Working Model 2005 – Release Guide
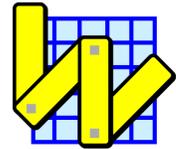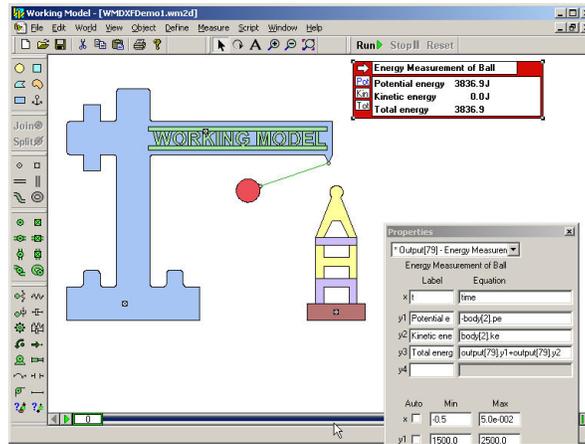
- New formula language commands (see user manual for details)

Simulation Functions	
ke()	Returns the total kinetic energy of all bodies
peuniformgravity()	Returns the total uniform gravitational potential energy of all bodies
uniformgravity()	Returns the uniform gravitational acceleration
length(id, id)	Returns the length between two points, two bodies (their centers of masses), or a point and a body (its center of mass)
lengthp(id, id)	Returns the first time derivative of the length between two points, two bodies (their centers of masses), or a point and a body (its center of mass)
lengthpp(id, id)	Returns the second time derivative of the length between two points, two bodies (their centers of masses), or a point and a body (its center of mass)
linearmomentum()	Returns the linear momentum of all the bodies in either the x or y direction
angularmomentum(id)	Returns the angular momentum of all the bodies relative to a body (id = body ID), the world (id = 0), or the system center of mass (id = 10012)
Object Functions	
body[id].restitution	Same as body[id].elasticity
body[id].cm	Same as body[id].cofm
body[id].momentum	Returns the linear momentum (.x or .y) or angular momentum (.r) of a body
body[id].pe	Returns the body's potential energy due to a uniform gravitational field
body[id].ke	Returns the body's kinetic energy
constraint[id].active	Returns whether a constraint is active, i.e., affecting the motion of its constrained bodies
constraint[id].isactivewhen	Returns the result of the condition in the constraint's "Active when" dialog
Math Functions	
dot(vectorA, vectorB)	Returns the dot product of vectorA and vectorB
cross(vectorA, vectorB)	Returns the cross product of vectorA and vectorB
angle(vectorA, vectorB)	Returns the angle between vectorA and vectorB
express(vectorA, B, C)	Given vectorA expressed in basis B, returns a vector expressed in basis C
gaussian / pulse	
ramp / ramp2	
sawtooth / sinusoid	Various *Input Curves*. See user manual for usage and description
squarewave / squarewave2	
step / step0 / step1 / step2	

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- Excel input data increased from old limit of 4080 values to computer memory limit

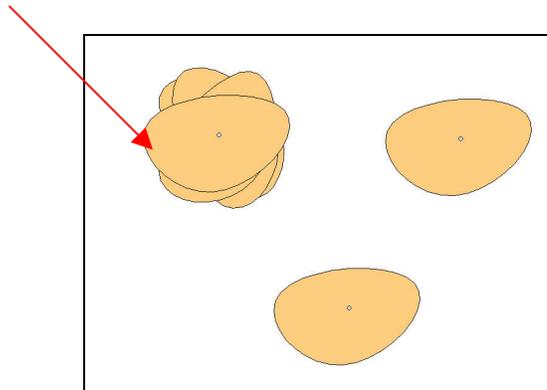|	A	B
1	Time (s)	Distance
2	0.1	0.100
3	0.2	0.199
4	0.3	0.296
5	0.4	0.389
6	0.5	0.479
7	0.6	0.565
8	0.7	0.644
9	0.8	0.717
10	0.9	0.783
11	1	0.841
12		

Distance
.199

- Updated to be compatible with DXF version 2000
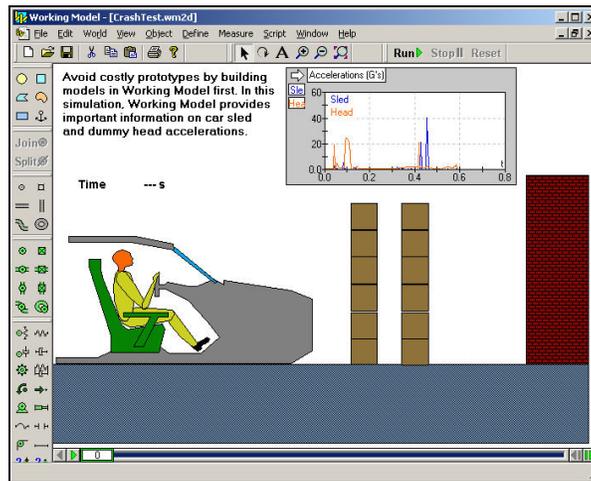
- Enables tracking of a single object (unable to track single object in WM2004)

