



# **Structural Analysis & Design Software**



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# Webinar

# Introduction to Time History Analysis in RFEM 6



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Presenter

CEO - USA Office



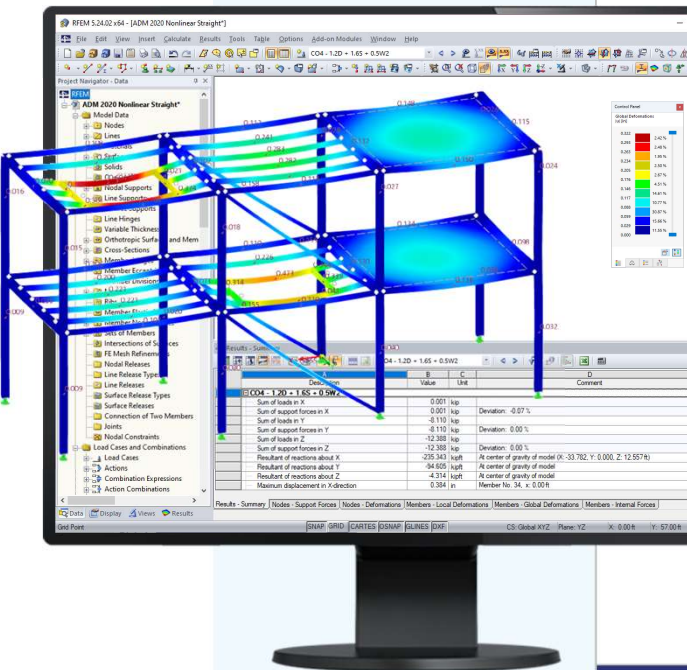
**Alex Bacon, EIT**  
Moderator

Technical Support Engineer



**Cisca Tjoa, PE**  
Moderator

Technical Support Engineer



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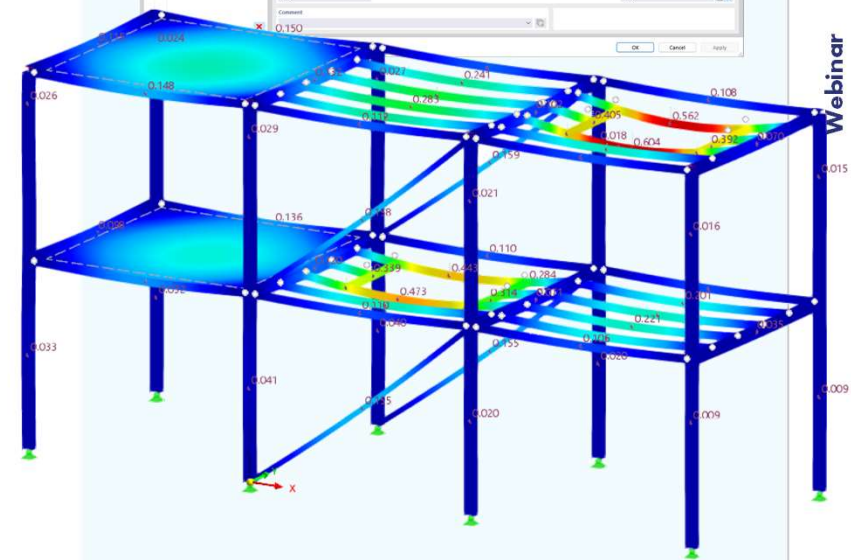
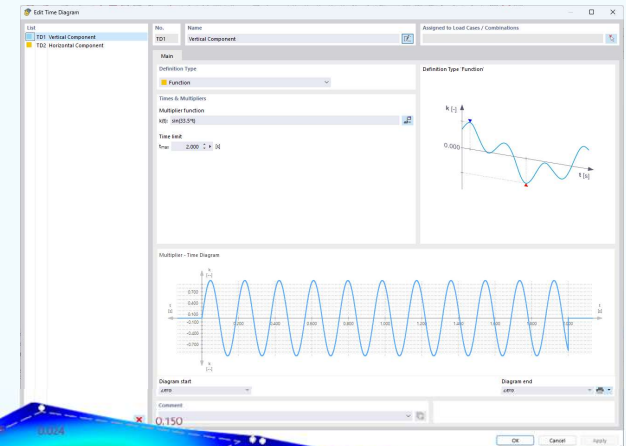


