Helical Strakes:
Coverage Length & Density Considerations

VIV Solutions

VIV suppression benefits of helical strakes on a deepwater tubular can be optimized by pre-determining the amount and location of strakes prior to installation.

Ascertaining how much of a tubular to cover with suppression becomes a critical question when utilizing helical strakes. Often it is not possible to fully cover a tubular due to connectors, anodes, and other appurtenances. There are also important questions regarding the performance of helical strakes when only a portion of the tubular is covered, for example when the top portion of a tubular is straked and the remainder is left bare.

For many of the world's oceans, currents decay fairly monotonically with depth. This means that helical strake coverage length determination is primarily a computation of the depth to which helical strakes should be installed. While this computation may be performed using a popular VIV response prediction model such as SHEAR7, the program requires experimental calibration data to produce an accurate result. To date, most VIV response prediction programs cannot compute the effect of helical strake coverage length or density with sufficient accuracy.

In order to better understand the effects of strake coverage length, VIV Solutions team members performed VIV tests of a long tubular in sheared flow at prototype Reynolds numbers with mode numbers in excess of 15. The nearly 100-foot long pipe section was towed in a circular basin around a center pivot point, therefore allowing the outer portion to experience the highest flow speeds (mimicking stronger ocean currents near the top of the water column).

Two biaxial accelerometers were scientifically placed at the anti-node locations near the inner and outer ends of the pipe in order to measure peak vibrations. Acceleration data points incorporate both displacement and frequency information, hence they most closely represent the fatigue-inducing bending stresses associated with VIV.

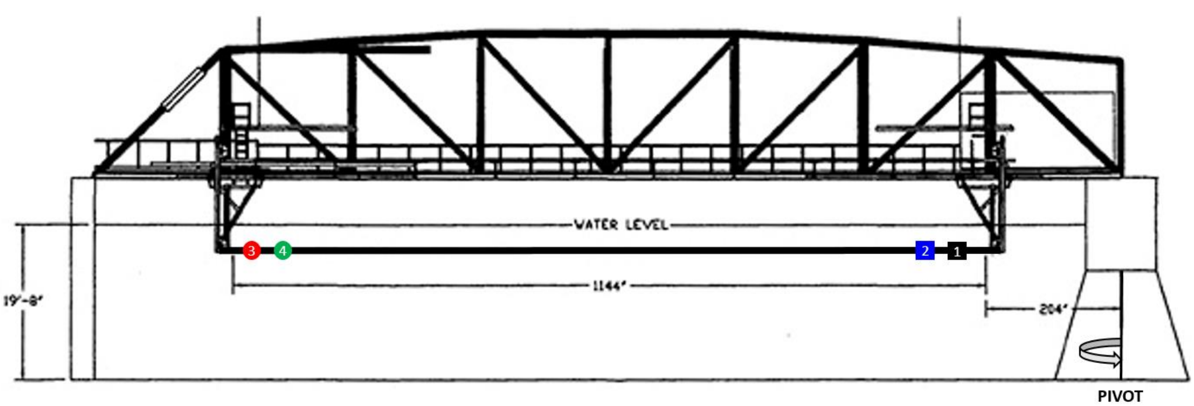
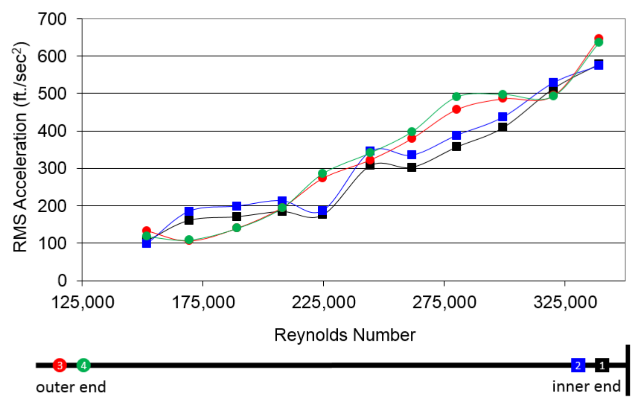
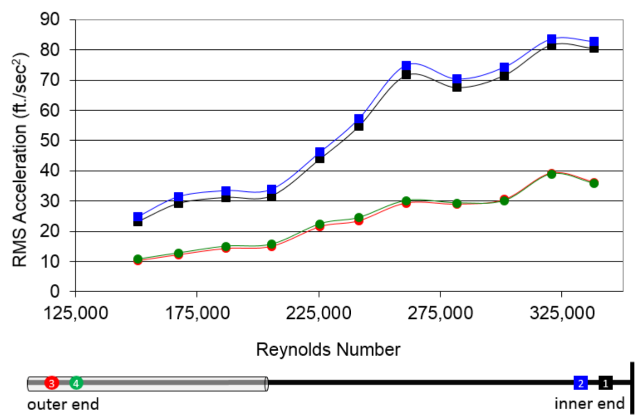
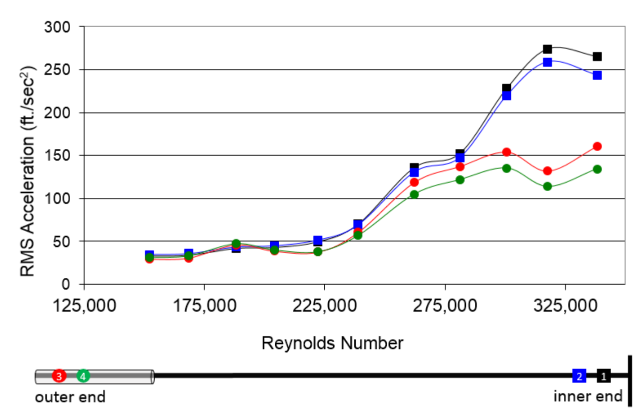


