Statics – TAM 211

Fall 2018

Discussion 1 – Intro to MATLAB

Xu Zhaoyu（许照宇）

- PhD candidate in structural engineering (Zhejiang University)

- MCs in structural steel design (Imperial College London)

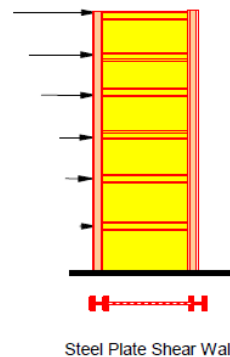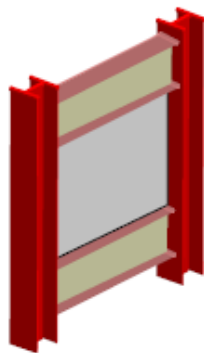- BEng in civil engineering (Zhejiang university)

Research area

- Stability of steel structure

- Plate structure: Steel plate shear wall

- Shell theory

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(photo: Nippon Steel, Japan)

Steel Plate Shear Wall

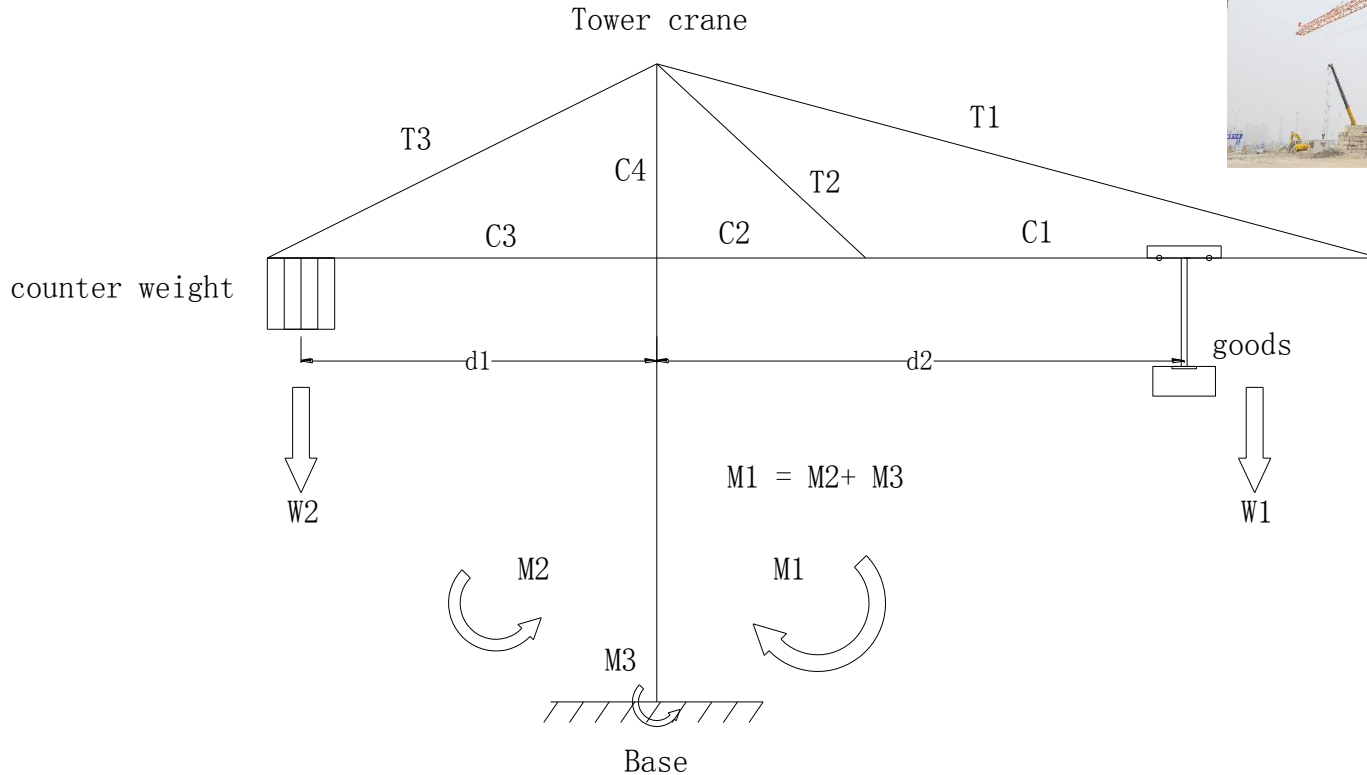Typical SPSW with frame members
(Figures: A. Astaneh-Asl, 2001)

Example: The counter weight used in tower crane

Tower crane

T3

T1

C4

T2

C3

C2

C1

counter weight

ceh.com.cn

goods

d1

d2

W2

M1 = M2+ M3

W1

M2

M1

M3

Base

Part of the bending moment (M1) generated by goods can be offset by counter weight (M2). In other words, counter weight helps to balance the tower cane and reduce the demand on the base.