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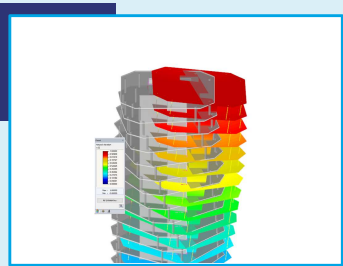


# Content

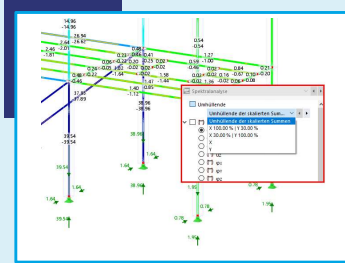
- 01 Introduction to Dynamic Analysis Add-ons in RFEM 6
- 02 Natural vibration analysis utilizing Modal Analysis Add-on
- 03 External excitation over time utilizing Time History Analysis Add-on
- 04 Example 1: Machine-induced vibration analysis
- 05 Example 2: Blast analysis



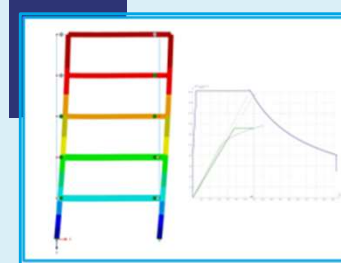
# Dynamic Analysis Add-ons for RFEM 6



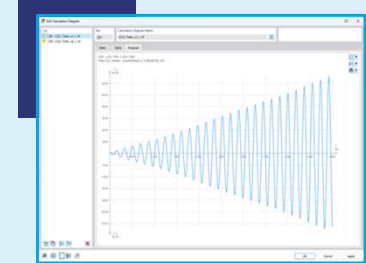
## Modal Analysis



## Response Spectrum Analysis



## Pushover Analysis

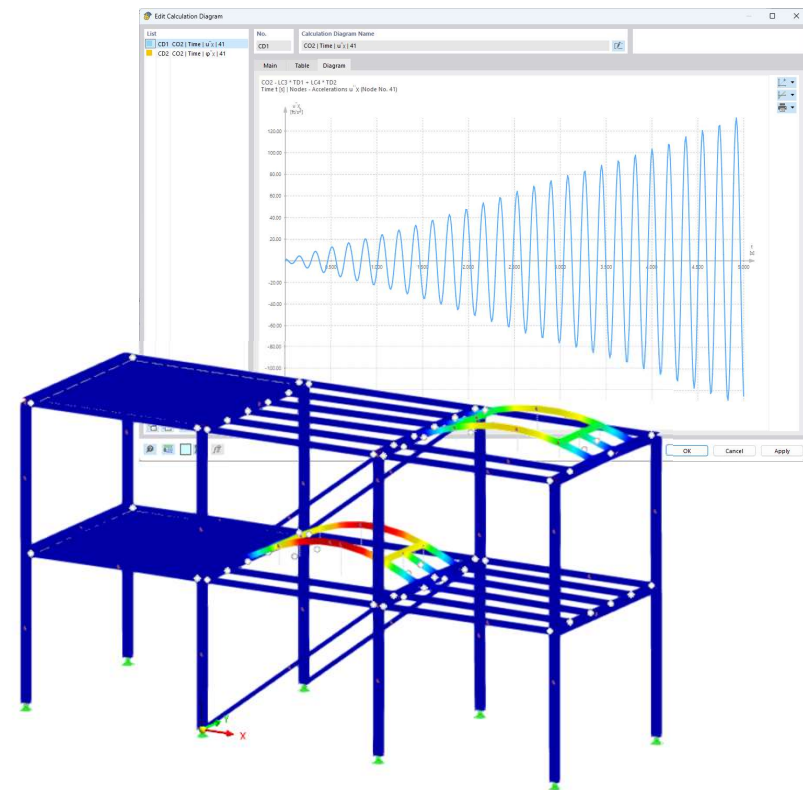


## Time History Analysis



# Time History Analysis Add-on Features

- Improved analysis integration and workflow in RFEM 6
- Combine user-defined or function time diagrams with nodal, member, surface, free and generated loads
- Combine multiple independent excitation functions
- Linear Implicit Newmark or Linear Modal solver available
