MUDMAN

How to Cheaply Build a Foundation for Your New Home. Yes, A D-I-Y House Foundation can be Built Without Using Cement, Steel, or Heavy Equipment!

Yes, you can build your own affordable home foundation without paying a contractor.

Author's Note:

This article compares the 3 best foundation building options for the do-it-yourself home builder who is operating on a limited budget. The information presented here is primarily intended to be a practical reference text for homesteaders and people who have been displaced for a variety of reasons. However, constructing building foundations using the methods described here might be of interest to architects and home builders with money to spare because the methods discussed here place less strain on the environment. Aside from budgetary considerations and

conventional cement foundations.

At this time, there is small but rapidly growing number of low-capital "mom-and-pop" types of companies who would be willing and able to construct a building foundation using the gravel and old rubber tire method; however, most Old Rubber Tire and Gravel Bag foundations will still be made by owner-builders for the foreseeable future.

The report presented here also provides a bit of background and factual information about building Loose Rock/ Dry Stack types of foundations. The building process for Loose Rock/ Dry Stack types of building foundations can be contracted out more easily than Old Rubber Tire foundations, but there is still a limited number of people who specialize in making dry stack foundations, so this choice of building foundation is still best implemented by owner-builders.

As of now, no contractors are offering any options to install gravel bag foundations; however, if this method of constructing building a foundation continues to grow in popularity, then some people might begin to offer services where they arrive and install these types of foundations.

The information presented in this report is also potentially useful for aspiring entrepreneurs who see a business opportunity offering to build home foundations with one of the methods covered here.

I hope this article is interesting and informative to those who are considering building their own homes as well as building contractors and architects.

Cheers!

An Analysis of Different Earthen Building Foundation Methods

The Purpose Of This Comparison Report

focused. The foundation types discussed here are **Dry Stack / Loose Rock** foundations, **Gravel Bag** foundations, and **Old Rubber Tire** foundations. These types of foundations will be evaluated because they seem to be the most practical choices for people looking to construct building foundations themselves.

Introduction

When an owner-builder decides to begin constructing new home, obviously, the first steps are surveying of the land at the building location, then clearing and preparing the chosen spot for construction. After a building site has been selected, the first step after the surveying is complete is to remove the plants and brush from the building site, and there may also be a need to remove rocks and trash from the intended building site some to the time. After the brush and plants have been removed and the surveying work is complete, then the process of construction can begin in earnest.

The first really noticeable phase in the construction process of any new building is the process of laying the new building's foundation. Foundations are truly critical to the construction process of any new building because they are the thing that gives any building its basic stability over the coming years of use and occupation.

A solid foundation is vital to the health of any building because having a solid place to rest is necessary to prevent that building's walls from falling over or developing cracks. Having a good foundation will also keep a building's roof attached to the walls and free of leaks as the years pass. Having a good foundation is necessary for a building to last because it will prevent that building from getting destabilized after a time of prolonged wet weather. A solid foundation will also prevent a building from getting damaged and destabilized by a short but intense period of flooding. Additionally, a well-made foundation will allow a building to survive earthquakes and winter freezes without trouble.

Background:

Common Dangers to Building

#1. Flooding

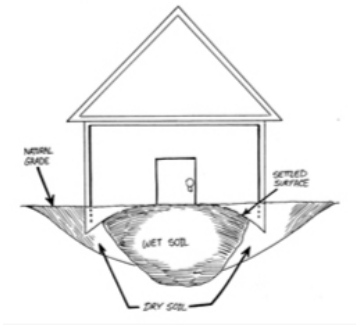
Flooding can take different forms. Sometimes flooding can take the form of a protracted period of rain that never allows the ground to dry, and this state of affairs creates soil conditions that where the ground is constantly wetted from continuous rainfall. Ground that is continually wetted from endless rainfall that eventually earns a pudding-like consistency which lends itself to building sliding down hillsides or having other foundation problems. Protracted periods of rain are also a threat to the structural integrity of buildings because extremely wet and puddling-like solid conditions create ground that is soft enough to make the weight of buildings push down on their foundations unevenly.

For traditional cement foundations, experiencing uneven loading is often disastrous because the long solid pieces of inflexible cement that constitute conventional concrete foundations crack if they are stressed unevenly. Uneven distribution of weight pushing down on traditional cement foundations often damages these types of foundations themselves, and having a conventional cement foundation that has been damaged by uneven weight distribution often leads to cracked walls and floors within the buildings that rest on top of damaged foundations. It is also common for the roofs of building that rest on damaged foundations to become detached from the rest of the building or severely damaged in some other manner.

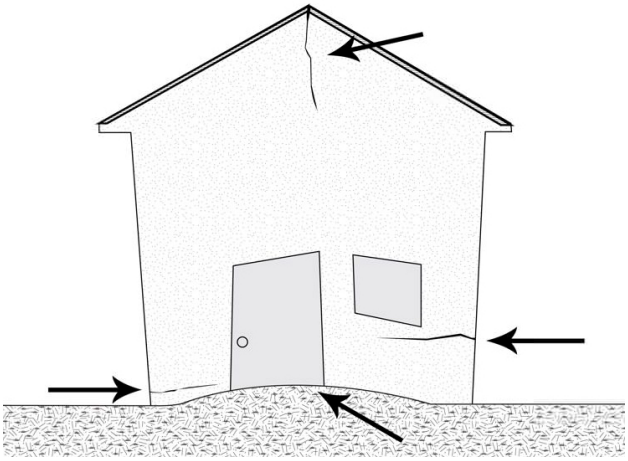
The image above shows a home in Tucson, Arizona that has taken damage from a recent bout of flooding. Damage to the conventional cement foundation pictured above is the result of an undermined foundation that has broken as a result of uneven weight distribution.

The damage seen above was not the result of fast moving water; but instead, the damage pictured above happened because the ground under the foundation softened as a result of a saturated water table that moved very close to the ground's surface and never permitted the ground to dry. The above illustration shows

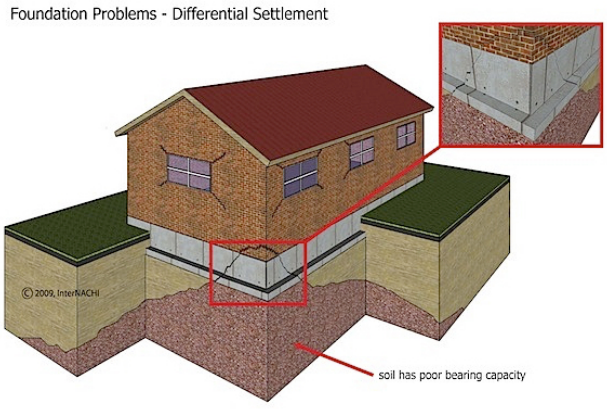
courtesy of ***tucsonfoundationrepair.com****)*



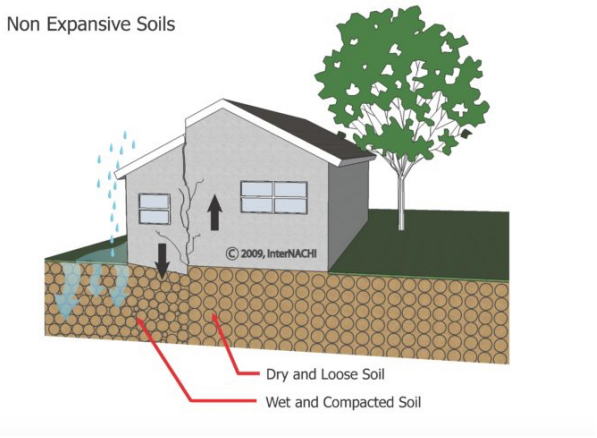
The illustration featured above shows how uneven soil moisture can create zones of uneven loading pressure. (Image courtesy of ***thefoundationrepairnetwork.com****)*



The illustration above is included to provide a visual reference for how water-saturated soil can create uneven loading on building foundations. In the illustration posted above, the ground directly under the home is less waterlogged than the soil on the periphery of the foundation, so in the scenario illustrated above, the soil on the edges of the foundation has less less load-bearing capacity than the soil under the home, and this state of affairs inevitably leads to uneven loading and foundation damage. (Image courtesy of ***american-waterworks.com****)*



The above illustration is included an an additional reference to illustrate how zones of uneven soil moisture can lead to uneven



The above illustration is included to show that very wet and waterlogged soil can develop a pudding-like consistency that compromises any ability to support the weight of a building that rests on this wet ground. (Illustration courtesy of ***brickkicker.com****)*

Having cracked walls and floors is a very real problem because this state of affairs can allow cold air and cold water to enter a flood-damaged building, and having large holes that allow cold air to enter definitely makes any type of building much less usable. In many places, heavy rains often arrive at the same times of the year as cold weather, and cold air entering a home because of foundation damage is a serious matter.

In California, and other regions of the planet with Mediterranean climates, heavy rains and flooding typically happen in the winter season, and although temperatures may not usually drop below the freezing point during a Mediterranean type of winter, the prevailing cold and damp conditions can easily cause deaths from hypothermia if precautions are not taken.

Hypothermia is simply the condition where a person's core body temperature drops below a point of safety, and damp wet conditions can lower a person's body temperature very effectively, even if no ice or snow is present. If a person is submerged in water, they will lose body heat 25 teams faster than they would in the air; therefore, any circumstances where people are exposed to wet and damp conditions is quite dangerous.

The human body typically maintains a temperature around 98.6 degrees Fahrenheit, so a person's body temperature can drop dangerously fast to fatally low levels if he or she is exposed to water or wet conditions accompanied by temperatures in the 30s and 40s, or even temperatures as high as the 50s on the Fahrenheit scale. According to the Mayo Clinic's website, potentially life threatening situations

having their body temperature lowered by just 5 degrees, and if exposure to wet conditions can wick the body heat from an unprotected person with shocking speed, then being wet in humid air with a temperature in the 50's is actually a potentially fatal set of circumstances.

Mark Twain once wrote that the coldest winter he ever spent was summer in San Francisco, and anyone who has attended enough San Francisco Giants baseball games during the summer will eventually see the fans in the stadium wearing heavy jackets and warm hats as the wind picks-up and the fog rolls in. As strange as it may sound, dangerous and potentially life-threatening cold can arrive in San Francisco even during the month of August, which is the truest month of summer in the Northern Hemisphere.

During the construction of the Golden Gate Bridge, several men froze to death on the job, and a few workers even froze to death during the summer months. The point is, temperatures do not have to be truly freezing to be deadly. Having broken walls can allow cold air to enter a building during a time of heavy rains; however, having damaged floors or a damaged roof can create an even more dangerous situation by allowing both cold air and cold water to enter into a building. A damaged floor can allow cold water to seep into a building from contact with water-saturated soil or by permitting water to enter a buildings from fast moving streams created by heavy rains.

Sometimes flooding is characterized by heavy rains that arrive over a very short period of time, and having a huge amount to water fall from the sky in a short period of time can quickly create shockingly large and rapidly flowing streams of water that can shift and relocate the dirt that supports building foundations. Flowing streams that remove dirt from under building foundations are actually a dangerous problem because they can quickly create uneven loading pressures across building foundations, and having uneven distributions of weight on building foundations typically leads to foundation damage, cracked walls, damaged floors, and roof problems.

The image above shows how a residential street can be transformed into a roaring river when a really heavy rainfall

*The image above shows a severely flooded city street on the island of Viti Luvu in the nation of Fiji. The above image shows a city street after the arrival of Cyclone Josie in 2018. Despite the massive amount of damage suffered by this storm, Josie was officially classified as only a category 1 cyclone. (Image courtesy of **looppng.com**)*

*The above photo shows a home in Boyd County, Kentucky with a section of its foundation that has been completely destroyed by heavy flooding. (Image courtesy of **uky.edu**)*

*The above illustration is included to show just how badly a building's foundation can be damaged when fast moving water arrives. The home seen in the above photo is in the process of getting its foundation repaired after taking massive damage from fast moving water that arose during a period of intense rainfall. (Image courtesy of **thespruce.com**)*

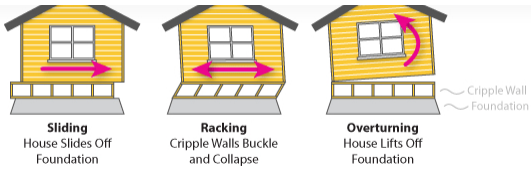
The photo posted above shows an apartment building in Istanbul, Turkey that had its foundation washed-out from a landslide induced by a prolonged period of rainfall. The building pictured above eventfully fell and broke into many pieces. The collapse happened on July 24, 2018. (Image courtesy of ***dailysabah.com****)*

#2. Earthquakes

Admittedly, earthquakes are more of a problem in certain parts of the world than others; however, earthquakes can happen absolutely anywhere, so it is always necessary to design and construct building foundations with earthquakes in mind. Countless millions of people around the world live in very earthquake-prone places, and the rim of the Pacific Ocean is one zone where untold millions of people live in areas that are very tectonically active. Some notable areas of intense earthquake risk and high population density in the Pacific Rim are Japan and California.

In addition to Japan and California, the West Coast of South America is also one of the Pacific Rim earthquake danger areas, and this region is particularly vulnerable to earthquake damage because of all the adobe brick building in use. Earthquakes have wreaked terrible havoc on the population of Peru over the years because estimates furnished by the *Built Construction Journal of India* indicate that around half of the population of Peru live and work in adobe brick homes that are neither designed by architects nor built by licensed construction companies. Sadly, the owner-constructed adobe buildings of Peru are typically not well prepared to withstand earthquakes.

One of the best ways to make any building more resistant to earthquake damage is to construct it with the best possible foundation. A solid foundation is a good defense against earthquake damage because any building that rests on a solid foundation will move less when the ground shakes, and a building that experiences less movement during an earthquake is less likely to have its walls or roof suffer



The above image shows three different ways that a building can take damage from an earthquake. (Image courtesy of ***earthquakesafety.com****)*

The image above shows a home in Los Angeles that has taken some pretty serious damage from an earthquake. Notice how the conventional cement foundation of the home in the above photo has been fractured by the earthquake's shaking. (Image courtesy of ***southlandretrofit.com****)*

Aside from the issue of constructing foundations that will prevent a building's walls from toppling or cracking when an earthquake strikes, building foundations should also be able to withstand the shaking of a strong earthquake without becoming damaged themselves. After every major earthquake, conventional cement foundations are damaged by the millions in some way or another, and having all of these damaged cement foundations in an area that has been ravaged by an earthquake inevitably means that billions of dollars in repair bills will be wracked-up over the coming years. Luckily, some types of foundations are pretty good at resisting damage from earthquakes, and fortunately, some types of foundations are also much easier to repair if they do suffer damage from an earthquake.

#3. Freezing

Admittedly, freezing is not a problem in every part of the world, but in places with colder winters both "**Heaping**" and "**Cracking**" can be a real problem for building foundations that have not been designed to properly withstand winter temperatures below the point where water freezes. The following information relating to building foundations getting damaged from heaping and cracking was provided courtesy of the website *concretenetwork.com*. Information pertaining to insulated foundations was also acquired at the same web site.

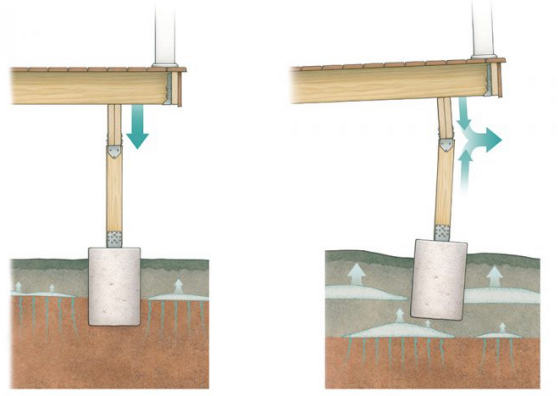
expansion of soil as it freezes causes the ground to expand upward in heap-like formations. Aside from developing heaps, waterlogged soil will also expand and develop wave-like formations as it freezes. Heaving typically happens when freezing soil has a moisture content of at least 80% along with a high silt content.

Around the world, building foundations typically rest below the official frost line for their locations because even soil in the coldest of places will maintain a temperature of around 55 degrees Fahrenheit when it is below the freezing zone.

Taking note of local frost lines is important when building a foundation because heaving typically happens at shallow depths. When constructing foundations in cold places, paying attention the the heaping process is important because heaping poses serious risks to the structural integrity of every type of building foundation. Heaving can damage any type of building because frozen ground that expands and forms heaps will exert pressure on building foundations in a horizontal or sideways manner.

Having portions of a foundation lifted by heaping can potentially damage any type of foundation because heaving can lift portions of foundations and potentially create points of uneven pressure distribution across an entire building's structure. Needless to say, it is not unusual for uneven pressure distributions on building foundations caused by heaving to result in severe damage across all parts of the structure, and these structural damages brought about from heaping can mandate all sorts of expensive repairs.

Aside form the possibility of having a building foundation lifted and loaded unevenly, frozen and expanding soil can also exert tremendous crushing pressure on building foundations. Slow but steady crushing pressure from the sides that is created by freezing and expanding ground is a threat to the structural integrity of a cement foundation because it can produce stress cracks if the foundation is poorly protected.



finehomebuilding.com)

"**Cracking**" is the process where water inside pieces of cement freezes and expands internally and this internal freezing then creates internal stresses that make cracks in pieces of cement. Both conventional Portland cement structures and sections of dried lime mortar are porous materials, and this means that water will saturate anything made of either of these substances through capillary action. The fact that both lime mortars and Portland cement can store water internally means that cracks can easily form inside these materials as internally trapped water freezes and expands during cold winter months.

The image above shows a conventional home foundation that has suffered damage due to having internal liquid water freeze solid and expand over many years of winter freezing cycles. (Image courtesy of ***kcpier.com****)*

Insulated Foundations

Insulated foundations offer cost savings and require less labor to build, and this is the case because insulated foundations are able to rest in trenches that are much shallower than those of conventional uninsulated foundations.

Insulated foundations can take 3 forms:

#1. Conventional cement foundations that are surrounded by polyurethane foam insulation.

#2. Old Rubber Tire foundations made from tired packed with pumice of some type.

#3. Gravel Bag foundations made from polypropylene bags filled with some type of pumice gravel.

The above image shows a conventional cement foundation that is protected by a thick layer of polyurethane foam insulation. (Image courtesy of ***hansenpolebuilding.com****)*

One reason that insulated foundations do not need to rest in trenches that are as deep as those of uninsulated foundations is because the insulation surrounding insulated foundations acts as cushioning against lateral pressure from heaping.

Insulated foundations are also able to resist heaping better than other types of foundations because they do not conduct or absorb cold to the same degree as single-piece cement foundations that lack insulation. Aside from insulated foundations offering a layer of cushioning and being poor conductors of temperature, having a layer of flexible material sounding that surrounds insulted foundations makes them much slower to drop to very cold temperatures, so they are less likely to be harmed by short but intense cold snaps. Insulated foundations are also able to keep frozen ground at bay because they are able to store heat and remain above the freezing point.

