What is Adaptive Reuse? Repurposing Buildings For a Sustainable Future

Written by: Jon Holmes, Content Marketing Specialist, Autodesk

Adaptive reuse is breathing new life into old buildings and transforming the architecture, engineering, construction, and operations (AECO) industry in the process. Rather than demolishing structures, adaptive reuse repurposes them for modern needs, preserving history while reducing waste and minimizing environmental impact.

With the built environment responsible for about 42% of global carbon emissions, adaptive reuse is gaining traction as a critical strategy for sustainable development. Trends like converting underutilized office spaces into housing or mixed-use developments are on the rise; RentCafe's Adaptive Reuse report shows that office building conversions make up 38% of the 147,000 residential adaptive reuse projects in the United States, showcasing the potential of this approach to meet evolving urban needs while supporting economic and ecological goals.

WHAT IS ADAPTIVE REUSE?

Adaptive reuse repurposes existing buildings for new uses, cutting waste and carbon while preserving history. It's a sustainable alternative to demolition, supported by tools like BIM and reality capture for efficient planning and design. This approach lowers embodied carbon, reduces costs, and helps meet urgent climate and housing goals.

TYPES OF ADAPTIVE REUSE IN ARCHITECTURE

Adaptive reuse can take many forms. In architecture, adaptive

reuse refers to repurposing an existing structure for new use, such as turning vacant buildings into schools, public parks, offices, or apartments.

Historic preservation

Both adaptive reuse and historic preservation can save historic buildings, but the approaches are different. Adaptive reuse aims to repurpose an old building or site for new uses; this process is often viewed as a compromise between preservation and demolition. Historic preservation, in contrast, sustains a building's existing form, integrity, and materials. Exterior additions and alterations don't fall within the scope of this treatment, but minimally invasive mechanical, electrical, and plumbing (MEP) upgrades and work required to meet new building codes are generally appropriate, according

to standards published by the National Park Service, which administers the National Register of Historic Places.

One of the biggest benefits of adaptive reuse over historic preservation is having the flexibility to use new, efficient architectural materials while still paying homage to the structure's history. This approach improves a building's performance while lowering its carbon footprint.

Renovation

Adaptive reuse, by design, implies renovation. While renovation is generally limited to repairing and refinishing a building but preserving the building's original purpose, adaptive reuse implies a transformation of use.

Integration

Integration involves constructing around an original structure, preserving that structure while encompassing it inside a new building. One striking example of integration is Denmark's Jægersborg Water Tower, which was converted by Dorte Mandrup into student housing.

Facadism

Facadism is the urban design tactic of preserving a building's facade while demolishing the bulk of the rest of the building to replace it with a modern structure. The process is known as a facadectomy; it preserves the streetscape view but is expensive because the facade, which is usually built from fragile historical materials, needs to be supported and protected during construction. Historic-preservation advocates tend to view facadism as a poor substitute for preserving an entire building, but supporters consider it a better alternative than erasing a city's historic footprint.

Infrastructure

While most adaptive reuse focuses on buildings, some of the most innovative adaptive reuse projects transform outdated or unused infrastructure into community features.

A famous example of adaptive reuse in infrastructure is New York City's High Line. Once an elevated railway known as the West Side Elevated Line, this lofty park winds through nearly 1.5 miles of lower Manhattan and features more than 500 species of plants and trees, resting spaces and viewing balconies, an open-air food market, and ramp accessibility.

BENEFITS OF ADAPTIVE REUSE

Adaptive reuse offers powerful benefits across sustainability, financial growth, cultural preservation, and community revitalization. Here's how it's transforming the built environment.

Cultural preservation

Adaptive reuse helps protect cultural heritage by preserving historic buildings and maintaining the architectural character of cities. This fosters a sense of continuity and identity for communities and also promotes tourism, attracting visitors interested in heritage and history.

