Sustainable Construction in the Retail Market

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Construction Management
Bed Bath & Beyond / Christmas Tree Shops
Paramus, New Jersey
Consultant: Dr. David Riley
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Occupant/Owner:
Christmas Tree Shops/
Bed, Bath & Beyond

General Contractor:
Schimenti Construction

Construction Manager:
Gregg Chappell

Architect:
CASCO

BED BATH & BEYOND/CHRISTMAS TREE SHOPS PARAMUS, NJ

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Design

-Roof top garden and pond
-2 Stories of Retail Space, 1 Story of parking deck
-170,000 SF of new construction

Structural

-Crane erected structural steel frame
-Cast in place concrete slabs and stairwell towers

MEP

-Installation of 9 rooftop HVAC units
-13 Electrical panels, (3) 277/480 Voltage
(10) 120/208 Voltage
-Point of sale (POS) system in cash-wrap
-Energy saving sensor equipment
-NOVAR automated control systems
-New wet-pipe fire sprinklers with audio
and visual fire alarms

Construction

-Mid project Construction Management change
-Raising of Bed Bath & Beyond and Christmas Tree Shops to allow for fire truck passage beneath them
-Structural renovations and additional concrete bridges between new building and existing parking structure to the south

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Executive Summary:

This thesis report as been based around the retail market and its involvement in sustainable design and construction. In particular you will find building information and analyses applying to the Bed Bath & Beyond / Christmas Tree Shops shopping center in Paramus, New Jersey. The depth contents include case studies of retail projects and companies who have made unique and prominent efforts in sustainability and application of LEED certification to the Bed Bath & Beyond / Christmas Tree Shops shopping center. This is designed to show what can be done to achieve a greater level of sustainability as well as what must be done to receive LEED accreditation. Furthermore, specific re-design examples will be included to demonstrate methods of reducing energy and resource use, and therefore life-cycle costs. Techniques to alter current buildings systems and the potential benefits are systematically displayed in each of the breadth topics and the results will be summarized.

Project Information

Design

The project design began with Bed Beth & Beyond hiring CASCO to do the entire design of the building. This included, but is not limited to: architectural, structural, mechanical and electrical designs. Please refer to the following project organization chart

Bidding

The entire project was put out in a competitive bidding process to hire a general contractor. Labor is designated as Local Union labor. The GC would be responsible for all construction aspects and hiring of all subcontractors to complete the project, with the exception of required subcontractors for certain specialty trades such as automated doors, control systems, and audio systems. These subs were pre-selected, but the GC was responsible for paying them. Insurance requirements for the GC were: $500,000 for workmen's compensation, $1,000,000 per occurrence for general liability, motor vehicle for $1,000,000, and an umbrella of $10,000,000. General Contractors were invited to bid on the project as the owner saw fit and hired based on their bid and foreseen quality of work. A balance of cost and quality were the deciding factors in choosing a General Contractor for the project. The contract was awarded as a lump sum and the project begun without the services of Schimenti Construction Company.

Schimenti was not involved previously due to insufficient time to bid the project. Although the project was the right scope and location for them, Schimenti's current situation wouldn't allow the resources to comfortably estimate the project and meet the bid deadline. The initial general contractor however failed to complete the project. In efforts to complete the project by their scheduled completion date, Bed Bath & Beyond hired Schimenti as a Construction Manager to finish off the remaining work.

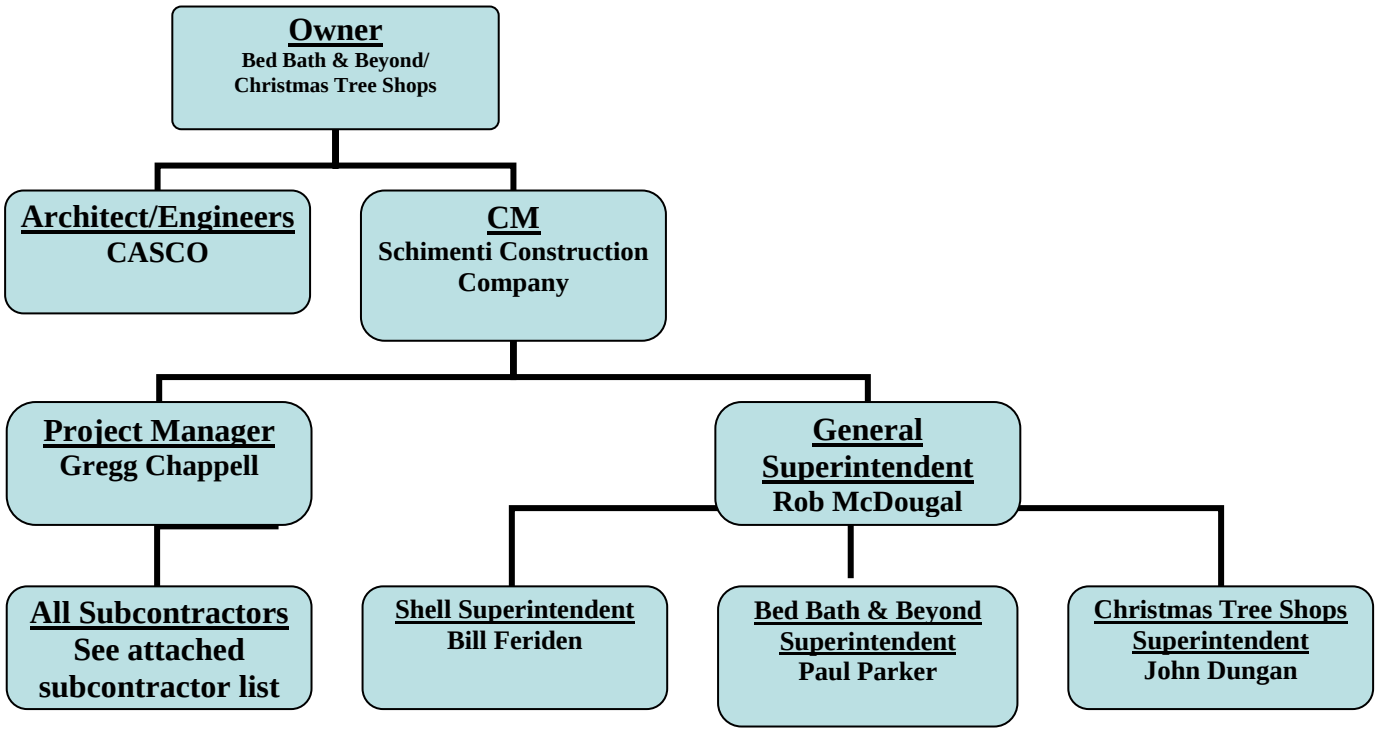
Construction

The project was originally broken into two phases. The first phase was the structural trades including: site work, piles, concrete foundations and structural steel. These trades were primarily assumed contracts from the failed General Contractor. The second phase was the remaining construction of the shell, base building, tenant spaces (Bed Bath & Beyond and Christmas Tree Shops) and the parking garage renovation associated with the construction of the third floor garden. The second phase was the portion that Schimenti Construction managed.

Contracts

Contracts were paid to subcontractors as a lump sum to complete their trades by the designated dates on the schedule. I believe lump sums were used due to the fact it's easier to manage a budget when you know how much you are going to pay, barring any unforeseen change orders. It's also often preferred by many subs. In the case of the payment to Schimenti, a cost plus fee contract made the most sense. Due to the unique nature of the situation the project had long been started and subcontractors were on site working already. With the project not being run from the beginning by Schimenti a cost plus fee was proper payment considering the risks involved and unknown costs to complete the unfinished work.

Project Organization Chart



Building Information

Building name: Bed, Bath & Beyond / Christmas Tree Shops

Location and site- Paramus, NJ, Ikea Shopping Center

Building Occupant Name- Bed Bath & Beyond/ Christmas Tree Shops

Occupancy or function types- Retail space

-112,683 SF of retail space

- 58,183 SF parking beneath building

Architectural

This project offered some unique situations which in return offered some unique architectural responses. The greatest example of this is the rooftop garden on top of the adjacent parking structure. There was an existing 3 story parking garage that was however the need to raise the building for fire truck clearance caused a difference in their heights. The architectural response to this was to fill the space with a ramp to provide access and a rooftop garden with a water feature. As well as unique features such as this, the building has high quality construction throughout the space. The building contains a large entry vestibule, ground level parking decks, vertical transportation, a vast retail space for two different stores, sales areas, and many private sections for employees and company members to work in. The building reflects high standards of architecture and requires a high quality of construction.

Demolition

Due to the project being on an empty lot the only demolition required was to remove an existing precast concrete structure in the adjacent parking garage to the north of the building so that it could be replaced with a more structurally sound support. There was also minor demolition to the garage to provide for bridging between the garage and the new Bed Bath & Beyond/ Christmas Tree Shops.

Structural Steel

The structural integrity of the building is provided by a steel structure frame. This was built by a different general contractor prior to Schimenti Constructions involvement. It was done with multiple cranes. Columns, beams and girders provide the frame along with metal decking to pour the slabs.

Concrete

Concrete was used for the slab on grade and 2nd and 3rd floor slabs. Prior to the pouring of the slab the large stairwell towers were formed and cast in place using the cranes. Due to the additional weight of the rooftop garden and pond there was the need for additional cast in place structures in the parking garage below it. Sidewalks were cast throughout the perimeter of the building and additionally concrete columns were used for support.

Masonry and EIFS

The exterior is a combination between simulated stone and EIFS finishing. CMU block with a brick veneer is used on some of the exterior and the stucco is used on the remainder. These walls are primarily for veneer purpose not load bearing. There is a unique curved masonry feature at the entrance way.

Mechanical

The building contains a wet pipe sprinkler system throughout its entirety supplied by a water riser. Copper domestic and sanitary plumbing lines are used along with steel gas lines. 9 rooftop units provide for the HVAC system that have exhaust ranging from 200 CFM to 10,000 CFM of air. A variety of different ducts sizes are used in distribution of forced air. The HVAC is run constantly during occupied hours and by demand during unoccupied hours. These settings are coordinated with the NOVAR control system to be installed. All ducts have smoke detectors for fire alarms. Mechanical room is in the South West corner of the building.

Electrical

The building is run off 13 electrical panels 3 with voltage 277/480 and the remainder at 120/208. They supply the constant lighting to the sales area and an unoccupied night lighting sequence controlled by the automated control system. Specialty lighting for the exterior is supplied for items such as external lights and signage lighting. Lighting is run both behind the drywall and in slabs to locations such as mid floor cash-wraps for the (POS), point of sale system. Fire alarm systems are throughout the store and both audio and visual alarms are generously used in all areas. The electrical room is in the South West corner of the building.