- Updated Text objects to work properly with mouse

Welcome to the world of simulation

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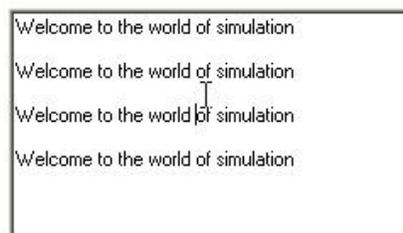
- Sliders can be placed on top of a graph without distorting graph output
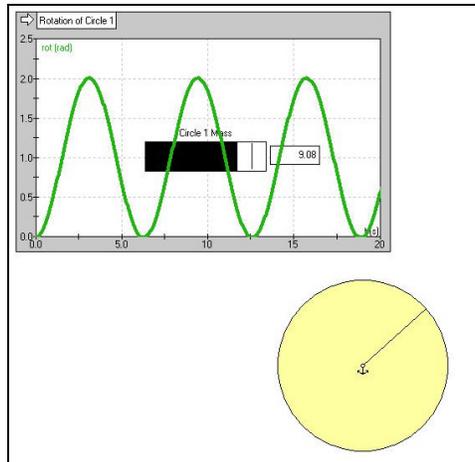

- Default animation step of **0.05 sec** and integrator error of **0.01 m** (in the Accuracy dialog box) for more accurate and predictable results by default
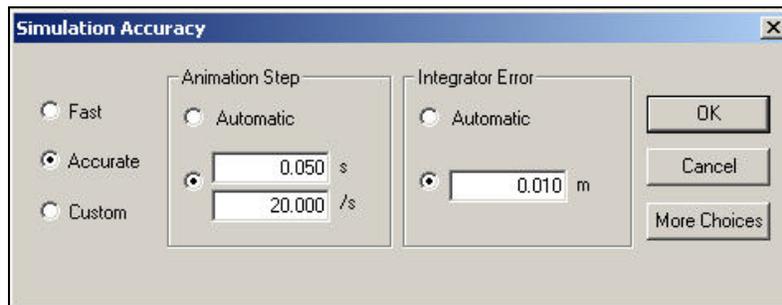
- New licensing schemes:
  - License that is node-locked to a single computer (based on computer ID)
  - License with time expiration
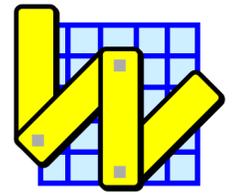 - License with limits for bodies, constraints, inputs, and outputs
  - Updated FLEXlm licensing code

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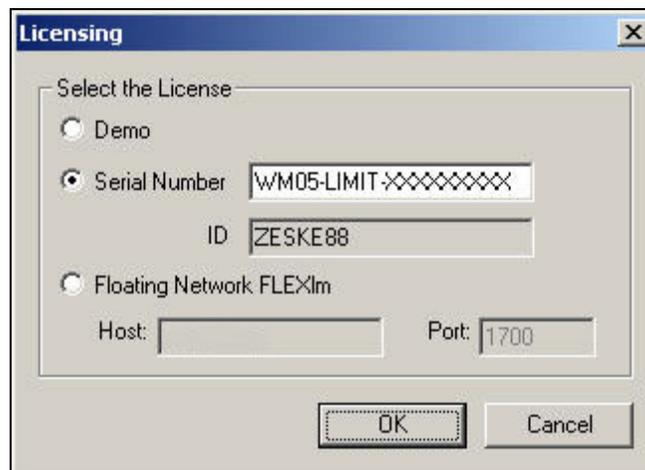
- "Educational use only" dialog box and installer license agreement for educational licenses
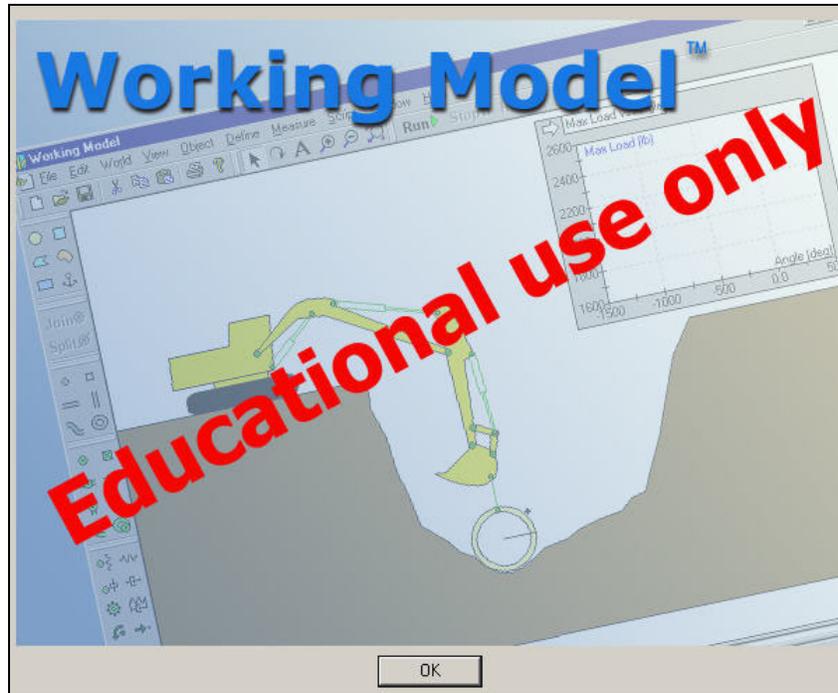
- CD-key installer message for educational single-user and homework licenses

