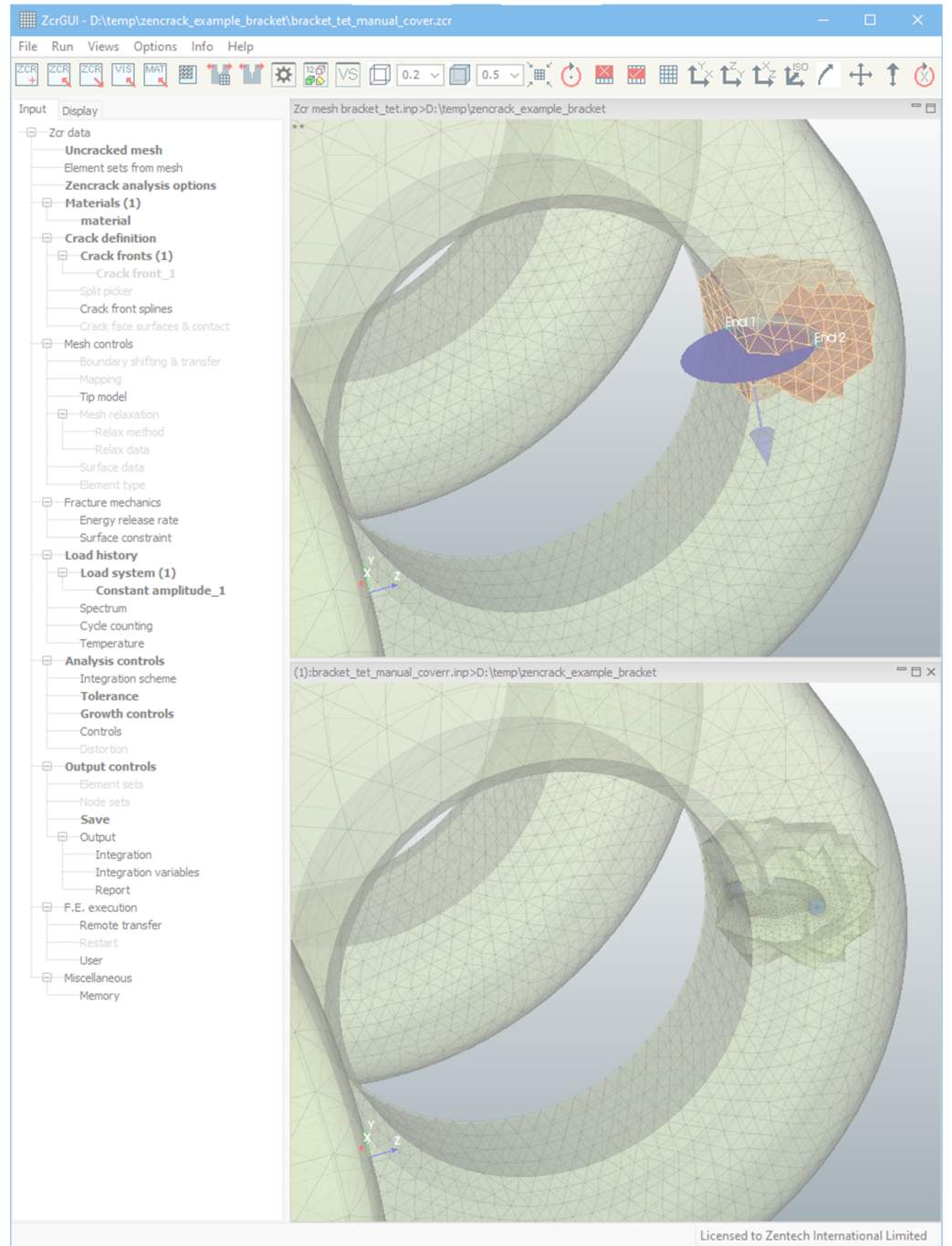


ZenCrack



Installation And Execution Version 9.2

Installation And Execution

Issue 9.2

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All pages of this manual are at Revision 0.

This version of the manual is for use with the latest software version indicated below and may also be issued with subsequent software releases if updates are not required.

Software versions are identified by version number and build date.

The Zencrack version and build date are shown in the banner at the start of the output file (i.e. the .rep file). The Zencrack GUI version and build date are shown in the program Help>About menu.

Program	Version	Build date	Manual version
Zencrack	9.2-1	23 February 2023	Issue 9.2 Revision 0, 50 pages
Zencrack GUI	9.2-a	23 February 2023	

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Table of Contents

1	Introduction	3
1.1	License types	3
1.2	Hardware requirements	4
1.3	Software requirements	4
1.3.1	Finite element interfaces	4
1.3.2	Fortran compiler	4
1.3.3	License server	5
1.3.4	Changes in software configurations	5
2	Installation - Zencrack Product	6
2.1	Windows	6
2.1.1	To install the program files (Windows)	6
2.2	To un-install Zencrack (Windows)	8
2.2.1	To install the documentation files (Windows)	9
2.2.2	To un-install the documentation files (Windows)	9
2.2.3	Remote execution of the finite element code	9
2.2.4	Possible issues	10
2.2.4.1	Program Compatibility Assistant warning	10
2.2.4.2	Zencrack GUI fails to execute	10
2.3	Linux	11
2.3.1	To install the program files (Linux)	11
2.3.2	To un-install Zencrack (Linux)	12
2.3.3	To install the documentation files (Linux)	13
2.3.4	To un-install the documentation files (Linux)	13
3	Installation - License Server	14
3.1	Windows	14
3.2	Linux	15
4	Setup Of Zencrack Product After Installation	16
4.1	The zencrack.ini file	16
4.1.1	[ABAQUS] section	17
4.1.2	[ANSYS] section	18
4.1.3	[NXNASTRAN] section	20
4.1.4	[LICENSE] section	21
4.1.5	[FORTRAN_LINUX] section	21
4.1.6	[FORTRAN_WINDOWS] section	22
4.1.7	[REMOTEFE] section	22
4.1.8	[RUNTIME] section	22
4.1.9	[MISC] section	23
4.1.10	[SETUP] section	23
4.2	The Zencrack GUI	24
4.3	Using Zencrack user subroutines	24

4.4	Configuring the plug-ins for Abaqus/CAE	26
5	Running Zencrack	28
5.1	Command prompt setup in Windows	28
5.2	Terminal window setup in Linux	28
5.3	Execution using runzcr92	29
5.4	Running the Zencrack GUI	31
5.5	Examples of command line execution	31
5.6	Killing a Zencrack job during execution	32
5.6.1	Windows	32
5.6.2	Linux	32
6	Verifying An Installation	33
7	Nodelocked and License Server (Network) Licensing	35
7.1	Information required to generate a license file	35
7.2	Nodelocked license file	35
7.3	Network License server	36
7.3.1	Configuring the license server	37
7.3.2	Starting the RLM server	37
7.3.2.1	Running the RLM server as a service on Windows	37
7.3.2.2	Starting the RLM server at system boot time on Linux systems	38
7.3.3	Browser-based license administration	39
7.3.3.1	Installing an updated RLM license file	40
7.3.4	Releasing locked licenses	40
7.3.5	Contents of the RLM license file	41
7.3.6	Configuring a client machine	41
8	Remote Execution Of The Finite Element Analysis	43
8.1	Configuration	43
8.2	Remote command timeout period	47
8.3	Zencrack input file	48
8.4	Execution of a Zencrack job with remote F.E. analysis	48
8.5	Limitations of the remote transfer capability	49
	References	50

List of Figures

2.1	Program Compatibility Assistant warning (shown for Zencrack 8.0-1 on Windows 7)	10
2.2	Failure of execution of the Zencrack GUI on Windows 7 machine	11
4.1	Zencrack command prompt (Windows)	25
4.2	Plug-in access in Abaqus/CAE	27
5.1	Zencrack command prompt (Windows)	28
7.1	Typical license status screen after selecting ‘Status’ from the left side menu	39
7.2	Typical server license status after selecting ‘zentechint’ from the Server Status of the main status screen	40
7.3	Typical server usage status	41

1 Introduction

This document describes installation, set-up and execution of Zencrack version 9.2-x for Windows x86 and Linux x86 platforms. The document includes installation of the Zencrack analysis product and GUI, and the RLM license server (which is required for network licensing). For sub-versions 9.2-2 onwards, any explicit references to 9.2-1 in this document should be read with 9.2-1 replaced by the appropriate sub-version number. In some places a generic reference is made to version 9.2-x. 64bit versions of Zencrack 9.2 are available for x86 machines running 64bit Windows or Linux.

Documentation uses pdf files (Adobe Acrobat version 5) and requires a suitable reader. The native Reader apps in Windows 8 and 10 that open pdf files do not allow use of cross-document links such as those in the Zencrack documentation main page. An alternative such as Adobe Reader is recommended instead. This can be downloaded from:

<https://get.adobe.com/uk/reader>

Up-to-date information on compatibility of different versions of the interfaced finite element codes is maintained on the Zencrack section of the Zentech website:

<https://www.zentech.co.uk/zencrack.htm>

If Zencrack user subroutines are to be used then an appropriate version of the Intel Fortran compiler must be installed. Up-to-date information on compatibility of compiler versions can also be found on the Zentech website:

https://www.zentech.co.uk/zencrack_support_fortran.htm

1.1 License types

Zencrack can be licensed using a nodelocked license file or using a token-based license server (i.e. network licensing) system. Both systems are based on the Reprise License Manager (RLM) [1].

For a nodelocked system the software (either Zencrack Standard or Zencrack Professional) can only be executed on the machines(s) specified in the license file. The nodelocked method does not require installation of a license server - only the placement of the supplied license file into the license sub-folder of the Zencrack installation.

For network licensing, a license server must be installed on a specified machine. The license file declares this machine as the license server and contains information about the licensed products. All files required for the license manager are supplied by Zentech - there is no requirement to download files from the Reprise website. The Zencrack product is then installed on one or more client machines (one of which could be the server machine). When a Zencrack job is executed on a client machine a request is made to the server to check out the required number of tokens for the job. This manual covers the basics of installing, starting and using the RLM license server. Additional information can be found in the RLM License Administration Manual supplied as part of the license server installation and the Zencrack documentation.

1.2 Hardware requirements

Memory requirements are generally governed by the requirements of the finite element analysis rather than by Zencrack so provided there is sufficient memory to run the finite element analyses of typical user models there should not be any memory issues for Zencrack.

The Zencrack analysis program is an ‘analysis engine’ so there are no special hardware requirements. Input and output to the analysis program is via ASCII text files.

The Zencrack GUI allows reading, modification and writing of Zencrack input files as well as display of finite element meshes and results data. It requires OpenGL support on the graphics card.

The Zencrack plug-ins for Abaqus/CAE and Abaqus/Viewer have no special hardware requirements beyond any requirements for running /CAE or /Viewer.

THE RLM license server and client installations are available for Windows 64bit machines or Linux 64bit machines.

1.3 Software requirements

Zencrack is supplied as an installer that contains executables, object files and ancillary support files - no third party files are required to be installed other than the finite element code which the user intends to use with Zencrack.

For Windows platforms Windows 10 is recommended.

1.3.1 Finite element interfaces

Zencrack is interfaced to Abaqus/Standard [2], Ansys/APDL [3] and Simcenter Nastran [4]. The Zencrack user license permits use with one or more of these finite element programs (which must be licensed separately from the appropriate vendor). The finite element program must be executed on the same machine as Zencrack unless the remote finite element execution option is activated. This capability is available if Zencrack is installed on a Windows PC with the finite element analysis required on a remote Linux or Unix machine.

It is generally expected that a machine on which Zencrack is to be installed already contains a local installation of Abaqus, Ansys or Simcenter Nastran. During the Zencrack installation procedure a setup program runs and requests user input about the f.e. version(s) to be used by Zencrack.

1.3.2 Fortran compiler

A Fortran compiler is only required if a Zencrack user subroutine option is to be used. When a job runs that requires a user subroutine, the Zencrack execution program automatically compiles the subroutine and links it with the supplied object files to create a new executable. This can be achieved using the -u command line option (see section 5.2). The Intel Compiler Classic, Version 2021.1 (part of Intel oneAPI) is required if user subroutines are to be used. Updated information about compatibility with Intel Fortran versions is available at:

https://www.zentech.co.uk/zencrack_support_fortran.htm

If user subroutines are not used, there is no requirement to have an Intel Fortran Compiler installed.

If there is uncertainty about the requirements for user subroutines at the time of installation, it is recommended that the ‘no compiler’ option is selected during the installation setup process. This can be changed at a later date by re-running the setup program.

Each installation of Zencrack contains a readme.txt file in its top-level directory that provides details of the operating system and compiler used to create that version of the software. If you have an earlier compiler version, you may need to upgrade to at least the compiler version used to create Zencrack, or have the necessary run-time files in place.

1.3.3 License server

For users with a license server arrangement all necessary files for the server installation are supplied in a separate license server installation file, i.e. one installation file for client product installation and one for license server installation.

1.3.4 Changes in software configurations

In the event of changes to the software configurations (for instance installing a newer version of the interfaced f.e. code, changes to the license server machine, installing a Fortran compiler), the Zencrack setup program may be re-run or the zencrack.ini file may be manually edited (see section 4).

