

# Studies on measurement of deflection characteristics in agricultural disc

■ VIJAY KUMAR, PRAMOD KUMAR AND R.N. PATERIYA

Received : 23.06.2015; Revised : 15.02.2016; Accepted : 09.03.2016

See end of the Paper for authors' affiliation

Correspondence to :

**VIJAY KUMAR**

Department of Farm Machinery and Power Engineering, College of Technology, PANTNAGAR (UTTARAKHAND) INDIA  
Email : [kumarvijaygour@gmail.com](mailto:kumarvijaygour@gmail.com)

■ **ABSTRACT** : The preliminary study is required for measurement of deflection in agricultural discs to check a fatigue life of agricultural discs and to know whether or not an agricultural disc is fit to be used in the field. The discs are used as soil engaging component in different agricultural machinery. Being the soil engaging component, discs wear out faster than other components and they have to be replaced very often. To ensure interchangeability, necessary dimensions, the method of testing and prescribed limits for deflection characteristics is major concern. A minimum of 3 agricultural discs chosen out of 10 for ensuring the deflection characteristics and a series of test was conducted on universal testing machine to evaluate deflection and result was compared with computational simulation software ANSYS workbench.

■ **KEY WORDS** : Agricultural Disc, Deflection, Universal testing machine, ANSYS workbench

■ **HOW TO CITE THIS PAPER** : Kumar, Vijay, Kumar, Pramod and Pateriya, R.N. (2016). Studies on measurement of deflection characteristics in agricultural disc. *Internat. J. Agric. Engg.*, **9**(1) : 32-34.

Farm mechanization ensures the effective and efficient utilization of inputs for higher productivity and sustainability. Appropriate farm mechanization helps in increasing production, optimal usage of resources and provides employment. Farm machinery and equipment provide a package of technology to increase land productivity by improved timeliness of operations, reduced crop losses and improved quality of agro-produce, increase efficiency of inputs used through their efficient measurement and placement, increase labour productivity by using labour saving and drudgery reducing devices, and reduced cost of cultivation. In the series of different disc parameter deflection is defined as linear distance traveled or amount of distance by which something is deflected when it bears load. A deflection is a test for determining the deformation produced due to maximum loading. With reference to the test set up given by IS:9217-1979 test code for Agricultural disc an

attempt has been made to develop the deflection test set up.

Compression of the specimen. UTM machine of the Department of the Civil Engineering, College of Technology, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar. The disc should be bolted horizontally after fully supporting its flat center portion. The deflection load should be applied on concave side of the disc at a distance within 25mm from outer edge of the disc. The load should be gradually increased in 5 steps up to a maximum value as specified in Table A. for particular size at an interval of 5 minutes each. Corresponding deflection at each load should be measured on a suitably fixed vernier height gauge. The force should be measured by using a portable precision hydraulic dynamometer. Record the deflection. The loading should now be decreased from maximum to 0 in decrement of 5 steps and the deflection and load should

Size of disc (mm)	Deflection load (kN)
660	11.76
610	9.80
560	7.84
510	5.88
455	4.41
405	3.43

be recorded in the manner stipulated. Calculate the permanent set or deformation produced due to maximum loading.

### Procedure and testing on UTM :

The disc is placed in the machine between the grips and an extensometer if required can automatically record the change in gauge length during the test. If an extensometer is not fitted, the machine itself can record the displacement between its cross heads on which the disc is held. However, this method not only records deflection of the disc but also all other extending/elastic components of the testing machine (but not required in this test) and its drive systems including any slipping of the specimen in the grips. Once the machine is started it begins to apply an increasing load on specimen.

This will enable us to check a fatigue life of disc. Deflection test conducted on agricultural discs will enable us to know the value of deflection of that particular disc. The value of deflection obtained from the test will help us to know whether or not an agricultural disc is fit to be used in the field or not by comparing with standard value of deflection as stated as in IS: 4366 (Part I)-1972 and IS: 4366 (Part II)- 1972.

The study has been undertaken with the following objectives:

- Study of the deflection test set up and its measurement of the deflection of the agricultural discs.
- Measurement of the deflection of the agricultural discs with the help of ‘Universal Testing Machine’ as per BIS norms.

### ■ METHODOLOGY

The test for measurement of deflection in agricultural discs was conducted with the help of throughout the tests the control system and its associated software record the load and extension or.

