CONCRETE PLACEMENT SAFETY, CONSOLIDATION & FORMS

Tips and advice from expert columnists on vertical concrete placement for a successful forming project.

CONCRETE CONTRACTOR®

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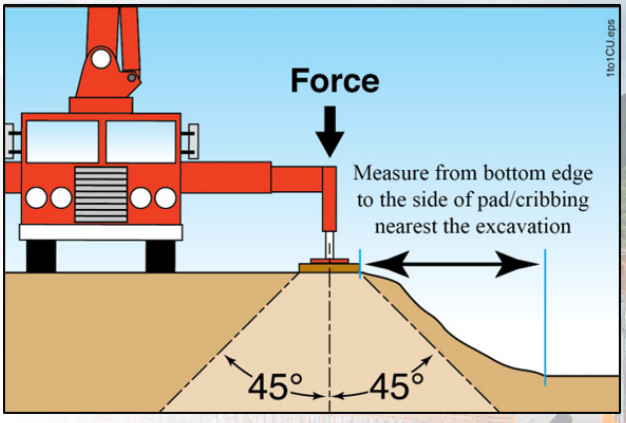
SAFETY AROUND THE BOOM PUMP

Concrete pumping improves productivity and safety on the job site by taking the most grueling manual labor out of a concrete pour. Reducing activities like wheeling and raking has prevented an uncountable number of injuries over the years–not to mention increased the quality of the concrete. However, concrete pumping isn't risk free. Electrocutions, hose whippings and tip overs are three of the more common safety issues that can be prevented when proper pump setup procedures are followed.

The Right Site

Concrete pump safety starts with a safe, uncluttered space for the pump truck on the job site. The ideal space should be level. It must be large enough for a pump with fully extended outriggers and away from excavations, while allowing room for the expected flow of ready mixed trucks. Per manufacturer requirements, a concrete pump must set up within three degrees of level.

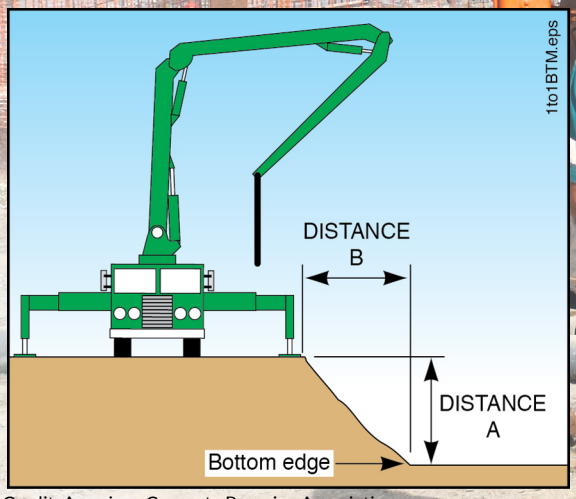


Credit: American Concrete Pumping Association

The 1:1 Rule

If the pump setup site is near an excavation, follow the One-to-One rule.

For every one foot of vertical drop, stay back from the base edge at least one foot. Take measurements from the edge of the outrigger pad nearest the excavation. Less-than-ideal soil conditions and engineered support walls are treated differently, so check with the pump operator for guidance. Some manufacturers may have more restrictive setback requirements depending on the size and weight of the unit. Always refer to the manufacturer's operation manual.



Credit: American Concrete Pumping Association

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Outriggers

Proper outrigger setup will drastically reduce the chance of a tip over on the jobsite. Tip overs are typically caused by either outriggers not having enough cribbing or surface area to properly support the unit, or in instances where the outriggers are not fully extended. Unknown factors, like underground voids, can also cause a tip over. The pump operator must be informed of back-filled areas or underground utilities in the area where the pump is set up.

Soil type on the job site will factor into outriggers. Different soil types have different load-bearing capacities. For instance, virgin ground typically supports approximately 14 psi while firm, compacted gravel supports 72 psi. A large boom can exert up to 120,000 LBF-FT on the soil. It is recommended to confirm soil conditions prior to setting up the pump.

When job site conditions prevent full extension of the outriggers and all other methods have been exhausted, shortrigging may be an option. Shortrigging should only be done on the side of the pump away from the pour. It involves its own set of guidelines and safety requirements. Never try shortrigging unless the operator is educated on the technique and responsible precautions are taken. Some concrete pumps have computer-controlled shortrigging lockout features; never shortrig without engaging this feature. Policies may differ between pump companies. Always refer to the manufacturer's operation manual.

Properly positioned under the outriggers, cribbing spreads the weight of the pump truck's load. When in doubt, always use more cribbing.

Credit: APA - The Engineered Wood Association

A boom coming in contact with power lines is the No. 1 cause of fatal accidents when using a concrete pump.

Credit: APA - The Engineered Wood Association

Power Lines

It is the position of the American Concrete Pumping Association (ACPA) that if power lines are within 20 feet (6m) of the area to be poured, a spotter must be employed whose only job is to observe the movement of the boom and warn the operator if the boom approaches the danger zone. The distance must be changed to 50 feet (15.25 m) if the power lines have more than 350,000 volts. (20 feet is 6 meters and 50 feet is 15.25 meters in the metric system). It is a good idea to mark the danger zone with cones, lumber, spray paint, caution tape or other identifying markers. As stated in the ASME B30.27 Safety Standard for Material Placement Systems, it is the contractor's responsibility to provide the spotter.

