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Direct Strength Method for Steel Deck

RESEARCH REPORT RP15-1

January 2015

Committee on Specifications
for the Design of Cold-Formed
Steel Structural Members



American Iron and Steel Institute

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PREFACE

The American Iron and Steel Institute (AISI) Standards Council selected this project as one of four winning research proposals for its 2014 Small Project Fellowship Program. Project selections were based on several factors, including the potential for long-term impact on the industry; steel industry engagement and co-funding; and results for the AISI standards development committee, the student, and the academic institution.

The objective of this project was to determine and compare the behavior and usable strength of existing floor and roof deck sections with both the Direct Strength Method (DSM) and Effective Width Method (EWM). It is anticipated that the results of this study will guide future research and development efforts.

DIRECT STRENGTH METHOD FOR STEEL DECK

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A RESEARCH PROJECT SPONSERED BY THE AMERICAN IRON AND STEEL
INSTITUTE AND THE STEEL DECK INSTITUTE

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ENGINEERING SCHOOL OF SUSTAINABLE INFRASTRUCTURE & ENVIRONMENT
UNIVERSITY OF FLORIDA
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LIST OF SYMBOLS AND DEFINITIONS

<u>Symbol</u>	<u>Definition</u>
A_g	Gross area of element including stiffeners
b	Flange width
b_e	Effective element width
b_o	Total flat width of stiffened element
b_p	Largest sub-element flat width
f	Stress
F_{cr}	Plate elastic buckling stress
F_y	Yield Stress
h	Width of elements adjoining stiffened element (depth of web)
I_G	Moment of inertia of gross section
I_{sp}	Moment of inertia of stiffener about centerline of flat portion of element
I'_x	Moment of inertia about element's own axis
k	Plate buckling coefficient
k_d	Plate buckling coefficient for distortional buckling
k_{loc}	Plate buckling coefficient for local sub-element buckling
L	Element length
M_{crd}	Critical elastic distortional buckling moment
M_{cre}	Critical elastic lateral-torsional buckling moment
M_{crl}	Critical elastic local buckling moment
M_n	Nominal flexural strength
M_{nd}	Nominal flexural strength for distortional buckling

M_{nDSM}	Nominal flexural strength calculated using direct strength method
M_{ne}	Nominal flexural strength for lateral-torsional buckling
M_{nEWM}	Nominal flexural strength calculated using effective width method
M_{nl}	Nominal flexural strength for local buckling
M_y	Yield Moment ($S_g F_y$)
n	Number of stiffeners in element
R	Modification factor for distortional plate buckling coefficient
S_e	Elastic section modulus of effective section
S_g, S_{xx}	Elastic section modulus of gross section
t	Thickness
w	Actual element width
$\bar{y}$	Distance from neutral axis to extreme fiber of section
β	Coefficient
γ	Coefficient
δ	Coefficient
Θ	Web angle from horizontal
Θ_{stiff}	Stiffener angle from horizontal
λ, λ_l	Slenderness factors
ρ	Reduction factor

ABSTRACT

With the proposed reorganization of the AISI S100 Standard, the Direct Strength Method (DSM) will take a position of equal footing with the Equivalent Width Method (EWM) for calculating strength. The majority of previous DSM studies focus on C and Z profiles while little study of panel sections, especially steel deck sections, has been performed. A study was undertaken to determine and compare the behavior and usable strength of existing floor and roof deck sections with both DSM and EWM. The Cornell University – Finite Strip Method (CUFSM) was used for the elastic buckling analysis, taking into account the wide, continuous nature of installed deck sections. Flexural capacity was analyzed for positive and negative flexure to account for gravity loading as well as uplift of the steel deck sections. We have included graphical representations of the relationships for DSM strength to the EWM strength ratio vs. material width to thickness ratio. While we are not exactly sure what the relationships mean yet, DSM strength seems to suffer vs. EWM strength for sections with relatively wide and thin compression flanges or in other words, large b/t ratios.

CHAPTER 1: INTRODUCTION

1.0 Acknowledgements

The presented research has been performed with the financial support of the American Iron and Steel Institute and the Steel Deck Institute.

1.1 Research Goals

As the Direct Strength Method (DSM) will be taking equal footing as the Effective Width Method (EWM) in the proposed reorganization of the AISI S100, we set following goals: Firstly, we aimed to analyze a variety of existing floor and roof deck sections to observe the behavior and compare the usable flexural strengths using both DSM and EWM. DSM has mostly been previously applied to C and Z profiles so it was necessary to develop a finite strip method (FSM) model that would accurately model and account for multi-web deck sections installed in an adjacent fashion. Once we developed a FSM model that would accurately represent installed floor and roof deck, we studied potential enhancements to existing deck sections that would take advantage of DSM (i.e. DSM predicts higher flexural strength than EWM).

1.2 Direct Strength Method

“A new design method: Direct Strength, has been created that aims to alleviate the current complexity, ease calculation, provide a more robust and flexible design procedure, and integrate with available, established, numerical methods” (DSM Design Guide *Preface*).

The Direct Strength Method (DSM) is one method of analyzing cold-formed steel (wide, light gauge) members. In DSM, the elastic buckling capacity is determined over the entire cross section rather than neglecting less “effective” portions of the cross section.

In order to apply DSM, the elastic local, distortional, and global buckling capacities are first computed. Graphical representations of local, distortional, and global buckling are illustrated below in Figures 1, 2, and 3 respectively. The lateral-torsional buckling, local buckling, and distortional buckling flexural strengths are calculated to observe the governing buckling mode per DSM 1.2.2.1, 1.2.2.2, and 1.2.2.3. In this study, we used the Cornell University Finite Strip Method to find the elastic local, distortional, and global buckling capacities.

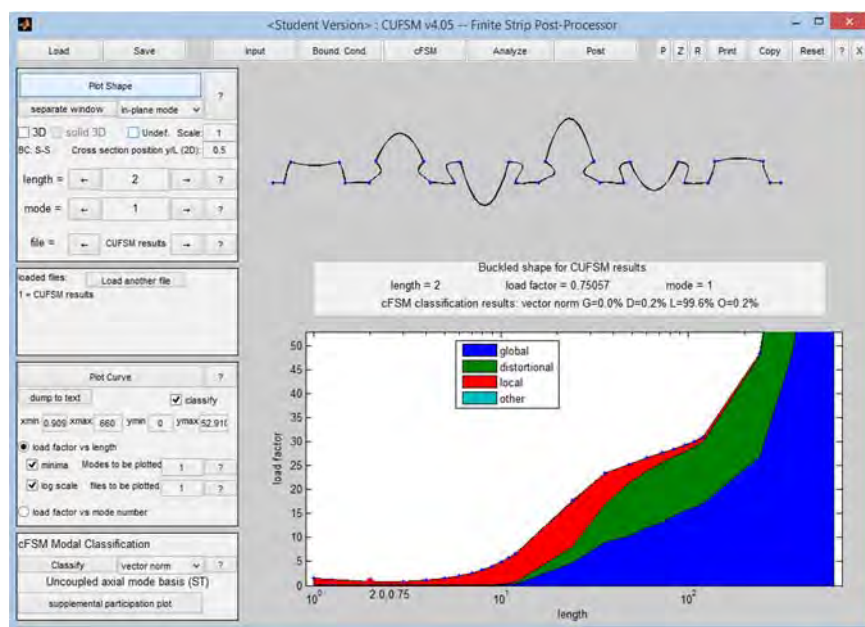


Figure 1 - 1.5B 22GA Deck 33 KSI Local Buckling (CUFSM Output)

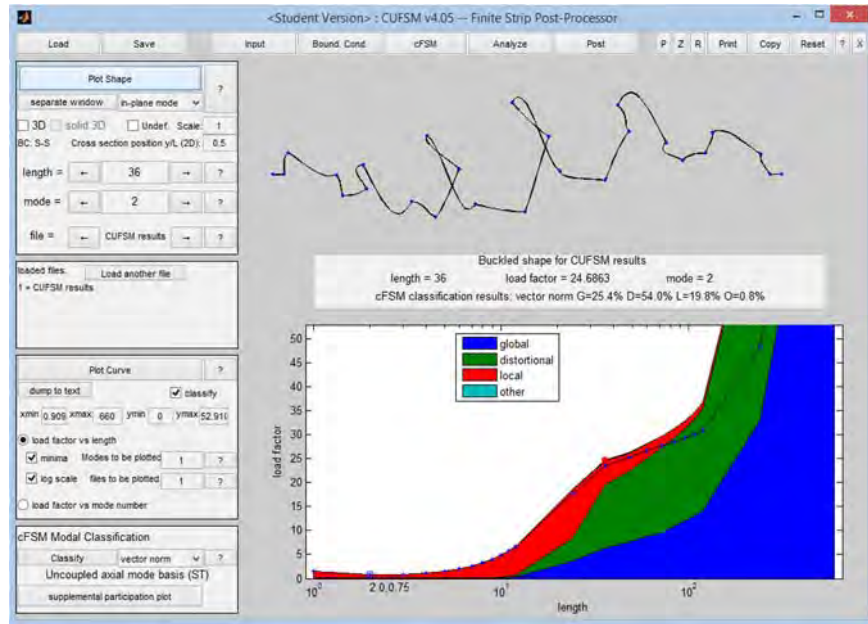


Figure 2 - 1.5B 22GA Deck 33 KSI Distortional Buckling (CUFSM Output)

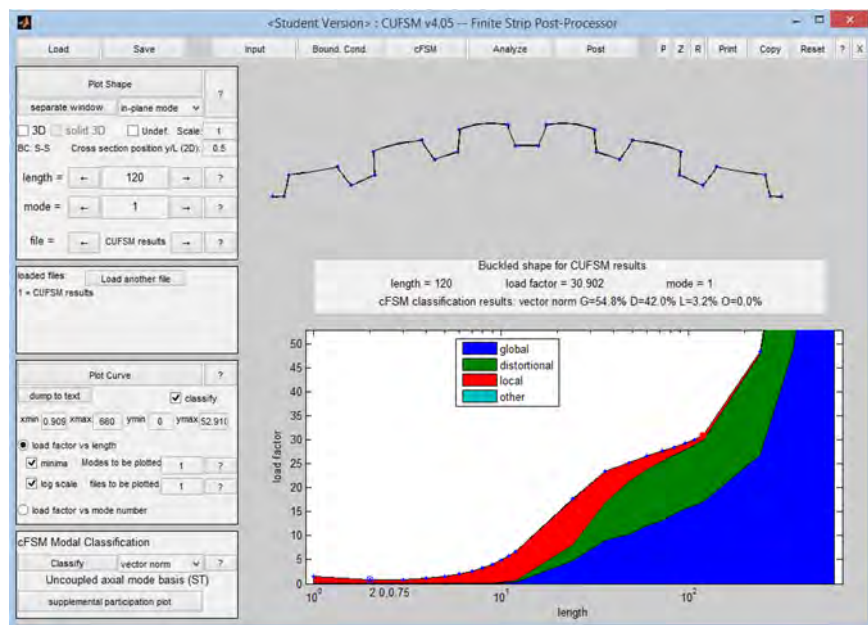


Figure 3 - 1.5B 22GA Deck 33 KSI Global Buckling (CUFSM Output)

1.3 Effective Width Method

The Effective Width Method (EWM) is another method for analyzing cold-formed steel members. In the EWM, an effective width of compression elements is computed and used as the lightly stressed areas, near the center of an element, are neglected. The regions near junctions or stiffeners are considered to be fully effective, as these areas are most effective in resisting the applied stress. Figure 4 shows the actual compression element and the effective width, b , of the element when subjected to compressive stress.

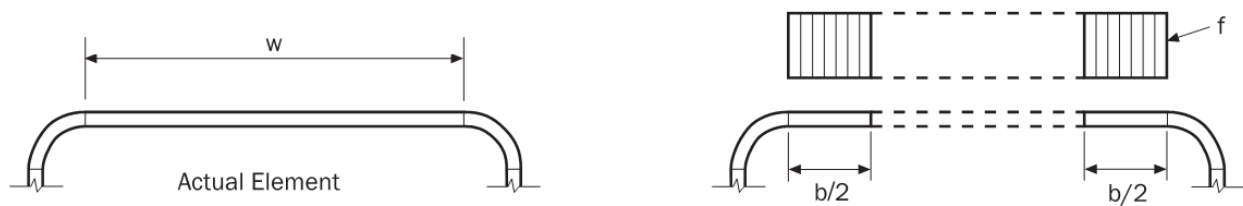


Figure 4 – Flange under Compressive Stress | Effective Element Width, b

The same stress concentrations can be seen for a web element experiencing a stress gradient in Figure 5.

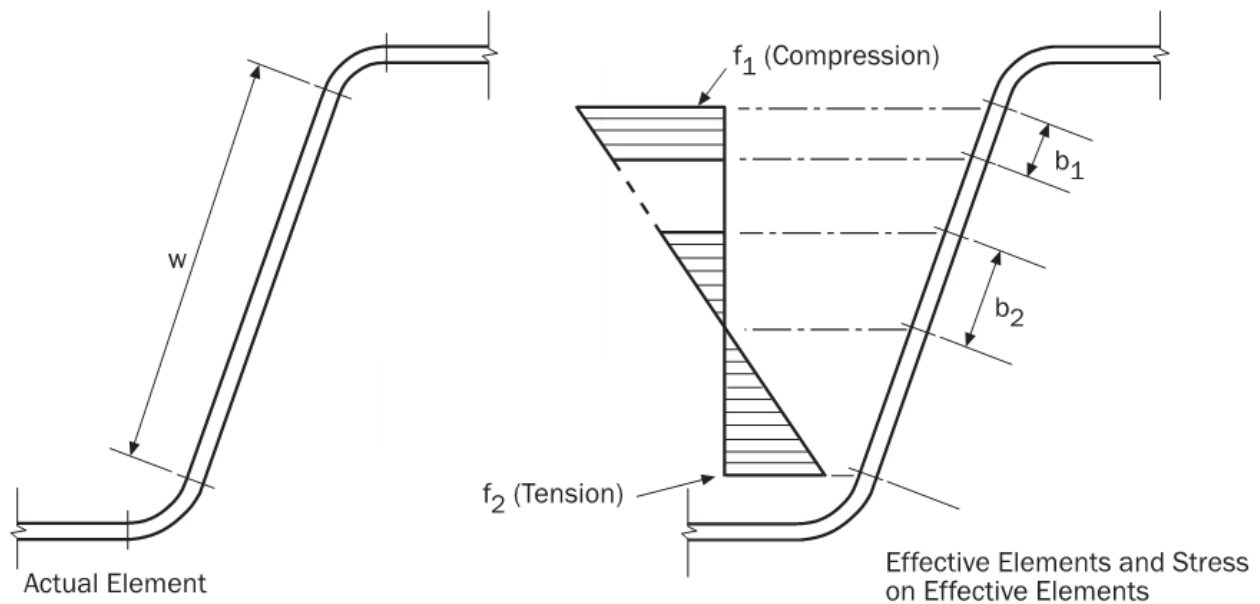


Figure 5 - Web under Stress Gradient

Once the effective width of a compression element is calculated, the effective section properties, center of gravity, and moment of inertia can be found by applying the parallel axis theorem in a tabular format as shown in Table 1.

Table 1 - Parallel Axis Theorem Applied to Obtain Effective Section Properties

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ⁴)
Lip	2	0.660	0.998	0.659	0.657	--
Bottom Corner	18	2.083	0.870	1.812	1.577	0.000
Web	18	22.386	0.508	11.370	5.775	1.513
Top Corner	18	2.083	0.146	0.303	0.044	0.000
Top Flange	9	7.071	0.018	0.127	0.002	--
Bottom Flange	8	6.286	0.998	6.272	6.259	--
Σ		40.568		20.543	14.314	1.513

$$\begin{aligned}
 \text{Solved } \bar{y} &= \Sigma Ly / \Sigma L = 0.506 \text{ in.} \\
 \bar{y}_{\text{EXTREME FIBER}} &= \max(\bar{y}, h - \bar{y}) = 0.509 \text{ in.} \\
 I_x &= [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t = 0.194 \text{ in.}^4 \\
 S_e &= I_x / \bar{y} = 0.381 \text{ in.}^3
 \end{aligned}$$

As the effective width of an element is dependent on the location of the neutral axis and the neutral axis is dependent on the effective width of an element, this becomes an iterative process involving a guess as to where the neutral axis actually lies. Often, an initial guess of the gross cross-sectional neutral axis is used. After the first iteration, the solved location of the neutral axis can be used as the new guess value until the guess location and the solved location are in agreement.

1.4 Cornell University Finite Strip Method

The Cornell University Finite Strip Method (CUFSM) is a tool that provides cross-section elastic buckling solutions. This powerful program allows the user to define a cross-section based on nodal coordinates, member end designations, fixities, etc. CUFSM allows the

user to apply axial and flexure stress and observe the elastic buckling solutions over a variety of user-defined unbraced lengths.

The analysis procedure is “specialized to apply to plate deformations beyond conventional beam theory. The semi-analytical finite strip method is a variant of the more common finite element method. A thin-walled cross-section is discretized into a series of longitudinal strips, or elements. Based on these strips elastic and geometric stiffness matrices can be formulated” (Ben Schafer).

1.5 Deck Sections

This study observes the comparison and behavior of DSM and EWM for both stiffened and unstiffened deck sections. The unstiffened deck sections are 1F and 1.5B. The stiffened deck sections are 1.5B, 2C, and 3C. The stiffened 1.5B Deck section is a non-standard shape. As a point of reference, we added the 2C compression flange stiffener to the compression flange of the 1.5B Deck section and performed the analysis to observe the benefits. The 1.5B and 2C Deck both include flange stiffeners 0.37 inches deep and 1.25 inches wide. The 3C Deck includes flange stiffeners 0.37 inches deep and 1 inch wide. Each deck section was checked for positive and negative flexure. Deck sections symmetric about the axis they bend in were analyzed for flexure in one direction. Each deck section was checked for yield stresses of 33, 40, 50, and 60 KSI at various gage thicknesses shown in Table 2. No cold working or cold forming was done to strengthen the deck sections.

Table 2 - Range of Yield Stresses and Thicknesses for Deck Sections

Deck Type	Yield Stress (KSI)	Thickness (GA)
1F	33, 40, 50, 60	26, 24, 22, 20
1.5B	33, 40, 50, 60	24, 22, 20, 18, 16
2C	33, 40, 50, 60	22, 20, 18, 16
3C	33, 40, 50, 60	22, 20, 18, 16

CHAPTER 2: PROCESS OF MODELING AND ANALYSIS

2.0 DSM Analysis Procedure

For DSM analysis, we developed a preprocessor to process input files for the elastic buckling analysis done with CUFSM. We then applied the CUFSM output (load factors) to the DSM equations to predict strength.

2.1 DSM Preprocessor

In order to run CUFSM to obtain the elastic buckling solutions, the user must define the cross-section's parameters. CUFSM takes in information such as the material properties, nodes, elements, and boundary conditions. As it can be very tedious to calculate nodal locations, assign member end designations, and enter other parameters manually, a preprocessor was created to expedite the process.

A preprocessor processes its input data to produce output that is used as input for another program. In this case, a MATLAB code was written to preprocess the information required to run CUFSM. This eased the process of segmenting and refining members to obtain more accurate results (i.e. the curved corners at joints could be segmented into many line elements that adequately represent a curve).

The preprocessor used in this study produced the input data for the Nodes, Members, and Lengths input areas for CUFSM. Once the information was entered, program files for each deck section and each thickness were retained for later accessibility for analyzing the deck sections at a variety of thicknesses and yield stresses.

2.2 DSM Deck Model

With Dr. Ben Schafer's advice, we ran two sets of models for each deck section: Curved Corner models and Straight Corner models. Curved corners were added at each point an element would change direction (i.e. the corners where the web and flange meet as well as where the flange and stiffener meet). Although the curved corner models provided more representative elastic buckling solutions, straight corner models, where no curvature appears at the element junctions, were modeled to accurately capture the buckling classification. The straight corner models were not used to evaluate strength because the models would have overly penalized the DSM by misrepresenting the actual flat length of the compression flange. The end nodal locations of the deck profile were restrained to account for adjacent deck sections and represent the wide and continuous nature of installed floor and roof deck.

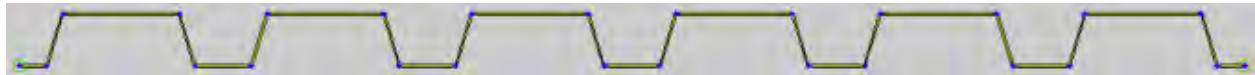


Figure 6 - Straight Corner Model | Buckling Modes

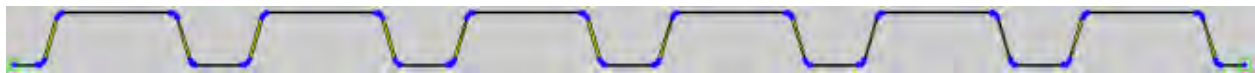


Figure 7 - Curved Corner Model | Elastic Strength

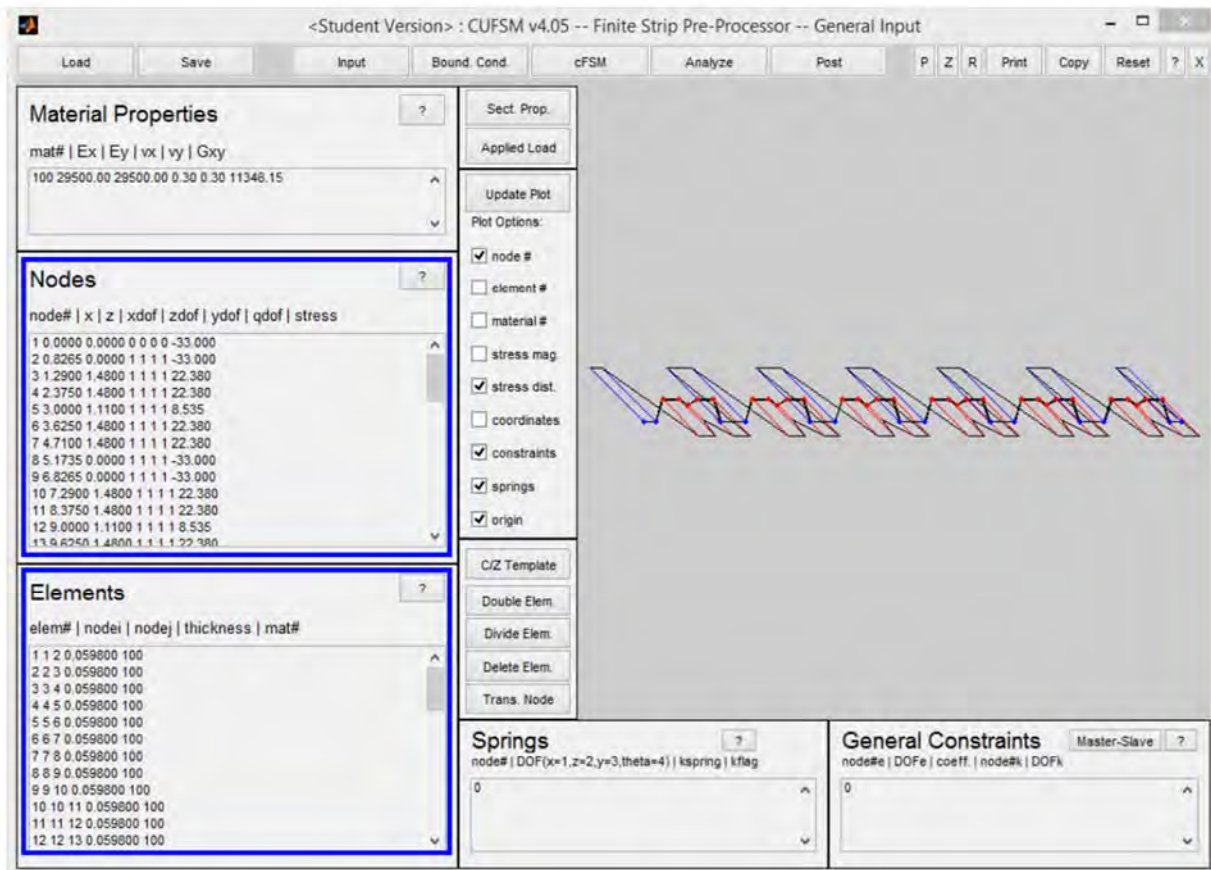


Figure 8 - CUFSM General Input

2.3 DSM Deck Analysis

The deck profile models were analyzed at stresses of 33, 40, 50, and 60 KSI for positive flexure and likewise at stresses of -33, -40, -50, and -60 KSI for negative flexure for a variety of unbraced lengths ranging from 1 inch to 50 feet. The CUFSM output supplies the load factors (nominal buckling moment to yield moment) which are used as input for the strength prediction for the deck profile, M_{nDSM} .

2.4 EWM Deck Analysis

As stated above, for EWM, an effective width of compression elements is computed and used as the lightly stressed areas, near the center of an element, are neglected. For each deck section, the parallel axis theorem was used in a tabular format to provide the effective section properties to obtain the effective nominal flexural strength using EWM, M_{nEWM} . The deck sections bend about their neutral axis for positive and negative flexure. The compression elements of the cross-section consist of the compression flange as well as a portion of the web element. The junctions are considered to be fully effective. For each deck section at each variety of thickness and stress, the webs were found to be fully effective. Only the compression flange then needed to be computed for its effective width before iterating to convergence to obtain the nominal flexural capacity of the effective section, M_{nEWM} .

CHAPTER 3: ANALYSIS | 1F DECK | $\pm$ BENDING



3.0 Executive Summary

The Direct Strength Method predicted higher strengths for all of the 1F Deck sections analyzed for positive and negative flexure in this study, 33-40KSI and 26-20GA. DSM is able to take advantage the short, flat compression flange. The nominal moment capacity ratio (M_{nDSM}/M_{nEWM}) ranged between 1.060 and 1.126.

