BOXES Exhibit currently at GRAM

Photo ©2007 Kulapat Yantrasast
Dedicated and opened in October 2007, the new Grand Rapids Art Museum (GRAM) is seeking LEED® Certification at the Gold Level. This culminates a quest by the Museum donors, trustees and staff, and the design and construction team, to create a place which is both a beautiful, commodious environment in which to contemplate art, and a neighborly institution in downtown Grand Rapids, exemplifying great sensitivity to how it impacts our environment.

This study documents the analyses and design decision-making process we undertook in pursuing a LEED® Gold certification. It also contains an accounting of the individual LEED® points we sought, and identifies specific systems, products, and methods we deployed to reach these goals.

From the seven years we've spent realizing this new museum, we've also outlined insights our team gained. It is our hope that these lessons learned, and shared, will embolden other institutions with exacting building requirements to integrate into their building programs the highest possible standards of LEED® certification.
New Building Team

Most members of the GRAM building team were new to the stringent design requirements for a fine art museum. Some had prior experience in design problem-solving with LEED® requirements for other building types. Four team members (*) below are LEED® Accredited Professionals.

OWNER
Grand Rapids Art Museum
101 Monroe Center
Grand Rapids, MI 49503
Michael Ellis, President of the Board
Celeste Adams, Museum Director
Randy van Antwerp, Finance Director

OWNER’S REPRESENTATIVE & PROJECT MANAGER
The Rise Group, LLC, Chicago
David Crowell
Peter M. Van Dyk
Thomas Calmeau

DESIGN ARCHITECT
wHY Architecture, Los Angeles
Kulapat Yantrasast
Yo Hakomori
Aaron Loewenson

ARCHITECT OF RECORD
Design+, Inc., Grand Rapids
Dave Mester
Douglas P. Smith
Ryan Garone, LEED AP*

GENERAL CONTRACTORS
Rockford / Pepper Construction, Grand Rapids
Shane Napper
Debra Sypien, LEED AP*

COST ESTIMATOR
Morgan Construction, Barrington, IL

COMMISSIONING AGENT
Carter & Burgess, Inc., Chicago
Stephen R Koenig, LEED AP*

STRUCTURAL ENGINEER
Dewhurst Macfarlane and Partners, New York

CONCRETE POUR
Photo ©2007 Kulapat Yantrasast

ENVIRONMENTAL ENGINEER
Atelier Ten, London

MECHANICAL, ELECTRICAL & PLUMBING ENGINEERS
Design+, Inc., Grand Rapids
Jim Wedeven
Marty Morgan
Lynn Surdock

LIGHTING CONSULTANT
Isometrix Lighting + Design, London
Filip Vermeiren

CIVIL ENGINEER
Moore & Bruggink, Grand Rapids

LANDSCAPE ARCHITECT
Design+, Inc., Grand Rapids
Matt Heidloff, RLA, LEED AP*

CURTAIN WALL CONSULTANT
W.J. Higgins & Associates, Wausau, WI

CONCRETE CONSULTANT
Reginald Hough, Larchmont, NY

INITIAL CONCEPT DESIGNER
Munkenbeck+Marshall LLC, London

CONCRETE CONTRACTOR
Grand River Construction, Grand Rapids
Vision & Financing

VISION

The early – and enduring – vision for this new building manifested when the museum’s Board of Trustees approved an expansion program in 2000. Soon thereafter, Grand Rapids philanthropist and long-time environmentalist Peter Wege pledged $20 million to the capital campaign, with the stipulation that the new museum building pursue LEED® Certification.

Mr. Wege believes that viewing art can and should engender a profound educational experience. He challenged GRAM to create a museum to showcase a growing art collection, and to be environmentally sensitive, for the greater good of Grand Rapids. Through the expression of his ideals and his financial generosity, he inspired the design team to aim for a LEED® certification. Ultimately the design team reasoned internally that it was feasible for the museum to pursue LEED® Gold.

It is no surprise that the initial impetus for a new art museum to seek LEED® Gold occurred in Grand Rapids. The area already has a rich concentration of over 30 LEED® registered projects, which qualifies it as one of the most LEED-conscious regions in the country. Western Michigan is home to world-renown furniture companies including Steelcase, Herman Miller, Knoll, and Haworth, all pioneer thought leaders in and practitioners of environmentally sensitive manufacturing, recycling, and consumer education. Michigan has more waterfront than any other state, and especially in Western Michigan, conservationists have long been proactive in protecting the waterfront in particular and the environment in general. Locally, there is a strong cultural reinforcement of the importance of stewardship of natural resources.