- Nonlinear elements are ignored or converted to linear elements
- Consider structural damping w/ Raleigh damping coefficients or Lehr's damping value
- Graphical display of results w/ calculation diagrams
- Result display in individual time steps or as an envelope during the time period duration



# Example 1: Machine-Induced Vibrations

Two Rotating Machines at 325 rpm:

$$m_m = 2000 \text{ lbs} = 62.16 \text{ slugs}$$

$$m_r = 700 \text{ lbs} = 21.76 \text{ slugs}$$

$$e = 0.75 \text{ in}$$

Excitation Frequency:

$$f_e = \frac{325 \text{ rpm}}{60 \text{ sec}} = 5.42 \text{ Hz}$$

Angular Frequency:

$$\omega_e = 2\pi \left( \frac{325 \text{ rpm}}{60 \text{ sec}} \right) = 34.03 \text{ rad/s}$$

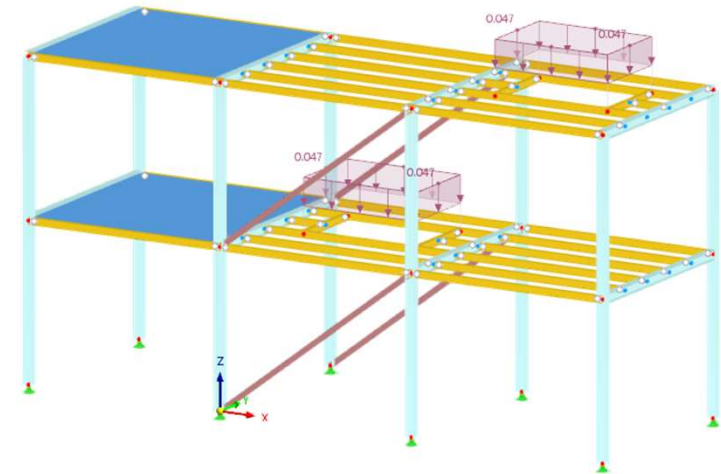
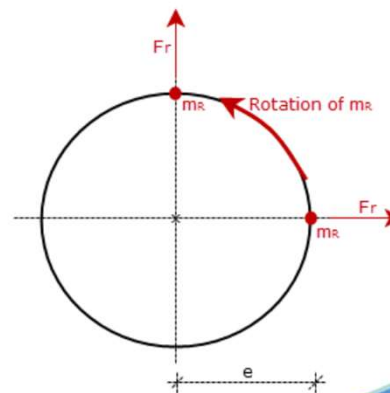
Centrifugal Force:

$$F_r = \omega_e^2 (e)(m_r) = 1.56 \text{ kip}$$

\* $\pi/2$  phase shift between  $F_{r\_vert}$  and  $F_{r\_horiz}$

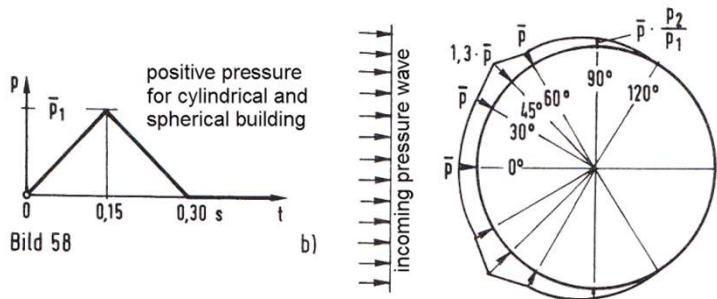
Applied Force/Length:

