Development of system for analysis of Concrete structure failure

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***Abstract**:* Concrete is the one of the most important material in civil engineering construction. A concrete is the homogeneous material made up of cement sand and aggregate. These ingredient of concrete gives better rigidity to the body of concrete. Due to better rigidity concrete strong in compression but weak in tension. When this concrete exposed to excessive loading it undergoes deformation which result in formation of cracks on the surface of concrete and also the excessive stresses and strains are developed. These parameter are responsible for failure of concrete structure. So its necessity to determine the deformation, stresses and strains. To determine the concrete structure failure parameter we develop the electronic system.

Using stain gauge sensors in the system we can determine the stress, strain and deformation developed on the concrete structure

***IndexTerms* - deformation, stress, strain, tension, concrete**

I. INTRODUCTION

There are different parameters affect on the concrete structure such as stress, strain and deformation. Stress is defined as the deforming force per unit area of the object. There are different types of stresses such as Types of stresses:

a) Tensile stress: - when the forces try to increase the length of material the stress is called tensile stress.
b) Compressive stress: - when the forces try to compress a material the stress is called compressive stress.
c) Shear Stress:-the stresses which act parallel or tangential to the plane under consideration.

Strain is defined as the amount of relative deformation caused by a force acting on an object. There are different type of strain such as

Types of strain

1. Tensile strain or Longitudinal strain: It is defined as the ratio of increase in length to the original length
2. Shear Strain: It is defined as the change in shape to the original shape.

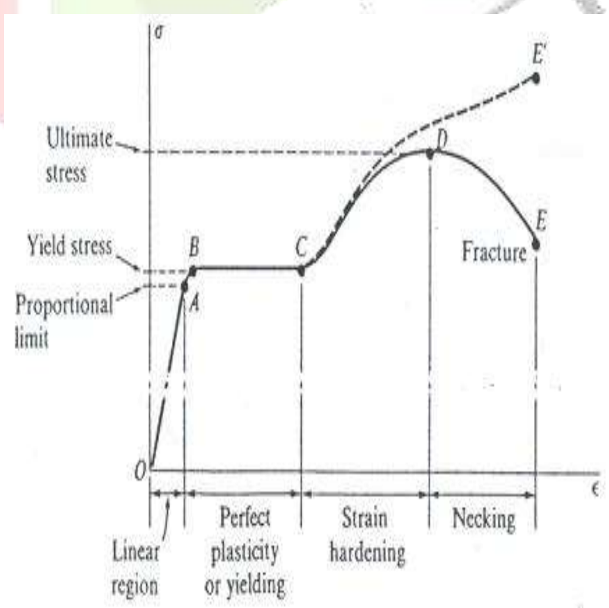

Figure: Stress Strain Diagram

1.1 Elastic behaviour

1. The curve is straight line trough out most of the region
2. Stress is proportional with strain
3. Material to be linearly elastic

1.2 Proportional limit

1. The upper limit to linear line
2. The material still respond elastically
3. The curve tend to bend and flatten out

1.3 Elastic limit:

1. Upon reaching this point, if load is remove, the specimen still return to original shape

1.4 Yielding

1. A Slight increase in stress above the elastic limit will result in breakdown of the material and cause it to deform permanently. This behaviour is called yielding
2. The stress that cause = Yield Stress at Yield Point
3. Plastic deformation Once yield point is reached, the specimen will elongate (Strain) without any increase in load Material in this state = perfectly plastic

1.5 Strain Harding

1. When yielding has ended, further load applied, resulting in a curve that rises continuously Become flat when reached

1.6 Ultimate Stress

1. The rise in the curve = Strain Hardening
2. While specimen is elongating, its cross sectional will decrease The decrease is fairly uniform

1.7 Necking

1. At the ultimate stress, the cross sectional area begins its localized region of specimen it is caused by slip planes formed within material Actual strain produced by shear strain As a result, “neck” tend to form Smaller area can only carry lesser load, hence curve downward Specimen break at Fracture Stress.

In this system we are using the strain gauge sensor which is very useful to calculate the different parameters affecting on the concrete structure. The parameters are given as follows

a) To determine the deformation of the concrete structural member.
b) To determine the strain developed in the concrete structural member.
c) To determine the stress developed in the concrete structural member.