"We are delighted to be a symbol of culture and community pride at the heart of Grand Rapids. With our central location, we seek to energize residents about both art and the environment," notes Museum Director Celeste Adams.

FINANCING

The museum’s capital campaign raised $76+ million in pledges from 38 foundations, 75 corporations, and 1100 individuals, and $10 million in Series B bonds. The GRAM received $100,000 from the The Kresge Foundation through its Green Building Initiative.
The new museum stands adjacent to Rosa Parks Circle, and completes the renewal of this 148,000sf block in downtown Grand Rapids, where it replaced a surface parking lot. The site was the distinct first choice (of six sites considered) for the new building, prized for the opportunities it presented to transform the city center, and capitalize on the proximity of the park, which offers an ice skating rink in winter. Under the building’s north portico, museum and park fuse to provide an outdoor space for environmental education programs, festivals, and other activities in every season.

GRAM is readily accessible via city bus, at the center of the downtown business district within a four-block walk of most major office buildings. The museum accommodates storage racks for ten bicycles, and changing rooms for employees. Five parking structures exist within a one block vicinity, so no additional public parking was built. The museum installed snowmelt coils beneath sidewalks along streets bounding the site to promote walking. Since the museum’s opening, Louis Street to the south has been re-energized and sees substantially increased foot traffic.

Trees and plantings were chosen for their native or adaptive qualities, and are zoned to take on the character of the season. Irrigation is timed and can be monitored and adjusted to reflect spot conditions. Stormwater runoff is collected and stored in cisterns which form the core of the museum’s grey water system.

Very early in the design process, a green roof was deemed incompatible with building requirements; however, the museum achieves other heat island reductions through the use of a white roof and the selection of light colored exterior paving materials. Since all parking is achieved underground and off site, the museum achieves heat reduction credit 7.1.

**LEED-NC VERSION 2.1: SUSTAINABLE SITES**

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<tr>
<th>PT</th>
<th>CREDIT NAME &amp; NUMBER</th>
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<tr>
<td>Y</td>
<td>Erosion &amp; Sedimentation Control (Prerequisite)</td>
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<td>Site Selection (Credit 1)</td>
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<td>Development Density (Credit 2)</td>
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<td>Alternative Transportation - Public Transport Access (Credit 4.1)</td>
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<tr>
<td>1</td>
<td>Alternative Transportation (Bicycle Storage/Changing Rooms) (Credit 4.2)</td>
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<td>Alternative Transportation (Credit 4.4) (Parking Capacity/Carpooling)</td>
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<td>1</td>
<td>Stormwater Management (Credit 5.1) (Rate and Quantity)</td>
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<td>1</td>
<td>Landscape &amp; Exterior Design to Reduce Heat Islands, Non-Roof (Credit 7.1)</td>
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<tr>
<td>1</td>
<td>Landscape &amp; Exterior Design to Reduce Heat Islands, Roof (Credit 7.2)</td>
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</table>

**TOTAL POINTS (OF POSSIBLE 14)**
Water Efficiency

GRAM relies on a grey water collection and storage system. Cistern tanks are sized to store runoff water equivalent to a ‘one hundred year’ storm.

Water is captured from the roof and stored in cisterns. Located in the garage, the cisterns are 15’ tall each, with a combined capacity of 19,000 gallons. The grey water is used by the reflecting pool and water wall in the pocket park next to the entrance, to irrigate plants and trees on the site, and for toilet flushing.

By reusing collected rainwater in this way, GRAM estimates it will reduce its demand for city-treated water by 20%. City water enters the system only when there is not enough rainwater stored. Together, these measures also afforded the GRAM a LEED® water use reduction credit of 40%.

