1. Analysis - Using Gross Section Properties

```
                                   PRESTRESSED GIRDER ANALYSIS                                                          PAGE 1
                                        (VERSION 2.00)

INPUT DATA

                                                                                                                  GIRD    GIRD    SLAB   (LL+IM)
                                                                                                                 APPLIED APPLIED APPLIED  APPLIED
                                                                                                                   TO      TO TRU   TO      TO
                                                                                                                 INITIAL INIT.  FINAL   FINAL
                                                                                                                 SECTION SECT.  SECT.   SECT.
                                                                                                                 (K-FT)  (K-FT) (K-FT)  (K-FT)

1 0   62.0  54.0   84  4.0   80.   7.1  86.   .0  3.3  1 1  270   4.0  24.0  7 1.0     0.    .00      0     0    200     0

   ANALYSIS              TRIAL NO.  1          PRE-TENSIONED

   GROSS SECTION PROPERTIES - GIRDER      (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
   ---------------------------------      (      IZOT = IZO + AYZ - YBM ( AY * YB )      )
                          AREA      YB       AY       AYZ       IZO       IZOT
                          (IN2)    (IN)     (IN3)     (IN4)     (IN4)     (IN4)
   GIRDER GROSS SEC       558.0    25.7     14364.    464175.   92241.    184659.
   GROSS COMPOSITE SECTION PROPERTIES     (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
   ----------------------------------     (      IZOT = IZO + AYZ - YBM (AY * YB )       )
                          AREA      YB       AY       AYZ       IZO       IZOT
   GIRDER ONLY            558.0    25.7     14364.    464175.   92241.    184659.
   SLAB ONLY              396.4    50.4     24840.    2037540.  2505.
   FILLET ONLY             17.1    54.4       931.    50690.    1.
   OVERHG ONLY              .0      .0         0.       0.       0.
   COMP SEC PROP         1171.5    42.5     39155.   2552415.  94745.     499923.

   CALCULATE SIMPLY SUPPORTED BEAM MOMENTS
   ---------------------------------------
      MG  = DEAD LOAD OF GIRDER ONLY  =   465.1
      MG1 = DEAD LOAD OF SLAB + FILLETS   511.4
      MG2 = ADDED DEAD LOAD           =   200.0    INPUTED VALUE
      MH  = LIVE LOAD MOMENT          =   922.1    HS20-44 TRUCK LOADING

      MULA = ULTIMATE MOMENT APPLIED  =  3801.7    1.3*(MG+MG1+MG2) + 1.3*(FS1 TRUCK)

                                   PRESTRESSED GIRDER ANALYSIS                                                          PAGE 2

   STRESSES W/O PRESTRESS - USING GROSS CROSS-SECTIONS
   ---------------------------------------------------
                          MOMENT (K')      FT (PSI)       FB (PSI)
   DL GIRDER                465.            845.          -770.
   DL SLAB + FILLET         511.            929.          -846.
   ADDED DL                 200.             54.          -206.
                          ----------      --------      --------
   TOTAL DL               1177.           1828.         -1822.
   (LL+I)H                  922.            248.          -948.
                          ----------      --------      --------
   TOTAL DL + (LL+I)       ----           2075.         -2769.

   SECTION STRESS - F DES (PSI)      (GREATER OF THE FOLLOWING)
   --------------------------
      FB - 1 * SQRT(F'C) * ALL. TEN. FACTOR =   2390.          FB (DL + ADD. DL)          =   1822.
```

The gross section properties are calculated by building up parts determined by the section dimensions. AY, AYZ and IØØ are the summations of the properties of the parts used to build up the section, these numbers can vary depending on how the section is split into parts. The area, YB, and ITOT are the overall section properties.

- The calculated moments are the program calculated simple beam moments or the moments input by the user.

- The ultimate applied moment is calculated using the beam moments listed. If the live load moment is calculated by the program, then the

P-truck moment will also be calculated to determine the maximum applied moment.

- Note the ultimate applied moment = 0.95 x nominal moment strength of a section.

2. Analysis - Using Transformed Section Properties

```
0    FINAL TRANSFORMED GIRDER PROPERTIES      (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
     ------------------------------------      (      ITOT = I00 + AY2 - SUM ( AY * YB )      )
                        AREA        YB          AY          AY2          I00          ITOT
                       (IN2)       (IN)       (IN3)       (IN4)        (IN4)        (IN4)
       GROSS GDR SEC   558.0       25.7      14364.     464175.      92241.      186650.
       (N-1)*AS'        17.8        4.0         71.        283.        ---
       TRAN GDR SEC    575.8       25.1      14435.     464460.      92241.      194808.
0    FINAL TRANSFORMED COMPOSITE GIRDER PROPERTIES      (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
     ------------------------------------------------      (      ITOT = I00 + AY2 - SUM ( AY * YB )      )
                        AREA        YB          AY          AY2          I00          ITOT
       TRAN COMP GDR  1189.3       42.2      50226.     2552699.      94748.      526310.
                          (E*YT)/R**2 =  1.8017          (E*YB)/R**2 =  1.5613

     STRESSES W/O PRESTRESS - USING FINAL TRANSFORMED CROSS-SECTIONS
     ---------------------------------------------------------------
                          MOMENT (K')          FT (PSI)          FB (PSI)
       DL GIRDER              465.              929.             -718.
       DL SLAB + FILLET       511.              911.             -790.
       ADDED DL               200.               54.             -193.
                          ----------         --------          --------
       TOTAL DL              1177.             1794.            -1701.
       (LL+I)E                922.              247.             -888.
                          ----------         --------          --------
       TOTAL DL + (LL+I)       ---              2041.            -2389.

     DESIGN STRESS - F DES (PSI)      (GREATER OF THE FOLLOWING)
     ---------------------------
       FB - 6 * SQRT(F'C) * ALL. TEN. FACTOR =    2209.          FB (DL + ADD. DL)          =    1701.

                                  PRESTRESSED GIRDER ANALYSIS                                    PAGE  3

     PRESTRESSING FORCE = PRETENSIONED
     ---------------------------------
       ALLOW. TENSION = ((FS * .75) - 35.00) =  167500. (PSI)      FINAL PRESTRESS FORCE   - PF  =  496591. (LBS)
       AREA OF PRESTRESSING STEEL - AST      =     2.96 (IN2)      INITIAL PRESTRESS FORCE - PI  =  541815. (LBS)

     STRESSES WITH PRESTRESS - USING FINAL TRANSFORMED CROSS-SECTIONS (PSI)
     ----------------------------------------------------------------------
     AT MIDSPAN                  TOP FIBER              BOTTOM FIBER
     ----------                  ---------              ------------
       # STRESSING       (FTI)     47.          (FBI)     1781.
       # DL GIRDER+SLAB  (FTF)   1049.          (FBF)      701.
       # FULL DES. LOAD  (FTF)   1350.          (FBF)     -380.
     AT 1/3 POINT ALONG SPAN LENGTH     TENDONS HARPED AT 1/3 POINTS
     ------------------------------     (ASSUME DL OR LL STRESS AT 1/3 PT. = 0.89 * STRESS @ CL)
       # STRESSING       (FTI)    -44.          (FBI)     1860.
       # FULL DEAD LOAD  (FTF)    857.          (FBF)      867.
       # FULL DES. LOAD  (FTF)   1128.          (FBF)      -95.

     CONCRETE STRENGTH REQUIRED (PSI)
     ------------------------------
       FCI = FIMAX/.60 =    3098.        FC  = FMAX/.40  =   3373.        FCMAX (USE)     =   4000.

     DEFLECTIONS (INCHES)      (DOWNWARD POSITIVE)
     -------------------
       DPI= -1.6687     DG=  .7630     DI=  -.9057     DPF= -1.0832     DSLB=  .8389     DADL=  .1214     DF=  -.1229

     CHECK ULTIMATE RESISTING MOMENT
     ------------------------------
       REINF. INDEX =       .043                  ULT. RESIST. MOMENT (K-FT)=   3439.62
       FSU    (PSI) =   263279.                  N.A. @ ULTIMATE LOAD (IN) =      3.90
```

- Transformed section properties are calculated using N = 7. The net transformed girder properties are calculated for post-tensioned girders.
- Note: Stresses with prestress are calculated at 1/3 span only for pretensioned girders with program calculated live load moment.
- The calculated deflection are based on the input P/S f'_c or P/S f'_c max required.
- The distance between top of the slab and the natural axis at the ultimate load is calculated for the girder section. However, the value may not be correct for some non-standard sections. For example, trapezoidal sections.

