



Guide to Safety Procedures for Vertical Concrete Formwork

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FOREWORD

The “Guide to Safety Procedures for Vertical Concrete Formwork” has been prepared by the Forming Section Engineering Committee of the Scaffolding, Shoring & Forming Institute, Inc., 1300 Sumner Avenue, Cleveland, Ohio 44115. It is suggested that the reader also refer to other related publications available from the Scaffolding, Shoring & Forming Institute.

The SSFI welcomes any comments or suggestions regarding this publication. Contact the Institute at the following address: Scaffolding, Shoring and Forming Institute, 1300 Sumner Ave., Cleveland, OH 44115.

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INTRODUCTION

Because of the widespread and constantly growing use of forming in construction today, it is vital that it be used properly and safely.

At present, the subject of forming is not covered in most standard reference works on safe construction practices; therefore, two objectives were established before preparing this guide:

1. To fill the need for information on forming and the safe and proper use thereof and -
2. To provide a guide to various federal, state and local authorities having jurisdiction over construction work in developing their own codes.

However, the information and recommendations contained herein do not supersede any applicable federal, state or local code, ordinance or regulation.

Safety precautions prescribed by OSHA and other government agencies should be followed at all times and persons working with forming equipment should be equipped with requisite safety devices.

The procedures outlined in this guide describe conventional procedures for erecting and dismantling forming systems. However, equipment and forming systems differ, and accordingly, reference must always be made to the instructions and procedures of the particular manufacturer or supplier whose equipment is being used. Since field conditions vary and are beyond the control of the Institute and its members, safe and proper use of this equipment is the responsibility of the user and not the Institute or its members.

SECTION 1 GENERAL

1.1 All form components and/or hardware must be kept clean, and if appropriate, lubricated to insure proper performance and to allow for proper inspection.

1.2 All form components must be inspected regularly for damage or excessive wear. Equipment found to be in these conditions must be replaced immediately and **not** re-used.

1.3 Field repair of modular formwork components (other than plywood repairs) must not be undertaken without consulting the manufacturer's qualified representative.

1.4 The forming layout shall be prepared or approved by a person qualified to analyze the loadings and stresses which are induced during the construction process. The layout shall be at the jobsite.

1.5 Forming installation and pouring procedures must comply with safe practices and with the requirements of the law and governmental regulations, codes and ordinances.

SECTION 2 ERECTION OF FORMWORK

2.1 Do not deviate from layout drawings when erecting formwork without the approval of a qualified designer.

2.2 Be certain that all wall ties are in place and secured as per manufacturer's recommendations. Do not weld, bend or otherwise alter wall ties as it may seriously reduce their strength.

2.3 Adequate temporary bracing must be in place while initially setting formwork. Assure that formwork is properly braced and stabilized against wind and other external forces.

2.4 Safe working platforms must be installed as per applicable safety standards and as stated in Section 5 herein.

2.5 When gang forming, lifting devices must be properly spaced and securely attached as per manufacturer's recommendations. Rigging must be arranged so that any one lifting bracket is not overloaded and that lifting cables are not at excessive angles, which will reduce allowable loads. Spreader beams with load equalizers are recommended for all but simple two point lifts.

Follow manufacturer's/supplier's recommended procedures concerning capacity and use of lifting hardware and crane.

2.6 A minimum of two tag lines must be used to control movement of crane-handled formwork. Do not allow personnel on or directly under any gang form while it is being moved or suspended in air.

2.7 Do not erect gang forms when jobsite wind conditions prevent safe maneuvering of gangs. Assure that all rigging connections are properly made in accordance with safe practices and procedures.

2.8 Formwork should be adequately braced, re-anchored, or otherwise secured prior to releasing lifting mechanism.

2.9 Wall forms must not be erected so as to support deck concrete loading unless the wall forms are a designed part of the deck support system.