2 Installation - Zencrack Product

This section describes installation of the Zencrack product. This is applicable for nodelocked licenses and for client installations when using a network license server.

It is recommended that the operating system should be up-to-date on any target machine before installing Zencrack.

As part of the program installation, a setup program is run to complete the configuration of the f.e. interface(s) and Fortran. This setup program runs in a command prompt/terminal window and searches for f.e. and Intel Fortran Compiler for oneAPI versions in default locations. If no suitable versions are found, options are provided to widen the search.

It is generally not recommended to run analyses or create any other files within the Zencrack installation directories.

2.1 Windows

The Zencrack product is supplied as two files:

Zencrack_9-2-x_Windows-64.exe - setup program containing the analysis program files and GUI.

Zencrack_9-2-x_Windows-doc.exe - setup program containing the documentation files.

The default program installation location is c:\Zencrack\9.2-x but this may be changed if required. Please note that:

- The user installing the program must have sufficient privilege to create files in the chosen installation location during installation.
- If multiple user accounts exist on the machine, any desktop shortcuts or Start Menu / Apps Page shortcuts are installed for the current user only.
- At run-time the GUI creates log files in the install folder so the user account that runs the GUI must have permission to write to that folder. The location of the log files can be changed via a setting in the GUI .ini file (see section 4.2).

The documentation can be installed before or after installation of the program. It is recommended that the documentation be installed into a sub-directory of the main Zencrack folder. For this reason the default documentation location is c:\Zencrack\9.2-x_document.

2.1.1 To install the program files (Windows)

1. Log in as the user required to execute Zencrack. Administrator privilege is not required but may reduce any system messages regarding UAC. The installing user must have permissions to create files in the chosen installation location.
2. Run the Zencrack_9-2-x_Windows-64.exe setup program to install Zencrack. Accept the license terms.
3. Define parameters for the installation on a series of screens. The default home directory c:\Zencrack\9.2-x is used throughout the remainder of these instructions. If selected, an

uninstaller executable, `uninstall_9-2-x.exe`, is created in the installation home directory. It is recommended that an uninstaller is created.

4. The following directory structure is created under the home directory:

<code>bin</code>	Zencrack executable, object and library files
<code>crack</code>	Crack-block files
<code>defaults</code>	Files with various default settings e.g. <code>tol.dat</code>
<code>demos</code>	Example input files - see the <code>readme.txt</code> file in this directory
<code>fe_abaqus</code>	Files related to the Abaqus interface (including /CAE plug-in files)
<code>fe_ansys</code>	Files related to the Ansys interface
<code>fe_gmsh</code>	Files related to remeshing
<code>fe_nxnastran</code>	Files related to the Simcenter Nastran interface
<code>gui</code>	Files related to the Zencrack GUI
<code>license</code>	Nodelocked license file should be placed here ¹
<code>machine_id</code>	Utility to extract details required to license Zencrack
<code>tools</code>	Execution file and location of the <code>zencrack.ini</code> file
<code>utils</code>	Utility programs: <code>3dmesh</code> : crack profile generator <code>process</code> : creates a <code>.csv</code> data file for specified node(s) on a crack front <code>rainflow</code> : rainflow cycle counting <code>tanh</code> : creates tabular growth data from tanh growth equation data <code>T4eRexec</code> : used for remote f.e. execution <code>T4eSSH</code> : used for remote f.e. execution examples directory for utility programs
<code>readme.txt</code>	Installation information
<code>versions.txt</code>	Version information

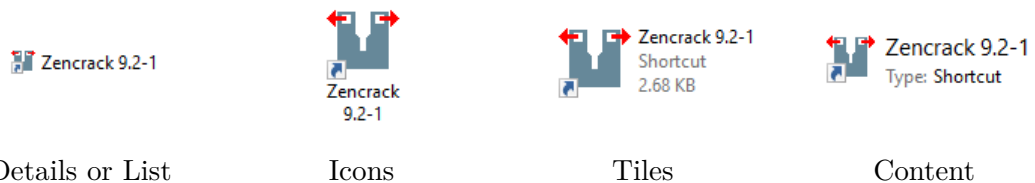
5. After placing files onto your hard disk the installer runs the final part of the Zencrack configuration in a command prompt window. This configuration procedure requests information on the location of f.e. codes and of the Fortran environment (if any). It then configures the Zencrack `.ini` file accordingly.
6. Choose whether or not to create entries in the Start Menu/Apps Page and/or desktop shortcuts. The Start Menu/Apps Page entries include a shortcut to the Zencrack command prompt and the Zencrack GUI (i.e. the same as the optional desktop shortcuts). This concludes the execution of the setup program.
7. If the 'Zencrack configuration' command prompt phase of the setup was successfully run during the setup (step 5), this step can be skipped, otherwise open a command prompt window, 'cd' to the `c:\Zencrack\9.2-x\tools` directory and issue the command '`runzcr92 setup`'. This configuration procedure requests information on the location of f.e. codes and of the Fortran environment (if any) and license type. It then configures the Zencrack `.ini` file accordingly.
8. For nodelocked licenses put a copy of your license file (see section 7) into the license directory if this was not done during the installation process.

¹The nodelocked license file is supplied separately from the program installation files. See section 7.

9. Some items in the zencrack.ini file can be manually modified after completion of installation. These items are described in section 4.

If no desktop shortcut was selected at step 6 but a shortcut is desired at a later date, the following procedure can be used:

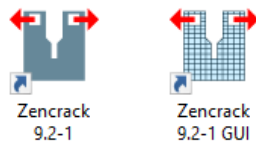
Right-click on the Zencrack shortcut file in the c:\Zencrack\9.2-x\tools directory and drag it onto your desktop. This shortcut is the file called 'Zencrack 9.2-x'. Depending upon the view setting for the folder, the file looks like this:



Select 'Copy here' or 'Create shortcut here'.

Repeat this process for the file c:\Zencrack\9.2-x\gui\zcrgui.exe to create a shortcut for the Zencrack GUI.

The desktop shortcuts should look like this after completion:



If the shortcuts do not display with these icons, a re-boot may be necessary.

Note: the configuration program detailed in step 5 above must be run at least once, either during the installation process or directly as described in step 7.

2.2 To un-install Zencrack (Windows)

The installation process creates an entry in the standard Windows list of installed programs if the 'Create uninstaller' option is used during the install process. The installation can then be uninstalled in one of two ways:

1. By selecting Zencrack 9.2-x from the standard Windows 'Uninstall a program / app' in the appropriate section of Control Panel or Settings. This is the recommended method.
2. By double-clicking the uninstall_9-2-x.exe file in the installation home directory.

If an uninstaller was not created during the install process, the following procedure can be used to manually remove the installation:

1. Delete files under the installation directory, e.g. c:\Zencrack\9.2-x in the above example, making sure to first backup any analysis files that may have been located there. It is not recommended to run analyses or create any other files within the Zencrack installation directories.
2. Delete any desktop shortcuts and Start Menu entries that were created.

2.2.1 To install the documentation files (Windows)

It is recommended that the documentation be installed into a sub-directory of the main Zencrack folder. The documentation is in pdf format and requires a suitable reader.

1. Double-click on Zencrack_9-2-x_Windows-doc.exe to start the installation process. Specify a home directory for the installation. The documentation does not have to be installed in the same location as the program files. The default is:

c:\Zencrack\9.2-x_document

2. Choose whether or not to create an uninstaller. If selected, an uninstaller executable, uninstall_9-2-x_document.exe, is created in the installation home directory. It is recommended that an uninstaller is created.
3. Choose whether or not to create entries in the Start Menu/Apps Page and/or a desktop shortcut. The Start Menu/Apps Page entries include a shortcut to the Zencrack documentation (i.e. the same as the optional desktop shortcut) and the Zencrack unit conversion utility.

If no desktop shortcut was selected at step 3 but a shortcut is desired at a later date, the following procedure can be used:

Right-click on zencrack92_documentation.pdf file in the c:\Zencrack\9.2-x_document directory.

Drag it onto your desktop.

Select 'Create shortcut here'.

2.2.2 To un-install the documentation files (Windows)

The installation process creates an entry in the standard Windows list of installed programs if the 'Create uninstaller' option is used during the install process. The installation can then be uninstalled in one of two ways:

1. By selecting Zencrack Documentation 9.2-x from the standard Windows 'Uninstall a program / app' in the appropriate section of Control Panel or Settings. This is the recommended method.
2. By double-clicking the uninstall_9-2-x_document.exe file in the installation home directory.

If an uninstaller was not created during the install process, the following procedure can be used to manually remove the installation:

1. Delete files under the installation directory, e.g. c:\Zencrack\9.2-x_document in the above example.
2. Delete any desktop shortcuts that were created.

2.2.3 Remote execution of the finite element code

A capability exists to allow remote execution of the finite element code on a Linux or Unix machine when Zencrack is installed on a Windows machine. This differs from the normal arrangement in

which Zencrack and the finite element code are executed on the same machine. Please see section 8 for more information. The standard installation procedure described in the previous sections must be followed before configuration of remote execution of the finite element code is possible.

2.2.4 Possible issues

2.2.4.1 Program Compatibility Assistant warning

If Windows UAC (User Account Control) is running on the installation machine, there may be additional system messages generated when installing from these files. In particular, for Windows 7 or 8 the Program Compatibility Assistant may appear at the end of an installation or uninstallation process e.g.:

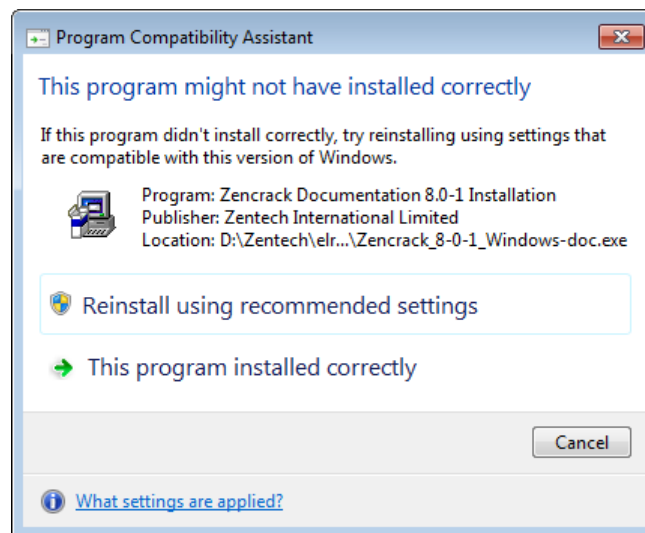


Figure 2.1: Program Compatibility Assistant warning (shown for Zencrack 8.0-1 on Windows 7)

If this occurs, you may safely click on ‘This program installed correctly’ or ‘Cancel’:

- If you click on ‘This program installed correctly’, Windows will create a registry entry to prevent this warning if you re-run the installer at a later date.
- If you click on ‘Cancel’, Windows will not make any entry in the registry regarding this warning. This is the recommended option.

2.2.4.2 Zencrack GUI fails to execute

On Windows 7 machines the Zencrack GUI for version 9.2-x may fail to execute after installation and give a message ‘Failed to execute script zcrgui’. To resolve this issue please install the latest Microsoft Visual C++ Redistributable runtime files for Visual Studio 2017 (vc_redist.x64.exe) by searching at <https://support.microsoft.com/> for ‘Visual C++ redistributable’.

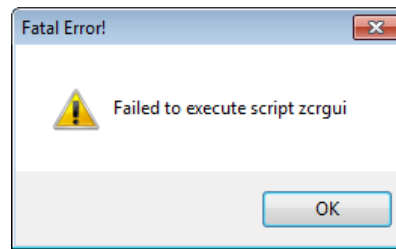


Figure 2.2: Failure of execution of the Zencrack GUI on Windows 7 machine

2.3 Linux

The Zencrack product is supplied as two files:

Zencrack_9-2-x_Linux_64.exe - setup program containing the analysis program files and GUI.

Zencrack_9-2-x_Linux-doc.exe - setup program containing the documentation files.

The default program installation location is `/home/Zencrack/9.2-x` where `/home` is the home directory for the user installing the program. This may be changed if required. Please note that:

- The user installing the program must have sufficient privilege to create files in the chosen installation location during installation.
- At run-time the GUI creates log files in the install folder so the user account that runs the GUI must have permission to write to that folder. The location of the log files can be changed via a setting in the GUI .ini file (see section 4.1.2).

The documentation can be installed before or after installation of the program. It is recommended that the documentation be installed into a sub-directory of the main Zencrack folder. For this reason the default documentation location is `/home/Zencrack/9.2-x_document`.