CHAPTER 3: ANALYSIS | 1F DECK | $\pm$ BENDING

3.1 M_{nDSM} / M_{nEWM} vs. Thickness Plot

Mn_{DSM} / Mn_{EWM} vs. Thickness

33 KSI 40 KSI 50 KSI 60 KSI

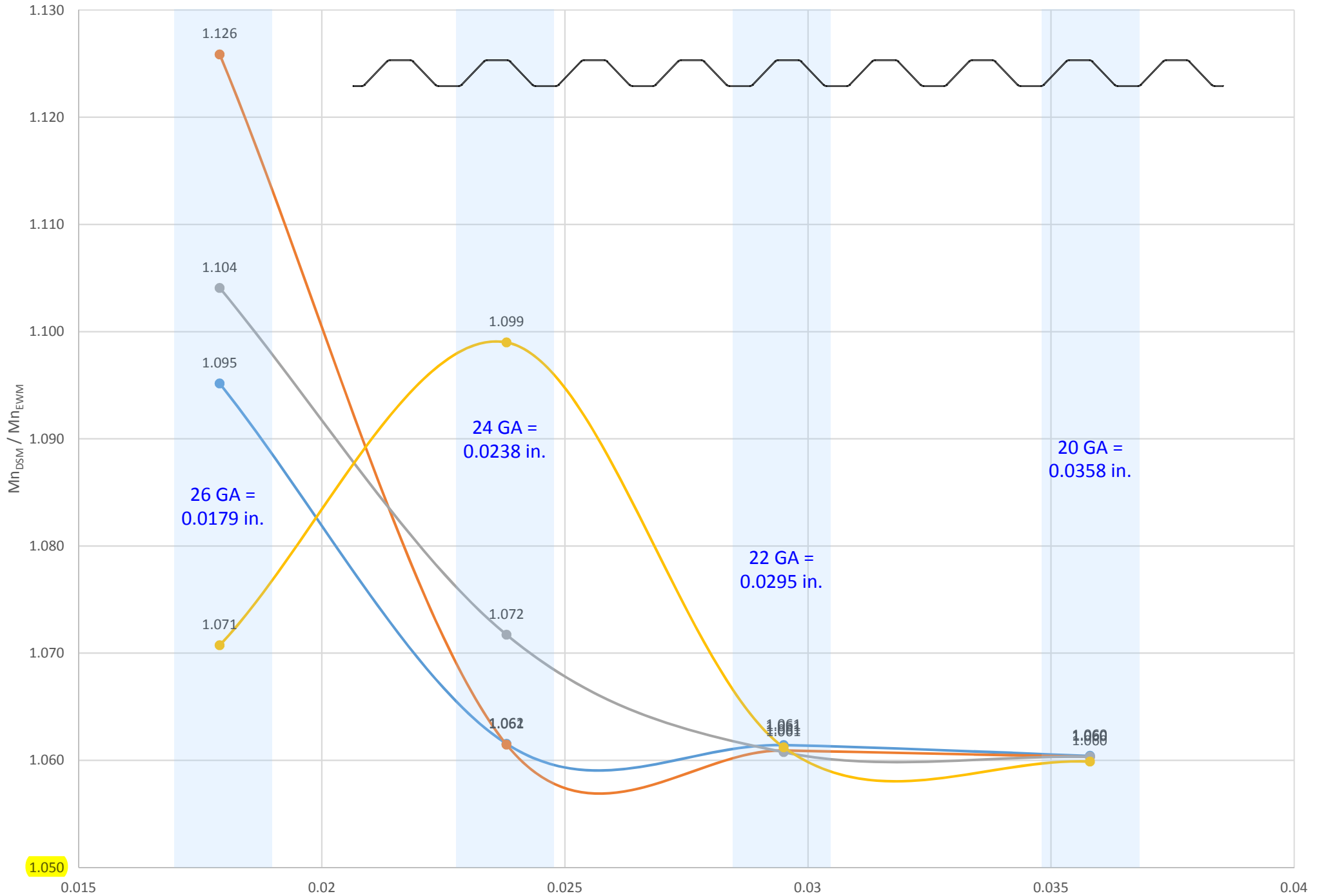


Figure 9 - 1F | Mn_{DSM} / Mn_{EWM} vs. Thickness | +/- Flexure

Thickness (in.)
1F Deck +/- Bending

CHAPTER 3: ANALYSIS | 1F DECK | $\pm$ BENDING

3.2 Analysis Results Summary

Table 3 - 1F | Analysis Results Summary | +/- Flexure

1F DECK - 33 KSI				
Gage	26	24	22	20
Thickness	0.0179	0.0238	0.0295	0.0358
Curve Radius	0.1340	0.1369	0.1398	0.1429
I _G (CUFSM)	0.103	0.137	0.170	0.206
y-bar (CUFSM)	0.500	0.503	0.506	0.509
S _{xx}	0.206	0.272	0.335	0.404
M _y	6.79	8.97	11.06	13.34
Mn _{DSM}	6.79	8.97	11.06	13.34
Mn _{EWM}	6.2	8.45	10.42	12.58
% ERROR	8.689%	5.797%	5.787%	5.697%

1F DECK - 40 KSI				
Gage	26	24	22	20
Thickness	0.0179	0.0238	0.0295	0.0358
Curve Radius	0.1340	0.1369	0.1398	0.1429
I _G (CUFSM)	0.103	0.137	0.170	0.206
y-bar (CUFSM)	0.500	0.503	0.506	0.509
S _{xx}	0.206	0.272	0.335	0.404
M _y	8.23	10.88	13.41	16.17
Mn _{DSM}	8.23	10.88	13.41	16.17
Mn _{EWM}	7.31	10.25	12.64	15.25
% ERROR	11.179%	5.790%	5.742%	5.690%

1F DECK - 50 KSI				
Gage	26	24	22	20
Thickness	0.0179	0.0238	0.0295	0.0358
Curve Radius	0.1340	0.1369	0.1398	0.1429
I _G (CUFSM)	0.103	0.137	0.170	0.206
y-bar (CUFSM)	0.500	0.503	0.506	0.509
S _{xx}	0.206	0.272	0.335	0.404
M _y	10.29	13.60	16.76	20.21
Mn _{DSM}	9.76	13.60	16.76	20.21
Mn _{EWM}	8.84	12.69	15.8	19.06
% ERROR	9.426%	6.691%	5.728%	5.690%

1F DECK - 60 KSI				
Gage	26	24	22	20
Thickness	0.0179	0.0238	0.0295	0.0358
Curve Radius	0.1340	0.1369	0.1398	0.1429
I _G (CUFSM)	0.103	0.137	0.170	0.206
y-bar (CUFSM)	0.500	0.503	0.506	0.509
S _{xx}	0.206	0.272	0.335	0.404
M _y	12.35	16.32	20.11	24.25
Mn _{DSM}	11.05	16.32	20.11	24.25
Mn _{EWM}	10.32	14.85	18.95	22.88
% ERROR	6.606%	9.007%	5.768%	5.649%

1F DECK - 33 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
26	0.0179	6.79	6.20	1.095
24	0.0238	8.97	8.45	1.062
22	0.0295	11.06	10.42	1.061
20	0.0358	13.34	12.58	1.060

1F DECK - 40 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
26	0.0179	8.23	7.31	1.126
24	0.0238	10.88	10.25	1.061
22	0.0295	13.41	12.64	1.061
20	0.0358	16.17	15.25	1.060

1F DECK - 50 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
26	0.0179	9.76	8.84	1.104
24	0.0238	13.60	12.69	1.072
22	0.0295	16.76	15.80	1.061
20	0.0358	20.21	19.06	1.060

1F DECK - 60 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
26	0.0179	11.05	10.32	1.071
24	0.0238	16.32	14.85	1.099
22	0.0295	20.11	18.95	1.061
20	0.0358	24.25	22.88	1.060

CHAPTER 3: ANALYSIS | 1F DECK | $\pm$ BENDING

3.3 Direct Strength Method Calculations

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	20	GA		
	Strength:	33	KSI		
	$M_y =$	13.34	kip-in	Length:	
local	$M_{crf}/M_y =$	8.29880	$M_{crf} = 110.70599$	kip-in	1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} =$	66.7 kip-in	- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} =$	66.7 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 13.34 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.35 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 13.34 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness})$$

$$M_{nd} = 13.34 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 13.34 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	20	GA		
	Strength:	40	KSI		
	$M_y =$	16.17	kip-in	Length:	
local	$M_{crf}/M_y =$	6.84650	$M_{crf} = 110.70791$ kip-in		1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} = 80.85$ kip-in		- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} = 80.85$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 16.17 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.38 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 16.17 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness}) \\ M_{nd} = 16.17 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 16.17 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	20	GA		
	Strength:	50	KSI		
	$M_y =$	20.21	kip-in	Length:	
local	$M_{crf}/M_y =$	5.47720	$M_{crf} = 110.69421$ kip-in		1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} = 101.05$ kip-in		- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} = 101.05$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 20.21 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.43 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 20.21 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness}) \\ M_{nd} = 20.21 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 20.21 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	20	GA		
	Strength:	60	KSI		
	$M_y =$	24.25	kip-in	Length:	
local	$M_{crf}/M_y =$	4.56430	$M_{crf} = 110.68428$ kip-in		1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} = 121.25$ kip-in		- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} = 121.25$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 24.25 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.47 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 24.25 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness}) \\ M_{nd} = 24.25 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 24.25 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	22	GA		
	Strength:	33	KSI		
	$M_y =$	11.06	kip-in	Length:	
local	$M_{crf}/M_y =$	5.68610	$M_{crf} = 62.888266$	kip-in	1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} =$	55.3 kip-in	- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} =$	55.3 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 11.06 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.42 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 11.06 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness}) \\ M_{nd} = 11.06 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 11.06 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	22	GA		
	Strength:	40	KSI		
	$M_y =$	13.41	kip-in	Length:	
local	$M_{crf}/M_y =$	4.69110	$M_{crf} = 62.907651$	kip-in	1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} =$	67.05 kip-in	- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} =$	67.05 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 13.41 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.46 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 13.41 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness})$$

$$M_{nd} = 13.41 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 13.41 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	22	GA		
	Strength:	50	KSI		
	$M_y =$	16.76	kip-in	Length:	
local	$M_{crf}/M_y =$	3.75280	$M_{crf} = 62.896928$	kip-in	1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} =$	83.8 kip-in	- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} =$	83.8 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 16.76 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.52 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 16.76 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness}) \\ M_{nd} = 16.76 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 16.76 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	22	GA		
	Strength:	60	KSI		
	$M_y =$	20.11	kip-in	Length:	
local	$M_{crf}/M_y =$	3.12740	$M_{crf} = 62.892014$	kip-in	1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} = 100.55$	kip-in	- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} = 100.55$	kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 20.11 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.57 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 20.11 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness}) \\ M_{nd} = 20.11 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 20.11 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	24	GA		
	Strength:	33	KSI		
	$M_y =$	8.97	kip-in	Length:	
local	$M_{crf}/M_y =$	3.72310	$M_{crf} = 33.396207$	kip-in	1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} =$	44.85 kip-in	- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} =$	44.85 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 8.97 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.52 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 8.97 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness}) \\ M_{nd} = 8.97 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 8.97 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	24	GA		
	Strength:	40	KSI		
	$M_y =$	10.88	kip-in	Length:	
local	$M_{crf}/M_y =$	3.07160	$M_{crf} = 33.419008$ kip-in		1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} = 54.4$ kip-in		- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} = 54.4$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 10.88 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.57 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 10.88 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness}) \\ M_{nd} = 10.88 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 10.88 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	24	GA		
	Strength:	50	KSI		
	$M_y =$	13.60	kip-in	Length:	
local	$M_{crf}/M_y =$	2.45730	$M_{crf} =$ 33.41928 kip-in		1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} =$ 68 kip-in		- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} =$ 68 kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 13.60 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.64 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 13.60 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness}) \\ M_{nd} = 13.60 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 13.60 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	24	GA		
	Strength:	60	KSI		
	$M_y =$	16.32	kip-in	Length:	
local	$M_{crf}/M_y =$	2.04770	$M_{crf} = 33.418464$	kip-in	1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} =$	81.6	kip-in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} =$	81.6	kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y$$

$$M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y$$

$$M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y$$

$$M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 16.32 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776$$

$$M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776$$

$$M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.70 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 16.32 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673$$

$$M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673$$

$$M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness})$$

$$M_{nd} = 16.32 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 16.32 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	26	GA		
	Strength:	33	KSI		
	$M_y =$	6.79	kip-in	Length:	
local	$M_{crf}/M_y =$	2.12660	$M_{crf} = 14.439614$	kip-in	1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} =$	33.95 kip-in	- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} =$	33.95 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 6.79 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.69 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 6.79 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness})$$

$$M_{nd} = 6.79 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 6.79 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	26	GA		
	Strength:	40	KSI		
	$M_y =$	8.23	kip-in	Length:	
local	$M_{crf}/M_y =$	1.75450	$M_{crf} = 14.439535$	kip-in	1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} =$	41.15 kip-in	- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} =$	41.15 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 8.23 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.75 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 8.23 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness})$$

$$M_{nd} = 8.23 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 8.23 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	26	GA		
	Strength:	50	KSI		
	$M_y =$	10.29	kip-in	Length:	
local	$M_{crf}/M_y =$	1.40360	$M_{crf} = 14.443044$	kip-in	1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} =$	51.45 kip-in	- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} =$	51.45 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 10.29 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.84 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 9.76 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness})$$

$$M_{nd} = 10.29 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 9.76 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1F			
	Gage:	26	GA		
	Strength:	60	KSI		
	$M_y =$	12.35	kip-in	Length:	
local	$M_{crf}/M_y =$	1.16970	$M_{crf} = 14.445795$	kip-in	1 in
dist.	$M_{crd}/M_y =$	5.00000	$M_{crd} =$	61.75 kip-in	- in
global	$M_{cre}/M_y =$	5.00000	$M_{cre} =$	61.75 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 12.35 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.92 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 11.05 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness}) \\ M_{nd} = 12.35 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 11.05 \text{ kip-in} \quad (\text{local-global controls})$$

CHAPTER 3: ANALYSIS | 1F DECK | $\pm$ BENDING

3.4 Effective Width Method Calculations

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 20 GA
Strength: 33 ksi
Thickness: 0.0358 in.
Total Height: 1.016 in.
Radius: 0.1429 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000021 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.998
Corners	0.116	0.146
Bottom Flange	0.786	0.998
Web	1.244	0.508
Top Flange	0.786	0.018

Guess $\bar{y}$: 0.506 in.

Stress in Flange: 32.803 ksi
k: 4
Fcr: 221.414 ksi
 λ : 0.385
 ρ : 1.113
Effective Width: 0.786 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.998	0.659	0.657	--
Bottom Corner	18	2.083	0.870	1.812	1.577	0.000
Web	18	22.386	0.508	11.370	5.775	1.513
Top Corner	18	2.083	0.146	0.303	0.044	0.000
Top Flange	9	7.071	0.018	0.127	0.002	--
Bottom Flange	8	6.286	0.998	6.272	6.259	--
Σ		40.568		20.543	14.314	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.506 in.
 $\bar{Y}_{\text{EXTREME FIBER}}$ = $\max(\bar{y}, h - \bar{y})$ = 0.509 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.194 in.⁴
 S_e = $I_x / \bar{y}$ = 0.381 in.³
Mn = **Se * Fy** = **12.58** k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 20 GA
Strength: 40 ksi
Thickness: 0.0358 in.
Total Height: 1.016 in.
Radius: 0.1429 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000021 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.998
Corners	0.116	0.146
Bottom Flange	0.786	0.998
Web	1.244	0.508
Top Flange	0.786	0.018

Guess $\bar{y}$: 0.506 in.

Stress in Flange: 39.762 ksi
k: 4
Fcr: 221.414 ksi
 λ : 0.424
 ρ : 1.135
Effective Width: 0.786 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.998	0.659	0.657	--
Bottom Corner	18	2.083	0.870	1.812	1.577	0.000
Web	18	22.386	0.508	11.370	5.775	1.513
Top Corner	18	2.083	0.146	0.303	0.044	0.000
Top Flange	9	7.071	0.018	0.127	0.002	--
Bottom Flange	8	6.286	0.998	6.272	6.259	--
Σ		40.568		20.543	14.314	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.506 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.509 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.194 in.⁴
 $S_e = I_x / \bar{y} =$ 0.381 in.³
Mn = Se * Fy = 15.25 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 20 GA
Strength: 50 ksi
Thickness: 0.0358 in.
Total Height: 1.016 in.
Radius: 0.1429 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000021 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.998
Corners	0.116	0.146
Bottom Flange	0.786	0.998
Web	1.244	0.508
Top Flange	0.786	0.018

Guess $\bar{y}$: 0.506 in.

Stress in Flange: 49.702 ksi
k: 4
Fcr: 221.414 ksi
 λ : 0.474
 ρ : 1.131
Effective Width: 0.786 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.998	0.659	0.657	--
Bottom Corner	18	2.083	0.870	1.812	1.577	0.000
Web	18	22.386	0.508	11.370	5.775	1.513
Top Corner	18	2.083	0.146	0.303	0.044	0.000
Top Flange	9	7.071	0.018	0.127	0.002	--
Bottom Flange	8	6.286	0.998	6.272	6.259	--
Σ		40.568		20.543	14.314	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.506 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.509 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.194 in.⁴
 $S_e = I_x / \bar{y} =$ 0.381 in.³
Mn = Se * Fy = 19.06 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 20 GA
Strength: 60 ksi
Thickness: 0.0358 in.
Total Height: 1.016 in.
Radius: 0.1429 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000021 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.998
Corners	0.116	0.146
Bottom Flange	0.786	0.998
Web	1.244	0.508
Top Flange	0.786	0.018

Guess $\bar{y}$: 0.506 in.

Stress in Flange: 59.642 ksi
k: 4
Fcr: 221.414 ksi
 λ : 0.519
 ρ : 1.110
Effective Width: 0.786 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.998	0.659	0.657	--
Bottom Corner	18	2.083	0.870	1.812	1.577	0.000
Web	18	22.386	0.508	11.370	5.775	1.513
Top Corner	18	2.083	0.146	0.303	0.044	0.000
Top Flange	9	7.071	0.018	0.127	0.002	--
Bottom Flange	8	6.286	0.998	6.272	6.259	--
Σ		40.568		20.543	14.314	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.506 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.509 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.194 in.⁴
 $S_e = I_x / \bar{y} =$ 0.381 in.³
Mn = Se * Fy = 22.88 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 22 GA
Strength: 33 ksi
Thickness: 0.0295 in.
Total Height: 1.010 in.
Radius: 0.13975 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000019 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.995
Corners	0.113	0.140
Bottom Flange	0.786	0.995
Web	1.244	0.505
Top Flange	0.786	0.015

Guess $\bar{y}$: 0.503 in.

Stress in Flange: 32.802 ksi
k: 4
Fcr: 150.343 ksi
 λ : 0.467
 ρ : 1.133
Effective Width: 0.786 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.995	0.657	0.653	--
Bottom Corner	18	2.037	0.870	1.771	1.541	0.000
Web	18	22.386	0.505	11.299	5.703	1.513
Top Corner	18	2.037	0.140	0.285	0.040	0.000
Top Flange	9	7.071	0.015	0.104	0.002	--
Bottom Flange	8	6.286	0.995	6.253	6.220	--
Σ		40.476		20.369	14.158	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.503 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.506 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.160 in.⁴
 $S_e = I_x / \bar{y} =$ 0.316 in.³
Mn = Se * Fy = 10.42 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 22 GA
Strength: 40 ksi
Thickness: 0.0295 in.
Total Height: 1.010 in.
Radius: 0.13975 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000019 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.995
Corners	0.113	0.140
Bottom Flange	0.786	0.995
Web	1.244	0.505
Top Flange	0.786	0.015

Guess $\bar{y}$: 0.503 in.

Stress in Flange: 39.760 ksi
k: 4
Fcr: 150.343 ksi
 λ : 0.514
 ρ : 1.113
Effective Width: 0.786 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.995	0.657	0.653	--
Bottom Corner	18	2.037	0.870	1.771	1.541	0.000
Web	18	22.386	0.505	11.299	5.703	1.513
Top Corner	18	2.037	0.140	0.285	0.040	0.000
Top Flange	9	7.071	0.015	0.104	0.002	--
Bottom Flange	8	6.286	0.995	6.253	6.220	--
Σ		40.476		20.369	14.158	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.503 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.506 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.160 in.⁴
 $S_e = I_x / \bar{y} =$ 0.316 in.³
Mn = Se * Fy = 12.64 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 22 GA
Strength: 50 ksi
Thickness: 0.0295 in.
Total Height: 1.010 in.
Radius: 0.13975 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000019 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.995
Corners	0.113	0.140
Bottom Flange	0.786	0.995
Web	1.244	0.505
Top Flange	0.786	0.015

Guess $\bar{y}$: 0.503 in.

Stress in Flange: 49.699 ksi
k: 4
Fcr: 150.343 ksi
 λ : 0.575
 ρ : 1.074
Effective Width: 0.786 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.995	0.657	0.653	--
Bottom Corner	18	2.037	0.870	1.771	1.541	0.000
Web	18	22.386	0.505	11.299	5.703	1.513
Top Corner	18	2.037	0.140	0.285	0.040	0.000
Top Flange	9	7.071	0.015	0.104	0.002	--
Bottom Flange	8	6.286	0.995	6.253	6.220	--
Σ		40.476		20.369	14.158	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.503 in.
 $\bar{Y}_{\text{EXTREME FIBER}}$ = $\max(\bar{y}, h - \bar{y})$ = 0.506 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.160 in.⁴
 S_e = $I_x / \bar{y}$ = 0.316 in.³
Mn = Se * Fy = 15.80 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 22 GA
Strength: 60 ksi
Thickness: 0.0295 in.
Total Height: 1.010 in.
Radius: 0.13975 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000019 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.995
Corners	0.113	0.140
Bottom Flange	0.786	0.995
Web	1.244	0.505
Top Flange	0.786	0.015

Guess $\bar{y}$: 0.503 in.

Stress in Flange: 59.639 ksi
k: 4
Fcr: 150.343 ksi
 λ : 0.630
 ρ : 1.033
Effective Width: 0.786 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.995	0.657	0.653	--
Bottom Corner	18	2.037	0.870	1.771	1.541	0.000
Web	18	22.386	0.505	11.299	5.703	1.513
Top Corner	18	2.037	0.140	0.285	0.040	0.000
Top Flange	9	7.071	0.015	0.104	0.002	--
Bottom Flange	8	6.286	0.995	6.253	6.220	--
Σ		40.476		20.369	14.158	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.503 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.506 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.160 in.⁴
 $S_e = I_x / \bar{y} =$ 0.316 in.³
Mn = Se * Fy = 18.95 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 24 GA
Strength: 33 ksi
Thickness: 0.0238 in.
Total Height: 1.004 in.
Radius: 0.1369 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000018 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.992
Corners	0.111	0.134
Bottom Flange	0.786	0.992
Web	1.244	0.502
Top Flange	0.786	0.012

Guess $\bar{y}$: 0.500 in.

Stress in Flange: 32.800 ksi
k: 4
Fcr: 97.857 ksi
 λ : 0.579
 ρ : 1.071
Effective Width: 0.786 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.992	0.655	0.649	--
Bottom Corner	18	1.995	0.869	1.735	1.508	0.000
Web	18	22.386	0.502	11.235	5.639	1.513
Top Corner	18	1.995	0.134	0.268	0.036	0.000
Top Flange	9	7.071	0.012	0.084	0.001	--
Bottom Flange	8	6.286	0.992	6.235	6.184	--
Σ		40.393		20.212	14.018	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.500 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.503 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.129 in.⁴
 $S_e = I_x / \bar{y} =$ 0.256 in.³
Mn = Se * Fy = 8.45 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 24 GA
Strength: 40 ksi
Thickness: 0.0238 in.
Total Height: 1.004 in.
Radius: 0.1369 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000018 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.992
Corners	0.111	0.134
Bottom Flange	0.786	0.992
Web	1.244	0.502
Top Flange	0.786	0.012

Guess $\bar{y}$: 0.500 in.

Stress in Flange: 39.758 ksi
k: 4
Fcr: 97.857 ksi
 λ : 0.637
 ρ : 1.027
Effective Width: 0.786 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.992	0.655	0.649	--
Bottom Corner	18	1.995	0.869	1.735	1.508	0.000
Web	18	22.386	0.502	11.235	5.639	1.513
Top Corner	18	1.995	0.134	0.268	0.036	0.000
Top Flange	9	7.071	0.012	0.084	0.001	--
Bottom Flange	8	6.286	0.992	6.235	6.184	--
Σ		40.393		20.212	14.018	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.500 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.503 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.129 in.⁴
 $S_e = I_x / \bar{y} =$ 0.256 in.³
Mn = Se * Fy = 10.25 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
 calc by: RKD
 check by: TS

Deck: 1F
 Gage: 24 GA
 Strength: 50 ksi
 Thickness: 0.0238 in.
 Total Height: 1.004 in.
 Radius: 0.1369 in.
 θ : 46.39 deg
 θ : 0.810 rad
 Curve I'_x : 0.000018 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.992
Corners	0.111	0.134
Bottom Flange	0.786	0.992
Web	1.244	0.502
Top Flange	0.786	0.012

Guess $\bar{y}$: 0.503 in.

Stress in Flange: 50.000 ksi
 k: 4
 Fcr: 97.857 ksi
 λ : 0.715
 ρ : 0.968
 Effective Width: 0.761 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.992	0.655	0.649	--
Bottom Corner	18	1.995	0.869	1.735	1.508	0.000
Web	18	22.386	0.502	11.235	5.639	1.513
Top Corner	18	1.995	0.134	0.268	0.036	0.000
Top Flange	9	6.848	0.012	0.081	0.001	--
Bottom Flange	8	6.286	0.992	6.235	6.184	--
Σ		40.170		20.209	14.018	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.503 in.
 $\bar{Y}_{\text{EXTREME FIBER}}$ = $\max(\bar{y}, h - \bar{y})$ = 0.503 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.128 in.⁴
 S_e = $I_x / \bar{y}$ = 0.254 in.³
Mn = Se * Fy = 12.69 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 24 GA
Strength: 60 ksi
Thickness: 0.0238 in.
Total Height: 1.004 in.
Radius: 0.1369 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000018 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.992
Corners	0.111	0.134
Bottom Flange	0.786	0.992
Web	1.244	0.502
Top Flange	0.786	0.012

Guess $\bar{y}$: 0.507 in.

Stress in Flange: 60.000 ksi
k: 4
Fcr: 97.857 ksi
 λ : 0.783
 ρ : 0.918
Effective Width: 0.721 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.992	0.655	0.649	--
Bottom Corner	18	1.995	0.869	1.735	1.508	0.000
Web	18	22.386	0.502	11.235	5.639	1.513
Top Corner	18	1.995	0.134	0.268	0.036	0.000
Top Flange	9	6.493	0.012	0.077	0.001	--
Bottom Flange	8	6.286	0.992	6.235	6.184	--
Σ		39.815		20.205	14.018	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.507 in.
 $\bar{Y}_{\text{EXTREME FIBER}}$ = $\max(\bar{y}, h - \bar{y})$ = 0.507 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.126 in.⁴
 S_e = $I_x / \bar{y}$ = 0.248 in.³
Mn = **Se * Fy** = **14.85** k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 26 GA
Strength: 33 ksi
Thickness: 0.0179 in.
Total Height: 0.998 in.
Radius: 0.13395 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000017 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.989
Corners	0.108	0.129
Bottom Flange	0.786	0.989
Web	1.244	0.499
Top Flange	0.786	0.009

Guess $\bar{y}$: 0.504 in.

Stress in Flange: 33.000 ksi
k: 4
Fcr: 55.353 ksi
 λ : 0.772
 ρ : 0.926
Effective Width: 0.728 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.989	0.653	0.645	--
Bottom Corner	18	1.952	0.869	1.697	1.475	0.000
Web	18	22.386	0.499	11.169	5.573	1.513
Top Corner	18	1.952	0.129	0.251	0.032	0.000
Top Flange	9	6.549	0.009	0.059	0.001	--
Bottom Flange	8	6.286	0.989	6.216	6.148	--
Σ		39.784		20.045	13.874	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.504 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.504 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.095 in.⁴
 $S_e = I_x / \bar{y} =$ 0.188 in.³
Mn = Se * Fy = 6.20 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 26 GA
Strength: 40 ksi
Thickness: 0.0179 in.
Total Height: 0.998 in.
Radius: 0.13395 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000017 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.989
Corners	0.108	0.129
Bottom Flange	0.786	0.989
Web	1.244	0.499
Top Flange	0.786	0.009

Guess $\bar{y}$: 0.509 in.

Stress in Flange: 40.000 ksi
k: 4
Fcr: 55.353 ksi
 λ : 0.850
 ρ : 0.872
Effective Width: 0.685 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.989	0.653	0.645	--
Bottom Corner	18	1.952	0.869	1.697	1.475	0.000
Web	18	22.386	0.499	11.169	5.573	1.513
Top Corner	18	1.952	0.129	0.251	0.032	0.000
Top Flange	9	6.166	0.009	0.055	0.000	--
Bottom Flange	8	6.286	0.989	6.216	6.148	--
Σ		39.401		20.041	13.874	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.509 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.509 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.093 in.⁴
 $S_e = I_x / \bar{y} =$ 0.183 in.³
Mn = Se * Fy = 7.31 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 26 GA
Strength: 50 ksi
Thickness: 0.0179 in.
Total Height: 0.998 in.
Radius: 0.13395 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000017 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.989
Corners	0.108	0.129
Bottom Flange	0.786	0.989
Web	1.244	0.499
Top Flange	0.786	0.009

Guess $\bar{y}$: 0.514 in.

