



The Department offers the following additional comments specific to Items 1-4 in ZPMC's letter:

1. **Item No. 1:** The Department is requiring ZPMC to meet the contract requirements and follow their approved DCP.
2. **Item No. 2:** The Special Provisions complements AWS D1.5 Section 3.5.1.1 in Section 10-1.59, "Steel Structures," subsection "Shop Welding," subsection "Design Details" when it states that the "*Component wall of box girder shall be straight within 1/1000 ...*"
3. **Item No. 3:** Sweep (straightness) and flatness are by definition two different measurements for two completely different tolerances. Based on the Department's present understanding, the panel flatness is the issue of concern with the OBGs produced to date, not straightness. It is appropriate, therefore, to reference the AASHTO flatness specification, not the AWS straightness specification.

Although ZPMC correctly stated that the measured flatness deviation of the OBG skin plates is less than the greater of AASHTO equation 1, they incorrectly determined the value of the variable "D." The variable "D" is not equal to the 5m distance between the floor beams, but is defined in Section 11.4.13.2 of AASHTO as equal to, "*the least dimension along the boundary of the panel.*" The least dimension is controlled by the definition of the panel, which is explained in Section 11.4.13.2 (a) and specifies that, "*The term 'panel' as used in this article means a clear area of steel plate surface bounded by stiffeners, webs, flanges, or plate edges and not further subdivided by any such elements.*"

$$5 \text{ mm or } \frac{D}{144 \sqrt{T}}$$

AASHTO Equation 1

where:

*D: The least dimension along the boundary of the panel in inches.*

*T: The minimum plate thickness of pane in inches.*

For example, if a 2.945m x 16.41m typical bottom plate without stiffeners is fabricated by butt-welding 14mm thick plates together as shown in Figure 1, then the least dimension along the boundary of panel would be 2.945 m or 115.90 inches between the plate edges. Since T is defined as, "*the minimum thickness in inches of the plate comprising the panel,*" and the thickness is equal to 14mm or 0.55 inches, the maximum deviation from detailed flatness would not exceed the greater of:

$$5 \text{ mm or } \frac{115.9}{144 \sqrt{0.55}} = 1.08 \text{ " or } 28 \text{ mm}$$

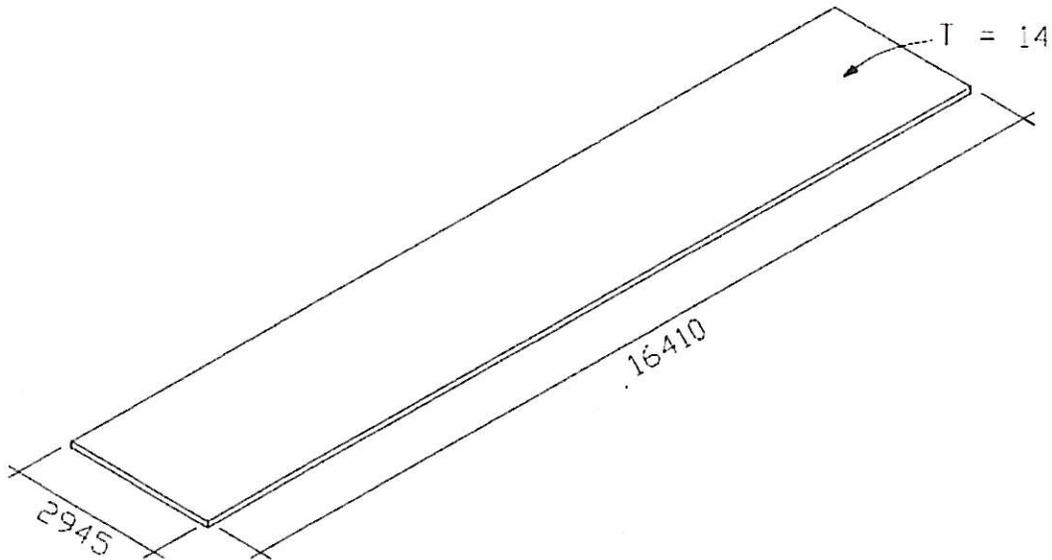


Figure 1: Typical Fabricated Bottom Plate without Stiffeners

Since 28mm > 5mm, 28mm would govern in this case for the unstiffened plate. However, once stiffeners are welded onto the plate, the least dimension along the boundary panel becomes the least dimension between the stiffeners, which is 420mm or 16.54 inches (see Figure 2). The maximum deviation from detailed flatness for the stiffened plate would not exceed the greater of the following:

$$5 \text{ mm} \text{ or } \frac{16.54}{144 \sqrt{0.55}} = 0.15 \text{ " or } 4.0 \text{ mm}$$

Since 5mm > 4mm, 5mm would be the governing panel flatness for the stiffened panel.

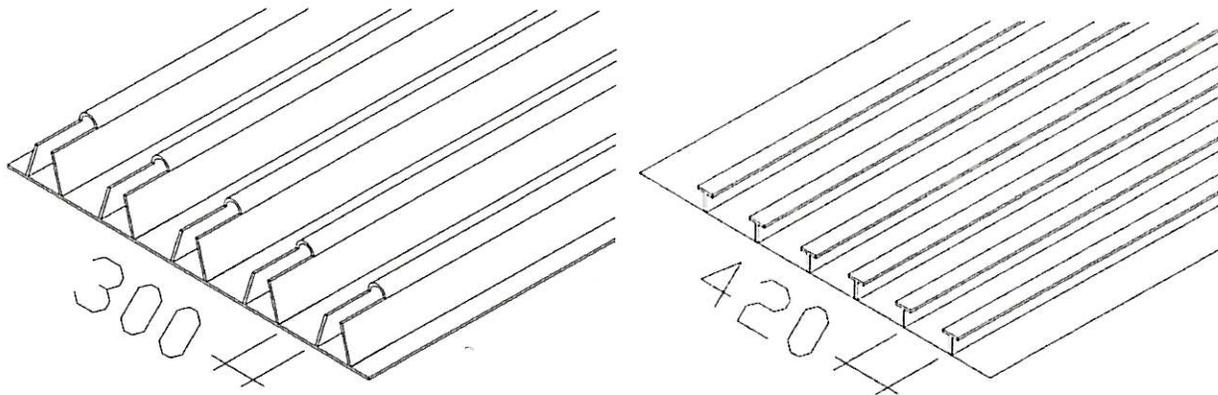


Figure 2: Typical Fabricated Panel with Closed U-Ribs and WT Ribs

Section 11.4.13.1 defines the length of a “template” (also known as a “straightedge”) to determine the flatness of panels, and to verify that they conform to the specified flatness requirements. Again, flatness deviations can be measured with a straightedge both locally and globally for a given panel. This section states, “*The template edge may have any length not exceeding the greatest dimension of the element being examined and, for any panel, not exceeding 1.5 times the least dimension of the panel; it may be placed anywhere within the boundaries of the element.*” Section 11.4.13.1 defines an element and states that “*The term element as used herein refers to individual panels, stiffeners, flanges, or other pieces.*” Again, a panel as defined above is “*a clear area of steel plate bounded by stiffeners....*” **Therefore, a panel bounded by stiffeners is defined as an element.**

For the WT stiffened panel shown in Figure 2, the local flatness requirements would be checked with a straightedge not exceeding  $1.5 \times 420\text{mm} = 630\text{mm}$ . The section also states that the deviations “*shall be measured between adjacent points of contact of the template edge with the element.*” The 630mm long template (straightedge) could be used to check both transversely between stiffeners, and along the length of the stiffeners to determine local deviations as shown in Figure 3.