LEED-NC VERSION 2.1:
WATER EFFICIENCY

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<td>1</td>
<td>Water Efficient Landscaping - Reduce by 50% (Credit 1.1)</td>
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<td>1</td>
<td>Water Efficient Landscaping - (No Potable Use or No Irrigation) (Credit 1.2)</td>
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<tr>
<td>1</td>
<td>Innovative Wastewater Technologies (Credit 2)</td>
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<tr>
<td>1</td>
<td>Water Use Reduction (Credit 3.1) (Reduce by 50%)</td>
</tr>
<tr>
<td>1</td>
<td>Water Use Reduction (Credit 3.2) (Reduce by 30%)</td>
</tr>
</tbody>
</table>

5 TOTAL POINTS (OF POSSIBLE 5)
Energy & Atmosphere

HEATING, VENTILATION & AIR CONDITIONING

Given the delicate nature of fine art, and the imperative to keep museum temperature and humidity tightly controlled (the optimum relative humidity is 50%, and the temperature setpoint is 72°F), one early concern was how to meet indoor air quality standards and reduce energy consumption. Several concepts for gaining heating and ventilation and cooling efficiencies were vetted and abandoned, generally out of aesthetic or cost concerns. These included an underground heat sink labyrinth system for pre-tempering outside air, solar walls, and photovoltaic cells embedded in a glass canopy.

The chosen system of displacement ventilation meets ASHRAE 55 standards, in accordance with LEED® guidelines. In the lobby and galleries, air is discharged at low velocities from the floor, so supply air does not need to be as cold (generally, 65° v. 55° F) as with other systems, and supply fans consume less energy. Most cooling occurs just above the floor, where the people are. Evaporative cooling lowers the air temperature of the outdoor air to make it more effective for use as condenser air, removing the heat from the refrigerant cooling cycle, thereby averting the need for a rooftop cooling tower. Secondary spaces (storage, toilets, etc.) are exhausted to the outdoors through heat recovery units which pre-heat outdoor air used for ventilation, per the building code.

Energy recovery wheels preheat and precool outside / fresh air using exhaust air. It is more effective than fixed exchangers which are also used in air handling units at the GRAM which do not use outside air. Energy recovery wheels get more cost effective as they get bigger. Fixed exchangers mostly transfer sensible heat (they work mostly in the winter) while wheel exchangers transfer both sensible and latent heat (they take humidity out of the air during the summer).

LIGHTING

A second imperative in housing and displaying fine art is to control the quantity of natural light to which art pieces are exposed. Too much natural light is as hazardous to art as are too much heat or humidity. The challenge for the design team became how to capitalize on the building's footprint and massing (which maximized exterior walls) and the site's openness (facing a park) to harness natural light, which is generally the most pleasant to be in, while not creating conditions that are inherently harmful to displaying art.

Relying on the building's sections to discover how best to harmonize the requirements for art display, aesthetics, and LEED® Gold, the team determined two principal means for admitting daylight: 'lanterns' atop the three main gallery spaces, and triple glazing shaded by louvers in the lobby and circulation spaces.

In the museum's main windows (Figure 1, page 9), daylight enters the building through a series of fixed aluminum louvers. Between layers of glass, Argon gas refracts a portion of light waves from the building interior.
rendering and dimming capability. In areas where high light levels were required, lighting was supplemented with more efficient metal halide or fluorescent lamps.

Although the fittings could take 250W PAR lamps, through mock-ups the team discovered that museum requirements could be met with PAR halogen lamps ranging from 75 to 100W. This enabled specifying the precise wattage needed, as opposed to a more common practice of specifying more wattage than needed and scrimming down light levels to achieve the desired effect.

Together, the HVAC and lighting systems and efficiency measures are designed to yield a 34% cost savings (and 30% less energy consumed) when compared with a baseline building. All fittings are ‘local’ US products.

Atop the galleries (Figure 2, at right) light enters the three lanterns on all sides, through louvers between sheets of glazing. Inside the building, operable blinds enable further control over the admission of daylight.

Although museum lighting is exempt under ASHRAE, GRAM lighting design conforms to control and energy consumption standards of ASHRAE 90.1. Indirectly, the lighting load was reduced to suit the indirect heating system.

While not the most energy efficient, spotlights are tungsten source, due to their good colour
The design team aggressively pursued using as many recycled and locally produced materials in the building as were aesthetically and economically feasible.

**RECYCLED MATERIALS**

GRAM earned a 20% credit for recycled building materials used in this project (see table below). Many of the materials can be recycled again.

Although The City of Grand Rapids already has progressive trash collection and recycling policies which make it relatively convenient for institutions and citizens to participate, throughout the construction on this project, the contractor practiced careful sorting, disposal and materials management.

