PERFORM-3D Version 4.0.4

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Release Date: 2008-12-23

Contents

1. Installation Instructions for PERFORM-3D Version 4.0.4.
2. Significant changes from Version 4.0.3.

1. INSTALLATION INSTRUCTIONS FOR PERFORM-3D VERSION 4.0.4

If you are installing Version 4.0.4 from a CD, please follow the installation instructions for Version 4.0.0 (see later in this file).

If you already have any of Versions 4.0.0 to 4.0.3 installed, and have obtained Version 4.0.4 as a download patch, please follow the instructions in this section.

The download consists of three files, as follows.

1. This ReadMe file.
2. Perform-3D.exe.
3. Pf3DEngineV404.dll.

To install Version 4.0.4, go to all computers that have an earlier version installed, and replace the files Perform-3D.exe and Pf3DEngineV4xx.dll with the new files. If you wish, you can do this by moving the file PERFORM-3DV404patchfor403.zip to the PERFORM-3D program folder, then unzipping. Alternatively, unzip in a different folder, then replace the files in the PERFORM-3D program folder.

2. SIGNIFICANT CHANGES FROM VERSION 4.0.3

PERFORM-3D Version 4.0.4 fixes the following known bug in Version 4.0.3.

Incident 16595
An Incident was resolved in which the program generated a runtime error 364 after the license was lost rather than just stopping execution.

PERFORM-3D Version 4.0.3

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Release Date: 2007-11-16

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3. Installation Instructions for PERFORM-3D Version 4.0.3.
4. Significant changes from Version 4.0.2.

1. INSTALLATION INSTRUCTIONS FOR PERFORM-3D VERSION 4.0.3

If you are installing Version 4.0.3 from a CD, please follow the installation instructions for Version 4.0.0 (see later in this file).

If you already have Version 4.0.0, Version 4.0.1 or Version 4.0.2 installed, and have obtained Version 4.0.3 as a download patch, please follow the instructions in this section.

The download consists of three files, as follows.

4. This ReadMe file.
5. Perform-3D.exe.
6. Pf3DEngineV403.dll.

To install Version 4.0.3, go to all computers that have an earlier version installed, and replace the files Perform-3D.exe and Pf3DEngineV4.dll with the new files. If you wish, you can do this by moving the file PERFORM-3DV403patchfor402.zip to the PERFORM-3D program folder, then unzipping. Alternatively, unzip in a different folder, then replace the files in the PERFORM-3D program folder.

2. SIGNIFICANT CHANGES FROM VERSION 4.0.2

PERFORM-3D Version 4.0.3 fixes all known bugs in Version 4.0.2. The significant bugs are as follows. They have been fixed in Version 4.0.3.

Incident 13453
Modal Damping. There is an error in the implementation of "modal" damping. Experience indicates that if this error has any effect, that effect will usually be serious, with results that are obviously incorrect. However, this may not always be the case. If you have run analyses using modal damping, you should re-run some analyses with Version 4.0.3, to make sure that the error has not had a significant effect.

We recommend that whenever you use modal damping you run a few analyses with comparable Rayleigh damping, to see if there are significant differences. If you find a case where modal and Rayleigh damping give substantially different results, please let us know.

Incident 13472
Addition of New Mass Pattern in a Very Large Structure. If you have a structure with a very large number of nodes, and if you try to add a new Mass Pattern, you may get a fatal "overflow" error.

PERFORM-3D Version 4.0.3 adds one significant new feature to Version 4.0.2, as follows.

Incident 13475
***Strength Loss in Steel Columns Different for Bending Moment and Axial Force*.**
If a FEMA column component or a PMM hinge component is deformed past its ductile limit (Point L in the F-D relationship), it loses strength. In Version 4.0.2 the strength reduction for bending moment and axial force can be different for steel columns, but not for concrete columns. Version 4.0.3 allows you to specify different strength reductions for bending moment and axial force for concrete columns as well as steel columns. Typically you will specify a smaller reduction in axial strength than in bending strength.

PERFORM-3D Version 4.0.2

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Release Date: 2007-02-05

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5. Installation Instructions for PERFORM-3D Version 4.0.2.
6. Significant changes from Version 4.0.1.