Discussion group activity - 12% of grade

- Work in groups of 3-4 students

- Goals:
  - Gain experience in team-work
  - Apply engineering concepts learned in lecture to real-world problems or hands-on activities

- Be prompt: if you are more than 5 minutes late, you will not be allowed to complete the activity

- You need to attend the discussion in which you are registered, otherwise, your assignment will not be graded

dubishere.com

Course websites

MAIN PAGE

https://courses.engr.illinois.edu/tam211/fa2018/

ZJUI TAM 211: Statics

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Welcome to the official course website for TAM 211 at ZJUI this Fall 2018.

TAM 211 has always been a very difficult transition course for students in their early semesters of college. This course is challenging because students are exposed to multiple online teaching platforms (Prairie Learn, Blackboard, computer-based testing), multiple requirements in terms of frequent homework assignments, written assignments, quizzes, structured worksheets in Discussion sections that require working with a team of people, and the need for good personal time management skills. It is one of the first of many rigorous courses that undergraduate engineering students will experience in their college studies. Our goal as educators is to help our undergraduate students to achieve academic success and graduate as engineers. We train our undergraduate students to learn broad fundamental engineering knowledge that will allow them to have enough background to directly address, or know where to look for answers to address, the technological challenges of today and the future. Engineering is not about memorization; it is about being a problem solver, using one's general knowledge, and applying it to new areas.

The key to succeeding in TAM 211, or any class, is to practice the material **before** the time for assessment (quiz or exam). This course has many opportunities to practice; use them to your advanatge. Ask for help from the instructional staff or your friends (but do not just copy your friends answers - that is not practicing the material).

NOTE: This website is always under construction!! Feel free to peruse, wander, and learn a bit about what's coming up this Fall, but dates/times/assignments etc. are subject to change. If you have any questions, feel free to drop us a line at the discussion forum on Blackboard (see link below).

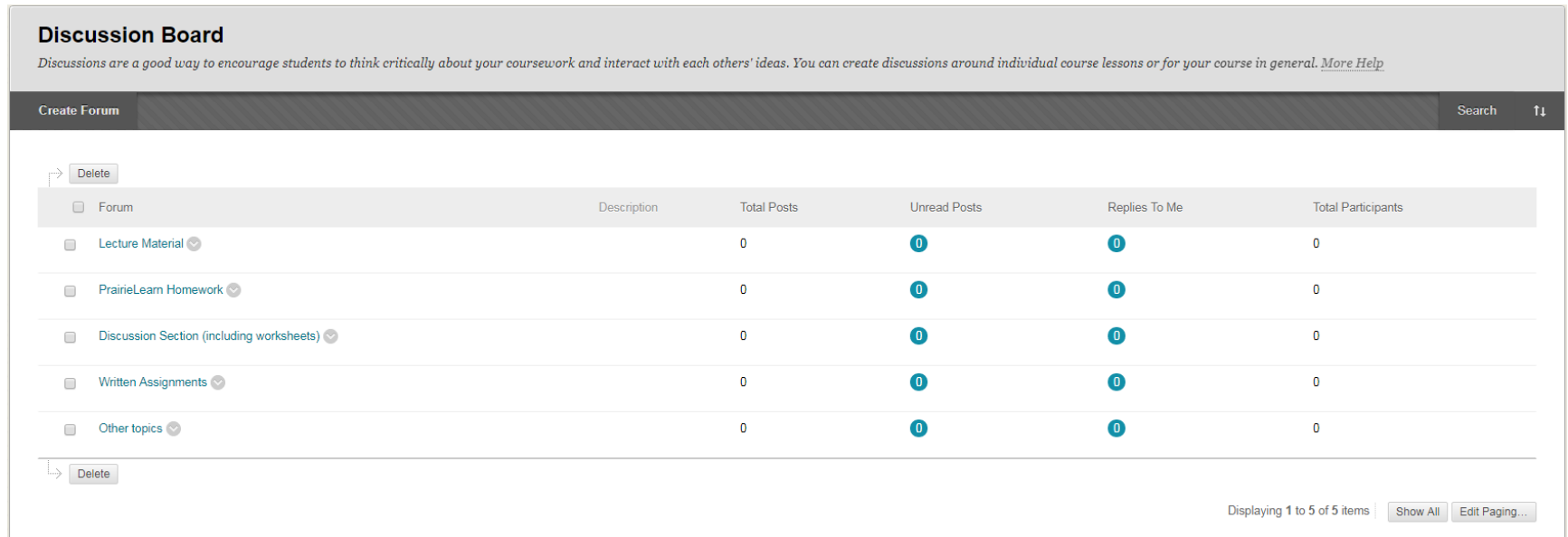As well as the pages on this website, this course uses:

