

PENNDOT e-Notification



Bureau of Information Systems
Application Development Division

ABLRFD

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Release of Version 1.4

The Department's LRFD Abutment and Retaining Wall Analysis and Design Program (ABLRFD) has been revised as described on the attached Summary of October 2003 Revisions – Version 1.4. The User's Manual has also been revised and it is now available in Adobe Acrobat PDF format.

Consultants and others, who have a current license agreement for ABLRFD Version 1.1, 1.2 or 1.3 can obtain Version 1.4 for a license update fee of \$500 for private organizations and \$50 for governmental agencies. The forms for Software Update Request and Request for PennDOT's Engineering Software License can be downloaded from the web site at <http://penndot.engrprograms.com>.

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SUMMARY OF OCTOBER 2003 REVISIONS - VERSION 1.4

Since the release of ABLRFD Version 1.3 several revision requests and user requested enhancements have been received. This release of ABLRFD Version 1.4 contains the following revisions and enhancements.

1. A user input horizontal live load has been added to be applied on the Backwall (Request 10)
2. The output routines have been revamped to decrease program size and to allow easier modification. A blank page that appears when no warnings are present at the end of the input echo has been removed (Request 11).
3. The program does not stop with an error if the height of backfill is zero at the analysis point for a design run (Request 27).
4. Two new user inputs have been added to the FTG command that allows the user to control the increments that the program uses to increase the footing width and thickness. These can be used to speed up the program for a design run (Request 29).
5. Significant modifications have been made as to how settlement is calculated for foundations on cohesive soil and a "Detailed Consolidation Settlement" report has been added to the output. (Requests 30, 112).
6. A copyright notice has been added to the program output for use during beta testing (Request 31).
7. The pile selection process has been modified to utilize all possible pile patterns (Request 32).
8. The bearing capacity routine has been modified so that if at least one soil layer has no cohesion, but has an internal angle of friction, the N_{cq} does not have to be entered on the SOI card (Request 34).
9. A user input horizontal wind load acting on the substructure has been added to the program (Request 35).
10. Additional compiler settings in Visual Fortran have been activated to trap divide by zero errors (Request 36).
11. The Average Load Factor is now being shown in the Foundations section of the Factored Load Table in the output (Request 40).
12. The program now calculates the area of reinforcement correctly for backwalls (Request 42).
13. The water pressure part of the saturated backfill is now factored as a water load and it is no longer considered as a component of the horizontal earth pressure. The horizontal earth pressure equations have been modified to better model the application of the forces upon the structure (Request 53).
14. The program now checks the height difference between the front and back water levels to assure that it complies with DM-4 3.11.3. Also, the program will verify that the back water level depth does not fall below the bottom of soil layer(s) for spread footings, or bottom of footing for all foundation types on rock. (Request 56).
15. The footing moment calculation for final surcharge has been corrected when temporary surcharge is entered as zero. This applies to Live Load and Earth Surcharge (Request 71).
16. The minimum water differential between the front and back water levels for US units is now considered as 3'-0" instead of 3'-3". (Request 98)
17. The User Manual Chapter 5 description of the MRD Parameter 2 (Development Length Correction Factor) was modified to exclude reference to epoxy coating. Epoxy coating is already considered for development length calculations in the program and should not be entered by the user (Request 101).

18. The metric values for moist and saturated density of backfill have been updated to be in accordance with DM-4 Section 3.11.5.5 (Request 108)
19. The bearing capacity routines now consistently use the absolute value of eccentricity when calculating effective footing width. For the case of negative eccentricity, this prevents the effective footing width from exceeding the actual width of the. (Request 111).
20. The program has been revised to use the height of stem measured to the top of footing when computing stem forces and moments. Previously the height of stem measured to the bottom of footing was used. For retaining walls the program reports results for both Temporary and Final Construction Stages. Because the Temporary Construction Stage will not control for Retaining Walls, the lateral earth pressure (EH) is computed only for the Final Construction Stage. This lateral earth pressure is then applied to the Temporary Construction Stage (Request 113).
21. For retaining walls, the method of computing lateral earth pressure for broken backfills has been revised to use a backfill soil with a internal friction angle $\phi = 33^\circ$ and the broken backfill calculations have been documented in the User's Manual. Input items have been added to the Materials (MAT) input command for "Backfill Friction Angle", "Backfill Unit Weight Dry ", "Backfill Unit Weight Saturated ", and "Minimum Equivalent Fluid Pressure". The Active Earth Pressure Coefficient (Ka) is now calculated separately for Stem and Foundation earth pressure calculations, and a "Lateral Earth Pressure Intermediate Values" report has been added to the output (Request 114).
22. A tolerance has been added to the front and back water height check to eliminate a false warning message (Request 117).
23. The program has been revised to assign the proper soil category when computing Soil Bearing Capacity for Category 3 (sand over clay) when the shear zone is less than the soil height. (Request 118)

