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Retaining Wall Construction During Winter Months

One of the most notable concerns with the construction of any foundations in colder climates is the need to bury past frost depth. This is due to the effects of frost heaving. As water freezes, it expands by approximately 9% in volume. This expansion in volume has little effect in areas of soil where water is not pooled or collected in significant amounts. As those small pools of water freeze and expand, it forces the soil around it to move. With an expansive force of nearly 50,000 psi (345,000 kPa), ice can easily disturb shallow foundations. Therefore, different states and territories have differing minimum frost depths, dependent upon their individual climates. The figure below provides an example of average frost depth ranges across North America.

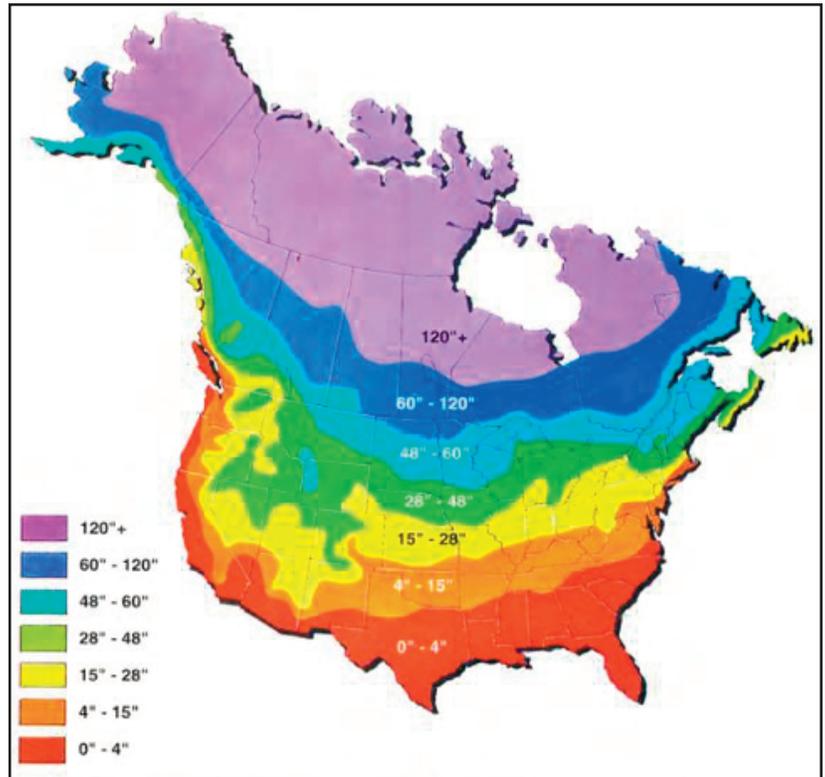


Figure 1: Generalized frost depth chart of North America dependent upon soil types

The values shown are the minimum depth in inches that a foundation must be buried to be past frost depth. This frost depth has to do with the geothermal energy of the earth. It is the point at which the water within the soil no longer begins to freeze, and therefore no longer begins to have an expansion effect on soils and foundations. In the construction of Segmental Retaining Walls (SRW's), there is no need to worry about frost depth. Retaining walls constructed with segmental or modular block units are designed to be able to move, eliminating the need to bury a foundation past frost depth. With the ability to almost completely ignore the effects of frost heave, it leads to the question of whether or not construction of SRW's can be continued year-round, through winter months. The simplified answer is yes.

Being able to continue projects during winter can add a large source of revenue to many contractors' companies. This can even be the difference between a good and a bad year for some businesses. However, there are many details to consider in constructing during winter months in colder

Retaining Wall Construction During Winter Months

climates. Just because the worry of frost heave is minimized due to the movability of SRW's does not mean it does not need to be considered at all.

As previously stated, frost heave is the movement of soils due to the expansion that occurs when the collected water within that soil freezes. Therefore, you must take actions to fight against the frost heave that has already begun to occur, depending on the types of soils you are dealing with, as different soils will have varying degrees of water retention. Should a wall foundation be constructed on already frozen ground, there is a large chance the wall will experience differential settlement as the soils below and around the wall begin to thaw with warmer weather. This alone can cause a wall to fail. There are two key factors to combat and prevent this differential settlement.

