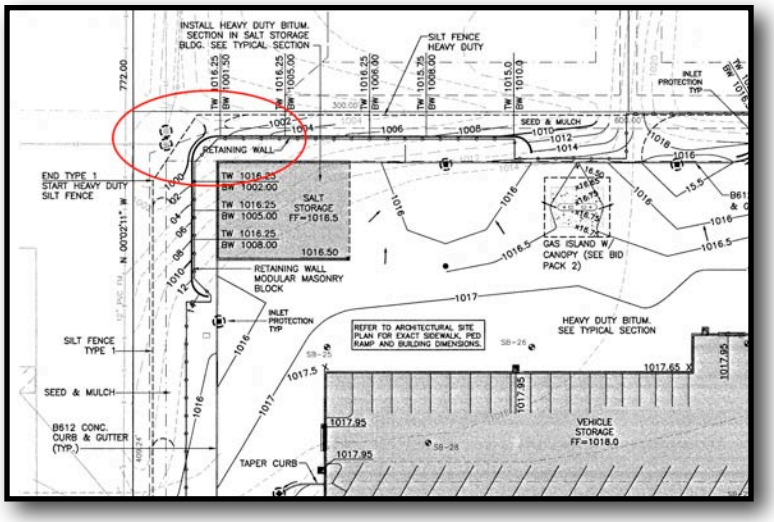
Design Parameters

Wall Geometry

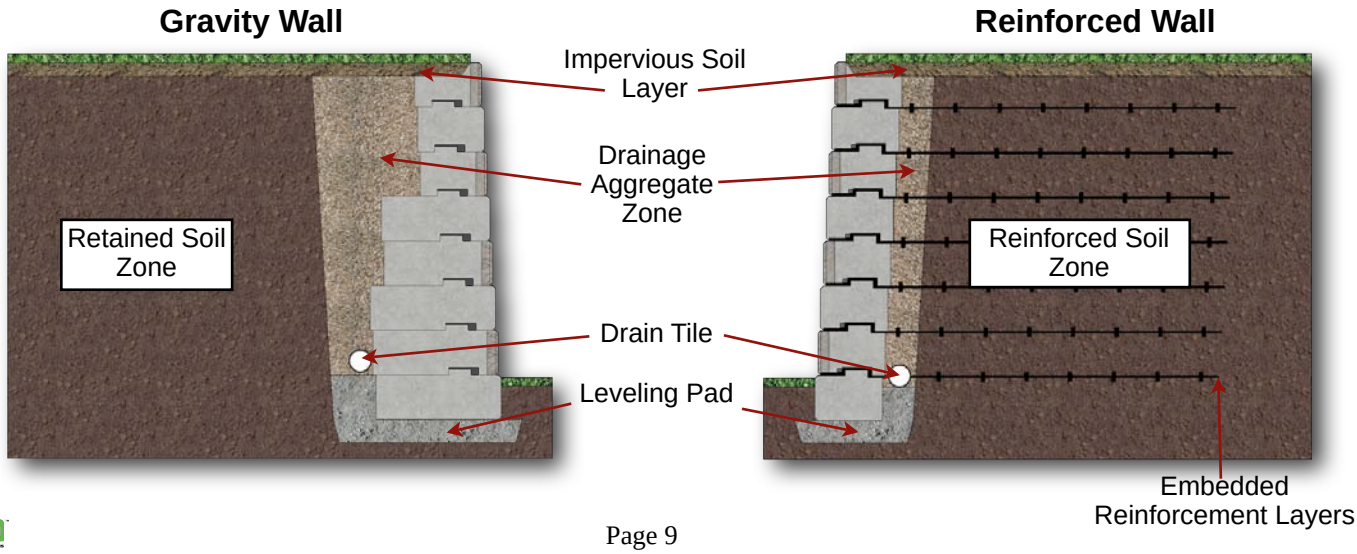
When planning a ReCon retaining wall, the most logical place to start is the wall location and where it resides with reference to the project site and topography. For most commercial projects this information is usually found on the site-grading plan. A great deal of the information necessary to properly design a ReCon retaining wall can be found there. In addition to the calculation of wall heights and lengths, designers study this plan in order to gather information about adjacent structures, surcharges, site access, property lines, utility locations and site drainage. All of these factors influence the final design and construction of a ReCon retaining wall.



