The Collapse Of The Quebec Bridge

SFWR ENG 3J03

2003

Ahalika Nava

Agenda

- History
- Hierarchical Management Structure
- Progress of the Bridge
- The Day of the Collapse
- Investigation
- Case Analysis
- Spin-off of the disaster: The Iron Ring
- Conclusion
- Endnotes
- Bibliography
- Open Discussion (Question answer period)

History

- In 1882 Quebec Bridge Company was granted the contract for the bridge
- Due to short finance , nothing was done until 1887 when Quebec Bridge was incorporated with the Railway Company
- Now the new management demanded to get the project rolling a.s.a.p. and Theodore Cooper, the most reputed engineer of that time became the main consulting engineer for the project

- Construction was contracted to : Phoenix Bridge Company

- Initial design was produced by: Peter Szlapka , which was reviewed and approved by Cooper.

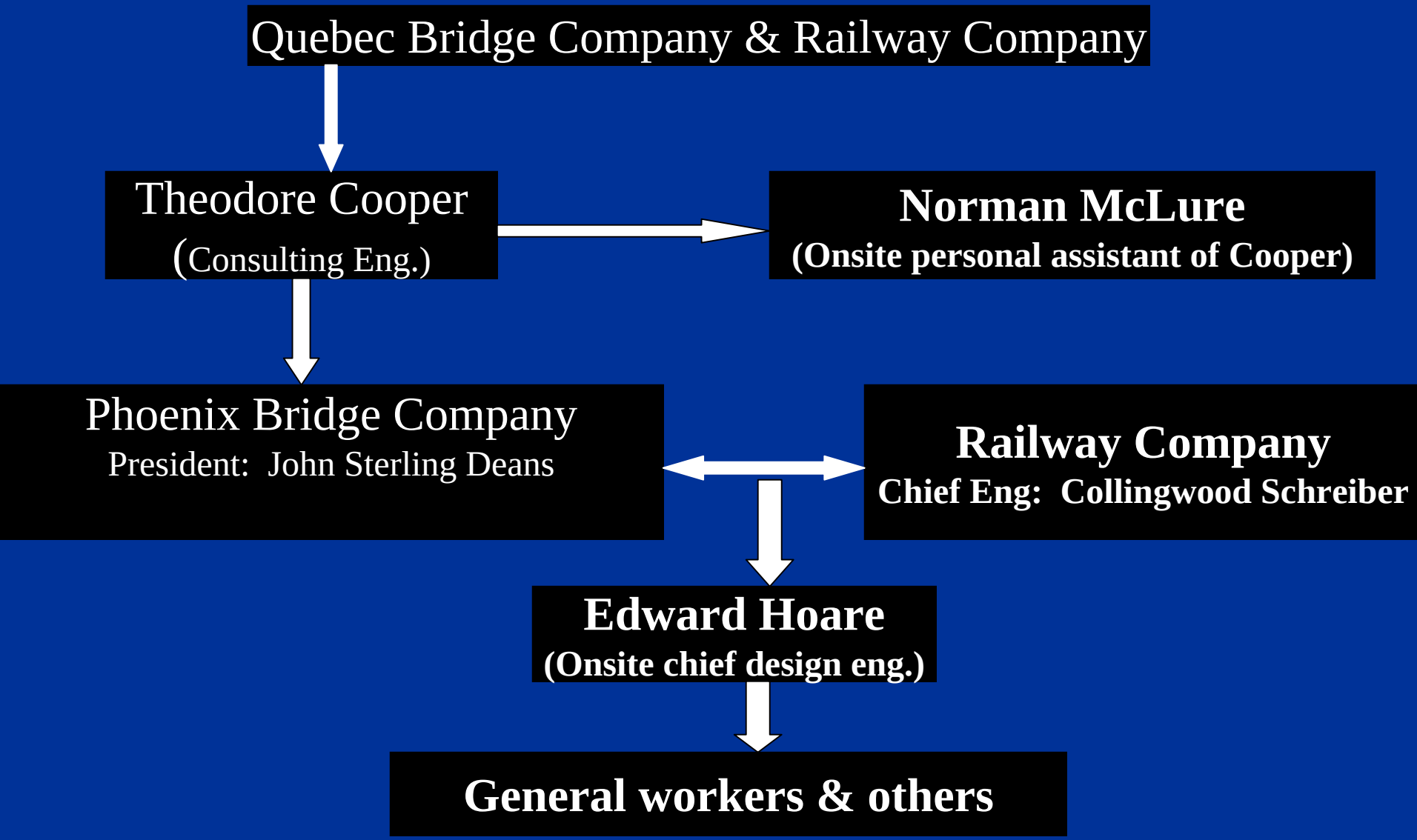
- Upon Cooper's recommendation the "loading of the bridge…[was increased]…by extending the length of the center span from… [1,600 to 1,800 feet]." [1]

