BELL ENGINEERING
CIVIL & ENVIRONMENTAL
17 ECHO COVE WAY
SPOFFORD, NEW HAMPSHIRE 03462
(603) 363-9966

PROJECT NAME/ LOCATION: BRF 010-01 (43)
SHEET #: 1 OF 7
CALCULATED BY: Ron Bell DATE: 3-31-14
CHECKED BY: DATE:
SCALE:

STATE OF VERMONT RONALD K. BELL NO 8394 PROFESSIONAL ENGINEER

REVISED DECK CALCULATIONS

DUE TO RELATIVELY NARROW PRECAST SLAB WIDTHS THE HIGHER LOAD OF USING THE DESIGN TANDEM LOAD ON THE EQUIVALENT WIDTH STRIP OR DESIGN ACCORDING TO 4.6.2.1.4c - Transverse Edges was EVALUATED. USING THE DESIGN TRUCK ON 1/2 OF THE EQUIVALENT STRIP PRODUCED THE GREATEST LOAD.

EQUIVALENT STRIPS

$+M = 26.0 + 6.6S = 72.2''$
$-M = 48.0 + 3S = 69.0''$

1/2 EQUIVALENT STRIPS = $+M = 36.1''$; $-M = 34.5''$

multiple lane modifier
Virans temp. bridge modifier

DESIGN TRUCK LOADS = $1.2 \times 0.9 \times 1.33 \times 16$ KIPS = 22.982 KIPS
IM

(+) LOAD PER 1/2 Eq. STRIP = $\frac{1}{72.2/2} \times 12 \times 22.982 = 7.661$ K-ft
(−) $= \frac{1}{34.5} \times 12 \times 22.982 = 7.994$ K-ft

PATCH LOAD WIDTH = 20" + 6" = 26"
2(45° depth to neutral axis)

(+) UNIFORM LOAD OVER PATCH WIDTH = $\frac{7.661}{2.167'}$ = 3.535 KIPS/ft
(−) UNIFORM LOAD " " " = $\frac{7.994}{2.167}$ = 3.689 KIPS/ft

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PROJECT NAME/ LOCATION: BRF 010-01 (43)
SHEET #: 2 OF #7
CALCULATED BY: Ron Bell DATE: 3-31-14
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SCALE:

STATE OF VERMONT
RONALD K BELL
NO 8394
PROFESSIONAL ENGINEER

FROM ENERCAL for 3.535 KIPS/ft

+M = 6.74 K-ft
FOR 3.685 (-) moment:
-M @ 1/4 bf = 9.65 K-ft

DESIGN BOTTOM REINFORCEMENT:

$$w_{DL} = \frac{(.150\ K)}{ft^2} \times 7/12 \times 1ft = 0.88\ K/ft$$

$$M_{DL} = \frac{0.088\ K/ft \times (6.948)^2}{10} = 0.425\ K\text{-}FT$$

$$M_{strength\ I} = (1.25)(0.425) + (1.75)(6.74)$$
$$= 12.326\ K\text{-}ft = 147.912\ K\text{-}in$$

$$\phi M_N = \phi \left[A_s f_y \left(d_s - 1/2 \frac{A_s f_y}{0.85 f'_c b}\right)\right] \geq M_{STRENGTH\ I}$$

$\phi = 0.9$
$f_y = 60\ KSI$
$f'_c = 5\ KSI$
$d_s = 7'' - (1''\ cover - 0.5\ (0.625))$
$= 5.687''$

Try #5 bars @ 7" O.C.

$$0.9\left[(0.531(60))\left(5.677 - 1/2 \frac{(.531)(60)}{0.85 \times 5 \times 12}\right)\right] = 154.1\ K\text{-}in > 147.9$$

OK

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PROJECT NAME/ LOCATION: BRF 010-01 (43)
SHEET #: 3 OF 7
CALCULATED BY: Ron Bell DATE: 3-3-19
CHECKED BY: DATE:
SCALE:

STATE OF VERMONT RONALD K BELL NO 6694 PROFESSIONAL ENGINEER

DESIGN NEGATIVE REINFORCEMENT

FROM POSITIVE CALC $W_{DC} = 0.088$ K-ft

SPAN LENGTH FOR NEGATIVE: REDUCES + 1/2 $B_f \approx 6.5'$

$M_{DC} = (1/10)(0.088\ K/ft)(6.5)^2 = 0.372$ K-ft

FACTORED MOMENTS: $(1.25)(0.372) + (1.75)(9.65)$ (From Enercalc)