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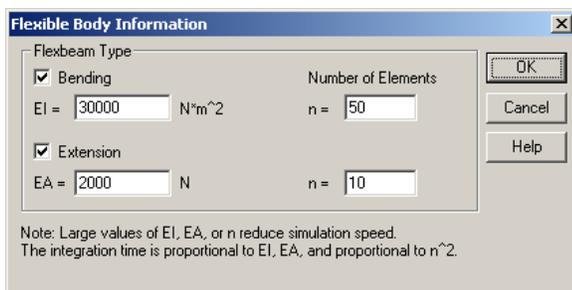# Working Model 2004 New Features[*]

Overview

1. **Improved ability to create flexible bodies (Flexbeams)**
2. **FlexLM licensing**
3. **DC Motor and DC Actuator**
4. **Generic Coord-to-Coord Constraint**
5. **Generic Point-to-Point Constraint**
6. **DXF import expanded to version 12 through version 2000**
7. **Dynamic memory allocation for objects**
8. **Tutorial guide (PDF format) now included – a $50 value**
9. **Updated user interface**
10. **Improved graphing capabilities**
11. **Instantaneous vector values can be displayed with vectors**
12. **Color of bodies linked to formula language and can change on the fly**
13. **Feel the motion and/or collision**

* Runs on Microsoft® Windows® 95/98/98SE/Me/NT®4.0/2000/XP

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1. Improved ability to create flexible bodies (Flexbeams)

Significant new features have extended the popular **Flexbeam** script:

- Create flexible beams in bending mode, extension mode, or both
- Create flexible beams from rectangles and four-sided polygons (tapered beams) in any orientation
- Automatically heal polygons before creating flexible beams
- Re-attach constraints and points attached to the original body
- Create sliders for bending and/or extension stiffness and damping
- Significantly increase the maximum number of flexible beam elements
- Improve error checking

Flexbeam input dialog box
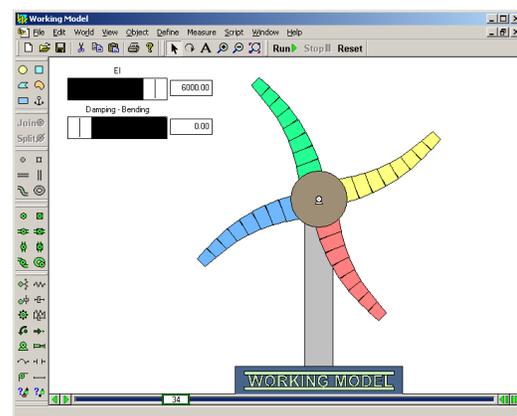
Sample Flexbeam output

2. FlexLM licensing

The flexibility of FlexLM licensing, e.g., network licensing across subnets, is added to Working Model 2004. New WM2004 license options include:

- Counted node-locked single-user license
- Multi-user license through a network server

Working Model 2004 also supports existing hardware dongle license options without additional charge. New or replacement hardware dongle license are available with additional charge. WM2004 also supports educational licensing with proof of full-time academic affiliation and use.
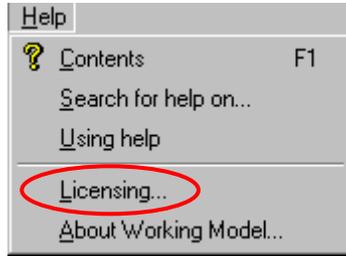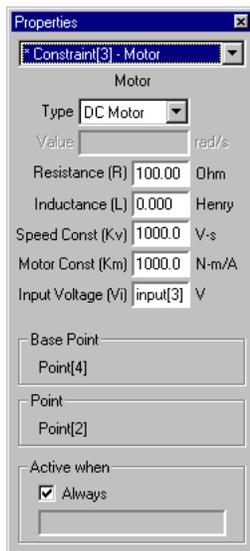

