Working Platforms and Equipment Support Mats

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Sponsors: CGPR

Start/Completion Dates: August 2015 / April 2017

Project Background
Each year, rig tilting and overturning on construction sites results in risk to worker safety, damage to equipment, and schedule delays. The cause for rig instability is bearing capacity failure of the subgrade soil underlying the rig as seen in Figure 1.

![Overturned Rig due to Bearing Capacity Failure](image)

Figure 1: Overturned Rig due to Bearing Capacity Failure

In combat rig tilting and overturning, working platforms (layers of compacted granular material, which may include one or more layers of geosynthetic reinforcement) and equipment support mats (timber mats, metal plates, and fabricated metal mats) are commonly used on construction sites to support heavy equipment on weak subgrade soils.

Project Objectives
The three principal objectives of this research are listed below:

1. Locate useful existing documents and calculators pertaining to the design and installation of working platforms and equipment support mats
2. Summarize the obtained information
3. Prepare worked out design examples

Design Overview
Working platforms and equipment support mats used to support heavy construction equipment
are designed using separate criteria, but both require the bearing pressures due to construction equipment loading to be known. Bearing pressures are determined by simplifying distributions of pressures due to crane weight and activity to concentrated point loads acting at their centroids. A resultant force and location is determined using load and moment equilibrium, which is then used to calculate trapezoidal or triangular bearing pressures. The method proposed by Meyerhof (1951) is then used to transform the non-uniform bearing pressures into equivalent uniform bearing pressures with shortened equivalent bearing lengths, which are then used in working platform or equipment support mat design.

Working platforms are compacted, layers of granular material that overly weaker subgrade soil. Geosynthetics may be used to act as a filter between the working platform or provide additional resistance by being placed at lower depths in the working platform. The working platform is designed assuming a punching shear failing mechanism, which is the shear stress required to cause bearing capacity failure in the subgrade soil and punch a vertical plane through the platform material. The final result of working platform design is the determination of a working platform thickness that will provided a required surface resistance to support heavy crane equipment.

Equipment support mats are steel plates, orthotropic sections, or fabricated mats that are designed based on an effective bearing length. The effective bearing length is the section of the mat that is in contact with the ground and contributing support to the equipment loaded onto the mat. This method determines the effective bearing length based on the allowable bending strength in the mat, allowable shear strength in the mat, allowable bearing pressure of the soil, and deflection of the mat. The effective bearing length is then used to determine the capacity of the mat.

Equipment support mats may overly working platforms to optimize design. The working platform is first designed to support lighter equipment on the construction site and then moveable equipment support mats are designed to support heavier construction equipment.

Research Plan and Progress

The research completed tasks are listed below:

1. An excel spreadsheet by the Federation of Piling Specialists (FPS) was obtained to determine the pressure acting on the subgrade soil due to equipment loading.
2. A document titled “Working platforms for tracked plant” by the Building Research Establishment (BRE) and the Federation of Piling Specialists (FPS) was obtained to outline working platform design procedures.
3. The *Mobile Crane Support Handbook* by David Duerr was obtained to outline equipment support mat design procedure.
4. The excel layout and procedure used by the Federation of Piling Specialists excel spreadsheet was explained.
5. The design of working platforms prescribed by the Building Research Establishment and Federation of Piling Specialists was summarized.
6. The design of fabricated mats prescribed by David Duerr was summarized.
7. The design of steel plates and orthotropic mats was established and summarized using the same ideology as David Duerr.
8. The design of equipment support mats overlying working platforms was established and summarized.
9. A design example for determining bearing pressures using the Federation of Piling Specialists excel spreadsheet was worked out.
10. A design example for a working platform was worked out.
11. Two design examples for equipment support mats were worked out, one for a timber mat and the other for a steel plate.
12. A design example for using equipment support mat overlying a working platform was worked out.