$= 17.353$ K-ft $= 208.230$ K-in

$$\phi M_n = \phi\left[(A_s)(f_y)\left(d_s - \frac{1}{2}\frac{A_s f_y}{0.85 f'_c b}\right)\right] \geq M_{strength\ I}$$

$\phi = 0.9$
$f_y = 60$ KSI
$f'_c = 5$ KSI

broom finish

$d_s = 7' - 2''$ cover $+ 0.25'') - 0.5(.625) = 5.063''$

$b = 12''$

TRY #5 bars @ 4.5" O.C. $A_s = 0.827\ in^2$

$$0.9\left[(0.827)(60)\left(5.063 - \frac{1}{2}\frac{(0.827)(60)}{0.85 \times 5 \times 12}\right)\right]$$

$= 204.387$ K-ft N.G.

TRY #5 bars 4" O.C.

$\phi M_N = 226.79$ K-in > 208.230 K-in OK

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SHEET #: 4 OF 7
CALCULATED BY: Ron Bell DATE: 3-31-14
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SCALE:

DISTRIBUTION REINFORCEMENT IN BOTTOM

PE 9.7.3.2 = 0.67 % = (0.531)(67) = 0.356

≈ 12" o.c.

NOTE: TOP LONGITUDINAL STEEL ONLY NEED TO MEET TEMP + SHRINKAGE REQUIREMNTS

∴ #5 bars @ 12" o.c. OK

SUMMARY:

BOTTOM BARS PERPINDICULAR TO BEAMS = #5 @ 7" o.c

TOP BARS PERPINDICULAR TO BEAM = #5 @ 4" o.c.

Top + Bottom Bars Parallel to Beam = #5 @ 12 o.c.

Top Clear = 2.0"

BOTTOM CLEAR = 1.0"

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(603) 363-9966

Project Title: Marlboro BRF 010-01(43)
Engineer: Ron Bell
Project Descr: Deck Design moment calcuation
Project ID: 2014-011

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POSITIVE MOMENT

Printed: 31 MAR 2014, 8:19AM

General Beam Analysis

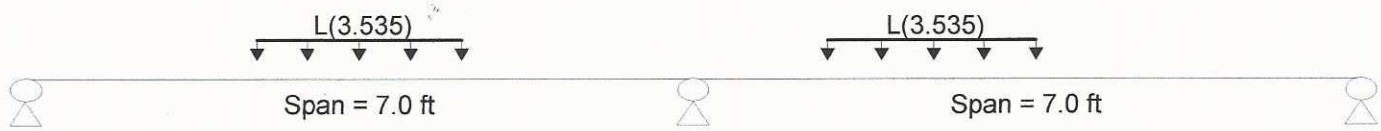
File = C:\Users\Ron\DOCUME~1\ENERCA~1\MAA450~1.EC6
ENERCALC, INC. 1983-2013, Build:6.13.8.31, Ver:6.13.12.31

Lic. # : KW-06009396 Licensee : Bell Engineering

Description : Calculation of moment using Equivalent width. Wheel spacing = 6'.

General Beam Properties

Elastic Modulus	29,000.0 ksi						
Span #1	Span Length =	7.0 ft	Area =	10.0 in^2	Moment of Inertia =	100.0	in^4
Span #2	Span Length =	7.0 ft	Area =	10.0 in^2	Moment of Inertia =	100.0	in^4



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Load for Span Number 1
Uniform Load : L = 3.535 k/ft, Extent = 2.417 -->> 4.584 ft, Tributary Width = 1.0 ft
Load for Span Number 2
Uniform Load : L = 3.535 k/ft, Extent = 1.420 -->> 3.587 ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Maximum Bending =	9.718 k-ft	Maximum Shear =	6.309 k
Load Combination	L Only	Load Combination	L Only
Location of maximum on span	7.000ft	Location of maximum on span	7.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	0.014 in
Max Upward L+Lr+S Deflection	0.000 in
Max Downward Total Deflection	0.014 in
Max Upward Total Deflection	0.000 in