Insulated foundations are able to remain above the freezing point because they permit warmer temperatures from below the frost line to rise and remain trapped inside the material of that constitutes most of their mass. Insulated foundation are less vulnerable to taking damage from heaping because retaining and then releasing heat from below the frost line allows them to ward-off frozen and expanding ground by warming and thawing whatever water that is trapped inside whatever soil they are touching.

Foundation Depth Requirements

In places that experience truly extreme cold, such as, Siberia and most parts of Alaska, heaping is such a problem that many buildings do not rest directly on the ground itself; but instead, they sit on top of wooden stilts that are attached to small cement pier blocks resting above the ground line. Given the possibility that the ground will warp during times of very cold weather, different regions of the world have

Buildings around the world are typically expected to rest at least six inches below the calculated depth of the point where local soil will freeze. The colder the place; the deeper the foundation. For instance, as published on the website *decks.com*, the state of Florida has an official frost line depth of 1 inch, whereas the entire state of Minnesota has a minimum frost line depth requirement of 60 inches for all building foundations. In the northernmost parts of Minnesota, the laws governing foundation freezing depths demand that every building foundation rest a staggering 100 inches below the soil line. 100 inches amounts to around around 8-feet. A 8-foot trench for a home's foundation is deep indeed!

Why Conventional Cement Foundations Will Not Be Compared In This Report

Conventional poured-cement foundations will not be covered here for many reasons, but the first reason is because these types of foundations are typically expensive and not well-suited for those wishing to build the foundations of their construction projects themselves. The first factor that creates such high costs for building conventional cement foundations is the fact that hiring a contractor and possibly more than one set of subcontractors is not cheap. Hiring contractors to build conventional cement foundations is expensive for more than one reason, but one immediate reason that conventional cement foundations are expensive is because building these types of foundations requires paying several specialized teams of people to perform many hours of hard physical labor that also demands a certain amount of skill.

Aside from the labor costs, hiring contractors to install conventional building foundations is also costly because a contractor's crew will need to have access to expensive equipment. For example, one of the items of expensive equipment that a conventional cement foundation building contractor will often need is the large wood and steel molds that are set-up when pouring big slabs of cement. Aside from needing to have the molds and tools, the cement itself is relatively expensive. Buying the steel that is used to

Aside from simply being expensive to build, equipping new buildings with conventional cement foundations are not wonderful choices because these types of foundations are actually not all that great after the construction process is finished.

The above image shows a typical cement building foundation that is almost ready to receive its final filling of cement. In the final stages of the construction process liquid cement will be added to the molds that have been set in place in the photo above. The cement foundation under construction in the image above has a completed lattice of internal steel supporting bars the is ready for the final application of cement. (Image courtesy of ***123rf.com****)*

Conventional Cement Foundations are Not so Great Once the are Built

Many of the big problems associated with conventional cement foundations stem from the practice of builders internally reinforcing cement foundations with bars of cheap low-quality steel. Bars made from low-quality steel are imbedded in most conventional cement foundations in order to help strengthen the finished products. Ironically, information published at *theconstructor.org*, describes how the metal reinforcing bars that are so often embedded into poured concrete structures in order to lend them added strength will eventually chemically react with the surrounding cement and actually weaken the structures they are meant to strengthen.

Any concrete structure that has been reinforced with internal steel pieces will eventually suffer from structural problems because the chemicals that constitute the cement will react with the steel at some point and slowly dissolve the metal. Additionally, as the steel within a reinforced concrete structure slowly dissolves, the cement

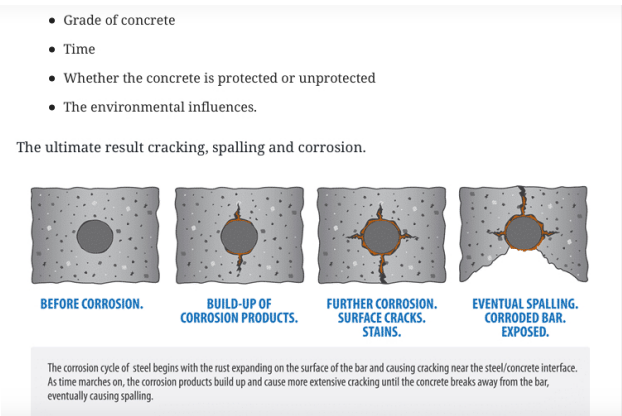
inside of concrete, estimates place the real working life of a steel-reinforced cement bridge at about 50 years, and after as little as 25 years many steel-reinforced poured concrete structures are already showing serious signs of internal structural degradation.

Aside from the problems caused by steel reacting with chemicals inside the surrounding Portland cement, any water that manages to find its way to whatever steel sits within a reinforced concrete structure will soon cause this steel rust. Water can find its way to the steel pieces inside a reinforced concrete structure by way of wicking its way through the cement by capillary action or by worming its way through cracks in the cement, and following the pathways made by deep cracks in cement structures will eventually lead water to the pieces of steel imbedded in the structure.

Whenever rust has occurred on an iron-based metal such as steel, each bit of this rust was originally 1/6th of its original steel volume when it was just steel; in other words, when rust forms it represents a 600% expansion in volume compared to the original volume of steel occupying the same space. Having any rust within a steel-reinforced concrete structure inevitably leads to structural problems because expanding rust creates slow but intense pressure, and the slow-moving by powerful internal pressures caused by rusting steel will eventually give brittle concrete masses stress fractures from within.

*The image above shows the steel inside of a concrete structure that has corroded due to water getting in to the concrete and causing the steel to oxidize. (Image courtesy of **civildigital.com**)*

*The image above shows a steel reinforced cement structure that is suffering from internal degradation and structural failure. (Image courtesy of **surtreat-info.weebly.com**)*



The above text and diagram are included to provide a visual reference for the degrading process of steel supports embedded within a cement structure. (Image courtesy of ***theconstructor.org****)*

Aside from the problem of having internal chemical reactions weakening steel-reinforced cement over time, any foundation built with concrete, or even lime mortar, is also prone to wicking water up from the soil. Both lime and Portland cement will transport water through capillary actions and act as a storage material for water because both materials are porous, somewhat like sponges.

Building contractors frequently have to repair damage to buildings that has resulted from water wicking-up through cracks in cement. Building contractors are also constantly repairing problems caused by water wicking-up through cement foundations and damaging whatever wooden wall components come into contact with cement foundations. Indeed, wooden structural pieces suffer damage where they come into contact with the tops of cement foundations, but earthen walls are also prone to suffering damage when they have direct contact with cement foundations that wick water upward from the soil.

Due to their water-wicking problems, cement and lime foundations need a layer of sealant to prevent moisture damage to other sections of the buildings sitting on top. Lastly, due to their stiffness and lack of flexibility, both conventional cement foundations and lime foundations also have problems resisting damage from earthquakes.

Problems with Big Cement Foundations

The video posted above shows a conventional Portland cement retaining wall of a large foundation pit that suffers a catastrophic structural failure after a period of intense rainfall. The video posted above is included to demonstrate that even very large cement foundations are still quite vulnerable to suffering catastrophic and rapid collapses due to Portland cement's hard but brittle nature.

*The image posted above is included to show that conventional cement building foundations can reach truly massive proportions, yet they still suffer from all the same basic drawbacks that plague cement foundations that support small buildings. (Image courtesy of **horizoneng.ca**)*

The Problem of Expensive Repairs for Conventional Cement Foundations

Conventional cement foundations are quite expensive to repair if they have been damaged by floods, freezing, or earthquakes. Many different methods of repair exist for

actually work quite well; however, repairing a conventional cement foundation is always expensive.

A typical repair job for a conventional cement foundation involves workers digging pits and trenches around the damaged portions of a foundation by using hand tools like jackhammers, shovels, and picks. After the pits needed to access the damaged parts of a conventional cement foundation have been dug, then the damaged portions of the foundation are leveled-off by using hydraulic jacks. During a cement foundation's repair process, after the foundation has been leveled by hydraulic jacks, then the next step is to prop-up the damaged sections of the foundation with specially-made pieces of Portland cement. The last step in the repair process for a conventional cement foundation is to fill-in the fixed sections of the foundation with final sealing covers of Portland cement.

The cost of repairing a damaged conventional cement foundation is so high that many foundation repair companies also offer financing and installment packages that allow their customers to pay back the cost of their services over a period of years. Despite their high cost, foundation repairs are often deemed necessary because homes that do not have their damaged foundation repaired can be legally prohibited from being sold and damaged foundations often make habitation tenuous regardless of legal issues. Additionally, any piece of commercial real estate that needs foundation repairs can easily find itself condemned by building inspectors, and getting condemned by building inspectors might result in a commercial property becoming legally unsellable or publicly prohibited from use of any type.

For many people who have a decent level of personal wealth, the prospect of having to finance their badly needed foundation repairs is not pleasant; however, it is typically not a situation that will ruin them financially. By contrast, homesteaders and people living on meager budgets are typically unable to afford expensive repairs to damaged conventional cement foundations, and this is yet another good reason why people without a lot of money might want to consider constructing foundations from one of the methods discussed here.

Countless companies across the world offer foundation repair services; however, the cost of repairing conventional cement foundations is never cheap. The phots above shows workers lifting and re-aligning a structurally compromised conventional cement foundation by using precision lifting tools.

Repairs to conventional cement foundations are pricey because fixing these types of foundations requires expensive specialized tools and some measure of expertise. People who want to get into the foundation repair business must also obtain the proper licensing and insurance, and they must also be legally bondable. Given all of the requirements needed to get into the business of repairing conventional cement foundations, it is no surprise that customers are hit with big expenses. (Image courtesy of ***carolinafoundationrepair.com****)*

One way to repair a damaged cement foundation is to use hydraulic jacks to level the broken foundation, then to use specially designed pieces of Portland cement to prop-up the foundation, and the last part of the repair process is to pour a new layer of cement around the supporting blocks of Portland cement in order to seal the repaired area. The method of repairing a damaged conventional cement foundation that consists of lifting the damaged sections of the foundation, then propping the lifted sections in place with blocks of cement, and finally sealing the repaired areas with cement works quite well, but it is expensive, labor-intensive, and time consuming. (Image courtesy of ***worldfoundationrepair.net****)*

The image above shows a conventional cement foundation with a damaged corner that has been leveled and propped-up by pieces of specially made Portland cement. The hole in the ground where this cement home foundation's corner has been leveled and propped-up is now almost ready to receive its final layer of cement back filling. (Image courtesy of ***houselevleingandslabfoundationrepair.com****)*

The above phots shows a stack of Portland cement pair blocks that will be used to support foundations after they have been leveled with hydraulic jacks. (Image courtesy of ***foundationrepair.net****)*

The video posted above shows some of the methods used to repair conventional cement foundations. Yes, indeed, many

A Word about Traditional Lime Mortar Foundations

Prior to the wide-spread adoption of Portland cement as a building material, lime mortar was used to bind bricks and rocks together. Lime mortar has been made since ancient times, and this building material predates the Roman Empire. Aside from having ancient origins in Europe, variations of lime mortar has been used for millennia in countless parts of the world.

Lime mortar is made by heating limestone rocks or crushed seashells in kilns or by heating crushed seashells or limestone pieces on open fires. Once the seashells or limestone pieces that are used as the primary ingredient in lime mortar have been properly cooked, the finished mixture called "Quicklime" is obtained. Quicklime is then slaked in water for at least 3 months before it is used as a binding mortar for rocks or bricks. A more detailed description of the lime production process is available in **another article** (http://mudman.blog/2017/05/03/making-adobe-earthquake-resistant/) posted on Mudman.blog.

Until the 20th century, most homes rested on foundations made from local field stones bound together with a lime mortar of some type. Lime foundations offered the advantage of being somewhat water resistant, so these types of foundations permitted homes to have walk-in basements that sat below the frost line and stayed at least somewhat dry. Lime foundations were also popular in the past because they offered the advantage of being easy to make at the farm level.

Despite their convenience and their ability to prevent the passage of liquid water, lime and rock foundations are prone to wicking water over time, and this process of wicking water makes them vulnerable to cracking from cold weather. Another disadvantage associated with lime foundations is their tendency to degrade over time if the lime is wet. Although lime is more flexible than Portland cement, is is still not very flexible when compared to old rubber tires or gravel bag foundations, so it is also very prone to taking damage from earthquakes. Given their tendency to take damage from earthquakes, crack when

The above photo shows a traditional lime and rock foundation from a house built in the 19th century that is located in Victoria, British Colombia, Canada. (Image courtesy of ***tonytremblaystonemasonry.wordpress.com****)*

The above video shows the problems associated with traditional lime and rock foundations.

Why Rubble Trench Foundations Will Also Not be Compared in This Report

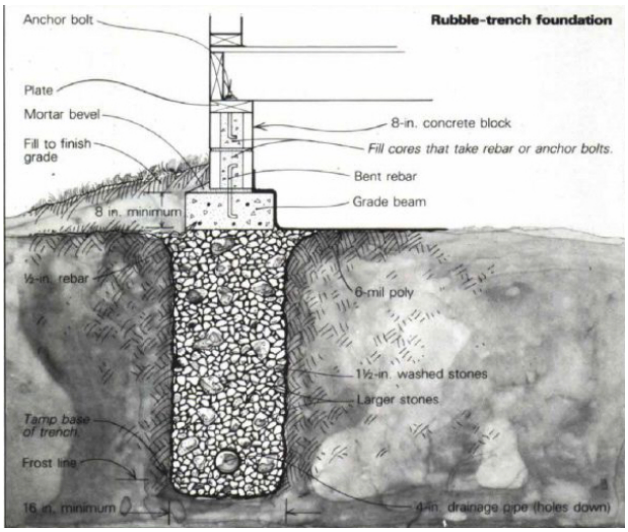
As mentioned by Quentin Wilson is his article about rubble trench foundations that was posted on *greenhomebuilding.com*, rubble trench foundations are popular with the natural building community despite their

are very cheap and easy to make. Despite being cheap and easy to make, rubble trench foundations are really not the best choice for building foundations because they are not very solid. Rubble trench foundations are not very solid because they are essentially just ditches in the ground filled with gavel, and these types of foundations offer no structural support if the walls of the ditches where they rest are ever compromised.

Although any type of man-made building foundation will fail if enough of the ground underneath is removed; none the less, a strong building foundation will continue to stand even after the side walls of its foundation trench have been washed out. Unlike other types of foundations, gravel trench foundations will fail if any section of their trench side walls have been washed out.

Rubble trench foundations are particularly prone to failing when a flood brings fast moving water because the side walls of the ditches that form these types of foundations are typically removed when water is flowing with any speed in the places they have been constructed. When the side walls of a rubble trench foundation have been washed-out, the gravel where the building rests will then spill-out into the empty space where the wall of the foundation ditch used to be, and this new stare of affairs will create an empty space where the building will have no supported at all.

Rubble trench foundations may have a long history of use in the Middle East and India, and they may be popular with people who are building their own homes at this time; however, their vulnerability to taking damage from flowing water makes them a rather poor overall choice. On account of their poor flooding resistance, rubble trench foundations will not be evaluated in this writing.



The illustration above is included to provide a basic visual representation of rubble trench foundations. (Image courtesy of

The photos above is included to provide a visual reference for how rubble trench foundations are made. (Image courtesy of ***endevourcentre.com****)*

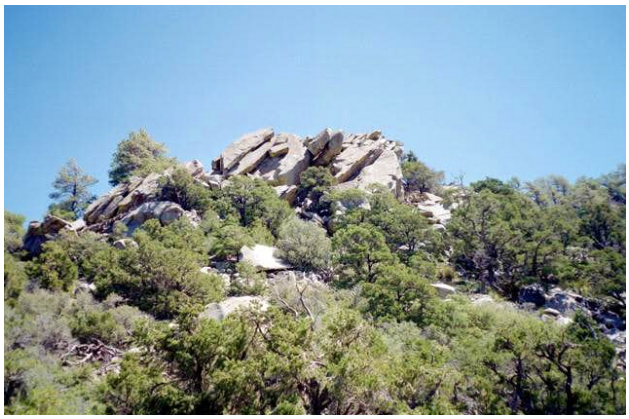
The photo above is a bit blurry; none the less, it is included because is shows how a rubble tench foundation looks during the construction process. (Image courtesy of ***trctimberworks.com****)*

The Best Types of Foundations

Natural rock outcroppings provide the best possible platforms for setting new buildings, so if a rock outcropping is available on a lot, a plot of rural land, or on some portion of a an intended building site, then any portion of that rock outcropping that can be used to support a building should be used.

Raised rock outcroppings are not always available at building sites; however, when they are present, they provide the best possible resistance against earthquakes, freezing, and flooding.

have a building get damaged by flooding if it rests on top of a relatively high natural rock outcropping.



The image above shows a rock outcropping at an unknown location. The image above is posted to provide a reference for how rock outcroppings often look. (Image courtesy of ***summitpost.org****)*

The image above shows a rock outcropping located on a private lot for sale in the state of Idaho. (Image courtesy of ***pinterest.com****)*

The image above shows rock outcroppings on a lot for sale outside of Missoula, Montana. (Image courtesy of

The image above shows a prefabricated home that is mounted on a large natural rock outcropping as opposed to resting on a man-made foundation. The home pictured above is located on a piece of rural land northwest of Sydney, Australia. (Image courtesy of ***dwell.com****)*

The photo above shows the Tula house in British Colombia, Canada. A photo of the Tula House is included because the this home is perched on top of a large rock outcropping of granite that provides the best possible resting place for a building. (Image courtesy of ***homedit.com****)*

The image above was take by the author in 2014. The above image shows a yoga studio at an eco-village and intentional community near the town of Pisac. Pisac is located in the Sacred Valley region of Peru, and the Sacred Valley is about one hour's drive north of the city of Cusco. ***Most*** *of the yoga studio pictured*

and walkway at the front of this small building are made from locally sourced dry-stacked rock and the front portions of this small building do not rest on the natural slab of rock at the base of the cliff; however, the back 3/4 of the yoga studio rest on a slab of natural granite.

The above photo shows another home outside of Pisac, Peru. This photo was also taken by the author. The adobe home pictured above was built on top of a natural rock outcropping. Not all of the home seen in the above photo rests on top of a rock outcropping; however, most of the house shown above rests on a patch of naturally occurring exposed granite.

Types of Man-Made Foundations Being Evaluated

Each type of foundation being evaluated in this report was chosen:

#1. Because it is inexpensive.

#2. Because it can be constructed without the help of a cement contractor.

#3. Because it will not wick moisture upwards like a cement or lime foundation.

In order to be discussed here, each of the types of foundations being evaluated also has to be capable of extending out of the ground at least 18 inches. All of the foundation types discussed here have to be able to protrude from the ground at least 18-inches because all walls made of earthen construction materials need at least 18-inches of clearance above the ground line in order to prevent water damage from flooding.

