

# Modeling and Analysis; Performance Modeling

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## Abstract

Principles and concepts of modeling performance.

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October 3, 2016  
status: preliminary  
draft  
version: 0

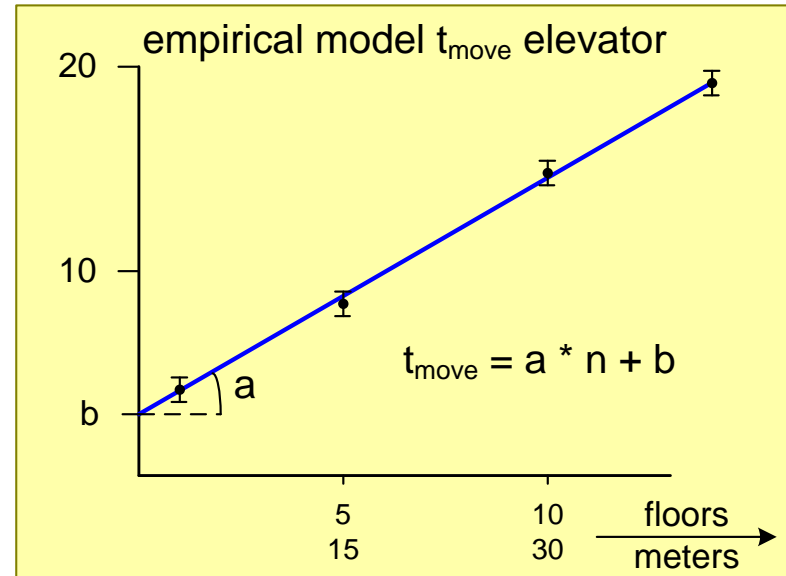
<p><b>Empirical model:</b> a model based on observations and measurements.</p> <p>An empirical model <i>describes</i> the observations.</p> <p>An empirical model provides <i>no understanding</i>.</p>	
<p><b>First principle model:</b> a model based on theoretical principles.</p> <p>A first principle model <i>explains</i> the desired property from first principles from the laws of physics.</p> <p>A first principle model <i>requires values</i> for incoming parameters to calculate results.</p>	

# Empirical versus First Principle Models

**Empirical** model: a model based on **observations** and **measurements**.

An empirical model **describes** the observations.

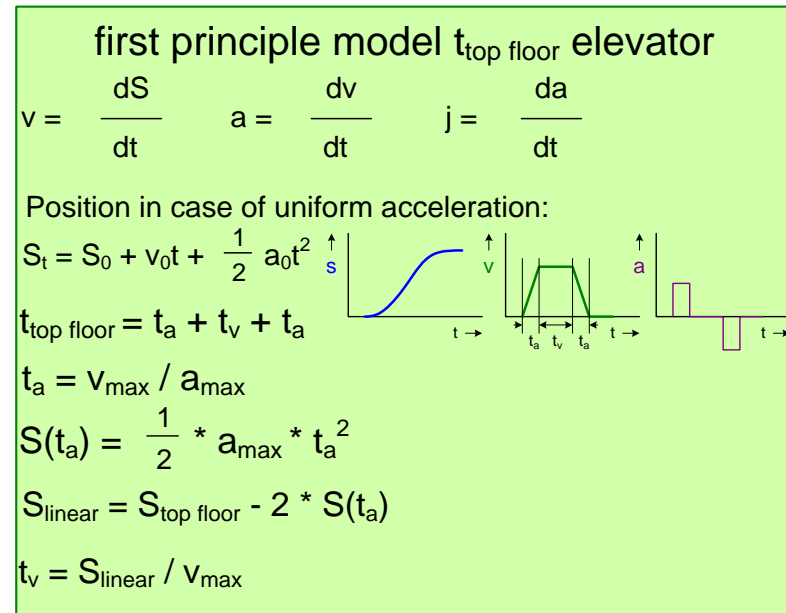
An empirical model provides **no understanding**.



**First principle** model: a model based on **theoretical** principles.

A first principle model **explains** the desired property from first principles from the **laws of physics**.

