

DARMANI GRAIN STORAGE

HOPPER BIN and FLAT BOTTOM bin - FOUNDATION RECOMMENDATION

A. Recommendations

Both the Flat and hopper bin foundations must function as a structural unit in order to distribute the load safely from the either the steel hopper base (hopper bin) or a Steel floor/concrete pad (Flat bin) to the subgrade . This can only be achieved if the **proper granular base foundation is used in combination** with an engineered concrete pad /pilings or a **Heavy duty** structural steel skid foundation or a Steel bin floor.

Removal of topsoil, organic material and very soft subgrade materials is critical to bin foundation performance. Upon excavation, the ground should be proof rolled and any material that experiences significant rutting or deformation should be removed, bins should be bases on a stiff subgrade.

Inadequate drainage is considered to be a major contributing factor to potential failures. Ideally, bins should be constructed on high ground where natural drainage carries rainfall away from the bin foundation. As a minimum, the base must be constructed above natural grade, not below. Prior to construction of the base, the site should be cross-graded or crowned to prevent future accumulation of rainfall in the foundation area. Under no circumstances should bins be constructed in areas where the natural ground is below the seasonal water table (i.e. Sloughs)

Granular base course meeting the Saskatchewan Highways Specification 3505 is suitable material. **Preferably Type 33**, or alternately Type 31 or 35 base course is appropriate. Each 6" lift of the base material should be uniformly compacted to be 98% Proctor (SPMDD). The minimum thickness of the granular pad should be 12 inches for the 18 and 19 foot diameter bins with a min. 18 inches for the 21-27 foot diameters.

Type 33 consists of an intimate mixture of course aggregate, sand, clay and water. The final surface of the compacted base must be very level in order to prevent eccentric loading of the steel hopper base. A maximum differential of $\pm 1/4$ inch is

recommended under steel hopper base. The base surface should be shaped until condition is achieved.

B. Guidelines for FOUNDATION and construction crews

It is understood that the majority of these bins will be constructed without engineering. While DARMANI is not liable for any damage which occurs due to insufficient engineering, this section is intended to provide some partial suggestions that will help installers construct foundations within the spirit of the recommendations in the preceding section. Notwithstanding any recommendations contained herein, DARMANI recommends that any bin foundation should be inspected and approved by a qualified civil or geotechnical engineer.

B1.1 Site Clearing

Removal of topsoil or organic material can be achieved using dozer, bobcat or front end loader. If the soil underneath the topsoil is very wet or soft, such that the dozer, bobcat or front end loader causes significant rutting, then it may be necessary to over-excavate or to dry the native material. Drying can be achieved by discing or cultivating the area and then re-compacting it.

Visually check to ensure that surface water had a natural path to flow from the bin area and then check that the cleared surface slopes gently towards the surface water outlet. It may be necessary to do some grading or ditching to achieve positive site drainage. This check can be accomplished using a straight piece of lumber and carpenter's tool.

B1.2 Subgrade proof roll

Once the subgrade is shaped, it should be proof rolled to check for soft spots and weak materials. Use a loaded front end loader or moderately loaded grain truck and slowly drive back and forth across the subgrade area to detect soft areas. Remove any materials that rut or defect more than 1 inch.

B1.3 Base Course Selection

The quality of the base course is one of the main success factors for bin foundation. Any local gravel supplier who contracts to the provincial highway authority should recognize and be able to supply a suitable material. **Request Type 33 base course** and ask the supplier to test results of this material. Pit run is not suitable material and without test results, it is difficult to be confident the aggregate meets the base course specifications.

B1.4 Base Course Placement

A smooth drum packer with vibratory capability is the optimal equipment for base course compaction. Using loaded trucks or other farm machinery is a practice that has a history of unsatisfactory performance in terms of inadequate compaction and non-uniform compaction.

The following guidelines are recommended:

- The base course should not be so dry that it is dusty and not so wet that it feels “greasy” or that there is free water. Add water if too dry and use a disc/cultivator to promote evaporation of too wet.
- It is **not practical** to compact thick granular layers. Place about 6 inches thickness of material maximum compact. Repeat 6 inches lifts to minimum required thickness.
- Extend the base course beyond the edge of the steel hopper base a distance of > 2 feet plus the end slope. For example, if pad is in a circular formation, a 24’ cone requires 33’ compacted area in the bottom lift, 30’ on the middle lift 27’ on the top lift.
- For each lift, run **the packing equipment** across the back until the entire surface has had one pass. Avoid the concentrated compactive effort (i.e. More passes of the packer in one area compared to another), as this is potentially dangerous. Repeat with additional passes until the layer feels quite firm and doesn’t deflect under load.
- Compaction to 98% Proctor is critical to foundation performance. It is difficult to assess this without quality assurance testing. Visual or empirical rules (i.e. Resistance to excavation, deflection under load) provide qualitative indications of compactive effort; however, this can be misleading depending on various environmental factors.

B1.5 Level check

Locate the centre of the proposed bin foundation. Use a straight piece of lumber which is about half as long as the bin diameter and carpenter’s level. Pivot the lumber from the centre and check the uniformity of the elevation under the foundation rings using the carpenter’s level. Note the high and low spots and then raise the low spots with additional gravel. Compact as required.

B1.6 Site Grading

Ensure that the site is final graded to promote drainage away from the bin grade.