# Statics - TAM 211

**Lecture 42 – Final Class**

**May 1, 2018**

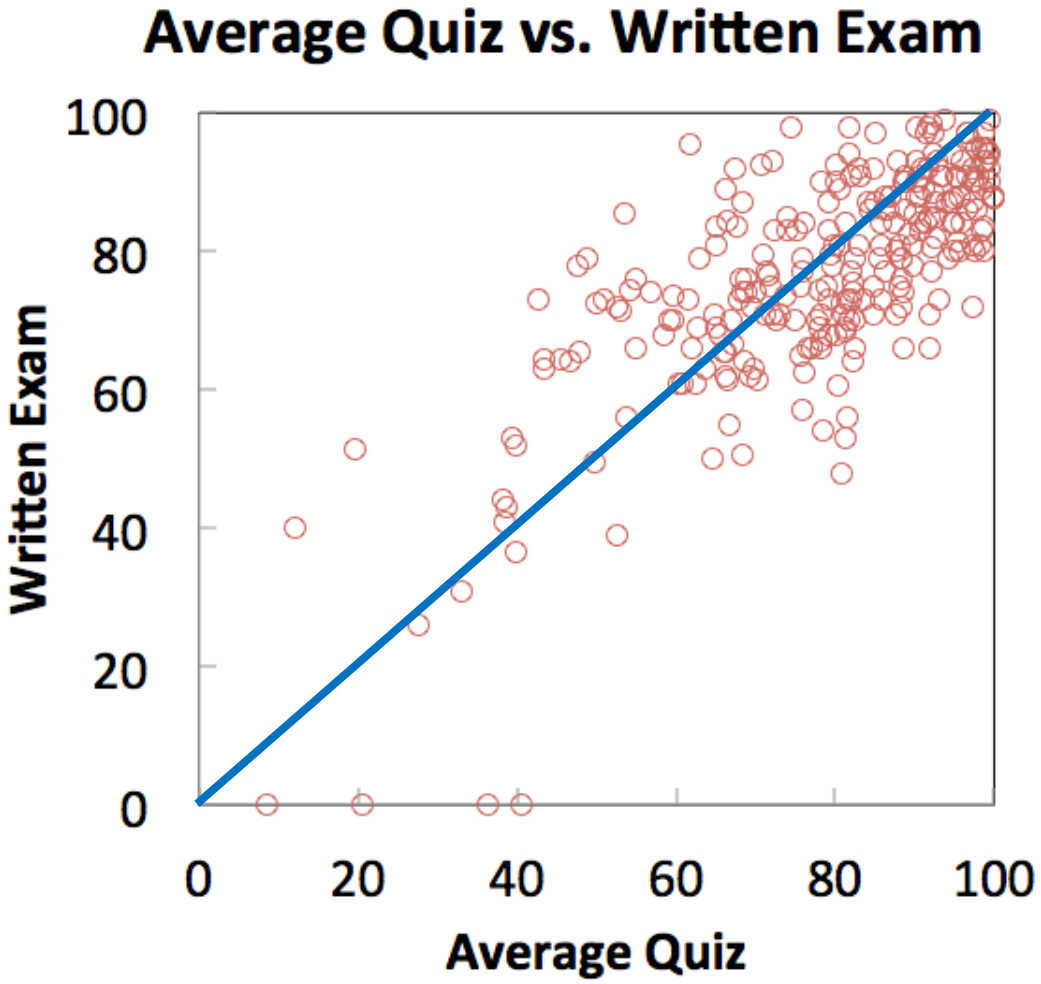
giphy.com

# Announcements

- Check ALL of your grades on Compass2g. Report issues
  - TAs will hold an **exam viewing session on Thursday May 3 from 9:00am – 2:00pm** in room **143 Mechanical Engineering Building (MEB).** Exams can be viewed. TAs will address grading questions. No pictures of exams.
- Upcoming deadlines:
  - Wednesday (5/2)
    - Written Assignment 6
  - Quiz 7
    - Fluid Pressure - Virtual Work
    - CBTF (Thurs-Tues: 5/3-8)
    - Reserve 3 hour time slot
    - Quiz is planned for 50 minutes
    - However CBTF will allow up to 3 hours

favim.com

Average of quizzes 1-5 with the lowest score dropped



# Grade distribution for TAM 210 & 211

In class i-Clickers: 3%

Discussion group activity: 8%

Online Tutorial (Mastering Engrg): 6%

Online Homework (PrairieLearn): 10%

Written Assignments: 8%

Quizzes (@ CBTF ): 40% (Drop Lowest)