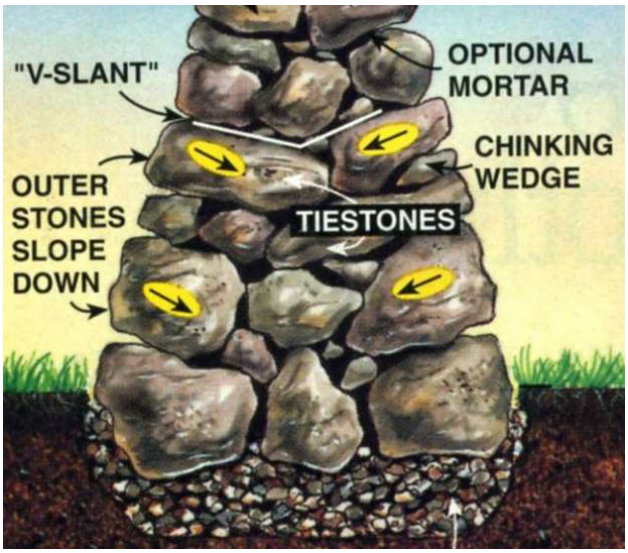
Stack Foundations

The Loose Rock or Dry Stack style of building foundation is made by stacking rocks without any type of mortar. This style of foundation has been a very popular means of supporting earthen and wooden buildings for thousands of years. A dry stack foundation works best if the rocks that form the foundation are stacked in wide piles and placed within a trench for additional stability. To achieve the same level of stability as a conventional cement building foundation, a typical wall of a dry-stacked stone foundation will have to be around 2 and a half (2.5) times wider than a conventional poured-cement foundation wall.

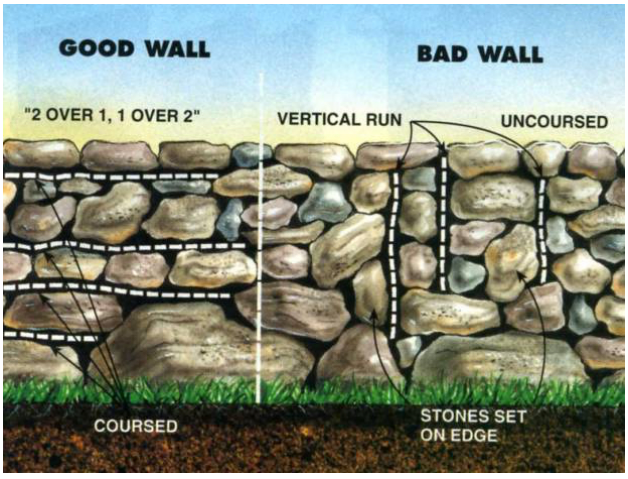
The dry stack method of foundation construction often uses wedge-shaped flat stones that are stacked with their slightly narrower sides facing inward towards the center of the wall. The stones that are used to construct dry stack foundations typically have one end that is slightly thicker than the other because if the outside edge is a bit thicker it will create a wall that has stones that are inclined to slip towards the center of the wall.

The practice of setting stones within a dry stack wall in such as way as to slide inward in the event of of an earthquake has been in use for millennia. Dry-stack foundation have also been traditionally built so that the rocks that make-up the walls will not only fall inward if shaken, they will also slide towards the center of the wall as the foundation settles over time.

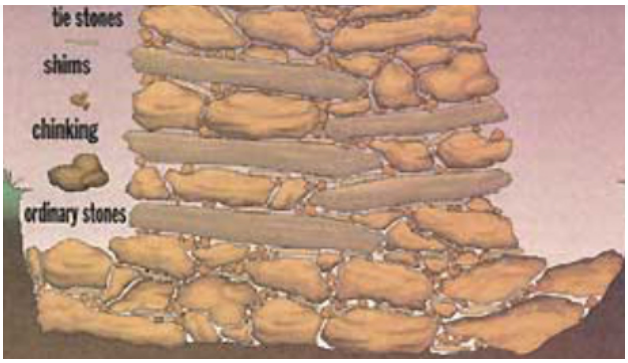
Another tried-and-true method of making dry-stack building foundations more resistant to earthquake damage is to fill the centers of the walls with as many small rocks as possible and then to seal the inner portions with a glue of tightly packed small grain gravel. The small rocks and the small grain gravel inside of a dry-stack rock wall are placed where they are in order to hold the inner portions of the wall together more firmly. Aside from using flat paving stones and round river stones as the rocks in a dry-stack foundation, quarried rocks of various sizes with flat edges and square corners can be used successfully to make dry-stacked stone walls and building foundations.



Although many dry-stack fences, and even retaining walls, are not built with stones that slant inward, it is always best practice to build a dry stack wall with stones that will fall towards the center when shaken by an earthquake. The above illustration is included to serve as a visual reference for how to stack the components of a dry stack wall so that they will fall inward when shaken or settle inward over time. It is also not a bad practice to fill small gaps in a dry-stack foundation wall with small stones and as much tightly packed small grain gravel as possible in odder to provide extra structural strength. (Image courtesy of ***bestlife52.com****)*



The above illustration is included to also show that the pieces of a good dry-stack building foundation should be set in orderly rows and the presence of vertical spaces should always be avoided when building dry stack walls. (Image also courtesy of ***bestlife52.com****)*



The above illustration shows how a dry stack wall should have its internal pieces arranges so that the entire structure is designed to settle inward over time or after being shaken by an earthquake. (Image courtesy of ***motherearthnews.com****)*

Many old buildings around the world have successfully used the loose stack type of foundation for many millennia; however, this practice has become far less common in recent centuries because lime mortars and Portland cement have become the material of convenience for constructing building foundations.

Not surprisingly, as the problems associated with conventional Portland cement structures and traditional lime foundations are becoming more well-know to contractors, architects, and home owners, people are beginning to re-examine the idea of supporting new buildings with old traditional loose-rock foundations. Kentucky, and the entire Appalachian Mountain region of North America has a long history of using dry rock to build entire buildings, in addition to constructing retaining walls, bridges, and the foundations of wooden buildings, and it is here in the Appalachian Mountains that the renaissance for dry stack building is most prominent. As of today, most of the new buildings that are constructed with loose rock foundations are in Kentucky, and most of the associations and training programs for loose rock building are located in the Appalachian Mountains.

Building a dry stack building foundation is essentially the same process as building dry stack retaining walls or fences, so the videos posted below are still useful, even if none of the videos posted below focus on building dry stack building foundations.

Building retaining walls from dry stacked stones basically uses the same practices and materials as building foundations from dry stacked rocks.

Dry Stack Foundations Under Construction

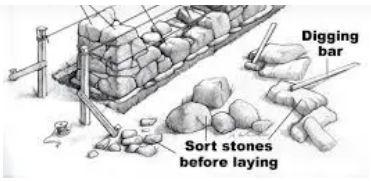
The image above shows a dry stack building foundation that is under construction. Adding some tightly-packed small grain gravel to the spaces wiring this wall would add extra structural strength. (Image courtesy of ***thiscobhouse.com****)*

*The above photo shows a dry stack foundation that is under construction. (Image courtesy of **rankinbrothers.ca**)*

*The above photograph of a dry stone foundation under construction is provided courtesy of The Stone Trust. (**stonetrust.org**)*

*The above image depicts another conventionally framed wooden home built with a dry-stacked stone foundation. (Photo courtesy of natural **homebuilding.org**)*

*The above photo depicts a loose stone building foundation under construction. The builder seen in this above photo is using flagstones that are intended for making patios and walkways to construct the foundation for a new addition to his home. (Photo courtesy of **borrowedground.com**)*



*The above illustration depicts established dry stone building techniques. (Photo provided courtesy of **Pinterest.com**)*

Examples Of Completed Dry Stack Foundations

*The above photograph depicts a dry stone foundation that is built into a hillside in Upstate New York. The above photograph is provided courtesy of The Drystone Conservancy. (**drystone.org**)*

*The photo above depicts a conventional wooden-framed home in New Hampshire that has been constructed with a loose stone foundation. (Photo courtesy of **nhhomemagazine.com**)*

*The above photo shows a cob wall with a dry rock foundation. (Photo provided courtesy of **Pinterest.com**)*

The image above shows a cob wall that is under construction built on top of a foundation of dry stacked rocks. The building pictured above is still under construction; however, construction of the dry stack foundation is complete. (Image courtesy of ***hapnlin.com****)*

The above image shows the Church of St. Esteban in New Mexico. The Church of St. Esteban is made of adobe and rests on a large foundation of dry-stacked stones. The outer edges of the church's foundation are covered with mud plaster, yet the foundation itself is made of local field stones. Dry-stacked local field stones are what supports this church, even if the natural local rocks are not always visible. (Image courtesy of Mike Nardacci. The image seen above was posted on ***altamontenterprise.com****)*

4 Valuable Rules to Follow when Building a Dry-Stack Foundation

layer, or course, of stone upon which the rest of the wall sits. The Foundation Stones are usually the largest stones in the wall, and may be partly or entirely below ground depending on the conditions in which the wall is being built.

First Lift: This refers to the lower portion of the wall, from the foundation to the level of the through stones. This includes the face stones, hearting and pinning. The first lift is made of larger stones than the second lift.

Through stones: These are stones that extend through the wall, connecting the two sides. They are typically set roughly every meter along the wall and are halfway up the height of wall. The purpose is to prevent the sides from separating and are absolutely crucial to building a sound wall structure.

Second Lift: This is the top half of the wall, between the through stones and the cope. Like the first lift the term is inclusive of the face stones, hearting, and pinning. The stones are typically smaller than those in the first lift.

Cope: These are the top stones on the wall. There are numerous styles used for copes, but they all basically serve the purpose of adding additional height and capping of the wall in a structurally sound manner.

Hearting: This is the small stones used to fill in the gaps between the face stones in the wall. Hearting is scaled, like the face stone. Larger hearting is used near the bottom of the wall and smaller pieces near the top.

Pinning: Pinning stones are used to hold the face stones in place. They are very similar to hearting and could be considered a part of the hearting. But pinning stones are specifically chosen and placed to wedge the face stones in place, where hearting stones are only roughly placed to fill in gaps.

Batter: Batter is the term used to describe the angle of the face of the wall. In other words the wall is narrower at the top than the bottom so the sides are angled inward. This angle is the batter.

Course: A course is the term used to describe a layer of face stones in the wall. Some walls are built without courses, which are referred to as random walls. In many walls however the stone is arranged into courses. The courses may be more or less rigid depending on the stone, walling style and the waller.

Face stones: Face stones are the stones that can be seen in the side of the wall. The face stone make up the majority of the volume and structure of the wall. They are sometimes referred to as 'wallstones'.

Face: The term face can refer to the wall collectively or to individual stones. In both cases it means the side(s) that can be seen. In other words the side of the wall is called the wall face. But, the side of a stone that is visible in the finished wall is called the face of the stone.

The above set of definitions is provided courtesy of ***thestonetrust.org***

1. Set the length of the stone into the wall:

This means that the end of each stone is the part visible in the final wall. In other words the length of each stone is perpendicular to the direction of the wall. Think of how firewood is stacked, with each piece perpendicular to the overall direction of the stack, so all you see are the ends of the pieces. A stone wall should be built the same way.

When stones are placed with the wall so that the sides are visible, it creates a much weaker wall and is called **tracing**. Tracing is one of the most common errors made, and is one of primary reasons walls fall down.

Setting the length into the wall. This view is looking down on a course in the wall. Correctly built is on the left. Incorrect 'tracing' is shown on the right

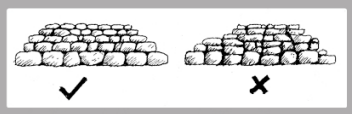
Image provided courtesy of ***thestonetrust.org***

2. Heart the Wall Tightly:

Gaps in the interior of the wall, between the face stones, should be tightly filled with small stones. The tighter the hearting, the stronger the wall. However fewer larger hearting stones are much stronger than many small little bits. Anything that can be easily shoveled is too small to use for hearting (and absolutely no concrete gravel or soil!). Hearting stones are much better if they are flat or angular. Rounded stones can act like ball bearings. Hearting stones should be placed individually, not randomly thrown in. Hearting takes place as the wall is being built, make sure each course is completely hearted before beginning the next course. Not properly hearting a wall allows stones to move independently of one another, resulting in a structurally weak wall that will not last.

Image provided courtesy of ***thestonetrust.org***

What should not be done is to stack stones so that there are vertical joints running from one course to the next. Such joints are called Running Joints or Stack Bonds. Walls with running joints are very weak and look poor. The image to the left is looking at the face of a wall.

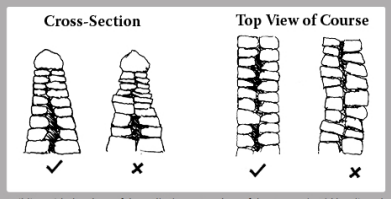


Correct coursing of joints on the left. Incorrect on the right, resulting in many running joints.

Image provided courtesy of ***thestonetrust.org***

5. Build With the Plane of the Wall:

This means to align the stones so that there is an even plane to the faces of the wall. String lines are especially useful to keeping an even plane to the wall. The outer most 'bump' of each stone is what should be in-line. By doing this the wall will look smooth and even. This applies both in cross section and in each course as the images below show. It is easy to get out of plane by building with the face of the stones below rather than following guide strings and always lining up the outer bumps of each stone.



Building with the plane of the wall. The outer edges of the stones should be aligned.

These are the basic rules of walling. If these rules are followed your walls should be strong and beautiful. There are also many more techniques that will make your wall even stronger, and features that can be incorporated for different purposes and situations. Come to one of our many workshops to learn how to build a stone wall for yourself!

Image provided courtesy of ***thestonetrust.org***

Safety Gear

Wearing the appropriate clothing and safety gear is important when walling. Steel-toed boots are very important. It does not take a very large rock to seriously crush a toe.

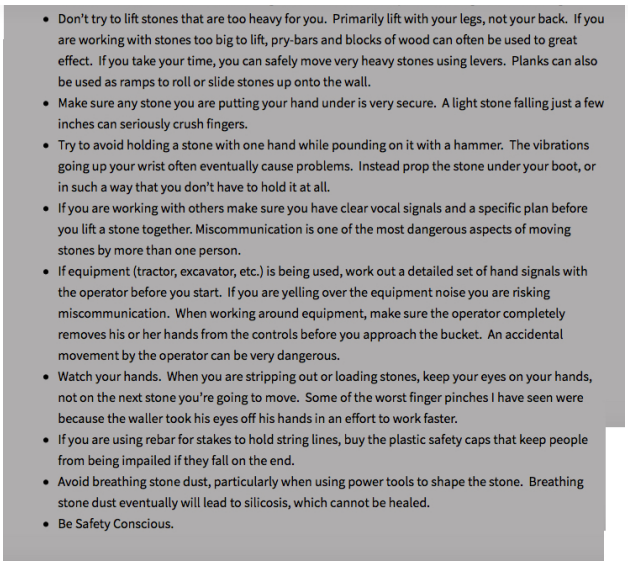
While some professional wallers prefer to work with bare hands, most people prefer to wear gloves. I find that the cloth covered gloves with the palm and fingers coated in rubber provide the best combination of protection and dexterity. Different weights are available for different temperatures. Leather gloves provide more protection, but limit dexterity. I do use insulated leather gloves in the winter to keep my hands warm. However, even the toughest leather gloves only last about for 50 hours when working with stone. Don't be tempted to use expensive builders' gloves (Iron Clad, etc.) as they only last about 1 day before wearing out. One of the best sources for gloves and other safety gear is Galeton.

I always recommend wearing long pants and sleeves when working with stone. It saves me from numerous minor scrapes and abrasions. If you choose to wear shorts expect to get scraped up a bit. In hot temperatures I use clothing made from lightweight light-colored fabrics. I find that I stay surprisingly cool because my skin is shaded from the sun.

Eye protection is very important if you are doing any reshaping or cutting, and really should be worn continuously. Invest in a comfortable pair of safety glasses so you're not tempted to take them off. You only have two eyes, and you want to keep it that way. If you are using any power tools (drills, saws, etc.) be sure to where ear and eye protection along with anything else instructed by the manufacturer.

Breathing stone dust, particularly the fine dust from running dry power saws should be avoided. While limestone based dust is not directly harmful, silica dust is. Granite, and related stones, along with Portland cement is very high in silica so it is important to avoid exposure. If you have to dry-cut stone wear a respirator.

Image provided courtesy of ***thestonetrust.org***



- Don't try to lift stones that are too heavy for you. Primarily lift with your legs, not your back. If you are working with stones too big to lift, pry-bars and blocks of wood can often be used to great effect. If you take your time, you can safely move very heavy stones using levers. Planks can also be used as ramps to roll or slide stones up onto the wall.
- Make sure any stone you are putting your hand under is very secure. A light stone falling just a few inches can seriously crush fingers.
- Try to avoid holding a stone with one hand while pounding on it with a hammer. The vibrations going up your wrist often eventually cause problems. Instead prop the stone under your boot, or in such a way that you don't have to hold it at all.
- If you are working with others make sure you have clear vocal signals and a specific plan before you lift a stone together. Miscommunication is one of the most dangerous aspects of moving stones by more than one person.
- If equipment (tractor, excavator, etc.) is being used, work out a detailed set of hand signals with the operator before you start. If you are yelling over the equipment noise you are risking miscommunication. When working around equipment, make sure the operator completely removes his or her hands from the controls before you approach the bucket. An accidental movement by the operator can be very dangerous.
- Watch your hands. When you are stripping out or loading stones, keep your eyes on your hands, not on the next stone you're going to move. Some of the worst finger pinches I have seen were because the waller took his eyes off his hands in an effort to work faster.
- If you are using rebar for stakes to hold string lines, buy the plastic safety caps that keep people from being impailed if they fall on the end.
- Avoid breathing stone dust, particularly when using power tools to shape the stone. Breathing stone dust eventually will lead to silicosis, which cannot be healed.
- Be Safety Conscious.

Image provided courtesy of ***thestonetrust.org***

#2. Old Rubber Tire Foundations

The Old Rubber Tire type of building foundation is made by filling a trench with layers of old tires. As each layer of tires is placed, each tire is then individually filled with very tightly compacted gravel of one type or another. At this time, the practice of using old rubber tires packed with gravel as a raw material for constructing foundations for buildings is still a relatively new and novel idea for most people, so this way of building home foundations has still not gained any mainstream acceptance at this time; however, awareness of this technique is spreading quickly.

The entire concept of constructing building foundations from gravel and old tires is less than a decade old; therefore, this way of constructing foundations for new buildings is still not widely practiced. Despite this method's lack of public awareness, a small number of non-profit organizations are focused on building homes for very poor people living in very poor countries have used this method extensively, and they have developed considerable expertise in this area.

An example of one such non-profit organization that has embraced the Old Rubber Tire style of making building foundations is ***Abundant Edge***. In America and Europe there is now a small number of tiny "Green" construction companies who offer consumers the possibility paying someone to construct a cheap Old Rubber Tire foundation to support additions that are being grafted onto existing

One cottage industry rubber tire foundation building company located in the United States is ***Les Virgen Bases***. Companies willing to build Old Rubber Tire foundations are likely to see their numbers increase in the coming years because all that is required to get started in the rubber tire foundation building business is a pickup truck, a few simple tools, and a small collection of people willing to put in some hard work.