3. Results - Final Prestressing Force Calculated

A sample output is shown below:

PRESTRESSED GIRDER ANALYSIS PAGE 6

RESULTS - FINAL PRESTRESSING FORCE CALCULATED

TRIAL NO.	STRESSES INITIAL TOP (PSI)	STRESSES INITIAL BOTTOM (PSI)	STRESSES FINAL TOP (PSI)	STRESSES FINAL BOTTOM (PSI)	CONCRETE STRENGTH INIT. (KSI)	CONCRETE STRENGTH FINAL (KSI)	FINAL PRESTRESSING FORCE (KIPS)	ULTIMATE MOMENT APPLD (K-FT)	ULTIMATE MOMENT RSTN (K-FT)	DEFLECTIONS (SEE MEMO) DPI (FT)	DEFLECTIONS (SEE MEMO) DEF1 (FT)	DEFLECTIONS (SEE MEMO) DEF2 (FT)	DEFLECTIONS (SEE MEMO) DEF3 (FT)	SECTION PROPERTIES GIRDER I (IN4)	SECTION PROPERTIES GIRDER A (IN2)	SECTION PROPERTIES GIRDER YB (IN)	SECTION PROPERTIES COMPOSITE I (IN4)	SECTION PROPERTIES COMPOSITE YB (IN)
0 1	47.	1781.	1330.	-380.	3.10	3.37	497.	3801.7	3479.6	-.139	-.375	.070	-.010	184807	576	25.1	526318	42.2

NOTE: DEFLECTIONS ARE POSITIVE DOWNWARD
NOTE: DEFLECTIONS ARE BASED ON INPUT P-S F'C
NOTE: FOR P-S CONCRETE F'C USE 4000. PSI
NOTE: APPLIED ULTIMATE MOMENT EXCEEDS ULTIMATE RESISTING MOMENT. MILD STEEL IS REQUIRED.

This report contains the following output:

- Midspan Fiber Stresses, both Initial (at the time of stressing) and Final (under full design load) in psi (English Units) or kPa (Metric Units).
- Concrete Strength Requirement, both Initial (temporary stress condition) and Final (design load stress condition) in psi (English Units) or kPa (Metric Units).
- Final prestressing force required in kips (English Units) or kN (Metric Units).

- Ultimate Moments, both applied and resisting, in kip-ft (English Units) or kN-m (Metric Units). If a moment is entered by the user under Note D, that moment is used to calculate the ultimate applied moment rather than any program calculated live load moment for HS and P ultimate moment.
- Deflections in feet - four deflections (DPI, DEF1, DEF2, DEF3). These deflections have different meanings when analyzing the structure as a box girder than they do when analyzing the structure as single stringer elements. Deflections are positive downward. To interpret your results, see the chart below:

Deflection No.	Cause of Deflection	
	Box Girder (Non-Composite)	Single Girder (With Composite Slab)
DPI		Stressing Only
DEF1	Stressing Only	Stressing + DL Girder
DEF2	DL Only	DL Slab
DEF3	DL Additional	All Above + Creep

For a single Girder, DEF3 is the total amount the girder deflects from its original position. The deflection due to creep is not listed but may be found by adding DEF2 and DEF3 and subtracting DEF1 from the sum. A coefficient of creep of 1.5 is used by the program. See Appendix 1 for deflection evaluations.

Section Properties - Results shown under Girder are the moment of Inertia (I), the area (A) and the distance from the bottom of the girder or soffit to the centroidal axial of the cross section (YB). For composite girder construction the results shown are for the girder only. Results shown under composites are the moment of inertia (I), and the distance from the bottom of the girder or soffit to the the centroidal axial of the cross section (YB). For composite girder construction, the top slab has been included. For a noncomposite construction, the I and YB should be same as shown under Girder. Moments of inertias are in in^4 or mm^4, areas are in in^2 or mm^2, and distances are in inches or millimeters.

Note: For the output in metric units, "10^4" is shown as "10^4" and "10^6" is shown as "10^6".

4. Results - Final Prestressing Force Given

A sample output is shown below:

PRESTRESSED GIRDER ANALYSIS PAGE 4

RESULTS - FINAL PRESTRESSING FORCE GIVEN

TRIAL NO	INPUT PRSTR FORCE (KIPS)	CONCRETE STRENGTH INIT. (KSI)	CONCRETE STRENGTH FINAL (KSI)	ULTIMATE MOMENT APPLD (K-FT)	ULTIMATE MOMENT RSTG (K-FT)	DEFLECTIONS (SEE MEMO) DFI (FT)	DEFLECTIONS (SEE MEMO) DEF1 (FT)	DEFLECTIONS (SEE MEMO) DEF2 (FT)	DEFLECTIONS (SEE MEMO) DEF3 (FT)		FIBRE STRESSES TOP (PSI)	FIBRE STRESSES BOTT. (PSI)	SECTION PROPERTIES A (IN2)	SECTION PROPERTIES I (IN4)	SECTION PROPERTIES YB (IN)
0 1	497.	3.10	3.37	3801.7	3482.3	-.139	-.076	.073	-.010	STRESSING	46.	1783.	571.	194814.	25.1
										PLACE SLAB	1048.	703.	574.	194814.	25.1
										ADD. D.L.	1102.	510.	1189.	526340.	42.2
										FULL DES. LOAD	1349.	-378.	1189.	526340.	42.2

NOTE: DEFLECTIONS ARE POSITIVE DOWNWARD
NOTE: DEFLECTIONS ARE BASED ON INPUT P-S F'C
NOTE: FOR P-S CONCRETE F'C USE 4000. PSI
NOTE: APPLIED ULTIMATE MOMENT EXCEEDS ULTIMATE RESISTING MOMENT. HILD STEEL IS REQUIRED.

This report contains the following output:

- Concrete Strength Requirement both initial and final in ksi (English Units) or MPa (Metric Units).
- Ultimate Moments both applied and resisting in kip-ft (English Units) or kN-m (Metric Units).
- Deflections in feet (English Units) or m (Metric Units).
- Midspan fiber stresses at the time of stressing, after slab placement, after addition of added dead load, and under full design load. Results are in psi (English Units) or kPa (Metric Units).
- Section Properties: Results shown are the moments of inertia (I) in in^4 (English Units) or mm^4 (Metric Units), the area (A) in in^2 (English Units) or mm^2 (Metric Units), and the distance (YB) in inches (English Units) or mms(Metric Units) from the bottom of the girder or soffit to the cross section.
- Notes are included for the P-S concrete f'_c to use (either minimum allowed by the specs or maximum required by the analysis), if the applied ultimate moment exceeds the ultimate resisting moment, or if the allowable tension has been exceeded.

The following table shows the section properties and the elements considered for the various stages of a pretensioned bridge:

Loading Stage	Method of Calculation	Elements Considered	Remarks
Time of Stress	Transformed Sec./Net	Girder Only	
Slab Placement	Transformed Sec./Gross	Girder Only	
Added D.L.	Transformed Sec./Gross	Girder and Slab	Composite Girder
Added D.L.	Transformed Sec./Gross	Girder Only	Non-Composite Girder
Full Design Load			Same as added D.L.

The following table shows the section properties and the elements considered for the various stages of a pretensioned bridge:

Loading Stage	Method of Calculation	Elements Considered	Remarks
Time of Stress	Transformed Sec./Net	Total Cross Section	
Slab Placement			Ignore Results
Added D.L.	Transformed Sec./Gross	Total Cross Section Excluding Rails	
Full Design Load			Same as added D.L.

For more information on the results calculated for ultimate moments and deflections, see the "Results - Final Prestressing Force Calculated" portion of these instructions.

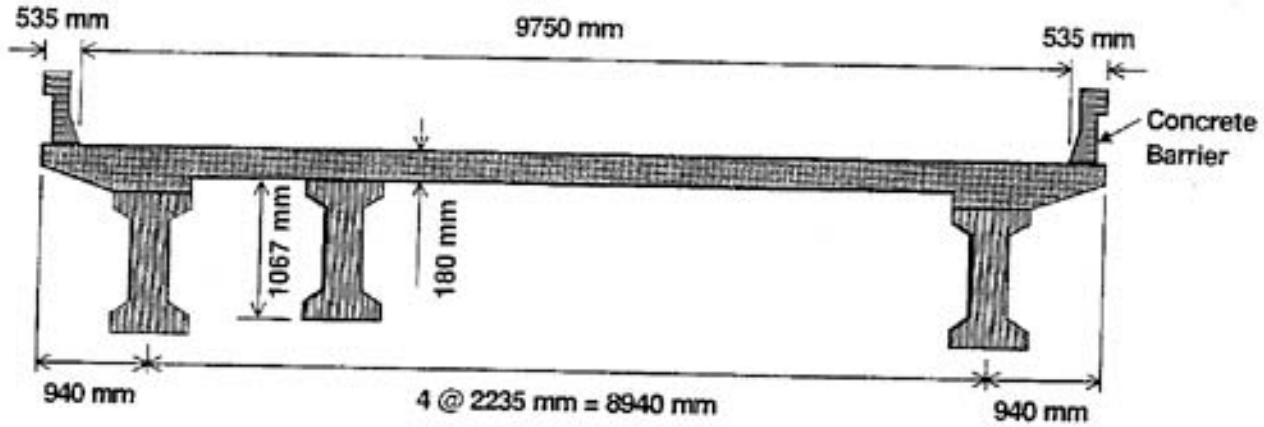
Example Problems

Attached are example problems to illustrate how the program works. Only important portions of the example problems are shown here. The following table lists the type of bridge being analyzed, and the special characteristics of each of the sample problems.

