MEG Earth Energy System

Your interest in energy savings and environmental issues are best served with our focus on sustainable objectives and energy efficiency. MEG geothermal corporation's mission is to offer our customers a sustainable, clean and reliable source of energy for their commercial, residential and industrial requirements.

www.megenergy.ca
www.meggeothermal.ca

MEG Earth Energy System (EES) solution includes analysis of energy requirements, assessment of earth source energy supply, presentation of alternative solutions and implementation.
An Earth Energy System or a low grade geothermal system normally utilizes the earth energy at shallow depth of 2 to 100meters. This abundant source of energy is freely available everywhere and can be extracted fast and inexpensively. This supply of energy has no limitations and the usage is not metered. With today's technology there is enough geothermal available to meet everyone's needs for the next 5,000 years and beyond.


EES Heating & Air conditioning
Offices, North Vancouver

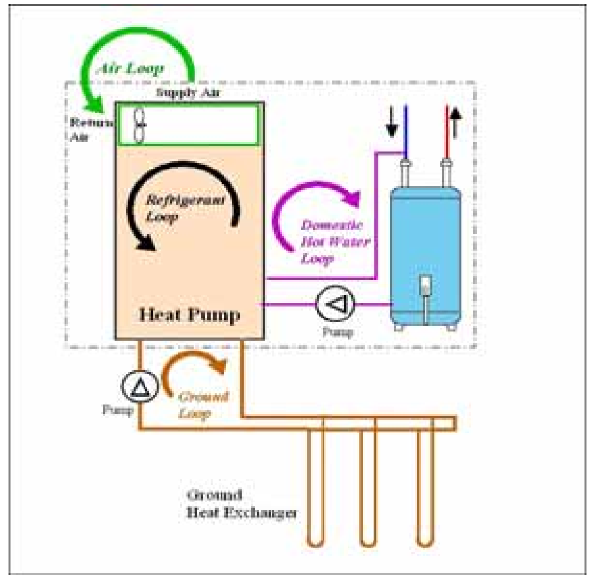
Earth Energy has been used in a highly elegant and durable style in some of the earliest civilizations. The ancient city of Yazd (circa 5000 BC) is a repository of many outstanding examples of EES coupled with wind towers. In this low grade geothermal system the cooling properties of earth (heat sink) were used as a natural air conditioning. The same concept was also used to keep winter ice till and during hot and long summers of desert.
Some of these wonderful structures are still standing in good condition.


Early Geothermal Structure
Yazd

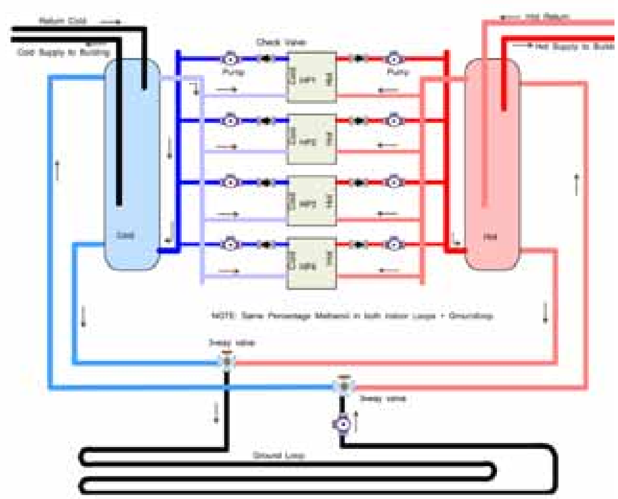
With today's technology EES are greatly advanced in design, manufacturing and installation techniques which allow application in wide spectrum of uses everywhere. EES provide heat by extracting it from the earth or a body of water and provide cooling by reversing this process. These systems are also called ground-source heat pump (GSHP or GHP).

What does EES offer?

