

## **Green & Clean: The Designer's Impact on Housekeeping and Maintenance**

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### **Capsule Description**

The design, construction, commissioning and demolition of buildings have enormous and well- documented environmental and human health impacts. However, the impacts from the operations and maintenance of buildings over their life times (25 - 50 years) are often overlooked. This paper will identify many of the typical problems associated with the designing of buildings and their interiors that have a direct impact on the indoor environment from a house-keeping and maintenance point of view.

Some of the specific issues being addressed include how interior designs can be improved to positively impact the cleanability and maintainability of buildings, and how the selection of interior materials can actually lower maintenance costs, while decreasing impacts on building occupants, cleaning personnel and the environment.

### **Abstract**

It is well documented that enormous liabilities exist for building owners, many resulting from building designs and construction that expose occupants to poor indoor air quality due to exposure to toxic substances. While material selection, along with operations and maintenance of the HVAC and other mechanical systems, are crucial to lessening these exposures, there is no doubt that cleaning and housekeeping strategies will also play a pivotal role in maintaining healthy indoor environments. This is especially true when considering those impacts over the entire life time of the building. Thus, the post-commissioning ongoing operational management practices will directly effect the indoor environment.

Many environmentally-concerned designers and architects now strive to specify materials and products that minimize or even eliminate the emission of toxic substances. Formaldehyde, solvents and other toxic materials are substituted with water-based and more benign alternatives. The release of CFC's (chlorofluoro- carbons) has also been identified as a serious environmental problem, and are being re-

placed. Even so, the most eco-savvy design and build professionals often fail to consider how the building design and interior finishes themselves can force the cleaning personnel to utilize hazardous cleaning products and processes, increasing liabilities and risks, as well as creating negative impacts on the building occupants and the environment outdoors.

Designers and architects typically specify devices that reduce the building consumption of water and may even recommend gray water systems for landscaping. But most are not familiar with opportunities to utilize conservation devices that can significantly reduce the amount of chemical cleaning products to be used within the building, which can result in an excellent cost and source reduction strategy.

Designers and architects specify HVAC filtration systems and placement of air intakes in locations that minimize potential pollutants, which can infiltrate the building causing discomfort and productivity losses to occupants. But often forget other design strategies that further reduce soils and particulate matter brought in by pedestrian traffic, an opportunity for point source control.

Design and build professionals work hard to maximize the use of floor space for matters of practicality, efficiency, comfort and productivity of the occupants. What is often overlooked is designing adequate space to meet the needs of the cleaning staff, such as areas to store and mix cleaning chemicals, maintain tools and equipment and to dispose of waste materials.

The costs associated with cleaning the average urban office building is \$1.38 per square foot, and run as high as \$2.32 / sq.ft. in New York City. However, there are a number of practical design decisions that can significantly reduce these costs. Some of these features include designing entry ways that prevents soils from entering the building; selection of material that reduces the frequency of cleaning; and designing in order to reduce the time cleaning person-

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nel actually spend cleaning. The reduction in cleaning costs resulting from these design changes are estimated to run as high as 25% to 33% of the total costs, and translate into significant savings, year, after year, after year. This unique and informative paper will offer designers and architects simple and practical cleaning and maintenance guidelines and specific suggestions. These include:

- entryways that keep soils out of the building
- restrooms that are easy to clean, thus reducing tenant complaints
- janitorial closets and chemical storage areas that don't drive cleaning personnel crazy

These design features can:

- reduced annual cleaning and maintenance costs
- maintain the building's appeal over its life time
- minimize toxic exposures (liability) to the cleaning personnel, building occupants and the environment
- increase the marketability of the building
- improved tenant satisfaction and tenant retention

## Entry Ways

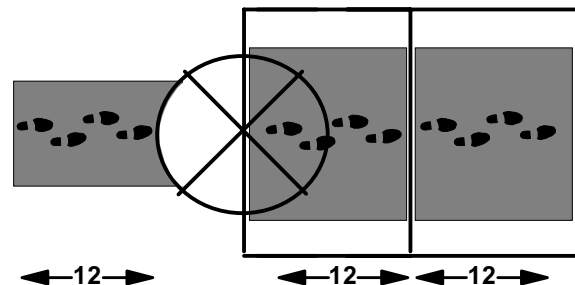
The cleaning industry estimates that 85% of soils and particles that we work so arduously (and expensively) to remove from a building are tracked in through the entry ways. Designs that capture soils before they are tracked throughout the lobby and further into other office areas can make a major impact on the frequency of vacuuming and dusting, and the washing, stripping and recoating of floors. Reducing cleaning frequencies can directly impact costs, as 90% of the cleaning budget is attributed to labor expenses. Additionally, by removing these soils and particles prior to entering the building, we can also extend the life of the surface areas themselves, and the mechanical systems and filters.

