# MAKING THE CASE

David Glasofer

BY ELI GOLDSTEIN, AIA

Maplewood, N.J., is a town with a plan: reduce its greenhouse gas emissions 20% by 2015. Starting in 2006, it redesigned its recycling program, converted its non-specialty motor vehicle fleet to hybrids, and completed an energy audit of its municipal buildings among other initiatives. The township wanted its new Police and Court Building to reflect its green values, so it decided to pursue LEED certification.

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## Building Program

The original Maplewood Police and Court Building, built in 1930, had become functionally obsolete. A new building was needed to provide additional space as well as infrastructure to support more advanced telecommunications technology. The building program called for a 100-seat courtroom/meeting room, a 10-cell detention facility, dispatch/communications center, fitness center, locker/shower rooms, squad room, nine-bay garage, a sally port, staff bunk rooms, training room, conference rooms, four-lane indoor firing range, and offices for the municipal court and for the police department.

To accommodate future requirements, provisions were to be made for horizontal and/or vertical expansion. To accommodate this request, the third floor of the building was designed solely as a future growth space.

Although police and court facilities are often thought of as somewhat insular building types, the municipality wanted the building to provide spaces that could be shared with the Maplewood community. Toward that end, several conference rooms were designed to be used by community groups when not needed for police or court purposes. Since completion, those rooms have accommodated a larger variety of users than anticipated, but the heaviest users continue to be those involved in township business.

The firing range also was designed to be used by others. Police personnel are required to participate in firearms training and testing on a regular basis, and few ranges are in the vicinity. Therefore, the township decided that nearby municipalities would find it convenient and cost-effective to send officers to the Maplewood range. Several outside agencies have trained their personnel here, but the township has found it more difficult than anticipated to compete with other ranges for business.

To be visually recognizable as a municipal structure, the township requested the use of materials and/or forms typical of Maplewood's older municipal facilities, especially its iconic Town Hall. These included decorative red brick in Flemish bond, stone water tables and trim, arched openings, slate roofing, and ornamental metal railings. To be visually compatible with neighboring structures, the building was designed to comply with the architectural guidelines of the Special Improvement District in which the project was located, even though, as a public project, it was exempt from them.

Opposite **Located at the highest point along Maplewood's major commercial street, the Police & Court Building is visible from a long distance, especially after dark.**

Above **Garages, parking, and vehicular circulation are concentrated on the north side of the building, out of public view.**

### BUILDING AT A GLANCE

Building Name
Maplewood Police and Court Building

Location Maplewood, N.J., approximately five miles west of Newark, N.J.

Owner Township of Maplewood, N.J.

Principal Uses Police Headquarters and Municipal Court
Includes 100-seat courtroom meeting room, a 10-cell detention facility, dispatch/communications center, fitness center, locker/shower rooms, squad room, nine-bay garage, a sally port, staff bunk rooms, training room, conference rooms, four-lane indoor firing range, offices

Employees/Occupants Average is 25 during the day; with 150 on court days. The night shift may have as few as three occupants.

Gross Square Footage 42,000 (5,000 of which is unfinished)
Conditioned Space The building was provided with systems capable of conditioning 100% of the interior. However, they serve the unfinished third floor at a reduced level. The HVAC system dedicated to the firing range only operates when the firing range is in use.

Distinctions/Awards
LEED Silver Certification

Cover Story in *Masonry Construction*

Golden Trowel Award, International Masonry Institute/N.J., Top Green Building Project

Featured on the website of the International Masonry Institute

Total Cost
$16,250,000 for construction, about $1,000,000 for architectural and engineering services, including LEED administration

Construction Cost per Square Foot $387

Substantial Completion/Occupancy
March 2008


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Visitors arrive in a two-story lobby filled with daylight, some of which penetrates the courtroom through windows on the left or the fitness center through the glass block floor.

## Building Envelope and Site

Law enforcement and judicial facilities must accommodate several different occupant groups—the public, the police, the judiciary, and the detained—each with its own security requirements and circulation network. Accommodating these multiple networks can yield low building efficiency (i.e., the ratio of net to gross area), not to mention disorientation on the part of users. With the cost of such facilities being roughly $400 per gross square foot, it is imperative that this ratio be as high as possible. Since the façade is among a building's costliest components, it is also imperative that floor-to-floor heights be no more than necessary.