2.3.1 To install the program files (Linux)

1. Log in as any user with sufficient privilege to meet the requirements stated above.
2. Run the Zencrack_9-2-x_Linux_64.exe setup program to install Zencrack. Accept the license term.
3. Define parameters for the installation on a series of screens. The default home directory `/home/Zencrack/9.2-x` is used throughout the remainder of these instructions.
4. The following directory structure is created under the home directory:

bin	Zencrack executable, object and library files
crack	Crack-block files
defaults	Files with various default settings e.g. tol.dat
demos	Example input files - see the readme.txt file in this directory
fe_abaqus	Files related to the Abaqus interface (including /CAE plug-in files)
fe_ansys	Files related to the Ansys interface
fe_gmsh	Files related to remeshing
fe_nxnastran	Files related to the Simcenter Nastran interface

gui	Files related to the Zencrack GUI
license	Nodelocked license file should be placed here ²
machine_id	Utility to extract details required to license Zencrack
tools	Execution file and location of the zencrack.ini file
utils	Utility programs: 3dmesh : crack profile generator process : creates a .csv data file for specified node(s) on a crack front rainflow : rainflow cycle counting tanh : creates tabular growth data from tanh growth equation data examples directory for utility programs
versions.txt	Version information

5. After placing files onto your hard disk the installer runs the final part of the Zencrack configuration in a terminal window. This configuration procedure requests information on the location of f.e. codes and of the Fortran environment (if any). It then configures the Zencrack .ini file accordingly.
6. If the ‘Zencrack configuration’ terminal window phase of the setup was successfully run during the setup (step 5), this step can be skipped, otherwise open a terminal window, ‘cd’ to the /home/Zencrack/9.2-x/tools directory and issue the command ‘./runzcr92 setup’. This configuration procedure requests information on the location of f.e. codes and of the Fortran environment (if any) and license type. It then configures the Zencrack .ini file accordingly.
7. For nodelocked licenses put a copy of your license file (see section 7) into the license directory if this was not done during the installation process.
8. Some items in the zencrack.ini file can be manually modified after completion of installation. These items are described in section 4.

The installation process creates a soft link runzcr92x which can be used to execute Zencrack jobs from a terminal window. Two entries, PATH and ZCR_DIR_TOOLS_921, are added to the /home/.bashrc file.

2.3.2 To un-install Zencrack (Linux)

The installation process for Linux does not create an uninstaller. Instead, uninstalling is a manual process:

- Delete the installed folder /home/Zencrack/9.2-x making sure to first backup any analysis files that may have been located there. It is not recommended to run analyses or create any other files within the Zencrack installation directories.
- Edit the /home/.bashrc file and remove the two entries created for Zencrack 9.2. These are PATH and ZCR_DIR_TOOLS_921 variables similar to these examples:

²The nodelocked license file is supplied separately from the program installation files. See section 7.


```
PATH=$PATH:/home/engineer/Zencrack/9.2-1/tools;export PATH; # ADDED BY
INSTALLER - DO NOT EDIT OR DELETE THIS COMMENT - 049A27FB-85D7-A000-B009-
1E90ABF09210 5510A28B-9722-CCA4-BF36-27A805FBBE66

ZCR_DIR_TOOLS_921=/home/engineer/Zencrack/9.2-1/tools;export
ZCR_DIR_TOOLS_921; # ADDED BY INSTALLER - DO NOT EDIT OR DELETE THIS COMMENT -
049A27FB-85D7-A000-B009-1E90ABF09210 5510A28B-9722-CCA4-BF36-27A805FBBE66
```

2.3.3 To install the documentation files (Linux)

It is recommended that the documentation be installed into a sub-directory of the main Zencrack folder. The documentation is in Adobe Acrobat version 5 format and requires a suitable reader.

1. Double-click on Zencrack_9-2-x_Linux-doc.exe to start the installation process. Specify a home directory for the installation. The documentation does not have to be installed in the same location as the program files. The default is:

/home/Zencrack/9.2-x_document

2. Choose whether or not to create an uninstaller. If selected, an uninstaller executable, `uninstall_9-2-x_document`, is created in the installation home directory.

2.3.4 To un-install the documentation files (Linux)

The installation process creates an uninstaller in the installation home directory if the 'Create uninstaller' option is used during the install process. The installation can then be uninstalled by double-clicking the file (`uninstall_9-2-x_document`).

To manually delete the installation, delete files under the installation directory, i.e. `/home/Zencrack/9.2-x_document` in the above example.

3 Installation - License Server

This section describes installation of the RLM license server. Installation of the license server is not necessary if you are using a nodelocked license file or if a suitable version of the RLM license server is already installed on your selected server machine.

The RLM license server is available for Windows x86-64 and Linux x86-64 machines. The client (i.e. Zencrack product) installations may be on any Windows x86-64, or Linux x86-64 machines with network access to the server.

The extraction and installation of the license server files is described below. For further information on configuring the license server and monitoring license usage, refer to section 7.3 and the RLM License Administration Manual.

The RLM License Administration Manual contains information that is oriented towards the person who installs and administers RLM. In general, as a Zencrack end-user, you should not need to refer to this manual. The RLM License Administration Manual is supplied as part of the Zencrack documentation and with the RLM license server install files. Note that:

- Some topics in the RLM License Administration Manual are not relevant to the licensing of Zencrack.
- The RLM version used by Zencrack 9.2 is v14.

3.1 Windows

The RLM files are supplied in one setup file, Zencrack_RLMv14.Windows.exe. The file contains 64bit versions of the license server:

- The generic license server rlm.exe.
- The Zentech International license server zentechint.exe.
- The RLM command line utilities rlmutil.exe.
- The RLM License Administration Manual, RLM_License_Administration.pdf.
- The license request program, machine_id.exe (see section 7.1).

If Windows UAC (User Account Control) is running on the installation machine, there may be additional system messages generated when installing from these files.

The license file is provided separately and can be placed in any location. However, the configuration is simpler if the license file is located in the same folder as the installed server binaries.

To install the license server

1. Log in as an administrator.
2. Run the setup program to extract the files into your chosen location on the server. The files are extracted into a sub-folder rlm_v14 in the chosen location.

If the machine is also to contain a client installation, it is recommended that the server location is outside the folder of a specific Zencrack version e.g. c:\Zencrack would be appropriate but c:\Zencrack\9.2-x would not.

3. Place the supplied server license file in the same `rlm_v14` sub-folder as the extracted files (either using the option provided during the installation or manually upon completion of the installation).
4. After placing the license file in the `rlm_v14` sub-folder, refer to section 7.3.2 for information on starting the license server.

3.2 Linux

The RLM files are supplied in one setup file, `Zencrack_RLMv14_Linux-64.exe`. The file contains 64bit versions of the license server:

- The generic license server `rlm`.
- The Zentech International license server `zentechint`.
- The RLM command line utilities `rlmutil`.
- The RLM License Administration Manual, `RLM_License_Administration.pdf`.
- The license request program, `machine_id.exe` (see section 7.1).

The license file is provided separately and can be placed in any location. However, the configuration is simpler if the license file is located in the same folder as the installed server binaries.

To install the license server

1. Run the setup program to extract the files into your chosen location on the server. The files are extracted into an `rlm_v14` sub-folder in the chosen location.
If the machine is also to contain a client installation, it is recommended that the server location is outside the folder of a specific Zencrack version e.g. `/home/Zencrack` would be appropriate but `/home/Zencrack/9.2-x` would not.
2. Place the supplied server license file in the same `rlm_v14` sub-folder as the extracted files (either using the option provided during the installation or manually upon completion of the installation).
3. After placing the license file in the `rlm_v14` sub-folder, refer to section 7.3.2 for information on starting the license server.

Note that the programs `rlm`, `rlmutil` and `machine_id.exe` should be run from within a terminal window.

4 Setup Of Zencrack Product After Installation

Zencrack requires that several variables be set up prior to executing the program. Other optional settings can also be made as part of the program configuration. The required and optional variables are defined in the zencrack.ini file in the tools sub-folder of the Zencrack installation. Additional notes on all items described in the following sections are contained in the zencrack.ini file itself.

The execution of the setup program during or after the installation process configures the variables highlighted in red in the following sections. The other variables described in the following sections must be configured by editing the zencrack.ini file.

The setup program can be re-run at any time to update the highlighted variables in the following sections by using the command:

```
runzcr92 setup
```

for Windows

```
runzcr92x setup
```

for Linux

Re-running the setup program and saving any values will create a new zencrack.ini file. Existing settings will either be retained or modified, depending upon the choices made when running the program. A backup of any existing zencrack.ini file is made before a new .ini file is created.

4.1 The zencrack.ini file

The zencrack.ini file is located in the tools folder of the Zencrack installation. It contains settings which are used by the Zencrack analysis program and the Zencrack GUI. The .ini file is split into 'sections' with each section defining a series of 'variables'. Section names are enclosed in square brackets and variables have values assigned via an equal sign. Comments begin with a # character e.g.:

```
[LICENSE]
#
# Two licensing methods are available:
# network      - Network licensing using RLM license server
# nodelocked   - Nodelocked licensing using RLM license file
#
# The variable ZENCRACK_LICENSE defines the licensing method being used and
# should be set to NETWORK or NODELOCKED e.g.:
# ZENCRACK_LICENSE = NETWORK
# Additional information is contained in the following sections.
#
ZENCRACK_LICENSE = NETWORK
#
# Settings for network licensing using RLM license server
# #####
#
# ZENCRACK_RLM_SERVER must be set to reference the license server machine.
# This can be done through a port number and IP address or a port number
```

```

# and machine name e.g.
# ZENCRACK_RLM_SERVER = 2764@192.168.1.1
# ZENCRACK_RLM_SERVER = 2764@SERVERNAME
#
ZENCRACK_RLM_SERVER = 2764@localhost
#
# The value of ZENCRACK_WAIT is the number of minutes that a job should wait
# in a queue to obtain license tokens if the tokens are being used by another
# job. The maximum allowed value is 9999 minutes. A value of 0 means that a
# job will stop immediately if no license tokens are available.
#
ZENCRACK_WAIT = 30
#

```

4.1.1 [ABAQUS] section

The variables in this section allow definition of the Abaqus version to be used by Zencrack. These variables must be set if the Zencrack license has an Abaqus interface.

ZCR_ABAQUS

the full location of the Abaqus executable file provided as part of the Abaqus program installation and used to run Abaqus. Prior to Abaqus 2016: abqxxx.exe, where xxx refers to a version number, e.g. 610ef1, 6111, 6121 etc.

For Abaqus 2016 to Abaqus 2021: abqlauncher.exe

For Abaqus 2022: SMALauncher.exe

ZCR_ABAQUS_VER

the Abaqus version which may optionally include the sub-version, e.g. 6.12-1, 2018, 2022.

For version 2016 onwards the inclusion of Golden or Hotfix details are optional. They can be specified with 'Golden' or 'HotFix n' included. For example:

2018 Golden.

2018 HotFix 1 for Abaqus 3DEXPERIENCE R2018x HotFix 1 (FP1806).

Only the main version is included by the Zencrack setup program so the optional addition of Golden or HotFix versions must be specified by editing the zencrack.ini file.

ZCR_ABAQUS_OPTIONS

defines command line options for running Abaqus. This must contain 'interactive'. Other Abaqus command line options may be added. For example the CPUS option can be added to specify how many CPUs are used by Abaqus jobs submitted by Zencrack, e.g.:

ZCR_ABAQUS_OPTIONS = interactive cpus=4

ZCR_ABAQUS_SURFACE The value of the SURFACE parameter on Abaqus *CONTOUR INTEGRAL requests is controlled by ZCR_ABAQUS_SURFACE. This will only have an effect for Abaqus 6.5 or later. It can be overridden for individual jobs by the SURFACE parameter on Zencrack keyword ENERGY RELEASE RATE. Values are omit, free or none. The value none is recommended.

The [ABAQUS] section defines the default Abaqus version to be used by Zencrack. If it is required to configure Zencrack for possible use with multiple Abaqus versions, then one or more additional Abaqus sections can be defined in the .ini file. Such additional sections must be named [ABAQUSXXX] where XXX represents a user chosen character string (e.g. an Abaqus version). All four of the variables named above must be defined in the [ABAQUSXXX] section even if they have the same value as the variables in the [ABAQUS] section.

To run a Zencrack job using a non-default Abaqus version the ‘-abaqus’ option is used on the Zencrack command line followed by the value of the XXX string. The Zencrack GUI does not currently support the alternative Abaqus sections and always uses the default section.

The example below shows a case where Abaqus 2022 is the default version and Abaqus 6.14-1 is an alternative version.

```
[ABAQUS]
ZCR_ABAQUS = c:\SIMULIA\EstProducts\2022\win_b64\code\bin\smalauncher.exe
ZCR_ABAQUS_VER = 2022
ZCR_ABAQUS_OPTIONS = interactive cpus=4
ZCR_ABAQUS_SURFACE = none
#
[ABAQUS614]
ZCR_ABAQUS = c:\simulia\abaqus\6.14-1\exec\abq6141.exe
ZCR_ABAQUS_VER = 6.14-1
ZCR_ABAQUS_OPTIONS = interactive cpus=4
ZCR_ABAQUS_SURFACE = none
```

To run Zencrack with Abaqus 6.14 instead of the default version 2022:

```
runzcr92 -j jobname -abaqus 614
```

4.1.2 [ANSYS] section

The variables in this section allow definition of the Ansys version to be used by Zencrack. These variables must be set if the Zencrack license has an Ansys interface.

ZCR_ANSYS the full location of the file ansys.exe provided as part of the Ansys program installation and used to run Ansys. To use a non-default Ansys product, ensure that ‘-p productname’ is included in the definition of ZCR_ANSYS_OPTIONS (see below).

ZCR_ANSYS_VER

the Ansys version must include the sub-version and, for version 11.0, any service pack number, e.g. 11.0SP1, 16.0, 17.2, 19.0.

For versions since the ‘20XX Rx’ naming convention the value required is the numeric equivalent as derived from the folder path for the version e.g. 19.4 for 2019R2, 22.2 for 2022 R2 etc.