Sustainable Construction in the Retail Market
Depth

Introduction:

The purpose of this analysis is to look at the retail portion of the construction industry and its transition to sustainable design. In particular, I will be focusing on LEED retail for new construction as the pilot guide has been recently released. My original goal was to look at the retail market and help determine why owners have been resisting LEED buildings more then other project types and additionally what can be done to encourage owners to build this way. In the middle of my initial research, in February of 2007, LEED released "LEED Retail for New Construction – Pilot Version 2", a more finished and focused manual that will lead to the final retail LEED certification reference guide. At this time I decided to refocus my efforts on this pilot guide and other retail projects that have made an effort to incorporate LEED points. Throughout my research I have come across some great examples of sustainable projects such as People's Food in Portland, Oregon and additionally planned programs for major retail corporations such as Wal-Mart Inc. This portion of my thesis project will display both People's Food and Wal-Mart as case studies to showcase some of the steps these individual companies have taken to build more environmentally sound buildings. As well as case studies, I will focus on my particular building, Bed Bath & Beyond and Christmas Tree Shops in Paramus, New Jersey, and how environmentally conscious changes to the project can achieve a LEED certification. Specific LEED point requirements and methods to achieve these points will be outlined in order to obtain 36 which qualifies for a silver certification.

Case Study 1: People's Food, Portland, OR. March, 2003.

Overview:

- 5,400 SF
- Design-Build project
- 55% new construction, 45% renovation
- 2 Story building grocery store
- Total project cost: $900,000
- Variety of rooms including offices, conference rooms, retail space, restrooms
- Winner of BEST (Businesses for an Environmentally Sustainable Tomorrow) in 2003 and Southeast Portland Uplift Community Award in 2003

The Project:

- The design process included the efforts of a general contractor, local architect, energy-efficiency engineer, energy consultant, and expansion project manager.
- The general contractor had very little experience with green building and was responsible for many processes including the electrical system, plumbing, framing, roofing, drywall installation, insulation, concrete, and the excavation and general site work.
- In order to promote lifetime efficiency and proper maintenance, the project designer created a detailed and project specific operations manual.

The Design:

Site: The choice of site location and features helps maintain undeveloped land and reduces the impact on the environment via excessive automobile use.

Methods employed:

- The building is located in an urban setting to avoid contributing to sprawl.
- There was no development on prime agricultural land or habitat for endangered species.
- The site is pedestrian-friendly and offers such attributes as bicycle racks, showers for pedestrian commuters, incentives for pedestrian commuters, and access to public transportation.
- All development was done on previously developed land.

Water: Reducing the amount of contaminants in storm water runoff and reducing water consumption helps keep local water tables healthy and replenished.

Methods employed:

- Reduction in amount of paved driveways. This allows for water absorption into the ground and thus into the natural water table instead of flowing on pavement surfaces carrying pollutants into the water.
- A green roof was created which absorbs rainfall to irrigate the plants rather than pouring into a downspout.
- Indigenous plants are used for the landscaping which means they can survive without the use of excessive landscape irrigation while simultaneously contributing to the local natural aesthetic.
- Rainwater is collected in basins to be distributed for a variety of uses in the building. It is incorporated in both a gray-water system and a drip landscape irrigation system. A drip system is

more efficient for landscaping because conventional sprinklers lose a large percentage of water to evaporation before reaching the roots of the plants.
- Water efficient fixtures are used in restrooms to decrease water consumption.

Energy: Efficient mechanical systems and natural ventilation can both reduce the annual cost of building function as well as avoid drawing from dwindling energy supplies.

Methods employed:
- Low-emissivity windows and natural daylight allow for natural and free energy.
- Insulation values used exceed code requirements to help avoid unnecessary energy loss (Whole-wall value greater then 25).
- Energy monitors are used to provide accurate data and ensure the building is functioning as planned.
- Underground thermal breaks are installed in the slab to avoid conduction losses into and out of the building.
- Produce storage is placed on the northern side of the building where solar heat gain is at a minimum. This means there is no need for additional energy to cool this area.
- Geothermal energy is drawn from the earth to be integrated into an energy system of passive ventilation, solar gain, and high efficiency natural gas combustion.
- Water heaters and gas furnaces in the top 20% of efficiency are used.
- High efficiency T8 Fluorescent lamps used throughout the building.
- In the winter months, deciduous trees located on the south side of the building allow sunlight to pass through the windows and directly hit the thermal mass of the masonry floors and cob walls. In the summer, the tree's foliage provides shade to help keep the building cool.

Materials: Selection of materials allows projects to reuse recycled materials to avoid diminishing resources while incorporating materials that avoid environmental hazards.

Methods employed:
- Salvaged and certified materials are preferred wherever possible. Certified wood from the Forest Stewardship Council are used for all woodwork.
- Metal studs consist mainly of recycled content.
- All materials are obtained from local suppliers and manufacturers to avoid transportation cost and pollution, while supporting local economies.
- Approximately 90% of building waste was recycled or reused. Many of these materials were taken to a non-profit building recovery operation.
- On renovated portions of the building, existing structural elements were maintained to avoid the need for new materials.
- Low VOC paint is used for the interior and exterior paint coats.

Indoor Environment: Providing the means for a high thermal comfort level and air quality promotes a productive and healthy environment.

Methods employed:
- Employees have many temperature controls in the area to allow for personal comfort levels.
- Large windows and open floor plans allow an abundance of natural lighting into the spaces.
- Formaldehyde and VOC rich products are avoided to maintain a high quality of indoor air.

- Non-smoking policies are enforced to avoid secondhand smoke and building damage.
- Frequent mechanical maintenance ensures the continuous proper function of the building.

Commissioning: Properly commissioned and maintained buildings help reduce the life-cycle cost of a project as well as ensure proper function throughout its duration.

Methods employed:

-The HVAC system designers will inspect the system after installation to ensure that it is performing according to the design's standards. There are plans to install monitoring equipment shortly after construction to measure energy use and determine accurate cost savings. I believe it is important for owners to see actual costs rather then just projected costs, providing a concrete value to their investment of energy efficient systems.

Modeling & Simulations: Modeling is important to provide accurate energy information.

-DOE2 Interactive Modeling is a modeling software program in which a user can enter weather information to gain very accurate models of expected energy use
-EQuest Building Energy Simulation was also used to help predict annual energy costs

Premium Costs: Some of the aspects of this project have an initial cost increase, although in many cases they are quickly offset by annual cost savings.

- The HVAC system cost $63,000 ($11.50/SF), which is approximately $26,000 more then a minimally coded project of similar scope. The system received $9,100 in Oregon Business Energy Tax Credits and a $10,000 Emerging Technology Grant from the City of Portland Office of Sustainable Development. These grants help offset 73% of the premium.
- The cost of the partial eco-roof was $4,750. ($19.00/SF). Due to its stormwater management benefits, the project received a $2,500 grant from the Community Watershed Stewardship which offset 53% of the premium.
- The installed lighting system cost $3,850. The project's annual electricity savings are 11,459 kilowatt hours which leads to an annual energy cost savings of $573. The payback period for installed lighting is expected to be 6.1 years including a utility rebate of $360.
- Certified and local wood products never cost more than 15% beyond the cost of typical products. Overall, the project only added 5-10% to its costs by using a combination of cheaper salvaged materials and slightly more expensive certified and local materials.

Overall Outcome & Valuable Lessons:

- People's Food consumes 16% less energy than mandated by an already strict Oregon Energy Code and saves roughly $1,700 each year in energy costs.
- Many of the efforts to build sustainably were responded to with government and private organization grants and support.
- The integrated design-build process allowed for a variety of professionals working together to produce a well-designed and executed project.
- Premium initial costs are very quickly offset by annual cost savings.

Case Study 2: Wal-Mart Stores Incorporated in the year 2012

Overview:

Wal-Mart Stores Incorporated has instituted a company initiative to become increasingly more environmentally conscious and energy efficient from now through the year 2012. They plan to change the way their buildings are designed, the way they transport products, and the way the products they sell are manufactured. They have set goals and briefly discussed how they will proceed in reaching them.

Goals:

-To Be Supplied 100% By Renewable Energy
- Existing stores 25% more efficient in 7 years.
- New stores 30% more efficient in 4 years.

-To Create Zero Waste
- Have a 25% reduction in solid waste in 3 years.
- All private brand packaging improved in 2 years.

-To Sell products that Sustain our Resources & Environment
- To have 20% supply base aligned in 3 years.
- Design and support Green Company Program in China.

The Plan:

Wal-Mart is looking for ways to reduce their ecological footprint while keeping profit in mind. They believe that working on sustainability will be environmentally conscious and mutually beneficial to everyone involved.

Members of Wal-Mart's team are currently researching methods of improving building performance and reducing energy consumption at the same time. These efforts are financially conscious while considerate of diminishing energy supplies. Currently, Wal-Mart has multiple laboratories monitoring experimental store prototypes to determine the success of their efforts thus far. The experimental stores employ aspects such as drip landscape irrigation systems, drought tolerant landscaping plants, LED interior and exterior lighting, heat recovery systems, recycled content construction materials and higher efficiency mechanical systems. So far the buildings are showing good results and they are continually working to improve upon their current design.

Another aspect of the initiative is to work with product manufacturers in an effort to share technologies and ideas in sustainability. Wal-Mart is asking many packaging companies to reduce the size of the packaging and to use easily recyclable materials. For example, Wal-Mart initially worked with toy manufacturers to improve the packaging on 16 items. The result was 230 less shipping containers in the distribution process, 1,000 less barrels of oil used, and 3,800 fewer trees consumed. This coming year they plan to amplify these efforts more then 10 times. Another design approach they have used to reduce waste is creating a "sandwich bale" plastic packaging which presses plastic between 2 stacks of cardboard and bundles it for transportation. So far they have diverted nearly 1100 tons of plastic from landfills. As an added bonus, recyclers actually pay Wal-Mart for the plastic, so this approach has actually become profitable to the company. In addition to working with manufacturers, Wal-Mart has started their own organic cotton farming line to provide

all organically made products. This is an excellent example of sustainability extending to all aspects of the product, from material, to packaging, to transportation.

Wal-Mart is putting additional effort into their transportation system to help reduce truck emissions, which in return, is also going to become profitable for them. By the year 2012 Wal-Mart's goal is to reduce carbon monoxide emissions by 25%, which will have a great effect on the environment. Using local suppliers is also part of their plan and this in return reduces transportation costs, which can be quite significant.

These efforts and more are setting Wal-Mart apart as an environmentally focused company. Of course, I believe that many efforts are driven by monetary motives and desire to have an ethical appeal to consumers, but that does not make the efforts less beneficial. Currently, Wal-Mart is working to improve on their initiative as well as meet their current goals, while also working to generate incentives to manufacturers and buyers.

LEED Certification
Based on "LEED Retail for New Construction – Pilot Version 2"
Bed Bath and Beyond / Christmas Tree Shops

Introduction:

In this section I am considering my particular thesis building and what alterations need to be made to achieve a LEED certification based on the newly released retail pilot guide. It is important to note that in some cases there is little to no change required in the design in order to achieve the LEED credit. This is important for owners to understand because in many cases high-quality construction projects and designs will naturally qualify for credits. For example, it is economically logical to attempt to use regional material suppliers to avoid paying excessive transportation fees and increased lead times. Other items such as energy efficiency and a high quality indoor environment are important characteristics designers are often already focused on.