**Associated Landscape Features:** Better entry way designs must begin at the outside of the building. Approaches to the building should be of stone, brick or concrete and textured as opposed to smooth surfaces so that soils are scraped off peoples' shoes before they can enter the building. The entry way should also be pitched so that it will drain easily and not collect water and liquids. Water spigots should be installed at these locations to frequently wash-off the exterior walks.

The selection of vegetation at the entry areas should be of native species that require little maintenance — trimming, watering and fertilizing. In addition, "dirty" plants should be avoided. These are plants that drop berries, flowers and leaves which can be tracked or blown into the building.

**Vestibule Size:** The ideal entry way design should follow the concept used in "clean rooms" where multiple vestibules capture and remove soils before they enter the building. A large circumference revolving door entering into a vestibule at least 12 feet long could be the first line of defense. Ideally, this first vestibule would have a large floor grate with active vacuum exhausting directly to the outside.

This vestibule would then open via an automated sliding door to a second 12 foot vestibule with a matted or carpeted flooring material to dry shoes and capture any final soils before entering the lobby, again through an automated sliding door.



It is important to note that the reasoning behind the need for a minimum of 12 feet for the vestibules (or for entry way walk-off mats that are commonly used) is each foot steps to hit the mats at least twice and is considered the minimum length or number of steps required to generate any degree of success.

**Gratings & Walk-Off Mats:** Architectural gratings are extremely valuable in high traffic entry ways. This is especially true in regions with a high frequency of inclement weather. Walk-off mats should be recessed into the floors and constructed of synthetic materials with rubber or vinyl backings. Many design elements can be incorporated into those mats, such as logos and color combinations so that the mat becomes a permanent feature in the entry way. Adding architectural design elements to the mats also reduce the tendency for using the mats only during inclement weather. Walk-off mats can also be used outside the entrances, an especially good idea in sandy areas, such as in desert or beach settings.

**Electrical Outlets:** Electrical outlets in the entry way are a necessity in order to power the vacuum cleaners and occasional wet/dry vacuums necessary to maintain the vestibules, walk-off mats and floorings.

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**Cost Savings:** The total amount of a building's cleaning budget that is currently allocated for the dusting, vacuuming, mopping, waxing and stripping floors to remove these soils and particles, ranges from 30% to 50% and sometimes higher. A better entry way design as outlined here, can reduce these activities and the associated costs.

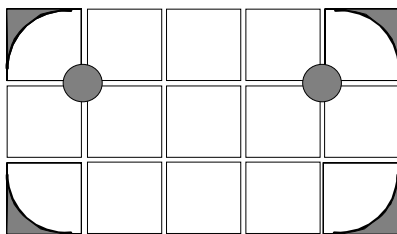
A building with an average cleaning rate of \$1.38 / sq.ft., can attribute \$0.69 to these activities. Entry way designs that incorporate these recommendations can reduce these cleaning costs by 30% to 50%. In Chicago with an average cleaning rate of \$1.63 / sq.ft., this savings alone can account for as much as \$0.41 / sq.ft. Thus, in Chicago for each increment of 100,000 sq.ft., the cleaning costs could be reduced by \$41,000 annually.

## Restrooms

Restrooms require an enormous amount of effort (labor) and chemistry to maintain an acceptable level of cleanliness from both an aesthetic and health standpoint. Unlike many routine cleaning jobs, restroom maintenance is often carried out multiple times throughout the day, and can be done as often as hourly in high traffic, public areas. It is also important to note that the restroom areas require the frequent use of hazardous (highly acidic and caustic) cleaning agents, often after normal office hours when the ventilation systems have been turned off to conserve energy. This exposes cleaning personnel to higher occupation health and safety risks.

**Flooring Materials:** It is recommended that restroom floors be of terrazzo, glazed ceramic or other types of stone tile. Selecting tile with minimal porosity is highly recommended. Furthermore, larger tiles minimize grout lines, which consistently present problems, especially in men's restrooms under the urinals. The grout itself should be dark in color, never white.