SECTION 3 BRACING

3.1 Aligners (alignment devices, plumbing struts) are considered only as alignment devices with no provisions for withstanding concrete pressure or any portion thereof. Maintain forms plumb during pour to ensure that aligners are not supporting or stabilizing concrete pressures.

3.2 Braces used to withstand concrete pressure must be designed by a qualified formwork designer.

3.3 Unless specified, wind loading and other external lateral loads are not considered in the manufacturer's layout drawings.

3.4 The adequacy of stakes, dead-men, sills, anchor-bolts, etc., must be determined to assure

safe support of the imposed brace loads. The responsibility for adequate anchorage of braces should be assigned only to those personnel with sufficient experience to assure sound judgement.

3.5 Before removing braces, assure that the concrete has attained sufficient strength to safely support the imposed load at support locations.

3.6 Do not exceed the rated load of the braces.

3.7 Inspect installed braces immediately after installation for correctness of spacing and proper attachment device.

SECTION 4 WALKWAY SYSTEMS

4.1 All walkway systems must be properly positioned, spaced and fastened as per manufacturer's specifications and all applicable safety regulations.

4.2 Walkway systems must be in place along the upper level of formwork. Workers must never attempt to walk or stand on top of forms.

4.3 Scaffold brackets must be attached with the manufacturer's recommended connectors. Never use substitutes or make-shift devices. Never hang brackets from wall ties after removal of forms.

4.4 All walkway platforms must utilize at least two (2) planks laid side by side, and must overlap their support ledger by not less than 6 inches. Unsupported ends of scaffold planks must not project more than 12 inches past their support ledger.

4.5 Scaffold planks must be minimum 2 inch x 10 inch nominal lumber and must be scaffold grade as recognized by approved grading rules for the species of lumber used, or must be of materials having equivalent or greater strength. Scaffold planks must safely support a minimum of 25 pounds per square foot over a maximum span of 8 feet.

4.6 When deemed appropriate by the competent person, scaffold planks must be nailed and clinched, bolted or otherwise positively secured against dislodgement from effects of wind, weather, gang form lifting operations or the like. Bolt heads and nails must be driven flush with tops of planks to prevent tripping hazards.

4.7 All scaffold bracket platforms must be equipped with guardrails, midrails and toeboards along all open sides and ends and be maintained secure and in good condition at all times. Guardrails must be of at least 2 x 4 nominal sized lumber, with minimum 1 x 6 or 2 x 4 nominal midrails, with toeboards at least 4 inches high, supported by 2 x 4 nominal lumber uprights spaced not more than 8 feet apart, or must be of other materials providing equivalent or greater strength and protection.

4.8 Maximum spacing between scaffold brackets is eight feet. Never exceed this distance unless the walkway system has been specifically designed for a greater distance. Follow manufacturer's recommendations as to loading and spacing of scaffold brackets. Unless designed otherwise, scaffold brackets are designed to support a maximum load of 25 pounds per square foot when spaced on 8 foot centers. Scaffold brackets are not designed for

the additional loads imposed from stacking rebar or placing other equipment on walkways.

4.9 Always brace and/or otherwise secure forms and scaffold from overturning due to attachment and use of scaffold brackets.

4.10 Never allow persons to work on one level of walkways if others are working directly below or overhead unless proper protection is provided, such as safety nets.

4.11 It is unsafe and unlawful for persons to occupy any form walkway while the form is being moved.

4.12 Access ladders or other suitable safe methods must be used to obtain access to walkway platforms. Do not position ladders so

that their weight while being used can effect the strength or stability of the scaffold and formwork.

4.13 Do not use form panels as a ladder.

4.14 If using walkway systems is not practical, personnel must be protected against falls by means of personal fall arrest system attached to components having adequate strength to meet or exceed applicable codes or by safety nets or other equivalent protection. Personnel protected by personal fall arrest system must exercise additional care when handling formwork components.