Whenever power lines are present, it is the contractor's responsibility to inform the pump provider. It is imperative that a pre-pour meeting be held whenever power lines are present on a job site. Everyone on the job site should be trained in power line and electricity safety, where the danger zone is, and the purpose of the danger zone.

Do not set outriggers on uneven soil or hills, and never bridge cribbing over a hole.

Credit: APA - The Engineered Wood Association

> *"The B30.27 standard is intended to prevent or minimize injury to workers and otherwise provide for the protection of life, limb and property by prescribing safety requirements."*

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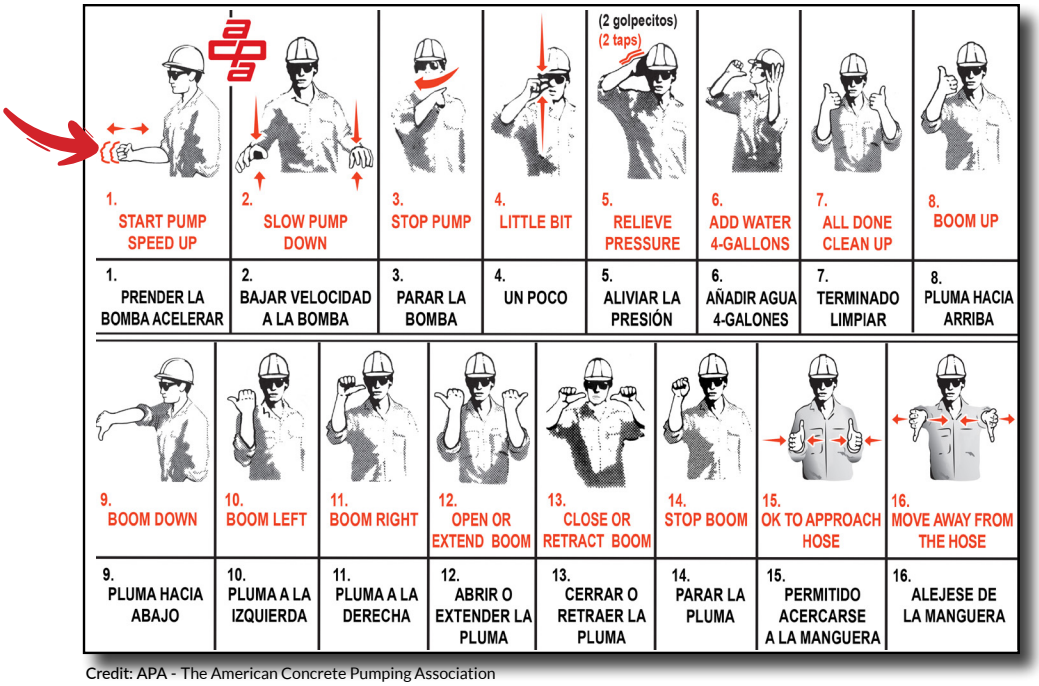
Contractor Responsibilities

Contractors should be aware of their responsibilities as stated in the ASME B30.27 Safety Standard for Material Placement Systems.

- Order the right size boom.
- Have a place prepared for the pump before it arrives on the job.
- Inform the operator of backfilled areas, soft or muddy areas, or under ground obstructions.
- Have cribbing nearby the setup area prior to the pump's arrival.
- Never try to coerce the operator into performing an unsafe activity.

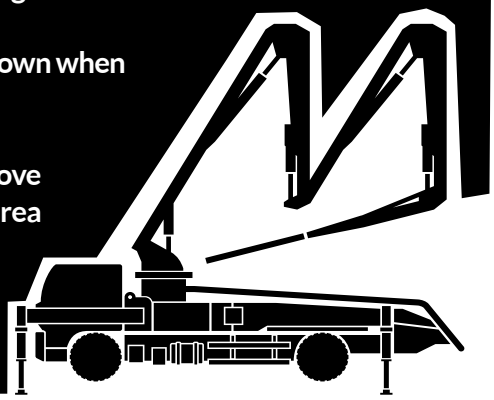
The American Concrete Pumping Association - Learn the ACPA's safety hand signals for concrete pump operators and workers on site.



Credit: APA - The American Concrete Pumping Association

These three won't stop it from happening, but you can reduce injury to yourself and those around you.

1. Remember to wear your safety personal protective equipment – ensure those around you are wearing those as well.
2. Ensure the boom tip is not pointing down when pump is turned off.
3. Recognize signs of a blockage, and move away from the end hose movement area should one be detected.



Double-Ended Hose Safety

Safe Practices for the Intended Use of Concrete Delivery and End Hoses, from the ACPA addresses the proper safety methods for using concrete delivery hoses with two ends.

"It's important for concrete contractors and concrete pumpers to understand when and where to use each type, as double-ended concrete delivery hoses increase the potential for serious personal injury when used as an end hose," says ACPA Executive Director Christi Collins.

While double-ended hoses do have their place on the jobsite, the safety bulletin explains that it is imperative that contractors "only use a single-ended end house at the discharge of the boom and on the discharge end of the lay-down placing line."