Life in the Fast Lane for Old Rubber Tire Foundations

The faster way to build a foundation by using gravel and old rubber tires is to have a supply of old rubber tires that have one tire wall removed. Building a foundation with tires that only have a tire wall on one side simply involves placing the tire-walled side of each tire facing downward and then just filling and packing each tire from the top.

Fortunately, building any structure from old tires that only have one tire wall still creates structures that are extremely strong, long-lasting, and resistant to earthquakes. Having to simply fill individual tires from one side and not having to worry about packing gravel under the lip of the tire wall on the top side of each tire makes the whole process of building any structure from old rubber tired packed with gravel much faster and less labor-intensive.

Note: Always leave at least 1-2 inches or 3-5 centimeters of a tire wall when trimming for a foundation component! Totally removing a tire wall may make the tire a bit easier to fill, but it will diminish the tires strength a bit too much.

removing the side walls form large tires may be a bit more difficult.

The solution to the problem of removing just one tire wall from a larger old rubber tire is to use a high pressure water-jet cutting machine to remove one tire wall from each old tire. High pressure water-jet cutting machines simply cut whatever material they need to cut be using a jet of water that has been compressed to very high levels; such as, having a jet of water that has been compressed to between 30,000 and 90,000 pounds per square inch. Most industrial water-jet cutting machines also use water that contains some type of industrial grit like very small diamonds. Industrial grit is added to the water used in water-jet cutting machines in order to add an extra level of cutting efficiency; however, adding grit to the water used in a water-jet cutter greatly reduces the working life of the water-jet machines's cutting stream nozzle and using grit-saturated water for cutting generally increased the costs of equipment maintenance.

Water jet cutting machines vary in price, but a brand new unit typically costs around 100,000 USD, so it would not be unreasonable for a building contractor or institution to spend the money needed to buy a water-jet cutting machine in order to prepare old rubber tires for applications in building foundations; however, buying an industrial water jet cutting machine is probably not a great investment for a one-time home builder or any group of people operating on a tight budget.

Regrettably, at this time there are not really any water-jet cutting machines that can be rented to strip tires of their side walls so that they will be better-suited for for making building foundations. Yes, it is possible to contract-out the tire trimming work, but it will not be cheap, and it way involve a fair amount of shipping and waiting. Unfortunately, most people who are working on a limited budget will mostly likely have to build their Old Rubber Tire foundations from tires that have not been modified by and cutting process.

The above video shows a water-jet cutting machine trimming an old rubber tire for use in different applications.

The image above shows how to begin trimming the top wall of an old rubber tire. (Image courtesy of ***instructables.com****)*

***instructables.com**)*

The process of removing just one tire wall from each old tire opens-up countless possibilities for using many old rubber tires as a large-scale replacement for cement. The image above is admittedly not of the best quality; however, it is included because it shows an experimental roadway that is being made from old rubber tires that have had one tire wall removed and then packed with gravel. The tires seen in the above photo still have their tire walls on their bottom sides, but they have open tops that are easy to fill with gravel and then to compact. Thus far, experiments with roadways made from old rubber tire and gravel have yielded unexpectedly positive results, it seems that a large-scale, cheap, eco-friendly, and practical replacement for roads paved with cement and asphalt has been discovered.

*Roadways made from old rubber tires that have been filled with gravel have better drainage than conventional cement and asphalt roads, and gravel and old rubber tire roads also last longer under wear and tear. Besides just lasting longer, roads made from old rubber tires and gravel are cheaper to repair when the need arises. (Image courtesy of **mysanantonio.com**)*

*The above photo shows the construct process of a section of road made from repurposed old rubber tires. (Image courtesy of **weibold.com**)*

Fashion Way

The above video shows how an untrimmed rubber tire is packed in order to be used a part of a building foundation.

Under Construction

*Photo above shows a tire and gravel foundation in Kenya that is almost ready for the next phase of building construction; namely, building the structure of the building that will rest on the platform of old rubber tires. (This photograph was sourced from **abundantedge.com**)*

*The photo above depicts an Old Rubber Tire foundation being built to support a conventional wooden-framed home. (This photo was furnished from: **lesvirgensbases.org)***

*The above photo shows a rubber tire house foundation this is under construction. (Photo courtesy of **lesvirgenbases.org**)*

The above photo shows a newly finished rubber tire and gravel foundation constructed on a slightly inclined building location in Ireland. (Photo courtesy of ***radharc.eile.wordpress.com****)*

The above photograph depicts an Old Rubber Tire foundation that is under construction in the United Kingdom. (Photograph sourced from:
sureline.org.uk*)*

The image above shows a new rubber tire foundation that is under construction in England. (Above photo courtesy of ***houseoflotti.co.uk****)*

The image above also shows another a rubber tire foundation that is under construction in England. (Above photo courtesy of ***houseoflotti.co.uk****)*

The above 2 photographs show the foundation of a new straw-bale church being built in South London, England, United Kingdom. The 2 photos posted above show a building

*The above photo is sourced courtesy of **The Earthship Academy**.*

*The image above shows a rubber tire foundation under construction in England. (Image courtesy of **coca-casa.org**)*

*The image above shows a set of gravel-packed rubber tires that have been set in line to become part of the foundation of a new building. (Image courtesy of **jeffrythenaturalbuilder.com**)*

*The image above shows a rubber tire foundation under construction in a suburban neighborhood in Russia. (Image courtesy of **forumhouse.ru**)*

Examples Of Completed Old Rubber Tire Foundations

*Rubber tires can make for decent foundations, even on hillsides. The image above shows an owner-built home in Lima, Peru that rests on stacks of gravel-filled tires that are a bit crooked, yet sturdy enough to keep the house well supported for decades to come. (Image courtesy of **bemethat.com**)*

*The image above shows a home-made greenhouse that rests on a foundation of old rubber tires. The greenhouse pictured above is located at an eco-village in rural Uruguay. (Image courtesy of **ecoexperienceuruguay.wordpress.com**)*

The image above shows an owner-built home constructed on a plot of unclaimed land in a peripheral part of Lima, Peru. The foundation pictured above incorporates dry-stacked stones as well as old rubber tires that have been filled with small rocks gathered from the vicinity. The tires used to support the home in the above photo may look a bit crooked, but they are in fact quite strong, and despite the somewhat rickety appearance of the wall in the above photo, this home is actually quite well supported. (Image courtesy of ***semanticscholar.com****)*

#3. Gravel Bag Foundations

Author's Note: Discussing building house foundations from bags of gravel was an afterthought at best; none the less, after watching a video on the **mylittlehomstead** Youtube channel I became intrigued with the concept of using gravel bags as a foundation building material. The mind-opening video about gravel bag foundations that I watched watched on YouTube showed the foundation of an earth bag house being made from polypropylene superadobe bags. After watching the YouTube video that shows a house foundation being made from polypropylene tubing, I decided that it would be worth discussing the possibility of making building foundations from polypropylene bags.

The above video introduced me to the idea of using polypropylene bags as a foundation building material.

About Gravel Bag Foundations

A third option exists for those who are looking to build foundations for their new homes quickly and cheaply, and this option is to mount a new building on top of polypropylene sacks that have been filled with gravel. The idea of using polypropylene bags as the main component in a building foundation comes from the practice of building with earth bags. People who have some expertise with earth bag construction have developed a technique for making the foundations of these buildings by using the same bags used to make the rest of the building, except they choose to fill the lowest rows of bags in the earth bag building with small rocks or gravel, as opposed to sand or dirt.

This method of building a foundation certainly has noticeable drawbacks and limitations; none the less, this way of building a foundation is still worth considering as an option for those who are looking to build their own home foundations. Building a new home that has a gravel bag foundation is worth considering because this method is **fast**, **cheap**, **simple,** and **requires little physical exertion**.

building that rests on layers of gravel-filled polypropylene sacks is betting its future on the integrity of the woven polypropylene bags themselves holding strong. In other words, when a gravel bag foundation is chosen as the foundation building option, then the entire integrity of a new building will rest on the strength and integrity of a few thin plastic membranes that constitute the skins of a few small vertical layers of plastic bags that have been stuffed with gravel.

A gravel bag foundation's most glaring weakness is its vulnerability to atmospheric degradation; however, there are ways to protect these precious polypropylene sacks from the ravages of Earth's atmosphere.

Construction

*The photo above is included to show what equipment and tools will be needed to construct a gravel bag foundation for a new building. (Photo courtesy of **instructables.com**)*

*The image above is a screen capture from a video posted on **Wikipedia.org**.*

*The above photo shows a group of men in Uganda setting a layer of gravel-filled bags in place that will eventually form the foundation for a new earth bag house. (Image courtesy of **earthbaguganda.blogspot.com**)*

The above image shows a thick polypropylene bag that has been filled with gravel and is now getting stitched shut before it is placed as a foundation component. (Image courtesy of ***instructables.com****)*

The image above shows a level being used to ensure that the layers of gravel bags constituting a foundation's second course have an even place to rest. (Image courtesy of ***instructables.com****)*

The image above is included to show how a first course of gravel bags should look after is has been properly checked for having a level top surface. The layer of gravel bags pictured above also has a layer of barbed wire applied to its top in order to help the next layer of bags stay in place. (Image courtesy of ***instructables.com****)*

The image posted above is included to show how a second layer of gravel-filled bags should be placed during the construction process of a gavel bag foundation. (Image courtesy of ***instructables.com****)*

The image above shows a gravel bag foundation under construction. This photos shows a a first layer of bags getting tamped-down and set in their final resting place. (The image above was sourced from ***ecoearthbag.blogspot.com.)***

The photo above shows children helping to fill polypropylene foundation bags with gravel. The bags seen in the above photo will constitute the foundation for a new school the children in this photo will attend when the final building process has been completed. The construction project shown in the photo posted above was furnished courtesy of Lakshyam NGO. Lakshyam NGO is a charity that does all sort of projects to help the most needy people in India. (Photo courtesy of ***thebeterindia.com****)*

The above photo shows volunteers filling foundation bags with gravel. (Image courtesy of ***thebeterindia.com****)*

In the above photo, 2 volunteers are filling a polypropylene sack with gravel. This gravel-filled bag in the above photo will soon become part of the foundation for a new school. (Image courtesy of ***thebetterindia.com****)*

*The photo posted above shows a gravel bag foundation nearing completion in New Deli, India. (This photo was also sourced from **thebetterindia.com.**)*

Examples Of Completed Gravel Bag Foundations

Author's Note: It is hard to find photos that really show any completed gravel bag foundations that have buildings resting on top.

The above photo shows a cob home under construction. Notice that the foundation of this new building is made from gravel bags.

Foundation Evaluation Criteria

Why Flooding Will not be Covered

For the 3 types of foundations being evaluated here, the criteria of flooding will not be covered because neither Old Rubber Tire foundations, Loose Rock/ Dry Stack foundations, nor Gravel Bag are not particularly vulnerable to being damaged by flooding. As mentioned earlier,

foundations and lime mortar foundations are also fairly vulnerable to suffering damage from flowing water during periods of flooding. In light of their vulnerability to suffering damage from flooding, neither rubble trench, conventional cement foundations, nor old lime and rock foundations will be analyzed in this comparison.

As mentioned by Quentin Wilson on *greenhomebuilding.com*, gravel trench foundations can easily get completely washed-out in the event of an intense moving water type of flooding situation, particularly if the gravel trench is set up on a hillside. Conventional cement filled trench-style foundations are also particularly venerable to being undermined in a flowing water type of flooding situation due to being made of inflexible material and often having very narrow bases.

According to *stonehendgemasonry.ca*, conventional Portland cement typically has over 4 times the structural strength as lime mortar, and having internal steel bars only adds to the overall strength of conventional cement foundations, so it is no surprise that these types of foundations are often built with somewhat narrow measurements. Narrow structural measurements may be fine for a conventional cement foundation's structural support characteristics; however, having narrow bases makes these types of foundations more vulnerable to taking damage from fast moving water that results from flooding.

Because of their wide bases, both Old Rubber Tire foundations and Loose Rock foundations will typically maintain their structural integrity, even when the walls of their foundational trenches are completely washed away. Gravel bag foundations will also maintain their support structures if the sides of the trenches are completely washed away; provided that they are also built with wide bottoms and tapering sides.

Loose Rock/Dry Stack foundations will have very little vulnerability to damage from flowing water if they are made sufficiently thick and placed at a decent level below the land grade of the building site they occupy. In parts of China and other places, there has been a very long tradition of people safely building homes and other buildings in known flood plane areas so long as the buildings had high and secure Loose Rock/Dry Stack foundations that would perch their buildings above projected flood water levels.

As Quentin Wilson mentioned, there is a long history of earthen buildings and also wooden buildings being safely constructed on top of ornamental ponds; so long as these buildings sat on top of good Loose Rock/ Dry Stack foundations. Loose Rock foundations are possibly the best

wick water up to the building above.

Another point to consider is the fact that practically any type of individual man-made building foundation can suffer some type of damage if the ground where is is resting is bulging or sagging due to differences in the water content of soil that rests several meters below the building. Uneven loading pressures will strain any type of building and whatever type of foundation it is resting upon, so it is hard to counter uneven loading if it is caused by conditions many meters below the surface of the ground.

Note: As mentioned previously, buildings that rest on fairly high natural rock outcroppings are practically invulnerable to receiving damage from flooding or from uneven loading caused by soil waterlogging; however, any type of man-made building foundation will take some type of damage if fast-moving streams created by heavy downpours arrive with enough volume and speed. Despite the building options presented here, no type of foundation made by people can truly withstand the most severe moving water in a flash-flooding type of situation. Additionally, if the ground under a foundation is completely washed-out, that part of a building will take some damage regardless of which material was chosen to make the building's foundation.

#1. The Cost of Buying Materials

This measure is included in order to determine how much it is likely to cost if a builder choose to buy the materials needed to build a foundation of this type.

Buying Dry Stack Rocks

Many landscaping supply companies sell rocks that are intended for building dry-stack retaining walls and fences. Dry-stack rocks are typically sold by the ton and offered in pallets.

*The image above who's a pallet of stones that are designated for building dry stack walls and foundations. The stones seen above are sold by ASAP Stone Supply of Austin, Texas. (Image courtesy of **asapstonesupply.com**)*

*The image above shows a pallet of medium-sized dry stack field stones gathered from the Tennessee countryside. (Image courtesy of **hippstone.com**)*

*The image above shows pallets of small dry stack stones at the Hipps Stone yard in North Carolina. (Image courtesy of **hippsstone.com**)*

Buying Bulk Gravel

*The image above shows all sorts of different types of landscaping gravel for sale at a bulk landscaping materials dealer in Reno, Nevada. (Image courtesy of **moananursury.com**)*

*The image above shows gravel for sale at a builder's supply yard in Indiana. (Image courtesy of **estesmaterials.com**)*

*The above image shows a gravel truck making a delivery at a chosen location. When gravel is purchased, many sellers offer free delivery services or charge a modest fee for gravel delivery. (Image courtesy of **shutterstock.com**)*

*Many gravel yards offer loading services for their customers. (Image courtesy of **hardscapematerials.com**)*

Buying Old Rubber Tires

Old rubber tires can often be found for free, but sometimes the convenience offered by paying a bit of money for the desired amount of tires that are all of the correct size is worth a bit of money. A few companies around the world offer old rubber tires for sale to the general public.

*The above image is a pile of tires for sale from Globarket. Globarket is a private company, not a governmental organization, and California-based Globarket is the largest handler and recycler of used scarp tires in North America. Globarket is a good source for any type of tires that might be used to make a new home foundation in North America. (Image courtesy of **globarket.com**)*

The image above shows some of the inventory for sale by Green Wave Traders of India. Both India and Pakistan have a rather large and well-developed used tire recycling industry. Companies in the old tire selling business in both India and Pakistan are more than happy to sell any type of used tire to customers anywhere in the world. The web site ***IndiaMart.com*** *has many listings for companies in India and Pakistan that sell used tires both domestically and internationally. (Image courtesy of* ***greenwavetraders.com****)*

Buying Polypropylene Bags

many home improvement stores sell durable polypropylene bags that are intended to be filled with dir and used as a flood control measure. Army surplus stores and many websites also sell a wide variety of polypropylene bags that are intended for flood control as well as military use. The military buys large numbers of polypropylene bags that are intended to be filled with sand, dirt, or gravel and used to make bunkers, foxholes, and trenches. Polypropylene bags suitable for use in gravel bag building foundations are generally not hard to find and do not cost very much.

Click image to open expanded view

Military Sand bags Deluxe Quality - 10 Sandbags, Polypropylene Empty Heavy Duty Green poly (10)

by Greenstar

63 customer reviews | 6 answered questions

Price: $12.99 FREE Shipping on orders over $25 shipped by Amazon or get Fast, Free Shipping with Amazon Prime & FREE Returns

Size: 10 bags

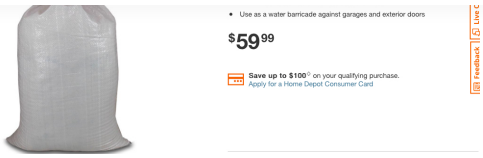
10 bags	20	50 bags	100 bags
$12.99	$25.99	$59.00	$117.00

- 14 x 26 inches - Hold Over 50 Pounds
- High Quality Polypropylene Green / Olive Drab Sand bags
- 1,600 to 2,000 hours of UV (6 to 9 months)
- Strong Drawstring Closure. These sandbags is the most strong you can buy
- FAST SHIPPING - Priority mail 2 business day shipping. These flood sand bags can be used everywhere you need. It can be used for flooding also

› See more product details

New (1) from $12.99 & FREE shipping on orders over $25.00. Details

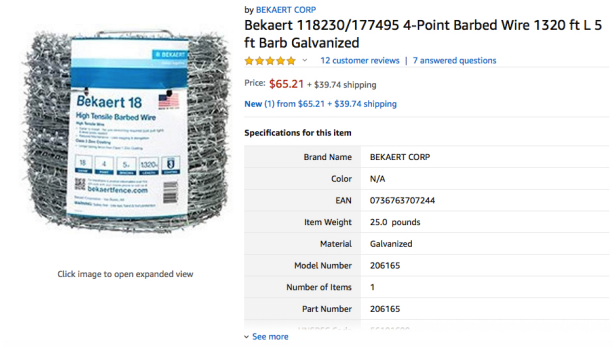
The image above is a screen capture of an ***amazon.com*** *listing for military-grade polypropylene sandbags.*



The image above is a screen capture from an online listing for heavy-duty polypropylene flood bags on the ***Home Depot's*** *website.*

Buying Barbed Wire for a Gravel Bag Foundation

Barbed wire is typically not sold in hardware stores; however, it is usually available at farm and agricultural supply stores, and it is also easy to purchase many types of barbed wire online. Barbed wire is typically not very expensive nor hard to find.



The image above is a screen capture form an ***Amazon.com*** *listing of barbed wire for sale.*

The image above is a screen capture of a listing for barbed wire that is for sale online at ***agrisupply.com***

#2. The Scavenger Hunt Factor

The Scavenger Hunt Factor is a term used to describe how easily a given foundation can be made from locally available

obtain. The Scavenger Hunt Factor is an important factor to consider for people who have been displaced from their homes and need to build new living spaces with whatever materials they can find in their new area.