Outlined below will be 36 LEED points I have deemed most attainable, all prerequisite credits, the requirements to achieve the points, and strategies that can be used to attain them for the Bed Bath & Beyond / Christmas Tree Shops. I have listed more than the minimum number of points required for a silver rating, because often a point or two previously considered attainable falls through. It is wise to exceed the minimum to avoid the risk of missing the target accreditation. The point requirements for the different accreditation levels are as followed:

71 Possible Points
Certified 26–32 points
Silver 33–38 points
Gold 39–51 points
Platinum 52–69 points

SS Prerequisite 1: Construction Activity Pollution Prevention (Required)

Requirements: Create and implement an erosion and sedimentation control plan for construction activities. The plan must fulfill 2003 EPA Construction rules or local standards if more stringent. The goal of this prerequisite is to prevent soil loss, prevent sedimentation of stormwater run-off into local streams and bodies of water, and avoid polluting the air with particles.

Strategies: Create a SWPPP (Stormwater Pollution Prevention Plan), with the following outline as recommended by the environmental protection agency:

- Cover/title page
- Project and SWPPP contact information
- Site and activity description, including a site map
- Identification of potential pollutant sources
- Description of controls to reduce pollutants
- Maintenance/inspection procedures
- Records of inspections and follow-up maintenance of BMPs
- SWPPP amendments
- SWPPP certification

Methods to prevent the erosion of soil, control sediment, and minimize the impact of construction processes include; phase the construction to avoid entire site involvement at once, control stormwater on and off of the project, control the site perimeter, protect storm drain inlets, stabilize all soil on the site, and pay particular attention to slopes. For the Bed Bath & Beyond project, I would recommend the use of BMPs, best management practices, such as silt fences to catch sediment before it can leave the site, reduced amount of impervious surfaces during construction to allow for proper drainage into the ground, and avoid contamination of stormwater. Additionally, I would place restraining blankets on the more sloped areas to avoid soil movement. Furthermore, all waste products must be stored in a fashion that avoids rainfall to keep the water pollutant free.

Silt fences: $29.95 / 100 ft. from U.S. Fence Inc. The fences come preassembled to avoid affecting the schedule or requiring more man hours to put up. Approximate site perimeter is 1300 feet. Silt fences for the entire perimeter preventing sediment from leaving the site, would cost $389

Silt fence.
Picture Credit: U.S. Fence Inc.

SS Credit 1: Site Selection
(1 Point)

Requirements: Project must be on land that does not qualify as:
- Prime farmland as defined by the United States Department of Agriculture.
- Previously undeveloped land whose elevation is lower than 5 feet above the elevation of the 100-year flood as defined by FEMA.
- Land that is specifically identified as habitat for any species on Federal or State threatened or endangered lists.
- Within 100 feet of any wetlands as defined by United States Code of Federal Regulations.
- Previously undeveloped land that is within 50 feet of a water body. Must be consistent with the terminology of the Clean Water Act
- Land which prior to acquisition for the project was public parkland.

Strategies: The only approach that can be taken here is to research the land on which the project is planned prior to acquiring it to ensure it does not meet any of the above criteria. In the case of Bed Bath & Beyond, this point needed no additional effort and the site qualifies for the LEED point already.

SS Credit 2: Development Density & Community Connectivity
(1 Point)

Requirements: Option 1: Construct or renovate a building on a previously developed site and in a community with a minimum density of 60,000 square feet per acre net. *Option 2:* Construct or renovate a building on a previously developed site, within 1/2 mile of a residential zone or neighborhood with an average density of 10 units per acre net, within 1/2 mile of at least 10 Basic Services, and with pedestrian access between the building and the services.

Strategies: This is often an easy point for retail buildings, because in many cases they are constructed in high density areas. It is simply logical to build a store in an area where many people live and other accommodations are available as it will be beneficial to business. In the case of Bed Bath & Beyond this credit is already accomplished as it was built on previously developed land that is adjacent to an IKEA shopping center and within a half mile from the Garden State Plaza and Bergen Mall. The plaza is a mall that contains the 10 services required with sidewalks between the buildings.

Bed Bath & Beyond / Christmas Tree Shops at point A
Picture Credit: Mapquest.com

SS Credit 4: Alternative Transportation (Up to 4 Points)

Option A. Public Transportation Access: (1 point)

Requirements: Locate project within 1/2 mile of public transportation.
Strategies: Research the area where you are looking to open a new retail location and find out the nearest bus line. In the case of Bed Bath & Beyond this is yet another point that required no additional effort. There is a bus stop at the Bergen Mall via route #168 on the New Jersey Transit.

Option B. Bicycle Commuting: (1 point)

Requirements Provide bicycle storage for 5% of building employees and 1% of project customers. Also institute one of the following: lockable changing areas, showers, bike maintenance program, or bike route assistance.
Strategies: Bike storage is an inexpensive add-on for the project and can be placed adjacent to the sidewalks at the entrance of most buildings. Bike Rack Shops sells a 6 bike rack for $85 and it requires only one to accomplish the 5% of employee minimum, since the average employee count around busy retail seasons is 120 employees (5% x 120 = 6). My recommendation in accomplishing a bike maintenance program would be to contact a local bike repair store and request their assistance in establishing a company program offering discounted repair rates. I believe many companies would offer a small discount in exchange for an abundance of customers as a result of the program. Adding route signs out of the site would be an easy alternative as well.

Option C. Low Emitting & Fuel Efficient Vehicles: (1 point)

Requirements: Provide preferred parking for low-emitting and fuel-efficient vehicles to accommodate 3% of the total vehicle parking capacity of the site. In this case the total parking including the parking garage and ground floor of Bed Bath & Beyond is 2230, thus 3% would require 67 preferred parking spaces.
Strategies: Mark parking spots adjacent to handicapped spots for hybrid cars only and equip the parking officers with a list of acceptable cars. This does not add any significant cost to the project.

Option H. Commuting Education: (1 point)

Requirements: Provide a board or computer in the retail project that provides the following information:
- Information on carpooling programs
- Transit trip planning assistance
- Transit Maps
- Maps of preferred bike routes and the location(s) of secure bicycle parking, lockers and showers, if provided
- Summary of the company Transportation Management Plan
- Who to contact for more information

Strategies: Flyers of transit maps can often be acquired from local transit websites and locations. Providing a bulletin at the entrance of the building would be an affordable and easy way to gain a LEED point.

SS Credit 6.2: Stormwater Design: Quality Control
(1 Point)

Requirements: Implement a stormwater management plan that reduces impervious cover, promotes infiltration, and captures and treats the stormwater runoff from 90% of the average annual rainfall using acceptable best management practices (BMPs).

Strategies: In connection with SS Prerequisite 1, I recommend installing permanent BMPs such as silt fences and planting grass on sloped areas to maintain the sedimentation control practiced during construction. Additionally, I believe a long-term maintenance plan is necessary to address the product life of these fences and other aspects of the permanent control system.

SS Credit 7.1-7.4: Heat Island Effect: Non-Roof
(Up to 4 Points)

Requirements: Place a minimum of 25% of parking spaces under cover (defined as under ground, under deck, under roof, or under a building). Any roof used to shade or cover parking must have an SRI, solar reflectance index, of at least 29. Points are given for (25%, 50%, 75%, and an SRI value of 79 to fulfill the following equation (Area of SRI Roof / 0.75) + (Area of vegetated roof / 0.5) >= Total Roof Area).

Strategies: Due to the design of the Bed Bath & Beyond project, much of the parking is under cover since there are 4 levels of parking garage and only the top level on the garage deck is exposed. As well as the garage, the ground floor of the Bed Bath & Beyond / Christmas Tree Shop building is primarily covered parking. The total percentage of underground parking as built is 73% (1630 of 2230), therefore a minor rearrangement of spots and removal of a few outdoor parking spots would increase the total to 75%, accomplishing 3 of the 4 credits. I recommend using a concrete additive on the finished layer of the concrete roof. The additive would only be necessary for a small amount of concrete and would achieve the reflectance value needed to attempt the 4th point in this category. Common gray concrete tends to have an SRI of 35-40 when new, and will be sufficient to achieve the first 3 of these points where an SRI of 29 is needed. For the 4th credit, the roof above Bed Bath & Beyond is the model SR-50 roof with an SRI of 83. With the additive in the concrete to reach 79, SRI the entire roof will meet reflective requirements. The credit equation becomes:

(Area of SRI Roof / 0.75) + (Area of vegetated roof / 0.5) >= Total Roof Area)
(228,500 / 0.75) + (9500 / 0.5) = 323,667 SF > 238,000 SF

If desired 64,250 SF of roofing can be left under 79 SRI, but still above 29 SRI, to achieve all 4 points.

The roof of the parking garage
Picture Credit: Dan Baker

Roof top garden and pond feature
Picture Credit: Dan Baker

SS Credit 8: Light Pollution Reduction
(1 Point)

Requirements: All non-emergency interior lighting shall be automatically controlled to turn off during non-business hours. Provide manual override capability for after hours use. Furthermore, only light areas as required for safety and comfort. Do not exceed 80% of the lighting power densities for exterior areas and 50% for building facades and landscape features as defined in ASHRAE/IESNA Standard 90.1-2004. The project will be classified in a lighting category and must meet all requirements listed as well. For the area of the Bed Bath & Beyond one of the higher lighting categories, LZ3, is designated.

LZ3 requirements as stated by LEED are: design exterior lighting so that all site and building mounted luminaires produce a maximum initial illuminance value no greater than 0.20 horizontal and vertical foot-candles at the site boundary and no greater than 0.01 horizontal foot-candles 15 feet beyond the site. Document that no more than 5% of the total initial designed fixture lumens are emitted at an angle of 90 degrees or higher from nadir.

Strategies: In the case of Bed Bath & Beyond, like many retail projects, there is an overall control system. NOVAR control systems are used to both monitor and manage MEP activities and can be used to sequence non-business hour actions. The controls can be programmed to turn off all non-night lights left on after a specific hour unless specified otherwise. If these requirements are taken into consideration during the design phase of the project, lights can be selected which produce intense light only in certain directions, and the lighting location can be determined so as not to provide unnecessary light. Being that the area of Paramus in which Bed Bath & Beyond is being constructed is an urban area, the lighting requirements are far more lenient then if the project was in a more rural setting, making the requirement much more attainable. It is highly recommended to that lighting design teams with experience and access to lighting simulation programs are hired, to ensure the lighting conforms to regulations.

WE Credit 1.1-1.2: Water Efficient Landscaping: Reduce by 50%
(Up to 2 Points)

Requirements: Reduce potable water consumption for irrigation by 50% (100% to receive the 2nd point) from a calculated baseline case. Reductions shall be attributed to any combination of the following items:

- Plant species factor
- Irrigation efficiency
- Use of captured rainwater
- Use of recycled wastewater
- Use of water treated and conveyed by a public agency specifically for non-potable uses

Strategies: In many retail projects there is no significant amount of landscaping area; usually there are only small areas of grasses and trees including green spots between parking rows and sparse patches of vegetation around the building. The simplest way to obtain this credit point is to use regional plants in the design. Determining which plants are native to the area and require little to no watering decreases the landscaping water demand significantly. For portions of the landscape that do indeed require watering, a drip system is preferable as normal landscape sprinklers let most of

the water evaporate before it is absorbed into the earth well enough to reach the plants. A drip system has very little evaporation and can be connected to rain monitors which cost around $20 each. The rain monitors tell the system to not use stored or tap water for irrigation if there has been sufficient rainfall recently. Although drip systems can be more costly then a normal sprinkler system, the cost is not an overwhelming premium and savings in water easily offset the premium quickly. I also recommend placing a rain collection basin on the site. Harvesting rain can accommodate all of the water needed to landscape, obtaining the 2nd point in this category, and can also be used in connection with other LEED WE credits to follow.

