Honorable Mention

AIA/COTE TOP TEN GREEN PROJECTS 2007

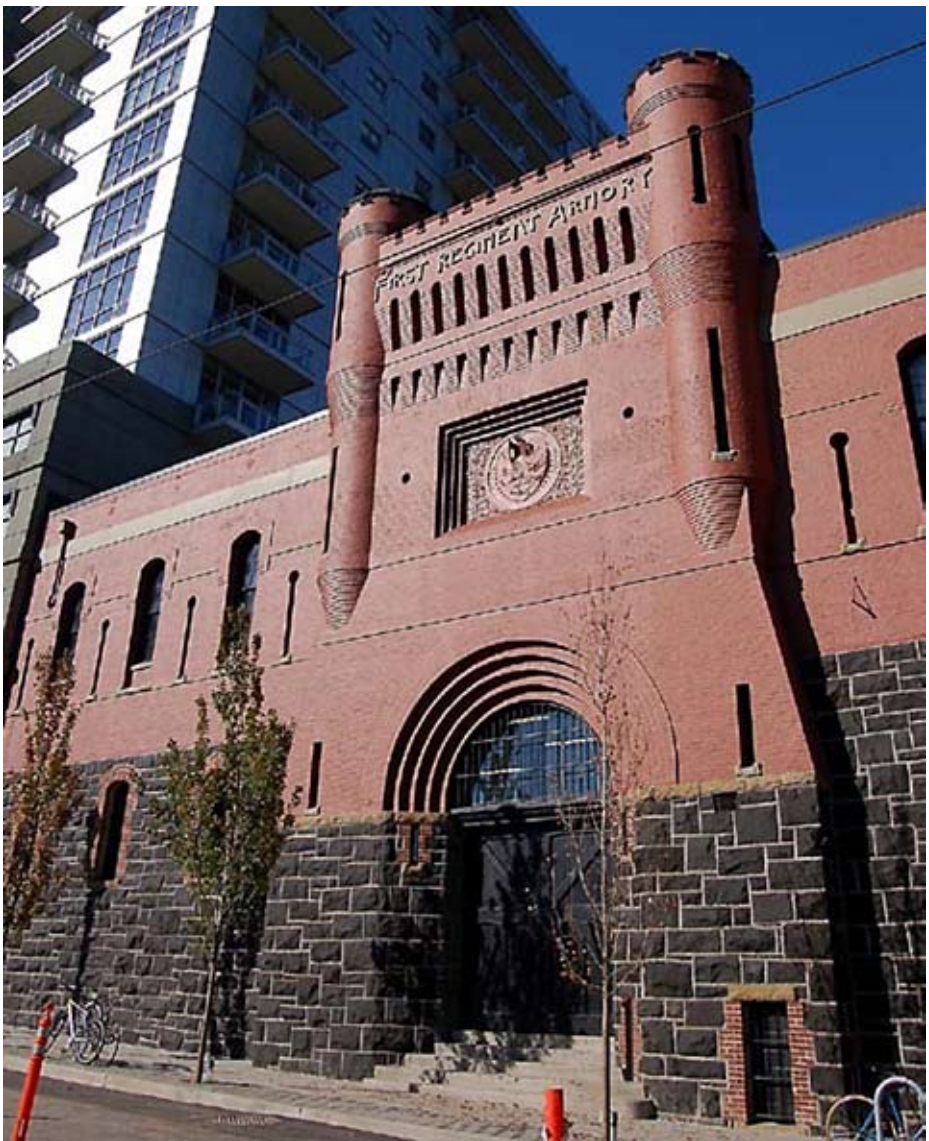
Gerding Theater at the Armory

Location: Portland, OR **Architect: GBD Architects, Inc.**

OVERVIEW

Now occupied by the Portland Center Stage theater company, the Gerding Theater is listed on the National Register of Historic Places. The Romanesque Revival building—which features narrow gun-sight windows and a 100' x 200' clear space spanned by arching Douglas fir trusses—was originally constructed in 1891 to house local units of the Oregon National Guard.

To fit 55,000 ft^2 of program space in a 20,000 ft^2 footprint while preserving the existing roof, the project team excavated 30 feet into the ground. To seismically brace the structure and acoustically isolate two performance spaces, the team built a concrete box inside the existing shell via two 14-foot-wide doors. The immensely challenging process was likened to building a ship inside a bottle.



This photo shows the eastern exterior wall.