ZCR_ANSYS_OPTIONS

defines command line options for running Ansys. This may include, for example, the number of processors used to run Ansys jobs or a specific Ansys licensed product, e.g.:

```
ZCR_ANSYS_OPTIONS =-np 4 -p prf.
```

ZCR_ANSYS_CNV

defines the default type of Ansys uncracked mesh file. The default is ‘automatic’ for automatic determination of the type as normal or solid model. The other allowed values are ‘normal’ or ‘solidmodel’. This setting is overridden for individual jobs by the ‘-a’ command line option. It is recommended that the value ‘automatic’ be used.

The [ANSYS] section defines the default Ansys version to be used by Zencrack. If it is required to configure Zencrack for possible use with multiple Ansys versions, then one or more additional Ansys sections can be defined in the .ini file. Such additional sections must be named [ANSYSXXX] where XXX represents a user chosen character string (e.g. an Ansys version). All four of the variables named above must be defined in the [ANSYSXXX] section even if they have the same value as the variables in the [ANSYS] section.

To run a Zencrack job using a non-default Ansys version the ‘-ansys’ option is used on the Zencrack command line followed by the value of the XXX string. The Zencrack GUI does not currently support the alternative Ansys sections and always uses the default section.

The example below shows a case where Ansys 2022 R1 is the default version and Ansys 2019 R2 and Ansys 14.5 are configured as alternative versions:

```
ZCR_ANSYS = c:\Program Files\ANSYS Inc\v221\ansys\bin\winx64\ansys221.exe
ZCR_ANSYS_VER = 22.1
ZCR_ANSYS_OPTIONS = -np 2
ZCR_ANSYS_CNV = AUTOMATIC
#
[ANSYS2019R2]
ZCR_ANSYS = c:\Program Files\ANSYS Inc\v194\ansys\bin\winx64\ansys194.exe
ZCR_ANSYS_VER = 19.4
ZCR_ANSYS_OPTIONS = -np 2
ZCR_ANSYS_CNV = AUTOMATIC
#
[ANSYS145]
ZCR_ANSYS = c:\Program Files\ANSYS Inc\v145\ansys\bin\winx64\ansys145.exe
ZCR_ANSYS_VER = 14.5
ZCR_ANSYS_OPTIONS = -np 2
ZCR_ANSYS_CNV = AUTOMATIC
```

To run Zencrack with Ansys 14.5 instead of the default version 2022 R1:

```
runzcr92 -j jobname -ansys 145
```

4.1.3 [NXNASTRAN] section

The variables in this section allow definition of the Simcenter Nastran version to be used by Zencrack. These variables must be set if the Zencrack license has a Simcenter Nastran interface.

ZCR_NXNASTRAN	the full location of the Simcenter Nastran executable provided as part of the stand-alone or package Simcenter installation being using. Refer to the zencrack.ini file for examples of stand-alone or NX, Simcenter3D and Femap package installations.
ZCR_NXNASTRAN_VER	the Simcenter Nastran version. Only version 10.0 and later are supported by Zencrack. Refer to the zencrack.ini file for examples of stand-alone or NX, Simcenter3D and Femap package installations.
ZCR_NXNASTRAN_OPTIONS	defines command line options for running Simcenter Nastran. The setting scratch=yes is strongly recommended to prevent creation of potentially large .DBALL and .MASTER files. This may also include, for example, the number of processors used to run Simcenter Nastran e.g.: ZCR_NXNASTRAN_OPTIONS = scratch=yes parallel=4
ZCR_NXNASTRAN_EXTRA	not currently used.

The [NXNASTRAN] section defines the default Simcenter Nastran version to be used by Zencrack. If it is required to configure Zencrack for possible use with multiple Simcenter Nastran versions, then one or more additional NXNastran sections can be defined in the .ini file. Such additional sections must be named [NXNASTRANXXX] where XXX represents a user chosen character string (e.g. a Simcenter Nastran version). All four of the variables named above must be defined in the [NXNASTRANXXX] section even if they have the same value as the variables in the [NXNASTRAN] section.

To run a Zencrack job using a non-default Simcenter Nastran version the ‘-nxnastran’ option is used on the Zencrack command line followed by the value of the XXX string. The Zencrack GUI does not currently support the alternative Simcenter Nastran sections and always uses the default section.

The example below shows a case where a stand-alone Simcenter Nastran 2021.2 installation is the default version and Simcenter Nastran 2022.1 is an alternative version available as part of an NX2007 installation:


```

ZCR_NXNASTRAN = c:\Program Files\Siemens\SimcenterNastran_2021.2\bin\nastran.exe
ZCR_NXNASTRAN_VER = 2021.2
ZCR_NXNASTRAN_OPTIONS = scratch=yes parallel=4
ZCR_NXNASTRAN_EXTRA =
#
[NXNASTRANNX2007]
ZCR_NXNASTRAN = c:\Program Files\Siemens\NX2007\NXNASTRAN\bin\nastran.exe
ZCR_NXNASTRAN_VER = 2022.1
ZCR_NXNASTRAN_OPTIONS = scratch=yes parallel=4
ZCR_NXNASTRAN_EXTRA =

```

To run Zencrack with the Simcenter Nastran 2022.1 version instead of the default version 2021.2:

```
runzcr92 -j jobname -nxnastran NX2007
```

4.1.4 [LICENSE] section

This section defines items for licensing. If using nodelocked licensing only ZENCRACK_LICENSE needs to be defined - the license file is then placed into the license folder of the Zencrack installation.

ZENCRACK_LICENSE the type of licensing being used, either NETWORK or NODELOCKED. This must always be defined.

ZENCRACK_RLM_SERVER the location of the RLM license server specified in the form `port@IPaddress` if network licensing is being used. The port number is stated in the license file on the license server. The IP address is the LAN address of the server machine. This variable does not need to be defined for nodelocked licenses.

ZENCRACK_WAIT the number of minutes that a job should wait in a queue to obtain license tokens if the tokens are being used by another job. The maximum allowed value is 9999 minutes. A value of 0 means that a job will stop immediately if no license tokens are available. This variable does not need to be defined for nodelocked licenses.

4.1.5 [FORTRAN_LINUX] section

This section contains Fortran configuration information for Linux installations. ZCR_FORTRAN is the only variable which should need to be changed - this change is best achieved via the setup program (on installation or later by runzcr92x setup).

ZCR_FORTRAN This variable defines the location of the setvars.sh file for initialising the Intel Fortran compiler.

ZCR_FORTRANSTRING This string defines the system command to invoke the Fortran compiler. On installation this is 'ifort'.

ZCR_FORTRAN64 This string is used by Zencrack when compiling/linking a user subroutine - it should not be modified.

4.1.6 [FORTRAN_WINDOWS] section

This section contains Fortran configuration information for Windows installations. ZCR_FORTRAN is the only variable which should need to be changed - this change is best achieved via the setup program (on installation or later by runzcr92 setup).

ZCR_FORTRAN	This variable defines the location of the setvars.bat file for initialising the Intel Fortran compiler.
ZCR_FORTRANSTRING	This string defines the system command to invoke the Fortran compiler. On installation this is 'ifort /traceback'.
ZCR_FORTRANLINK	This string is used by Zencrack when compiling/linking a user subroutine - it should not be modified.
ZCR_FORTRAN64	This string is used by Zencrack when compiling/linking a user subroutine on 64bit Windows systems- it should not be modified.

4.1.7 [REMOTEFE] section

This section contains setting for remote execution of the f.e. analysis on a Linux or Unix machine when Zencrack is installed on a Windows machine. This capability and the variables which need to be defined are described in section 8.

4.1.8 [RUNTIME] section

This section contains modifiable defaults for run-time options.

ZCR_OVERWRITE	Defines whether or not previous output files are overwritten when a job runs. Value 'no' is set at installation, i.e. if a job identifies that previous output files exist it will abort without overwriting the existing files. This can be changed to 'yes'. For individual jobs, the value of ZCR_OVERWRITE can be overridden by using the '-o' command line option e.g.
---------------	--

```
runzcr92 -j jobname -o yes
```

All jobs executed from the Zencrack GUI use '-o yes' regardless of the value of ZCR_OVERWRITE.

ZCR_FE_TYPE Value 'input' is set at installation meaning 'use the f.e. analysis type defined on the OPTIONS keyword of the .zcr file'. This default value in the .ini file should not generally be changed - use the '-f' command line option for individual jobs instead. The values for ZCR_FE_TYPE and the '-f' command line options are:

- = input to follow the definition in the .zcr file
- = mesh to force a mesh-only analysis (no f.e. execution)
- = check to force a datacheck f.e. analysis
- = full to force a full f.e. analysis

For example, to force a 'mesh-only' analysis the command line option would be:

```
runzcr92 -j jobname -f mesh
```

4.1.9 [MISC] section

This section contains other modifiable defaults. The exe, lib and obj locations would not normally need to be modified.

ZCR_DEFAULTOUT Defines the default string applied to the input zcr filename to generate the output filenames when the OUTPUT parameter is omitted from the FILES keyword. The default is 'r'. For example:

- if `DEFAULTOUT = _crack`
- and the zcr file is `example.zcr`
- then the output files are `example_crack.*` (e.g. `example_crack.rep`)

ZCR_DEFAULT_EXE The default Zencrack executable location. This is:

- <install folder>\bin\zcr92.exe Windows
- <install folder>/bin/zcr92.exe Linux

For individual jobs, an alternative Zencrack executable can be used by using the '-e' command line option e.g.

```
runzcr92 -j jobname -e mysavedZcrExecutable.exe
```

ZCR_DEFAULT_LIB The default Zencrack library location. This is:

- <install folder>\bin\zcr92_library.lib Windows
- <install folder>/bin/libzcr92.a Linux

ZCR_DEFAULT_OBJ The default Zencrack object location. This is:

- <install folder>\bin\zencrack.obj Windows
- <install folder>/bin/zencrack.o Linux

4.1.10 [SETUP] section

The variables in this section define aspects of the program version and configuration and should not be modified.

```

VERSIONname = 9.2-1
RUNZCRFILE = runzcr92.exe
FILEPATH = zcrpath921.bat
EXESTEM = zcr92
HELPPFILE = help_command_line.txt

```

4.2 The Zencrack GUI

The Zencrack GUI uses the main zencrack.ini file for those items which it shares with the Zencrack analysis program. Once the zencrack.ini file is configured, there is no additional configuration required for the Zencrack GUI.

A separate zencrack_gui.ini file exists in the gui folder of the Zencrack installation to allow control over certain aspect of the GUI behaviour. This file is described in the Zencrack GUI Manual.

At runtime the GUI creates a log file and an error file plus a temporary input file. By default these are located in the gui install folder. This location can be modified by setting three items in the zencrack_gui.ini file (which default to blank indicating the gui folder and standard names should be used):

```

#Logfile =                # Name of GUI log file (including path).
                          # Default if omitted =
                          # <Zencrack install folder>\gui\zcrgui_log.txt.
#Errfile =                # Name of GUI error file (including path).
                          # Default if omitted =
                          # <Zencrack install folder>\gui\zcrgui_err.txt.
#TMPAVEDIR =             # Location of intermediate .zcr files
                          # (default if omitted = <Zencrack install folder>
                          # \gui\zencrack_gui.zcrX.tmp).

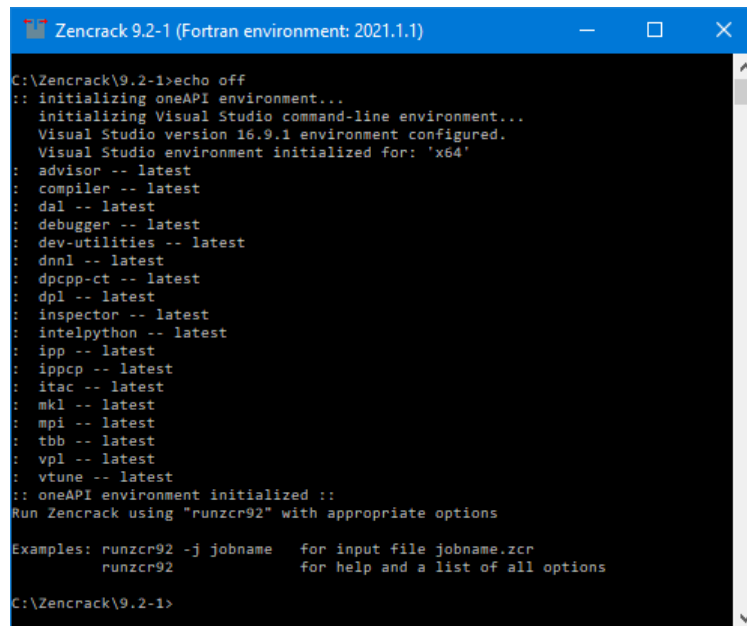
```

4.3 Using Zencrack user subroutines

A Zencrack user subroutine is included in an analysis by using the '-u' command line option as described in section 5.2.

