SENTRAN

TechNote

Innovative Measurement Solutions

DOUBLE-ENDED VS. SINGLE-ENDED SHEAR BEAMS

Literally thousands of industrial process weighing systems applications require solutions every year. In each case, it is the responsibility of the project engineer or weighing systems professional to determine which load cell best meets the needs of the application. With the proliferation of shear beam load cell technology over the past thirty years, it has become the load cell technology of choice in these situations because of its unparalleled ruggedness, excellent performance, adaptability and value. Still, it doesn't end here. There is one more choice to be made . . . single-ended shear beam or double-ended shear beam?

BASICS OF SHEAR BEAM DESIGN

The shear beam strain gauge force transducer was designed to address performance deficiencies in other types of load cells. The improvements this approach introduced included:

- Greater adverse load tolerance
- Lower sensitivity to adverse loads
- Lower overall height
- High tolerance of dynamic forces and vibrations
- Better sealing and environmental protection
- Greater flexibility of application
- Lower cost without sacrificing performance

SHEAR BEAM LOAD CELL APPLICATION

The decision to use a signal-ended shear beam or a double-ended shear beam is dictated by any combination of four factors which are:

- Overall Performance
- Price
- Manufacturer defined options
- Availability of complimentary mounting hardware

Generally speaking, single-ended shear beams are applied in capacity ranges of 1,000 pounds to 10,000 pounds. In the past, even higher capacity ranges were common, sometimes up to several hundred thousands of pounds capacities. Today, these load cell behemoth's have been replaced by double-ended shear beams in most situations above 10,000 pounds, for several practical reasons.

Single-Ended Shear Beam

Double-Ended Shear Beam

SENTRAN, LLC 4355 LOWELL STREET, ONTARIO, CA 91761, U.S.A.
888-545-8988 T: 909-605-1544 FAX: 909-605-6305 **www.sentranllc.com**

First, the double-ended shear beam approach was adopted as a method of providing a lower cost load cell without sacrificing performance at the higher rated capacities. The material costs of the load cell element, as well as the mounting hardware, become very significant as the capacity rating increases. As an example, a typical single-ended shear beam rated at 50,000 pounds weighs approximately 53 pounds. This compares to a double-ended shear beam of the same capacity, which typically weighs approximately 27 pounds. That results in a material savings of 26 pounds, nearly 50%, of high alloy tool steel or stainless steel. This ratio of two to one is very typical throughout the higher capacity ranges.

Has quality or performance been compromised? On the contrary, double-ended shear beam performance in the higher capacity ranges is typically better than single-ended shear beams on the basis of combined error. Double-ended shear beams inherently provide:

- Greater adverse load tolerance
- Lower sensitivity to adverse loads
- Higher tolerance to dynamic forces and vibrations
- Measurements are independent of load position in the longitudinal axis, meaning low induced errors as a result of thermal expansion and contraction (of a weigh vessel, for instance)

LOADING TECHNIQUES

The double-ended shear beam is supported at both ends and is center loaded. The overall result is a reduction in measurement errors. This is primarily due to the fact that the load in a double-ended shear beam application, reacts evenly from both ends against the area of the supporting base plate assembly. It is not cantilevered.

In a single-ended shear beam approach, with only one end supported and the load applied at the opposite or "live" end, the weighing assembly experiences a significant uplifting, or "overturning" moment. This is due to the applied leverage defined by the distance from the loading point to the reaction point. Therefore, significantly more material is required for the load cell element and mounting hardware to manage the loads experienced in the higher capacity ranges. The double-ended shear beam design produces a unique, compact and high-strength weigh module when coupled with the appropriate weighing assembly/mount. One example is the classic SENTRAN Model MC Series. This particular assembly is certified for applications in areas of high seismic activity, wind loading and process vibration. One hundred percent side-loading can be tolerated with 100% of vertical load applied. This fact attests to the structural integrity of the double-ended shear beam in the vertical and horizontal planes.

The complimentary weighing assemblies available with many double-ended shear beams, provide for completely self-checking weighing systems, totally eliminating the requirement for stay rods of other physical restraints common to some types of load cells. Provisions for thermal expansion and contraction are provided in premium weigh modules employing double-ended shear beams. The combination of these two factors significantly reduce the possibility of measurement errors induced by mechanical binding and misalignments.

Single-Ended Shear Beam Load Cell
Integrated into Companion Weigh Module MF

Double-Ended Shear Beam Load Cell
Integrated into Companion Weigh Module MC

IN CONCLUSION

Shear beam technology is clearly the premiere load cell technology today. Both single-ended shear beams and double-ended shear beams have their place in the broad range of load cell applications. The single-ended shear beams are clearly a good choice for lower capacity applications, where material content does not differ significantly and adequate mount clamping of the cantilever beam can be accomplished. Double-ended shear beams are the ultimate choice for higher capacity situations, as they address the need for more cost efficient designs while maintaining excellent performance. Double-ended shear beams offer higher tolerance of dynamic forces and vibrations, and lower sensitivity to unwanted forces in these situations.

Overall, shear beam load cell technology has contributed significantly to advancing the performance capabilities of load cells in virtually all weighing applications.