Public Service™

Public Service
Company of Colorado

2420 W. 26th Avenue, Suite 100D, Denver, Colorado 80211

September 9, 1987
Fort St. Vrain
Unit No. 1
P-87316

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Attention: Mr. Jose A. Calvo
Director, Project Directorate IV

Docket No. 50-267

SUBJECT: Request for Additional Information on FSV Building 10

REFERENCES:
1) NRC Letter, Heitner to Williams, dated 7/28/87, (G-87255)
2) Telecon, PSC (Goss) and Stone & Webster (Rodell) to NRC (Heitner) and Brookhaven National Laboratory (Miller) on 8/13/87
3) PSC Letter, Lee to Hunter, dated 8/23/85, (P-85298)

Dear Mr. Calvo:

This letter responds to the request for additional information related to Fort St. Vrain Building 10, posed in Reference 1. The requested additional information as stated in Reference 1, along with PSC's response, is listed below.

A001
1/1

ITEM 1

NRC REQUEST

Reference is made to the computer code PILAY2. Please provide descriptive material for this code. If the computer code generates frequency dependent interaction coefficients, a plot of the stiffness and damping interaction coefficients as a function of frequency should be provided.

PSC RESPONSE

PILAY2 is a computer program developed by Systems Analysis Control and Design Activities, The University of Western Ontario, under the direction of Professor M. Novak. The program calculates the stiffness and damping coefficients and internal forces and displacements of a single vertical pile embedded in layered soil media for all vibration modes including torsion.

The program is based on a theoretical model that derives the soil reactions from a continuum and represents the pile by finite elements. The model is approximate but incorporates the variation of soil properties with depth, imperfect fixity of the pile tip, material damping of soil, and effects of slippage and nonlinearity. The following assumptions and limitations are associated with the use of PILAY2:

Assumptions

1. The pile is vertical, linearly elastic, and its material damping is included.

2. The pile is of a circular cross section.

3. The cross section of the pile can be constant or stepwise variable.

4. The head of pile can be either fixed or pinned.

5. A portion of pile can be freestanding above ground.

6. The pile is perfectly bonded to the soil. Pile separation can be accounted for by considering the adjacent layer of soil as void.

7. The soil is linearly elastic, and its properties can be different in each horizontal layer.

8. If the soil deposit is homogeneous, its stiffness can vary in a continuous manner due to the continuous increase in confining pressure (Parabolic Distribution).

9. With rigid bodies, the soil underneath the base can be layered and its stiffness within the soil column under the base can be different from that outside the column in each layer.

10. A zone of cylindrical cross section around the pile can be accounted for in which the soil parameters differ from those of the outer region (Composite media).

Limitations

1. Maximum number of soil layers is 30.

2. Single vertical pile.

3. Circular solid pile.

4. Number of frequencies which can be solved at one time is 10.

5. Units of input and output can be any acceptable system as long as they are consistent.

6. Weakened zone for Rigid-Body analysis is limited only to the zone next to the footing.

As was discussed in Reference 2, although the PILAY2 code is capable of generating frequency dependent interaction coefficients, PSC does not deem this warranted or cost effective and hence this function has not been performed.

ITEM 2

NRC REQUEST

Sketches or drawings should be provided showing the caisson/slab/wall configurations upon which Public Service Company of Colorado concluded that the foundation system is two to four times stiffer than the caissons.

PSC RESPONSE

Figure 1 is a sketch of the Building 10 caisson/wall configuration. The base slab is 1'-0" thick with grade beams spanning between adjacent piles. This information is also shown in detail on the Public Service Company drawings which were previously submitted in response to item 1 of Reference 3.

A calculation is provided as Attachment 1 which numerically demonstrates that the relative stiffness of the wall system is two to four times that of the caissons.

If you have any questions concerning this subject, please contact Mr. M.H. Holmes at (303) 480-6960.

