Executive Summary

Federated Department Stores is constructing a new Bloomingdales in Chevy Chase, Maryland. It is 180,000 square feet of retail space. The project is being delivered as a design-bid-build of 18.86 million in 21 months, from November 2005 to August 2007.

After the project is studied I have decided to complete research in two areas, and complete analysis in two areas helping to add value to the project. The research was completed regarding a mid construction redesign and building respect issues that seemed to be lacking between two general contractors. The first study was completed to analyze whether Ultraviolet Germicidal Irradiation systems would be beneficial to the HVAC system. The final analysis was used to establish a more efficient building envelope system.

When analyzing the use of UVGI systems, several sources were established to confirm credible information. Instillation cost and material costs were calculated and compared to an assumed financial savings of the addition of the UVGI systems. Although the initial investment is substantially for the installation and equipment, it will slowly pay for itself due to cost savings of employment absenteeism and reduced 'sick building syndrome' side effects.

Due to complex sequencing and minimal site space an alternative for the building envelope was analyzed. Originally, it was an analysis of a masonry system, but an Exterior Insulation Finishing System was chosen. The systems were both researched and a cost comparison was completed, followed more detailed by a energy saving analysis. The analysis showed a large energy savings, while reducing structural load substantially. This system has been found to be very beneficial to the value of the project.

In conclusion, the final recommendations are to construct the building envelope using a 4" EIF system and not the panel system; present the UVGI system utilization to the owner using forward communication to establish the fact, proceeding as approved. The following report presents the analyses in greater detail.

Client Information

Federated Department Stores, founded in 1929, is an every growing enterprise. Federated stands today as the nation's largest department store retailer. Federated prides itself on understanding and meeting the needs of American consumers in ways unmatched by any other retailer by offering an exceptional level of service by highly trained sales associates and a large quantity of quality merchandise offered.

One of Federated most successful branches is Bloomingdale's, America's only nationwide, full-line, upscale department store. The Bloomingdales division has experienced outstanding performance and strategic progress. Bloomingdales has expanded multiple times in the last several years including a new flagship store on the west coast located in San Francisco.

Sequencing is not as big of an issue to this owner because they will be occupying the entire building. Federated biggest expectation is bringing a quality project in on time to help the company further deliver a high quality product to the consumers they are catering to.

Project Overview

Site Plan

The Site plan for Bloomingdales is in a suburban area with limited room for equipment and setup. Addressed in this site plan is the immediate area surrounding the Bloomingdales site. Placement of fencing and traffic flow onto and off of the site is noted. Please see Appendix A.

Local Conditions

Local building code regulates height restrictions on most high rise buildings. For this reason most buildings in the area are designed as cast-in-place concrete with a structural steel frame. On this particular project contractors bought monthly parking passes as there was none for long term use. Another option is the Metro which has a stop located only several hundred yards from the site. The soil conditions on site are moderately undesirable, with the soil being composed of very poor organic clayey soils. There was no recycling of materials on this project. This decision was aided by the tipping fee of sixty dollars per ton for roll off dumpster.

Building Systems Summary

Structural System

The structural system of the building consists of mainly ¾" lightweight concrete slab on metal deck supported by structural steel. The formwork for the concrete structure will be traditional hand sawn and built plywood. For placement, concrete deliveries are made to the streets west and south of the building (Friendship Boulevard, Western Avenue. respectively) and placed using a pumping method. The foundation consists of a cast-in-place reinforced parking garage.

Mechanical System

The buildings mechanical system is handled through the penthouse mechanical room on roof. It houses (2) 230 ton chillers with power induction boxes. The HVAC system design criteria used that of Washington, DC. The requirements for outdoor air were 88 degrees Fahrenheit dry bulb (DB), and 74 degrees wet bulb (WB). Indoor was 75 degrees DB, with a special needs area required in the cosmetics area of 72 degrees DB.

Electrical Systems

Underground duct banks are the source for the primary feeders which are routed to the building. Distribution voltage is provided at 11,256V/480/277V/208/120V. The switch boards are tin plated 4000A rated, 480/277V, circuits.

Curtain Glass Wall

The curtain wall consists of metal panels, vision glass, and aluminum mullions and headers. The mullions are mostly prefabricated to ensure quality control as
well as aid installation. For installation, embeds are placed into the slab where needed. These embeds will be used to fasten the curtain wall headers and footers. The windows will then be installed from the interior of the building.

Project Delivery System

Design-Bid-Build was used on this Bloomingdales project which is typical of Federated and most retail stores of this size. This approach allows for an architect to be hired for design and will proceed to put the drawings out to bid once they have reach the point where the drawings are substantially complete. This allows for a quick and efficient design to competition process. On this project the Architect also served as the designers for the MEP system. Please note the project team illustration in Table 1. Federated choose to use Lump Sum contracting for each entity.

