CE 414: Prestressed Concrete
Lecture 19
Continuous beam

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- Reversal of moments
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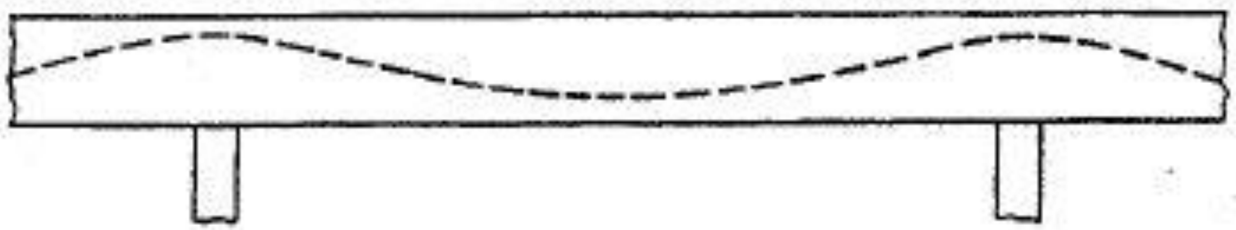
1. Frictional loss in continuous tendons. This can be serious if there are many reversed curves, if the curves possess large deflection angles, or if the tendons are excessively long. Such loss can be minimized by using relatively straight cables in undulating or haunched beams. The usual methods of overtensioning, with stressing from both ends, can also be used to reduce frictional losses, as discussed in Chapter 4.
2. Shortening of long continuous beams under prestress. This may produce excessive lateral force and moments in the supporting columns, if they are rigidly connected to the beams during prestressing. Provisions are usually made to permit movement at the beam bearings or rocking of the columns.
3. Secondary stresses. Secondary stresses due to prestressing, creep and shrinkage effects, temperature changes, and settlements of supports could be serious for continuous structures unless they are controlled or allowed for in the design. One interesting point in continuous prestressed structures is that these secondary stresses can often be utilized to good advantage so that they will add to the economy of the structure.

4. Concurrence of maximum moment and shear over supports. It is believed that the concurrence of maximum moment and shear at the same section may decrease the ultimate capacity of a beam. This happens over the supports of most continuous beams. Hence care must be taken to reinforce such points properly for both shear and moment if high ultimate strength is desired. The elastic strength, however, is not affected by such concurrence.

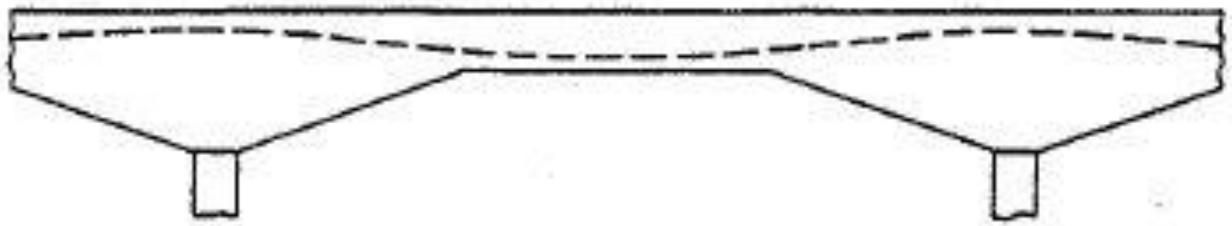
5. Reversal of moments. If live loads are much heavier than dead load, and if partial loadings on the spans are considered, continuous beams can be subjected to serious reversal of moments. This can sometimes be overcome by proper design, such as extensive use of nonprestressed steel in combination with prestressed concrete.

