REDUCING THE COST OF GREEN

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INTRODUCTION

There is a general perception that building green will cost more. Here, we want to examine to what extent this is true, what are the factors influencing increased costs, and, perhaps most important, look for ways of controlling these costs. A few studies have tracked the cost of LEED Certified buildings in the last few years, and the general finding as well as the consensus is that a LEED Certified building does not involve significantly more cost, whereas LEED Silver, Gold, and Platinum designations do—the higher the certification achieved, the greater the extra cost. The average additional costs seem to be in the range of 2–5% for Silver, 5–10% for Gold, and 10% or more for Platinum. However, at the individual project level the answer is not quite so simple. Most of us have been involved in, or know of, projects that abandoned the quest for green recognition because of budget restraints. However, as green building becomes increasingly popular, there are numerous ways to achieve the most sustainability while keeping costs within feasible boundaries.

SOME BACKGROUND INFORMATION

Let's look at some of the factors affecting the reported cost ranges. The number of potential green buildings is increasing every year, seemingly at a geometric rate, so the pool of samples is getting much larger. As the push to build sustainably increases, so it becomes more acceptable and therefore easier. More important, the cost equation depends on the type and quality of building. The higher quality or more expensive—not necessarily of course the same thing, but probably—the building design, the less the impact of sustainable upgrades. In percentage terms, items that might cost the same for any building, for example, bike racks, are being applied to a higher base cost and therefore will incur less percentage increase. However, a higher level of quality is already being paid for, and specifying the performance or the sustainable materials needed for a green building will probably not impact the construction cost in many cases. Thus, to achieve a level of green certification on a developer's office building where return on capital investment for first costs is being maximized, every measure above the minimum that works will have the potential to impact the cost. At the other end, a prestigious institutional building—a university library for example—can usually accomplish at least the first two levels of LEED—Certified & Silver—without any expense, simply by making the right decisions in design and specification.

This issue of the base building that we are comparing any given green project to, and how that impacts cost, is fairly self-obvious. The simple fact is that better quality costs more. In trying to produce a building that uses less resources, provides a healthy environment for its occupants, and costs less to heat and cool over its life, we are undoubtedly providing quality. Where the norm is to use the least costly solution that will do the job, then any attempt to do things a little differently may push costs up. Two simple examples here might be floor coverings and energy systems. Both of these categories, coincidentally, also impact more than one category of LEED points. The flooring can be chosen so that it provides less off-gassing, is made from either renewable materials, or is itself recyclable—or both. Thus, the right choice can make more than one contribution. Linoleum is a popular choice with designers, but it costs more than VCT. Similarly, green certified carpet will also be a bit more expensive than the minimally acceptable commercial grade.

Energy systems, principally HVAC, are critical to a green building; obviously they play a major role in determining the energy consumption. They also impact the quality of air in a building and potentially may give the occupants more control over environmental

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conditions. The least expensive HVAC units may be fancoil units, that do not supply fresh air, or rooftop units that generally are not especially efficient, and do not provide the capability of zoning to allow for more control. As soon as LEED certification is established, HVAC systems will have to be designed for higher performance and will almost certainly cost more.

To work around these disadvantages and still create an inexpensive green building, takes careful design. It can be done; the result may not look quite like the "base" building that it is being compared with. For some clients and occupiers this may be fine. But for standard office buildings, for example, it may be a reason for the perception that green is too expensive. Now that we have the LEED Core and Shell standards available, the requirements for this type of building are simpler and we can expect to see more acceptance in the commercial market. The fact that the largest proportion of LEED Certified buildings is in the office building category should not make us assume that many rentable office buildings are green. Most of the qualifying buildings are corporate headquarters or government offices and the like, purposely designed for specific occupants who are in search of a higher quality environment. They are not obliged to make a profit at market rates.