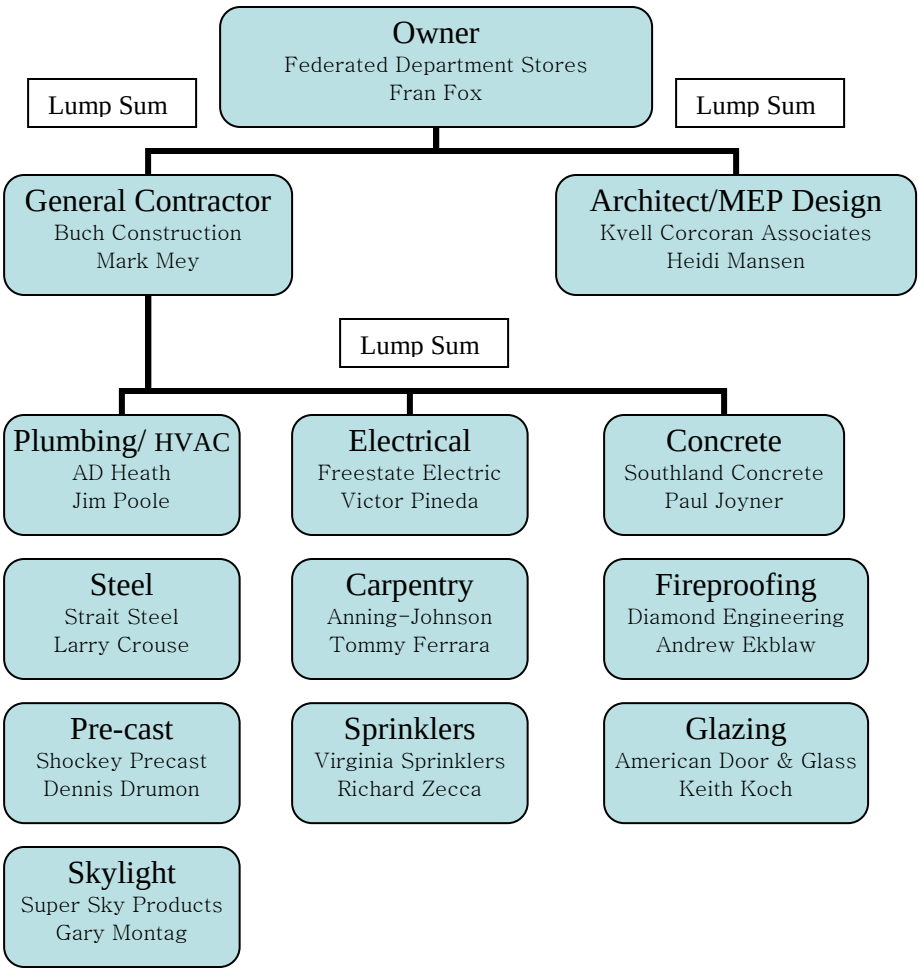
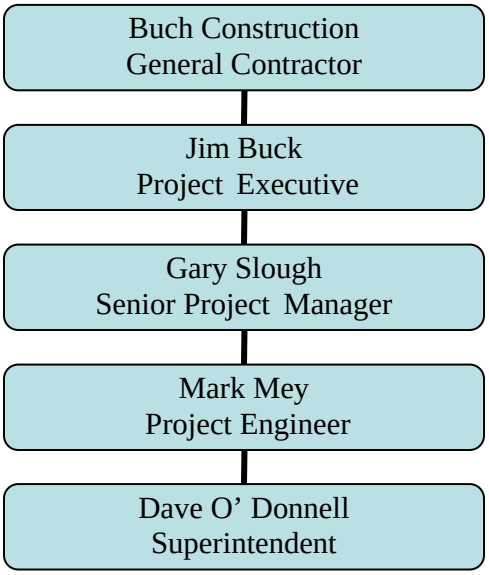


Table 1.

Staffing Plan

Table 2



In the above Table 2 an illustration is provided to help visualize the project team and the position they command. In order to keep everyone on the project team at Buch up-to-date with construction progress, a free flow of information is required between the project Executive, Project Manager, Project Engineer, and Superintendent. The Project Executive advises and approves all outgoing and incoming correspondence between Buch Construction, Federated, and the subcontractors. The Project Manager oversees most subcontractor correspondence, scheduling, billing and other financial information on Buch's behalf. It is the duty of the Project Engineer to take care of handling submittals, RFIs, processing change orders, meeting minutes, and whatever else is required to help ease the work load on the rest of the team. Both the PM and PE coordinate directly with the Superintendent to make sure all field personnel and the subcontractor's people are on task to make the schedule. While the Superintendent oversees the work being performed on site and executes safety checks to make sure everything is in order to reduce the chance of accidents.

Project Cost Evaluation

The below costs were obtained through Buch and then the appropriate construction costs were used to calculate the cost per square foot. The following table is a breakdown of the contracts awarded to each subcontractor and their respective work. A building size of 180,000 ft2 has been assumed for this Bloomingdales. The Project cost codes can be viewed in Appendix A

Construction Cost		CC:	$14,240,000
Construction Cost per square foot		CC/SF:	$79.11/ SF
Total Project Cost		TC:	$18,860,000
		TC/SF:	$104.78/SF
Structural System:		TC:	$3,100,000
		TC/SF:	$17.22/ SF
Concrete:	$1,410,000		
Structural Steel:	$1,690,000		
Mechanical System:		TC:	$3,080,000
		TC/SF:	$17.11/ SF
Fire system:	$780,000		
Electrical System:		TC:	$2,100,000
		TC/SF:	$11.66/ SF

Parametric Estimate using D4 Cost 2002

Assumptions:

- Due to the limited amount of sources available for the parametric estimate, these three projects were used to calculate the similar Lecture Hall project:
    - Net Plex Center, 171,809 ft2, 4 Floors, Cost $13,630,891
    - Scottsdale Memorial hospital, 188,641 ft2, 3 Floors, Cost $10,743,299
    - Shops of Rockville, 138,406 ft2, 1 Floors, Cost $18,263,563
- Although the Shops of Rockville were a close overall project cost the square footage was approx. 1.3 times smaller than that of Bloomingdales. In an attempt to obtain a higher parametric estimate, the other two more costly projects were included in the overall “Smart Averages” offered by D4 Cost.

• Appropriate subdivisions with their respective percentages, in relation to the IGMP Bids and 'Total Direct Cost' shown above, have been added to the parametric estimate for a more in depth cost comparison.

While none of these projects are the exact type of building as the Bloomingdales project they do offer some range of acceptance when looking at a project of its relative size. It is expected that the accompanied project estimates will range in estimates due to the higher level of technical aspects to projects such as the hospital. The estimate of probable cost for the Net Plex Center offers the most comparison, considering the fact that it is a smaller project by approximately 10,000 sq. ft. can be marginalized by multiple tenants and the added floor.

Square Foot Estimate using RS Means 2005

Assumptions:

• Since the main function of the building is a department store, the estimate of a Precast Exterior and Steel Frame 200,000 ft^2 Retail Store is used.
• To factor in the large Skylight space in the center of the building, an addition of $200, 000 is included in Building Type costs.
• A Rockville location factor of 0.91 is used for the Bloomingdales. Inflation cost have not been calculated in this estimate.

Building Type	$/SF	SF	Factor	Cost
Retail	97.26	180,000	0.91	15,931,188

RS Means Estimate (w/ Location Factor and added cost of skylight): **$16,131,188**

The estimate derived from RS Means was slightly short of the estimated overall cost of Bloomindales but is still within a respectable 4%. In order to receive more accurate estimates one would have to do detailed material take-offs and similar approximations.

Building Respect Research

Overview

The following research is a compilation of information obtained through surveys and other resources. The research outlines the critical aspects of building respect between all parties involved during construction on site. It outlines the pivotal areas that determine the success or failures of a project.

Analysis

This particular project, as many others, had the complication of multiple construction management firms sharing the site and had other projects being completed in close proximity. This project was situated on a site where the entire block was controlled by one developer who was developing the near by sites and had contracted a general contractor to complete all below grade work, while contracting another to construct above grade. This created a site with adjacent general contractor directly on top of one another. Phasing and access was part of the initial agreement between May Company (now Federated) and the developer, New England Development, but delays to both projects have made this original agreement ambiguous.

