

Overview:

This whitepaper discusses different mechanical mounting methods, the “perfect” plane for drivers and driven equipment, mechanical device chocking, and modern mechanical chocking solutions.

Understanding Different Mechanical Mounting Methods

Liners. Liners are blocks of steel or stainless steel that are milled to match the machine foot to the foundation/skid. The requirements for a successful installation is a ‘bluing’ of surfaces wherein a successful installation is a minimum of 75% contact on both sides of the chock. Typically, this configuration is achieved by milling the foundation flat or at a 1 degree taper. The installation is typical for many applications where there is a concern of environmental forces, such as blasts and other combatant duty in a military application. These applications do not consider cost as the primary issue – military applications have to get the mission accomplished while getting the crew home.

Shims. Shims are a lamination of thin materials that accommodate the differences between the foundation and machine. Commercially this is the most prevalent method of machinery mounting. It is a trial and error method of mounting that is low cost for the materials but typically causes the most problems in the field. If the foundation is not flat, the probability of long term success is marginal at best. Factually, with all its problems for low power units (100kW) or less it probably the best solution.

Poured compounds. Poured compounds have been adopted for a significant population of larger mass rotating machinery. From grouts (concrete) to epoxy resins, these poured compounds are by definition the ‘perfect’ chock. When properly mixed, poured and dammed, they fill the void from foundation to the machine foot. However, their restrictions are load. Load from clamping force must be calculated and applied per the manufacturer’s guidelines. The installers must be trained, and the products are not reusable. Special care must be made for transported systems. Once cured, they do not accommodate any changes. Plus, there is a service life for these products. These are good products for larger systems where stiffness is not essential for the equipment.

Mechanical Chock. Simply put, these consist of a threaded system that locks in place to create the mounting plane for the equipment. The mechanical chock was first patented in the US in the 1870’s. A problem was / is that mechanical chocks are not easy to manufacture and require a volume of sales to make them an economical solution for the whole marketplace. There are many configurations of mechanical chocks wherein the favorable characteristic is that they are reusable; however be cautious of

Please note each method is vastly different and has some sort of limitation. For example, mechanical chocks need to have their base part fully supported, and there are height and diameter considerations. While epoxy resins have load limited characteristics with height restrictions, liners generally have no restrictions. However, they are extremely expensive to manufacture and unique to install.

“mechanical chocks” that include an outside device to lock the chock in-place. These styles are not reusable. When “out-of-the-box”, they are not cheap. However, when considered by the equipment shareholders and stakeholders, they are often the lowest cost solution for the lifecycle of the machinery from the production line until time of obsolescence. Again, the chocking method is part of the whole mounting system. The machine is usually provided flat; the foundation is usually not. The chock is the interface. The system accommodates the perfect-to-the-not-so-perfect while creating a coplanar surface for the equipment.

Mounting on a “Perfect” Plane

Whether we specify a fabricated foundation or a concrete mass, we need a “filler.” The filler is called a liner, chock, or shim, and these items are used to match the “perfect” component foot with the “perfect” foundation. As an industry, we see on our computer monitors from manufacturers of equipment and steel suppliers – it’s all perfect. Just add in the fill (see Figure 1 below).