Photo: Brian Libby

Full project profile:
www.aiatopten.org/hpb/overview.cfm?ProjectID=833

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Location: **Portland, OR** **Architect:** **GBD Architects, Inc.**

Sustainable Design Intent & Innovation

Reusing an existing building conserved not only the embodied energy of the existing brick, stone, and wood trusses but also the craftsmanship of the unique façade. The team minimized the use of finish materials to conserve resources and reinforce the character of the original building. New materials were selected for their regional availability, recycled content, and low chemical emissions.

Accessible by public transportation, the theater also features showers and changing areas for employees who commute by bicycle or foot. A park alongside the building offers outdoor seating and native vegetation. The site also features pervious pavers, increasing stormwater infiltration.

Rainwater captured from the roof is used to flush toilets and urinals. The rainwater harvesting system, lack of a permanent irrigation system, dual-flush toilets, and low-flow showerheads and faucets combine to reduce the project's demand for potable water by 88%.

The building is connected to an efficient district-chilled-water plant, and chilled beams are used to cool the building. Hot water can also be circulated. Displacement and underfloor ventilation were installed in the lobby and main theater. Advanced glazing maximizes daylighting while minimizing winter heat loss and summer heat gain. In different parts of the building, lighting is controlled by photosensors, occupancy sensors, and dimming switches.

This photo shows the truss and mezzanine.

Photo: Brian Libby

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Location: **Portland, OR** **Architect:** **GBD Architects, Inc.**

Regional/Community Design & Connectivity

The Armory has a long, rich history in the cultural life of the city: beginning as the largest covered public space in the city, it evolved to house many functions. In recent decades, however, it had lost much of its prominence. For the last 30 years, the building was used as a beer-keg warehouse.

A performing-arts consultant had recommend that Portland Center Stage (PCS) find a smaller, more intimate space, and the Armory offered a chance for PCS to create a more direct connection with its audience on a more intimate scale. By relocating to the heart of the most successful urban redevelopment project in the city's history, the company was also able to play a more visible and accessible role in the community.

Given the fortress-like character of the building's exterior, PCS wanted to extend its reach beyond the walls of the theater. The theater lobby evolved into a stage for the expression of public life: with doors open all day, the café, couches, interactive exhibits, and lighting design become set pieces for the stories that unfold on the stage. The team paid as much attention to the design of this space as a place for "public theater" as it did to the two stages. In addition, a "sliver park" along one side of the building provides public open space.

Although no parking spaces are dedicated to the building, multiple options are available for car-free access: the streetcar passes on both sides of the building, several bus lines are within a two-block radius of the project, a car-share vehicle is parked near the building, and designated carpool drop-off space is located at the site. To encourage biking, multiple bike racks, as well as showers and changing rooms, are provided for the staff.

The theater is part of Portland's revitalized Pearl District, a pioneer in green urban design. All of the buildings in the five-block Brewery Blocks project were built to LEED standards. On a regional scale, the project supports the goals of Portland's 2040 Growth Concept by contributing to urban density and brownfield redevelopment.

Use other transport options: 74%

Parking spaces per person: 0.00

Trolley tracks are visible in front of the building in this photo.

Photo: Josh Partee

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Gerding Theater at the Armory

Location: **Portland, OR** **Architect:** **GBD Architects, Inc.**

Land Use & Site Ecology

The project is built to the edge of the property and shares the block with a 15-story residential tower. Still, the project team tried to make the most of the natural resources available on the site.

A "sliver park" along the long edge of the building offers outdoor seating and native vegetation in a neighborhood with little open space. The sidewalk was widened, and several parking spaces were eliminated, narrowing the street to allow for an outdoor gathering space.

Pervious pavers increase rainwater infiltration on site, and street trees and a high-emissivity roof reduce the project's contribution to the urban heat-island effect.

This image shows the Brewery Blocks site plan around The Armory.

Photo: GBD Architects, Inc.

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Gerding Theater at the Armory

Location: **Portland, OR** **Architect:** **GBD Architects, Inc.**

Bioclimatic Design

The Gerding Theater at the Armory was built on a very constrained site, both logistically and climatically. A 15-story building directly to the south shades the project, limiting solar access and making passive solar design or onsite electricity generation nearly impossible.

The fairly mild Northwest climate allowed the project team to leave the inner face of the brick shell exposed without compromising the energy performance of the envelope. This existing mass, along with the new concrete floors and walls, serves as a thermal flywheel to reduce diurnal temperature swings.

Since the building massing, envelope, orientation, and footprint were already established, the bioclimatic response was focused on the performance of interior ventilation and conditioning systems. The design team used radiant systems, low-velocity systems, and low-energy systems where possible to reduce energy use as well as visual obstructions and acoustic impacts in the performance space. Excavating into the ground provided greater insulation and earth-coupling benefits.