II. Relative Study Of Existing Methods

Electronic speckle pattern interferometry [ESPI] is flexible and efficient tool for characterization of material properties of complex materials [1].

An image correlation technique can deal with complicated strain fields in structures or structural materials [4]. The ESPI technique is also enables contour measurement function .The inspection of components under load and for direct comparison of measured contour and strain data with FEA stimulation. For analysis of large deformation, 3D image correlation technique was developed. In this technique 2 camera observe the object under the investigation and calculate the 3D surface of component using photogrammetric algorithm. The correlation of images taken at different load levels leads to complete information about the deformation and strains on each point of the surface.

Optical fibers are transparent fibers, usually made of glass or plastic, for transmitting light. They are also useful in medical procedure, automobile and aircraft. The optical fibers can be used as sensors to measure strain, temperature, pressure and other parameters. Fiber optic sensors are classified in to two type

1. Intension-metric sensor relies on variation the radiant transmitted through optical fibre.
2. Interofero-metric sensor relies on measured induced phase change in light propagating through an optical fiber.

The optical fibers are embedded in various kinds of structure such as buildings, road, damsand other concrete or steel structures. It has different applications such as application to stress sensor, application to strain sensor, application to crack monitoring, applications to cable and FRP monitoring [2].

Strain, stress and deformation are the measure factors which affects on the concrete structure .Strain and Displacement measurement during elastic and plastic deformation using metamaterial based wireless and passive sensor [3].

Wireless measurement of the elastic and plastic deformation of a rebar, providing beneficial information for remote structural health monitoring and post-earthquake damage assessment. Metamaterial sensors has some disadvantages such as

a) It only works for limited range of wavelength.
b) Tiny structure fabricated with high precision.
c) For given functionality, you can’t change the shape of metamaterial during operation

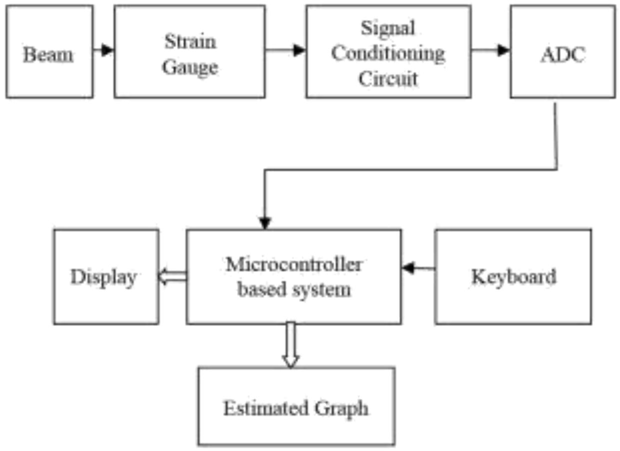

Figure: Proposed system

a. ***Beam***: A beam is a structural element that is capable of withstanding load primarily by resisting against bending.
b. ***Strain gauge***: It is a device used to measure strain on an object. Strain gauge consists of an insulating flexible backing which supports a metallic foil pattern. As the object is deformed, the foil is deformed, causing its electrical resistance to change.
c. ***Signal Conditioning Circuit***: signal conditioning circuit require for manipulating an analog signal in such a way that it meets the requirements of the next stage for further processing. Operational amplifier are commonly employed to carry out the amplification of the signal in the signal conditioning stage.
d. ***Analog to Digital Converter (ADC)***: It converts an input analog voltage or current to a digital number proportional to the magnitude of the voltage or current
e. ***Microcontroller***: From the analysis of change in resistance period for successive samples storage will be obtained and number of sample will be stored. Using analytical tools and equations analysis of stress, strain, deformations takes place
f. ***Keyboard***: for making system interactive.
g. ***Display***: For displaying estimated values and curves.

III. Conclusion

Concrete structures are suffering from stress, strain and deformation due to overloading on the beam and column. With the help of electronic system these parameters can be recorded. In proposed system we are suggesting stain gauge as sensor for measuring of deformation. By comparing the readings overstress can be detected .This will help in detection and prevention of failure of concrete structure.

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