10. Tenth phase: Concrete placement

10.1. Concrete ordering

After wall is built and ready for concreting, calculate the required concrete amount once again.

1) Make a quick calculation for the required amount of the concrete – count up the area of the vertical wall projection and then multiply as follows :

For 100mm (4") wall thickness – total area (m^2) x 0,102 m^3 concrete
For 150mm (6") wall thickness - total area (m^2) x 0,152 m^3 concrete
For 200mm (8") wall thickness - total area (m^2) x 0,203 m^3 concrete
For 250mm (10") wall thickness - total area (m^2) x 0,254 m^3 concrete
For 300mm (12") wall thickness - total area (m^2) x 0,305 m^3 concrete
For 350mm (14") wall thickness - total area (m^2) x 0,365 m^3 concrete

Add 5% for waste

Preparation of the concrete mix

We advise the following parameters for concrete:

Compressive strength: 25Mpa (3.500psi) during 28 days
Aggregate size: 10mm (3/8") for 127-254mm (5"0") wall thickness
13mm (1/2") for 305-356mm (12"4") wall thickness
Water/cement ratio: no more than 0,4

Settlement: 100-152mm (4"- 6") or 50mm (2") with application of super-plasticizer.

For the specific project, another concrete mix ratio can be used, but for this case you should follow the project guidelines.

Example:

Total area of the vertical projection of walls with thickness 250mm (10"): 215.31m^2 (2316.73 ft^2)
Required amount of concrete: 215.31 x 0.254 = 54.69m^3 (71.64 yd^3)

Add 5% for waste: 54.69 x 1.05 = 57.43m^3. (75.23 yd^3)

Checklist for the works to be done prior to concreting

Make few hours available one day before concreting to double check the required work performance.

##	Description of work	Done
1	Does the layout match the plan everywhere?	
2	Are the walls plumb everywhere?	
3	Do all walls have 90 degree angles?	
4	Ensure that the upper level of concrete is even along the perimeter of the building.	
5	Are all bucks for walls and windows placed, fixed and aligned?	
6	Are the window and door bucks connected securely to the formwork?	
7	Are the bucks braced with diagonal props to prevent leaning?	
8	Are all cuts and weak spots reinforced?	
9	Are all sleeves and anchors for services inserted and glued securely?	
10	Are all anchors for interior walls placed?	
11	Is horizontal reinforcement installed in all panels? Is there enough overlapping provided?	
12	Is vertical reinforcement installed in all panels' courses? Is there enough overlapping provided?	
13	Are all ledges (if any) placed and secured?	
14	Is the additional reinforcement for openings installed?	
15	Are all anchor-bolts or straps (if required) placed on the top of the wall?	
16	Are there plywood squares 1x4 available to screw them over the weak spots if appeared?	
17	Has the building department inspected and approved your construction?	
18	Was the construction inspected and approved by your Engineer? (If required)	
19	Is the construction site clean for operation of the concrete truck and pump?	
20	Did you order concrete?	
21	Did you order the pump?	

10.2. Concrete pressure

During the placement, concrete applies outward pressure on the formwork. Armopanel™ is designed to withstand such pressure.

The outward pressure can be the highest in the bottom of a lift. Due to this, connecting meshes, which link panels together, have to be installed. Such connectors are placed @ 1200mm (48”) along the panel height.

As the concrete hardens, the pressure is reduced nearly to zero. When the crew begins the placement of the concrete of the second lift, the concrete of the first lift is usually hard enough to avoid problems at the bottom of the wall (such as bulging). During the placement of the concrete of the second layer, the highest concrete pressure occurs at the bottom of the second layer.

The following factors increase the pressure:

- Falling concrete force,
- Vibration,
- Water added to the concrete

When concrete falls into the formwork, it exerts outward pressure approximately 1.5 times more than the pressure it exerts when it is already in the formwork. There are many ways of reducing the pressure of the flowing concrete, including: application of S-shaped boom pump, 50mm (2”) line for any type of pumps and breaking the concrete flow with a shovel. Failure to use these measures leads to the risk of increased concrete pressure. The greatest pressure is in the bottom of the concrete layer, therefore, this area must be carefully watched.

Vibration also causes the concrete pressure to increase by 1.5. This problem can be minimized if a vibrator with a small diameter is used. Optimally, the diameter should be 20mm (¾”). The diameter of the vibrator should never exceed 25mm(1”). During vibration, the maximum pressure occurs at the bottom of the wall.

If you add extra water to the concrete, pressure may be increased by more than 1.5 times, depending on the added volume.

This will cause the actual concrete strength to be lower than required.

10.3. Concrete pouring

The speed of pouring of concrete into the Armopanel™ depends on the outdoor air temperature and should not exceed the following speeds at each temperature level.