Exam: 25%

Concept Inventory (EC): #1 or #2 for 0.5%, both for 1.5%

# Grade distribution

**Final grades:** The total score *s* corresponds to final grades as follows.

| | | |
|---|---|---|
| $97\% \le s \le 100\%$ A+ | $92\% \le s < 97\%$ A | $89\% \le s < 92\%$ A- |
| $86\% \le s < 89\%$ B+ | $82\% \le s < 86\%$ B | $79\% \le s < 82\%$ B- |
| $76\% \le s < 79\%$ C+ | $72\% \le s < 76\%$ C | $69\% \le s < 72\%$ C- |
| $66\% \le s < 69\%$ D+ | $59\% \le s < 66\%$ D | $55\% \le s < 59\%$ D- |
| $s < 55\%$ F | | |

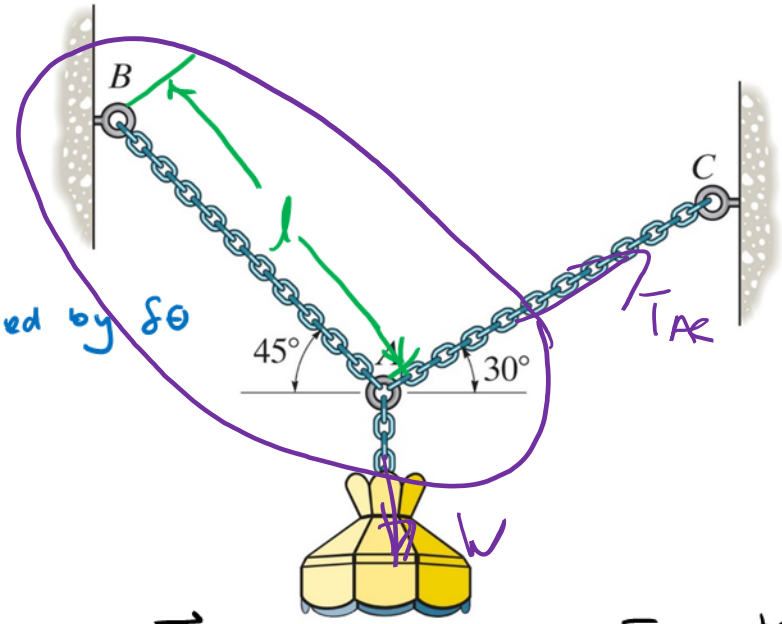
**Grades:** on Compass2g

- Any errors in grade reporting on Compass must be reported within 2 weeks of the due date or by the last day of class, whichever is earlier.
- Missing grade for discussion section or a written report, contact appropriate TA (personally or via Piazza).
- Missing grade from online tutorial or homework, exam, or i>clicker, contact the instructor (via Piazza).

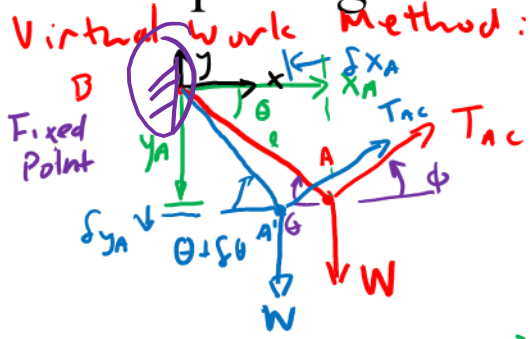
# Chapter 11: Virtual Work

Determine the tension in the cable $AC$.

