Research Facility in Manufacturing and Materials Engineering

Manufacturing Facility - Metal Additive Manufacturing System

Manufacturing research lab has advanced materials processing facility consists metal additive manufacturing (AM) system, the method that relies on a digital data file being transmitted to a machine then builds the component. The technology helps us make complex parts from various engineering materials with high standards of quality that are not possible using conventional manufacturing methods. With a building volume of 250 x 250 x 325 mm, the EOS M 290 allows a fast, flexible and cost-effective production of metal parts directly from CAD data.

The laboratory consists of a powerful 400W fiber laser with fully mechanised powder bed system (Make: EOS M 290) imported from Germany. The metal printing system is capable of printing a complex structure with Direct Metal Laser Sintering technology for printing major kind of metallic materials with a building volume of 250 mm x 250 mm x 325 mm. The system is complemented with an array of Softwares such as Materialise Magics, EOS print, EOS state and EOS access for making a final functional part from CAD model.

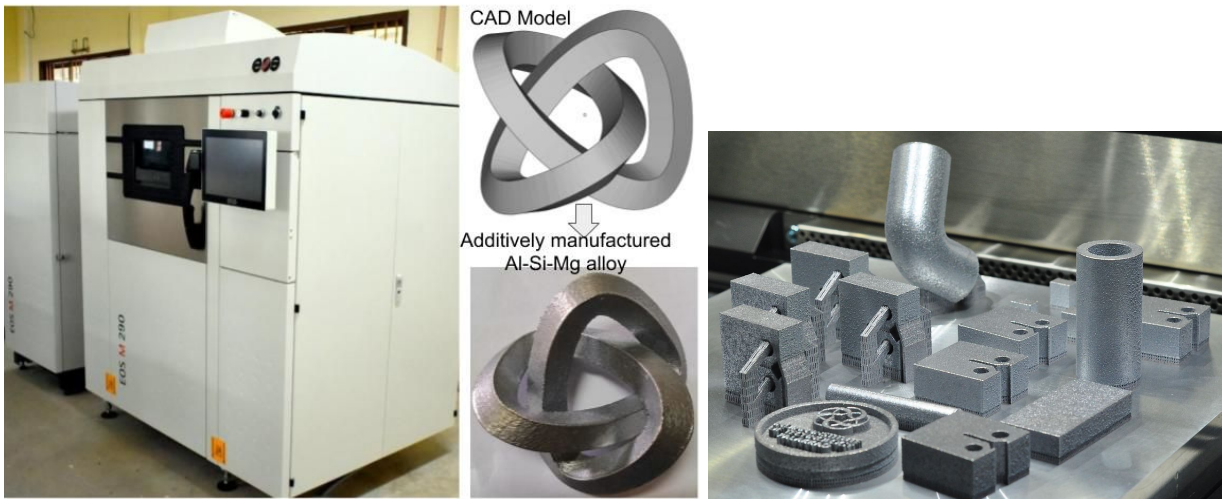


Figure 1: 3D Metal Printer with Al-Si-Mg printed components

Manufacturing Facility - Wire Electric Discharge Machining (WEDM)

Manufacturing lab also have Electronica make ECOCUT wire electric discharge machine set up. This is a 5-axis type CNC controlled machine. Each axis is run by separate drive mechanisms with a minimum resolution of 1 µm. Deionised water is used as the dielectric for the system. Coated and uncoated conductive wire electrodes are used to cut various profiles on difficult to cut materials in this setup.

Machining stability analysis: The inter electrode gap (IEG) state is studied for machining stability. The stability levels are classified and the machining performances are compared between each level. The IEG condition is found as one of the major factors influencing the overall machine performance and stability.