Conversely, some people in various parts of the world who are not refugees fleeing wars or environmental catastrophes like tsunamis or tropical storms have virtually no money anyway, so they are forced to build a foundations for their new homes without any funding at all; therefore, they are forced to use only materials that are easy to find locally and can be acquired without paying money.

Where to Find Big Rocks that are Suitable for Making Dry Stack Foundations

Finding Materials

Finding stone to work with is one of the first tasks to undertake when working on a new wall or extending the height of an existing wall. Buying stone from a quarry or supplier is easiest, but is also expensive. Typical costs for quarried ledge stone or gathered fieldstone, delivered to your site, run between $125 to as much as $300 a ton. Generally most of this cost is due to the labor and equipment costs involved with quarrying, gathering, and shipping. Remember a ton of stone is not much when it comes to building a wall. If your wall is an average of 2 feet thick and 3 feet, 9 inches high, 1 ton of stone will give you 2 feet of length. Buying stone by the pallet is typically even more expensive unless you are dealing with a very small quantity. However, if you are looking for a very specific type of stone that is not available locally, buying palletized stone may be your best option.

On projects in rural areas stone can often be gathered from other places on the property. While taking down old walls as a source for material is generally not considered acceptable, and in some states is illegal, there are often stone piles in or near old agricultural fields. Often these were piled on bedrock outcroppings or near old trees. In some cases stone was also piled against a wall in order to remove it from the fields. All of these former agricultural dump spots can be good sources of stone. While there is a lot of labor involved to move the stone, the material is free.

Another good source for stone can be from local gravel and sand pits, which often screen out the rocks. While not all pit owners will allow you to pick rocks from their piles, some pits will sell the stones at a reasonable price. Some stone quarries and stone processing (shaping) facilities also have tailing or slag piles that can be picked through for a minimal fee or even free. Once again though, you typically have to supply the labor to get the stone yourself. The main thing to remember though is to get stone as locally as possible.

I am often asked if a certain type or shape of stone is a good type of stone to work with. My usual answer is that all types and shapes of stone can be used to build a wall; the type and shape of stone just informs the style and look of the wall. Many people think of thin flat stone as being 'good' and round or irregular stone as being 'bad'. In fact neither is true, they just lend themselves to different looks. Flat stones can be a pain to deal with because it takes so many to build a wall up to finished height. Large round stones may give a more irregular finish but can be much faster to build with. The one size of stone that can be difficult to work with are the fairly round baseball to softball size. While it is easy to build with some stones like this, it is very difficult to build a strong wall when a majority of the stones fit into that category. Our photo gallery is an excellent place to see different examples of the many types of stone that can be used for your projects.

*The image above is an excerpt from The Stone Trust's website. (**thestonetrust.org**)*

*suitable for building dry-stack walls and dry-stack building foundations is readily available free of cost. (Image courtesy of **mindate.org**)*

*The image above shows rural land in the Smoky Mountains of Tennessee. This photos is posted to illustrate that many places have an abundance of natural stones that can be found laying on top of the ground. (Image courtesy of **americanhiker.org**)*

*The image above shows a large pile of rocks suitable for building a home or a loose rock/ dry stack foundation for a home. The image above shows a large collection of rocks on ranching land in Eastern Oregon that is managed by the U.S Forest Service. (Image courtesy of the **U.S Forest Service**)*

The image shown above depicts a class of geology students from Midwestern State University in Wichita Falls, Texas out on a field

often filled with enough naturally occurring rocks to build dry-stack house foundation from free local materials. (Image courtesy of ***thewichitan.com****)*

The image above shows private acreage in Southern Utah. This image is included to show that many types of land have abundant natural supplies of rocks that would work admirably for all types of dry-stack construction. (Image courtesy of ***wallpaper13.com****)*

The image above shows rocks suitable for building a dry-stack foundation that are easily available in great numbers on a piece of homesteading land in West Texas. (Image courtesy of ***texasflashdude.wordpress.com****)*

The image above show how many places have an abundance of rocks suitable for making dry-stack foundations that are close the the surface of the ground. (Image courtesy of ***gardenloka.com****)*

are Great Places to Find Both Big Rocks Suitable for Building Dry Stack Foundations and Small Rocks Suitable for Filling Gravel Bags and Old Rubber Tires

*The image above shows a creek that crosses rural acreage in Missouri. Creek beds are great places to find both large rocks suitable for dry stacking and smaller rocks suitable for making foundations by filling old rubber tires or gravel bags. (Image courtesy of **instantacres.com**)*

*Urban and suburban creeks like the one pictured above also provide a good place to acquire smaller gravel stones at no cost. Small stones that are suitable for filling old rubber tires or gravel bags can be gathered in a lot of places by using buckets or a wheelbarrow. The image seen above shows a creek running through a suburban housing area in North Carolina. (Image courtesy of **ncseagrant.ncsu.edu**)*

*The image above shows an urban stream flowing through Viarapalayam, India. Urban waterways like this one pictured above may not have clean water, and they might be filled with trash; however, they do provide a good source of free foundation-building rocks of all sizes. (Image courtesy of **sandrp.in**)*

*The image above shows a garbage-choked and fairly polluted stream running thought the outskirts of New Delhi, India. This urban stream bed may not be a nice place, but it offers plenty of good larger rocks that are suitable for making dry-stack rock foundations that are capable of supporting new houses for the needy. The stream pictured above also offers plenty of smaller stones that are good for filling old rubber tires or gravel bags. (Image courtesy of **ck12.org**)*

*urban stream running though Charlotte, North Carolina. (Image courtesy of **all-geo.org**)*

Obtaining Pieces of Waste Cement is Another Viable Option for Building Dry Stack Foundations

*The above image shows a retaining wall that is made from recycled waste concrete. The image above is included to show that recycled waste concrete is a great material for building dry stack foundations. (Image courtesy of **Pinterest. com**)*

*The image above shows a recycled concrete retaining wall that is under construction. The basic procedure for building a retaining wall from recycled concrete pieces involves using the same tools, materials, and techniques as constructing a building foundation from the same materials as any other type of dry-stack building foundation. Waste concrete is often available to the general public at city dumps free of charge. (Image courtesy of **ecohistorical.wordpress.com**)*

*The image above shows a large pile of waste concrete in New Zealand. The photo above shows a large pile of concrete that is going to be crushed and reused as a key ingredient in new batches of cement. (Image courtesy of **atlasconcrete.co.nz**)*

*The image above shows a municipal dump's cement waste section. Many municipal dumps around the world offer free access to people who are looking to salvage pieces of waste concrete. In light of old pieces of Portland cement being seen as a waste product with disposal problems, many municipalities around the world are more than happy to give this material to anyone looking to find a new way to make use of this stuff. (Image courtesy of **braenstone.com**)*

How to Get Small Rocks that are Good for Making Both Gravel Bag and Old Rubber Tire Foundations

In many locations, the soil contains a good supply of small rocks that are suitable for filling rubber tires in order to make a building foundation or to fill heavy polypropylene sacks to make a gravel bag foundation. In many places, the excavation process

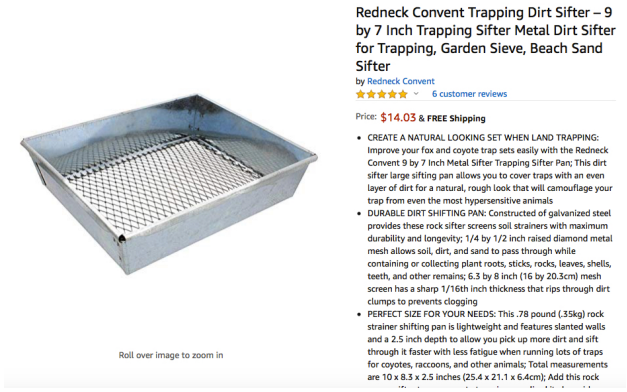
*constitute the parts of an inexpensive home foundation. (Image courtesy of **purelivingforlife.com**)*

*The above photo is included to show that rocks suitable for filling gravel bags and packing old rubber tires are often found in topsoil. The soil pictured in the above photo is full of good gravel suitable for filling old rubber tires or polypropylene bags, the catch is just that the rocks in the soil simply need to be separated from the rest of the mixture. (Photo courtesy of **homereference.com**)*

*The image above shows a simple kitchen colander being used to strain the rocks from the surrounding soil. (Image courtesy of **instructables.com**)*

*Small rocks can easily be strained from rocky soil with a simple and inexpensive mesh screen. (Image courtesy of **Scorch Works** channel on **YouTube.com**)*

*The image above shows how gravel can easily be strained from soil by using a simple wire mesh strainer. (Image courtesy of **beetleeyes.com**)*



*The image above is a screen capture from **Amazon.com**. The image above shows a listing for a rock strainer that is for sale. Rock strainers are sold at many types of stores and also sold on many websites; rock strainers are also typically very inexpensive.*

Where to Find Old Rubber Tires for Free

The image above shows a local family-owned tire shop in Albuquerque, New Mexico. This image is included because it illustrates that used tires are often available for free from tire shops. Tire shops tend to regard used tires as a waste product and a disposal headache, so they are often very happy to have

The image above shows a legal urban tire dump. Places like the one pictured above exist in countless cities around the world and it is quite likely that whomever oversees this legal and licensed urban storage area for old worn-out tires will not charge a fee if someone wants to relieve them of a few old tires. For most legal tire dumps, having people come and take away old rubber tires is often a welcome thing because old tires are generally viewed as a waste product and a disposal headache.

Learning the exact location of these legal urban storage areas for old tires may not always be easy and straight-forward; however, if someone is persistent and patient in their search, then chances are overwhelming that they will eventually learn the location of an urban tire dump and gain access to some free or very cheap used tires. The best way to learn the location of an urban used tire yard is to begin by asking around at tire shops. (Image is supplied courtesy of ***wikipedia.org.*** *The image above shows an urban storage area for old tires in an unknown location)*

Local landfills and bumps are also a good potential source of old tires. The image above shows a pile of used tired sitting at the town dump for the city of Greenville, Wisconsin. Local city dumps scattered across a larger area are likely to collectively offer enough suitable tires to construct a solid building foundation. (Image courtesy of ***cityofgreenville.com****)*

The image above shows a huge facility that has hundreds of thousands of old tires sitting in the open. Truly huge dumps for old tires are found just outside of large metropolitan areas around the world as well as out in rural areas. Gaining access to scavenge a few old tires from a place like the one pictured above is not likely to be too difficult; however, some money may need to be offered if any old tires are to be scavenged.

Another issue with obtaining tires from huge tire dumps is that getting to these places might require a bit of driving and a large truck might be needed to move all of the tires needed to make a building foundation in one trip; as opposed to making many short and small trips. If a lot of driving is required to get to the tire yard, it might make more sense to take all of the needed tires to the construction site in one trip. The image above was taken from a photo drone and shows a huge tire dump on the southwest side of the city of San Antonio, Texas. (Image courtesy of ***mysanantonio.com****)*

The above image shows a well-known tire dump near the town of Delmar. Delmar is in the southern part of the state or Delaware. This Delaware tire dump is estimated to hold around 500,000 individual tires of many different sizes and in all sorts of different conditions. (Image courtesy of ***thecapegazette.com****)*

The image above shows an illegal tire dump in a rural area of South Fulton County in the state of Georgia. The presence of illegal tire dumps out in rural areas is not a good thing, and MudMan does not endorse or support the practice of illegally dumping old tires; none the less, if the location of a large illegal tire dump can be learned, then a free supply of tires sufficient to build a typical home foundation is pretty much assured. (Image courtesy of the ***W-SB Television Station****)*

The image above shows a pile of tires at the Monterey County Solid Waste Authority's tire recycling facility. Monterey County is located along the coastline in Central California. Many counties and parishes around the world have local solid waste disposal departments that are connected with the local government, and official government approved tire drop-off locations will often let local residents have tires for free. Local waste management organizations often let local people have tires for free because old rubber tires are are typically considered to be a waste product. Tires are often just given away for free by local governments because most municipalities are more than happy to see people find ways to repurpose this waste product. (Image courtesy of ***co.monterey.ca.us****)*

#3. Labor

Aside from cost of materials, people looking to construct their building foundations themselves have to consider the

#4. Earthquake Resistance

How well does this foundation type withstand earthquakes.

#5. Resistance to Freezing

This criteria examines how cheap and easy it is to construct a cold-tolerant foundation using this method. This evaluation criteria also assesses how well a given type of building foundation will resist all of the types of damage associated with very cold conditions.

#6. Resistance to Atmospheric Degradation

Some newer types of foundation construction use synthetic materials, and these petroleum-based synthetic materials are vulnerable to accelerated degradation from atmospheric factors over a long period of time. Such atmospheric catalysts to the degradation of synthetic materials include:

- Exposure to atmospheric oxygen.
- Exposure to atmospheric ozone.
- Exposure to heat.
- Exposure to UV radiation in the form of sunlight.
- Exposure to acidic rain

#7. Beauty Contest Factor

Some foundation materials have attractive appearances and can be left exposed as a prominent feature of the building once the construction process is finished. This

#8. Repairability

Note: All of the types of foundation discussed in this writing are cheaper to repair than conventional foundation made from Portland cement with internal steel reinforcements.

Admittedly, the types of foundations covered here are generally not overly vulnerable to taking damage; however, dry-stack foundations are a bit vulnerable to suffering damage from earthquakes, and any kind of foundation can suffer some damage if all of the ground underneath has been swept away in a flood or the ground where the building rests is heaving from water saturation. Given the possibility that any type of foundation can suffer some type of damage for whatever the reason, it is worth mentioning which type of foundation is the easiest to repair if the need ever arises.

Foundation Repairs can Take Two General Forms.

#1. Lifting and Shoring a Wall and then Fixing the Damaged Foundation that Supports that Wall.

The building pictured above has also taken some damage to its foundation, so both foundation and wall repairs will be necessary for the building pictured above.

The image above shows a scenario where the best approach to repairing the damage would be lifting the walls of the building with jacks and then proceeding to repair the foundation as needed. Once the foundation is set properly and repaired, the cracks in the adobe walls of the church can then be repaired by chiseling out form-fitted spaces to set I-shaped wooden tie rods that transverse the cracks in the wall and then filling the spaces around the tie-rods with cob. The final phase of the repair work is covering the repaired cracks in the wall with new layers of plaster. (Image courtesy of ***sfgate.com****)*

The above photo shows a home outside of the town of Hancock in the Catskills Mountains of Upstate New York. The part of the home pictured above had part of its foundation completely removed by an epic flash flood that struck the area back in 2006. In this case, the section of the damaged house pictured will need to be raised on jacks; that section of the foundation will need to be completely rebuilt. (Image courtesy of ***nytimes.com****)*

No matter what type of foundation a building has, if the wall above the foundation can be salvaged, then a certain amount of lifting for damaged building sections may be chosen in place of completely building a new wall. If a wall that rests on top of a damaged foundation does not need to be complexity rebuilt, then some means of keeping that building's wall supported while repairs to the foundation are happening will be necessary.

rented at equipment rental places or purchased from various companies. The foundation jack seen in the above photo is operated by a large threaded screw mechanism, but other foundation jacks are actuated by compressed air or hydraulic mechanisms. (Image courtesy of ***ellisequipment.com****)*

When foundation repairs are necessary some type of lifting mechanism will be needed along with some method of keeping the lifted foundation in place while repair work takes place. (Image courtesy of ***emmertelevation.com****)*

#2. Completely Rebuilding an Entire Section of a Foundation and the Wall that Rests on Top.

If a wall and a section of foundation have been completely destroyed, then an entire section of foundation will have to be build and an entirely new section of wall will have to be constructed to replace the old section that has been damaged beyond any possibility of repair.

The image above shows an earthquake damaged building in Mexico City. The damage pictured above provides a scenario where an entire section of building foundation will have to be rebuilt along with the structure of the building that rests upon the new foundation section. (Image courtesy of ***cbsnews.go.com****)*

This issue is worth considering if a builder or an architect is considering creating a larger building. Scalability is also an issue when considering the possibility of constructing a home that rests on a steep hillside or has more than 2 floors.

Countermeasures to the Problem of Tire Rubber and Polypropylene Bags Degrading in the Atmosphere

Is it Really Important to Protect an Old Rubber Tire of Gravel Bag Foundation from Atmospheric Exposure?

The truth is, protecting old rubber tires from atmospheric exposure is not an immediate necessity; however, the polypropylene bags that constitute Gravel Bag Foundations can not be left out and exposed to sunlight for more than a few days. Polypropylene bags absolutely have to have solid protection from the elements because they degrade very quickly in sunlight; by contrast, old rubber tires can last for many years out in the open atmosphere without any protection from sunlight, heat, cold, or moisture.

People who are in desperate situations where they need to construct a house immediately in order to have life-saving shelter from cold, rain, or baking sunlight, are not going to be overly concerned about building foundations for their new homes that will last for several decades or even centuries; but instead, they are going to be most concerned about having a solid foundation that will support their new homes right now.

As already stated, Old Rubber Tire foundations really do not need any protection from exposure to atmospheric factors in the short term; but if at all possible, an Old Rubber Tire foundations should always be gifted with the best

form part of any building's foundation so that the building will have a solid resting place for as long as possible.

*The image above shows a house that sits on top of a hillside fortified by old rubber tires. The home pictured above is located in Globe, Arizona. This photo is admittedly not of the best quality, but it was included to demonstrate that old rubber tires can actually last for decades, even out in the extreme heat and pounding desert sun in Arizona. (Anybody who has ever been to Globe Arizona in the summer months will attest to just how hot this town can get and how incredibly strong that desert sunlight can be.) (Image courtesy of **lapia.info**)*

So Why Bother Protecting Old Rubber Tires?

As stated earlier, old rubber tires decay slowly in the atmosphere, even when exposed to the elements without any protection; none the less, it is still a good idea to protect any tires that sit above the soil line in an Old rubber Tire Foundation because these tires that sit above the ground line can last a lifetime, and even several centuries; provided that they are well protected.

Work + Time + Money = 😀 + ❤️ + 🌈 & 🦄

Unless a builders are in a situations of immediate and dire need, they should do whatever **Work** is necessary to ensure that their Old Rubber Tire foundations are as well protected as possible from the elements. Aside from putting in the work that is needed, builders should also take the **Time** they will need to build their Old Rubber Tire foundation as well as possible so that the tires that form the building foundation will continue to have the best possible protection from atmospheric influences. Unless builders of Old Rubber Tire foundations are in situations of immediate and dire need, they should also spend whatever **Money** is needed to build

So, when people are building a foundations for a new building by using old rubber tires and gravel, they should always be willing to put in the work, avoid trying to rush the building process if at all possible, and no cut corners during the building process, and lastly, they should be willing to spend whatever money is necessary.

How to Protect Old Rubber Tire Foundations from Atmospheric Decay

#1.

Make sure that any rubber tires that constitute an Old Rubber Tire building foundation are kept buried and away from any exposure to atmospheric oxygen if they rest below the ground line. In other words, keep any gravel-filled tires that rest in the foundation trench covered in soil after the build is complete.