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
Overall MAXimum Envelope													
Dsgn. L = 7.00 ft	1			6.74	-9.72	9.72					6.31		
Dsgn. L = 7.00 ft	2			4.87	-9.72	9.72					6.31		
L Only													
Dsgn. L = 7.00 ft	1			6.74	-9.72	9.72					6.31		
Dsgn. L = 7.00 ft	2			4.87	-9.72	9.72					6.31		

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D+L	1	0.0140	3.123		0.0000	0.000
D+L	2	0.0102	3.662		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	2.441	11.528	1.351
L Only	2.441	11.528	1.351
D+L	2.441	11.528	1.351

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Project Title: Marlboro BRF 010-01(43)
Engineer: Ron Bell
Project Descr: Deck Design moment calcuation
Project ID: 2014-011

NEGATIVE MOMENT

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Printed: 31 MAR 2014, 5:24PM

General Beam Analysis

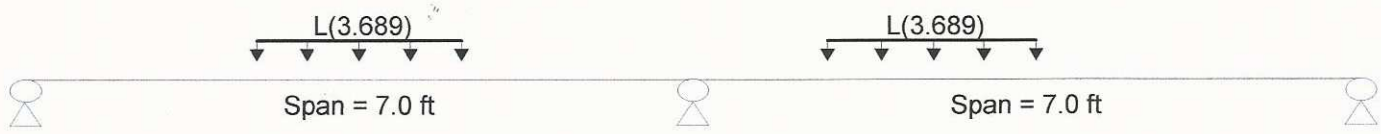
File = c:\Users\Ron\DOCUME~1\ENERCA~1\MAA1F7~1.EC6
ENERCALC, INC. 1983-2013, Build:6.13.8.31, Ver:6.13.12.31

Lic. # : KW-06009396 Licensee : Bell Engineering

Description : Calculation of moment using Equivalent width. Wheel spacing = 6'.

General Beam Properties

Elastic Modulus	29,000.0 ksi						
Span #1	Span Length =	7.0 ft	Area =	10.0 in^2	Moment of Inertia =	100.0	in^4
Span #2	Span Length =	7.0 ft	Area =	10.0 in^2	Moment of Inertia =	100.0	in^4



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Load for Span Number 1
Uniform Load : L = 3.689 k/ft, Extent = 2.417 -->> 4.584 ft, Tributary Width = 1.0 ft
Load for Span Number 2
Uniform Load : L = 3.689 k/ft, Extent = 1.420 -->> 3.587 ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Maximum Bending =	10.142 k-ft	Maximum Shear =	6.584 k
Load Combination	L Only	Load Combination	L Only
Location of maximum on span	7.000ft	Location of maximum on span	7.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	0.015 in
Max Upward L+Lr+S Deflection	0.000 in
Max Downward Total Deflection	0.015 in
Max Upward Total Deflection	0.000 in

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
Overall MAXimum Envelope													
Dsgn. L = 7.00 ft	1			7.04	-10.14	10.14					6.58		
Dsgn. L = 7.00 ft	2			5.08	-10.14	10.14					6.58		
L Only													
Dsgn. L = 7.00 ft	1			7.04	-10.14	10.14					6.58		
Dsgn. L = 7.00 ft	2			5.08	-10.14	10.14					6.58		

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D+L	1	0.0146	3.123		0.0000	0.000
D+L	2	0.0106	3.662		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	2.548	12.030	1.410
L Only	2.548	12.030	1.410
D+L	2.548	12.030	1.410

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Project Title: Marlboro BRF 010-01(43)
Engineer: Ron Bell
Project Descr: Deck Design moment calcuation
Project ID: 2014-011

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NEGATIVE MOMENT

Printed: 31 MAR 2014, 5:24PM

General Beam Analysis

File = c:\Users\Ron\DOCUME~1\ENERCA~1\MAA1F7~1.EC6
ENERCALC, INC. 1983-2013, Build:6.13.8.31, Ver:6.13.12.31