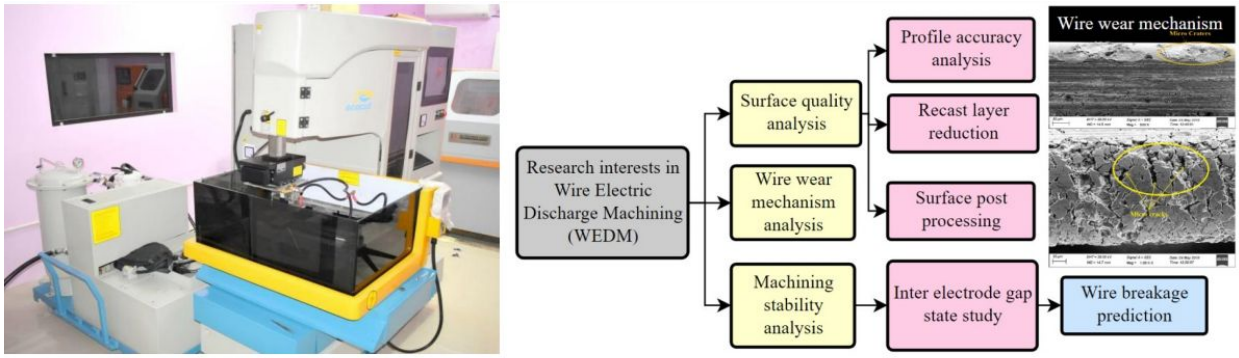


Figure 2: Wire EDM setup and research glimpse

Machined surface quality analysis: The part accuracy is studied with respect to the machining stability and wire vibrations. The effect of wire strength on part accuracy is being researched. The initial results show a direct relationship between the geometric accuracy and the wire vibrations caused by IEG instabilities. Surface integrity study including recast layer thickness reduction, thermal residual stress reduction etc. are also being attempted as part of research.

Research highlights as follows,

Electrode wear comparisons: The effects of wire electrode coatings on the machining performance is being studied and performance improvements are observed and reported. Condition monitoring and adaptive control: The research group plans to setup a condition monitoring system for machine incorporating multi sensorial approach.

Materials Testing Facility - Rolling Contact Fatigue

Materials testing lab is equipped with a twin disc rolling contact fatigue (RCF) tester with scope for real time assessment of the failure due to repeated severe contact stress. RCF is the phenomenon by which the durability of the contact surfaces is reduced due to repeated contact under rolling/sliding contact conditions. The test rig is used to simulate such contact stresses between any mating parts such as bearings, gears, rail wheels etc. The system is equipped with an accelerometer g sensor with 1g limit. The test rig has a water-cooled spindle motor that can function up to 24000 rpm with a pneumatic cylinder setup which can apply load up to 4.5 kN. Specimens are mounted and kept in place via collet chucks which are capable to hold 10mm and 30mm specimen loaded against discs of 180 mm diameter. RCF failure is predominant in gears, rolling bearings and cams which find wide application in machine tools, automobile and aerospace industries.