COMMITMENT FROM THE OUTSET

The stage of the process at which the decision is made to seek a level of green certification will also impact, not only the successful outcome, but very likely the cost of achieving it. The ideal situation, as any green architect knows, is when the owner is committed to sustainability from the outset. The parameters of the building program can be set to make achieving that goal easier and much more likely. I've heard a leading green architect remark that he has been called in to advise a design team on how to make the building green. When he asked at what stage the drawing was, he was told that construction documents were nearly complete. Immediately he walked away from the assignment, since the building was already designed. The same response is appropriate to a situation where the owner is not behind the process. Proponents of sustainable design always insist that the design process has to be collaborative to fully integrate appropriate strategies; this has been a major contribution of the green building movement, in my opinion, quite apart from helping to achieve the major goal. The collaborative model helps to lessen the cost by:

- Integrating solutions and making use of synergy between different design disciplines.
- Allowing value-based decisions on an informed basis at an early stage.
- Making sure that all parties are on board and understand the issues.
- Involving the owner and users, and acknowledging their priorities.

This early meeting of the minds can also pay off at later stages when decisions have to be made on a cost basis if, as is often the case, it becomes necessary to modify the design to keep within budget. The owner's priorities can be respected, although some apparent sacrifice may be needed. Here also an understanding of how changing the design in some way may impact other systems and the performance of the building, gained from the collaborative method, makes it easier to assess different cost-saving measures. Of course this more intense method of designing may involve more expense, and we will return to this later.

THE IMPACT OF LEED

Before going into more detail on some green cost factors, let's step back and consider the impact of LEED. The certification system started and maintained by the U.S. Green Building Council is the most widespread one for defining sustainable building in the U.S.A., and I am implicitly taking it for granted that everyone reading this article is familiar with it at least in outline. Yet eight years ago it did not exist. Its impact on the achievability of green building has been immense.

It is not the only available rating system even in the U.S. (e.g., *Green Globes*), and in other countries there are various other systems (e.g., *BREAM*), some of them older. However, it has become such an industry standard that we can refer to it and use its assumptions without having to give any justification or explanation. Speaking for myself, it is the only rating system I have experience of. It makes sense to refer to it in a discussion of the costs of green building. But could a building be more sustainable and cost less if it did not have to garner LEED points to qualify for certification?

On the one hand, LEED influences design teams to look for the "low hanging fruit" and with maybe a few tweaks to total up a number of ways to fulfill the certification criteria without going much out of our way, whether it be by not irrigating or by specifying low odor caulks, or the like. Then it tends to promote a "second round" of more substantial measures such as more efficient HVAC systems or a serious use of recycled or renewable resources. All these measures are good and can add up to some sustainable impact.

On the other hand, what it does not do for most designs is to radically effect the way the building program and design is proposed. If the aim is Platinum, rather than just Certified or Silver, then it will engender some serious design impact, because a building that has merely been tweaked cannot expect to achieve that status. But in the main, as I see it, it is a way of making buildings a bit more energy efficient, a bit more rational, and I hope more pleasant to work or live in than their baseline comparison. For example, there is no premium or point apportioned under LEED for making a building smaller in size or more economical in its structure.

The necessity of comparing the LEED candidate building with a base case scenario of the same size and configuration, means that any impetus towards smarter design in the basic layout, or reducing the footprint, is rendered null and void. Under a renovation scenario, there is an incentive to re-use more and have less totally new construction, which is admirable. But with new construction, there is little incentive via the points system to do less building. Of course, there is always the option of reducing area by careful design, in order to make part of the budget available to pay for other green, LEED-validated features.

OPTING FOR SUSTAINABILITIES WITHOUT LEED

If the impetus is to have the most sustainable building possible, without regard to LEED, the design choices might be a little different. A client and his designers might want to focus on certain aspects that are important to them, that make the most sense in their context. Energy use, for example, might become paramount, instead of just several points that become increasingly hard to afford as they seek to garner a higher rating.

The precise location and area of the country might play a bigger part in design choice. It is easy to understand why it has been hard for LEED to allow for this issue of regional variation, and admirable that USGBC intends to take geographical location into account in a future version of LEED. That is not to say that the chosen measures would be any less expensive, just that the owner could choose more for his money, and perhaps there would be a clearer realization that some fundamental changes in approach are needed. Extra time and energy would still be needed on the part of the design team for research and exploration of alternatives, but the paperwork for the accreditation would be reduced.