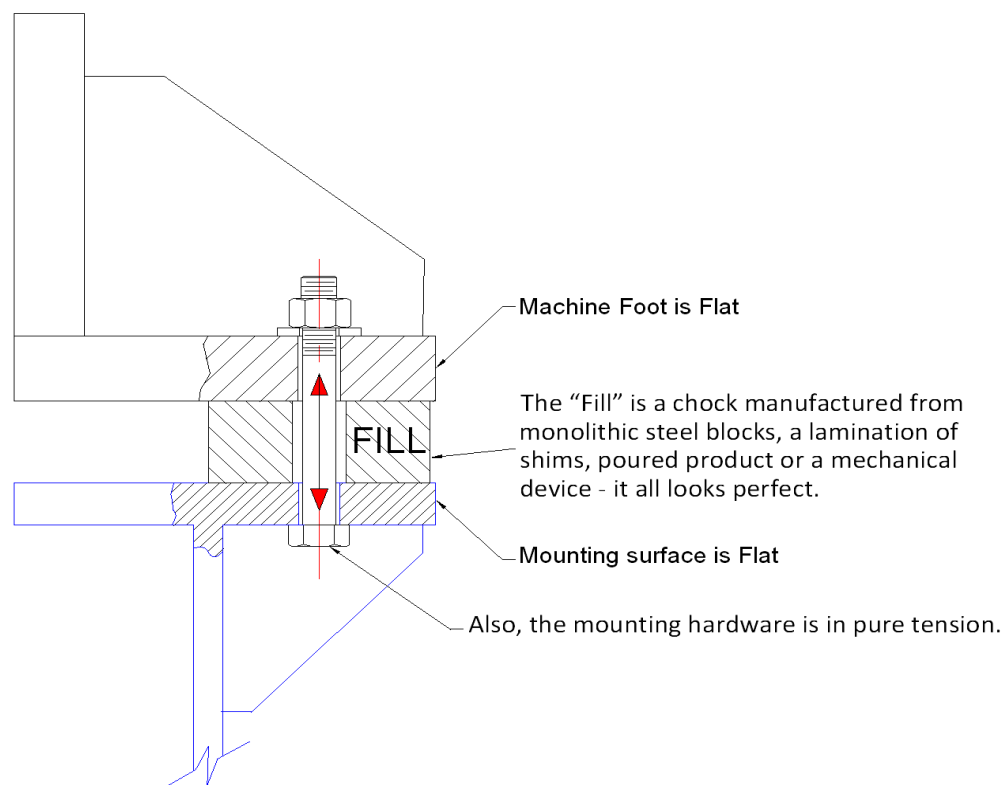


Figure 1.

Figure 1 depicts all components in the system such that they are all in plane and aligned. The whole system is perfect! With such a design we expect long life and little maintenance. We wish this were true, but this is as real as unicorns and fairy dust. **The reality is that the system transmits energy from the driver or driven machine through the filler, hardware, and to the foundation.**

Figure 2 below shows how step shimming as a means of machinery mounting is not always the best method. While in some applications this form of mounting may be ‘good enough’, the days of having low power with heavy weight systems at low power ratings are no longer commonplace. **The Field Reality is** that the system will start to breakdown (even though you had a perfect plan).

What happened? Soon after start-up, the system operates with minor **vibration**. The mounting bolt has loosened, causing the shims to “walk”. If the application has poured chocks, they are cracked or pulverized. If this is a system with mechanical chocks, they will appear to loosen.

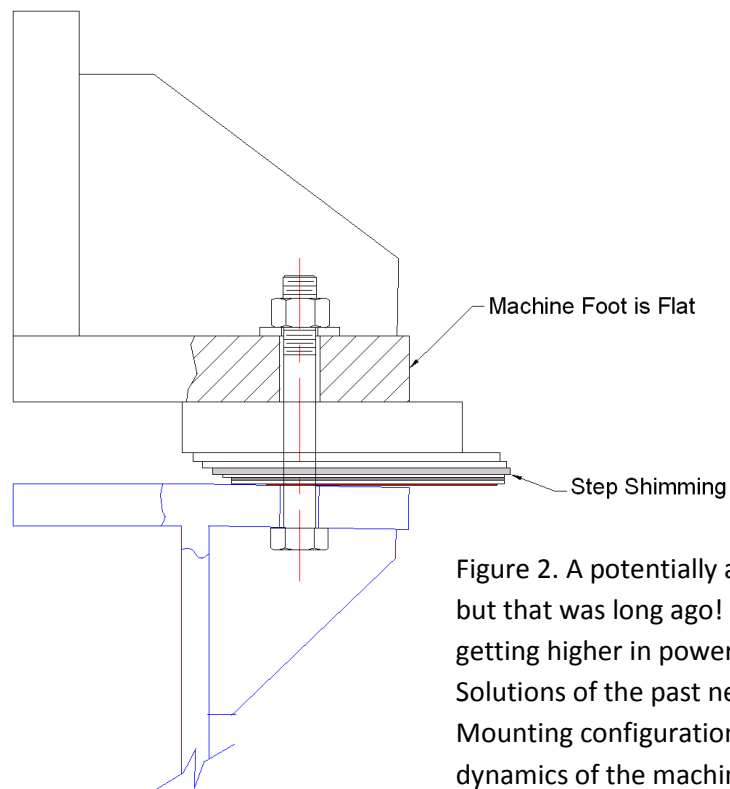


Figure 2. A potentially acceptable configuration – but that was long ago! Machines have been getting higher in power with a smaller footprint. Solutions of the past need to be revisited. Mounting configurations need to be stiff for dynamics of the machine and stability of the foundation structure.

Let’s examine the mounting system. In many cases, the problem is not with the rotating machine. The equipment provided is stiff, the unit is fabricated with a good plane relative to the CG of the machine, and fastener surfaces are adequate for perpendicularity and parallelism.