The lamp weighs 10 lb.




Virtual Work Method:




$\phi$ stays the same when $\theta$ is deflected by $\delta\theta$

$\vec{x}_A = l\cos\theta\,\hat{i} \rightarrow \delta\vec{x}_A = -l\sin\theta\,\delta\theta\,\hat{i}$

$\vec{y}_A = -l\sin\theta\,\hat{j} \rightarrow \delta\vec{y}_A = -l\cos\theta\,\delta\theta\,\hat{j}$

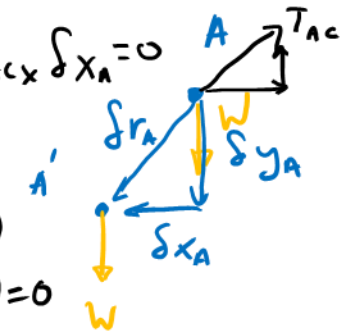
$\vec{W} = -W\hat{j}$

$\vec{T}_{AC} = T_{AC}\cos\phi\,\hat{i} + T_{AC}\sin\phi\,\hat{j}$

$\vec{T}_{AB}$ : No force due to cable AB since ~~it does not move.~~ we are assuming that AB is a link within the control volume and $\vec{T}_{AB}$ does not work.

Virtual work:

$$\delta U = \delta\vec{F}\cdot d\vec{r}$$
$$= W\,\delta y_A + T_{ACy}\,\delta y_A + T_{ACx}\,\delta x_A = 0$$