Unique spaces

A commitment to adaptive reuse often leads to distinctive character-rich spaces that stand out from more uniform new construction. Flexibility follows aesthetics as many buildings are repurposed for multiple uses and easily adapted to future needs.

Community engagement

Revitalizing an old building often draws interest and involvement from the surrounding community. This can foster a sense of ownership among residents and enhance community pride, creating stronger social ties.

Energy efficiency potential

Older buildings may not be as energy-efficient; adaptive reuse projects offer opportunities to integrate modern energy-saving technologies like insulation, solar panels, and smart systems, enhancing the building's performance and reducing long-term operational costs.

FIVE EXAMPLES OF ADAPTIVE REUSE

Lake|Flato's adaptive reuse headquarters: A showcase of sustainability

Lake|Flato transformed a 100-year-old car dealership in San Antonio into its new, sustainable headquarters. Instead of building anew, the architecture firm embraced adaptive reuse, turning the historic structure into a future-ready, hybrid workplace.

The project, called "Living the Dream," preserved key elements such as the original brick facade and concrete beams, while introducing modern touches, including a year-round courtyard

created from a former garage. This outdoor space fosters connection with nature and serves as an extension of the office, providing space for work and social events.

Using digital tools such as laser scanning and 3D modeling, the firm optimized material reuse, daylighting, and energy performance. These strategies helped the project align with Lake|Flato's sustainability goals, with certifications for Zero Carbon and WELL on the horizon.

The adaptive reuse of the building minimized embodied carbon and also enhanced employee well-being, demonstrating how old spaces can be revitalized to serve modern needs sustainably.

Building 12: A landmark adaptive reuse at San Francisco's Pier 70

Building 12, a World War II-era ship-hull factory, anchors the 28-acre Pier 70 redevelopment in San Francisco. As part of the project's first phase, the historic building underwent a transformative adaptive reuse to preserve its industrial past while preparing for future challenges such as rising sea levels.

Developers chose to preserve the building's iconic steel columns and corrugated siding, reducing embodied carbon emissions. However, lifting the entire structure by 10 feet was necessary to address sea-level rise projections, a monumental task that limited some of the carbon savings.

Despite these challenges, the project exemplifies adaptive reuse, blending history with innovation. Once completed in the mid-2020s, Building 12 will feature maker studios, retail spaces, and offices, becoming a vibrant hub of creativity and commerce. The architects behind the project used advanced tools to ensure precision in the restoration process, emphasizing the importance of reusing existing structures to minimize carbon impact.

Building 12 is set to be a symbol of urban renewal, showcasing how old buildings can be revitalized into modern, sustainable, mixed-use spaces while honoring their industrial heritage.

The Standard London: A 1970s Brutalist building revived as a boutique hotel

In the heart of London's King's Cross neighborhood, Orms architects transformed a 1970s Brutalist office building into a chic 266-room boutique hotel, The Standard London. This adaptive reuse project preserved the building's postwar architectural heritage while introducing bold design elements, including three new stories for a restaurant, bar, and rooftop terrace.

The project team collaborated with MEP and structural consultants to retain as much of the original structure as possible. Digital tools helped integrate modern systems for heating, cooling, and lighting, optimizing the building's sustainability while reducing embodied carbon emissions.

The Standard London demonstrates how adaptive reuse can transform outdated structures into modern, sustainable spaces, preserving history and minimizing environmental impact. The project sets a high bar for future retrofits, embracing reuse as a key strategy in sustainable urban development.

World of Wine: Revitalizing 200-year-old port wine warehouses into a vibrant cultural hub

The World of Wine (WOW) in Porto, Portugal, is a stunning example of adaptive reuse, transforming centuries-old port wine warehouses into a dynamic arts and entertainment complex. Led by architecture firm Broadway Malyan, the project repurposed hundreds of 200-year-old structures into a tourist hotspot featuring seven museums, 14 restaurants, a wine school, galleries, and shops — all while preserving the site's historical significance.

