WHAT IS A STRUCTURAL INSPECTION?

A structural - or engineering - inspection is above all, an **opinion** as to the structural condition and integrity of the building or home. That is, in the opinion of the engineer 1) were the structural elements (foundation, framing, etc.) designed and built to accept the anticipated loads to be placed upon them, and 2) are they continuing to perform their intended function?

The ability to render such an opinion is fundamental to this definition. By law in most states, only a registered Professional Engineer is permitted to render an opinion as to the structural integrity of a building. Certainly others may observe and report defects (rot, cracks, etc.) but an opinion as to their significance can only be rendered by an engineer (or in some cases, an architect).

It must be remembered that an *opinion* is not a guarantee. There are parallels in all professions. A physical performed by a doctor is not a guarantee of continued good health but an *opinion* as to your current condition and chances for the future. Similarly, an accountant does not guarantee that your tax return will pass an IRS audit but simply does, what in his *opinion*, will be best. A lawyer accepts a case based on his *opinion* of its merits - not the certainty of success.

As with the human body, there are variables in building structures that are not predictable. Soils move in a non-linear fashion. The exact time and amount of movement cannot be predicted. Wood is an imperfect material, subject to swelling, shrinkage, rot, etc. Certain loads are variable by their nature (e.g. snow, wind). And without disassembly, many structural components cannot be seen during an inspection.

The value of a structural inspection then, as in all professions, is largely dependent on the experience and qualifications of the individual who performs it. A registered Professional Engineer has, at a minimum, completed a four year accredited college program, worked for at least four years under the direction of other like professionals, and passed a 16 hour exam. He or she is required by their professional code of ethics to practice only in areas competent to do so and to be accountable for the work they do. Individuals who are in private practice who are not registered (even if they have taken engineering courses) may not call themselves engineers.

Criterium Engineers are registered Professional Engineers with usually at least 10 years of buildings related experience. They are trained by Criterium to provide inspections and must participate in Criterium Engineers' peer review and continuing education programs. The following pages outline in greater detail, the actual scope of a structural inspection.

STRUCTURAL ENGINEERING INSPECTION CRITERIA

For the purposes of providing inspections for relocation or other clients, the term "engineering inspection" shall apply essentially to a structural inspection of the building. This type of inspection can only be performed by a registered Professional Engineer.

PURPOSE: To determine the structural integrity and soundness of the building.

A. FOUNDATION

To be inspected: All accessible/visible portions of the foundation (i.e. slab, floor, walls) will be examined for evidence of distress and deterioration (e.g. cracks, movement, bowing, attachment).

Report on: The significance of any distress or deterioration. Where appropriate, suggested approaches to repair including an estimated range of costs for the repairs will be provided.

B. BASEMENT/CRAWL SPACE WATER

To be inspected: Surface drainage conditions around the building, evidence of water entry and/or accumulation in the crawl space/basement, excessive moisture, and the presence and condition of water control systems equipment.

To be reported: Description of water related conditions, adequacy of water control systems; limitations of inspection; potential risks of water entry; approximate scope of repairs recommended, approximate cost of repairs.

C. FRAMING

To be inspected: Investigate all accessible/visible portions of the building (e.g. floor, ceiling, roof framing); identify wood deterioration, insect activity and/or rot and other related deterioration; visually evaluate adequacy of framing other structural components.

Report on: Evidence of structural deficiencies, approximate scope of structural repairs required, approximate cost of structural repairs required.

D. ROOF

To be inspected: Roof surfacing, layers, flashing, sheathing (Fire Resistant Plywood), gutters for condition, type, current performance and evidence of leakage.

Report on: Conditions requiring attention; and approximate cost to repair/replace.

E. INTERIOR/EXTERIOR

To be inspected: Examine interior and exterior of building for evidence of distress, deterioration and weather tightness (siding and windows) that might indicate conditions affecting the overall structural integrity and stability of the building.

Report on: Evidence of distressed or deteriorated conditions and significance of same, as well as suggested approaches to the repair including an estimated range of costs for the repairs will be provided.

F. GENERAL

Other items related specifically to the structure will be examined and evaluated. These may include decks, porches and other attached structures (e.g. garages). In addition, as engineers, we have an ethical obligation to report any significant safety hazards noted during an inspection.

