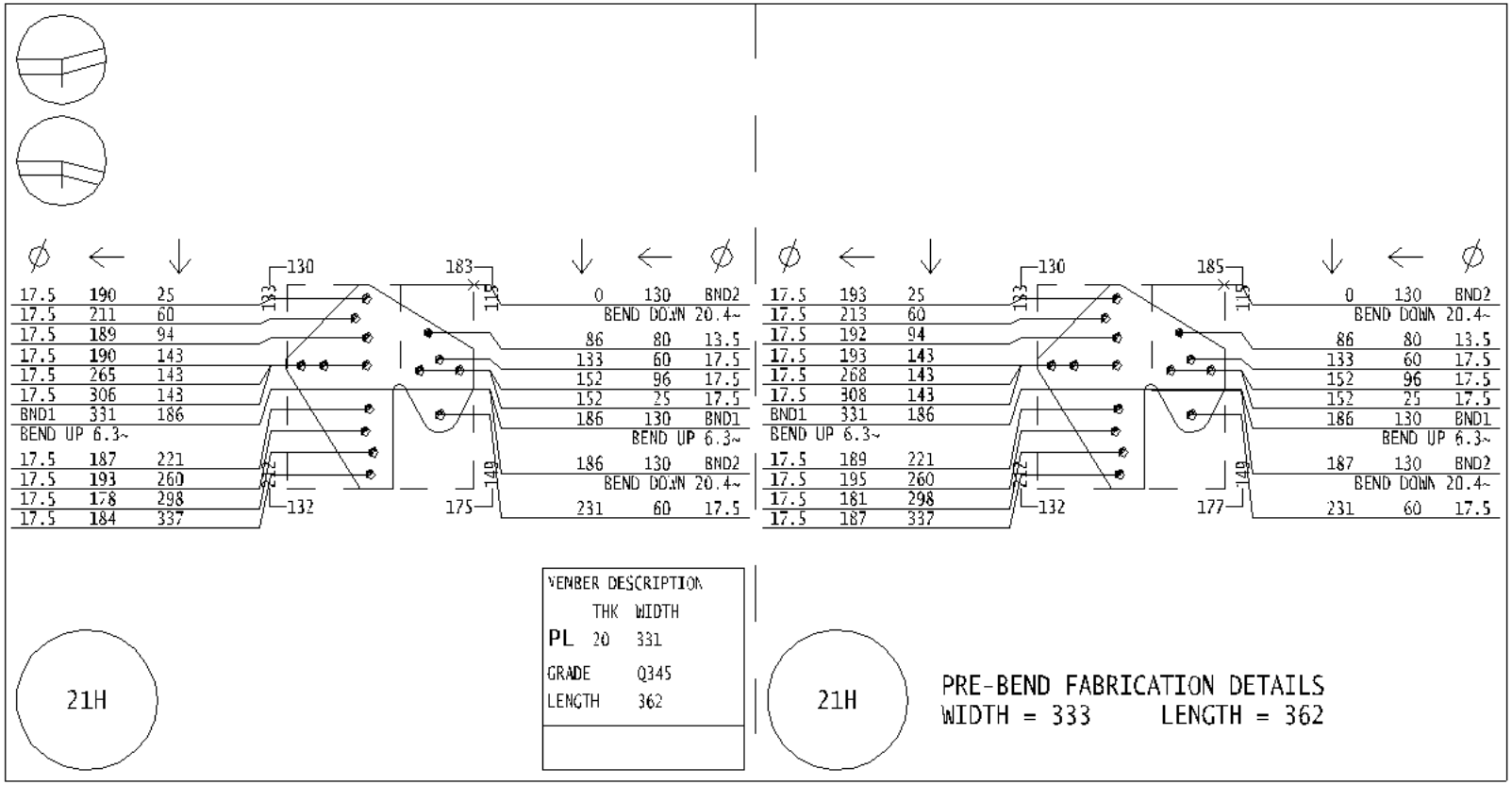
TowerSmart

Tower Detailing Tips

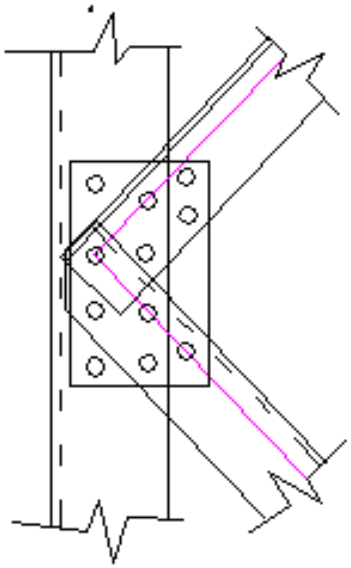


Series 2

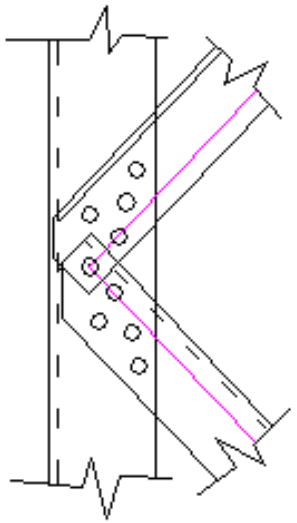
gad TECHNOLOGIES
Software Developers

Tower Detailing Tips

When I first started as a tower detail draftsman I was taught that if you could save a gusset plate on a tower you save $1000's of dollars. The logic was this, a plate saved on a corner of size 300 x 200 x 8mm thickness, weighs approximately 3.7kg, times it by 2 (left and right side) times it by 4 (faces of tower body) times it by 200 (approximate suspension towers in an average line) equals around 6 tons, at $1500 (US) a ton this works out to be $9,000, well worth a detailer spending a few hours on a connection to reduce the chance of a gusset plate.



Sample node with 5 bolts required per K member (quick detailing solution)



Sample node with 5 bolts required per K and no gusset plate (expanded K solution)

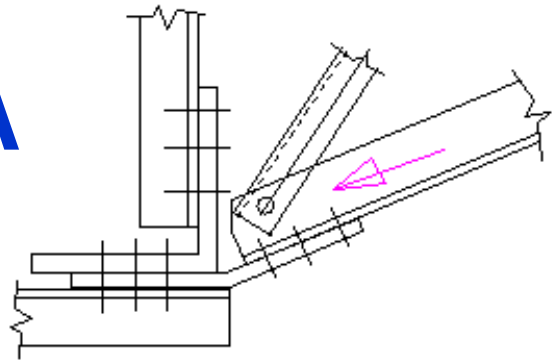