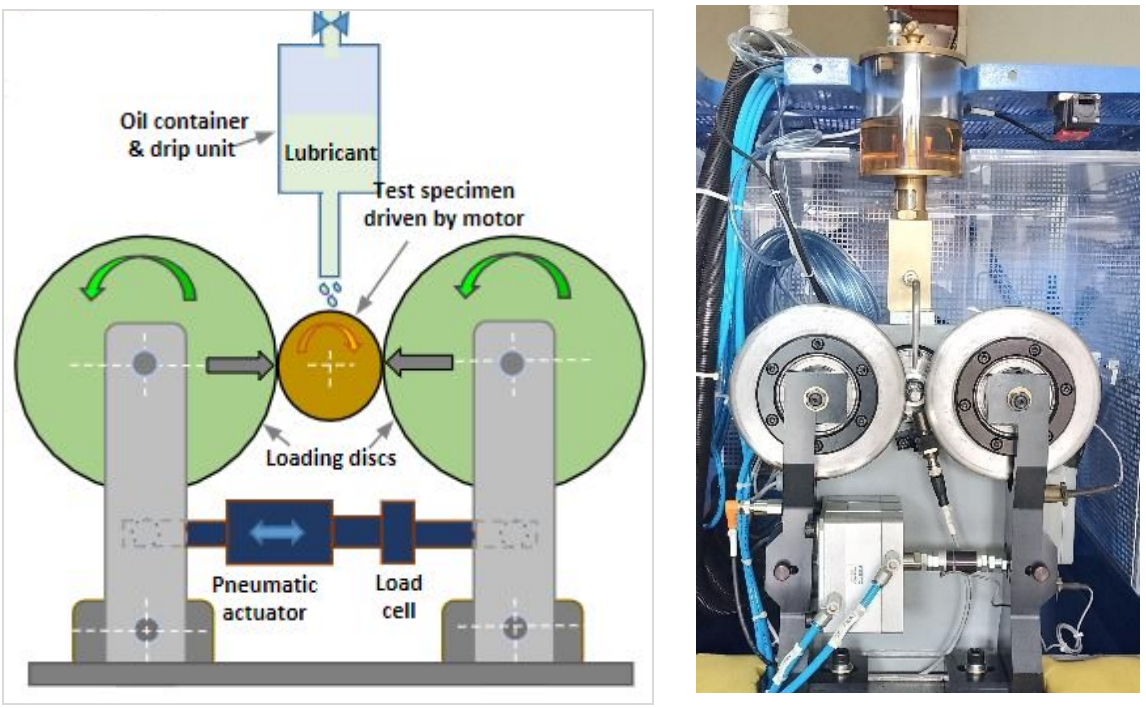


Figure 3: Rolling Contact Fatigue (RCF) Setup

Servo Hydraulic Fatigue Testing Machine (100 kN)

Medium force fatigue testing machine that is servo-hydraulic built for static and dynamic testing of materials at various frequencies and temperatures is available in design lab. The test setup has 3 section furnace to heat up to 1000 ° C. The test system is useful for testing materials under room temperature and high temperature as high as 1000 °C. The machine is capable of doing tension, compression, Low cycle fatigue and High cycle fatigue tests on various materials following ASTM and ISO standards.

The following tests can be done on the machine

1. Tension, Compression, Flexural
2. Fatigue Crack Propagation
3. J_{1c}, K_{1c}, CTOD Fracture Mechanics
4. Low and High Cycle Fatigue
5. Low and High Temperature Tests

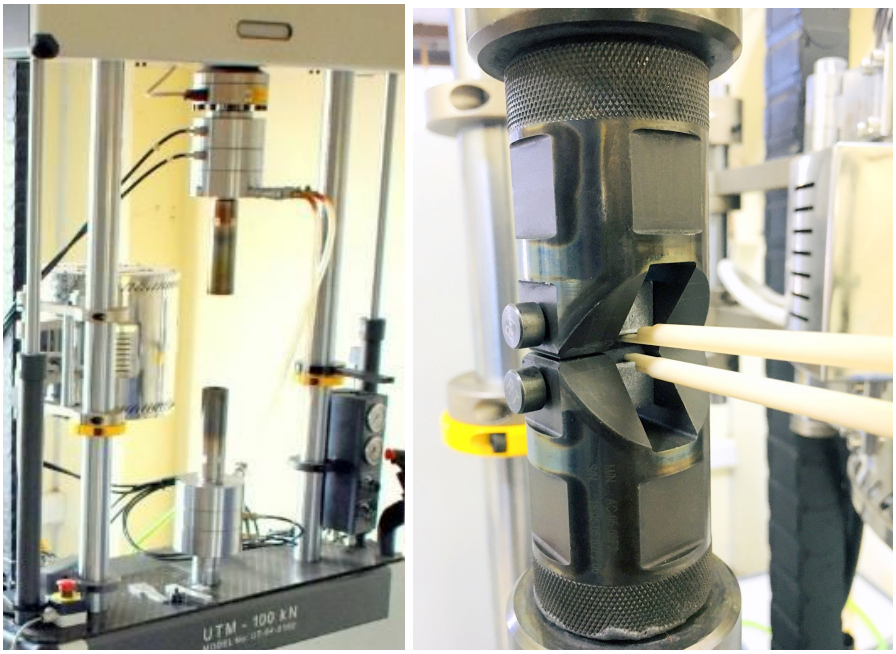


Figure 4: Hydraulic actuator with Fracture toughness (K_{1C}) test test setup

Rotating Beam Bending Fatigue Testing Machine

Moving components and machine parts are often exposed to periodically fluctuating loads. Even if the dynamic load is far below the static load capacity, this load can lead to fracture of the component after a long time because of material fatigue. Laboratory is equipped with rotating beam bending fatigue testing machine which helps in finding the fatigue strength of bars under reverse bending stress. The machine is capable of applying 300N on an 8 mm diameter metal bar at max 2800 rpm.