In winter, Earth Energy System takes heat from the earth or a body of water and, elevates it to a level appropriate for building heating. In summer, this is reversed, and heat from a building is rejected to the ground or body of water for air conditioning. The same system can also provide supplemental hot water, for domestic uses.
EES provide benefits beyond heating and cooling. First, significant energy savings can be achieved through the use of these systems compared with other heating and cooling arrangements. This is due to use of a free and sustainable resource heat stored in the ground. Second, their maintenance costs are generally lower than those of conventional systems (there is no combustions and their very high efficiency results in low operating costs). Third, EES require less space than conventional systems. Only one small unit provides both heating and cooling. *In a large building*, where a conventional system would require baggy air ducts to transport heating and cooling from a central plant to the extremities of the building, a compact liquid loop can be used to transport heat between the ground and multiple, smaller heat pumps scattered around the building, just like boiler / tower HVAC system but with much higher efficiency. Fourth, EES capacity, or the maximum heating or cooling load that can be met by the system, is less affected by extreme heat or extreme cold than an air conditioner is. Heating and cooling plants are sized on the basis of their capacity in worst-case conditions, so a smaller ground-source heat pump can achieve a desired level of plant capacity. Fifth, the EES generally provides a more comfortable interior environment and better air quality than conventional heating and cooling systems. There are a number of reasons for this; the temperature of the air heated by an EES tends to be lower than that of a combustion system, and the volume of heated air higher. In addition, in cooling mode, better air quality results from increased removal of humidity. The cooling surfaces of an EES are often kept at a lower temperature than those of conventional air conditioners; more water vapor condenses on these colder surfaces, reducing humidity levels.
Furthermore, multiple, small heat pumps scattered around a large building permit the occupants of the area serviced by each heat pump to control their environment directly (heating and cooling on demand), rather than having to try to control the output of a central plant servicing the entire building.

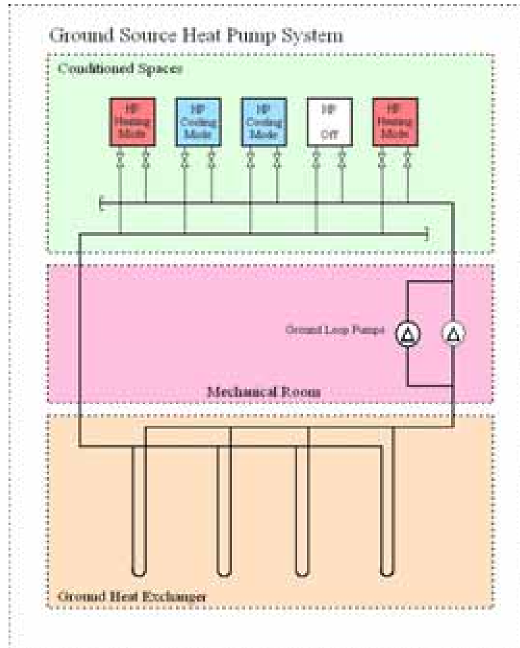


Simple Residential System



Hot / Cold on demand with Radiant Heat

A final advantage of these systems is reduced peak electricity consumption during summer time. Peak loads during the summer generally coincide with time of high cooling loads, so EES which are more efficient can lower peak electricity load charges levied on commercial or industrial buildings and can reduce strain on the electric network.



Components of EES

EES has three major components: the ground or surface water loops (GHX), the heat pump (HP) and the distribution system (DS).

GHX transfers heat into or out of the ground or body of water. This is a coil or pipe carrying water, antifreeze mixture, or another heat transfer fluid. It may be buried in the ground, in which case it is called a ground-coupled system, or submerged in a lake or pond, in which case it is called a surface water system. When the temperature of the fluid in the heat exchanger is higher than the temperature of the ground or water, heat flows out of the GHX and building cooling can be performed. When the temperature of the fluid in the heat exchanger is lower than its surroundings, heat flows into the GHX.