- Online homework via PrairieLearn
- Discussion forum on Blackboard
- Gradebook on Blackboard

More website links here

Discussion 1 – Intro to MATLAB

Discussion Board

Blackboard: c.zju.edu.cn

Use: blackboard discussion board to send questions and responds

Grader center

Blackboard: c.zju.edu.cn

Check you grades and report error with 2

Discussion 1 - Intro to MATLAB

Course websites

Policies

ZJUI TAM 211: Statics

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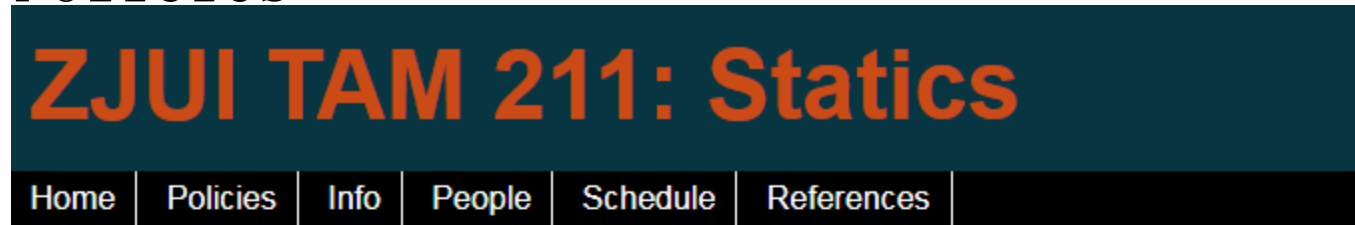
Below are the course policies for this class. Please read through them and familiarize yourself with the policies regarding course logistics. Details specific to course content can be found on the Info page.

Absences
Academic integrity, harassment, and discrimination
Computer-Based Testing Facility
Contact and obtaining help
Discussion
Gradebook
Lectures
Special accommodations

Discussion 1 – Intro to MATLAB

PrairieLearn

https://prairielearn.engr.illinois.edu/pl/login

Login in with your @intl.zju.edu.cn account

PrairieLearn

An online system for problem-driven learning

| | Add or remove courses |

Sign in with Illinois

Sign in with Google

Sign in with Microsoft

Using add or remove courses button to add course

Assessments		
	Available credit	**Score**
Homeworks		
HW1 Vector Math	100% until 23:59, Tue, Sep 18 ❓	Not started
Quizzes		
Q0 Example Quiz	None ❓	0%

Forces are vectors

- Vectors have direction and magnitude

https://www.mathsisfun.com
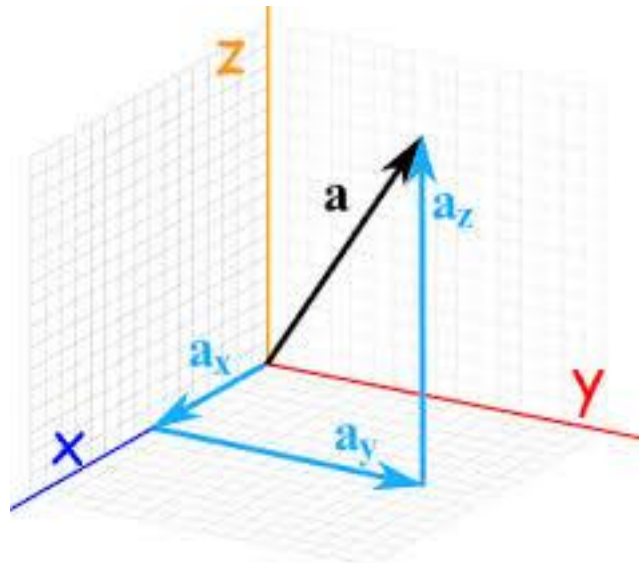
- We will use the following operations with forces
  - Adding
  - Subtracting
  - Calculating the resultant
  - Taking the dot product
  - Taking the cross product with moment arm vectors

