Fairings:
Coverage Length & Density Considerations

Fully covering a deepwater tubular with fairings can prove to be impractical, thus it is important to optimize the quantity of fairings required as well as their placement along the tubular to maximize VIV suppression benefits.

While the application of fairings can both increase a tubular's fatigue life and decrease drag, it is not always possible or economical to fully cover a tubular with fairings. Aside from the desire to minimize the cost of VIV suppression by only covering the necessary portion of a span, the presence of connectors, anodes, and other appurtenances can restrict the ability to install fairings over the entire length. It is therefore critical to understand how much of a tubular's span should be covered with fairings in order to render a partial coverage system effective.

Many of the world's ocean currents decay fairly monotonically with depth. This means that fairing coverage is primarily a computation of the depth to which fairings should be installed. This estimation may be performed using a popular VIV response prediction model such as SHEAR7; however, the program requires experimental calibration data to produce an accurate result. To date, most VIV response prediction programs cannot compute the effect of fairing coverage length or density with sufficient accuracy.

In order to better understand the effects of fairing 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.

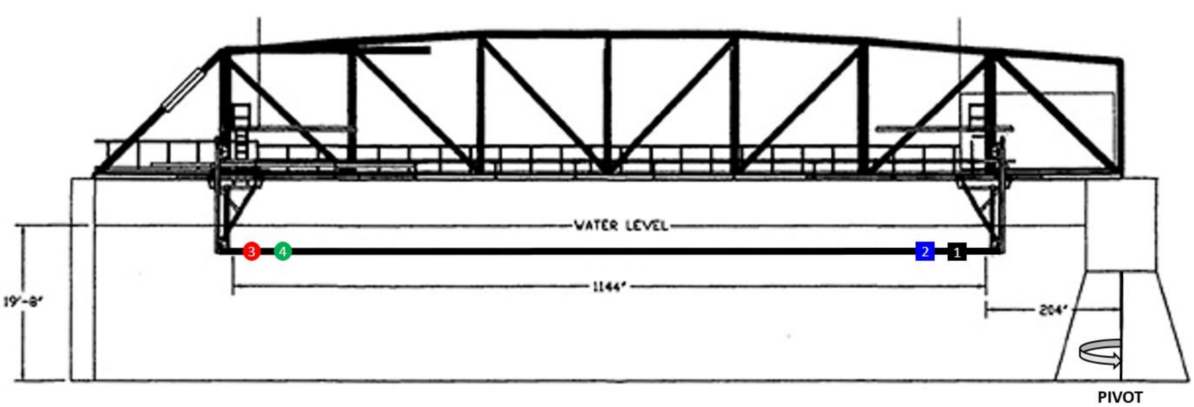
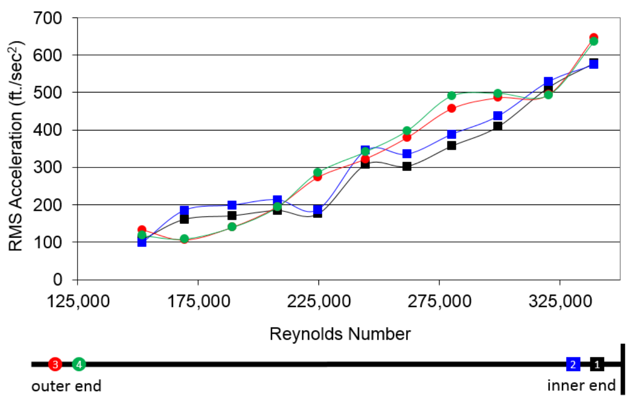
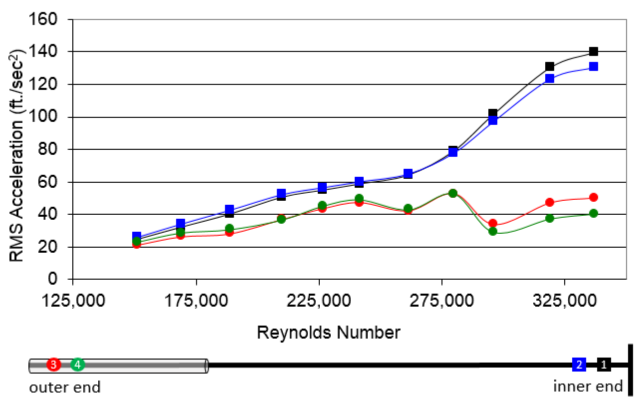
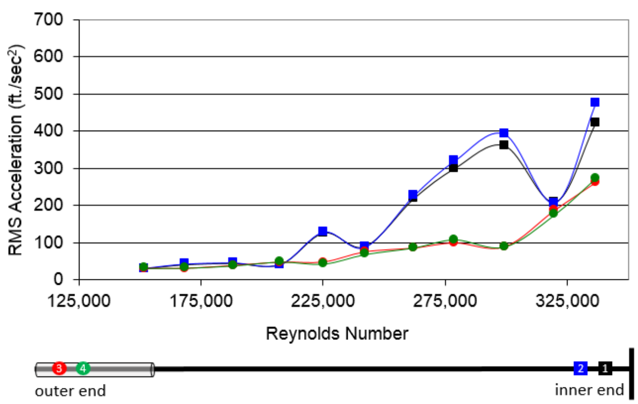


