CREATE SHEAR STAIR FOR REINFORCEMENT OF CONCRETE BEAMS

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Abstract

For shear design of R/C beams with rectangular and T-section, there is a number of steps procedure and equations provided by ultimate strength design method according to ACI-code. The large number of equations and fork of solution steps, Causes a lot of confusion and boredom for student or designer. Checked the most common and authoritative textbooks that dealt with design of concrete structures according to (ACI-08). From long experience in teaching reinforced concrete material, show that shear stair has more effect to give beginner engineering students speed to achieve shear design steps by less time and effort. This study focuses on rectangular and T-section beams consider shear force due to the loads applied vertically, using SI units. Finally, I reached a simplified stair to track shear strength steps easily and conveniently, named as shear stair.

Index Terms: *Shear design; Beam reinforcement; Shear strength; Shear stress distribution.*

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1. INTRODUCTION

In concrete structures, there are many textbooks and researches which dealt with how to get shear and its reinforcement. But, I have not found anybody to tell us a simple and easy way of how to calculate. I've been personal suffering in conveying information of this subject to the beginner engineering students[1][2].

Concrete beams are widely used as a main member to construct buildings in Iraq. STAAD/pro is widely used as a structural analysis and design program. Sometimes, to give design more confidently, we need to compare the results of program with the results of manual calculations[3].

Most common beams, rectangular section and T-section apply vertical loads (dead and live loads). Beams, like that, will be subjected to the bending moment and shear force and torsional moment[4]. This study focuses on beams of rectangular section and T-section dealt with shear force only. Usually, transvers reinforcement called stirrups is used for shear strength in addition to shear carried by concrete.

2. NOTATION

The terms in this list are used in the study[5][6].

V_u = factored shear force, kN.

V_c = nominal shear strength provided by concrete, kN.

f_y = specified yield strength of steel, MPa.

f_c' = specified compressive strength of concrete, MPa.

b = width of beam, mm.

d = effective depth of beam, mm

A_v = area of shear reinforcement,

S = spacing between center to center of stirrups,

$\emptyset$ = reduction factor of shear strength (0.85).

3. PROPOSED METHOD

The study related to prepare shear stair (Fig.1) for design beams has the following properties:

- Concrete rectangular and T- sections, straight profile.
- Subjected vertical load which created shear force.
- Using ultimate strength design method with (ACI318-08).
- Using equations with SI unit.
- Design of transvers reinforcement.

- Shear strength of concrete be $V_c = \frac{1}{6}\sqrt{f'_c}\,bd.$

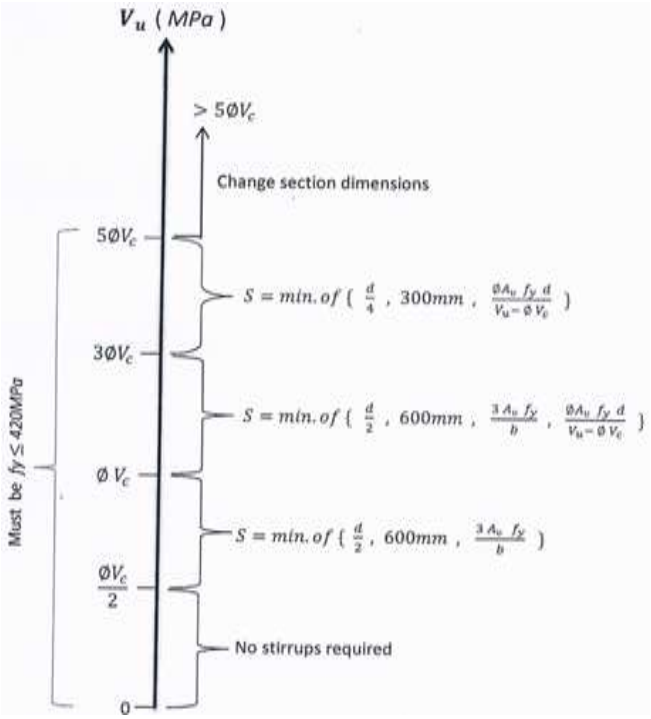


Fig -1: Stair of Shear Strength

3. APPLICATION AND RESULTS

Rectangular section beam subjected to the factored load shown in fig. 2. Given: b= 300mm, d = 600mm,

$f_y = 280MPa,\ f'_c = 25MPa$

use stirrups $\emptyset 8$, Neglect self-weight. design the necessary shear reinforcement in form of two leg Stirrups?

Solution

$V_c = \frac{1}{6}\sqrt{25}(300)(600) * 10^{-3} = 150kN$

$\frac{\emptyset V_c}{2} = \frac{0.85(150)}{2} = 63.75kN$

$\emptyset V_c = 127.5kN$

$3\emptyset V_c = 382.5kN$

$5\emptyset V_c = 637.5kN$

ZONE-1: $V_u < \frac{\emptyset V_c}{2}$ *No stirrups required*

ZONE-2: $\frac{\emptyset V_c}{2} < V_u < \emptyset V_c$

$S = \{\frac{d}{2} = 300mm, 600mm, \frac{3A_v f_y}{b} = \frac{3(100.6)(280)}{300} = 281.4mm\}$

$S_{min} = 281.4mm$ *use* $\emptyset 8@250mm$

ZONE-3: $\emptyset V_c < V_u < 3\emptyset V_c$

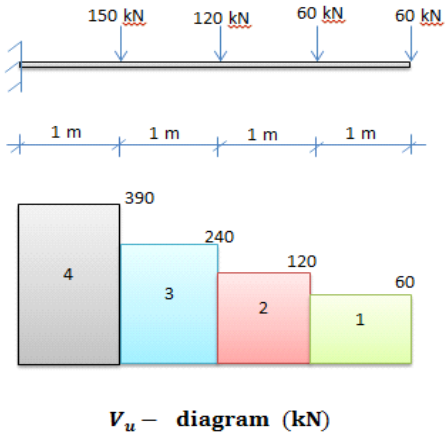
$S = \{\frac{d}{2} = 300mm, 600mm, \frac{3A_v f_y}{b} = 281.4mm, \frac{\emptyset A_v f_y d}{V_u - \emptyset V_c} = \frac{0.85(100.6)(280)(600)}{(240-127.5)*10^3} = 127mm\}$

$S_{min} = 127mm$ *use* $\emptyset 8@125mm$

ZONE-4: $3\emptyset V_c < V_u < 5\emptyset V_c$

$S = \{\frac{d}{4} = 150mm, 300mm, \frac{\emptyset A_v f_y d}{V_u - \emptyset V_c} = \frac{0.85(100.6)(280)(600)}{(390-127.5)*10^3} = 55mm\}$

$S_{min} = 55mm$, *use* $\emptyset 8@55mm$, *can use 4 − legs to increase spacing*



$V_u -$ **diagram (kN)**

Fig -2: Application Example

CONCLUSIONS

From my academic and practical experience, has concluded the following points:

- By using STAAD/pro program, the researcher can recognize the value of shear at any section of the beam. Proposed shear stair is a simple and easy way to see how much stirrups required for any shear. Obviously, the program has the

facility to do so, but sometimes to promote confidence that can be calculated manually.

- Manually, proposed shear stair is a quick way to design beams and one way slabs. Especially, when they are in accordance with the properties as mentioned in (ACI-08, 8.3.3).
- I noticed that shear stair is considered clear and easy path. Students or designers accept it without confusion or boredom.

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BIOGRAPHIES

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