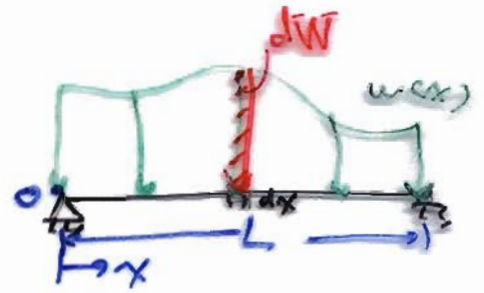# Distributed Loads

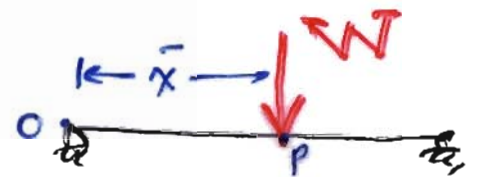To replace the distributed loads by a simple one, the two systems must be **equivalent**.

For the two systems to be equivalent, the two following conditions must be satisfied:

Σ Forces must be the **same** in the two systems

Σ Moments " " " " " "

① Forces:

ΣF_y is equivalent $\Rightarrow$

$$dW = dA = w\,dx$$

$$\int dW = \int_0^L w\,dx$$

$$= \int dA \quad \Rightarrow \quad \boxed{W = A}$$

② Moments

ΣM_o is equivalent $\Rightarrow$

$$\bar{x}\,W = \int x\,dW$$

$$dW = w\,dx = dA$$

$$\Rightarrow \bar{x} = \frac{\int x\,dW}{W} \quad \Rightarrow \quad \boxed{\bar{x} = \frac{\int x\,dA}{A}}$$

If the load is composed of "pieces" of linear functions, (constant) then

$$\boxed{W = F_R = \sum_{i=1}^{n} A_i}$$

$$\boxed{\bar{x} = \frac{\sum_{i=1}^{n} \bar{x}_i A_i}{\sum_{i=1}^{n} A_i}}$$