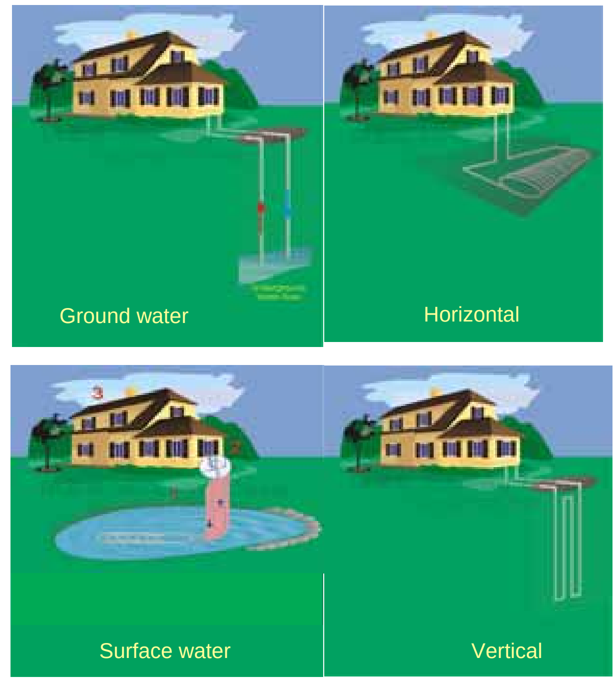
The second major component is a specially designed liquid-source heat pump. This is a device that uses compression and expansion of a refrigerant to drive heat flows between the inside of the building and the outdoor GHX. Naturally Heat will flow only from hotter to colder matter, but a HP will draw heat from the ground at, say, 5ºC and use it to warm a building at, say, 21ºC. The device "pumps" heat against its natural tendency, just like a water pump makes water flow uphill.

Distributed HP coupled with GHX

The third major component is the system for distributing heating and cooling inside the building. Typically heat pumps with short ductwork to distribute hot or cold air and to provide humidity control are used. However other methods such as hydro radiant, air displacement, high or low velocity fan coil and any combination can also be used.

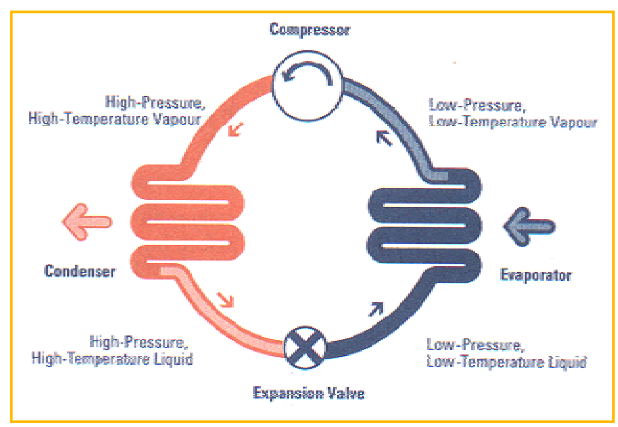
For larger commercial buildings there are usually multiple heat pumps (perhaps one for each zone) attached to the earth connection through a building loop. *This provides greater control of the conditions of each zone, and even heat exchange between zones. For example, sunny rooms can extract excess heat and redistribute it to cooler areas of the building.*

Types of GHX



The earth loops can take a number of different forms. There are two common configurations for GHX: the vertical and the horizontal earth loop configurations. In the vertical configuration, heat transfer occurs in a series of vertical boreholes drilled typically 60 to 150meters into the ground. The heat exchanger pipe runs down to the bottom of the hole and then back to the surface. Horizontal subsurface supply and return headers connect the boreholes in parallel. Once the pipe has been installed, the holes are back-filled and grouted. Grouting is the filling of the borehole with a special material that prevents surface water from contaminating groundwater and one aquifer from flowing into another.
In the horizontal earth loop configuration, the pipe is buried, usually at about 2 meters (6 feet) below the surface, in one or more horizontal trenches. In this case supply and return headers connect the trenches in parallel.

