[Technical Calculations]
Calculation of Life Span of Linear Systems 2

**Load Calculations**
Since a linear system bears the weight of the work while it performs a reciprocating linear motion, the load exerted on the system can vary depending on the work's center of gravity, thrust acting position change, and the speed changes by starting, stopping and acceleration, deceleration.

Table 2. Use Conditions and Load Calculation Formulas

<table>
<thead>
<tr>
<th>Type</th>
<th>Condition of Use and Load</th>
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</thead>
<tbody>
<tr>
<td>Vertical Axis</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>P=W 1/4X=W 1/2X=W 0,3W 1/2W</td>
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It is necessary to take these conditions into consideration when selecting a linear system.

**Mean Load Derived from Fluctuating Loads**
In general, the load acting upon a linear system can change according to how the system is used. This happens for example when the reciprocating motion is started, stopped as compared to constant speed motion, and whether or not work is present during transfer, etc. Therefore, in order to correctly design the life span under various conditions and fluctuating loads, it is necessary to obtain a mean load and apply it to the life span calculations.

(1) When load changes in steps by a travel distance (Fig. 3)
- Travel distance E1 subjected to load P1
- Travel distance E2 subjected to load P2
- Travel distance E3 subjected to load Pn

Mean load Pm can be obtained using the following formula:

\[
P_{m} = \frac{1}{E_{1} + E_{2} + E_{3} + \ldots + E_{n}} (P_{1} + P_{2} + P_{3} + \ldots + P_{n})
\]

(2) When load changes almost linearly (Fig. 4)

Mean load Pm can be approximated by the following formula:

\[
P_{m} = \frac{1}{E} (P_{m1} + P_{m2} + P_{m3} + \ldots + P_{mn})
\]

(3) When the load change resembles a sinusoidal curve as shown in Fig. 5

Mean load Pm can be approximated by the following formula:

\[
P_{m} = \frac{1}{E} (P_{m1} + P_{m2} + P_{m3} + \ldots + P_{mn})
\]

**Slide Ways**
Rated life span is the total travel distance each linear guide of the same series can endure under the same conditions, without the occurrence of flaking in 90% of the system.

Rated life span can be obtained as follows from the basic dynamic load rating and the load to the slide guide.

\[
L_{f} = \frac{C}{P} \left( \frac{C_{1}}{P} \right)^{1/2}
\]

Where:
- \(L_{f}\) : Rated Life Span(km)
- \(C\) : Basic dynamic load rating(N)
- \(P\) : Acting Load(N)
- \(C_{1}\) : Basic Static Load Rating per Roller(N)
- \(Z\) : Number of Rolling Elements

The life span hours can be calculated as a number of hours by obtaining the travel distance for a unit of time. It can be obtained using the following formula, in which stroke length and stroke cycles are assumed to be constant.

\[
L_{h} = \frac{L_{t}}{2 \pi E_{1} n}
\]

Where:
- \(L_{h}\) : Life Span Hours(h)
- \(L_{t}\) : Life Span Hours(km)
- \(E_{1}\) : Stroke Length(cm)
- \(n\) : Reciprocating Times per Minutes(minutes)

The life span for slide ways is calculated by using the following formula.

\[
L_{h} = \frac{L_{t}}{2 \pi E_{1} n}
\]