Landscape drip system supplies
water straight into the ground
Picture Credit: Eco-Plus Green Building Store

WE Credit 2: Innovative Wastewater Technologies
(1 point)

Requirements: Reduce potable water use for building sewage conveyance by 50% through the use of water conserving fixtures (water closets, urinals) or non-potable water (captured rainwater, recycled graywater, and on-site or municipally treated wastewater).

Strategies: If a rainwater collection basin is used to help obtain the landscaping credits, the excess water can be used to flush toilets in a gray water system. Currently on the design, standard bathroom fixtures are used, 2.0 gallons per flush, but if they are exchanged for high-efficiency toilets and faucets, a great deal of water can be saved. I also recommend using waterless urinals; air suction is used instead of water, eliminating water demand altogether for those fixtures. High-efficiency toilets are available which use a mere 1.1 gallons per flush. Assuming one third of the toilet flushes are waterless urinals, the total amount of water consumed would be 40% of the standard gallon use.

WE Credit 3.1-3.2: Water Use Reduction: 20%-30% Reduction
(Up to 2 Points)

Requirements: Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including outdoor irrigation for landscaping) after meeting the Energy Policy Act of 1992.

Strategies: Bed Bath & Beyond does not have any water demand during building use other then restrooms and kitchenettes for employees, so if effort is extended to reach 50% wastewater reduction for the previous credit, it will be quite simple to attain both points by reducing water consumption by 30%. In addition to higher efficiency toilets, it is beneficial to install flow restrictors on bathroom sinks. The restrictors keep faucets from exceeding the flow-rate needed to properly wash hands and reduce the chance of wasting water. See Breadth topic "Plumbing Fixture Re-Design".

Flow restrictor installed on the sink piping.

Waterless urinal uses no water to flush.

Picture Credits: Eco-Plus Green Building Store

EA Prerequisite 1: Fundamental Commissioning of the Building Energy Systems (Required)

Requirements:

1) Designate an individual as the Commissioning Authority (CxA) to lead, review and oversee the completion of the commissioning process activities.
a) The CxA shall have documented commissioning authority experience in at least two building projects.
b) The individual serving as the CxA shall be independent of the project's design and construction management, though they may be employees of the firms providing those services. The CxA may be a qualified employee or consultant of the Owner.
c) The CxA shall report results, findings and recommendations directly to the Owner.
d) For projects smaller than 50,000 gross square feet, the CxA may include qualified persons on the design or construction teams who have the required experience.
2) The Owner shall document the Owner's Project Requirements (OPR). The design team shall develop the Basis of Design (BOD). The CxA shall review these documents for clarity and completeness. The Owner and design team shall be responsible for updates to their respective documents.
3) Develop and incorporate commissioning requirements into the construction documents.
4) Develop and implement a commissioning plan.
5) Verify the installation and performance of the systems to be commissioned.
6) Complete a summary commissioning report.

Strategies: Although commissioning can be a costly task to add to a project (typically between 0.5% and 1.5% of overall project, and as much as $375,000), the result is a much improved building throughout its life-cycle. It is important to involve experienced commissioners early on in the process to make certain the required scheduling duration is included in project management plans. It is preferred to have a commissioning team that has done LEED buildings before because the process is more in-depth than typical projects and is vital to both the building's success and acquiring LEED accreditation. I predict this to be the highest additional initial cost to the project in an attempt to get accredited.

EA Prerequisite 2: Minimum Energy Performance (Required)

Requirements:

Design the building project to comply with both:

- The mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) of ASHRAE/IESNA Standard 90.1-2004
- The prescriptive requirements (Sections 5.5, 6.5, 7.5 and 9.5) or performance requirements (Section 11) of ASHRAE/IESNA Standard 90.1-2004 and additionally the project must obtain 2 points within EA credit 1, Optimize Energy Performance.

Strategies: In order to obtain any of the 10 LEED points which make up the majority of the energy credits, the ASHRAE/IESNA standards must be exceeded, meaning that building to code standards is not a problem and is accomplished merely by designing a standard quality building. The only extra work needed to meet this prerequisite is to obtain 2 of the 10 points for going above and beyond this requirement. The percentage above standards required to get the 2 points will be outlined in EA Credit 1, Optimize Energy Performance

EA Prerequisite 3: Fundamental Refrigerant Management (Required)

Requirements:

Zero use of CFC-based refrigerants in new base building HVAC&R systems and free-standing and/or plug-in equipment. Small HVAC units (defined as containing less than 0.5 lbs of refrigerant), and other equipment are not considered part of the base building system and are not subject to the requirements of this credit.

Strategies: Due to the increase in LEED projects throughout the country that require CFC free HVAC equipment there is a plethora of available suppliers in all regions of the country, especially more urban settings like Paramus, New Jersey. The HVAC unit already in the specifications of the Bed Bath & Beyond is available with R-22, an HCFC based refrigerant which is not compatible with this credit, or R-410A, an HFC refrigerant with equal efficiency to R-22 and is LEED compliant.

EA Credit 1: Optimize Energy Performance (Up to 10 Points, Minimum of 2)

Requirements: Reduce the proposed building performance rating compared to the baseline building performance rating per ASHRAE/IESNA Standard 90.1-2004. All energy loads must be calculated using energy simulation programs.

% Energy Cost Savings (minimum)

New Building	Existing Building	Points
10.5%	3.5%	1
14.0%	7.0%	2
17.5%	10.5%	3
21.0%	14.0%	4
24.5%	17.5%	5
28.0%	21.0%	6
31.5%	24.5%	7
35.0%	28.0%	8
38.5%	31.5%	9
42.0%	35.0%	10

Strategies: Employ mechanical engineers that have considerable experience using energy simulation programming and a vast knowledge in energy saving equipment. To acquire the 2 points needed to get LEED certification, the Bed Bath & Beyond project would need to achieve 14% cost savings since it is new construction. The HVAC RTUs specified are typically a Lennox LGC300H which is compliant with the ASHRAE standards as well as Energy Star certified. With a seasonal energy efficiency rating (SEER) of 13.25, an energy efficiency ratio (EER) of 12.2, and an integrative part load value (IPLV) of 14.7. ASHRAE 90.1 specifies a minimum SEER of 10.0 (13.3 is 33% more efficient) and a minimum EER of 10.5 (12.2 is 16% more efficient). Ductwork in Bed Bath & Beyond is galvanized steel which is the type used in ASHRAE standards, so there should not be any additional inefficiencies. It appears as if the mechanical designers on this project were quite energy conscious, even without attempting a LEED certification.

EA Credit 5: Measurement and Verification
(1 Point)

Requirements: Develop and implement a Measurement & Verification (M&V) Plan. The M&V period shall cover a period of no less than one year of post-construction occupancy.

Strategies: This credit is not difficult to achieve for the Bed Bath & Beyond project or many other retail projects. The NOVAR control system, as mentioned before, not only consists of automated controls, but also a monitoring system that is capable of measuring actual energy use throughout the building. Without any further effort the NOVAR system can be used to track the energy use and confirm that the building meets all the desired energy requirements from design.

NOVAR Control Console
Picture Credit: NOVAR

EA Credit 6: Green Power
(1 Point)

Requirements: Provide at least 35% of the building's electricity from renewable sources by engaging in at least a two-year renewable energy contract. Renewable sources are as defined by the Center for Resource Solutions (CRS) Green-e products certification requirements.

Strategies: Using the total electrical load from the buildings, determine the increased cost of purchasing 35% of that value from a green power supplier. There is a premium cost in using green suppliers, but as there is increasing experience with green projects there has been a steady decrease in additional cost. The requirement is only a 2 year contract and if the owner of Bed Bath & Beyond decided that the green power was a premium they cannot afford to continue paying, they have the option of purchasing their power from standard electrical suppliers. The cost of green power in New Jersey is typically 14.4 cents per kwh which is 27% more then the 11.27 cents per kwh for standard electricity. If the contract was for the minimum of 35% green power to achieve this credit the increase would total less than 10% additional electrical cost.

MR Prerequisite 1: Storage & Collection of Recyclables
(Required)

Requirements: Do a study on the occupancy waste materials and decide the top 5 wastes. Make a plan of where to take them for recycling. Provide an easily-accessible area that serves the retail project and is dedicated to the separation, collection and storage of materials for the minimum of the top 3 recyclable waste streams as identified by a waste study.

Strategies: Very often in retail projects the top 5 waste materials are office paper, plastic, cardboard, glass, and metal or wood, however, this needs to be a company specific waste study as different companies will have a different quantity of waste depending on their products. This prerequisite is relatively painless to achieve as only the top 3 waste materials need to be addressed. For example, providing recycling bins for office paper, plastic, and cardboard would qualify the project for this requirement. Logical locations for these containers would be to place the office paper recycling bin near the office space of Bed Bath & Beyond and place the cardboard and plastic recycling bins between the loading docks and storage areas. By placing them in convenient locations the likelihood of use is much higher. RecyclingBins.com sells bins like the one below for $35, and its design makes it difficult to put anything but office paper in it, keeping things properly separated.

Office paper recycling bin
Picture Credit: RecyclingBins.com

MR Credit 2.1-2.2: Construction Waste Management: Divert 50-75% (Up to 2 Points)

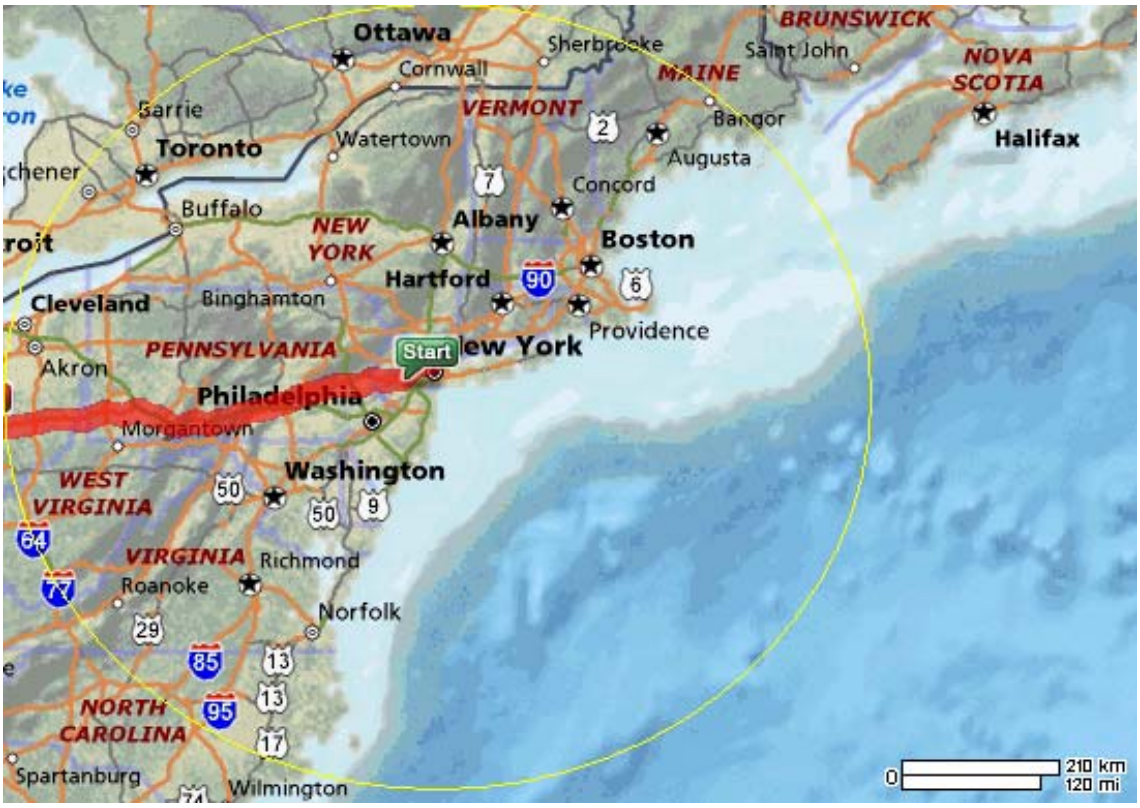
Requirements: Recycle and/or salvage at least 50% of non-hazardous construction and demolition debris. Develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or co-mingled. Excavated soil and land-clearing debris do not contribute to this credit. Calculations can be done by either weight or volume, but must be consistent throughout.