Reducing steel weight is a terrific saving especially for a connection that will be used numerous times along the line but not all detailing solutions that save on weight are the most economical, some manufacturing costs far exceed the cost saved in weight.

Tower Detailing Tips

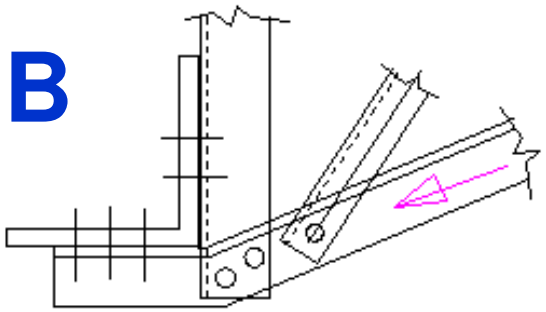
Below is a plan view of a connection at bottom cross arm chord to superstructure body.

Which do you believe is the better detail ? Which would you choose ?

A



B



From a detailing perspective both are just as good as each other. The one on the left (A) is a detail without using bent bottom chord, it connects the bottom chord to body by a thicker bent plate , the outside frame member is extended to the bend line to strengthen the plate further. The detail on the right (B), wraps the bent bottom chord around the corner, so saving on plate but needs the longitudinal frame to tie in the cross-arm chord since placing the chord outside of body gave it more eccentricity and being mainly compression members, it requires further support.