Located in Vila Nova de Gaia, the warehouses were originally built to store port wine but fell into disrepair after wine storage laws changed. The 37,000-square-meter (398,000-square-foot) site, completed in 2020, blends contemporary design with the original granite brickwork and wooden beams. In areas where structures were beyond repair, facades were preserved to honor the buildings' heritage.

The project team coordinated complex renovations, reinforced foundations, and integrated modern amenities like air conditioning and parking while preserving the historical integrity of the site. The meticulous planning ensured the project stayed nearly on schedule, despite challenges posed by the COVID-19 pandemic.

Now a thriving cultural hub, WOW has won numerous awards and solidified Porto's status as a top tourist destination, merging history with modern attractions.

Matta Sur Complex: Bridging past and future in Santiago's adaptive reuse project

The Matta Sur Complex in Santiago, Chile, is an exemplary adaptive reuse project. This innovative development connects a restored 19th-century school building to a new medical facility, creating a mixed-use hub that combines history with modern design.

The project preserved 80% of the original building, blending it with a new, sustainable structure while adding community spaces including kitchens, a gym, and a nursery school. Designed for sustainability, the new building maximizes natural light, features a green roof for cooling, and includes energy-efficient systems.

The firm's use of BIM technology was crucial for the project's success, marking a pivotal moment in its digital transformation. The project included cross-continental collaboration, with project teams in Chile and Spain working seamlessly through shared digital models. This advanced coordination helped meet the project's complex requirements, from restoring the historic building to achieving ambitious sustainability goals.

The Matta Sur Complex now serves as a model for blending tradition and innovation, providing Santiago's community with a sustainable, functional, and culturally significant space.

NEW TECHNOLOGIES IN ADAPTIVE REUSE ARCHITECTURE

In adaptive reuse projects, advanced technologies and sustainable practices enhance efficiency, cost-effectiveness, and environmental responsibility. Key tools like building information modeling (BIM), 3D scanning and printing, the Internet of Things (IoT), smart systems, and sustainable materials are transforming this process.

BIM

BIM creates detailed digital models that allow teams to assess buildings accurately, minimizing surprises during adaptation. It also facilitates real-time collaboration and virtual simulations, helping ensure aesthetic and structural goals are met.

3D scanning and printing

3D scanning and printing revolutionize documentation and restoration. Scanning captures precise building data, especially in older structures with incomplete plans, while 3D printing enables the creation of custom architectural elements, ideal for replicating historical features.

IoT and smart systems

IoT and smart systems improve energy efficiency and building performance by automatically adjusting systems such as HVAC and lighting based on occupancy. IoT devices provide real-time data, enabling predictive maintenance, while smart controls add modern conveniences to older buildings.

Sustainable materials

Sustainable materials are central to adaptive reuse, reducing environmental impact by reusing original materials such as wood and brick. Eco-friendly upgrades, such as low-VOC paints and green insulation, enhance health and sustainability, while energy-efficient retrofits like solar panels and green roofs improve long-term performance.

Together, these technologies and materials blend old and new, making adaptive reuse a powerful approach to evolving the built environment.

SUSTAINABILITY IN ADAPTIVE REUSE

Adaptive reuse is one of the most impactful ways to build sustainably — preserving materials, reducing carbon emissions, and extending the lifecycle of the built environment.

Environmental impact of adaptive reuse

Adaptive reuse has a significant environmental advantage, reducing construction waste and lowering the carbon footprint compared to new builds. By repurposing existing materials, it limits the need for new resource extraction and energy-intensive processes. Upgrading older buildings with energy-efficient systems also cuts operational energy use, reducing greenhouse gas emissions and conserving natural resources.