Licensing menu
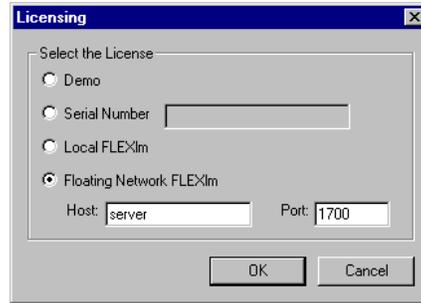
Licensing dialog box

3. DC Motor and DC Actuator

Model DC motors and DC actuators with the following input parameters:
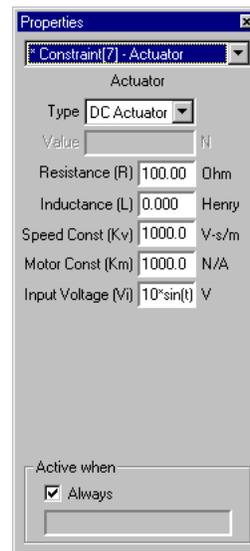
- Motor Resistance (R)
- Motor Inductance (L)
- Motor Back-EMF Speed Constant (Kv)
- Motor Force/Torque Constant (Km)
- Motor Input Voltage (Vi)
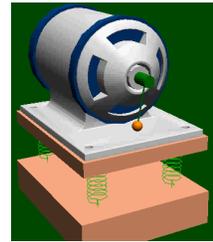
The value of these parameters can be set with a number, slider, or any Working Model formula.
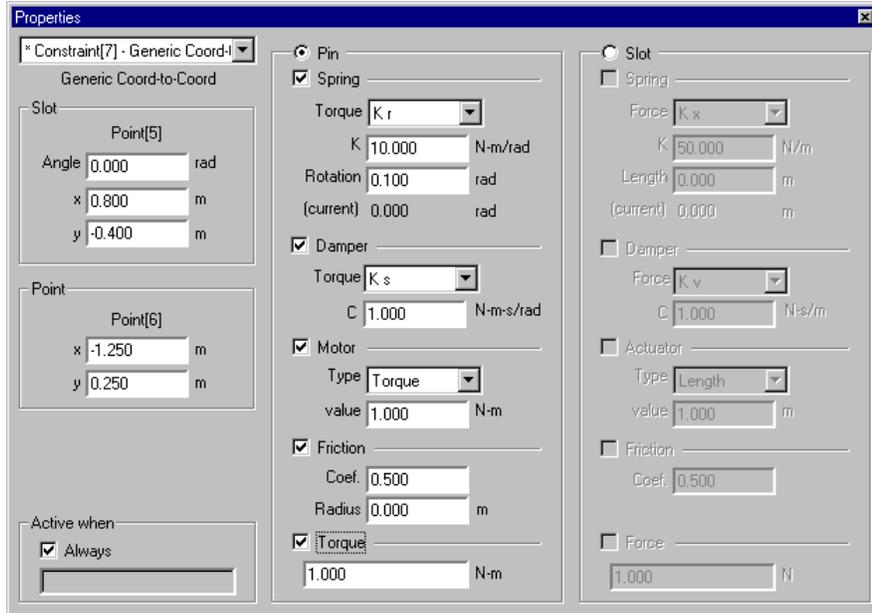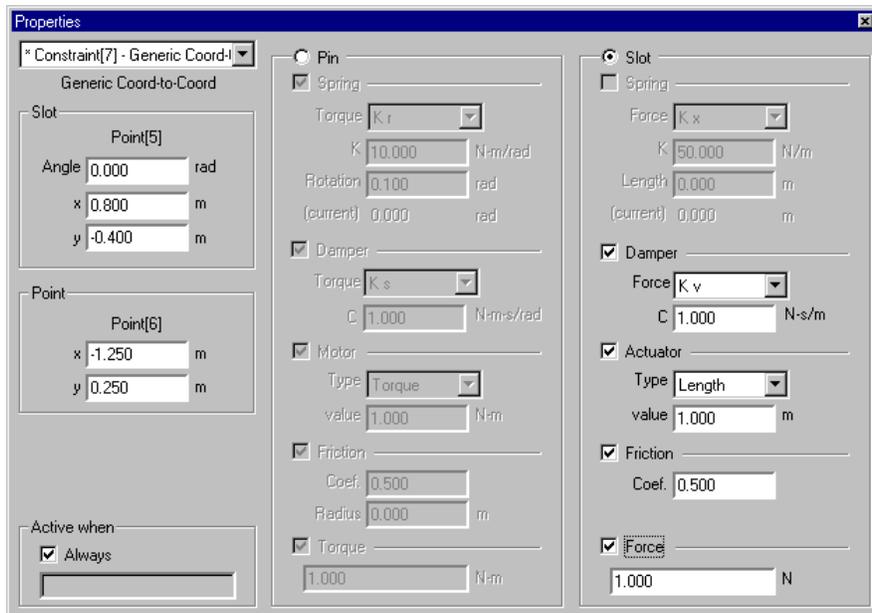

DC motor properties

DC actuator properties

4. Generic Coord-to-Coord Constraint

- The Generic Coord-to-Coord **Pin** Constraint is a powerful tool for advanced users and is useful for combining properties and measurements of various torque-producing devices, including torsional springs, torsional dampers, torque motors, rotational friction, and torques.

