CHAPTER 9

ANALYTICAL WORK – ‘2D’ FRAME

9.1 GENERAL

To validate the experimental results, non-linear finite element analysis has been carried out using ANSYS-10 software for ‘2D’ frame (1) and (2). A comparative study was made between experimental and analytical values.

The following are the detailed input parameters adopted for the analytical work

1 Drawing tools : Key points, lines, areas, volume area generate, volume generate, volume glue, line glue.

2 Material properties :

   (i) Reinforcement Steel
       Youngs modulus : 21610kg/mm²
       Density       : 7850kg/m³
       Poisson ratio : 0.3

   (ii) Concrete
       Youngs modulus : 2308 kg/mm²
       Density       : 2400kg/m³
       Poisson ratio : 0.17

   (iii) Brick Masonry
       Youngs modulus : 339.7kg/mm²
       Density       : 2000 kg/m³
       Poisson ratio : 0.25
3 Element type:
(i) Reinforcement Link 8 spar Steel
(ii) Concrete Solid 65 (10 node)
(iii) Brick Solid 45 (8 node)

4 Meshing:
Solid used for hexa mesh using mape mesh (brick mesh)

5 Boundary conditions:
Frame bottom concrete pillars fully arrested at all degrees of freedom (ux, uy, uz)

6 Applying loads:
Frame (1):
Top beam - Apply 10 kN to 80 kN
Bottom beam – 10 kN to 80 kN
Frame (2):
Top beam - Apply 10 kN to 140 kN
Bottom beam – 10 kN to 140 kN

9.2 ANALYTICAL WORK – ANSYS 10 ‘2D’ FRAME:

RC frames (1) and (2) were modeled in ANSYS-10 software as shown in Figure 9.1 (a) for frame (1) and Figure 9.1 (b) for frame (2).

Model Frame    Model for steel link    Meshing and boundary Conditions

Figure 9.1(a) The R.C frame modeled in ANSYS –10 for frame (1)
Model Frame  Model for steel link  Meshing and boundary conditions

Figure 9.1(b) The R.C frame modeled in ANSYS -10 for frame (2)

After every lateral loading, deformations were recorded. Also, stress distribution were studied. The deformed shape of the software model for frame (1) for various cycles are shown in Figure 9.2 (a) and for ultimate load is shown in Figure 9.2 (b).

LOAD – 10 kN ,
DEFLECTION – 1.41

LOAD – 20 kN ,
DEFLECTION – 3.40

Figure 9.2(a) Deformed shape of the software model for frame (1)
LOAD – 30 kN,
DEFLECTION – 6.72

LOAD – 40 kN,
DEFLECTION – 8.33

LOAD – 60 kN,
DEFLECTION – 20.36

LOAD – k0 KN,
DEFLECTION – 26.42

Figure 9.2(a) (Continued)
LOAD – 80 kN, DEFLECTION – 47.45

Figure 9.2(b) Ultimate deformed shape of the software model for frame (1)

The deformed shape of the software model for Frame (2) for various cycles are shown in Figure 9.3(a) and for the ultimate load is shown in Figure 9.3(b)

LOAD – 30 kN, DEFLECTION – 1.85

LOAD – 40 kN, DEFLECTION – 2.56

Figure 9.3(a) Deformed shape of the software model for frame (2)
LOAD – 70 kN,
DEFLECTION – 9.85

LOAD – 80 kN,
DEFLECTION – 15.19

LOAD – 100 kN,
DEFLECTION – 22.84

LOAD – 110 kN
DEFLECTION – 33.05

LOAD – 120 kN,
DEFLECTION – 41.59

LOAD – 130 kN,
DEFLECTION – 49.86

Figure 9.3(a) (Continued)
The results obtained from analytical study for frame (1) and (2) are compared with experimental values and are tabulated (Table 9.1). In the analytical study, it is noticed that a sudden increase in deflection after the base shear of 40 kN (nearly equal to experimental value of 40 kN) for Frame (1) and after the base shear of 80 kN (nearly equal to experimental value of 80 kN) for Frame (2). This proves the initiation of captive column behaviour adjacent to the gap region in frame (1) and the failure takes place earlier, whereas in frame (2) the failure of the frame is delayed.

Load Vs deflection results from the experimental study and analytical study are plotted and compared in a graph form for frame (1) and (2) (Figure 9.4).
Table 9.1 Comparison of Base shear Vs top storey deflection

<table>
<thead>
<tr>
<th>Load Cycle No.</th>
<th>Base Shear in kN</th>
<th>Frame (1)</th>
<th>Frame (2)</th>
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<td>Analytical</td>
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Figure 9.4  Comparison of base shear Vs top storey deflection for frame (1) and (2) with experimental and analytical