- The reason being is that "Piers constructed in deeper water would be subject to the heavy ice floes of the main channel. Closer to shore, they would be less vulnerable…[so, it's quicker to build] ,…speeding up the completion of the entire work by at least one year.

- To keep down the increased cost of steel in the superstructure…, Cooper recommended… modified specifications that would allow for higher unit stresses.”[2]
- Again there was a slack time until “…1903 [when]… Canadian Government… [granted]… $ 6.7 million.” [3]

- Things started speeding up again and to fabricate the steel with no more loss of time …” there was no re- computation of assumed weights for the bridge under the revised specification”. [4]
- Cooper did not intervene. He decided to accept the theoretical estimates of the Phoenix Company”, without review!

Hierarchical Management Structure



Progress Of The Bridge

- Cooper hardly visited the site as his health declined
- In 1903 Collingwood (Railway Eng.) wanted the department to hire another Consulting Engineer to review Cooper's work
- Cooper was annoyed and refused of any sort of subordination.
- In 1903 Robert Douglas (Eng. Of Railway) criticized the high unit stresses on the bridge.

- **Nothing was done as "… confidence in Cooper was the byword just then…".** 5

- **On Feb 1, 1906 E.L. Edwards (inspector) notified Cooper of the actual weight of the steel in the bridge to be way over initial estimation.**

- **Cooper considered the weight to be still within reasonable limits**

- **In June 1907 McLure reported buckling at 7-L and 8-L compression chords and later 8-L and 9-L chords were found bent**