1. INSTALLATION INSTRUCTIONS FOR PERFORM-3D VERSION 4.0.2

If you are installing Version 4.0.2 from a CD, please follow the installation instructions for Version 4.0.0 (see later in this file).

If you already have Version 4.0.0 or Version 4.0.1 installed, and have obtained Version 4.0.2 as a download patch, please follow the instructions in this section.

The download consists of three files, as follows.

7. This ReadMe file.
8. Perform-3D.exe.
9. Pf3DEngineV4.dll.

To install Version 4.0.2, go to all computers that have Version 4.0.0 or Version 4.0.1 installed, and replace the files Perform-3D.exe and Pf3DEngineV4.dll with the new files. If you wish, you can do this by moving the file PERFORM-3DV402patchfor401.zip to the PERFORM-3D program folder, then unzipping. Alternatively, unzip in a different folder, then replace the files in the PERFORM-3D program folder.

2. SIGNIFICANT CHANGES FROM VERSION 4.0.1

PERFORM-3D Version 4.0.2 fixes a number of bugs in Version 4.0.1. The significant bugs are as follows. These have all been fixed in Version 4.0.2.

> ***Error in Text File for Usage Ratios in Deflected Shapes Task.*** If you save element usage ratios from the Deflected Shapes task, the elements are not identified correctly in the text file. Specifically, the Node I coordinates for the elements may be incorrect. Also, PERFORM-3D may give an incorrect error message stating that the text file can not be written, and will write only a part of the file.

Error if 2-Node and 4-Node Deformation Gage Elements are Both Used. If you use both 2-node gage elements (strain or beam type rotation) and 4-node gage elements (wall type rotation or shear strain) in a structure, there can be an error (PERFORM will terminate with an out of bounds error message).

***Error in Plotting F-D Relationship for FEMA Beam, Concrete Type Component*.** In the Component Properties task, there is an error in plotting the F-D relationship for FEMA Beam, Concrete Type components. Specifically, the negative U point is not plotted correctly – the D value is stored correctly, but the D value in the plot is incorrect. This has been fixed in Version 4.0.2.

PERFORM-3D Version 4.0.1

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Release Date: 2006-10-01

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1. Installation Instructions for PERFORM-3D Version 4.0.1.
2. Significant changes from Version 4.0.0.

1. INSTALLATION INSTRUCTIONS FOR PERFORM-3D VERSION 4.0.1

If you are installing Version 4.0.1 from a CD, please follow the installation instructions for Version 4.0.0 (see later in this file).

If you already have Version 4.0.0 installed, and have obtained Version 4.0.1 as a download patch, please follow the instructions in this section.

The download consists of three files, as follows.

1. This ReadMe file.
2. Perform-3D.exe.
3. Pf3DEngineV4.dll.

To install Version 4.0.1, go to all computers that have Version 4.0.0 installed, and replace the files Perform-3D.exe and Pf3DEngineV4.dll with the new files. If you wish, you can do this by moving the file PERFORM-3DV401patchfor400.zip to the PERFORM-3D program folder, then unzipping. Alternatively, unzip in a different folder, then replace the files in the PERFORM-3D program folder.

2. SIGNIFICANT CHANGES FROM VERSION 4.0.0

PERFORM-3D Version 4.0.1 fixes the following bugs in Version 4.0.0.

> ***Error in Fiber Beam and Fiber Column Cross Sections.*** The stiffnesses for Fiber Beam and Fiber Column cross sections are not calculated correctly. Wall cross sections are not affected. The error is not present in Version 2. The error can lead to incorrect results, and may cause the program to crash. There is no simple work-around. If you have used Fiber Beam or Fiber Column cross sections, and have analyzed the structures with Version 4.0.0, you should repeat the analyses with Version 4.0.1.

Error in Exporting and Importing Component Properties. In the Component Properties task you can export selected component properties from one analysis model and re-import them into a different model. This feature does not work correctly in Version 4.0.0.

Error in Element Colors for Combinations and Envelopes Task. In the Combinations and Envelopes task, if you plot a structure with colored elements, and if you use a limit state group, the element colors can be incorrect. This will happen if the limit state group chosen in the Element Colors page is different from that in the Structure page. If you have used element colors to make design decisions, you should check the results using Version 4.0.1.