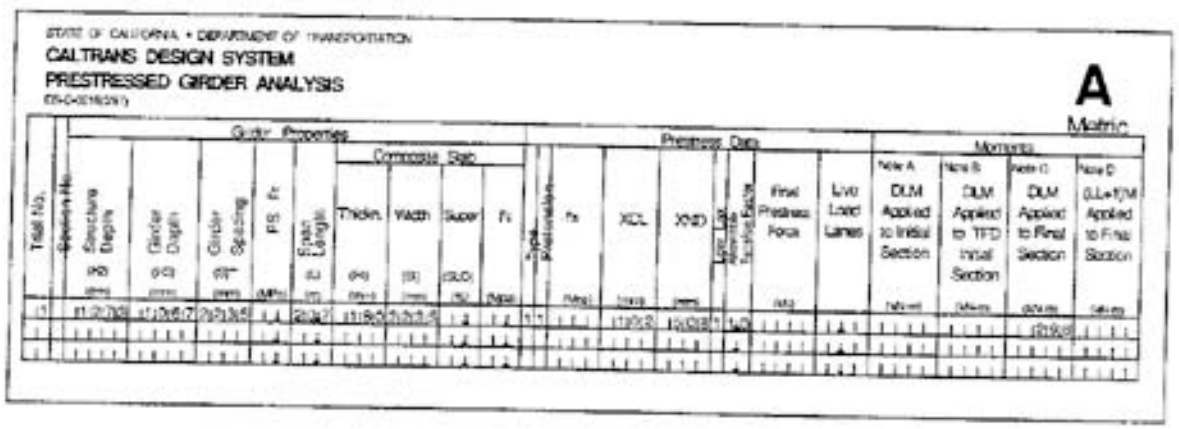
Problem No.	Bridge Type	Units Used	Special Characteristics
1	Std. "I" Girder	Metric	None.
2	Std. "I" Girder	English	Continuous for LL using max HS20 LL + IM.
3	Std. "I" Girder	Metric	Illustrates use of Symmetric Section Dimensions Sheet.
4 (with Text file)	Non-Std. "I" Girder	Metric	Illustrates use of Non-Symmetric Section Dimensions Sheet.
5	Special Girder	English	Illustrates use of Section by Parts Sheet. All moments are specified.
6 (with Text file)	Cored Slab	English	Illustrates Analysis of Cored Slab Bridge.

Example Problem 1 (Metric)

Simply Supported



Design span = 20.7 m
DL moment barrier + AC = 298 kN-m



Output for Example Problem 1:

```
                    CALIFORNIA DEPARTMENT OF TRANSPORTATION

                    DIVISION OF STRUCTURES - DESIGN                    PRESTRESSED GIRDER ANALYSIS

                          (VERSION 2.00)

INPUT DATA

                                                   D                    L
                                                   E                    O
 T S                                               T                    W
 E E                                             T E                                    DLM    ULM    DLM   (LL+I)M
 I C                                             Y N          X    X   L                 APPLIED APPLD APPLD  APPLD
 A T  STRUC GRDR  DRDR  P-S  SPAN  -- COMPOSITE SLAB -- P S  C    M   A ALL  FINAL  LIVE  TO    TO END TO    TO
 L N  DEPTH DEPTH SPAC  F'C  LENG  THK WIDTH SUPR  F'C  E N  L    D   X TRK  FORCE  LANES INITIAL DIST. FINAL FINAL
      (mm.) (mm.) (mm) (MPa)  (m)  (mm) (mm) (%)  (MPa)    (MPa) (mm)  (mm)          (kN)          SECTION SECT. SECT. SECT.
                                                                                                   (kN-m) (kN-m) (kN-m) (kN-m)

 1 0  1273  1067  2235 28.0  30.7  181 2235  .9 22.5  1 1 :1862: 102   504 Y 1.0    0.    .30     0     0   298     0

NOTE: ASSUMED DATA IS BRACKETED BY COLONS.

ANALYSIS                TRIAL NO.  1          PRE-TENSIONED

0   GROSS SECTION PROPERTIES - GIRDER        (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
                                             (      ITOT = IOO + AY2 - SUM ( AY * YB )      )
                          AREA        YB          AY          AY2          IOO          ITOT
                       (10^3*mm^2)   (mm)    (10^3*mm^3)  (10^6*mm^4)  (10^6*mm^4)  (10^6*mm^4)
     GROSS GDR SEC        306        507       155200       100335       18160        39738
0   GROSS COMPOSITE SECTION PROPERTIES       (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
                                             (      ITOT = IOO + AY2 - SUM (AY * YB )       )
                          AREA        YB          AY          AY2          IOO          ITOT
     GIRDER ONLY          306        507       155200       100335       18160        39738
     SLAB ONLY            402       1183       475921       563014        1086
     FILLET ONLY           13       1080        13551        14436           1
     OVERHG ONLY            0          0            0            0           6
     COMP SEC PROP        721        895       644672       677785       19247       120558

CALCULATED SIMPLY SUPPORTED BEAM MOMENTS

   XMG = DEAD LOAD OF GIRDER ONLY  =   386.2
   XMD = DEAD LOAD OF SLAB + FILLET=   523.9
   XMO = ADDED DEAD LOAD           =   298.3    INPUTED VALUE
   XML = LIVE LOAD MOMENT          =  1079.4    HS20-44 TRUCK LOADING

   XULM = ULTIMATE MOMENT APPLIED  =  3922.4    1.3*(DM1+XMD+XMO) + 1.3*(2.5 TRUCK)

STRESSES W/O PRESTRESS - USING GROSS CROSS-SECTIONS

                        MOMENT (kN-m)        FT (kPa)        FB (kPa)
   DL GIRDER                386.              5437.          -4931.
   DL SLAB + FILLET         524.              7375.          -6619.
   ADDED DL                 298.               427.          -2213.
                        ----------          --------        --------
   TOTAL DL                1208.             13239.         -13833.
   (LL+I)M                 1079.              1544.          -8000.
                        ----------          --------        --------
   TOTAL DL + (LL+I)       ===               14783.         -21841.

DESIGN STRESS - F DES (kPa)      (GREATER OF THE FOLLOWING)

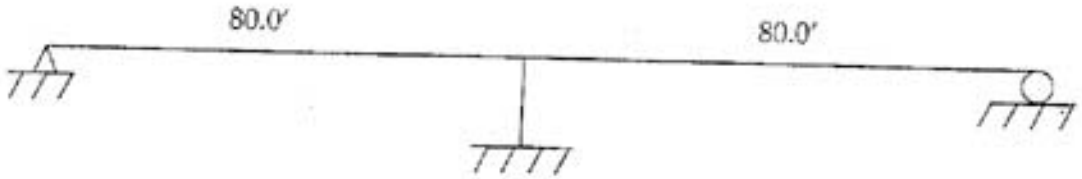
   FB - 0.9*SQRT(F'C) * ALL. TEN. FACTOR  =  19200.          FB (DL + ADD. DL)          =  13833.
   NOTE :- REAL CALCULATIONS ARE IN ENGLISH UNITS
```

```
C    FINAL TRANSFORMED GIRDER PROPERTIES        (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
     ----------------------------------------    (      ZTOT = ZOO + AYD - SUM ( AY * YB )      )
                          AREA        YB        AY       AYZ        ZOO       ZTOT
                        (10^3*mm^2)  (mm)   (10^3*mm^3) (10^6*mm^4) (10^6*mm^4) (10^6*mm^4)
       GROSS GIR SEC      306         507      155200     100333      18160      39728
       (N-1)*AS'           12         102        1202        123       ----
       TRAN GIR SEC       318         492      156402     100456      18160      41604
C    FINAL TRANSFORMED COMPOSITE GIRDER PROPERTIES      (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
     ----------------------------------------------      (      ZTOT = ZOO + AYD - SUM ( AY * YB )      )
                          AREA        YB        AY       AYZ        ZOO       ZTOT
       TRAN COMP GIR      720         802      645174     670197     18247     127841
                        (N*YT)/N**2 =  1.7126          [N*YB]/N**2 =  1.4877
     STRESSES W/O PRESTRESS - USING FINAL TRANSFORMED CROSS-SECTIONS
     ---------------------------------------------------------------
                          MOMENT (kN-m)        FT (kPa)        FB (kPa)
       DL GIRDER            386.                5333.           -4570.
       DL SLAB + FILLET     524.                7234.           -6200.
       ADDED DL             298.                 412.           -2057.
                          ----------          ---------       ---------
       TOTAL DL            1208.               12999.          -12827.
       (LL+I)m             1079.                1564.          -7444.
                          ----------          ---------       ---------
       TOTAL DL + (LL+I)   ---                 14563.          -20271.
     DESIGN STRESS - F DES (kPa)      (GREATER OF THE FOLLOWING)
     ---------------------------
       FB - 0.5*SQRT(F'C) * ALL. TEN. FACTOR =   17628.          FB DL + ADD. DL)          =   12827.
       NOTE :- FINAL CALCULATIONS ARE IN ENGLISH UNITS
     PRESTRESSING FORCE - PRETENSIONED
     ---------------------------------
       ALLOW. TENSION = ((FS * .75) - 241.32) =  1154913. (kPa)      FINAL PRESTRESS FORCE   - PF  =  2268231. (N)
       AREA OF PRESTRESSING STEEL - ASP        =      1.96 (10^3*mm^2) INITIAL PRESTRESS FORCE - PI  =  2541148. (N)
     STRESSES WITH PRESTRESS - USING FINAL TRANSFORMED CROSS-SECTIONS (kPa)
     ----------------------------------------------------------------------
     AT MIDSPAN                  TOP FIBER                 BOTTOM FIBER
     ----------                  ---------                 ------------
       @ STRESSING        (FTI)   -425.          (FBI)    15368.
       @ DL GIRDER+SLAB   (FTD)   7474.          (FBD)     6954.
       @ FULL DES. LOAD   (FTF)   9474.          (FBF)    -2646.
     AT 1/3 POINT ALONG SPAN LENGTH      TENSIONS HAPPEN AT 1/3 POINTS
     -----------------------------       (ASSUME DL OR LL STRESS AT 1/3 PT. = 0.89 * STRESS @ CL)
       @ STRESSING        (FTI)   -1012.         (FBI)    13171.
       @ FULL DEAD LOAD   (FTD)   6295.          (FBD)     6239.
       @ FULL DES. LOAD   (FTF)   7832.          (FBF)     -418.
     CONCRETE STRENGTH REQUIRED (kPa)
     --------------------------------
       FCI = FTMAX/.60 =   26442.        FC  = FMAX/.45  =   32667.        FCMAX (FCU)     =   27994.
     DEFLECTIONS (mm)          (DOWNWARD POSITIVE)
     -------------------
       DPD=    -45.57    DG =  16.54    DS = -27.03    DSF = -33.35    DSLB = 22.44    DADL = 4.16    DF =  -4.76
     CHECK ULTIMATE RESISTING MOMENT
     -------------------------------
       REINF. INDEX =       .060                    ULT. RESIST. MOMENT (kN-m)=   3793.54
       FST    (kPa) =  1803851.                     V.A @ ULTIMATE LOAD (kN) =     97.52
     RESULTS - FINAL PRESTRESSING FORCE CALCULATED
     TRIAL      STRESSES              CONCRETE   FINAL      ULTIMATE          DEFLECTIONS                    SECTION PROPERTIES
     NO.   INITIAL      FINAL         STRENGTH   PRESC      MOMENT            (SEE MEMO)                GIRDER          COMPOSITE
         TOP BOTTOM  TOP BOTTOM  INCT. FINAL  FORCE    APPLD   RESD   DF1  DCF1  DCF2  DEFS     I        A     YB     I     YB
        (kPa) (kPa) (kPa) (kPa)  (kPa) (kPa)  (kN)     (kN-m)  (kN-m) (mm)  (mm)  (mm)  (mm) (10^6*mm^4) (10^3*mm^2) (mm) (10^6*mm^4) (mm)
0    1  -424 15368  9474 -2646  26.4  23.7  2268      3922    3739 -43.6 -27.0  22.4  -4.8     41604      317   492  127841   802
     NOTE: DEFLECTIONS ARE POSITIVE DOWNWARD
     NOTE: DEFLECTIONS ARE BASED ON INPUT 3-S F'C
     NOTE: FOR 3-S CONCRETE F'C USE  27994. kPa
     NOTE: APPLIED ULTIMATE MOMENT EXCEEDS ULTIMATE RESISTING MOMENT. MILD STEEL IS REQUIRED.
```