ACPA lists the following examples as situations where a double-ended hose is required:

- If you will be laying out pipeline in addition to the boom.
- When using a lay-down with more than one hose after the pipe for distribution of the concrete.
- For attaching the nozzle at the end of a shotcrete hose.

If a double-ended hose is in fact required, the bulletin further notes that as pipe and hoses are removed a single-ended house must be used as the end hose at all times, meaning that as you are removing hoses, you have to remove the next-to-last hose, and then slide the single-ended end hose in to hook up to the system that remains.

Improve Safety & Productivity Around Forming

From selecting the right concrete forms to fall protection to training, make sure you are following the proper safety procedures on your construction site.

Select The Right Formwork

Formwork, the temporary or permanent molds used to hold wet concrete until it sets, is a crucial element in concrete construction. The selection of formwork greatly affects the schedule, labor requirements, quality and total cost of a project. Because conditions vary for each individual project, there is no simple formula for choosing the right formwork supplier or system. Formwork typically accounts for40-60% of the total cost of a building's structural concrete frame. For concrete walls, the cost can be in the 50-60% range. These percentages include the cost of material and labor, with the largest cost for labor. It is important to analyze labor costs thoroughly, as this is the bigger number and reducing this number will have a much greater impact on bottom-line costs.

Get Involved Early

Contact formwork suppliers at the very early design stage of the project. This can allow for as much information as possible to be incorporated into the bid documents, which will provide a more accurate cost to the owner. Formwork suppliers can advise on sizing structural concrete members to meet standard form dimensions. And, because major form suppliers typically are involved in a large number of projects in a wide variety of construction markets, they can draw upon their resources to suggest formwork means and methods. Also of importance is to ask concrete forming contractors to be involved early in the design stage of the structure. They are ultimately the people who will be physically building the structure and can provide a tremendous amount of knowledge as to the most economical means and methods.

Know When To Purchase And When To Rent

Another consideration is whether to purchase or rent a system. This decision should be based on the duration of the project and the overall strategy of the company. Typically, if a form system has to be rented for more than 8-10 months, purchasing the system might be more economical. However, along with the purchase of a system, there are additional costs such as maintenance and storage. Some formwork companies offer services for customers who purchase their equipment. The quality of the product also must be considered in the decision-making process. Steel-framed wall formwork with standard plywood facing will require more maintenance and repair throughout the life of the form than hot-dipped galvanized steel frames with specially manufactured plywood designed for longer life.

Ensure Proper Access

Proper access is a really important component of formwork use at a worksite as it affects the schedule, budget and safety. Workers must be able to get to the workplace using safe horizontal and vertical access routes. There are ladder systems available that have been designed to be integral parts of the overall formwork system to allow safe access to various points on the formwork.

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> *"Formwork typically accounts for 40-60% of the total cost of a building's structural concrete frame. For concrete walls, the cost can be in the 50-60% range."*

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Make Fall Protection The Top Priority

At construction sites, falls are one of the top killers in the industry every year and therefore, fall protection is a major safety concern. For a construction worker, "feeling" safe is as important as actually being safe. It is important for productivity and peace-of-mind that a worker has a feeling of security as they move about the formwork structure. A worker will perform his/her duties much more productively if they are comfortable with the structure under their feet. If you are working on top of something that feels rickety, you don't feel as confident and that can result in a loss of productivity. You want your formwork structure to be outfitted with equipment that meets OSHA requirements for fall protection.

Further, a worker needs a safe, easy way to climb from one area to the next, so it is important to have proper ladders installed for easy, safe access from Point A to Point B on the formwork. On platforms where people will be working, install secure guardrails to protect workers from falls. One recent innovation that is improving fall protection procedures on high-rise structures is protection screens. They fully enclose a building's slab edge, providing a completely contained safe and more productive working environment.

These systems anchor to a slab edge around the perimeter of the building. Perimeter protections screens, used at the upper floors of high-rise buildings as they are erected, provide protection from wind, weather and the fear of falling. Screen safety systems offer protection for the working floor and up to three floors below. Other safety precaution ideas include good guardrails, toe boards and solid anchorages where workers can tie-off using their own personal fall arrest systems.

Ensure Accurate Handling And Proper Assembly

One of the common mistakes that contractors make at a worksite is not following the engineering drawings for assembling and setting-up the formwork. Not following set-up instructions letter-by-letter can lead to accidents. Trying to cut corners to save set-up time could result in unsafe working conditions and unnecessary downtime. When setting-up and dismantling a formwork structure, follow instructions carefully to ensure safety. Ties, installed properly, will hold the formwork firmly in place as the concrete is poured. The formwork must be properly supported before removal of the ties and the formwork is removed from the set concrete.

As an example, Doka's series of work platforms feature the "Xsafe" system that provides complete, all-around safety before a worker steps onto the platform. The platforms offer extra-safety precautions at the work site through integrated, telescoping ladders, auto-closing manhole lids, and side- and end-guards that integrated into the platform. Another job site innovation that reduces jobsite crane time and formwork labor requirements is formwork lifting elevators that mount to the exterior of a building, allowing all formwork to be cycled from floor to floor without the need for a crane. These table lifting systems are used in conjunction with the smaller table method and also allow for other construction material including handset shoring, vertical formwork and reshores from below to cycle from floor to floor with the need for a crane.

