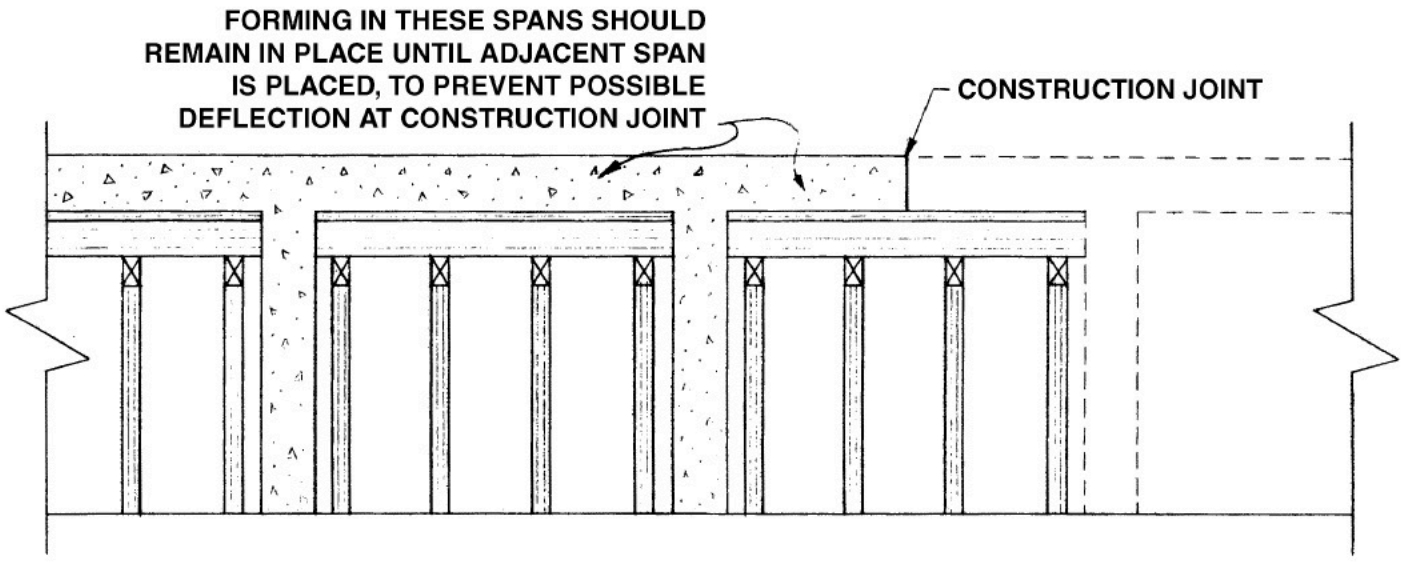

Fig. 3.3—Forming and shoring restraints at construction joints in supported slabs.

3.2.2.2—Bulkheads for joints should preferably be made by splitting the bulkhead along the lines of reinforcement passing through the bulkhead. By doing this, each portion can be positioned and removed separately. When required on the engineer/architect's plans, beveled inserts at control joints should be left undisturbed when forms are stripped and removed only after the concrete has been sufficiently cured. Wood strips inserted for architectural treatment should be kerfed to permit swelling without causing pressure on the concrete.

3.2.3 *Sloping surfaces*—Sloped surfaces steeper than 1.5 horizontal to 1 vertical should be provided with a top form to hold the shape of the concrete during placement, unless it can be demonstrated that the top forms can be omitted.

3.2.4 *Inspection*—The inspection should be performed by a person certified as an ACI Concrete Construction Inspector or a person having equivalent formwork training and knowledge.

3.2.4.1—Forms should be inspected and checked before the reinforcing steel is placed to confirm that the dimensions and the location of the concrete members will conform to the structural plans.

3.2.4.2—Blockouts, inserts, sleeves, anchors, and other embedded items should be properly identified, positioned, and secured.

3.2.4.3—Formwork should be checked for camber when specified in the contract documents or shown on the formwork drawings.

3.2.5—*Cleanup and coatings*

3.2.5.1—Forms should be thoroughly cleaned of all dirt, mortar, and foreign matter and coated with a release agent before each use. Where the bottom of the form is inaccessible from within, access panels should be provided to permit thorough removal of extraneous material before placing concrete. If surface appearance is important, forms should not be reused if damage from previous use would cause impairment to concrete surfaces.