**Drains & Moldings:** Restroom floors should contain drains to allow them to be flood rinsed and easily squeegeed. Floor moldings should be made of the same flooring materials and rounded flooring tiles should be used in the corners to make it easier to keep corners clean.

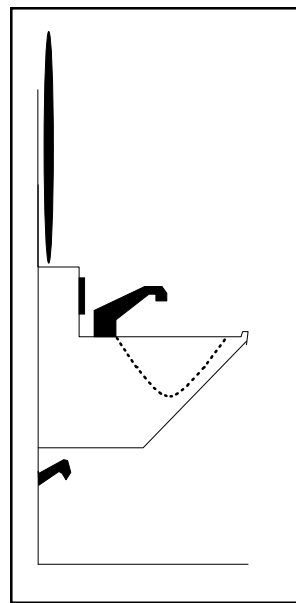


**Counter Designs:** From a cleaning standpoint, the best counter designs have sinks recessed into the counter top or molded as a single unit with a front lip to keep water from spilling onto the floor. The counter tops should be graded to eliminate standing water.

A sink at a child's height is recommended for high traffic public restrooms that are used by large numbers of children. This reduces the amount of water splashed about by kids, who find it difficult to use an adult sized counter. This is the same strategy that is used when installing urinals at a lower height for children.

Hot and cold water spigots should be installed under the counters to make them easily accessible to fill a typical mop bucket, as well as for connecting a water hose.

**Sinks:** The sinks themselves should be designed out of an easy to maintain material. The deeper the sinks are the less splashing that will take place, thus reducing the frequency of cleaning the counter tops. Sinks selection should avoid any decorative ribs or ridges which makes them more difficult to keep clean.



**Counter Materials:** Some examples of recommended materials for countertops include stainless steel, cultured marble, ceramic tile, DuPont Corian and other similar materials. Another environmentally preferred material is the new "Environ" from Phenix Biocomposites which is a material made from waste paper and soy bean resins. Be aware that the composite materials scratch more easily than stainless steel or tiles, and may be more suitable for executive washrooms, as opposed to high traffic public restrooms. For ease of cleaning and aesthetic

appeal, a marbled or textured surface hides water spots and soils better than solid colors.

**Sink Controls (Sensors & Faucets):** Automated sensing devices are recommended for sinks to minimize water use, as well as the amount of metal handles and valves that require cleaning, which inevitably get damaged from years of scouring with harsh cleaning products.

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Splashing onto countertops can be reduced by installing faucets that reach further into the middle of the sink (longer than the typical 5 inches). The controls for the automated faucets can be built into an 8 inch high box creating a back-splash and shelf that also keeps water off of mirrors, again cutting down on cleaning. Installation of the faucets leaving at least one inch space between the faucet and backsplash makes it easy to get a sponge through for cleaning purposes.

**Soap Dispensers:** Metal, in-counter hand soap dispensers tend to be problematic and difficult to repair, consuming unnecessary time to refill. Plastic bulk-fill type soap dispensers mounted to the wall are recommended. Dispensers with pumps that are pushed towards the wall, as opposed to ones that require a handle which is pulled away from the wall are also recommended. These are less expensive to purchase and maintain, do not get torn-down as frequently and reduce the time necessary to refill with soap.

**Toilets & Urinals:** Electric sensors are recommended for urinals and toilets. The amount of pipes and plumbing that is visible should be minimized to reduce cleaning and potential damage to the metal pipes and fittings. Bathroom must meet the requirements of the Americans with Disabilities Act (ADA), and where appropriate should meet the needs of children. The balance of the urinals (those other than for the disabled or children) should be raised a few inches higher than normal, encouraging the user to stand closer to the urinal, reducing the amount of urine that is splashed onto the floor. Both toilets and urinals should be suspended from the back walls making them easier to clean under.

**Stalls & Partitions:** Stalls and partitions should be made of a non-porous material. For high traffic restrooms, stainless steel or the same solid surfacing material used for the counter tops are recommended. While all materials look good when newly installed, painted metals and wood laminates inevitably become damaged and a haven for bacteria, and therefore are discouraged.

Urinal partitions should be avoided as they require routine cleaning which contributes to costs. Ideally, all stalls and partitions would be suspended from ceilings or extended from walls, expediting floor cleaning and eliminating soil buildup on legs and supports. The wall materials themselves should be easy to clean. And the use of a tiled wainscot is highly recommended, especially around urinals and toilets.

