- Stress Ribbon Bridge

A Stress Ribbon Bridge is a tension structure, similar in many ways to a simple suspension bridge. The stress ribbon design is rare. Few people including bridge engineers are familiar with this form and fewer than 50 have been built worldwide. The suspension cables are embedded in the deck which follows a catenary arc between supports. Unlike the simple span the ribbon is stressed in compression which adds to the stiffness of the structure. Such bridges are typically made from concrete reinforced by steel tensioning cables. They are used mainly for pedestrian and cycling traffic. Stress ribbon bridges are very economical, aesthetic and almost maintenance free structure. They require minimal quantity of materials. At present studies, on combining stress ribbon bridges with cables or arches, to build most economical stress ribbon bridges.

Form Of A Stress Ribbon Bridge

Superstructure

A typical stress ribbon bridge deck consists of precast concrete planks with bearing tendons to support them during construction and separate prestressing tendons which are tensioned to create the final designed geometric form. The joints between the planks are most often sealed with in-situ concrete before stressing the deck. The prestressing tendons transfer horizontal forces in to the abutments and then to the ground most often using ground anchors. The tendons are encased in ducts which are generally grouted after tensioning in order to lock in the stress and protect them from corrosion. Since the bending in the deck is low, the depth can be minimized and results in reduction in dead load and horizontal forces in abutments.

Substructure

The abutments are designed to transfer the horizontal forces from the deck cables into the ground via ground anchors. Pedestrians, wind and temperature loads can cause large changes in the bending moments in the deck close to the abutments and accordingly crack widths and fatigue in reinforcement must be considered. The ground anchors are normally tensioned in 2 stages, the first step is tensioned before the deck is erected and the rest, after the deck is complete. If stressed in one stage only, there will be a large out of balance force to be resisted by the abutments in the temporary case. The soil pressure, overturning and sliding has to be checked for construction as well as permanent condition.

Ground Conditions

The ideal ground condition for resisting large horizontal forces from the ribbon is a rock base. This occurs rarely but suitable foundations can be devised even if

competent soils are only found at some depth below the abutments. In some cases where soil conditions do not permit the use of anchors, piles can also be used. Horizontal deformations can be significant and are considered in the design. It is also possible to use a combination of anchors and drilled shafts. Battered micropiling is another alternative which can resist the load from the ribbon because of its compression and tension capacity.