When project boarders so closely located to one another a leader, usually the owner or developer, must make setting constraints and agreements between the two top priority. After communication and responsibility issues are discussed extensively upfront, regulating this agreement is critical to the success of not only their project, but the success of the other(s) as well. Revisiting this development plan early and often is critical. Impacts, communication, and priorities must all be clearly defined to create a successful working relationship.

Projects in close proximity such as these are an opportunity either for professional growth by great success, or disaster. It is an opportunity for separate companies to come together to form a unique entity or view the other company as competition and refuse to commingle. A key to the success of a co-managed site is clearly defined roles and job functions. This allows for both companies to have a well defined base and goals, if the foundation of a project is weak it too will fail as that of the project itself.

Allocating time for communication is of the utmost importance, allowing the owner representative a prospective of daily progress and work activities. The owners representation should be the coordinator of these activities and establish coordination between the parties involved. It is in turn the responsibility of all parties involved monitor coordination between themselves. Even the most well laid plans in the construction industry can change, unscheduled activities, shifting priorities, and who is responsible for any incurred penalties are always issues. If a mutual respect between contractor exist and the developer is well informed then these issues may be addressed and handled more appropriately that that of a site with none of the above.

Communication in today's world we can not just assume that face-to-face interaction can account for all that is required. All information systems; email, software, technical support, etc., must be integrated in some way to assure information is being received by those who need to receive it, closing all gaps in communication.

On the Bloomingdales project there existed a site with conditions of two general contractors sitting directly on top of one another. One had establish themselves earlier than the other, as they had been contracted to construct the sub grade parking structure and top out of the pad that Bloomingdales was to be built upon. The integration of the two contractors was in the garage levels as installation of the elevators, elevator lobbies, and the MEP related work surrounding them. The developer established meetings between the two contractors to aid in the coordination process, project progress, and any discrepancy issues that arose. Unfortunately, it was that none of the negative items ever ended up appearing on the meeting minutes, so to the casual observer, there never appeared to be a problem, therefore little was ever fixed. This is possibly the lack of view of the developer, as relationship began to sour from the initial turnover of the pad. Beginning with an unrealistic completion date due to delays and project redesign, a lack of constructive communication, and a poor relationship between contractors, it is apparent that the project will be completed with out improvement on either party's behalf.

From studying the relationships between the contractors it is ever more apparent that there must be a presence of leadership from the beginning, allowing for clear and frequent communication. A clients understanding of added cost implications of poor relations will help to establish this and solve any

inherent conflicts that arise, or there will be controversy. Establishing dominance will not help anyone, as no one individual or company can foresee all issues.

Much of the construction between the two companies hinged on what the other was doing, requiring communication for logistics of deliveries, staging areas, material storage, utility shutdown coordination, and perhaps the most important personnel safety. Lack of coordination and conflicting interests it was impossible for these task to be performed efficiently on either behalf. As the others lack of progress caused lack of progress on the others part a domino effect was established, causing more relationship tension between the two.

Due to delays and rescheduling conflicts between the exterior completion and the site work completion Buch had to utilize swinging scaffolding when applicable, but it was necessary to be on the ground for some of the work. This issue would normally be very minimal if coordinated, but there was resistance by both parties.

Conclusion

Building respect issues are applied to any project at any level. The opportunity for personal interests and personalities increases with added personnel, regardless of topic. This is compounded when working on a close proximity site, but with little effort and mutual respect any project can be successful. The five most important issues gathered from research are;

1.) The number one priority should be establishing and effective communication system where all issues, good and bad, are addressed by forward communication.
2.) Regardless of self interest and priorities it is of the utmost importance that everyone strives to work as a team.
3.) No good will come from altercations between contractors or project teams.
4.) This requires an owner of developer to take control of the situation and lead by example.
5.) If a clearly defined goal is set and every entity knows their defined role then each entities individual failures and success will be highlighted.

Project Redesign Research

Overview

The following research is a compilation of information obtained through surveys and other resources. The research outlines the critical during redesign of a project, higlighting the pivotal areas that determine the success or failures of a project.

Analysis

Redesign phases during projects are a common occurrence; unfortunately redesign is rarely very efficient particularly if construction has already begun. Specifically on fast track projects, projects with anticipated cost greater than the budget allows, or in this case a buy out. When deciding whether to use a Construction Manager one most look at what the Client Drivers are; for a lump sum price contract the best time would be after the documents are completed and coordinated, while a CM's true value is obtained when the preconstruction services can be utilized if hired at the same time as the A/E. This will allow the CM will be providing constructability reviews, cost estimates, value engineering, and scheduling information.

This is regulated ultimately by the owner's construction or contracting knowledge and experience. The less competent the owner is in the design/procure/build industry, the sooner they need to seek qualified help. More competent owners who build regularly and maintain qualified staff may choose to forego the use of a CM altogether and deal directly with A/E firms.

There are costs with any delay, especially re-design. If there is a major re-design effort the A/E will ask for a substantial increase for added effort, delays usually mean added time to make subcontractor awards and inflation adds costs. In this case May Company, the original owner, was bought out by Federated requests a major change it is usually because the occupancy or the stakeholders have changed and are still unclear about their needs, wants, and limitations.

In the business world, all entities that perform work for money must have the deliverables aligned with financial reward or penalty. Otherwise, resources and effort will be directed toward the best opportunity for profit. All parties involved must be reminded that it is in everyone's best interest to adhere to the schedule. It is there fore imperative that a Construction Manager be present to ask questions that have not been thought of or expressed yet such as communication with the user groups, site logistics, construction details and coordination between the A/E groups, subcontractor market conditions, value discussions, and schedule maintenance, as well as help identify other issues that may crop up as a result of the redesign which can then be addressed ahead of later realization in the field. Though this is highly beneficial, it requires frequent meetings and conversations, adding to the responsibility of the owner.

The issue of redesign may have a benefit through problem solving. Problems always present an opportunity for team building. The process then boils down to people helping people and territorial lines begin to fade somewhat so that you end up with a solution that everyone has bought in to and can take ownership of.

Many times Construction Management company's are accused of want to do what is easiest, cheapest, and fastest. This leaves many negative impacts on the designers and project. Construction Managers must put any motivating factors aside, and offer an objective point of view. It must always be regarded that the entity at risk is wide open for a number of claims relating to scope change and schedule.
In the case of this Bloomingdales the entire project was redesigned prior to the drawings being released, much like the entire original project where it was intended to be design-bid-build. Unfortunately, the owner(s) during the transition did not see the benefit of having the input of Buch, allowing the designer control of the information that would be disclosed.