LIMITATIONS

An engineering inspection should not be construed to be any of the following:

1. A complete code compliance inspection.

   Such an inspection is a practical impossibility for any existing construction, since it is dependent on many things that cannot be seen, and on the status of codes that were applicable at the time the building was built.

2. An inspection for hazardous materials.
   Except in the case of obvious visual evidence of hazardous materials, an engineering inspection is not a comprehensive evaluation for hazardous materials.

3. An inspection of heating, cooling, plumbing and electrical systems.

4. A fire safety inspection (unless otherwise specifically requested).

5. A repair design.
   To the extent that defects are observed, approaches and related costs for effecting a satisfactory repair will be suggested. Neither the actual design of the repair nor any design drawings are included in the scope of an engineering inspection but may be provided by Criterium Engineers for an additional fee.

STRUCTURAL DEFECTS - WHAT REALLY MATTERS?

Are those cracks significant? That is a question often asked by our clients. Here are a few guidelines to help you distinguish between significant cracking and normal cracking.

First, keep in mind that the older the building, the more likely some cracks will develop. Cracks that would be considered unusual in a new building are often quite normal in an older building. By older, we are referring to a building thirty to forty years old more. Buildings less than thirty years old that develop significant cracking deserve further investigation. Such cracking often indicates other structural problems, not normal aging.

Concrete Foundations and Slabs

Concrete will almost always develop some cracking. Cracks in concrete floors that are narrow (less than 1/16 inch) and follow a random pattern throughout the floor are common and usually indicate normal shrinkage and/or marginal curing and placement of the concrete. These cracks typically do not indicate any other type of structural problem. As long as the floor is flush from one side of the crack to the other, the crack is probably of little or no structural significance. As differential movement develops, however, such that the slab on one side of the crack is significantly lower (more than 1/8 inch) than on the other side, then settlement of the soil below the slab may be occurring which deserves further investigation.

In certain parts of the country, particularly in the west, control joints are used on concrete slabs to help control cracking. When control joints are installed properly, random cracking is less likely to occur. The sketch at the left shows a concrete joint. Typically concrete joints should be installed in any concrete slab greater than 30 feet square.

Concrete walls often develop vertical cracks that are slightly wider at the top than the bottom. This indicates some settlement in the soil under the foundation, which is common. If the crack appears more or less the same width on the inside and outside of the wall, it is typically of little concern. If, however, the crack is wider (particularly cracks that grow to 1/8 inch or more) on the inside than the outside (or not even visible on the outside), this is indicative of inward movement of the foundation wall which is often a more significant structural problem requiring further investigation.

If the wall has moved in or out such that the wall surface is not flush from one side of the crack to the other, this also indicates some movement of the wall which requires further structural investigation.

Diagonal cracks emanating from the corner of window or door openings are also typically an indication of settlement. The size of the cracks here will indicate whether structural concern is warranted. Typically, cracks more than 1/8 inch wide are noteworthy.

Concrete Block Foundations

Cracking in a concrete block foundation will often follow a step-like pattern along the joints in the concrete block. Such cracking is common and typically does not indicate a major structural problem.

Any cracks that would suggest inward movement of the wall, however, do deserve further investigation. Here, the same criteria as applies to concrete walls is applicable.

Of particular concern in concrete block walls are horizontal cracks typically located within the upper half of the wall. Such a crack, particularly if it is wider on the inside of the wall than on the outside, often indicates inward movement of the block wall which, if left unattended, will cause failure of the wall. This is probably the most significant type of cracking common to foundation walls. The sketch at left shows this type of cracking.

To preform best, concrete block foundations should be reinforced both horizontally and vertically.

Concrete Block Walls Above Ground

In the southeast and throughout other areas in the southern United States, concrete block is used to construct walls above ground as well as for foundations. This system is typically combined with slab-on-grade foundation systems.

In the southern states, foundation walls to protect from frost are unnecessary due to the moderate temperatures. However, slab-on-grade foundations without a perimeter footing are vulnerable to movement which can lead to cracking of the above-ground block walls.

