



## 5. VERIFICATION OF MAXWELL'S RECIPROCAL THEOREM

Ex. No.: 3

Date: 29.04.2018

### AIM

To verify Maxwell's Reciprocal Theorem

### BASIC CONCEPT

Maxwell's Reciprocal Theorem is as follows:

The deflection at A due to unit force at B is equal to deflection at B due to unit force at A.

Thus  $\delta_{AB} = \delta_{BA}$

### APPARATUS

1. Deflection bench arrangement
2. Deflectometer
4. Scale

### PROCEDURE

1. Place the given beam over the supports and measure the span of the beam.
2. Place the load at  $\frac{1}{4}$ <sup>th</sup> of span (point A) from left hand side and place the deflection at mid span of the beam (point B).
3. Load the beam at an uniform rate at point A from 1 kg to 4 kg and note down the corresponding deflectometer readings at point B.
4. Remove load at point A at the same uniform rate and note down the corresponding deflectometer readings at point B.
5. Place load at point B and deflectometer at point A.
6. Load the beam at an uniform rate at point B from 1 kg to 4 kg and note down the corresponding deflectometer readings at point A.

**TABULATION**

**Table 1: Load at A and deflection at B**

Least count of the deflectometer = 0.01 mm

| S.No. | Load in |      | Deflectometer reading at B (Deflection, $\delta$ ) |                       |                  |                 |
|-------|---------|------|--|-----------------------|------------------|-----------------|
|       | kg      | N    | Loading (Divisions)                                | Unloading (Divisions) | Mean (Divisions) | Deflection (mm) |
| 1     | 0.5     | 4.9  | 17   | 16                    | 16.5             | 0.165           |
| 2     | 1.0     | 9.8  | 32   | 32                    | 32               | 0.32            |
| 3     | 1.5     | 14.7 | 46   | 47                    | 46.5             | 0.465           |
| 4     | 2.0     | 19.6 | 63   | 63                    | 63               | 0.63            |

Mean:  $(1.580/4)$   
 $=0.395$

**Table 2: Load at B and deflection at A**

Least count of the deflectometer = 0.01 mm

| S.No. | Load in |      | Deflectometer reading at A (Deflection, $\delta$ ) |                       |                  |                 |
|-------|---------|------|--|-----------------------|------------------|-----------------|
|       | kg      | N    | Loading (Divisions)                                | Unloading (Divisions) | Mean (Divisions) | Deflection (mm) |
| 1     | 0.5     | 4.9  | 15   | 16                    | 15.5             | 0.155           |
| 2     | 1.0     | 9.8  | 31   | 32                    | 31.5             | 0.315           |
| 3     | 1.5     | 14.7 | 45   | 48                    | 46.5             | 0.465           |
| 4     | 2.0     | 19.6 | 60   | 60                    | 60               | 0.6             |

Mean:  $(1.535/4)$   
 $=0.38375$

7. Remove load at point B at the same uniform rate and note down the corresponding deflectometer readings at point A.
8. The results are tabulated.

## **RESULT**

Deflection at A due to force at B is 0.38375, and, deflection at B due to force at A is 0.395.

## **INFERENCE**

Successfully verified Maxwell's Reciprocity Theorem, experimentally.