For projects that don't have a formal site-grading plan, wall designers still need this information to be gathered, even if perhaps in a less formal way. Regardless of the source, access to this information is critical to proper design; determination of unit types; and the formulation of accurate unit quantities and cost estimates.

Soils Information

Segmental retaining walls (SRWs) are by definition a soil structure with a modular and mortarless aesthetic facing. In some cases, the facing itself can provide sufficient resistance to natural soil forces and potential wall movement. When this is true, the wall is commonly referred to as a "gravity wall". **The ability to construct taller gravity walls is one of the key advantages of the ReCon Series 50 retaining wall system.** How and why ReCon can achieve these heights will be addressed in the appropriate sections of this manual. When the mass, footprint and other properties of the facing units are insufficient to restrain movement of a given segmental retaining wall structure, soil reinforcement is introduced to the soil mass behind the wall to increase stability. These composite structures are commonly referred to as reinforced segmental retaining walls or "MSE walls", which is an acronym for "mechanically stabilized earth".



If soil is a main component of an SRW structure, then it is necessary for wall designers to know and understand the properties of these soils. Soils come in a “near infinite” number of types and compositions. In commercial projects, SRW wall designers often learn about the properties of the soils on a project site from a Soil Boring Log. Knowledgeable civil or geotechnical engineers evaluate this information in order to predict a completed SRW’s performance. In the absence of detailed soils information, wall designers must make some assumptions about the soil properties in order to proceed. When assumptions about soils must be made, they are usually, and should be, conservative in order to preserve the necessary safety factors for wall integrity. There are some soils that should never be used in a SRW. A detailed discussion of all soil types and properties is beyond the scope of this manual. The determination of particular soil suitability for use in a SRW rightfully belongs within the realm of a trained and experienced civil or geotechnical engineer.

The soils that are of critical interest to a wall designer are categorized into five basic “zones” with respect to their location in and around the finished wall.

1) The *leveling pad* is not really a zone, per se, but is an integral and necessary part of a well-designed, well-built SRW. It consists of a material similar to that of road gravel that allows for drainage, but also contains enough fines to allow it to compact well and “hold its shape”. Class 5, ¾” minus, crush & run and road base are some of the regional names given to this type of material. The dimensions for the leveling pad vary and are discussed elsewhere in this manual.
2) The *drainage zone* is typically an imported, well-draining crushed rock material that fills the voids in and around the facing units to a minimum depth of one foot behind the back of the facing. This zone functions as a “French drain” to transport water otherwise trapped behind the finished wall to a drainage collection or dispersal area. This material should be relatively free of fine-grained materials and also should be “self-compacting”. This eliminates the need to operate compaction equipment in close proximity to the back of the wall facing.
3) The *foundation soil zone* comprises the area immediately beneath the facing components and drainage zone and is responsible for providing adequate support for the weight of the retained wall above. If the wall is a reinforced SRW, the foundation zone also extends beneath and behind the wall to a distance roughly equal to the depth of the embedded soil reinforcement.
4) The *reinforced soil zone* only exists in MSE walls and extends from the back of the drainage zone to an embedded depth equal to the back of the geosynthetic soil reinforcement. This soil may have its origin on-site or it can be a “select fill” material brought on-site from elsewhere. The properties of this material strongly influence the performance characteristics of the reinforced soil mass and, as such, have a significant effect on the strength, length and quantity of soil reinforcement in the finished wall. Ultimately, the design of a finished soil-reinforced wall is greatly affected by the material confined within this soil zone.
5) The *retained soil zone* is the material either behind the reinforced soil zone, in the case of a soil-reinforced SRW, or behind the drainage zone in a gravity retaining wall. Soil characteristics within this zone also have a significant effect on the design of the finished wall in the same way that the reinforced soil zone does.

Unit Characteristics

There are a number of characteristics of the wall facing units themselves that contribute to the final SRW wall design.