#2.

Cover any rubber tires that will rest above the soil line with 1-2 layers of foundation sealant, then cover the layers of dried foundation sealant with 1-2 layers of roof sealant. It is best to set-aside a week or two for preparing tires that will rest above the soil line for resisting atmospheric degradation. During the prepping process for the tires that will eventually rest above the soil line, it is best to coat the tires both inside and outside with the layers of foundation sealant and roof sealant before filling them with gravel and packing them into their final resting places. It is always best to cover tires with protective coatings against atmospheric degradation before any gravel has been added if the tires will be be set above the soil line in their final resting spot.

*and dried thoroughly before any layers of foundation sealant are applied. (Image courtesy of **ehow.com**)*

*The above illustration provides an example of the equipment that will be needed to cover the tires with the needed sealants. **Note**: The coatings that will cover a tire designated to become part of the above ground section of a building foundation will be different than the paint pictured above. (Image courtesy of **behr.com**)*

*The above illustration shows a good way to position a tire for receiving a coating of foundation sealant and a later set of coatings with roof sealant. (Image courtesy of **behr.com**)*

The image above shows a cleaned tire receiving a coating of some type from a paint roller. It is important to cover both the inside and the outside of each tire that will rest above the ground level, and it is also important to cover both the inside and outside of the tires that will be used for foundation building with multiple coatings of both foundation sealant and heat-resistant roof sealant. Multiple coating of different sealants will help tires last a very long time, even when they rest above the ground line. (Image courtesy of ***behr.com****)*

#3.

Once the final layer of packed tires has been set, the next step will be to cover any exposed tire rubber with 1-3 additional coats of foundation sealant on any exposed parts that are set above the soil line followed by 1-3 coats of roof sealant on the same parts that are exposed to the atmosphere and rest above the soil line. In total, the exposed outsides of the tires that will rest above the soil line may have up to 6 layers of protective coatings applied before the foundation is complete!

#4.

Cover as much of the tires that are exposed to the atmosphere as possible with soil so long as the soil never makes contact with the main building wall. Covering as much as possible of the foundation should always be viewed as the second to last step in the foundation building process.

#5.

Cover the small exposed strip of painted and sealed tire rubber with a layer of fine decorative gravel as a means of protecting the rubber against heat and UV radiation.

The image above shows a good decorative gravel that will not hold on to moisture, nor wick water upward. This gravel would make an excellent final layer of protection for any part of an Old Rubber Tire foundation that rests above the soil line and cannot be covered by having a berm of dirt shoveled on top of it. A layer of the type of gravel shown above would provide an added layer of protection from strong sunlight as well as heat. (Image courtesy of ***westseattlestone.com****)*

How to Protect Gravel Bag Foundations from Atmospheric Decay

#1.

In order to avoid the possibility of a gravel bag foundation degrading, the first step is to use at least 3 layers of bags for each individual gravel-bag foundation piece; even the bags of gravel that rest below the soil line in the foundation trench should be triple-bagged for extra strength and for added protection from degradation. Each polypropylene bag costs around 60 cents, so triple-bagging each gravel-filled foundation bag is not a bad idea, especially considering that adding a few extra layers of bags to each peace of a new Gravel Bag foundation will give the finished structure badly needed added strength and boosted resistance to degradation.

#2.

paint brush or small paint roller to cover the tops of every layer that has just been set with foundations sealant. The tops of the first layer of bags that form this style of foundation should have pieces of barbed wire placed on top of them after hey have been tamped-down, then a layer of foundation sealant should be applied to the tops of each bag that forms this new foundation layer.

The next layer of polypropylene bags should be set and tamped down while the foundation sealant on top of the previous layer is still wet. Adding a layer of foundation sealant between the layers of bags that sit above the ground line should be done because it will help to keep atmospheric oxygen away from the bags when the foundation is finally finished. Even foundation bags that will rest below the soil line when the foundations is complete should also be completely covered with layers of foundation sealant in order to provide the best possible protection agains degradation; therefore, after the layers of bags that will rest in the foundation trench have been set it is a good idea to go back and cover the sides in several layers of foundation sealant and even a few layers of paint.

#3.

After the final course of gravel bags has been placed and tamped-down, then 3-4 coats of foundation sealant should be a applied to any gravel bags that are resting above the ground line, and this application of foundation sealant should be followed by the application of 3-4 coats of roof sealant. The process of covering the exposed gravel bags that rest above the ground line may take up to a week or more, however, the process of paining the outsides of the exposed polypropylene foundation bags with foundation sealant and roofing paint is worth the wait and the trouble if the process of covering the foundation's vulnerable parts will allow the the structure to last a lifetime.

#4.

Cover as much of the surface area of the sealant-covered gravel bags that are exposed to the atmosphere as possible with soil; so long as the soil never makes contact with the main building wall. Covering as much of the exposed side-area of the foundation as possible should always be viewed as the second to last step in the foundation building process.

#5.

protecting the rubber agains heat and UV radiation.

The illustration above depicts a good colorful pea gravel that will provide a layer of protection agains UV radiation and heat, yet not wick water or hold moisture. (Image courtesy of ***westseattlestone.com****)*

Buying the Foundation Sealants to Cover and Protect both Tires and Polypropylene Bags

Finding online listings for foundation sealants available for purchase is fairly easy; however, most hardware stores and home improvement stores do not sell a foundation sealant suitable to cover atmospherically exposed rubber tires or polypropylene bags; thus, an internet-based special order for suitable foundations protectants and sealants will most likely have to be made. Luckily, Amazon.com offers one type of foundation sealant that will work quite well for protecting the above-the-ground-line rubber in Old Rubber Tire and Gravel Bag types of building foundations.

*The image above is a screen capture of a listing for a foundation sealant sold at Lowes home improvement stores. (Image courtesy of of **lowes.com**)*

*The image above is a screen capture from **Amazon.com**. The above image shows an Amazon.com for-sale listing for a natural-rubber-based foundation sealant that will last a long time and provide decent atmospheric resistance to any exposed tire rubber or polypropylene bag skin.*

Buying the Protective Paint

silicone-based white roofing paint that is for sale. After layers of foundation sealant have been applied, coating the exposed tire rubber or polypropylene bag material in several layers of roofing paint will provide the best additional protection against heat, UV light, water, and degradation from fungus and bacteria.

*The image above is a screen capture from **Home Depot's webpage**. The listing captured above shows a 5-gallon bucket of heat-resistant and silicone-based roofing paint that is warranteed for around 30 years of atmospheric exposure after just one application.*

*Standard exterior paint can also be used to cover exposed tires and gravel bags. The image above is a screen capture of a listing for a type of paint sold at **Home Depot** stores.*

Adding an Optional Outer Coating that Consists of Painted Layers of EPDM Armor

EPDM is a synthetic rubber compound that is often made into sheets, and these sheets are used as a roofing material on commercial and institutional buildings with flat roofs as well roofing material for houses and motor homes. EPDM is used for all sorts of industrial purposes such as drive belts and rubber gaskets; however, the chemical formula and manufacturing process are less important to discuss here than the uses of this material for building purposes.

layers of protection, so EPDM can be considered to be a pretty durable material. EPDM is a useful material to extend the life of Old Rubber tire and Gravel Bag Foundations because it can be cut into sheets and applied over the tops of already sealed rubber tire and gravel bag foundations in order to add extra longevity to any parts of a foundation that rest above the soil line. EPDM is also used to line ponds and to cover the ground below the grass line at dog parks. EPDM membranes also line the ground at amusement parks and large outdoor concert venues.

EPDM can be purchased online in large rolls, and the cost of standard roofing EPDM is usually around 1.50 USD per square foot. The best way to add longevity to the exposed section of an old Rubber Tire foundation or a Gravel Bag foundation is to cover the sealant-coated sections that rest above the soil line with several layers of painted EPDM lining. For best protection, the EPDM lining should be 3- 4 layers thick, and each layer should ideally be covered in at leas one layer of sealant paint to add extra longevity. Ideally, the actual amount of rubber tires or polypropylene bags that rest above the ground line and are not covered in soil would be very minimal, and that exposed 3 inches of ribber tire or polypropylene bag skin would be well covered in layers of sealant-coated EPDM and gravel.

The above photo shows how EPDM can be purchased by the square foot from various dealers. (Image courtesy of ***bestmaterials.com****)*

The above illustration shows a ground line being installed at a city dog park in Upstate New York. (Image courtesy of

*The image above shows 2 workers setting sheets of EPDM to cover the roof of a large commercial building. (Image courtesy of **unitedhomeexperts.com**)*

*The above illustration shows how a foundation that has already been well sealed can be made even less vulnerable to atmospheric damage by being covered in a additional layers of painted and sealant-coated EPDM sheeting. (Image courtesy of **jlconline.com**)*

Is it Being Excessive to Have all of These Layers of Sealant, EPDM, and Gravel Covering the Parts of Foundations Made from Rubber Tires or Gravel Bags that Rest Above the Ground Line?

It may seem a bit excessive to coat every part of an Old Rubber Tire or Gravel Bag type of foundations with so many layers protection; however, if the parts of a foundation that are vulnerable to atmospheric decay are sufficiently well-protected, then the foundation will last a lifetime and never need any maintenance. If the layers covering the above-ground portions of an Old Rubber Tire or Gravel Bag foundation are given the best possible protections, then either one of these types of foundations should be able to endure for a period of centuries without any difficulties.

Information

#1. Research Sources For Loose Rock/ Dry Stack Foundations

Online resources and information about these types of building foundations were not very extensive; however, two resources provided sufficient information to complete this foundational assessment. The first and most extensive resource examined was The Drystone Conservancy located in Lexington, Kentucky. The Drystone Conservancy is a nonprofit organization which is dedicated to preserving the traditional practice of building all sorts of structures from loose dry stones. The Drystone Conservancy is dedicated to preserving this craft because they believe this method of construction offers an easy and cheap way to build many different types of structures, structures made of dry stacked stone last a long time, and this type of construction is also very environmentally friendly. The other source of research information about dry stone building was an article on the greenhomebuilding.com web page written by Quentin Wilson which discussion the different types of foundations used for adobe construction.

drystone.org is The Drystone Conservancy's webpage

Foundations for Adobe by Quentin Wilson found in web site green **homebuilding.com**, no date posted

#2. Research Sources For Gathering Information About Old Tire Foundations

Information about used tire foundations can be found online; however, this information is scattered around in a collection of different short posts on several web pages.

Owen Geiger, **Naturalbuilding.blog 03/29/2009** This article by Owen Geiger was a wonderful source of information concerning Old Rubber Tire foundations and cold weather. This is the place where I learned about insulated foundations and Old Rubber Tire foundations made with packed scoria gravel.

Building A tire Foundation by Jay Warmke, article posted on web site **bluerockstation.com**, no date posted

Tires Are Safe, author not listed, found on the web site greenhouseofthefuture.com, no date posted. This is the

Recycling Old Tires by Bill Sitkin found on the web site **greenhomebuilding.com,** no date posted

Tires Used to Build Earthquake Resistant Homes by Marisa McNatt found on the website **earth911.com** 03/12/2010

greenbuilding.com natural foundation sealants section

#3. Research Sources For Gathering Information About Gravel Bag Foundations

Admittedly, information about these types of building foundations is scarce, but what information I did gather about these types of foundations came from **earthbagbulding.com** and the **My Little Homestead Youtube channel**.

Research Sources for Pricing Information

The costs of gravel and rock have to be evaluated when discussing either of the types of building foundations examined here, as does the cost of having a conventional foundation installed for the purposes of comparison and reference.

homeadvisor.com has provided basic information about the costs of conventional foundations and gravel by the ton.

grenbuildingsupply.com has provided basic information and pricing concerning environmentally friendly foundation and basement sealants.

contractors-stone.com has provided basic information about the number of tons of rock needed to construct dry stone foundations and the approximate per-ton costs of different stacking stone choices.

Homedepot.com

Lowes.com

Discussion of Findings:

Foundations

Cost of Building Materials — (Third Place Finisher)

Loose rock foundations will typically cost about half of what a regular cement foundation costs if basic flat limestone pieces are used. Basic flat limestone pieces cost around 128 dollars per ton because they are not very processed and are typically somewhat large, and they are less expensive because the have rough edges that are not considered as aesthetically pleasing or as easy to stack. A loose stacked foundation built with basic flat limestone pieces will have a rougher appearance with larger gaps between the stones, but the larger rock sizes will still ensure sufficient wall stability and strength. A conventional foundation typically costs around seven dollars per square foot of the home it supports, so a loose rock foundation will have a price of $ 3.50 per square foot of the home.

If a builder chooses to use fancy decorative-quality loose-stack rocks that are sold specifically to be used for making dry-stack retaining walls, then the cost will go up to around 375 dollars per ton for the materials. Dedicated decorative dry-wall stacking stones are typically much smaller than basic limestone flat rocks that are not very processed; however, the smaller and more expensive dedicated dry-stack stones are cut so that they will fit together much more tightly and precisely, thus creating solid structures with these stones is still very easily done. If fancy trimmed retaining wall stones are used, the cost of this type of foundation will be approximately 80% the cost of a conventional cement foundation. The advantage to using dedicated retaining wall stones is not so much a question of strength or wall integrity, it is more a matter of appearances. Dedicated trimmed stacking stones give the foundation walls an elegant look when finished.

Scavenger Hunt Factor — (Winner)

It would seem that finding the small rocks needed for making the two other types of foundations would make either the Old Rubber Tire foundation or the Gravel Bag foundation the way of choice for those looking to build a foundation from local materials without spending any money; however, finding old rubber tires suitable for making a solid foundation may not always be as easy as it

seems that larger rocks that could be used to construct a building foundation can always be found somewhere, so the Dry Stack foundation actually comes-in as the winner when the scavenger hung factor is considered.

Labor — (🥈 Second Place Finisher 😐)

Loose rock foundations are an excellent choice for those looking to build their homes themselves without involving contractors. Building a dry rock foundation wall is typically not back-breaking work and requires no power tools, heavy equipment, or messy cement mixing. Building a dry stone foundation involves performing a type of labor that is more focused on careful thought and patient placement of rocks as opposed to a lot of physical exertion. Some people really enjoy the patient and thoughtful type of work that building dry-stack walls requires, and some do not. One person can typically build a dry rock foundation if they apply one week of dedicated full-time work. If dedicated stacking stones are used, no tools except levels and string will be needed. If heavier lime stone flat rocks are chosen, then a simple stone chisel and hammer might be needed to help some pieces fit together more soundly.

Earthquake Resistance — (😭 Clearly the Biggest Loser!)

Loose Rock foundations are a good choice for new building construction because they are relatively inexpensive and do not have a problem with water wicking up the foundation and wetting the earthen walls. Dry-stack foundations are also a viable choice because they are so resistance to atmospheric degradations; however, these types of foundations are somewhat more vulnerable to damage from earthquakes than other types of foundations covered here; such as, Old Rubber Tire foundations and Gravel Bag foundations.

The rocks that constitute these types of foundations are stacked as tight as possible by the builder; however, without mortar holding the rocks together, and without using building blocks that have been deliberately engineered to fit together very tightly, dry stack foundations could still be thought of as having structural components that are kind of loose and thus somewhat vulnerable to taking damage from earthquakes.

Given the relative looseness of the components that constitute a dry stack foundation, these type of foundations

foundations. Despite the internal looseness of the rocks in a dry stack foundation, a decent and well-made dry stack building foundation will actually have about the same earthquake resistance as a conventional cement foundation.

Freezing Resistance — (🥉 Tentative Third Place Finisher 😐)

Loose Rock foundations rate quite favorably when compared to lime mortar or cement foundations when evaluating for resistance to damage from cold weather. Because loose rock foundations are not made of porous material they do not wick water and are less prone to cracking from internal water freezing and expanding than a cement or lime mortar foundation. Unlike some other types of foundations, loose rock foundations will not qualify as insulated foundations, and for this reason full excavation depths for whatever the soil frost line is for the place of building will have to be met.

Resistance to Atmospheric Decay — (🏆 The Clear Winner in this Department!)

Loose Rock foundations are made of inert rock, thus there is no concern about the materials that form these types of foundations breaking down in the sunlight. With Dry-stack foundations there is also no concern about or dealing with oxidation destroying the foundation materials, as is the problem with certain other foundation types. Loose Stone foundations also offer builders the benefit of never having to worry if heat will damage their foundations or if high temperatures will contribute to the rocks breaking down.

Loose rock foundations also do not have any problems with internal chemical breakdown that results from cement reacting with internal iron reinforcing bars as is typical of conventional cement foundations. A well-built dry stacked rock foundation will pretty much last indefinitely and will never suffer any issues from atmospheric or internal degradation.

Beauty Contest Factor — (🥇 Winner 😀)

so dry stack foundations not only provide excellent support, but they can also serve as nice decorative features. Admittedly, some types of stone are more decorative and aesthetically pleasing than others; for instance, a dry stack house foundation can be made from elegant but expensive pieces of Carmel Stone, or made from less aesthetically pleasing, but cheap pieces of recycled Portland cement scavenged from a city dump.

Aside from looking good in their own right, dry stack foundations can also serve as vertical gardens for cliff-dwelling plants adapted to living in the cracks within cliff faces where very little soil is present. The same succulents and grasses that work well as living roof plants also grow quite well in pockets of soil wedged into the spaces within dry stack-foundation walls.

The above image shows a cob wall with a dry stack stone foundation. Notice how the dry stack foundation in the above photo serves as more than just a means of support, but also a prominent decorative feature. (Image courtesy of ***thujawoodart.com****)*

The image above shows a cob garden wall in England. The foundation for this wall is made from dry stacked local rocks, and acts as a prominent design feature in addition to serving a practical support function. (Image courtesy of ***downtoearthproject.org.uk****)*

The above image is included to show that handfuls of dirt can be purposely wedged into the space in a dry stack stone foundation wall and then various species of cliff-dwelling plants can be planted in the small patches of soil. Many types of mosses and succulent plants have evolved to grow in small patches of dirt on cliffs walls, so there is no problem finding decorative plants that will happily take root and grow in a dry-stack foundation. (Image courtesy of ***plantpostings.com****)*

The image above shows a cliff-dwelling succulent plant that is also adapted for dry conditions. Plants like the one seen above make nice decorative additions to dry-stack foundation walls in dry climates. Some succulent plants naturally grow in cliffside cracks in high mountains, so they are suitable to add as decorative plants in dry stack foundations that rest in cold climates. (Image courtesy of ***statebystategardening.com****)*

*The above photos shows different types of plants that lend themselves well to vertical gardens as well as living roofs. The same types of plants that work well for living roofs and vertical gardens also work quite well as decorative additions to the exposed faces of dry-stack building foundations. (Image courtesy of **bhg.com**)*

Repairability — (🏅 Winner 😀)

One nice selling point for Loose Rock foundations is the fact that when these foundation types are damaged from an earthquake or flood, they are very easy and cheap to repair; unlike conventional cement foundations. Despite having some vulnerability to earthquake damage, many earthen buildings that were constructed in very earthquake-prone places have successfully stood for many centuries.

