Pressure and Stress in Workplace with Reference To Mathematics

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Abstract

In this paper force, pressure, stress and deformation are explained mathematically. Then stress and pressure in our workplace are studied. Finally we research the facts how to deal with them.

Key ward: Force, Pressure, Stress and Strain.

Indroduction

When stress persists, it can take a toll on your health and well-being. A stressful work environment can contribute to problems.

Definition of Pressure

Pressure depends on how much force is exerted. Pressure is directly proportional to force. However, pressure is not the same thing as force. Pressure also depends on the area over which the force is applied.
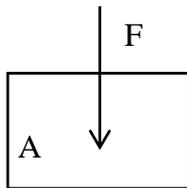

Figure 1　Force on Surface

Mathematically $\quad P = \dfrac{F}{A}$

Where　A is area of the surface on contact.
　　　　F is normal force, P is pressure.

Difference between force and pressure

When a force is exerted on an object, pressure is also exerted on the object. But force and pressure are not the same thing.

Suppose we are going to exert a force of 5 Newton on our partner and suppose our partner has the following two choices;

(i) A 5 Newton force exerted with the point end of a pin.

(ii) A 5 Newton force exerted with flat side of a mathematical book.

What will you pick?

Figure 2　Forces depend on area

Both the pin and the book will exert the same force. You will get the same acceleration from either force. Although both pin and the book exert the same force they exert very different pressure.

Pressure depends on the amount of force and area over which the force is applied.

More force, more pressure, and more area less pressure.

So, the force exerted with the pin will hurt a lot, the force exerted with the book won't.

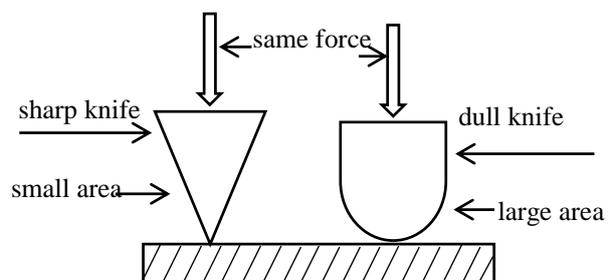**A sharp knife cut better than a dull knife**

Figure 3　Same forces

The sharp knife has a very small area of contact with the surface. The dull knife has a much larger area of contact. If both knives are pushed down with the same force, the sharp knife will exert a much greater

pressure on the surface than the dull knife and pressure cuts.

Example(1)

Figure 4 Pressure on floor

Let 60 kg girl wearing high heel shoes balance on a single heel. The heel is circular with a diameter of 1.5cm. We can find the pressure exerted by the heel on the horizontal floor.

$$\text{mass} \ = \ m \ = 60 \text{kg}$$

$$\text{Radius} = \ r \ = \ \frac{1.5}{2} \times 10^{-2} \text{m}$$

$$\text{Force} \ = \ F \ = \ \ mg \ = 60 \text{ x } 9.8$$

$$\text{Area} \ \ = \ A \ = \ \pi r^2 \ = \pi \times \left(\frac{1.5}{2} \times 10^{-2} \right)^2$$

$$\text{Pressure} = l = \frac{F}{A} \ = \ \frac{60 \times 9.8}{3.142 \times (0.75 \times 10^{-2})^2}$$

$$= \ 3.32 \times 10^6 \ \text{Nm}^{-2}$$

So to create a large amount of pressure, you can either exert a large force or exert a force over a small area (or do both).

Definition(1)

Naturally pressure can cause stress inside an object. Stress represent intensity of internal resisting forces develop at a point.

The mathematical definition of stress is defined as the force exerted per unit area.

$$\text{stress} \ = \ \sigma \ = \ \frac{F}{A} = \frac{Force}{Area}$$

Difference between stress and pressure

Pressure represent intensity of external forces acting at a point.

Stress represent intensity of resisting forces develop at a point.

Pressure is a cause, stress is an effect.

Strain (deformation)

When a material is loaded with a force, it produces a stress which then causes a material to deform.

The amount of deformation is strain.

Mathematically, strain $= \dfrac{extension}{original \ length}$

Example(2)

A metal wire is 2.5 mm diameter and 2m long. A force of 12N is applied to it and it stretches 0.3mm.

We can determine stress and strain in the wire.

$$\text{Area A} \ = \ \pi r^2 \ = \ 3.142 \times \frac{25}{16}$$

$$= \ 4.909 \ \text{mm}$$

$$\text{Stress} \ \ = \frac{F}{A} = \frac{12}{4.909}$$

$$\text{Strain} \ \ = \ \frac{X}{L} = \frac{6.3}{2000} = 0.00015$$

deformation per unit length.

More Force, More Pressure, More Stress and Stain.

More Area, Less Pressure, Less Stress and Strain.

Pressure and stress in our work place

In our daily life, we often experiences pressure and stress, where at home, at school, at our work place etc.

❖ Work plays an important role in the lives of most people.
❖ In our workplace all fine and well but sometimes do go wrong.
❖ Because there are limits to what people are capable of handling and those limits differ from one person to the other.
❖ When an employee is unable to meet the demands of work within the time available, work pressure problem arises that can lead to work stress.
❖ Pressure is the amount of demands on us increases beyond our ability to cope.
❖ Work stress can eventually cause the employee to feel excessively tired and exhausted.
❖ Where as stress is to feel over stretched and we feel the strain of deformation.

