Steps in the Method of Repeating Variables

There are 6 steps that comprise the method of repeating variables. These are listed concisely in Fig. 7-22 in the text, as repeated below:

The Method of Repeating Variables

Step 1: List the parameters in the problem and count their total number n.

Step 2: List the primary dimensions of each of the n parameters.

Step 3: Set the *reduction* j as the number of primary dimensions. Calculate k, the expected number of Π's,
$$k = n - j$$

Step 4: Choose j *repeating parameters*.

Step 5: Construct the k Π's, and manipulate as necessary.

Step 6: Write the final functional relationship and check your algebra.

Step 4 is often the most difficult or mysterious step. There are guidelines provided in Table 7-3, but it takes practice to know which repeating variables to choose wisely.

FIGURE 7–22
A concise summary of the six steps that comprise the *method of repeating variables*.

The final functional relationship is given as the *dependent* Π, Π_1, as a function of the *independent* Π's, Π_2, Π_3, … , Π_k, i.e., $\Pi_1 = f(\Pi_2, \Pi_3, \ldots, \Pi_k)$

Guidelines for choosing the repeating variables in Step 4 of the method of repeating variables: (See Table 7-3 in the text for more details):

1. Never pick the *dependent* variable. Otherwise, it may appear in all the Π's, which is undesirable.
2. The chosen repeating parameters must not *by themselves* be able to form a dimensionless group. Otherwise, it would be impossible to generate the rest of the Π's.
3. The chosen repeating parameters must represent *all* the primary dimensions in the problem.
4. Never pick parameters that are already dimensionless. These are Π's already, all by themselves.
5. Never pick two parameters with the *same* dimensions or with dimensions that differ by only an exponent.
6. Whenever possible, choose dimensional constants over dimensional variables so that only *one* Π contains the dimensional variable.
7. Pick common parameters since they may appear in each of the Π's.