SECTION 5 SPECIAL APPLICATIONS

5.1 Fasteners for support brackets, friction collars and other friction devices must be pre-tensioned to the manufacturer's specification during erection and re-checked immediately prior to placing concrete.

5.2 Assure that anchor brackets are attached properly and with required thread engagement per manufacturer's recommendations. The proper anchor bolts and inserts must be used and be of adequate strength for combined shear and tension loadings. Assure that the concrete has attained sufficient strength to properly allow the designed use of these devices with the required safety factors.

5.3 Assure that anchor brackets are installed so that they are equally loaded and are installed

correctly prior to setting the formwork. Anchor bolts must be tight and brackets level.

5.4 When erecting forms for battered walls, allowance must be provided for proper anchorage to resist resulting uplift forces.

5.5 Layouts must be prepared by a qualified formwork designer for all one-sided and cantilevered wall forming applications. Ensure that all anchorages and bracing are installed per layout drawings. Follow manufacturer's recommendations regarding installation and use of anchoring devices.

5.6 For all other special applications, for example, jump forms, climbing forms, etc., consult manufacturer.

SECTION 6 INSPECTION

6.1 Inspect completed formwork prior to placing concrete to assure proper placement and secure connections of ties and associated hardware. All threaded connectors, such as ties, inserts, anchor bolts, etc., must also be checked for proper thread engagement.

6.2 Inspect erected form walkway systems before each use. Assure that bolts, nuts, and other connections are fastened securely.

6.3 Inspect bracing attachments and form alignment after each form cycle. Inspect installed forms and braces immediately prior to pour and during pour.

SECTION 7 CONCRETE PLACING

7.1 The contractor must verify prior to and during concrete placing that the method of placement and rate of pour is consistent with formwork design. **DO NOT OVERLOAD FORMWORK.**

7.2 Concrete must not be placed in any manner which imposes impact loads that exceed the rated capacity of the form.

7.3 Instruct personnel on proper vibration. Do not use vibrator to move concrete. Do not vibrate further than one-foot into the previous lift. Avoid vibrator contact with wall ties. External vibrators must not be attached to formwork unless it was designed for their use.

SECTION 8 STRIPPING FORMWORK

8.1 Follow manufacturer's recommended field procedures - generally, reverse the order of procedures used in erection of formwork. Be certain that concrete has sufficiently set to carry its own weight and any imposed loads prior to stripping formwork.

8.2 When gang-forming, secure the lifting mechanism prior to removal of ties, anchors and/or bracing.

8.3 Use extreme caution for all formwork to assure that no panel, walkway bracket, brace or any other form component is unfastened prematurely.

8.4 Assure that all disconnects have been made and the bond of the formwork to concrete has been broken prior to lifting of gang form.

SECTION 9 GLOSSARY OF TERMINOLOGY

ALIGNER
(plumbing strut or alignment device)

Lumber or metal members used to align vertical formwork.

ANCHOR BRACKET

A projecting member designed in combination with a specified anchor to attach to a previous concrete pour so as to support the dead weight of the subsequent formwork and live loads specified.

ANCHORS

Devices used to secure formwork, braces or accessories to previously placed concrete, either embedded during placement or set in holes drilled in hardened concrete. There are two basic parts: the embedded anchor device and the external fastener which is removed after use.

BATTER WALL

Wall with one or both faces slanting from the vertical, usually creating a wall thicker at its base than at its top.

BEAM FORM

The entire formwork to form the bottom and both sides of a beam.

BEAM POCKET

Opening left in a vertical member in which a beam is to rest; also an opening in a column or girder form where forms for intersecting beams will be framed.

