⊛ Applications of dynamic similarities :-

* Buckingham Pi- Theorem :-

If there are 'n' variables, whether dependent or independent, in a dimensionally homogenous equation and if these variables contain 'm' fundamental dimensions, then the variables are arranged ($n-m$) dimensionless forms. These dimensionless forms are known as Pi (π) terms.

$X_1 = f(X_2, X_3, X_4, \ldots X_n)$ — X_1 = dependent variable; $X_2, X_3, X_4 \ldots X_n$ are independent variables.

$$F(X_1, X_2, X_3, X_4, \ldots X_n) = 0$$

$$F(\pi_1, \pi_2, \pi_3, \pi_4 \ldots \pi_{n-m}) = 0$$

Here each π term contains $(m+1)$ variables appear repeatedly in each π-term

Thus.

$$\pi_1 = X_2^{a_1} X_3^{b_1} X_4^{c_1} X_1$$

$$\pi_2 = X_2^{a_2} X_3^{b_2} X_4^{c_2} X_5$$

$$\pi_3 = X_2^{a_3} X_3^{b_3} X_4^{c_3} X_6$$

$$\pi_4 = X_2^{a_4} X_3^{b_4} X_4^{c_4} X_7$$

$$\pi_{n-m} = X_2^{a_{n-m}} X_3^{b_{n-m}} X_4^{c_{n-m}} X_n$$

X_2, X_3 and X_4 → repeating variable

Since there are 3 fundamental dimensions thus each π-term will contain (3+) or 4 no of variables.

* Rules for selecting the repeating variables :-

→ Never select dependent variable as repeating variable.

→ select one from geometric property i.e, Length, diameter, etc.

→ select one from kinematic property i.e, velocity acceleration.

→ select one from fluid property i.e, density, viscocity etc.

→ care must be taken so that all three variables must contain

M, L, T