This photo shows the main theater seats and stage.

Photo: Josh Partee

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Gerding Theater at the Armory

Location: **Portland, OR** **Architect:** **GBD Architects, Inc.**

Light & Air

A theater is often unoccupied for much of the day but requires high ventilation and cooling loads during the few hours of a performance. Though daylight is generally undesirable, high rates of ventilation delivered with little noise is essential.

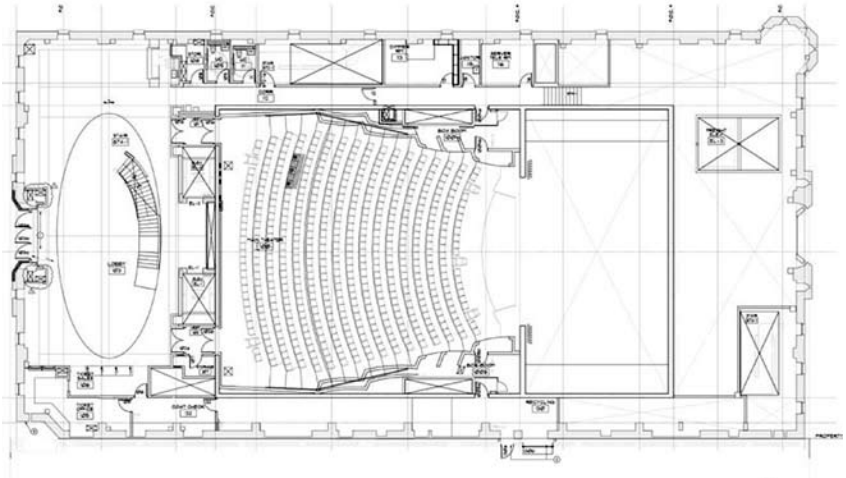
Computer fluid dynamics (CFD) modeling was done to confirm ventilation effectiveness within the building. This system delivers fresh air under every other theater seat, providing uniform temperature and ventilation throughout the audience. Displacement ventilation provides greater user comfort, greater energy efficiency, and less noise than conventional ventilation systems. Noise was also reduced through the use of a fan wall within the air-handling units in mechanical rooms made up of multiple smaller fans that do not require sound-trap elements in ductwork design. Electronic filtration improves air quality.

The building's existing shell had only small windows and gun slots. New windows could not be added, however, without violating the criteria for historic preservation, so regularly occupied work and rehearsal spaces were located on top of the theater volume, where they could receive daylight and natural ventilation via skylights. Operable skylights were strategically positioned on the roof to provide adequate daylight to regularly occupied work spaces and the entrance lobby. About 75% of the regularly occupied office, rehearsal, and meeting space is daylit; this represents about 25% of the entire building. These skylights were not designed to meet thermal comfort needs without additional ventilation, however. Underfloor air distribution in the work spaces provides individual control of floor vents with adjustable lighting and cooling from an integrated chilled-beam and light-fixture system above.

The building's energy-management system uses daylight sensors and occupancy sensors to dim or turn off electric lights when daylight is adequate or when rooms are unoccupied. Carbon dioxide monitors in all air-handling units provide demand-based ventilation for varying occupant loads. The mechanical systems are zoned to meet program functions and provide ventilation at rates appropriate to maintain comfort in offices, performance spaces, and gathering spaces while maximizing efficiency.

Percent of building area that is daylit: 25%

Percent of building that can be ventilated or cooled with operable windows:



This drawing shows the theater floor plan.

Photo: GBD Architects, Inc.

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Gerding Theater at the Armory

Location: **Portland, OR** **Architect:** **GBD Architects, Inc.**

Water Cycle

In a region characterized by nine months or rainy weather and three months of dry summer, the Gerding Theater takes advantage of the site's rainfall while minimizing the negative impacts of its water flows. Rainwater harvested from the roof is used to flush the toilets and urinals, reducing the amount of potable water used for sewage conveyance by more than half. Overflow from the 10,000-gallon storage tank and a portion of the sidewalk runoff drain to a stormwater planter and is treated through the natural filtration of the vegetation and soil medium.

The nearby Willamette River's water quality is threatened during large storms due to overflows from the city's combined sewer system. The rainwater-harvesting system and stormwater swales rely on a combination of reuse, detention, transpiration, and mechanical filtration to reduce the quantity of stormwater entering the municipal sewer system by 26%, compared with a conventional system.

The rainwater harvesting system, lack of a permanent irrigation system, dual-flush toilets, and low-flow showerheads and faucets combine to reduce the project's total demand for potable water by 88%.