To maximize the efficiency of the plans and maintain a simple interior organization, we took advantage of the fact that we were dealing with a multi-story building. In a one-story police building, the cellblock must abut spaces along the exterior wall, so that detainees can be transferred from the sally port without crossing the paths of other users. By contrast, we were able to locate the cellblock in the middle of the basement, because it is served by a dedicated elevator adjacent to the sally port on the floor above.

To minimize floor-to-floor heights, we coordinated the ductwork with the floor framing, so that ducts never had to pass under girders. This allowed the ceilings to be much closer to the framing above than is normally the case, enabling the building height to be reduced by about 10%, decreasing the cost of construction and the surface area through which to gain or lose heat.

Other strategies that reduced the volume of building materials included using acoustic metal floor and roof decking for sound control instead of separate suspended ceilings, leaving the superstructure exposed to view wherever possible in the finished building, and using modular masonry design to reduce cutting and waste.

The building's locally sourced materials include its red brick veneer and slate roofing. Both require little maintenance, have long useful lives, and reprise the palettes of the township's other public buildings. Low-emitting paints, coatings, adhesives, sealants, and carpets were used throughout.

The site was just large enough to accommodate the building and staff and official parking. To accommodate weekday visitor parking, the municipality entered into a long-term agreement with the administrators of the church next door, to share its parking lot.

## ENERGY AT A GLANCE

Annual Energy Use Intensity (Site)
101 kBtu/ft$^2$

Natural Gas 45 kBtu/ft$^2$

Electricity 54 kBtu/ft$^2$

Renewable Energy 2.5 kBtu/ft$^2$ (approximate)

Annual Source Energy 227 kBtu/ft$^2$

Annual Net Energy Use Intensity
99 kBtu/ft$^2$

Savings vs. Standard 90.1-1999 Design Building 40.7%

Heating Degree Days 4,782

Cooling Degree Days 1,413

## WATER AT A GLANCE

Annual Water Use 380,000 gallons

## BUILDING ENVELOPE

**Roof**
Type Membrane roofing over high-performance insulation and slate roofing over high-performance insulation
Overall R-value 30
Reflectivity of Slate 20%

**Walls**
Type 4 in. masonry veneer over 8 in. engineered steel studs
Overall R-value 21
Glazing percentage 30%

**Basement**
Basement wall insulation R-value
10 (2 in. of extruded polystyrene)

**Windows**
U-value 0.27 to 0.29
Solar Heat Gain Coefficient (SHGC)
0.24 for vision glass and 0.38 for daylight glass
Visual Transmittance 47% for vision glass and 70% for daylight glass

**Location**
Latitude 40°, 43'
Orientation Front elevation of building faces south

## Lighting

Daylighting is an integral part of the design. In general, the offices are concentrated on the second floor. Their windows are glazed with vision glass to 8 ft above the floor, and daylight glass above that. Lightshelves are mounted between these upper and lower lites, shading the vision glass and redirecting that daylight through the clerestory, deep into the interior. Sensors turn on the lights only when spaces are occupied and insufficient daylight is available to serve them.

The main lobby, located on the south side of the building, faces the street. Its south wall is heavily glazed, allowing daylight to flood the space. Interior windows in its north wall and glass block in its floor allow this daylight to be shared with the adjacent courtroom and with the fitness center below.

Daylight from the lobby above filters through its glass block floor into the fitness center below. Windows into the surrounding corridors help distribute daylight even further.

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For security reasons, none of the windows are operable. A revolving entrance door helps control air exchange.

The building's air-handlers are located in a well on the roof (see building section). Clerestories around the perimeter of the well bring daylight into the third floor. This floor was left unfinished initially, but is ultimately expected to be subdivided for future offices. A grid-connected 20 kW photovoltaic array is mounted above the air-handlers, at the sill level of the clerestory. Sufficient room was left around the perimeter of the array to satisfy the air-supply requirements of the rooftop units.