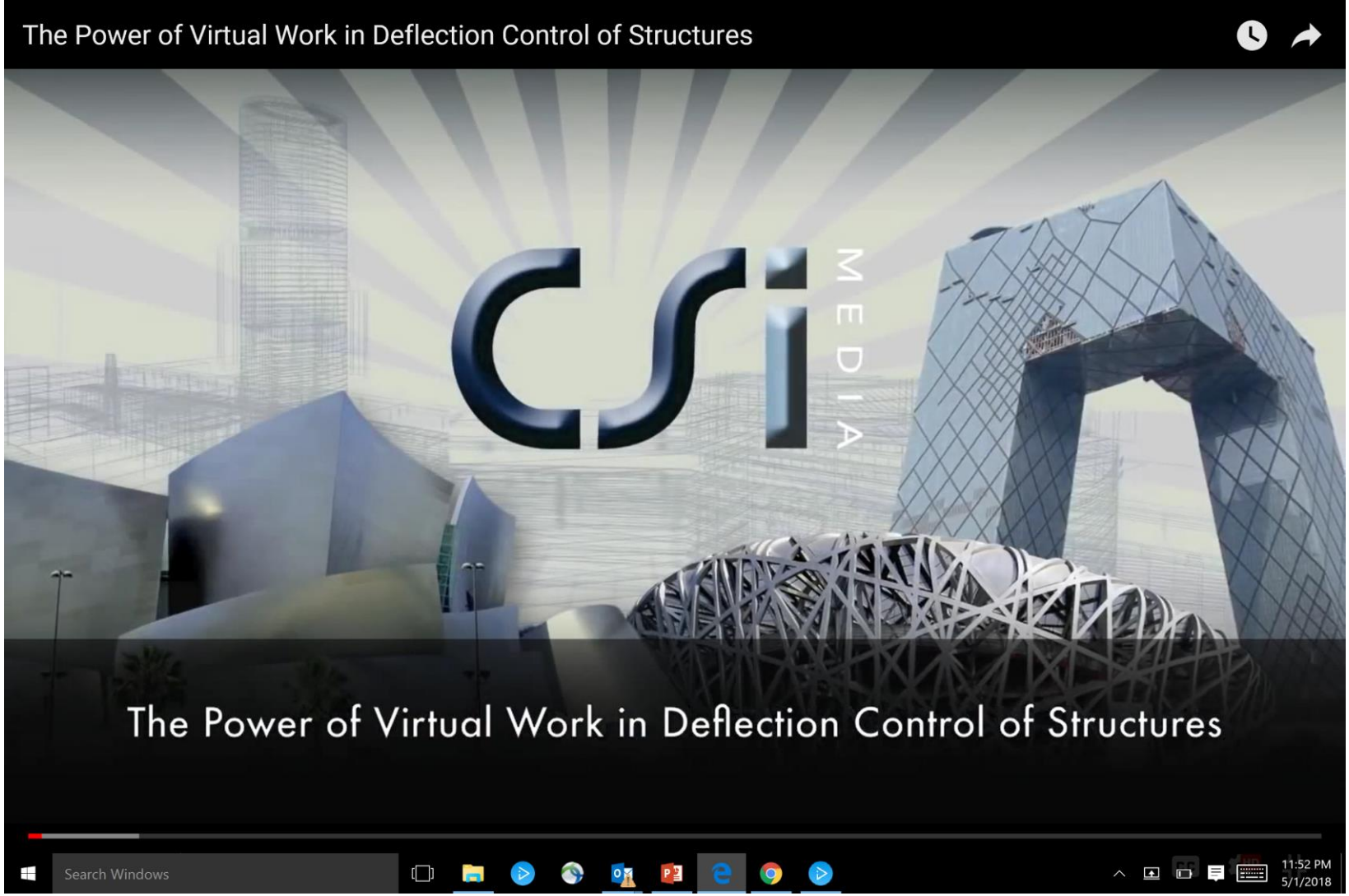

$$-W(-l\cos\theta\,\delta\theta) + T_{AC}\sin\phi\,(-l\cos\theta\,\delta\theta) + T_{AC}\cos\phi\,(-l\sin\theta\,\delta\theta) = 0$$

$$\underbrace{(+W\cos\theta - T_{AC}\sin\phi\cos\theta - T_{AC}\cos\phi\sin\theta)}_{\text{set}=0}\,l\,\delta\theta = 0$$

$$\Rightarrow T_{AC}(\sin\phi\cos\theta + \cos\phi\sin\theta) = W\cos\theta$$

$$\boxed{T_{AC} = \frac{W\cos\theta}{\sin\phi\cos\theta + \cos\phi\sin\theta}}$$

✓ same as before w/ $W = 10$ lb, $\phi = 30°$, $\theta = 45°$




Explanation of virtual work and its application to building design by Ashraf Habibullah is a structural engineer and software developer, best known as the founder, President, and CEO of Computers and Structures, Inc., a structural and earthquake engineering software company based in Berkeley, California.

