#Jenny

Finally I get this ebook, thanks for all these I can get now!

#Rio

Cool! I'am really happy

#Markus Jensen

I did not think that this would work, my best friend showed me this website, and it does! I get my most wanted eBook

#Hun Tsu

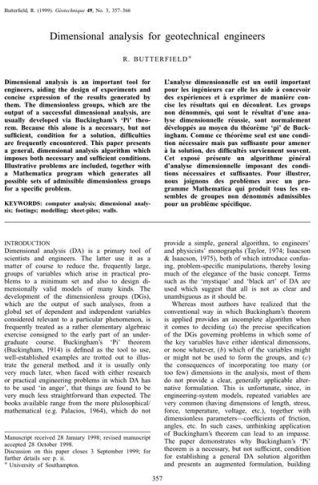
wtf this great ebook for free?!

#Che Salsa

My friends are so mad that they do not know how I have all the high quality ebook which they do not!

#Diego Butler

so many fake sites. this is the first one which worked! Many thanks



Butterfield, R. (1999). *Géotechnique* **49**, No. 3, 357–366

Dimensional analysis for geotechnical engineers

R. BUTTERFIELD*

Dimensional analysis is an important tool for engineers, aiding the design of experiments and concise expression of the results generated by them. The dimensionless groups, which are the output of a successful dimensional analysis, are usually developed via Buckingham's 'Pi' theorem. Because this alone is a necessary, but not sufficient, condition for a solution, difficulties are frequently encountered. This paper presents a general, dimensional analysis algorithm which imposes both necessary and sufficient conditions. Illustrative problems are included, together with a Mathematica program which generates all possible sets of admissible dimensionless groups for a specific problem.

KEYWORDS: computer analysis; dimensional analysis; footings; modelling; sheet-piles; walls.

L'analyse dimensionnelle est un outil important pour les ingénieurs car elle les aide à concevoir des expériences et à exprimer de manière concise les résultats qui en découlent. Les groupes non dénommés, qui sont le résultat d'une analyse dimensionnelle réussie, sont normalement développés au moyen du théorème 'pi' de Buckingham. Comme ce théorème seul est une condition nécessaire mais pas suffisante pour amener à la solution, des difficultés surviennent souvent. Cet exposé présente un algorithme général d'analyse dimensionnelle imposant des conditions nécessaires et suffisantes. Pour illustrer, nous joignons des problèmes avec un programme Mathematica qui produit tous les ensembles de groupes non dénommés admissibles pour un problème spécifique.

INTRODUCTION

Dimensional analysis (DA) is a primary tool of scientists and engineers. The latter use it as a matter of course to reduce the, frequently large, groups of variables which arise in practical problems to a minimum set and also to design dimensionally valid models of many kinds. The development of the dimensionless groups (DGs), which are the output of such analyses, from a global set of dependent and independent variables considered relevant to a particular phenomenon, is frequently treated as a rather elementary algebraic exercise consigned to the early part of an undergraduate course. Buckingham's 'Pi' theorem (Buckingham, 1914) is defined as the tool to use, well-established examples are trotted out to illustrate the general method, and it is usually only very much later, when faced with either research or practical engineering problems in which DA has to be used 'in anger', that things are found to be very much less straightforward than expected. The books available range from the more philosophical/mathematical (e.g. Palacios, 1964), which do not provide a simple, general algorithm, to engineers' and physicists' monographs (Taylor, 1974; Isaacson & Isaacson, 1975), both of which introduce confusing, problem-specific manipulations, thereby losing much of the elegance of the basic concept. Terms such as the 'mystique' and 'black art' of DA are used which suggest that all is not as clear and unambiguous as it should be.

Whereas most authors have realized that the conventional way in which Buckingham's theorem is applied provides an incomplete algorithm when it comes to deciding (*a*) the precise specification of the DGs governing problems in which some of the key variables have either identical dimensions, or none whatever, (*b*) which of the variables might or might not be used to form the groups, and (*c*) the consequences of incorporating too many (or too few) dimensions in the analysis, most of them do not provide a clear, generally applicable alternative formulation. This is unfortunate, since, in engineering-system models, repeated variables are very common (having dimensions of length, stress, force, temperature, voltage, etc.), together with dimensionless parameters—coefficients of friction, angles, etc. In such cases, unthinking application of Buckingham's theorem can lead to an impasse. The paper demonstrates why Buckingham's 'Pi' theorem is a necessary, but not sufficient, condition for establishing a general DA solution algorithm and presents an augmented formulation, building

Manuscript received 28 January 1998; revised manuscript accepted 28 October 1998.
Discussion on this paper closes 3 September 1999; for further details see p. ii.

* University of Southampton.