13. Beam rebar arrangement

1) Principle of beam rebar arrangement

① Calculate the size and depth of beams according to the drawing and arrange them in a suggested order, that is, exterior beams and big beams (G) & deep beams first and then binding small beams (B beams) later.

② Supervisor has to check if the bar used at the top span meets the requirement on the drawing. Shorter bar than required might be used to save cost when the span is longer than 8,000mm, the bar standard.

③ The bar might deflect from undesirable vibration when placing concrete if the double reinforcement or top end bar are tied with tying wires. To prevent this, 3 pieces of stirrups are used to tie the bars at the top and as many pieces to place double-leg bar & top bar on the bottom bar.

④ Cap tie bar should carry out 1 by 1 at least.

※ The 1st stirrup should be arranged with the space 50mm from the perimeter of side pillar.
※ The splice for upper part rebar of beam's end and lower part rebar of beam's center apply tension splice length.

<Main bar arrangement>

<Distance of stirrup>

※ Apply the above except the case of marking separately on beam chart.
※ S1-S4 : stirrup distance

2) Types of stirrup

<a> Open type

1. beam without cap tie bar
2. beam to be arranged by front end without twisting
3. beam without anti-earthquake plan

<b> Closed type

1. slab on both sides
2. slab on one-side
3. no slab on both sides
3) Position of beam tying (splice)

1. Calculation of bender

When bent bars are used to reinforce beams, bending point of the bar is usually calculated as \( \frac{L_o}{4} \) distance from the center of the pillar. However, it is formal to divide it into 4 parts from the end of beam reinforcement to the other end.
② An example for processing
Anchorage (fixed) bars are classified as the top bars and the bottom bars, when the former have tensile loads and the later have compression loads. Therefore, the top bars and bottom bars set fixed splice length with same method because it has difficulty in working separately for processing and assembling. (criterion of concrete structure plan)
In a real construction, 40d is used for both of them for convenience sake.

③ Cover depth of beams

a) Stirrup with spacer should be tied several times.
b) Pay attention when arranging reinforcements in order to have enough cover depth.

4) Bending position of bender (classification of tension & compression)

※ Using the bent bars in beams is Japanese style, while cutoff bar is now in common.
5) Beam rebar arrangement (CUT TYPE)

① In case of beam

![Diagram of beam rebar arrangement]

- **Note**
  1) * : apply general bars splice length (A class splice) as standard splice length & fixed length of rebar (22 page 6) for above size
  2) ** : fixed as standard hook form about center part bottom bar's 25%
  3) splice length according to splice position of rebar arrangement
     - tying on upper part rebar (beam) block : apply A class tension rebar splice
     - tying except upper part rebar (beam) block : apply B class tension rebar splice
     - tying on lower part rebar (beam) block : apply A class tension rebar splice
     - tying except lower part rebar (beam) block : apply B class tension rebar splice
6) Beam rebar arrangement by using stepped pulley

The types of step are classified as planar step, elevated step, step in material according to their shapes.

In each case, arrangement is in vertical or in horizontal.

If the worker has no choice but to bend the bar, bend it at low grade.

When the mid span of a beam has steps as shown below left, the bar might be necessarily bent, which is quite undesirable.

The load tends to straightly pass through.

If pulled out, the bar does not straighten as it looks.

Far from straightening, it will break or fracture.

Needless to say, it is recommended that the worker cut the bars and arrange them separately, as depicted below.

Wrong method

Correct method
7) **Hunch beam**

1. Bend the bars at the bottom in a hunch former and anchor them onto the pillar.
2. Bend a half of the bars at the bottom to let the anchorage length penetrate the pillar and anchor near the hunch point.
3. One size bigger stirrup should be used at the hunch point.

![Diagram of Hunch Beam](image)

8) **Pillar-holding rebar (Butterfly stitching rebar/Stirrup closing rebar)**

1. As few drawing gives direction on pillar-holding rebar, it is common to use it at every third stirrup.
   
   If not, all junctions of pillar-holding rebar should be confined per every stirrup.

![Diagram of Butterfly Stitching Rebar](image)

*Better if one end hooked 135°*
9) Symbol of beam

- Continuous end of beam
- Center of beam
- Exterior of beam
- Interior of beam
- Outside of beam
10) Detailed drawing of beam rahmen(arrangement)

Each floor bottom structure plane figure symbol & beam chart symbol
※ You should check pillar size & rebar Q'ty per each floor, and also arrange after checking rebar Q'ty & drawing of outer pillar’s front and side.