Example Problem 2 (English)

Simply supported for dead load of girder.

Span continuous for added dead load and live load.



Design of Span 1

Span Length = 80 ft Girder Spacing = 8′-6″ Girder Depth = 4′-6″

Top Slab = 7.625″ Structure Depth = 5′-4″

- Added DL Moment = 195
- $(LL+I)_H$ = 888 k-ft; $(LL+I)_P$ = 1618 k-ft
- Moments or continuous spans must be determined by an analysis program that allows continuous spans (eg., Frame, BDS, etc.).
- Moments are at centerline of span.
- P-Truck moment to be input = $\frac{1618}{5/3}$ = 971 k-ft

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
CALTRANS DESIGN SYSTEM
PRESTRESSED GIRDER ANALYSIS
DS D-0003 (REV. 11/97)

A
English

Trial No.	Section No.	Girder Properties: Structure Depth (HD) (in)	Girder Depth (HG) (in)	Girder Spacing (SG) (in)	(PS) f'c (ksi)	Span Length (L) (ft)	Composite Slab: Thick (HS) (in)	Width (SB) (in)	Super (SLD) (psf)	f'c (ksi)	Type Cross-Section	Prestress Data: Fs (kip)	XCL (in)	XND (in)	Low Fail	Midspan Tension Failure	Final Prestress Force (kips)	Live Load Lanes	Moments: Note A DLM Applied to Initial Section (kip-ft)	Note B DLM Applied to TFD Initial Section (kip-ft)	Note C DLM Applied to Final Section (kip-ft)	Note D (LL+I)M Applied to Final Section (kip-ft)
11		16(40)	15(40)	110/2	4	80.0	7.625	110/2			1	1		18.0	21.7.0	1	1.0					
12		16(40)	15(40)	110/2	4	80.0	7.625	110/2			1	1		18.0	21.7.0	1	1.0				1110.5	1818.8
																	1618.9				1110.5	1617.1