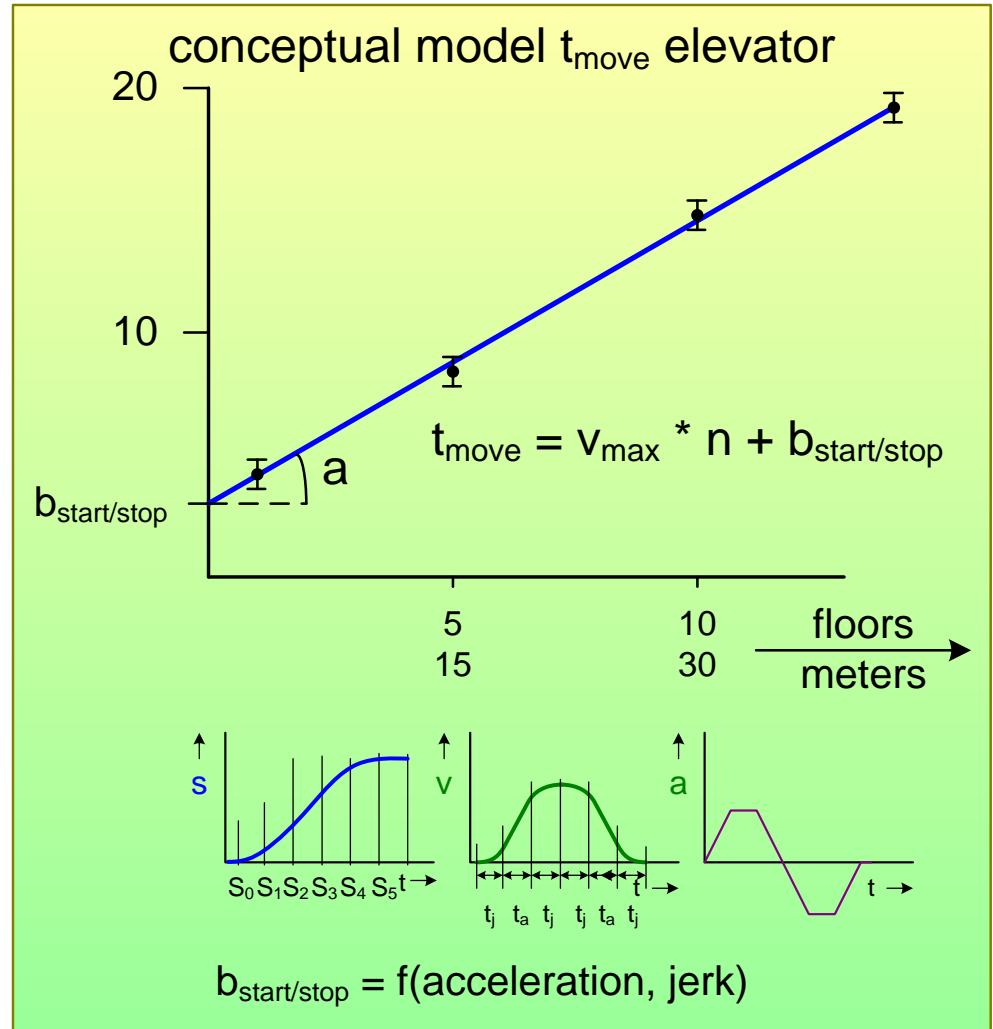
A first principle model **requires values** for **incoming parameters** to calculate results.



# Conceptual = Hybrid of Empirical and First Principle

**Conceptual** model: a model **explaining observations** and **measurements** using some **first principles**.

A conceptual model is a **hybrid** of empirical and first principle models; **simple** enough to **understand** and to **reason, realistic** enough to make **sense**.



# From Zero to Higher Order Formulas

*most simple  
order of magnitude*

0<sup>th</sup> order    main function  
                  main parameters

constant velocity  
 $t_{\text{top floor}} = S_{\text{top floor}} / v_{\text{max}}$

*improved estimation*

1<sup>st</sup> order    add most significant  
                  secondary contributions

constant acceleration  
 $t_{\text{top floor}} = S_{\text{top floor}} / v_{\text{max}}$   
 $- a_{\text{max}} * t_a^2 / v_{\text{max}} + 2 * v_{\text{max}} / a_{\text{max}}$

*more accurate, understanding*

2<sup>nd</sup> order    add next level of  
                  contributions

constant jerk  
 $t_{\text{top floor}} \sim S_{\text{top floor}} / v_{\text{max}} - a_{\text{max}} * t_a^2 / v_{\text{max}}$   
 $+ 2 * v_{\text{max}} / a_{\text{max}} + 2 * a_{\text{max}} / j_{\text{max}}$