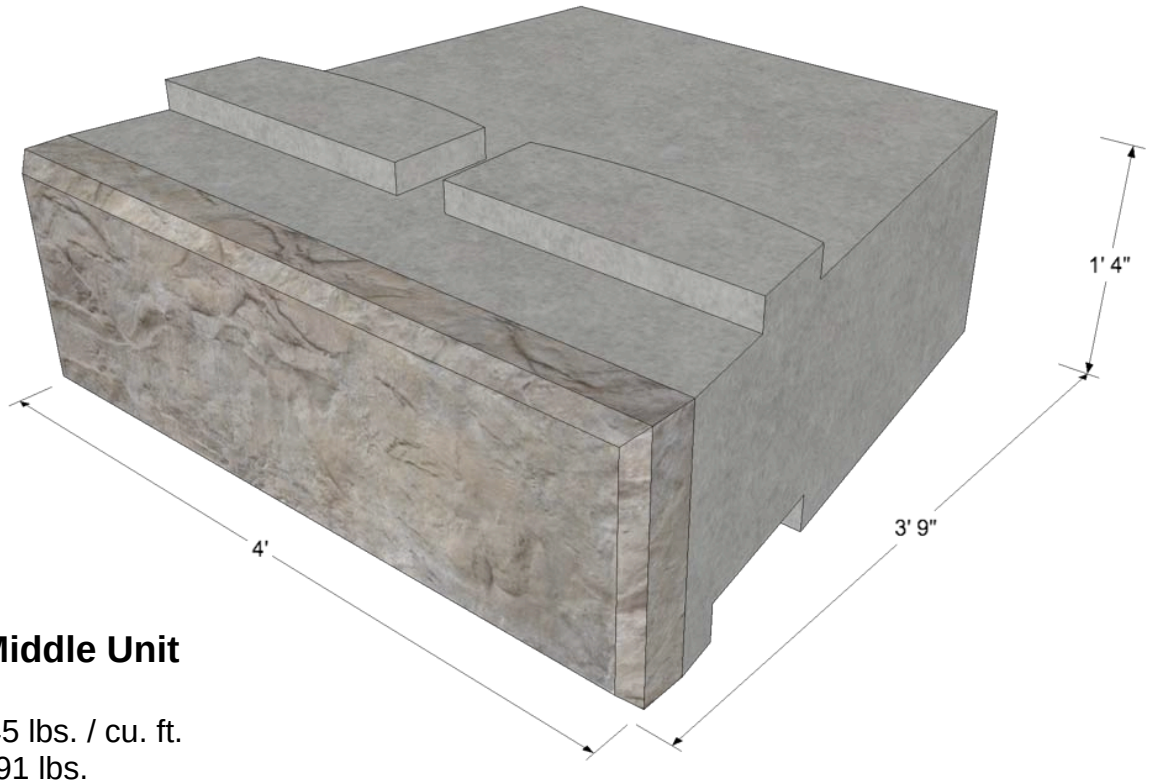
1.Dimensions
- A.Height
- B.Width
- C.Depth

2.Weight
- A.Volume
- B.Density
- C.Center of Gravity
- D.Infill Weight

3.Unit Setback / Wall Batter

4.Durability

These key characteristics are listed in the ReCon shapes chapter.



45” Full Middle Unit

Density - 145 lbs. / cu. ft.
Weight - 2491 lbs.
Volume - 17.18 cu. ft.
Batter - 3.6°