Output for Example Problem 2:

```
                                   CALIFORNIA DEPARTMENT OF TRANSPORTATION                                   PAGE 1
                                         PRESTRESSED GIRDER ANALYSIS
                                              (VERSION 2.00)

INPUT DATA                                  P                                                                
                                            R                   L                                            
                                            E                   O                                            
T S                                         T                   W                                  SDM    SDM    SDM  (LL+I)M
N E                                       T E                                                    APPLIED  APPLD  APPLD  APPLD
I C                                       Y N        X    X  L     FINAL  LIVE                    TO     TO SPB  TO     TO
A T  STRUC GIDR  GIDR  P-S  SLAB  -- COMPOSITE SLAB -- P S    C    N  A ADJ  PRESTT  LOAD   INITIAL  INIT.  FINAL  FINAL
L N  SPCNG DEPTH SPAC  F'C  LONG  DECK WIDTH SPCG. F'C E N  F'S  L    O  E DIS  FORCE  LANES  SECTION  SECT.  SECT.  SECT.
     (IN.) (IN.) (IN) (KSI) (FT)  (IN) (IN) (%)  (KSI)     (KSI) (IN) (IN)        GCIP)          (K-FT) (K-FT) (K-FT) (K-FT)
1 0  64.0  54.0  102 :4.0:  80.   7.6 102.   .0 :2.3: 1 1 :270:  6.0  27.6  Y 1.0     0.    .00      0      0    195    888
NOTE: ASSUMED DATA IS BRACKETED BY COLONS.

   ANALYSIS          TRIAL NO.  1        PRE-TENSIONED

0  GROSS SECTION PROPERTIES - GIRDER      (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
   ------------------------------------   (      IYOY = IOO + AY2 - SUM ( AY * YB )      )
                        AREA       YB        AY        AY2        IOO       IYOY
                        (IN2)     (IN)     (IN3)      (IN4)      (IN4)      (IN4)
     GROSS GDR SEC      558.0     25.7     14364.   464175.     92241.   186659.
0  GROSS COMPOSITE SECTION PROPERTIES     (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
   ------------------------------------   (      IYOY = IOO + AY2 - SUM (AY * YB )       )
                        AREA       YB        AY        AY2        IOO       IYOY
     GIRDER ONLY        558.0     25.7     14364.   464175.     92241.   186659.
     SLAB ONLY          775.2     60.2     46667.  2809356.      3721.
     FILLET ONLY         45.6     55.2      2517.   138945.        22.
     OVERHG ONLY          .0       .0         0.        0.         0.
     COMP SEC PROP     1378.8     46.1     63548.  3412476.     95994.   379569.

   CALCULATED SIMPLY SUPPORTED BEAM MOMENTS
   ----------------------------------------
     DM1 = DEAD LOAD OF GIRDER ONLY  =   465.1
     DM2 = DEAD LOAD OF SLAB + FILLET=   684.2
     DM3 = ADDED DEAD LOAD           =   195.0    INPUTED VALUE
     DMW = LIVE LOAD MOMENT          =   888.0    INPUTED VALUE
     MTOAD = ULTIMATE MOMENT APPLIED =  2671.1    1.3*(DM1+DM2+DM3) + 2.17*DMW

                                         PRESTRESSED GIRDER ANALYSIS                                         PAGE 2

   STRESSES W/O PRESTRESS - USING GROSS CROSS-SECTIONS
   ---------------------------------------------------
                        MOMENT (K')       FT (PSI)       FB (PSI)
     DL GIRDER            465.             845.          -770.
     DL SLAB + FILLET     684.            1242.         -1132.
     ADDED DL             195.              32.          -186.
                        ----------       -------        -------
     TOTAL DL            1344.            2120.         -2088.
     (LL+I)M              888.             145.          -847.
                        ----------       -------        -------
     TOTAL DL + (LL+I)   ----             2265.         -2936.

   DESIGN STRESS - F DES (PSI)      (GREATER OF THE FOLLOWING)
   --------------------------

     FD = 6 * SQRT(F'C) * ALL. DEN. FACTOR =   2584.          FB (DL + ADD. DL)          =   2088.

0  FINAL TRANSFORMED GIRDER PROPERTIES    (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
   ------------------------------------   (      IYOY = IOO + AY2 - SUM ( AY * YB )      )
                        AREA       YB        AY        AY2        IOO       IYOY
                        (IN2)     (IN)     (IN3)      (IN4)      (IN4)      (IN4)
     GROSS GDR SEC      558.0     25.7     14364.   464175.     92241.   186659.
     (N-1)*AS'           20.2      6.0       121.      729.       ---
     TRAN GDR SEC       578.2     25.1     14485.   464904.     92241.   194714.
```

```
0   FINAL TRANSFORMED COMPOSITE GIRDER PROPERTIES        (PROPERTIES CALCULATED FROM BOTTOM-OF SECTIONS)
                                                         (      IXXT = IXX + AXZ - SUM ( AX * YB )      )
                        AREA        YB        AX        AXZ        IXX        IXXT
    TRAN COMP GIR      3360.0      45.5     63670.    3413205.    96594.     611638.
                     (F*YT)/F**2 =  1.0415              (F*YB)/F**2 =  1.4209

    STRESSES W/O PRESTRESS - USING FINAL TRANSFORMED CROSS-SECTIONS
                                                                                    ---------------------------
                          MOMENT (K')        FT (PSI)        FB (PSI)
    DL GIRDER               865.              832.           -720.
    DL SLAB + FILLET        684.             1222.          -1059.
    ADDED DL                195.               32.           -174.
                          ---------         --------        --------
    TOTAL DL               1344.             2088.          -1953.
    (LL+I)S                 888.              148.           -793.
                          ---------         --------        --------
    TOTAL DL + (LL+I)      ----               2236.          -2745.

    DESIGN STRESS - F DES (PSI)      (SHOWING OF THE FOLLOWING)

      FD = 6 * SQRT(F'C) * ALL. DES. FACTOR =    2366.          FB (DL + ADD. DL)          =    1953.

                                                PRESTRESSED GIRDER ANALYSIS                                    PAGE 3

    PRESTRESSING FORCE - PRESTRESSED

      ALLOW. TENSION = (0.8 *  .75) - 35.00) =  167500. (PSI)        FINAL PRESTRESS FORCE   - PF  =  565237. (LBS)
      AREA OF PRESTRESSING STEEL - ASP       =     3.37 (IN2)        INITIAL PRESTRESS FORCE - PI  =  639477. (LBS)

    STRESSES WITH PRESTRESS - USING FINAL TRANSFORMED CROSS-SECTIONS (PSI)
                                                                                    ---------------------------
    AT MIDSPAN                  TOP FIBER              BOTTOM FIBER
    ----------                  ---------              ------------
      @ STRESSING       (PSI)    122.          (PSI)    1957.
      @ DL GIRDER+SLAB  (PSI)    1428.         (PSI)     588.
      @ FULL DES. LOAD  (PSI)    1609.         (PSI)    -375.

    CHECKS: STRESSES REQUIRED (PSI)
                                                                                    ---------------------------
      FCI = FTMAX/.60 =   3333.        FC = FMAX/.40  =   4020.        FCMAX (USE)     =   4020.

    DEFLECTIONS (INCHES)      (COMPUTED POSITIVE)
                                                                                    ---------------------------
      DPI= -1.6724    DG=  .7532    DS=  -.9092    DPP= -1.0879    DSLB= 1.1227    DNDL=  .1016    DF=  .1364

    CHECK ULTIMATE RESISTING MOMENT
                                                                                    ---------------------------
      REINF. INDEX =      .046                    ULT. RESIST. MOMENT (K-FT)=   3971.09
      FSU    (PSI) =  263603.                     N.A  @ ULTIMATE LOAD (IN) =      3.71

                                                PRESTRESSED GIRDER ANALYSIS                                    PAGE 4

PRESTR - FINAL PRESTRESSING FORCE CALCULATED

TRANS.    STRESSES              CONCRETE   FINAL      ULTIMATE                DEFLECTIONS                SECTION PROPERTIES
 NO.   INITIAL      FINAL       STRESSES   PREST      MOMENT                  (SEE MDMC)                 GIRDER          COMPOSITE
      TOP BOTTOM  TOP BOTTOM   INIT. FINAL  FORCE    AVAIL   REQD     DPI    DPP.    DSP2    DSP3     I     A    YB      I     YB
      (PSI) (PSI) (PSI) (PSI)  (PSI) (PSI)  (KIPS)   (K-FT)  (K-FT)   (FT)   (FT)    (FT)    (FT)   (IN4) (IN2)  (IN)   (IN4)  (IN)

0 1   122. 1957. 1609. -375.   3.39  4.02   565.   3971.1  3971.1   -.139  -.076   .694    .011  134273  578  25.1  611638  45.5

    NOTE: DEFLECTIONS ARE POSITIVE DOWNWARD

    NOTE: DEFLECTIONS ARE BASED ON P-S F'CMAX

    NOTE: FOR P-S CONCRETE F'C USE 4020. PSI
```

```
                                        PRESTRESSED GIRDER ANALYSIS                                                    PAGE  5

INPUT  DATA

                                                P
                                                R                   L
                                                E                   O
 T E                                            S                   W                                  DLM    DLM    DLM  (LL+I)M
 R E                                            T                                                    APPLIED  APPLD  APPLD  APPLD
 I C                                            Y S        X    X   I      FINAL  LIVE   TO     TO IND  TO     TO
 A T  STRUC GIRD GIRD F-S  SPAN  -- COMPOSITE SLAB -- F S        C    M   A ALL  PREST  LOAD  INITIAL  INIT.  FINAL  FINAL
 L N  DEPTH DEPTH SPAC F'C LENG  THCK WIDT STRX F'C E N F'S      L    D   X TEN  FORCE  LANES SECTION  SECT.  SECT.  SECT.
      (IN.) (IN.) (IN) (KSI) (FT) (IN) (IN) (4)  (KSI)    (KSI) (IN)  (IN)        (KIP)        (K-FT) (K-FT) (K-FT) (K-FT)
 2 C   64.0  54.0 102 :4.0:  80.   7.6 102.   .0 :3.3: 1 1 :270:  6.0  27.0  Y 1.0   639.   .00     0      0    395    571
NOTE: ASSUMED DATA IS BRACKETED BY COLONS.

   ANALYSIS            TRIAL NO.  2          PRE-TENSIONED

   GROSS SECTION PROPERTIES - GIRDER      (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
   ---------------------------------      (      ITOT = IOO + AY2 - SUM ( AY * YB )      )
                          AREA        YB        AY        AY2        IOO       ITOT
                          (IN2)      (IN)      (IN3)      (IN4)      (IN4)      (IN4)
      GROSS GDR SEC       558.0      25.7     14364.    464175.     92241.    186659.
   GROSS COMPOSITE SECTION PROPERTIES     (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
   ----------------------------------     (      ITOT = IOO + AY2 - SUM (AY * YB )       )
                          AREA        YB        AY        AY2        IOO       ITOT
      GIRDER ONLY         558.0      25.7     14364.    464175.     92241.    186659.
      SLAB ONLY           795.2      69.2     46667.   2909056.      3731.
      FILLET ONLY          45.6      55.2      2517.    138945.        22.
      OVHNG ONLY            .0        .0         0.         0.         0.
      COMP SEC TOOP      1378.8      46.1     63548.   3512476.     95994.    579569.
   CALCULATED SIMPLY SUPPORTED BEAM MOMENTS
   ----------------------------------------
      XM1 = DEAD LOAD OF GIRDER ONLY  =    460.1
      XM2 = DEAD LOAD OF SLAB + FILLET=    684.2
      XM3 = ADDED DEAD LOAD           =    195.0     INPUTTED VALUE
      XM4 = LIVE LOAD MOMENT          =    971.0     INPUTTED VALUE
      XULMA = ULTIMATE MOMENT APPLIED =   3850.9     1.3*(XM1+XM2+XM3) + 2.17*XM4

                                        PRESTRESSED GIRDER ANALYSIS                                                    PAGE  6

   STRESSES W/O PRESTRESS - USING GROSS CROSS-SECTIONS
   ---------------------------------------------------
                          MOMENT (K')        FT (PSI)        FB (PSI)
      DL GIRDER              460.              845.            -770.
      DL SLAB + FILLET       684.             1243.           -1132.
      ADDED DL               195.               32.            -186.
                          -----------       --------        --------
      TOTAL DL              1344.             2120.           -2088.
      (LL+I)M                971.              159.            -927.
                          -----------       --------        --------
      TOTAL DL + (LL+I)     ----               2279.           -3015.

   DESIGN STRESS - F DES (PSI)      (GREATER OF THE FOLLOWING)
   --------------------------
      FD = 6 * SQRT(F'C) * ALL. TEN. FACTOR  =    2635.          FD (DL + ADD. DL)          =    2088.

   FINAL TRANSFORMED GIRDER PROPERTIES    (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
   -----------------------------------    (      ITOT = IOO + AY2 - SUM ( AY * YB )      )
                          AREA        YB        AY        AY2        IOO       ITOT
                          (IN2)      (IN)      (IN3)      (IN4)      (IN4)      (IN4)
      GROSS GDR SEC       558.0      25.7     14364.    464175.     92241.    186659.
      (N-1)*AS'            22.9       6.5       137.       824.       ---
      TRAN GDR SEC        580.9      25.0     14501.    464999.     92241.    190228.
   FINAL TRANSFORMED COMPOSITE GIRDER PROPERTIES     (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
   ---------------------------------------------     (      ITOT = IOO + AY2 - SUM ( AY * YB )      )
                          AREA        YB        AY        AY2        IOO       ITOT
      TRAN COMP GDR      1401.7      45.4     63685.   3413300.     95994.    615755.
                       (N*YT)/N**2 =  1.6284          (N*YB)/N**2 =  1.4086
```

