The structural floor plan of a three-story (ground plus 3 floors) office building is shown on the next page. The roof covers the hole used for the elevator shaft and stairwells. The new building will be located in Houston, Texas. Story floor systems consist of one-way pan joists supported on column lines A through F. The design loads for the floor (in addition to the self-weight) include a superimposed dead load of 20 psf to account for partitions, plumbing, etc and a design live load of 75 psf, plus a 0.25 kip/ft wall load around the building perimeter. The dimensional variables for the project are defined as: L = 30 ft; f'c = 4,000 psi; fy = 60,000 psi; Bw = 6 in.; Sw = 30".

Design the slab of the first floor as a pan joist system supported by beams along column lines A through F. Assume beams (section 2) exist on columns line 1-4 and ignore geometric space differences if the equal spacing of the joists do not fit within the bay width between the column lines (normally this is handled by adjusting formwork).

**Required:**

1. Determine the height of each joist by satisfying ACI Table 9.5a for both the critical span of the joists and also the critical span of the supporting beams.

2. Determine moment and shear envelopes for the joists using the ACI coefficient method for the load combination of 1.2 DL + 1.6 LL.

3. Determine the reinforcement required in the joists for moment resistance at the critical sections.

4. For a typical interior span only, determine the length of this reinforcement based on the moment envelope and the detailing requirements in ACI 318 (just like beam bending).

5. Sketch a plan of the floor and the reinforcement required for a typical joist in the floor. Specify the lengths and the total number of bars (including stirrups if necessary) required for the pan joists of the first floor.
1.

**Plan View**

- **Section 1-1**
  - $t = 5''$
  - $tw = 12'' - 2''$
  - $Bw = \text{??}$
  - $Sw = \text{??}$

- **Section 2-2**
  - $t = 5''$
  - $tw = 12'' - 2''$
  - $Bw = \text{??}$
  - $Sw = \text{??}$

**Dimensions**

- $L = 30 \text{ ft}$
- $fc' = 4,000 \text{ psi}$
- $fy = 60,000 \text{ psi}$
- $Bw = 6 \text{ in.}$
- $Sw = 30 \text{ in.}$