The signs of deformation are

1. Headaches
2. Upset stomach
3. Anger
4. Depression
5. High blood pressure
6. Heart disease
7. Dry mouth
8. Chest Pain
9. Memory problems
10. Lack of concentration or focus
11.

Some cause and effects of stress in our workplace are

- ❖ heavy workload
- ❖ Unpleasant work environment
- ❖ Longer workhour
- ❖ The demands of the job exceed the capabilities
- ❖ uncomfortable workplace
- ❖ Relationship with colleagues
- ❖ Boring and mundane work

Whatever the root of causes stress workers, tends to fatigued, prone to mistakes and injuries. Workers who are stressed today can be disabled tomorrow.

Having your employees suffering from work stress can result in lower productivity.

Dealing pressure and stress in our workplace

- ❖ Many people cope with stress in ways only compound Problems by drinking too much.
- ❖ Without smart habits for dealing, that could be stressful life.

I would like to shear some habits that help you to reduce your work stress.
- ❖ Quickly recognize and reduce stress in any situation.
- ❖ One thing at a time.
- ❖ Write everything down.
- ❖ Don't make mountain out of mole hills.
- ❖ Before you go to sleep set a side relaxation time such as mediation (Yoga)
- ❖ Balance fully focused work with complete rest 45 min work, 15 min break.
- ❖ Disconnected over the weekend.
- ❖ Do that by staying away from work.
- ❖ Make sure you take time to do what you love (shopping, go to cinema).
- ❖ Keep a very simple work place.
- ❖ Let your lunch be a slow time of relaxing.
- ❖ spend your time with happy people.
- ❖ Find reasons to laugh and feel grateful even when going through difficulties.
- ❖ Repair wound feelings and damaged relationship.
- ❖ Exercises daily and maintain your health.

Besides a leader sets clear goals for his employees and encourages mindfulness of his team. He should offer a flexible work environment and workplace recognition. He should maintain open communication. He should let negatively anger or stress rub off on his employees. He should ensure his employees then feelings of stress and pressure are reduced.

Employees spend a lot of time with their co-workers and the most people enjoy their time at work. The more comfortable workplace they are the less stress out. If people enjoy spending time with co-working they will be less stressed at work.

A better workplace leads to increased productivity, collaboration and improve workplace morale and we

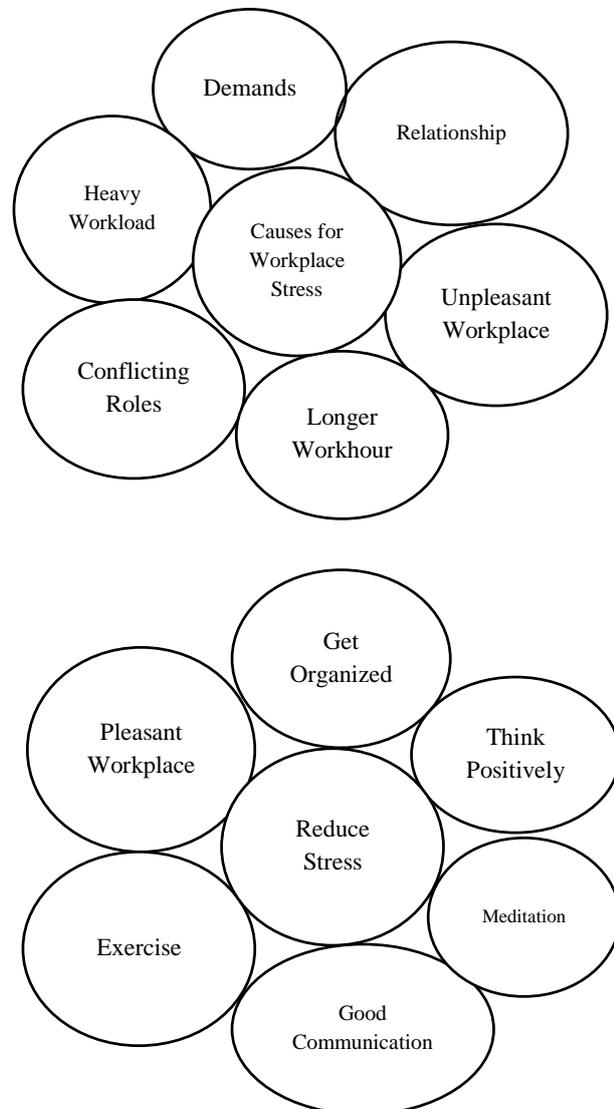can be a healthier, happier and more stronger in our workplace.

Figure 5 Diagram for happier workplace

Conclusion

$$\text{Stress} \quad = \quad \frac{Force}{Area}$$

$$\underset{\text{(relieve work stress)}}{\text{Stress}} = \frac{\text{Reduced force (by helping your employees)}}{\text{More area (by Co.working (or) team together)}}$$

A better workplace leads to increased productivity, collaboration and improve workplace morale and we can be a healthier, happier and more stronger in our workplace.

Acknowledgements

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