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"A worker needs a safe, easy way to climb from one area to the next, so it is important to have proper ladders installed for easy, safe access from Point A to Point B on the formwork."

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Don't Overlook Proper Formwork Ties

With formwork, it is necessary to have the proper ties in place to secure the formwork. Having the proper ties in place and not exceeding the maximum pour pressure as per the design not only guarantees safety, but also will ensure the work is correctly done. For example, if you pour the concrete in too fast and the ties are not strong enough, it creates excess pressure on the forms. The ties can fail and the formwork can move, creating an unsafe condition and work that must be redone.

Select The Optimal Assembly Method For Your Project

Having the formwork pre-assembled at the supplier's shop not only can save you time in the field, but it also provides many safety advantages. As opposed to the often crowded, cluttered construction site, a shop will have clean, smooth, level areas for building the formwork. This allows the formwork to be more accurately assembled, more solidly built, and be aligned better– important aspects for safe construction and use.

Pre-assembly at the shop also gives the supplier access to all the safety devices necessary for the formwork structure (i.e., guardrails, trap doors, etc.) and ensures that they will be properly installed. A contractor should expect the formwork supplier to have all necessary safety equipment included in the system design and in the bid.

Safety First

Every worker at construction site knows about safe practices. Union craftspeople learn safe practices during their apprenticeship, and several trade organizations promote the safe and proper use of forming and shoring equipment. However, while safety is never a simple matter, if safety equipment features are easy to use then workers will use them. The purpose of safe practices is so that all workers have a common level of knowledge and that they will all do things the same safe way. For a contractor, enforcing safety at a worksite is the most crucial aspect of getting a job done. With everyone following safe practices, not only will there be fewer accidents (or none at all) but also benefits in increased productivity and efficiency.

Training

Formwork technology is constantly changing and you should take advantage of the training now being offered on the proper and safe utilization of forming equipment by the equipment suppliers. Some formwork manufacturers offer training sessions for their products with both classroom and hands-on learning. An excellent way to boost your field forces productivity is to have them attend these training sessions.

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Choosing a Formwork System

To help determine the most efficient solution for a project, a contractor will evaluate several forming systems. Simply stated, you have two choices: an inexpensive forming material that is labor-intensive or a forming system that while costing more, provides high productivity, built-in safety features and is more labor efficient.

Other factors the contractor will evaluate when choosing a formwork system include:

- Is the material you require readily available? Does the supplier manufacture the material or do they purchase it from another company?
- Can the formwork supplier pre-assemble some or all of the formwork prior to delivery? This can reduce rental cost, save labor requirements and minimize assembly area requirements.
- Does the supplier provide on-site field service to train and reduce the learning curve of the formwork crew?
- How safe is the system to install, use and dismantle? Can the forms easily be climbed and are tie-off points built into the system where required?
- What experience does the firm have with your type of project?
- Does the supplier offer engineering services? Will the supplier provide formwork assembly drawings specifically for the project or only provide general drawings of the system?

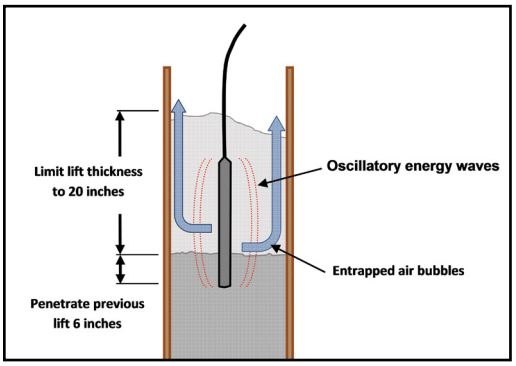
Defining Consolidation Issues

Honeycomb, subsidence cracks, cold joints and excessive surface air voids are common surface blemishes associated with ineffective concrete consolidation. In addition to being unsightly, formed surfaces with blemishes may not conform to the requirements of the contract documents. When this occurs, surface blemishes become defects and subsequently must be repaired. Along with the expense of repairing surface defects, it is difficult and sometimes impossible to make repairs match the color and texture of the surrounding concrete. By understanding the causes and using effective consolidation techniques, contractors can avoid repair costs and aesthetic disputes due to consolidation-related surface blemishes.

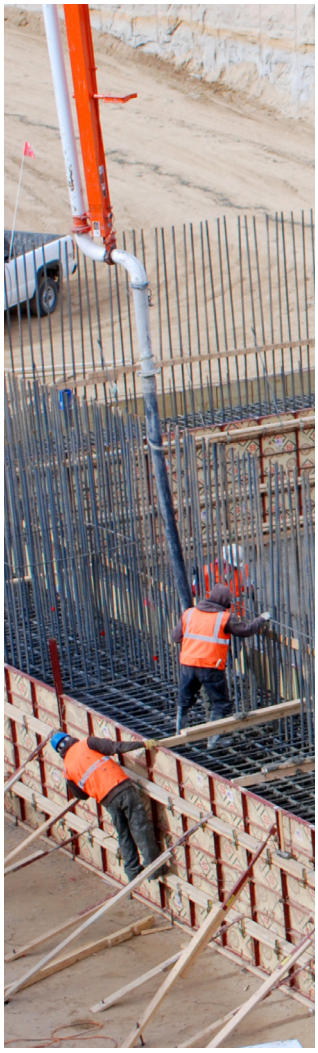
Consolidation using an internal vibrator occurs in two stages:

1) Leveling - Concrete is temporarily liquified due to the rapid oscillatory motion transmitted to the concrete by the vibrator. Due to the energy imparted to the concrete, coarse aggregate particles become suspended, large voids between aggregates fill with mortar and concrete settles due to gravity.

