

**RC-PADD**

# **Getting Started**

**SPECIAL-PURPOSE STRUCTURAL DESIGN SOFTWARE**

**Version 2.2**

 **QuakeFrame Software Ltd**

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USERS ARE ADVISED TO MAKE THEIRSELVES FAMILIAR WITH THE THEORETICAL BACKGROUND OF THE CALCULATIONS AND VERIFY THE RESULTS WITH OTHER METHODS.

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# Introduction

## Overview

RC-PADD stands for “Reinforced Concrete – Post-Analysis Designer and Detailer”. It is a special-purpose program for the structural design of reinforced concrete structures and the subsequent detailing. The post-analysis nature of the program gives it more power functionality over conventional ‘integrated’ programs that can carry out altogether the structural analysis and the structural design. Once the structure is analyzed using a reliable structural analysis program, the model and the results are imported to RC-PADD, where the structural design and detailing are carried out.

RC-PADD provides an interactive environment where the users can try out various design schemes and select the most appropriate, using their own engineering judgement. The interface is simple and user-friendly, yet it provides all the necessary information to help the engineer investigate all the parameters involved and thus maintain control over the design. Furthermore, in case that the design is not adequate, the error can be easily identified by investigation of the various checks that are displayed, so that the engineer can take the appropriate corrective action.

RC-PADD provides a solution to the issue of compatibility between the structural design process and the detailing process. This is achieved by defining first the reinforcement and then conducting the structural design calculations. In contrast, the traditional method is to calculate first the required reinforcement area and then to select the reinforcement that matches more closely. Furthermore, by subdividing the beams into three regions, with different assigned reinforcement, the reinforcement throughout the beam length is represented more realistically.

Importing the model is very straightforward. The model is first exported from the structural analysis program in a compatible format file. During the importing procedure, the user creates the combination design loadcases. Importing is done!

While RC-PADD was particularly developed to perform earthquake-resistant design, it may also be used in most other design situations, such as gravity and wind loading. Earthquake-resistant design is achieved by carrying out the necessary seismic checks, such as for the joints and the member end-sections, a feature that only very few programs in the market can do. It should be emphasized that RC-PADD is probably the only software in the market that can calculate the rotational ductility of the members, which is one of the most important parameters in earthquake-resistant design.

The advantages of RC-PADD over conventional ‘integrated’ programs are:

- The reinforcement representation is more realistic.
- It provides a simple, attractive and clear graphics user display for the design.
- The user can modify the reinforcement manually.
- Each member may be designed independently.
- The calculations are based on the actual reinforcement.
- It uses different design situations and material partial factors.
- Sections are discretized into a large number of fibers, which results to more accurate calculations.
- It has more extensive design functionality.
- It conducts numerous checks to ensure the quality of the design.
- Detailed output of the design and the calculations.

## Features

RC-PADD comes in three editions, the features of each are shown in the following table.

<b>FEATURES</b>	<b>Express</b>	<b>Static</b>	<b>Seismic</b>
<b>Model</b>			
Beam limit	50	No limit	No limit
Column limit	50	No limit	No limit
Wall limit	50	No limit	No limit
Story limit	2	No limit	No limit
<b>Design</b>			
Design codes: EC2, EC8, ACI-318-08. Manual definition of other codes.	✓	✓	✓
Design methods: Material Partial Factor, Resistance Reduction Factor.	✓	✓	✓
Beam shapes	• Rectangular	• Rectangular • Tee	• Rectangular • Tee
Column shapes	• Rectangular	• Rectangular • Circular • Angular • Tee	• Rectangular • Circular • Angular • Tee
Wall shapes	• Rectangular	• Rectangular	• Rectangular
Three design situations and material partial factors	✓	✓	✓
Generation of combination loadcases from primary loadcases	✓	✓	✓
Combination loadcases generation wizard	✓	✓	✓
Rotational ductility calculation for beams, columns and walls	✗	✗	✓
Checks for end-section maximum design shear resistance	✗	✗	✓
Checks for avoidance of hinge formation on columns	✗	✗	✓
Manual definition of ground level	✓	✓	✓
User-defined design parameters and creation of preferred design parameters file	✓	✓	✓
<b>Displacement Analysis</b>			
Checks for second-order (P-Delta) effects	✗	✗	✓
Checks for interstory drift limit	✗	✗	✓
<b>Materials</b>			
Elasto-plastic with inclined post-yield branch material model for reinforcement steel	✓	✓	✓
Parabolic concrete stress-strain material models: Unconfined (Eurocode 2/ACI-318) confined (Eurocode 2) and confined (Kent & Park)	✓	✓	✓

Table 1. RC-PADD features (1).