STRESSES W/O PRESTRESS - USING FINAL TRANSFORMED CROSS-SECTIONS

	MOMENT (K')	FT (PSI)	FB (PSI)
DL GIRDER	465.	830.	-714.
DL SLAB + FILLET	684.	1221.	-1050.
ADDED DL	195.	33.	-173.
TOTAL DL	1344.	2084.	-1936.
(LL+I)H	971.	162.	-860.
TOTAL DL + (LL+I)	---	2246.	-2796.

PRESTRESSED GIRDER ANALYSIS PAGE 7

PRESTRESSING FORCE - PRETENSIONED

ALLOW. TENSION = ((FS * .75) - 35.00) = 167500. (PSI)
AREA OF PRESTRESSING STEEL - AST = 3.81 (IN2)

FINAL PRESTRESS FORCE - PF = 639000. (LBS)
INITIAL PRESTRESS FORCE - PI = 722928. (LBS)

STRESSES WITH PRESTRESS - USING FINAL TRANSFORMED CROSS-SECTIONS (PSI)

AT MIDSPAN		TOP FIBER		BOTTOM FIBER
@ STRESSING	(FTI)	36.	(FBI)	2284.
@ DL GIRDER+SLAB	(FTF)	1349.	(FBF)	886.
@ FULL DES. LOAD	(FTF)	1544.	(FBF)	-147.

CONCRETE STRENGTH REQUIRED (PSI)

FCI = FIMAX/.60 = 3937. FC = FMAX/.40 = 3858. FCMAX (USE) = 4000.

DEFLECTIONS (INCHES) (DOWNWARD POSITIVE)

DFI= -1.8759 DG= .7614 DC= -1.1145 DFF= -1.3623 DSLB= 1.1200 DADL= .1012 DF= -.1411

CHECK ULTIMATE RESISTING MOMENT

REINF. INDEX = .052
FSU (PSI) = 262768.

ULT. RESIST. MOMENT (K-FT)= 4458.88
N.A @ ULTIMATE LOAD (IN) = 4.19

PRESTRESSED GIRDER ANALYSIS PAGE 8

RESULTS - FINAL PRESTRESSING FORCE GIVEN

TRIAL NO	INPUT PRSTR FORCE (KIPS)	CONCRETE STRENGTH INIT. (KSI)	CONCRETE STRENGTH FINAL (KSI)	ULTIMATE MOMENT APPLD (K-FT)	ULTIMATE MOMENT RSTS (K-FT)	DFI (FT)	DEFLECTIONS (SEE MEMO) DEF1 (FT)	DEF2 (FT)	DEF3 (FT)		FIBRE STRESSES TOP (PSI)	FIBRE STRESSES BOTT. (PSI)	SECTION PROPERTIES A (IN2)	SECTION PROPERTIES I (IN4)	SECTION PROPERTIES YB (IN)
0 2	639.	3.94	3.86	3850.9	4458.9	-.156	-.093	.093	-.012	STRESSING	36.	2284.	581.	195228.	25.0
										PLACE SLAB	1349.	886.	581.	195228.	25.0
										ADD. D.L.	1382.	713.	1402.	615755.	45.4
										FULL DES. LOAD	1544.	-147.	1402.	615755.	45.4

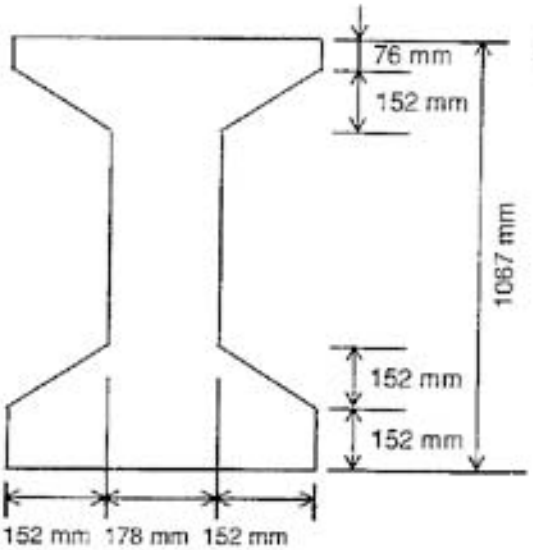
NOTE: DEFLECTIONS ARE POSITIVE DOWNWARD

NOTE: DEFLECTIONS ARE BASED ON INPUT P-S F'C

NOTE: FOR P-S CONCRETE F'C USE 4000. PSI

Example Problem 3 (Metric)

Standard Symmetric "T" Girder



Using section dimension cards

Girder spacing = 2235 mm
Span length = 20.7 m
Slab thickness = 180 mm
Structure depth = 1235 mm

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
CALTRANS DESIGN SYSTEM
PRESTRESSED GIRDER ANALYSIS

A
Metric

Trial No.	Given Properties						Composite Slab				Prestress Data							Moments			
	Elevations (HE) (mm)	Girder Depth (HG) (mm)	Girder Spacing (S) (mm)	HS, f_c (MPa)	Span Length (L) (m)	Thickn. (HF) (mm)	Width (B) (mm)	Stress (HUDI) (MPa)	f_c (MPa)	Prestress Force (kN)	Live Load Lanes	Note A DLM Applied to Final Section (kN-m)	Note B DLM Applied to TPD Initial Section (kN-m)	Note C DLM Applied to Final Section (kN-m)	Note D (L.L.+I)M Applied to Final Section (kN-m)
1	1,2,7,3	1,0,6,7	2,3,3,5	▲	2,0,7	1,8,0	8,2,3,5	0,2	▲	0 1	▲	1,5,5	4,0,3,4	1	0	▲	2,8,8
				▲	▲				▲							▲	
				▲	▲				▲							▲	

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
CALTRANS DESIGN SYSTEM
PRESTRESSED GIRDER ANALYSIS - SECTION DIMENSIONS
Symmetrical Sections