Very truly yours,

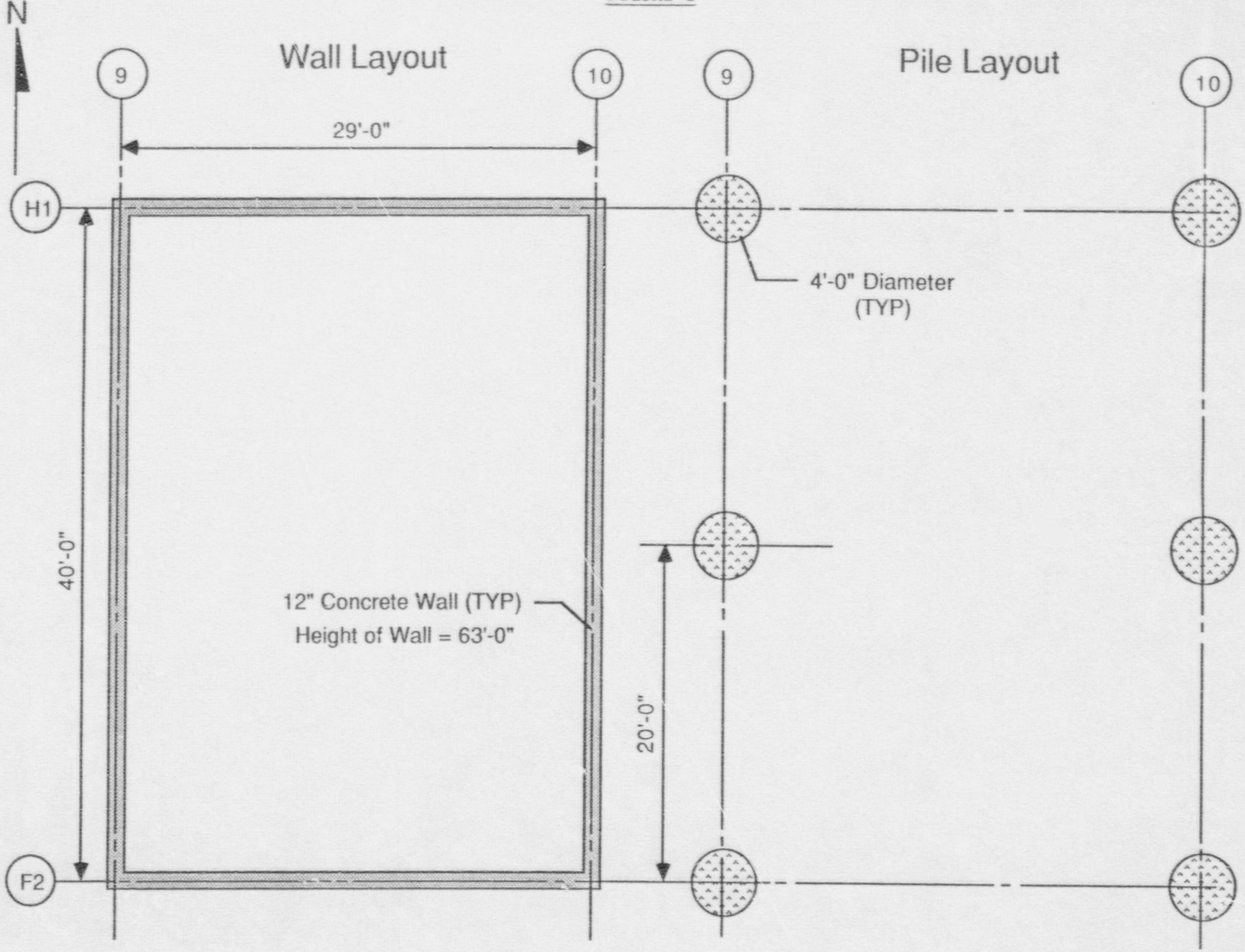
D. W. Warembourg

D. W. Warembourg, Manager
Nuclear Engineering Division

DWW/MM:pa

Attachment

FIGURE 1


N
Wall Layout
Pile Layout
9
10
9
10
29'-0"
H1
F2
40'-0"
20'-0"
4'-0" Diameter
(TYP)
12" Concrete Wall (TYP)
Height of Wall = 63'-0"

Comparison of Wall to Caisson Stiffnesses

The stiffness of these systems is determined by the moments of inertia. The moment of inertia of the wall system is calculated considering the width and the height of the wall. The caisson stiffness is calculated considering the areas of the caisson and the distance from the neutral axis. Figure 1 depicts the Building 10 wall and caisson configuration.

The moment of inertia of the wall is determined by the equation:

$I = bd^3/12$ where b = width of wall = 1'0"
d = depth of wall = 63'0"

Therefore, for the building 10 wall system (neglecting the moment of inertia of the grade slab and grade beams):

$$I = 2\left[\frac{1.0'\ (63.0')^3}{12}\right] = 4.17 \times 10^4 \ \text{FT}^4$$

The moment of inertia of the caisson system is determined by the equation:

$I = \Sigma Ad^2$ where A = area of caisson = 12.57 ft^2
d = distance from neutral axis
= 14'6" for N-S axis
= 20'-0" for E-W axis

Therefore, for the Building 10 caisson system:

$$I_{N-S} = 6\ (12.57\ \text{FT}^2)\ (14.5\ \text{FT})^2 = 1.59 \times 10^4 \ \text{FT}^4$$

$$I_{E-W} = 4\ (12.57\ \text{FT}^2)\ (20.0\ \text{FT})^2 = 2.01 \times 10^4 \ \text{FT}^4$$

As demonstrated above, the inertia of the wall system falls within the previously stated range of two to four times that of the caissons.