$$\frac{F_r}{L} = \frac{1.56 \text{ kip}}{33.6 \text{ ft}} = 0.047 \text{ kip/ft}$$



# Example 2: Blast Analysis

- Pressure wave formed by explosion
- Use of "free load - varying along perimeter"
- Triangular shaped development of load vs. time
- User-defined time diagram



© Dynamik der Baukonstruktionen by Christian Petersen

No.	r	Factor ka	Load pa
1	0.00	1.00	0.000
2	30.00	0.67	-4.700
3	60.00	1.00	-10.000
4	75.00	1.00	-13.000
5	90.00	1.00	-10.000
6	120.00	1.00	-10.000
7	150.00	1.00	-10.000
8	180.00	1.00	-13.000
9	195.00	1.00	-10.000
10	210.00	0.67	-4.700
11	240.00	0.00	0.000





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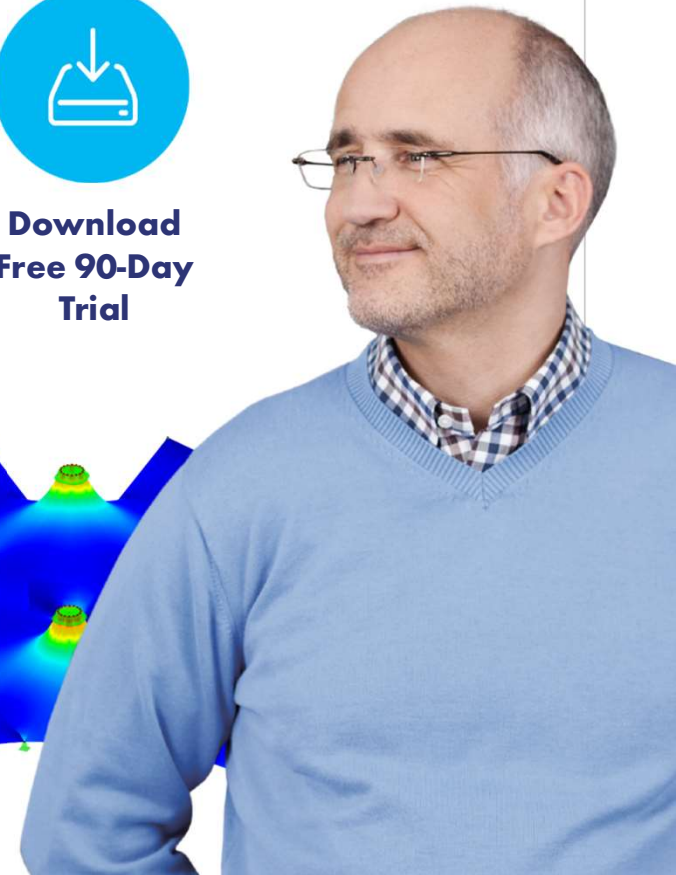
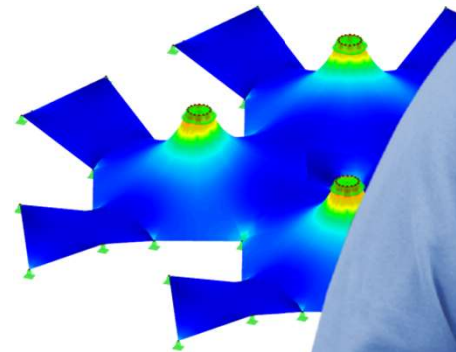
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