One of these drivers is the choice of wood species. Choosing oak over mahogany would dramatically reduce materials costs but may not achieve the desired look. During the design process the team should review the characteristics of various species and tour several timber frames before selecting the species.

Another cost driver is the quality of the wood, whether green (freshly felled), kiln dried or reclaimed. Each of these can markedly affect the price of the frame, with green wood typically the least expensive and reclaimed wood the most expensive. A rule of thumb is that the drier the wood, the more stable, hence less checking and tighter joints over time. These issues rarely have a structural impact on the frame and are usually aesthetic choices. Requiring certified woods (Forest Stewardship Council certified) sometimes affects price and availability of certain species and should be reviewed during the design process.

The finish on the timbers is yet another cost consideration. As discussed above, each time the framer works with the timber, it affects the cost of the frame. A rough-sawn frame is the simplest. Requiring S4S requires additional milling. Sanding and oiling, hand-hewn finishes, adzing and sandblasting all provide distinct looks but require multiple handling of the timbers.

Planning for the raising is an often misunderstood cost driver in timber framing. Raising a timber frame takes an awful lot of space and this is something that is often lacking around construction sites. The best case scenario for the timber framer is to have an area equal to the dimensions of an entire bent (end wall) available on the ground to assemble the frame and ready it for raising. In this best case there are no other walls existing on the site, just a clear, level, squared deck. This is the easiest and least costly situation, while raising the frame after three of the four walls are standing or trying to raise trusses in a room where the roof has already been placed makes for a more difficult and costly installation.

Access and site requirements also drive costs. A steeply sloping lot or an inaccessible driveway may preclude the use of a crane to raise the frame and add many labor hours for installation.

One way to control costs is to design a hybrid frame that utilizes timber framing in the highly visibility areas and uses stick framing or SIPS construction in the remainder of the spaces. Often timber-framed great rooms and front porches are clad with and then married to SIPS construction. As discussed above, SIPS provide structural support. Additionally, because of their design, they can be used as structural building members, so whole buildings can be constructed of SIPS.

Another hybrid technique is to include trusses in the design that are supported by SIPS or stick-framed walls. It should be recognized though that trusses can be structural or decorative, but the cost for each will be about the same so they might as well earn their keep.

In conclusion, timber framing is not only one of the oldest construction techniques known to man, it is also among the most beautiful. That, coupled with its sustainable nature, long life and design flexibility, should make it the choice method for anyone contemplating a new building project.

Written by Amy Cornelius, LEED AP.
Amy works with Hugh Lofting Timber Framing, Inc., a LEED for Homes registered contractor.

ABOVE: For a boathouse project in Cape May, NJ, that was designed in a collaboration between Hugh Lofting Timber Framing, the owner and an architect, pegs were trimmed in preparation for raising the bent, or end wall. BELOW: This custom carriage house, designed by Hugh Lofting, features three bays, a loft and a lower-level storage area. It is crafted of Douglas fir and finished with a pine tongue-and-groove ceiling, pine board-and-batten siding and hardwood flooring.

Frame of Reference

A simple design and a collaborative process are often hallmarks of a successful timber-framing project

Timber framing is one of the oldest construction techniques known to man, but it remains one of the least understood in the marketplace. Evocative pictures greet us from magazines and coffee-table books, encouraging visions of grand rooms and entrances for homes, churches, office buildings, barns and even enhancements to our landscapes. The problem arises after the vision: how do we design, build and afford the dream?

Timber Framing Today

The traditional definition of timber framing – "a frame constructed of heavy timbers using mortise and tenon joinery that is held together with wooden pegs" – is expanding as the industry and design aesthetics evolve.

Designers' desires for longer spans and more complex joinery, coupled with increased engineering review rigor, are driving timber framers to include more steel in their projects and to use a multitude of metal fastening systems. The steel can be hidden within the frame or it can be visible, or expressed. Most often expressed steel is seen as an integral part of the overall design of the structure.

Many timber framers are also working with manufactured timbers, including glued-laminated and PSL (parallel-strand lumber) material. These timbers, manufactured from thin pieces, or "slices," of kiln-dried wood and then adhered under pressure, have high tensile strength and allow designers to achieve significant spans. They can also be quite beautiful.

Timber frames are manufactured in a variety of ways. Most shops use some combination of power tools (chain mortise machines, etc.) and hand tools, such as chisels and mallets, for joint cleanup. Some specialized companies work in environments that are powered by water wheels and use only hand tools, others are slightly more automated and there are an increasing number of shops that employ CNC (computer numerical control) technology. CNC technology allows computer design programs to communicate directly with large robotic milling machines that then cut the entire frame. Some companies cut entire frames using CNC technology while others cut repetitive components, leaving the unique or more visible pieces to be hand-cut. Even in the fully automated

frame shops, there is still a certain amount of hand work involved in cleaning up and finishing the frame, and sometimes in the more specialized compound joinery.

A Natural Choice

In a timber frame, the structure of the building is exposed inside the building. This is akin to inviting the outdoors inside, bringing the occupants closer to nature while providing almost all of the decoration that the home or structure may ever need. The interior spaces created are unencumbered by structural walls, allowing for an open floor plan that can be reconfigured to the occupants' needs and have a tangible feeling that exudes warmth, strength and security.

Timber framers work with many species of wood and many work with wood that is local to their community. Each species has its own characteristic look and personality. Newly sawn or green oak is particularly personable when it is introduced to the heated environment. A framer once told me that his client complained of gunshots downstairs in the night – it was the oak frame checking as it dried in the dry heat of the house. Timber framers use a variety of species, including hardwoods (beech, birch, chestnut, elm, oaks, maple, cherry and hickory) and softwoods (cedar, firs, hemlock, larch, pine, spruce and tamarack).