But from a manufacturing perspective, detail (A) is far better. Let me explain why …

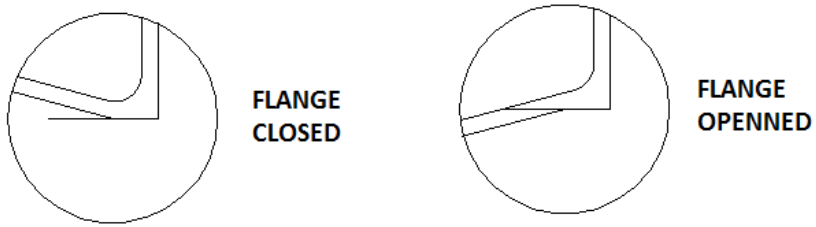
Tower Detailing Tips

Bending angles to reduce steel weight was a good option many decades ago when most steel was fabricated manually and determined by the boilermaker (marker off) but now with automated manufacturing (CNC) it is becoming costlier to bend a hot rolled angle (L, EA, UA etc) than to add some extra steel via bent plate.

Costs to consider for bending angles are …

- Bending angles is still a manual process (more labour costs)
- Tolerance (stretching / compression) dependant on skill of metalworker
- Requires female and male dies to be fabricated for double bent angles
- Holes near bends have to be drilled post bending
- Quality assurance for bent angles hard to control once mass production starts
- Transport of bent angles more cumbersome (by truck, shipping container etc)

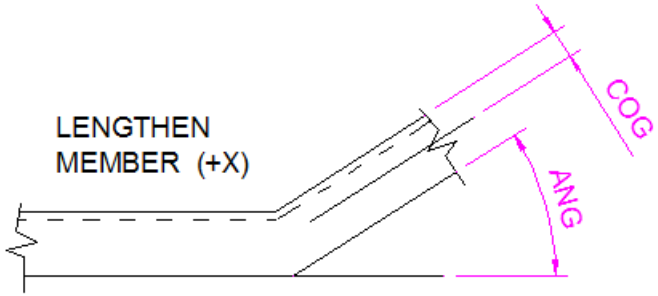
But the nature of towers requires bending, and there is nothing wrong with bending plates or the flanges of angles known as ‘open’ and ‘closes’. This is because the holes can still be pre-punched without being affected by these simple bends.

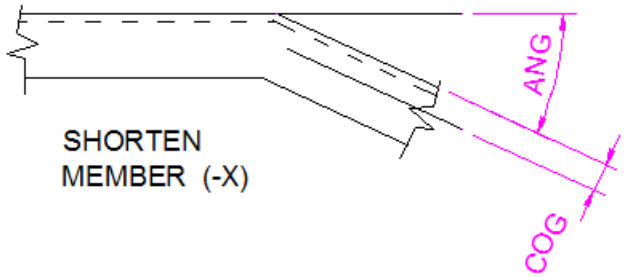


Tower Detailing Tips

When bending plates (or angles) it is important to add the appropriate allowances due to the bends. Below are the formulas we use in TowerSmart, these formulas have been used for over 3 decades but please be aware that it depends on the bending process your factory adopts (cold, hot, temperature, speed etc).

ADJUSTMENT FORMULA FOR SINGLE BEND ANGLES OR PLATES





BEND UP

COG = Centre Of Gravity / 2 (if Angle)
COG = Plate Thickness / 3 (if Plate)
+X = (Tan(ANG / 2) * COG) * 2