Stress in Flange: 50.000 ksi
k: 4
Fcr: 55.353 ksi
 λ : 0.950
 ρ : 0.809
Effective Width: 0.635 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.989	0.653	0.645	--
Bottom Corner	18	1.952	0.869	1.697	1.475	0.000
Web	18	22.386	0.499	11.169	5.573	1.513
Top Corner	18	1.952	0.129	0.251	0.032	0.000
Top Flange	9	5.718	0.009	0.051	0.000	--
Bottom Flange	8	6.286	0.989	6.216	6.148	--
Σ		38.954		20.037	13.873	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.514 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.514 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.091 in.⁴
 $S_e = I_x / \bar{y} =$ 0.177 in.³
Mn = Se * Fy = 8.84 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1F
Gage: 26 GA
Strength: 60 ksi
Thickness: 0.0179 in.
Total Height: 0.998 in.
Radius: 0.13395 in.
 θ : 46.39 deg
 θ : 0.810 rad
Curve I'_x : 0.000017 in.³

Element	L (in.)	y from top (in.)
Lip	0.330	0.989
Corners	0.108	0.129
Bottom Flange	0.786	0.989
Web	1.244	0.499
Top Flange	0.786	0.009

Guess $\bar{y}$: 0.519 in.

Stress in Flange: 60.000 ksi
k: 4
Fcr: 55.353 ksi
 λ : 1.041
 ρ : 0.758
Effective Width: 0.595 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	0.660	0.989	0.653	0.645	--
Bottom Corner	18	1.952	0.869	1.697	1.475	0.000
Web	18	22.386	0.499	11.169	5.573	1.513
Top Corner	18	1.952	0.129	0.251	0.032	0.000
Top Flange	9	5.357	0.009	0.048	0.000	--
Bottom Flange	8	6.286	0.989	6.216	6.148	--
Σ		38.592		20.034	13.873	1.513

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.519 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.519 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.089 in.⁴
 $S_e = I_x / \bar{y} =$ 0.172 in.³
Mn = Se * Fy = 10.32 k-in.

CHAPTER 4: ANALYSIS | 1.5B DECK | + BENDING



4.0 Executive Summary

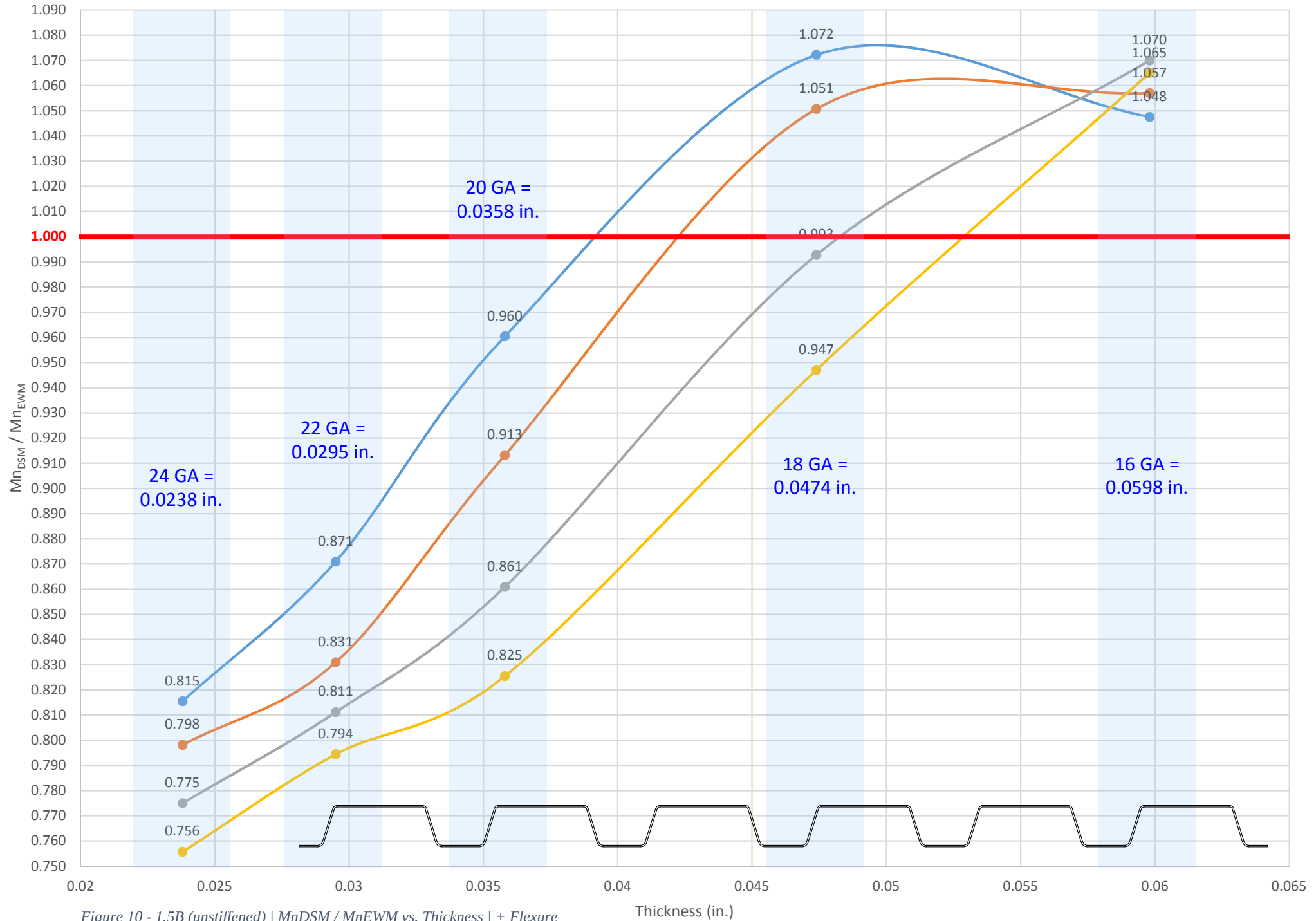
The Direct Strength Method predicted lower strengths for the majority of the 1.5B Deck sections undergoing positive flexure. It appears that DSM predicts lower strengths for sections with thin and wide compression elements. DSM predicted higher strengths than the EWM for 16GA at each yield stress and 18GA at 33 KSI and 40 KSI. DSM predicted lower strengths for all other sections of 1.5B Deck analyzed for positive flexure in this study. The nominal moment capacity ratio (M_{nDSM}/M_{nEWM}) ranged between 0.756 and 1.072.

CHAPTER 4: ANALYSIS | 1.5B DECK | + BENDING

4.1 M_{nDSM} / M_{nEWM} vs. Thickness Plot

Mn_{DSM} / Mn_{EWM} vs. Thickness

33 KSI 40 KSI 50 KSI 60 KSI



CHAPTER 4: ANALYSIS | 1.5B DECK | + BENDING

4.2 Analysis Results Summary

Table 4 - 1.5B (unstiffened) | Analysis Results Summary | + Flexure

1.5 B DECK - 33 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
CL Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I _G	0.4345	0.5389	0.6543	0.8674	1.0957
ȳ _G	0.9127	0.9150	0.9176	0.9223	0.9273
S _{xx}	0.4761	0.5889	0.7131	0.9405	1.1816
My	15.71	19.43	23.53	31.04	38.99
Mn _{DSM}	10.43	14.85	20.36	31.04	38.99
Mn _{EWM}	12.79	17.05	21.2	28.95	37.22
% ERROR	-22.627%	-14.815%	-4.126%	6.733%	4.540%

1.5 B DECK - 40 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
CL Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I _G	0.4345	0.5389	0.6543	0.8674	1.0957
ȳ _G	0.9127	0.9150	0.9176	0.9223	0.9273
S _{xx}	0.4761	0.5889	0.7131	0.9405	1.1816
My	19.04	23.56	28.53	37.62	47.26
Mn _{DSM}	11.82	16.86	23.16	36.45	47.26
Mn _{EWM}	14.81	20.29	25.36	34.69	44.71
% ERROR	-25.296%	-20.344%	-9.499%	4.829%	5.396%

1.5 B DECK - 50 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
CL Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I _G	0.4345	0.5389	0.6543	0.8674	1.0957
ȳ _G	0.9127	0.9150	0.9176	0.9223	0.9273
S _{xx}	0.4761	0.5889	0.7131	0.9405	1.1816
My	23.80	29.45	35.66	47.02	59.08
Mn _{DSM}	13.64	19.50	26.86	42.43	59.08
Mn _{EWM}	17.6	24.04	31.2	42.74	55.22
% ERROR	-29.032%	-23.282%	-16.158%	-0.731%	6.534%

1.5 B DECK - 60 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
CL Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I _G	0.4345	0.5389	0.6543	0.8674	1.0957
ȳ _G	0.9127	0.9150	0.9176	0.9223	0.9273
S _{xx}	0.4761	0.5889	0.7131	0.9405	1.1816
My	28.57	35.34	42.79	56.43	70.90
Mn _{DSM}	15.34	21.95	30.27	47.98	69.81
Mn _{EWM}	20.3	27.63	36.67	50.66	65.55
% ERROR	-32.334%	-25.877%	-21.143%	-5.586%	6.102%

1.5 B DECK - 33 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
24	0.0238	10.430	12.79	0.815
22	0.0295	14.850	17.05	0.871
20	0.0358	20.360	21.2	0.960
18	0.0474	31.040	28.95	1.072
16	0.0598	38.990	37.22	1.048

1.5 B DECK - 40 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
24	0.0238	11.820	14.81	0.798
22	0.0295	16.860	20.29	0.831
20	0.0358	23.160	25.36	0.913
18	0.0474	36.450	34.69	1.051
16	0.0598	47.260	44.71	1.057

1.5 B DECK - 50 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
24	0.0238	13.640	17.6	0.775
22	0.0295	19.500	24.04	0.811
20	0.0358	26.860	31.2	0.861
18	0.0474	42.430	42.74	0.993
16	0.0598	59.080	55.22	1.070

1.5 B DECK - 60 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
24	0.0238	15.340	20.3	0.756
22	0.0295	21.950	27.63	0.794
20	0.0358	30.270	36.67	0.825
18	0.0474	47.980	50.66	0.947
16	0.0598	69.810	65.55	1.065

CHAPTER 4: ANALYSIS | 1.5B DECK | + BENDING

4.3 Direct Strength Method Calculations

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	16	GA		
	Strength:	33	KSI		
	$M_y =$	38.99	kip-in	Length:	
local	$M_{crf}/M_y =$	2.87320	$M_{crf} = 112.02607$	kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	389.9	kip-in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	389.9	kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y$$
$$M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y$$

$$M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y$$

$$M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 38.99 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776$$

$$M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776$$

$$M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.59 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 38.99 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673$$

$$M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673$$

$$M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness})$$

$$M_{nd} = 38.99 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 38.99 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	16	GA		
	Strength:	40	KSI		
	$M_y =$	47.26	kip-in	Length:	
local	$M_{crf}/M_y =$	2.37040	$M_{crf} =$	112.0251 kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	472.6 kip-in	- in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	472.6 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 47.26 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.65 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 47.26 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 47.26 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 47.26 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	16	GA		
	Strength:	50	KSI		
	$M_y =$	59.08	kip-in	Length:	
local	$M_{crf}/M_y =$	1.89630	$M_{crf} =$	112.0334 kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	590.8 kip-in	- in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	590.8 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 59.08 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.73 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 59.08 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 59.08 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 59.08 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	16	GA		
	Strength:	60	KSI		
	M_y	70.90	kip-in	Length:	
local	M_{crf}/M_y	1.58030	$M_{crf} = 112.04327$	kip-in	2 in
dist.	M_{crd}/M_y	10.00000	$M_{crd} = 709$	kip-in	- in
global	M_{cre}/M_y	10.00000	$M_{cre} = 709$	kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 70.90 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.80 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 69.81 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 70.90 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 69.81 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	18	GA		
	Strength:	33	KSI		
	$M_y =$	31.04	kip-in	Length:	
local	$M_{crf}/M_y =$	1.82000	$M_{crf} =$	56.4928 kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	310.4 kip-in	- in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	310.4 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 31.04 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.74 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 31.04 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 31.04 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 31.04 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	18	GA		
	Strength:	40	KSI		
	$M_y =$	37.62	kip-in	Length:	
local	$M_{crf}/M_y =$	1.50150	$M_{crf} =$	56.48643 kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	376.2 kip-in	- in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	376.2 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 37.62 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.82 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 36.45 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 37.62 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 36.45 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	18	GA		
	Strength:	50	KSI		
	$M_y =$	47.02	kip-in	Length:	
local	$M_{crf}/M_y =$	1.20120	$M_{crf} = 56.480424$	kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	470.2	kip-in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	470.2	kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y$$
$$M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y$$

$$M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y$$

$$M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 47.02 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776$$

$$M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776$$

$$M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.91 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 42.43 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673$$

$$M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673$$

$$M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness})$$

$$M_{nd} = 47.02 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 42.43 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	18	GA		
	Strength:	60	KSI		
	$M_y =$	56.43	kip-in	Length:	
local	$M_{crf}/M_y =$	1.00100	$M_{crf} =$ 56.48643 kip-in		2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$ 564.3 kip-in		- in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$ 564.3 kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 56.43 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.00 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 47.98 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 56.43 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 47.98 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	20	GA		
	Strength:	33	KSI		
	$M_y =$	23.53	kip-in	Length:	
local	$M_{crf}/M_y =$	1.05570	$M_{crf} = 24.840621$	kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	235.3	kip-in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	235.3	kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 23.53 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.97 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 20.36 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 23.53 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 20.36 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	20	GA		
	Strength:	40	KSI		
	$M_y =$	28.53	kip-in	Length:	
local	$M_{crf}/M_y =$	0.87099	$M_{crf} = 24.849345$	kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	285.3	kip-in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	285.3	kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 28.53 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.07 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 23.16 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 28.53 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 23.16 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	20	GA		
	Strength:	50	KSI		
	$M_y =$	35.66	kip-in	Length:	
local	$M_{crf}/M_y =$	0.69678	$M_{crf} = 24.847175$	kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	356.6	kip-in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	356.6	kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 35.66 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.20 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 26.86 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 35.66 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 26.86 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	20	GA		
	Strength:	60	KSI		
	$M_y =$	42.79	kip-in	Length:	
local	$M_{crf}/M_y =$	0.58066	$M_{crf} = 24.846441$	kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	427.9	kip-in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	427.9	kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 42.79 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.31 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 30.27 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 42.79 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 30.27 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	22	GA		
	Strength:	33	KSI		
	$M_y =$	19.43	kip-in	Length:	
local	$M_{crf}/M_y =$	0.72750	$M_{crf} = 14.135325$	kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	194.3	kip-in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	194.3	kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 19.43 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.17 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 14.85 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 19.43 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 14.85 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	22	GA		
	Strength:	40	KSI		
	M_y	23.56	kip-in	Length:	
local	M_{crf}/M_y	0.60020	$M_{crf} = 14.140712$	kip-in	2 in
dist.	M_{crd}/M_y	10.00000	$M_{crd} = 235.6$	kip-in	- in
global	M_{cre}/M_y	10.00000	$M_{cre} = 235.6$	kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 23.56 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.29 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 16.86 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 23.56 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 16.86 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	22	GA		
	Strength:	50	KSI		
	$M_y =$	29.45	kip-in	Length:	
local	$M_{crf}/M_y =$	0.48016	$M_{crf} = 14.140712$	kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	294.5	kip-in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	294.5	kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 29.45 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.44 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 19.50 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 29.45 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 19.50 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	22	GA		
	Strength:	60	KSI		
	$M_y =$	35.34	kip-in	Length:	
local	$M_{crf}/M_y =$	0.40013	$M_{crf} = 14.140594$	kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	353.4	kip-in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	353.4	kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 35.34 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.58 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 21.95 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 35.34 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 21.95 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	24	GA		
	Strength:	33	KSI		
	$M_y =$	15.71	kip-in	Length:	
local	$M_{crf}/M_y =$	0.48401	$M_{crf} = 7.6037971$	kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	157.1	kip-in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	157.1	kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 15.71 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.44 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 10.43 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 15.71 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 10.43 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	24	GA		
	Strength:	40	KSI		
	$M_y =$	19.04	kip-in	Length:	
local	$M_{crf}/M_y =$	0.39931	$M_{crf} = 7.6028624$	kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	190.4	kip-in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	190.4	kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 19.04 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.58 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 11.82 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 19.04 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 11.82 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	24	GA		
	Strength:	50	KSI		
	$M_y =$	23.80	kip-in	Length:	
local	$M_{crf}/M_y =$	0.31945	$M_{crf} =$	7.60291 kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	238 kip-in	- in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	238 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 23.80 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.77 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 13.64 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 23.80 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 13.64 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	24	GA		
	Strength:	60	KSI		
	$M_y =$	28.57	kip-in	Length:	
local	$M_{crf}/M_y =$	0.26621	$M_{crf} = 7.6056197$	kip-in	2 in
dist.	$M_{crd}/M_y =$	10.00000	$M_{crd} =$	285.7	kip-in
global	$M_{cre}/M_y =$	10.00000	$M_{cre} =$	285.7	kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 28.57 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.94 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 15.34 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness}) \\ M_{nd} = 28.57 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 15.34 \text{ kip-in} \quad (\text{local-global controls})$$

CHAPTER 4: ANALYSIS | 1.5B DECK | + BENDING

4.4 Effective Width Method Calculations

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 16 GA
Strength: 33 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.510
Corners	0.276	0.194
Bottom Flange	1.377	1.510
Web	1.275	0.770
Top Flange	3.144	0.030

Guess $\bar{y}$: 0.626 in.

Stress in Flange: 22.588 ksi
k: 4
Fcr: 38.589 ksi
 λ : 0.765
 ρ : 0.931
Effective Width: 2.928 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.510	2.080	3.141	--
Bottom Corner	12	3.309	1.346	4.452	5.991	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	0.194	0.642	0.125	0.007
Top Flange	6	17.565	0.030	0.525	0.016	--
Bottom Flange	5	6.884	1.510	10.394	15.694	--
Σ		47.739		29.870	34.033	1.898

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.626 in.
 $\bar{Y}_{\text{EXTREME FIBER}}$ = $\max(\bar{y}, h - \bar{y})$ = 0.914 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.031 in.⁴
 S_e = $I_x / \bar{y}$ = 1.128 in.³
Mn = Se * Fy = 37.22 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 16 GA
Strength: 40 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.510
Corners	0.276	0.194
Bottom Flange	1.377	1.510
Web	1.275	0.770
Top Flange	3.144	0.030

Guess $\bar{y}$: 0.642 in.

Stress in Flange: 28.581 ksi
k: 4
Fcr: 38.589 ksi
 λ : 0.861
 ρ : 0.865
Effective Width: 2.719 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.510	2.080	3.141	--
Bottom Corner	12	3.309	1.346	4.452	5.991	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	0.194	0.642	0.125	0.007
Top Flange	6	16.315	0.030	0.488	0.015	--
Bottom Flange	5	6.884	1.510	10.394	15.694	--
Σ		46.489		29.832	34.031	1.898

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.642 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.898 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 1.004 in.⁴
 $S_e = I_x / \bar{y} =$ 1.118 in.³
Mn = Se * Fy = 44.71 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 16 GA
Strength: 50 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.510
Corners	0.276	0.194
Bottom Flange	1.377	1.510
Web	1.275	0.770
Top Flange	3.144	0.030

Guess $\bar{y}$: 0.662 in.

Stress in Flange: 37.686 ksi
k: 4
Fcr: 38.589 ksi
 λ : 0.988
 ρ : 0.787
Effective Width: 2.473 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.510	2.080	3.141	--
Bottom Corner	12	3.309	1.346	4.452	5.991	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	0.194	0.642	0.125	0.007
Top Flange	6	14.838	0.030	0.444	0.013	--
Bottom Flange	5	6.884	1.510	10.394	15.694	--
Σ		45.012		29.788	34.030	1.898

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.662 in.
 $\bar{Y}_{\text{EXTREME FIBER}}$ = $\max(\bar{y}, h - \bar{y})$ = 0.878 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.970 in.⁴
 S_e = $I_x / \bar{y}$ = 1.104 in.³
Mn = Se * Fy = 55.22 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
 calc by: RKD
 check by: TS

Deck: 1.58
 Gage: 16 GA
 Strength: 60 ksi
 Thickness: 0.0598 in.
 Total Height: 1.540 in.
 Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
 Curve I'_x : 0.000592 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.510
Corners	0.276	0.194
Bottom Flange	1.377	1.510
Web	1.275	0.770
Top Flange	3.144	0.030

Guess $\bar{y}$: 0.679 in.

Stress in Flange: 47.317 ksi
 k: 4
 Fcr: 38.589 ksi
 λ : 1.107
 ρ : 0.724
 Effective Width: 2.275 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.510	2.080	3.141	--
Bottom Corner	12	3.309	1.346	4.452	5.991	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	0.194	0.642	0.125	0.007
Top Flange	6	13.650	0.030	0.408	0.012	--
Bottom Flange	5	6.884	1.510	10.394	15.694	--
Σ		43.824		29.753	34.029	1.898

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.679 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.861 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.940 in.⁴
 $S_e = I_x / \bar{y} =$ 1.092 in.³
Mn = Se * Fy = 65.55 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 18 GA
Strength: 33 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.504
Corners	0.268	0.183
Bottom Flange	1.377	1.504
Web	1.275	0.764
Top Flange	3.144	0.024

Guess $\bar{y}$: 0.659 in.

Stress in Flange: 25.070 ksi
k: 4
Fcr: 24.245 ksi
 λ : 1.017
 ρ : 0.771
Effective Width: 2.423 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.504	2.072	3.115	--
Bottom Corner	12	3.215	1.344	4.321	5.808	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	0.183	0.589	0.108	0.007
Top Flange	6	14.536	0.024	0.345	0.008	--
Bottom Flange	5	6.884	1.504	10.351	15.565	--
Σ		44.522		29.358	33.525	1.897

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.659 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.868 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.761 in.⁴
 $S_e = I_x / \bar{y} =$ 0.877 in.³
Mn = Se * Fy = 28.95 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 18 GA
Strength: 40 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.504
Corners	0.268	0.183
Bottom Flange	1.377	1.504
Web	1.275	0.764
Top Flange	3.144	0.024

Guess $\bar{y}$: 0.678 in.

Stress in Flange: 31.905 ksi
k: 4
Fcr: 24.245 ksi
 λ : 1.147
 ρ : 0.705
Effective Width: 2.215 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.504	2.072	3.115	--
Bottom Corner	12	3.215	1.344	4.321	5.808	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	0.183	0.589	0.108	0.007
Top Flange	6	13.290	0.024	0.315	0.007	--
Bottom Flange	5	6.884	1.504	10.351	15.565	--
Σ		43.276		29.329	33.524	1.897

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.678 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.850 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.737 in.⁴
 $S_e = I_x / \bar{y} =$ 0.867 in.³
Mn = Se * Fy = 34.69 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
 calc by: RKD
 check by: TS

Deck: 1.58
 Gage: 18 GA
 Strength: 50 ksi
 Thickness: 0.0474 in.
 Total Height: 1.527 in.
 Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
 Curve I'_x : 0.000543 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.504
Corners	0.268	0.183
Bottom Flange	1.377	1.504
Web	1.275	0.764
Top Flange	3.144	0.024

Guess $\bar{y}$: 0.699 in.

Stress in Flange: 42.216 ksi
 k: 4
 Fcr: 24.245 ksi
 λ : 1.320
 ρ : 0.631
 Effective Width: 1.985 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.504	2.072	3.115	--
Bottom Corner	12	3.215	1.344	4.321	5.808	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	0.183	0.589	0.108	0.007
Top Flange	6	11.911	0.024	0.282	0.007	--
Bottom Flange	5	6.884	1.504	10.351	15.565	--
Σ		41.897		29.296	33.523	1.897

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.699 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.828 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.708 in.⁴
 $S_e = I_x / \bar{y} =$ 0.855 in.³
Mn = Se * Fy = 42.74 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 18 GA
Strength: 60 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.504
Corners	0.268	0.183
Bottom Flange	1.377	1.504
Web	1.275	0.764
Top Flange	3.144	0.024

Guess $\bar{y}$: 0.717 in.

Stress in Flange: 53.042 ksi
k: 4
Fcr: 24.245 ksi
 λ : 1.479
 ρ : 0.576
Effective Width: 1.809 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.504	2.072	3.115	--
Bottom Corner	12	3.215	1.344	4.321	5.808	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	0.183	0.589	0.108	0.007
Top Flange	6	10.856	0.024	0.257	0.006	--
Bottom Flange	5	6.884	1.504	10.351	15.565	--
Σ		40.842		29.271	33.523	1.897

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.717 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.811 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.685 in.⁴
 $S_e = I_x / \bar{y} =$ 0.844 in.³
Mn = Se * Fy = 50.66 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
 calc by: RKD
 check by: TS

Deck: 1.58
 Gage: 20 GA
 Strength: 33 ksi
 Thickness: 0.0358 in.
 Total Height: 1.516 in.
 Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
 Curve I'_x : 0.000500 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.498
Corners	0.261	0.173
Bottom Flange	1.377	1.498
Web	1.275	0.758
Top Flange	3.144	0.018

Guess $\bar{y}$: 0.707 in.

Stress in Flange: 28.850 ksi
 k: 4
 Fcr: 13.830 ksi
 λ : 1.444
 ρ : 0.587
 Effective Width: 1.845 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.498	2.064	3.091	--
Bottom Corner	12	3.126	1.343	4.198	5.637	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	0.173	0.541	0.094	0.006
Top Flange	6	11.071	0.018	0.198	0.004	--
Bottom Flange	5	6.884	1.498	10.311	15.445	--
Σ		40.880		28.904	33.056	1.896

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.707 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.809 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$ 0.520 in.⁴
 $S_e = I_x / \bar{y} =$ 0.643 in.³
Mn = Se * Fy = 21.20 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 20 GA
Strength: 40 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.498
Corners	0.261	0.173
Bottom Flange	1.377	1.498
Web	1.275	0.758
Top Flange	3.144	0.018

Guess $\bar{y}$: 0.725 in.

Stress in Flange: 36.702 ksi
k: 4
Fcr: 13.830 ksi
 λ : 1.629
 ρ : 0.531
Effective Width: 1.669 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.498	2.064	3.091	--
Bottom Corner	12	3.126	1.343	4.198	5.637	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	0.173	0.541	0.094	0.006
Top Flange	6	10.015	0.018	0.179	0.003	--
Bottom Flange	5	6.884	1.498	10.311	15.445	--
Σ		39.825		28.886	33.056	1.896

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.725 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.790 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.501 in.⁴
 $S_e = I_x / \bar{y} =$ 0.634 in.³
Mn = Se * Fy = 25.36 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 20 GA
Strength: 50 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.498
Corners	0.261	0.173
Bottom Flange	1.377	1.498
Web	1.275	0.758
Top Flange	3.144	0.018

Guess $\bar{y}$: 0.746 in.

Stress in Flange: 48.426 ksi
k: 4
Fcr: 13.830 ksi
 λ : 1.871
 ρ : 0.472
Effective Width: 1.483 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.498	2.064	3.091	--
Bottom Corner	12	3.126	1.343	4.198	5.637	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	0.173	0.541	0.094	0.006
Top Flange	6	8.895	0.018	0.159	0.003	--
Bottom Flange	5	6.884	1.498	10.311	15.445	--
Σ		38.705		28.866	33.055	1.896

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.746 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.770 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.481 in.⁴
 $S_e = I_x / \bar{y} =$ 0.624 in.³
Mn = Se * Fy = 31.20 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 20 GA
Strength: 60 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.498
Corners	0.261	0.173
Bottom Flange	1.377	1.498
Web	1.275	0.758
Top Flange	3.144	0.018

Guess $\bar{y}$: 0.761 in.

Stress in Flange: 60.000 ksi
k: 4
Fcr: 13.830 ksi
 λ : 2.083
 ρ : 0.429
Effective Width: 1.350 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.498	2.064	3.091	--
Bottom Corner	12	3.126	1.343	4.198	5.637	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	0.173	0.541	0.094	0.006
Top Flange	6	8.100	0.018	0.145	0.003	--
Bottom Flange	5	6.884	1.498	10.311	15.445	--
Σ		37.909		28.851	33.055	1.896

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.761 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.761 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$ 0.465 in.⁴
 $S_e = I_x / \bar{y} =$ 0.611 in.³
Mn = Se * Fy = 36.67 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 22 GA
Strength: 33 ksi
Thickness: 0.0295 in.
Total Height: 1.510 in.
Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000477 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.495
Corners	0.257	0.168
Bottom Flange	1.377	1.495
Web	1.275	0.755
Top Flange	3.144	0.015

Guess $\bar{y}$: 0.740 in.