Timber framing is one of the most sustainable building methods available, supporting good forest management, low-carbon-input manufacturing processes and energy efficiency. Timber frames are typically manufactured off-site and raised in a matter of days. The prefabricated nature of the frame reduces construction time and site waste. Also, the choice of enclosure systems for the frame can make it very energy efficient and airtight.

A significant percentage of timber frames are enclosed with SIPS (structural insulated panels) that, when installed, form a blanket of insulation around the frame that provides a significant R-value, very little thermal bridging and an airtight barrier. Much like a sandwich, SIPS are constructed of two outer layers of OSB (oriented strand board) that are filled with a thick layer of foam (polystyrene or polyurethane). The SIPS are applied to the outside of the timber frame, leaving the timbers fully exposed. SIPS are manufactured off-site and can be pre-cut for windows and door penetrations, further lessening on-site construction waste and construction time.

This structure features Douglas fir solid king-post trusses with a glued-laminated bottom chord. The ceiling is Douglas fir tongue-and-groove decking that provides a warm feeling and adds to the structural integrity.

Design Basics

Simple, uncomplicated design does not mean boring. It does mean that keeping the design simple, without complex roof systems, multiple dormers and various appurtenances, will help minimize costs while showcasing the timbers without clutter.

Timber framing is extremely labor intensive. Even frames that have been cut on CNC machines often require hand finishing. Every time the timber framer works with the timber, the cost increases. So, if you have a kiln-dried, S4S (smooth four sides) timber that is perfectly straight and the final design requires the same, the framer will work with it about three times: assessing, laying-out and cutting. Each time the design becomes more complex – such as when the project utilizes antique wood that is by nature often out of square and/or filled with nails, hand-hewn finishes, hand-carved embellishments and compound joinery – the time spent with the timber increases. This makes a direct impact upon the project budget. Not that any of these things are bad, but they should be recognized up front by the design team.

Complexity also brings with it increased volumes of wood. Timber orders are measured in board footage, where a board foot equals a piece of wood that measures one in. by one ft. long by one ft. wide. Adding hips, valleys and dormers to the frame increases the total board footage that is purchased for the project, and the loss factor in each piece increases as steep angles are cut into the timbers. In the case of dormers, the total board footage of the roof increases and the pieces that are added to the project are much more complex, adding to materials and labor expense.

Collaborative Design

The collaborative design process is an iterative one that refines the design as the scope of the project evolves and is crucial to a successful timber frame project. Collaborative design is a communication intensive process that has measurable benefits; these may include, for example, identifying synergies between building size, fenestration and mechanical equipment needs, or synergies between plantings, building orientation and water use.

It is important to assemble the collaborative design team early in the process, preferably at the conceptual design stage, and charge them with developing complete, solid plans before starting any construction. The team should at least include the client, the architect/designer, the builder, the timber framer, the HVAC contractor or consultant, the sustainable and/or civil engineer (if any) and the landscape architect. The plans they develop should include architectural, structural and framing, mechanical, storm water, electrical and plumbing.

Many times clients avoid MEP drawings to save costs, with the belief that the general contractor and subcontractors will be able to develop the best mechanical program. When stick framing a structure, this approach often results in cost overruns. Given the prefabricated nature of timber framing and the limited interior walls, this approach quickly results in problems with routing and installing utilities. These problems frustrate the construction team and often result in additional costs for materials and labor. Avoiding the MEP drawings may also have long-term cost effects on operating the building because design synergies were not considered at the onset.

Bringing this team in early lays a foundation of good communication at the outset of the project that flows throughout the entire construction process. It allows for tighter bidding, reduces cost overruns from change orders and reduces total construction time. It also sends a message to the construction team that this is a project that has been well thought out. This often causes the construction team to take greater care in their own work, resulting in a better project all around.

Timber framing is a specialty business and a timber framer should be included in the design process for a number of reasons. Most importantly, the lack of interior walls and the prefabricated nature of the frame present unique challenges for routing mechanical systems, and there is little wiggle room for changing the frame once it is fabricated. That is not to say that you are "stuck" with the framer for the duration of the project. The timber framer can be brought to the project as a paid consultant to address design issues and to develop a set of CAD drawings to be used in the bidding process. In this role, the timber framer will identify potential factors that affect cost and buildability, including timber sizing, wood species and design complexities, and identify design problems such as stair openings and door and frame conflicts. By identifying pitfalls and opportunities early, the client will save money and time on the frame that can be rolled into the project as a whole.

Pam Hinton is the executive director of the Timber Frame Business Council. "Our goal as an industry is to become more interactive with architects earlier in the process," she says. "Our membership of experienced timber framers can help architects and their clients save money and make the projects more successful. Working as a team, the timber framer can do what it takes to express the architect's vision in wood – a good collaboration will express the intent of the design and maximize the potential of the materials used."

Cost Analyses

There is no doubt that timber framing is more expensive than stick framing, but collaborative design and simple design help to control costs. The collaborative design process helps to achieve the vision with a timber frame design that optimizes structural strength, total board-foot volume and manufacturing processes. During the design process, other cost drivers are determined and weighed against the overall project goals.

In re-creating the Pennsylvania barn, pains were taken to be authentic by using traditional joinery and reusing the oak nails or pegs while incorporating new lighting technology. Tucked beneath the loft, the kitchen features an efficient layout with lots of workspace.