NBBJ helped Massachusetts General transform a constrained site on its historic, urban campus into an opportunity to advance its medical care, enable future change, and create a new hub for its campus.
Massachusetts General Hospital (MGH) needed to expand its services in order to meet a growing patient population and continue to provide the world-renowned, quality care it’s known for. The hospital decided to build a new addition to its extremely compact campus in downtown Boston, with a high-tech, patient-centered healing environment that could meet MGH’s current needs and grow with the needs of the community for the next 100 years.

The tight urban site and programmatically dense building mandated a high level of precision in the project’s design and delivery. Building Information Modeling allowed the design team to manage the complexities of fitting a 14-story building on a compact site, make multiple connections to existing buildings, and link numerous departments within, all while maximizing opportunities for future flexibility, daylight, patient safety, and staff productivity.

Through careful planning and design, daylight is brought deep into the core of the building, and views to the outdoors and places of respite are readily available for patients, visitors, and staff. The patient floor design maximizes the number of beds per floor while reducing travel distances for nurses and noise levels for patients.

Constraints can become opportunities when design efforts are coordinated early in the process, allowing for more focused attention on designing for the wellbeing of patients, families, and staff.
Building for the Third Century of MGH

Serving nearly 1.4 million outpatients and discharging more than 48,000 patients annually, MGH needed to significantly expand its facilities in order to continue providing the quality care it’s known for. Over the years, the demand for outpatient procedures, emergency department visits and acute care inpatient beds grew to far exceed the facilities of the hospital. This increased demand led MGH to alter its original plan for a smaller outpatient facility—which was one of two new buildings proposed in its 1999 Campus Master Plan—to build a larger facility that could house core hospital services.

MGH was also approaching its 200th year anniversary and saw the opening of this new facility as an opportunity to celebrate its bicentennial while advancing the hospital into its next century of care. Originally dubbed the Building for the Third Century, the new 530,000-square-foot Lunder Building is designed as an enduring structure that will meet MGH’s needs, and serve and grow with the community for the next century.

Next-Generation Care

Founded in 1811, Massachusetts General Hospital (MGH) is the third oldest hospital in the United States and the oldest and largest hospital in New England. Renowned for its excellence in medical care, education, and research, MGH is consistently ranked among the top five hospitals in the nation by U.S. News & World Report, and was ranked #1 in 2012.

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Urban Response

The massing of the building is a reflection of the program within, where the five-story bed tower is visually separated from the procedural floors below. The exterior of the building is a formal response to the horizontal and vertical nature of the adjacent Yawkey and White buildings, respectively—creating a visual language that fits with the surrounding urban context. Fritted fins along the lower levels provide privacy for patients and staff on the inside and help break down the exterior mass of the building for pedestrians below. At street level, a paved walkway, stairs, and a canopy create a distinct place and pathway for visitors, directing them to the hospital’s main entrance.
As one of America’s largest academic medical centers, MGH exhibits many characteristics that typify these institutions—a tight, urban campus comprised of many buildings from different eras, complex programmatic demands, and the need for high-level coordination and communication between facilities and campus operations. Located at the heart of the MGH campus, it was critical that the Lunder Building facilitate the integration of teaching, research, and patient care by enabling connections between existing buildings.

NBBJ used circulation modeling to develop the ideal connections for ease of facility access, patient transport to services elsewhere on campus, and materials flow. Due to constrictive floor-to-floor ceiling heights within existing buildings, the decision was made to limit connections to five floors, where pedestrian traffic and logistical connections to existing buildings were most critical.

**Well Connected**

Up to 25,000 people a day travel through the second floor corridor connection.

**MATERIALS MANAGEMENT CONNECTION**

The loading dock and sterile processing department are located on levels LL1 and LL2 respectively, and service the entire campus. Connecting to the White and Ellison buildings below grade, these connections are critical for campus-wide materials distribution.

**EMERGENCY DEPARTMENT CONNECTION**

In addition to a new lobby connection to the White building entrance, the ground floor provides a seamless ED addition to the existing ED in the White building, enabling the phased renovation of the entire emergency department.