3.2.5.2—Form coatings should be applied before placing of reinforcing steel and should not be used in such quantities as to run onto bars or concrete construction joints.

3.2.6—*Construction operations on the formwork*

3.2.6.1—Building materials, including concrete, should not be dropped or piled on the formwork in such a manner as to damage or overload it.

3.2.6.2—Runways for moving equipment should be provided with struts or legs as required and should be supported directly on the formwork or structural member. They should not bear on or be supported by the reinforcing steel unless special bar supports are provided. The formwork should be suitable for the support of such runways without significant deflections, vibrations, or lateral movements.

3.2.7 *Loading new slabs*—Overloading of new slabs by temporary material stockpiling or by early application of permanent loads should be avoided. Loads, such as aggregate, lumber, reinforcing steel, masonry, or machinery should not be placed on new construction in such a manner as to damage or overload it.

3.3—Tolerances

Tolerance is a permissible variation from lines, grades, or dimensions given in contract documents. Suggested tolerances for concrete structures can be found in ACI 117.

The contractor should set and maintain concrete forms, including any specified camber, to ensure completed work is within the tolerance limits.

3.3.1 *Recommendations for engineer/architect and contractor*—Tolerances should be specified by the engineer/architect so that the contractor will know precisely what is required and can design and maintain the formwork accordingly. Specifying tolerances more exacting than needed can increase construction costs.

Contractors should be required to establish and maintain control points and benchmarks in an undisturbed condition until final completion and acceptance of a project. Both should be adequate for the contractor's use and for reference to establish tolerances. This requirement can become even more important for the contractor's protection when tolerances are not specified or shown. The engineer/architect should specify tolerances or require performance appropriate to the type of construction. Specifying tolerances more stringent than commonly obtained for a specific type of construction should be avoided, as this usually results in disputes among the parties involved. For example, specifying permitted irregularities more stringent than those allowed for a Class C surface (Table 3.1) is incompatible with most concrete one-way joist construction techniques. Where a project involves features sensitive to the cumulative effect of tolerances on