Precipitation managed on site: 26%

Total water used indoors: 106,170 gal/yr

Total water used outdoors: 0 gal/yr

Percent of total water from reclaimed sources: 18%

Percent wastewater reused on-site: 0%

Calculated annual potable water use: 1.93 gal/sf/yr

The upstairs portion of the lobby is shown here.

Photo: Josh Partee

Honorable Mention

AIA/COTE TOP TEN GREEN PROJECTS 2007

Gerding Theater at the Armory

Location: Portland, OR **Architect:** GBD Architects, Inc.

Energy Flows & Energy Future

Energy-efficient buildings typically rely on two main approaches: a high-performance envelope and extensive daylighting. Neither of these strategies was possible here, however, given the historic shell and the desire to maintain the exposed brick interior. Additionally, the theater is located on a logistically and climatically constrained site. A 15-story building directly to its south shades the project, limiting solar access and making passive solar design and onsite electricity generation nearly impossible.

Since the building massing, envelope, orientation, and footprint were already established, the project's energy-efficiency strategy is focused on its mechanical systems. The building is connected to an efficient district-chilled-water plant located two blocks away. The project benefits from the plant efficiency as well as the avoided capital costs, space requirements, and ongoing maintenance onsite chillers. The refrigerant used is R-123, which has the lowest global-warming index of all common fluorocarbons and is free of CFCs.

Chilled beams are used for cooling in the administrative office, providing more efficient cooling and greater comfort than a conventional fan-driven mechanical system. These overhead suspended fixtures (with integrated lighting) supply radiant cooling by convection, allowing air cooled by coming in contact with radiator fins to sink at low velocity to the occupied zones below. Alternatively, hot water can be circulated to provide warm air circulated by a small fan. High-efficiency gas-fired condensing boilers provide all the heating needs for the building.

The heating and cooling system was designed to work in concert with the underfloor ventilation system. Displacement ventilation in the lobby, theaters, and offices uses the buoyancy of warm air to draw stale air quietly up and away from the occupants' breathing zone. Some of this air exits the building through operable skylights. The raised-floor plenum in the top-floor offices allows individual control of the air vents as well as easier reconfiguration of spaces. The passive chilling and air-circulation features reduce the project's energy use for mechanical systems by 40%.

Advanced glazing systems maximize daylighting while minimizing winter heat loss, summer heat gain, and air infiltration. In addition, the fairly mild climate allowed the project team to leave the inner face of the brick shell exposed without compromising the envelope's energy performance. This existing mass, along with the new concrete floors and walls, serves as a thermal flywheel, reducing diurnal temperature swings.

Lighting control strategies were used to minimize energy use. Where appropriate, lighting is dimmed automatically when daylight is sufficient. Many spaces in the administrative areas were provided with occupant-controlled dimming. Occupancy sensors control lighting in back-of-house corridors, which are typically unoccupied.

Portland Center Stage purchases renewable electricity for all of its electricity needs.

ENERGY PERFORMANCE

Ratings

EPA:
HERS:
Percent total energy savings: 29

	Base Case	Design Case
Total energy (Btu/sf/yr)	459	336
Electricity (Btu/sf/yr)	811	610
Natural gas (Btu/sf/yr)	1,601	1,024
Other: (Btu/sf/yr)	536	471

Heating (Btu/sf/yr)	1,435	857
Cooling (Btu/sf/yr)	536	471

Cooling capacity (sf/ton)		
Lighting load connected (W/sf)		.83
Lighting load after controls (W/sf)		.83
Plug load (W/sf)		2.0

Peak electricity demand (W/sf)	60.126	52.89

Percent on-site renewable energy: 0

Percent grid-supplied renewable energy: 100

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Materials & Construction

Approximately 79% of the existing Armory building was reused, conserving the embodied energy in the building materials and preserving the craftsmanship and aesthetic character of the original 30"-thick brick walls and rusticated basalt stone foundation.

The team minimized the use of finish materials to conserve resources and reinforce the character of the original building. Structural concrete floors are exposed in high-traffic areas, for example. Lifecycle cost considerations were consistent with the project team's goals of durability, simplicity, and honest expression of the materials' character.

Inside, the masonry walls were left exposed to maintain the historic character of the interior. The exterior brick shell and Douglas fir bowstring trusses were retained in their entirety, while the existing concrete floor was removed to allow for excavation to a depth of 30 feet for additional building area. The clear-span space had few original interior walls. Asbestos and lead paint were abated to mitigate hazards.