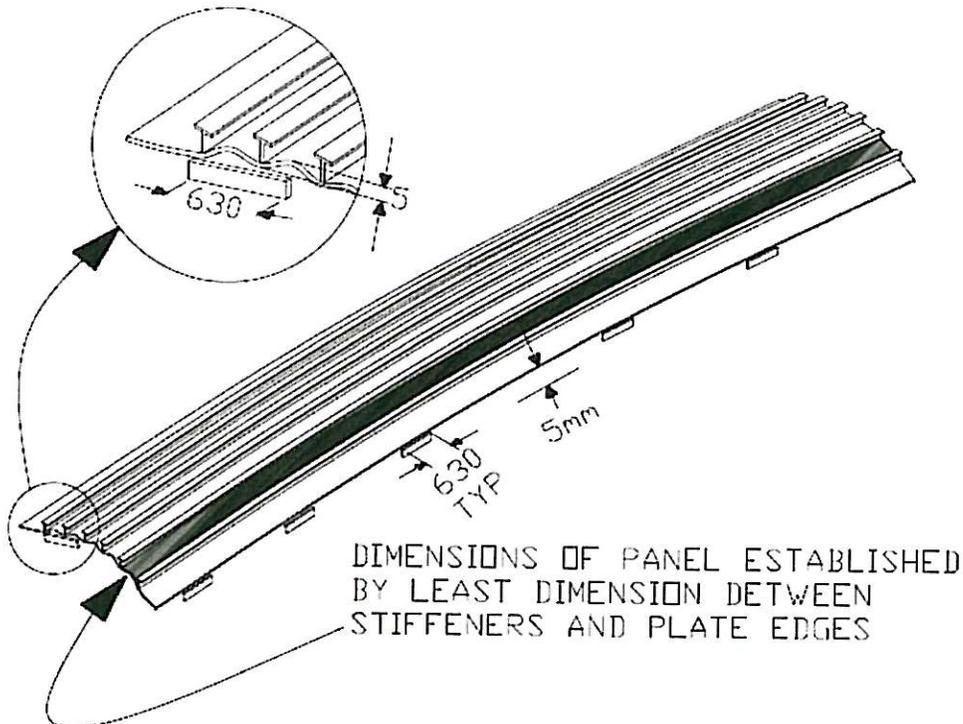


Figure 3: Straightedge Measurements taken Transversely and Along the Length of the Panel

Once floor beams are placed on the panel, typically at 5m intervals as shown in Figure 4, an “element,” defined by the steel area bounded by the panel stiffeners, is equal to 420mm x 5m.