- **MATLAB clinic**
  - Friday afternoon 13:00 to 16:00, library cafe
  - Course website has a MATLAB help document (see Reference page)

Why use MATLAB to do these operations?

- It will make our life easier!
- Avoid rounding errors
  - 1% rule for Prairie Learn
- Faster than doing the calculations by hand, especially useful for timed quizzes and exams

What is MATLAB

- High level language for technical computing
- Stands for **MAT**rix **LAB**oratory
- Everything is a matrix - easy to do linear algebra

http://www.mathworks.com/help/
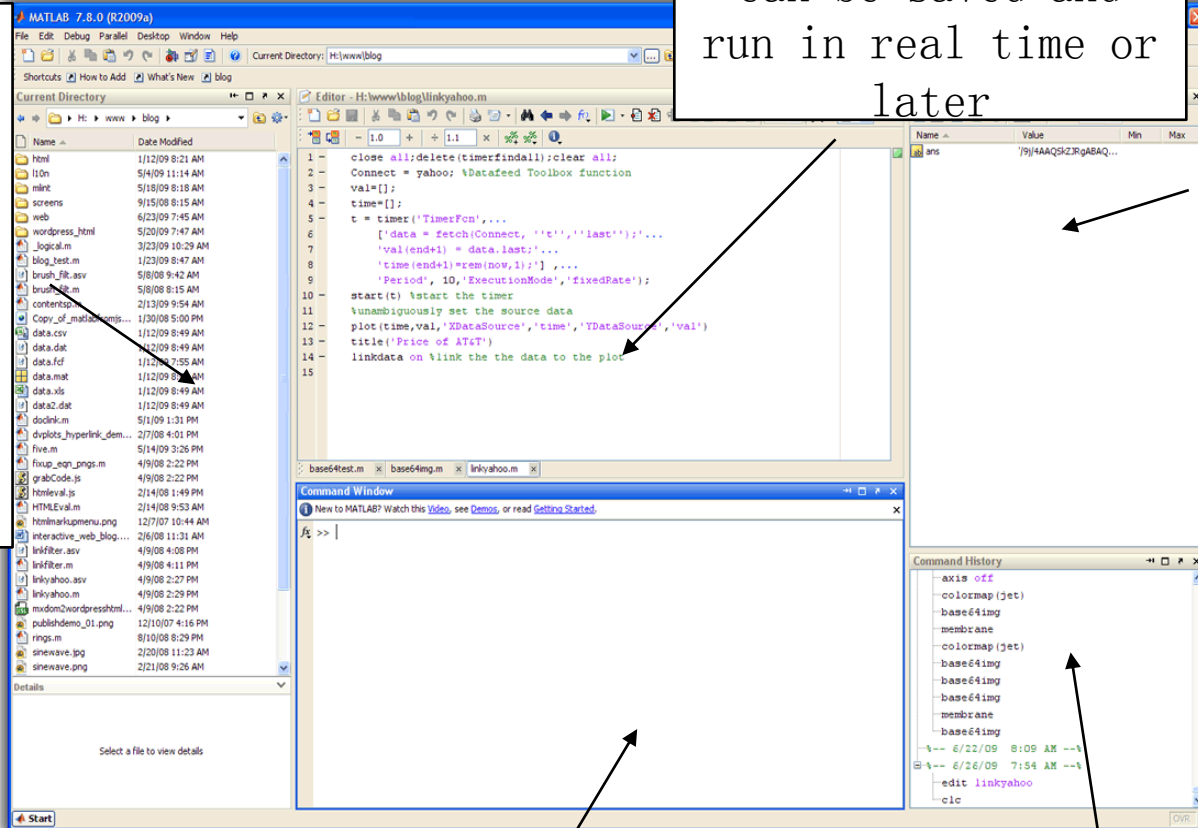
MATLAB Desktop