The redesign on the Bloomingdales projected seemed to be inefficient and frustrating from the standpoint of Buch. A dozen or more drawing delivery dates were reported that expired before drawings were actually delivered (almost 5 months after the initial reported date). Buch was not well informed about changes and were able to plan for nothing prior to physically having drawings in hand.

Critical schedule items such as the MEP systems could have been expedited ahead of finish information to allow a smoother startup, this did not happen. Buch had received a bulletin with numerous lighting changes just days before the owner supplied fixtures were to be on site for installation. This system essentially left Buch in waiting for almost 9 months on the interior while there was no information provided on what the interior would look like or demand.

An earlier drawing release date would have allowed almost all, except lighting materials, in the plenum space to have been out in advance of the rest of the drawings. Items such as the HVAC equipment and sprinkler systems could have been approved and released for shop drawings and coordination ahead of the interior that was still in redesign. The issue at hand was that the drawing circulation was dependent on that of the interior designer who completed all of their design (fixture work, flooring, etc.) and then passed all of their completed drawings to the architect who is also in charge of the MEP drawings, therefore instead of allowing Buch to receive information gradually they received everything at once. Because of this concentrated release construction is behind as are material deliveries, causing a domino effect on the interior of the buildings, putting the first floor behind, follwed by the second, and so on. This is due to both shop drawing time and county approval, as well as the need to coordinate heights with the HVAC contractor and new ceiling heights as they have changed a several times since the original drawings as well.

Several other key items could have been expedited if released before hand. One of these issues was the restrooms. Important issues of fixture approval, millwork and stone top shop drawings all had to be approved and verified. Added to this was the issue of clarity, layout was unclear from the original drawings and needed to be field measured, changed, and verified as required. If floor layout in key areas was approved in advance allowing for interior walls to be erected. The owner is also providing the light fixtures for the job and we are installing them. Due to the delayed release of interior drawings these fixtures will not arrive until several weeks after they are ready for installation, delaying ceiling completion and inspections. At the current schedule lighting fixtures will be coordinated with the painting and flooring contractor, who was contracted directly by the owner, adding cost at the required need of added flooring protection.

Many of the constructability issues were a direct result of poor relations on site and lack of attention to field changes before the redesign was decided upon. A specific example of this was that a couple of large diameter storm pipes couldn't be set where they were shown on the original drawings so they were moved in from the perimeter approximately 1.5 feet. The new redesign drawings didn't account for these as they were in reality, resulting in a field change. It was required to drill new holes through the slab, relocate this large pipe, and fill the old holes to work with the new design. This is costly.

Unfriendly situations related to material lay out was a constant concern. The method of transport of materials to interior spaces was to leave the west curtain wall open to allow for materials to be loaded onto a lift. This results in decreased efficiency compared to erecting from scaffolding or a lift and results in increased cost due to this and additional roof protection, etc.

Plenum trade coordination, particularly HVAC and Sprinkler took place long after it should on a normal building track because they were released at the same time as other trades. Another consideration is the time necessary to complete shop drawings needed approved by the county. This resulted in a late start for the plenum trades. Because of the projected end date, it was necessary to start framing walls prior to sprinkler and duct installation in most areas, resulting in enclosed areas with less than optimal spaces, leaving it difficult to install components of the HVAC and sprinkler systems. When compared to having an open floor plan, which would have been ideal, the result is lot of field reworking, damaged materials, and time loss.

Conclusion

Through out research there are four main points that were repeatedly addressed; Information distribution, const control, time savings, and constructability. Applying these points to this specific project are outlined below.

Information distribution – would have allowed for easier transition, better morale onsite during redesign. Neither Buch nor subcontractors were well informed, leaving them to ask if they would be performing this work, and if so, what the scope of work is.

Cost control – several items had to be value engineered after the interior was re-bid because there was no mechanism for cost control. The interior design took nearly 9 months, and portions of the ductwork, a critical item, had to be redesigned after costs were analyzed.

Time savings – Some time savings could have been realized due to the above. Also, the owner seemed to be surprised in the costs of extended general conditions, etc. due to the delay. Had Buch been a part of the communication process, they could have better understood this and expedited design, allowing certain items would be able to start ahead of time. A month or two could have been saved if portions of the drawings were known or had been released in portions.

Constructability – running into several issues in the field where input from the general contractor would have allowed things to proceed more efficiently. A specific example of this were lacking coordination of the changes that had to be made prior to redesign were not incorporated into the new design drawings, resulting in conflicts that cost them time and the owner money to resolve.

Ultraviolet Germicidal Irradiation

Need For UVGI Devices

Everyone faces many risks, including various pollutants and toxins in their daily environments. These issues are multiplied when indoors and subjected to confined spaces with others. Many people do not realize how dangerous the air inside buildings can be to their health. Many studies have shown that indoor air pollutants can, on average be five times greater that the pollutants in the outdoor air.

When considering that the estimates of time spent indoors for the average person in approximately 80% of their lifetimes it apparent that quality indoor air is critical. Various micro-organisms such as bacteria, viruses, molds, and fungi often become airborne and this is a common cause of illness or allergy. Add to these complications of indoor air system we most now account for the threat of biological terrorism, the eradication of airborne pathogens becomes even more important.

'Sick Building Syndrome'

For years office workers have suffered unexplained headaches, asthma, allergy like symptoms and other respiratory distress now recognized as sick building syndrome, or SBS. Although there have been many reports on SBS, (there is no precise definition) cost estimates range to billions due to absenteeism and lowered productivity. SBS is caused by poor indoor air quality from energy-efficient, airtight buildings and the resulting concentration of airborne contaminants.

Figure 1

Causes of SBS

When trying to understand UVGI devices it is helpful to try to understand the causes of SBS. The main contributors to SBS are the high levels of pathogens, allergens, and the existence of microbes. The main contributors to these are the naturally damp cooling coils that are an ideal space for breeding of molds an bacteria, as seen

in Figure 1. These growths cause the efficiency of the HVAC systems to drop drastically causing a larger use of energy to condition the air. Without proper filtering these spores can become airborne, becoming circulated into the air. Further causes can be that of volatile organic compounds, or VOCs. Many building materials release these VOCs into the air; new carpet, wall coverings, glues, adhesives, paints, etc. All of these contributors added to the symptoms of SBS.

CAUSES OF INDOOR AIR POLLUTION

There are many items in a home or public space that can be sources of indoor air pollution.

Building materials and furnishings:

New or damp carpeting. Cabinets or furniture made of pressed-wood products.

Deteriorated asbestos-containing insulation.

Combustion sources:

Oil, gas, kerosene, coal, wood, tobacco products.