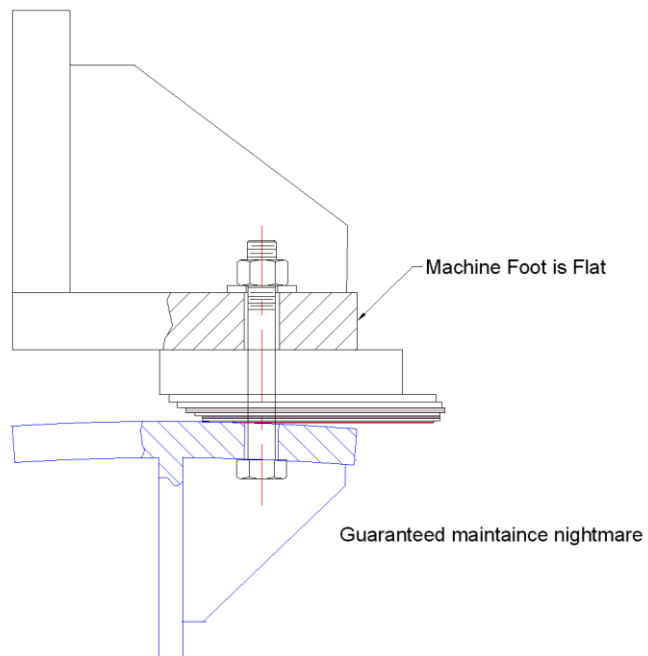
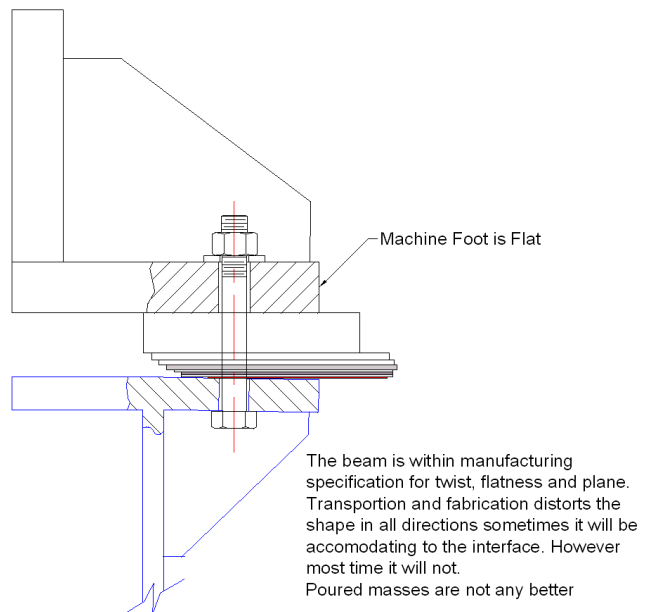
Figure 3 below shows unreliable shim installation. The real problem is the angular offset of the beam that is within tolerance for the beam fabrication. Skid fabrication may make the situation more challenging, and coupled with welding in a gusset, this typically pulls the mounting plan further out of plane.

Why is this a Problem?

- If the shims are perfect, they will walk out.
- If they have burrs, debris between layers, or if they are bent, they will walk out more quickly.
- If epoxy resins or grout are used – they will fail.

It may not be due to the shims or the trimming needed to eliminate the soft foot. It may not be a poor mix of the chemicals. It could be the bolt! We will get to those problems later on, but let's concentrate on the chock.

Chocking creates the perfect mounting plane for the equipment. The perfect and strong mounting plane not just for the commissioning and warranty period, but through the lifecycle of the equipment.



Machinery Chocking Solutions

The reason for discussing machinery chocking solutions includes cost to manufacture, cost to maintain, and lifecycle costs of the critically aligned or critically positioned machine.

The below scenarios are generally the same for most types of applications. The assumptions are that the machine foot (or rail) is flat, and the foundation has some type of contour. The contour is created from beam manufactures, welding, transportation, and /or stresses from mounting the skid in the application.

Please note our experience with these scenarios disqualifies poured compounds as chocking solutions for seriously rigorous duty applications.

The objective of chocks, liners, shims, and fillers between a machine and its foundation is to:

- Give the machine a good base that will transmit the reactive energy of the machine into the foundation. The foundation gives the component something to push against while it transmits force for its primary work. The work of turning generators, gears, or other shafts is the purpose of the machine. Permitting the machine to operate effectively is the mission of the chocking system.
- Reduce the manufacturing cost of the foundation. If milling foundations were easy, cheap, and sustainable, there would be no need for chocking elements. Everything would be hard-mounted directly to the foundation; however, the reality is that the final fabricated skid / foundation that is transported to the field and tightened with its mounting and interface systems will not match the engineered plans.

