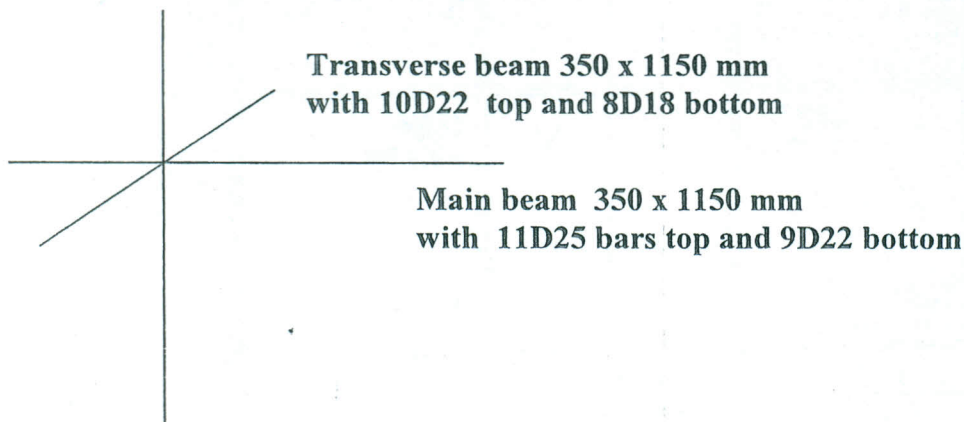


- 
- Notes: 1. Any missing data is to be reasonably assumed.  
2. Design Aids can be used.
- 

**Question 1: ( 30 % )**

Design the main direction of the interior beam-column joint shown in the figure. This joint is a part of ductile moment resisting reinforced concrete frame in seismic region. The height of each storey is equal to 4.40 m. The concrete characteristic compressive strength is equal to 30 MPa. The yield strength of the longitudinal bars is equal to 400 MPa and the yield strength of the transverse reinforcement is equal to 240 MPa. The beam stirrups are  $\phi$  10 with spaces 100 mm and the column stirrups ( 4-legs ) are  $\phi$  10 with spaces 85 mm. Take the factor (  $k_j = 1.6$  ).

Column 900x900 mm with 20 $\Phi$ 22 bars  
with column axial load equal to 1100 KN

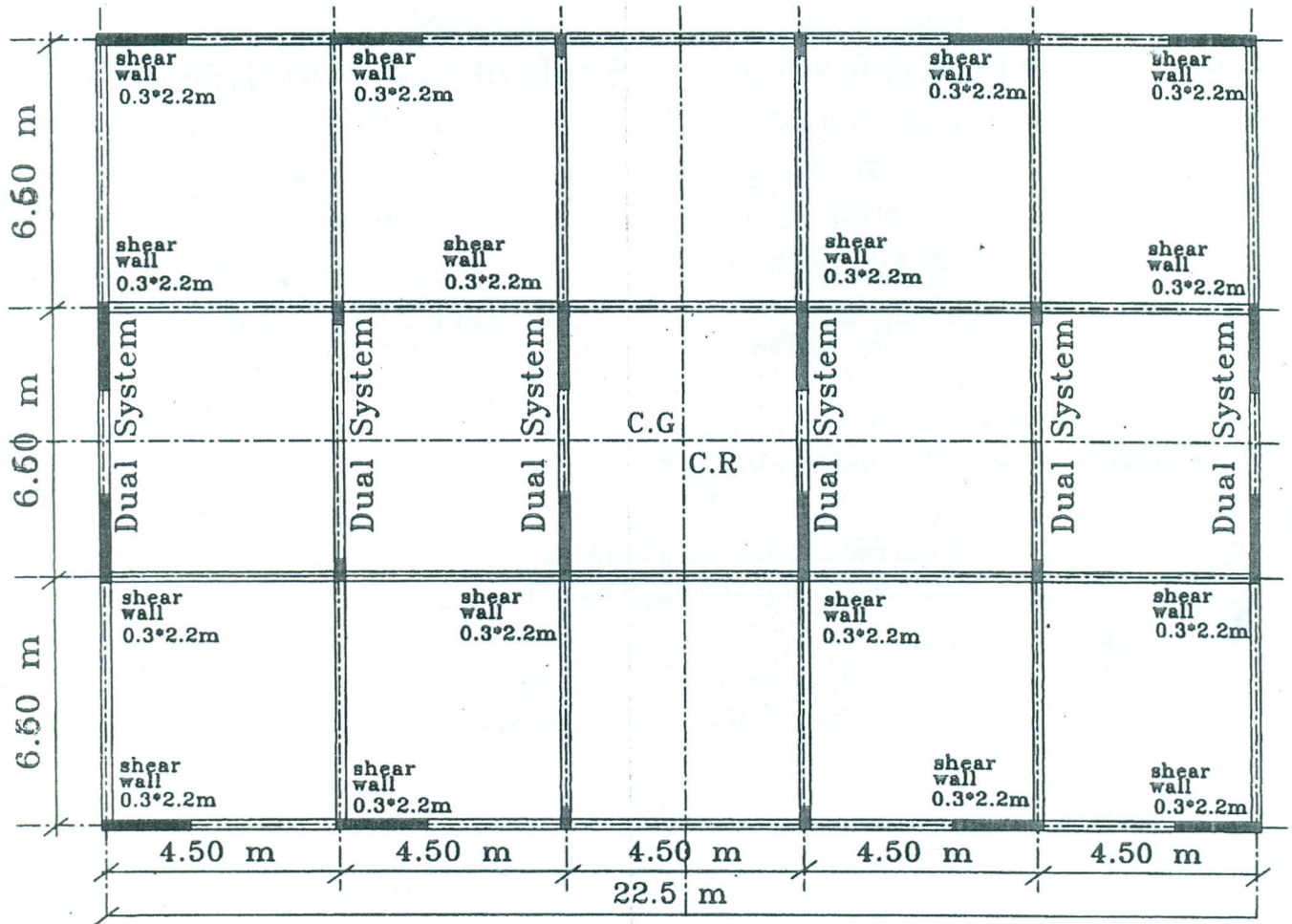


**Question 2: (20 %)**

Calculate the available ductility of a doubly reinforced section of breadth 350 mm and total height 1250 mm. The tension reinforcement consists of 8 bars with diameter 20 mm and the compression reinforcement is 3 bars with diameter 18 mm. The design characteristic compressive strength of concrete is equal to 25 N/mm<sup>2</sup> and the steel is 360/520.

### Question 3: ( 34 % )

Perform the seismic analysis in the critical direction of the public building shown in the figure. The building consists of 8 stories and the height of each story is equal to 4.15 m. The live load per unit area of the building is equal to  $800 \text{ kg/m}^2$  and the total dead is equal to  $650 \text{ kg/m}^2$ . The building site is located in Alexandria and the soil type C. The seismic forces in each direction will be resisted by 8 shear walls each of cross section  $300 \times 2200 \text{ mm}$  arranged as shown in the figure. Check the stresses between the walls and the foundations.



### Question 4: (16 %)

- Explain the types of seismic waves.
- Explain the types of R/C systems for earthquake resistance.
- What is meant by ' Stiffness degradation of a cantilever beam under cyclic load reversals ?
- Explain how to choose appropriate stiffness for seismic design.

*My best wishes,  
Prof. Dr. Ahmed Yousef*