Structural materials for seismic reinforcing, acoustic insulation, and long spans were selected to maximize performance, aesthetics, and environmental responsibility. Concrete contained varying percentages (10%-40%) of flyash, depending on structural requirements; structural steel contained 90% recycled content.

About 45% of the new materials used in the project, by cost, were manufactured within 500 miles of the project site, and products with recycled content were preferred. Over 58% of the wood used in the millwork, finish carpentry, doors, and formwork was certified according to Forest Stewardship Council (FSC) standards. Paints, adhesives, and carpets were selected for their low levels of volatile organic compounds (VOCs), and composite woods were selected for their lack of added urea-formaldehyde.

This photo of the theater lobby highlights the project's use of concrete.

Photo: Owen Carey

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Long Life, Loose Fit

Reusing the Armory has extended its already long life; while the building's current use as a theater is less-easily adaptable than its original use, the building is anticipated to last at least another 100 years. The renovation also doubled the building's usable space without expanding its footprint.

The move into the Armory was actually a downsizing for Portland Center Stage, supporting the organization's desire for a more intimate theater experience and closer connection to the audience and community.

The constraints of the existing shell forced the design team to make efficient use of the available space. Placing the rehearsal studio and staff kitchen with the top floor administration offices not only made the kitchen available to double as lounge and informal meeting space but also fostered interactions among actors and administrators.

To improve long-term flexibility, the public spaces were also designed to support multiple functions. The smaller black box theater, two-level lobby, and outdoor park are available for classes, lectures, special events, outdoor performances, and festivals.

The project team made a great effort to make the functions efficient and compact yet still adaptable. The top-floor work areas feature an underfloor air-distribution plenum, allowing for reconfiguration without altering the ductwork runs.

By keeping finishes to a minimum, especially in the lobby and other public spaces, the building lets the essential, more durable materials such as brick and concrete take the brunt of wear and tear and continue to show their age gracefully.

Taken during construction, this photo shows the interior wall construction.

Photo: Portland Historic Rehabilitation Fund

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Collective Wisdom & Feedback Loops

This project involved an unusual number of consultants with specialized expertise. While the complexity of the project could make this coordination difficult, it also encouraged project members to view their efforts as supporting a large, ambitious, and worthy goal. The sense of pride and stewardship for restoring a community treasure was evident throughout the process.

The ambitious goals for building performance and LEED certification required more design time; however, the construction schedule required the process to keep moving forward. Concrete had to be poured while critical design decisions were still being made. To meet specific LEED requirements, many systems were still being designed late in the construction documents phase.

An in-depth commissioning plan was carried out by a third party to ensure that the building would function as intended. The window to correct issues was very short, however, given the building flushout schedule and the approach of opening night for Portland Center Stage's first performance in its new home.

The many different experiences and perspectives of working on this project were documented and presented to the community in a book called "Voices of the Armory," published by a local nonprofit called Friends of the Armory. Woven into the story, told by the Portland Center Stage director, are accounts from the lenders, fundraisers, developers, designers, engineers, sustainability consultants, contractors, metal workers, former visitors to the building, government officials, and even fans of professional wrestling.

The building is intended to serve as an educational tool. Multiple tours were offered during construction, and tours will continue regularly to provide insight into the project's green design. Educational displays and interactive media installations describe the history of the building as well as issues of environmental responsibility and historic preservation as told by industry and civic leaders. In just the first few months following its reopening, hundreds of visitors toured the building, engaged in lectures, and participated in community-outreach ventures.

Much of the success of the project in terms of performance and satisfaction can be attributed to a client who became so informed and active in the design process. As the last of six major buildings in the Brewery Blocks redevelopment, the Gerding Theater benefited from a design team with a great deal of experience working together, which made the process more collaborative than usual.

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Jury Comments

"This is long life/loose fit project. Finding the right tenant here was half the battle for reusing this building without serious intervention. They achieved LEED Platinum performance, but they did not muck it up." – **Anne Schopf, FAIA / Mahlum Architects / Seattle, WA**

"They were so careful in choosing the systems. You so easily could have seen ducts all over; they went with displacement ventilation. They took very good care with all the elements. The original wood truss, which looks amazing, was left in place." **– Alisdair McGregor, Arup / San Francisco, CA**

"This is such a theatrical building … so perfect to have a theater inside! Bringing it back as a theater is genius. This is the kind of thing that creates a destination in a city. This is about using the building stock we have. And people respond; this is part of their heritage. **– Susan Szenasy / Metropolis / New York, NY**

"This kind of project really effectively establishes the inherent connection between historic preservation and sustainability." **– John Quale, Assistant Professor / University of Virginia School of Architecture / Charlottesville, VA**

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