ABSTRACT

This paper discusses aspects of terramechanics and mobility that are applicable to the operation of tracked trenchers on very soft clays. A mobility envelope approach is presented (based upon the failure envelope approach for surface footings under combined loading) and a method for comparing traction requirements and soil resistance is outlined such that the operability can be defined for particular conditions. Successful operation of the trencher requires that the combined vertical, horizontal and torsional loads must always lie on, or within, the mobility envelope. In addition to demonstrating a rational approach to determining trencher mobility in very soft soils, a possible framework for the selection of operational limits and load/resistance factors is discussed.

KEY WORDS: Terramechanics; Trencher; Mobility; Soft Clays; Skid Steering.

INTRODUCTION

Tracked subsea trenchers equipped with jetting or cutting systems are used to bury pipelines and cables. The mobility of these trenchers may not be adequate in soft soils even if the static bearing capacity of the trencher is adequate. Good mobility requires both sufficient traction and sufficient bearing capacity if the trencher is to progress steadily. Lack of mobility and/or total immobilisation requires recovery and repositioning of the trencher with the associated impact on trench quality and time loss. Mobility problems are not uncommon in the offshore industry. This paper discusses aspects of terramechanics and mobility that are applicable to the operation of tracked trenchers in very soft clays. It concludes by developing a mobility envelope approach such that the operability can be defined for particular conditions.

TRENCHING EQUIPMENT

CTC Marine Projects operates various subsea tracked trenchers, of which the T3 is taken as an example (Figure 1). The T3 has been designed and built by SMD Hydrovision for the trenching of pipelines, flowlines and umbilicals. The T3 has the ability to bury pre-laid pipe, flowlines or cables in soft/sandy seabed conditions by means of its jetting or cutting system. Two jetting swords attached at the rear of the machine fluidise the soil around the product causing it to be lowered below seabed level. The T3 tracks may be fitted with grousers that are approximately 10cm x 10cm. Further details of the T3 are given in Table 1.

Figure 1: Photograph of the T3 (in cutter mode)

This type of trencher is called a “track laying vehicle” which for brevity is usually abbreviated to “tracked vehicle”. A schematic drawing of a track is shown in Figure 2. The track is rotated around the vehicles wheels using a driving sprocket, which is normally located at the front and/or rear of the track. Good track contact with the terrain in between the front and rear sprockets is achieved by a series of road wheels. As discussed later a track with more road wheels gives a more uniform bearing pressure.

TERRAMECHANICS

The collective technical term used to refer to the mobility means used to propel and maneuver machines over varying terrains is “running gear” (Wong, 2001, Muro & O’Brien, 2004). Terramechanics is the