**SECOND FLOOR CORRIDOR CONNECTION**

On any given day, 25,000 people arrive at the Charles/MGH T Stop and travel through the Yawkey Building and through Lunder’s second floor corridor to access other areas of the MGH campus.

**PROCEDURAL CONNECTIONS**

The third floor connections provide direct access to the White, Ellison, and Wang buildings. All surgical patients check-in and are prepped in the Wang building, then are transported to Lunder or White for their procedures. Post-surgery, outpatients leave through the Wang building, and inpatients are taken to recovery rooms in the Lunder building or elsewhere on campus.
Managing Complexity

The Lunder Building is an incredibly complex building that not only makes external connections to existing infrastructure on campus, but also internally links a number of different programmatic elements. The 14-story building houses a five-story patient tower, high-tech procedural floors, an emergency department, receiving dock, a sterile processing department, a processing department, a five-story patient tower, and new emergency and radiation oncology units. The challenge was to stack this varied program onto an extremely compact site in a way that would maximize future flexibility and minimize disruption to the hospital’s services elsewhere on campus.

Design Tool: Building Information Modeling

The design team employed Building Information Modeling (BIM) technologies to navigate the complexity of the site and explore program alternatives during the design and documentation phases. A working 3D model was created enabling each design team member to layer in trade-specific details as the design progressed, to ensure that all of the building’s components and connections fit and worked within the site. Built-in “collision detection” systems allowed for the early identification of problems and their solutions prior to the start of construction.

The 3D model was used to develop core elements of the building, including architecture; interiors; planning intent; and structural, mechanical, and electrical systems. BIM was also used as a communication tool for sharing ideas with the building’s users, obtaining city approvals, and demonstrating how construction was being phased to avoid on-site complications.
Breaking Site Constraints

The project brief specified a need for more beds to meet increases in patient volume and a shift from double to single patient rooms for the benefit of infection prevention, privacy, and greater patient/family-centered care.

However, adding more single rooms typically increases the size of the floor plate, which increases travel distances for nurses, and further separates clinical collaborators who work in close proximity to one another. Site constraints and the square floor plate of the patient tower also made it challenging to provide everyone access to daylight, which was a major design goal for the new building.

NBBJ developed numerous options for maximizing daylight and the number of patient beds per floor while minimizing travel distances for staff. The big “a-ha” was in fracturing and shifting the floor plate to break apart the nursing pods and create a central circulation spine that traverses the floor plate diagonally. The spine creates a direct link between an interior atrium and exterior garden, improves wayfinding, and allows daylight deep into the core of the building.

Rather than creating a square loop of patient rooms along the perimeter and a central nursing core, the resulting plan yields two interlocking c-shaped groups of beds which allows for more rooms per floor; increases clinical connection; and minimizes staff travel times to patient rooms, central supply, and support areas.
Enhancing Patient Safety and Satisfaction

A connection to the outdoors and natural light is known to speed up the healing process and increase patient, family, and staff satisfaction. Naturally lit spaces also have operational and sustainable benefits by decreasing reliance on electrical energy. A major design goal was to bring daylight as deep into the space as possible and provide views to gardens and the Boston cityscape.

Patient rooms feature full-height windows, and a five-story garden atrium and exterior bamboo garden bring daylight deep into the patient tower, providing rooms along the core of the building access to natural light and views to the outdoors.

Several measures were taken in the design of the patient rooms to provide patients, family, and staff with maximum comfort and safety. Personal protection equipment cabinets are located outside each room for convenient point-of-use access to gloves, masks, and gowns; a five-foot-wide entrance with a sliding glass door enables ease of entry and greater visibility; a caregiver work station faces patients so records can be updated while keeping the patient in sight; a semi-opaque toilet room door with a nightlight inside eases wayfinding in the dark; and a patient lift operates from the bed to the toilet room to help nurses transport patients who are unable to walk.
Sliding glass doors maintain visibility while keeping the noise out when closed.

Saw-tooth corridors (as opposed to straight corridors) minimize sound reflection and transmission.

Acoustical ceiling tiles absorb the sounds of conversation.

Rubber floors dampen the sound of people and equipment moving down the hallways.