In the event that this type of foundation does get damaged it is the easiest to repair. Repairs to these types of foundations typically involve just restacking and resetting a collection of small and medium-sized stones that can be easily carried and moved without heavy equipment. Additionally, no specialized equipment other than a foundation jack is likely to ever be required to repair a dry-stack building foundation, nor is the repair process for this type of foundation likely to be very hazardous, labor intensive, or lengthy.

***avalonfoundationrepair.com**)*

Scalability — (🥈 Second Place Finisher 😐)

Foundations for large buildings can certainly be made from dry-stacked rocks, and many very large building foundation have been made over the millennia by stacking huge monolithic stones on top of one another, and the Architecture of the Gods in Peru and the Great Pyramids in Egypt bare living testament that truly huge dry-stack foundations can be made.

Although it is possible to make large-scale building foundations from loosely stacked rocks of great size, making building foundations in this fashion is a bit too demanding to work as a practical alternative to constructing large building foundations through conventional methods that are characterized by using Portland cement and internal steel reinforcements.

Even thought is is very possible to do, moving huge monolithic rocks into place and then stacking them with the kind of precision that is rewired to form a solid foundation for large buildings requires will undoubtedly require fair amount of time, a fair amount of specialized equipment, and a lot of money.

*The photo above shows giant slabs of marble that have recently been cut from a quarry. Very large pieces of rocks other than marble can be queried and then cut to exacting specification; however, this process is not fast or cheap. Even after they are quarried and cut, very precisely trimmed large pieces of rock still have to be transported and dropped into place, and the process of transporting and placing huge and precisely trimmed rocks is inevitably going to be slow and expensive. This photo is included to illustrate that large monolithic rocks that have been cut from quarries are available and these rocks can certainly be used as the building blocks for large-scale dry stack building foundations. (Photo furnished courtesy of **gettyimages.com**)*

*The image above shows a wall made from dry-stack rocks of huge proportions in Peru. Many walls and buildings foundations like the one pictured above are found scattered throughout Peru. A few churches in Peru still rest on foundations made from very large and very precisely cut rocks; however, it is unclear exactly how old these massive mortarless stone structures actually are, and it is also unclear exactly how these huge stones were cut to such prices measurements and moved into place. Although it is probably within the the technical capability of the present age, constructing walls and building foundations by carefully placing very precisely cut pieces of extremely hard rock on top of one another, making standard large buildings from this method is likely to remain commercially unviable for the foreseeable future. (Image courtesy of **pixabay.com**)*

#2. Old Tire Rubber Tire Foundations

Cost of Building Materials– (Second Place Finisher)

Old Rubber Tire foundations can potentially cost almost nothing to build; however, it is best to assume that an Old Rubber Tire type of foundation will cost about a fifth of what a regular foundation would, thus putting the cost of a tire foundation at around 1.40 per square foot of the building. Many tire centers will give away old tires for free because tire centers have to pay to dispose of their used tires.

The problem with obtaining tires for free is that it may be difficult to obtain enough tires that are of the same size or in a suitable condition. If an old rubber tire foundation is to be build with the proper strength, then most of the tires have to be the same size and they must also be in at leas decent condition. Larger tires can be used for the lower reaches of old rubber tire foundations, but for the upper levels of these types of foundations, tires of the same size

project, tire recycling companies can typically sell people similarly sized sets of old tires for very modest prices.

When looking to simply purchase the used tires needed to build an old rubber tire type of foundation, the best bet is always to look locally in the country where the building is under construction; however, the option of purchasing suitable tires from India and Pakistan is worth considering.

The typical cost of a specifically sized assortment of tires that a customer orders is only a few cents per pound, and the cost of having a shipping container loaded with a very specific size and grade of old tires and sent to its intended destination is generally less than 1000 USD, regardless of the final destination. So, expect to pay around 800 USD to 1000 USD to have a 40-foot container filled with hand-picked and correctly sized tires shipped from India to Long Beach, CA. Figure that having all of the tires that are necessary to build an Old Rubber Tire foundation for a new building will cost around 2000 USD for the combined cost of the shipping and product, and the arrival time will be around 30 days.

As for the cost of the gravel which fills the tires, the price of regular road gravel is about 35 dollars per ton. If the tires are being used to make a foundation in a cold area, and scoria rock gravel is chosen to pack the old rubber tires instead of regular gravel, then the cost will be around 70 dollars per ton for the scoria rock.

Scoria is a contractor's trade name for light and porous volcanic rock also commonly referred to as pumice. Scoria gravel may cost more than conventional gravel; however, if this type of gravel is chosen to build an insulated type of foundation, then a lot less gravel will be needed. The process of building an insulated type of foundation does not require digging a foundation trench that is as deep; thus, less tires will be needed and less graved will be needed for packing these tires. Given the lessened need for materials, choosing to pack the old rubber tires in a building foundations with insulating scoria gravel will not drive up the cost of building the foundation as badly as one might assume.

When the main construction process of an old rubber tire foundation is complete, there is still a need for atmospheric sealing of the above ground tires, so the cost of buying foundation sealants will create an added expense. The foundation sealants used to finish these types of building bases typically cost about one hundred dollars for a 5-gallon bucket, and depending on the size of the foundation, there will have to be many buckets of this sealant used before the foundation is completed.

foundation wall. Some people might want to invest in a bit of nice looking gravel to cover the atmospherically exposed bases of their old rubber tire building foundation walls, and decorative gravel typically costs around 75 dollars per ton.

Scavenger Hunt Factor– (Second Place Finisher)

First, finding a sufficient number of small rocks to pack the old tires should not be a problem. Secondly, old rubber tires can often be found at neighborhood tire shops; however, it is rarely completely certain that an individual shop will have enough old tired to construct a building foundation, so more than one shop will most likely have to be visited. Additionally, it is not a given that a tire shop will have tires that are all of the same size. Additionally, if a tire is to become part of a building foundation, it has to be in good enough condition to function as a strong building component; for example, a tire cannot have any big cuts through it or have any large holes in it if it is going serve as part of a new building's foundation.

Yes, it is possible to scrounge-up enough old tires of the right size from one tire shop or even a few different shops in the same area; however, it is quite likely that a trip to a distant tire dump will have to be made in order to find enough tires of the right size for building a foundation. There is also a decent chance that obtaining enough old tires of the right size that are needed to make a decent building foundation will require paying some money and using the services of a company that deals in old tires; for this reason, building a foundation from scavenged old rubber tires that were not purchased with money may not be as easy as it would seem at a glance.

Lastly, if larger tractor or truck tires are going to be used as the foundation for a new building, then obtaining enough of these larger tires that have to all measure to the correct size may require contacting a used tire company or having a special set of personal connections.

Labor — (Clearly the Biggest Loser!)

Although the material cost of used rubber tires and gravel are not be very high, building these types of foundations involves many hours of hard physical labor. The tires that make-up the structure of this type of building foundation have to be filled with gravel and carefully packed with a tamping tool little by little for the tires to achieve the solid

foundation will typically require a few weeks of hard, long, and boring days marked by real physical toil for a do-it-yourself builder.

Another factor to consider when building this type of foundation is the issue of having to move the tires around. True, old tired designed to serve standard passenger cars are not really all that heavy, and they can be rolled around as opposed to being carried; none the less, moving the tires and positioning them in their final resting places can still require some pretty heavy lifting, and this type of work can be mighty unpleasant in very cold, very hot, or very rainy weather. Building a foundation from larger truck or tractor tires will also inevitably demand even more lugging and straining to place the tires in their final resting places.

After the below-the-soil-line foundation tires have been packed and set in place, the next step will involve painting the tires that will be exposed to the atmosphere above the soil line with several coats of foundation sealing compound, then a few coats of house paint will need to be applied in order to cover the exposed dry foundation sealant. True, the tire-sealing process is does not consist of back-breaking toiling work; however, this process will add to the time to the building project and the process of painting the ties will also add to the total tally of labor needed to complete this type of foundation.

Painting the exposed tires that are destined to rest above the ground line with several layers of foundation sealant and then coating them with several additional layers of regular exterior paint may not be back-breaking labor; none the less, this process is still going to be quite time-consuming, rather messy, and this whole exercise will certainly not be much fun in hot weather!

Earthquake Resistance (The Clear Winner in this Department!)

Because gravel filled tires have wide bases and are quite heavy when fully compacted, they provide very solid platforms on which to place buildings. Because of the weight of the gravel packed rubber tires, these types of foundations tend to not move very much when the ground shakes. Of all the foundation types in existence today, the packed-gravel and old rubber tire type of foundation seems to be the best one when evaluating for earthquake resistance.

Old Rubber Tire foundations are not made from solid pieces of inflexible material such as cement or lime mortar and stone foundations, and for this reason, they are not prone

flat plates that just rest on top of one another when they are finished, the end result is that these gravel-packed tires are capable of moving a bit when an earthquake strikes. Given the fact that these type of foundations are not solid pieces, they are very heavy, and they are ringed with flexible rubber, it is likely that no amount of ground shaking will ever result in a tire foundation having to be repaired.

Freezing Resistance (🏆 The Clear Winner in this Department!)

If Old Rubber Tire foundations are packed with light and porous gravel made from volcanic rock that is commonly called **scoria**, they are considered to be the functional equivalent of insulated foundations. In most parts of the United States, the winters are not really cold enough to merit an insulated foundation and packing the tires that constitute a building foundation with regular gravel will suffice.

*The image above shows how scoria gravel looks when sold at a gravel yard in bulk. (Image courtesy of **westseattlestone.com**)*

*The image shows scoria gravel for sale in bulk. (Image courtesy of **westseattlestone.com**)*

Even if an old rubber tire foundation is simply filled with regular gravel and buried below the required frost line, this type of foundation is still not going to be very vulnerable to cracking from external lateral pressure exerted by the expansion of freeing ground, nor will this type of foundation be vulnerable to internal cracking from trapped water expanding when frozen. The inherent flexibility of rubber and gravel makes this type of building foundation very hard to damage from freezing.

Insulated foundations are only required to be a around a foot deep in all but the absolute coldest of places. Even in the coldest of places, insulated foundations rarely have to be more than 2-feet deep. Scoria gravel typically costs about twice as much per ton as regular gravel; however, if an insulated foundation is constructed from old rubber tires and scoria gravel, then the amount of gravel needed will typically be cut in half. In cold climates such as the prairie provinces of Canada, old rubber tire foundations can save builders a lot of money on materials and excavation costs.

Resistance to Atmospheric Decay —

(Second Place Finisher. Yes, Atmospheric Exposure is a Problem for Sure for Old Rubber

Foundation is not the Biggest Loser in this Category. 😐)

Old tires tend to break down somewhat slowly over time if they are exposed to atmospheric oxygen; however, they will only last a few decades at most if they are continuously exposed to a combination of atmospheric oxygen, high temperatures, and UV radiation from sunlight. If a builder chooses to use an Old Rubber Tire foundation as the platform for a new building, then care must be taken to make sure that all of the tires in the foundation are exposed to as little atmospheric oxygen heat, and sunlight as possible.

Tires buried in the ground will break down very slowly over a period of centuries or perhaps even millennia; however, tires that are potentially exposed to atmospheric oxygen, heat, and sunlight if they are poking-out above the soil line should to be covered in dirt as high-up as possible. Additionally, some sort of foundation sealant should always be applied in more than one layer; additionally, some type of paint should cover the layers of dried foundation sealant. Along with the other layers of protection for the tires that rest above ground, a few layers of prepared EPDM coving should be also be applied to the parts that rest above the soil line, and some type of gravel should cover any areas where the painted layers of EPDM sheeting are exposed to the atmosphere.

The best way to initially seal any tires that are sticking-up above the soil line is to paint all of them with several layers of foundation sealant, then to paint the dried layer of foundation sealant with several layers of oil-based exterior house paint. Lastly, a covering of dirt should be shoveled onto the tires and their sealant coated EPDM covering until a gap of as little as one inch exists between the dirt layering on the EPDM sheets and the wall material above the foundation. The best method of protecting the small exposed strip of exposed EPDM rubber that sits just below the beginning of the building's wall is to to cover this area in small-sized gravel.

As mentioned earlier, the best strategy to keep the atmospherically exposed rubber tires that rest above the ground line from degrading over time is to cover as much of these tires as possible with soil; unfortunately, berms of soil can not reach all of the way up to the beginning of the earthen or wooden walls of a building because soil wicks water from the surrounding ground and stays wet after a rain. Having wet soil touching a building's walls will eventually lead to degraded earthen wall material if liquid water comes into contact with this type of wall. A wooden wall will also suffer from accelerated rot if is is in contact

to be exposed to the atmosphere at least to some minimal degree.

Other layer of protection besides just foundation sealants are needed because the chemical formulas of foundation sealants are designed to be flexible and tolerant of oxygen exposure; however, these coatings are not designed to withstand prolonged and harsh exposure to heat or sunlight in conjunction with continual exposure to atmospheric oxygen. Applying a few coats of paint over dry layers of foundation sealant will also help to prolong the life of an old tire foundation. Gravel, as opposed to lime or concrete is the material of choice for covering the exposed and sealed rubber components of any type that rests above the ground line in Old Rubber Tire styles of building foundations because gravel will not crack over time or wick water up to the bases of any wooden or earthen building walls in the same way as a cement or lime plaster coating.

Aside from exposure to UV radiation and oxygen accelerating the decay of the rubber tires themselves, exposure to heat also speeds up oxygen-fueled chemical breakdown of of any type of rubber, including EPDM. Unfortunately, exposure to UV light, atmospheric oxygen, and heat also accelerate the decay of paint coatings as well as foundational sealant coatings and rubber; and this is why keeping as much of any rubber foundation components and their sealants covered in soil or gravel is a good practice. In order to promote as long a life as possible, any rubber components in Old Rubber Tire foundations that cannot be covered in soil should be covered in layers of different types of sealants as well as layers of gravel in order to cut back on exposure to all sorts of atmospheric factors.

Ideally, mounds of fine gravel will be applied to cover the small exposed section of rubber material in any Old Rubber Tire foundation. A fine jagged pea-type gravel is the best option to use as a final layer of covering for that small exposed strip of foundation rubber that can not be covered in soil yet still rests below the beginning of a building wall. Small-grained gravel is the best option for covering any rubber parts that must take some atmospheric exposure because small-grained gravel contains rocks that are large enough to avoid wicking water up to the wall, yet these rocks are also small enough to create a barrier against direct exposure to atmospheric oxygen or the sun's beating heat.

Foundation sealants are designed to last around 30 years with oxygen exposure, but they are also designed to work without exposure to sunlight or high temperatures. Despite being designed to stay intact when exposed to atmospheric oxygen, the dried layers of applied foundation sealants and paint coatings that sit on the exterior base walls of

background of exposure to atmospheric oxygen.

If a good covering of sealed layers of EPDM membranes exists and covers the rubber tires that sit above the ground line, and if this veneer of EPDM layering exists in combination with a good skirt of gravel, then a solid system of protection for the parts of an Old Rubber Tire foundation that rest above the ground line and take some atmospheric exposure is in place. If the combination of protective measures that includes paint layers, foundation sealant coatings, EPDM, and gravel is in place, then an Old Rubber Tire foundation should not need any maintenance for a minimum of 30 years. If all of the recommended protective measures are taken for an Old Rubber Tire foundation, then it should last for at least 100 years without needing any maintenance.

Beauty Contest Factor (Second Place Finisher)

Although old rubber tired are not generally thought of as being attractive to look at, many people have invented all sorts of ways to repurpose old rubber tires for all sorts of applications. Although the best thing to do from a preservation standpoint is to cover rubber tires in layers of EPDM, dirt, and decorative gravel, a house with an old rubber tire foundation can go the opposite direction and make the tires the form the building's foundation into a prominent feature of the building. The tires that form the visible foundation walls of a building with this type of foundation can be made into a prominent artistic feature by painting them all sorts of bright colors and making no attempt to hide the fact that the home rests on a bed of old worn-out rubber tires.

Having exposed tires is generally not recommended; however, if the tires that constitute an Old Rubber Tire foundation are given several good coats of foundation sealant, then covered with several good coats of roofing paint, and finally finished-off with a few good coats of oil-based house paint, then the tires will be safe from any atmospheric decay for at least a few decades. If a home owner or occupant of a house with exposed foundation tires chooses to highlight the tires that make-up the foundation, then they can simply accept the responsibility of ensuring the the tires get a few fresh coats of paint about every 10 years.

One of the most obvious choices for beautifying a building with an Old Rubber Tire foundation is to simply cover the buried and coated rubber tires that rest above the ground line with decorative rocks and pebbles. The image above shows the selection of available decorative gravels at a landscape supply yard in New Jersey. (Image courtesy of ***wikistone.com****)*

Note: The painted tires in the image above are stacked into vertical columns in a similar fashion to how the old rubber tires in the visible and above-ground portions of an Old Rubber Tire foundation.

The above illustration provides an idea of how a home owner could choose to accentuate and celebrate the rubber tires in the building's foundation by painting them all sorts of bright colors. (Image courtesy of ***revistaartesanto.com.br****)*

Note: Tires that form the above-ground exposed wall in an Old Rubber Tire foundation are stacked one on top of another to form straight columns as opposed to staggered tires like the image above shows, but the image above is included as a reference to demonstrate some of the ways that old tires can be painted.

*or gravel and choosing to paint them all sorts of colors. (Image courtesy of **Pinterest.com**)*

Note: Tires that form the above-ground exposed wall in an Old Rubber Tire foundation are stacked one on top of another to form straight columns as opposed to staggered tires like the image above shows, but the image above is included as a reference to demonstrate some of the ways that old tires can be painted.

*The image above is included to provide an idea of how a decoratively painted set of rubber tires in a building foundation might appear of the builder has chosen to make the rubber tires that form the foundation into a canvas for artistic expression. (Image courtesy of **jdsneakeraj.com**)*

*The image above is included to show that the rubber tires that form the exposed walls of a building foundation can certainly be used as a great canvas for painting and artistic expression. (Image courtesy of Rita Wright on **pinterest.com**)*

Repairability — (😭 Clearly the Biggest Loser!)

of foundation gets undermined by heavy rising floodwaters, then the entire area of the damage will have to be cleared and the tires removed and the gravel recovered as much as possible. Repairing an old rubber tire foundation will demand a certain amount of hard physical labor because any significant repair work will require moving heavy tires along with lugging and packing gravel. Moving heavy tires and then setting them in place and finally packing them will also be somewhat awkward if the process has to happen under a sequin of the building that the foundation supports that is presently resting on props and jacks.

If an entire section of an Old Rubber Tire foundation that has been washed-out will require reseting several tires, packing them again with gravel, and having to ensure that the tires that are re-applied in the repair location so that they are completely level with the rest of the foundation tires will involve a lot of careful measuring and checking and rechecking level lines before the final repair process has been completed. Creating a level platform for a new stack of gravel-packed tires is likely to require reapplying a new bed of gravel for the tires and careful attention to the height and orientation of each additional tire set in place.

Scalability — (🏆 The Clear Winner in this Department!)

