q) Guide wall should be used to improve the lateral tolerance of the shoring systems execution.

r) Loose- to medium – dense sands may undergo liquefaction during an earthquake. The depth of potential liquefaction should be assessed for the earthquake conciliations appropriate to the site. It may be necessary to carry the foundation of the retaining wall below the liquefaction zone, or compact the soil within the zone using deep vibro compaction (Seed H.B. et al (1983) and Ishihara (1993). BS 8002: 1994, Section 3.3.4.4.

s) In shallow excavations or structures built adjacent to a tidal waterfront area, piping or uplift may occur due to water pressure differences generated by tidal action. Structures should be checked against instability from these causes.

t) The normal tolerances in the formation of close bored pile walls should be maximum 1 in 75 to 1 in 100 for verticality and 50 mm for lateral plan tolerances measured at right angles to the line of the wall. (BS 8002: 1994, Section 4.4.7.5.1)

u) The required verticality tolerance for secant piles is normally of the order of 1:200 and for positional tolerances of the order of 25 mm, where walls have to be constructed in close proximity to other structures. (BS 8002: 1994, Section 4.4.7.5.1)

v) The safety and stability of nearby buildings and service should not be put at risk.

1.6 DESIGN GUIDELINES FOR BUILDING PILES

1.6.1 DESIGN CRITERIA FOR PILING WORKS

a) The permissible service stress should not exceed 25% of the specified cube strength at 28 days as per BS 8004 : 1986, Section 7.4.4.3.1

b) The ultimate axial load should not exceed the value of “N” given in BS 8110, Part 1 : 1997, Section 3.8.4.3

c) The minimum percentage of reinforcement shall be according to Table 3.25 of BS 8110, Part 1 : 1997

d) Pile bearing capacity calculations as per (Tomlinson’s Pile Design and Construction Practice) as advised by BS 8004: 1986, Section 4.5.3. The different types of soil and the nature of shaft resistance when using bentonite, water or full length casing shall be taken into consideration. Negative skin friction should be added to the applied load in case of piles penetrating reclaimed soil.

e) Piles shall be designed with a minimum safety factor of 2.5.

f) Uplift capacity of single pile is normally less than the friction capacity in compression (Poisson’s effect), and hence shall be taken not greater than 0.7 of the friction capacity estimated for compressive capacity.

g) Considering horizontal force and bending moment resulting from out of position by 75 mm in horizontal direction at working level, and out of the plump (verticality) by 1:75 according to BS 8004: 1986, Section 7.1 and 7.4.5.4.8. Where the pile head is fully restrained by tie beams, pile caps or raft, the contribution of the restraining system shall be considered to the favour of pile design.

h) Considering lateral load acting on pile as resulted from super structure analysis and shall be in the order of 5 % of the pile capacity at least.

i) Elastic analysis to obtain the lateral straining actions using (Reese & Matlock).

j) The stirrups of the pile shall be checked according to Table 3.8 of BS 8110, Part 1: 1997 and shall not be closer than 150 mm centres to ensure proper placing of concrete as per BS 8004 : 1986, Section 7.4.4.4.2.

k) The length of steel bars anchored to the foundation to be according to Table 3.27 of BS 8110, Part 1: 1997.

l) To prevent ingress of water and aggressive ground water penetrating the concrete, the design shall be to BS 8102 Type B using BS 8007 with a 0.20 mm crack width.

m) Settlement calculations under the working loads to be provided. The expected value to be within 1% of the pile diameter.

n) Assessment of pile group settlement shall be carried out by the foundation design Engineer and shall be compared to acceptance limits adopted for the project.

o) Pile skin friction in sand should be reduced by 50 % in case of using bentonite as drilling slurry.

p) For friction piles the spacing should be not less than three times the pile diameter, and not less than twice the pile diameter for end bearing piles as per BS 8004: 1986, Section 7.3.4.2. Piles spacing is recomended to be minimum 2.5 times the pile diameter.