BEAM SIDE	Vertical side panels or parts of a beam form.
BOX-OUT	An opening or pocket formed in concrete positioning a box-like form within the wall forms.
BRACE	Any external structural member used to resist horizontal forces exerted on the forms such as wind loads.
BRACKET	Projecting member from a structure to support weight beyond its face.
BREAK-BACK	The distance from the face of concrete to the end of the remaining imbedded portion of a tie (snapped off wire-tie, or the face of concrete clearance of a three-piece tie inner unit) (also referred to as Cut-Back).
BRICK LEDGE (Brick Seat)	Ledge on wall or footing to support a course of masonry.
BUCK	Framing to void an opening in a wall, such as a door buck, which forms the opening for a door.
BUG HOLE	Void on the surface of formed concrete caused by an adhering air or water bubble not displaced during consolidation.
BULKHEAD	A partition in the forms blocking fresh concrete from a section of the forms or closing the end of a form, such as at the construction joint.
CAMBER	An inward curvature of a wall or an upward curvature of an elevated slab or beam form to improve appearance or to compensate for anticipated load deflection.
CANTILEVER FORM	A special forming technique in which the lateral concrete pressure is resisted by a cantilevered vertical member.
CAPITAL	The tapered upper section of a column under the drop head. Conical shaped with round columns, pyramidal shaped with square columns.
CAULK	To use a putty-type material to seal form joints from grout leakage.
CHAMFER	A beveled external corner. It is usually formed in the concrete work by use of a chamfer strip placed in the form at the outside corner to provide a rounded or beveled corner.
CHASE	An elongated void or opening formed into a concrete surface.
CLEANOUT	An opening in the forms for removal of refuse, closed before the concrete is placed.
CLEAT	Small board used to connect two or more pieces of formwork lumber together.

CLIMBING FORM	A form which is raised vertically for succeeding lifts of concrete in a given structure, usually supported on anchor bolts or rods embedded in the top of the previous lift. The form is moved only after an entire lift is placed and (partially) hardened; this should not be confused with a slip form which moves during placement of the concrete.
COIL BOLT	The hex-head outer unit of a three-piece wall tie with external contoured threads to engage the helical threads of a coil tie inner unit.
COIL TIE	The non-reusable inner unit or center part of a three-piece wall form tie. Ties are made with two or more straight wire struts with helix coils welded at each end forming female threads.
COLUMN CLAMP	Any of the various types of stiffening or fastening units to hold a column form sides together.
CONSTRUCTION JOINT	The surface where two adjacent placements of concrete meet, frequently with a keyway or reinforcement across the joint.
CONTROL JOINT	Formed, saw cut, or tooled groove in a concrete surface to regulate the location of shrinkage cracks.
CORBEL	The projection from the face of a concrete wall which is used to support a beam or elevated slab.
CROSSMEMBER	Intermediate stiffening member of a form panel connected at both ends of the perimeter frame.
CRUSH PLATE	An expendable strip of wood used as a pad to protect either the form or concrete surface from damage during prying action to strip forms.
DADO	Rectangular groove in the perimeter frame of a form which allows for the passage of ties without leaving a gap between forms.
DEAD LOAD	The load of forms, stringers, joists, reinforcing rods, and the actual concrete to be placed.
DEADMAN	A steel beam, block of concrete or other heavy item used to provide anchorage for a guy line or form brace.
DESIGN PRESSURE	The predetermined load per square foot at form face predicated by pressure, temperature, rate of concrete placement and height of concrete above point considered.
DIAPHRAGM	Cross walls positioned between long span, deep beams to provide lateral stability to the beams.
DOUGHNUT	A large washer of any shape to increase bearing area of bolts and form ties, also to act as a shim.
DRAFT	The slight taper difference between opposite sides of a form so that it will readily strip out the concrete.