PERFORM-3D Version 4.0.0

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Release Date: 2006-09-01

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1. Installation Instructions for PERFORM-3D Version 4.0.0.
2. Compatibility with Earlier Versions.
7. Additions for Version 4.
8. Known Bugs in Version 2.51.

1. INSTALLATION INSTRUCTIONS FOR PERFORM-3D VERSION 4.0.0

The installation instructions are available in three places:

1. The "PERFORM-3D Installation Card" link on the PERFORM-3D CD browser.
2. A printed document included with the program package.
3. In the file *PERFORM-3D_Install_Instructions.pdf* in the root folder of the CD.

The instructions include information about the software protection system used and installation options and instructions. You can choose between a Standalone or Network installation.

For new Network installations, see the *License Manager System Administrator's Guide* for more detailed information about the License Manager and the License Manager Administration program "WlmAdmin.exe".

This installation contains the License Manager program SentinelLM 7.2.0.23. If you are currently running an earlier version of SentinelLM then it should be uninstalled prior to installing this version. ***IMPORTANT!*** All commuter licenses should be checked in before uninstalling the old version.

If you experience problems with the license please refer to the appropriate "*License Trouble Shooting Guide...*" located in the PERFORM-3D folder.

2. COMPATIBILITY WITH EARLIER VERSIONS

If you are a new user you do not need to read this section.

The last release version of PERFORM-3D is Version 2.51. Some users have received beta versions with later version numbers. Version 4.0.0 replaces all earlier versions.

Any structures that you have set up in older version can be opened in Version 4. Also, any analyses that you have run with earlier versions can be processed using Version 4.

One restriction is that if you have set up an Analysis Series in an earlier version, and have run some analyses in that series, you may not be able to add more analyses to that series. If this is the case, if you try to add more analyses you will get an error message. To run analyses you must either remove the existing analyses from the Analysis Series, or start a new series.

Also, if you open an existing structure in Version 4, and if you make any changes or run any analyses, you will not be able to open that structure in Version 2. In ace you need to go back, we recommend that you make copies of important structures using Version 2, then work with those copies in Version 4.

Version 4 installs PERFORM-3D in a different folder than earlier versions. One consequence of this is that the default Structures folder has a different location. If you have analyses in the default Structures folder, they will not show up in the Default list when you start the program. To fix this, move all files in the default Structures folder from the old location to the new one.

A second consequence is that the most recently opened structures will not be shown in the Recent list. To fix this, you can copy the RecentStructures.PF3D file from the old PERFORM-3D folder to the new one.

3. ADDITIONS FOR VERSION 4

If you are a new user you do not need to read this section.

This section describes the main features that have been added since Version 2.51.

Results Processing

1. ***Load Case Combinations*.**

   In Version 2, limit state usage ratios can be examined for only one load case at a time, using either the Usage Ratio Graphs or Deflected Shapes task. In order to calculate usage ratios for combinations of load cases in Version 2, it is necessary to write the usage ratios for each load case to text files, and to process them using a spreadsheet program. A new Combinations/Envelopes task in Version 4 allows load case combinations to be specified within PERFORM-3D, and for usage ratios to be calculated and displayed for these combinations.

2. ***FEMA 440 Methods for Push-Over Analysis*.**

FEMA 440 proposes a new Linearization method for static push-over analysis, and also proposes a number of changes in the Coefficient method. Version 4 adds a new General Push-Over Plot task that implements these methods, in addition to the Capacity Spectrum and FEMA 356 Coefficient methods.

3. ***Hinge Plotting for Frame Elements*.**

   In a deflected shape plot, the elements can be colored depending on their Demand/Capacity ratios. In the usual case where a beam or column element has plastic hinges at both ends, the element D/C ratio is the ratio for the "worst" hinge, and the plot does not show which hinge is critical. Version 4 adds a new plotting option that shows individual hinges in Frame elements, and colors them based on their D/C ratios. Among other things, this can be used to show which end of a beam or column element is more critical.

4. ***Approximate Damping Ratio*.**

   The concept of a modal damping ratio, as a percentage of critical damping, is strictly applicable only for linear structural behavior. However, it is possible to calculate an approximate equivalent damping ratio for nonlinear behavior. Version 4 adds this option. The user guide explains the assumptions.

