BEAM TO BEAM - FINPLATE CONNECTION

TEDDS calculation version 2.0.14

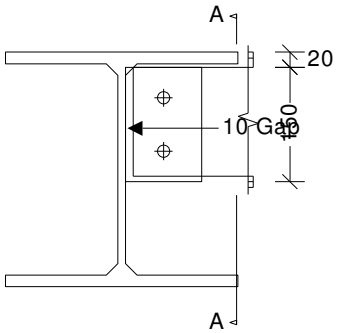
Section Details

Supporting Beam UC 305x305x97 $Grade_{supporting}$ = **"S275"**

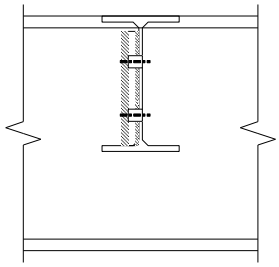
Supported Beam UB 178x102x19 $Grade_{supported}$ = **"S275"**

Finplate - 150 x 100 x 10 $Grade_{finplate}$ = **"S275"**

Bolts M16 (Grade 8.8)



SECTION THROUGH SUPPORTING BEAM



SECTION A - A

Connection Details

number of bolt rows n_{bolts} = **2**

Bolt pitch p_{bolts} = **70** mm

Bolt eccentricity a_{bolts} = **50** mm

End projection t_1 = **10** mm

Finplate end distance (top & bottom) $e_{1finplate}$ = **40** mm

Finplate edge distance $e_{2finplate} = d_{finplate} - a_{bolts}$ = **50** mm

Finplate length $l_{finplate} = p_{bolts} \times (n_{bolts}-1) + 2 \times e_{1finplate}$ = **150** mm

Supported Beam edge distance $e_{2supported} = a_{bolts} - t_1$ = **40** mm

Weld leg length s_{weld} = **8** mm

Supported Beam end reaction Q = **7.0** kN

Finplate type $type_{finplate} = if(t_{finplate} < 0.15 \times a_{bolts}, "long", "short")$

$type_{finplate}$ = **"short"**

Notch details

Top notch length $c_{topnotch}$ = **158** mm

Top notch depth $d_{ctopnotch}$ = **20** mm

Bottom notch length $c_{bottomnotch}$ = **158** mm

Bottom notch depth $d_{cbottomnotch}$ = **15** mm

Check 1 - Essential detailing requirements

Finplate thickness $t_{finplate}$ = **10** mm

Supported Beam web thickness $t_{supported}$ = **5** mm

For ductility: either max. web thickness **0.50d** = **8.0** mm

or max. fin plate thickness **0.50d** = **8.0** mm

Pass - Thickness limits for ductility

Finplate Length $l_{finplate}$ = **150** mm

Finplate length for torsional requirements : PASS

End and edge distances PASS dimensional requirements

PASS - Grade 8.8 bolts being used

OK - supported beam depth < 610 mm

Check 2 - Capacity of bolt group connecting finplate to web of supported beam (taking account of eccentricity 'a')

Elastic section modulus of bolt group

$Z_{bolts} = n_{bolts} \times (n_{bolts} + 1) \times p_{bolts} / 6$ = **70** mm

Force on outermost bolt due to moment

$F_m = Q \times a_{bolts} / Z_{bolts}$ = **5.0** kN

Force on bolt due to shear

$F_v = Q / n_{bolts}$ = **3.5** kN

Resultant force on bolt due to direct shear and moment

$F_r = \sqrt{(F_v^2 + F_m^2)}$ = **6.1** kN

Bearing strength

$p_{bsfinplate}$ = **460** N/mm^2

$p_{bssupported}$ = **460** N/mm^2

Bearing capacity per bolt

$P_{bs} = \min(d_{bolts} \times p_{bsfinplate} \times t_{finplate}, d_{bolts} \times p_{bssupported} \times t_{supported})$ = **35** kN