<b>FEATURES (cont.)</b>	<b>Express</b>	<b>Static</b>	<b>Seismic</b>
<b>Reinforcement</b>			
Three longitudinal regions for main reinforcement of beams	✓	✓	✓
Beam reinforcement layers: two top rows, two bottom rows, one flange row	✓	✓	✓
One longitudinal region for main reinforcement of columns and walls	✓	✓	✓
Critical and middle regions for shear reinforcement of beams and columns	✓	✓	✓
Manual assignment of reinforcement	✓	✓	✓
Continuous reinforcement over continuous beam supports	✓	✓	✓
Detailing checks: main and shear reinforcement ratio and spacing	✓	✓	✓
Manual definition of the reinforcing bar sizes used in the design	✓	✓	✓
<b>User Interface</b>			
Simple and clear graphics display for the section shape and reinforcement arrangement	✓	✓	✓
Display output of design main results	✓	✓	✓
<b>General</b>			
Project information table	✓	✓	✓
Compatible structural analysis programs	ETABS, SAP2000		
Report exporting formats	Rich-Text (MS Word), PDF, HTML, JPEG, Bitmap		
Units supported	N-mm, N-cm, N-m, KN-mm, KN-cm, KN-m, lb-in, lb-ft, kip-in, kip-ft		

**Table 2. RC-PADD features (2).**

# Getting Started

## Installation

Installing the program is a very straightforward two-step procedure:

- The installation of the program itself has to take place. Opening the following file will initiate the installation wizard.  
RC-PADD 2.0.1 Setup.exe  
Notice that the program version is included in the name.
- The second step is to install the license file, which is essential in running the program, using the following file. The license file has to be installed in the same folder as the program.  
RC-PADD License 2.0.0 Setup.exe  
e.g. if the program was installed in the folder 'C:\Program Files\QuakeFrame Software\RC-PADD\', the license file has to be installed in the same folder as well.

Once installed, the program is fully functional for a period of 30 days after which an activation key is required, which is given upon purchase.

To download the installation files users must register to the website.

## Upgrading

### Minor version

Upgrading from a previous minor version takes place by installing only the program file. The installation wizard will detect and remove the previous version and subsequently install the new version. Again, the new version of the program has to be installed in the same folder as the license file. When upgrading, the license file has to remain intact.

Minor version upgrade, means that the first number of the version remains the same while the second number is increased.

### Major version

Upgrading from a previous major version takes place by installing both the new program file and the new license file. The installation wizard will detect and remove the previous version and subsequently install the new version. Again, the new version of the program has to be installed in the same folder as the license file. Upon purchasing a major upgrade, the user has to first deactivate the license file and transmit the deactivation code to QuakeFrame.

Major version upgrade, means that the first number of the version is increased.

## License Manager

The very first screen that appears when RC-PADD is run is the License Manager, shown in Figure 1.



Figure 1. License Manger.

The following information appears:

- **Status.** The activation status will appear as 'Activated' or 'Not activated'. If the product has not been activated, it is stated whether the trial period has expired.
- **Registration information.** The serial number of the product as well as the name of the user and the company name will be displayed.
- **Activation code.** This box will be editable only if the product has not been activated. The 'Authorization Request Code' is the code that the user has to report to *QuakeFrame* to get the respective 'Activation Code'.

## Activation

Once the user purchases the product, he will obtain an activation code from *QuakeFrame*. The user states the Authorization Request Code and the respective Activation Code is given. Once the Activation Code is entered successfully, the product will be activated. This means, that any expiration date restrictions will be released.

## Deactivation

The user will be required to deactivate the program in case of transferring the license to another computer or making alterations to the hardware or the configuration of the computer. Upon pressing the 'Deactivation' button, a deactivation code will be issued. The deactivation code is written in a text file named 'DEACTIVATION\_LOG.txt' in the program file folder.

To get a new Activation Code, the user will have to state the Deactivation Code to *QuakeFrame*.

### Software Protection

RC-PADD is protected against fraudulent use and pirate copying using the state-of-the-art software protection technology.

The program will work only on the computer on which it is installed. To make sure that this is so, it observes some characteristics of the hardware and the configuration. If they change, then the program interprets that as a fraudulent attempt to transfer the program to another computer. Therefore, users are required to deactivate the program before making any changes to the hardware or the configuration. The program may be activated again, after the changes are completed.

### System Requirements

To install RC-PADD the system must meet the following minimum requirements.

- 512 MB RAM
- 40 MB free hard drive space
- Windows XP, Vista or Server 2003.
- Microsoft Framework.NET v2.0
- Windows installer 2.0

### Compatible Programs

RC-PADD collaborates with the following structural analysis programs.

- ETABS
- SAP2000

### Manuals

The following manuals come with the program.