**The Power of Virtual Work in Deflection Control of Structures**

https://youtu.be/LkyBlEuCrBE

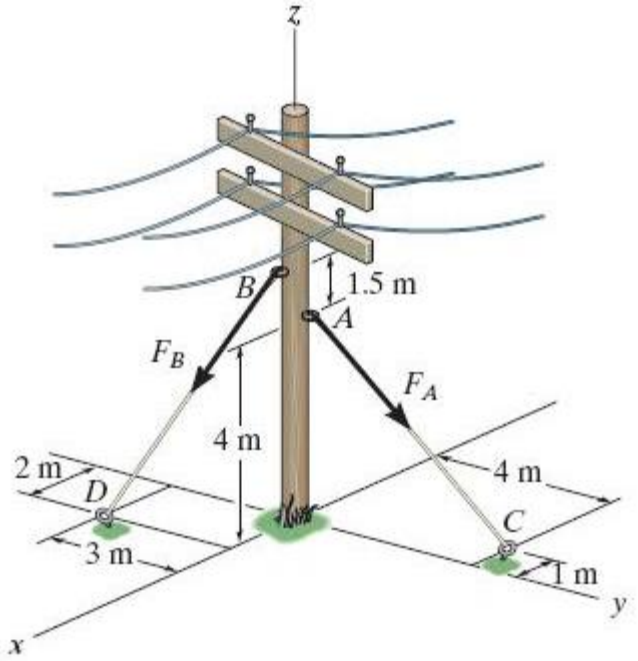
# Course Overview

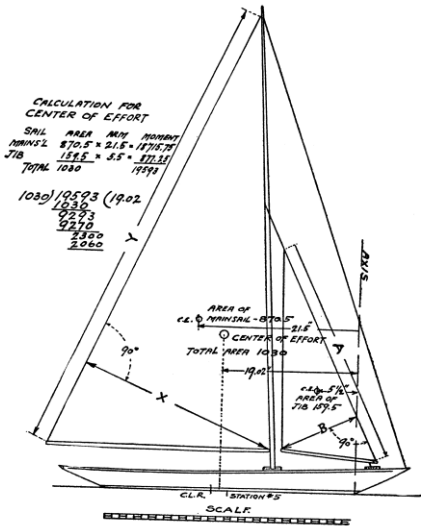
**Description:** In this course, we will cover fundamental concepts that are used in every engineering discipline. We will begin with forces, moments and move towards structural analyses of frames, devices, and machines. By the end, you will be able to solve rigid body mechanics problems that will inform the design of everything from bridges to biomedical devices.

**Big Idea:** Clear knowledge of external forces (boundary conditions) is required to determine what constraints are necessary for the safe (static equilibrium) development and design of any widget. Free body diagrams are an essential tool for understanding the forces and moments on a body.

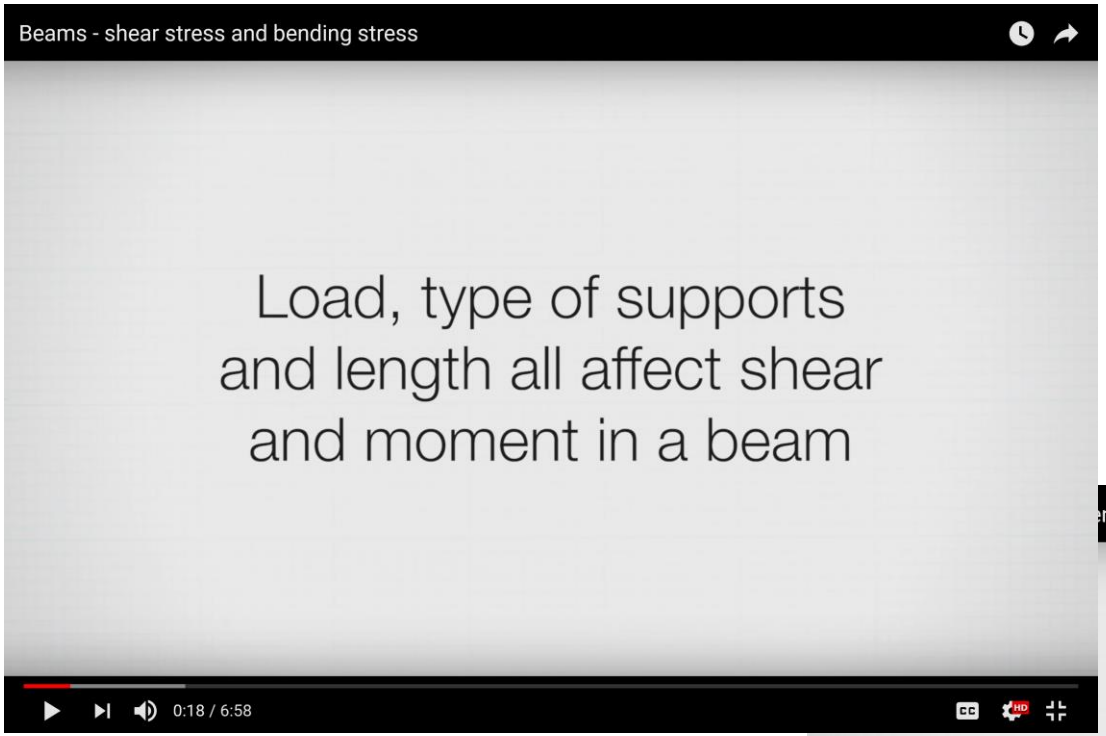
Chapter 1: General Principles
Chapter 2: Force Vectors
Chapter 3: Equilibrium of a particle
Chapter 4: Force System Resultants
Chapter 5: Equilibrium of (2D & 3D) Rigid Bodies
Chapter 6: Structural Analysis
Chapter 7: Internal Forces
Chapter 8: Friction
Chapter 9: Centroids, Fluid Pressure
Chapter 10: Moment of Inertia
Chapter 11: Virtual Work