Strategies: Develop a waste management plan to avoid contributing to landfills as much as possible. Materials that can be easily recycled include: cardboard, metal, brick, acoustical tile, concrete, plastic, clean wood, glass, gypsum wallboard, carpet and insulation. Creating a centralized recycling location and informing all subcontractors and laborers of its location can improve the amount of materials actually recycled. In addition to diverting the waste from landfills, it is important to keep detailed records of quantities recycled compared to actual waste. 50% diversion is enough for 1 point and 75% will earn the 2nd.

MR Credit 5.1-5.2: Regional Materials: 10-20% Extracted, Processed & Manufactured Regionally (Up to 2 Points)

Requirements: Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site for a minimum of 10% (based on cost) of the total materials value. 20% for an additional point.

Strategies: For Bed Bath & Beyond this credit is a very simple one and for other projects it is often fulfilled inadvertently. Paramus, New Jersey is central to many popular construction regions, as seen in the map below. Therefore, not only are regional materials accessible but also more affordable. It makes sense economically to purchase materials that are regional because transportation costs are affected by gas prices and are an increasingly more significant portion of material costs. In addition to being more affordable, it is easier to manage materials and minimize lead time from transportation. Cities such as Toronto, Ottawa, Boston, Pittsburgh, Philadelphia, New York, and Washington D.C. are all within the 500 mile radius marked in yellow on the following page.



500 mile radius from Paramus, NJ
Picture Credit: Mapquest.com

MR Credit 7: Certified Wood
(1 Point)

Requirements: Use a minimum of 50% of wood-based materials and products, certified in accordance with the Forest Stewardship Council's (FSC).

Strategies: Determine local suppliers of certified wood to work towards both this credit and the regional material credit (MR Credit 5.1-5.2). The FSC site provides a directory of certified wood suppliers and I have researched several in the New Jersey and New York area that have a large selection of wood products. Saranac Hollow Woodworking in New York qualifies for the 500 mile regional radius and carries certified wood products including plywood, lumber, flooring, and a variety of hardwoods. There is typically a premium price for FSC certified wood so a good strategy when maintaining a tight budget while still achieving this point is to combine a combination of certified wood with cheaper salvaged wood products.

EQ Prerequisite 1: Minimum IAQ Performance (Required)

Requirements: Meet the minimum requirements of Sections 4 through 7 of ASHRAE 62.1-2004, Ventilation for Acceptable Indoor Air Quality. Mechanical ventilation systems shall be designed using the Ventilation Rate Procedure or the applicable local code, whichever is more stringent.

Strategies: This prerequisite is established to ensure there is a sufficient amount of fresh air allowed into the building to keep carbon dioxide levels low enough and provide a high quality of air for employees and shoppers. It is also important to keep both this credit and the Optimizing Energy Performance credit (EA Credit 1) in mind at the same time, because in many regions bringing too much outdoor air into the building will take a lot of energy to heat or cool it to desired temperatures.

EQ Prerequisite 2: Environmental Tobacco Smoke (ETS) Control (Required)

Requirements: Minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to Environmental Tobacco Smoke (ETS).

Strategies: The best strategy, and the case in most retail buildings, is to not allow smoking in the building at all. Additionally, outdoor smoking must be kept 25 feet from entries. The only effort required to aid the non-smoking policy is to install signs near entries informing visitors of the 25 foot rule.

EQ Credit 1: Outdoor Air Delivery Monitoring (1 Point)

Requirements: Install permanent monitoring systems that provide feedback on ventilation system performance to ensure that ventilation systems maintain design minimum ventilation requirements. Configure all monitoring equipment to generate an alarm when the conditions vary by 10% or more from set-point. Monitor carbon dioxide concentrations within all densely occupied spaces (those with a design occupant density greater than or equal to 25 people per 1000 sq.ft.).

Strategies: Purchase a ventilation monitor that can be linked to the automated control systems. In Bed Bath & Beyond's case the NOVAR control panel is available. The Test Equipment Depot sells a combination ventilation monitor and infrared gas sensor that monitors carbon dioxide and other potentially hazard gases. This piece of equipment cost $695 and can be used in tandem with the NOVAR automated controls to fulfill all of the requirements for this credit and more.

TIF8600 ventilation and gas monitor
Picture Credit: Test Equipment Depot

EQ Credit 4.1: Low-Emitting Materials: Adhesives & Sealants (1 Point)

Requirements: All adhesives and sealants used on the interior of the building (defined as inside of the weatherproofing system) shall comply with the requirements of the following:

Architectural Applications	VOC Limit [g/L less water]	Specialty Applications	VOC Limit [g/L less water]
Indoor Carpet Adhesives	50	PVC Welding	510
Carpet Pad Adhesives	50	CPVC Welding	490
Wood Flooring Adhesives	100	ABS Welding	325
Rubber Floor Adhesives	60	Plastic Cement Welding	250
Subfloor Adhesives	50	Adhesive Primer for Plastic	550
Ceramic Tile Adhesives	65	Contact Adhesive	80
VCT & Asphalt Adhesives	50	Special Purpose Contact Adhesive	250
Drywall & Panel Adhesives	50	Structural Wood Member Adhesive	140
Cove Base Adhesives	50	Sheet Applied Rubber Lining Operations	850
Multipurpose Construction Adhesives	70	Top & Trim Adhesive	250
Structural Glazing Adhesives	100		
Substrate Specific Applications	**VOC Limit [g/L less water]**	**Sealants**	**VOC Limit [g/L less water]**
Metal to Metal	30	Architectural	250
Plastic Foams	50	Nonmembrane Roof	300
Porous Material (except wood)	50	Roadway	250
Wood	30	Single-Ply Roof Membrane	450
Fiberglass	80	Other	420
Sealant Primers	**VOC Limit [g/L less water]**		
Architectural Non Porous	250		
Architectural Porous	775		
Other	750		

Strategies: Careful selection of adhesives and sealants to make sure the VOC limits are within the requirements is necessary. Clearly stating the VOC level requirements in contracts and specifications will help maintain this standard. Green Floors provides adhesives and sealants for a variety of tasks which contain 97% lower VOC levels than current criteria calls for.

EQ Credit 4.2: Low-Emitting Materials: Paints & Coatings (1 Point)

Requirements: Architectural paints, coatings and primers applied to interior walls and ceilings: Do not exceed the VOC content limits established in Green Seal Standard GS-11. VOC level requirements are listed below:

- Flats: 50 g/L
- Non-Flats: 150 g/L
- Clear wood finishes: varnish 350 g/L; lacquer 550 g/L
- Floor coatings: 100 g/L
- Shellacs: Clear 730 g/L; pigmented 550 g/L
- Stains: 250 g/L

Strategies: As with the sealants and adhesives credit, clearly state requirements and where possible state suppliers of low VOC materials. AFM Safe Coat is a provider of all of the materials specified in this credit and works with direct focus on LEED credits. Their products are labeled LEED qualified and they have many VOC free options. Benjamin Moore, the paint supplier used in Bed Bath & Beyond as built, also has a line of “green products” which meet requirements.

EQ Credit 4.3: Low-Emitting Materials: Flooring
(1 Point)

Requirements: All flooring materials must comply with the VOC requirements below:

- Clear wood finishes: varnish 350 g/L; lacquer 550 g/L
- Floor coatings: 100 g/L
- Waterproofing sealers 250 g/L; sanding sealers 275 g/L; all other sealers 200 g/L
- Shellacs: Clear 730 g/L; pigmented 550 g/L
- Stains: 250 g/L
- Ceramic tile adhesive: 65 g/L
- Grout and mortar: 250 g/L

Strategies: As with the previous two credits, follow the same strategies. Knight Premium Flooring is a company that has a variety of flooring options that are all LEED certified. Retail buildings typically have multiple flooring types to provide aesthetic accent to particular areas of the sale floor, so it is helpful to find a flooring company such as Knight that can provide many types of tiles and floorings.

EQ Credit 4.4: Low-Emitting Materials: Composite Wood & Agrifiber Products
(1 Point)

Requirements: Composite wood and agrifiber products used on the interior of the building (defined as inside of the weatherproofing system) shall contain no added urea-formaldehyde resins. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins. Furniture and equipment are not considered base building elements and are not considered under this credit.

Strategies: Starting this year, Columbia Forest Products have released a variety of wood products with no urea-formaldehyde present. Although this company is not within the 500 mile radius, not all materials need to be to meet the requirements for (MR Credit 5.1-5.2)

EQ Credit 6.1: Controllability of Systems: Lighting and Thermal Comfort
(1 Point)

Requirements: Provide individual lighting controls for 90% of retail employees in office and administrative spaces, enabling adjustments to suit individual task needs and preferences. Furthermore, provide individual thermal comfort controls for 50% of retail employees.

Strategies: The simplest way to accomplish this credit is to place thermostats for temperature control and put certain office lights on dimmer switches. The only caution needed in doing so is to make sure employees are not able to alter temperatures greatly which would result in high energy expenses. Many thermostats for this situation can be locked at minimum and maximum temperatures to avoid this possibility.

EQ Credit 7.2: Thermal Comfort: Employee Verification
(1 Point)

Requirements: Agree to implement a thermal comfort survey of building employees within a period of 6 to 18 months after occupancy. This survey should collect anonymous responses about thermal comfort in the building including an assessment of overall satisfaction with thermal performance and identification of thermal comfort-related problems. Agree to develop a plan for corrective action if the survey results indicate that more than 20% of occupants are dissatisfied with thermal comfort in the building.

Strategies: This is a very easy point to earn with no associated construction costs. A very simple survey that would only take a few minutes to complete could be distributed after the first year operations. There are plenty of free survey programs available on the internet which compile the answers in percentages, facilitating this process.

