6.4.2   Wall-equivalent dual type structure

Figure 6.4.2-1: Structure comprising only columns and perimeter walls, project <B_642-1>

The structure derives from the frame type structure of §6.4.1 by replacing columns c2, c5, c8 and c11 of cross-section 400/400 with four perimeter walls of cross-section 2000/300.

The main mode shapes of the modal analysis of the first case of the wall system are illustrated in the following page (The modes of the other three cases are similar). In the next four pages, the characteristic quantities for all cases are presented.

It is extremely useful to compare between the variants of the wall system, but also between the frame and wall systems.

General conclusions of the wall system:

1) In all cases, the natural period of the first mode shape is of the order of 0.70 sec. If however the stiffnesses of the elements are taken as being 100% of the elastic, the value of periods is of order of 0.50 sec (see §6.3.3).
2) The wall system behaviour is clearly better than the behaviour of the frame system, particularly when in the presence of a basement with perimeter walls.

Modal analysis results of the wall type structure
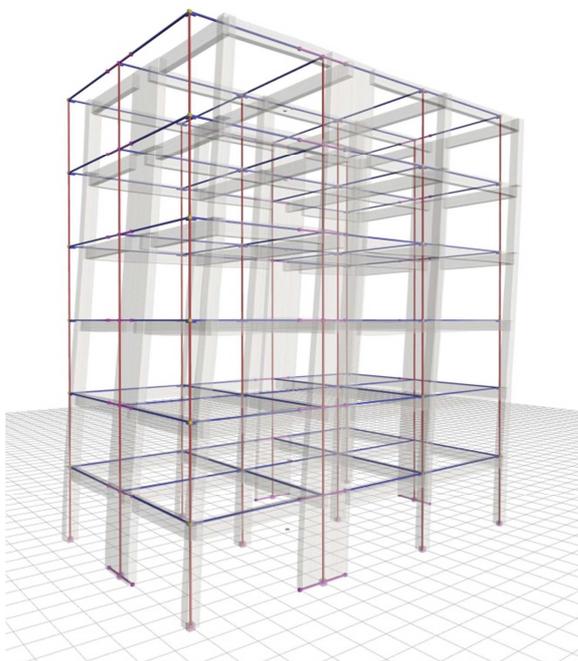
Fixed condition at the ground level (project <B_642-1>)

Figure 6.4.2-2: 1st mode:
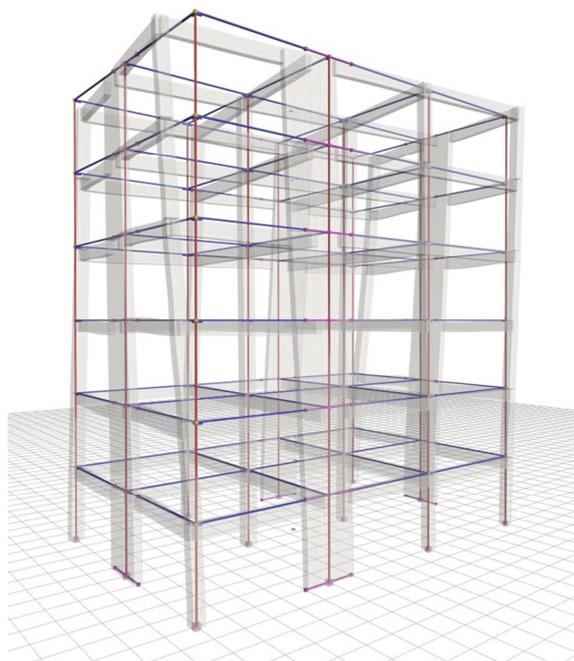*T_x=0.644 sec, C_x=6.6%, C_y=70.7%*