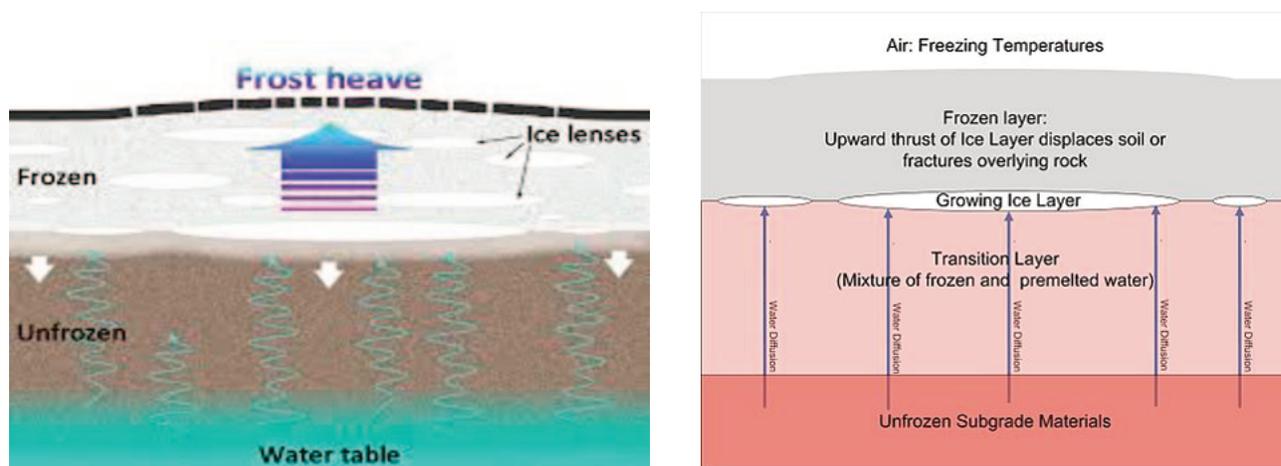


Figure 2: (Left) and **Figure 3** (Right): Frost heave within soils due to the expansive forces of pockets of water as freezing begins to occur

Preparation is key for any project, and even more so for winter construction. Therefore, Allan Block stresses the need for contractors and installers to work closely with an engineer to create a detailed, written plan prior to any construction. To eliminate the negative effects of any current frost expansion within the soils, heating of the soils is mandatory. This thawing of the soil will allow the contractor or installer to remove any poor soils. Should heating of the soils not be an option, then excavation to below frost depth and the replacement of poor soils with clean granular material is required. The allowance of poor soils, such as clay soils that retain moisture, will limit the capability of proper compaction, and will do little to combat differential settlement.

Proper compaction is important in all wall designs, regardless of the time of year or climate conditions. In winter, however, should an installer attempt compacting frozen soils, they will find it nearly impossible. As stated previously, water has an expansive force of nearly 50,000 psi (345,000 kPa). This is enough force to topple large scale buildings. A hand operated compaction machine will have difficulty with this force as well. Therefore, it is not recommended to use site soils for neither the in-

Retaining Wall Construction During Winter Months

TECH SHEET #620
PAGE 3

fill nor the retained soils. It is recommended to use wall rock (Section 1 Part 2.3) with less than 10% fines for backfill. The allowance of any percentage of clay or silty soils will begin to change the water retention attributes and characteristics of the material. The use of wall rock or similar granular material will limit these negative effects, allow for proper compaction, and increase the draining capacity of the wall.

As can be seen, the two major considerations for winter construction come in the forms of preparation and compaction. Whether it be heating the existing soils or excavating to below frost depth, preparation is key in winter construction. It may add an additional cost to the project but going without is likely to cause an even bigger expense in issues further along down the line. Without proper preparation, we cannot have proper compaction. It is important to limit the use of onsite soils during winter construction. Using wall rock for the entirety of the infill will limit any effects from ice heaves and differential settlement during installation and long after the wall is installed. Allan Block retaining walls are built to last and following these winter construction tips will help to ensure just that.

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