Such cracking leaves these walls vulnerable to weather penetration, particularly in areas where wind driven rain is common. Proper reinforcement of block walls (both horizontally and vertically) will minimize this cracking.

However, if you see significant (1/8 inch wide or more) step-like cracking in above-ground concrete walls, further structural investigation is recommended. Hairline cracks (less than 1/16 inch) on the other hand are typically indicative of normal movement and do not represent a structural problem.

Weathertightness

Unless a structural problem is evident, the most significant consequence of cracking is the loss of weathertightness. All cracks should be kept sealed.

Wood Framing

With conventional wood frame construction, some shrinkage and distortion of the wood is common. Wood is not a perfect material. It will change shape as it dries out and ages. Cracking in a corner, for example, is common and usually does not indicate any type of structural problem. Cracking which follows the joint between a wall and a ceiling is also quite common.

Cracking in the center of the wall, however, particularly diagonal cracking, is often evidence of some structural movement. Such cracks may radiate from the corners of door or window openings or may extend across the middle of a wall section.

Here we must consider the difference types of walls in which such cracks occur.

First, on an exterior wall, diagonal cracking is probably a direct result of some settlement of the foundation. You should also expect to see some settlement cracking in the foundation. To the extent that this cracking has stabilized and is no longer growing, it probably does not represent a significant structural problem. However, if the house is quite new or if evidence suggests that the cracks are growing, further structural investigation is needed.

Second, if the diagonal cracking is on an exterior load bearing wall, the adequacy of the load bearing elements comes into question. Diagonal cracking would indicate some sagging of these load bearing elements which may indicate inadequate foundations and supports at the lowest level of the building.

Third, if the cracks are in an interior non-load bearing wall, and if it's a relatively new house, the framing immediately under that wall may not be adequate. We have found situations where an interior wall is supported on plywood between the joists rather than directly over the joists. This can lead to enough structural sagging to permit cracking.

Visible Sags

In any home, it is useful to look at the lines of a building to evaluate the general plumbness, levelness and squareness. A sagging roof line, for example, in a relatively new building, may be indicative of inadequate framing. We recently found a home in California where 2x4s were used as roof rafters despite the fact that the design called for 2x8s. The evidence was the sagging roof. Further investigation revealed a severely deficient roof structure.

You should look at the top of openings (over doors or windows, for example) or along the main girder/carrying timber in a basement, garage, attic, or utility room. If sags are evident, the adequacy of the framing is questionable, especially in a relatively new home.

Again, keep in mind that an older home will sag even if the framing is adequate. This is a condition referred to as creep where the actual grain structure of the wood tends to relax as time passes, allowing for some sagging although no actual reduction in strength of the member has occurred. This is similar to the "sagging" that occurs in our own bodies as we age.

In summary, cracks that continue to grow, follow a diagonal line, or indicate inward movement are often red flags indicating a more significant structural problem. Hairline cracks, cracks in corners, and cracks of random patterns are typical of most construction and typically do not indicate serious structural problems.

Finally, keep in mind that as a building ages, some cracking becomes more and more likely.

Whenever the cause of cracking is questionable, an engineer should be consulted to diagnose the problem. Evaluating the structural condition of any building is a sophisticated, complex process requiring both experience and technical training. A Registered Professional Engineer is the right choice for such an investigation.

CRAWL SPACES - OUT OF SIGHT, OUT OF MIND?

Many homes in our country are built over crawl spaces. The alternatives, of course, are full basements or slab-on-grade construction. Crawl spaces are an effective compromise that allows for a utility space under the floor and offers a more resilient and, therefore, more comfortable floor. Crawl spaces do not, however, offer additional storage and utility space as would be the case with basements. Crawl spaces are preferred in areas where wet soil conditions would make it improbable that a dry basement could be treated.

When crawl spaces don't work, the next and preferred step is a slab on grade construction using a concrete slab placed directly on the ground.

Our inspections of crawl spaces around the country have revealed a number of common problems, many of which have easy solutions. The following is a summary of our observations:

Moisture/Condensation - Crawl spaces are ideal places where condensation can occur. Condensation encourages rot, mildew and insect infestation. Condensation, therefore, must be controlled. Condensation in a crawl space can be controlled by the following:

1. Adequate Ventilation - A minimum of one square foot of free ventilator area should be provided for each 150 square feet of crawl space floor area. Vents should be installed to ensure cross ventilation, or effective air flow. Vents should be kept open throughout all of the warmer months of the year, closing them only for brief times when freezing of plumbing is a risk.