Liquid-Source Heat Pump



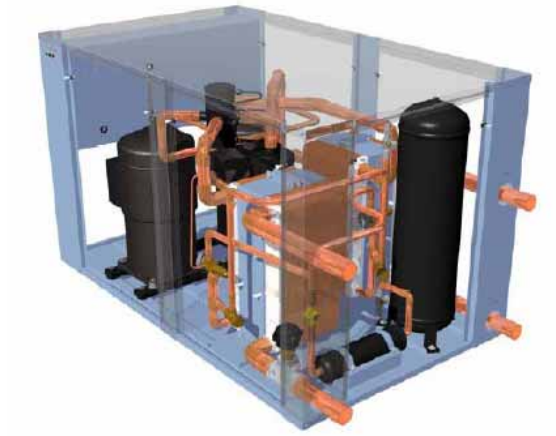
Natural Resources Canada

The liquid-source heat pump operates according to the same principle as a home refrigerator. In a heating mode, the heat from the GHX arrives at a heat exchanger, called the evaporator. On the other side of the heat exchanger is cold refrigerant in a mostly liquid state. The refrigerant is even colder than the temperature of the heat transfer fluid from the earth connection, so heat flows into the refrigerant. This heat causes the liquid refrigerant to evaporate; its temperature does not change much. This low pressure and low temperature gaseous refrigerant then passes into an electrically-driven compressor. This drastically raises the refrigerant's pressure and, as a consequence, its temperature. The high temperature, high pressure, gaseous output of the compressor is fed into a second heat exchanger, called the condenser. In most cases air to be heated is blown by a fan through this heat exchanger; in some systems, however, water or another heat transfer fluid will take the place of air for heat distribution. Since the refrigerant is hotter than the air or heat transfer fluid, it transfers heat to it. As it loses heat, the refrigerant's temperature drops somewhat and it condenses. This high temperature liquid refrigerant then passes through an expansion valve. The valve reduces the pressure of the refrigerant, and consequently, its temperature drops significantly.

This low temperature liquid is then fed into the evaporator, and the cycle continues. In this way, the heat from the water or other heat transfer fluid in the earth connection is transferred to the air in the building.

The heat pump requires electricity to run the compressor, fans, circulation pumps, and controls, *but the heating or cooling energy provided by the system is generally two to four times the electrical energy consumed. This 200 to 400% efficient* operation compares favorably with electrical resistance heating, which cannot exceed 100% efficiency, and reduces electricity consumption compared to conventional air conditioners up to 70% for heating and up to 50% for cooling.

When compared to even the most efficient gas technologies ground-source heat pumps can save significant quantities of energy. Natural Resources Canada



Liquid to liquid HP

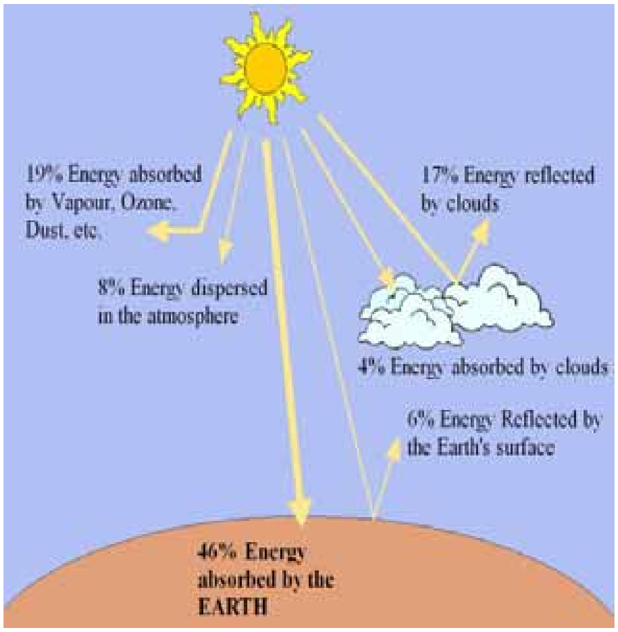
EES Resource, Ground Temperatures

The ground is the heat sink and source for an EES. But where does the heat that is extracted from the ground come from? And what happens to the heat that is rejected to the ground?

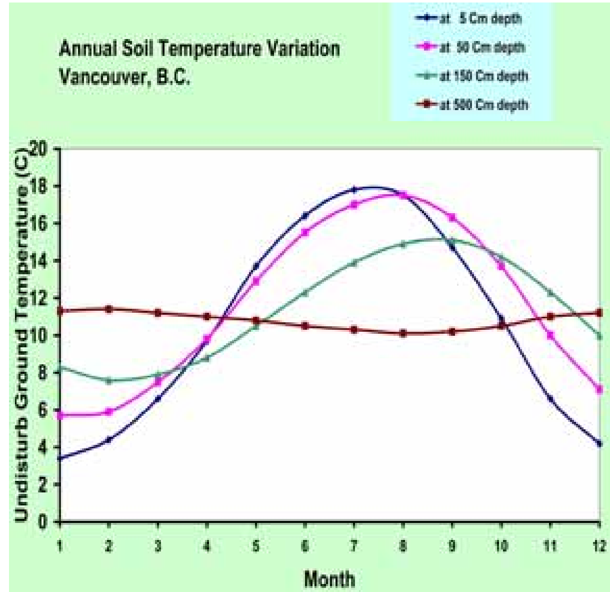
Ultimately, the heat extracted from the ground by an EES comes from either the heat stored from sun or from heat injected into the ground during the cooling season.

