

CUSTOMER SUPPORT NOTE

Model Units and Units for Some Common LUSAS Inputs

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This support note is issued as a guideline only.



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1. Introduction

When creating a new model, a system of units must be chosen. LUSAS offers a wide range of unit systems. Once selected, the unit system is used consistently throughout modelling (pre-processing) and results evaluation (post-processing). Certain unit systems may be better suited or more convenient for specific types of analysis.

Each unit system defines a set of units for force, length, mass, time, and temperature. This Technical Note provides guidance on selecting an appropriate system, summarises the units commonly used in LUSAS inputs, and explains how to use the unit converter.

2. Managing units in LUSAS

2.1 Choosing a suitable system of units

Bridge and civil engineers typically prefer forces in kN or kips, and moments in kNm or kip-ft. For such analyses, the unit sets **kN, m, t, s, °C** or **kip, ft, slug, s, °F** are appropriate.

For detailed local analyses, such as the assessment of a steel component, it may be more convenient to have stresses expressed in MPa (N/mm²) or ksi (klbf/in²). In these cases, the unit sets **N, mm, t, s, °C** or **kip, in, ksi, s, °F** are preferable.

For thermal analyses, where loading and results involve energy terms rather than structural stresses, it is usually simpler to use base SI units, such as **N, m, kg, s, °C** or **N, m, kg, s, K**. This ensures that energy is expressed conveniently in joules ($J = N \cdot m$ or $kg \cdot m^2/s^2$), power in watts ($W = J/s = N \cdot m/s = kg \cdot m^2/s^3$), and flux in $J/m^2 \cdot s$ (kg/s^3).

Many metric and US customary unit systems are available, as shown in Figure 1 (File > Model Properties... > General tab). It is also possible to select the *Units unset* option to create a custom consistent system of units. In this case, caution should be exercised when using attributes from the library.



Figure 1 – Available model units.

Timescale units, set from the relevant drop-down list in the General tab, control how time-based values appear in dialogs and are reported in results. Available timescale units include

seconds, minutes, hours, days, and increments (Table 1). For example, in a creep analysis of a concrete structure – a slow, time-dependent phenomenon – it is typically more practical to use days as the timescale unit. This makes it easier to review results over periods of several years.

Model unit of time	Always seconds. The time unit embedded in the physical definition of certain quantities (e.g., acceleration, force).
Timescale units	Seconds, minutes, hours, days, and increments. Applicable to inputs and outputs where time is the only quantity, unless otherwise stated.

Table 1 – Model unit of time and timescale units.

2.2 Units for some common LUSAS inputs

Table 2 lists the units used for some common LUSAS inputs.

Entity	Metric Units	US Units	Base SI Units (for reference)
Acceleration	m.s ⁻²	in.s ⁻²	m.s ⁻²
Area	m ²	in ²	m ²
Bulk Modulus	N.m ⁻²	ksi	kg.m ⁻¹ .s ⁻²
Convection Heat Transfer Coefficient	W.m ⁻² .K ⁻¹ or J.m ⁻² .s ⁻¹ .K ⁻¹	kslinch.s ⁻³ . °F ⁻¹	kg.s ⁻³ .K ⁻¹
Density	kg.m ⁻³	kslinch.in ⁻³	kg.m ⁻³
Displacement	m	in	m
Displacement (rotations)	rad	rad	m.m ⁻¹
Energy	J	kslinch.in ² .s ⁻²	kg.m ² .s ⁻²
First Moment of Area	m ³	in ³	m ³
Flux (Total, CL)	W or J.s ⁻¹	kslinch.in ² .s ⁻³	kg.m ² .s ⁻³
Flux (Distributed, FLD)	W.m ⁻² or J.m ⁻² .s ⁻¹	kslinch.s ⁻³	kg.s ⁻³
Force	N	kip	kg.m.s ⁻²
Length	m	in	m
Mass	kg	kslinch	kg
Moment	N.m	kip-in	kg.m ² .s ⁻²
Poisson's Ratio	[dimensionless]	[dimensionless]	[dimensionless]
Power	W or J.s ⁻¹	kslinch.in ² .s ⁻³	kg.m ² .s ⁻³
Product Moment of Area	m ⁴	in ⁴	m ⁴
Radiation Heat Transfer Coefficient ¹	W.m ⁻² .K ⁻⁴ or J.m ⁻² .s ⁻¹ .K ⁻⁴	kslinch.s ⁻³ . °F ⁻⁴	kg.s ⁻³ .K ⁻⁴
Rate of Internal Heat Generation (RIHG) ⁴	W.m ⁻³ or J.m ⁻³ .s ⁻¹	kslinch.in ⁻¹ .s ⁻³	kg.m ⁻¹ .s ⁻³
Second Moment of Area	m ⁴	in ⁴	m ⁴
Specific Heat Capacity ²	J.kg ⁻¹ .K ⁻¹	in ² .s ⁻² . °F ⁻¹	m ² .s ⁻² .K ⁻¹
Specific Heat Coefficient (Volumetric Heat Capacity) ²	J.m ⁻³ .K ⁻¹	kslinch.in ⁻¹ .s ⁻² . °F ⁻¹	kg.m ⁻¹ .s ⁻² .K ⁻¹
Spring stiffness	N.m ⁻¹	kip.in ⁻¹	kg.s ⁻²
Strain	[dimensionless]	[dimensionless]	[dimensionless]
Stress	N.m ⁻²	ksi	kg.m ⁻¹ .s ⁻²
Temperature	K	°F	K
Thermal Conductivity ³	W.m ⁻¹ .K ⁻¹ or J.m ⁻¹ .s ⁻¹ .K ⁻¹	kslinch.in.s ⁻³ . °F ⁻¹	kg.m.s ⁻³ . K ⁻¹
Thermal Expansion Coefficient	K ⁻¹	°F ⁻¹	K ⁻¹
Time	s	s	s
Torsional Constant	m ⁴	in ⁴	m ⁴
Velocity	m.s ⁻¹	in.s ⁻¹	m.s ⁻¹
Young's Modulus	N.m ⁻²	ksi	kg.m ⁻¹ .s ⁻²