Stress in Flange: 31.737 ksi
k: 4
Fcr: 9.391 ksi
 λ : 1.838
 ρ : 0.479
Effective Width: 1.505 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.495	2.059	3.078	--
Bottom Corner	12	3.079	1.342	4.131	5.544	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	0.168	0.516	0.086	0.006
Top Flange	6	9.033	0.015	0.133	0.002	--
Bottom Flange	5	6.884	1.495	10.289	15.380	--
Σ		38.747		28.673	32.804	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.740 in.
 $\bar{Y}_{\text{EXTREME FIBER}}$ = $\max(\bar{y}, h - \bar{y})$ = 0.769 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.398 in.⁴
 S_e = $I_x / \bar{y}$ = 0.517 in.³
Mn = Se * Fy = 17.05 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 22 GA
Strength: 40 ksi
Thickness: 0.0295 in.
Total Height: 1.510 in.
Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000477 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.495
Corners	0.257	0.168
Bottom Flange	1.377	1.495
Web	1.275	0.755
Top Flange	3.144	0.015

Guess $\bar{y}$: 0.757 in.

Stress in Flange: 40.000 ksi
k: 4
Fcr: 9.391 ksi
 λ : 2.064
 ρ : 0.433
Effective Width: 1.361 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.495	2.059	3.078	--
Bottom Corner	12	3.079	1.342	4.131	5.544	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	0.168	0.516	0.086	0.006
Top Flange	6	8.165	0.015	0.120	0.002	--
Bottom Flange	5	6.884	1.495	10.289	15.380	--
Σ		37.879		28.661	32.804	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.757 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.757 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.384 in.⁴
 $S_e = I_x / \bar{y} =$ 0.507 in.³
Mn = Se * Fy = 20.29 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 22 GA
Strength: 50 ksi
Thickness: 0.0295 in.
Total Height: 1.510 in.
Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000477 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.495
Corners	0.257	0.168
Bottom Flange	1.377	1.495
Web	1.275	0.755
Top Flange	3.144	0.015

Guess $\bar{y}$: 0.772 in.

Stress in Flange: 50.000 ksi
k: 4
Fcr: 9.391 ksi
 λ : 2.307
 ρ : 0.392
Effective Width: 1.233 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.495	2.059	3.078	--
Bottom Corner	12	3.079	1.342	4.131	5.544	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	0.168	0.516	0.086	0.006
Top Flange	6	7.395	0.015	0.109	0.002	--
Bottom Flange	5	6.884	1.495	10.289	15.380	--
Σ		37.109		28.649	32.803	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.772 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.772 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.371 in.⁴
 $S_e = I_x / \bar{y} =$ 0.481 in.³
Mn = Se * Fy = 24.04 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 22 GA
Strength: 60 ksi
Thickness: 0.0295 in.
Total Height: 1.510 in.
Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000477 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.495
Corners	0.257	0.168
Bottom Flange	1.377	1.495
Web	1.275	0.755
Top Flange	3.144	0.015

Guess $\bar{y}$: 0.784 in.

Stress in Flange: 60.000 ksi
k: 4
Fcr: 9.391 ksi
 λ : 2.528
 ρ : 0.361
Effective Width: 1.135 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.495	2.059	3.078	--
Bottom Corner	12	3.079	1.342	4.131	5.544	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	0.168	0.516	0.086	0.006
Top Flange	6	6.813	0.015	0.100	0.001	--
Bottom Flange	5	6.884	1.495	10.289	15.380	--
Σ		36.527		28.641	32.803	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.784 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.784 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.361 in.⁴
 $S_e = I_x / \bar{y} =$ 0.461 in.³
Mn = Se * Fy = 27.63 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 24 GA
Strength: 33 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.492
Corners	0.253	0.163
Bottom Flange	1.377	1.492
Web	1.275	0.752
Top Flange	3.144	0.012

Guess $\bar{y}$: 0.770 in.

Stress in Flange: 33.000 ksi
k: 4
Fcr: 6.112 ksi
 λ : 2.324
 ρ : 0.390
Effective Width: 1.225 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.492	2.055	3.066	--
Bottom Corner	12	3.035	1.341	4.071	5.460	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	0.163	0.493	0.080	0.005
Top Flange	6	7.349	0.012	0.087	0.001	--
Bottom Flange	5	6.884	1.492	10.270	15.322	--
Σ		36.977		28.478	32.577	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.770 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.770 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.298 in.⁴
 $S_e = I_x / \bar{y} =$ 0.387 in.³
Mn = Se * Fy = 12.79 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
 calc by: RKD
 check by: TS

Deck: 1.58
 Gage: 24 GA
 Strength: 40 ksi
 Thickness: 0.0238 in.
 Total Height: 1.504 in.
 Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
 Curve I'_x : 0.000457 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.492
Corners	0.253	0.163
Bottom Flange	1.377	1.492
Web	1.275	0.752
Top Flange	3.144	0.012

Guess $\bar{y}$: 0.783 in.

Stress in Flange: 40.000 ksi
 k: 4
 Fcr: 6.112 ksi
 λ : 2.558
 ρ : 0.357
 Effective Width: 1.123 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.492	2.055	3.066	--
Bottom Corner	12	3.035	1.341	4.071	5.460	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	0.163	0.493	0.080	0.005
Top Flange	6	6.739	0.012	0.080	0.001	--
Bottom Flange	5	6.884	1.492	10.270	15.322	--
Σ		36.367		28.471	32.577	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.783 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.783 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.290 in.⁴
 $S_e = I_x / \bar{y} =$ 0.370 in.³
Mn = Se * Fy = 14.81 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 24 GA
Strength: 50 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.492
Corners	0.253	0.163
Bottom Flange	1.377	1.492
Web	1.275	0.752
Top Flange	3.144	0.012

Guess $\bar{y}$: 0.797 in.

Stress in Flange: 50.000 ksi
k: 4
Fcr: 6.112 ksi
 λ : 2.860
 ρ : 0.323
Effective Width: 1.015 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.492	2.055	3.066	--
Bottom Corner	12	3.035	1.341	4.071	5.460	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	0.163	0.493	0.080	0.005
Top Flange	6	6.088	0.012	0.072	0.001	--
Bottom Flange	5	6.884	1.492	10.270	15.322	--
Σ		35.715		28.463	32.577	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.797 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.797 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.281 in.⁴
 $S_e = I_x / \bar{y} =$ 0.352 in.³
Mn = Se * Fy = 17.60 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 24 GA
Strength: 60 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	1.492
Corners	0.253	0.163
Bottom Flange	1.377	1.492
Web	1.275	0.752
Top Flange	3.144	0.012

Guess $\bar{y}$: 0.808 in.

Stress in Flange: 60.000 ksi
k: 4
Fcr: 6.112 ksi
 λ : 3.133
 ρ : 0.297
Effective Width: 0.933 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.378	1.492	2.055	3.066	--
Bottom Corner	12	3.035	1.341	4.071	5.460	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	0.163	0.493	0.080	0.005
Top Flange	6	5.598	0.012	0.067	0.001	--
Bottom Flange	5	6.884	1.492	10.270	15.322	--
Σ		35.225		28.457	32.577	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.808 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.808 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.273 in.⁴
 $S_e = I_x / \bar{y} =$ 0.338 in.³
Mn = Se * Fy = 20.30 k-in.

CHAPTER 5: ANALYSIS | 1.5B DECK | - BENDING



5.0 Executive Summary

The Direct Strength Method predicted higher strengths for the majority of the 1.5B Deck sections undergoing negative flexure. The compression flange is the lower flange for this section and DSM is able to take advantage of the shorter compression flange width. DSM predicted lower strengths than the EWM for 24GA at yield stresses of 50 and 60 KSI and for 22GA at 60 KSI. DSM predicted higher strengths for all other sections of 1.5B Deck analyzed for negative flexure in this study. The nominal moment capacity ratio (M_{nDSM}/M_{nEWM}) ranged between 0.929 and 1.059.

CHAPTER 5: ANALYSIS | 1.5B DECK | - BENDING

5.1 M_{nDSM} / M_{nEWM} vs. Thickness Plot

Mn_{DSM} / Mn_{EWM} vs. Thickness

33 KSI 40 KSI 50 KSI 60 KSI

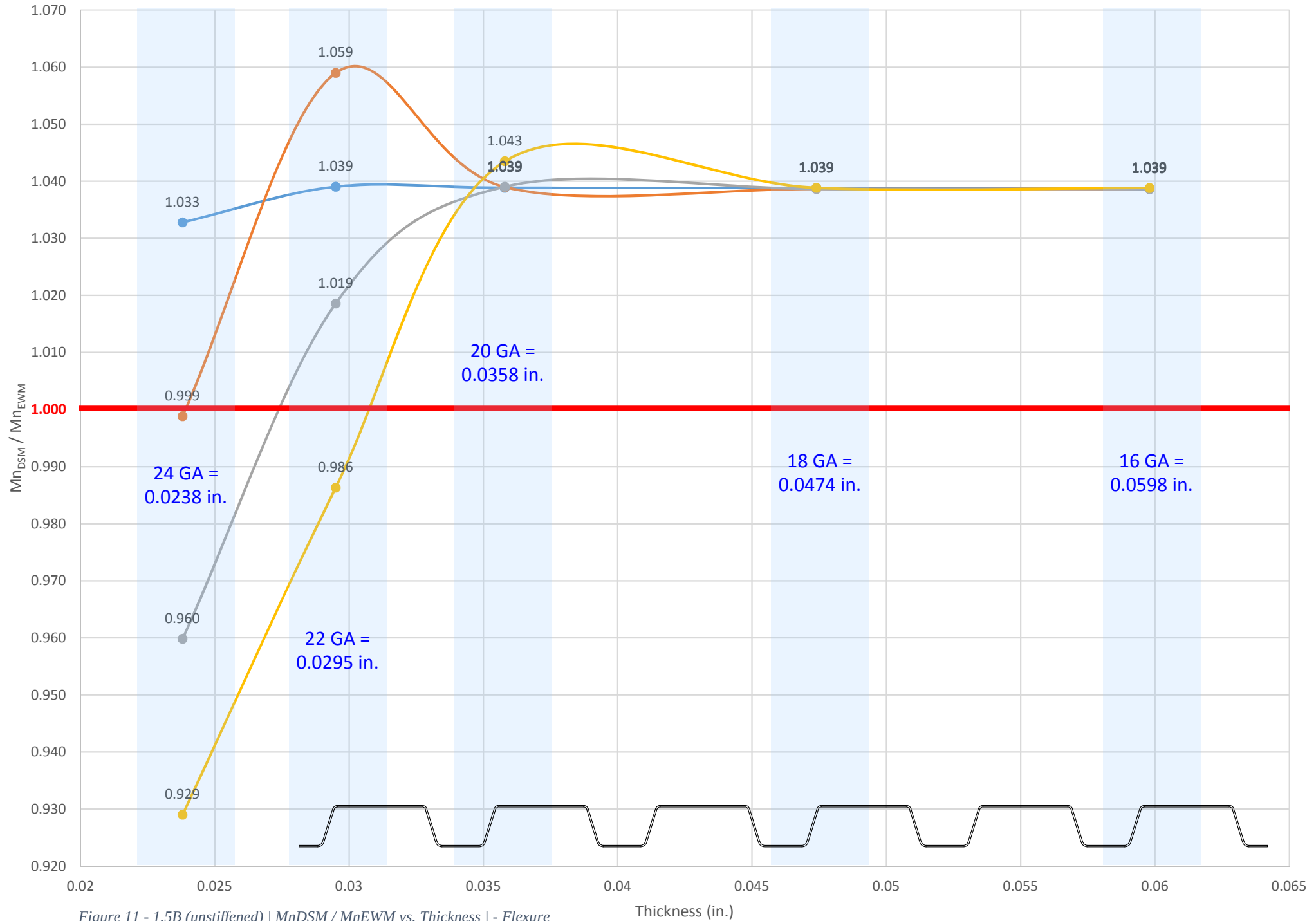


Figure 11 - 1.5B (unstiffened) | Mn_{DSM} / Mn_{EWM} vs. Thickness | - Flexure

1.5B Deck Negative Bending

CHAPTER 5: ANALYSIS | 1.5B DECK | - BENDING

5.2 Analysis Results Summary

Table 5 - 1.5B (unstiffened) | Analysis Results Summary | - Flexure

1.5 B DECK - 33 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
CL Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I_G	0.4345	0.5389	0.6543	0.8674	1.0957
$\bar{y}_G$	0.9127	0.9150	0.9176	0.9223	0.9273
S_{xx}	0.4761	0.5889	0.7131	0.9405	1.1816
My	15.71	19.43	23.53	31.04	38.99
Mn_{DSM}	14.80	19.43	23.53	31.04	38.99
Mn_{EWM}	14.33	18.7	22.65	29.88	37.54
% ERROR	3.176%	3.757%	3.740%	3.737%	3.719%

1.5 B DECK - 40 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
CL Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I_G	0.4345	0.5389	0.6543	0.8674	1.0957
$\bar{y}_G$	0.9127	0.9150	0.9176	0.9223	0.9273
S_{xx}	0.4761	0.5889	0.7131	0.9405	1.1816
My	19.04	23.56	28.53	37.62	47.26
Mn_{DSM}	16.86	23.52	28.53	37.62	47.26
Mn_{EWM}	16.88	22.21	27.46	36.22	45.5
% ERROR	-0.119%	5.570%	3.750%	3.721%	3.724%

1.5 B DECK - 50 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
CL Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I_G	0.4345	0.5389	0.6543	0.8674	1.0957
$\bar{y}_G$	0.9127	0.9150	0.9176	0.9223	0.9273
S_{xx}	0.4761	0.5889	0.7131	0.9405	1.1816
My	23.80	29.45	35.66	47.02	59.08
Mn_{DSM}	19.58	27.41	35.66	47.02	59.08
Mn_{EWM}	20.4	26.91	34.32	45.27	56.88
% ERROR	-4.188%	1.824%	3.758%	3.722%	3.724%

1.5 B DECK - 60 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
CL Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I_G	0.4345	0.5389	0.6543	0.8674	1.0957
$\bar{y}_G$	0.9127	0.9150	0.9176	0.9223	0.9273
S_{xx}	0.4761	0.5889	0.7131	0.9405	1.1816
My	28.57	35.34	42.79	56.43	70.90
Mn_{DSM}	22.11	31.01	41.99	56.43	70.90
Mn_{EWM}	23.8	31.44	40.24	54.32	68.25
% ERROR	-7.644%	-1.387%	4.168%	3.739%	3.738%

1.5 B DECK - 33 KSI				
Thickness		Mn_{DSM}	Mn_{EWM}	Mn_{DSM} / Mn_{EWM}
24	0.0238	14.800	14.33	1.033
22	0.0295	19.430	18.7	1.039
20	0.0358	23.530	22.65	1.039
18	0.0474	31.040	29.88	1.039
16	0.0598	38.990	37.54	1.039

1.5 B DECK - 40 KSI				
Thickness		Mn_{DSM}	Mn_{EWM}	Mn_{DSM} / Mn_{EWM}
24	0.0238	16.860	16.88	0.999
22	0.0295	23.520	22.21	1.059
20	0.0358	28.530	27.46	1.039
18	0.0474	37.620	36.22	1.039
16	0.0598	47.260	45.5	1.039

1.5 B DECK - 50 KSI				
Thickness		Mn_{DSM}	Mn_{EWM}	Mn_{DSM} / Mn_{EWM}
24	0.0238	19.580	20.4	0.960
22	0.0295	27.410	26.91	1.019
20	0.0358	35.660	34.32	1.039
18	0.0474	47.020	45.27	1.039
16	0.0598	59.080	56.88	1.039

1.5 B DECK - 60 KSI				
Thickness		Mn_{DSM}	Mn_{EWM}	Mn_{DSM} / Mn_{EWM}
24	0.0238	22.110	23.8	0.929
22	0.0295	31.010	31.44	0.986
20	0.0358	41.990	40.24	1.043
18	0.0474	56.430	54.32	1.039
16	0.0598	70.900	68.25	1.039

5.3 Direct Strength Method Calculations

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	16	GA		
	Strength:	-33	KSI		
	M_y	38.99	kip-in	Length:	
local	M_{crf}/M_y	7.42470	$M_{crf} = 289.48905$	kip-in	2 in
dist.	M_{crd}/M_y	6.00000	$M_{crd} = 233.94$	kip-in	- in
global	M_{cre}/M_y	6.00000	$M_{cre} = 233.94$	kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 38.99 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.37 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 38.99 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 38.99 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 38.99 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	16	GA		
	Strength:	-40	KSI		
	M_y	47.26	kip-in	Length:	
local	M_{crf}/M_y	6.12540	$M_{crf} = 289.4864$ kip-in		2 in
dist.	M_{crd}/M_y	6.00000	$M_{crd} = 283.56$ kip-in		- in
global	M_{cre}/M_y	6.00000	$M_{cre} = 283.56$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 47.26 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.40 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 47.26 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 47.26 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 47.26 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	16	GA		
	Strength:	-50	KSI		
	$M_y =$	59.08	kip-in	Length:	
local	$M_{crf}/M_y =$	4.90030	$M_{crf} = 289.50972$ kip-in		2 in
dist.	$M_{crd}/M_y =$	6.00000	$M_{crd} = 354.48$ kip-in		- in
global	$M_{cre}/M_y =$	6.00000	$M_{cre} = 354.48$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 59.08 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.45 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 59.08 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 59.08 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 59.08 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	16	GA		
	Strength:	-60	KSI		
	M_y	70.90	kip-in	Length:	
local	M_{crf}/M_y	4.08360	$M_{crf} = 289.52724$	kip-in	2 in
dist.	M_{crd}/M_y	6.00000	$M_{crd} = 425.4$	kip-in	- in
global	M_{cre}/M_y	6.00000	$M_{cre} = 425.4$	kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 70.90 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.49 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 70.90 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 70.90 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 70.90 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	18	GA		
	Strength:	-33	KSI		
	M_y	31.04	kip-in	Length:	
local	M_{crf}/M_y	4.77600	$M_{crf} = 148.24704$ kip-in		2 in
dist.	M_{crd}/M_y	6.00000	$M_{crd} = 186.24$ kip-in		- in
global	M_{cre}/M_y	6.00000	$M_{cre} = 186.24$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 31.04 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.46 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 31.04 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 31.04 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 31.04 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	18	GA		
	Strength:	-40	KSI		
	$M_y =$	37.62	kip-in	Length:	
local	$M_{crf}/M_y =$	3.94020	$M_{crf} = 148.23032$ kip-in		2 in
dist.	$M_{crd}/M_y =$	6.00000	$M_{crd} = 225.72$ kip-in		- in
global	$M_{cre}/M_y =$	6.00000	$M_{cre} = 225.72$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 37.62 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.50 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 37.62 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 37.62 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 37.62 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	18	GA		
	Strength:	-50	KSI		
	$M_y =$	47.02	kip-in	Length:	
local	$M_{crf}/M_y =$	3.15220	$M_{crf} = 148.21644$ kip-in		2 in
dist.	$M_{crd}/M_y =$	6.00000	$M_{crd} = 282.12$ kip-in		- in
global	$M_{cre}/M_y =$	6.00000	$M_{cre} = 282.12$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 47.02 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.56 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 47.02 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 47.02 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 47.02 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/25/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	18	GA		
	Strength:	-60	KSI		
	$M_y =$	56.43	kip-in	Length:	
local	$M_{crf}/M_y =$	2.62680	$M_{crf} = 148.23032$ kip-in		2 in
dist.	$M_{crd}/M_y =$	6.00000	$M_{crd} = 338.58$ kip-in		- in
global	$M_{cre}/M_y =$	6.00000	$M_{cre} = 338.58$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 56.43 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.62 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 56.43 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 56.43 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 56.43 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	20	GA		
	Strength:	-33	KSI		
	$M_y =$	23.53	kip-in	Length:	
local	$M_{crf}/M_y =$	2.84230	$M_{crf} = 66.879319$	kip-in	2 in
dist.	$M_{crd}/M_y =$	6.00000	$M_{crd} =$	141.18 kip-in	- in
global	$M_{cre}/M_y =$	6.00000	$M_{cre} =$	141.18 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 23.53 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.59 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 23.53 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 23.53 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 23.53 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	20	GA		
	Strength:	-40	KSI		
	$M_y =$	28.53	kip-in	Length:	
local	$M_{crf}/M_y =$	2.34490	$M_{crf} = 66.899997$	kip-in	2 in
dist.	$M_{crd}/M_y =$	6.00000	$M_{crd} =$	171.18 kip-in	- in
global	$M_{cre}/M_y =$	6.00000	$M_{cre} =$	171.18 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 28.53 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.65 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 28.53 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 28.53 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 28.53 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	20	GA		
	Strength:	-50	KSI		
	$M_y =$	35.66	kip-in	Length:	
local	$M_{crf}/M_y =$	1.87590	$M_{crf} = 66.894594$	kip-in	2 in
dist.	$M_{crd}/M_y =$	6.00000	$M_{crd} =$	213.96	kip-in
global	$M_{cre}/M_y =$	6.00000	$M_{cre} =$	213.96	kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 35.66 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.73 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 35.66 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 35.66 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 35.66 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	20	GA		
	Strength:	-60	KSI		
	$M_y =$	42.79	kip-in	Length:	
local	$M_{crf}/M_y =$	1.56320	$M_{crf} = 66.889328$	kip-in	2 in
dist.	$M_{crd}/M_y =$	6.00000	$M_{crd} = 256.74$	kip-in	- in
global	$M_{cre}/M_y =$	6.00000	$M_{cre} = 256.74$	kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 42.79 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.80 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 41.99 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 42.79 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 41.99 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	22	GA		
	Strength:	-33	KSI		
	M_y	19.43	kip-in	Length:	
local	M_{crf}/M_y	2.00370	$M_{crf} = 38.931891$	kip-in	2 in
dist.	M_{crd}/M_y	6.00000	$M_{crd} = 116.58$	kip-in	- in
global	M_{cre}/M_y	6.00000	$M_{cre} = 116.58$	kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 19.43 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.71 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 19.43 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 19.43 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 19.43 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	22	GA		
	Strength:	-40	KSI		
	$M_y =$	23.56	kip-in	Length:	
local	$M_{crf}/M_y =$	1.65300	$M_{crf} =$	38.94468 kip-in	2 in
dist.	$M_{crd}/M_y =$	6.00000	$M_{crd} =$	141.36 kip-in	- in
global	$M_{cre}/M_y =$	6.00000	$M_{cre} =$	141.36 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y$$

$$M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y$$

$$M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y$$

$$M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 23.56 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776$$

$$M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776$$

$$M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.78 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 23.52 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673$$

$$M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673$$

$$M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness})$$

$$M_{nd} = 23.56 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 23.52 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	22	GA		
	Strength:	-50	KSI		
	M_y	29.45	kip-in	Length:	
local	M_{crf}/M_y	1.32240	$M_{crf} = 38.94468$	kip-in	2 in
dist.	M_{crd}/M_y	6.00000	$M_{crd} = 176.7$	kip-in	- in
global	M_{cre}/M_y	6.00000	$M_{cre} = 176.7$	kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 29.45 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.87 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 27.41 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 29.45 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 27.41 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	22	GA		
	Strength:	-60	KSI		
	$M_y =$	35.34	kip-in	Length:	
local	$M_{crf}/M_y =$	1.10200	$M_{crf} =$ 38.94468 kip-in		2 in
dist.	$M_{crd}/M_y =$	6.00000	$M_{crd} =$ 212.04 kip-in		- in
global	$M_{cre}/M_y =$	6.00000	$M_{cre} =$ 212.04 kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 35.34 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.95 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 31.01 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 35.34 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 31.01 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	24	GA		
	Strength:	-33	KSI		
	$M_y =$	15.71	kip-in	Length:	
local	$M_{crf}/M_y =$	1.37370	$M_{crf} = 21.580827$	kip-in	2 in
dist.	$M_{crd}/M_y =$	6.00000	$M_{crd} =$	94.26 kip-in	- in
global	$M_{cre}/M_y =$	6.00000	$M_{cre} =$	94.26 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 15.71 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.85 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 14.80 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 15.71 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 14.80 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	24	GA		
	Strength:	-40	KSI		
	M_y	19.04	kip-in	Length:	
local	M_{crf}/M_y	1.13330	$M_{crf} = 21.578032$	kip-in	2 in
dist.	M_{crd}/M_y	6.00000	$M_{crd} = 114.24$	kip-in	- in
global	M_{cre}/M_y	6.00000	$M_{cre} = 114.24$	kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 19.04 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.94 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 16.86 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 19.04 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 16.86 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	24	GA		
	Strength:	-50	KSI		
	$M_y =$	23.80	kip-in	Length:	
local	$M_{crf}/M_y =$	0.90665	$M_{crf} =$ 21.57827 kip-in		2 in
dist.	$M_{crd}/M_y =$	6.00000	$M_{crd} =$ 142.8 kip-in		- in
global	$M_{cre}/M_y =$	6.00000	$M_{cre} =$ 142.8 kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 23.80 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.05 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 19.58 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 23.80 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 19.58 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B			
	Gage:	24	GA		
	Strength:	-60	KSI		
	$M_y =$	28.57	kip-in	Length:	
local	$M_{crf}/M_y =$	0.75554	$M_{crf} = 21.585778$	kip-in	2 in
dist.	$M_{crd}/M_y =$	6.00000	$M_{crd} = 171.42$	kip-in	- in
global	$M_{cre}/M_y =$	6.00000	$M_{cre} = 171.42$	kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 28.57 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.15 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 22.11 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness}) \\ M_{nd} = 28.57 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 22.11 \text{ kip-in} \quad (\text{local-global controls})$$

5.4 Effective Width Method Calculations

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 16 GA
Strength: 33 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.030
Corners	0.276	0.194
Top Flange	1.377	0.030
Web	1.275	0.770
Bottom Flange	3.144	1.510

Guess $\bar{y}$: 0.610 in.

Stress in Flange: 21.644 ksi
k: 4
Fcr: 201.212 ksi
 λ : 0.328
 ρ : 1.004
Effective Width: 1.377 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.030	0.000	0.000	--
Bottom Corner	12	3.309	1.346	4.452	5.991	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	0.194	0.642	0.125	0.007
Top Flange	6	8.260	1.510	12.472	18.832	--
Bottom Flange	6	18.862	0.030	0.564	0.017	--
	Σ	49.036		29.907	34.032	1.898

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.610 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.930 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 1.058 in.⁴
 $S_e = I_x / \bar{y} =$ 1.138 in.³
Mn = Se * Fy = 37.54 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 16 GA
Strength: 40 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.030
Corners	0.276	0.194
Top Flange	1.377	0.030
Web	1.275	0.770
Bottom Flange	3.144	1.510

Guess $\bar{y}$: 0.610 in.

Stress in Flange: 26.235 ksi
k: 4
Fcr: 201.212 ksi
 λ : 0.361
 ρ : 1.082
Effective Width: 1.377 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.030	0.000	0.000	--
Bottom Corner	12	3.309	1.346	4.452	5.991	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	0.194	0.642	0.125	0.007
Top Flange	6	8.260	1.510	12.472	18.832	--
Bottom Flange	6	18.862	0.030	0.564	0.017	--
Σ		49.036		29.907	34.032	1.898

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.610 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.930 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 1.058 in.⁴
 $S_e = I_x / \bar{y} =$ 1.138 in.³
Mn = Se * Fy = 45.50 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 16 GA
Strength: 50 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.030
Corners	0.276	0.194
Top Flange	1.377	0.030
Web	1.275	0.770
Bottom Flange	3.144	1.510

Guess $\bar{y}$: 0.610 in.