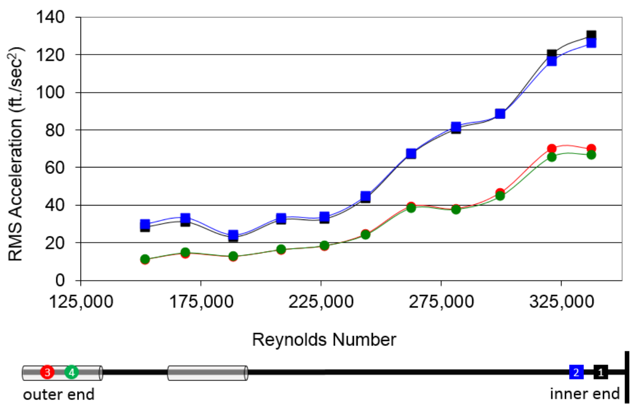
Figure 1 – Rotating Arm Diagram

The bare cylinder was tested along with various coverage lengths and densities of helical strakes (each with a 17.5D pitch and a 0.25D fin height). The table below provides an overview of the corresponding results. Note the presence and location of helical strakes depicted by the grey cylinder(s) in each illustration.

Table 1 – Helical Strake Test Configurations

Bare Pipe (No Strakes)		• Nearly linear increase in acceleration at both ends of the tubular as Reynolds number (speed) increases • Close to the same level of vibration and both the inner and outer ends, which indicates a low level of system damping
37.2% Coverage at Outer End		• Accelerations at the inner end are larger than those at the outer end (attributable to vibrations originating from the remaining section of 80% bare pipe) • Accelerations at the outer end are reduced by well over 90% for the highest Reynolds numbers (i.e., the highest current speeds) • Accelerations at the inner end are reduced by about 80% • Confirms that VIV Solutions' helical strake design effectively reduces vortex-induced vibrations
18.6% Coverage at Outer End		• Outer end accelerations are at least 75% lower than the corresponding bare cylinder accelerations • Inner end accelerations are approximately 50% lower than the bare cylinder condition • Still an adequate amount of VIV reduction achieved with minimal strake coverage

26.7% Split Coverage at Outer End



- If the middle 10.5% strakes are removed for the the 37.2% coverage case the performance of the strakes remains quite high at both the inner and outer ends
- While this arrangement is not as effective as the configuration with a full continous 37 percent coverage length, it illustrates that a high degree of suppression efficiency can be obtained with less than full coverage density

While helical strakes are a little more sensitive to coverage density than fairings, it is still possible to obtain good VIV suppression with a helical strake density that is less than 100 percent. VIV Solutions recommends a coverage density greater than 70 percent for standard fairings and a coverage density of no less than 85 percent for helical strakes. This information is extremely beneficial when considering the quantity of suppression devices required to improve a tubular's fatigue life.

VIV Solutions' helical strakes are engineered to induce random shedding of vortices along a tubular as the oncoming current encountesr the strake's helically wrapped fins. The flow disruption prevents adjacent vortices from correlating along a straked tubular's span. Alternate strake geometries (such as a 16D pitch, for example) are available upon request and may provide similar performance results.

While the exact optimal density and coverage length may be different for non-linear current profiles, the high Reynolds number test results shown herein are useful for both riser model calibrations and obtaining a qualitative sense of how helical strakes should be arranged over actual tubulars in the field.

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