STRENGTHENING RC COLUMNS WITH CFRP

Repairing and strengthening existing RC structures has become increasingly popular within the industry. RC structures can fail due to but not limited to the following reasons:

- Neglecting crucial factors in the design and/or construction phase
- Changing the usage of a structure resulting in a change in the applied loads
- Structural damage as a result of an earthquake or environmental factors

Figure 1- Rhino Carbon Fiber™ Strengthening Products

WHY CFRP?

The most common techniques of strengthening RC columns are jacketing, steel jacketing and CFRP jacketing. CFRP has a greater demand than the other options due to its superior specifications:

1. High strength to weight ratio
2. Increases stiffness as well as strength of the section
3. Lightweight
4. Easy and fast installation
5. Corrosion-resistant
6. Reduces costs of transportation and installation
7. Prevents buckling of the column
8. Improves the load-carrying capacity of columns
9. Enhances the flexural stiffness of the repaired section

WHY DO WE SUGGEST CFRP FOR RC COLUMN STRENGTHENING?

CFRP is an excellent strengthening solution for RC columns and doesn't add considerable weight, mass and stiffness. The seismic behavior of the whole structure remains steady after strengthening the columns, which is critically important for the structure's integrity.

The confinement effectiveness of CFRP-wrapping RC columns depends on the items below:

1. Type of fiber and resin

2. Fiber thickness
3. Fiber orientation
4. Concrete strength
5. Shape and corner radius of the concrete column
6. Slenderness ratio of the column
7. The bond between CFRP and concrete

EFFECT OF SHAPE AND CORNER RADIUS OF AN RC COLUMN'S CROSS SECTION ON CFRP EFFECTIVENESS:

Since CFRP will be bent while applying around columns, the bending affects the effectiveness of CFRP and its confinement of the column. The corner radius has significant effects on confinement effectiveness. [1] CFRP on circular columns has a stronger confinement than square columns (where the corner radius is zero). The low ultimate strength of CFRP wrapping on sections with smaller corner radius' is due to stress concentration in the corners of the column [1].

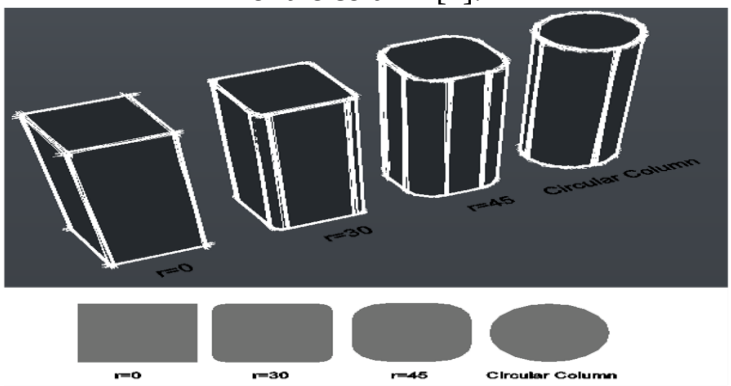

Figure 2- Corner radius variations for RC columns

FAILURE MODES OF A CFRP-STRENGTHENED RC COLUMN

1. Tensile rupture of the CFRP jacket, usually near a corner due to stress concentration (especially for square or rectangular sections)
2. Delamination of the CFRP jacket
3. Combination of delamination and tensile rupture of the CFRP jacket

- Items 2 & 3 are scenarios for sections with a higher corner radius. Delamination failure can be reduced by a sufficient length of CFRP overlap around the column.
- In circular columns, it is assumed that when the hoop stress in CFRP reaches its tensile strength, the CFRP will fail and rupture.

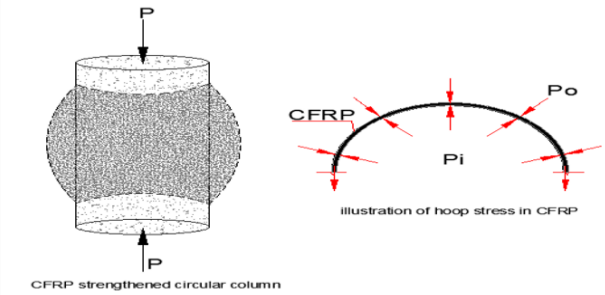

Figure 4- Hoop tension in CFRP- strengthened circular column

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