Generic Coord-to-Coord Properties - **Pin**

- The Generic Coord-to-Coord **Slot** Constraint is a powerful tool for advanced users and is useful for combining properties and measurements of forces along slots, including dampers, actuators, friction, and forces.

Generic Coord-to-Coord Properties - **Slot**

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5. Generic Point-to-Point Constraint

The Generic Point-to-Point Constraint is a powerful tool for advanced users and is useful for combining properties and measurements of rods, ropes, separators, springs, dampers, actuators, and forces.
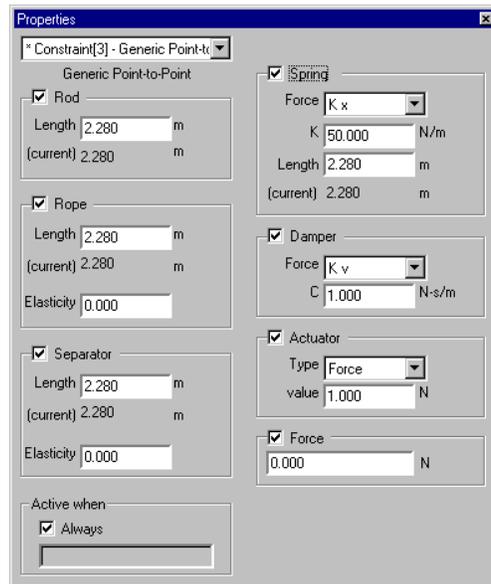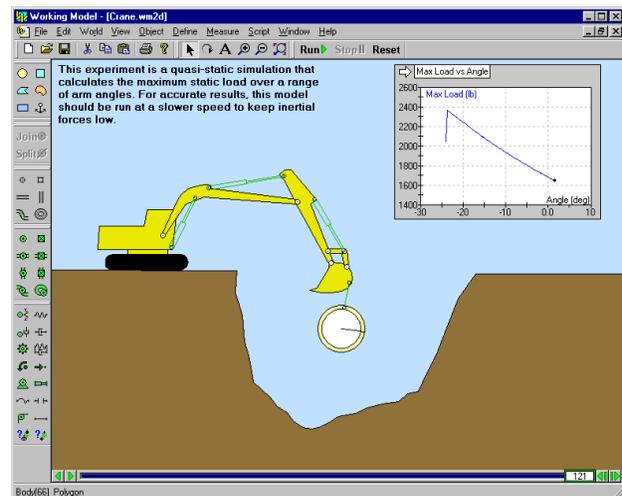

Generic Point-to-Point Properties

6. DXF import expanded to version 12 through version 2000

Updated CAD DXF import now supports DXF versions 12, 13, 14, and 2000. In addition, DXF import automates certain conversions from arcs and line segments to polygons.
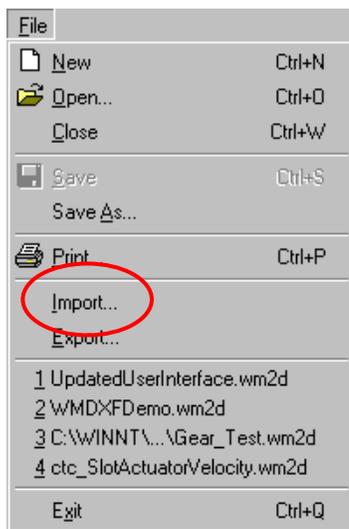
DXF Import

Sample DXF import

7. Dynamic memory allocation for objects

With dynamic memory allocation, the number of bodies, constraints, points, inputs, and output meters used in a simulation is limited only by your computer's memory.