Current Directory: A window that shows which folder you are in and all the files that are in it

Editor: A place to write commands that can be saved and run in real time or later

Workspace: Variables you define are displayed here

Command Window: A place to write commands, perform calculations

Command History: What you type in the box to the left of this one is saved here

Workspace

- MATLAB remembers old commands
- **And** variables as well
- Each Function maintains its own scope
- The keyword `clear` removes all variables from workspace
- The keyword `who` lists the variables

Matrices & Vectors

- All (almost) entities in MATLAB are matrices
- Easy to define:
- Order of Matrix –
  - m=no. of rows, n=no. of columns
- Use ',' or ' ' to separate row elements -- use ';' to separate rows

```
>> A = [16 3; 5 10]
  A =     16      3
           5     10
```

```
>> A = [-5 1 -8]
  A =     -5 1 -8
```

Defining vectors in MATLAB

```
>> A = [-5 1 -8]
```

- A → variable name

- How many rows are in A?

- How many columns are in A?

- A(1,1) = -5   A(1,2) = 1
        A(1,3) = ??

- How do we edit a vector?

Adding vectors in Matlab

```
>> A = [-5 1 -8]
```

```
>> B = [6 -3 4]
```

- To add
  - Define vector 1
  - Define vector 2

  - C = A + B; C = ??? (always define your solution as a variable, in case you need it in a later step)

- To subtract….

Dot and cross product, determinant

- `det(D)` : determinant of a square matrix

- `dot(A,B)`: dot product of two vectors
- `cross(A,B)`: cross product of two vectors

Useful trig functions

- Trigonometric and their inverse
  - cos(x)   acos(x)
  - sin(x)   asin(x)
  - tan(x)   atan(x)
  - cot(x)   acot(x)
  - csc(x)   acsc(x)
  - sec(x)   asec(x)
                   atan2(x,y)

Note that all of these are in radians

Cosd = cosine(# in degrees)

OR

Convert from radians to degrees
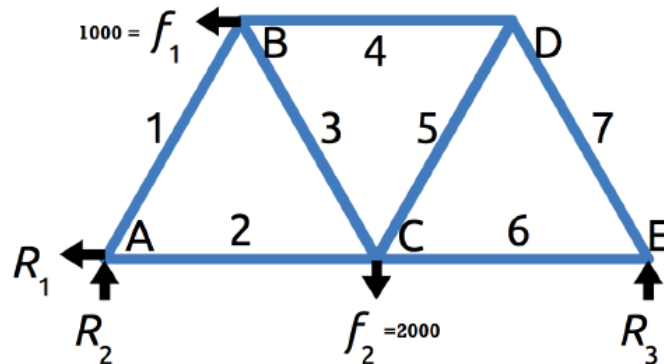rad2deg
Deg2rad
Do the math itself, pi is predefined in Matlab as "pi"

Solving linear equation

- Consider a truss problem: CS101 Lecture #24

$$0.5x_1 + x_2 = R_1 = f_1$$
$$0.866x_1 = -R_2 = -0.5f_2 - 0.433f_1$$
$$-0.5x_1 + 0.5x_3 + x_4 = -f_1$$
$$0.866x_1 + 0.866x_3 = 0$$
$$-x_2 - 0.5x_3 + 0.5x_5 + x_6 = 0$$
$$0.866x_3 + 0.866x_5 = f_2$$
$$-x_4 - 0.5x_5 + 0.5x_7 = 0$$

Solving linear equation

CS101 Lecture #24

$$\begin{pmatrix} 0.5 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0.866 & 0 & 0 & 0 & 0 & 0 & 0 \\ -0.5 & 0 & 0.5 & 1 & 0 & 0 & 0 \\ 0.866 & 0 & 0.866 & 0 & 0 & 0 & 0 \\ 0 & -1 & -0.5 & 0 & 0.5 & 1 & 0 \\ 0 & 0 & 0.866 & 0 & 0.866 & 0 & 0 \\ 0 & 0 & 0 & -1 & -0.5 & 0 & 0.5 \end{pmatrix} \underline{x} = \begin{pmatrix} 1000 \\ -1433 \\ -1000 \\ 0 \\ 0 \\ 2000 \\ 0 \end{pmatrix}$$

A·x=b