This is a list of error corrections and or enhancements that are known but will be implemented in a later version:

1. A minimum value of tension will be allowed in caissons and piles. (Request 13)
2. The backfill material properties will become user input items. They are currently hard coded in as system parameters (Request 43).
3. The J-bars protruding from footings in to the stem will be epoxy coated regardless of whether the user specifies epoxy coated bars or not as per DM-4 Section 5.4.3.6P (Request 44).
4. The concrete density will become a user specified input item. The user will have to specify two concrete densities. One will be used for calculating the Modulus of Elasticity, the other will be for load considerations (Request 45).
5. The following revisions will be made to conform to DM-4 2000 specifications and standards.
 - a. Increase the maximum value for the Temp. ES on LDC card by 10 ft (3.05m). Update pp. 3-25 and 3-26 of manual to be consistent with nomenclature of 2000 DM-4 (Request 47).
 - b. Use equations for active earth pressure coefficient rather than table of values (Request 48,49).
 - c. Revise elastic settlement for foundations on stiff cohesive soils - refers back to Eq. D10.6.2.2.3b-1. Update p. 3-40 of manual to reflect the use of equation D10.6.2.2.3b-1 for the case of stiff cohesive soils. Add μ_o from equation D10.6.2.2.3b-1 to input under SOI or CNS input commands (Request 50)

- d. Update manual (Section 3.5.2.9) and program to accommodate new equation for d_v . If Eqn. A5.7.3.3.1 is satisfied for the section, it is under reinforced or balanced and d_v should be computed when no prestressing is present (as in abutments) (Request 52).
6. The reinforcement modification factors will conform to AASHTO Article 5.11.2.1.3 and 5.11.2.4.2. (Request 55, 82)
7. Reinforcement design algorithm will be optimized and the design reinforcement output will be clarified (Request 57, 99)
8. Increment width before thickness in footings for a design run to speed up execution. (Request 60)
9. The program will be revised to correct unit conversion errors for input items in the LAB, LRT, DLL, SLL, and EQL commands. (Request 61)
10. The Wind Load Factor (WL) will be modified to 1.0 for both service and strength limit states. (Request 66)
11. A negative 2" eccentricity will be applied at the bearings for the minimum load case. Currently the positive 2" eccentricity is applied for both the maximum and minimum load cases (Request 69).
12. The program will calculate moment resistance based on Temperature and Shrinkage steel when a negative moment is detected in the stem. (Request 80)
13. Pile Group Resistance will be shown as "kips(kN)/unit length" versus the current output which is "resistance per unit width of structure". (Request 83)
14. A new Friction Force Input item will be added. The friction force will be applied at the bearings. (Request 84)
15. The program will be revised to only apply the Development Length Reduction Factor once. Currently, the factor located on the MRD card Parameter 2 is applied twice. To apply a correction factor correctly, the user should enter the square root of the Correction Factor to be used. (Request 101)
16. The maximum shear in a footing on piles/caissons will be evaluated at various points of interest within piles located in the toe/heel projection. Similarly the maximum shear in a spread footing will be evaluated at incremental points along the toe/heel projection. Currently the program assumes the critical shear location at the back face of the stem or an effective depth away from the stem depending on the sign of the moment. Until this revision is implemented, the user must perform hand computations to check the maximum shear in the heel/toe projection. Refer to PennDOT e-Notification ABLRFD No. 1 for further details. (Request 110)
17. The program will be revised, for piles, to check that the ratio of unfactored vertical load to horizontal load is not be less than 3.5 (excluding seismic forces) as specified in Section 6.15.1P of DM-4 (Request 115).