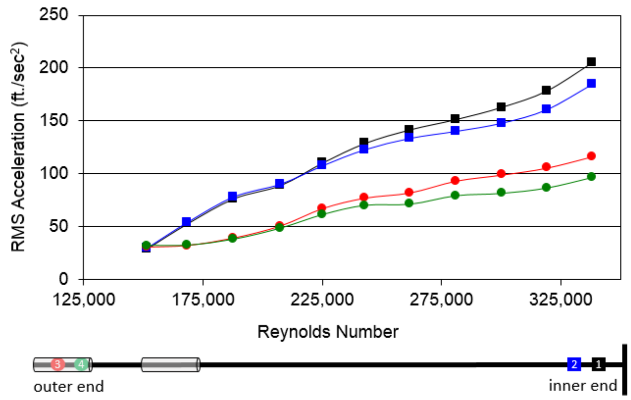
Figure 1 – Rotating Arm Diagram

The bare cylinder was tested along with various coverage lengths and densities of fairings. The table below provides an overview of the corresponding results. Note the presence and location of fairings depicted by the grey cylinder(s) in each illustration.

Table 1 – Fairing Test Configurations

Bare Pipe (No Fairings)		• 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
30% Coverage at Outer End		• Accelerations at the inner end are larger than those at the outer end (attributable to damping imposed by fairings and vibrations originating from the remaining section of 70% bare pipe) • Outer end accelerations are 90% lower than the corresponding bare cylinder accelerations • Inner end accelerations are almost 80% lower than the bare cylinder condition • Confirms that VIV Solutions' short fairing design effectively reduces vortex-induced vibrations
20% Coverage at Outer End		• Accelerations at the inner end are reduced by only 20-40% • Accelerations at the outer end are reduced by just over 50% for the highest Reynolds numbers (i.e., the highest current speeds) • Evident that this particular configuration of fairing coverage provides inadequate VIV reduction

20% Split Coverage at Outer End



- If the fairings for the 20% coverage case are spread apart (in this case into two separate sections), the performance of the fairings is substantially improved at both the inner and outer ends
- While this arrangement is not as effective as the configuration with a full continous 30 percent coverage length, it illustrates that a fair degree of suppression efficiency can be obtained with less than full coverage density

Another test to determine the effects of fairing coverage density was performed by spreading various segments of fairings over the outer 37% of the test cylinder. The results are shown below. (Note that the efficiency is still limited since only the outer 37% of the test cylinder was covered with fairings.)

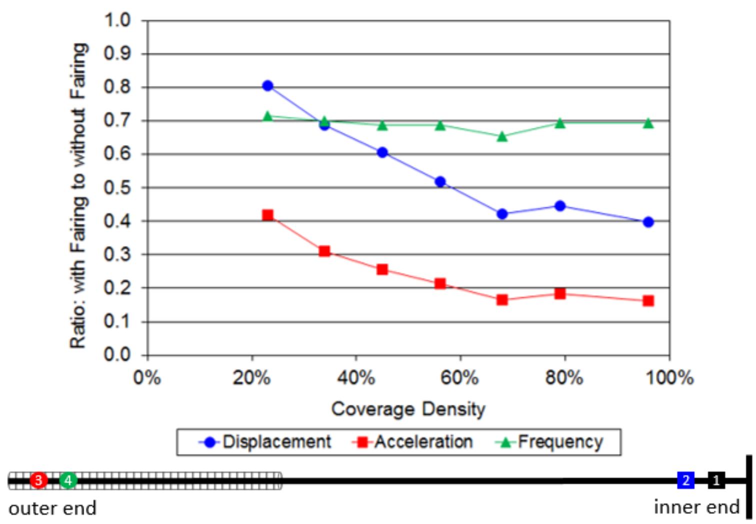


Figure 2 – Various Coverage Densities Along 37% of Tubular at Outer End

Beyond a density of about 70%, the suppression performance of the fairings remains reasonably constant. Thus, it is possible to concur that a coverage density of 100% has little advantage over a coverage density of 70% in the regions where fairings are applied. This information is extremely beneficial when considering the quantity of fairings required to dress a riser. It can lead to substantial cost savings while still achieving performance requirements for improved fatigue life and low drag.

VIV Solutions' fairings are engineered to interrupt the correlation of vortex shedding along a tubular, which makes it more difficult for vortices to form along adjacent bare spans when fairings are present. Alternate fairing geometries 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 fairings should be arranged over actual tubulars in the field.

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