INDIAN INSTITUTE OF TECHNOLOGY MADRAS

DEPARTMENT OF MECHANICAL ENGINEERING |

Ph.D. Seminar Talk 1

Title of the Seminar: Effect of Laser Beam Incident Angle on Welding of Ti6Al4V with Fiber Lasers.

Speaker: Mr. Jigar K Pathak (ME20D010)

Ph.D. Research Scholar, Department of Mechanical Engineering, IIT Madras.

DATE & TIME	VENUE	ONLINE
21 November 2026, Friday, 03:00 PM.	**Online.**	**Join via Google Meet:** https://meet.google.com/rfx-yqud-zet

Guide: Dr. Sivasrinivasu Devadula, ME.

Co-Guide: Prof. (Emeritus) Ramesh Babu N, ME.

SCAN TO JOIN

ABSTRACT

Laser beam welding (LBW) is widely used for welding Ti6Al4V alloys in aerospace applications. LBW has localized high-energy fluence with low-energy input compared to other fusion welding processes, resulting in narrower heat-affected zones. On the other hand, most metals are highly reflective when the laser beam impinges perpendicular to the surface, making the process inefficient. Hence, this work proposes to employ shallow angle incidence to reduce the reflectivity during the welding of Ti6Al4V material. For this purpose, bead-on plate (BOP) LBW is conducted on mill-annealed Ti6Al4V material by employing a fiber laser source with a maximum power of 3 kW and a wavelength of 1080 nm. It is observed from the results that at a normal incident angle and low laser power, the penetration depth is too low to generate a weld bead. Analyzing the cross-section of the weld bead, obtained from SEM, perpendicular to the weld direction reveals that the increase in laser incident angle up to an optimal angle resulted in increased bead dimensions (width and height), and beyond that, the dimensions decreased. However, the optimal incident angle changed when the laser power was changed. The major finding of this study is that at 600 W and a normal incident angle, the laser could not penetrate and generate a weld bead due to low absorptivity, while at an incident angle of 300, 450, and 600, weld beads are generated because of increased absorptivity. Similarly, the increase in weld dimensions with the increase in laser power is observed. At higher laser power, under fill and oxide formation are observed. The feed rate is less predominant than the incident angle and the power.