Unlike the Other Types of Foundations Covered Here, Old Rubber Tire Foundations Offer a True Economy of Scale with a Great Savings in Cost!

Old rubber tires are an interesting foundation-making material because they actually offer a viable and cheap option to building with cement when large building are being designed and built. Although the numbers are still small, a few new skyscrapers have been built in India that rest on footings made from repurpose old rubber tires, so the idea of using old rubber tires to set very large buildings is not just a crazy and unproven idea. Future sports stadiums and large institutional buildings such as schools, churches, hospitals, and shopping centers can all be built on foundations of old rubber tires.

When very large buildings are constructed, the foundation parts made of old rubber tires will eventually be completely burred in the ground and will not see any exposure to atmospheric forces of decay such as sunlight or sunlight, so the rubber tire foundations that will support large buildings in the future will have the potential to last for many centuries.

*The above photo was included to show that some specially vehicles use truly huge tires that will eventually make great building pieces for massive foundations capable of supporting huge structures such as sports stadiums, factories, and skyscrapers. (Image courtesy of **sinotruck-parts-store.com**)*

*Old rubber tire foundations can also serve as sturdy bases for large multi-story buildings. Large tires that serve mining, farming, and construction equipment can be covered in layers of sealant, placed in their permanent resting places, and then packed with gravel in order to serve as foundations for large buildings. Building a foundation from very large tires such as the ones pictured above also offers builders and architects a great way to construct solid foundations for homes that rest on hillsides. (Image courtesy of **edenshalefarm.com**)*

The large tired pictured above can be filled with gravel and used as a good base for supporting large multi-story buildings. The

Salvadori company offers a valuable service because getting a huge tire retreaded and reconditions is cheaper than purchasing a new out-sized and specialized tire.

The Salvadori company does business on every continent except Antartica, and they are able to greatly extend the life span of very large tires; however, even very skilled and knowledgable specialists who know how to keep tires in use can only repair a tire a limited number of times before it becomes a waste product. Ideally, a huge tire that has been salvaged and repaired as many times as possible would have a wonderful new mission in life when repurposed as an item of construction material. (Image courtesy of ***salvadori.com****)*

The image above is admittedly not of the best quality; none the less, it is included because it shows workers in India setting a huge number of old rubber tired in place that will soon be filled with packed gravel. The stacks of old rubber tires seen in the above photo will eventually form the bed where a large skyscraper will rest. The network of old rubber tires pictured above was chosen as the foundation for a new skyscraper because this building material was cheaper than Portland cement and offered better protection from earthquakes as well as better resistance against taking damaged from the continual presence of groundwater rising from a low water table.

The practice of construction buildings with Old Rubber Tire foundations seem to have a bright future because they actually offer architects and engineers an alternative to cement when designing and constructing the foundations of vary large buildings. (Image courtesy of ***ijlemr.com****)*

The image above shows a huge retaining wall that has been made from worn-out mining dump truck tires at the Highland Valley copper mine in British Colombia, Canada. Every year the mine produces around 900 worn-out giant mining truck tire, and 900 old mining truck tires is sufficient to make one foundation for a giant skyscraper building. Notice how tall and large the retaining wall is in the above photo. The above photo was posted to show that old rubber tire foundations can be scaled-up to massive proportions and used to support huge structures. (Image courtesy of ***cim.magazine.org****)*

The image above is included to show that even smaller tires can be used to make huge retaining walls as well as foundations for large buildings. The above photo shows a massive retaining wall in Australia that was build entirely from old rubber tires and gravel. The old rubber tires used to make the massive retainer wall seen above all had one tire wall removed so that each individual tire only needed to be filled from the top and then packed. (Photo courtesy of ***ecoflex.com.au****)*

The photo posted above shows an entire section of a major highway in Australia that is supported by rubber tires packed with gravel. The highway section pictured above also includes a cement culvert to allow a stream to pass under this section of highway. The photo above is included to show that gravel-packed old rubber tires can provide a base that is large enough and strong enough to support sections of even the largest highways that receive a continual load of the heaviest traffic. The tires that form this gulley-fill with a culvert were also

#3. Gravel Bag Foundations

Cost — (Winner)

Gravel bag foundations truly cost the least if someone decided to forgo a scavenger hunt and simply purchase the materials. Polypropylene bags suitable for making a gavel bag foundation can be purchased from many websites and most hardware stores sell polypropylene bags intended to hold sand and then be used as a flood control measure. Polypropylene flood-control sand bags typically cost less than a dollar a piece, so even when the foundation bags are double or even triple bagged the cost of securing the bags is going to be rather negligible. For example, Home Depot sells strong polypropylene bags suitable for making a gravel bag building foundation for about 60 cents per bag.

Barbed wire can also be purchased quite easily for a low cost at most agricultural supply stores and hardware stores, and many websites sell large rolls of barbed wire at low cost. A roll of 1300 feet of good quality barbed wire typically sells for around 40 USD on Amazon.com and the shipping is usually less than 15 USD.

Unlike purchasing old rubber tires, the polypropylene bags are not bulky or heavy and so no truck, wagon, or trailer is required to transport the bags. Even a rather large box of polypropylene can still be carried by one person without too much trouble.

Conversely, the gravel that fills the bags can be purchased for a rather low cost. One advantage that comes with using a gravel bag type of foundation is the fact that pretty much any type or grade of gravel can be used to fill the polypropylene bags that form the building foundation, so long as the gravel pieces are not too large, so whatever suitable gravel is the cheapest at the time is always going to be the logical choice when filling the foundation bags. Covering the polypropylene bags that form the foundation of a new building in layers of foundation sealant and paint is also not overly expensive.

Scavenger Hunt Factor — (Last Place Finisher)

bags that are suitable for use in a building foundation that are in good condition and just sitting around for free is not going to be easy in a lot of places. Yes, the foundation bags themselves do not cost too much, but just finding suitable bags that are available for free in a remote area or a disaster zone is probably not going to be easy. Obtaining the necessary roles of suitable barbed wire that go between the layers of gravel-filled foundation bags is also not likely to be very easy without any exchange of money, and it is also unlikely that a disaster area or a very remote spot will have easy access to quality boxes of barbed wire.

Labor — (Winner)

Building this type of foundation is the fastest and does not require a huge amount of hard physical labor. When building a gravel bag foundation, a person can simply fill each individual bag with gravel at its final resting place. When the bag is in place and being filled with gravel, if the foundation is being built properly, then the place where the bag will rest will have been prepared with sections of barbed wire resting below, and the part below the bag's final resting spot will also have been recently wetted with a layer undried foundation sealant.

After an individual bag has been moved to its prepared final resting spot and filled with gravel, then it will be sewn shut, and finally tamped down in its final resting spot. The good news is that the steps associated with preparing a foundation bag's final resting spot, filling the bag, and then applying the final touches are not all that physically draining.

Earthquake Resistance — (Second Place Finisher)

A gravel bag foundation is not as prone to shifting in an earthquake as a dry stack foundation; however, this type of foundation is not as sturdy as an Old rubber Tire type of building base. A gravel bag foundation can potentially shift when the ground shakes, yet this type of building foundation is not nearly as prone to cracking or taking damage from an earthquake as a conventional cement foundation.

If a gravel bag foundation is made with bags of gravel that have been triple bagged and there has also been a decent layering of barbed wire and foundation sealant between each successive layer of foundation bags, then this type of foundation is unlikely to suffer much damage unless the earthquake is truly devastating. Another way to make

most layer, with would effectively give a good and structurally sound gravel bag foundation a shape somewhat like that of a pyramid.

Freezing — (🥈 Second Place Finisher 😐)

Polypropylene bags can also be filled with scoria gravel, so this type of foundation can also be considered an insulated foundation if it is filled with the right kind of rock. Unlike conventional cement foundations, this type of building foundation is not particularly vulnerable to cracking from internal water freezing and expanding, and this lower degree of vulnerability to freezing damage is due to the bags that form the foundation having some degree of flexibility. This type of foundation scores a little lower in the freezing resistance category than old rubber tire foundations because polypropylene bags are generally not as sturdy and solid as rubber tires, so there is a bit more vulnerability to suffering damage or degradation from freezing cycles and water expanding as it turns from a liquid to solid ice.

The image shows scoria gravel for sale in bulk. The image above is the same one accompanies the section discussing freezing resistance for old rubber tire foundations, this same image is included because the same gravel used to fill rubber tires to make insulated rubber tire foundations is used to make insulated gravel bag foundations. (Image courtesy of ***westseattlestone.com****)*

(Clearly the Biggest Loser!)

The thin membranes forming the bags that constitute the pieces of a gravel bag foundation are particularly vulnerable to degradation from exposure to UV ration in sunlight. Exposure to oxygen, UV radiation, and physical abrasion can all destroy polypropylene foundation bags within a few weeks.

Note:

The portions of a Gravel Bag style of foundation that rest above the soil line should be protected with all of the same techniques and methods as rubber tires that rest above the soil line in Old Rubber Tire types of foundations.

If the gravel-filled bags that constitute the components of a gravel bag foundation are kept protected with layers of foundation sealant, roof paint, EPDM sheeting, and decorative gravel in the same manner as rubber tires in an Old Rubber Tire type of foundation, then this type of foundation can certainly last for several decades, and even perhaps centuries.

*The image above shows what happens to polypropylene bags that have been left and exposed to sunlight for just a few short days! (Image courtesy of **earthbagbuilding.com**)*

*The image above is a screen capture from the website **earthbagbuilding.org**. This photo is included to show what can happen to polypropylene bags when they are exposed to sunlight for even a relatively short amount of time.*

*The image above shows a gravel bag foundation that has taken severe damage from exposure to sunlight. (Image courtesy of **lilyannfouts.com**)*

*The image above shows a severely sun damaged gravel bag foundation. (Image courtesy of **lilyannfouts.com**)*

Face Finisher 😉)

It is possible to paint the exposed portions of a gravel bag foundation all sorts of colors, and it is possible to cover the exposed portions of gravel bag foundations with different types of decorative gravel, but this type of foundation really does not lend itself well to any real aesthetic beauty. Given this type of foundation's vulnerability to atmospheric decay, the best option is to cover the gravel-filled polypropylene bags in layers of sealant, and then to cover the polypropylene gravel bags with additional layers of sealant-covered EPDM, and to finally cover the small parts of one of these types of foundations that are exposed to the atmosphere with with a solid covering of decorative gravel.

The best option for decorating one of these types of foundations is to cover the parts that are not burried below a layer of soil with a solid covering of decorative gravel. The image above shows a selection of decorative gravels that are for sale at a landscaping supply company in New Jersey. *(Image courtesy of* ***wikistone.com****)*

The image above is included because it shows how the external parts of a building's foundation can actually function as a canvas for painting and mural making. Although it is not advised or recommended, the top layers in a gravel bag foundation can actually rest above the ground line without being covered in dirt or gravel, provided that the bags are covered in many layers of foundations sealant, many layers of paint, and several well-coated layers of EPDM membrane. Provided the foundation bags are properly sealed and protected behind layers of EPDM membranes, the exposed face of a gravel

building. (Image courtesy of ***houselogic.com****)*

Repairability — (Second Place Finisher)

Repairing a damaged section of gravel bag foundation will simply involve dismantling the existing structure, recovering the gravel if at all possible, and then rebuilding a new section of foundation. The process of dismantling the existing foundation section would involve emptying the eating gravel bags and then using a saw of some type to cut apart the sealant-covered bags that are glued together and effectively forming one solid structure. Some care will have to be taken when cutting and removing old pieces of bags; however, the whole process should not be too difficult.

Sawzalls are excellent tools for dismantling old section of sealant coated gravel bag foundations. (Image courtesy of ***djvmerchandise.com****)*

Box-cutter types of knives are also useful tools for dismantling old sections of gravel bag foundations; however, these knives are very sharp and quite potentially dangerous, so a lot of caution should be observed when using one of these tools. (Image courtesy of ***uline.com****)*

The image above shows a simple pair of pliers. Having a set of pliers to grab sections of sealant-coated polypropylene bag skin is always handy when repairing a damaged section of gravel-bag foundation. (Image courtesy of ***mscdirect.com****)*

Scissors designed to cut sheet metal or gasket material are also useful tools for removing old sections of sealant-covered polypropylene bag skin. (Image courtesy of fine ***homebuilding.com****)*

Scalability — (🥉 Last Place Finisher 😟)

Large bags of sand are used to stop floodwaters and also to function as ballistic barriers in war zones; however, in order to function as foundation components for large buildings large bags of sand have to be able to continually withstand enormous pressures from the weight of the buildings resting on top. Rubber tires packed with gravel have been proven to be able to withstand the continual application huge amounts of pressure; however, the membranes of large polypropylene flooding control bags just do not have structural strength that is comparable to rubber tires.

Gravel bags are even less likely to be able to withstand the pressures that arise when a large and heavy building shifts on its foundation during an earthquake. In summary, building a foundation from gravel bags works fine for

The large bags featured in the image above might work well as a flood control technology, but large polypropylene bags like the ones seen above just do not have the wall and membrane thickness to be able to withstand the continual pressures exerted from above by a large building, much less the short-term but extreme pressures placed on building foundations when the ground shifts under a heavy building during and earthquake. (Image courtesy of ***bigbagusa.com****)*

The image above shows a stack of large polypropylene flood-control bags. Large polypropylene flood-control bags like the ones seen in the photo above may be stackable but they are not strong enough to support a large building. (Image courtesy of ***bigbagusa.com****)*

The above photo shows a military helicopter dropping large polypropylene flood-control bags filled with dirt onto a

Conclusions

From the standpoint of **Cost** the clear winner is the Gravel Bag foundation. A loose rock foundation is still relatively inexpensive compared to conventional Portland cement foundations, but is still nowhere near as cheap as a Gravel Bag foundation.

When considering the **Scavenger Hunt Facto**r, the winner is the Dry-Stack style of foundations. The Dry-Stack style of foundations is the winner when it comes to just finding he needed materials because most places have some type of naturally occurring rocks suitable for building a Dry-Stack foundations that can be found near the surface of the soil.

When evaluating the 3 different foundation types discussed in this report on the criteria of **Labor** the clear winner is the Gravel Bag rock foundation.

From the standpoint of **Earthquake Resistance** the winner of this comparison is clearly the Old Rubber Tire type of foundation, the Loose Rock style of foundation clearly does not handle earthquakes as well as either Old Rubber Tire foundations or Gravel Bag foundations.

Freezing Resistance is clearly in favor of the old rubber Tire style of foundation, especially if scoria gravel is used to pack the tires.

From the standpoint of **Atmospheric Resistance**, the clear winner is the Loose Rock style of foundation. The Loose Rock style of building foundations will not be effected by oxidation or heat nor will it be susceptible to degradation from exposure to the ultra violet radiation found in sunlight.

When considering the issue of the **Beaty Contest Facto**r, the winner is this category is the Dry Stack style of foundations; however, the Old Rubber Tire style of foundations an offer some pretty cool options for colorful artistic expression.

When considering which type of foundation is the best at lending itself to R**epairs**, the Dry-Stack type of foundation comes in first. The Dry-Stack type of building foundation is the most repairable because few tools are needed, no chemicals need to be mixed or applied, and there is no back-breaking toil involved in a typical repair process.

When evaluating for the factor of **Scalability**, the Old Rubber Tire school of foundation building takes the prize. Yes, it is possible to build large foundations from huge

Author's Note:

If I had to pick one of the two types of foundations evaluated in this writing for my own home I would choose the loose stone type of foundation simply because it is not susceptible to atmospheric degradation. This type of foundation is more susceptible to earthquake damage than a tire foundation, but not having to worry about the materials making up the foundation of my home breaking down over time is a nice feature. If money is a primary consideration than the best option is the Gravel Bag foundation, followed by the Old Rubber Tire style of foundations; however, I would rather pay a little more for something that potentially looks great and I do not have to maintain.

The link to the PDF file posted below features a short comparison between Loose Rock Foundations and Old Rubber Tire foundations. The PDF file posted below is included as a bonus feature or an extra.

Evaluation of Foundations (https://mudman.blog/wp-content/uploads/2017/05/evaluation-of-foundations8.pdf)

Thanks for your time and consideration.

Cheers!

6 thoughts on "How to Cheaply Build a Foundation for Your New Home. Yes, A D-I-Y House Foundation can be Built Without Using Cement, Steel, or Heavy Equipment!" »

Hi Hans,

Nice job on the feasability report! I didn't even know it was possible to make foundation out of rubber. I like the criterion that you have used to evaluate the different types of foundations. I'm not sure if its too safe to use these materials, but hey you've done the research! Things are looking good around here. Again, nice 👍 job!

★ Loading...

Hi Mudman-
A couple questions about packed tire foundations...
1) Why are they stacked in vertical columns, instead of staggered (earthship style)?
2) To avoid issues with exposure to air/sunshine/etc., why not used packed tires for the underground work, and then lay dry-stacked stone on top of them? Only the stone would come up above the ground-level.
Thanks for a very detailed study.

★ Loading...

> Hello Brian,
>
> Foundation tires need to be stacked in vertical columns because if they were staggered, then the gravel would not pack as tightly, and stacking tires in an overlapping fashion potentially also potentially leads to uneven load distribution. Uneven load distribution is a problem in a foundation because it lends itself to structural instability. Another issue with stacking tired in an uneven manner is having exposed pockets of horizontal space in a foundation wall if the tires sit above the ground level. Having pockets of horizontal space in a foundation wall makes sealing the foundation against water penetration, ice penetration, and UV exposure much more difficult; in other words, vertical columns lend themselves better to painting and sealing. Also, draping sheets of EPDM over a tire foundation wall that is made from staggered tires will not be as easy.
>
> As for just using rubber tires for all of the below-ground portions of a building foundation and then using one or two layers of dry stack rock for the portions that are exposed to the atmosphere, that is a great idea. I had also thought of building hybrid foundations that incorporate ribber tires for everything that is buried and dry stack rock for everything that sits above the dirt, but I never got around to putting that information into my article, but I will look into doing that

Thanks for the comment, I hope my information is helpful.

Hans L.

★ Loading...

This was interesting to learn. I bet this article will help all the people dealing with floods around the world right now. Cheers.

★ Loading...

How about building a small 16×16 foot tiny house, using 5 gravel filled tires (one in each corner and one in the middle), building with wood or straw bales, then fitting dry-stack stones around the periphery between the structure and the earth. The tires will hold up the building, be sheltered from the elements, the dry-stack rocks will prevent wicking and be pleasant to look at. This would be the cheapest to build and repair since around here in the Los Angeles area, tire shops have to pay to dispose of old tires. In fact, I got a shop owner to pay me for gas to take away used tires.

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Hello Vasken,

Your idea is good, but I believe it would take more than five tires to make this project work properly. To do it right you would need to sink at least three tires, and perhaps 4 in each location, so ti would realistically take around 15-20 gravel-filled tires to make a truly deep and solid foundation for the tiny homes that you are envisioning, but this process would still be cheaper than using cement to make a foundation.

I would also recommend covering any old tires that are exposed to atmospheric oxygen with a coating of earthen plaster and lime.

Please feel free to contact me if you have any further questions.

Thanks,

Hans L.

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