EQ Credits 8.1-8.2: Daylight & Views: Daylight 75-90% of Spaces
(Up to 2 Points)

Requirements: Demonstrate, through records of indoor light measurements, that a minimum daylight illumination level of 25 foot-candles has been achieved in at least 75% of all regularly occupied sales and customer service areas and any employee administration and support spaces occupied for critical visual tasks. Measurements must be taken on a 10-foot grid for all occupied spaces and must be recorded on building floor plans.

Strategies: These credits are often attainable for retail buildings. They tend to have a very open floor plan and an abundance of natural light. The open floor plans and shelving that does not reach to the ceiling allow light to continue further into the floor area. There are also large spans and small columns throughout the Bed Bath & Beyond floor plan and this allows views to be maintained deeper into the room. Skylights can be used to allow more natural light into the building and as many companies have done studies indicating natural light is good for sales more light will be incorporated into building designs. There will be an added expense to have the building mapped out and measured to confirm this credit.

ID Credit 1: Innovation in Design
(1 Point Each)

Option A - Occupant Recycling:

Requirements: Have in place a recycling program that addresses diversion from landfill disposal as the separation, collection and storage of materials for recycling, including (at a minimum) paper, glass, plastics, cardboard/OCC, metals, batteries and fluorescent light bulbs. Collect and recycle at least 95% of the batteries used, collect and recycle at least 95% of the fluorescent light bulbs used, and divert/recycle 40% of total waste stream (by weight or volume).

Strategies: This strategy can be obtained in tandem with MR Prerequisite 1 and again containers can be placed in locations heavy in employee activity. A bin for batteries and fluorescent light bulbs can be placed near a kitchenette or central office location with highly visible signs. The real effort in this credit is simply employee awareness and participation.

Option D - Green Educational Program:
Requirements:
Two of the following three elements must be included in the educational program:
1) A comprehensive signage program built into the building's spaces to educate the occupants and visitors of the benefits of green buildings.
2) The development of a manual, guideline or case study to inform the design of other buildings based on the successes of this project. This manual will be made available to the USGBC for sharing with other projects.
3) An educational outreach program.

Strategies: I would recommend that the implementation of this credit be assisted by the designer of the project, as he or she will already have extensive knowledge on sustainable processes. It would be a proper service to the owner of the buildings to provide some literature on the topic and allow them to display it to educate others and complete this credit.

ID Credit 2: LEED Accredited Professional (1 Point)

Requirements: At least one principal participant of the project team shall be a LEED Accredited Professional (AP).

Strategies: This point is almost automatic on LEED projects. It is extremely important to have a LEED AP on the project to ensure the success of the accreditation. This is unlikely to be considered an additional cost to the project, despite the possible debate of having to hire someone to fulfill this role. Many companies have already begun offering courses and reimbursement for accreditation tests for employees. Since it is a requirement is to have a LEED AP on the project, this can be someone in the design side, project management side, or even a superintendent.

Conclusion:

After doing a LEED analysis on the Bed Bath & Beyond / Christmas Tree Shops, I believe that the building is a strong candidate for a LEED certification. As seen in previously discussed credits, many aspects of this project qualify, or nearly qualify without much additional effort, for LEED points. New Jersey in particular is a great place to work on LEED accreditation due to the incentives, rebates and green energy initiatives in place. These rebates and incentives can help offset some of the initial cost of green products and procedures. Getting a LEED certification is not only beneficial from an ethical standpoint, but also from an economical and reputational standpoint as well. The initial cost and inexperience with LEED projects can often deter many owners from attempting certification, but the life-cycle cost reduction can be substantial, especially as energy costs continue to increase. Additionally, it would be beneficial to retail companies' reputation to build sustainably, because it informs the public that the company is interested in more than just profit and they intend to be a responsible corporation.

Retail buildings create unique design and construction projects and it is important that they are treated as such. Although the LEED retail guide is extremely similar to the standard new construction guide, there are some specific features, points, and requirements that are catered to retail projects.

The United States Green Building Council has taken a very important step for sustainable retail projects in their release of "LEED Retail for New Construction – Pilot Version 2" and it assuredly will be made into a finalized guide in the near future. Although LEED is not the only form of sustainable construction guidelines it is a very prominent one and their leadership in the process is very vital. I strongly believe that retail companies will show more interest in LEED projects in the near future and this will be a great benefit to themselves, their communities, and society as a whole.

Window Re-Design
Breadth – Mechanical/Architectural

Introduction:

The following analysis will be done to determine the effects of exchanging standard, double glazed tinted windows to a variety of other window types including low emissivity, high reflectance, and single glazed. Many details of the Bed Bath & Beyond / Christmas Tree Shops will be researched and entered into an energy simulation program, EQuest, to find a more accurate representation of the buildings energy costs. In connection with my depth in sustainable retail construction, my intentions are to find possible alternatives that would benefit a more sustainable, energy efficient design. Below you will find graphs and charts generated by EQuest on the following window types:

-Double clear ¼" glass, ½" air
-Double low-emissivity ¼"glass, ¼" air
-Double reflectance ¼" glass, ¼" air
-Single clear 1/8" glass
-Triple low-emissivity film ¼"glass, ¼" air

My goal with this analysis is to find windows that will lower energy consumption enough to offset the initial cost of adding higher quality windows within the lifetime of the building.

Procedure:

EQuest requires the user to fill out 39 pages of building profile information to obtain an accurate representation of the buildings systems, design, and use. General information such as building square footage, site direction, and exterior materials are initially selected. As the program continues, more detailed information is asked, including the type of mechanical systems, percentage of different occupancy types, and most importantly for this analysis, window square footage and layouts. For the Bed Bath & Beyond / Christmas Tree Shops project, the windows were categorized as 4'x4', 6'x8', and 4'x8' and the following percentages of each side of the building were glass windows:

-North side: 4'x4' - 4.8% of building façade
6'x8' - 0.0% of building façade
4'x8' - 2.0% of building façade

-East side: 4'x4' - 2.7% of building façade
6'x8' - 6.6% of building façade
4'x8' - 0.0% of building façade

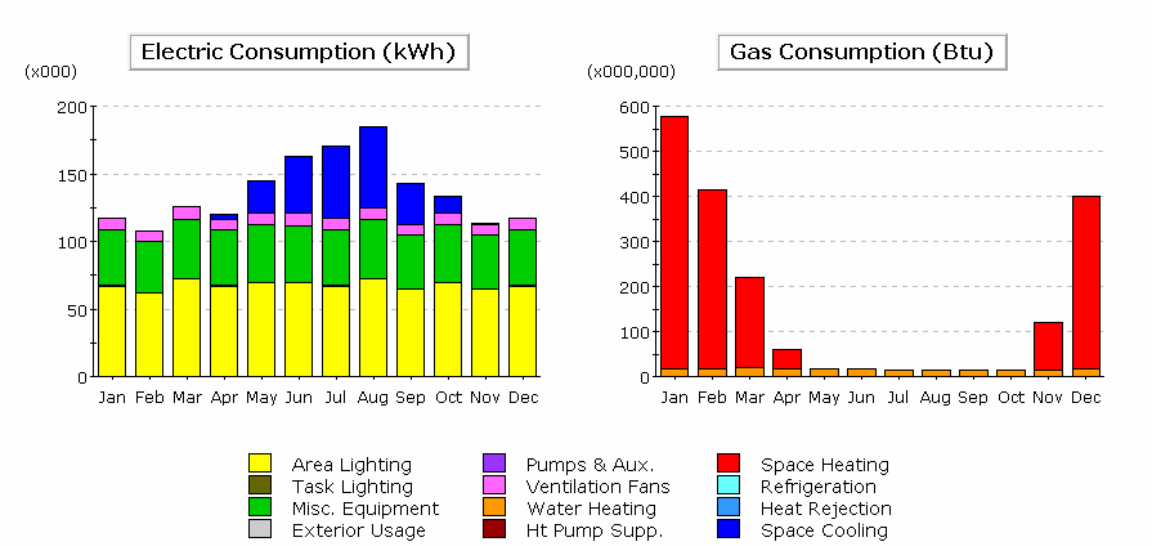
-South side: 4'x4' - 3.9% of building façade
6'x8' - 3.5% of building façade
4'x8' - 0.0% of building façade

-West side: 4'x4' - 2.9% of building façade
6'x8' - 22.4% of building façade
4'x8' - 0.0% of building façade

Window information such as wall percentages, dimensions, and sill heights remained the same, along with all other building information, to give the analysis a consistent base. The only information that changed from simulation to simulation was window type. The following pages contain a month by month breakdown of energy use by task and process as provided by the EQuest software. Since the only difference is window type, the energy change between simulations can be solely attributed to the window selection.

EQuest Data:

Simulation 1:
Double clear ¼" glass, ½" air



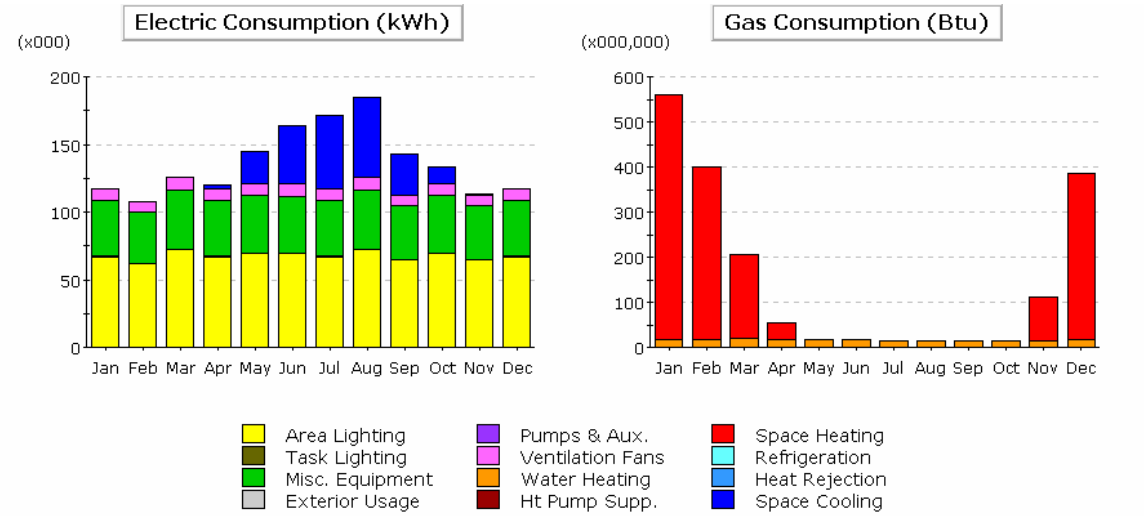
Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	0.5	3.3	23.2	42.5	53.9	59.4	30.2	12.3	0.6	-	225.7
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	8.4	7.7	9.1	8.4	8.8	8.8	8.4	9.1	8.1	8.8	8.1	8.4	102.0
Pumps & Aux.	0.1	0.1	0.1	0.0	0.0	-	-	-	0.0	0.0	0.0	0.1	0.4
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	41.3	37.8	43.6	40.9	42.4	42.0	41.3	43.6	39.7	42.4	39.7	41.3	495.9
Task Lights	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.9
Area Lights	67.0	61.6	72.1	66.9	69.6	69.4	67.0	72.1	64.4	69.6	64.4	67.0	811.0
Total	117.2	107.5	125.7	120.0	144.3	163.1	171.0	184.6	142.7	133.4	113.1	117.2	1,639.8