Figure 6.4.2-3: 2nd mode:
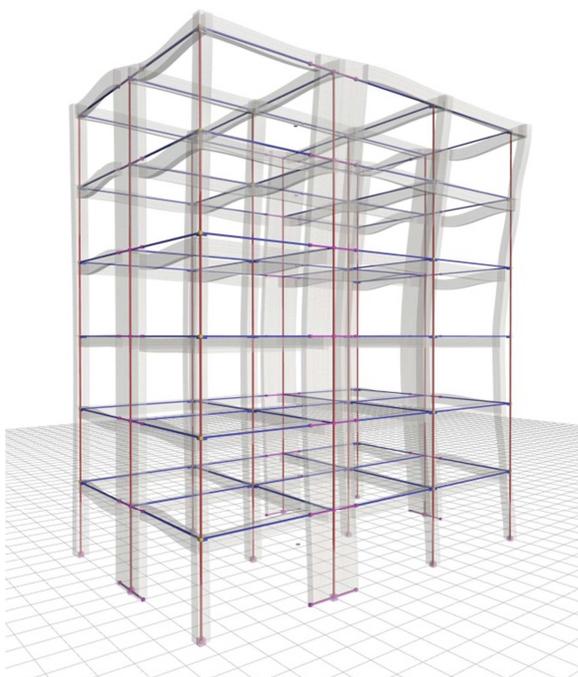*T_x=0.639 sec, C_x=70.5%, C_y=6.6%*

Figure 6.4.2-4: 3rd mode:
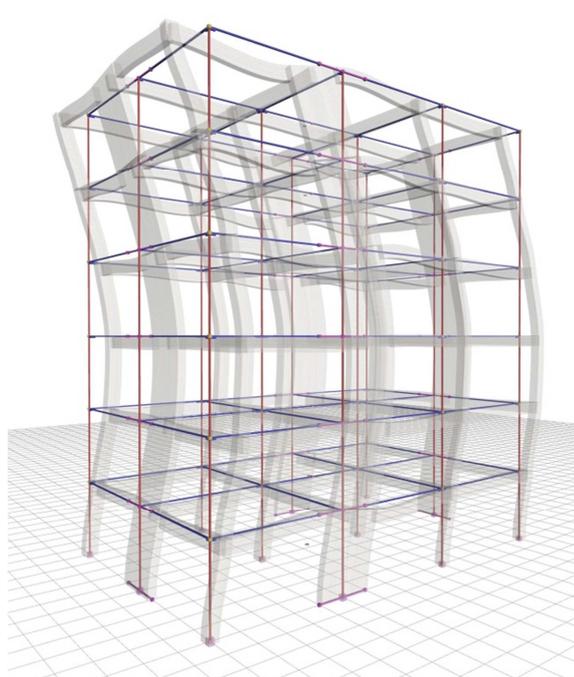*T_x=0.456 sec, C_x=0.5%, C_y=0.0%*

Figure 6.4.2-5: 4th mode:
T_x=0.187 sec, C_x=1.8%, C_y=10.7%

In the absence of symmetry in y direction, the fundamental mode shape in x (the 2nd) has also a component in y, meaning that both translational and torsional responses are developed.

The sum of the effective modal masses of the 12 first modes amounts to 99.5% and 98.1% of the total mass of the structure in x and in y directions respectively.
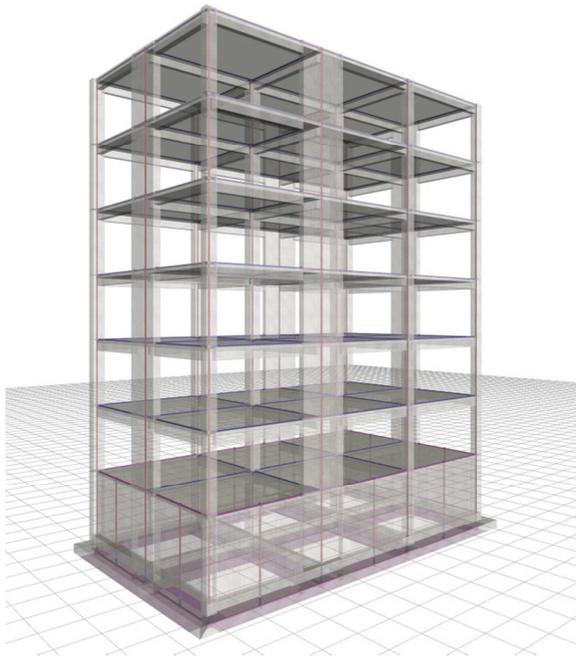
Case 4: Basement with perimeter walls (project <B_642-4>)