Stress in Flange: 32.794 ksi
k: 4
Fcr: 201.212 ksi
 λ : 0.404
 ρ : 1.127
Effective Width: 1.377 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.030	0.000	0.000	--
Bottom Corner	12	3.309	1.346	4.452	5.991	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	0.194	0.642	0.125	0.007
Top Flange	6	8.260	1.510	12.472	18.832	--
Bottom Flange	6	18.862	0.030	0.564	0.017	--
Σ		49.036		29.907	34.032	1.898

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.610 in.
 $\bar{y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.930 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$ 1.058 in.⁴
 $S_e = I_x / \bar{y} =$ 1.138 in.³
Mn = Se * Fy = 56.88 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 16 GA
Strength: 60 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.030
Corners	0.276	0.194
Top Flange	1.377	0.030
Web	1.275	0.770
Bottom Flange	3.144	1.510

Guess $\bar{y}$: 0.610 in.

Stress in Flange: 39.353 ksi
k: 4
Fcr: 201.212 ksi
 λ : 0.442
 ρ : 1.136
Effective Width: 1.377 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.030	0.000	0.000	--
Bottom Corner	12	3.309	1.346	4.452	5.991	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	0.194	0.642	0.125	0.007
Top Flange	6	8.260	1.510	12.472	18.832	--
Bottom Flange	6	18.862	0.030	0.564	0.017	--
Σ		49.036		29.907	34.032	1.898

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.610 in.
 $\bar{y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.930 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 1.058 in.⁴
 $S_e = I_x / \bar{y} =$ 1.138 in.³
Mn = Se * Fy = 68.25 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 18 GA
Strength: 33 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.024
Corners	0.268	0.183
Top Flange	1.377	0.024
Web	1.275	0.764
Bottom Flange	3.144	1.504

Guess $\bar{y}$: 0.603 in.

Stress in Flange: 21.532 ksi
k: 4
Fcr: 126.418 ksi
 λ : 0.413
 ρ : 1.131
Effective Width: 1.377 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.024	0.000	0.000	--
Bottom Corner	12	3.215	1.344	4.321	5.808	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	0.183	0.589	0.108	0.007
Top Flange	6	8.260	1.504	12.421	18.678	--
Bottom Flange	6	18.862	0.024	0.447	0.011	--
Σ		48.848		29.459	33.525	1.897

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.603 in.
 $\bar{y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.924 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.837 in.⁴
 $S_e = I_x / \bar{y} =$ 0.905 in.³
Mn = Se * Fy = 29.88 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 18 GA
Strength: 40 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.024
Corners	0.268	0.183
Top Flange	1.377	0.024
Web	1.275	0.764
Bottom Flange	3.144	1.504

Guess $\bar{y}$: 0.603 in.

Stress in Flange: 26.099 ksi
k: 4
Fcr: 126.418 ksi
 λ : 0.454
 ρ : 1.135
Effective Width: 1.377 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.024	0.000	0.000	--
Bottom Corner	12	3.215	1.344	4.321	5.808	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	0.183	0.589	0.108	0.007
Top Flange	6	8.260	1.504	12.421	18.678	--
Bottom Flange	6	18.862	0.024	0.447	0.011	--
Σ		48.848		29.459	33.525	1.897

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.603 in.
 $\bar{y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.924 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.837 in.⁴
 $S_e = I_x / \bar{y} =$ 0.905 in.³
Mn = Se * Fy = 36.22 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 18 GA
Strength: 50 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.024
Corners	0.268	0.183
Top Flange	1.377	0.024
Web	1.275	0.764
Bottom Flange	3.144	1.504

Guess $\bar{y}$: 0.603 in.

Stress in Flange: 32.624 ksi
k: 4
Fcr: 126.418 ksi
 λ : 0.508
 ρ : 1.116
Effective Width: 1.377 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.024	0.000	0.000	--
Bottom Corner	12	3.215	1.344	4.321	5.808	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	0.183	0.589	0.108	0.007
Top Flange	6	8.260	1.504	12.421	18.678	--
Bottom Flange	6	18.862	0.024	0.447	0.011	--
Σ		48.848		29.459	33.525	1.897

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.603 in.
 $\bar{y}_{\text{EXTREME FIBER}}$ = $\max(\bar{y}, h - \bar{y})$ = 0.924 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.837 in.⁴
 S_e = $I_x / \bar{y}$ = 0.905 in.³
Mn = Se * Fy = 45.27 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 18 GA
Strength: 60 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.024
Corners	0.268	0.183
Top Flange	1.377	0.024
Web	1.275	0.764
Bottom Flange	3.144	1.504

Guess $\bar{y}$: 0.603 in.

Stress in Flange: 39.148 ksi
k: 4
Fcr: 126.418 ksi
 λ : 0.556
 ρ : 1.087
Effective Width: 1.377 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.024	0.000	0.000	--
Bottom Corner	12	3.215	1.344	4.321	5.808	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	0.183	0.589	0.108	0.007
Top Flange	6	8.260	1.504	12.421	18.678	--
Bottom Flange	6	18.862	0.024	0.447	0.011	--
Σ		48.848		29.459	33.525	1.897

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.603 in.
 $\bar{y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.924 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.837 in.⁴
 $S_e = I_x / \bar{y} =$ 0.905 in.³
Mn = Se * Fy = 54.32 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 20 GA
Strength: 33 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.018
Corners	0.261	0.173
Top Flange	1.377	0.018
Web	1.275	0.758
Bottom Flange	3.144	1.498

Guess $\bar{y}$: 0.597 in.

Stress in Flange: 21.425 ksi
k: 4
Fcr: 72.114 ksi
 λ : 0.545
 ρ : 1.094
Effective Width: 1.377 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.018	0.000	0.000	--
Bottom Corner	12	3.126	1.343	4.198	5.637	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	0.173	0.541	0.094	0.006
Top Flange	6	8.260	1.498	12.373	18.534	--
Bottom Flange	6	18.862	0.018	0.338	0.006	--
Σ		48.671		29.043	33.056	1.896

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.597 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.919 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.631 in.⁴
 $S_e = I_x / \bar{y} =$ 0.686 in.³
Mn = Se * Fy = 22.65 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 20 GA
Strength: 40 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.018
Corners	0.261	0.173
Top Flange	1.377	0.018
Web	1.275	0.758
Bottom Flange	3.144	1.498

Guess $\bar{y}$: 0.597 in.

Stress in Flange: 25.969 ksi
k: 4
Fcr: 72.114 ksi
 λ : 0.600
 ρ : 1.055
Effective Width: 1.377 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.018	0.000	0.000	--
Bottom Corner	12	3.126	1.343	4.198	5.637	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	0.173	0.541	0.094	0.006
Top Flange	6	8.260	1.498	12.373	18.534	--
Bottom Flange	6	18.862	0.018	0.338	0.006	--
Σ		48.671		29.043	33.056	1.896

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.597 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.919 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.631 in.⁴
 $S_e = I_x / \bar{y} =$ 0.686 in.³
Mn = Se * Fy = 27.46 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 20 GA
Strength: 50 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.018
Corners	0.261	0.173
Top Flange	1.377	0.018
Web	1.275	0.758
Bottom Flange	3.144	1.498

Guess $\bar{y}$: 0.597 in.

Stress in Flange: 32.462 ksi
k: 4
Fcr: 72.114 ksi
 λ : 0.671
 ρ : 1.002
Effective Width: 1.377 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.018	0.000	0.000	--
Bottom Corner	12	3.126	1.343	4.198	5.637	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	0.173	0.541	0.094	0.006
Top Flange	6	8.260	1.498	12.373	18.534	--
Bottom Flange	6	18.862	0.018	0.338	0.006	--
Σ		48.671		29.043	33.056	1.896

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.597 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.919 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.631 in.⁴
 $S_e = I_x / \bar{y} =$ 0.686 in.³
Mn = Se * Fy = 34.32 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 20 GA
Strength: 60 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.018
Corners	0.261	0.173
Top Flange	1.377	0.018
Web	1.275	0.758
Bottom Flange	3.144	1.498

Guess $\bar{y}$: 0.590 in.

Stress in Flange: 38.265 ksi
k: 4
Fcr: 72.114 ksi
 λ : 0.728
 ρ : 0.958
Effective Width: 1.319 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.018	0.000	0.000	--
Bottom Corner	12	3.126	1.343	4.198	5.637	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	0.173	0.541	0.094	0.006
Top Flange	6	7.915	1.498	11.856	17.759	--
Bottom Flange	6	18.862	0.018	0.338	0.006	--
Σ		48.326		28.525	32.281	1.896

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.590 in.
 $\bar{y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.926 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.621 in.⁴
 $S_e = I_x / \bar{y} =$ 0.671 in.³
Mn = Se * Fy = 40.24 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 22 GA
Strength: 33 ksi
Thickness: 0.0295 in.
Total Height: 1.510 in.
Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000477 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.015
Corners	0.257	0.168
Top Flange	1.377	0.015
Web	1.275	0.755
Bottom Flange	3.144	1.495

Guess $\bar{y}$: 0.593 in.

Stress in Flange: 21.366 ksi
k: 4
Fcr: 48.966 ksi
 λ : 0.661
 ρ : 1.010
Effective Width: 1.377 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.015	0.000	0.000	--
Bottom Corner	12	3.079	1.342	4.131	5.544	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	0.168	0.516	0.086	0.006
Top Flange	6	8.260	1.495	12.347	18.456	--
Bottom Flange	6	18.862	0.015	0.278	0.004	--
	Σ	48.576		28.817	32.804	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.593 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.916 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.519 in.⁴
 $S_e = I_x / \bar{y} =$ 0.567 in.³
Mn = Se * Fy = 18.70 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
 calc by: RKD
 check by: TS

Deck: 1.58
 Gage: 22 GA
 Strength: 40 ksi
 Thickness: 0.0295 in.
 Total Height: 1.510 in.
 Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
 Curve I'_x : 0.000477 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.015
Corners	0.257	0.168
Top Flange	1.377	0.015
Web	1.275	0.755
Bottom Flange	3.144	1.495

Guess $\bar{y}$: 0.588 in.

Stress in Flange: 25.494 ksi
 k: 4
 Fcr: 48.966 ksi
 λ : 0.722
 ρ : 0.963
 Effective Width: 1.326 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.015	0.000	0.000	--
Bottom Corner	12	3.079	1.342	4.131	5.544	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	0.168	0.516	0.086	0.006
Top Flange	6	7.958	1.495	11.895	17.780	--
Bottom Flange	6	18.862	0.015	0.278	0.004	--
Σ		48.273		28.364	32.127	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.588 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.922 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.512 in.⁴
 $S_e = I_x / \bar{y} =$ 0.555 in.³
Mn = Se * Fy = 22.21 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
 calc by: RKD
 check by: TS

Deck: 1.58
 Gage: 22 GA
 Strength: 50 ksi
 Thickness: 0.0295 in.
 Total Height: 1.510 in.
 Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
 Curve I'_x : 0.000477 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.015
Corners	0.257	0.168
Top Flange	1.377	0.015
Web	1.275	0.755
Bottom Flange	3.144	1.495

Guess $\bar{y}$: 0.579 in.

Stress in Flange: 31.109 ksi
 k: 4
 Fcr: 48.966 ksi
 λ : 0.797
 ρ : 0.908
 Effective Width: 1.251 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.015	0.000	0.000	--
Bottom Corner	12	3.079	1.342	4.131	5.544	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	0.168	0.516	0.086	0.006
Top Flange	6	7.503	1.495	11.215	16.764	--
Bottom Flange	6	18.862	0.015	0.278	0.004	--
Σ		47.818		27.685	31.112	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.579 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.931 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.501 in.⁴
 $S_e = I_x / \bar{y} =$ 0.538 in.³
Mn = Se * Fy = 26.91 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 22 GA
Strength: 60 ksi
Thickness: 0.0295 in.
Total Height: 1.510 in.
Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000477 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.015
Corners	0.257	0.168
Top Flange	1.377	0.015
Web	1.275	0.755
Bottom Flange	3.144	1.495

Guess $\bar{y}$: 0.572 in.

Stress in Flange: 36.573 ksi
k: 4
Fcr: 48.966 ksi
 λ : 0.864
 ρ : 0.863
Effective Width: 1.187 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.015	0.000	0.000	--
Bottom Corner	12	3.079	1.342	4.131	5.544	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	0.168	0.516	0.086	0.006
Top Flange	6	7.125	1.495	10.650	15.919	--
Bottom Flange	6	18.862	0.015	0.278	0.004	--
Σ		47.440		27.120	30.267	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.572 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.938 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.491 in.⁴
 $S_e = I_x / \bar{y} =$ 0.524 in.³
Mn = Se * Fy = 31.44 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 24 GA
Strength: 33 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.012
Corners	0.253	0.163
Top Flange	1.377	0.012
Web	1.275	0.752
Bottom Flange	3.144	1.492

Guess $\bar{y}$: 0.575 in.

Stress in Flange: 20.450 ksi
k: 4
Fcr: 31.872 ksi
 λ : 0.801
 ρ : 0.906
Effective Width: 1.247 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.012	0.000	0.000	--
Bottom Corner	12	3.035	1.341	4.071	5.460	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	0.163	0.493	0.080	0.005
Top Flange	6	7.480	1.492	11.160	16.649	--
Bottom Flange	6	18.862	0.012	0.224	0.003	--
	Σ	47.709		27.449	30.840	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.575 in.
 $\bar{y}_{\text{EXTREME FIBER}}$ = $\max(\bar{y}, h - \bar{y})$ = 0.928 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.403 in.⁴
 S_e = $I_x / \bar{y}$ = 0.434 in.³
Mn = Se * Fy = 14.33 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 24 GA
Strength: 40 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.012
Corners	0.253	0.163
Top Flange	1.377	0.012
Web	1.275	0.752
Bottom Flange	3.144	1.492

Guess $\bar{y}$: 0.568 in.

Stress in Flange: 24.253 ksi
k: 4
Fcr: 31.872 ksi
 λ : 0.872
 ρ : 0.857
Effective Width: 1.180 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.012	0.000	0.000	--
Bottom Corner	12	3.035	1.341	4.071	5.460	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	0.163	0.493	0.080	0.005
Top Flange	6	7.081	1.492	10.565	15.761	--
Bottom Flange	6	18.862	0.012	0.224	0.003	--
Σ		47.310		26.854	29.952	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.568 in.
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.936 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.395 in.⁴
 $S_e = I_x / \bar{y} =$ 0.422 in.³
Mn = Se * Fy = 16.88 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 24 GA
Strength: 50 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.012
Corners	0.253	0.163
Top Flange	1.377	0.012
Web	1.275	0.752
Bottom Flange	3.144	1.492

Guess $\bar{y}$: 0.559 in.

Stress in Flange: 29.542 ksi
k: 4
Fcr: 31.872 ksi
 λ : 0.963
 ρ : 0.801
Effective Width: 1.103 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.012	0.000	0.000	--
Bottom Corner	12	3.035	1.341	4.071	5.460	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	0.163	0.493	0.080	0.005
Top Flange	6	6.619	1.492	9.875	14.733	--
Bottom Flange	6	18.862	0.012	0.224	0.003	--
Σ		46.848		26.165	28.924	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.559 in.
 $\bar{y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.945 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.386 in.⁴
 $S_e = I_x / \bar{y} =$ 0.408 in.³
Mn = Se * Fy = 20.40 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 1.58
Gage: 24 GA
Strength: 60 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

Element	L (in.)	y from top (in.)
Lip	0.689	0.012
Corners	0.253	0.163
Top Flange	1.377	0.012
Web	1.275	0.752
Bottom Flange	3.144	1.492

Guess $\bar{y}$: 0.551 in.

Stress in Flange: 34.702 ksi
k: 4
Fcr: 31.872 ksi
 λ : 1.043
 ρ : 0.756
Effective Width: 1.041 in.

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.012	0.000	0.000	--
Bottom Corner	12	3.035	1.341	4.071	5.460	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	0.163	0.493	0.080	0.005
Top Flange	6	6.247	1.492	9.320	13.905	--
Bottom Flange	6	18.862	0.012	0.224	0.003	--
Σ		46.476		25.610	28.096	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L =$ 0.551 in.
 $\bar{y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$ 0.953 in.
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$ 0.378 in.⁴
 $S_e = I_x / \bar{y} =$ 0.397 in.³
Mn = Se * Fy = 23.80 k-in.

CHAPTER 6: ANALYSIS | 1.5B DECK (STIFFENED) | + BENDING



6.0 Executive Summary

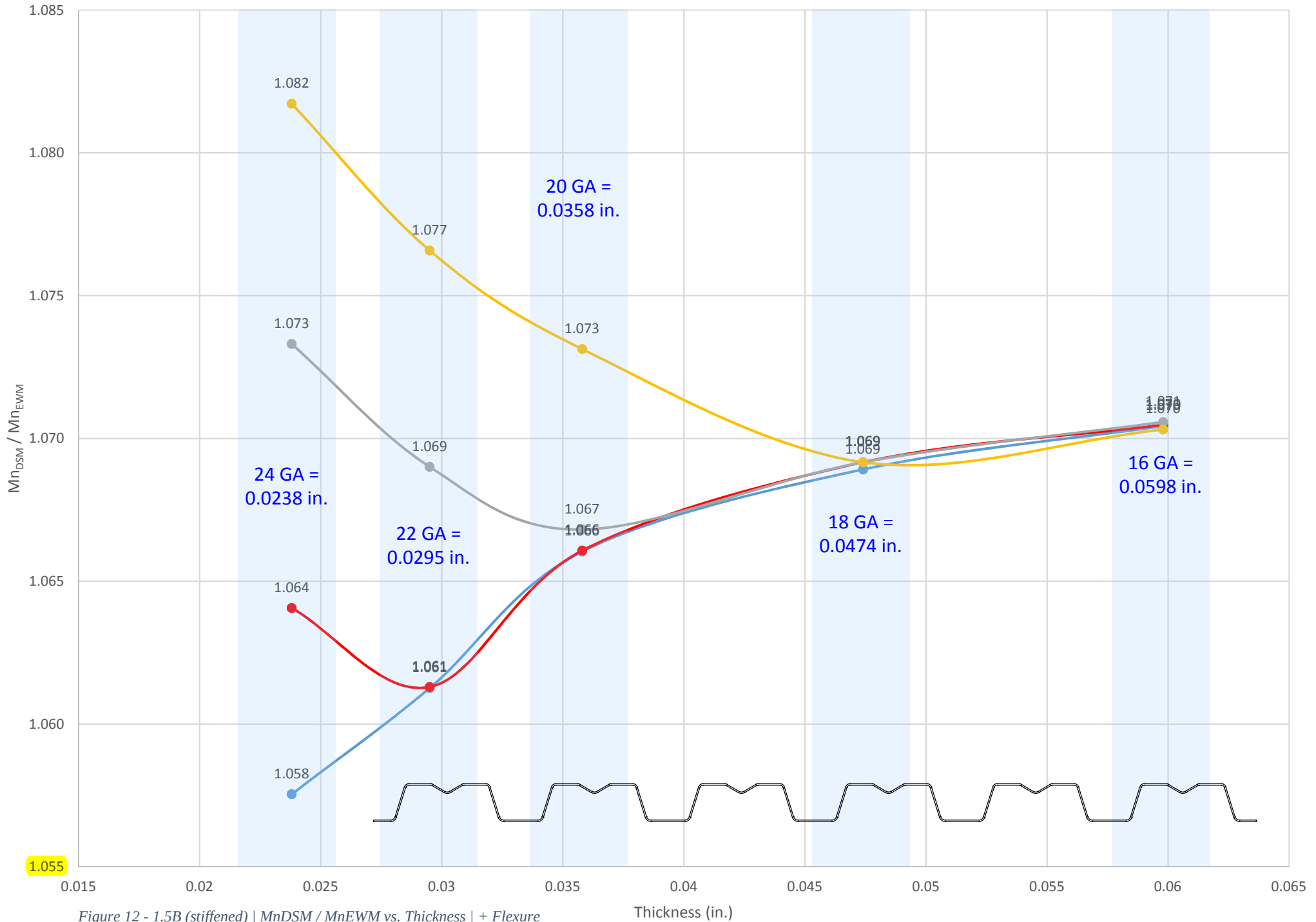
To observe how a stiffened deck section performs compared to an unstiffened deck section, we created a non-standard shape by adding the compression flange stiffener from the 2C Deck to the 1.5B Deck. With the addition of the stiffener in the compression flange, the Direct Strength Method predicted higher strengths for each of the 1.5B Deck sections undergoing positive flexure. The nominal moment capacity ratio (M_{nDSM}/M_{nEWM}) ranged between 1.058 and 1.082. We believe that we see an increase in strength with DSM due to the decreased flat width of the compression flange.

CHAPTER 6: ANALYSIS | 1.5B DECK (STIFFENED) | + BENDING

6.1 M_{nDSM} / M_{nEWM} vs. Thickness Plot

Mn_{DSM} / Mn_{EWM} vs. Thickness

33 KSI 40 KSI 50 KSI 60 KSI



6.2 Analysis Results Summary

Table 6 - 1.5B (stiffened) | Analysis Results Summary | + Flexure

1.5B DECK (stiffeners) - 33 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I _c (CUFSM)	0.407	0.505	0.616	0.815	1.025
y-bar (CUFSM)	0.89116	0.89128	0.89289	0.89359	0.89359
S _{xx}	0.457	0.567	0.690	0.912	1.147
M _y	15.07	18.71	22.76	30.09	37.84
M _{n_{DSM}}	15.07	18.71	22.76	30.09	37.84
M _{n_{EWM}}	14.25	17.63	21.35	28.15	35.35
% ERROR	5.441%	5.772%	6.195%	6.447%	6.580%

1.5B DECK (stiffeners) - 40 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I _c (CUFSM)	0.407	0.505	0.616	0.815	1.025
y-bar (CUFSM)	0.89116	0.89128	0.89289	0.89359	0.89359
S _{xx}	0.457	0.567	0.690	0.912	1.147
M _y	18.27	22.68	27.59	36.48	45.87
M _{n_{DSM}}	18.27	22.68	27.59	36.48	45.87
M _{n_{EWM}}	17.17	21.37	25.88	34.12	42.85
% ERROR	6.021%	5.776%	6.198%	6.469%	6.584%

1.5B DECK (stiffeners) - 50 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I _c (CUFSM)	0.407	0.505	0.616	0.815	1.025
y-bar (CUFSM)	0.89116	0.89128	0.89289	0.89359	0.89359
S _{xx}	0.457	0.567	0.690	0.912	1.147
M _y	22.84	28.35	34.49	45.60	57.34
M _{n_{DSM}}	22.84	28.35	34.49	45.6	57.34
M _{n_{EWM}}	21.28	26.52	32.33	42.65	53.56
% ERROR	6.830%	6.455%	6.263%	6.469%	6.592%

1.5B DECK (stiffeners) - 60 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I _c (CUFSM)	0.407	0.505	0.616	0.815	1.025
y-bar (CUFSM)	0.89116	0.89128	0.89289	0.89359	0.89359
S _{xx}	0.457	0.567	0.690	0.912	1.147
M _y	27.40	34.02	41.38	54.72	68.80
M _{n_{DSM}}	27.4	34.02	41.38	54.72	68.8
M _{n_{EWM}}	25.33	31.6	38.56	51.18	64.28
% ERROR	7.555%	7.113%	6.815%	6.469%	6.570%

1.5B DECK (stiffeners) - 33 KSI				
Thickness		M _{n_{DSM}}	M _{n_{EWM}}	M _{n_{DSM}} / M _{n_{EWM}}
24	0.0238	15.07	14.25	1.058
22	0.0295	18.71	17.63	1.061
20	0.0358	22.76	21.35	1.066
18	0.0474	30.09	28.15	1.069
16	0.0598	37.84	35.35	1.070

1.5B DECK (stiffeners) - 40 KSI				
Thickness		M _{n_{DSM}}	M _{n_{EWM}}	M _{n_{DSM}} / M _{n_{EWM}}
24	0.0238	18.27	17.17	1.064
22	0.0295	22.68	21.37	1.061
20	0.0358	27.59	25.88	1.066
18	0.0474	36.48	34.12	1.069
16	0.0598	45.87	42.85	1.070

1.5B DECK (stiffeners) - 50 KSI				
Thickness		M _{n_{DSM}}	M _{n_{EWM}}	M _{n_{DSM}} / M _{n_{EWM}}
24	0.0238	22.84	21.28	1.073
22	0.0295	28.35	26.52	1.069
20	0.0358	34.49	32.33	1.067
18	0.0474	45.60	42.65	1.069
16	0.0598	57.34	53.56	1.071

1.5B DECK (stiffeners) - 60 KSI				
Thickness		M _{n_{DSM}}	M _{n_{EWM}}	M _{n_{DSM}} / M _{n_{EWM}}
24	0.0238	27.4	25.33	1.082
22	0.0295	34.02	31.60	1.077
20	0.0358	41.38	38.56	1.073
18	0.0474	54.72	51.18	1.069
16	0.0598	68.80	64.28	1.070