Combustion appliances (vented or unvented):

Gas ranges and ovens, gas water heaters, furnaces, gas clothes dryers, wood or coal burning stoves, fireplaces, and space heaters.

Products for cleaning and building maintenance:

Air fresheners, glues and adhesives, paints and coating materials.

Central heating and cooling systems:

Air ducts and shafts contaminated with mold and fungi.

Outdoor sources:

Radon, pesticides, outdoor air pollution (factories, etc.) and combustion engines

So what can be done to help aid the systems that already exist. One of the most progressive solutions is in systems that utilize Ultraviolet Germicidal Irradiation, or UVGI. Ultraviolet Germicidal Irradiation, or UVGI, is a method of sterilization that uses ultraviolet light at sufficiently short wavelengths to break down micro-organisms. It is used in a variety of applications, such as food, air and water purification. UV has been a known mutagen at the cellular level for more than 100 years. The original utilization of UV was against tuberculosis, in the early 20th century by Niels Finsen. It is effective in destroying the

nucleic acids in these organisms so that their DNA is disrupted by the UV radiation. This process is called irradiation.

The application of UVGI to sterilization has been an accepted practice since the mid-20th century. It has been used primarily in medical sanitation and sterile work facilities. Increasingly it was employed to sterilize water, as the holding facilities were enclosed and could be circulated to ensure a higher exposure to the UV. In recent years UVGI has found renewed application in air sanitization.

The effectiveness of germicidal UV in such an environment depends on a number of factors: the length of time a micro-organism is exposed to UV, power fluctuations of the UV wavelength, the presence of particles that can protect the micro-organisms from UV, and a micro-organism's ability to withstand UV during its exposure.

In many systems redundancy in exposing micro-organisms to UV is achieved by circulating the air or water repeatedly. This ensures multiple passes so that the UV is effective against the highest number of micro-organisms and will irradiate resistant micro-organisms more than once to break them down.

A separate problem that will affect UVGI is dust or other substances that create a film coating the bulb, which can lower UV output. Therefore bulbs require annual replacement and scheduled cleaning to ensure effectiveness. The lifetime of germicidal UV bulbs varies depending on design. A typical bulb is shown in the above Figure 2

Figure 2

Although this process of utilizing UV to destroy bacteria in the air, it was found to be effective only when the air stood still. This causes the passing air to not receive enough exposure time to the ultraviolet light to have much effect on the destruction of bacteria, mold, and virus DNA. To solve this problem an overcompensation of UV is concentrated on rapidly moving air, achieving a highly effective air sterilizer. Unfortunately, the increase in UV causes the system to be slightly less cost effective. Regardless, UVGI has been proven to effectively destroy, among others; Bird Flu, TBC, MRSA, Influenza, Anthrax, and SARS.

Costs for installed UVGI systems can vary widely, depending on the building and the HVAC system. The expense is more than offset by energy cost savings and the economic benefits of reduced absenteeism and increased productivity of healthy workers. These systems easily fit into standard air conductors, with 'plug and play systems it allows for easy access and maintenance which is important to the maintenance of the system. Typicall installation shown at the right in Figure 3

Figure 3

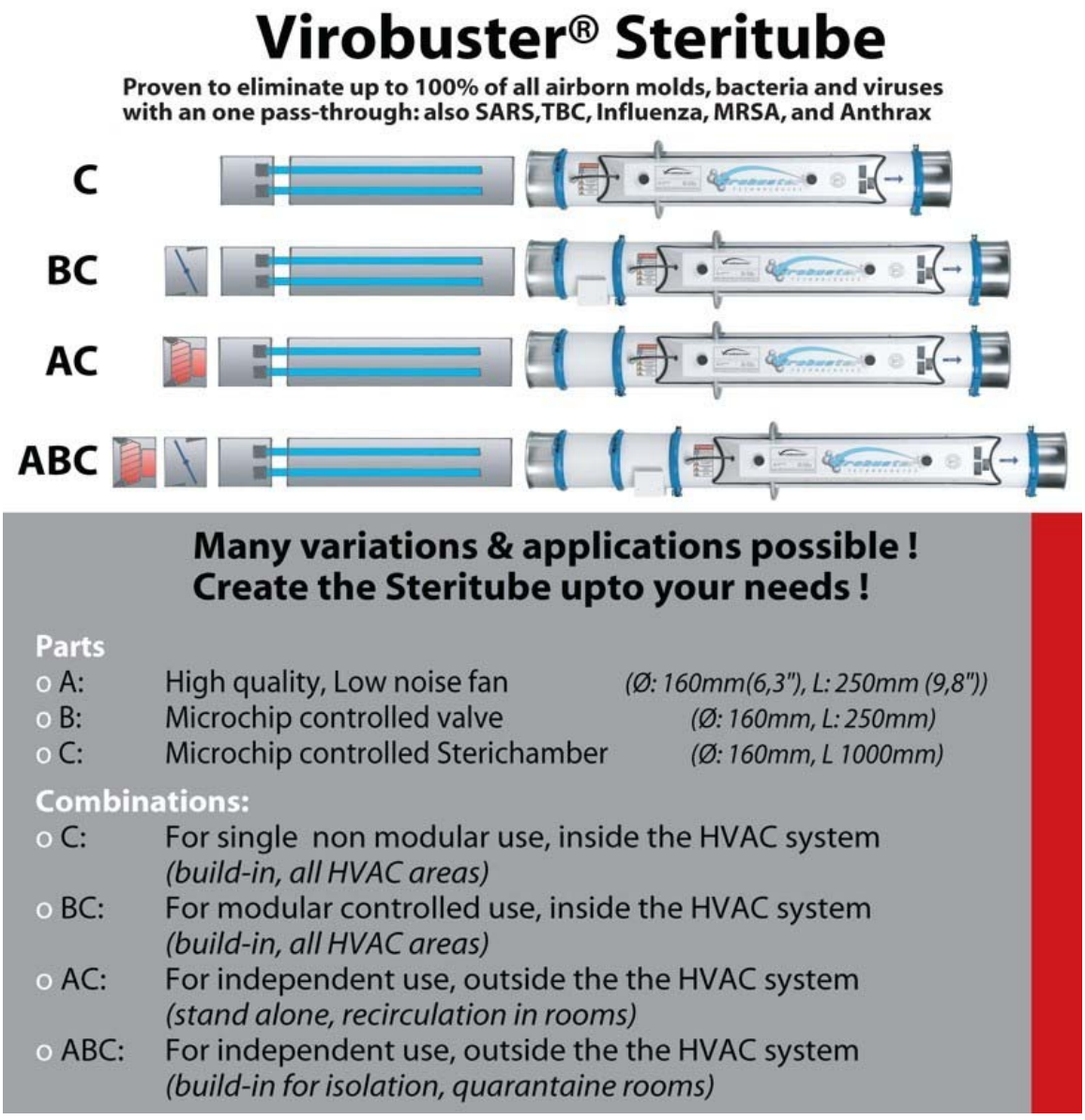
Technical Considerations

The following is the electrical requirements of materials required. This work could be completed by a standard electrician. Prevailing wages in (Appendix

