MSE 577 – Fall 2023
Principles of Failure Analysis
Course Overview

Principles of Failure Analysis combines lectures and readings from online resources and class handouts and textbook assignments and a series of hands-on sessions where students work individually and in groups to analyze failures in structural materials. The course will focus on failure of components and is divided into the following general topical areas:

1. What is Failure Analysis?
2. Analytical Approaches and Types of Fracture
3. Case Histories and Tools and Techniques
4. Failure Analysis Team Projects

Failure Analysis Projects:
Project 1: (Short Project) Students will work in groups to provide a plan and preliminary investigation of a student provided failure, including macroscopic inspection and photographic documentation. A report detailing the initial findings and development of a proposal for a more detailed analysis will be required.

Project 2: (Major Project) Teams will be investigate a failed component during the second half of the term. Each team will document the failure, research the service expectations (history, stresses, temperatures, environments) and materials of the component, prepare a plan of investigation, request resources for further study (SEM time, specimen prep, photography equipment), conduct the approved plan and prepare a report and presentation of the findings.

Reading assignments will come from three sources and from instructor notes and handouts. The sources are:

- Understanding How Components Fail, Third Edition, by Donald J. Wulpi, ASM International, 2013
- ASM Handbook, Volume 11, Failure Analysis and Prevention.
- How to Organize and Run a Failure Investigation, Daniel P. Dennis, ASM International, 2005

These sources are available online in our library and readings from them will be assigned frequently.

Case studies of failed components will be used throughout the course to integrate knowledge and skills required for failure analysis and to demonstrate the methods used in accurate determination of the causes of failure.

Instructors:
Professor John Allison, Room 3018 Dow Building, johnea@umich.edu
Dr. Sahar Farjami, Room 2224B Dow Building, farjami@umich.edu

How will performance be assessed?

Grading Plan:

Homework (6)	25%
Exam	25%
Failure Analysis Project 1	20%
Failure Analysis Project 2	30%

MSE 577 PRINCIPLES OF FAILURE ANALYSIS – FALL 2023
CLASS SCHEDULE (PRELIMINARY)

Week	Class	Date	Format / Location	Lecturer	Topic / Reading Assignments
1	1	Aug 29	Lecture / 1014 Dow	Allison	Introduction and Class Overview
	2	Aug 31	Lecture / 1014 Dow	Allison	Organizing a Failure Analysis
2	3	Sept 5	Lecture / 1014 Dow	Farjami	Types of Failures **(HW 1 Due)**
	4	Sept 7	Lecture / 1014 Dow	Farjami	Fracture Surface Analysis **(HW 2 Due)**
3	5	Sept 12	Lab / Van Vlack	Farjami	Safety Review and Project Procedures Overview Project 1: Documenting Failed Components -
	6	Sept 14	Team / Van Vlack	Allison / Farjami	Project 1: Background Research, Planning and Analysis
4	7	Sept 19	Lecture / 1014 Dow	Allison	Complex Stresses **(HW 3 Due)**
	8	Sept 21	Team / Van Vlack	Allison / Farjami	Project 1: Analysis activities and consultations
5	9	Sept 26	Team / Van Vlack	Allison / Farjami	Project 1: Analysis activities and consultations
	10	Sept 28	Team / Van Vlack	Allison / Farjami	Project 1: Analysis activities and consultations **(Project 1 Report Due Oct 1)**
6	11	Oct 3	Presentations / 1014 Dow	Allison / Farjami	Project 1. Project presentations (CATME Peer Review)
	12	Oct 5	Lecture / 1014 Dow	Allison	Fracture Mechanics **(HW 4 Due)**
7	13	Oct 10	Lecture / 1014 Dow	Allison	Fatigue Analysis
	14	Oct 12	Lecture / 1014 Dow	Allison	Residual Stress **(HW 5 Due)**
		Oct 17	**No Class – Study Break**		
8	15	Oct 19	Lecture / 1014 Dow	Allison	Exam Review
9	**16**	**Oct 24**	**Exam / 1014 Dow**		**Exam**
	17	Oct 26	Team / Van Vlack	Allison / Farjami	Project 2: Planning
10	18	Oct 31	Team / Van Vlack	Allison / Farjami	Project 2 Analysis activities and consultations

	19	Nov 2	Lecture (Virtual) 1014 Dow	Jason Hertzberg	Consumer Product Recalls - An Engineering Perspective Guest Lecture Dr. Jason Hertzberg, Corp. VP Exponent
11	20	Nov 7	Team / Van Vlack	Allison / Farjami	Project 2 Analysis activities and consultations
	21	Nov 9	Team / Van Vlack	Allison / Farjami	Project 2 Analysis activities and consultations
12	22	Nov 14	Lecture (Virtual) 1014 Dow	Erik Mueller	Guest Lecture Dr. Erik Mueller National Traffic Safety Board (NTSB)
	23	Nov 16	Team / Van Vlack	Allison / Farjami	Project 2 Analysis activities and consultations **(HW 6 Due)**
13	24	Nov 21	Team / Van Vlack	Allison / Farjami	Project 2 Analysis activities and consultations
		Nov 23	**No Class – Thanksgiving**		
14	25	Nov 28	Team / Van Vlack	Allison/ Farjami	Project 2 Analysis activities and consultations **(Project 2 Report Due)**
	26	Nov 30	Presentations / 1014 Dow	Allison/ Farjami	Project Presentations (CATME Peer Review)
15	27	Dec 5	Lecture / 1014 Dow	Allison	Failure Prevention and Wrap Up

*Note: The schedule is subject to change depending on project schedules, additional guest lectures and additional lectures. It is anticipated that substantial failure analysis project work will take place outside of the normal class time. Outside of class hours, facilities in Van Vlack should be scheduled with Dr. Farjami.