DUTCHMAN (cribbing)	Usually a solid lumber thickness utilized to fill in under one side of equal height wall forms such as on a side slope footing, also to compensate for lineal dimension variation between opposing forms due to a slight angle corner or curved wall.
ELEVATION	A drawing showing a specific area projection of a structure on a vertical plane.
EMBEDMENT	An insert, anchor bolt or other device attached at the form face so as to be encapsulated by the concrete for future attachments or structural performance.
END-BARS	Perimeter frame members similar to end-rails but are usually perpendicular to crossmembers.
END-RAILS	Perimeter frame members of prefab form panel which are perpendicular to side-rails.
EXPANSION JOINT	A thickness of flexible material between consecutive placements of concrete to absorb linear expansion of concrete.
FACTOR OF SAFETY	Ratio of ultimate load to allowable load.
FALSEWORK (Shoring)	The temporary structure erected to support work in the process of construction, such as shoring or vertical post to support an elevated wall or spandrel beam.
FILLER	A non-standard width form panel used to take up odd dimensions.
FILLER STRIP	Piece of wood, metal or other material placed between large ganged slab form areas and vertical surfaces to permit easy stripping.
FILLET	A beveled or rounded inside corner.
FORM COATING	Anti-bonding material applied to form face surface to induce easy stripping.
FORMWORK	The total system of support for freshly placed concrete including the mold or sheathing which contacts the concrete as well as all supporting members, hardware, and necessary bracing.
FULL LIQUID HEAD	Concrete pressure where the entire pour is still in a liquid state.
GANG FORM	A large area of wall form with independent structural integrity. May also be a grouping of panels to be used as a unit for convenience in erecting, stripping and reusing.
GIRDER FORM	Self-supporting form system where the load is carried in bending by the side panels.
GRADE STRIP	A temporary wood strip secured to form face prior to concrete placement to denote finished grade elevation.

GUYS (Guy Wire)	Cable anchor from ground to top of wall form to brace in one direction through tension.
HAIRPIN	The wedge used to tighten some types of form ties, also a hairpin-shaped anchor set in place while concrete is plastic.
HANDBOOK FORM	A modular form erected and stripped by hand rather than a crane.
HAUNCH	A projection built on a wall or column used to support a load outside the wall or column.
HE-BOLT	The outer unit of a three-piece wall tie, of which the external threads of the outer units engage the internal threads of an inner unit such as a coil tie.
HEAD (Liquid Head)	The vertical height measurement of liquid concrete in wall form.
HONEYCOMB	Undesirable voids left in the formed concrete surface revealing unbonded coarse aggregates.
INITIAL SET	An early state of the concrete curing process at transformation from a liquid to a solid.
INNER UNIT (Inner Tie)	The non-reusable center part of a three-piece she-bolt tie.
INSERT	A female threaded connector embedded in a concrete to which a male anchor device can be connected.
INVERT	The lowest visible surface; the floor of a drain, sewer, tunnel, culvert, or channel.
JUMBO	Traveling support for forms, commonly used in gang-formed tunnel work.
KERF	To make a series of cuts or notches in order to curve a wood member.
KEYWAY	A recess or groove created in an earlier pour of concrete which is filled with concrete of the next pour giving shear strength to the joint.
KICKER	A piece of wood (block or board) or metal attached to a formwork member to take the thrust of another member.
KNEE BRACE	A brace between horizontal and vertical members in a building frame or formwork to make the structure more stable.
LEDGER	A horizontal structural member secured to a concrete wall and used to support forms.
LIFT BEAM	See Spreader Beam.