o Weight	*+/- 5kg (11 lbs)*
o Build-In Dimensions	*200(7.89") x 200 x 1500mm (59")*
o Electric power	*(A): 60Watt, (B): 15Watt, (C): 190Watt,*
o UVC power	*57Watt*
o Pressure drop	*+/- 5Pa (0.0015"/Hg)*
o Voltage	*230/110 Volt, 50/60 Hz*
o Airflow capacity	*300 m^3/h(176 CFM) per Steritube*
o Max. per cluster	*12 Steritubes*
o Max. per HVAC syst.	*300 m^3/h - 100.000 m^3/h and up*

Design Considerations

The following is an illustration of the equipment used, provided by Virobuster.



Steryltube comparison

Steryltubes are designed to 180 cubic feet per minute with almost 100% effectiveness. The advantage over other systems such as the Ozone generators is that they do not emit harmful byproducts such as ozone. Ozone at the atmospheric level is known to cause symptoms in those that are using them for the original problem. Issues such as chronic lung illnesses, allergens, and other respiratory problems are only instigated by ozone, which can also cause permanent damage with high doses of long term exposure. Though Ozone generators usually produce 2% ozone this can be enough. Below in figure 4 is a comparison of Steryltubes to other popularly used sterilization systems.

	Blygold Steryltube	Microgenix	Sanuvox	Bioclimatic	Tio2	Ionisation	O3 Genartor
Effective technology	* UVC: Yes	* Filter: Initially Yes * UVC: YES	* UVC: Yes * UVV(=O3): Yes	* UVC: Yes * Ionisation: Yes * Ozone: Yes	* Photocatalyse: Yes	* Yes (partly)	* O^3: Yes
Efficient implementation	* Controlled: Yes	* Big pressure drop and not controlled	* Low kill rate (create mutants) * Not controlled	* Big pressure drop * Not controlled	* Large surface area needed	* Pressure drop * Low airflow * Corona effect	* Very effective
Dilution rate	* Very High (3,5 m/s)	* Normal (1,0 m/s)	* Very low (0,3 m/s)	* Normal (1,0 m/s)	* Low (0,6 m/s)	* Low 0,8 m/s)	* Very high (3 m/s)
Health effect	* Good	* Normal	* Minimal	* Negative due to Ozone	* Very low	* Minimal	* Negative due to Ozone
Technical implementation and maintenance	* Modularity	* Bad, large volume * Costum design	* Bad, ad hoc implementation * Custom design	* Bad, very large volume	* Large surface needed	* Large surface needed * Custom design	* Good
Fungi	* Very Good	* Good	* Bad	* Good	* Moderate	* Moderate	* Very good
Bacteria	* Very Good	* Good	* Moderate	* Good	* Moderate	* Good	* Very good
Viruses	* Very Good	* Moderate	* Good	* Good	* Good	* Bad	* Very good
Price setting	* Good	* Bad	* Moderate	* Bad	* Moderate	* Very good	* Very good

Figure 4

Number of tubes to be used in Bloomingdales:

Tubes: 16700 meters x 5 meters x 2ach / 300 cmh = 557tubes through out

Material: $2500/tube x 557tubes = $1,392,500

Labor: 3 h installation x $43.77 wage = $73139.67 (Prevailing wage in Appendix C)

Total Cost: $1465639.67

When accounting for time lost due to SBS and unproductive works this cost will be substantially reduced over the life cycle of the building.

Conclusion

In summary a properly designed UVGI systems has the ability to;

- Irradiate the cooling coils allowing UV to kill molds, bacteria, viruses and prevent growth of these spores within the HVAC system. Thereby increasing efficiency and reducing airborne contaminants.
- As air is recirculated through the HVAC system, UVGI continuously and progressively treats the air to reduce microbial contaminants and the SBS symptoms that can result.
- UVGI alone does not destroy VOCs, unless the ultraviolet lamps produce toxic ozone, a very undesirable contaminant at atmospheric levels.
- Utilizing photo catalytic reactors can help to further reduce airborne microbial and VOCs. They are inexpensive, yet highly effective to operate without consuming power and without creating heat.
-A 20% reduction in sickness and a 40% reduction in respiratory problems
- Will cause savings due to lowered absenteeism and increased productivity)
- 30% to 40% energy savings from cooling coils operating efficiently to their original specs, due to no biofilm growth

Precast Panel Alternatives

Overview

This is an analysis between the utilization of precast panels and Exterior Insulation Finishing Systems. The most critical issues for both systems are the design and shop drawing phase. Precast panels are more involved because openings and embeds need to be coordinated up front before the pieces are cast. Possibly the most critical aspect of precast panels are that of the dimensions. This step obviously being critical so that the pieces fit properly when delivered to the site and erected. Many Architects precive precast panel facades, usually consisting of thin brick with a composite backing, with no guarantee that the running bond will line up exactly between panels, to be aesthetically unpleasing. To be economical, the panels should be limited in sizes; therefore, the aesthetics of the facade may be compromised from the architect's standpoint, which will not help to persuade the choice.

Though panelized brick on metal studs allows the use of full-depth brick, this was not the case for the Bloomingdales project. Site access is consistently important because a crane must be able to access all sides of the building to erect the panels, causing coordination and sequencing issues during erection. Once again, some architects and owners prefer the appearance of field-laid brick because that is how past projects, and adjacent buildings were constructed. There is the same concern of the running bond lining up between panels. Many architects, owners, and contractors are interested in panelized brick because of the shortage of skilled masons. Field-laid brick is taking longer than before because the lack of productivity and lack of skilled laborers in today’s practice.

This has caused me to look into other options for the façade solution. While researching brick veneers other alternatives were displayed, accompanied by the issue of energy efficiency. This has persuaded me to completing an energy analysis on the alternative of EIFS; reference Appendix D for energy calculations.