Utilisation factor $U_{check2} = F_r / P_{bs}$ = **0.173**

Bearing capacity of bolt group connecting finplate to web : PASS

Check 3b - strength of the supported beam at the net section - 2 flanges notched

for shear

$p_{ysupported}$ = **275** N/mm^2

Distance top supported beam to 1st hole $e_{tsupported}$ = **60** mm

$e_{tasupported} = e_{tsupported} - d_{ctopnotch}$ = **40** mm

$e_{bsupported} = D_{supported} - e_{tsupported} - (n_{bolts} - 1) \times p_{bolts}$ = **48** mm

$e_{basupported} = e_{bsupported} - d_{cbottomnotch} =$ **33** mm

$A_{vsupported} = 0.9 \times (e_{tasupported} + (n_{bolts} - 1) \times p_{bolts} + e_{basupported}) \times t_{supported} =$ **617** mm^2

$A_{vnetsupported} = A_{vsupported} - n_{bolts} \times D_{hbolts} \times t_{supported} =$ **444** mm^2

Effective net area coefficient

$K_{esupported} =$ **1.20**

Plain shear capacity of supported beam

$P_{vPsupported} = \min(0.6 \times p_{ysupported} \times A_{vsupported}, 0.7 \times K_{esupported} \times p_{ysupported} \times A_{vnetsupported}) =$ **101.8** kN

$A_{v1supported} = (e_{tasupported} + (n_{bolts} - 1) \times p_{bolts}) \times t_{supported} =$ **528** mm^2

$e_{3supported} = a_{bolts} - t_1 =$ **40** mm

$A_{teffsupported} = (e_{3supported} - 0.5 \times D_{hbolts}) \times t_{supported} =$ **149** mm^2

Block shear capacity of supported beam

$P_{vBsupported} = 0.6 \times p_{ysupported} \times A_{v1supported} + 0.6 \times K_{esupported} \times p_{ysupported} \times A_{teffsupported} =$ **116.6** kN

Shear capacity of the supported beam $P_{vsupported} = \min(P_{vPsupported}, P_{vBsupported}) =$ **101.8** kN

Shear force on supported beam $Q =$ **7.0** kN

Utilisation factor $U_{check3shear} = Q / P_{vsupported} =$ **0.069**

Shear capacity of supported beam : PASS

for bending - 2 flanges notched

$Z_{notched} = t_{supported} \times (D_{supported} - d_{ctopnotch} - d_{cbottomnotch})^2 / 6 =$ **16313** mm^3

Moment capacity of notched section $M_{capnotched} = p_{ysupported} \times Z_{notched} =$ **4.5** kNm

Moment applied to notched section $M_{appnotched} = Q \times \max(c_{topnotch}, c_{bottomnotch}) =$ **1.1** kNm

Utilisation factor $U_{check3moment} = M_{appnotched} / M_{capnotched} =$ **0.246**

Moment capacity of notched section : PASS

Check 3c - local stability of notched supported beams restrained against lateral torsional buckling - 2 flanges notched

Depth of top notch $d_{ctopnotch} =$ **20** mm

Length of top notch $c_{topnotch} =$ **158** mm

Depth of bottom notch $d_{cbottomnotch} =$ **15** mm

Length of bottom notch $c_{bottomnotch} =$ **158** mm

$Check_{depth} = \max(d_{ctopnotch}, d_{cbottomnotch}) =$ **20** mm

$Check_{length} = \max(c_{topnotch}, c_{bottomnotch}) =$ **158** mm

Depth of both notches less than limit of D/5 : PASS

$Grade_{supported} =$ **"S275"**

$dot = D_{supported}/t_{supported} =$ **37.0**

$c_{limit} = if(or(Grade_{supported} == \text{“S275”}, Grade_{supported} == \text{“300”}), if(dot<=54.3, D_{supported}, 160000 \times D_{supported}/dot^3),$
$if(dot<=48.0, D_{supported}, 110000 \times D_{supported}/dot^3))$

c_{limit} = **177.8** mm

Length of both notches less than limit : PASS

Check 4 - strength of the finplate at the net section under bending and shear

for shear

$p_{yfinplate}$ = **275** N/mm^2

Distance from bottom of finplate to bottom hole $e_{1finplate}$ = **40** mm

$e_{1afinplate} = e_{1finplate}$ = **40** mm

$A_{vfinplate} = 0.9 \times (2 \times e_{1afinplate} + (n_{bolts} - 1) \times p_{bolts}) \times t_{finplate}$ = **1350** mm^2