However as the basis for this discussion, let us stick with LEED and its implications, as published studies certainly use this as their yardstick for degree of greenness and attendant cost premiums.

SPECIFIC COSTS OF LEED

Turning to specific cost areas, let us look at the beginning of the process. Designing a green building generally, up to this point in time, costs more. The conventional wisdom is that for a small to medium sized commercial building the premium is in the range of $30,000.00. That includes the registration and the documentation required to apply for LEED certification. It is not very much, but it could be 3% of the total budget, or a 50% premium on the architects' fees, so it is not negligible. And generally it is much harder to get owners to commit to up-front money that has to be paid directly, rather than rolled into a construction loan and mortgage where it might represent 200.00 a month. This cost is undoubtedly incurred when a design team starts to design green buildings, and will tend to decrease as they become more experienced and may need not only less time but less outside consultation. Since this cost does not go up proportionally with the cost of construction, once again the building which starts out as more expensive has a lower cost premium in achieving sustainability. Also, the less green "features" the designer seeks to incorporate into the design, the less onerous this up-front premium is likely to be.

Not only the need to do research and evaluate proposals, but the process of re-designing and fine tuning can add time and costs for the design team. Many designers really want to produce sustainable buildings, but find that the conscientious effort to do so will make their profits vanish. A clear commit-

BASE BUILDING - ADDITION

Stone Masonry facing	500	SF	38.00	19,000
CMU backup	500	SF	12.00	6,000
Wall framing & sheathing	2300	SF	6.50	14,950
- framing at panels	250	SF	8.00	2,000
Stucco - lower story	750	SF	10.00	7,500
Siding - upper story	1550	SF	5.00	7,750
Metal panel & trim	250	SF	35.00	8,750
Construction joints/caulk	125	LF	6.00	750
				$66,700

ALTERNATE - STUCCO

Wall framing & sheathing	3050	SF	6.50	19,830
Stucco	3050	SF	8.00	24,400
				$44,230

ALTERNATE - METAL PANELS

Wall framing	3050	SF	5.50	16,780
Metal siding	3050	SF	15.00	45,750
				$62,530

Example: Cost estimate with alternates. Small quantities and more trades will increase costs, especially on smaller jobs.

ment from the client and a clear direction from the designer are imperative if design is to proceed efficiently. The design charrette is a feature that sustainable design has introduced into the practice landscape, and it seems a good one. Time is taken at the outset to get all the players into a discussion. When participants bring their expertise to the table and are open and forthcoming, it can undoubtedly help to avoid misunderstandings later.

GREEN CATCHES ON

There is great awareness of green building among the architectural community and an underlying thirst to put it into practice. There appear to be many times the number of LEED-certified professionals waiting for their chance as there are actual openings for their services, even though the number of green projects is mushrooming. Experience is a great teacher, so once having sampled the intricacies of green design as mentioned above, a design team or office can continue to put into practice what it has learned. Familiarity with the process, and familiarity with certain building types and solutions, will help to reduce the cost premium. Specialization does pay off, as long as there is a market or a niche; those design firms that have been able to make a specialty of green building seem to be able to do it more efficiently with a benefit to the owner in terms of both design and construction costs.

Once design is under way, the old adage applies—KISS (Keep it Simple and Sustainable), or, perhaps in architectural lingo, "Less is More." There may be a temptation to re-invent the wheel among teams new to sustainable design, although now there are many resources available, drawing both on the experience of completed projects and organizations that specialize in some aspect of sustainable building, to find out what works. With so many ideas for green design features, the temptation can be to incorporate too much. This is going to impact construction costs, as we will see. At the design stage it will also take up resources, with team members working on a variety of different ideas. The LEED checklist, with its requirement that a certain number of criteria be fulfilled, can feed into this syndrome, the "let's throw everything at it and see what sticks" approach. If there is not a category waiting to earn a credit for a pet idea, then there are the "Innovation in Design" points that are quite rightly available to encourage innovation or green ideas that do not fit the existing categories. For the sake of greater simplicity in building construction, as well as in order to make more efficient use of the design team, it would be better to decide at the outset which aspects of design are important, or which techniques one has the best expertise in, and pursue those. All architecture tends to attract the creative personality, naturally, and there are many dreams waiting to see the light of day. Green design by its nature attracts a