2. If a crawl space has a dirt floor, the floor should be covered with polyethylene, typically 67 millimeters or thicker to resist damage and tearing. Ideally, the polyethylene could be covered with sand or other materials to prevent damage. The joints of the polyethylene should be overlapped by at least 12 to 24 inches. The polyethylene should cover the entire floor area of the crawl space.

3. If natural ventilation is ineffective, one or more

fans can be installed coupled to a humidistat to circulate air when the humidity in the crawl space is particularly high. This will help encourage drying and minimize condensation.

Water Accumulation - Another typical problem in crawl spaces is water accumulation. The consequences are similar to that of condensation, however, the source is different. Good surface drainage with ground sloping away from the building will help minimize water entry into a crawl space. If water entry is persistent, the installation of crushed rock to guide water into a sump where it can be pumped out of the crawl space is strongly recommended. It is important that a crawl space be kept free of standing water.

Access - Access to a crawl space is important to allow periodic inspections. Access should be reasonably convenient through a hatch in the floor or an outside entry that can be easily opened. Without reasonable access, there will be little reason to inspect the crawl space from time to time. As a result, problems may develop into serious conditions before discovery. Always be sure to have reasonable access to any crawl space.

Mechanical Equipment Deterioration - Again related to moisture, it is typical that mechanical equipment located in a crawl space will deteriorate rapidly if there is not good ventilation and moisture control. Mechanical equipment should be inspected at least annually and kept in good working order.

Insulation - There are essentially two schools of thought on crawl space insulation. One that would put the insulation around the perimeter and the other that would put it on the underside of the floor. Either system will work provided it is enhanced by good ventilation. Insulating the perimeter will offer more protection against freezing pipes and other equipment. However, it also increases heating requirements since it increases the amount of space to be heated. Perhaps more importantly, however, insulating the perimeter walls assures that the underside of the first floor remains visible for periodic inspections to check insect infestation or rot.

Minimum Clearance - Technically, most current building codes require a minimum of 18 inches of clearance from the underside of the first floor framing to the floor of a crawl space. Ideally, a crawl space should have even more space. We would recommend two to three feet whenever possible. Less than 18 inches, however, is certainly inadequate. Such a small space increases the probability of rot and insect infestation. If your crawl space has less than 18 inches clearance under the first floor framing, we strongly recommend additional excavation to provide more clearance. Such excavation should be limited, however, so as not to undermine the structural integrity of the footings.

Crawl spaces offer many advantages to the construction of a home and are the preferred method in certain parts of the country. Crawl spaces can also be a serious liability if improperly maintained. Check yours against the criteria recommended and make improvements wherever necessary. It will enhance the future life and value of your home.

FOUNDATIONS

Whether in the southwest, the northeast or anywhere in between, a home is supported on a foundation.

Typical of the southwest and southeast is a slab-on-grade foundation. In the central parts of the country, a crawl space enclosed by a perimeter foundation wall is common. As you move to the more norther states, a full basement enclosed by a perimeter foundation wall is the most common.

Regardless of the type, a foundation serves two important purposes.

The first is to support the weight of the building and to distribute it over a sufficiently large area of soil to minimize the risk of settlement and other structural movement as the building ages.

The second and equally important function of the foundation is to isolate the building from the effects that might surround it, most specifically insects in the soil and moisture related to the soil, either as a result of a high water table (naturally occurring water below ground level) or poor surface drainage.

Foundations are typically built of poured concrete (some refer to it as cast-in- place concrete), concrete block and wood.

While it is a somewhat controversial subject, most sound engineering principles would argue that poured concrete will produce a better foundation than concrete block. This, of course, assumes unreinforced concrete lock is used as is typical for most residential construction throughout the United States.

If concrete block were constructed with reinforcement such as is typical for most commercial construction, it could then be expected to perform equally as well as poured concrete.