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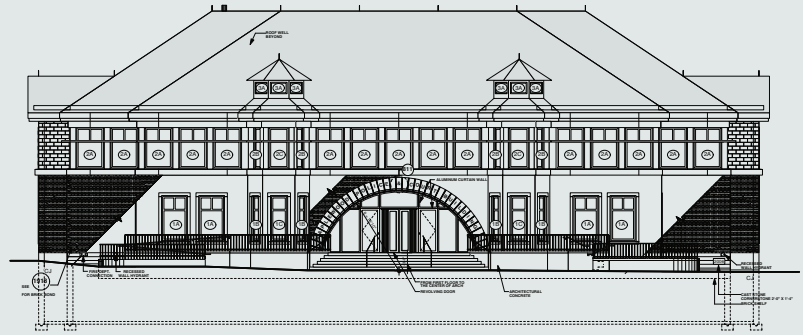
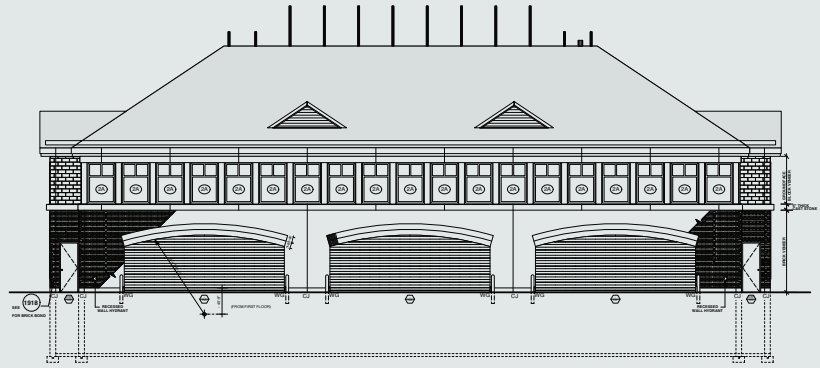
Within the secure portion of the building's interior, all four floors are accessed from glazed stairwells.

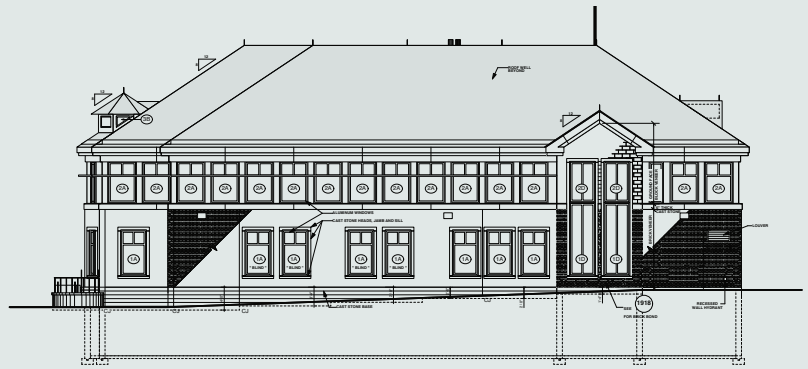
## MAPLEWOOD BUILDING ELEVATIONS



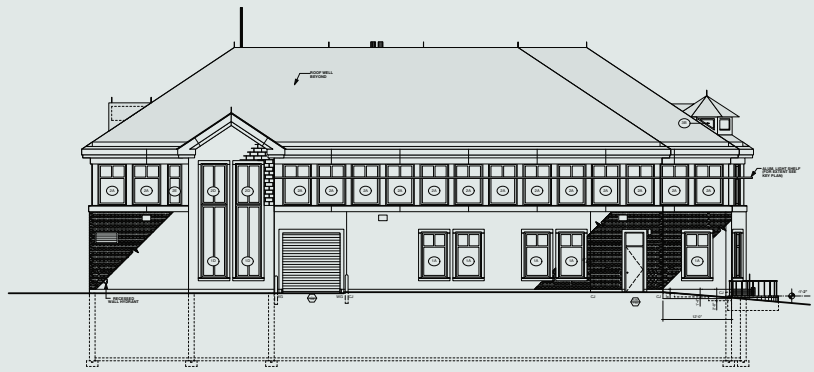
SOUTH ELEVATION



NORTH ELEVATION



EAST ELEVATION



WEST ELEVATION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A grand masonry vault marks the building's main entrance. Exits are located under cross-vaults, one of which is visible here.