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## 8. Tutorial guide (PDF format) now included – a $50 value

The PDF version of the tutorial guide is now included on the Working Model CD.
With nine comprehensive exercises that emphasize the fundamental tools of motion simulation technology, this tutorial guide takes the user from beginning concepts to building a functional working model. Topics include:

|		
Introductory Demonstration	Double-slotted rod	Piston Engine
Cruise Control with MATLAB	Belt-Driven Camshaft	Scripting
Making Visually Appealing Models	Earthquake Simulation	Advanced Scripting

9. Updated user interface

1. New default colors for bodies
2. New graphs and graphing options
3. Vector values can be displayed with vectors
4. New meter for feeling motion and/or collision (requires a force-feedback mouse or joystick)
5. New colors in the Run toolbar
6. New DC motor and DC actuator
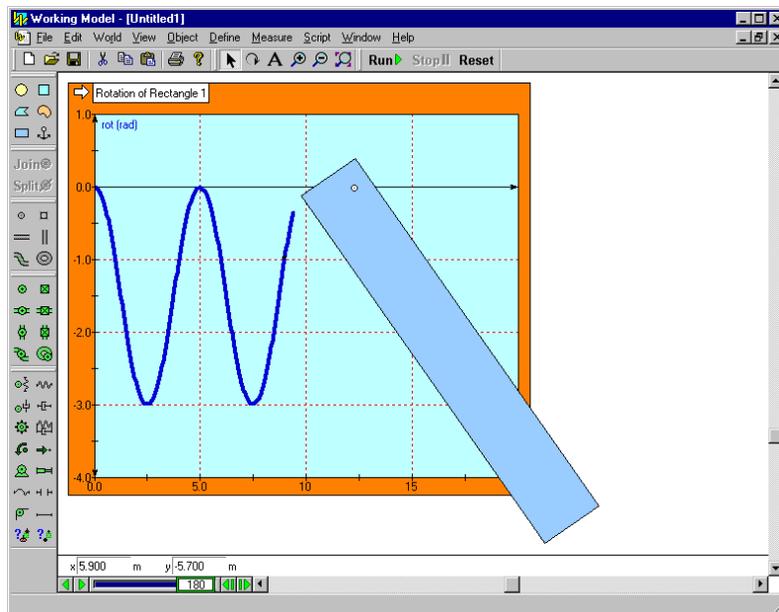7. New generic joints
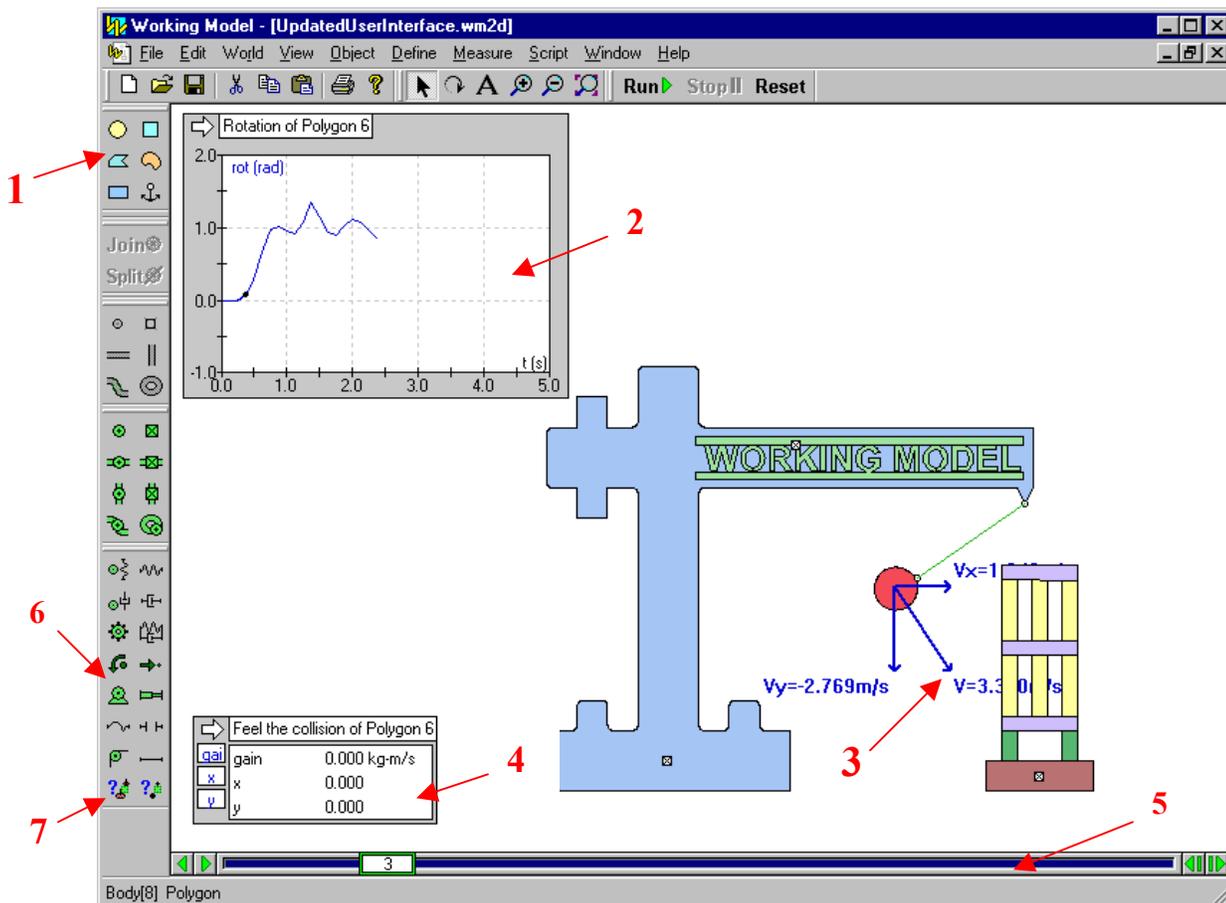
10. Improved graphing capabilities

