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Time an Unveiled Dimension in Engineering Practice

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ABSTRACT: Length –Breadth and Height are the basic dimensions of the object in Nature. According to some scientists and researchers time could be considered as fourth dimension; however this has not universally accepted. A confused state is there about the time. Some scholars are ready to accept is as the fourth dimension while the other side is denying it. However when we are thinking about Engineering practices, the significance of time cannot be ignored .There are various concepts in all the streams of Engineering and technology which are based on time. Especially when we are talking about derivative(i.e. rate of change of a variable with respect to time), we are using it in various fields of Engineering, eg .flow rate of water ,change in temperature of body with respect to time .The life of ball bearing is also calculated in the terms of hours. In the reliability analysis we are calculating MTBF(Mean Time Between Failures).Though these are theories are explaining the utility of time factor ,still it is an unpredictable element due to uncertainty. Just like mathematically you can calculate the life of ball bearing, but it is just a prediction in practical the life of ball bearing may not be same as the calculated figure. The failure can occur earlier or after the calculated figure. This paper is based on the significance and utility of the time in Engineering practice and its unpredictability.

KEYWORDS*:* time, relativity, time consideration in Engineering, relative time, 4th dimension

I. INTRODUCTION

Definition of time:-As per dictionary meaning ‘time’ is the thing that can be measured in seconds –minutes –hours –days-years. But time is the relative concept, though the unit is same it can differ from application to application, which can elaborated by following examples.

a) Life span of human or any other animal is considered as time

b) It is said that “it will take just 2 hours” while explaining the travelling time from one location to another location

c) When we are saying in forecasting of weather “Weather will remain dry for next 48 hours”. Here we express prediction about future.

d) Fixed interval of time is always refereed for activities and events.

e) “Light from sun reaches Earth in 8 minutes.

These are the few examples , where the concept is utilized in different ways to express information regarding activities, events etc. time. Now we will see something regarding the basic dimensions of the object.

II. BASIC DIMENSIONS IN UNIVERSE

Any physical object in the universe can be described by its Length-Width and Height .If you are having these three dimensions then you can decide the outer form or **“shape”** of the object. There is specific definition of 1meter.And it is uniform or standardized .Similarly there is also specific definitions of 1second-1 minute .But example stated earlier, time can be described in different aspects. This flexibility not applicable for the measurement of length. Now we will see the relationship of these basic dimensions with time by taking a simple example. Let us take the Animals having different shapes(Obviously the 3 dimensions Length-Breadth-Height are different for different Animals.)

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Animal/Worm	Average life span(Approximate)
Micro organisms	May be from few seconds to Infinite years
Amoeba	1-2 Days
Ant	2-3 Years
Mouse	3-4 Years
Cat	12-15 Years
Dog	9-10 Years
Cow	22 Years
Donkey	45 Years
Tiger	22Years
Human	70-80 Years
Tortoise	200-300 Years

Talble.1

From the table you can conclude that the life span or time is different for the animals having different shapes (different length-different width and different height.)some one can say that as the **"Shape/Size of the animals increases, lifespan also increases "** .But it is partially true .Because the microorganisms are very very small in shape but they can be Immortal .Mathematically we can say that

$T \propto f(L,B,H)$

Hence $T=K * f(L,B,H,)$ where

L=Length of Animal

B=Breadth of Animal

H=Height of Animal

K= constant of proportionality

But we are not able to determine the exact equation of function and hence we cannot find out the value of K .Hence this statement is incomplete. Instead of that we can say **"for different shape/size, lifespan is different" .**Now take the case of some Engineering Materials

Material/Object	Life span
Life of Big wooden box(Depends on the type of wood)	Less
Life of medium size Aluminium Box	More than that of Wooden box
Life of small Cast – Iron box	More than that of first two

Talble.2

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In case of Materials the life span can not be decided by the outer shape(i.e.by outer dimensions Length-Breadth-Height),but we have to consider the properties of the materials like strength-stiffness-hardness. And these properties depends on the molecular structure of the material. The materials like plastics, Uranium have the maximum or indefinite life span. So in case of material we can make a generalize statement **"The molecular shape decides the life span of that particular Material" .**How ever in both the cases the uncertainty of time is there. A man can die at the age of 40 years as well as he can live for100 years. And the wooden box can sustain for 2 days and also it can sustain for 15 years .How ever in case of Material there may be different concepts

1)Life of the Material

2)Life of the object which is made by using particular Material.

However in case of Animal there is also a difference

1)Life of each part of body

2)Life of Entire body

3)Life of body-cells

Hence it can be concluded that time is the relative concept. And that is the difference between other dimensions and time.

III.TIME IN PHYSICS AND ENGINEERING

The great scientist Ernestine has discovered the concept of Relative time .Ernestine's equation of relative time is as follows

$$\Delta t' = \frac{\Delta t}{\sqrt{1-\frac{v^2}{c^2}}}$$

Where

$\Delta t'$ = Time interval between same events measured by different observes

Δt =Time interval between co local events

v is the relative velocity between the observer and the moving clock

c=velocity of light. It was the first effort inn modern science to describe the concept relative time.

