

Designing Concrete Structures:

Carbon Fiber-Reinforced Polymer (CFRP) Shear Strengthening



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Reported by ACI Committee E702

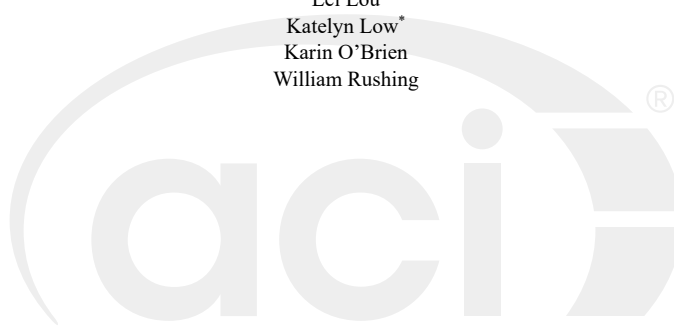
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ACI E702.7-22 Designing Concrete Structures: Carbon Fiber-Reinforced Polymer (CFRP) Shear Strengthening.

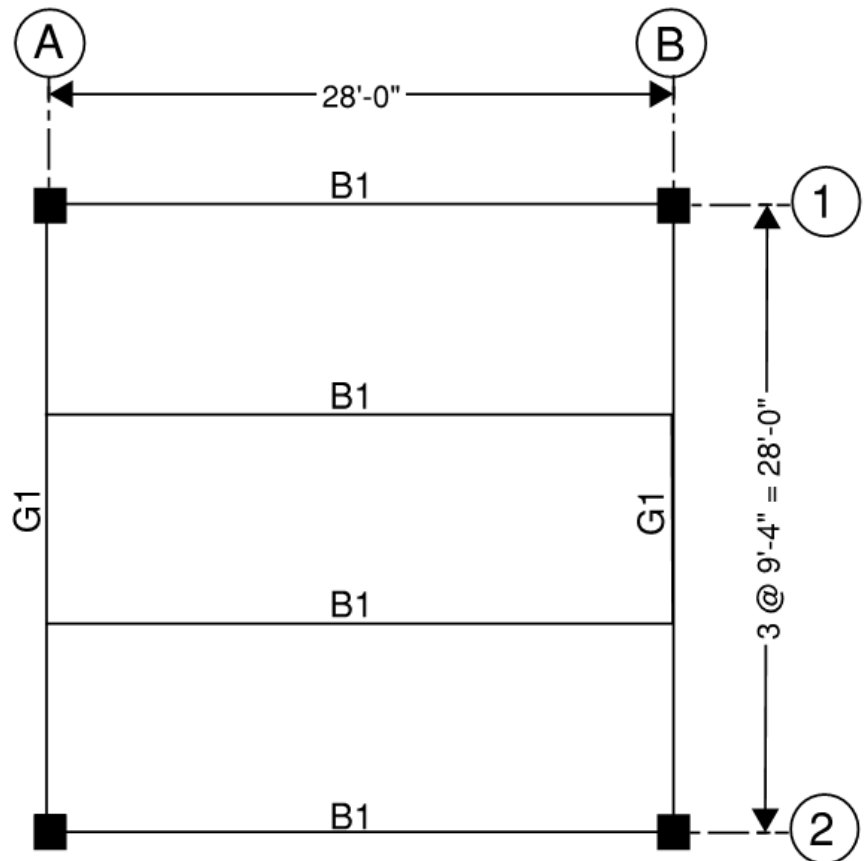
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- Typical bay of a one-way slab is shown below.
- The slab consists of a 6-inch thick reinforced concrete slab supported on 24-inch deep by 8-inch wide concrete beams.

f'_c :	5,000 psi
f_y :	60,000 psi


$$V_u(\max) @ d = 41.4 - \left(\frac{21.6}{12}\right)(2.66) = 36.6 \text{ kips}$$

Problem Statement: A given interior beam requires shear strengthening to establish original design strength. The beam was poured with 3000 psi normal weight concrete in lieu of 5000 psi normal weight concrete. Strengthen the beam with FRP sheets using a wet layup method. FRP properties are given below.

FRP Properties

$t_f = .0065$ in.
 $f_{fu}^* = 550,000$ psi
 $\epsilon_{fu}^* = 0.017$
 $E_f^* = 33,000,000$ psi

Also:

$f'_c = 3000$ psi NWC
 $b_w = 8$ in.
 $h = 24$ in.

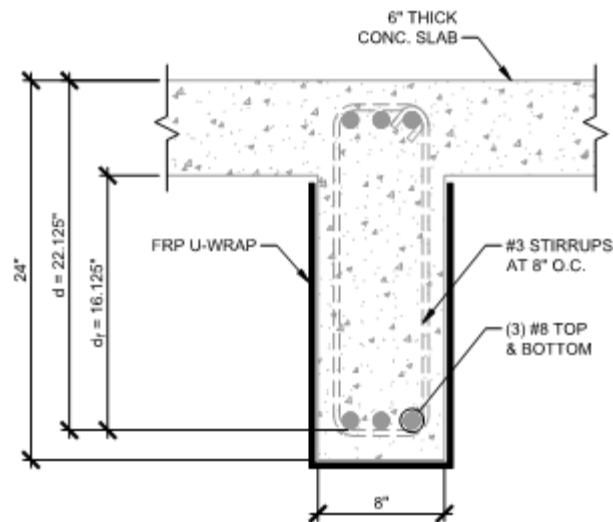


Figure 1.1 - Section View

Notes		ACI Ref.
Calculate $V_{C_{orig}}$	Calculate original design shear contribution of concrete $V_{C_{orig}} = 2 \times \sqrt{f'_c} \times b_w \times d$ cover = 1.5 in. Check minimum shear per linear foot, to qualify for shear capacity equation 22.5.5.1(a): $A_v(\min) = 0.0018b_wd = (0.0018)(8)(21.625) = 0.31 \text{ sq. in.}$ Shear reinforcement provided is No. 3 at 8 in. $A_v(\text{provided}) = (2)(0.11)(12/8) = 0.33 \text{ sq. in.} > A_v(\min)$	ACI 318-19 9.5.3.1 22.5.5.1 20.5.1.3.1
Calculate $V_{C_{as-built}}$	$d = 24 \text{ in.} - 1.5 \text{ in.} - 3/8 \text{ in.} - 1/2 \text{ in.} = 21.625 \text{ in.}$ $V_{C_{orig}} = 2 \times \sqrt{5000} \times 8 \times 21.625$ $= 24,500 \text{ lbs} \Rightarrow 24.5 \text{ kips}$ Calculate as-built concrete shear contribution $V_{C_{as-built}} = 2 \times \lambda \times \sqrt{f'_c} \times b_w \times d$ $\lambda = 1.0$	ACI 318-19 19.2.4.3 ACI 318-19 22.5.5.1