Quiet in the Halls

Noise is one of the top complaints of hospitalized patients in the United States and can raise blood pressure, interrupt sleep, increase sensitivity to pain, and raise stress levels. NBBJ employed a combination of strategies to reduce noise throughout the building. Elevators, public waiting areas, and staff meeting rooms are located along the central circulation spine away from the patient rooms. Dispersed “interaction zones” prevent nurses and clinicians from congregating at one main nursing station, while support and service areas are tucked away off the main corridor. Rubber flooring and acoustical ceiling tiles buffer the sound of movement and chatter. Large, sliding glass doors to patient rooms provide greater visibility and allow natural light to enter the corridors, while keeping the noise out when closed. Using a standardized Hospital Consumer Assessment survey, MGH has seen increases of six percentage points and higher on the quietness questions for the Lunder patient units.
Letting the Light In

A bamboo garden was planted atop the mechanical floor to provide ICU rooms with calming views and ample daylight for family and staff caring for patients in the most critical of conditions.
A Flexible Platform for Future Practice

The fourth floor houses some of the most progressive medical technologies available, including two intraoperative hybrid ORs using Zeego equipment (image upper left) and an OR suite using an intraoperative magnetic resonance imaging (IMRI) device mounted on a ceiling track that can move between two adjacent operating rooms (image upper right).

Rather than having to transport patients for imaging post-surgery, surgeons can now perform precise imaging during procedures that will allow unprecedented accuracy, safety, and efficiency. The hybrid rooms feature an imaging system that captures previously difficult vantage points during procedures for both catheter and open cases. A radiolucent operating table can be interchanged with a traditional operating table for standard procedures, doubling the functionality of each room.

The IMRI suite, which was not part of the original plans, came online during construction planning as more advanced MRI devices became available. NBBJ redesigned the fourth floor to fit the new three-room suite by incorporating one of the existing ORs with an adjacent MRI bay, and relocating a restroom and some storage space.

The design of the suite required meticulous planning. The 18,000 pound imaging device has a magnetic field 60,000 times more powerful than the Earth’s, so the magnet had to be shielded from steel columns, beams, and electrical transformers. To contain the magnet’s forces and keep interferences out, copper and silicon steel make up a continuous barrier behind all wall surfaces, the ceiling, and floors to create this shield.

Concentric ovals on the floor mark the levels of the magnet’s pull, ensuring that operating instruments and other metal items are kept at a proper distance when the magnet is brought into the room. Ceiling booms allow mounted lights and equipment to be easily moved out of the way.

In advance of the latest technology, the hallway that was used to transport the MRI in and out of the building was designed with larger beams and more reinforcing steel to withstand the load of the IMRI machine. The exterior wall at one end of the corridor was built in a modular fashion so it could be easily removed to hoist new equipment through the wall during installation and for future replacement.
The Lunder Emergency Department (ED) addition provides 17,500 square feet of expanded space, which includes new patient registration and triage bays for walk-ins; acuity-adaptable screening and acute areas; trauma rooms; a hazardous materials decontamination area; and an enclosed ambulance garage. As part of a larger plan to increase emergency services at the hospital, transitioning these services to the Lunder Building allowed existing ED spaces in the White and Ellison buildings to undergo phased renovations.

The new ED also supports a split-flow process that MGH piloted in their existing ED. The goal is to cut long patient wait times and “leaves without treatment” by separating the flow of the sickest patients from those who are less sick. Walk-in patients arrive at a space filled with light and views and are met by a greeter nurse who does an immediate assessment and sends the sickest patients to a bed and pediatric patients to the pediatric ED. Beyond the greeter nurse are five glass-enclosed triage/registration bays that allow nurses to quickly register and check vital signs for the less-sick patients, who are then sent to a screening room where a physician conducts an extended diagnostic triage. From there, patients can be sent for post-screening follow-up, directly for treatment, or to a hospital bed.

Patients arriving by ambulance are assessed in a separate stretcher triage area. The triage staff work area, which has views to the ambulance bay and the walk-in area, is the hub that observes and supports both the stretcher and walk-in patients. The final result is decreased wait times, quicker care for sicker patients, and greater visibility for staff while also providing patient privacy.
Muted tones, natural finishes, pendant lights, and wall-wash lighting add to the calming atmosphere.