6.3 Direct Strength Method Calculations

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	16	GA
	Strength:	33	KSI
	$M_y =$	37.84	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	22.34510	$M_{cr\ell} = 845.5386$ kip-in 1 in
dist.	$M_{crd}/M_y =$	14.43000	$M_{crd} = 546.0312$ kip-in 11 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1892$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 37.84 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.21 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 37.84 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.26 \quad (\text{distortional slenderness})$$

$$M_{nd} = 37.84 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 37.84 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	16	GA
	Strength:	40	KSI
	$M_y =$	45.87	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	18.43470	$M_{cr\ell} = 845.5997$ kip-in 1 in
dist.	$M_{crd}/M_y =$	11.90000	$M_{crd} = 545.853$ kip-in 11 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 2293.5$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 45.87 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.23 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 45.87 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.29 \quad (\text{distortional slenderness})$$

$$M_{nd} = 45.87 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 45.87 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	16	GA
	Strength:	50	KSI
	$M_y =$	57.34	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	14.74770	$M_{cr\ell} = 845.6331$ kip-in 1 in
dist.	$M_{crd}/M_y =$	9.52000	$M_{crd} = 545.8768$ kip-in 11 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 2867$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 57.34 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.26 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 57.34 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness})$$

$$M_{nd} = 57.34 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 57.34 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	16	GA
	Strength:	60	KSI
	$M_y =$	68.80	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	12.28990	$M_{cr\ell} = 845.5451$ kip-in 1 in
dist.	$M_{crd}/M_y =$	7.93000	$M_{crd} = 545.584$ kip-in 11 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 3440$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y$$
$$M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y$$
$$M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y$$
$$M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 68.80 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776$$
$$M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776$$
$$M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.29 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 68.80 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673$$
$$M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673$$
$$M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.36 \quad (\text{distortional slenderness})$$

$$M_{nd} = 68.80 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 68.80 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	18	GA
	Strength:	33	KSI
	$M_y =$	30.09	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	14.84880	$M_{cr\ell} = 446.8004$ kip-in 1 in
dist.	$M_{crd}/M_y =$	11.36000	$M_{crd} = 341.8224$ kip-in 12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1504.5$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 30.09 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.26 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 30.09 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.30 \quad (\text{distortional slenderness})$$

$$M_{nd} = 30.09 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 30.09 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	18	GA
	Strength:	40	KSI
	$M_y =$	36.48	kip-in
Length:			
local	$M_{cr\ell}/M_y =$	12.25040	$M_{cr\ell} = 446.8946$ kip-in
dist.	$M_{crd}/M_y =$	9.38000	$M_{crd} = 342.1824$ kip-in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1824$ kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 36.48 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.29 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 36.48 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.33 \quad (\text{distortional slenderness})$$

$$M_{nd} = 36.48 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 36.48 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	18	GA
	Strength:	50	KSI
	$M_y =$	45.60	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	9.80020	$M_{cr\ell} = 446.8891$ kip-in 1 in
dist.	$M_{crd}/M_y =$	7.50000	$M_{crd} = 342$ kip-in 12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 2280$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 45.60 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.32 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 45.60 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.37 \quad (\text{distortional slenderness})$$

$$M_{nd} = 45.60 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 45.60 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	18	GA
	Strength:	60	KSI
	$M_y =$	54.72	kip-in
Length:			
local	$M_{cr\ell}/M_y =$	8.16690	$M_{cr\ell} = 446.8928$ kip-in
dist.	$M_{crd}/M_y =$	6.25000	$M_{crd} = 342$ kip-in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 2736$ kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 54.72 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.35 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 54.72 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.40 \quad (\text{distortional slenderness})$$

$$M_{nd} = 54.72 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 54.72 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	20	GA
	Strength:	33	KSI
	$M_y =$	22.76	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	8.94530	$M_{cr\ell} = 203.595$ kip-in 1 in
dist.	$M_{crd}/M_y =$	8.76000	$M_{crd} = 199.3776$ kip-in 12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1138$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 22.76 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.33 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 22.76 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.34 \quad (\text{distortional slenderness})$$

$$M_{nd} = 22.76 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 22.76 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	20	GA
	Strength:	40	KSI
	$M_y =$	27.59	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	7.37980	$M_{cr\ell} = 203.6087$ kip-in 1 in
dist.	$M_{crd}/M_y =$	7.23000	$M_{crd} = 199.4757$ kip-in 12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1379.5$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 27.59 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.37 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 27.59 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.37 \quad (\text{distortional slenderness})$$

$$M_{nd} = 27.59 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 27.59 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	20	GA
	Strength:	50	KSI
	$M_y =$	34.49	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	5.90380	$M_{cr\ell} = 203.6221$ kip-in 1 in
dist.	$M_{crd}/M_y =$	5.78000	$M_{crd} = 199.3522$ kip-in 12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1724.5$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 34.49 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.41 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 34.49 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.42 \quad (\text{distortional slenderness})$$

$$M_{nd} = 34.49 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 34.49 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	20	GA
	Strength:	60	KSI
	$M_y =$	41.38	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	4.91990	$M_{cr\ell} = 203.5855$ kip-in 1 in
dist.	$M_{crd}/M_y =$	4.82000	$M_{crd} = 199.4516$ kip-in 12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 2069$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 41.38 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.45 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 41.38 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.46 \quad (\text{distortional slenderness})$$

$$M_{nd} = 41.38 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 41.38 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)	
	Gage:	22	GA	
	Strength:	33	KSI	
	M _y =	18.71	kip-in	Length:
local	M _{crf} /M _y =	6.31630	M _{crf} = 118.178 kip-in	1 in
dist.	M _{crd} /M _y =	7.43000	M _{crd} = 139.0153 kip-in	12 in
global	M _{cre} /M _y =	50.00000	M _{cre} = 935.5 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 18.71 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.40 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 18.71 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.37 \quad (\text{distortional slenderness})$$

$$M_{nd} = 18.71 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 18.71 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	22	GA
	Strength:	40	KSI
	$M_y =$	22.68	kip-in
Length:			
local	$M_{cr\ell}/M_y =$	5.21100	$M_{cr\ell} = 118.1855$ kip-in
dist.	$M_{crd}/M_y =$	6.13000	$M_{crd} = 139.0284$ kip-in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1134$ kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 22.68 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.44 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 22.68 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.40 \quad (\text{distortional slenderness})$$

$$M_{nd} = 22.68 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 22.68 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)		
	Gage:	22	GA		
	Strength:	50	KSI		
	$M_y =$	28.35	kip-in		Length:
local	$M_{crf}/M_y =$	4.16880	$M_{crf} =$	118.1855 kip-in	1 in
dist.	$M_{crd}/M_y =$	4.91000	$M_{crd} =$	139.1985 kip-in	12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} =$	1417.5 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 28.35 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.49 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 28.35 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness})$$

$$M_{nd} = 28.35 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 28.35 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)	
	Gage:	22	GA	
	Strength:	60	KSI	
	$M_y =$	34.02	kip-in	Length:
local	$M_{crf}/M_y =$	3.47400	$M_{crf} = 118.1855$ kip-in	1 in
dist.	$M_{crd}/M_y =$	4.09000	$M_{crd} = 139.1418$ kip-in	12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1701$ kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 34.02 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.54 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 34.02 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.49 \quad (\text{distortional slenderness})$$

$$M_{nd} = 34.02 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 34.02 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)	
	Gage:	24	GA	
	Strength:	33	KSI	
	M _y =	15.07	kip-in	Length:
local	M _{crf} /M _y =	4.25890	M _{crf} = 64.18162 kip-in	1 in
dist.	M _{crd} /M _y =	6.23000	M _{crd} = 93.8861 kip-in	24 in
global	M _{cre} /M _y =	50.00000	M _{cre} = 753.5 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 15.07 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.48 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 15.07 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.40 \quad (\text{distortional slenderness})$$

$$M_{nd} = 15.07 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 15.07 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	24	GA
	Strength:	40	KSI
	$M_y =$	18.27	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	3.51360	$M_{cr\ell} = 64.19347$ kip-in 1 in
dist.	$M_{crd}/M_y =$	5.14000	$M_{crd} = 93.9078$ kip-in 24 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 913.5$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 18.27 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.53 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 18.27 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.44 \quad (\text{distortional slenderness})$$

$$M_{nd} = 18.27 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 18.27 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	24	GA
	Strength:	50	KSI
	$M_y =$	22.84	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	2.81090	$M_{cr\ell} = 64.20096$ kip-in 1 in
dist.	$M_{crd}/M_y =$	4.11000	$M_{crd} = 93.8724$ kip-in 24 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1142$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 22.84 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.60 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 22.84 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.49 \quad (\text{distortional slenderness})$$

$$M_{nd} = 22.84 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 22.84 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	24	GA
	Strength:	60	KSI
	$M_y =$	27.40	kip-in
Length:			
local	$M_{cr\ell}/M_y =$	2.34240	$M_{cr\ell} = 64.18176$ kip-in
dist.	$M_{crd}/M_y =$	3.42000	$M_{crd} = 93.708$ kip-in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1370$ kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y$$
$$M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y$$
$$M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y$$
$$M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 27.40 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776$$
$$M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776$$
$$M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.65 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 27.40 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673$$
$$M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673$$
$$M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.54 \quad (\text{distortional slenderness})$$

$$M_{nd} = 27.40 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 27.40 \text{ kip-in} \quad (\text{local-global controls})$$

6.4 Effective Width Method Calculations

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 16 GA
Strength: 33 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.199 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000010 in.³

Guess $\bar{y}$: 0.629 in.

Stress in Flange: 22.812 ksi
k: 13.475
Fcr: 130.002 ksi
 λ : 0.419
 ρ : 1.000
Effective Width: 3.320 in.

δ : 1.056
lsp: 0.004 in.⁴
 γ : 63.186
 β : 3.359
kd: 7.896
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.510
Corners	0.276	0.194
Corners _{Stiff}	0.116	0.238
Bottom Flange	1.377	1.510
Web	1.275	0.770
Web _{Stiff}	0.564	0.215
Top Flange	3.320	0.110

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.510	2.079	3.139	--
Bottom Corner	12	3.309	1.346	4.452	5.991	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	0.194	0.642	0.125	0.007
Top Flange	6	19.920	0.110	2.183	0.239	--
Bottom Flange	5	6.884	1.510	10.394	15.694	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.325	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.872	0.000	0.000	0.000
Σ		50.093		31.527	34.254	1.898

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.629 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.910 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.975 in.⁴
 S_e = $I_x / \bar{y}$ = 1.071 in.³
Mn = Se * Fy = 35.35 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 16 GA
Strength: 40 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.199 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000010 in.³

Guess $\bar{y}$: 0.629 in.

Stress in Flange: 27.651 ksi
k: 13.475
Fcr: 130.002 ksi
 λ : 0.461
 ρ : 1.000
Effective Width: 3.320 in.

δ : 1.056
Isp: 0.004 in.⁴
 γ : 63.186
 β : 3.359
kd: 7.896
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.510
Corners	0.276	0.194
Corners _{Stiff}	0.116	0.238
Bottom Flange	1.377	1.510
Web	1.275	0.770
Web _{Stiff}	0.564	0.215
Top Flange	3.320	0.110

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.510	2.079	3.139	--
Bottom Corner	12	3.309	1.346	4.452	5.991	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	0.194	0.642	0.125	0.007
Top Flange	6	19.920	0.110	2.183	0.239	--
Bottom Flange	5	6.884	1.510	10.394	15.694	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.325	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.872	0.000	0.000	0.000
Σ		50.093		31.527	34.254	1.898

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.629 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.910 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.975 in.⁴
 S_e = $I_x / \bar{y}$ = 1.071 in.³
Mn = Se * Fy = 42.85 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 16 GA
Strength: 50 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.199 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000010 in.³

Guess $\bar{y}$: 0.629 in.

Stress in Flange: 34.563 ksi
k: 13.475
Fcr: 130.002 ksi
 λ : 0.516
 ρ : 1.000
Effective Width: 3.320 in.

δ : 1.056
lsp: 0.004 in.⁴
 γ : 63.186
 β : 3.359
kd: 7.896
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.510
Corners	0.276	0.194
Corners _{Stiff}	0.116	0.238
Bottom Flange	1.377	1.510
Web	1.275	0.770
Web _{Stiff}	0.564	0.215
Top Flange	3.320	0.110

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.510	2.079	3.139	--
Bottom Corner	12	3.309	1.346	4.452	5.991	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	0.194	0.642	0.125	0.007
Top Flange	6	19.920	0.110	2.183	0.239	--
Bottom Flange	5	6.884	1.510	10.394	15.694	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.325	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.872	0.000	0.000	0.000
Σ		50.093		31.527	34.254	1.898

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.629 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.910 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.975 in.⁴
 S_e = $I_x / \bar{y}$ = 1.071 in.³
Mn = Se * Fy = 53.56 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 16 GA
Strength: 60 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.199 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000010 in.³

Guess $\bar{y}$: 0.629 in.

Stress in Flange: 41.476 ksi
k: 13.475
Fcr: 130.002 ksi
 λ : 0.565
 ρ : 1.000
Effective Width: 3.320 in.

δ : 1.056
lsp: 0.004 in.⁴
 γ : 63.186
 β : 3.359
kd: 7.896
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.510
Corners	0.276	0.194
Corners _{Stiff}	0.116	0.238
Bottom Flange	1.377	1.510
Web	1.275	0.770
Web _{Stiff}	0.564	0.215
Top Flange	3.320	0.110

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.510	2.079	3.139	--
Bottom Corner	12	3.309	1.346	4.452	5.991	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	0.194	0.642	0.125	0.007
Top Flange	6	19.920	0.110	2.183	0.239	--
Bottom Flange	5	6.884	1.510	10.394	15.694	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.325	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.872	0.000	0.000	0.000
Σ		50.093		31.527	34.254	1.898

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.629 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.910 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.975 in.⁴
 S_e = $I_x / \bar{y}$ = 1.071 in.³
Mn = Se * Fy = 64.28 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.5B (stiffeners)
Gage: 18 GA
Strength: 33 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.157 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000009 in.³

Guess $\bar{y}$: 0.622 in.

Stress in Flange: 22.701 ksi
k: 16.607
Fcr: 100.657 ksi
 λ : 0.475
 ρ : 1.000
Effective Width: 3.320 in.

δ : 1.056
lsp: 0.003 in.⁴
 γ : 99.481
 β : 3.760
kd: 9.730
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.504
Corners	0.268	0.183
Corners _{Stiff}	0.113	0.225
Bottom Flange	1.377	1.504
Web	1.275	0.764
Web _{Stiff}	0.564	0.209
Top Flange	3.320	0.103

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.504	2.070	3.113	--
Bottom Corner	12	3.215	1.344	4.321	5.808	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	0.183	0.589	0.108	0.007
Top Flange	6	19.920	0.103	2.054	0.212	--
Bottom Flange	5	6.884	1.504	10.351	15.565	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.319	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.885	0.000	0.000	0.000
Σ		49.905		31.066	33.726	1.897

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.622 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.905 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.772 in.⁴
 S_e = $I_x / \bar{y}$ = 0.853 in.³
Mn = Se * Fy = 28.15 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.5B (stiffeners)
Gage: 18 GA
Strength: 40 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.157 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000009 in.³

Guess $\bar{y}$: 0.622 in.

Stress in Flange: 27.517 ksi
k: 16.607
Fcr: 100.657 ksi
 λ : 0.523
 ρ : 1.000
Effective Width: 3.320 in.

δ : 1.056
Isp: 0.003 in.⁴
 γ : 99.481
 β : 3.760
kd: 9.730
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.504
Corners	0.268	0.183
Corners _{Stiff}	0.113	0.225
Bottom Flange	1.377	1.504
Web	1.275	0.764
Web _{Stiff}	0.564	0.209
Top Flange	3.320	0.103

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.504	2.070	3.113	--
Bottom Corner	12	3.215	1.344	4.321	5.808	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	0.183	0.589	0.108	0.007
Top Flange	6	19.920	0.103	2.054	0.212	--
Bottom Flange	5	6.884	1.504	10.351	15.565	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.319	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.885	0.000	0.000	0.000
Σ		49.905		31.066	33.726	1.897

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.622 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.905 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.772 in.⁴
 S_e = $I_x / \bar{y}$ = 0.853 in.³
Mn = Se * Fy = 34.12 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 18 GA
Strength: 50 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.157 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000009 in.³

Guess $\bar{y}$: 0.622 in.

Stress in Flange: 34.396 ksi
k: 16.607
Fcr: 100.657 ksi
 λ : 0.585
 ρ : 1.000
Effective Width: 3.320 in.

δ : 1.056
Isp: 0.003 in.⁴
 γ : 99.481
 β : 3.760
kd: 9.730
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.504
Corners	0.268	0.183
Corners _{Stiff}	0.113	0.225
Bottom Flange	1.377	1.504
Web	1.275	0.764
Web _{Stiff}	0.564	0.209
Top Flange	3.320	0.103

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.504	2.070	3.113	--
Bottom Corner	12	3.215	1.344	4.321	5.808	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	0.183	0.589	0.108	0.007
Top Flange	6	19.920	0.103	2.054	0.212	--
Bottom Flange	5	6.884	1.504	10.351	15.565	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.319	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.885	0.000	0.000	0.000
Σ		49.905		31.066	33.726	1.897

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.622 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.905 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.772 in.⁴
 S_e = $I_x / \bar{y}$ = 0.853 in.³
Mn = Se * Fy = 42.65 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 18 GA
Strength: 60 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.157 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000009 in.³

Guess $\bar{y}$: 0.622 in.

Stress in Flange: 41.275 ksi
k: 16.607
Fcr: 100.657 ksi
 λ : 0.640
 ρ : 1.000
Effective Width: 3.320 in.

δ : 1.056
Isp: 0.003 in.⁴
 γ : 99.481
 β : 3.760
kd: 9.730
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.504
Corners	0.268	0.183
Corners _{Stiff}	0.113	0.225
Bottom Flange	1.377	1.504
Web	1.275	0.764
Web _{Stiff}	0.564	0.209
Top Flange	3.320	0.103

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.504	2.070	3.113	--
Bottom Corner	12	3.215	1.344	4.321	5.808	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	0.183	0.589	0.108	0.007
Top Flange	6	19.920	0.103	2.054	0.212	--
Bottom Flange	5	6.884	1.504	10.351	15.565	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.319	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.885	0.000	0.000	0.000
Σ		49.905		31.066	33.726	1.897

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.622 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.905 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.772 in.⁴
 S_e = $I_x / \bar{y}$ = 0.853 in.³
Mn = Se * Fy = 51.18 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 20 GA
Strength: 33 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.119 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.616 in.

Stress in Flange: 22.597 ksi
k: 21.505
Fcr: 74.355 ksi
 λ : 0.551
 ρ : 1.000
Effective Width: 3.320 in.

δ : 1.056
lsp: 0.002 in.⁴
 γ : 172.608
 β : 4.314
kd: 12.600
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.498
Corners	0.261	0.173
Corners _{Stiff}	0.110	0.214
Bottom Flange	1.377	1.498
Web	1.275	0.758
Web _{Stiff}	0.564	0.203
Top Flange	3.320	0.097

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.498	2.062	3.089	--
Bottom Corner	12	3.126	1.343	4.198	5.637	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	0.173	0.541	0.094	0.006
Top Flange	6	19.920	0.097	1.932	0.187	--
Bottom Flange	5	6.884	1.498	10.311	15.445	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.313	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.896	0.000	0.000	0.000
Σ		49.729		30.637	33.238	1.896

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.616 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.900 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.582 in.⁴
 S_e = $I_x / \bar{y}$ = 0.647 in.³
Mn = Se * Fy = 21.35 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 20 GA
Strength: 40 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.119 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.616 in.

Stress in Flange: 27.390 ksi
k: 21.505
Fcr: 74.355 ksi
 λ : 0.607
 ρ : 1.000
Effective Width: 3.320 in.

δ : 1.056
Isp: 0.002 in.⁴
 γ : 172.608
 β : 4.314
kd: 12.600
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.498
Corners	0.261	0.173
Corners _{Stiff}	0.110	0.214
Bottom Flange	1.377	1.498
Web	1.275	0.758
Web _{Stiff}	0.564	0.203
Top Flange	3.320	0.097

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.498	2.062	3.089	--
Bottom Corner	12	3.126	1.343	4.198	5.637	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	0.173	0.541	0.094	0.006
Top Flange	6	19.920	0.097	1.932	0.187	--
Bottom Flange	5	6.884	1.498	10.311	15.445	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.313	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.896	0.000	0.000	0.000
Σ		49.729		30.637	33.238	1.896

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.616 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.900 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.582 in.⁴
 S_e = $I_x / \bar{y}$ = 0.647 in.³
Mn = Se * Fy = 25.88 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 20 GA
Strength: 50 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.119 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.617 in.

Stress in Flange: 34.332 ksi
k: 21.505
Fcr: 74.355 ksi
 λ : 0.680
 ρ : 0.995
Effective Width: 3.304 in.

δ : 1.056
Isp: 0.002 in.⁴
 γ : 172.608
 β : 4.314
kd: 12.600
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.498
Corners	0.261	0.173
Corners _{Stiff}	0.110	0.214
Bottom Flange	1.377	1.498
Web	1.275	0.758
Web _{Stiff}	0.564	0.203
Top Flange	3.304	0.097

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.498	2.062	3.089	--
Bottom Corner	12	3.126	1.343	4.198	5.637	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	0.173	0.541	0.094	0.006
Top Flange	6	19.824	0.097	1.923	0.187	--
Bottom Flange	5	6.884	1.498	10.311	15.445	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.313	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.896	0.000	0.000	0.000
Σ		49.633		30.628	33.237	1.896

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.617 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.899 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.581 in.⁴
 S_e = $I_x / \bar{y}$ = 0.647 in.³
Mn = Se * Fy = 32.33 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 20 GA
Strength: 60 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.119 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.630 in.

Stress in Flange: 42.617 ksi
k: 21.505
Fcr: 74.355 ksi
 λ : 0.757
 ρ : 0.937
Effective Width: 3.111 in.

δ : 1.056
Isp: 0.002 in.⁴
 γ : 172.608
 β : 4.314
kd: 12.600
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.498
Corners	0.261	0.173
Corners _{Stiff}	0.110	0.214
Bottom Flange	1.377	1.498
Web	1.275	0.758
Web _{Stiff}	0.564	0.203
Top Flange	3.111	0.097

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.498	2.062	3.089	--
Bottom Corner	12	3.126	1.343	4.198	5.637	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	0.173	0.541	0.094	0.006
Top Flange	6	18.666	0.097	1.811	0.176	--
Bottom Flange	5	6.884	1.498	10.311	15.445	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.313	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.896	0.000	0.000	0.000
Σ		48.475		30.516	33.226	1.896

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.630 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.886 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.570 in.⁴
 S_e = $I_x / \bar{y}$ = 0.643 in.³
Mn = Se * Fy = 38.56 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 22 GA
Strength: 33 ksi
Thickness: 0.0295 in.
Total Height: 1.510 in.
Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000477 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.098 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.613 in.

Stress in Flange: 22.539 ksi
k: 25.794
Fcr: 60.558 ksi
 λ : 0.610
 ρ : 1.000
Effective Width: 3.320 in.

δ : 1.056
Isp: 0.002 in.⁴
 γ : 253.018
 β : 4.745
kd: 15.113
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.495
Corners	0.257	0.168
Corners _{Stiff}	0.108	0.208
Bottom Flange	1.377	1.495
Web	1.275	0.755
Web _{Stiff}	0.564	0.200
Top Flange	3.320	0.094

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.495	2.058	3.076	--
Bottom Corner	12	3.079	1.342	4.131	5.544	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	0.168	0.516	0.086	0.006
Top Flange	6	19.920	0.094	1.866	0.175	--
Bottom Flange	5	6.884	1.495	10.289	15.380	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.310	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.902	0.000	0.000	0.000
Σ		49.633		30.405	32.975	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.613 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.897 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.479 in.⁴
 S_e = $I_x / \bar{y}$ = 0.534 in.³
Mn = Se * Fy = 17.63 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 22 GA
Strength: 40 ksi
Thickness: 0.0295 in.
Total Height: 1.510 in.
Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000477 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.098 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.613 in.

Stress in Flange: 27.320 ksi
k: 25.794
Fcr: 60.558 ksi
 λ : 0.672
 ρ : 1.000
Effective Width: 3.320 in.

δ : 1.056
Isp: 0.002 in.⁴
 γ : 253.018
 β : 4.745
kd: 15.113
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.495
Corners	0.257	0.168
Corners _{Stiff}	0.108	0.208
Bottom Flange	1.377	1.495
Web	1.275	0.755
Web _{Stiff}	0.564	0.200
Top Flange	3.320	0.094

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.495	2.058	3.076	--
Bottom Corner	12	3.079	1.342	4.131	5.544	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	0.168	0.516	0.086	0.006
Top Flange	6	19.920	0.094	1.866	0.175	--
Bottom Flange	5	6.884	1.495	10.289	15.380	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.310	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.902	0.000	0.000	0.000
Σ		49.633		30.405	32.975	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.613 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.897 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.479 in.⁴
 S_e = $I_x / \bar{y}$ = 0.534 in.³
Mn = Se * Fy = 21.37 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 22 GA
Strength: 50 ksi
Thickness: 0.0295 in.
Total Height: 1.510 in.
Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000477 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.098 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.628 in.

Stress in Flange: 35.578 ksi
k: 25.794
Fcr: 60.558 ksi
 λ : 0.766
 ρ : 0.930
Effective Width: 3.088 in.

δ : 1.056
Isp: 0.002 in.⁴
 γ : 253.018
 β : 4.745
kd: 15.113
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.495
Corners	0.257	0.168
Corners _{Stiff}	0.108	0.208
Bottom Flange	1.377	1.495
Web	1.275	0.755
Web _{Stiff}	0.564	0.200
Top Flange	3.088	0.094

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.495	2.058	3.076	--
Bottom Corner	12	3.079	1.342	4.131	5.544	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	0.168	0.516	0.086	0.006
Top Flange	6	18.529	0.094	1.736	0.163	--
Bottom Flange	5	6.884	1.495	10.289	15.380	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.310	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.902	0.000	0.000	0.000
Σ		48.243		30.275	32.962	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.628 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.882 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.468 in.⁴
 S_e = $I_x / \bar{y}$ = 0.530 in.³
Mn = Se * Fy = 26.52 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 22 GA
Strength: 60 ksi
Thickness: 0.0295 in.
Total Height: 1.510 in.
Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000477 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.098 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.642 in.

Stress in Flange: 44.356 ksi
k: 25.794
Fcr: 60.558 ksi
 λ : 0.856
 ρ : 0.868
Effective Width: 2.882 in.

δ : 1.056
lsp: 0.002 in.⁴
 γ : 253.018
 β : 4.745
kd: 15.113
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.495
Corners	0.257	0.168
Corners _{Stiff}	0.108	0.208
Bottom Flange	1.377	1.495
Web	1.275	0.755
Web _{Stiff}	0.564	0.200
Top Flange	2.882	0.094

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.495	2.058	3.076	--
Bottom Corner	12	3.079	1.342	4.131	5.544	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	0.168	0.516	0.086	0.006
Top Flange	6	17.292	0.094	1.620	0.152	--
Bottom Flange	5	6.884	1.495	10.289	15.380	--
Low Corner _{Stiff}	0	0.000	1.302	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.310	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.902	0.000	0.000	0.000
Σ		47.006		30.159	32.951	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.642 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.868 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.457 in.⁴
 S_e = $I_x / \bar{y}$ = 0.527 in.³
Mn = Se * Fy = 31.60 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.5B (stiffeners)
Gage: 24 GA
Strength: 33 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.079 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000007 in.³

Guess $\bar{y}$: 0.610 in.

Stress in Flange: 22.494 ksi
k: 32.413
Fcr: 49.531 ksi
 λ : 0.674
 ρ : 0.999
Effective Width: 3.318 in.

δ : 1.056
lsp: 0.002 in.⁴
 γ : 407.100
 β : 5.343
kd: 18.991
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.492
Corners	0.253	0.163
Corners _{Stiff}	0.107	0.202
Bottom Flange	1.377	1.492
Web	1.275	0.752
Web _{Stiff}	0.564	0.197
Top Flange	3.318	0.091

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.492	2.054	3.064	--
Bottom Corner	12	3.035	1.341	4.071	5.460	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	0.163	0.493	0.080	0.005
Top Flange	6	19.909	0.091	1.806	0.164	--
Bottom Flange	5	6.884	1.492	10.270	15.322	--
Low Corner _{Stiff}	0	0.000	1.301	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.307	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.908	0.000	0.000	0.000
Σ		49.536		30.195	32.738	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.610 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.894 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.386 in.⁴
 S_e = $I_x / \bar{y}$ = 0.432 in.³
Mn = Se * Fy = 14.25 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.5B (stiffeners)
Gage: 24 GA
Strength: 40 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.079 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000007 in.³

Guess $\bar{y}$: 0.623 in.

Stress in Flange: 28.265 ksi
k: 32.413
Fcr: 49.531 ksi
 λ : 0.755
 ρ : 0.938
Effective Width: 3.115 in.

δ : 1.056
Isp: 0.002 in.⁴
 γ : 407.100
 β : 5.343
kd: 18.991
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.492
Corners	0.253	0.163
Corners _{Stiff}	0.107	0.202
Bottom Flange	1.377	1.492
Web	1.275	0.752
Web _{Stiff}	0.564	0.197
Top Flange	3.115	0.091

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.492	2.054	3.064	--
Bottom Corner	12	3.035	1.341	4.071	5.460	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	0.163	0.493	0.080	0.005
Top Flange	6	18.690	0.091	1.695	0.154	--
Bottom Flange	5	6.884	1.492	10.270	15.322	--
Low Corner _{Stiff}	0	0.000	1.301	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.307	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.908	0.000	0.000	0.000
Σ		48.317		30.084	32.728	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.623 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.881 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.378 in.⁴
 S_e = $I_x / \bar{y}$ = 0.429 in.³
Mn = Se * Fy = 17.17 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 24 GA
Strength: 50 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.079 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000007 in.³

Guess $\bar{y}$: 0.640 in.

Stress in Flange: 37.030 ksi
k: 32.413
Fcr: 49.531 ksi
 λ : 0.865
 ρ : 0.862
Effective Width: 2.863 in.

δ : 1.056
lsp: 0.002 in.⁴
 γ : 407.100
 β : 5.343
kd: 18.991
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.492
Corners	0.253	0.163
Corners _{Stiff}	0.107	0.202
Bottom Flange	1.377	1.492
Web	1.275	0.752
Web _{Stiff}	0.564	0.197
Top Flange	2.863	0.091

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.492	2.054	3.064	--
Bottom Corner	12	3.035	1.341	4.071	5.460	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	0.163	0.493	0.080	0.005
Top Flange	6	17.176	0.091	1.558	0.141	--
Bottom Flange	5	6.884	1.492	10.270	15.322	--
Low Corner _{Stiff}	0	0.000	1.301	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.307	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.908	0.000	0.000	0.000
Σ		46.803		29.947	32.715	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.640 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.864 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.368 in.⁴
 S_e = $I_x / \bar{y}$ = 0.426 in.³
Mn = Se * Fy = 21.28 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 24 GA
Strength: 60 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

bo: 3.144 in.
h: 1.275 in.
bp: 0.895 in.
Ag: 0.079 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000007 in.³

Guess $\bar{y}$: 0.655 in.