**LOCAL MATERIALS**

A key driver of energy consumption and equipment emission in nearly any construction project is the transport of building materials to the site. The design team identified significant materials options that were sourced and produced within 500 miles of the site. GRAM earned a 'local materials' credit for over 58% of materials from appropriate sources.

### RECYCLED MATERIALS

<table>
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<tr>
<th>MATERIAL</th>
<th>COST</th>
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<tr>
<td>Rebar</td>
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<td>Structural Steel</td>
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<td>Concrete</td>
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<td>Raised Flooring</td>
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<td>Hardware</td>
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<tr>
<td>Masonry</td>
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<tr>
<td>Metal Doors &amp; Frames</td>
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<td>Landscaping</td>
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<td>Roofing</td>
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<tr>
<td>Overhead Doors</td>
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<td>Wood Doors</td>
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<tr>
<td>Fireproofing</td>
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<td>Millwork &amp; Custom Casework</td>
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<tr>
<td>Tackboards</td>
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**RECYCLED MATERIALS, VALUE $3,130,537.75  20.56% RECYCLED**

**ALL MATERIALS, TOTAL VALUE $8,057,140.99**
LEED-NC VERSION 2.1: MATERIALS & RESOURCES

PT CREDIT NAME & NUMBER

Y Storage & Collection of Recyclables (Prerequisite 1)
1 Construction Waste Management Divert 50% (Credit 2.1)
1 Construction Waste Management Divert 75% (Credit 2.2)
2 Recycled Content - Specify 5% & 10% Post-consumer & Post-industrial (Credit 4)
2 Local / Regional Materials - of 20% above, 50% harvested locally (Credit 5)

6 TOTAL POINTS (OF POSSIBLE 13)

REGIONAL MATERIALS

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<td>Windows</td>
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<td>Tackboards</td>
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<tr>
<td>Stains, Lacquers and Sealers</td>
<td>$6,431.00</td>
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<tr>
<td>Sealants and Caulking</td>
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<tr>
<td>Finish Carpentry</td>
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<tr>
<td>Trash Receptacles</td>
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LOCAL / REGIONAL MATERIALS, VALUE $4,737,738.43 58.8% REGIONAL
ALL MATERIALS, TOTAL VALUE $8,057,140.99

ENTRANCE TO BOOK & GIFT SHOP
Photo ©2007 Chris Barrett, Hedrich Blessing
Indoor Environmental Quality

Although museum-specific HVAC and lighting requirements are stringent and somewhat challenging to reconcile with LEED® standards using conventional means, indoor air and environmental quality standards for museums dovetail very well with LEED® requirements. Both standards strictly preclude smoking in all areas of the building.

The museum’s ventilation system incorporates carbon dioxide (CO₂) controls to track continuously the levels of CO₂ present in the building, and trigger the ventilation system to admit more new outside air as needed.

The museum makes extensive use of materials certified as ‘Low-Emitting,’ including 29 adhesives, 6 paints, 3 types of carpeting, and 4 types of wood and agrifiber products. The overall levels of volatile organic compounds (VOC g/l) actually specified are less than one-quarter the allowable levels under LEED® certification standards.

LEED-NC VERSION 2.1: INDOOR ENVIRONMENTAL QUALITY

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<td>Minimum IAQ Performance (Prerequisite)</td>
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<td>Environmental Tobacco Smoke Control (Prerequisite)</td>
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<td>Carbon Dioxide (CO₂) Monitoring (Credit 1)</td>
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<td>Low-Emitting Materials, Adhesives &amp; Sealants (Credit 4.1)</td>
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<td>Low-Emitting Materials, Paints (Credit 4.2)</td>
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<td>1</td>
<td>Low-Emitting Materials, Carpet (Credit 4.3)</td>
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<td>Low-Emitting Materials, Composite Wood &amp; Agrifiber (Credit 4.4)</td>
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<td>Indoor Chemical &amp; Pollutant Source Control (Credit 5)</td>
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<td>Thermal Comfort, Comply with ASHRAE 55-1992 (Credit 7.1)</td>
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<tr>
<td>1</td>
<td>Thermal Comfort, Permanent Monitoring System (Credit 7.2)</td>
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9 TOTAL POINTS (OF POSSIBLE 15)
GRAM is deeply committed to leading by example in Grand Rapids, and among museums everywhere. In preparation for the museum’s opening, GRAM officials spoke extensively in the community, emphasizing aspects of the museum which focus on its sensitivity to the environment, and the process of seeking LEED® Gold Certification. Currently on view at the museum is ‘Four Salvaged Boxes,’ an exhibit showcasing the approach and process of designing a new art museum with the added challenges of being most energy efficient and friendly to the environment.