D
Metric

Trial No.	HXT (mm)	HXB (mm)	H4L (mm)	H5L (mm)	H6L (mm)	H7L (mm)	H8L (mm)	H9L (mm)	B3L (mm)	W (mm)	B4L (mm)	B5L (mm)	B6L (mm)	B7L (mm)	B8L (mm)	S
1	0	0	7,8	1,5,2	1,5,2	1,5,2	0	0	1,5,2	1,7,8	1,5,2	0	1,5,2	0	1,5,2	0

Output for Example Problem 3:

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                                   CALIFORNIA DEPARTMENT OF TRANSPORTATION                                    PAGE 1
                                     PRESTRESSED GIRDER ANALYSIS
                                          (VERSION 2.00)

TRIAL SECTION DIMENSIONS

TRIAL                                   SYMMETRIC SECTIONS
 NO.  BDT  BDB  BWL  BTL  BBL  WTL  BBL  BTL  BBL   W   BWL  BTL  BBL  BTL  BBL  S
  1    0    0   76  152  152  152    0    0  152  178  152    0  152    0  152  0

                                  PRESTRESSED GIRDER ANALYSIS                                                 PAGE 2

INPUT  DATA                                                  P
                                                             R                  I
                                                             E                  O
 T S                                                         T                  W                                  DEM    DEM    DEM  (LL+I)M
 R E                                                       T E                                                    APPLIED APPLD APPLD  APPLD
 I C                                                       Y N        X     X   L      FINAL  LIVE              TO     TO END  TO    TO
 A T  STRAC GIRD  GIRD  P-S  SPAN  -- COMPOSITE SLAB --  P S        C     K   A ALL  PREST  LOAD              INITIAL INIT.  FINAL FINAL
 L N  DEPTH DEPTH SPAC  F'C  LENG  THCK MODE SUPR  F'C  E N  F'S   L     D   X TEN  FORCE  LANES              SECTION SECT.  SECT. SECT.
      (mm.) (mm.) (cm) (MPa)  (m)  (mm) (mm) (%)  (MPa)      (MPa) (mm)  (mm)          (kN)                 (kN-m) (kN-m) (kN-m) (kN-m)
 1 C  1273  1067  2235 28.0  20.7   190 2235   .0 22.5  0 1 :1862:  89   483  Y 1.0     0.    .00            0      0    298      0
NOTE: ASSUMED DATA IS INDICATED BY COLONS.

    ANALYSIS              TRIAL NO.  1          PRE-TENSIONED

0   GROSS SECTION PROPERTIES - GIRDER      (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
    ---------------------------------      (      IPOT = I00 + AY2 - SUM ( AY * YB )      )
                        AREA        YB        AY        AY2        I00        IPOT
                     (10^3*mm^2)   (mm)  (10^3*mm^2) (10^6*mm^4) (10^6*mm^4) (10^6*mm^4)
      GROSS GIR SEC      305       558     155019     100166      18178      39669
0   GROSS COMPOSITE SECTION PROPERTIES     (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
    ----------------------------------     (      IPOT = I00 + AY2 - SUM (AY * YB )       )
                        AREA        YB        AY        AY2        I00        IPOT
      GIRDER ONLY        305       508     155019     100166      18178      39669
      SLAB ONLY          402      1183     475921     563014       1086
      FILLET ONLY         13      1080      13535      14617          1
      OVERHG ONLY          0         0          0          0          0
      COMP SEC PROP      720       896     644474     677797      19263     120414
    CALCULATED SIMPLY SUPPORTED BEAM MOMENTS
    ----------------------------------------
      XM1 = DEAD LOAD OF GIRDER ONLY  =   385.7
      XM2 = DEAD LOAD OF SLAB + FILLET=   523.8
      XM3 = ADDED DEAD LOAD           =   298.3     INPUTED VALUE
      XM4 = LIVE LOAD MOMENT          =  1679.4     HS20-44 TRUCK LOADING
      XULM = ULTIMATE MOMENT APPLIED  =  3821.7     1.3*(XM1+XM2+XM3) + 1.3*(XM TRUCK)

                                  PRESTRESSED GIRDER ANALYSIS                                                 PAGE 3

    STRESSES W/O PRESTRESS - USING GROSS CROSS-SECTIONS
    ---------------------------------------------------
                        MOMENT (kN-m)        FT (kPa)        FB (kPa)
      DL GIRDER            386.              5439.          -4934.
      DL SLAB + FILLET     524.              7387.          -6701.
      ADDED DL             298.               427.          -2217.
                        ----------         --------        --------
      TOTAL DL            1208.              13253.         -13851.
      (LL+I)M             1679.              1544.          -8020.
                        ----------         --------        --------
      TOTAL DL + (LL+I)   ---                14797.         -21871.

    DESIGN STRESS - F DES (kPa)      (GREATER OF THE FOLLOWING)
    --------------------------
      FD = 0.5*SQRT(F'C) * ALL. TEN. FACTOR  =   19228.          FD (DL + ADD. DL)          =   13851.
      NOTE :- REAL CALCULATIONS ARE IN ENGLISH UNITS
```

```
0   FINAL TRANSFORMED GIRDER PROPERTIES        (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
    ---------------------------------------     (      IPOT = IGO + AX2 - SGN ( AX * YS )      )
                          AREA        YB          AX          AX2         IGO         IPOT
                        (10^3*mm^2)   (mm)     (10^3*mm^3) (10^6*mm^4) (10^6*mm^4) (10^6*mm^4)
      GROSS GDR SEC      303         508        155619      100166       18178       39669
      (N-1)*AS'           12          39         1020          32         ---
      TRAN GDR SEC       317         492        156647      100217       18178       41613
0   FINAL TRANSFORMED COMPOSITE GIRDER PROPERTIES      (PROPERTIES CALCULATED FROM BUILT-UP SECTIONS)
    ---------------------------------------------------     (      IPOT = IGO + AX2 - SGN ( AX * YS )      )
                          AREA        YB          AX          AX2         IGO         IPOT
      TRAN COMP GDR       732        882        645500      677089       18565      127797
                                 (D*YT)/D**2 =  1.7653                (D*YB)/D**2 =  1.5120
    STRESSES W/O PRESTRESS - USING FINAL TRANSFORMED CROSS-SECTIONS
    ---------------------------------------------------------------
                              MOMENT (kN-m)        FT (kPa)          FB (kPa)
      DL GIRDER                 386.                5325.            -4501.
      DL SLAB + FILLET          524.                7233.            -6195.
      ADDED DL                  298.                 412.            -2059.
                              ---------           --------          --------
      TOTAL DL                 1208.               12970.           -12855.
      (LL+I)N                  1079.                1582.            -7449.
                              ---------           --------          --------
      TOTAL DL + (LL+I)        ----                14552.           -20264.
    DESIGN STRESS - F DES (kPa)      (GREATER OF THE FOLLOWING)
    ---------------------------
      FB = 0.5*SQRT(F'C) * ALL. TEN. FACTOR) =   17021.          FB (DL + ADD. DL)          =   17015.
      NOTE :-  REAL CALCULATIONS ARE IN ENGLISH UNITS

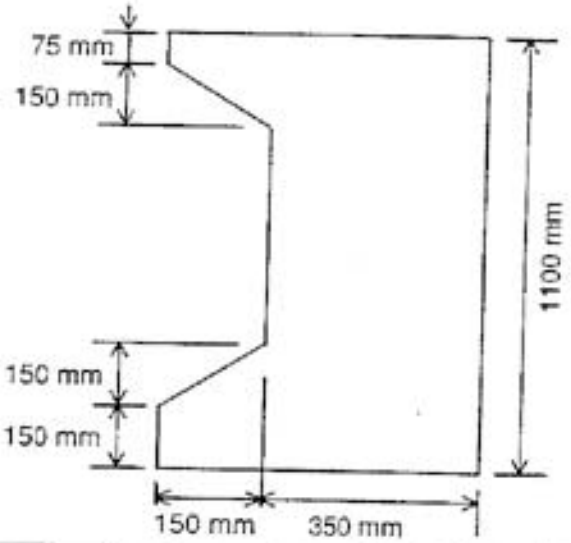
                                    PRESTRESSED GIRDER ANALYSIS                                          PAGE 4

