



FORMING SECTION

SSFI TECHNICAL BULLETIN

Form Pressure and Pour Rate Basics

The designer of concrete formwork must consider two forces. One force, usually vertical, is the *weight or load* of the concrete on the surface supporting it. For example the weight of a concrete sidewalk must be supported by the earth under it. The other force, usually horizontal, is the *pressure* that fluid concrete exerts on the forms that restrain it. This force can be very high and is determined by the *height* of the fluid concrete. Because this force is due to the height of the *fluid* concrete, the force can consequently be controlled by restricting the placement of the concrete in the form.

Note that the length and width of the concrete placement has nothing to do with the force of the fluid concrete. In other words, in the case of a wall form, the *width* of the wall has nothing to do with the force of the fluid concrete against the form. (The only real effect of the wall width is that a thin wall form can be filled much faster with fluid concrete than a thick wall form, resulting in a much higher height of fluid concrete. This height of fluid concrete is commonly referred to as the *liquid head*.) Wall forms can be designed for any pressure but authoritative sources, such as the American Concrete Institute, suggest a minimum *design pressure* of 600 pounds per square foot (psf) (CSA requires a 1000 pound minimum in Canada). The following formula provides a rough estimate of the pressure from liquid concrete:

$$p = 150 \times h \text{ and: } h = p/150$$

where:

- p is the pressure in pounds per square foot, psf;
- h is the height of the *fluid concrete (liquid head)*, in feet.
- (150 is the weight of normal concrete pounds per cubic foot)

Note that a form designed for 600 psf will allow a liquid concrete height of 4 feet. (Other factors that must be considered are re-vibration, pumping from the bottom, and self consolidating concrete. Formulas for calculating concrete pressure that account for these factors can be found in ACI 347.)

A limited pour rate will provide time for the concrete to begin hardening and thus reduce the height of the fluid concrete. Therefore, placing the concrete slowly will result in reduced pressure on the forms and diminish the possibility of form failure. Conversely, placing the concrete rapidly, as can easily be done in the case of a thin wall, will result in a high form pressure because the concrete does not have the chance to begin hardening. This resulting high form pressure may exceed the ability of the form to restrain the force.

The time it takes for the concrete to harden, known as the *set or set-up time*, is affected by various factors. One major factor determining the set-up time is the *temperature* of the concrete (not the air, but the concrete). The higher the temperature of the concrete, the quicker the concrete hardens. *Admixtures*, materials added to the basic concrete mix, can also affect how quickly the concrete hardens. Some admixtures, known as *retarders*, slow down the set-up time while other admixtures, known as *accelerators*, can speed up the set-up time. Obviously, if you are designing the formwork or placing the concrete, it is essential to know the *mix design* (what's in the concrete) so you can design the formwork and place the concrete properly.

To successfully place concrete that results in an acceptable finished product, the concrete placer, (the worker filling the form with concrete) must know the *design pressure* of the forms he/she is using and the *set-up time* for the concrete being placed. Without knowing these two parameters the worker is only guessing; the result will be a poor looking finished product at best and a failed form at worst. Don't risk it—find out the design pressure and set-up time!

This Technical Bulletin was prepared by members of the SSFI Forming Section.

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