OPEN FORUM
PROBLEMS AND SOLUTIONS

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Formwork Issues

Q1: Are all steel form designs the same?

A1: The answer to this question is no, because there are different types of steel forms depending on the application.

In general, there are two types of custom steel forms, namely, self-stressing forms and non-self-stressing, or free-standing forms.

Designing non-self-stressing forms includes designing the form skin, longitudinal skin stiffeners and transverse gussets such that the form will resist the hydrostatic pressure of the concrete. The deflections of the form must not exceed the allowable dimensional tolerances of the concrete product.

Self-stressing forms require that the forms be designed to resist the hydrostatic and compressive forces introduced with prestressing.

Twenty-five years ago, the standard design for self-stressing forms was to make use of compression bars to carry the prestress forces. The skin was designed to resist only the hydrostatic forces from the concrete (see Fig. 1).

After much thought and analysis, we determined that in some cases the compression bars could be eliminated by increasing the thickness of the skin and increasing the size and quantity of the longitudinal stiffeners. We called this a "stress-skin design" and began incorporating this design in 1978 (see Fig. 2). Subsequently, we contracted with The Consulting Engineers Group (CEG) to carry out a load test to determine the actual stress levels in a double tee form using this design.

Upon completion of the test, CEG furnished us with a summary and analysis of the test results. This information allowed us to further refine our design of self-stressing forms. The elimination of stressing bars (when possible) allowed us to build more economical forms.

In some cases, such as inverted-tee beam forms, a combination of skin and stressing bars are used to carry the prestressing forces.

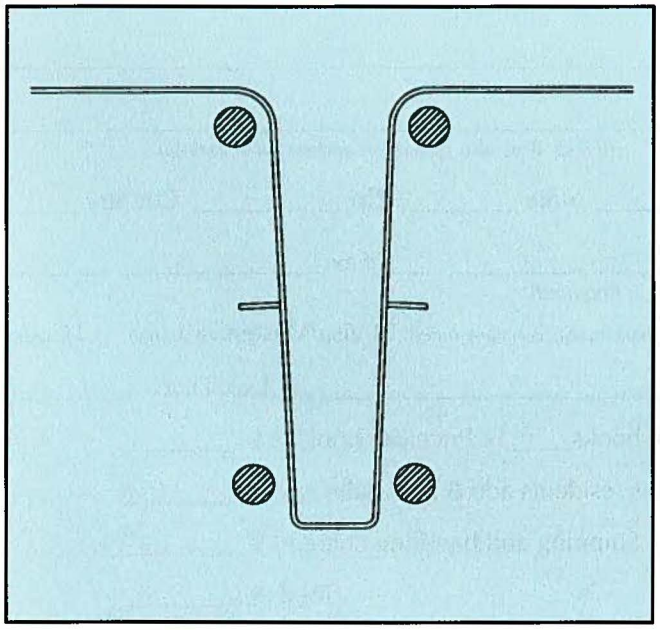

Fig. 1. Original standard design for self-stressing forms.

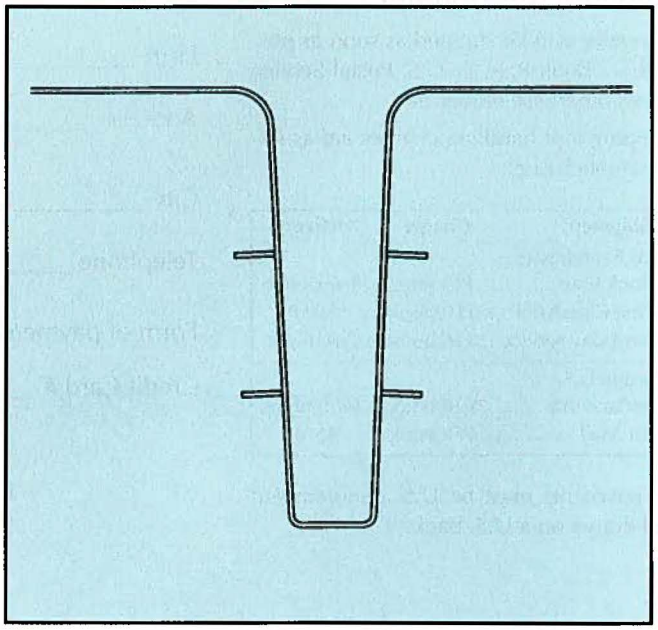

Fig. 2. Current stress-skin design for self-stressing forms.

Table 1. Checklist of questions before ordering forms.

When ordering a form or comparing quotes from different form manufacturers, always be specific about the form's intended use and then review the following partial checklist:

- Is the form self-stressing or non-self-stressing?
- If the form is self-stressing what is the required capacity?
- What is the skin thickness?
- What is the gusset material thickness and spacing?
- What size chamfers are required?
- Are there any extra holes required in the form skin? If so, how are they plugged when not in use and by whom?
- Are all form sections matched and marked?
- Is Vibrotrack included for external vibration?
- Are any heat holes required?
- If top and under ties are required, what are the spacings?
- On double tee forms, will strands be deflected? If yes, with a top or bottom depressor system?
- Are product headers required and/or included?
- Are stem fillers required and/or included?
- Does the form have drafted or straight sides?
- Are there any keyways required and/or included?

So, what is a standard form design today? We have almost always used $^3/_{16}$ in. (4.76 mm) thick gussets spaced 30 in. (762 mm) on center as our standard on most forms. However, we have some customers who ask for $^1/_4$ in. (6.35 mm) gussets on 20 in. (508 mm) centers and $^3/_8$ in. (9.53 mm) gussets where form sections bolt together. These producers want their forms to last a long time! Other customers will tell us that they purchase a form to cast one job only. In these cases, gusset spacings of 40 in. (1016 mm) centers will probably be adequate.

Frequently, we get requests concerning modifications required to cast a slightly different product using an existing form. This generally requires additional stressing capabilities. Often, this happens with stadium riser forms.

As an example, some producers have used the same forms in casting several different stadiums. They have requested that we design their stadium riser forms with the intent of using them for multiple projects. This requires the use of design concepts that may make the form a little more expensive up front, but much more economical over the years.

In general, thicker form skin and closer gusset and stiffener spacings will result in a more durable and longer-lasting form.

When ordering forms, it is important to specify the exact form needs for each particular project. Are the forms intended to last 20 years, or will they be used for only six months with the intention of discarding them after the job is complete? Table 1 provides a checklist of questions that should be asked before ordering forms.

In summary, some form designs may vary from one manufacturer to the next. It is important to know what kind of form is needed, how long the form is intended to last, and how much experience the form designer possesses. The old adage, "you get what you pay for," also applies to custom steel forms. Therefore, in planning the purchase of forms, it is prudent to deal with an experienced form manufacturer.

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DISCUSSION NOTE

The Editors welcome discussion of reports, articles, and problems and solutions published in the PCI JOURNAL. The comments must be confined to the scope of the article being discussed. Please note that discussion of papers appearing in this issue must be received at PCI Headquarters by February 1, 2001.