Whether constructed of poured concrete or concrete blocks, it is critical that the concrete and mortar be cured properly. This means maintaining a proper temperature (ideally between 50 and 90 degrees Fahrenheit) and a moist environment for at least the first five days after the concrete has been put in place. This applies equally to the mortar used to join concrete block. Improper curing will lead to weakened concrete and mortar which will typically deteriorate prematurely.

While still in the minority, wood is becoming a more common foundation material. Functionally, widespread acceptance of wood foundations (referred to as PWF or permanent wood foundations by the American Plywood Association) has yet to be achieved. Properly assembled, however, a wood foundation can be quite durable. For specific recommendations, we suggest contacting the American Plywood Association (APA) at P.O. Box 11700, Tacoma, Washington 98411 and requesting their

literature on permanent wood foundations.

Equally important to the construction of a sound foundation is proper preparation of the soil beneath the foundation and slab-on-grade. typically, six to twelve inches of porous material (gravel, crushed rock, etc.) should be placed below the various elements of the foundation. This is particularly important for slab-on-grade construction. This material should then be compacted (in layers is ideal) to maximize stability.

Also important to a durable, stable foundation is a subsurface drainage system. This is important in any part of the country to control water around the foundation. It is particularly important for homes with crawl spaces and basements to help keep water out.

A good drainage system is a benefit in parts of the country that are affected by expansive clay soils such as parts of the southwest, and the Ohio River valley. A good drainage system maintains a stable moisture level in the soil.

A good drainage system consists of rigid, PVC perforated pipe installed around the outside of the foundation (at the level of the bottom of the footing) and in severely wet conditions around the inside of the foundation (under the concrete floor slab) as well. This drainage system should drain to a "daylight" outlet or a sump pump. A daylight outlet would be one that allows the water to flow naturally (by gravity) down and out. Such drainage should also take into consideration the possible consequences of draining water onto adjacent property. Carrying drainage water across the property line may violate some state or municipal regulations.

Wherever frost penetration into the soil is a consideration, the entire perimeter foundation wall must extend into the soil to a depth that will protect it from frost. In southern states where freezing temperatures are experienced only occasionally, this penetration may be as little as one foot. In the most northern states, however, such penetration of the foundation to protect it form frost could be as much as five to six feet.

Even in states where frost protection is not necessary, a six to twelve inch penetration into the soil along the perimeter of the building will help control erosion and provide more structural integrity. This is recommended for good quality construction.

Following are a few telltale signs of significant structural conditions in a foundation.

LONG HORIZONTAL CRACKS (in the middle third of the height of the wall) often indicate inward movement of the foundation walls which requires repair.

MULTIPLE, DIAGONAL CRACKS, often radiating off the corner of basement windows, may indicate settlement in the soil. the next important question is whether these cracks are continuing to grow. This can only be determined over an extended period of time.

In concrete block foundations, where cracks are present and adjacent blocks are NO LONGER FLUSH with each other, some structural movement is present that may require further investigation.

For new construction, note that all foundations should have some type of bituminous waterproofing (typically a black, brushed on material) applied to the outside. Since concrete block and poured concrete are not watertight, this bituminous sealant will help minimize water penetration. In severely wet areas, more aggressive membrane waterproofing (alternating layers of hot tar and felt paper, for one example) is recommended.

Foundation come in many forms. What is most important is that there not be evidence of significant movement in the foundation and that it be constructed in a durable manner. Without a good foundation, no matter how well built the rest of the house, it won't last long.

FOUNDATION UPS AND DOWNS

Foundations - the mere word suggests stability, soundness and permanence. Unfortunately, in residential construction, that is often not so. In many parts of our country, foundations have a nasty habit of moving and it's not always down!

In the Southwest, expansive clay soils often referred to as Bentonite (although the actual culprit involves other types of clay), when wet, will actually expand and push a structure (even large, commercial structures!), upward, causing severe structural damage. Well designed foundations in the Southwest often rely of caissons or piles driven deep into the ground to isolate them from the expansive soils.

Garage and basement floor slabs are designed to "float," independent of the adjacent foundations.

Most building experts from that part of the country agree that expansive soils are one of the most severe structural problems they encounter.