### ■ RESULTS AND DISCUSSION

Types of discs, size of discs, concavity, load, deflection used in the study are given in Table 1. The Universal testing machine was used for measurement of deflection in three different type of disc. When the disc of 486mm of diameter is tested in the machine by applying maximum load of 6 kN, then the control system and its associated software record the deflection of 0.0436 mm shown in Table 1. Hence, disc is slightly deflected. When the disc of 610mm of diameter and 90 mm concavity is tested in the machine by applying maximum load 10.4 kN, then the control system and its associated software record the deflection of 0.375mm shown in Table 1. Hence, disc is more deflected. When the disc of 610mm of diameter and 88 mm concavity is tested in the machine, then the control system and its associated software record the deflection of 0.304mm shown in Table 1. Hence, disc is more deflected.

**Table 1: Experimental results of deflection of the discs**

Type of disc	Size of disc (mm)	Concavity (mm)	Load (kN)	Deflection (mm)
Paddy harrow (Disc 1)	486	76	6	0.0436
Harrow (Disc 2)	610	90	10.4	0.375
Harrow (Disc 3)	610	88	10.534	0.304

This result also verified by simulation of agricultural discs in ANSYS Workbench by applying load on concave side of disc and fixing bottom of the disc. When the simulation is carried out on the disc of 486 mm of diameter and concavity of 76 mm, then system records the deflection of 0.58473 mm shown in Fig. 1. Again we simulate the disc of 610 mm of diameter and 90 mm concavity,

Then the system records 1.8035 mm deflection by applying 10.4 kN shown in Fig 3. After simulation of the disc of 610 mm of diameter and 88 mm concavity, then the system records 1.717 mm deflection by applying 10.534 kN shown in Fig 2.

For different size of disc, the larger size of disc shows more deflection as compare to smaller size of disc. For same size of disc, more concave disc shows more deflection as compare to less concave disc. The maximum value of deflection is obtained in harrow disc of 610 mm of diameter and 90 mm concavity. When we compare the experimental data with computational software data, simulation software results show more

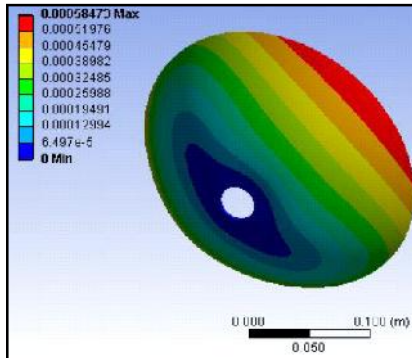


Fig. 1: 486 mm disc and concavity 76 mm total deflection (max) 0.00058473 (m)

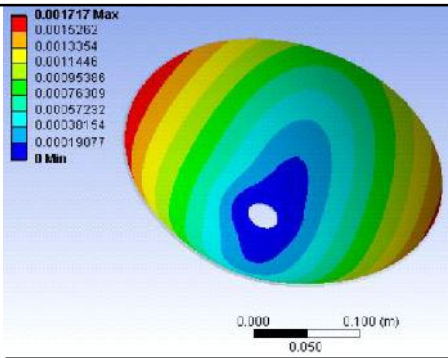


Fig. 2: 610 mm disc and concavity 88 mm total deflection (max) 0.001717 (m)

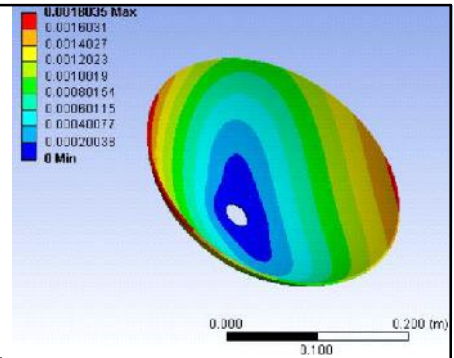


Fig. 3: 610 mm disc and concavity 90 mm total deflection (max) 0.0018035 (m)

deflection than experimental data. The software computational gives more precise result because it is based on finite element analysis.



Fig. 4 : Universal testing machine and application of load on disc

### Conclusion :

The preliminary study for measurement of deflection in agricultural discs was conducted with the help of universal testing machine found satisfactory because the permanent deflection shall not exceed 5mm for nominal sizes of agricultural disc as per BIS and test will help us to know whether or not an agricultural disc is fit to be used in the field.

### Acknowledgment :

Appreciation is extended to the G.B.P.U.A.T., Department of Farm Machinery and Power Engg.

### Authors' affiliations:

**PRAMOD KUMAR AND R.N. PATERIYA**, Department of Farm Machinery and Power Engineering, College of Technology, PANTNAGAR (UTTRAKHAND) INDIA Email : kumar.pramod719@gmail.com

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