In Engineering practice, there are another two basic concepts which are related to time. They are velocity and acceleration

$v=\frac{dx}{dt}$

Where v is velocity, and x is distance travelled, t is time. The definition of velocity is rate of change distance with respect to time. The acceleration is defined as rate of change of velocity with respect to time .And the equation for acceleration is given by following formula.

$a=\frac{dv}{dt}$

Where a is the acceleration. However in the both concepts the 'time' is relative concept i.e. for 1st hour distance covered is 10 km.,in next one hour the distance travelled is 18 Km.etc.

Another important concept, which is related to time is an Exponential decay or half life decay. Using the equation of half life decay we can calculate the time required for the decaying quantity to fall to one half of its initial value. The equation for half life decay is,

$t_{1/2} = \frac{in(2)}{\gamma}$

Where

γ=decay rate

The application of this equation is particularly in the field of nuclear energy to calculate half life period of radioactive elements. In general practice we are not using this equation to calculate the life of particular object i.e. say life of gear-life of chair. And there may be difference in calculated value and actual value. Hence we can not say about any exact life span in that case.

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However in Mechanical Engineering, precisely in Design Engineering there are two concepts infinite life and finite life. In case of ball bearings there is the exact mathematical formula to calculate the life of ball bearing.

$L_{10}=(C_r/P_r)^3$ Where,
L_{10}=Basic life rating in Million revolutions
C_r= Basic dynamic load rating
P_r=Equivalent dynamic load factor
However we can calculate the life of bearing in hours also ,i.e. in the terms of time.
L_{10}(in hours)$=(10^6/60*n)*(C_r/P_r)^3$ Where n is the rotational speed per minute.
This equation tells us the exact life span of ball bearing .Design Engineering gives the better approach to calculate the time by emphasizing on the theories of fatigue failure and and stress strain approaches. Fatigue failure is defined as the tendency of Material to fracture by means of progressive brittle cracking under repeated alternating or cyclic stresses of intensity considerably below the normal strength. Using the S-N curve (Stress amplitude v/s Number of cycles) analysis you can predict about the life of component in terms of no of cycles. But you cannot predict about the exact life span. Because it depends on the use and application of that particular component. Just take a simple example . Suppose 'A' and 'B' are using the same Bearing and the life of bearing is say 10000 Hrs. Now 'A' is using the bearing for 8Hrs./Day and for 25 Days in a Month. Then the life of the bearing will be 5 Years. But 'B' is using the bearing for 10 Hrs/day and for 30 Days in a Month. Then the life of bearing will be approximately 3.5 Years. Hence the exact life span of gear cannot be calculated. In Manufacturing Engineering there is the equation to calculate the life of cutting tool. It is well-known as Taylor's equation,
$VT^n=C$ Where
V=Cutting speed
T=Tool life
C=Constant (depends on the material)
Using this equation we can calculate the tool life. But in this case also the failure time is also unpredictable. Because it depends on the user. In Control Engineering there are types of responses such steady state response-transient response. In which the input variable is given in the terms of time and the output response is plotted according to the input. The figure shows the graph of system. The portion of the graph where there is variation in time is called as transient response and the portion of graph where the output remains constant with respect to time is called as steady state response.

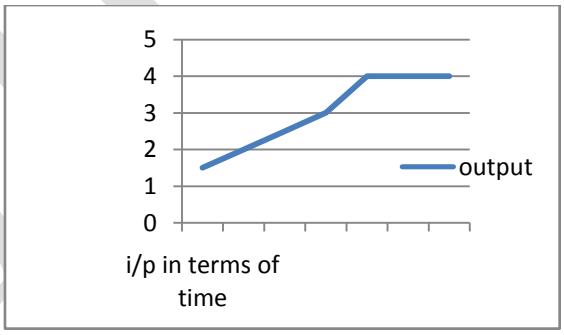

Chart No.1

The time factor is also considered in the theory of Dimensional analysis, which has an application in Fluid mechanics and Control Engineering. So this is review regarding time and how it is utilized in Engineering practices. We have seen

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various theories in basic science regarding time. Along with that we have also seen the application of time in various fields of Engineering. After the study we have concluded the following things.

IV. CONCLUSION

1) Time is an unpredictable dimension.
2) In Engineering practice, we can predict about life of gears, shafts, bearings and the IC's .But we cannot predict about exact time of failure.
3) Some Engineering materials have infinite life, or they are immortal. But the objects made by that Materials may not have infinite life.
4) It can be said that the life of Material depends on the Molecular structure up to certain extent. Hence in future it is possible to produce the immortal Materials.
5) You can predict about creation time of any object. But its very difficult to predict about the failure moment of an object.
6) Evaluation of time will help to develop Advanced Engineering Techniques in future.

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