Temperature Fº (Cº)	Feet/hour (mm/hour)
41º (5º)	2.5 (800)
50º (10º)	3.5 (1050)
60º (15º)	3.75 (1150)
70º (20º)	4.0 (1200)
86º (30º)	4.0 (1200)
90º (32º) and higher	4.25 (1300)

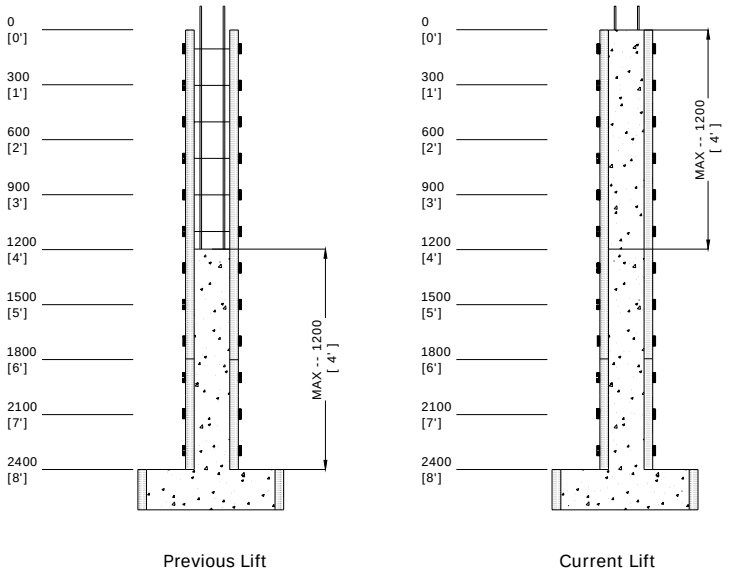

Figure 10.1

Concrete pouring will be performed in accordance with Canadian Building Code and Standards: CAN/CSA-A23/1-00/CAN/CSA-A23/2-00 (American Standards - ACI-318 and ACI-332).

Environmental factors influencing the concrete mixture selection are as follows: outdoor air temperature, quality and temperature of the components, wind, direct and indirect sun rays, etc. The above-mentioned factors are of no concern when using Armopanel™ stay-in-place formwork with polystyrene boards.

Use of our panels allows the customer to build even during the cold season without the use of special thermo-blankets. While the concrete hardens, heat is discharged which allows the concrete to harden even further without the use of super plasticisers. Armopanel™ stay in place formwork provides best concrete quality during the warm season as well.

Good moisture retention of the concrete significantly affects the quality of the concrete and the hardening speed. Under optimal moisture retention, the influence of shrinkage and creep are also significantly reduced, thus, making the structure more durable and strong.

To place the concrete better, it is highly recommended to use super plasticisers for better flow of concrete with limited volume of water (water/cement ≤4, slump 4”). Concrete mix design varies for particular projects.

Select the wall to start the work. Start the concrete placing through the sill of each window buck till the concrete fills the bottom of the wall.

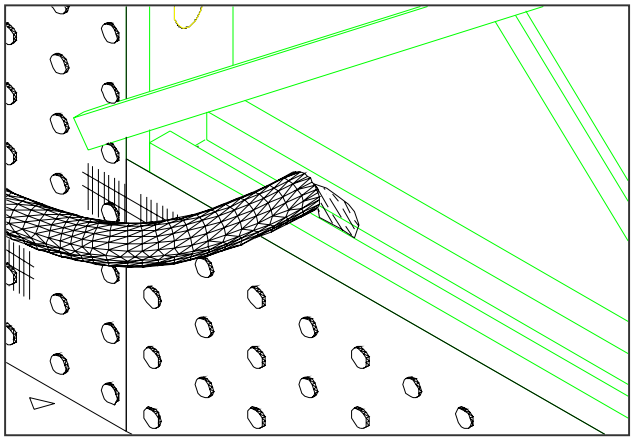

Figure 10.2

After placing concrete below windows, start pouring the concrete 1200 mm (48”) from the corner of the building, but not directly in the corner (for placement of the concrete refer to the table above).
Move the pouring of concrete down the wall until you reach 1200mm (48”) from the other corner of the building.

Pour concrete in the same manner on every wall performing the work around the building in the same direction (clockwise or counter-clockwise).