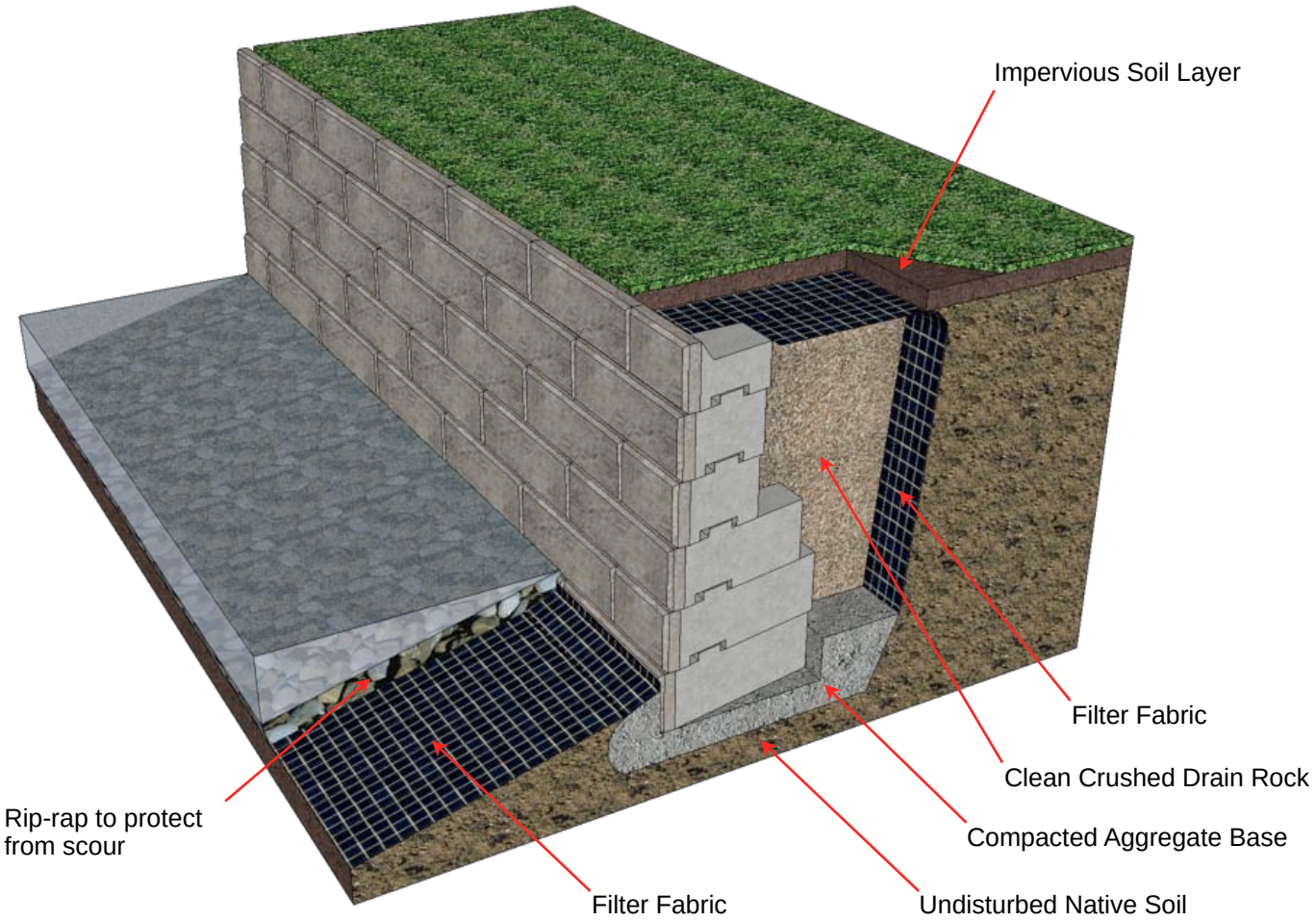
Water / Drainage

Most problems associated with SRWs can be traced back, directly or indirectly, to water. The presence of water, whether or not anticipated, affects soil mechanics and places extra strain on a finished wall. Water trapped behind a wall greatly increases retained pressures. A high water table can weaken foundation soils to the point where they are unable to continue to support the wall. Moving water over the top or along the bottom of a finished wall can erode away the soil to the point where the wall becomes unstable and must be rebuilt. Finally, drainage must be considered during the construction period as well as when the wall and final grading is completed. Water “traffic” on an unfinished project site can be entirely different than what is designed for and intended on the completed project. In short, the presence of water accentuates weaknesses in wall design and/or construction. As such, care must be taken to avoid these water issues when designing and installing a ReCon “Series 50” retaining wall.

By the same token, ReCon “Series 50” units are an excellent choice for the unique challenges that water applications present. The durability, mass, footprint and specific gravity of a “Series 50” wall enables designers to comfortably tackle these applications.

Shoreline or seawall retaining wall applications are unique and should be treated as such. The design for these applications can vary significantly. Consult a qualified wall design engineer for these situations and make sure to check all governing code requirements.

The following diagram illustrates some of the special construction and design elements of a typical water application.



Surcharges

When a SRW is exposed to additional loads, whether permanent or temporary, the overall wall design is affected. Usually, when a structure, building, roadway or top slope is within twice the height of the SRW wall face, its impact on the stability of the wall must be evaluated. This is only a general rule based on the most common soil types. Wall design engineers must consider many other factors which may adjust this proximity formula.

Surcharges may stabilize or destabilize a ReCon wall, depending on their type and / or relative proximity to the wall.

By definition, surcharges are usually classified as a “live load” or “dead load”. A live load is generally temporary in nature. An example might be a fully loaded semi truck traveling along a roadway within close proximity to the finished SRW. Because it is by definition temporary, any stabilizing contribution of a live-load surcharge is usually ignored. Ultimately, this results in a more conservative design with an improvement in the overall safety factors for certain aspects of the wall design.