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	557.5	396.2	198.6	42.1	0.2	-	0.1	-	-	0.4	105.2	381.8	1,682.0
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	18.3	17.3	20.1	18.3	17.5	16.0	14.3	14.7	13.2	15.0	15.1	17.1	196.7
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	575.7	413.5	218.7	60.3	17.7	16.0	14.4	14.7	13.2	15.3	120.3	398.9	1,878.6

Simulation 2:
Double low-emissivity ¼"glass, ¼" air



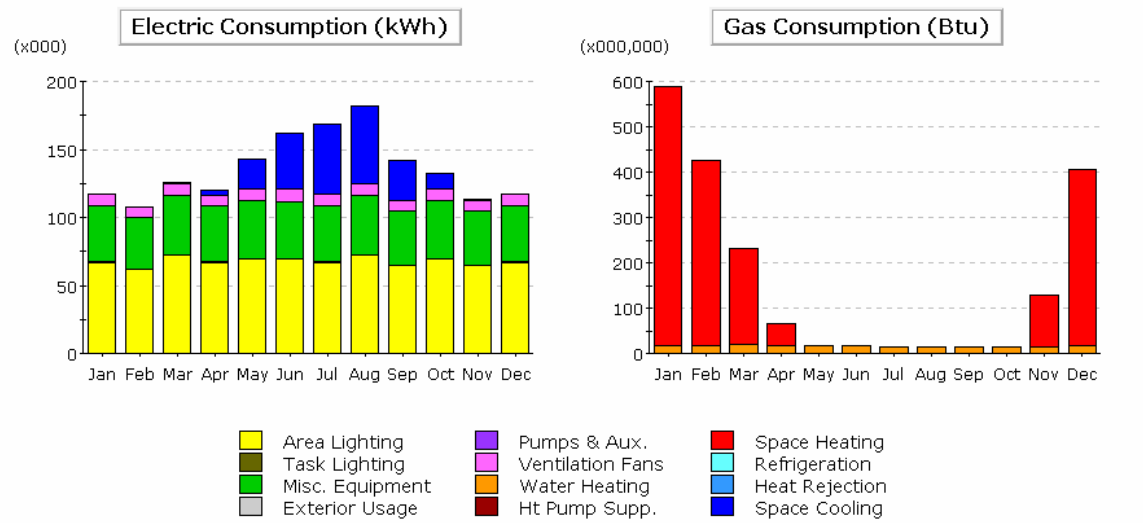
Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	0.6	3.4	23.6	43.0	54.3	59.9	30.6	12.6	0.6	-	228.7
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	8.5	7.8	9.1	8.5	8.8	8.8	8.5	9.1	8.1	8.8	8.1	8.5	102.7
Pumps & Aux.	0.1	0.1	0.1	0.0	0.0	-	-	-	0.0	0.0	0.0	0.1	0.4
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	41.3	37.8	43.6	40.9	42.4	42.0	41.3	43.6	39.7	42.4	39.7	41.3	495.9
Task Lights	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.9
Area Lights	67.0	61.6	72.1	66.9	69.6	69.4	67.0	72.1	64.4	69.6	64.4	67.0	811.0
Total	117.2	107.6	125.9	120.1	144.8	163.7	171.5	185.1	143.2	133.8	113.3	117.2	1,643.4

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	541.0	381.4	186.1	37.4	-	-	0.1	-	-	0.5	95.9	368.3	1,610.6
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	18.3	17.3	20.1	18.3	17.5	16.0	14.3	14.7	13.2	15.0	15.1	17.1	196.7
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	559.3	398.7	206.2	55.6	17.5	16.0	14.4	14.7	13.2	15.4	111.0	385.3	1,807.2

Simulation 3:
-Double reflectance ¼" glass, ¼" air



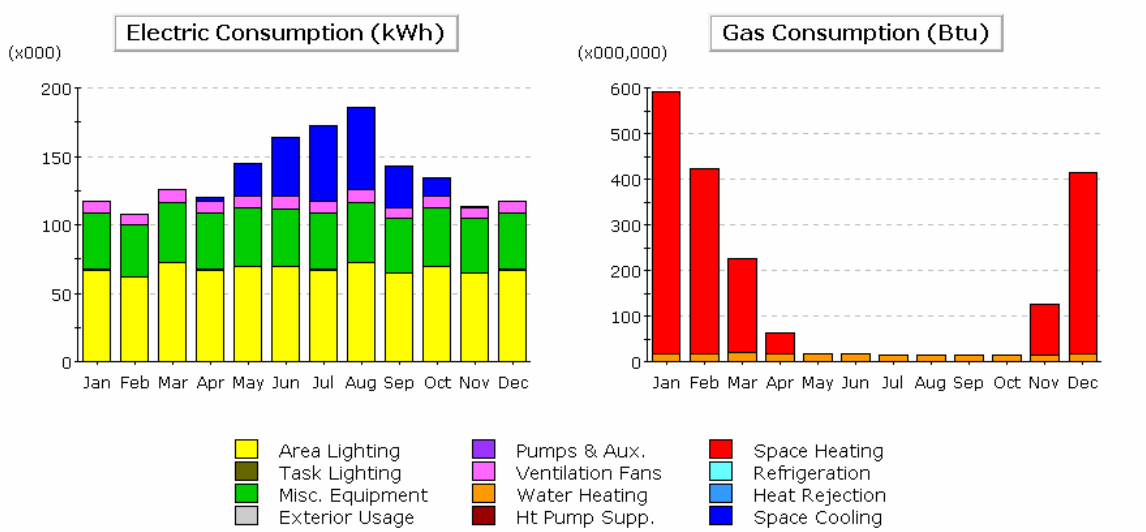
Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	0.4	3.0	22.0	40.9	51.4	57.2	29.1	11.7	0.5	-	216.2
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	8.3	7.7	9.0	8.3	8.7	8.7	8.3	9.0	8.0	8.7	8.0	8.3	100.8
Pumps & Aux.	0.1	0.1	0.1	0.0	0.0	-	-	-	0.0	0.0	0.0	0.1	0.4
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	41.3	37.8	43.6	40.9	42.4	42.0	41.3	43.6	39.7	42.4	39.7	41.3	495.9
Task Lights	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.9
Area Lights	67.0	61.6	72.1	66.9	69.6	69.4	67.0	72.1	64.4	69.6	64.4	67.0	811.0
Total	117.1	107.4	125.5	119.6	143.0	161.5	168.4	182.3	141.5	132.7	113.0	117.1	1,629.1

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	569.0	408.0	210.0	46.9	-	-	0.1	-	-	0.5	113.5	390.0	1,737.9
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	18.3	17.3	20.1	18.3	17.5	16.0	14.3	14.7	13.2	15.0	15.1	17.1	196.7
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	587.2	425.3	230.1	65.2	17.5	16.0	14.4	14.7	13.2	15.4	128.6	407.1	1,934.6

Simulation 4:
Single clear 1/8" glass



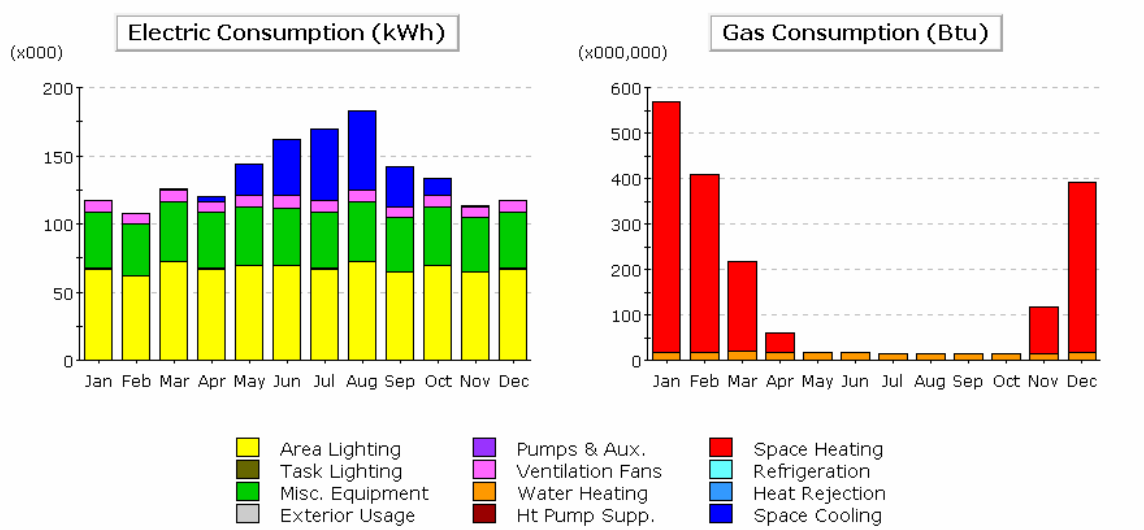
Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	0.5	3.4	23.8	43.3	54.8	60.4	30.6	12.5	0.6	-	229.9
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	8.6	7.9	9.3	8.6	9.0	9.0	8.6	9.3	8.3	9.0	8.3	8.6	104.3
Pumps & Aux.	0.1	0.1	0.1	0.0	0.0	-	-	-	0.0	0.0	0.0	0.1	0.4
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	41.3	37.8	43.6	40.9	42.4	42.0	41.3	43.6	39.7	42.4	39.7	41.3	495.9
Task Lights	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.9
Area Lights	67.0	61.6	72.1	66.9	69.6	69.4	67.0	72.1	64.4	69.6	64.4	67.0	811.0
Total	117.4	107.7	126.0	120.3	145.1	164.2	172.1	185.8	143.3	133.8	113.3	117.4	1,646.3

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	573.5	406.4	205.4	43.6	0.1	-	0.1	-	-	0.4	110.2	396.1	1,735.8
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	18.3	17.3	20.1	18.3	17.5	16.0	14.3	14.7	13.2	15.0	15.1	17.1	196.7
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	591.8	423.7	225.5	61.9	17.6	16.0	14.4	14.7	13.2	15.4	125.2	413.2	1,932.4

Simulation 5:
-Triple low-emissivity film ¼"glass, ¼" air



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	0.5	3.3	22.6	41.6	52.1	57.9	29.7	12.0	0.6	-	220.2
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	8.3	7.7	9.0	8.3	8.7	8.7	8.3	9.0	8.0	8.7	8.0	8.3	101.0
Pumps & Aux.	0.1	0.1	0.1	0.0	0.0	-	-	-	0.0	0.0	0.0	0.1	0.4
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	41.3	37.8	43.6	40.9	42.4	42.0	41.3	43.6	39.7	42.4	39.7	41.3	495.9
Task Lights	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.9
Area Lights	67.0	61.6	72.1	66.9	69.6	69.4	67.0	72.1	64.4	69.6	64.4	67.0	811.0
Total	117.1	107.5	125.6	119.8	143.6	162.2	169.2	183.0	142.1	133.1	113.1	117.1	1,633.2