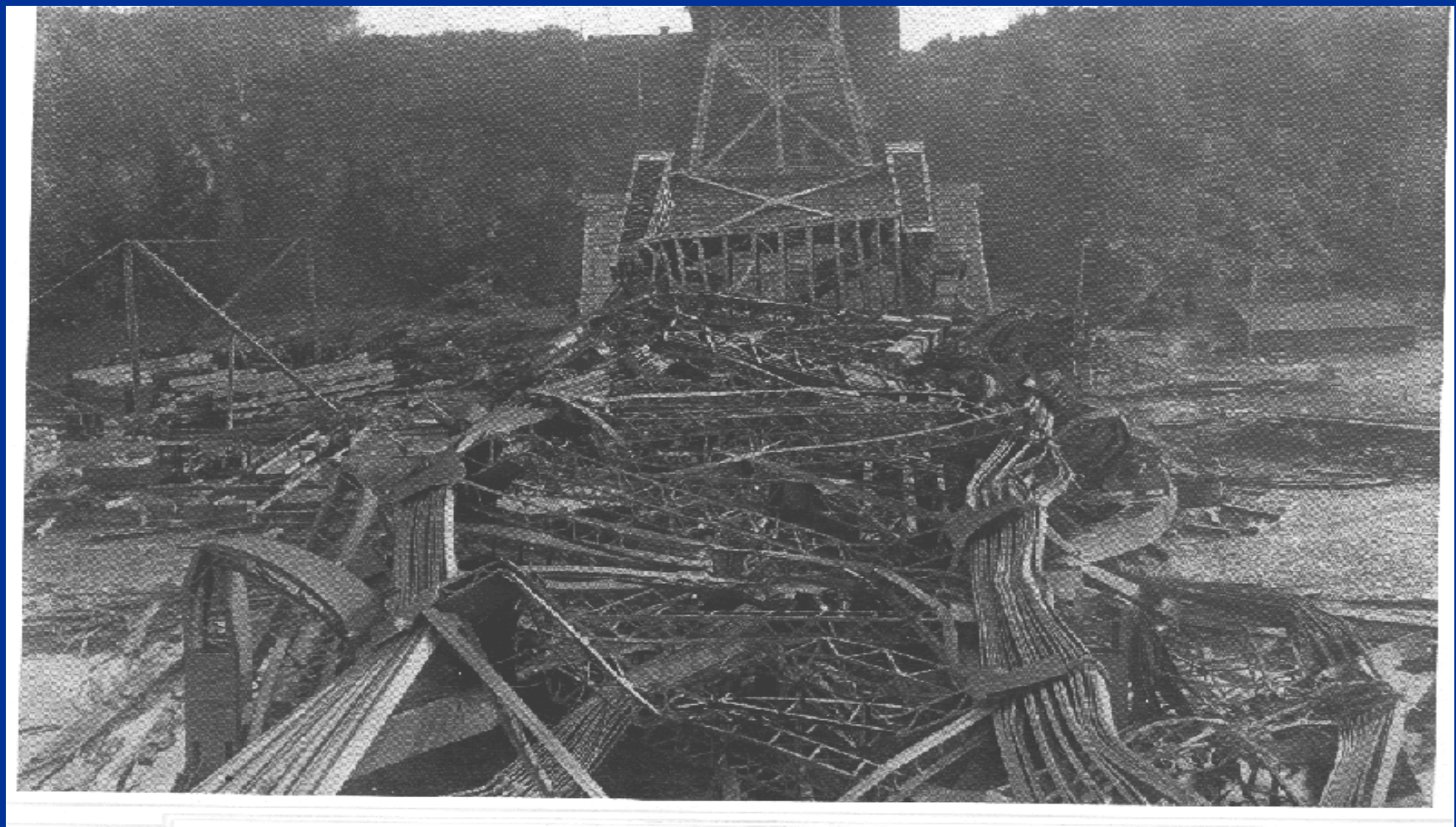
- **On Aug 27, 1907 9-L chord which was " three quarters of an inch out of line"….was now " two & one quarter inches ", out of line.** 6

- **Work was freezed for that day and McLure wrote to Cooper.**

The Day Of The Collapse

- **Work resumed as Hoare saw no immediate danger**
- **McLure met Cooper at New York and notified the increased deflection in 9-L, and immediately Cooper sent a telegram to Pheonixville which read: " Add no more load to bridge till after due consideration of facts."** 7
- **"Telegram reached at 3:00 pm, John Deans read it and disregarded it"** 8
- **Bridge collapsed at: 5:15 pm, Aug 29,1907**
- **" Eighty five workers crashed into the water, [and] only 11 survived."** 9

The Collapse



Investigation

- **Royal Commission which was appointed by the government to inquest the case concluded that "failure is attributed… [to the] errors in judgment on the part of these two engineers", Cooper and Szlapka.** [10]

- **John Deans was criticized for poor judgment and Bridge Company for " appointing the unqualified Edward Hoare as responsible engineer at the site."** [11]

Case Analysis

- **Stakeholders:** Government, Quebec & Railway Company, Phoenix Company, Cooper and Szlapka along with other engineers, workmen, and public.

- Causes for failure
  1) Short Finance
  2) Time Constrain
  3) Negligence to follow proper professional procedures:
     i.e: - disregard for re-computations of revised specs.
     - Dean disregarding the telegram of Cooper
  4) Ego of Cooper, i.e: refusing subordination and stopping the drafts to be individually reviewed

Broken Laws of ethics

- "It is the duty of a practitioner to the public, to the practitioner's employer, to the practitioner's clients, to act at all times with":
  - Fairness and loyalty to associates, clients & employer
  - Fidelity to public needs
  - Devotion to high ideals of personal honor & professional integrity
  - Knowledge of developments in the area of professional engineering relevant to any services that are undertaken, and
  - Competence in the performance… 12

- “Practitioner must co-operate in working with other professionals engaged on a project” . 13

Broken Laws and associated engineers

Fidelity to public	Loyalty to associates	Competence in performance	Co-operation to other professionals
Cooper Szlapka	John Dean	Edward Hoare	Cooper

Spin-Off of the Collapse: The Iron Ring

(The Ritual of the calling of an Engineer)