Zencrack on Windows is configured for use with user subroutines as follows:

- When the Zencrack setup program is executed it requests details of the required Fortran environment. Upon completion of the setup a file zcrpath92x.bat is created in the Zencrack .\tools directory. This file contains an initialisation for Fortran. This should not need to be modified by the user.
- When the Zencrack shortcut is used to start a Zencrack command prompt session, the zcr-path92x.bat file is used to configure the command prompt window. The title bar of the command prompt window includes details of the Fortran environment and the initialisation of the Fortran compiler is reported in the window, e.g.:



```

C:\Zencrack\9.2-1>echo off
:: initializing oneAPI environment...
  initializing Visual Studio command-line environment...
  Visual Studio version 16.9.1 environment configured.
  Visual Studio environment initialized for: 'x64'
: advisor -- latest
: compiler -- latest
: dal -- latest
: debugger -- latest
: dev-utilities -- latest
: dnnl -- latest
: dpcpp-ct -- latest
: dpl -- latest
: inspector -- latest
: intelpython -- latest
: ipp -- latest
: ippcp -- latest
: itac -- latest
: mkl -- latest
: mpi -- latest
: tbb -- latest
: vpl -- latest
: vtune -- latest
:: oneAPI environment initialized ::
Run Zencrack using "runzcr92" with appropriate options

Examples: runzcr92 -j jobname   for input file jobname.zcr
          runzcr92              for help and a list of all options

C:\Zencrack\9.2-1>

```

Figure 4.1: Zencrack command prompt (Windows)

Zencrack on Linux is configured for use with user subroutines as follows:

- The zencrack.ini file contains a variable called ZCR_FORTRANSTRING which is set to the default string to execute for the target system, e.g. ifort
- If you use a non-standard command line name to execute your Fortran compiler, you should change this variable.
- When a job is executed that requires a Zencrack user subroutine, the Fortran environment must be configured in the terminal window from which the job is executed in addition to defining the variable ZCR_FORTRANSTRING, e.g. for Linux with Intel Fortran for oneAPI 21.1.1:

```

source /opt/intel/oneapi/compiler/21.1.1
runzcr92x -j myjob -u myusersub.f

```

If a Zencrack user subroutine is used and the compilation and linking process is successful, the newly created executable is saved in the job folder. On both Windows and Linux the file is zcr92_user.exe. This executable can be used for subsequent jobs via the -e command line option. On Linux the specification of the executable in a local folder requires a './' before the executable name e.g.:

```
runzcr92 -j myjob_new -e zcr92_user.exe
```

for Windows

```
runzcr92x -j myjob_new -e ./zcr92_user.exe
```

for Linux

4.4 Configuring the plug-ins for Abaqus/CAE

Use of the plug-ins for Abaqus/CAE for creating and maintaining Zencrack input files is largely replaced by the Zencrack GUI from version 7.9-1 onwards. The recommended approach is to use the Zencrack GUI. The plug-ins for Abaqus/CAE are an optional additional installation item which must be configured manually as described in this section.

The Abaqus/CAE plug-ins are available on all platforms on which Zencrack is supported. They require Abaqus version 6.8 or later. The plug-ins will report an error if they are executed within an earlier version of Abaqus. Compatibility with Abaqus versions later than Abaqus 2022 cannot be guaranteed.

Due to changes in the Python version between Abaqus 6.9/6.10 and 6.13/6.14 there are three sets of files provided with each installation - one for Abaqus 6.8-6.9, one for Abaqus 6.10-6.13 and one for Abaqus 6.14 or later. (In these version descriptions, 6.x also includes 6.x-EF).

The plug-in files are installed with the Zencrack product and need to be copied into the Abaqus environment. The Zencrack installation contains a folder `fe_abaqus` with sub-folders:

- `zencrackplugins_6-8_6-9` for Abaqus 6.8 and 6.9
- `zencrackplugins_6-10_6-13` for Abaqus 6.10 to 6.13
- `zencrackplugins_6-14_onwards` for Abaqus 6.14 or later.

There are a number of options available for configuring Abaqus plug-ins so each user should consult their Abaqus administrator and/or the relevant section of the Abaqus/CAE User's Manual. However, the following summarises the options that are available.

When Abaqus/CAE starts it searches for plug-in files in a number of locations. Suggested possible locations for the Zencrack plug-ins are:

- `abaqus_dir\abaqus_plugins`, where `abaqus_dir` is the Abaqus parent directory. Simply copy the entire `zencrackplugins_xx` folder into the `abaqus_dir\abaqus_plugins` folder (for example creating `abaqus_dir\abaqus_plugins\zencrackplugins_xx`). This is the easiest method.
- Define `plugin_dir`, where `plugin_dir` is a directory specified in the Abaqus environment file by the environment variable `plugin_central_dir`. Using this method you can store plug-ins in a central location that can be accessed by all users at your site if the directory to which `plugin_central_dir` refers is mounted on a file system that all users can access. Alternatively if the only additional Abaqus plug-ins that you are using are the Zencrack plug-ins you can set this variable to point to the `zencrackplugins` folder in the Zencrack installation, e.g.:

```
plugin_central_dir = "c:\\Zencrack\\9.2-x\\fe_abaqus\\zencrackplugins_6-10_6-13"
```

Once configured the plug-in is available from the Abaqus plug-ins menu and appears as an additional tab named 'Zencrack' as shown in Figure 4.2. For more information on the plug-in refer to the Interface To Abaqus Manual.

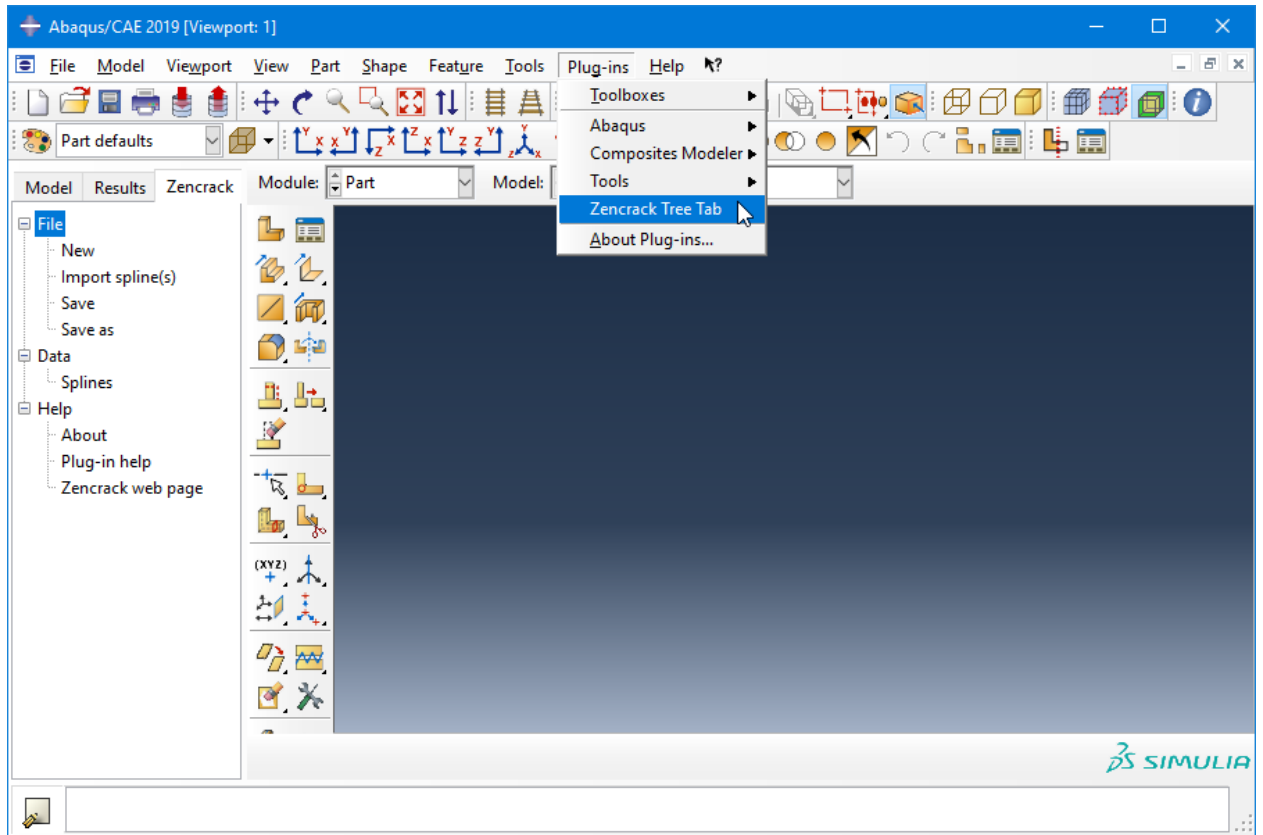


Figure 4.2: Plug-in access in Abaqus/CAE

5 Running Zencrack

Zencrack is executed using the `runzcr92` executable located in the `tools` directory of the Zencrack installation. This section describes the execution options in detail.

When using the Zencrack GUI, an analysis can be started from the Run Zencrack drop-down menu. The screen input collects the necessary information to run the job, starts a command prompt or terminal session and runs the jobs. Refer to the GUI Manual for more information.

5.1 Command prompt setup in Windows

Zencrack is executed from a command prompt session. A Zencrack shortcut is included in the Start Menu/Apps Page or on the desktop (if these options were selected during installation). If not, a shortcut is included in the `.\tools` directory. This can be copied to the desktop as described in section 2.1.1. The shortcut icon looks like this:



The Zencrack shortcut starts a command prompt session that is set up to execute Zencrack. The session is created with a `PATH` that includes the Zencrack `.\tools` directory. The session is also set up for Fortran if it is installed, e.g.:

```

Zencrack 9.2-1 (Fortran environment: 2021.1.1)
C:\Zencrack\9.2-1>echo off
:: initializing oneAPI environment...
  initializing Visual Studio command-line environment...
  Visual Studio version 16.9.1 environment configured.
  Visual Studio environment initialized for: 'x64'
: advisor -- latest
: compiler -- latest
: dal -- latest
: debugger -- latest
: dev-utilities -- latest
: dnnl -- latest
: dpcpp-ct -- latest
: dpl -- latest
: inspector -- latest
: intelpython -- latest
: ipp -- latest
: ippcp -- latest
: itac -- latest
: mkl -- latest
: mpi -- latest
: tbb -- latest
: vpl -- latest
: vtune -- latest
: oneAPI environment initialized ::
Run Zencrack using "runzcr92" with appropriate options

Examples: runzcr92 -j jobname   for input file jobname.zcr
          runzcr92              for help and a list of all options

C:\Zencrack\9.2-1>
  
```

Figure 5.1: Zencrack command prompt (Windows)

5.2 Terminal window setup in Linux

The Zencrack installation creates an environment variable and soft link to the `runzcr92.exe` file which allow Zencrack to be executed from any terminal window.

Note that to allow sub-versions to be installed, the default command used to run Zencrack on Linux

includes the sub-version number i.e. runzcr921 for version 9.2-1, runzcr922 for version 9.2-2 etc.

5.3 Execution using runzcr92

The program is run using the runzcr92 command for Windows or runzcr92x for Linux (see section 5.2). This command must be executed in a command prompt or terminal window from the directory containing the .zcr input file.

There are seven command line options for the script that can be used in combination and five 'stand-alone' options:

Command line options that can be used in combination are noted in the help_command_line.txt file in the tools folder of the Zencrack installation:

Command line options that can be used in combination are:

```
-j job -u user -e exe -o owrite -f fetype -r remote -fe fecmdline -a ansyscnv
-abaqus ver -ansys ver -nxnastran ver -ini file
```

where :

```
-j job      : job is the Zencrack job name (without .zcr extension)

-u user     : user is the name of a Zencrack user subroutine.

-e exe      : exe is the Zencrack executable to be used.
              The pathname for this executable should not contain spaces.
              If this option is used with the -u option it specifies the name
              of the newly created executable.

-o owrite   : owrite   is "yes"    to automatically overwrite old output files.
              is "no"     to stop if previous output files exist.

-f fetype   : fetype   is "input"  for analysis as defined in the input file.
              is "mesh "  for mesh-only analysis.
              is "check"  for datacheck/sizing f.e. analysis.
              is "full"   for full f.e. analysis.

-r remote   : remote   is "yes"    to run f.e. analyses on a remote computer.
              is "no"     to run f.e. analyses on the local computer.

-fe fecmdline:fecmdline is a string of options for the f.e. analysis command
                        line in addition to options defined in the zencrack.ini
                        file by ZCR_ABAQUS_OPTIONS, ZCR_ANSYS_OPTIONS or
                        ZCR_NXNASTRAN_OPTIONS.

-a ansyscnv : ansyscnv defines the type of Ansys model:
              "automatic" for automatic detection of a normal or
              solid model file.
              "normal"    for a normal batch input.
              "solidmodel" for a solid model input.

-abaqus ver  : ver     defines the section in the .ini file to be used to
                        define the Abaqus version. The default is to use
                        settings in section [ABAQUS].
                        This option looks for settings in [ABAQUSver].
```

```

        ver would be expected to be an Abaqus version
        number e.g.
        -abaqus 2020
        would extract information from section [ABAQUS2020].

-ansys ver      : ver      defines the section in the .ini file to be used to
                        define the Ansys version. The default is to use
                        settings in section [ANSYS].
                        This option looks for settings in [ANSYSver].
                        ver would be expected to be an Ansys version
                        number e.g.
                        -ansys 2019R2
                        would extract information from section [ANSYS2019R2].

-nxnastran ver : ver      defines the section in the .ini file to be used to
                        define the NX Nastran version. The default is to use
                        settings in section [NXNASTRAN].
                        This option looks for settings in [NXNASTRANver].
                        ver would be expected to be an NX Nastran version
                        number e.g.
                        -nxnastran 2021
                        would extract information from section [NXNASTRAN2021].

-ini file      : file      defines the .ini file to be used in place of the
                        zencrack.ini file. If the .ini file is not in the
                        current folder, a full path must be given.

Command line options that can be used on their own are:

setup          : to run the Zencrack setup program
                (to configure some items in zencrack.ini)
gui           : to run the Zencrack GUI
3dmesh        : to run utility 3dmesh
process       : to run utility process
rainflow filename : to run utility rainflow with an input file named filename
tanh filename  : to run utility tanh with an input file named filename
help          : to view help/configuration information

```

A number of screen messages are generated when the runzcr92 command is executed. These show some of the options that are set for the job. For example, for the job n01a described in section 6 executed with a network license the following is seen under Windows (with similar for Linux):

```

C:\Zencrack\9.2-1\demos\crack-block\ansys\verify>runzcr92 -j n01a

ZENCRACK 9.2-1
-----

Running Zencrack analysis.

Job           : n01a.zcr
Time          : 07-03-2023 12:33:45

Using RLM network licensing method.
Attempting checkout of license for ZENCRACK Standard with interface to Ansys.
1 token is required.
Successfully acquired 1 token from localhost.