LEED certification and adaptive reuse

Adaptive reuse is particularly well-suited for achieving LEED certification, integrating several key sustainability strategies. By preserving existing structures, it reduces environmental impact through the reuse of the building shell, minimizing the need for new materials. Using sustainable materials, such as recycled and reclaimed resources, further aligns with LEED credits. Modernizing buildings with energy-efficient HVAC, lighting,

and insulation systems optimizes energy use, while low-VOC materials and improved ventilation systems enhance indoor air quality. Retrofitting with water-efficient systems also helps conserve resources.

Adaptive reuse and the circular economy

Adaptive reuse aligns seamlessly with circular economy principles, which aim to minimize waste and keep resources in circulation. By extending the life of buildings, adaptive reuse preserves valuable materials and reduces the need for new construction. It also helps close material loops by reusing and recycling materials like salvaged wood or brick during renovation. This approach enhances resource efficiency by limiting the extraction of new materials while incorporating energy-saving upgrades to improve operational performance. It also reduces landfill waste by preventing demolition and keeping materials in use longer.

BEST PRACTICES FOR SUCCESSFUL ADAPTIVE REUSE PROJECTS

Key considerations for adaptive reuse projects include:

Project planning

Successful adaptive reuse projects require careful planning, collaboration, and community engagement. Planning involves evaluating the building's structure, zoning laws, and historical significance while budgeting for surprises like structural damage. Setting sustainability goals such as energy upgrades or LEED certification early on guides the project's direction.

Collaboration

Collaboration is vital for adaptive reuse projects, which require architects, engineers, and sustainability experts to work together efficiently. Digital tools keep everyone aligned, reducing costly delays.

Community engagement

Community engagement ensures local support by involving residents early, highlighting benefits like new housing or public spaces and addressing concerns transparently. Partnering with local organizations strengthens ties and helps navigate challenges. These strategies ensure smoother and more successful adaptive reuse projects.

FUTURE OUTLOOK ON ADAPTIVE REUSE ARCHITECTURE

Urban planning is evolving to meet sustainability goals, adapt to changing space needs, and optimize existing infrastructure. Here are the key trends shaping the future:

1. Office-to-residential conversions

With the rise of remote work, many cities are repurposing vacant office buildings into residential spaces. This addresses housing shortages while revitalizing urban areas. Cities like New York and London are updating policies to support these conversions.

2. Mixed-use developments

Urban planners are prioritizing mixed-use developments that blend residential, commercial, and recreational spaces. This trend promotes walkability, reduces commute times, and creates vibrant, community-centered neighborhoods.

3. Government policies and incentives

Governments are supporting adaptive reuse with tax credits, grants, and zoning changes. Cities are adjusting building codes to allow conversions and incentivizing energy-efficient retrofits. Programs such as the U.S. Historic Tax Credit and Europe's Green Deal encourage sustainable development.

4. Sustainability and circular economy

Adaptive reuse fits into the circular economy by extending building life and reducing resource consumption. Cities are pushing for energy-efficient upgrades, green infrastructure, and nature-based solutions like rooftop gardens and parks.

5. Market predictions

The adaptive reuse market is expected to grow, driven by environmental goals, housing demand, and government incentives. Smart cities and IoT integration are becoming critical, with more buildings featuring smart systems for energy efficiency and urban mobility.

6. Transit-oriented development (TOD)

Planners are focusing on transit-oriented developments that reduce car dependency. These projects, centered around public transit hubs, combine residential, commercial, and retail spaces to promote sustainable urban living.

About the Author

Jon Holmes is a content marketing specialist at Autodesk, focusing on SEO and owned media. Based in Metro Detroit, he is a copywriter by trade, a poet-philosopher at heart, and an all-around creative in spirit. Before joining Autodesk, Holmes drove engagement and conversions for digital mortgage companies, AI start-ups, SAAS manufacturing apps, and more.

About the Article

Republished from Design & Make. Design & Make with Autodesk publishes thought leadership to inspire leaders in architecture, construction, manufacturing, engineering, and design. From greener buildings to smarter products to mesmerizing blockbusters, Autodesk software helps their customers to design and make a better world for all.