2) De-aeration - The remaining entrapped air bubbles rise to the surface and escape, especially the large bubbles. It is not possible to remove all the entrapped air bubbles; however, vibration should continue until the cessation of large air bubbles occurs.



Due to the oscillatory energy waves, entrapped air bubbles are driven to the form face and move upward to escape.



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Tips To Defining Consolidation Issues

- Use the largest and most powerful internal vibrator.
- Systematically vibrate the concrete area through the full depth of the lift, penetrating the previous lift.
- Limit the distance between insertions so the area visibly affected by the vibrator overlaps the adjacent just-vibrated area. Continue vibrating until the coarse aggregate particles become embedded, a thin film of mortar forms on the top surface and along the form faces, and large air bubbles stop escaping from the surface.
- Listen to the pitch or tone of the vibrator. When the vibrator is first inserted into the concrete, vibrator frequency drops but then increases and finally becomes constant when the concrete is free of entrapped air bubbles.
- Deposit concrete with a maximum lift thickness of about 20-inches. Make lifts level as possible and do not use the vibrator to move concrete horizontally.
- Plunge the vibrator vertically into the concrete. Use a uniform spacing not to exceed about one and a half times the radius of influence over the entire placement area.
- Let the vibrator sink by means of its own weight to the bottom of the lift and penetrate the previous lift about 6 inches.
- Manipulate the vibrator with an up-and-down motion for 5 to15 seconds to knit the two layers together. Do not worry about over-vibrating the concrete; most concrete is under-vibrated.
- Withdraw the vibrator gradually with a series of up-and-down motions so air bubbles are worked upward in front of the vibrator.
- Rapidly extract the vibrator from the concrete when the head becomes partially exposed. If the vibrator hole does not close, partially remove and quickly reinsert the vibrator a short distance away from the hole.

Honeycomb

Honeycomb occurs when mortar fails to completely fill the spaces between the coarse–aggregate particles leaving irregular voids or stony zones in the concrete. Typically, honeycombing occurs along the form face and in many cases is limited to the region between the form face and reinforcement. Causes include congested reinforcement and narrow forms, insufficient paste due to segregation of the concrete, improper fine to coarse aggregate ratio, improper placement procedures (excessive concrete free fall and lift thicknesses), trying to place stiff and dry concrete, difficult construction conditions, and insufficient consolidation efforts.

Subsidence Cracks

Subsidence cracks, sometimes called plastic settlement cracks, occur when additional settlement or consolidation occurs after the freshly placed concrete has been vibrated and finished. Causes of delayed settlement include excessive bleeding and incomplete concrete consolidation. Cracks form in the plastic concrete because of some type of restraint that restricts concrete settlement. Subsidence cracking in columns and walls commonly occurs over fixed items such as tie bolts and reinforcement and in columns and walls where settlement is restrained by wedging or arching of the concrete. Deep concrete sections are more prone to subsidence cracking.

This form of plastic cracking can be minimized by using proper placing and consolidation procedures and essentially eliminated by revibration. Revibration is not harmful, can mend subsidence cracks and reconsolidate concrete after delayed settlement has occurred. If the vibrator can be inserted into the concrete and removed without leaving a hole, it is not too late to revibrate the concrete.

Cold Joints

Cold joints are different than lift or layer lines. Lift lines occur when successive lifts of concrete are not completely knitted together. In many cases, lift lines occur because of color variations between loads of concrete and do not indicate there is a joint or discontinuity in the concrete.

In contrast, a cold joint is a discontinuity between two lifts of concrete. They occur when, due to a concrete placement delay, the earlier lift of concrete hardens sufficiently to preclude knitting and bonding of the two lifts. Except for the unsightly appearance, cold joints are typically not a concern unless the concrete is unreinforced or an environmental tank.

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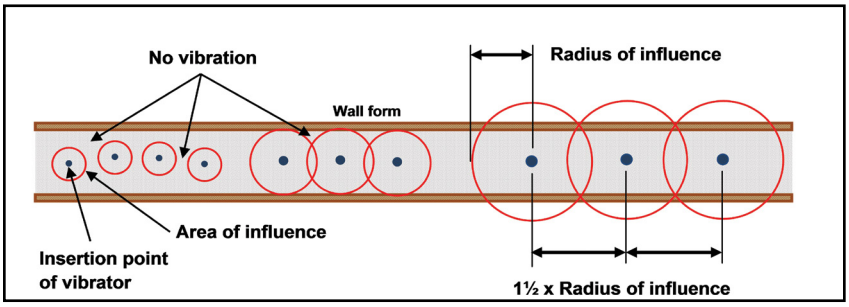
Avoid honeycombing by using appropriate concrete mixtures with sufficient workability, proper placement and consolidation techniques.