**Ventilation:** One of the biggest challenges is keeping the restroom smelling fresh and clean. Often, regardless of

how hard the cleaning personnel work, there will be complaints. The bigger problem is actually not the fault of cleaning, but instead because of poor air circulation in the restroom. Unfortunately, many times the results of these complaints is that extra labor is expended or unnecessary chemicals, air fresheners and odor masking agents must be used. Good ventilation is extremely important in these areas. Large, public restrooms should have multiple vents, placed over the toilets and urinals.

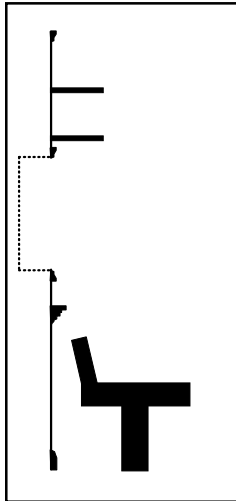
**Lighting:** Designers and architects should select light fixtures that are easy to clean and avoid shades and reflectors that capture dust. Other considerations are fixtures which allow light bulbs to be changed quickly, long-lasting energy efficient lighting which reduce the frequency of changing light bulbs and occupancy sensors which reduce the need to clean light switches.

**Cost Savings:** Proper design and material selection in the restroom can reduce the frequency and the time necessary for cleaning. The obvious benefits are a reduction in labor costs and reduced exposures to hazardous chemicals. In a traditional office building approximately 15% to 25% of the cleaning budget will be dedicated to bathroom maintenance. Effective design and material selection as recommended here, can reduce these cleaning costs, as well as decrease overall liability, and help maintain a higher level of aesthetics.

### **Tenant Areas - Finishes**

The tasks that consume the largest portion of the cleaning budget are dusting, vacuuming, mopping and spot cleaning. These activities can be impacted by the selection of interior finishes by reducing either the time needed or frequency in which these cleaning activities are required. These reductions can in turn, significantly reduce the associated cleaning costs.

**Selection Considerations:** When selecting the finishes for interiors their ability to resist soiling and ease in maintenance should be given careful thought. Perhaps the most important consideration should be to minimize the number of different materials selected as it applies to requirements for cleaning. An interior utilizing a dozen different materials — woods, marble tile floor with cement grouting, glass windows, brass trims, synthetic fabric upholstery, 100% wool carpeting and jute backing, etc., may require a dozen different cleaners and an equally large number of cleaning techniques. Carefully consider cleaning requirements when making recommendations of finishes, especially as the number of different finishes increase in a given area.



**Materials To Avoid:** Soft metals can be easily damaged either during cleaning with harsh chemicals or being scratched during normal use. These more vulnerable metals, which include brass, copper, chrome and aluminum, should be avoided. Soft woods, such as pine and fir should also be avoided, as should uncoated hard woods. These materials are some of the most problematic for cleaning personnel.

**Color Considerations:** In the selection of colors for carpeting and fabrics, architects and designers

should consider the product's ability to stay looking clean. Dark shades are preferred over light ones, and carpets with patterns and designs are preferred over solids.

**Interior Design Features:** Dusting is a very labor intensive activity and thus, very costly. Interior design features such as shelves, banisters, moldings, trims, sills, ledges and benches, collect dust that would otherwise fall to the floor and could be easily removed by vacuuming. Thus, by minimizing these types of interior design features, we can reduce the dusting and its associated costs.

**Carpet Issues:** Carpets with excessively long naps should be avoided as they are more time consuming to vacuum. Carpet squares can be easily replaced to preserve the overall appearance of the floors, and offer a good solution for high traffic areas.

## **JANITOR'S CLOSETS AND CHEMICAL STORAGE AREAS**

Far too often in an effort to maximize usable (or leasable) floor space, buildings are designed without janitorial closets, or ones that are so small as to create a nightmare of extra work, wasted time and inefficiencies for the cleaning staff. While it is critical to maximize usable footage, it is equally important to provide building occupants with a pleasant, safe and healthy indoor environment. And this requires that tools, equipment, chemicals, water sources, and supplies are conveniently available and safe to use, and that cleaning and maintenance jobs can be done efficiently.