EIFS systems

Three materials are the make up of EIFS. The first being an insulating board which can come in numerous shapes and thicknesses usually made of polystyrene or polyisocanurate foam. The second requires an application of adhesive with wire mess placed over the adhesive. The durable water resistant layer of acrylic plaster, made of a polymer and Portland cement, is applied to on top of the insulation an reinforced with fiberglass mesh for added strength. A typical finish usually consists of a acrylic plaster that can be varied in a wide variety of colors and textures. System visually displayed in Figure 1 below

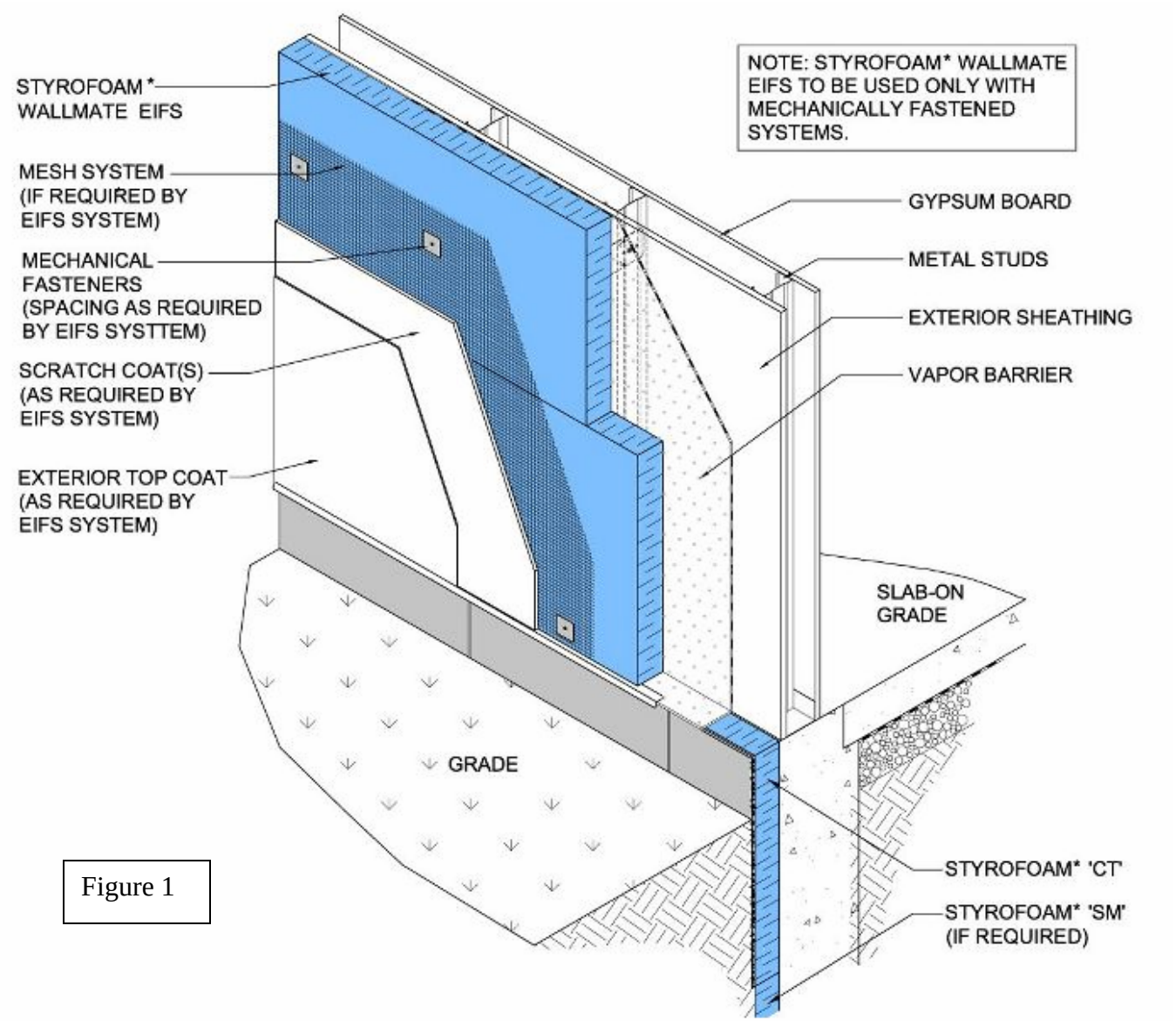


Figure 1

As with any construction EIFS faces challenges when exposed to the harsh outdoor elements. EIFS is no exception and has \both positive and negative aspects. One of primary advantages of EIFS is the limited time of erection and low cost. The systems variable texture, colors, and material selection allow for a versatile design, allowing for an attractive aesthetic. Added considerations are that EIFS is very light weight, especially when compared to other systems, allowing a possible structural reduction of upwards of 350 tons. The EIFS provides an excellent R value for insulation properties and helps to regulate expansion and contraction of structural members.

The EIFS is not in any way without its drawbacks. Many of these can be reduced, or eliminated with proper design and installation or added benefit of moisture draining systems that will be discussed later. Without a moisture draining system the largest issue is that of moisture within the system. Through use of vapor barriers past systems are designed to be moisture tight, but are not always capable of performing at one hundred percent performance. Once moisture enters the system it is also very complicated to correct. Water infiltration can lead to many side effects; delamination, separation of the base coats or finish coats, discoloration of the finish, or the worse case a system detaching from the building itself.

Cracking on window joints (above)

Resulting water damage from failure (above)

Failures usually occur at joint areas, specifically expansion joints, and joints between other façade materials. Minimizing these possibilities is critical to the success of the system. Utilizing the input of the architectural group, and providing detailed joint construction is only the staring component of a successful system. This allows for a sealant contractor that is experienced in EIFS construction, to properly install the panels. Sealants are just as important as any other aspect of construction, as it must allow for proper expansion and contraction, as well as provide the proper seal between materials such as

curtain walls. Qualified inspectors of these systems will also help to insure that they had been properly installed.

A regulation of cracks must also be maintained. Not only is this potential side effect an unpleasing aesthetic these can also be a potential point of water entry. As mentioned above the chance for this occurrence is best reduced by proper design and installation. Aiding in construction is proper placement of reinforcement connections. Areas around reinforcement should lap to create a water tight connection. Diagonal reinforcement helps to ensure this at corners. Proper curing times of 24 hours are needed to ensure the bonding of different layers of the EIFS, therefore construction needs to be protected from extreme heat, freezing, water and dirt. If these panels are to be constructed in place of precast placement during the winter months, this will require added time, which in turn will add cost. Application of a proper base coat will also help reduce the risk of any cracking that may occur.

Weather will play a large factor in which type of fastening can, and should be used. Most adhesives need a temperature greater that freezing to be applied, otherwise a mechanical fastener is required. Though mechanical fasteners are avoided, they are an option when the appropriate temperature can not be maintained. Heating areas may result in complication of uneven surfaces, thereby reducing the insulation efficiency, reducing the systems overall product.