Matching the size of the vibrator to the job and limiting the insertion spacing to one and a half times the radius of influence will minimize honeycombing and other form surface blemishes.

Surface Air Voids

Surface air voids are small, regular or irregular cavities, usually less than 5/8 inches in diameter, caused by entrapment of air bubbles in the surface of formed concrete. These are normal for vertical cast-in-place concrete and not considered a defect unless voids exceed the maximum size specified by the contract documents.

Contractors can minimize these by using: smooth, impermeable formwork; the thinnest coat possible of an appropriate release agent; limited lift thicknesses; high-frequency vibrators; and proper vibrating procedures with sufficient periods of vibration to de-aerate the concrete.

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Surface air voids or bugholes are acceptable for vertical cast-in-place concrete walls and columns unless voids exceeds the maximum allowed size.

Tips for Successful Vertical Concrete Placement

- Planning cannot be overemphasized. Attention to detail is critical and the key personnel must be aware of the formwork tolerances, finish surface quality requirements, and proper placement and vibration procedures. A thorough plan can help ensure success of any wall.
- Ensure the mix design has been submitted, approved and ordered.
- Finalize the means of placement
- Concrete superintendent plans the placing rate, which will determine truck spacing; vibrator type, either external, internal or a combination of both; and placement access/pour platforms and testing/cleanup areas.
- Concrete superintendent reviews grades with the formwork superintendent.
- A placing sequence should be discussed in advance of form close up, considering these restrictions.
- Concrete superintendent reviews locations of all blockouts and embeds that will block the flow of concrete from above — this is critical as these locations will result in rock pockets/consolidation issues if the placing crew is not aware of them.
- Ensure the team is clear about who has authority to reject concrete and for what reasons.
- Have adequate, dedicated power for vibrators on critical pours and ensure backup power readily available.

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Working Your Forming Panels

How To Notice Quality Plywood

When ordering concrete forming panels, it's important to understand what you will get—quality materials or a product that won't perform. APA certifies engineered wood products to some of the most stringent standards in the world. The standards, PS 1 for plywood only, and PS 2 for all structural wood panels are designed to assess the ability of engineered products to perform in their intended application and are tested for installed attributes such as concentrated load, uniform load, bond performance, and expansion with moisture content. Complementary standards in Canada are CSA-O121 for Douglas-fir plywood and CSA-O325 for all structural wood panels.

JCredit: APA - The Engineered Wood Association

Plywood panel flexure testing at APA's Tacoma research laboratory.

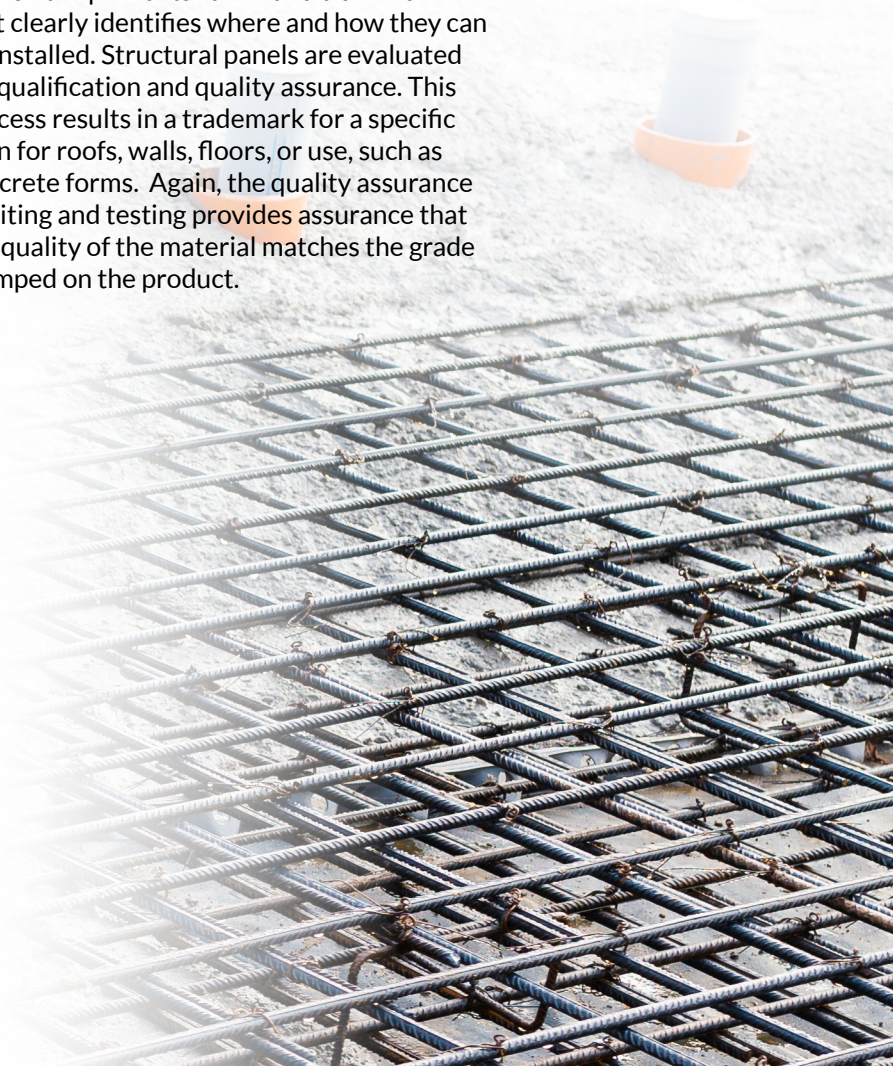
JCredit: APA - The Engineered Wood Association

The APA trademark signifies the manufacturer's commitment to a rigorous program of quality verification and testing.