```

```
Starting mesh generation
Completed mesh generation
*** Zencrack job completed without any errors
Time: 07-03-2023 12:33:46
```

5.4 Running the Zencrack GUI

The Zencrack GUI can be started on Windows via a Start Menu shortcut, a desktop shortcut or via the `runzcr92` command in a command prompt window.

```
runzcr92 gui
```

The Zencrack GUI can be started on Linux via the `runzcr92` command in a terminal window.

```
runzcr92x gui
```

5.5 Examples of command line execution

The program is run from the command line using the `runzcr92` command for Windows or `runzcr92x` for Linux (see section 5.2). Examples of command lines are listed below.

Help and configuration information (this echoes the contents of the `help_command_line.txt` file and lists parameters that are set in the current configuration):

```
runzcr92 help
```

Run job example:

```
runzcr92 -j example
```

Run job example with forced overwrite of any previous results files:

```
runzcr92 -j example -o yes
```

Run job example with 4 processors for the Abaqus finite element runs:

```
runzcr92 -j example -fe "cpus=4"
```

Run job example with 4 processors for the Ansys finite element runs:

```
runzcr92 -j example -fe "np -4"
```

Run job submod using the Abaqus global model results file called global:

```
runzcr92 -j submod -fe "globalmod=global"
```

Run job myanalysis using Zencrack user subroutine `user_dadn.f`:

```
runzcr92 -j myanalysis -u user_dadn.f
```

Run job myanalysis using Zencrack user subroutine user_dadn.f and save the executable as user_dadn.exe:

```
runzcr92 -j myanalysis -u user_dadn.f -e user_dadn.exe
```

Run the gui:

```
runzcr92 gui
```

Run utility program 3dmesh:

```
runzcr92 3dmesh
```

Run utility program process:

```
runzcr92 process
```

5.6 Killing a Zencrack job during execution

The preferred option for killing a Zencrack job is to kill the job during the finite element analysis phase, as described in the following sections. When the f.e. analysis terminates the Zencrack process should continue, fail to find the expected results and report an error in the .rep file to that effect (i.e. the Zencrack process should finish normally). If the Zencrack process itself must be stopped, the same procedures can be followed as below but should instead be applied to the zcr92.exe process. However, note that a remeshing job starts a sub-process which may continue in the background after the Zencrack executable is terminated.

5.6.1 Windows

A finite element analysis is best terminated via Task Manager. In the Start/Run box in Windows 7 or the Search box in Windows 8 or 10 enter Task Manager and start the task manager by selecting from the resulting list of options. On the Processes tab of Task Manager identify the finite element executable job that is running as part of the Zencrack process, select that row and click on 'End task'.

5.6.2 Linux

From a terminal window enter 'ps aux' to list running processes. Identify the process id number for the finite element executable. Issue the command 'kill xxxx' where xxxx is the process id number.

6 Verifying An Installation

Once the program is ready for execution, the supplied examples in the crack-block\<fe interface>\verify sub-directory of the demos program directory can be executed to verify the installation. These examples are based on the ex01 files described in section 2 of the Examples Manual. It is recommended that all example files are copied to a new location before being executed, thus ensuring that a virgin copy of the files is retained in the Zencrack directory. The following is suggested after copying the files to a new location:

- Run a mesh generation example to confirm that Zencrack is running:

Windows users should start a Zencrack command prompt window by double-clicking the 'Zencrack' shortcut icon.

Change to the directory containing the example files

(e.g. <user location of installed files>\demos\crack-block\<fe interface>\verify).

Run job:

- a01a for Abaqus users:

```
runzcr92 -j a01a
```

- n01a for Ansys users:

```
runzcr92 -j n01a
```

- x01a for Simcenter Nastran users:

```
runzcr92 -j x01a
```

To confirm that the analysis completes successfully, check the a01ar.rep, n01ar.rep or x01ar.rep output file. The banner at the top of the file should correctly identify the customer and license details from the license file. At the end of the output file there should be a message:

```
New mesh created.  
***ANALYSIS COMPLETE***
```

The cracked mesh should be created as a01ar.inp, n01ar.ans or x01ar.dat.

Sample output is contained in the demos\<crack-block>\<fe interface>\verify\output directory for comparison purposes.

- Run an initial crack analysis to confirm that the f.e. interface is set up correctly:

Run:

- a01c for Abaqus users:

```
runzcr92 -j a01c
```

- n01c for Ansys users:

```
runzcr92 -j n01c
```

- x01c for Simcenter Nastran users:

```
runzcr92 -j x01c
```

To confirm that the analysis completes successfully, check the a01cr.rep, n01cr.rep or x01cr.rep output file. The banner at the top of the file should correctly identify the customer and license details from the license file. At the end of the output file there should be a message:

```
Analysis of initial crack only.  
***ANALYSIS COMPLETE***
```

Sample output is contained in the demos\crack-block\<<fe interface>\verify\output directory for comparison purposes.

7 Nodelocked and License Server (Network) Licensing

Zencrack is licensed using the Reprise License Manager (RLM) with either a nodelocked license file or a network license server system. The following sections describe these options.

7.1 Information required to generate a license file

The Zencrack installation contains a sub-directory called 'machine_id' containing an executable that can be used to collect and report the information required before a license file can be issued. (This machine_id executable is also included with the installation of the RLM license server files). The machine_id program must be run on either:

- for a nodelocked license, the machine on which Zencrack is to be run
- or,
- for network licensing, the machine (server) on which the license manager will run

The program requests identification of the organisation to be licensed, contact details, which finite element interfaces are required and what licensing method is to be used. Upon completion a file called zencrack.txt is generated which should be sent to Zentech for creation of the license file. The file should not be edited so, if corrections are necessary, the machine_id program should be re-executed.

Note - a Zencrack Professional license also permits Zencrack Standard jobs to be run.

7.2 Nodelocked license file

A nodelocked license allows Zencrack to be executed only on the machines(s) specified in the license file and allows only one Zencrack run at a time. This file must be located in the 'license' sub-directory of the Zencrack installation and may be given any name as long as it has a .lic extension.

This method requires the setting ZENCRACK_LICENSE=NODELOCKED in the zencrack.ini file. A sample license file is shown below, note that the last 'License' line allows Zencrack Professional to be run - without this in a nodelocked file only Zencrack Standard is licensed.

```
### Zencrack 9.2
LICENSE zentechint zencrack 9.2 31-aug-2023 single hostid=54e7d61e7a81
  start=01-mar-2023 issuer="U.K.\01252 376388\Commercial"
  customer="Zentech International Limited" contract="590B Finchley
  Road\London\NW11 7RX" replace _ck=e108084dfe sig="60PG452V7H9BRY6FCA
  1D92JBK1XQ4RTMTQG33PG22MOAKU8F0DOHPBYWG3NJWEP1J8JDSTKFSB00"
### ZCRGUI 9.2
LICENSE zentechint zcrgui 9.2 31-aug-2023 single hostid=54e7d61e7a81
  start=01-mar-2023 _ck=240fc15d29 sig="60PG4580G62THK0VP87S596PXGNK1P
  U5NNUQGPX208A1JU3FS19VHVJXMHGGDOH77876FE9E4TA0"
### ZCRREMESH 9.2
LICENSE zentechint zcrremesh 9.2 31-aug-2023 single
  hostid=54e7d61e7a81 start=01-mar-2023 _ck=630fc1bb57 sig="60P0453CD3
  QQKRD2V3UR9M5S342DQJF1YP2VEER22HQT6798YHM98XW2DEDD7GUYN9U61N2GH4"
### ZCRABAQUS 9.2
LICENSE zentechint zcrabaqus 9.2 31-aug-2023 single
```

```

    hostid=54e7d61e7a81 start=01-mar-2023 _ck=5c0fc10426 sig="60P0452J90
    Y5AJA83T2E8KH7H24G9KQAYA775XR22H0W2SD9CQOXQM9QVV33JK88KW4RA0FSOC"
### ZCRANSYS 9.2
LICENSE zentechint zcransys 9.2 31-aug-2023 single hostid=54e7d61e7a81
    start=01-mar-2023 _ck=0d0fc1ed87 sig="60P0450GWM65XPV0BS8QA6S4NENDHP
    97QUDNUD822GXGMQGR0GEUNXC31PQCSPNER8CCM57S10"
### ZCRNXNASTRAN 9.2
LICENSE zentechint zcrnxnastran 9.2 31-aug-2023 single
    hostid=54e7d61e7a81 start=01-mar-2023 _ck=bc0fc1f78c sig="60PG4527TX
    04532WAOX8CS7TQ8UH5QXQJM8SHQ822M085YRV69016CTNCX56AVUFVFD9B9MAR480"
### ZENCRACKPROF 9.2
LICENSE zentechint zencrackprof 9.2 31-aug-2023 single
    hostid=54e7d61e7a81 start=01-mar-2023 _ck=980fc1e939 sig="60P0452SE5
    7KDYC70FWY3PM2D1TVAS5CJF9C8YG22HG02PAVQ2W194GSADEM442EKUDNR8SB8"

```

7.3 Network License server

A network license requires the Reprise License Manager (RLM) system to be running on a network server. Under this method of licensing the Zencrack product is installed on one or more client machines on the same network as the server (or on the server itself). The necessary license server files are supplied by Zentech - there is no requirement for end users to download files directly from the Reprise website. Installation of the license server files is described in section 3. This section describes the configuration and use of the license server.

The license file supplied for use with the license server is valid to run only on the specified server machine and is configured with a number of 'tokens' and a list of licensed finite element interfaces. When a Zencrack job is executed on a client machine, a request is made to the server to check out the required number of tokens for the job:

- Zencrack Standard analysis requires 1 token
- Zencrack Professional analysis requires 3 tokens

In addition the finite element interface for the job is checked against the licensed finite element interfaces. If the interface is allowed and sufficient tokens are available the job executes. If tokens have been taken by another job that is still executing the job waits and re-checks for available tokens every 10 seconds. If, after a user specified time, the tokens are still unavailable the job exits.

This method requires the setting `ZENCRACK_LICENSE=NETWORK` in the `zencrack.ini` file. A sample license file is shown below, note that the first 'HOST' line specifies the server machine hosting the licenses. The supplied license files containing a line 'ISV zentechint'. In the example below a specific port, 49600, has been added on this line.

```

### Zencrack 9.2
HOST ZEN_DELL_05 54e7d61e7a81 2764
ISV zentechint port=49600
LICENSE zentechint zencrack 9.2 31-aug-2023 3 start=01-mar-2023
    issuer="U.K.\01252 376388\Commercial" customer="Zentech
    International Limited" contract="590B Finchley Road\London\NW11
    7RX" replace _ck=e108084dfe sig="60PG452V7H9BRY6FCA1D92JBK1XQ4RTMTQ
    G33PG22MOAKU8F0DOHPBYWG3NJWEP1J8JDSTKFSB00"
### ZCRGUI 9.2

```



```
LICENSE zentechint zcrgui 9.2 31-aug-2023 3 start=01-mar-2023 replace
  _ck=24084bff30 sig="60PG453NKSAJE3WDY9PPGSBBERQ13GMCUQS4H2UR22M0ABVHC
  7N23VBTVJKFNND5GWBWJDX45704G"
### ZCRREMESH 9.2
LICENSE zentechint zcrremesh 9.2 31-aug-2023 3 start=01-mar-2023
  replace _ck=63088a29d5 sig="60PG452MYCPPV4P46435QBW00V72CCNFKT2MHQ82
  2M0812PKGDAKAVOE3XYRFJB0TF328YA3GA2G"
### ZCRABAQUS 9.2
LICENSE zentechint zcrabaqus 9.2 31-aug-2023 1 start=01-mar-2023
  replace _ck=5cd68311ff sig="60P0451DC70MKPVGS1P6U1MD6WCXXBFRNFF2202
  2HMBMBEHTKK1XXB07WHP6STV656M4661H4"
### ZCRANSYS 9.2
LICENSE zentechint zcransys 9.2 31-aug-2023 1 start=01-mar-2023
  replace _ck=0dd6347501 sig="60P0453X9HJ7MQRKYK2HJG20NH7VFRS90HTN1DR2
  2HTWKU3ABN91VY1H8H5UYSE606B03WFWEV"
### ZCRNXNASTRAN 9.2
LICENSE zentechint zcrnxnastran 9.2 31-aug-2023 1 start=01-mar-2023
  replace _ck=bcd6e3dbbd sig="60Q04580P0R3MNJ35HURK3XRNDCKAE8X4EYHJSDH
  08AG1B98W1M19SKTUKP3315P3K31RF4BSQV8R"
```

7.3.1 Configuring the license server

Five files are supplied for the license server machine:

- The generic license server, rlm on Linux, rlm.exe on Windows.
- The Zentech International license server, zentechint on Linux, zentechint.exe on Windows.
- The RLM utilities, rlmutil on Linux, rlmutil.exe on Windows.
- The license file, with extension .lic, that describes the user rights to the Zencrack product.
- The RLM License Administration Manual, RLM_License_Administration.pdf.