Example of pro-forma workout for increased HVAC efficiency, for a commercial building. Utility costs increased at 8% initially, 6% after 3 years.

Building Area		20,000 SF		Total load 45 tons	
	Utility Cost Electric Per kWh	HVAC Cost Add Efficiency $8,000.00	HVAC Saving 4,500kWh/yr	Tax Savings/ (cost)	TOTAL SAVINGS/ (COST)
Year	$	Mortgage cost	$	$	$
2006	0.09	715.80	405.00	241.06	(69.74)
2007	0.10	715.80	437.40	231.61	(46.79)
2008	0.10	715.80	472.39	221.43	(21.98)
2009	0.11	715.80	500.74	212.80	(2.26)
2010	0.12	715.80	530.78	203.65	18.63
2011	0.13	715.80	562.63	193.94	40.76
2012	0.13	715.80	596.38	183.63	64.21
2013	0.14	715.80	632.17	172.67	89.03
2014	0.15	715.80	670.10	161.08	115.38
2015	0.16	715.80	710.30	148.73	143.24
2016	0.17	715.80	752.92	135.68	172.80
2017	0.18	715.80	798.10	121.79	204.08
2018	0.19	715.80	845.98	107.21	237.40
2019	0.20	715.80	896.74	91.42	272.36
2020	0.21	715.80	950.55	74.77	309.52
2021	0.22	715.80	1007.58	57.21	348.99
2022	0.24	715.80	1068.03	38.60	390.83
2023	0.25	715.80	1132.11	18.78	435.10
2024	0.27	715.80	1200.04	(2.30)	481.94
2025	0.28	715.80	1272.04	(24.60)	531.64
TOTALS		**$14,316.00**	**$15,441.98**	**$2,589.17**	**$3,715.15**
Mortgage rate 20 yrs @ 6.5%					
Initial cost of improved HVAC				**$8,000**	
Initial Savings on energy cost				**$405**	
Apparent "payback" period w/out inflation				**17.8**	**Years**
Actual payback shown above				**6**	**Years**
(For a generic, hypothetical tax situation)					

good share of dreamers. Choosing the best path and concentrating on it is going to mean rejecting many of those dreams on any given project. That does not mean they have no value, just that design should be logical and decisions need to be made based on real value and the owners' and users' needs.

The necessity for logic in design means that designers need a good grasp of building science and technology. Green building means that far more analysis has to be done than with traditional architecture, and that there are specific, often numerical, criteria to satisfy. In order to make the design team more efficient and for design to not entail extra costs, it is advisable to have technical expertise in the team. Ideally every architectural designer should have the ability to understand the effect on building performance of any design decision. For example, every time a window opening is placed on a plan or elevation, it affects the future provision of daylight, of views, and a component of heat gain and loss. It seems wasteful to have to call in a specialist to determine the optimum fenestration for daylight.

In addition, members of the team need to be able to work closely together. An architect needs to understand how a mechanical engineer works and the implications of design choices. Similarly, the team needs engineers who wholeheartedly embrace green design and have ideas on how to accomplish the goals. Up until now, even though mechanical design may be the single most important aspect in saving resources over the life of a building, there has been less training available for them than for architects in the specifics of green and LEED requirements.