- Initiated in 1922 by seven Engineers
- Purpose: to motivate consciousness of the profession and to emphasize the need for the engineers to abide by the Professional Code of Ethics
- Worn in: the pinky finger of the working hand as a constant reminder of the importance of preserving human lives
- Copyrighted: in Canada and US

Conclusion

Lessons to be learned:

- Always place public safety at the forefront of your professional consciousness
- Maintain professional behavior and never let ego get the better of you
- Co-operate and respect your associates
- Welcome professional criticisms &
- All in all, have high standard of professional conduct, be true to yourself in terms of your capabilities and follow the Code of Ethics.

EndNotes

- John Tarkov, “Prelude to Failure”, Carleton page, http://www.civeng.carleton.ca/ECL/reports/ECL270/Prelude.html, Feb 26,2003
- John Tarkov, “Prelude to Failure”, Carleton page, http://www.civeng.carleton.ca/ECL/reports/ECL270/Prelude.html, Feb 26,2003
- John Tarkov, “Prelude to Failure”, Carleton page, http://www.civeng.carleton.ca/ECL/reports/ECL270/Prelude.html, Feb 26,2003
- John Tarkov, “Prelude to Failure”, Carleton page, http://www.civeng.carleton.ca/ECL/reports/ECL270/Prelude.html, Feb 26,2003
- John Tarkov, “Prelude to Failure”, Carleton page, http://www.civeng.carleton.ca/ECL/reports/ECL270/Prelude.html, Feb 26,2003
- John Tarkov, “Prelude to Failure”, Carleton page, http://www.civeng.carleton.ca/ECL/reports/ECL270/Prelude.html, Feb 26,2003
- John Tarkov, “Falling Slowly—Slowly Falling”, Carleton page, http://www.civeng.carleton.ca/ECL/reports/ECL270/Prelude.html, Feb 27,2003
- John Tarkov, “Falling Slowly—Slowly Falling”, Carleton page, http://www.civeng.carleton.ca/ECL/reports/ECL270/Prelude.html, Feb 27,2003
- John Tarkov, “Falling Slowly—Slowly Falling”, Carleton page, http://www.civeng.carleton.ca/ECL/reports/ECL270/Prelude.html, Feb 27,2003
- John Tarkov, “The Judgment”, Carleton page, http://www.civeng.carleton.ca/ECL/reports/ECL270/Prelude.html, Feb 26,2003
- John Tarkov, “The Judgment”, Carleton page, http://www.civeng.carleton.ca/ECL/reports/ECL270/Prelude.html, Feb 26,2003

- The Code of Ethics of Professional Engineers Ontario, “What is code of ethics”, Section 77 or Regualtion 941, http://www.peo.on.ca/Ethics/ethics.html, Mar 2,2003
- The Code of Ethics of Professional Engineers Ontario, “Professional Engineers Ontario Code of Ethics, section 77 of the O.Reg. 941”, http://www.peo.on.ca/Ethics/ethics.html, Mar 2,2003

Bibliography

- Ralph Modjeski, H.P.Borden. C.N Monsarrat, “The Quebec Bridge”,Ottawa, May 31, 1919.
- John Tarkov, “A Disaster in the making”, Carleton page, http://www.civeng.carleton.ca/ECL/reports/ECL270/Disaster.html, Feb 27,2003
- By the Department of Material Science and Engineering, “ Engineering Disaster: Learning from Failures.”, http://www.matscieng.sunysb.edu/disaster/
- “Structural Engineering”, http://www.eng.ucalgary.ca/CSCE-Students/structural_bridges_Canada.htm
- “ Not designed by U of T grads”, http://www.civ.toronto.edu/funstuff/disaster/quebec.htm
- Globe & Mail, yr.1907

- The Code of Ethics of Professional Engineers Ontario, “What is code of ethics”, Section 77 or Regualtion 941, http://www.peo.on.ca/Ethics/ethics.html, Mar 2,2003
- The Code of Ethics of Professional Engineers Ontario, “Professional Engineers Ontario Code of Ethics, section 77 of the O.Reg. 941”, http://www.peo.on.ca/Ethics/ethics.html, Mar 2,2003