The supplied files are installed as described in section 3. It is recommended that the license file be installed in the same folder as the RLM license server files.

7.3.2 Starting the RLM server

It is recommended that RLM is configured as a service on Windows and to start at bootup on Linux machines.

If this is not done the license server can simply be started by executing the rlm command in the license server folder (provided that the license file is in the same folder):

```
rlm > output_file
```

7.3.2.1 Running the RLM server as a service on Windows

Installing RLM as a service is done in a command window. Once installed as a service, it remains installed until it is explicitly deleted as a service. Installing RLM as a service does not start RLM; services are started via the Windows Services control panel, and at boot time. RLM is installed using the RLM program itself, with special arguments.

Example:

```
rlm -install_service -service_name rlm-zencrack -dlog
c:\Zencrack\rlm_v14\server.log -c c:\Zencrack\rlm_v14\yourlicense.lic
```

This installs RLM as a service under the name 'rlm-zencrack'. When started via the Services control panel or at boot time, RLM will be passed the '-c c:\Zencrack\rlm_v14\yourlicense.lic' arguments, and it will write debug log information to the file c:\Zencrack\rlm_v14\rlm-zencrack.log. Note: if no '-c' argument is given, the RLM program will read all licence files (.lic) present in the RLM installation directory.

To start the service after installing it:

```
Start > Control Panel > Administrative tools > Services
Locate rlm-zencrack. Right-click > Properties > Start
The service should now start.
Click OK or Cancel to leave the Properties screen.
```

The full set of options for the rlm -install_service command are:

```
rlm -install_service -dlog [+]logfile [-service_name sname] <rlm runtime args>
```

where

logfile is the pathname for the server debug log. This parameter is required. If preceded by the '+' character, the logfile will be appended, rather than created.

sname is an optional name for the installed service. If not specified, sname defaults to 'rlm'. If sname contains embedded whitespace, it must be enclosed in double quotes.

<rlm runtime args> are any other command line arguments to be passed to rlm when it is started.

The server status can be checked from the command line using:

```
rlmutil rlmstat
```

Alternatively the browser-based utility described in section 7.3.3 may be used to monitor the license server.

If it is required to remove the service it is necessary to first stop the service via Control Panel > Administrative tools > Service. Then from the command line:

```
rlm -delete_service -service_name rlm-zencrack
```

Note: The above command prompt needs to be 'Run as administrator'

7.3.2.2 Starting the RLM server at system boot time on Linux systems

On most Unix and Linux systems, system services are started at boot time, usually via startup scripts located in /etc/rc.<something>. For further information and a sample script that defines the necessary RLM variables please refer to the RLM License Administration Manual.

7.3.3 Browser-based license administration

The RLM server contains an embedded Web Server that can be used to perform most administration of the RLM server itself. The web server allows you to retrieve server and license status, cause the servers to re-read the license files, switch debug or report log files, move the current report log file to a new name, or shut down the license servers. Using this web-based interface, you can administer the license servers from any platform, and you do not need to install the RLM utilities - you only need a web browser.

The web server is started automatically on port 5054 when rlm is started. To use the web server, simply point your browser to: <http://ServerHostName:5054> (or use the server network IP address, e.g. <http://192.168.3.4:5054>) and select the operation you would like to perform. You will be prompted for any required information. Typical status screens are shown in Figure 7.1 and Figure 7.2.

For further information please refer to the RLM License Administration Manual.

The screenshot shows the 'Reprise License Server Administration' web interface. The main content area displays the status for 'rim' on 'zen_dell_05 (port 2764)'. It includes a table for RLM software and command versions, a table for rlm Statistics, and a table for ISV Servers.

RLM software version	v14.1 (build 3)
RLM comm version	v1.2
debug log file	c:\zencrack\rlm_v14\server.log
license files	c:\zencrack\rlm_v14\zencrack_zen_dell_05_LM_2021-01-30 lic zencrack_zen_dell_05_LM_2023-02-07_to_2024-01-31 lic

rlm Statistics	Since Start	Since Midnight	Recent
Start time	03:07 07:41:17	03:07 07:41:18	03:07 13:47:20
Messages	11 (0sec)	11 (0sec)	1 (0sec)
Connections	11 (0sec)	11 (0sec)	1 (0sec)

ISV Servers	Name	port	Running	Restarts	Server Status	License Usage	Debug Log	REREAD	TRANSFER	SHUTDOWN
	zentechint	49676	Yes	0	zentechint	zentechint	zentechint	zentechint	zentechint	zentechint

Figure 7.1: Typical license status screen after selecting 'Status' from the left side menu

Reprise License Server Administration
Copyright (c) 2006-2020 Reprise Software, Inc. All Rights Reserved.

ISV zentechint status on zen_dell_05 (port 49676)

zentechint software version	v14.1 (build 3)
zentechint comm version	v1.2
debug log file	c:\zenCrack\rlm_v14\zentechint.dlog
report log file	_na_

zentechint Statistics	Since Start	Since Midnight	Recent
Start Time	03:07 07:41:19	03:07 07:41:20	03:07 13:47:20
Messages	49 (0/sec)	49 (0/sec)	9 (0/sec)
Connections	14 (0/sec)	14 (0/sec)	4 (0/sec)
Checkouts	11 (0/sec)	11 (0/sec)	1 (0/sec)
Denials	0 (0/sec)	0 (0/sec)	0 (0/sec)
License Removals	0 (0/sec)	0 (0/sec)	0 (0/sec)
Current Connections	0		

License pool status

Product	Pool	Ver	Expires	count	soft lim	reuse	res	timeout	share	checkouts	Show Usage
zenCrack	1	9.2	31-jan-2024	30	30	0	0	0	None	4	usage...
zcrgui	2	9.2	31-jan-2024	30	30	1	0	0	None	1	usage...
zcresmesh	3	9.2	31-jan-2024	30	30	0	0	0	None	0	usage...
zcrahaque	4	9.2	31-jan-2024	1	1	0	0	0	None	2	usage...
zcranys	5	9.2	31-jan-2024	1	1	0	0	0	None	2	usage...
zcromastran	6	9.2	31-jan-2024	1	1	0	0	0	None	2	usage...

Enter license password to select license results. Only licenses with matching passwords (or with no passwords) will be displayed above.

License Password:

Figure 7.2: Typical server license status after selecting 'zentechint' from the Server Status of the main status screen

7.3.3.1 Installing an updated RLM license file

If it is required to install a new license file, the file should first be placed in the same folder as the existing license file. The browser-based license administration facility described in section 7.3.3 can then be used to re-read the license file:

- Select 'Reread/Restart Servers' from the left pane.
- Set the ISV box to 'all' or 'zentechint' and select REREAD LICENSES.

7.3.4 Releasing locked licenses

Occasionally the license server may hold onto license tokens if a job ends in an unexpected system-related way, or there may be a need to forcibly remove a license that is in use. To release locked tokens:

- Select 'Status' from the left pane.
- In the server table select 'zentechint' in the 'Server Status' column. This shows a screen similar to the one in Figure 7.2.
- In the 'License pool status' table, click on 'usage' in a row which has non-zero checkout. This shows a screen similar to the one in Figure 7.3.
- Click on 'Remove' to release licenses.

Alternatively:

- Select 'Status' from the left pane.

- In the server table select 'zentechint' in the 'License Usage' column.
- Select Get License Usage on the next screen. This shows a screen similar to the one in Figure 7.3.
- Click on 'Remove' to release licenses.

The screenshot shows the Reprise License Server Administration web interface. The main content area displays the following data:

License status for ISV zentechint

Product	Pool	Ver	user	host	PID	req ver	# lic	# res	Out time	Click to REMOVE
zorgui	2	9.2	chris	zen_deit_05	22892	9.2	1	0	03/07 13:54	Remove

License pool status

Product	Pool	Ver	Expires	count	soft lim	inuse	res	timeout	share	checkouts	Show Usage
zencrack	1	9.2	31-jan-2024	30	30	0	0	0	None	4	usage...
zorgui	2	9.2	31-jan-2024	30	30	1	0	0	None	1	usage...
zcrepmesh	3	9.2	31-jan-2024	30	30	0	0	0	None	0	usage...
zorabaqis	4	9.2	31-jan-2024	1	1	0	0	0	None	2	usage...
zoramsys	5	9.2	31-jan-2024	1	1	0	0	0	None	2	usage...
zcomxnastran	6	9.2	31-jan-2024	1	1	0	0	0	None	2	usage...

Buttons: Refresh, Back

Figure 7.3: Typical server usage status

7.3.5 Contents of the RLM license file

The server license file contains information that configures the license server and describes all the licenses granted from Zentech International to the end-user. License files have 3 types of lines: HOST, ISV and LICENSE.

The HOST line specifies the license server machine (by ethernet address) and includes the port through which clients can access the license server.

The ISV line specifies that the license server information is for ISV 'zentechint'.

The LICENSE lines describe license grants from Zentech International to the end-user. All license files (except evaluation licenses) contain a license grant for product 'zencrack'. This specifies the total number of license tokens available, the license expiry date and includes details about the customer (e.g. company name, address, etc). Other parameters (e.g. a license start date) may also be included. One or more additional license lines are present depending upon the licensed finite element interfaces. A sample license file is shown in section 7.3.

7.3.6 Configuring a client machine

The Zencrack program is installed on the client machine following the procedure in section 2.

Zencrack configuration is contained in a file zencrack.ini as described in section 4.1. Three variables are defined in this file for use with the license server:

ZENCRACK_LICENSE

This variable is set to NETWORK to indicate that a network license server should be used.

```
ZENCRACK_LICENSE = NETWORK
```

ZENCRACK_RLM_SERVER

This variable specifies the license server machine using the syntax port@Ipaddress. The port number is contained in the license file installed on the license server. The IP address is the LAN address of the license server machine. For example, if the license server is machine 192.168.1.10:

```
ZENCRACK_RLM_SERVER = 2764@192.168.1.10
```

In the special case that the license server and the client machine are the same machine, the special 'localhost' name may be used without the need to use the actual machine name or IP address i.e. 2764@localhost.

ZENCRACK_WAIT

This variable defines the number of minutes that a job should wait for license tokens to become available if they are in use by another job. The availability of tokens is checked every 10 seconds while the job is waiting.

```
ZENCRACK_WAIT = 30
```

This option is not the same as a strict queue option available with license managers. If several jobs are in a 'wait' state at the same time the first job to continue execution is the first one to check for license tokens when they become available rather than the first job that reached a wait condition. Note - the RLM end user environment variable for queuing (RLM_Queue) must not be set as this option is not supported within Zencrack.

8 Remote Execution Of The Finite Element Analysis

This section describes the configuration and use of the ‘remote f.e.’ capability in Zencrack. This capability allows users with Zencrack on a Windows platform to execute the finite element part of a Zencrack job on a Linux or Unix machine on the same network.

The ‘remote f.e.’ capability in Zencrack uses the following procedures:

- FTP to copy files from the local to the remote machine.
- An Rexec or SSH command to run a script on the remote machine. The script runs the finite element program on the remote machine.
- FTP to copy files from the remote to the local machine.

The capability utilises the plink.exe [5], T4eRexec.exe or T4eSSH.exe executables [6] to establish the remote connection. T4eRexec is a utility that is similar to the Windows REXEC command except that it allows a password as input. To run commands on a Rexec compatible operating system, such as Linux, the Rexec daemon has to be running on the target system. Note that passwords are transmitted in clear text. A more secure option is the plink or T4eSSH utility. These are secure implementations of the SSH protocol to allow access to a UNIX/Linux operating system. The plink.exe, T4eRexec.exe and T4eSSH.exe files are supplied with Zencrack in the utils folder of the Zencrack installation and should not be moved from that folder. In addition, the full PuTTY.zip file, of which plink.exe is a part, is also included.

The three utilities plink, T4eRexec and T4eSSH are provided for convenience - only one needs to be selected and used when configuring the remote f.e. capability.

Note that passwords for access to the remote machine are set up in clear text in the runzcr78.bat file.

It is necessary to ensure that any firewalls allow the necessary communication between the local and remote machines. On the local machine plink.exe, T4eRexec.exe or T4eSSH.exe and the FTP daemon must be able to communicate with the remote machine. The Rexec protocol must be enabled on the target machine if using T4eRexec. The FTP daemon must also be running on the remote machine. Please consult your system documentation for information on these processes.

