DEFLECTION CHECK OF POST-TENSIONED FLOOR SYSTEMS

This narrative outlines the procedure for deflection check in design of post-tensioned floor systems. It is based on the recommendations of ACI-318 as expounded in ADAPT Technical Note TN292.

- Allowable deflection limits
  Refer to Table 1 of the appendix. The allowable calculated deflection varies between L/240 and L/480, where L is the deflected span. The selection of the allowable value depends on the finish of the structure. It is defined as follows.

  - L/240 for floor construction supporting or attached to non-structural elements that are not likely to be damaged by large deflections.
  - L/480 for floor construction supporting or attached to non-structural elements likely to be damaged by large deflections.

  For typical construction in Dubai, where heavy partition masonry or other block type partitions are used, it is recommended to use L/350

- Method of Deflection Calculation
  - When using ACI-318 or IBC
    - Two-way floor systems: Use Finite Element Method with gross cross-section, no cracking, since code stresses are limited
    - One-way slabs and beams: Use Finite Element Method with due allowance for cracking only if design is based on “cracked class,” otherwise calculate deflection based on gross cross-section.
  - When using non-US codes
    - Design based on stresses for non-cracked sections: Use Finite Element Method with gross cross-section. It is not required to perform cracked deflection calculation
    - Design based on post-cracking stresses: Use Finite Element Method and calculated deflections based on cracked sections.

- Load Combinations and Long-Term Effects
  - Long-term multiplier for creep and shrinkage C = 3
  - Installation of construction likely to be damaged by deflection assumed 30 days after casting concrete. From figure A1 C1= 0.55
  - Time from casting of concrete to when structure is placed in service 6-months From Figure A1, conservatively C2 = 0.2

- Load combination for long-term deflection combination plus instantaneous deflection due to live load are given below:

C1*C*(SW + SDL + PT) + 0.3*C2*C*LL + 0.7*LL

0.55*3*(SW + SDL + PT) + 0.3*0.2*3*LL + 0.7*LL

1.65*(SW + SDL + PT) + 0.18*LL + 0.7*LL < L/350

- Immediate deflection due to live load
  - If calculation is based on cracked section

[1.65*(SW + SDL + PT) + 1.00*LL] - [1.65*(SW + SDL + PT)] < L/350

  - If calculation is based on uncracked section

1.00*LL

APPENDIX

TABLE A1 MAXIMUM PERMISSIBLE COMPUTED DEFLECTIONS
(ACI-318-08; TABLE 9.5(b))

Type of member	Deflection to be considered	Deflection limitation
Flat roofs not supporting or attached to nonstructural elements likely to be damaged by large deflection	Immediate deflection due to live load	L/180 *
Floors not supporting or attached to nonstructural elements likely to be damaged by large deflection	Immediate deflection due to live load	L/360
Roof or floor construction supporting or attached to nonstructural elements likely to be damaged by large deflection	That part of the total deflection occurring after attachment of nonstructural elements(sum of the long-time deflection due to all sustained loads and the immediate deflection due to any additional live load)****	L/480 **
Roof or floor construction supporting or attached to nonstructural elements not likely to be damaged by large deflection		L/240 ***

Notes:

* Limit not intended to safeguard against ponding. Ponding should be checked by suitable calculations of deflection, including added deflections due to ponding of water, and considering long-term effects of all sustained loads, camber, construction tolerances, and reliability of provisions for drainage.

** Limit may be exceeded if adequate measures are taken to prevent damage to supported or attached elements.

*** But not greater than tolerance provided for nonstructural elements. Limit may be exceeded if camber is provided so that total deflection minus camber does not exceed limit.

**** Long-time deflection shall be determined using established procedures, but may be reduced by amount of deflection calculated to occur before attachment of nonstructural elements. This amount shall be determined on basis of accepted engineering data relating to time-deflection characteristics of members similar to those being considered.

LONG-TERM DEFLECTIONS

For design purposes, the long-term deflection of a floor system due to creep and shrinkage can be expressed as a multiplier to its instantaneous deflection.

Long-term deflection due to sustained load:

$$\Delta_l = C * \Delta_i$$

Where

Δ_l = long-term deflection;

Δ_i = instantaneous deflection; and

C = multiplier.

For conventionally reinforced floor systems C = 4
For post-tensioned floor systems C = 3

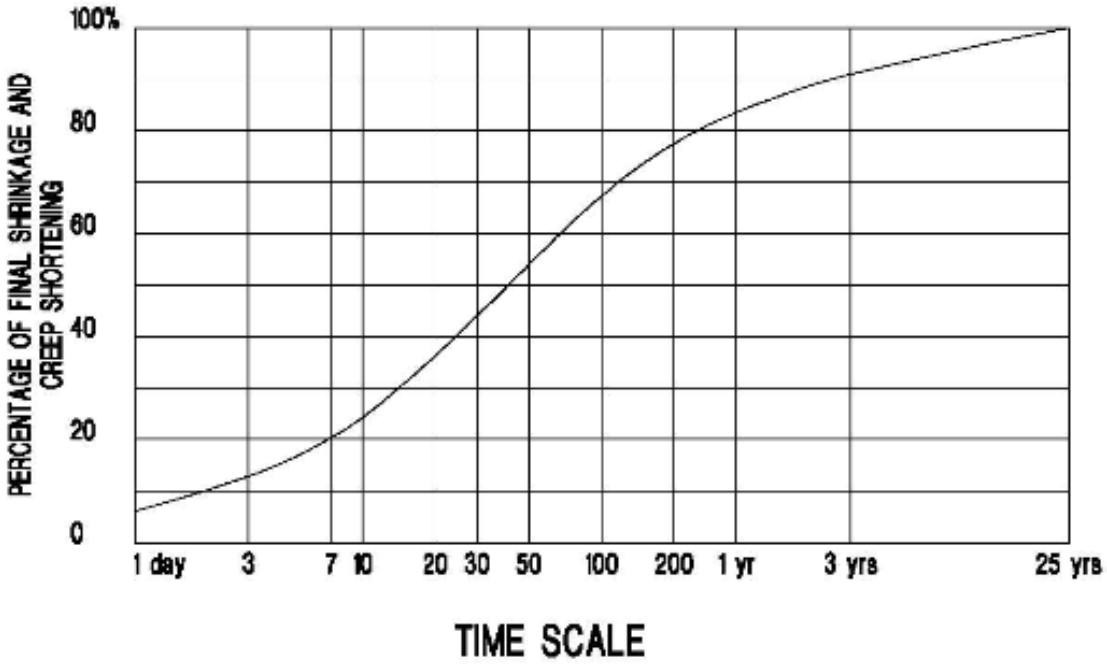

FIGURE A1 LONG-TERM SHORTENING OF CONCRETE MEMBERS DUE TO CREEP AND SHRINKAGE WITH TIME