## Building Systems and Energy Use

The building uses a highly efficient (0.66 kW/ton) water-cooled condensing chilled water system. As demand for cooling decreases, the flow of water to the chiller decreases (via variable speed pumping) to the minimum flow established by its manufacturer. Upon reaching minimum flow, the water temperature increases. The cooling tower is located in the building's parking lot, and is piped underground to the mechanical room in the building's basement. As most buildings of this size are conditioned with DX-type rooftop units, LEED considers that approach the baseline for this project's (less than 150 tons) energy modeling.

Other equipment contributing to the building's performance include sealed combustion modulating gas boilers, and variable speed drives on chilled water and hot water pumps. Rooms and spaces on similar operating schedules are zoned together. The building is conditioned with variable volume air-handlers and chillers capable of stepped operation, so that the supply of conditioned area is matched to demand.

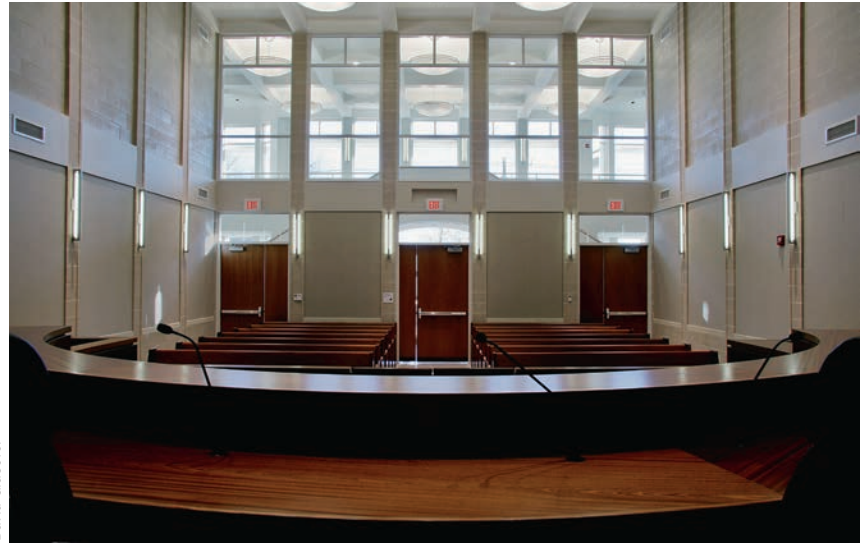
### KEY SUSTAINABLE FEATURES

- Low-flow plumbing fixtures
- Recycled Material (structural steel)
- High-performance glazing
- Low-emitting materials
- Indoor firing range with heat-recovery system
- 20 kW photovoltaic array suspended over rooftop equipment
- Economizer cycle to provide free cooling when outdoor conditions are appropriate
- Daylighting
- Carbon dioxide monitoring
- Stormwater management
- Other Major Sustainable Features: Tight coordination of ductwork with structural framing minimizes floor-to-floor heights, reducing the building's surface area, resulting in lower construction and operating costs.

Township entered into a shared parking agreement with the church next door, allowing the public to use the church parking lot on weekdays.

### ENERGY USE 2010

| 2010 | Net Electricity (kWh) | Gas (therms) |
|---|---|---|
| January | 53225 | 4995 |
| February | 47856 | 4412 |
| March | 45537 | 2451 |
| April | 48519 | 1018 |
| May | 56300 | 919 |
| June | 63165 | 257 |
| July | 83379 | 180 |
| August | 73134 | 173 |
| September | 64113 | 213 |
| October | 54827 | 498 |
| November | 47257 | 1220 |
| December | 46826 | 2776 |
| **Total** | **684138** | **19112** |



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Above left The masonry walls of the lobby give way to wood paneling surrounding the well of the courtroom.