Lic. # : KW-06009396 Licensee : Bell Engineering

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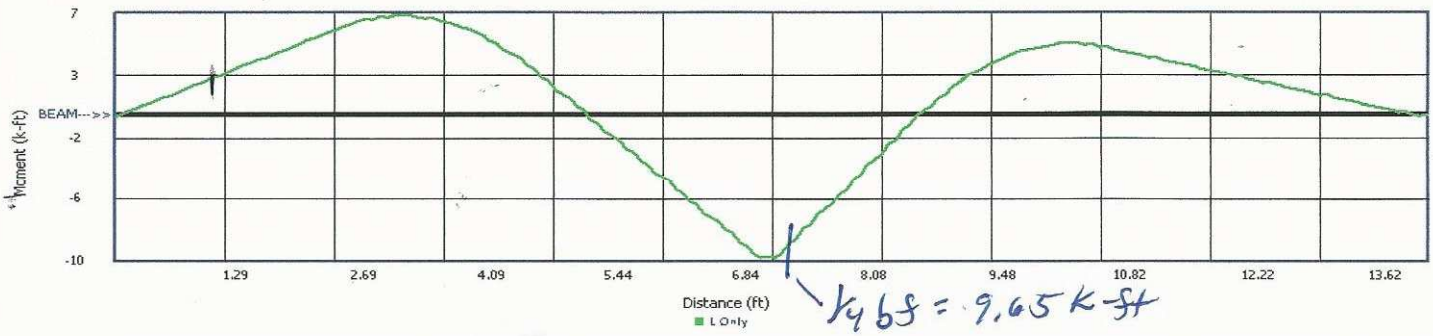

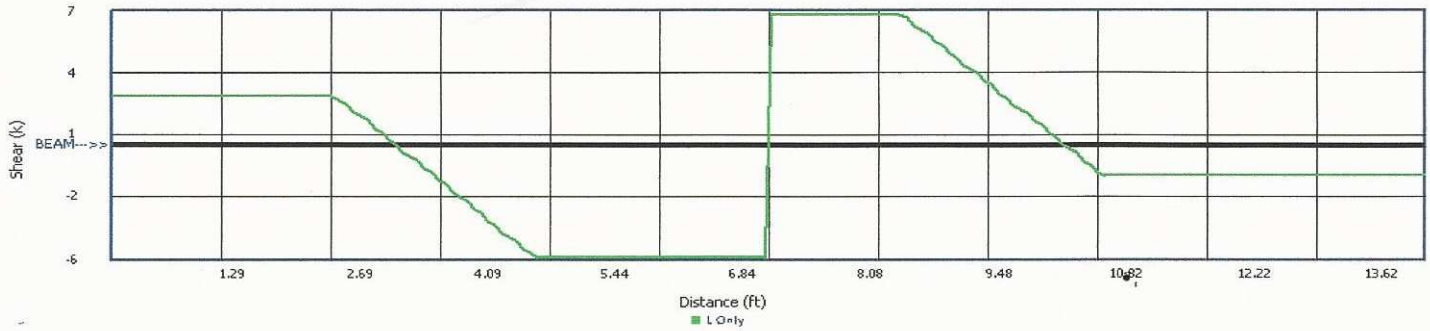

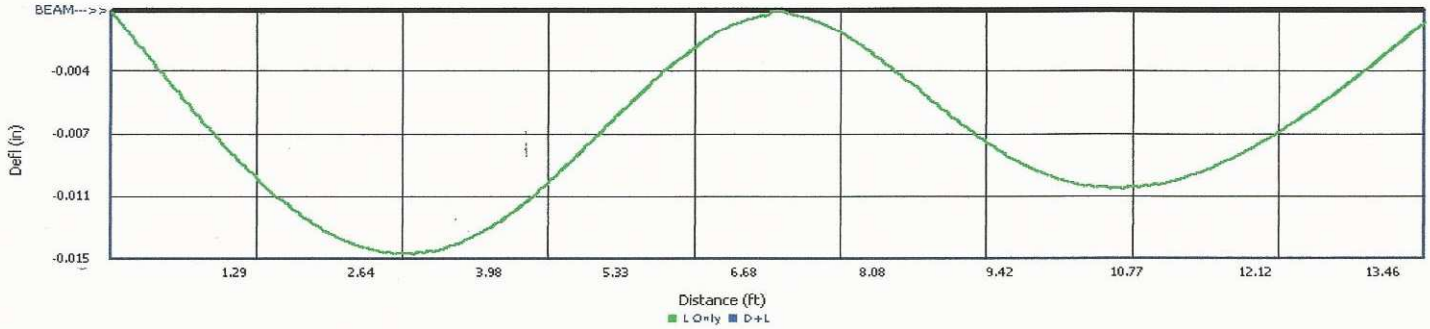

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