MEEG 3013 Quiz #5.m20.091

1. Define the values of (a) \(<x-a>^n\), (b) \(\int_{-\infty}^{x} <x-a>^n \, dx\).

2. A timber beam is shown. (a) Determine the reactions \(A\) and \(C\) at \(A\) and \(C\). (b) Using singularity functions, find the location \(x_D\) and magnitude \(M_D\) of the maximum bending moment at \(D\). (c) Knowing that the available stock consists of beams with an allowable stress of 14 MPa and a rectangular cross section of 30-mm width and depth \(h\) varying from 80 mm to 160 mm in 10-mm increments, determine the value of \(h\) for most economical cross section.

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1. \(<x-a>^n = (x-a)^n\) if \(x-a \geq 0\) & \(n > 0\)
\(<x-a>^n = 1\) if \(x-a \geq 0\) & \(n \leq 0\)
\(<x-a>^n = 0\) if \(x-a < 0\) or \(n < 0\)
\(\int_{-\infty}^{x} <x-a>^n \, dx = \frac{1}{n+1} <x-a>^{n+1}\) if \(n > 0\)
\(\int_{-\infty}^{x} <x-a>^n \, dx = <x-a>^{n+1}\) if \(n \leq 0\)

2. (a) FBD & Equilibrium: \(A = 875\ \text{N} \uparrow\) & \(C = 685\ \text{N} \uparrow\).
(b) \(q = 875 <x>^{-1} - 480 <x>^0 + 320 <x-2.5>^1\)
\(V = 875 <x>^0 - 480 <x>^1 + 160 <x-2.5>^2\)
\(M = 875 <x>^1 - 240 <x>^2 + \frac{160}{3} <x-2.5>^3\)
Noting that \(M\) is maximum when \(V = 0\), we get
\(x_D = 1.822916\ \text{m}\) \(\Rightarrow x_D = 1.823\ \text{m}\)
\(M_{\max} = M_D = 797.526\ \text{N} \cdot \text{m}\) \(\Rightarrow M_D = 798\ \text{N} \cdot \text{m}\)
(c) \(h_{\min} = 0.10674\ \text{m}\). Choose beam with \(h = 110\ \text{mm}\).