The design of the open portico reaching into the year-round park affords an excellent venue for educational activities for adults and children. Saturday morning programs and guided tours are available to groups and individuals by request.

The museum created an entire branding campaign, "eARTh friendly," which showcases the interconnectivity between the earth and art. This message is applied extensively in publications and merchandise in the museum book and gift shop.

LEED® Accredited professionals on the project covered many disciplines. They included: Ryan Garone and Matt Heidloff of Design+, Debra Sypien of Rockford / Pepper Construction, and Steve Koenig of Jacobs Carter Burgess.

GRAM policies for maintenance and housekeeping are highly commensurate with ‘green’ housekeeping principles. Paper products used for cleaning are recycled. Cleaning chemicals have the green seal of approval, and dispersal systems to eliminate waste. Hardware used by cleaning personnel is optimized to protect air quality, and minimize water consumption and noise levels.

LEED-NC VERSION 2.1: INNOVATION & DESIGN PROCESS

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<td>Innovation in Design Exemplary Performance WEc3 (Credit 1.1)</td>
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<td>Innovation in Design Exemplary Performance (Credit 1.2)</td>
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<tr>
<td>1</td>
<td>Innovation in Design Educational Programs (Credit 1.3)</td>
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<tr>
<td>1</td>
<td>Innovation in Design Green Housekeeping (Credit 1.4)</td>
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<td>1</td>
<td>LEED Accredited Professional (Credit 2)</td>
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5 TOTAL POINTS (OF POSSIBLE 5)
Trustees & Capital Committees

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Edith I. Blodgett
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Peter C. & Pat Cook
Peter & Gay Cummings
John & Marilyn Drake
Bob & Judy Hooker
David & Marilyn Hunting
Clare & Grace Jarecki
Mary Ann Keeler
Fred & Bernedine Keller
Sam & Jane Kravitz
David & Paula LaClaire
Jack H. Miller
Charles & Stella Royce
Leslie Tassell
Dr. Luis Tomatis & Gretchen Minnhaar
Jay & Betty VanAndel
START FROM WHAT IS IMPORTANT.
This new museum began with a deep-seated belief in the profound influence of art, a finely developed conscience toward the environment, and a vision for unifying the two. Despite extraordinarily challenging project conditions – including a complete turnover in design, construction and project management personnel, and budget shortfalls – the overarching vision was kept intact and viable by the team. As the building took form, so did the environmental impact goal evolve, from general (a ‘green building’) to specific (the first museum seeking LEED® Gold certification).

WORK AGAINST THE MYTH.
The prevailing thinking is that the museum building type is anything but ‘green,’ given that it is imperative for museums to maintain constant humidity and temperature levels, and admit ‘new’ air all the time. These indoor air quality requirements virtually assure that a museum cannot rely on natural ventilation to the extent that LEED® Certified buildings generally do. Without reaping significant gains in energy system efficiency, the design team esteemed it would be difficult if not impossible to attain a high level of LEED® certification.

To address this need, the GRAM deployed large energy recovery wheels to admit fresh air to the museum. Although not uncommon in other building types, energy recovery wheels were untested in fine art museums, and proved a good fit for this application.

TYPICAL ‘GREEN’ SOLUTIONS ARE OFTEN NOT BEST.
An openness to working ‘against the myth’ often reveals unexpected options. Questioning the appropriateness of prevailing ‘green’ solutions requires a design team to understand a building’s particular requirements deeply, and early on. One possible outcome is that a building does not have to ‘look’ green to ‘be’ green.

An exhaustive investigation of locally available building resources revealed systems and materials options for the GRAM which do meet art museum-level aesthetic and performance requirements, and were economical to implement. Our ‘leaving no stone unturned’ increased the level of LEED® Certification which the GRAM could pursue, and best of all, enabled us to further refine our vision for the project.