Quality Assurance

Once certified, engineered wood products are evaluated based on a strong quality assurance policy that includes reviewing mill quality procedures, APA third-party audits of the mill quality system, and quality testing that verifies the quality and performance of engineered wood products. Finally, APA's quality assurance policies have proactive steps to ensure quality issues are dealt with promptly.

Qualified products are then authorized by APA so the products can bear a trademark that clearly identifies where and how they can be installed. Structural panels are evaluated for qualification and quality assurance. This process results in a trademark for a specific span for roofs, walls, floors, or use, such as concrete forms. Again, the quality assurance auditing and testing provides assurance that the quality of the material matches the grade stamped on the product.



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Rating, Standards & Source

Imported panels, in comparison, could come in three different categories, and the purchaser needs to be aware of the implications. In one instance, it could be an imported engineered wood product that has similar span rating or grade information as APA uses, but the product quality may not be the same as an APA stamped product.

The imported engineered wood product could be trademarked to a foreign standard. The standard could be legitimate, but a foreign standard will not have a North American span or grade rating.

The panel may identify the source of the product, the thickness, and the manufacturer, but if there is no standard reference listed in the trademark, there's no telling how it was made and whether the combination of glue, wood species and manufacturing will result in a product with adequate structural performance. In some cases, the panel might have a clear face with an attractive pattern, and it could look like a 3/4-in. panel that could be used in a structural application.

Without a standard in the trademark, the wood species used could have inferior strength and stiffness. The glue could have inferior moisture performance or have high formaldehyde emissions. The degree of quality assurance is completely unknown. An APA trademark provides the assurance of appropriate qualification and quality assurance evaluation that yields a product that provides performance matching the product trademark.

APA has responded to inquiries in the past of questionable trademarks, particularly on structural panels. In certain cases, APA noted that panel stiffness was low in comparison to the product trademark rating. In some of the panels, the bond quality was low, and formaldehyde emissions were higher than normal for North American structural panels. When purchasing engineered wood products, such as concrete form panels, the APA trademark provides the assurance of a quality product that will consistently perform as labeled for span rating or grade.

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APA - The Engineered Wood Association

The glue bond on this imported concrete form panel failed, causing the panel to delaminate.

Credit: APA - The Engineered Wood Association

Formwork represents close to half the cost of a concrete structure, warranting serious and detailed consideration when sourcing.

Optimize Your Wooden Form Panel

Ensure you are getting the most out of your concrete forms—and your budget—with these simple panel care recommendations.

Stripping: Metal bars or pry bars should not be used on plywood because they will damage the panel surface and edge. Use wood wedges, tapping gradually when necessary. Plywood's strength, lightweight and large panel size helps reduce stripping time and the cross-laminated construction resists edge splitting.

Cleaning & Release Agent Application: Soon after removal, plywood forms should be inspected for wear, cleaned, repaired, spot primed, refinished, and lightly treated with a form-release agent before reusing.

Handling & Storage: Care should be exercised to prevent panel chipping, denting, and corner damage during handling. Panels should never be dropped. The forms should be carefully piled flat, face-to-face and back-to-back, for hauling. Forms should be cleaned immediately after stripping and can be solid-stacked or stacked in small packages, with faces together. This slows the drying rate and minimizes face checking. Plywood stack handling equipment and small trailers for hauling and storing panels between jobs will minimize handling time and damage possibilities. During storage, the stacks of plywood panels should be kept out of the sun and rain or covered loosely to allow air circulation without heat build-up.

Coating & Agents: Protective sealant coatings and release agents for plywood increase form life and aid in stripping. "Mill-oiled" Plyform® panels may require only a light coating of release agent between uses. Specifications should be checked before using any release agent on the forms. Plywood form coatings, such as lacquers, resin or plastic base compounds, and similar field coatings sometimes are used to form a hard, dry, water-resistant film on plywood forms. In most cases, the need for the application of release agents between pours is reduced by the field-applied coatings.

Effect of Admixtures on Forming Panels: Admixtures are chemicals added to a concrete mix to change the properties of a basic mix of cement, water, and aggregate. They can speed or retard setting times, increase workability, increase air content, decrease water permeability or increase strength among other effects. Admixtures include pozzolans such as silica fume, blast-furnace slag, and fly ash. The use of admixtures is relatively common and many of these additives increase the abrasiveness and/or alkalinity of the concrete. While wood and phenolic overlays are resistant to alkaline solutions and abrasion, the use of admixtures may significantly decrease the "normal" life of a concrete-forming panel.

APA-trademarked concrete form panels can be used repeatedly with proper care.