Table 2 – Units for some common LUSAS inputs.

¹ **Radiation Heat Transfer Coefficient:** The radiation heat transfer coefficient required in LUSAS is equal to the emissivity of the material multiplied by the Stefan-Boltzmann constant.

² **Specific Heat Coefficient:** The Specific Heat Coefficient is defined as the Specific Heat Capacity of the material multiplied by its density. Its units are $\text{J}\cdot\text{m}^{-3}\cdot\text{K}^{-1}$. This property is also known as the Volumetric Heat Capacity.

³ **Thermal Conductivity Units in HHC Analysis:** When the HHC material uses a time unit of days, the input units for thermal conductivity are: $\text{J}\cdot\text{m}^{-1}\cdot\text{day}^{-1}\cdot\text{K}^{-1}$ (equivalently, $\text{kg}\cdot\text{m}\cdot\text{s}^{-2}\cdot\text{day}^{-1}\cdot\text{K}^{-1}$).

⁴ **RIHG Units in HHC Analysis:** When the HHC material uses a time unit of days, the input units for RIHG are: $\text{J}\cdot\text{m}^{-3}\cdot\text{day}^{-1}$ (equivalently, $\text{kg}\cdot\text{m}^{-1}\cdot\text{s}^{-2}\cdot\text{day}^{-1}$).

2.3 Units converter

The *Units Converter and Variation Utility* dialog (Figure 2) can be accessed from any dialog where dimensional input is required by clicking on the right-hand edge of an edit box or grid cell that supports such input. Units may be converted at the time of data entry using this utility. The available conversion units depend on the type of input expected, and the model units displayed correspond to those currently in use.

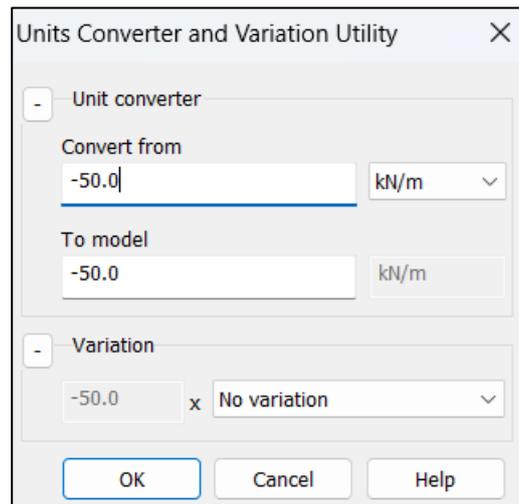


Figure 2 – Units Converter and Variation Utility dialog.

3. Summary

LUSAS offers a wide range of unit systems. Once selected, the unit system is used consistently throughout modelling (pre-processing) and results evaluation (post-processing). Key points:

- 1) Certain unit systems may be better suited or more convenient for specific types of analysis.
- 2) Units can be converted at the time of data entry through the *Units Converter and Variation Utility* dialog.

If you have any doubts or require specific advice for your type of analysis, please contact the LUSAS Technical Support team at support@lusas.com.