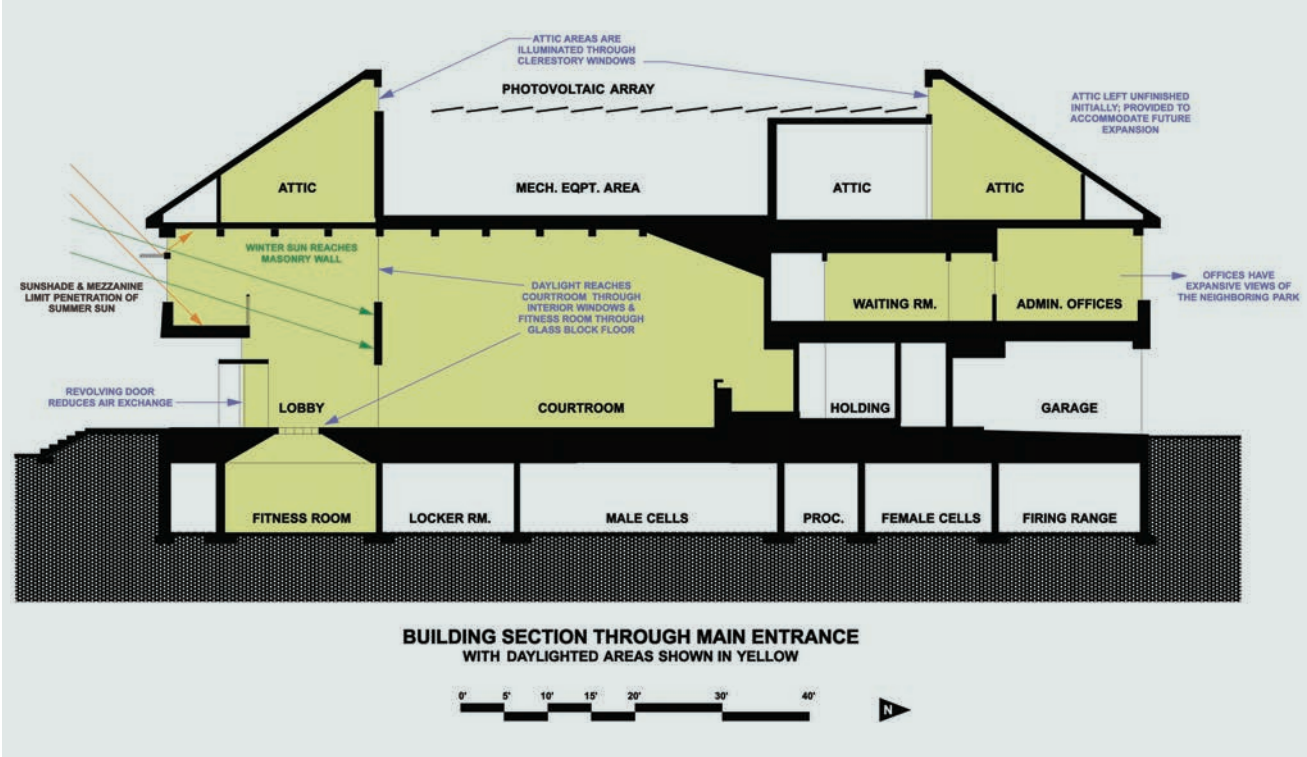
Above From the judge's bench can be seen the glazing through which the courtroom borrows daylight from the adjacent lobby.

To ensure that sufficient capacity is always available for cooling this around-the-clock operation, the chiller has twice the capacity needed to satisfy the design load. The BMS is programmed to equalize the runtimes of the building's four chiller barrels.

Interior lighting is controlled with occupancy sensors and continuously dimmable ballasts.

To ensure air quality inside and outside the building, the indoor firing range is exhausted through HEPA filters and supplied with 100% outside air. The range is served by two air-handling units, each outfitted with a heat-pipe recovery coil. The exhaust unit is located just above the bullet trap, while the makeup air unit is located just behind the firing line. The two coils are connected with refrigerant piping. Seventy percent of the heat from the exhaust airstream is recovered and used to temper the makeup air. Sufficient cooling is provided by the high velocity laminar flow of the range's airstream so that mechanical cooling was deemed unnecessary.