LIFT BRACKET	Special brackets attached to top of ganged forms to facilitate fast, safe attachment of crane sling lines.
LIFTER	A mechanical lifting device used to vertically elevate ganged forms to subsequent vertical reuses.
LINER	Any sheet or layer of material attached directly to the inside face of the forms to improve surface quality, alter the texture, or to imprint specific architectural patterns on the finished concrete.
LIVE LOAD	The total weight of workers, equipment, buggies, vibrators and other loads that will exist and move about due to the method of placement, leveling and screeding of the concrete pour.
LOAD EQUALIZERS	A system of equalizing sheaves designed to distribute the load equally to each form lift point when multiple-leg slings are used to lift a form.
MODULAR FORMWORK	Prefabricated all-metal or metal-supported-plywood systems in standard sizes with an integral provision for tie and connecting hardware.
MONOLITHIC	Concrete placement technique in which the slab, the beams, the columns, and the walls or any combination of the above elements are poured at the same time.
MUDSILL	A plank, or concrete slab, on the ground, to provide a level surface and support to concrete forms.
MULTI-LIFT	The vertical stacking of forms in tiers for any height wall. A wall requiring more than one row of forms is generally referred to as multi-lift.
NAILER	Strip of wood or other material attached to or set in concrete or attached to steel to facilitate making nailed connections.
OFFSET	A displacement or abrupt change in line or the distance between two parallel lines; such as a change in wall thickness which will create a vertical offset.
ONE-SIDED FORMWORK	A wall formwork system having only one forming side, requiring special provisions for tying and support. Commonly required when placing concrete against sheet pile, slurry walls, soldier beam embankments, and existing concrete or concrete block walls.
PANEL	A section of form sheathing constructed from boards, plywood, metal sheets, etc., that can be erected and stripped as a unit. Panels can be built on jobsite or prefabricated factory built.
PAN-JOIST	A light slab with ribs normally 24 to 36 inches on center acting as beams. The joists or ribs run at right angles to primary beams or girders.
PARAPET	That part of a wall that extends above the roof level.

PENCIL ROD	Metal rod (wire), usually about ¼" diameter, used in conjunction with special bearing clamps to perform as a wall form tie.
PENETRATION	Any concrete embedment device that must pass through the form face (such as anchor bolts, rebar, or dowel rods).
PERMANENT FORM	Any form that remains in place after the concrete has developed its design strength. The form may or may not become an integral part of the structure.
PILASTER	Column built with a wall, usually projecting beyond the wall face.
PLATE	A flat horizontal member such as a 2 x 4 placed on the footing for leveling and upon which the forms are set, sometimes referred to as a "shoe."
PLUMB	Vertical or the act of making vertical.
POST-TENSIONED CONCRETE	Reinforced concrete in which, after the concrete has set and sufficiently hardened, the desirable distribution of stress is achieved by post tensioning steel tendons, bars or wires.
PRECAST CONCRETE	Concrete units (such as beams, joists, deck panels, or wall panels) cast elsewhere than its final position and then set in place.
PRESTRESSED CONCRETE	A system for utilizing the compressive strength of concrete by producing required compressive stresses with highly stressed tension rods, tendons or wires.
REBAR	Abbreviation for "Reinforcing Bar."
RETAINING WALL	A wall, which is designed to resist horizontal loads such as those imposed by soil or water.
RIBS	Parallel structural members backing sheathing in a prefabricated form. Same as crossmembers.
RIGGING	Suspension components, such as chains, shackles, connecting links and eye hooks used to suspend formwork gangs or components from a crane or similar lifting device.
RUSTIFICATION	A groove in the concrete formed by securing a strip to the face of the formwork. Also referred to as a "feature strip."
SAFETY FACTOR	See Factor of Safety.
SCAB	A small piece of wood fastened to two formwork members to secure a butt joint.
SCAFFOLD BRACKET	A premanufactured cantilevered bracket designed to attach to formwork gangs and support scaffold planks that are used for a work platform when placing and vibrating concrete.
SCAFFOLDING	An elevated platform supporting workers, tools, and materials, either attached to wall forms or free standing.