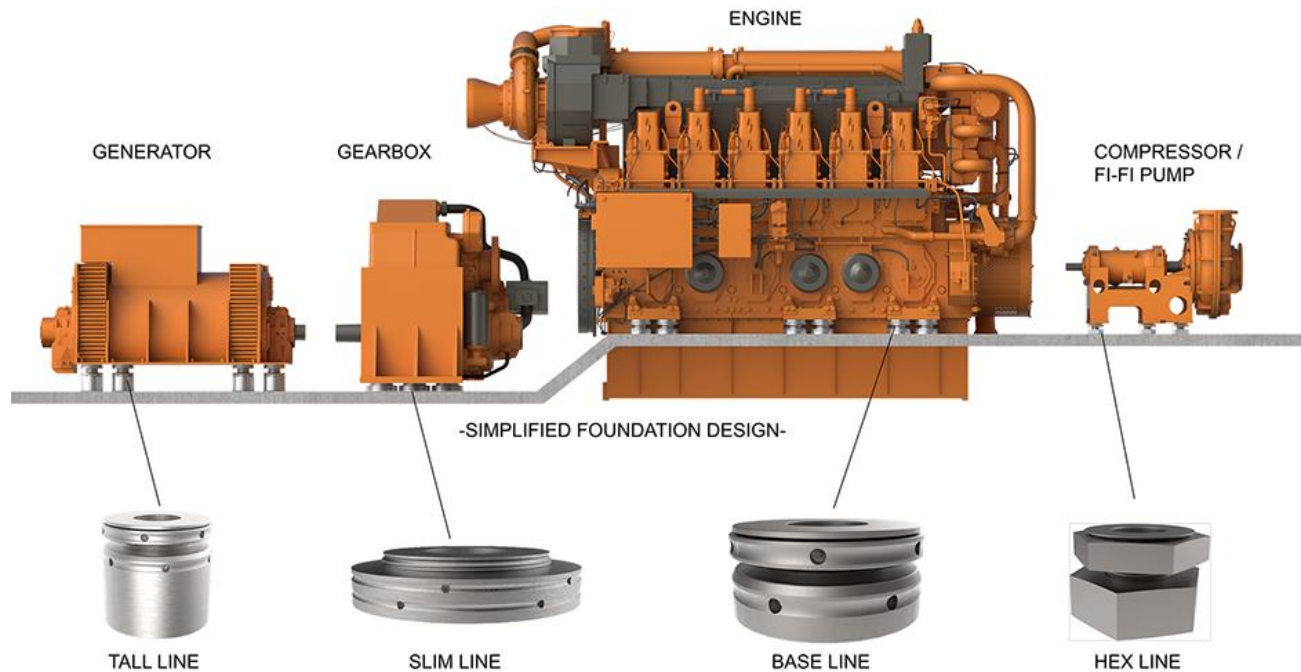
A term used to describe the final installed configuration problem is “**soft foot**”. Soft Foot will destroy the machine, which is why Machinery Mounting Solutions promotes a reusable system that achieves zero soft foot.

The RotaChock

The RotaChock is an adjustable, self-leveling and reusable equipment mounting chock. The RotaChock is a blend of engineering and years of field experience to produce a strong, stiff and elegant device to end machinery soft foot.

The core technologies are from diverse backgrounds of applications that are time-tested and standardized under a variety of technical organizations and societies. We package these successful techniques differently and have made the RotaChock the easiest mechanical chock to install and reuse.

We have blended technologies to evolve mechanical chocking and proudly present a technically superior product. The RotaChock can be provided in a variety of configurations to suit the application, and can be manufactured in a variety of materials to suit various applications and environments.



The technical approach for the development of the RotaChock was to create the highest load rating viable while using the lowest yield strength material required by industry (316 Stainless Steel per API Guidance). Our approach means the normal carbon steel and alloy steel chocks have an even greater margin of safety over and above the stated chock ratings. The RotaChock is easy to install and can be adjusted with a variety of hand tools usually available in the field. Also, the RotaChock needs to be reusable. The ability to readjust the mounting plane to accommodate modularity of machinery, settling of the foundations and machine wear is an essential element to lowering life cycle costs of machines.

Conclusion

We did not discuss foundation stiffness in this paper, but it must be the primary issue when examining the whole system. Torsionally weak foundations will be a problem no matter what the application or environment; these issues will not be fixed by any chocking method.

There are many acceptable techniques for mounting machinery, but it is critical to consider the application. There are many styles of mechanical chocks in the marketplace, so make sure to examine them all before making your decision. If you have any questions, call us toll free at 877-460-0050.

About Machinery Mounting Solutions

Machinery Mounting Solutions is a design and manufacturing corporation that creates rigid mounting chocks for marine, industrial, pipeline, processing and transportation machinery. Learn more at www.machinerymountingsolutions.com.