In the Northeast, particularly in the more northern sections, where history has seen glaciers visit, large deposits of very fine soil often referred to as marine clay leave unstable layers of material unsuitable for normal foundations. This clay is so sensitive that even slight changes in loading can mean several inches of settlement during the first year after construction. This material often does not stabilize and settlement will continue almost in-definitely.

A foundation involving a rigid, concrete slab or other provisions to uniformly distribute the load of the structure over the soil is often necessary to offset the characteristics of this type of soil.

The shifting sands of time are also a potentially unstable base for our buildings. In the Southeast and other parts of our country where our buildings must rest on sand, care must be taken to prevent erosion and other movement of the sand that could lead to structural problems. For the same reason we enjoy sand on the beach; it is a dry, shifting material, easily encouraged to move, making it a potentially unstable companion for our foundations.

For the best foundation, rock ledge or dense, well-graded soils (consisting of some sand and some clay) are ideal.

Oh! And don't assume that all foundations are created equal. Varying soils types and sizes of footings. Not all buildings are constructed using a compatible foundation and footing system.

One should not assume that simply because something is called a foundation, it is, in fact, sound. If large cracks, particularly those that are wider at the top, are noticed in any foundation, these may signal movement in that structure which often deserves further investigation.

WHAT IS THE BEST FOUNDATION?

We are often asked what kind of foundation is best. From many years of experience, here are a few of our thoughts:

Full height basement:

> Advantages: good access to mechanical and electrical systems, adequate space for appliances and equipment, extra storage space.
> Disadvantages: vulnerable to water leakage, not well suited to some soil types, typically most expensive to build.

Crawl space (minimum eighteen inches deep):

> Advantages: good to fair access to mechanical and electrical systems.
> Disadvantages: vulnerable to water leakage, not well suited to some soil types, moderately expensive to build.

Slab-on-Grade:

> Advantages: least expensive to build.
> Disadvantages: no access to mechanical land electrical systems, more difficult to heat, less comfortable floor surface.

Cast in place concrete:

> Advantages: most durable, most water tight, strongest.
> Disadvantages: more expensive in some geographic areas.

Concrete masonry units (CMU or concrete block):

> Advantages: less expensive in some geographic areas.
> Disadvantages: less durable, less water tight, more vulnerable to movement.

Wood (PWF or Permanent Wood Foundation):

> Advantages: less expensive in some geographical areas, can be built in any weather, more flexible for interior finishes, water tight if constructed properly.
> Disadvantages: general acceptance is low, vulnerable to water leakage if not constructed properly, vulnerable to movement.

Soil conditions and budgets permitting, most experts agree that the best foundation is built of cast in place walls enclosing a crawl space or basement. This provides access to the mechanical and electrical systems, good durability and optimum structural integrity.

Of course, any foundation is only as good as the soil it rests on. Properly designed footings, caissons, piles or other supports are always important. No home should be built without a thorough analysis of the underlying soils. From the expansive clays of the Southwest to the glacial clays of the Northeast, if improperly accommodated, any soil can cripple even the best foundation.

BASEMENT WATERPROOFING

How do you keep water out of a basement?

In new construction, cast-in-place concrete foundations are more resistant to water penetration than concrete block. Bituminous waterproofing should be used, at a minimum, to seal the outside of any foundation wall, however.

An effective perimeter drain system should be installed to collect water from around the foundation and under the slab. The National Association of Home Builder's booklet on dry basements entitled, "Basement Water Leakage - Causes, Prevention, and Correction," recommends perimeter drains on the inside and outside of the foundation. These drains should either flow downward to a gravity outlet (natural drainage) or to a sump where the water can be discharged with a sump pump.

A building built in a wet site should take advantage of additional waterproofing, a membrane system. One example of a membrane system consists of multiple layers of impervious material applied in a hot tar mopped system to the outside of the foundation. Special attention should be paid to the joint between the wall and the footing.

The concrete floor and walls (whether block or concrete) should be reinforced to minimize cracking.

A water problem in an existing basement can only effectively be dealt with by re-waterproofing the outside of the foundation walls and/or upgrading the exterior foundation drainage system. Both approaches require excavation around the outside of the foundation.