Credit: APA - The Engineered Wood Association

Many imported forming panels do not undergo comparable product qualification testing. Without such tests, it's impossible to determine how the panel will perform for the intended use. As an internationally accredited testing laboratory, APA put imported hardwood plywood panels from China and Brazil up against domestic plywood certified to the U.S. Product Standard PS 1. The import test results indicated inferior mechanical and connection properties and severe failure for bond durability. Only one tested sample would have met the formaldehyde limits imposed by the California Air Resources Board and U.S. Environmental Protection Agency.

Look for concrete forming panels bearing the APA trademark. It appears only on products manufactured by APA members committed to APA's rigorous program of quality inspection and testing.

Where do I find APA-trademarked concrete forming panels?
APA-member manufacturers are located throughout North America. Hundreds of distribution centers throughout the U.S. and Canada inventory a wide selection of concrete-forming panels and engineered wood products. The APA provides a complete list of members manufacturing concrete-forming panels at www.performancepanels.com.

What is O & ES or OES?
Oiled and edge-sealed. Surfaces of concrete form panels are lightly coated with oil and the edges sealed if specified.

How many pours can I get out of a sheet of concrete forming plywood?
Many factors affect the number of pours expected from a sheet of concrete forming plywood, including the expected finish on the concrete, the overlay (if any), the concrete mix, maintenance, and care. Up to 10 pours can be expected from a B-B grade non-overlaid panel. With reasonable care, HDO Plyform will normally produce 20 to 50 reuses or more. Consult with your supplier for advice on maximizing the number of pours.

What's The Biggest Difference Between APA-Trademarked Concrete Forming Panels Over Imported?

APA-trademarked concrete form panels are manufactured to stringent product standards (such as Voluntary Product Standard PS 1, Structural Plywood, and Voluntary Product Standard PS 2, Performance Standard for Wood Structural Panels) and are subject to APA's rigorous, state-of-the-art quality verification and testing programs.

@vanik88-stock.adobe.com

Phillip Berezhonoy @ AdobeStock

SOURCES:

"Safe Concrete Pump Setup Will Help Prevent Tip Overs and Electrocutions", by Rebecca Wasieleski, provided by the American Concrete Pumping Association. ForConstructionPros.com/10884367

"Best Practices for Using Concrete Delivery and End Hoses", by Amy Wunderlin. ForConstructionPros.com/21104923

"Prevent Hose-Whipping Accidents", by Allied Insurance Brokers alliedinsbrokers.com/hose-whipping

"10 Ways to Improve Safety and Productivity on Your Forming Jobsite", by Doka USA. ForConstructionPros.com/10302370

"How to Use an Internal Vibrator", by Kim Basham, PhD PE FACI, KB Engineering LLC. forconstructionpros.com/10726176

"Tips to Minimize Concrete Consolidation Issues with Forming Projects", by Kim Basham, PhD PE FACI, KB Engineering LLC ForConstructionPros.com/10726215

"7 Tips for a Successful Vertical Concrete Placement", by Greg Smith ForConstructionPros.com/10848218

"Concrete Forms: A Quick Guide to Imported vs North American Engineered Wood", by Kurt Bigbee, APA – The Engineered Wood Association forconstructionpros.com/21342969

"5 Best Practices to Optimize Concrete Form Lifespan", by Warren Hamrick, APA – The Engineered Wood Association. ForConstructionPros.com/21521093

ADDITIONAL RESOURCES:

ACI SP-004: Formwork for Concrete
The ACI's 8th edition of "Formwork for Concrete" is a major revision to bring it up-to-date with "Guide to Formwork for Concrete (ACI 347R-14)." Revisions include referencing current standards and practices, removing outdated or irrelevant material, adding content on new developments in formwork technology and practice, and updating the look and layout of the document.
https://www.concrete.org/store/productdetail.aspx?ItemID=SP48TH

American Concrete Pumping Association
Job site safety begins with properly trained personnel. ACPA Certified Operators have successfully completed a comprehensive safety training program which helps to ensure the safety of those working with or around a concrete pump on the job. More information regarding the ACPA operator certification program can be found at www.concretepumpers.com. The website also offers free safety materials while the ACPA Online Store sells a variety of safety videos, posters, decals and more.
https://www.concretepumpers.com/

Employers and employees will find a variety of safety materials on the ACPA's online Safety/Training hub, including safety publications and materials providing information for creating a safe environment when working around concrete pumps on the jobsite.
https://www.concretepumpers.com/content/safety

We Are Safer Together
One accident is too many. For more information regarding the ACPA's safety campaign to bring heightened awareness of the AMSE B30.27 Safety Standard for Material Placement Systems visit www.wearesafertogether.org. https://www.wearesafertogether.org

American Society of Concrete Contractors
The ASCC is committed to informing responsible decision-making and promoting safety in the concrete industry. At the forefront of these initiatives is their Safety & Risk Management Council and Technical Committee's **position statements** that cover topics of major interest regarding building with concrete.
https://ascconline.org/Safety/Safety-Benefits-Publications
https://ascconline.org/Technical/General-Concrete/Position-Statements

Concrete Foundations Association
The CFA produces position statements that can explain, impact or enhance the understanding of key aspects for building with concrete. The positions relate to actual jobsite issues and become technical aspects of the certification programs we are involved. CFA's Technical Positions are regularly implemented in the field and referenced in industry guides, standards and published in numerous trade magazines.
https://www.cfaconcretepros.org/technical-positions

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