FIRST COST VERSUS LIFE CYCLE COSTS

Energy usage and other factors that affect the cost of the building are crucial in the quest for sustainability and we need to be able to quantify the payback. The

whole issue of first cost versus life cycle costs needs to be understood by all parties. On the one hand it is usually self-evident that the energy consumed during the life of a building is going to be many times the energy and equivalent resources used in construction. On the other hand that is not immediately clear that there is a financial benefit to the owners in paying for a better building in order to reap those benefits. Since a green building does usually cost somewhat more, the designer needs in many cases to be able to make a concrete case for suggested sustainability measures. To some extent realistic analysis can do this—another reason for technical proficiency among the consultants and the value of logical analysis. A pro forma of projected costs over a realistic time span may make the situation clearer. At the present time, capital is relatively cheap to borrow and returns on investment are low. Escalation of construction costs is high, perhaps around 8% per year currently. Utility costs are also rising fast, and likely to continue to do so. So it is important to show that money invested now in a better building will in fact produce a return. Annual savings translate into money available to pay back the cost of construction, and this amount will increase every year.

A fuller explanation for arriving at the Internal Rate of Return is given in the paper by Gary Wolff. In order to make the savings—or otherwise—more apparent to non-financiers, a simple spreadsheet comparison may be drawn up. Here we are not outlining a method of analysis, so much as making a case for its use as a tool. A pro forma—which is really another name for a financial plan in a specific circumstance, or part of one—can help the owner to show lenders or controllers the money freed up by measures that save running costs. Savings on energy use is the obvious candidate, but it can extend to other areas such as materials.

Now that we have a situation where escalation of construction costs is running significantly ahead of usual returns on investment, it may make more sense to install longer-lasting materials. It is impossible to know the future, but an informed analysis will show that increasing demand for materials and increasing regulation are going to make construction materials consistently more expensive, quite apart from the increasing cost of energy. Therefore it is not necessary to rely on the intangible benefits of sustainable building, self-evident though they are to those of us who are committed.

Thermal design that results in lower operating costs should also result in smaller equipment and therefore some first-cost savings, although the extent of the reduction is often disappointing to designers and owners. Engineers need to be able to discuss frankly with owners or future users the parameters and the likely effect of various decisions. Unfortunately, with the endless proliferation and upgrading of codes, there may sometimes be less wiggle room on decisions affecting comfort that one might wish.

Other decisions will not by themselves give any first-cost savings, for example, making daylight illumine large areas, since it is still dark at night and electric lighting has to be installed. However, other decisions on lighting levels needed, the use of task lighting, and the reflectivity of surfaces will affect the fixture density. Light fixture choice is a place where first cost, energy use and cost, and aesthetics are interwoven. It is worth looking at in some detail at the design stage, and evaluating the necessary level of illumination for each space. Reducing cost by choosing the type and quantity of light fixtures based on lighting levels required makes sense for any type of project, of course, but is particularly appropriate for green designs. This is because sustainable design indicates minimizing the resources used; using efficient fixtures will use less material and less energy to run. In addition there is more need for analysis in green projects, as outlined above, and therefore the tools for efficient integrated lighting design are, or should be, available. Effective use of daylight combined with open plan layouts, minimum levels of background lighting, and task lighting available where and when required have been a feature of many office buildings.

More efficient lighting with carefully designed illumination reduces the required electrical consumption, and therefore the cooling load. This means that energy costs are reduced twofold by decreasing the lighting load in watts per area. Additionally, there can be a small reduction in first cost for the smaller size of cooling plant required. When the contribution of daylighting is combined with the electrical lighting and provision made for reduced use, the peak cooling load can probably be reduced, since at times of maxi-

mum cooling needs, i.e. at the hottest times of the day, high levels of daylight are available. The engineers have to be willing to take this situation into account in their calculations of cooling needs.

SUN SHADING

Turning to a different type of lighting issue, and choices in the exterior envelope, let us take a look at sun shading. It is often desirable to shade glass areas from the sun, either at all times of the year in hot climates, or during the summer in temperate areas. Just as with day lighting, size and placing of windows have an effect; but the design of overhangs, sun breaks and other shading methods can be calculated to block sunlight where needed. Generally, if integrated with the building envelope, shading measures will be less expensive. Custom metal grilles and other fabrications are often used for this purpose, and may form part of the building aesthetic. If done for visual appearance reasons, then it is not logical to attribute all the additional costs to improving energy performance. There are two or three approaches that may lessen costs of sun shading. Firstly, there may be easier ways to accomplish the shading, such as using an increased roof overhang. Usually, adding to part of the building that is already part of the design will be less expensive than adding new features, especially on a simpler building or where they increase the number of trades needed.