Other steps can be taken to minimize the chance of water penetration. Flashing materials may be integrated into the systems, but require close design with window contractors, as the flashing and EIFS must be place prior to window installation.

One of the less common issues with EIFS that still is an issue is impact damage. To solve this problem heavy duty mesh may be used in high traffic areas, or another material may be considered for these low level areas. Garage entrances, areas of egress, or delivery sites are all important areas that may be trimmed in other materials that are more resistant to impact. When impact damage does occur it is critical to repair the damaged area immediately so no water can intrude the area. This can be done with simple tools, and be closely associated in cost as any other veneer.

The most common complaint with EIFS is maintaining its appearance, or more specifically cleaning and maintaining the system. Due to the finishing coating not responding well to equipment that uses pressurized liquids for cleaning, it is recommended that a mild detergent is used. However, the use of acrylic finishes can reduce the finishes ability to pick up dirt. Acrylics also aid in maintaining the colorfastness of the system, which can be a problem do to exposure to the elements.

Many of the problems inherent with EIFS can be avoided with proper design and quality control during construction. Allowing the contractor/manufacturer access to the construction details and installation process to ensure it is done properly. If a quality applicator is selected there is no reason that when the safeguard are in place that EIFS could not perform as well as any other type of façade material.

Moisture Draining EIFS

Following a similar flashing and weep hole system used in brick construction, EIFS manufacturers have redesigned EIFS to allow for moisture run-off. Figure 2 illustrates the utilization of weep hole placement in a dual barrier system.The common constructions of these systems are described by;

1) A water membrane, usually asphalt felt is placed over the sheathing to prevent moisture penetration.

2) Some manufacturers apply a mesh or other medium directly over the building paper to create an opening between the sheathing and backside of the insulation board through which water can escape to the outside. Other manufacturers have added grooves or ridges to the EPS foam to allow water to pass to the bottom of the wall.

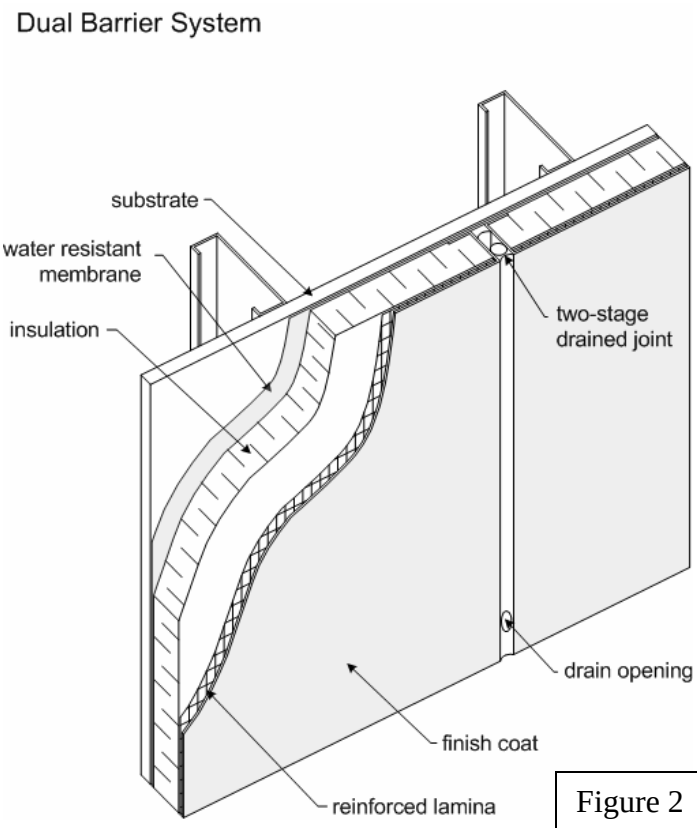


Figure 2

3) Metal flashing is placed at the bottom of the wall, around windows and doors and any other place where the synthetic stucco abuts something that is not stucco. The flashing "catches" the water and diverts it to the outside of the EIFS wall through weep holes.

Conclusion

A large time and cost savings was realized when comparing an EIFS to the precast panel system which was utilized on this project. A large energy savings was realized with the EIFS, which would increase savings and carry over to the owner.

An EIF system does not vary greatly from the panel system and may be easily approved by the architect and owner, as the system specification can be easily varied and aesthetically pleasing. The savings obtained from reduced load (examples in Appendix F), materials, needed crane and equipment, can be used to add overall quality to other aspects of the building or saved outright by the owner.

Qualified contractors should be sought to work on the system. Addition of experienced manufactures will be critical in obtaining guidance on design and construction. The constructability of the EIFS should be much like that of a masonry system in terms of scaffolding, material hoists, and material movement. Today very few commercial systems fail when a quality control system is in place, and an experienced contractor is handling the construction.

Final Conclusion

Building Respect Research

When originally conduction my research I never believed that I would find anything ground breaking or new. Rather, I was looking for the information that I came to find. That information, and the forward communication of this information, is the number one cause for a successful project. Leadership by the owner, or their representation is need to establish clearly defined goals and individual roles. Management must establish weekly or monthly meetings to lay out all progress and issues to be dealt with then and proceed from that point. If these issues aren't dealt with effectively it will handicap the entire project, leading to delays and time lost. The recommendation would be a more aggressively hands on approach from the owner. This would force both general contractors on site to deal with issues on a timely manner and not let them compound as they have.

Redesign Research

As stated above the information received and researched yielded no true surprises. Rather, it helped me to construct an outline of which can be applied later in my professional career. Though redesigns are very inefficient and time consuming some positive aspects have been learned to help control the overall effect. The final recommendation would be to allow more information distribution at earlier times. This could be aided by allowing the Buch to oversee the redesign as they may have valuable input into constructability, cost estimates, etc.

UVGI Systems

The analysis of the addition of UVGI systems into the HVAC system was helpful as a future reference. It seems UVGI is an ever growing technology the will eventually be common place in all medical construction, eventually branching out into other commercial applications. At this point the technology is still relatively expensive, but would add a valuable enginnering detail to the Bloomingdales system. It is recommended that the system be utilized regardless of the initial investment, because it will greatly reduce SBS and the complications associated with it.

Precast Panel Alternatives

The analysis of the precast system originally started out as a comparison between both a brick veneer and the precast panel used. The approach changed as research progressed, resulting in the comparison of Exterior Insulation Finishing Systems and the precast panels. As shown in the report, the EIFS has a substantial structural load reduction as well as an installation, energy, and financial savings. It is strongly recommended that the majority of the panel system be replaced by a 4" EIFS system.

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