

ACES-PSC performs the design of pretensioned concrete Super-T and related beams in accordance with the general design approach given in the Australian Standards bridge design code (AS5100.5). The module can either be accessed directly from within the main ACES program or run in stand-alone mode. It can also be readily customized to handle other section shapes and design codes. An EXCEL-style analysis process is used – change a parameter anywhere in the module then click the recalculate button to redo the entire design.

Open top Super-T Type 4: 2400 mm top flange

Units : mm, kN, MPa

Steam Relaxation

- 9360 Initial jacking force (Pj)
- 1.40 Steam relaxation factor (Fig 6.3.4) (k5)
- 0.093 Loss due to relaxation (Lsrl)
- 874 Loss of PS due to relaxation (Prl)
- 9.3 Loss as a percentage of Pj (Lsr)
- 8486 Prestress force remaining (Pjr)

Shrinkage Loss

- 621 Shrinkage strain (Table 6.1.7) (us)
- 6864 Area of prestressing steel (Ap)
- 953793 Area of composite girder (Ac)
- 750 Shrinkage PS loss (Pshsr)
- 8.0 Loss as a proportion of Pj (Lshr)
- 6846 PS remaining after shrinkage (Prs)

Elastic Deformation Loss

- 40 Mean girder strength (fcm)
- 195000 Modulus of stressing steel (Ep)
- 6864 Area of prestressing steel (Ap)
- 33995 Mean modulus girder concrete (Egm)
- 578300 Area of girder (Ag)
- 1.7330E+11 Girder moment of inertia (Ig)
- 502.1 Eccentricity (CG girder-strand group) (e)
- 8486 Prestress force remaining (Pjr)
- 1520 Girder self-weight moment (Msw)
- 22.62 Stress at CG strand group (fcgs)
- 891 Elastic deformation loss (Pelastic)
- 9.5 Loss as a percentage of Pj (Ledl)
- 7596 T

Creep Loss

- Due to PS + self-weight (SW)
- Due to deck+bitumen (SDL)

Summary of Losses

P	%Pj
9360	100
-874	9.3
-891	9.5
7596	81.2
-750	8.0
-964	10.3

ACES6.606: Run date - 28/8/2008

Heading: TEST PROBLEM

Job Name: Open top Super-T Type 4: 2400 mm top flange

Designer: GS

Comments: Test comment to check module

Units: mm, microstrain, kN, kN.m, MPa

DESIGN CODE: AS5100.5

PRESTRESS LOSSES

Clear, well annotated dialog boxes and reports that are customisable

Strand data (UNITS: kN, mm, MPa)

Enter data into table then click <Recalculate>

Row	Ybar (mm)	Total bars	No. bars debonded	No. bars included	Ybar x No. bars included
1	1435	2	0	2	2870
2	265	2	0	2	530
3	215	8	0	8	1720
4	165	12	4	12	1980
5	115	12	6	12	1380
6	65	8	2	8	520
7	0	0	0	0	0
8	0	0	0	0	0
Totals		44	12	44	9.0000E+03

Ybar = Distance of bar centreline from bottom of girder.

Tick to include ALL bars in analysis (all bars assumed to be bonded)

Recalculate

- 699 Location of girder centroid (Yb)
- 205 Eccentricity of stressing steel (Ycgs)
- 494.5 Eccentricity (CG girder-strand group) (e)

To refresh values on the main form click <Recalculate> on exit

OK View calcs

Initial jacking force (Pj) = 9360 kN

Estimated jacking force factor (Jf) = 0.780

Losses due to Steam Relaxation

Steam relaxation factor (k5) is the larger of 0.0 or:
 The maximum of: $1 + (Jf - 0.7) * 0.5 / 0.1$ = 1.400 (Fig 6.3.4)
 and: $(Jf - 0.4) / 0.3$ = 1.267

