

## 2021Q16

## (MINIMUM AREA, PRESSURE)

When erecting wind turbines, One Energy considers more factors than just the weight a crane can lift. It is also necessary to consider the pressure the ground beneath the crane can support. This is called the *ground bearing capacity*. The *ground bearing pressure* is the pressure exerted by the machine on the ground, which can be found using:

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

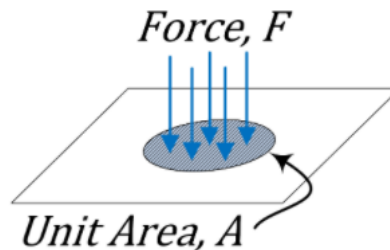


Figure 1. Pressure is force per unit area.

Sines, Jeff, *Engineered Software Knowledge Base, ESI*, <http://kb.eng-software.com/eskb/pipe-flt/general-theory-and-equations/total-and-static-pressure>

To avoid exceeding this capacity, it is necessary to distribute the weight of the crane and its load using a crane mat made from timber or similarly strong material. The purpose of the crane mat is to enlarge the area that the force is acting on, thereby decreasing the pressure exerted on the ground, as seen in the diagram below. Where B is the original area of the tire acting on the ground, and B' is the enlarged area due to the timber mat.

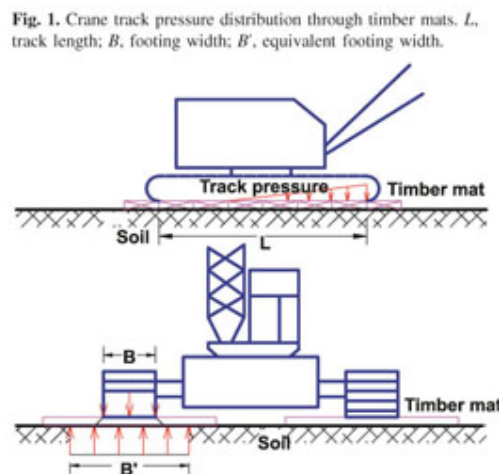


Fig. 1. Crane track pressure distribution through timber mats. L, track length; B, footing width; B', equivalent footing width.

Liu, Xiteng, et al. "Bearing capacity of soils for crawler cranes." *Canadian Geotechnical Journal*, vol. 45, no. 9, 2008, p. 1282+. Gale Academic OneFile

For all questions, assume an even distribution of force.

**Level 1:** Given 212,422 lbs. of force and a ground bearing pressure of 3000 lbs./sq ft., what is the area of the smallest crane mat that will satisfy the ground bearing capacity?

**Level 2:** A crane weighing 211,644 lbs. lifts a load of 100,000 lbs. The ground bearing capacity for this site is 2,000 lbs./sq ft. Is a crane mat with an area of 82 sq ft. large enough to distribute the load properly?

*A crane mat in use*