New graphing capabilities allow you to control:

- Thickness of curves and lines
- Plot background and frame colors
- Scaling of curves and lines
- Display of **X** and/or **Y** axes, grid lines, or grid labels
- Grid line colors
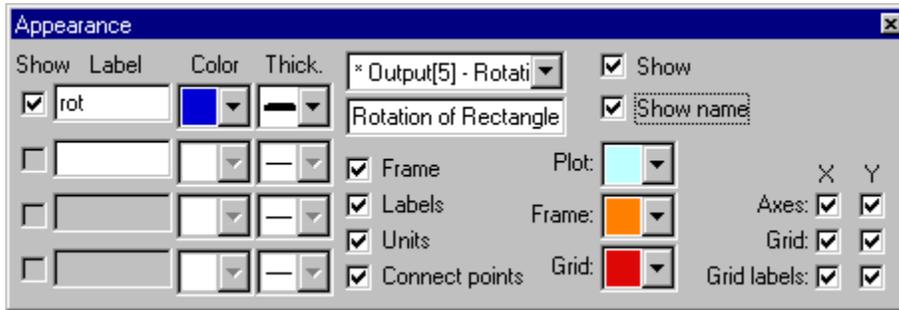

New: Appearance dialog box for graphs

Showing a body's motion in an improved graph

## 11. Instantaneous vector values can be displayed with vectors

The value of various vectors and their components can be displayed on screen. The vector values change dynamically as the simulation runs and provides excellent visual feedback on the magnitude/direction characteristics of vectors.
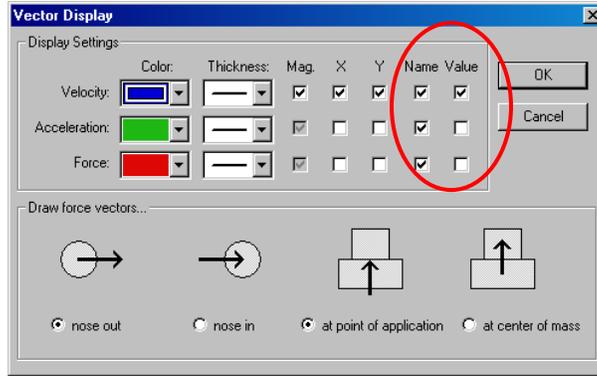

Updated Vector Display dialog box
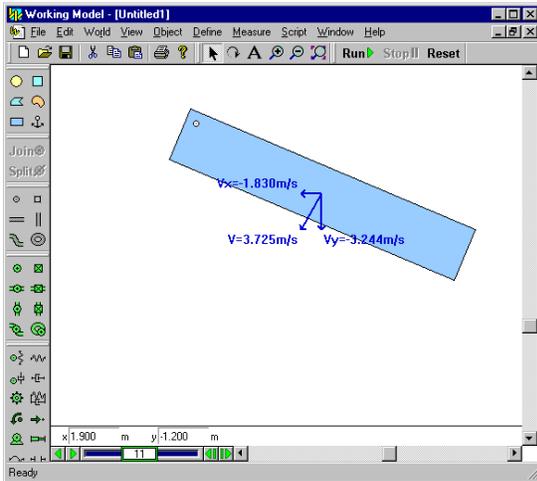

Instantaneous values shown with the vectors
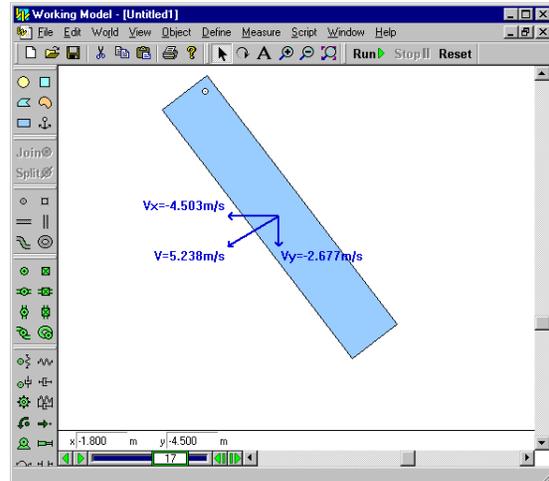
Note: Vector values change as the simulation runs

