

estimated work cost IDR 111,243,100. Strengthening the building by adding 4D10 bending and Ø8-150 shear reinforcement bars increases the beam capacity twice of the existing beam capacity, with an estimated work cost IDR 44,594,200. Comparing the three alternative strengthening methods, the addition of the reinforcement bars on composite steel beams is the most effective to be done because it is more economical and more accessible in the construction.

NOMENCLATURE

M_u	ultimate moment	kNm
M_n	nominal moment (capacity)	kNm
V_u	ultimate shear	kN
V_n	nominal shear (capacity)	kN
H	floor height	m
ϕ	reduction factor for capacity	
δ	displacement	mm
$q_{c\text{ av.}}$	penetration of conus (average)	kN/m ³
Q_p	tip resistance value	kN
A_s	area of reinforcement bar cross-section	mm ²
SF	safety factor	
Q_{ult}	supporting capacity of foundation	kN
Q_m	force from the building loads	kN

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