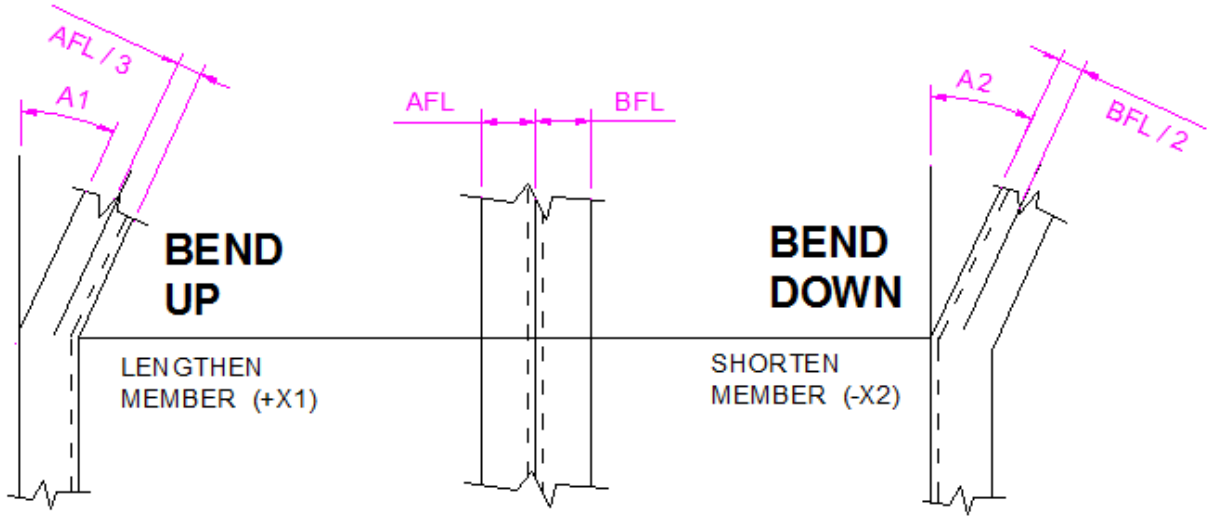
BEND DOWN

COG = Centre Of Gravity (if Angle)
COG = Plate Thickness / 3 (if Plate)
-X = (Tan(ANG / 2) * COG) * 2

Tower Detailing Tips

Double bent angles are a bit more complicated for calculating allowances but again these are the formulas in TowerSmart …

ADJUSTMENT FORMULA FOR DOUBLE BEND ANGLES

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'                  FIRST CALCULATE FACE BENDS ...
F1 = ArcTan(Tan(A2) / Sqrt(Tan(A1) ^ 2 + 1))       ' FACE BEND ON AFL
F2 = ArcTan(Tan(A1) / Sqrt(Tan(A2) ^ 2 + 1))       ' FACE BEND ON BFL

'                NEXT CALCULATE ALLOWANCE FOR AFL...
IF BEND UP      .... +X1 = (Tan(F1 / 2) * AFL / 3)
IF BEND DOWN .... -X1 = (Tan(F1 / 2) * AFL / 2)

'                THEN CALCULATE ALLOWANCE  FOR BFL...
IF BEND UP      .... +X2 = (Tan(F2 / 2) * BFL / 3)
IF BEND DOWN .... -X2 = (Tan(F2 / 2) * BFL / 2)