Secondly, the temptation may be to extend the sun shading grilles to areas or facades where shading is not functional or not needed. South facing windows can be shaded by horizontal projections; east and west windows generally cannot. Even vertical fins may be problematic at those elevations, and they are not only expensive but block sight lines. So that brings us to the third consideration, that the size and placing of windows and openings can affect energy loads if they admit a lot of unwanted sunlight, and that it is cheaper to design the overall building and its orientation and layout for optimal light, heat loss and gain, rather than rely on added technology and features.

ROOFING

Green roofs are a popular feature and can do much to improve the visual environment. However on a strict cost benefit basis, they are seldom a good value. Unless there is a very tight urban site with an overwhelming need to detain storm water on the roof in order to release it slowly, the sustainable benefits especially as measured in LEED can be achieved by less expensive means. A high-albedo roof will reduce the heat island effect in the same way as a green roof, and is less expensive. If increased mass is needed on the roof—which costs money not only in itself but for the structure needed to carry it—then the use of a concrete topping or a ballasted roof will be less expensive. The benefits of increased mass are often stated to lie not so much in sound control, which is a benefit if the building is under a flight path, as for thermal mass. An analysis of daily thermal cycles will determine if this is useful and can save energy. It is by no means automatically a benefit. Imagine the top floor of a dormitory, for example. The roof is heavy with a high thermal mass, and during the day tends to keep the space cooler as it slowly heats up. At night, instead of letting the temperature fall like the exterior environment, it continues to radiate heat and makes the interior hotter, or more in need of cooling, than it would otherwise be. A green or living roof is a very nice feature and can look great and soften the environment, but it is seldom a cost neutral feature.

FINISHES AND INTERIOR DESIGN

For finishes and interior design there are many tradeoffs available when selecting materials, as designers know. Stained and sealed concrete have become popular in sustainable buildings, since they use less resources, are long lasting, and are functional. A high-class colored polished concrete will cost more than vinyl tiles or carpet, but a more modest finish will be inexpensive. It is also more common now to leave exposed structure instead of suspended ceilings, an example of the different aesthetics that we referred to above. An exposed structure is not free, but it probably costs less than a hung ceiling. Savings with these types of finishes can be applied to other sustainable measures, whether it is sustainable wood flooring or improved mechanical systems. Another cost saving with exposed structure may be a reduction in floor-floor heights once the suspended ceiling is eliminated. An overall reduction in building height is one of the single most significant cost reductions available without compromising quality.

As with other areas of sustainable design, more responsibility is placed on the designer to understand principles and applications—in this case the attributes of products and materials. Increasingly there is a good deal of "greenwash" in the marketplace, with manufacturers striving to assure us that their product is "green" when in fact it is only marginally so.

SUSTAINABLE PRODUCTS IN THE MARKETPLACE

Specifications need to be written in such a way that the intended type of product or material is installed, while preferably leaving some choice. At this stage of green construction there are often few choices, so it can be difficult. As far as possible we should strive to improve the marketplace for sustainable products; but in fairness to the owner and his checkbook, we should not rely too much on unusual or exotic products. By being consistent from project to project and by continually asking for similar products, we can encourage local stockists and distributors to carry those products. A good example is FSC or other certified timber, and formaldehyde sheathing. If there is a consistent demand for a reasonable quantity, then supply lines will open. We can see this happening right now. This is another way in which it pays for design teams to hone their specialization and keep working in the same genres.

