

## ***“Failure Analysis of Aircraft Structures”***

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### **Course Objectives**

To introduce basic failure types and mechanisms observed in materials,

To introduce failure detection and analysis methods,

To introduce failure prevention methods

### **Course Learning Outcomes**

Students who successfully pass this course gain knowledge, skills and competency in the following subjects;

- Failure analysis methods and equipments
- Identification of failures and steps of failure analysis,
- Causes and mechanisms of failure in materials,
- Failure types and characteristics,

### **Course Description**

Failure(s) may be defined as the incapability of engineering components or structures to satisfactorily perform their intended function(s) safely, reliably, and economically. The cause(s) and mechanism(s) of failures can be determined by failure analysis practices.

Some failures may be insignificant, while others may have serious results such as aircraft accidents, disasters. Failures can be due to many different reasons. Common causes of failures could be related to improper design, defective manufacture, improper inspection, maintenance, abnormal operation, environmental effects and sabotage.

Service failures may cause:

- Causality
- Injuries to personnel
- Loss of property
- Release of hazardous materials
- Reducing reliability of the manufacturers and commercial users

Service failures of components and structures have been occurred in many industries. One of these industries is aircraft industry. The components and structures of aircrafts can fail and lead to aircraft accidents. Table 1 represents statistics about causes of fatal accidents represents 1,015 fatal accidents including commercial aircraft, from 1950 to 2010. Some exclusions had been made such as not considering military aircraft, private aircraft and helicopters. Fatal accidents due to mechanical failure institute 20 % of total accidents.

The causes of fatal accidents were determined by a kind of aircraft accident investigation practices. The main purpose of an accident investigation practices is to prevent future accidents consisting of many steps. One of those steps is metallurgical failure analysis of mechanical components. The cause(s) and mechanism(s) of failures can be determined by failure analysis practices. Corrective actions can be implemented by changing design, process or material. Thus, recurrences of the failures can be eliminated or minimized. Failure analysis practices of failed aircraft components have important effects for improving aircraft safety and reliability.

Main stages of a metallurgical failure analysis:

- Collection of back ground data about failed components
- Preliminary examination of failed components
- Selection, preservation and cleaning of the sample
- Non-destructive testing
- Mechanical testing
- Macroscopic examination and analysis
- Microscopic examination and analysis
- Metallographic examination of failed components
- Chemical analysis of parts
- Fracture mechanics analysis
- Testing under simulated conditions if required
- Analysis of all evidence of investigation
- Preparing of report with recommendations.