'              ALLOWANCE(+/-X) IS THE TOTAL OF BOTH
Total X = (X1 + X2)
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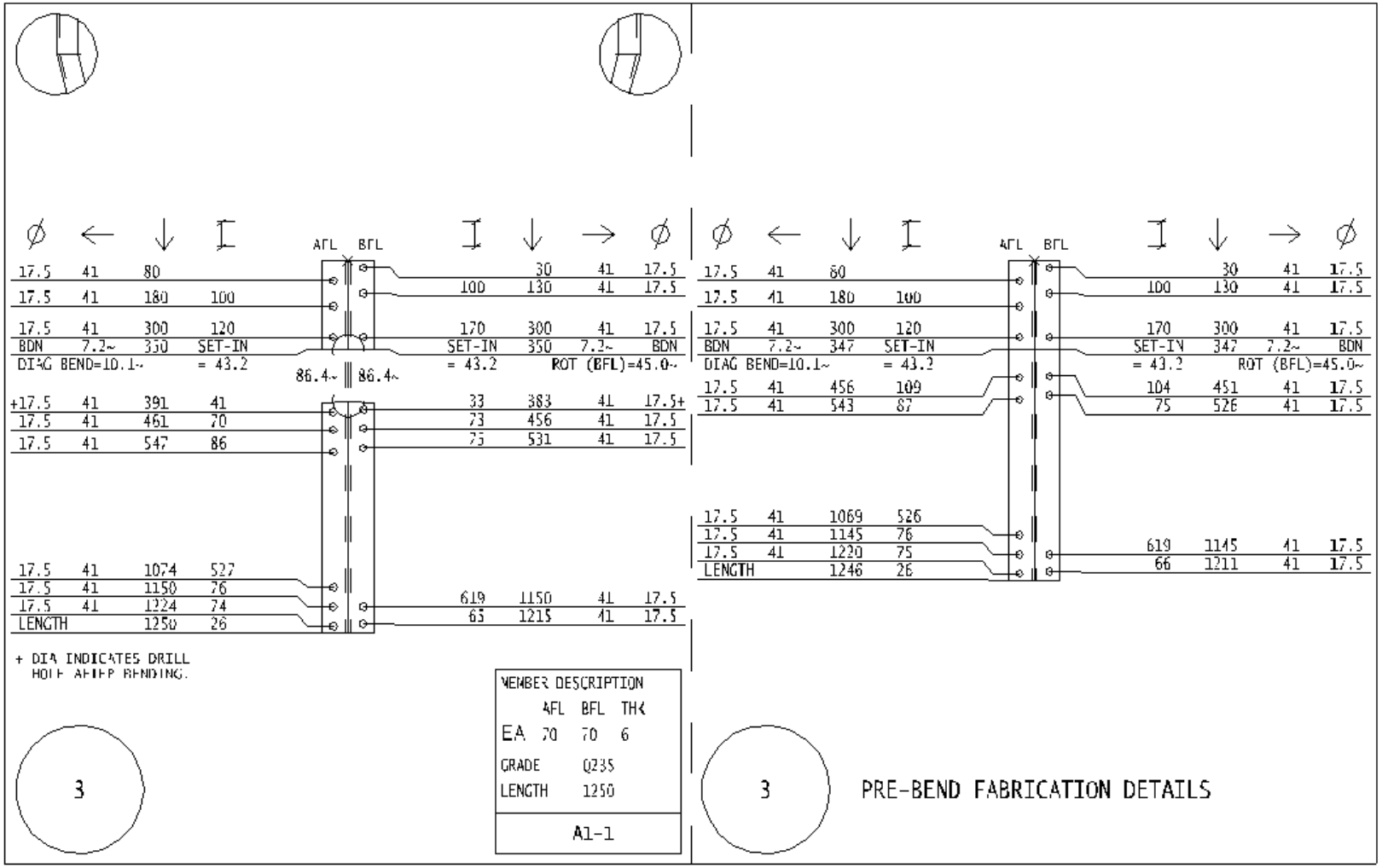
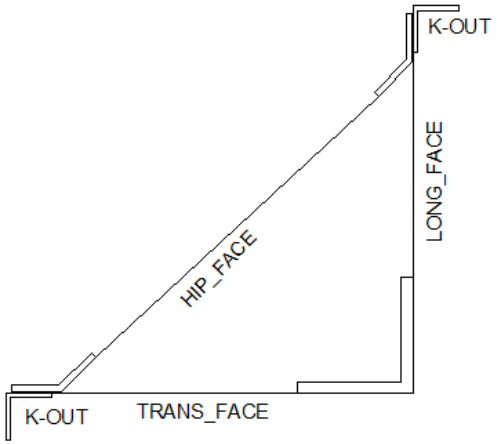
Tower Detailing Tips

When providing manufacturing data it is important to add these allowances to progressive dimensions before bending, also nominate which holes are to be drilled after bending. Below is a sample TowerSmart Fabrication Drawing (FD) showing pre and post-bend drawings.

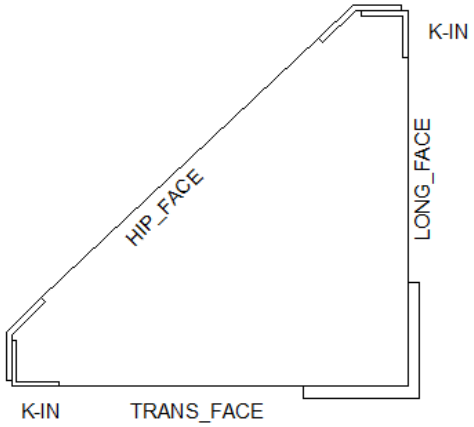


Tower Detailing Tips

In the next presentation (Tower Detailing Tips - Series 3) we go through the ways of connecting hip bracing to K-members.



HIPS ON K-AFL



HIPS ON K-BFL

For further information on tower detailing, visit us at …
www.towersmart.com.au

or send us an email …
enquires@towersmart.com.au

TowerSmart

3D Detailing Systems for Lattice Structures