Located three and four stories below grade, the Clark Center for Radiation Oncology incorporates soft lighting, natural finishes, garden-themed graphics, and both open and intimate spaces to create a sense of calm for patients and staff. The new Center houses the latest technology in radiation therapy and is designed for the comfort of both new and returning patients. The Center occupies two levels, and provides separate entries for new and returning patients.

New patients, arriving for their first consultation, enter on the upper floor separate from any clinical or treatment activity. Returning patients arrive on the lower level, where their routine path of travel begins with a two-story receiving lounge, then an art-filled corridor that leads to the dressing rooms. Another waiting lounge near the treatment rooms offers clustered seating for social interaction, or lounge chairs and bamboo banquettes for more privacy.

Inpatients arriving by stretcher have a private entry into the treatment room without having to pass through the more public areas. Small rooms are available immediately off the waiting lounge so that patients can consult with their caregivers in private.

Improving the Patient and Staff Experience

Radiation Oncology

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Inpatients arriving by stretcher have a private entry into the treatment room without having to pass through the more public areas. Small rooms are available immediately off the waiting lounge so that patients can consult with their caregivers in private.
A returning patient is guided from the waiting area to the treatment area.

The changing area for patients is designed with soothing colors and privacy in mind.

Translucent glass screens separate the waiting area from the corridor, giving patients and staff greater privacy.
The environmental graphics program is integral to the overall experience of being inside the Lunder Building, reinforcing the MGH brand and unifying the multiple departments and spaces within. Abstracted images of local foliage carry through the garden theme on each floor—from large-scale wall graphics to curtain and furniture details. Consistent, clear signage and the MGH branded blue are used throughout the building to assist visitors and patients with wayfinding and orientation.

Designed, Down to the Details

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A Healthy Neighbor

The Lunder Building is LEED NC Gold certified, and features sustainability measures that add to the aesthetics, experience, and efficiency of the building.

Material Selection
More than one-third of the materials used for construction were recycled or locally extracted or manufactured materials. Renewable materials were used for interior finishes.

Water Conservation
Low-flow plumbing fixtures were installed to reduce water consumption by 1.4 million gallons per year (20%). To eliminate the use of potable water for plant irrigation, systems capture rainwater and air cooling condensate for irrigation.

Energy Conservation
The exterior glazing system minimizes heat gain and loss while allowing daylight to enter. This system improves thermal performance by 39% and reduces baseline solar heat gain by 31%. The design achieves an overall reduction of energy demand by 10%.

Healthy Indoor Air
Interior finishes and furnishings are free of volatile organic compounds. An enhanced ventilation system maintains a constant supply of clean, healthy air.

Enhancing the Urban Environment
Greenery covers more than half of the building’s footprint area and light fixtures have been carefully selected to reduce light pollution. Delivery trucks and ambulances enter through the Lunder Building core to keep noise and activity off neighborhood streets.
"I see things on the Lunder patient units that I could only have dreamed of at other places I've worked. Private rooms, comforting colors, more light, floor to ceiling glass. It's fun to see something new that embodies a lot of the concepts we're looking for."

RICHARD EVANS, SENIOR DIRECTOR, SERVICES IMPROVEMENT DEPARTMENT, MGH
ABOUT NBBJ

NBBJ is an award-winning global design and architecture firm focused on helping clients capitalize on the relationship between people and the design of physical space to enhance organizational performance.

The world’s leading healthcare providers trust NBBJ to deliver measurable and sustainable improvement in performance and care. Our teams have partnered with some of the leading healthcare institutions worldwide, including nine of the top 14 U.S. News and World Report Honor Roll hospitals. Within the architecture industry, NBBJ has been hailed as “Most Admired” by peers in Interior Design’s annual Healthcare Giants survey, and ranked as the second largest healthcare design practice in the world by BD World Architecture.

NBBJ’s network of offices enables us to deliver quality projects that are regionally and locally appropriate. It allows us to act as a single creative force, leveraging the latest thinking from our NBBJ colleagues in other locations, bringing a rich blend of expertise to each project.

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