The ground absorbs about half of the solar radiation. The earth's crust stores this energy over long periods of time. In contrast, the heat coming from the core of the earth is not significant in shallow depth. The ground also loses a great deal of energy, for example, by radiating it to space and transferring it to the atmosphere.

A heat balance determines the temperature of the ground: it is the temperature at which all forms of losses match all forms of energy gains. At the surface, the gains and losses vary with the seasons: in winter the losses are higher and the gains lower than in summer. As a consequence, the surface temperature follows the air temperature. But below the surface, the ground stores energy, and reduces this variation. This dampening effect increases with greater depth, until, at a depth of about 5 m, the seasonal variation in ground temperature is negligible. Rather, the temperature will be at a constant level, somewhat above the annual average air temperature above ground. The actual difference between the annual average air temperature and the ground temperature will depend on such factors as climate, ground cover and vegetation, snow cover, slope, and soil properties.



This is illustrated in the diagram, showing ground temperature in Vancouver, BC, Canada, at four depths below the surface. Five centimeters below the surface, the ground reaches a minimum of about 3ºC during the winter months, and a maximum of about 18ºC in late summer. The amplitude of this cycle is less at 50cm below the surface, and is much lower at 150cm. The phase of the cycle of temperature variation shifts with depth, with increasing depth, ground temperature lags the moving average of air temperature more and more. *At about 5m below the surface, they are completely out of phase. At this depth the maximum ground temperature occurs during winter and the minimum during summer.* This is due to the long time required for heat to be transported through the ground.



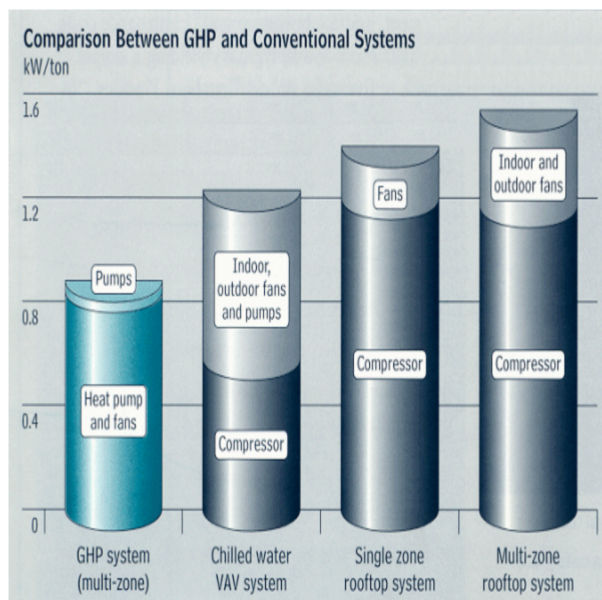
The ground's dampening effect on temperature variation is a key advantage of EES compared with conventional air conditioners. The efficiency and capacity of the systems are closely related to the difference in temperature between the inside of the building and the source or sink of heat. The smaller this difference, the more efficiently the heat pump can operate. *Because the ground temperature stays closer to the interior building temperature than does the outside air temperature, the ground source heat pump operates more efficiently than conventional air conditioners and its capacity varies less.* Natural Resources Canada

EES Costs

Earth Energy Systems are substantially less costly to operate compared to any conventional HVAC system. This is also valid for comparison with all kinds of systems whether it's using natural gas, coal, fossil fuels or electric heating.

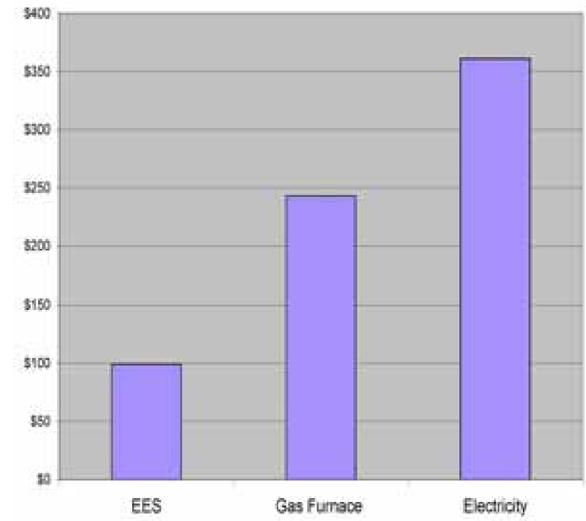
The operating costs of an EES professionally designed and installed are about 50-70% less for heating and about 35-50% less for cooling compared with any traditional HVAC. The equity pay back for initial costs in many cases is immediate and simple Pay back of a MEG system is estimated within 3 to 6 years depending on size of the structure and the application. *For larger structures the pay back may get shorter and possibly get to point of positive cash flow from day one.*