SCREED	The tool used to control the top surface elevation of freshly placed concrete.
SHEATHING	The material forming the contact face of forms, also called lagging or sheeting.
SHE-BOLT	The outer unit of a three-piece wall tie that contains female threads to engage the external threaded inner unit (rod).
SHIM	Thin pieces of material used to bring abutting members to an even, level bearing.
SIDERAIL	Perimeter frame member of prefab form panel which is perpendicular to crossmembers.
SILL	Horizontal bearing member as a plate. See Plate.
SKIN PLATE	The steel form face of an all-steel form.
SLAB	The thinner portion of the floor, usually of uniform depth, that is between the drop heads or beams.
SLING	A length of cable with a loop at each end, usually the cable line from the crane hook to ganged form.
SLIP FORM	A form which moves, usually continuously, during placing of the concrete. Movement may be either horizontal or vertical. Slip forming is like an extrusion process with the forms acting as moving dies to shape the concrete.
SNAP TIE	A wire-type tie with or without spreader washer or cones. After forms are released, the protruding tie ends are snapped off by twisting at a predetermined break-off crimp usually about 1" in the concrete.
SOLDIERS	Vertical wales used for strengthening or alignment.
SPANDREL BEAM	A beam in the perimeter of a building, spanning between columns and usually supporting floors or roof. An up-turned spandrel depth dimension extends above the floor, and a down-turned spandrel extends below the floor.
SPREADER	A brace, usually of wood, inserted in forms to keep the form faces the proper distance apart until the concrete is placed.
SPREADER BEAM	A beam utilized to distribute the weight of a ganged form through two or more equalized vertical pick-up points.
SPUD	Adjustable bolt-like strut extending between the skin of tunnel forms and bored rock tunnel walls to provide position support of the formwork.
STAKE	A pointed wood or metal object driven in ground to attach brace or to support form sides in footing forming.

STIFFENER	A structural member for the support of the plywood face or skin plate on panel forms sometimes called ribs.
STRIP	To remove formwork from concrete.
STRIPPING BAR	A solid bar positioned in-between form panels or adjoining ganged forms which is the first unit stripped thereby providing relief to readily strip the large form panels; also referred to as “wrecking strips.”
STRONGBACK	A load gathering member attached to the back of the formwork on the outside of the walers for added strength, to hold proper alignment (sometimes referred to as “stiffbacks”).
STUD	Supporting member to which sheathing is attached.
TAG LINE	Line connected to gang form or flying form to control free swing movement during crane lifting.
TAPER TIE	A one-piece reusable form tie with a slight taper to facilitate removal.
TELLTALE	Any device designed to indicate movement of formwork.
TEMPLATE	Thin plate or board frame used as a guide in positioning or spacing of form parts, reinforcements, anchors, etc.
TIE	A concrete form tie is a tensile unit adapted to holding concrete forms secure against the lateral pressure of unhardened concrete, with or without provision for spacing the forms a definite distance apart, and with or without provision for removal of metal to a specified distance back from the finished concrete surface.
TIE DADO	Half-slot thickness dado’s at the siderails of adjoining forms provide the tie location slot common to many prefabricated form systems.
TOENAIL	To drive a nail at an angle.
TRAVELER	Traveling support and bracing for ganged tunnel and culvert formwork.
WALER	Load gathering members used to hold studs or panel forms in position.
WALKWAY SYSTEM	All components including, but not limited to, scaffold brackets, scaffold planks, guard rails, toeboards and guard rail posts erected to provide a work platform for placing and vibrating concrete and to prevent workers from falling.
WATERSTOP	Rubber, plastic, or other material inserted in a construction joint to prevent the seepage of water through the joint.
WEDGE	A piece of wood or metal tapered to a thin edge, used to adjust elevation, tighten formwork, etc.
WEDGE BOLT	A two-way action designed wedge which contains a slot to facilitate its function as a connecting bolt also.

A P P E N D I X**SOME COMMON CAUSES OF FORM FAILURES**

Exceeding design (working) pressure

- (1) Excessive rate of pour
- (2) Mix design not taken into account
- (3) Improper vibration
- (4) Temperature not taken into account

Ties not placed properly.

Ties in place, but improperly fastened (insufficient thread engagement, etc.).

Improper design -- particularly when layouts were not provided by manufacturer.

Job-built fillers, corners and bulkheads which are not adequately designed by field personnel and become the weak-point of the system.

Failure to brace at least one side of formwork.

Connecting hardware not installed.

Lack of inspection by qualified personnel to see that form layout has been interpreted properly.