There are alternatives which will intercept the water using a channel-like system around the interior of the foundation wall to collect and guide the water into a sump and discharge it using a sump pump. These systems do not correct the water problem but they do control the water once it has entered the basement in a way that minimizes problems related to water entry. Such systems, while dealing more with the symptom than the cause, are typically less expensive because they can be accomplished from the inside.

There have been a few products to come on the market in the last several years that claim to seal a basement wall from the inside, either chemically (by impregnating the concrete with a chemical that reacts with certain components of the concrete causing a seal) or by applying a somewhat flexible membrane to the concrete surface. Neither of these products have been on the market long enough to verify the manufacturer's claims. They do, however, show promise.

Ultimately, when dealing with a basement water problem, the tried and true conventional methods working from the outside are still the most reliable.

Re-waterproofing the outside of a basement wall requires excavation to the full depth of the wall, careful cleaning of the wall surface and proper application of bituminous waterproofing. A multi-layered membrane system should be used if the surrounding water conditions are severe. At the same time, a perimeter drain system should be installed, similar to the recommendations noted above for a new foundation. If there are cracks in a wall, the cracks should be chipped out to form a V-groove along the length of the crack approximately one inch deep. The V-groove should then be sealed with a good quality epoxy or silicone caulking, filled with mortar and covered with bituminous waterproofing.

An effective, but sometimes expensive alternative, is epoxy injection into the crack. This can be done from the inside. The epoxy bonds with the concrete and creates a somewhat permanent seal against water penetration. The limitations to this system are cost and effectiveness, depending on the size of the crack. The smaller the crack, the less likely it is that full penetration injection is possible. However, before undertaking expensive excavation around the outside of a foundation, you may want to get proposals from local epoxy companies to compare the cost and potential effectiveness.

Waterproofing that is claimed to be effective by injecting into the soil on the outside of the foundation is almost always unsuccessful. Any attempt at sealing the outside of a foundation by injecting any material through the soil is time proven to be unreliable.

Basement water is controllable but there is no easy answer. Only the more complex and sometimes expensive approaches are truly reliable.

Peaceful coexistence is sometimes an appropriate resolution to a basement water problem. While keeping water out of a basement may seem ideal, there are risks. Preventing water from entering an older stone or concrete block foundation can cause water to accumulate on the outside of the foundation walls increasing water pressure on the walls themselves. The result can and has been total failure of the foundation wall. Where the construction of the foundation wall is marginal or questionable, the better approach to water control is to permit the water to enter, collect it into an interior drainage system, guide it to a sump and pump it away. The peaceful coexistence approach.

POST AND BEAM . . . IS IT ALL THE SAME?

Post and beam construction is currently enjoying a surge in popularity. Why? It's attractive, with exposed timber framing; its historic roots suggest more care and craftsmanship than most forms of contemporary construction; and it's often promoted as a "low cost" housing alternative.

Just what is post and beam construction? Generically, a system of timber posts and beams are used to construct a frame (perhaps best visualized as a "skeleton") within a building. Some obvious examples of post and beam construction are old New England barns where the frame (skeleton) is easily visible within the structure.

Since the wall panels of a post and beam structure are non-bearing (that is, they don't support loads from above, the frame does that), a variety of wall materials can be used. One common, contemporary method is to use thick foam panels with sheathing on the outside and sheetrock on the inside. This "sandwich" is glued together and provides good insulation and relatively quick construction.

Common features in a post and beam frame include knee braces to provide lateral stability and various types of joinery to connect adjacent posts and beams.

Post and beam construction, however, is NOT ALL THE SAME!

Historically, posts and beams were joined using mortise and tenon joints (the members actually fit together, with wood pegs to hold them in place) or other joinery techniques (doweled, splined, dovetailed, etc.) consistent with the pride and workmanship of the time. Knee braces and other secondary framing members were similarly joined.

Today, while some post and beam systems still offer pre-fitted, carefully detailed joinery; others offer superficial post and beam construction, using square cut framing members (no joinery, just nailed) and false connectors to augment the appearance. Still others are building structurally unstable frames, claiming that the foam-core "sandwich" panels are adequate to provide the needed bracing and, thus, eliminating knee braces and other diagonal components.

So all post and beam construction is not the same!