6. Moment peaks. Peaks of maximum negative moments may sometimes control the number of tendons required for the entire length of the beam. These peaks, however, can be strengthened by employing deeper sections or by adding prestressed and nonprestressed reinforcements over the portions where they are needed. Moment redistribution at ultimate will keep this from being a serious problem, provided we use cross sections with sufficient ductility for the peak support moment to be shifted to the adjoining sections near midspan which have smaller moment.
7. Difficulty in achieving continuity for precast elements. It is easy and natural to obtain continuity for cast-in-place construction, but continuity for precast elements cannot always be achieved without special effort. On account of difficulties in handling precast continuous beams, they are often precast as simple elements, to be made continuous after they are erected in place.
8. Difficulty in designing. It is more difficult to design continuous than simple structures. But, with the development of simpler methods, the design of continuous prestressed concrete beams can be made into a more or less routine procedure applying basic principles for continuous structures familiar to most engineers. These methods will be presented in the following sections. The use of the load-balancing concept is a much more useful design approach for continuous beams than for simple beams as will be demonstrated in the following chapter.



(a) Curved Tendons in Straight Beams

(b) Straight Tendons in Curved Beams



(c) Curved Tendons in Haunched or Curved Beams

(d) Overlapping Tendons

Fig. 10-4. Layouts for fully continuous beams.

$$a_{min} = \frac{M_{min}}{F} \quad \text{also} \quad a_G = \frac{M_G}{F_0}$$

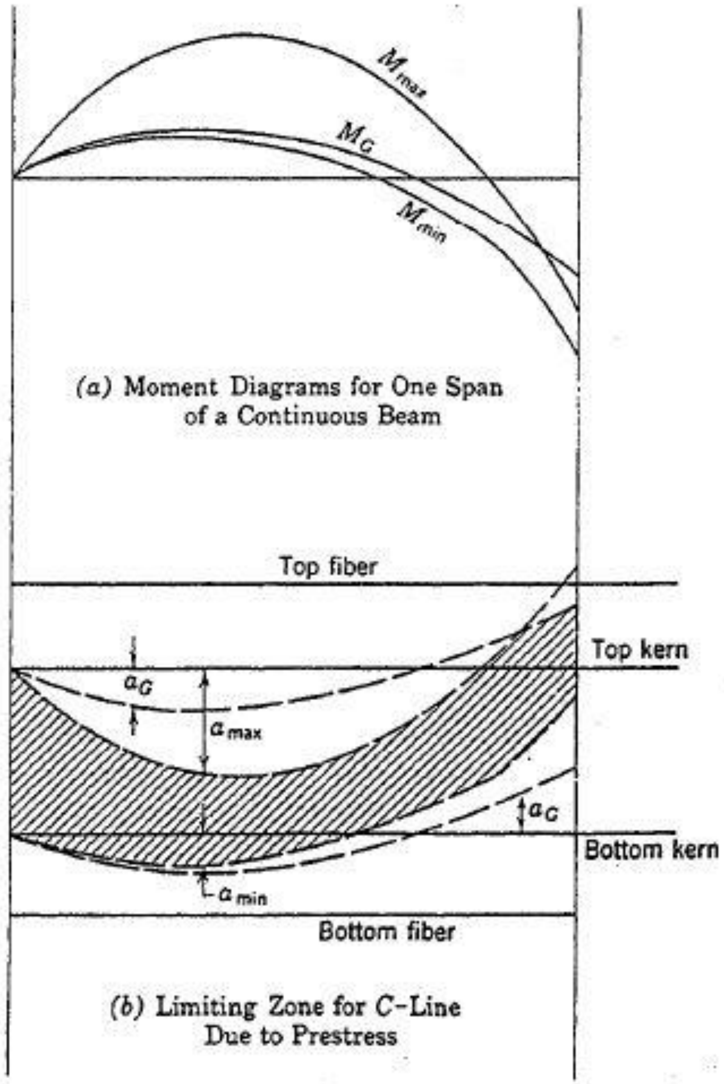


Fig. 10-20. Obtaining limiting zone for the C-line due to prestress.

where M_{min} = the algebraically smallest moment. The distances a_{min} and a_G should be plotted upward for $-M$ and downward for $+M$.

From the top kern, plot

$$a_{max} = \frac{M_{max}}{F} \quad \text{also} \quad a_G = \frac{M_G}{F_0}$$

again upward for $-M$ and downward for $+M$.