Stress in Flange: 46.309 ksi
k: 32.413
Fcr: 49.531 ksi
 λ : 0.967
 ρ : 0.799
Effective Width: 2.652 in.

δ : 1.056
lsp: 0.002 in.⁴
 γ : 407.100
 β : 5.343
kd: 18.991
kloc: 49.309
R: 1.707

Element	L (in.)	y from top (in.)
Lip	0.688	1.492
Corners	0.253	0.163
Corners _{Stiff}	0.107	0.202
Bottom Flange	1.377	1.492
Web	1.275	0.752
Web _{Stiff}	0.564	0.197
Top Flange	2.652	0.091

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	1.377	1.492	2.054	3.064	--
Bottom Corner	12	3.035	1.341	4.071	5.460	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	0.163	0.493	0.080	0.005
Top Flange	6	15.914	0.091	1.443	0.131	--
Bottom Flange	5	6.884	1.492	10.270	15.322	--
Low Corner _{Stiff}	0	0.000	1.301	0.000	0.000	0.000
Web _{Stiff}	0	0.000	1.307	0.000	0.000	0.000
High Corner _{Stiff}	0	0.000	0.908	0.000	0.000	0.000
Σ		45.541		29.832	32.705	1.895

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.655 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.849 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.358 in.⁴
 S_e = $I_x / \bar{y}$ = 0.422 in.³
Mn = Se * Fy = 25.33 k-in.

CHAPTER 7: ANALYSIS | 1.5B DECK (STIFFENED) | - BENDING



7.0 Executive Summary

The Direct Strength Method predicted higher strengths for each of the stiffened 1.5B Deck sections undergoing negative flexure. The compression flange is the lower unstiffened flange for this section and DSM is able to take advantage of the shorter compression flange width. The nominal moment capacity ratio (M_{nDSM}/M_{nEWM}) ranged between 1.037 and 1.157.

CHAPTER 7: ANALYSIS | 1.5B DECK (STIFFENED) | - BENDING

7.1 M_{nDSM} / M_{nEWM} vs. Thickness Plot

Mn_{DSM} / Mn_{EWM} vs. Thickness

33 KSI 40 KSI 50 KSI 60 KSI

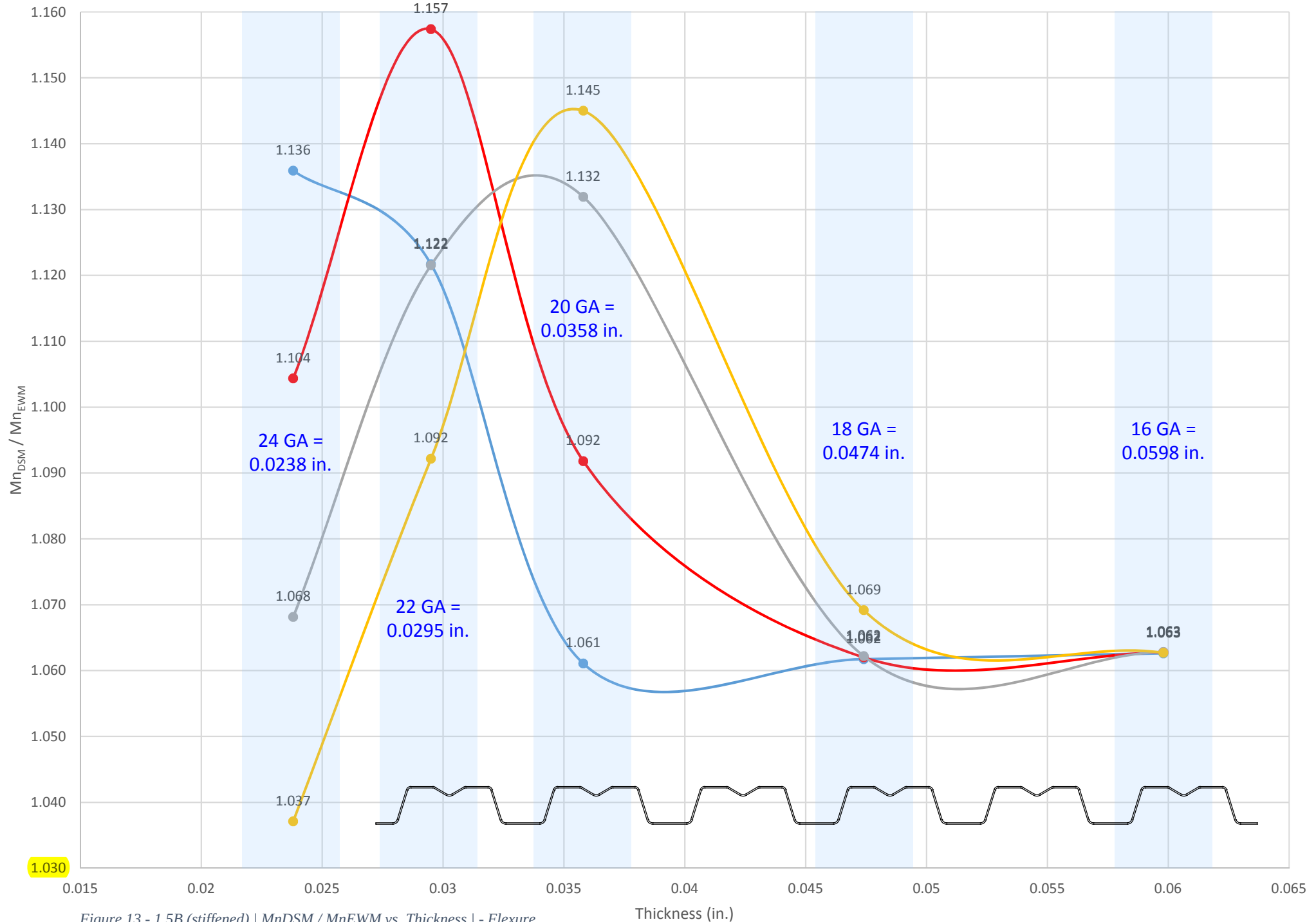


Figure 13 - 1.5B (stiffened) | Mn_{DSM} / Mn_{EWM} vs. Thickness | - Flexure

1.5B Deck w/ Stiffeners Negative Bending

7.2 Analysis Results Summary

Table 7 - 1.5B (stiffened) | Analysis Results Summary | - Flexure

1.5B DECK (stiffeners) - 33 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I _c (CUFSM)	0.407	0.505	0.616	0.815	1.025
y-bar (CUFSM)	0.89116	0.89128	0.89289	0.89359	0.89359
S _{xx}	0.457	0.567	0.690	0.912	1.147
M _y	15.07	18.71	22.76	30.09	37.84
M _{nDSM}	14.21	18.71	22.76	30.09	37.84
M _{nEWM}	12.51	16.68	21.45	28.34	35.61
% ERROR	11.963%	10.850%	5.756%	5.816%	5.893%

1.5B DECK (stiffeners) - 40 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I _c (CUFSM)	0.407	0.505	0.616	0.815	1.025
y-bar (CUFSM)	0.89116	0.89128	0.89289	0.89359	0.89359
S _{xx}	0.457	0.567	0.690	0.912	1.147
M _y	18.27	22.68	27.59	36.48	45.87
M _{nDSM}	16.19	22.65	27.59	36.48	45.87
M _{nEWM}	14.66	19.57	25.27	34.35	43.16
% ERROR	9.450%	13.598%	8.409%	5.839%	5.908%

1.5B DECK (stiffeners) - 50 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I _c (CUFSM)	0.407	0.505	0.616	0.815	1.025
y-bar (CUFSM)	0.89116	0.89128	0.89289	0.89359	0.89359
S _{xx}	0.457	0.567	0.690	0.912	1.147
M _y	22.84	28.35	34.49	45.60	57.34
M _{nDSM}	18.81	26.39	34.49	45.6	57.34
M _{nEWM}	17.61	23.53	30.47	42.93	53.95
% ERROR	6.380%	10.837%	11.656%	5.855%	5.912%

1.5B DECK (stiffeners) - 60 KSI					
Gage	24	22	20	18	16
Thickness	0.0238	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.1999	0.2028	0.2059	0.2117	0.2179
I _c (CUFSM)	0.407	0.505	0.616	0.815	1.025
y-bar (CUFSM)	0.89116	0.89128	0.89289	0.89359	0.89359
S _{xx}	0.457	0.567	0.690	0.912	1.147
M _y	27.40	34.02	41.38	54.72	68.80
M _{nDSM}	21.23	29.86	40.59	54.72	68.8
M _{nEWM}	20.47	27.34	35.45	51.18	64.74
% ERROR	3.580%	8.439%	12.663%	6.469%	5.901%

1.5B DECK (stiffeners) - 33 KSI				
Thickness		M _{nDSM}	M _{nEWM}	M _{nDSM} / M _{nEWM}
24	0.0238	14.21	12.51	1.136
22	0.0295	18.71	16.68	1.122
20	0.0358	22.76	21.45	1.061
18	0.0474	30.09	28.34	1.062
16	0.0598	37.84	35.61	1.063

1.5B DECK (stiffeners) - 40 KSI				
Thickness		M _{nDSM}	M _{nEWM}	M _{nDSM} / M _{nEWM}
24	0.0238	16.19	14.66	1.104
22	0.0295	22.65	19.57	1.157
20	0.0358	27.59	25.27	1.092
18	0.0474	36.48	34.35	1.062
16	0.0598	45.87	43.16	1.063

1.5B DECK (stiffeners) - 50 KSI				
Thickness		M _{nDSM}	M _{nEWM}	M _{nDSM} / M _{nEWM}
24	0.0238	18.81	17.61	1.068
22	0.0295	26.39	23.53	1.122
20	0.0358	34.49	30.47	1.132
18	0.0474	45.60	42.93	1.062
16	0.0598	57.34	53.95	1.063

1.5B DECK (stiffeners) - 60 KSI				
Thickness		M _{nDSM}	M _{nEWM}	M _{nDSM} / M _{nEWM}
24	0.0238	21.23	20.47	1.037
22	0.0295	29.86	27.34	1.092
20	0.0358	40.59	35.45	1.145
18	0.0474	54.72	51.18	1.069
16	0.0598	68.80	64.74	1.063

7.3 Direct Strength Method Calculations

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	16	GA
	Strength:	-33	KSI
	$M_y =$	37.84	kip-in
	Length:		
local	$M_{cr\ell}/M_y =$	7.43230	$M_{cr\ell} = 281.2382$ kip-in
dist.	$M_{crd}/M_y =$	27.74000	$M_{crd} = 1049.682$ kip-in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1892$ kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 37.84 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.37 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 37.84 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.19 \quad (\text{distortional slenderness})$$

$$M_{nd} = 37.84 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 37.84 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	16	GA
	Strength:	-40	KSI
	$M_y =$	45.87	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	6.13170	$M_{cr\ell} = 281.2611$ kip-in 1 in
dist.	$M_{crd}/M_y =$	22.89000	$M_{crd} = 1049.964$ kip-in 12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 2293.5$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 45.87 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.40 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 45.87 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.21 \quad (\text{distortional slenderness})$$

$$M_{nd} = 45.87 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 45.87 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	16	GA
	Strength:	-50	KSI
	$M_y =$	57.34	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	4.90530	$M_{cr\ell} = 281.2699$ kip-in 1 in
dist.	$M_{crd}/M_y =$	18.31000	$M_{crd} = 1049.895$ kip-in 12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 2867$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 57.34 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.45 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 57.34 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.23 \quad (\text{distortional slenderness})$$

$$M_{nd} = 57.34 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 57.34 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	16	GA
	Strength:	-60	KSI
	$M_y =$	68.80	kip-in
	Length:		
local	$M_{cr\ell}/M_y =$	4.08780	$M_{cr\ell} = 281.2406$ kip-in
dist.	$M_{crd}/M_y =$	15.26000	$M_{crd} = 1049.888$ kip-in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 3440$ kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 68.80 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.49 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 68.80 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.26 \quad (\text{distortional slenderness})$$

$$M_{nd} = 68.80 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 68.80 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	18	GA
	Strength:	-33	KSI
	$M_y =$	30.09	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	4.78110	$M_{cr\ell} = 143.8633$ kip-in 1 in
dist.	$M_{crd}/M_y =$	22.85000	$M_{crd} = 687.5565$ kip-in 12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1504.5$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y$$
$$M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y$$
$$M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y$$
$$M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 30.09 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776$$
$$M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776$$
$$M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.46 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 30.09 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673$$
$$M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673$$
$$M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.21 \quad (\text{distortional slenderness})$$

$$M_{nd} = 30.09 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 30.09 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)		
	Gage:	18	GA		
	Strength:	-40	KSI		
	$M_y =$	36.48	kip-in		Length:
local	$M_{crf}/M_y =$	3.94440	$M_{crf} =$	143.8917 kip-in	1 in
dist.	$M_{crd}/M_y =$	18.85000	$M_{crd} =$	687.648 kip-in	12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} =$	1824 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y$$
$$M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y$$
$$M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y$$
$$M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 36.48 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776$$
$$M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776$$
$$M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.50 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 36.48 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673$$
$$M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673$$
$$M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.23 \quad (\text{distortional slenderness})$$

$$M_{nd} = 36.48 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 36.48 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	18	GA
	Strength:	-50	KSI
	$M_y =$	45.60	kip-in
Length:			
local	$M_{cr\ell}/M_y =$	3.15560	$M_{cr\ell} = 143.8954$ kip-in
dist.	$M_{crd}/M_y =$	15.08000	$M_{crd} = 687.648$ kip-in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 2280$ kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y$$
$$M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y$$
$$M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y$$
$$M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 45.60 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776$$
$$M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776$$
$$M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.56 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 45.60 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673$$
$$M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673$$
$$M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.26 \quad (\text{distortional slenderness})$$

$$M_{nd} = 45.60 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 45.60 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	18	GA
	Strength:	-60	KSI
	$M_y =$	54.72	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	2.62960	$M_{cr\ell} = 143.8917$ kip-in 1 in
dist.	$M_{crd}/M_y =$	12.57000	$M_{crd} = 687.8304$ kip-in 12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 2736$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 54.72 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.62 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 54.72 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.28 \quad (\text{distortional slenderness})$$

$$M_{nd} = 54.72 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 54.72 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	20	GA
	Strength:	-33	KSI
	$M_y =$	22.76	kip-in
Length:			
local	$M_{cr\ell}/M_y =$	2.83930	$M_{cr\ell} = 64.62247$ kip-in
dist.	$M_{crd}/M_y =$	19.26000	$M_{crd} = 438.3576$ kip-in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1138$ kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 22.76 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.59 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 22.76 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.23 \quad (\text{distortional slenderness})$$

$$M_{nd} = 22.76 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 22.76 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	20	GA
	Strength:	-40	KSI
	$M_y =$	27.59	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	2.34250	$M_{cr\ell} = 64.62958$ kip-in 1 in
dist.	$M_{crd}/M_y =$	15.89000	$M_{crd} = 438.4051$ kip-in 12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1379.5$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 27.59 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.65 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 27.59 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.25 \quad (\text{distortional slenderness})$$

$$M_{nd} = 27.59 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 27.59 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)	
	Gage:	20	GA	
	Strength:	-50	KSI	
	M _y =	34.49	kip-in	Length:
local	M _{crf} /M _y =	1.87400	M _{crf} = 64.63426 kip-in	1 in
dist.	M _{crd} /M _y =	12.71000	M _{crd} = 438.3679 kip-in	12 in
global	M _{cre} /M _y =	50.00000	M _{cre} = 1724.5 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 34.49 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.73 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 34.49 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.28 \quad (\text{distortional slenderness})$$

$$M_{nd} = 34.49 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 34.49 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	20	GA
	Strength:	-60	KSI
	$M_y =$	41.38	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	1.56170	$M_{cr\ell} = 64.62315$ kip-in 1 in
dist.	$M_{crd}/M_y =$	10.59000	$M_{crd} = 438.2142$ kip-in 12 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 2069$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 41.38 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.80 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 40.59 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.31 \quad (\text{distortional slenderness})$$

$$M_{nd} = 41.38 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 40.59 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)	
	Gage:	22	GA	
	Strength:	-33	KSI	
	M _y =	18.71	kip-in	Length:
local	M _{crf} /M _y =	2.00510	M _{crf} = 37.51542 kip-in	1 in
dist.	M _{crd} /M _y =	16.27000	M _{crd} = 304.4117 kip-in	24 in
global	M _{cre} /M _y =	50.00000	M _{cre} = 935.5 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 18.71 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.71 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 18.71 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.25 \quad (\text{distortional slenderness})$$

$$M_{nd} = 18.71 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 18.71 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	22	GA
	Strength:	-40	KSI
	$M_y =$	22.68	kip-in
Length:			
local	$M_{cr\ell}/M_y =$	1.65420	$M_{cr\ell} = 37.51726$ kip-in
dist.	$M_{crd}/M_y =$	13.43000	$M_{crd} = 304.5924$ kip-in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1134$ kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \quad M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \quad M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \quad M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 22.68 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \quad M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \quad M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.78 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 22.65 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \quad M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \quad M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.27 \quad (\text{distortional slenderness})$$

$$M_{nd} = 22.68 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 22.65 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	22	GA
	Strength:	-50	KSI
	$M_y =$	28.35	kip-in
			Length:
local	$M_{cr\ell}/M_y =$	1.32340	$M_{cr\ell} = 37.51839$ kip-in 1 in
dist.	$M_{crd}/M_y =$	10.74000	$M_{crd} = 304.479$ kip-in 24 in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1417.5$ kip-in - in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 28.35 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.87 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 26.39 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.31 \quad (\text{distortional slenderness})$$

$$M_{nd} = 28.35 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 26.39 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)	
	Gage:	22	GA	
	Strength:	-60	KSI	
	M _y =	34.02	kip-in	Length:
local	M _{crf} /M _y =	1.10280	M _{crf} = 37.51726 kip-in	1 in
dist.	M _{crd} /M _y =	8.95000	M _{crd} = 304.479 kip-in	24 in
global	M _{cre} /M _y =	50.00000	M _{cre} = 1701 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 34.02 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.95 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 29.86 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.33 \quad (\text{distortional slenderness})$$

$$M_{nd} = 34.02 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 29.86 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	24	GA
	Strength:	-33	KSI
	$M_y =$	15.07	kip-in
Length:			
local	$M_{cr\ell}/M_y =$	1.37710	$M_{cr\ell} = 20.7529$ kip-in
dist.	$M_{crd}/M_y =$	12.01000	$M_{crd} = 180.9907$ kip-in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 753.5$ kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 15.07 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.85 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 14.21 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.29 \quad (\text{distortional slenderness})$$

$$M_{nd} = 15.07 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 14.21 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)	
	Gage:	24	GA	
	Strength:	-40	KSI	
	M _y =	18.27	kip-in	Length:
local	M _{crf} /M _y =	1.13610	M _{crf} = 20.75655 kip-in	1 in
dist.	M _{crd} /M _y =	9.91000	M _{crd} = 181.0557 kip-in	24 in
global	M _{cre} /M _y =	50.00000	M _{cre} = 913.5 kip-in	- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 18.27 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.94 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 16.19 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.32 \quad (\text{distortional slenderness})$$

$$M_{nd} = 18.27 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 16.19 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	24	GA
	Strength:	-50	KSI
	$M_y =$	22.84	kip-in
Length:			
local	$M_{cr\ell}/M_y =$	0.90890	$M_{cr\ell} = 20.75928$ kip-in
dist.	$M_{crd}/M_y =$	7.92000	$M_{crd} = 180.8928$ kip-in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1142$ kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \quad M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \quad M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \quad M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 22.84 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \quad M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \quad M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.05 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 18.81 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \quad M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \quad M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.36 \quad (\text{distortional slenderness})$$

$$M_{nd} = 22.84 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 18.81 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 1/11/2015

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	1.5B	(stiffeners)
	Gage:	24	GA
	Strength:	-60	KSI
	$M_y =$	27.40	kip-in
Length:			
local	$M_{cr\ell}/M_y =$	0.75742	$M_{cr\ell} = 20.75331$ kip-in
dist.	$M_{crd}/M_y =$	6.60000	$M_{crd} = 180.84$ kip-in
global	$M_{cre}/M_y =$	50.00000	$M_{cre} = 1370$ kip-in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 27.40 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.15 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 21.23 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.39 \quad (\text{distortional slenderness})$$

$$M_{nd} = 27.40 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 21.23 \text{ kip-in} \quad (\text{local-global controls})$$

7.4 Effective Width Method Calculations

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 16 GA
Strength: 33 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

Comp Flange: 1.377 in

θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000010 in.³

Guess $\bar{y}$: 0.898 in.

Stress in Flange: 33.000 ksi
k: 4.000
Fcr: 201.212 ksi
 λ : 0.405
 ρ : 1.128
Effective Width: 1.377 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.030
Corners	0.276	0.194
Corners _{Stiff}	0.116	0.238
Bottom Flange	1.377	0.030
Web	1.275	0.770
Web _{Stiff}	0.564	0.215
Top Flange	0.895	1.510

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.030	0.000	0.000	--
Bottom Corner	12	3.309	0.194	0.642	0.125	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	1.346	4.452	5.991	0.007
Top Flange	12	10.745	1.510	16.224	24.496	--
Bottom Flange	6	8.260	0.030	0.247	0.007	--
High Corner _{Stiff}	12	1.398	1.302	1.820	2.370	0.000
Web _{Stiff}	12	6.762	1.325	8.959	11.870	0.046
Low Corner _{Stiff}	12	1.398	0.872	1.219	1.064	0.000
Σ		50.475		45.340	54.989	1.944

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.898 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.898 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.969 in.⁴
 S_e = $I_x / \bar{y}$ = 1.079 in.³
Mn = Se * Fy = 35.61 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.5B (stiffeners)
Gage: 16 GA
Strength: 40 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

Comp Flange: 1.377 in
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000010 in.³

Guess $\bar{y}$: 0.898 in.

Stress in Flange: 40.000 ksi
k: 4.000
Fcr: 201.212 ksi
 λ : 0.446
 ρ : 1.136
Effective Width: 1.377 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.030
Corners	0.276	0.194
Corners _{Stiff}	0.116	0.238
Bottom Flange	1.377	0.030
Web	1.275	0.770
Web _{Stiff}	0.564	0.215
Top Flange	0.895	1.510

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.030	0.000	0.000	--
Bottom Corner	12	3.309	0.194	0.642	0.125	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	1.346	4.452	5.991	0.007
Top Flange	12	10.745	1.510	16.224	24.496	--
Bottom Flange	6	8.260	0.030	0.247	0.007	--
High Corner _{Stiff}	12	1.398	1.302	1.820	2.370	0.000
Web _{Stiff}	12	6.762	1.325	8.959	11.870	0.046
Low Corner _{Stiff}	12	1.398	0.872	1.219	1.064	0.000
Σ		50.475		45.340	54.989	1.944

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.898 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.898 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.969 in.⁴
 S_e = $I_x / \bar{y}$ = 1.079 in.³
Mn = Se * Fy = 43.16 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 16 GA
Strength: 50 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

Comp Flange: 1.377 in

θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000010 in.³

Guess $\bar{y}$: 0.898 in.

Stress in Flange: 50.000 ksi
k: 4.000
Fcr: 201.212 ksi
 λ : 0.498
 ρ : 1.121
Effective Width: 1.377 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.030
Corners	0.276	0.194
Corners _{Stiff}	0.116	0.238
Bottom Flange	1.377	0.030
Web	1.275	0.770
Web _{Stiff}	0.564	0.215
Top Flange	0.895	1.510

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.030	0.000	0.000	--
Bottom Corner	12	3.309	0.194	0.642	0.125	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	1.346	4.452	5.991	0.007
Top Flange	12	10.745	1.510	16.224	24.496	--
Bottom Flange	6	8.260	0.030	0.247	0.007	--
High Corner _{Stiff}	12	1.398	1.302	1.820	2.370	0.000
Web _{Stiff}	12	6.762	1.325	8.959	11.870	0.046
Low Corner _{Stiff}	12	1.398	0.872	1.219	1.064	0.000
Σ		50.475		45.340	54.989	1.944

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.898 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.898 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.969 in.⁴
 S_e = $I_x / \bar{y}$ = 1.079 in.³
Mn = Se * Fy = 53.95 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 16 GA
Strength: 60 ksi
Thickness: 0.0598 in.
Total Height: 1.540 in.
Radius: 0.2179 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000592 in.³

Comp Flange: 1.377 in

θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000010 in.³

Guess $\bar{y}$: 0.898 in.

Stress in Flange: 60.000 ksi
k: 4.000
Fcr: 201.212 ksi
 λ : 0.546
 ρ : 1.093
Effective Width: 1.377 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.030
Corners	0.276	0.194
Corners _{Stiff}	0.116	0.238
Bottom Flange	1.377	0.030
Web	1.275	0.770
Web _{Stiff}	0.564	0.215
Top Flange	0.895	1.510

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.030	0.000	0.000	--
Bottom Corner	12	3.309	0.194	0.642	0.125	0.007
Web	12	15.296	0.770	11.776	9.066	1.884
Top Corner	12	3.309	1.346	4.452	5.991	0.007
Top Flange	12	10.745	1.510	16.224	24.496	--
Bottom Flange	6	8.260	0.030	0.247	0.007	--
High Corner _{Stiff}	12	1.398	1.302	1.820	2.370	0.000
Web _{Stiff}	12	6.762	1.325	8.959	11.870	0.046
Low Corner _{Stiff}	12	1.398	0.872	1.219	1.064	0.000
Σ		50.475		45.340	54.989	1.944

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.898 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.898 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.969 in.⁴
 S_e = $I_x / \bar{y}$ = 1.079 in.³
Mn = Se * Fy = 64.74 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.5B (stiffeners)
Gage: 18 GA
Strength: 33 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

Comp Flange: 1.377 in
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000009 in.³

Guess $\bar{y}$: 0.893 in.

Stress in Flange: 33.000 ksi
k: 4.000
Fcr: 126.418 ksi
 λ : 0.511
 ρ : 1.114
Effective Width: 1.377 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.024
Corners	0.268	0.183
Corners _{Stiff}	0.113	0.225
Bottom Flange	1.377	0.024
Web	1.275	0.764
Web _{Stiff}	0.564	0.209
Top Flange	0.895	1.504

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.024	0.000	0.000	--
Bottom Corner	12	3.215	0.183	0.589	0.108	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	1.344	4.321	5.808	0.007
Top Flange	12	10.745	1.504	16.157	24.295	--
Bottom Flange	6	8.260	0.024	0.196	0.005	--
High Corner _{Stiff}	12	1.358	1.302	1.768	2.302	0.000
Web _{Stiff}	12	6.762	1.319	8.917	11.759	0.046
Low Corner _{Stiff}	12	1.358	0.885	1.201	1.062	0.000
Σ		50.208		44.830	54.259	1.943

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.893 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.893 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.767 in.⁴
 S_e = $I_x / \bar{y}$ = 0.859 in.³
Mn = Se * Fy = 28.34 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.5B (stiffeners)
Gage: 18 GA
Strength: 40 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

Comp Flange: 1.377 in
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000009 in.³

Guess $\bar{y}$: 0.893 in.

Stress in Flange: 40.000 ksi
k: 4.000
Fcr: 126.418 ksi
 λ : 0.563
 ρ : 1.082
Effective Width: 1.377 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.024
Corners	0.268	0.183
Corners _{Stiff}	0.113	0.225
Bottom Flange	1.377	0.024
Web	1.275	0.764
Web _{Stiff}	0.564	0.209
Top Flange	0.895	1.504

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.024	0.000	0.000	--
Bottom Corner	12	3.215	0.183	0.589	0.108	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	1.344	4.321	5.808	0.007
Top Flange	12	10.745	1.504	16.157	24.295	--
Bottom Flange	6	8.260	0.024	0.196	0.005	--
High Corner _{Stiff}	12	1.358	1.302	1.768	2.302	0.000
Web _{Stiff}	12	6.762	1.319	8.917	11.759	0.046
Low Corner _{Stiff}	12	1.358	0.885	1.201	1.062	0.000
Σ		50.208		44.830	54.259	1.943

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.893 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.893 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.767 in.⁴
 S_e = $I_x / \bar{y}$ = 0.859 in.³
Mn = Se * Fy = 34.35 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 18 GA
Strength: 50 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

Comp Flange: 1.377 in
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000009 in.³

Guess $\bar{y}$: 0.893 in.