A dead load, by contrast, is intended to be permanent. Although it will increase stresses on the wall depending on its type and proximity to the wall, it can also contribute to certain aspects of wall stability. Examples of a dead load could be a slope above the wall that adds the extra weight of the soil mass and must be accounted for in the wall design; or it may be a building exerting additional weight through its foundation or footing. Another common type of dead load found on SRW sites results from wall terracing. When a second (or third, etc.) SRW is built above another it needs to be evaluated to see if it is imposing additional stresses on the wall (or walls) beneath it.

Terraced Walls

Terraced walls are a common feature in retaining wall applications. From an engineering standpoint, these walls must be treated as a single composite structure if their proximity, in conjunction with other site and soil parameters, is such that an upper wall places additional load or stress on the wall (or walls) below.

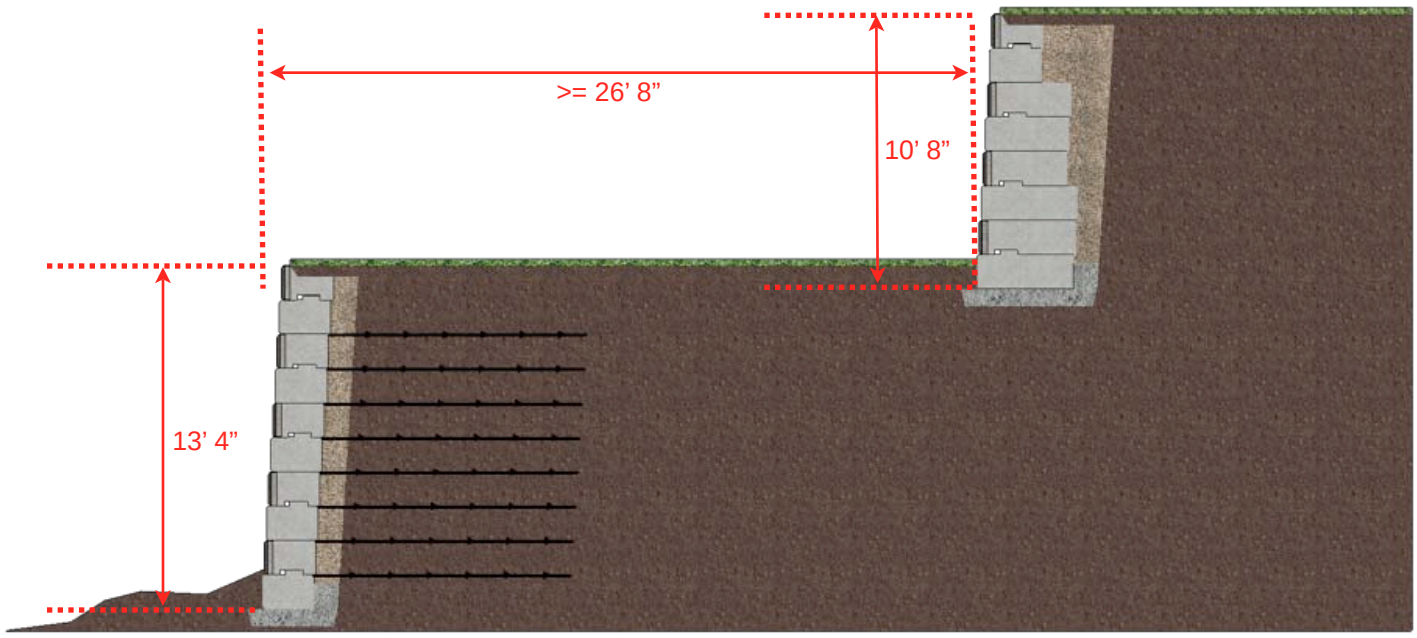
Most terraced walls may be considered independent of each other if they meet the requirements of the following rule of thumb.

Terraced Wall "2:1" General Rule

"Terraced walls may generally be considered independent of each other if… 1) the height of the upper wall is less than or equal to the height of the lower wall and… 2) the distance between the two walls is at least twice the height of the lower wall."

This general rule may not apply if soils are very poor, if toe or crest slopes are involved, or if there are additional surcharges present.

Terraced walls that do not meet the "2:1" rule usually require additional mass and / or soil reinforcement incorporated into the lower wall design in order to resist the additional stress incurred from the upper wall or walls.



Terraced Wall Example