$A_{vnetfinplate} = A_{vfinplate} - n_{bolts} \times D_{hbolts} \times t_{finplate}$ = **990** mm^2

Effective net area coefficient

$K_{efinplate}$ = **1.20**

Plain shear capacity of finplate

$P_{vPfinplate} = \min(0.6 \times p_{yfinplate} \times A_{vfinplate}, 0.7 \times K_{efinplate} \times p_{yfinplate} \times A_{vnetfinplate})$ = **222.8** kN

$A_{v1finplate} = (e_{1afinplate} + (n_{bolts} - 1) \times p_{bolts}) \times t_{finplate}$ = **1100** mm^2

$A_{tefffinplate} = (e_{2finplate} - 0.5 \times D_{hbolts}) \times t_{finplate}$ = **410** mm^2

Block shear capacity of finplate

$P_{vBfinplate} = 0.6 \times p_{yfinplate} \times A_{v1finplate} + 0.6 \times K_{efinplate} \times p_{yfinplate} \times A_{tefffinplate}$ = **262.7** kN

Shear capacity of the finplate $P_{vfinplate} = \min(P_{vPfinplate}, P_{vBfinplate})$ = **222.8** kN

Shear force on the finplate Q = **7.0** kN

Utilisation factor $U_{check4shear} = Q / P_{vfinplate}$ = **0.031**

Shear capacity of finplate : PASS

For bending

$I_{eff} = I_finplate(t_{finplate}, l_{finplate}, n_{bolts}, D_{hbolts}, p_{bolts})$ = **236.18** cm^4

$Z_{eff} = I_{eff} / (l_{finplate} / 2)$ = **31.49** cm^3

Applied moment $M_{app} = Q \times a_{bolts}$ = **0.4** kNm

Moment capacity $M_{cap} = p_{yfinplate} \times Z_{eff}$ = **8.7** kNm

Utilisation factor $U_{check4bending} = M_{app} / M_{cap}$ = **0.040**

Bending capacity of finplate : PASS

Check 6 - Strength of weld connecting finplate to supporting beam under bending moment and shear

Weld leg length s_{weld} = **8** mm

Finplate thickness $t_{finplate}$ = **10** mm

Utilisation factor $U_{check6} = (0.8 \times t_{finplate}) / s_{weld}$ = **1.000**

PASS : weld is not the weakest part of the connection

Check 7 - Local shear capacity of supporting beam web

$A_{vsupporting} = 0.9 \times l_{finplate} \times t_{supporting} =$ **1337** mm^2

$p_{ysupporting} =$ **275** N/mm^2

$P_{vsupporting} = 0.6 \times p_{ysupporting} \times A_{vsupporting} =$ **220.5** kN

Shear load on supporting beam $Q / 2 =$ **3.5** kN

Utilisation factor $U_{check7shear} = Q / (2 \times P_{vsupporting}) =$ **0.016**

Local shear capacity of supporting beam web: PASS

SUMMARY OF RESULTS

Check 2 - Capacity of bolt group connecting finplate to web of supported beam (taking account of eccentricity 'a')

Utilisation factor $U_{check2} =$ **0.173** **PASS**

Check 3b - strength of the supported beam at the net section - 2 flanges notched

Utilisation factor $U_{check3shear} =$ **0.069** **PASS**

for bending - 2 flanges notched

Utilisation factor $U_{check3moment} =$ **0.246** **PASS**

Check 3c - local stability of notched supported beams restrained against lateral torsional buckling - 2 flanges notched

Depth of top notch less than limit : PASS

Length of top notch less than limit : PASS

Check 4 - strength of the finplate at the net section under bending and shear

Shear utilisation factor $U_{check4shear} =$ **0.031** **PASS**

Bending utilisation factor $U_{check4bending} =$ **0.040** **PASS**

Check 6 - Strength of weld connecting finplate to supporting supporting beam under bending moment and shear

Utilisation factor $U_{check6} =$ **1.000** **PASS**

Check 7 - Local shear capacity of supporting beam web

Utilisation factor $U_{check7shear} =$ **0.016** **PASS**