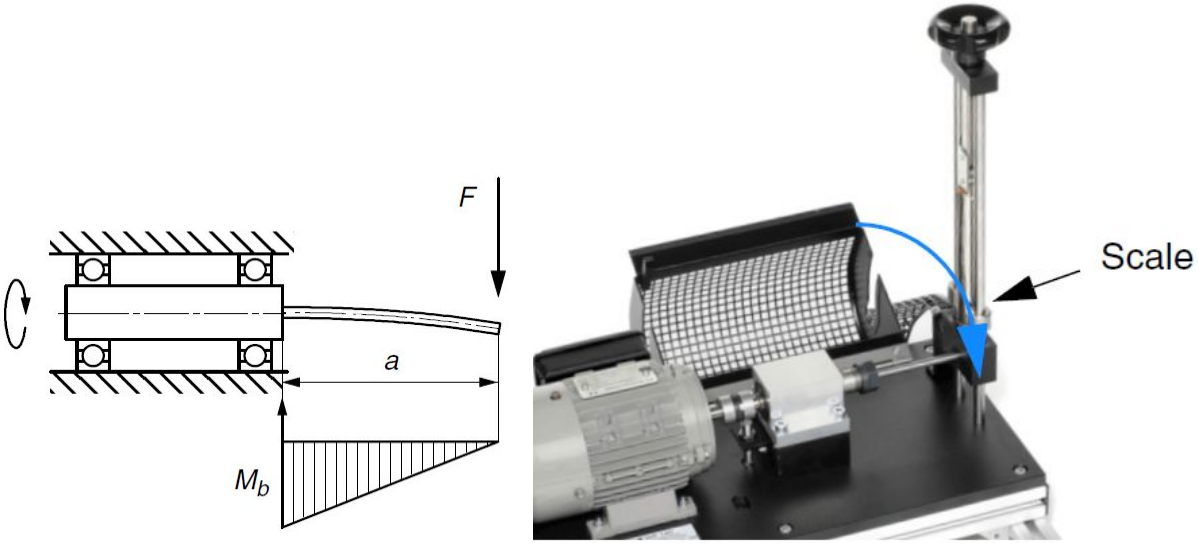
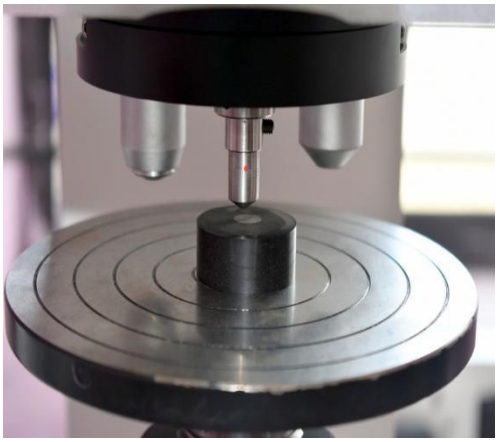


Figure 5: Rotating beam bending test setup (Reference: GUNT)

In this setup, a cantilever-mounted and rotating cylindrical specimen is subjected to a single force. The load on the specimen corresponds to a cantilever bending beam and the specimen is subjected to a pure reverse bending stress and breaks after a certain number of load cycles because of material fatigue. This machine also extends in finding the influence of different fillet radii and surface qualities on the fatigue strength and continuous adjustment of load amplitude is possible. The data acquisition system helps in recording and analyzing the data with precision.

Vivker’s Hardness Tester



Vicker’s hardness referred to as micro or macro hardness testing methods on the basis of load applied. The lab has got hardness testing facilities well suited for measuring the hardness of small, selected specimen regions. For each test a very small diamond indenter having pyramidal geometry is forced into the surface of the specimen. . This electrically loading machine can apply test force ranges from 1kgf to 50 kgf on the specimens and can measure hardness test range is from 8HV to 2900HV. The turret head of the hardness tester consists of a diamond indenter and two objective lenses of 10x and 20x magnifications.