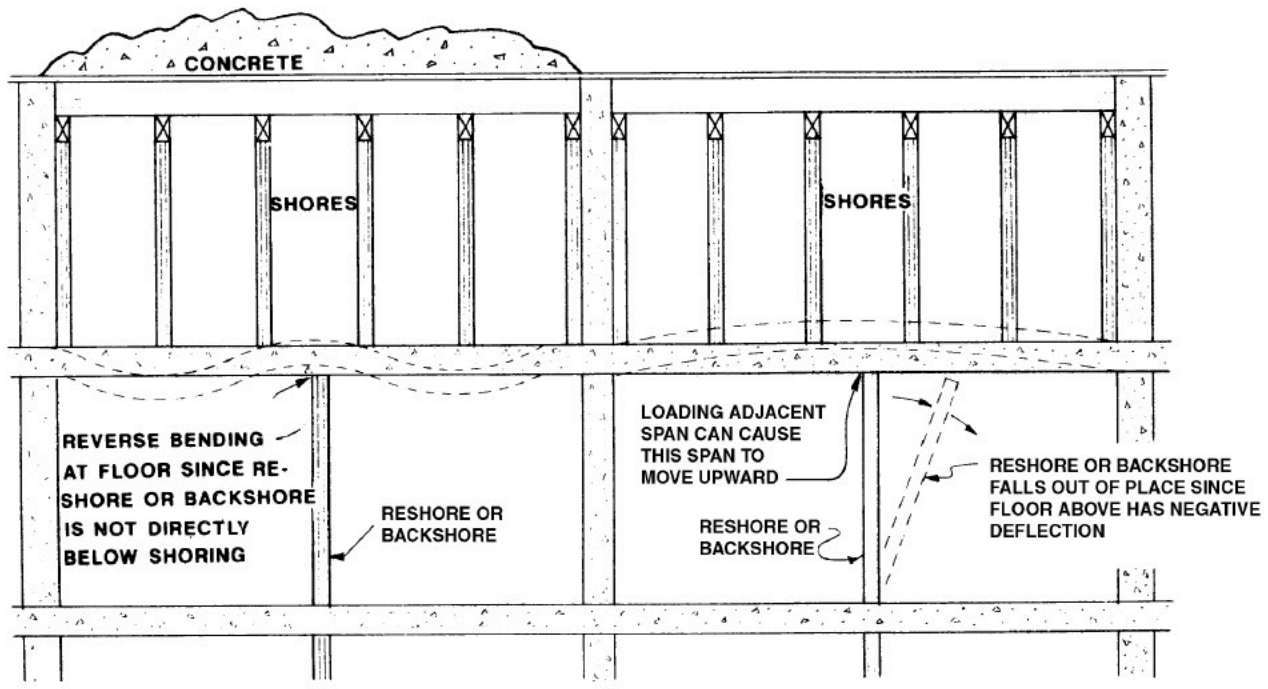

Fig. 3.4—Reshore installation. Improper positioning of shore from floor to floor can create bending stresses for which the slab was not designed.

Table 3.1—Permitted abrupt or gradual irregularities in formed surfaces as measured within a 5 ft (1.5 m) length with a straightedge

Class of surface			
A	B	C	D
1/8 in. (3 mm)	1/4 in. (6 mm)	1/2 in. (13 mm)	1 in. (25 mm)

individual portions, the engineer/architect should anticipate and provide for this effect by setting a cumulative tolerance. Where a particular situation involves several types of generally accepted tolerances on items such as concrete, location of reinforcement, and fabrication of reinforcement, which become mutually incompatible, the engineer/architect should anticipate the difficulty and specify special tolerances or indicate that governs. The project specifications should clearly state that a permitted variation in one part of the construction or in one section of the specifications should not be construed as permitting violation of the more stringent requirements for any other part of the construction or in any other such specification section.

The engineer/architect should be responsible for coordinating the tolerances for concrete work with the tolerance requirements of other trades whose work adjoins the concrete construction. For example, the connection detail for a building's façade should accommodate the tolerance range for the lateral alignment and elevation of the perimeter concrete member.

3.4—Irregularities in formed surfaces

This section provides a way of evaluating surface variations due to forming quality but is not intended for evaluation of surface defects, such as bugholes (blowholes) and honeycomb, attributable to placing and consolidation deficiencies. The latter are more fully explained by ACI 309.2R. Allowable irregularities are designated either abrupt or gradual. Offsets and fins resulting from displaced, mismatched, or misplaced forms, sheathing, or liners, or from defects in forming materials are considered abrupt irregularities. Irregularities resulting from warping and similar uniform variations from planeness or true curvature are considered gradual irregularities.

Gradual irregularities should be checked with a straightedge for plane surfaces or a shaped template for curved or warped surfaces. In measuring irregularities, the straightedge or template can be placed anywhere on the surface in any direction.

Four classes of formed surface are defined in Table 3.1. The engineer/architect should indicate which class is required for the work being specified or indicate other irregularity limits where needed, or the concrete surface tolerances as specified in ACI 301 should be followed.

Class A is suggested for surfaces prominently exposed to public view where appearance is of special importance. Class B is intended for coarse-textured, concrete-formed surfaces intended to receive plaster, stucco, or wainscoting. Class C is a general standard for permanently exposed surfaces where other finishes are not specified. Class D is a minimum-quality requirement for surfaces where roughness is not objectionable, usually applied where surfaces will be permanently concealed. Special limits on irregularities can be needed for surfaces continuously exposed to flowing water, drainage, or exposure. If permitted irregularities are different from those given in Table 3.1, they should be specified by the engineer/architect.

3.5—Shoring and centering

3.5.1 *Shoring*—Shoring should be supported on satisfactory foundations, such as spread footings, mudsills, or piling, as discussed in Section 2.7.

Shoring resting on intermediate slabs or other construction already in place need not be located directly above shores or reshores below, unless the slab thickness and the location of its reinforcement are inadequate to take the reversal of stresses and punching shear. The reversal of stresses results from the reversal of bending moments in the slab over the shore or reshore below as shown in Fig. 3.4. Where the conditions are questionable, the shoring location should be approved by the engineer/architect. If reshores do not align with the shores above, then calculate for reversal stresses. Generally, the dead load stresses are sufficient to compensate