- Getting Started
- User's Manual
- Design Manual
- Example Manual
- Tutorial Manual

### Technical support

Users can submit their questions by email at [support@quakeframe.com](mailto:support@quakeframe.com).

# Structural Design Process

## Overview

RC-PADD works by importing the results from a structural analysis model, which was previously created using a third-party program. The user sets the design parameters and the structural design process begins. At completion, all results may be printed or exported to a file.

## Structural Analysis

The first step is to build the model in the structural analysis program. The following rules must be followed, so that the model is importable to RC-PADD.

- The imported model must consist of elements that are supported in RC-PADD, as shown in Table 3.

RC-PADD Member	Element Type	Element Shape
Beam	Frame	Rectangular, circular, Tee, angular
Column	Frame	Rectangular, circular, Tee, angular
Wall	Shell	Rectangular

**Table 3. Supported elements.**

- All required primary loadcases must be contained in the imported file.
- All primary seismic resisting beam and column members must be oriented in the directions of the global X and Y axes.

## Units

The units imported are the same as the original structural analysis model. The following unit sets are supported:

- N-m, N-cm, N-mm, KN-m, KN-cm, KN-mm, lb-in, lb-ft, kip-in, kip-ft.

## Importing the Model – MS Access File

After the structural analysis is completed, the model with the results is exported to a file. The current version of RC-PADD supports only Microsoft Access format files. The file is then imported into RC-PADD. This is a very straightforward procedure.

## File Data Tables

The following data tables must be contained in the imported MS-Access files.

### **ETABS**

#### **Required**

[Control Parameters]

[Story Data]

- [Point Coordinates]
- [Column Connectivity Data]
- [Beam Connectivity Data]
- [Assembled Point Masses]
- [Frame Section Properties]
- [Static Load Cases]
- [Frame Assignments Summary]
- [Point Displacements]
- [Column Forces]
- [Beam Forces]

***Optional***

- [Wall Connectivity Data]
- [Pier Section Properties]
- [Project Information]
- [Response Spectrum Accelerations]
- [Pier Forces]

***SAP2000***

***Required***

- [Program Control]
- [Frame Section Properties 01 - General]
- [Load Case Definitions]
- [Joint Coordinates]
- [Connectivity – Frame]
- [Frame Section Assignments]
- [Joint Displacements]
- [Assembled Joint Masses]
- [Element Forces – Frames]
- [Objects and Elements – Joints]

***Optional***

- [Area Section Properties]
- [Connectivity – Area]
- [Area Section Assignments]
- [Project Information]
- [Element Forces – Area Shells]

**Create Combination Loadcases**

During the process of importing the model, the user is asked to define the combination loadcases to be created. The combination loadcases are created based on the primary

loadcases. The user also has to specify the design situation of each combination loadcase as Permanent/Transient, Accidental or Seismic.

### **Design Parameters**

The user then defines the various parameters to be used in the design, on the “Design Parameters” card. These design parameters are classified to the following six categories, each shown on a different tab.

#### **General**

Building characteristics and design options.

#### **Method / Factors**

Design method and design factors.

#### **Beams**

Parameters involved in the calculations and the checks of beams.

#### **Columns**

Parameters involved in the calculations and the checks of columns and joints.

#### **Walls**

Parameters involved in the calculations and the checks of columns and joints.

#### **Calculations**

Parameters that are used in the design algorithm.

### **Structural Design**

The structural design process is comprised of two steps. The first step is to carry out the design resistance calculations and checks. The second step is to carry out the seismic checks.

#### **Design Resistance Calculations**

First, the design resistance calculations have to be carried out. The user opens the card for each member, changes the various properties and carries out the calculations by pressing the “Calculate” button. The design resistance for each member is checked against the design forces obtained from the elastic structural analysis. Essentially this is an iterative procedure. The design of the member is successful only when the “Check Design” status on the member card is “OK”. Alternatively, the user may select the menu item Design>Calculate All, which will carry out the design resistance calculations for all members, using the current member properties.

#### **Seismic Design Checks**

The checks for the seismic design can be carried out only when the design of all members under the nominal structural analysis forces has been carried out successfully, that is, when the “Check Design” status for all members is “OK”. The user has to select the menu item Design>Check Seismic to carry out the checks.

## **Automatic Design**

RC-PADD features an automatic design routine which significantly speeds up the design process. Yet, due to the complexity of the problem, this routine takes into account only a few design parameters, as described below. The user may afterwards adjust manually the missing parameters to complete the solution.

Parameters considered in the automatic design routine:

- Reinforcement diameter, spacing, ratio
- Design resistance

## **Design Report Output**

The design report may be printed or exported to a text file. The user can opt which data will be printed.