Components and Elements

1. ***"Auto" Panel Zone Component.***

   In a steel frame structure, the properties of connection panel zones depend on the properties of the connected beams and columns. In Version 2, you must set up a panel zone component for each different beam-and-column combination, and you must be sure to assign the correct component to each panel zone element. Version 4 adds a new Auto Panel Zone component that simplifies this process. For this component you do not specify the column and beam sizes. Instead, PERFORM-3D determines these sizes for each different beam-and-column combination, and automatically calculates the required panel zone properties. A single Auto Panel Zone component may be all that is needed.

2. ***Bar Element with Buckling Hysteresis Loop*.**

   Version 4 adds a new Buckling Material, with a hysteresis loop of buckling type. This material can be used in Steel Bar/Tie/Strut elements to model buckling struts.

3. ***More Choices for Fiber Properties in Fiber Sections*.**

   In Version 2, fiber cross sections for beams and column can have fibers of either steel or concrete type. Version 4 adds two new fiber types, namely Tension-Only Material and Buckling Material.

4. ***Beam or Column Shear Strength Depends on Hinge Rotation.***

   In a reinforced concrete beam or column, the shear strength is usually smaller in plastic hinge regions than outside those regions. If the behavior in shear is required to remain essentially elastic, the shear strength can be checked using a Shear Force Strength Section. In Version 2 the shear strength at such a section is fixed (for a given performance level). Version 4 allows a Shear Force Strength Section to be linked to an adjacent flexural plastic hinge component, and the shear strength of the Strength Section can then depend on the rotation of the hinge.

   This applies to Shear Force Strength Sections only. If Shear Hinge components are used to model inelastic shear behavior, PERFORM-3D does not allow the shear hinge strength to depend on the moment hinge rotation.

5. ***Steel Column Ductile Limit Depends on Axial Force.***

   In FEMA 356 the ductile limit (FEMA 356 "C Point") for a steel column depends on the axial compression force. In PERFORM-3D Version 2 the corresponding point (the PERFORM "L Point") does not depend on the axial force. Version 4 adds this dependence, for steel FEMA column and steel PMM hinge components..

   This applies to steel columns only. For a concrete column, the FEMA 356 ductile limit depends on both the axial force and the shear force. PERFORM-3D does not consider this dependence.

6. ***Strength Loss in Steel Columns Different for Bending Moment and Axial Force.***

   If a FEMA column component or a PMM hinge component is deformed past its ductile limit, it loses strength. In Version 2 the amount of strength loss is the same for both bending moment and axial force (the PMM yield surface simply shrinks). For steel columns in Version 4 you can specify different strength reductions for bending moment and axial force. Typically you will specify a smaller reduction in axial strength than in bending strength.

7. ***Four-Node Rotation Gage for Shear Walls.***

   Version 2 has strain gage and beam-type rotation gage components, but has no convenient way to monitor hinge-type rotations in shear wall structures. Version 4 adds a 4-node rotation gage for this task.

8. ***Four-Node Shear Strain Gage for Walls.***

   PERFORM-3D calculates shear strains for individual wall elements, and you can set up limit states based on these strains. However, rather than considering individual elements, you may want to consider the effective shear strain over a larger area, for example a complete story in a wall structure. Version 2 has a "distortion" drift that can be used for

this purpose. However, since distortion drifts are not elements, they can not be shown colored in a deflected shape plot. Version 4 adds a 4-node shear strain gage element. These elements are similar to distortion drifts, but they can be colored in a deflected shape plot based on their D/C ratios.

9. ***Option for Complete Strength Loss at X Point.***

   The FEMA 356 force-deformation relationship for an inelastic component has initial strength loss at the ductile limit deformation (the FEMA 356 "C Point", corresponding to the PERFORM "L Point") and total strength loss at a larger deformation (the FEMA 356 "E Point"). In Version 2, inelastic components can lose strength at the L Point, but do not lose strength completely. For some components, Version 4 allows you to specify total strength loss at the PERFORM "X Point".