## MAPLEWOOD BUILDING SECTION

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The coffering of the lobby ceiling recalls that of the ceiling of Maplewood's iconic town hall. Here, the coffers were prefabricated to speed construction and reduce cost.

In conjunction with the project, the municipality entered into a long-term agreement with the local electrical utility to purchase sufficient green power to offset the building's electrical use, net of any excess energy generated on site and fed back into the grid.

A 20 kW photovoltaic array produces between 1,000 and 3,000 kWh per month, offsetting between 2% and 7% of the building's monthly electricity consumption. It is producing electricity in amounts consistent with design predictions.

## Water Consumption

The estimated average daily use is 1,037 gallons per day or 35 gallons per day per person. This is in the low to normal range for a building of this type. However, when more people are in the building (such as when court is in session), the water use levels approach the low range.

## Financing and Investment

The building is sited in the township's primary commercial district as an anchor for the district's redevelopment. This Special Improvement District is beginning to have new construction on surrounding sites, suggesting that the township's investment is beginning to pay off.

The Maplewood Police and Court Building's final construction cost was $16.2 million, which was financed primarily by municipal bonds. State grants provided $1.2 million, including a rebate for the photovoltaic system.

The governing body eschewed life-cycle analyses in favor of selecting

### BUILDING TEAM

**Building Owner/Representative**
Richard Calbi, P.E., Township Engineer

**Architect & LEED Administrator**
The Goldstein Partnership, Architects, Maplewood, N.J.
Eli Goldstein, AIA, LEED AP, Principal-in-Charge and Lead Designer
Laura Berwind, AIA, Project Manager

**General Contractor**
Seacoast Builders Corporation
David & James Schulz, Partners-in-Charge

**Mechanical/Electrical Engineer**
Omdex Incorporated, Mechanical/Electrical Engineers, Midland Park, N.J.
Milton Azous, P.E., Principal-in-Charge

**Structural Engineer**
Severud Associates, Structural Engineers, New York, N.Y.
Brian Falconer, P.E., Principal-in-Charge

**Site/Civil/Geotechnical Engineer**
Frank H. Lehr Associates, Site/Civil/Geotechnical Engineers, East Orange, N.J.
Richard Adelsohn, P.E., Project Manager

**Technology Consultant**
Nassoura Technology Associates, Technology Consultants, Warren Township, N.J.
Khaled Nassoura, P.E., Principal-in-Charge

**Landscape Architect**
Edgewater Design, LLC, Landscape Architects, Millburn, N.J.
Jan Saltiel, Principal-in-Charge

**Acoustics Consultant**
Ostergaard Acoustical Associates, Acoustical Consultants, West Orange, N.J.
Kring Herbert, Principal-in-Charge

**Photographer**
David Glasofer, Image Up Studio, Metuchen, N.J., and The Goldstein Partnership, Architects

among sustainable features by asking a simple question: "Will the anticipated annual savings of a particular feature equal or exceed the increase in municipal bonding costs associated with its design and construction?" If the answer was "yes," the feature was approved.

Because the cost premium for high-performance equipment generally increases with each increment of performance improvement, this rule kept the governing body from investing in performance improvements beyond the point of diminishing returns.

A geothermal system was rejected because it failed to meet the savings/costs criteria. The rooftop photovoltaic array was initially rejected for the same reason. However, after the township received a substantial grant toward its cost, the economics became sufficiently favorable to justify its inclusion.

An independent life-cycle cost analysis, done by Rutgers Center for Green Building after construction was completed, shows that the Police and Court Building is slightly less expensive on a life-cycle basis than the conventional, budget alternative as modeled in the building's LEED submittal. Solar renewable energy certificates are a crucial

## LESSONS LEARNED

The tighter the building envelope, the more sensitive building performance is to ventilation air volume. Although the building is occupied round-the-clock, the number of occupants ranges from as few as three at night and over weekends, to as many as 150 or more during court sessions, with an average of around 25. As with many high performance buildings, this one has minimal uncontrolled air infiltration. A network of carbon dioxide sensors provide real-time indications of air quality from which ventilation air requirements are calculated. The design was based on 20 cfm/person, and assumed simultaneous and full occupancy of each space. The BMS responds to the building's widely varying occupant loads by continuously sensing and calculating the volume of fresh air actually required. After occupancy, we learned that the amount of air delivered was extremely sensitive to the response of the BMS to changing occupant loads. Although the specified operations sequence required it to be appropriately programmed, our analysis of the building's actual gas use revealed that the volume of air being delivered (and conditioned) was substantially higher than necessary for the given number of occupants.