Life expectancy of a MEG geothermal HVAC is much longer than conventional systems. This is due to high quality materials, high efficiency and absence of combustion in the system. For GHX the life expectancy is over 50 years (based on manufacturer's published data).



US EPA

For space heating, *the U.S. Environmental Protection Agency (EPA)* has found that on a source fuel basis, accounting for all energy losses in power plant generation and utility grid transmission, GHP systems have 40% greater efficiency than air source heat pumps, nearly 50% greater efficiency than the best gas-fired furnaces, and 75% greater efficiency than oil-fired furnaces. Likewise, for space cooling, GHP systems are 30-50% more efficient than central chilled-water; variable-air-volume (VAV) systems or direct-expansion rooftop units. U.S. EPA

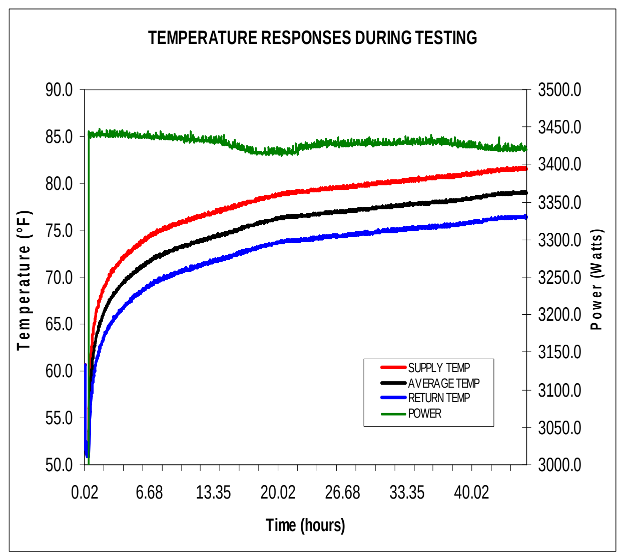


Capital costs of MEG geothermal systems coupled with suitable distribution arrangement are competitive in prices with conventional HVAC systems. This is partly due to continuous applied R&D on Earth Energy Systems that MEG pioneers.

In a new office building using a 193 kw MEG system, the equity pay back indicates to be immediate, using acceptable method of financial calculations. The simple pay back for the same is expected to be in 6 years and the operating savings are expected to reach $2.3 million within the life of the GHX. For this calculation we have used: inflation rate of 2.5% per annum, gas prices of 39¢ /cubic meter and electricity prices of 6.7¢ / KW/h. The savings of **GHG** reduction is not considered in this calculation.

Whenever the environmental tax credit takes effect, a substantial additional savings will be added. This system will be reducing **113 tco_2** per annum which equate to **45,900 litters** *of gasoline not being consumed per year*. Taking into account small foot print of MEG systems and considering today's technology for "Being Green" there is no competitions to what EES can offer.

A low grade geothermal system to meet goals of sustainability needs to be properly designed and professionally installed. Long term performances of GHX system is a major concern and should not be overlooked. MEG R&D engineers have studied characteristics of boreholes among others and have developed software and strict guidelines for design and installations of all components of an Earth Energy System.



MEG carries out Formation Thermal Conductivity (FTC) test with careful precision to assist professional design that considers long term performances and efficiency of a GHX system.

New FTC testing equipment was put together using field R&D, careful engineering and high quality precision components to deliver most accurate results for each and every test performed.

MEG dedicated team has also developed a specialized drilling rig for GHX purposes. This is a versatile, clean and reliable geothermal rig to carry-out borehole constructions without any sacrifice for design or efficiency.
Canada Drilling Corp is the flag of our drilling operation and the new rig is a first of its kind in the industry. It is utilized to efficiently construct boreholes that meet design requirements in different ground conditions.

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