8.1 Configuration

Zencrack should be installed on the target Windows machine and the setup program run in the usual way (see section 2.1). If there is to be a local f.e. capability in addition to the remote f.e. capability, it is suggested that the installation is verified before commencing with the remote f.e. configuration.

Zencrack is configured via the zencrack.ini file in the program .\tools directory. This file must be edited (e.g. using Notepad) to configure the remote f.e. execution. The as-installed file contains the following section:

```
[REMOTEFE]
#
# Items for remote f.e. execution.
#
# These options define variables required to run the f.e. analysis on a remote
# computer. ZCR_REMOTE_FE can be modified on the command line by the -r option.
#
ZCR_REMOTE_FE = no
#
ZCR_ABAQUS_REMOTE =
ZCR_ABAQUS_VER_REMOTE =
ZCR_ANSYS_REMOTE =
ZCR_ANSYS_VER_REMOTE =
ZCR_NXNASTRAN_REMOTE =
ZCR_NXNASTRAN_VER_REMOTE =
ZCR_LOGIN_UTIL =
ZCR_LOGIN_NAME =
ZCR_LOGIN_PWD =
ZCR_LOGIN_PATH =
ZCR_LOGIN_IP =
ZCR_LOGIN_SHELL =
ZCR_LOGIN_SCRIPT =
ZCR_LOGIN_EXTRA =
```

Some of these items must be set and others may be left blank, depending upon the f.e. interface and options required for the chosen remote execution utility. The items are described below.

ZCR_REMOTE_FE

This item defines the default status for f.e. execution. If it is set to ‘no’, then by default all f.e. jobs will be executed on the local machine. If it is set to ‘yes’, then by default all f.e. jobs will be executed on the remote machine.

This option can be overridden for an individual Zencrack analysis by using the -r command line option, which has values yes or no. For example, if ZCR_REMOTE_FE is set to ‘no’ but it is required to run a specific job with remote f.e. execution, the command line would be:

```
runzcr92 -j jobname -r yes
```

ZCR_ABAQUS_REMOTE

This is analogous to variable ZCR_ABAQUS for local execution. It defines the location of the Abaqus executable on the remote machine.

This can be left blank if Abaqus is not available on the remote machine or if Abaqus is not a licensed interface for the Zencrack installation.

ZCR_ABAQUS_VER_REMOTE	<p>This is analogous to variable ZCR_ABAQUS_VER used for local execution. It defines the Abaqus version on the remote machine.</p> <p>This can be left blank if Abaqus is not available on the remote machine or if Abaqus is not a licensed interface for the Zencrack installation.</p>
ZCR_ANSYS_REMOTE	<p>This is analogous to variable ZCR_ANSYS used for local execution. It defines the location of the Ansys executable on the remote machine.</p> <p>This can be left blank if Ansys is not available on the remote machine or if Ansys is not a licensed interface for the Zencrack installation.</p>
ZCR_ANSYS_VER_REMOTE	<p>This is analogous to variable ZCR_ANSYS_VER used for local execution. It defines the Ansys version on the remote machine.</p> <p>This can be left blank if Ansys is not available on the remote machine or if Ansys is not a licensed interface for the Zencrack installation.</p>
ZCR_NXNASTRAN_REMOTE	<p>This is analogous to variable ZCR_NXNASTRAN for local execution. It defines the location of the Simcenter Nastran executable on the remote machine.</p> <p>This can be left blank if Simcenter Nastran is not available on the remote machine or if Simcenter Nastran is not a licensed interface for the Zencrack installation.</p>
ZCR_NXNASTRAN_VER_REMOTE	<p>This is analogous to variable ZCR_NXNASTRAN_VER used for local execution. It defines the Simcenter Nastran version on the remote machine.</p> <p>This can be left blank if Simcenter Nastran is not available on the remote machine or if Simcenter Nastran is not a licensed interface for the Zencrack installation.</p>
LOGINUTIL	<p>The utility for remote execution of commands. This must be set to one of plink, t4erexec or t4essh.</p>
LOGINNAME	<p>This is the user name that is used to log into the remote machine.</p>
LOGINPWD	<p>This is the password for user name LOGINNAME on the remote machine.</p>
LOGINPATH	<p>This is the path on the remote machine into which all analysis files will be placed. The remote f.e. analysis will be executed in this directory. This item should include the trailing / on the path definition. The path can be a full path or a relative path in which case it is relative to the home directory for user LOGINNAME.</p>
LOGINIP	<p>This is the network IP address of the remote machine.</p>

LOGINSHELL	By default (if this item is blank) Zencrack uses the ksh shell when executing the script file that runs the finite element analysis on the remote machine. An alternative script, e.g. bash, can be set using this variable.
LOGINSRIPT	This item defines the name of a script located in the LOGINPATH folder that should be run before execution of the finite element analysis. This is optional and should be left blank if no script is to be executed.
LOGINEXTRA	This item defines any additional command line options that should be used with the chosen plink, T4eRexec or T4eSSH utility.

Notes for T4eRexec or T4eSSH:

- A timeout should be defined by including ‘-a 9999’ in LOGINEXTRA. This defines a timeout period of 9999 seconds during which a remote session command remains active if there is no response from the remote machine. See section 8.2 for more information regarding the timeout period.
- In some cases the ‘-A password’ option may need to be included when the T4eSSH utility is being used. (This ‘-A password’ option contains the word password rather than any user or system password). This option defines the authentication method.

Notes for plink:- The first time that the utility is used on the local machine, the user may be prompted to save a key for the remote machine in the PuTTY cache. Replying yes to this prompt should ensure the prompt does not appear again.

A special case exists to allow the full command line for plink, T4eRexec or T4eSSH to be specified using LOGINEXTRA. If the value of LOGINEXTRA starts with ‘fullcommandline’ then the remainder of the string is used as the full command line string for plink, T4eRexec or T4eSSH. The values of LOGINNAME and LOGINPWD are ignored for execution of commands on the remote machine (but are still used for ftp file transfers). The full command line option should generally not be required and is provided mainly for troubleshooting purposes. The full list of command line options for the utilities is available by typing plink, T4eRexec or T4eSSH at a Zencrack command prompt.

A sample configuration for remote execution of Abaqus and Ansys using T4eSSH may be:

```
ZCR_ABAQUS_REMOTE = /usr/SIMULIA/EstProducts/2020/linux_a64/code/bin/ABQLauncher
ZCR_ABAQUS_VER_REMOTE = 2020
ZCR_ANSYS_REMOTE = /ansys_inc/v211/ansys/bin/ansys211
ZCR_ANSYS_VER_REMOTE = 21.1
ZCR_NXNASTRAN_REMOTE = /home/nxnastran/x86_64linuxl/nastran
ZCR_NXNASTRAN_VER_REMOTE = 10.0
ZCR_LOGIN_UTIL = t4essh
ZCR_LOGIN_NAME = myusername
ZCR_LOGIN_PWD = mypassword
ZCR_LOGIN_PATH = /usr/test_remote/
ZCR_LOGIN_IP = 192.168.1.15
ZCR_LOGIN_SHELL = bash
ZCR_LOGIN_SCRIPT =
ZCR_LOGIN_EXTRA = -a 9999 -A password
```

A sample configuration for remote execution of Abaqus and Ansys using plink may be:

```
ZCR_ABAQUS_REMOTE = /usr/SIMULIA/EstProducts/2020/linux_a64/code/bin/ABQLauncher
ZCR_ABAQUS_VER_REMOTE = 2020
ZCR_ANSYS_REMOTE = /ansys_inc/v211/ansys/bin/ansys211
ZCR_ANSYS_VER_REMOTE = 21.1
ZCR_NXNASTRAN_REMOTE = /home/nxnastran/x86_64linuxl/nastran
ZCR_NXNASTRAN_VER_REMOTE = 10.0
ZCR_LOGIN_UTIL = plink
ZCR_LOGIN_NAME = myusername
ZCR_LOGIN_PWD = mypassword
ZCR_LOGIN_PATH = /usr/test_remote/
ZCR_LOGIN_IP = 192.168.1.15
ZCR_LOGIN_SHELL = bash
ZCR_LOGIN_SCRIPT =
ZCR_LOGIN_EXTRA =
```

8.2 Remote command timeout period

The timeout issue described in this section relates to the T4eRexec and T4eSSH utilities. There is no such timeout period for the plink utility.

When a command is executed on the remote machine using T4eRexec or T4eSSH, the local machine has a timeout period in which it expects some response from the remote machine. If there is no response within the timeout period the execution will stop and the following error is reported to the screen:

```
ERROR: Timeout while waiting for data
```

The LOGINEXTRA option should include parameter ‘-a 9999’ to set the timeout period to the maximum allowed value of 9999 seconds i.e.:

```
ZCR_LOGIN_EXTRA = -a 9999
```

During the solution phase of the finite element analysis on the remote machine there is a period of no response. If the solution phase exceeds the timeout setting then the command will time out and the Zencrack analysis will fail. The timeout period therefore sets an upper limit on the

elapsed duration of a phase of the finite element analysis. For Abaqus, for example, the pre.exe and standard.exe phases are separate and each may run for an elapsed time of up to the defined timeout period.

For Abaqus analyses which exceed 9999 seconds elapsed runtime but which have increments less than 9999 seconds, a solution to prevent the timeout is to include a simple Abaqus urdfil subroutine which writes to the screen upon completion of every increment:

```

subroutine urdfil(lstop,lovrwrt,kstep,kinc,dtime,time)
include 'aba_param.inc'
character*8 crray(513),nset
dimension array(513),jrray(nprecd,513),time(2)
equivalence (array(1),jrray(1,1))
equivalence (crray(1),jrray(1,1))
write(*,10) kstep,kinc,time(2)
10 format('Processing .fil file: step ',i4,' increment ',i4,
&        ' : total time ',1pe14.8)
return
end

```

At least one request for data to be written to the .fil file should be made in the uncracked mesh (i.e. *NODE FILE or *EL FILE with FREQ=1 in step 1). The subroutine is referenced via the Zencrack USER keyword in the .zcr input file.

8.3 Zencrack input file

One Zencrack keyword is relevant to remote f.e. execution: REMOTE TRANSFER. By default, all necessary files are transferred to and from the local machine. This keyword can be used to specify transfer of additional files.

The SAVE keyword operates in the normal way on files that are present on the local machine. So, for example, if SAVE, ODB=YES is specified, the remote ODB files are transferred to the local machine after each f.e. analysis and are then renamed and saved locally on the machine.

For remote f.e. analyses there are also issues related to case sensitivity in filenames. Care should be taken when specifying filenames in the input file.

In addition, other system / f.e. related issues may arise. For example, Abaqus user subroutines require an extension of .for on Windows and .f on Unix and Linux.

8.4 Execution of a Zencrack job with remote F.E. analysis

If the ZCR_REMOTE_FE variable described in section 8.1 is set to 'yes', then all jobs are automatically sent for remote f.e. execution. No additional options are required. In this configuration a local f.e. analysis can be forced for an individual Zencrack job by using the '-r no' option, e.g.:

```
runzcr92 -j jobname -r no
```

If the ZCR_REMOTE_FE variable described in section 8.1 is set to 'no', then all jobs are automatically sent for local f.e. execution. In this configuration a remote f.e. analysis can be forced for an individual Zencrack job by using the '-r yes' option, e.g.:

```
runzcr92 -j jobname -r yes
```

8.5 Limitations of the remote transfer capability

In the current implementation for Abaqus, the .odb file is always transferred from the remote machine if analysis results are extracted from the .odb file. The extraction of the results then takes place on the local machine. This requires that the same version of Abaqus be installed on the local machine as is on the remote machine. If this is not the case, the attempt to process the .odb file will generate an error message 'Error opening .odb file' on the screen and the analysis stops. In this situation the analysis must instead be set to extract results from the Abaqus .dat or .fil files (see parameter **RESULTS** on *ENERGY RELEASE RATE). In these cases there is no requirement for any Abaqus version to be installed on the local machine.

References

- [1] Reprise License Manage v14 from Reprise Software, Inc.
Website: <https://www.reprisesoftware.com>
- [2] Abaqus, version 2023. Abaqus is a trademark of Dassault Systèmes Simulia Corp. (SIMULIA), Providence, Rhode Island, U.S.A.
Website: <https://www.3ds.com/products-services/simulia>
- [3] Ansys, version 2023R1. Ansys is a trademark of SAS IP, Inc., a wholly owned subsidiary of Ansys Inc., Canonsburg, Pennsylvania, U.S.A.
Website: <https://www.ansys.com>
- [4] Simcenter Nastran, version 2212. NASTRAN is a registered trademark of the National Aeronautics and Space Administration. Simcenter Nastran is an enhanced proprietary version developed and maintained by Siemens Product Lifecycle Management Software Inc.
Website: <https://www.siemens.com>
- [5] PuTTY utility.
Website: <https://www.chiark.greenend.org.uk/~sgtatham/putty>
- [6] Utilities from Tools4ever.
Website: <https://www.tools4ever.com>

Zencrack

Version 9.2

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E-mail: info@zentech.co.uk
On-line: <https://www.zentech.co.uk/zencrack.htm>

