APPENDIX B: DEFLECTION

B1. General

The deformations of a structure and of its component members should be appropriate to the location, loading and function of the structure and the component members.

Deformations should be estimated using methods of analysis based on assumptions which reflect with reasonable accuracy the actual response of the structure to load.

It is not considered practicable in this Code of Practice to give limiting values for every deflection case, as each must be considered on merit. However, for guidance only, some values which have been found to give satisfactory service in areas not subject to earthquakes, are given below for certain structures and components.

B2. Deflection limits for specific cases

(1) *Beams*. For a beam supporting a concrete floor intended for human accommodation and having a span not exceeding 9 m, the calculated deflection due to imposed load alone and based on the uncased section should not exceed—

$$\frac{\text{Span}}{360} \quad \text{or} \quad \frac{\text{Cantilever Length}}{180}$$

(2) *Purlins*, Girts, Secondary Members. For a purlin, or a girt, or a secondary member supporting metal sheeting and with a span not exceeding 6 m, the calculated deflection due to imposed load should not exceed—

$$\frac{\text{Span}}{180} \quad \text{or} \quad \frac{\text{Cantilever Length}}{90}$$

(3) *Industrial Buildings*. The horizontal deflection at eaves level of the internal frames of an industrial building, relative to the deflection in the same direction of the end wall at that level, should be appropriate to the capacity of the roof sheeting to accommodate the resulting shear distortion. Where no special provision is made for the sheeting to accommodate or resist this movement, the calculated eaves movement due to imposed and wind load should be limited to

$$\pm\frac{\text{Frame Spacing in End Bay}}{250}$$

(4) *Tall Buildings*. The calculated total deflection due to imposed and wind loads for multistorey buildings should be limited to—

$$\frac{\text{Height of building}}{500}$$

The calculated inter-storey deflection should be limited to a value which will not cause unacceptable damage to internal or external finishes, and in no case should exceed

$$\frac{\text{storey height}}{400}$$

B3. Special conditions

In addition to the normal considerations which limit dead load deflection, both for aesthetic reasons and to prevent cracking of walls and other elements, consideration should be given to any special conditions which may apply. Some of these are:

(1) *Moment Increase Due to Deflection*. There is a possibility that a structure may become unstable if a combination of high axial load and deflection in a transverse direction can give rise to high secondary bending moments. If the lateral defection of a building is not restricted for other reasons this effect should be considered.

(2) *Load Increase Due to Beam Deflection*. Overloading, increase in deflection, and possible instability may occur in beams as a consequence of the ponding of water on roofs of low slope.

(3) *Damage to Cladding*. Relatively large lateral deflections may be acceptable in single-storey industrial structures since the stresses caused by secondary moments are usually small (see B3.1 above). However, such deflections may damage roof covering, particularly in the vicinity of stiff end walls. Similar damage can occur to walls and cladding.

(4) *Resonance.* Imposed loads applied rhythmically to structure may cause resonance and hence cause deflections and stresses greater than would result if the maximum value of the load were applied statically. This may occur when a frequency component of the applied load is close to a natural frequency of the structure.

Imposed loads which are conducive to resonance include dancing, vehicular traffic, earthquake disturbance, unbalanced rotating machinery, and wind loads which result from the periodic shedding of vortices as can occur from tower-like structures and from roofs. In addition to general structural vibration, associated phemomena are 'springiness' in floors and the 'flutter' of roofs. A possible consequence of a repetitive load is metal fatigue.

(5) *Deflection Analysis.* Calculated deflections may underestimate actual deflections where the method of analysis assumes a 'rigid' column zone at joints, and an adjustment, or calculation by another method (e.g. by assuming zero width columns) of the deflections may be necessary. Special attention should be given to this matter where the deflections are critical.