    PRESTRESSING FORCE - PRESTRESSING
    ---------------------------------
      ALLOW. TENSION = (FS +  .75) - 241.32) =  1154013. (kPa)        FINAL PRESTRESS FORCE  - PF  =  2222935. (N)
      AREA OF PRESTRESSING STEEL - ASP          =      1.92 (10^3*mm^2) INITIAL PRESTRESS FORCE - PI  =  2514903. (N)
      STRESSES WITH PRESTRESS - USING FINAL TRANSFORMED CROSS-SECTIONS (kPa)
      ---------------------------------------------------------------------
      AT MIDSPAN                  TOP FIBER                 BOTTOM FIBER
      ----------                  ---------                 ------------
        @ STRESSING       (FTI)    -747.          (FBI)     15369.
        @ DL GIRDER+SLAB  (FTF)    7191.          (FBF)      6860.
        @ FULL DES. LOAD  (FTF)    9185.          (FBF)     -2647.
      AT 1/3 POINT ALONG SPAN LENGTH     TENDONS DRAPED AT 1/3 POINTS
      -----------------------------      (ASSUME: DL OR LL STRESS AT 1/3 PT. = 0.89 * STRESS @ CL)
        @ STRESSING       (FTI)   -1333.          (FBI)     15871.
        @ FULL DEAD LOAD  (FTF)    5810.          (FBF)      8044.
        @ FULL DES. LOAD  (FTF)    7584.          (FBF)      -416.
      CONCRETE STRESSES REQUIRED (kPa)
      --------------------------------
        FCI = FMAX/.60 =   26442.        FC  = FMAX/.40 =   22960.        FCMAX (DES)     =   27994.
      DEFLECTIONS (mm)          (DOWNWARD POSITIVE)
      -------------------
        DPI=   -44.37    DG=    16.51    DS=   -28.00    DPF=   -54.74    DSLA=    22.43    DADD=    4.16    DF=   -8.15
      CHECK ULTIMATE RESISTING MOMENT
      -------------------------------
        REINF. INDEX =      .058                    ULT. RESIST. MOMENT (kN-m)=   3772.91
        FPU    (kPa) = 1825627.                     N.A. @ ULTIMATE LOAD (mm) =     96.66

    PROFILES - FINAL PRESTRESSING FORCE CALCULATED
    TENDON      STRESSES            CONCRETE   FINAL      ULTIMATE          DEFLECTIONS                    SECTION PROPERTIES
    NO.   INITIAL      FINAL        STRESSES   PRESTR     MOMENT            (SEE MEMO)                GIRDER            COMPOSITE
          TOP BOTTOM   TOP BOTTOM   INIT. FINAL FORCE      APPLD   RESTR   DEF1   DEF2   DEF3    I        A     YB      I     YB
          (kPa)  (kPa) (kPa) (kPa)  (MPa) (MPa)  (kN)      (kN-m)  (kN-m) (mm)   (mm)   (mm) (10^6*mm^4) (10^3*mm^2) (mm) (10^6*mm^4) (mm)
0   1   -746 15369  9185 -2648   26.6  23.0   2223       3521    3773 -44.6 -28.1  22.4  -8.1    41613      317   492  127796   882
    NOTE: DEFLECTIONS ARE POSITIVE DOWNWARD
    NOTE: DEFLECTIONS ARE BASED ON INPUT F'C
    NOTE: FOR F'C CONCRETE F'C USE  27994. kPa
    NOTE: APPLIED ULTIMATE MOMENT EXCEEDS ULTIMATE RESISTING MOMENT. MILD STEEL IS REQUIRED.
```

Example Problem 4 (Metric)

Non-Standard Non-Symmetric "I" Girder



Using section dimension cards

Girder spacing = 2300 mm
Span length = 20.5 m
Slab thickness = 200 mm

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
CALTRANS DESIGN SYSTEM
PRESTRESSED GIRDER ANALYSIS
DS-D-0016 (REV. 11/97)

A
Metric

Trial No.	Section No.	Girder Properties: Structure Depth (HS) (mm)	Girder Depth (HG) (mm)	Girder Spacing (SG) (mm)	PS Fc (MPa)	Span Length (SL) (m)	Composite Slab: Thickness (HC) (mm)	Width (BS) (mm)	Super (SLDL) (N/m)	Fc	Prestress Data: Tendon Profile	Fx (Mpa)	XCL (mm)	XNO (mm)	Jacking Force	Tendon Force	Final Prestress Force (kN)	Live Load Lanes	Moments: Note A DLM Applied to Initial Section (kNm)	Note B DLM Applied to TPD Initial Section (kNm)	Note C DLM Applied to Final Section (kNm)	Note D (LL+IM) Applied to Final Section (kNm)
1		1800.0	1700.0	2300.0	35.0	20.5	200.0	2300.0	7.0	35.0	3	1	1100.0	150.0	1.0		2	2			12.9	
1																						

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
CALTRANS DESIGN SYSTEM
PRESTRESSED GIRDER ANALYSIS - SECTION DIMENSIONS
DS-D-0025 (REV. 11/97)
Symmetrical Sections

D
Metric

Trial No.	HXT (mm)	HXB (mm)	H4L (mm)	H5L (mm)	H6L (mm)	H7L (mm)	H8L (mm)	H9L (mm)	B3L (mm)	W (mm)	B4L (mm)	B5L (mm)	B6L (mm)	B7L (mm)	B8L (mm)	S
1	0	0	75	150	150	150	0	0	150	200	150	0	150	0	150	0
1																

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CALTRANS DESIGN SYSTEM
PRESTRESSED GIRDER ANALYSIS - SECTION DIMENSIONS
DS-D-0025 (REV. 11/97)
Unsymmetrical Sections

E
Metric

Trial No.	B3R (mm)	B4R (mm)	B5R (mm)	B6R (mm)	B7R (mm)	B8R (mm)	H4R (mm)	H5R (mm)	H6R (mm)	H7R (mm)	H8R (mm)	H9R (mm)
1	150	0	0	0	0	150	150	0	0	0	0	0
1												

Text File for Example Problem 4

```
'$ This panel program is written by Raj Singh.'

'$ Output is in metric Units.'
'$ Input is in Metric units.'
'$ Output, Input, Free or Fixed Input in English'
'Units' 'M' 'M' 'F'

'$A Tr#.Sec#.Str D.Gr D.S.f'c.SpLn.Sl T.W.Supt.f'c.Ty.Fre.f's.XCL.XMD.LoLw.All F,YFF,LLL.DLM1.DML2.DLM3.DLM4'
'A' 1 0 1300.0 1100.0 2301 .0 20.5 200.0 2300 .0 .0 1 1 0 100.0 500.0 1 1.0 0 .0 0 0 299 0


'$D Tr#.EXT.EXB.B4L.B5L.B6L.B7L.B8L.B9L.B3L.W.B4L.B5L.B6L.B7L.B8L.S'
'D' 1 .0 .0 75.0 150.0 150.0 150.0 .0 .0 150.0 200.0 150.0 .0 150.0 .5 150.0 0


'$E Tr#.B3R.B4R.B5R.B6R.B7R.B8R.B4R.B5R.B6R.B7R.B8R.B9R'
'E' 1 150.0 .0 .0 .0 .0 150.0 1100.0 .0 .0 .0 .0 .0
```

Output for Example Problem 4:

```
                                CALIFORNIA DEPARTMENT OF TRANSPORTATION                                    PAGE 1
                                      PRESTRESSED GIRDER ANALYSIS
                                          (VERSION 2.00)

TRIAL SECTION DIMENSIONS

TRIAL                          SYMMETRIC SECTIONS
 NO.  EXT  EXB  B4L  B5L  B6L  B7L  B8L  B9L  B3L   W   B4L  B5L  B6L  B7L  B8L  S
  1    0    0   76  150  150  150    0    0  150  201  150    0  150    0  150  0

TRIAL                          UNSYMMETRIC SECTIONS
 NO.  B3R  B4R  B5R  B6R  B7R  B8R  B4R  B5R  B6R  B7R  B8R  B9R
  1   150    0    0    0    0  150 1100    0    0    0    0    0

                                      PRESTRESSED GIRDER ANALYSIS                                          PAGE 2

INPUT DATA                                        P
                                                  R              L
                                                  E              O
 T S                                              T              W                 DIM   DIM   DIM  (DL+DM)
 R E                                             T E                             AVAILED AVAIL NEED  NEED
 I C                                             Y N       X    X  L    FINAL  LIVE   TO    TO TED  TO    TO
 A T  STRUC GIRD  GIRD  P-S  SEN  — COMPOSITE SLAB — P S     C    N  A ALL  PRST  LOAD  INITIAL INIT. FINAL FINAL
 L N  DEPTH DEPTH SPAC  F'C  ENG  THK WIDTH SLEN  F'C E N  F'S  L    D  X IEN  FORCE LANES SECTION SECT. SECT. SECT.
      (m.)  (m.)  (cm)  (MPa)  (t)  (m)  (m)  (%)  (MPa)     (MPa) (m)  (cm)         (kN)          (kN-m) (kN-m) (kN-m) (kN-m)
 1 0  1300  1100  2301 28.0  20.5  200 2300   .0 22.5  1 1 -1862: 100   500  Y 1.0    0.    .00     0     0   298     0
NOTE: ASSUMED DATA IS ENCLOSED IN COLONS.
```