As far as possible we should choose products that are already available in our area. The same is true of types of construction; different practices prevail in different regions. A method of building that looks like a good idea in New Mexico may not be so cost effective in New Hampshire, even if there are no climatic implications. Construction is always changing, and new methods come into play, but it is inherently a conservative industry, especially when it comes to putting a price on a proposed building. Familiar details will always be priced more cheaply than the unfamiliar. And, to go along with this, it is self-evident that drawings should be clear and not leave questions unresolved. The idea of building "green" may already arouse some misgivings and skepticism among would-be contractors and subcontractors, so any special sustainable features in particular should be easy to understand. With conventional construction, especially residential, it is sometimes all right to assume that "the contractor will work it out on site." But with green building it is important to allay fears, on the one hand, and make sure the solution is worked out on the other. If the designer is not sure how a result can be achieved, how is the contractor's estimator supposed to know?

TRADES

Reducing the number of trades involved on a project nearly always leads to economies, unless the project is large approximately $20 million of construction or more. This applies to any building design, of course, but is especially relevant to green building. This is partly because of the tendency, hinted at above, for designers to throw a lot of features and solutions at a proposed design. Thus, in an attempt to fine-tune a building enclosure, or just to show off green features, there may be a palette of exterior finishes proposed. A proliferation of construction materials increases cost several ways: it entails more coordination, more changes in detailing, and may slow the project down. Generally, junctions between materials or methods take time and money, and are potential weak spots. Most trades would rather do a larger amount than a smaller, and would prefer repetitive work where workers can achieve some speed. There is always a dollar amount below which a job is not profitable or attractive; for example, though stucco is not an inherently expensive material, a small area of it may just be too much trouble and will end up costing far more on a square foot basis than a large one.

At this point in time, the number of contractors who are aware of green building and are willing to get to grips with it is rapidly increasing. Hitherto it has been a rather fringe activity, but it is rapidly becoming more mainstream. The more contractors and especially subcontractors there are who are familiar with the special requirements of green building, the better. The actual number of specialized requirements is not in fact that large, it is as much a matter of attitude. Competition is what keeps prices under control in construction, though given the current high rate of escalation, some might doubt this. So it is worthwhile to take the trouble to talk to as many local contractors as possible and get them on board. This will help projects to be bid more keenly and keep costs on a par with standard building, it will help the designer to educate him or herself and understand more of the realities of construction, and it may give the designer an edge in convincing prospec-

tive clients to trust him and give clients confidence to "go green."

SUMMARY

To summarize the points mentioned that can help to keep costs of construction down:

- Have design teams that are able to both specialize in relevant areas and work together; concentrate as much as possible on repeating the process and on certain design approaches, so that it becomes more efficient to design sustainable buildings. Look for a defined niche.
- Carry out analysis that allows cost and benefit numbers to be assigned, as well as selecting the best combination of measures.
- Understand the implications of green design at the outset; do not wait until the building is basically designed to apply "green" techniques. Find out owners' true priorities; help them understand that some choices may lead to a "different" appearance.
- Use smart design and a full understanding of program requirements to reduce floor area.
- Prepare a pro forma to help the owners understand the financial choices and potential paybacks.
- Look for the optimum use of glazing for daylight and sunlight penetration; use the minimum amount of glass necessary to do the job, since windows generally cost twice as much as the wall they are in and let out five times as much heat.
- Use efficient and selective lighting design; encourage mechanical engineers to design for realistic peak load rather than the maximum possible.
- Make the building envelope do as much work as possible without having to add special features.
- Carefully evaluate cost and benefits of green roofs and other fashionable solutions.
- Consider simple finishes where possible.
- Keep specifications as open as possible while making clear the performance needed.
- Limit the different trades required.
- Use known methods of construction as far as possible.
- Help to grow the pool of contractors locally who want to work on green buildings, increasing competition.
- Keep selecting the same products and materials so that they become more available.

CONCLUSION

The wave of the future is green building. Although the general perception is that it will cost more, careful planning, cooperative efforts in keeping LEED standards, and a keen eye for selecting quality, cost-effective materials and methods can produce superior buildings that are well within budget and truly sustainable.