**Plumbing:** Central storage areas need to be plumbed with both hot and cold water, and a large slop sink for cleaning

various cleaning tools, such as mops and floor buffing pads. In addition, the area should be plumbed to allow for the installation of chemical dilution equipment necessary for proper mixing of any concentrated cleaning chemicals that will be used. These chemical dilution devices cut chemical consumption by 50% as compared to non-portion controlled methods, and result in significantly reducing costs, and increased safety for cleaning personnel.

**Floor Drains & Electricity:** Floor drains are important, as the janitorial closets and central storage areas themselves require cleaning. Electricity is also necessary here, with multiple outlets installed to charge battery operated equipment.

**Location:** The location of the central storage area should be convenient to the loading dock for ease and added safety of receiving supplies and materials. Janitorial closets should be located near service elevators for ease of moving supplies.

**Janitorial Closets:** Janitorial closets should include hot and cold water, a slop sink for cleaning materials, electricity, and some shelving to store some items, such as toilet paper and hand towels. Recommended flooring material can be vinyl composite tile or concrete coated with a durable chemical-resistant coating.

**Ventilation:** Due to the types of products being stored and mixed in these areas, it is recommended that both janitorial closets and central storage areas should have direct outside exhaust. Furthermore, it is recommended to operate these areas under negative pressure.

**Size Considerations:** Central storage areas need to be large enough for chemical and equipment storage, including some shelving and having secured spaces, such as a locking cage large enough to keep some of the most hazardous chemicals and items.

Buildings that are primarily covered with hard flooring materials, such as vinyl tile or sheet linoleum require large storage areas for automatic scrubbing machines, buffers, burnishers, mops, buckets and chemicals. Whereas, buildings primarily covered with carpeting requires less storage space for equipment, such as backpack and upright vacuums.

Janitorial closets on tenant floors will vary in size depending on the overall size and design of the building. Some will need to be large enough to store equipment, such as floor machines and vacuums, along with a janitors cart. While others can be smaller, if the central storage area is easily accessible.

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## There's Cash In Trash

We are not talking about cash for recycled materials. Rather in a typical office building, cleaning personnel spend as much as 30% to 40% of their time "pulling" trash. Thus, in that building with an average cleaning cost of \$1.38 / sq. ft., we can attributed \$0.55 to this one activity alone. Interior designs that consider these issues can significantly impact cleaning costs.

These savings can be attained by designing interior layouts that facilitate the collection and disposal of trash. This can be accomplished by designing workspaces with minimal obstructions to trash receptacles, and easy access to main recycling areas and trash shoots. With the cooperation of the building occupants, these associated costs can be cut by 20% to 50%. In New York City with an average cleaning rate of \$2.32 / sq.ft., this savings can account for as much as \$0.46 / sq.ft. Thus, in New York City for each increment of 100,000 sq.ft., the cleaning costs can be reduced by \$46,000 annually.

## CONCLUSION

By designing buildings that balance both environmental and economic concerns, cleaning operations will be significantly impacted. By including a member of the cleaning industry to the design team, making positive recommendations as have been outlined in this paper, dramatic financial savings can be achieved.

	Current	Improved	Savings
Entry Way Impacts: Vacuuming, Dusting, Floor Care, etc.	\$0.56	\$0.28	\$0.28
Restrooms Cleaning	\$0.27	\$0.24	\$0.03
Trash Removal	\$0.41	\$0.21	\$0.20
Other: Spot Cleaning Finishes	\$0.14	\$0.13	\$0.01
Totals	\$1.38	\$0.86	\$0.52

It would not be unreasonable to achieve savings in the neighborhood of \$0.25 to \$0.50 / sq.ft., year, after year, after year. Moneys that would drop right to the bottom line. Additional benefits that could be realized from these design and material recommendations are reduced exposures to building occupants and cleaning personnel, as

well as to the greater outdoor environment. These benefits could add marketing potential resulting from a "greener" workspace, and add financial savings resulting from less wear on mechanical equipment and filters.

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## About The Author

Stephen P. Ashkin is vice president of the Rochester Midland Corporation and a leader in the chemical industry on the subjects of green housekeeping and environmentally preferable products. He is Chair of the ASTM Task Force that is writing the National Standard on *Stewardship For The Cleaning Of Commercial And Institutional Buildings*, and contributing author to both the U.S. Green Building Council's *LEED Building Rating System* and PTI's *Sustainable Building Technical Manual*. He consults with architects to design buildings that can be green, clean and cost effective at the same time. For more information call 716 / 336-2308, or E-Mail [steveashkin@compuserve.com](mailto:steveashkin@compuserve.com).

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