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	550.8	391.9	195.9	41.3	0.2	-	0.1	-	-	0.5	103.4	375.4	1,659.6
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	18.3	17.3	20.1	18.3	17.5	16.0	14.3	14.7	13.2	15.0	15.1	17.1	196.7
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	569.0	409.2	216.1	59.6	17.7	16.0	14.4	14.7	13.2	15.4	118.5	392.5	1,856.2

Summary:
In comparison to the baseline (Simulation 1) the following 4 simulations had a difference in (thousands of kwh, millions of BTUs) (% of baseline kwh, % of baseline BTUs):

Simulation 2 - (+3.6, -71.4) (+0.2%, -3.8%) Double low-emissivity ¼"glass, ¼" air
Simulation 3 - (-10.7, +56.0) (-0.7%, +3.0%) Double reflectance ¼" glass, ¼" air
Simulation 4 - (+6.5, +53.8) (+0.3%, +2.9%) Single clear 1/8" glass
Simulation 5 - (-6.6, -22.4) (-0.4%, -1.2%) Triple low-emissivity film ¼"glass, ¼" air

Unfortunately the analysis didn't provide results that were on par with the goals of this breadth. Although there were minor changes for each window type neither change provided a substantial benefit to the energy consumption. The greatest reduction in cooling cost came from the double reflectance windows, however as expected with a highly reflective window, the heating cost in the winter is increased as potential heat energy from the sun is reflected away. The greatest decrease in heating cost came from the double low-emissivity, but this provided no benefit to cooling costs. The only window that actually decreased the amount of cooling and heating energy was the triple low-emissivity film which provided only a 0.8% energy reduction on average.

I had hoped a change in window type would provide enough saved energy costs to pay for the more expensive window as well as provide a profitable life-cycle cost, but for the Bed Bath & Beyond project this was not the case. Although this re-design would not prove beneficial for this specific project, I still have hopes that it would have a more significant effect on a different project. As displayed in the procedure section there is not a relatively large percentage of windows on any side of the building. Only 7.4% of the south facing side, which has the most exposure to the sun, is glass, and only 10.7% of the entire façade is window area. I believe the Bed Bath & Beyond project is different then other retail projects due to its 3 story design. The retail spaces are on the 2nd and 3rd floor of the building and therefore the storefront is not at eye level like most retail stores. The storefront is typically an opportunity for the retail company to showcase products and grab the customer's attention and this causes a larger percentage of window space. A building with a much larger window percentage will have more room for solar gain and heat loss through the glass and therefore it is more important for them to select a higher quality window. I do believe that any energy reduction is a good thing, but it is important to provide economic benefit to a re-design of this nature, whether it is an initial or life-cycle cost reduction.

Plumbing Fixture Re-Design
Breadth - Mechanical

Introduction:

Below is an analysis on alterations that can be made to the plumbing fixtures used in the Bed Bath & Beyond / Christmas Tree Shops shopping center in Paramus, New Jersey. In connection with the "Sustainable Construction in the Retail Market" depth portion of this thesis, I will be re-designing portions of the project to improve the efficiency and sustainability of the building as well as make an appeal to life-cycle cost savings. Although it may seem as if drastic savings is unlikely due to the relatively low cost of water, modifications quickly add up and become significant over the life of the building. This re-design is beneficial in itself, but it is also important for applying for a LEED certification. Below I will summarize my findings on average cost of using standard and specified plumbing fixtures and accessories for Bed Bath & Beyond, in comparison to the cost of energy and water efficient fixtures. $0.004/gallon of water will be the standard rate used for this analysis. The following will be analyzed individually and then summarized for total savings:

- Toilets
- Urinals:
- Sinks:

The goal of this re-design is to increase efficiency without substantial initial cost while simultaneously reducing life-cycle costs.

Toilets:

The average toilet in the U.S. requires 2 gallons of water per flush, which is more than is actually needed to function properly. LEED projects typically install 1.6 gallon/flush toilets, however, there are still more efficient products on the market that can be used. Typically the alternate toilets require air compression to help aid the flushing process, but this allows them an increased savings in water use. In the Bed Bath & Beyond project there are 16 toilets; 12 in the women's rooms and 4 in the men's rooms. I propose to switch these toilets for 1.1 gallon/flush to save 0.9 gallons per flush as compared to the U.S. average.

Potential product: Wellworth Pressure Lite K-3531; list price $440.00
Standard toilet: $306.00 (averaged from multiple products)
Initial Premium: (440-306) * 16 toilets = $2144.00

Savings: The average woman will use the toilet 3 times a day while a man will use the toilet once and the urinal 3 times. Using a 310 day occupancy per year, since the store is open Monday through Saturday, and 120 employee count (60 men and 60 women) for Bed Bath & Beyond / Christmas Tree Shops, the water savings are listed below:

	YOUR BUILDING	U.S. AVERAGE	LEED BASELINE
Toilets			
Gallons per flush:	1.1	2.0	1.6
Flushes per day (men):	1.0	1.0	1.0
Flushes per day (women):	3.0	3.0	3.0
Water use (gallons/day):	264	**480**	**384**

Water reduction:

((480-264) gallons/day) x (310 days/year) = 66,960 gallons/year
Cost reduction:
(66,960 gallons/year) x ($0.004/gallon) = $267.84/year

Payoff period:

(Initial Premium) / (savings/year) = payoff period
($2144.00) / ($267.84) = 8 years

Urinals:

The average urinal in the U.S. requires 1.5 gallons of water per flush, despite the fact that no water is required to operate properly. LEED projects typically install 1.0 gallon/flush toilets, but waterless urinals provide much more savings. Typically they require no air compression while still providing odorless and sanitary service. In the Bed Bath & Beyond project there are 4 urinals using 1.5 gallons per flush each, and I propose to switch these toilets for waterless urinals to completely eliminate water use. The cost of maintenance, for the urinals, is approximately $1 per 1000 flushes and includes changing filters, traps and sanitation fluid in the drain.

Potential product: Waterless #2102 Sierra No-Flush Urinal; list price $377.00
Standard urinal: $351.00 (averaged from multiple products)
Initial Premium: (377-351) * 4 urinals = $104.00

Savings: The average man will use urinals 3 times. Using the 310 day per year occupancy and 120 employee count, 60 men and 60 women, for Bed Bath & Beyond / Christmas Tree Shops the water savings are listed below:

	YOUR BUILDING	U.S. AVERAGE	LEED BASELINE
Urinals			
Gallons per flush:	0	1.5	1.0
Uses per male per day:	3.0	3.0	3.0
Water use (gallons/day):	0	**270**	**180**

Water reduction:

((270-0) gallons/day) x (310 days/year) = 83,700 gallons/year
Cost reduction:
(83,700 gallons/year) x ($0.004/gallon) = $334.80/year

Payoff period:

(Initial Premium) / (savings/year) = payoff period
($104.00) / ($334.80) = 4 months

Sinks:
The average sink in the U.S. uses 2 gallons of water per minute (gpm), but the use of flow restrictors and low-flow aerators will prevent employees from using more water then necessary for the task. Another consideration includes automatic faucet censors that turn off water flow when the person moves their hands away. In the Bed Bath & Beyond project there are 8 sinks in the women's bathrooms, 6 in the men's bathrooms, and 1 in the kitchenette. I will be using 1.0 gpm flow restricting faucets in the bathrooms and 1.5 gpm flow restricting faucets in the kitchenette, due to requirements that kitchen sinks have a minimum flow-rate.

Potential product: Flow-restrictors can be purchased from most plumbing suppliers and cost approximately $20.00. Initial Premium: ($20.00) * 9 sinks = $180.00

Savings: I've made the assumption that the average employee will spend approximately 15 seconds a day rinsing something in the kitchen and 1 minute washing their hands after using the restroom. Using the 310 day per year occupancy and 120 employee count, 60 men and 60 women, for Bed Bath & Beyond / Christmas Tree Shops the water savings are listed below:

	YOUR BUILDING	U.S. AVERAGE	LEED BASELINE
Bathroom Sink Faucets			
Gallons per minute:	1	2.0	2.2
Actual flow (Gallons per minute x 0.67):	0.7	1.3	1.5
Minutes per person per day:	1.0	1.0	1.0
Water use (gallons/day):	80	**161**	**177**
Kitchen/Dining Area Faucets			
Gallons per minute:	1.5	2.0	2.2
Actual flow (Gallons per minute x 0.67):	1.0	1.3	1.5
Minutes per person per day:	0.25	0.25	0.25
Water use (gallons/day):	30	**40**	**44**

Water reduction:
((201-110) gallons/day) x (310 days/year) = 28,210 gallons/year
Cost reduction:
(28,210 gallons/year) x ($0.004/gallon) = $112.84/year

Payoff period:
(Initial Premium) / (savings/year) = payoff period
($180.00) / ($112.84) = 1 year, 8 months

Summary:

Savings: The total reduction in water use is listed in the table below. It lists the amount of water that would be used if average, standard fixtures were used, LEED minimum fixtures, and the fixtures I've selected for the building redesign.

	YOUR BUILDING	U.S. AVERAGE	LEED BASELINE
Your estimated water use*:			
Gallons per day:	374	**951**	**785**
Gallons per month:	11,376	**28,927**	**23,877**
Gallons per year:	115,940	**294,810**	**243,350**
% Reduction vs. average:	61		
% Reduction vs. LEED Baseline:	52		

Water reduction:
Over the 310 day occupancy per year the reduction in water is:
(294,810-115,940) gallons = 178,870 gallons
Cost reduction:
(178,870 gallons/year) x ($0.004/gallon) = $715.48/year

Payoff period:
(Initial Premium) / (savings/year) = payoff period
($2428.00) / ($715.48) = 3 years, 5 months

Conclusion:
The payoff period is quite fast. From that point on, there will be a $715.48 per year profit which will last the life of the building. Considering the possibility that the building will have a life of 40 years, the profit will total $26,191. Although at the time of construction $2,424 dollars may have some significance, in the long run there is a great deal of money to be saved.

In addition to saving money, the 61% reduction in comparison to standard plumbing fixtures qualifies the project for 2 of the 5 possible water efficiency credits in the LEED retail guide. This small and inexpensive step towards LEED certification garners 1/13 of the points needed.

Not only is this re-design successful in its goal to create a more efficient plumbing system, but it also profitable and ethically responsible.

Thesis Summary:

The retail market has proven to be a very interesting and unique portion of the construction industry. It has taken some additional time to follow the sustainable design trend of many other markets but, it appears their participation is right around the corner. Efforts have been set in motion by the United States Green Building Council and a LEED certification guide is on its way. As the retail market continues to get involved in sustainable projects the many benefits of green building will become increasingly more visible to owners.

Substantial reduction of life-cycle costs take some careful planning and design, as well as an experienced project team, but are extremely attainable if the effort is made. Having designers get involve in efficiency analyses and sustainable design practices are necessary steps and I recommend that on every project efforts are made to push the building's potential further.

Finding ways to make construction progressively more profitable, socially responsible, and higher in quality is an extremely important task to undertake and the participation of industry professionals, government agencies, and young minds are vital in its success.

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