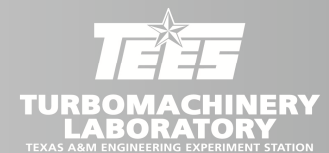


Torsional Rotordynamics of Machinery Equipment Strings

By

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Torsional Rotordynamics of Machinery Equipment Strings

SECTION 1: INTRODUCTION

Presented by: Mark A. Corbo, P.E.



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Effects of Uncontrolled Torsional Vibration

- Broken shafts
- Failed couplings
- Fractured gear teeth
- Blade failures
- Worn gears and splines



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Free Torsional Vibration of Two-Disk System

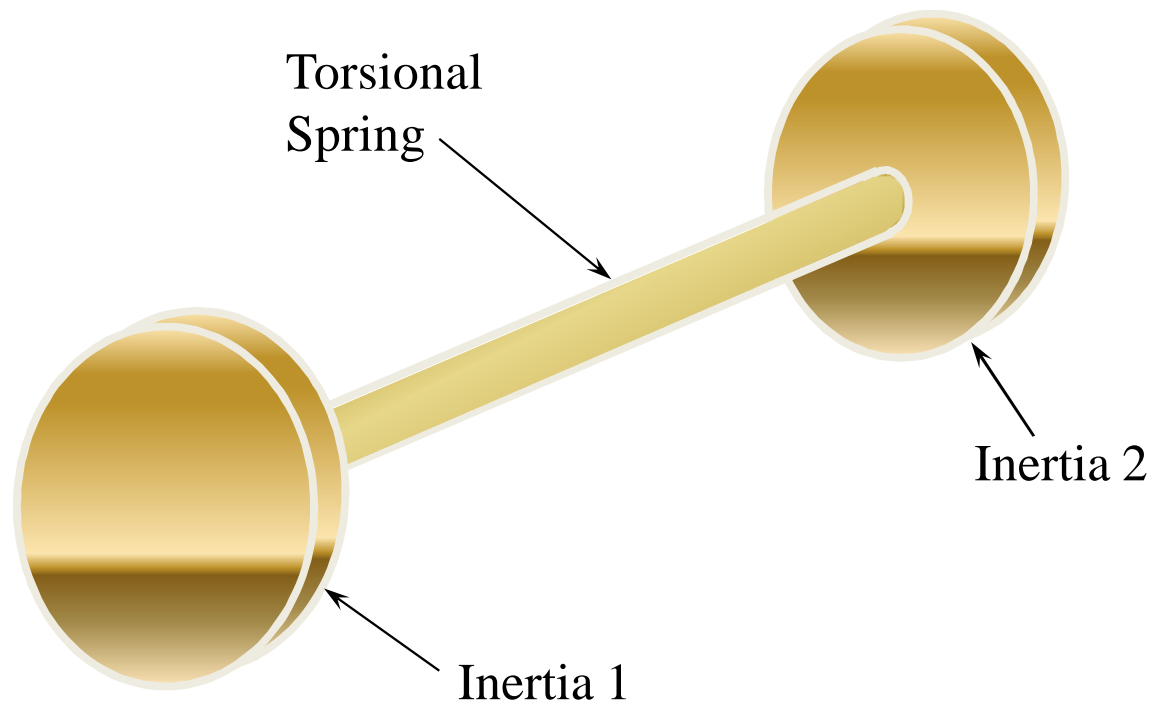
- Remove all external torques acting on system
- Disks vibrate out-of-phase about free position
- With no damping, oscillations continue indefinitely
- Vibrations have no impact on shaft speed
- Vibrations always occur at natural frequency
- Disks are analogous to masses; shaft is analogous to spring



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Two Inertia Torsional System



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Forced Torsional Vibration of Two-Disk System

- Apply sinusoidal torque to either of the disks
- Disks vibrate about equilibrium position
- Vibration occurs at excitation frequency
- Vibrations have no impact on shaft speed
- All elements experience sinusoidal fluctuations in torque and speed
- Induced shaft torque is dependent on frequency ratio



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Empirical Observations

- Turbomachinery failures are often caused by torsional vibration
- Torsional failures often occur without warning
- Most failures involve fundamental mode
- Most engineers know how to calculate natural frequencies
- Many engineers try to avoid resonant conditions at all costs
- Some engineers try to treat reciprocating systems and rotary systems in same manner
- Most torsional vibration problems are preventable



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Two Basic Types of Torsional Systems

1. Rotary Systems

- Motor-driven centrifugal compressors/pumps
- Turbine-driven centrifugal compressors/pumps

2. Reciprocating Systems

- Motor-driven reciprocating compressors/pumps
- Engine-driven centrifugal compressors/pumps
- Engine-driven reciprocating compressors/pumps



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Items to be Covered

- Introduction - Mark
- Basics of problem avoidance - Brian
- Achieving separation margins - Justin
- Steady-state response analysis - Brian
- Transient response analysis - Mark
- Machinery specific considerations - Brian



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Items to be Covered (Cont.)

- Variable frequency drives - Mark
- Reciprocating machinery - Justin
- Torsional testing - Justin
- Field problems/case studies – All



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