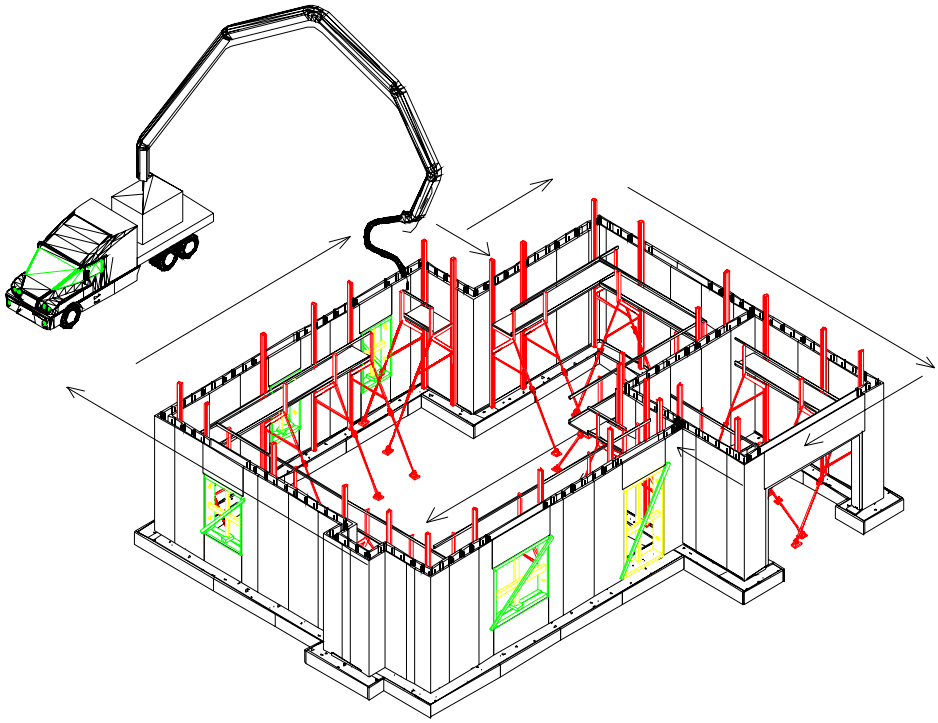

Figure 10.3

As soon as you have done one circle, repeat the same procedure as many times as you need to fill the wall. Maximum height of the poured concrete in one level is 1200mm (48”).
If you pour concrete from a chute, you will need one labourer to hold a shovel at the bottom of the chute to direct the concrete flow and slow its fall. At least, one labourer is required to watch the occurrence of bulges. Vibrate the concrete all the time during pouring.

Methods for concrete consolidation:

- Use the internal vibrator of ¾” diameter or less. Don’t forget to vibrate the concrete from the bottom of the wall to its top. Be very careful not to hit the formwork.
- Use a special external vibrator, which is applied to the exterior surface of the formwork directly to the plastic caps.

Useful tip:

Protect the top of the wall from damage with a positioning U-shaped element, which is placed on the top of the polystyrene boards.

After the pouring of concrete, vibrate every 500mm (20”) at most, along the wall. If the crew notices a bulge in the formwork, it is necessary to strengthen the damaged area by means of plywood, which is attached to the plastic caps of the panel.

If damage to the polystyrene panels occurs, stop the pouring of concrete. Damage to the polystyrene sheets occurs rarely, but is possible if the pouring speed of the concrete is too high or if the water quantity in the concrete mix is too high. Perform concrete pouring onto the next panel until the damaged panel is repaired. Remove the concrete around the damaged area of the panel and unscrew the plastic caps.
Cut out the damaged part of the polystyrene sheet and replace it. Secure the new part with plastic caps. Placement of concrete in this area may resume at any time after this procedure.
During concreting, check all line dimensions and adjust the bracing if required.
Approximately one day after concreting, remove the straps from both sides of each window and door buck.
Don't remove bracing and scaffolding until the concrete reaches the minimal strength. Usually it takes from 3 to 5 days.

10.4. Specific features for the design of the basement concrete walls

The phases for the forms' installation are the same as for the plain walls except the following specific features outlined in this chapter.
Any type of water-proofing intended for use on polystyrene surfaces (ICF application) can be applied to the Armopanel™ formwork. Application of the water-proofing on the backfilled panels can be performed by spraying.
Manufacturer's instructions must be followed while using any water proofing substance. Before application, panels must be cleaned and the yellow layer, formed after long exposure to ultra-violet rays, should be removed. The water proofing membrane should not be exposed to the sun for more than 5-7 days, otherwise, the membrane may loose its potency.
Following the installation of the water proofing system, it is required to provide drainage system around the building in accordance with the local Building Codes and regulations.

The soil backfilling of walls may be performed:

- Only upon reaching by concrete 85% from the designed strength (must be certified by lab),
- After the slab installation and securing of the backfilled panels at the top level,
- After application of water-proofing materials on the outside surfaces of the panels at minimum 6" higher the utmost top line from the backfilling of the basement wall and drainage system installation around the walls.

Soil for the backfilling of basement concrete walls must be free from organic additives and construction residue.
The most suitable backfill material are sand or gravel.
The backfilling must be done layer by layer (8" maximum) and compacted to the required density in accordance with the project.
While backfilling, you must not damage the waterproofing system of the walls. Backfilling of the basement facilitates the assembly of the formwork above grade.

The tables on pages of the Design Guide present fast estimates for optimal wall thickness at various depths and horizontal pressure from backfilling. The horizontal pressure from backfilling is presented as equivalent of the water pressure.