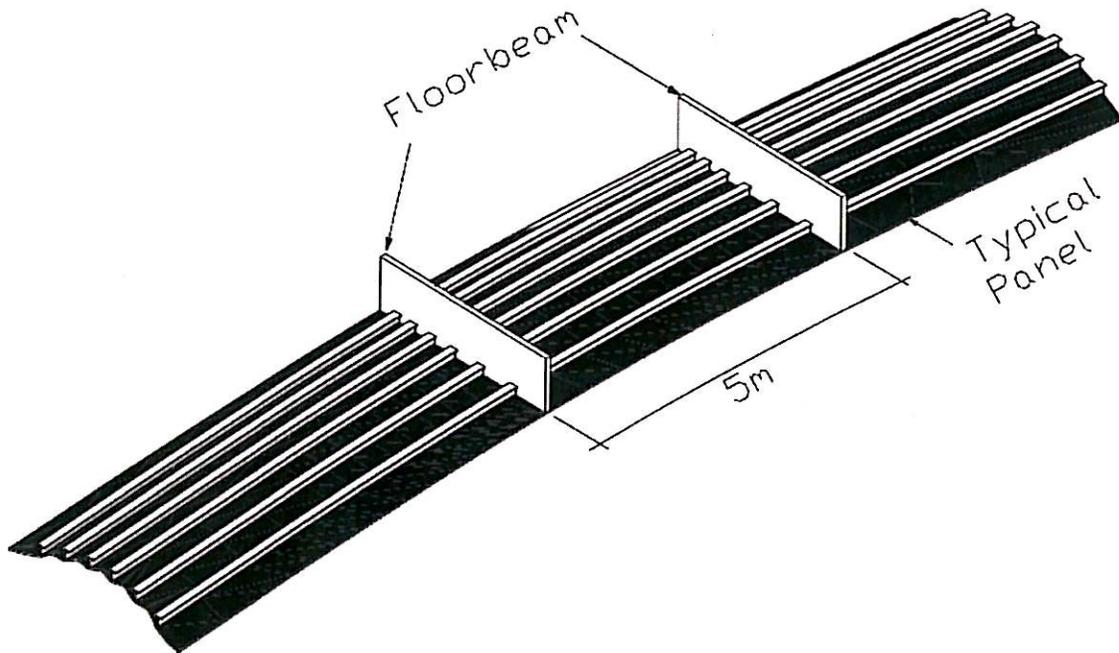


Figure 4: Typical Floor Beam Spacing of 5m

To determine global flatness deviations of this element, a straightedge "not exceeding the greatest dimension of the element being examined..." of 5m in length could be used as shown in Figure 5. As specified above, the maximum deviation measured shall not exceed the greater of either:

$$5 \text{ mm or } \frac{D}{144 \sqrt{T}}$$

When a panel is bound by stiffeners 420mm x 5m long, D is then equal to 420mm. With T=14mm, the maximum flatness deviation of the element measured between the 5m floor beams is governed by a panel flatness of 5mm.

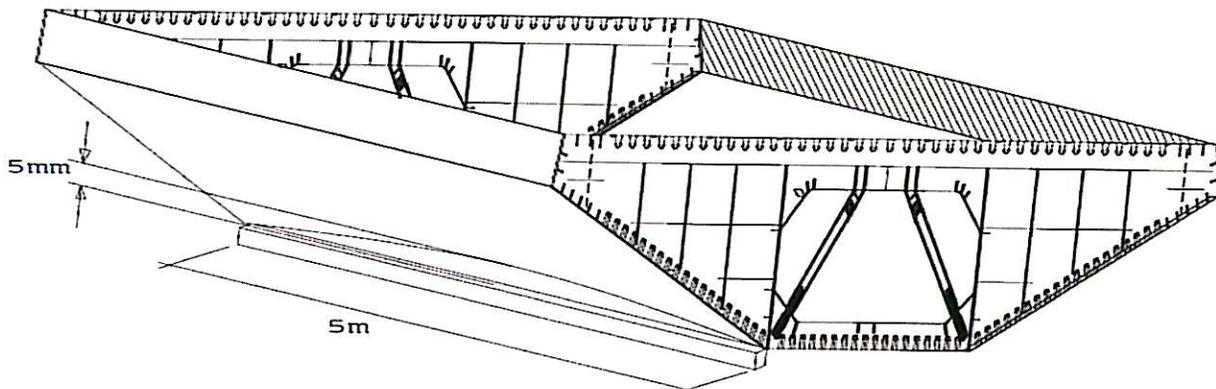


Figure 5: Five-Meter Straightedge Measurements Transversely and Along the Length of the OBG

4. **Item No. 4:** Section 55-3.17 of the Standard Specifications is superseded by Special Provision Section 10-1.59, "Steel Structures," subsection "Shop Welding," subsection "Design Details," Item G - Dimensional Tolerances, Item 3.

The Department requests that ABF provide the tolerances that ABF is requiring ZPMC to fabricate to, and provide the tolerances that quality control staff are inspecting to and utilizing for acceptance.

The Department's explanation of the straightness and flatness dimensional tolerances provided herein is consistent with the contract requirements of the Special Provisions as approved in the Contractor's DCP. Requiring the fabrication work to meet these requirements is not considered extra work and a change order is not warranted. Therefore, all costs and impacts of the repair work should be borne by the Contractor.

Please contact Doug Coe at 137-6132-2704 if you have any questions or would like to discuss this issue further.

Sincerely,



GARY PURSELL  
Resident Engineer

Attachment

cc: Peter Siegenthaler  
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File: 05.03.01