PENNDOT e-Notification

Bureau of Design
Bridge Quality Assurance Division

PAPIER
No. 010
July 24, 2003

Extracting Horizontal Shears at Bottom of Footing for Manual Specification Checks

The current version of the PAPIER computer program does not automatically perform specification checks for lateral forces at the foundation level. Such checks include lateral forces on piles/caissons and sliding for spread footings. While the program does not perform the specification checks, the lateral forces at the bottom of footing are computed and are accessible via the dump file. A procedure for extracting these shear forces is provided on the following pages. Until the program is enhanced to perform these specification checks automatically, which is planned for the next release (Version 1.2), designers are required to perform the computations manually. A release date for Version 1.2 has not been established at this time, but a 4th quarter 2003 date is anticipated.

Direct any questions concerning the above issue to:

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Versions 1.0 and 1.1 of the PAPIER computer program do not provide a formal output report for the lateral load analysis of a pile/caisson-supported footing or for the sliding check of a spread-supported footing. This shortcoming will be corrected in the next program release (Version 1.2).

While the current version of the program does not provide a formal output table, the necessary shear force information needed to manually perform the checks can be obtained from the intermediate dump file by following the procedure below:

1) In the input file, Parameter 1 of the OUI command must be set a to a value of '1' and Parameter 8 of the same command must be set to a minimum value of '1' (input values of '2' and '3' will also produce the required intermediate output.)

```
OUI   1,1,1,0,0,1,0,1,1
```

2) At the very end of the dump file, a table of contents listing is provided. Search for the heading "Combined Forces Report". Below is a sample taken from a dump file:

```
Combined Forces Report . . . . . . . . . . . . . . . . 142800
   Combined Forces in the Pier Cap                       142805
   Combined Forces in Column  1 . . . . . . . . . . . . 146268
   Combined Forces in Column  2                          148553
   Combined Forces - Footing  1 - Bottom of Footing . . . . . 150838
   Combined Forces - Footing  1 - Punching Shear             151227
   Combined Forces - Footing  1 - Max/Min Pile Forces . . . . . 151298
   Combined Forces - Footing  1 - Pile Punching Shear        151581
   Combined Forces - Footing  1 - Critical Faces . . . . . . 151785
```

3) The area of the dump file containing the necessary information is entitled "Combined Forces – Footing # - Bottom of Footing". To locate the output, perform a search on this text. Below is an excerpt from an actual dump file. The values of interest are the under `Vt` and `Vl` column headings, which are the shear forces in the transverse and longitudinal directions, respectively. The designer needs to scan through all 24 load cases to extract the maximum transverse and longitudinal values.

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```
Combined Forces - Footing  1 - Bottom of Footing ----------------------

  Footing  1 bottom          LC:  1    (Ax+  Mt+  Ml)

  Limit State          Ax+          Mt+          Ml          Vt          Vl
  -----------    ----------   ----------   ----------   ----------  ----------
    STR-I            10603.      -11018.      -3057.          0.        -15.
    STR-I            10603.       10715.       1143.          0.          8.
    STR-III           9603.      -15725.      -2784.        187.        -15.
    STR-III           9603.       15725.       1018.       -187.          8.
    STR-IV           11405.           0.      -3052.          0.        -15.
    STR-IV           11405.           0.       1024.          0.          8.
    STR-V            10339.      -11549.      -2954.         64.        -15.
    STR-V            10339.       11549.       1100.        -64.          8.
    SER-I             7085.       -7660.      -3686.         44.        -26.
    SER-I             7085.        7660.       1755.        -44.         14.
```

4) Note that, unlike the columns, the PAPIER program does not specifically maximize the shear force effects at the bottom of the footing. For columns, the shear forces are specifically maximized in Load Cases 25 thru 28. For the footings, however, only 24 load cases are evaluated. Nevertheless, in the vast majority of cases, the shear force in a particular direction is maximized whenever the moment in that direction is maximized, and so a separate maximization process is not considered necessary.

   The excerpt below, taken from the dump file, is for Load Case 25 at the bottom of column 1, in which the shear force in the transverse direction is being specifically maximized. Note that the resulting total shear force of 187 kips for STR-II limit state (the shear in Columns 1 & 2 must be added together since this example is a combined footing) matches the 187 kips reported above under Load Case 1 for the bottom of footing.

```
Column  1      0.000  Center          LC: 25    (Vt+  Mt)

 Limit State          Vt+          Mt
 -----------    ----------   ----------
   STR-I              22.        1090.
   STR-III           105.        5429.
   STR-IV             13.         669.
   STR-V              48.        2536.
   SER-I              37.        2077.

             CC         Vt+          Mt
             --   ----------   ----------
   STR-I      2          -11.        -613.
   STR-III    2           82.        4204.
   STR-IV     2          -13.        -669.
   STR-V      2           21.        1126.
   SER-I      2            9.         457.

   CC is the concurrent column number
```

Positive shear force in transverse direction is being maximized in this load case.