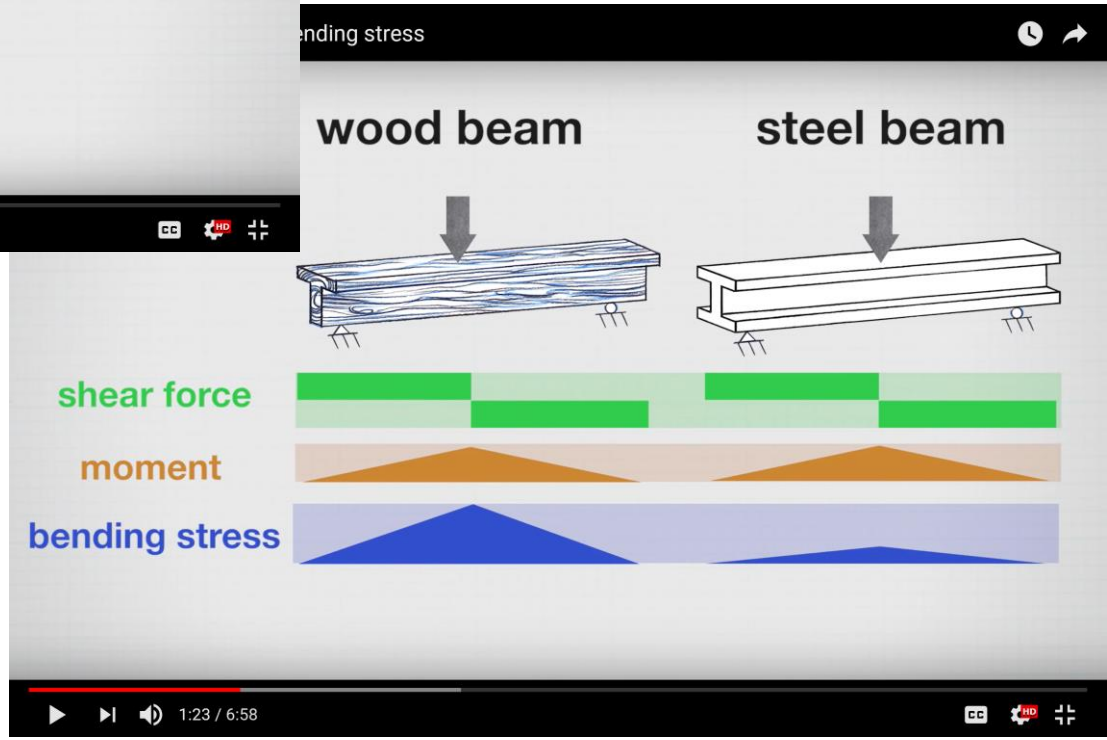
# Chapter 2: Force vectors along a line




# Chapter 7: Internal Forces / Chapter 10: Moment of Inertia




DartmouthX - The Engineering of Structures Around Us

https://youtu.be/CBWoJr9QgEE

# Chapter 6: Structural Analysis


6 bridge failures from the CIVL 260 course on Nov. 25, 2009 (the ones that didn't fail were boring). Each of the 15 groups designed a bridge from a limited amount of wood to span 8 ft(2.44m) and support a minimum of 60 kg (132 lb). The bridges were tested by loading 10kg (22lb) sandbags one at a time up to 100kg (220lbs). https://youtu.be/EYGm4vKOvRE

# Chapter 9: Fluid Pressure


**The Science of Water Pressure | History Channel**

https://youtu.be/0B0EhuxJsts


THANK
YOU