Steam relaxation factor (k5) = 1.400

Loss due to relaxation (Lsrl = $0.1 * k5 / 1.5$) = 0.093

Loss in PS due to relaxation (Prl = $-Lsrl * Pj$) = -873.6 kN

Loss as a proportion of Pj (Lsr = $-Prl * 100 / Pj$) = 9.3 %

Prestress force remaining (Pjr = $Pj + Prl$) = 8486.4 kN

Elastic Deformation Loss

Area of PS steel ($Ap = Nbbars * Pi * Ds^2 / 4$) = 6864.0 mm²

Mean girder concrete strength (fcm) = 40.0 MPa

Mean Young's Modulus of girder concrete (Egm) = 33995.0 MPa

Young's Modulus of stressing steel (Ep) = 195000.0 MPa

Calculation logs that display every equation in the design check and the value of every parameter used.

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Calculation log
! SHEAR DESIGN - Web shear cracking
!
! The algorithm to determine the ultimate shear force Vtf, is based on RF Warner, BV Rangan and
! "Concrete Structures" (Addison Wesley Longman)
!
! y2 = Dist from web/flange interface
! y3 = Dist from web/flange interface
! Dwf = Distance from bottom of girder
! P = Final prestress force
! e = Eccentricity (CG girder-strand)
! Ag = Area of precast girder
! Ig = Moment of Inertia of precast girder
! Ic = Composite moment of inertia
! sf = Flexural stress at web-flange
! st = Allowable principal tensile stress
! tf = Ultimate shear stress capacity
! Bw = Sum of widths of both webs
! Qfw = Shear flow constant at flange/web
! Mcf = Corresponding moment factor (=
! (used to calculate the corresponding moment when the shear capacity is reached)
!
! The solution for Vtf is based on the following equation:
!
! sf = (-P/Ag) - (P*e*y3/Ig) + Vtf*Mcf/Ic
!
! st = 0.33SQRT(f'cg) = SQRT((sf/2)2 + tf2) + sf/2 .. (2) Tensile stress
!
! Vtf = tf*Ic*Bw/Qfw ..... (3) Shear force capacity
!
! Equations (1), (2) and (3) can be combined to form a quadratic with

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Calculation log
! PRESTRESS LOSSES TAB - Elastic Deformation Losses
!
! Ap = Nbbars * Aps
!
! Nbbars: 44.0000000
! Aps: 143.300003
!
! Ap= 6305.20020
!
! fcgs = -Pjr*1000*(1/Ag+e*e/Ig) + Msw*1E6*Ig
!
! Ag: 572000.000
! e: 494.454529
! Ig: 1.68300003E+11
! e: 494.454529
! (1/Ag+e*e/Ig)= 3.20092727E-06
! e: 494.454529
! Ig: 1.68300003E+11
! Pjr: 7779.20020
! Msw: 1441.00000
!
! fcgs= -20.6670895
!
! Pelastic = fcgs*Ep*Ap/(Egmt*1000)
!
! Egmt: 32000.0000
! (Egmt*1000)= 32000000.0
! Ap: 6305.20020
! fcgs: -20.6670895
! Ep: 195000.000
!
! Pelastic= -794.077393

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FEATURES

- ❑ Design of PSC Super-T beams to AS5100.5 Clause 8.1.5. Torsion and cracking are not included in the design check. However, the effect of passive (non-prestressed) reinforcement is taken into consideration in the Ultimate Limit State check.
- ❑ Calculation logs give detailed descriptions of every equation used in the analysis as well as the immediate value of every parameter and variable set during the calculation.
- ❑ All equations and algorithms used in the design can be changed and customised.
- ❑ Parameter definitions used in the dialog boxes and equations can be changed to suit local conventions.
- ❑ A large number of parameters can be preset and saved to a defaults file. They will be auto-loaded when a new design is initiated. Default parameters can be customised.
- ❑ Output reports are in HTML form. The full design logic, all equations and all associated parameter values are shown.
- ❑ All reports can be customised using standard HTML editors.

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