If you're considering post and beam, or evaluating an existing post and beam home, ask the following questions:

1. Is it adequately braced?
2. Is the joinery superficial or of true quality?
3. What type of wood has been used in the frame?
4. Are there beveled edges and other quality detailing on the framing members?
5. Who supplied the framing components?
6. Who erected the frame?

As you discover the answers to these, and other, questions, you will begin to understand the important differences in post and beam construction.

BEARING WALLS

Although houses should be constructed so that every element serves an integral function that the house cannot survive without, they are not totally unchangeable. if that were the case, there would be no remodeling industry!

New owners mean new priorities for a home. The lifestyle of the owners that it was built for may be much different from the lifestyles of subsequent owners.

One of the most dramatic changes a home can take is the moving of walls. The easiest way to accomplish this is to rearrange or remove non-load bearing walls, also known as partitions.

Ultimately, almost any wall can be removed. But the removal of load- bearing walls is much more complicated and potentially more disastrous than removing partitions. Usually some sort of alternative support beam will have to be installed, and temporary support walls on either side of the load-bearing wall built to support the weight during the removal process.

A structural engineer can ascertain whether or not your redesign plan is sound. Any changes of this nature will require a building permit - the municipal building inspector will want to see drawings from a professional engineer before approval.

How can problems with a wall removal be determined in a house you are considering purchasing? One thing is to be more suspicious of interior cracking in a newer home. Other things to look for are:

- walls that run perpendicular to the joists often support the weight of those joists and walls below spliced or lapped (methods for joining two shorter joists to cover a longer span) joists are bearing.

- assume that all exterior walls are bearing walls, except in the case of walls in gabled ends, which are less likely to be bearing.

- in cases like small closets and hallways, some walls that run perpendicular to the joists may not be load-bearing.

- thin door jambs of 2" or less can indicate a non-bearing wall.

- the studs in a non-load bearing wall can be spaced 24 inches apart. Bearing walls have studs every 16" (with the exception of when 2x6's are used).

These kinds of hints offer guidelines to renovation possibilities. the only way to know for certain - important in this case - is to call in a professional who can go over renovation plans or suggest possibilities.

TRUSS LIFT

Do you have cracks in your home that seem to appear seasonally? Are these cracks located along the top of a wall that is located in the middle of the house? If your home was built within the last 10 to 20 years, it is possible that this cracking is the result of a phenomenon now referred to as Truss Lift.

Many homes in the last 10 to 20 years have been built using prefabricated trusses for the roof. These trusses are efficient, economical, and adequate as a roof framing system. However, they do have some unique characteristics that many home owners may not recognize.

A truss is typically supported on the ends only. Trusses are commonly constructed to span distances of 30 to 50 feet or more. This is a benefit since it allows greater flexibility with regard to interior walls, which are no longer required to specifically support the roof truss. Thus, your desire to move a wall can be satisfied more easily in a house with a truss roof system than one with a conventional roof framing system.

Trusses are made up of many small members in a triangular configuration (see sketch). These individual members are connected together, typically, with metal plates pressed onto the joints between the individual wood members.

Wood is affected by temperature and moisture changes. It expands and contracts. When the wood members of a truss are subject to variations of temperature and moisture, the resulting expansion or contraction can have a net effect on the entire truss that causes the truss, essentially, to life. Thus, at certain times of the year (typically following large changes in temperature and humidity) large cracks may appear between the wall and the truss.

This is predictable and, in fact, necessary for the truss to remain structurally healthy. Trying to restrict the movement in the truss can be counterproductive since it often cripples the proper performance of the truss itself.

Some installers of sheetrock (drywallers) have developed an effective method of dealing with truss lift. The sketch at the left shows the details. In essence, for the last few feet on either side of the wall, the ceiling drywall is attached to the wall, not to the truss. This allows the truss to move up and down while the drywall flexes to accommodate the movement. When properly done, no cracking need be expected.

An alternative is to attach trim to the ceiling, which extends down along the wall, but is not attached to the wall. In this way, when the truss moves, the trim slides up and down and no crack actually appears.

The most significant consequence of truss lift is the aesthetic impact of having large cracks open up along the top of a partition. Assuming trusses that were properly installed and designed, this condition has no other structural significance for the home.