

## Abutment Design Calculation (“ABUT”)

Description: ABUTMENT designs a reinforced concrete cantilever bridge abutment on spread or pile footings (maximum of four pile rows), with or without an approach slab.

Theory: The program analyzes an abutment similar to a retaining wall (refer to "RETWALL" write-up) with three additional loading cases to be considered:

- (1) A construction condition, without the superstructure in place, is checked for overturning and footing pressures (or pile loads). This situation must be considered if backfill operations precede superstructure erection.
- (2) A backwall loading condition is considered for the design of front face bars. This loading will be due to the dead load of the approach slab bearing on the backwall after the subgrade under the approach slab has settled, and live loading on the backwall. The program takes the conservative approach of neglecting the effects of horizontal pressure on the back face.
- (3) An arbitrary "fixed-pinned" loading condition for the design of front face bars.

A word explanation on loading condition "3" is required. When the abutment is backfilled it initially behaves as a cantilever structure, similar to a retaining wall. When the approach slab is poured, the weight of the approach slab is applied as a surcharge to the cantilever structure. The program first considers a cantilever system for the design of the footing and backface stem bars. It is a common opinion that, if the approach slab is doweled into the backwall, when the backfill settles a redistribution of forces occurs, and the abutment tends to be pinned on top and pressures also increase. This change will be due to creep in the backfill, and to a lesser extent, creep in the concrete.

The final outcome, as it applies to abutment design, is that with time the structure will tend to become pinned on top with resulting "positive" moments in the stem, requiring front face bars. At the present time, arbitrary methods of analysis are used by designers. The author has chosen to apply an arbitrary 125% of active earth pressure to a pinned-fixed structure to calculate the positive moment.