To ensure smooth and uninterrupted operation, program the BMS to respond gradually to changes. Another feature of many high performance buildings is that chilled water temperatures vary in response to load. However, to prevent freeze-up and short-cycling of the chiller, the BMS must be programmed to modulate chilled water temperature gradually in response to changing demand, just as the cruise-control system in a car responds gradually to changing grades. While troubleshooting the cooling system after start-up, our engineers found that the setpoints and equations with which the BMS had been programmed required fine-tuning to dampen its response.

Don't underestimate the risk of glare from large windows, even when outfitted with lightshelves. In spite of using vision glass with a low visible light transmittance and shading it with lightshelves, some occupants with desks near windows complained of glare. This was addressed through the addition of roller shades in appropriate locations.

Avoid large pressure differences. In the firing range, failure to turn on the exhaust and makeup fans simultaneously produced such a large pressure differential that it was impossible to open the door to enter or leave the area. To correct this, the exhaust and makeup air fans had to be interlocked.

Design to accommodate growth and change. To reduce the cost of providing public services, Maplewood explored, during design, the feasibility of sharing its court operations with those of neighboring South Orange (the municipality with which it already shares its school system). South Orange showed no interest at that time. However, soon after the building was completed, by which time the recession was under way, South Orange reversed its decision. Since the beginning of 2011, both townships have been operating their municipal courts out of this one building, to their mutual benefit. The building proved flexible enough to accommodate this change even though it was not designed for this purpose.

Fully investigate the sustainability implications of design changes prior to implementation. During construction, the municipality requested that the species of wood veneer used in the courtroom millwork and paneling be changed. It was not confirmed until much later that the new species was not available from certified forests. Had this been known at the time, the change probably would not have been approved.

Consider not only the performance of the building envelope, but also its form. The gains and losses of energy through the building envelope are a function of its resistance to heat flow and of its total area. Building codes and LEED address the thermal resistance of the building envelope, but they do not address the building's surface area or its ratio of surface area to volume. As a result, a building with an inefficient form but a high-performance envelope is looked upon more favorably than a compact building (enclosing the same interior area) having a slightly lower R-value, even though the latter may have much lower aggregate skin losses than the former. If the goal is to save energy, the codes and rating systems need to address the form factor, or ratio of surface area to volume. With its simple form, efficient internal layout, and tight floor-to-floor heights, the Maplewood Police and Court Building has a low ratio of surface area to volume.

A building's sustainability implications are not limited to those that fit on its site. As explained earlier, coordinating the site plan of this project with the site plan of the neighboring church resulted in benefits to both projects. Sharing the church's parking yielded a host of environmental benefits. Finally, sharing designated facilities in this building with community groups, and sharing its municipal court with a neighboring municipality, help provide public services more cost-effectively and sustainably.


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Above left Raising the entrance 3 ft above the street not only emphasizes its importance, but also protects it from vehicular attack less conspicuously than bollards.

Above The four-port indoor firing range is located in the basement, under the garage. Air is supplied above its firing line and exhausted above its bullet trap, through gaps in its baffled ceiling.

element in the positive economic performance, according to Rutgers.

## Conclusion

The holistic approach used in the design of the Maplewood Police and Court Building resulted in a building that maintains architectural continuity with Maplewood's existing municipal buildings; leverages limited public funds to invest in systems that pay for themselves within a fraction of the building's service life; incorporates facilities that can be shared with the public and with other municipalities; and reduces environmental impact by sharing parking with its neighbor. This holistic approach to sustainability can serve as a model for other municipalities. ●


### ABOUT THE AUTHOR

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