

**INTEGRAL UNIVERSITY LUCKNOW**  
**CIVIL ENGINEERING DEPARTMENT**  
**STRUCTURAL ANALYSIS LAB**

Structural analysis is the determination of the effects of loads on physical structures and their components. Structures subject to this type of analysis include all that must withstand loads, such as buildings, bridges, vehicles, machinery, furniture, attire, soil strata, prostheses and biological tissue. Structural analysis incorporates the fields of applied mechanics, materials science and applied mathematics to compute a structure's deformations, internal forces, stresses, support reactions, accelerations, and stability. The results of the analysis are used to verify a structure's fitness for use, often saving physical tests. Structural analysis is thus a key part of the engineering design of structures.

S.NO.	APPARATUS NAME	IMAGE	DISCRIPTION
1	<b>ELASTIC PROPERTIES OF DEFLECTED BEAM</b>		<p>Verification of moment Area theorem for slopes and deflection of the beam. Apparatus consists of a mild steel beam 2.5cm x 3 mm in cross section and 100cm long, pinned to two supports 70cm apart situated symmetrically. One of the ends can be fixed of given a known slope by applying a known moment of the end with the help of suspended loads. At the other end also a known moment can be applied. Vertical loads can be applied at various points along the span of the beam. A dial gauge with 25 mm travel (with a magnetic base) is supplied with the apparatus . Apparatus is supplied complete with a supporting stand and a set of weights.</p>

<p>2</p>	<p><b>THREE HING ARCH APPARATUS</b></p>		<p>A three-hinged system consists of two plates, connected together by means of a hinge with two hinged supports resting to the ground. When the plates consist of curved bars the system is called three-hinged arch; in the case these bars are straight or L shaped, the system will be called a three-hinged bent or frame. The distance <math>L</math> between the centres of the hinges at the supports is called the span of the arch. The distance <math>f</math> from the centre of the intermediate hinge to the straight line passing through the ground hinges is called its rise.</p>
<p>3</p>	<p><b>TWO HING ARCH APPARATUS</b></p>		<p>An arch is defined as a curved girder, having convexity upwards and supported at its ends. The supports must effectively arrest displacements in the vertical and horizontal directions. Only then there will be arch action.</p>

<p>4</p>	<p><b>CURVED MEMBER APPARATUS</b></p>		<p>Curved Member Apparatus. Our offered apparatus reflects true workmanship of our skilled professionals who manufacture this product using superior quality materials and modern technology in accordance with certified industrial standards. This apparatus has gained huge appreciation for its attributes like optimum quality, excellent finish and durability.</p>
<p>5</p>	<p><b>UNSYMETRICAL BENDING APPARATUS</b></p>		<p>A homogeneous elastic membrane attached to a fixed frame and subjected to a uniform pressure on one side--- analog of the bar in torsion: The shearing stress <math>t</math> will have the same direction as the horizontal tangent to the membrane at <math>Q'</math>, and its magnitude will be proportional to the maximum slope. The applied torque will be proportional to the volume between the membrane and the plane of the frame</p>

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## REDUNDENT JOINT APPARATUS



Comparison of experimental and theoretical results of forces in the members and the component displacement of the loaded joint D of a three bar suspension system for vertical loads.

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### THREE MEMBER STRUCTURAL FRAME



Any structure is designed for the stress resultants of bending moment, shear force, deflection, torsional stresses, and axial stresses. If these moments, shears and stresses are evaluated at various critical sections, then based on these, the proportioning can be done. Evaluation of these stresses, moments and forces and plotting them for that structural component is known as analysis. Determination of dimensions for these components of these stresses and proportioning is known as design.

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### COLUMN BUCKLING APPARATUS



Column buckling is a curious and unique subject. It is perhaps the only area of structural mechanics in which failure is not related to the strength of the material. A *column buckling analysis* consists of determining the maximum load a column can support before it collapses. But for long columns, the collapse has nothing to do with material yield. It is instead governed by the column's stiffness, both material and geometric

<p>9.</p>	<p><b>APPARATUS FOR VERIFICATION OF CLARK'S MAXWELL THEOREM</b></p>		<p>Maxwell-Betti Law of real work is a basic theorem in the structural analysis. Using this theorem, it will be established that the flexibility coefficients in compatibility equations, formulated to solve indeterminate structures by the flexibility method, form a symmetric matrix and this will reduce the number of deflection computations. The Maxwell-Betti law also has applications in the construction of influence lines diagrams for statically indeterminate structures. The Maxwell-Betti law, which applies to any stable elastic structure (a beam, truss, or frame, for example) on unyielding supports and at constant temperature.</p>
<p>10.</p>	<p><b>ELASTICALLY COUPLED BEAM APPARATUS</b></p>		<p>Apparatus consists of a three parallel bar suspension system with elastic beam at their upper and lower ends. The upper ends of the two outer suspension rods are tied to a vertical wooden board while central suspension rod may be tied to the center of another elastic beam supported at two outer ends only. Apparatus to be supplied should be complete with a supporting stand and a set of weights.</p>

