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Information Paper No. 1
FOUNDATION FOOTING DESIGN

Yes, we design and stamp foundations. The pictures on these two pages are all from examples of our work. Before we enter into a contract to design your foundation, however, there are some ideas that may be useful to understand.

Unless anchored to competent bedrock, a foundation is at risk of shifting (up, down, or slideways). By "competent bedrock" we mean bedrock that is not fractured, and is not likely to degrade over time or lose its ability to remain a stable, durable base for your building. And not all bedrock is alike. As can be imagined, a granite base will have a greater strength in compression than will sandstone. However, the nice thing about competent bedrock is that we have well-known and accepted values for the compressive resistance for all types of rock.

Without available bedrock, the risks for heaving and/or cracking can be high. These risks are compounded in our latitude due to the potential presence of permafrost. Thus we are at risk from a double-whammy:

- With the absence of permafrost, conditions similar to southern Canada can prevail – except that the depths to which ground freezes are much greater in the North. We do not want water to get underneath or adjacent to our foundation, for if it freezes, water will expand 9%. This expansive pressure can heave your slab or bow in your basement walls. So the strategy is clearly to get rid of all water around your foundation by good drainage.
- With permafrost, you can be affected from both below and above. If frozen ground thaws, it loses that expansion volume it derived from the ice formation (and often things are made worse because the melted water itself will drain away), leaving a subsidence in your ground level. As the ground subsides, so may your foundation. And permafrost degrades by being warmed. For this reason, our strategy in permafrost conditions is to maintain the frozen soil at temperatures below freezing. This is normally done by elevating the building on cribs or piles, or by adding a lot of rigid insulation – so that heat from the building does not affect the frozen soil beneath. A product called a thermosyphon also can keep the sub-surface soil frozen.

If competent bedrock is not available, an engineer would be dealing with granular material upon which to rest the foundation (this material is generally referred to prosaically as "soil"). There are many types and densities of soil – each having different bearing capacities, with hard-packed angular gravel being the highest. Clay is to be avoided, because (regardless of its frozen state) some clays are very expansive, and many will act like a liquid when saturated with water. This paper is not the place to discuss soil properties at length, however. The point is that if an engineer is to design a foundation that he or she can say will not move, this implies that sub-surface conditions are very important to understand. Engineers generally do not take kindly to mysterious conditions.

Just as Structural Engineers rely on the services of other experts to give us safe parameters for such environmental loads as wind, snow, and seismic, for mystery conditions below the ground we need the input of a good Geotechnical Engineer to provide us with soil parameters at the exact site where we are building. And, since geology can be locally quite variable, relying on information from some relatively near-by site may be extremely risky for both the engineer and for the client.

No Structural Engineer in his or her right mind will stamp a foundation design without knowing the essential bearing parameters of the soil on which a building rests. The analogy would be a building that was designed for Florida being built in an area of Nova Scotia that is known for its heavy snows.

We have used the word "risk" several times in this article. For sub-surface conditions, the element of risk goes up right along with the level of sub-surface mystery. Yet it is axiomatic that demystification can be expensive. Structural and Geotechnical Engineers should not be engaged frivolously.

At times, however, there may be a way of reducing the cost to you by assuming a degree of risk yourself. Depending on the type of building, an inexpensive foundation may be adequate enough. Cold storage sheds, for example, can heave and flex without causing too much damage (perhaps a cracked window pane or some flooring and wallboard that buckles). It is often worthwhile asking if it makes sense to put the same effort into designing a foundation for a storage shed as there is to design the foundation for a home.

On the other hand, perhaps designing an extremely strong foundation may be an acceptable way of approaching unknown sub-surface conditions – if it means that a geotechnical site investigation is not required. If a client understands that a Structural Engineer cannot guarantee the foundation design without the input of a Geotechnical Engineer, perhaps a very thick reinforced concrete slab that is designed to withstand some pressure from both above and below would be a reasonable approach. In this way, we can provide good designs that will minimize the risk of heaving and related problems, but we cannot guarantee there will be no movement (in fact, there probably will be). As long as you understand this clearly, we can sometimes dispense with engaging a Geotechnical Engineer.

This all depends on the Authorities Having Jurisdiction (local building inspection departments for example) agreeing to this approach. They, too, must agree in advance that accepting a higher risk is reasonable, given the context.

We hope you have found this information useful. Look for our other foundation wall Information Paper No. 2, which may help to explain why some concrete walls are not the same as others.