Figure 6.4.2-21: Structure and model
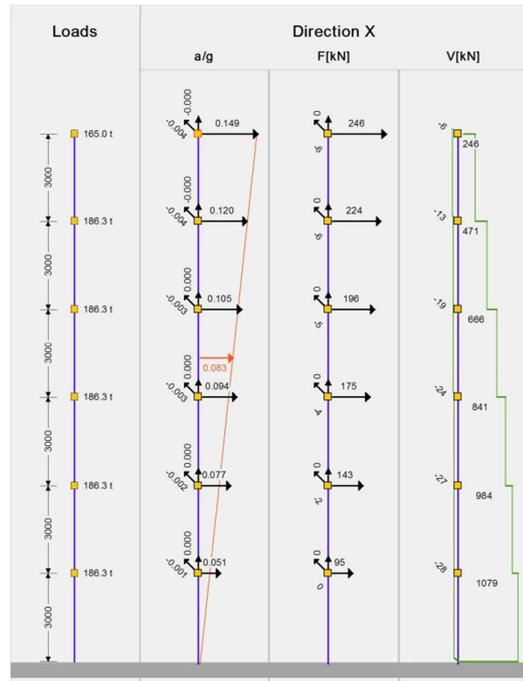*Ductile wall system in X and Y with q=3.60*

Figure 6.4.2-22: Seismic acceleration-forces-shear forces
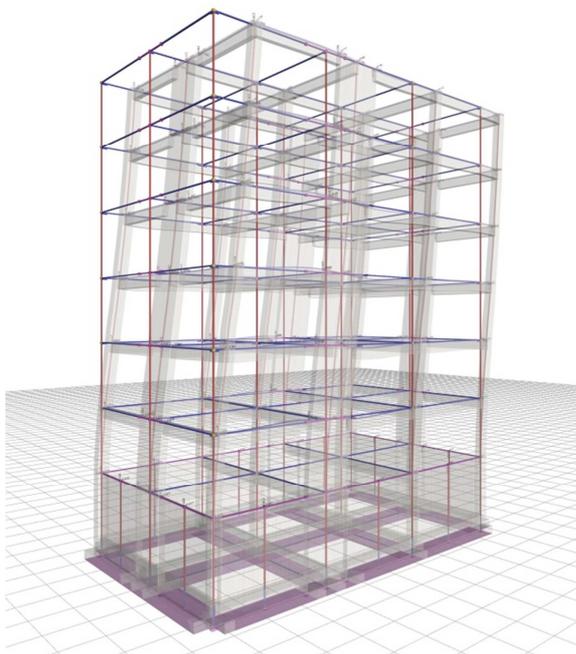*1st fundamental period:T_{1x}=0.643 sec, participation 61%*

Figure 6.4.2-23: Displacements under seismic action in x
δ_{max}=16.4 mm
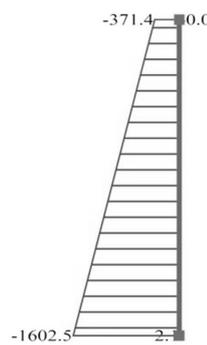
Bending moments of ground floor columns

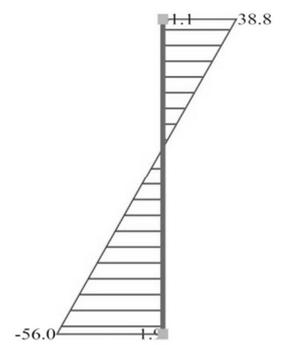*Figure 6.4.2-24:*
Ground floor wall
0c2 (2000/300)

Figure 6.4.2-25:
Ground floor column
0c6 (500/500)

The overall behaviour of the structure is much better compared to that of the strong foundation at the ground floor approaching that of the assumed fixed conditions at the base.