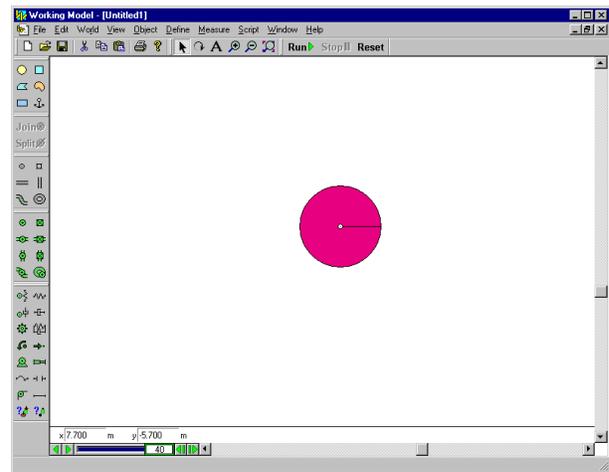## 12. Color of bodies can be linked to a formula and vary with time, velocity, force, …

Color of bodies can be controlled with the extensive Interactive Physics formula language. Enter constants, equations, conditions, etc., in the RGB components of the body color.
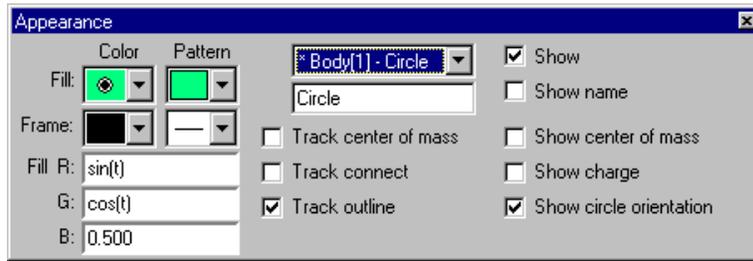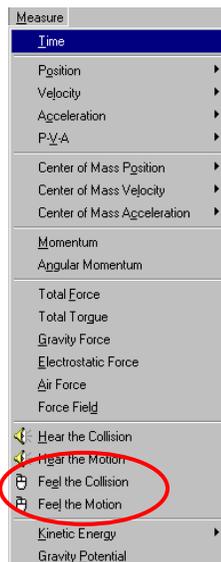

Appearance dialog box for bodies
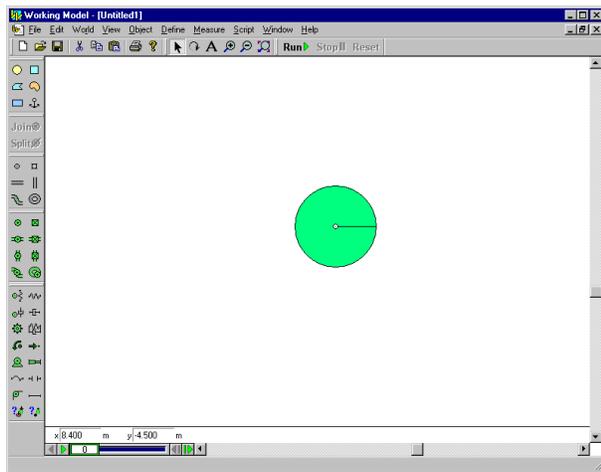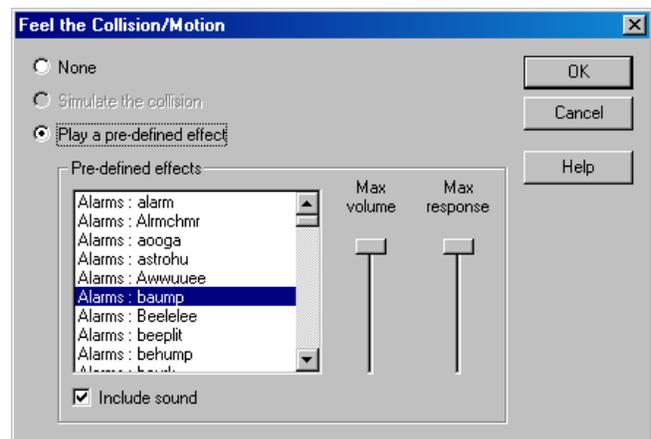

Body color at frame 0 (t= 0 s)

Body color at frame 40 (t = 2 s)

13. Feel the motion and/or collision (requires a force-feedback mouse or joystick)

Feel the motion and/or collision of bodies through a force-feedback mouse or joystick. Choose the default effect or an effect from the Immersion Studio library of mouse and sound effects.

Select Feel the Motion or Feel the collision

Choose haptics effects, volume, and response

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