10. ***More Control Over Hysteresis Loop Shape.***

    Version 2 allows you to specify stiffness degradation (and hence energy degradation) under cyclic loading, using energy dissipation factors. Given the energy dissipation factors, PERFORM-3D adjusts the unloading and reloading stiffnesses to provide the specified amount of energy dissipation. Version 2 does not give you control over how the stiffnesses are adjusted. For some components, Version 4 adds a new parameter that gives you greater control over the unloading and reloading stiffnesses.

11. ***Upper and Lower Bounds for Strength and Stiffness.***

    At the component property level, Version 4 allows you to specify upper and lower bounds on component strength and stiffness, expressed as multiples of the nominal strength and stiffness. Then when you start a new Analysis Series you can specify that strengths and stiffnesses other than the nominal values are to be used for any component. This allows you to account for uncertainty in the component properties without defining a new analysis model.

Load Cases and Analysis Methods

1. ***Push-Over Load Based on Masses and a Displacement Pattern.***

   For push-over analysis, Version 2 allows horizontal lateral loads based on either specified load patterns or mode shapes. Version 4 adds an option based on the masses and a user-specified displacement pattern that varies over the structure height. This is much simpler than using push-over load patterns.

2. ***Modal Damping.***

   Version 2 uses Rayleigh ($\alpha M + \beta K$) damping. Version 4 adds the option of modal damping.

3. ***Greater Flexibility in Analysis Series*.**

   In Version 2, for each new Analysis Series that is started, the mass and damping can be varied. Version 4 allows a wider variety of parameters to be varied. This allows you to set up a variety of different analysis models without duplicating the structure and changing its properties.

Productivity

1. ***Copy-Paste for Editing Component Properties*.**

   In Version 2, if several components have properties that are mostly the same, the properties of one component can be copied using "SaveAs", then edited to change the properties that are different. However, if a later change is made that affects several components (e.g. to add or modify a deformation capacity that is the same for many components), each component must be edited separately. Version 4 adds a Copy-Paste feature that can save time making such changes.

2. ***Filtering Component Lists*.**

   In PERFORM-3D, components are selected from drop-down lists. If there are many components of a given type, the drop-down list can be long, and finding a particular component can involve searching. Also, the components are listed in the order that they are defined, so that related components may not be adjacent to each other in the list. Version 4 adds a "filter" feature that allows only related components to be listed, and hence shortens the list.

3. ***Purging Component Lists*.**

   A component list may contain components that are not used in any elements or higher-level compound components. Version 4 adds a "purge" feature that deletes unused components.

Change in Terminology - "Cyclic Degradation" vs. "Dissipation"

For most inelastic components in PERFORM-3D, you can specify, as an option, that stiffness degradation occurs under cyclic deformation. This is done using "Dissipation Factors" that control the area of the degraded hysteresis loop relative to the non-degraded loop. If the dissipation factor is 1.0 (the default), there is no energy degradation, and no stiffness degradation. If the dissipation factor is smaller than 1.0, say 0.6, PERFORM-3D adjusts the unloading and reloading stiffnesses so that the area of the degraded loop, for a full cycle of deformation, is 0.6 times the area of the non-degraded loop.

Version 2 gives you little control over the details of how the unloading and reloading stiffnesses are adjusted. As noted earlier, Version 4 gives you more control. Given these changes, the terminology “Dissipation Factor” is not very descriptive. In Version 4, the terminology is changed to refer to the overall effect as “Cyclic Degradation”, and to change the term “Dissipation Factor” to “Energy Degradation Factor”.

4. KNOWN BUGS IN VERSION 2

If you are a new user you do not need to read this section.

PERFORM-3D Version 2.51 has the following known bugs. All known bugs have been fixed in Version 4.

Incorrect Structure Section Results for Beams with Multiple Element Loads. This can apply to beam elements that have element loads in the gravity load case. It is unlikely that it will apply to column elements, because column elements are unlikely to have element loads. If there is only a single element load pattern in the gravity load case (e.g. if a load pattern "DL + 0.25LL" is applied), there is no error. However, if there are two or more element load patterns (e.g., if one pattern is "DL" and the second is "0.25LL"), there may be an error, and the D/C ratios calculated for moment and shear strength sections may be incorrect. The only work-around is to apply only one element load pattern.