Stress in Flange: 50.000 ksi
k: 4.000
Fcr: 126.418 ksi
 λ : 0.629
 ρ : 1.034
Effective Width: 1.377 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.024
Corners	0.268	0.183
Corners _{Stiff}	0.113	0.225
Bottom Flange	1.377	0.024
Web	1.275	0.764
Web _{Stiff}	0.564	0.209
Top Flange	0.895	1.504

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.024	0.000	0.000	--
Bottom Corner	12	3.215	0.183	0.589	0.108	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	1.344	4.321	5.808	0.007
Top Flange	12	10.745	1.504	16.157	24.295	--
Bottom Flange	6	8.260	0.024	0.196	0.005	--
High Corner _{Stiff}	12	1.358	1.302	1.768	2.302	0.000
Web _{Stiff}	12	6.762	1.319	8.917	11.759	0.046
Low Corner _{Stiff}	12	1.358	0.885	1.201	1.062	0.000
Σ		50.208		44.830	54.259	1.943

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.893 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.893 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.767 in.⁴
 S_e = $I_x / \bar{y}$ = 0.859 in.³
Mn = Se * Fy = 42.93 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 18 GA
Strength: 60 ksi
Thickness: 0.0474 in.
Total Height: 1.527 in.
Radius: 0.2117 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000543 in.³

Comp Flange: 1.377 in

θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000009 in.³

Guess $\bar{y}$: 0.895 in.

Stress in Flange: 60.000 ksi
k: 4.000
Fcr: 126.418 ksi
 λ : 0.689
 ρ : 0.988
Effective Width: 1.360 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.024
Corners	0.268	0.183
Corners _{Stiff}	0.113	0.225
Bottom Flange	1.360	0.024
Web	1.275	0.764
Web _{Stiff}	0.564	0.209
Top Flange	0.895	1.504

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.024	0.000	0.000	--
Bottom Corner	12	3.215	0.183	0.589	0.108	0.007
Web	12	15.296	0.764	11.681	8.921	1.884
Top Corner	12	3.215	1.344	4.321	5.808	0.007
Top Flange	12	10.745	1.504	16.157	24.295	--
Bottom Flange	6	8.161	0.024	0.193	0.005	--
High Corner _{Stiff}	12	1.358	1.302	1.768	2.302	0.000
Web _{Stiff}	12	6.762	1.319	8.917	11.759	0.046
Low Corner _{Stiff}	12	1.358	0.885	1.201	1.062	0.000
Σ		50.108		44.827	54.259	1.943

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.895 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.895 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.763 in.⁴
 S_e = $I_x / \bar{y}$ = 0.853 in.³
Mn = **Se * Fy** = **51.18** k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 20 GA
Strength: 33 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

Comp Flange: 1.377 in

θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.888 in.

Stress in Flange: 33.000 ksi
k: 4.000
Fcr: 72.114 ksi
 λ : 0.676
 ρ : 0.998
Effective Width: 1.373 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.018
Corners	0.261	0.173
Corners _{Stiff}	0.110	0.214
Bottom Flange	1.373	0.018
Web	1.275	0.758
Web _{Stiff}	0.564	0.203
Top Flange	0.895	1.498

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.018	0.000	0.000	--
Bottom Corner	12	3.126	0.173	0.541	0.094	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	1.343	4.198	5.637	0.006
Top Flange	12	10.745	1.498	16.095	24.108	--
Bottom Flange	6	8.240	0.018	0.147	0.003	--
High Corner _{Stiff}	12	1.321	1.302	1.719	2.238	0.000
Web _{Stiff}	12	6.762	1.313	8.878	11.656	0.046
Low Corner _{Stiff}	12	1.321	0.896	1.183	1.060	0.000
Σ		49.936		44.354	53.580	1.942

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.888 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.888 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.577 in.⁴
 S_e = $I_x / \bar{y}$ = 0.650 in.³
Mn = Se * Fy = 21.45 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 20 GA
Strength: 40 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

Comp Flange: 1.377 in
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.896 in.

Stress in Flange: 40.000 ksi
k: 4.000
Fcr: 72.114 ksi
 λ : 0.745
 ρ : 0.946
Effective Width: 1.303 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.018
Corners	0.261	0.173
Corners _{Stiff}	0.110	0.214
Bottom Flange	1.303	0.018
Web	1.275	0.758
Web _{Stiff}	0.564	0.203
Top Flange	0.895	1.498

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.018	0.000	0.000	--
Bottom Corner	12	3.126	0.173	0.541	0.094	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	1.343	4.198	5.637	0.006
Top Flange	12	10.745	1.498	16.095	24.108	--
Bottom Flange	6	7.815	0.018	0.140	0.003	--
High Corner _{Stiff}	12	1.321	1.302	1.719	2.238	0.000
Web _{Stiff}	12	6.762	1.313	8.878	11.656	0.046
Low Corner _{Stiff}	12	1.321	0.896	1.183	1.060	0.000
Σ		49.512		44.346	53.580	1.942

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.896 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.896 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.566 in.⁴
 S_e = $I_x / \bar{y}$ = 0.632 in.³
Mn = Se * Fy = 25.27 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 20 GA
Strength: 50 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

Comp Flange: 1.377 in
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.905 in.

Stress in Flange: 50.000 ksi
k: 4.000
Fcr: 72.114 ksi
 λ : 0.833
 ρ : 0.884
Effective Width: 1.217 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.018
Corners	0.261	0.173
Corners _{Stiff}	0.110	0.214
Bottom Flange	1.217	0.018
Web	1.275	0.758
Web _{Stiff}	0.564	0.203
Top Flange	0.895	1.498

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.018	0.000	0.000	--
Bottom Corner	12	3.126	0.173	0.541	0.094	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	1.343	4.198	5.637	0.006
Top Flange	12	10.745	1.498	16.095	24.108	--
Bottom Flange	6	7.299	0.018	0.131	0.002	--
High Corner _{Stiff}	12	1.321	1.302	1.719	2.238	0.000
Web _{Stiff}	12	6.762	1.313	8.878	11.656	0.046
Low Corner _{Stiff}	12	1.321	0.896	1.183	1.060	0.000
Σ		48.996		44.337	53.580	1.942

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.905 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.905 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.551 in.⁴
 S_e = $I_x / \bar{y}$ = 0.609 in.³
Mn = Se * Fy = 30.47 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.5B (stiffeners)
Gage: 20 GA
Strength: 60 ksi
Thickness: 0.0358 in.
Total Height: 1.516 in.
Radius: 0.2059 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000500 in.³

Comp Flange: 1.377 in
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.913 in.

Stress in Flange: 60.000 ksi
k: 4.000
Fcr: 72.114 ksi
 λ : 0.912
 ρ : 0.832
Effective Width: 1.145 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.018
Corners	0.261	0.173
Corners _{Stiff}	0.110	0.214
Bottom Flange	1.145	0.018
Web	1.275	0.758
Web _{Stiff}	0.564	0.203
Top Flange	0.895	1.498

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.018	0.000	0.000	--
Bottom Corner	12	3.126	0.173	0.541	0.094	0.006
Web	12	15.296	0.758	11.592	8.786	1.884
Top Corner	12	3.126	1.343	4.198	5.637	0.006
Top Flange	12	10.745	1.498	16.095	24.108	--
Bottom Flange	6	6.872	0.018	0.123	0.002	--
High Corner _{Stiff}	12	1.321	1.302	1.719	2.238	0.000
Web _{Stiff}	12	6.762	1.313	8.878	11.656	0.046
Low Corner _{Stiff}	12	1.321	0.896	1.183	1.060	0.000
Σ		48.568		44.329	53.580	1.942

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.913 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.913 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.539 in.⁴
 S_e = $I_x / \bar{y}$ = 0.591 in.³
Mn = Se * Fy = 35.45 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 22 GA
Strength: 33 ksi
Thickness: 0.0295 in.
Total Height: 1.510 in.
Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000477 in.³

Comp Flange: 1.377 in
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.901 in.

Stress in Flange: 33.000 ksi
k: 4.000
Fcr: 48.966 ksi
 λ : 0.821
 ρ : 0.892
Effective Width: 1.228 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.015
Corners	0.257	0.168
Corners _{Stiff}	0.108	0.208
Bottom Flange	1.228	0.015
Web	1.275	0.755
Web _{Stiff}	0.564	0.200
Top Flange	0.895	1.495

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.015	0.000	0.000	--
Bottom Corner	12	3.079	0.168	0.516	0.086	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	1.342	4.131	5.544	0.006
Top Flange	12	10.745	1.495	16.061	24.007	--
Bottom Flange	6	7.366	0.015	0.109	0.002	--
High Corner _{Stiff}	12	1.300	1.302	1.693	2.203	0.000
Web _{Stiff}	12	6.762	1.310	8.857	11.600	0.046
Low Corner _{Stiff}	12	1.300	0.902	1.173	1.058	0.000
Σ		48.926		44.083	53.213	1.942

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.901 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.901 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.455 in.⁴
 S_e = $I_x / \bar{y}$ = 0.505 in.³
Mn = Se * Fy = 16.68 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 22 GA
Strength: 40 ksi
Thickness: 0.0295 in.
Total Height: 1.510 in.
Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000477 in.³

Comp Flange: 1.377 in
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.909 in.

Stress in Flange: 40.000 ksi
k: 4.000
Fcr: 48.966 ksi
 λ : 0.904
 ρ : 0.837
Effective Width: 1.152 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.015
Corners	0.257	0.168
Corners _{Stiff}	0.108	0.208
Bottom Flange	1.152	0.015
Web	1.275	0.755
Web _{Stiff}	0.564	0.200
Top Flange	0.895	1.495

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.015	0.000	0.000	--
Bottom Corner	12	3.079	0.168	0.516	0.086	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	1.342	4.131	5.544	0.006
Top Flange	12	10.745	1.495	16.061	24.007	--
Bottom Flange	6	6.915	0.015	0.102	0.002	--
High Corner _{Stiff}	12	1.300	1.302	1.693	2.203	0.000
Web _{Stiff}	12	6.762	1.310	8.857	11.600	0.046
Low Corner _{Stiff}	12	1.300	0.902	1.173	1.058	0.000
Σ		48.475		44.076	53.213	1.942

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.909 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.909 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.445 in.⁴
 S_e = $I_x / \bar{y}$ = 0.489 in.³
Mn = Se * Fy = 19.57 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 22 GA
Strength: 50 ksi
Thickness: 0.0295 in.
Total Height: 1.510 in.
Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000477 in.³

Comp Flange: 1.377 in
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.919 in.

Stress in Flange: 50.000 ksi
k: 4.000
Fcr: 48.966 ksi
 λ : 1.011
 ρ : 0.774
Effective Width: 1.066 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.015
Corners	0.257	0.168
Corners _{Stiff}	0.108	0.208
Bottom Flange	1.066	0.015
Web	1.275	0.755
Web _{Stiff}	0.564	0.200
Top Flange	0.895	1.495

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.015	0.000	0.000	--
Bottom Corner	12	3.079	0.168	0.516	0.086	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	1.342	4.131	5.544	0.006
Top Flange	12	10.745	1.495	16.061	24.007	--
Bottom Flange	6	6.395	0.015	0.094	0.001	--
High Corner _{Stiff}	12	1.300	1.302	1.693	2.203	0.000
Web _{Stiff}	12	6.762	1.310	8.857	11.600	0.046
Low Corner _{Stiff}	12	1.300	0.902	1.173	1.058	0.000
Σ		47.955		44.069	53.212	1.942

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.919 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.919 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.432 in.⁴
 S_e = $I_x / \bar{y}$ = 0.471 in.³
Mn = Se * Fy = 23.53 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 22 GA
Strength: 60 ksi
Thickness: 0.0295 in.
Total Height: 1.510 in.
Radius: 0.20275 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000477 in.³

Comp Flange: 1.377 in
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 0.927 in.

Stress in Flange: 60.000 ksi
k: 4.000
Fcr: 48.966 ksi
 λ : 1.107
 ρ : 0.724
Effective Width: 0.997 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.015
Corners	0.257	0.168
Corners _{Stiff}	0.108	0.208
Bottom Flange	0.997	0.015
Web	1.275	0.755
Web _{Stiff}	0.564	0.200
Top Flange	0.895	1.495

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.015	0.000	0.000	--
Bottom Corner	12	3.079	0.168	0.516	0.086	0.006
Web	12	15.296	0.755	11.544	8.713	1.884
Top Corner	12	3.079	1.342	4.131	5.544	0.006
Top Flange	12	10.745	1.495	16.061	24.007	--
Bottom Flange	6	5.979	0.015	0.088	0.001	--
High Corner _{Stiff}	12	1.300	1.302	1.693	2.203	0.000
Web _{Stiff}	12	6.762	1.310	8.857	11.600	0.046
Low Corner _{Stiff}	12	1.300	0.902	1.173	1.058	0.000
Σ		47.540		44.063	53.212	1.942

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.927 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.927 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.422 in.⁴
 S_e = $I_x / \bar{y}$ = 0.456 in.³
Mn = Se * Fy = 27.34 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.58 (stiffeners)
Gage: 24 GA
Strength: 33 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

Comp Flange: 1.377 in
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000007 in.³

Guess $\bar{y}$: 0.917 in.

Stress in Flange: 33.000 ksi
k: 4.000
Fcr: 31.872 ksi
 λ : 1.018
 ρ : 0.770
Effective Width: 1.060 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.012
Corners	0.253	0.163
Corners _{Stiff}	0.107	0.202
Bottom Flange	1.060	0.012
Web	1.275	0.752
Web _{Stiff}	0.564	0.197
Top Flange	0.895	1.492

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.012	0.000	0.000	--
Bottom Corner	12	3.035	0.163	0.493	0.080	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	1.341	4.071	5.460	0.005
Top Flange	12	10.745	1.492	16.030	23.915	--
Bottom Flange	6	6.363	0.012	0.076	0.001	--
High Corner _{Stiff}	12	1.282	1.301	1.669	2.171	0.000
Web _{Stiff}	12	6.762	1.307	8.837	11.549	0.046
Low Corner _{Stiff}	12	1.282	0.908	1.164	1.056	0.000
Σ		47.800		43.841	52.881	1.941

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.917 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.917 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.348 in.⁴
 S_e = $I_x / \bar{y}$ = 0.379 in.³
Mn = Se * Fy = 12.51 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.5B (stiffeners)
Gage: 24 GA
Strength: 40 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

Comp Flange: 1.377 in

θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000007 in.³

Guess $\bar{y}$: 0.926 in.

Stress in Flange: 40.000 ksi
k: 4.000
Fcr: 31.872 ksi
 λ : 1.120
 ρ : 0.717
Effective Width: 0.988 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.012
Corners	0.253	0.163
Corners _{Stiff}	0.107	0.202
Bottom Flange	0.988	0.012
Web	1.275	0.752
Web _{Stiff}	0.564	0.197
Top Flange	0.895	1.492

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.012	0.000	0.000	--
Bottom Corner	12	3.035	0.163	0.493	0.080	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	1.341	4.071	5.460	0.005
Top Flange	12	10.745	1.492	16.030	23.915	--
Bottom Flange	6	5.926	0.012	0.071	0.001	--
High Corner _{Stiff}	12	1.282	1.301	1.669	2.171	0.000
Web _{Stiff}	12	6.762	1.307	8.837	11.549	0.046
Low Corner _{Stiff}	12	1.282	0.908	1.164	1.056	0.000
Σ		47.363		43.835	52.881	1.941

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.926 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.926 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.339 in.⁴
 S_e = $I_x / \bar{y}$ = 0.366 in.³
Mn = Se * Fy = 14.66 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.5B (stiffeners)
Gage: 24 GA
Strength: 50 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

Comp Flange: 1.377 in
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000007 in.³

Guess $\bar{y}$: 0.935 in.

Stress in Flange: 50.000 ksi
k: 4.000
Fcr: 31.872 ksi
 λ : 1.253
 ρ : 0.658
Effective Width: 0.906 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.012
Corners	0.253	0.163
Corners _{Stiff}	0.107	0.202
Bottom Flange	0.906	0.012
Web	1.275	0.752
Web _{Stiff}	0.564	0.197
Top Flange	0.895	1.492

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.012	0.000	0.000	--
Bottom Corner	12	3.035	0.163	0.493	0.080	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	1.341	4.071	5.460	0.005
Top Flange	12	10.745	1.492	16.030	23.915	--
Bottom Flange	6	5.437	0.012	0.065	0.001	--
High Corner _{Stiff}	12	1.282	1.301	1.669	2.171	0.000
Web _{Stiff}	12	6.762	1.307	8.837	11.549	0.046
Low Corner _{Stiff}	12	1.282	0.908	1.164	1.056	0.000
Σ		46.874		43.830	52.881	1.941

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.935 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.935 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.329 in.⁴
 S_e = $I_x / \bar{y}$ = 0.352 in.³
Mn = Se * Fy = 17.61 k-in.

EFFECTIVE WIDTH METHOD
NEGATIVE BENDING
CFS Floor & Roof Deck Sections

date: 1/12/2015
calc by: RKD
check by: TS

Deck: 1.5B (stiffeners)
Gage: 24 GA
Strength: 60 ksi
Thickness: 0.0238 in.
Total Height: 1.504 in.
Radius: 0.1999 in.
 θ : 72.5 deg
 θ : 1.265 rad
Curve I'_x : 0.000457 in.³

Comp Flange: 1.377 in

θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000007 in.³

Guess $\bar{y}$: 0.943 in.

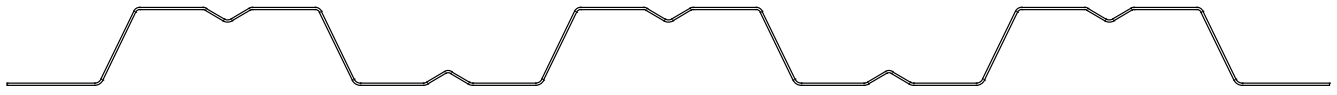
Stress in Flange: 60.000 ksi
k: 4.000
Fcr: 31.872 ksi
 λ : 1.372
 ρ : 0.612
Effective Width: 0.843 in.

Element	L (in.)	y from top (in.)
Lip	0.688	0.012
Corners	0.253	0.163
Corners _{Stiff}	0.107	0.202
Bottom Flange	0.843	0.012
Web	1.275	0.752
Web _{Stiff}	0.564	0.197
Top Flange	0.895	1.492

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	0	0.000	0.012	0.000	0.000	--
Bottom Corner	12	3.035	0.163	0.493	0.080	0.005
Web	12	15.296	0.752	11.501	8.647	1.884
Top Corner	12	3.035	1.341	4.071	5.460	0.005
Top Flange	12	10.745	1.492	16.030	23.915	--
Bottom Flange	6	5.055	0.012	0.060	0.001	--
High Corner _{Stiff}	12	1.282	1.301	1.669	2.171	0.000
Web _{Stiff}	12	6.762	1.307	8.837	11.549	0.046
Low Corner _{Stiff}	12	1.282	0.908	1.164	1.056	0.000
Σ		46.493		43.825	52.881	1.941

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 0.943 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 0.943 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.322 in.⁴
 S_e = $I_x / \bar{y}$ = 0.341 in.³
Mn = Se * Fy = 20.47 k-in.

CHAPTER 8: ANALYSIS | 2 DECK (STIFFENED) | $\pm$ BENDING



8.0 Executive Summary

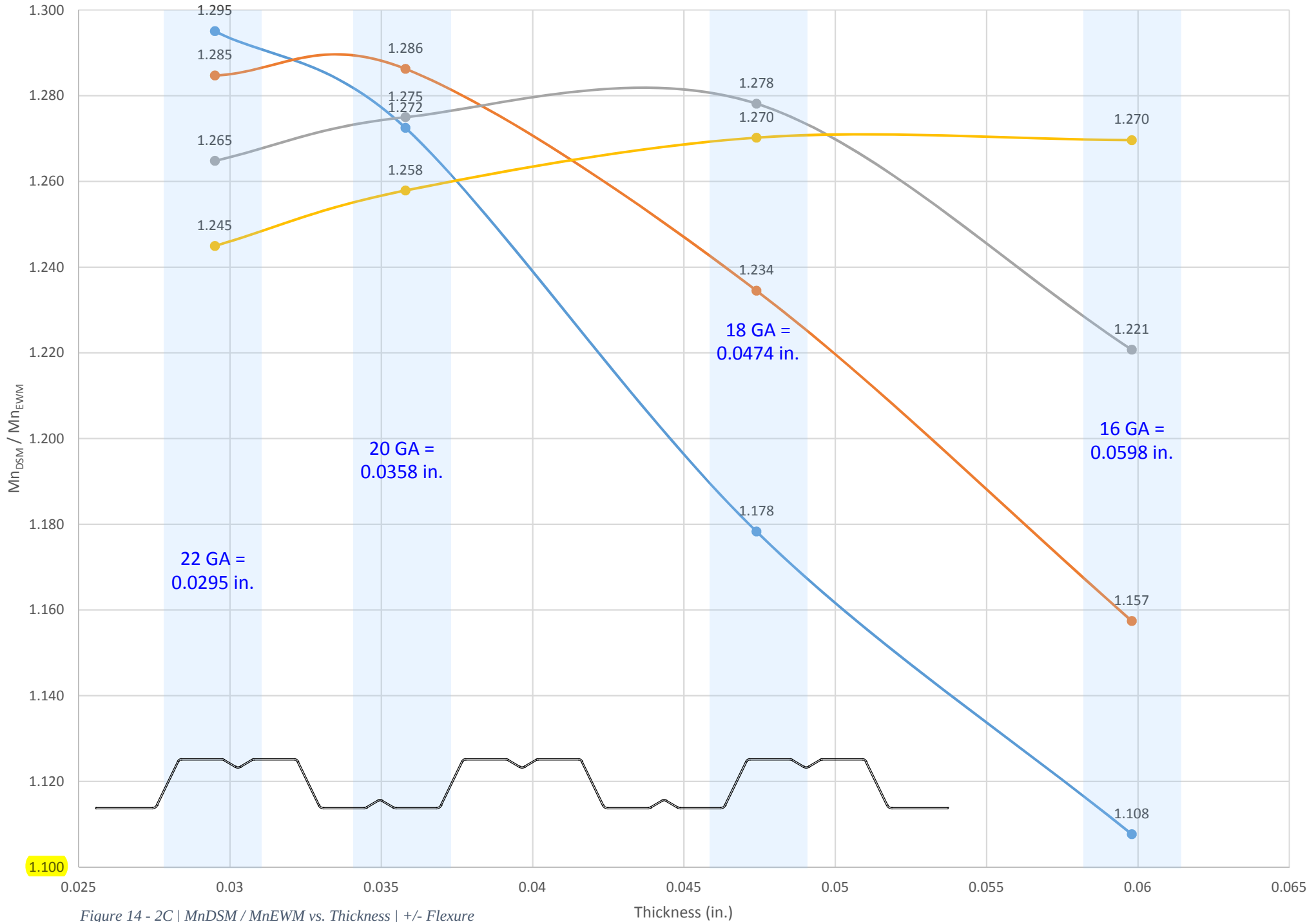
The Direct Strength Method predicted higher strengths for each of the 2C Deck sections undergoing positive and negative flexure. Similar to the stiffened 1.5B Deck, the 2C Deck is able to take advantage of the DSM with the compression flange stiffener breaking up and decreasing the flat width the compression element. The nominal moment capacity ratio (M_{nDSM}/M_{nEWM}) ranged between 1.108 and 1.295.

CHAPTER 8: ANALYSIS | 2 DECK (STIFFENED) | $\pm$ BENDING

8.1 M_{nDSM} / M_{nEWM} vs. Thickness Plot

Mn_{DSM} / Mn_{EWM} vs. Thickness

33 KSI 40 KSI 50 KSI 60 KSI



8.2 Analysis Results Summary

Table 8 - 2C | Analysis Results Summary | +/- Flexure

2 DECK - 33 KSI				
Gage	22	20	18	16
Thickness	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.2028	0.2059	0.2117	0.2179
I _G (CUFSM)	1.030	1.249	1.654	2.087
y-bar (CUFSM)	1.04876	1.05239	1.05907	1.06621
Sxx	0.982	1.187	1.562	1.958
My	32.40	39.18	51.55	64.61
Mn _{DSM}	31.25	39.18	51.55	64.61
Mn _{EWM}	24.13	30.79	43.75	58.33
% ERROR	22.784%	21.414%	15.131%	9.720%

2 DECK - 40 KSI				
Gage	22	20	18	16
Thickness	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.2028	0.2059	0.2117	0.2179
I _G (CUFSM)	1.030	1.249	1.654	2.087
y-bar (CUFSM)	1.04876	1.05239	1.05907	1.06621
Sxx	0.982	1.187	1.562	1.958
My	39.27	47.49	62.49	78.31
Mn _{DSM}	35.78	45.74	62.49	78.31
Mn _{EWM}	27.85	35.56	50.62	67.66
% ERROR	22.163%	22.256%	18.995%	13.600%

2 DECK - 50 KSI				
Gage	22	20	18	16
Thickness	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.2028	0.2059	0.2117	0.2179
I _G (CUFSM)	1.030	1.249	1.654	2.087
y-bar (CUFSM)	1.04876	1.05239	1.05907	1.06621
Sxx	0.982	1.187	1.562	1.958
My	49.08	59.36	78.11	97.89
Mn _{DSM}	41.60	53.55	76.51	97.89
Mn _{EWM}	32.89	42	59.86	80.19
% ERROR	20.938%	21.569%	21.762%	18.082%

2 DECK - 60 KSI				
Gage	22	20	18	16
Thickness	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.2028	0.2059	0.2117	0.2179
I _G (CUFSM)	1.030	1.249	1.654	2.087
y-bar (CUFSM)	1.04876	1.05239	1.05907	1.06621
Sxx	0.982	1.187	1.562	1.958
My	58.90	71.23	93.73	117.47
Mn _{DSM}	46.91	60.53	87.15	116.82
Mn _{EWM}	37.68	48.12	68.61	92.01
% ERROR	19.676%	20.502%	21.274%	21.238%

2 DECK - 33 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
22	0.0295	31.25	24.13	1.295
20	0.0358	39.18	30.79	1.272
18	0.0474	51.55	43.75	1.178
16	0.0598	64.61	58.33	1.108

2 DECK - 40 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
22	0.0295	35.78	27.85	1.285
20	0.0358	45.74	35.56	1.286
18	0.0474	62.49	50.62	1.234
16	0.0598	78.31	67.66	1.157

2 DECK - 50 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
22	0.0295	41.60	32.89	1.265
20	0.0358	53.55	42.00	1.275
18	0.0474	76.51	59.86	1.278
16	0.0598	97.89	80.19	1.221

2 DECK - 60 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
22	0.0295	46.91	37.68	1.245
20	0.0358	60.53	48.12	1.258
18	0.0474	87.15	68.61	1.270
16	0.0598	116.82	92.01	1.270

8.3 Direct Strength Method Calculations

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	16	GA		
	Strength:	33	KSI		
	$M_y =$	64.61	kip-in	Length:	
local	$M_{crf}/M_y =$	5.86000	$M_{crf} = 378.6146$ kip-in	2	in
dist.	$M_{crd}/M_y =$	3.93000	$M_{crd} = 253.9173$ kip-in	12	in
global	$M_{cre}/M_y =$	12.06000	$M_{cre} = 779.1966$ kip-in	120	in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 64.61 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.41 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 64.61 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.50 \quad (\text{distortional slenderness}) \\ M_{nd} = 64.61 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 64.61 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	16	GA		
	Strength:	40	KSI		
	$M_y =$	78.31	kip-in	Length:	
local	$M_{crf}/M_y =$	4.84000	$M_{crf} = 379.0204$ kip-in		2 in
dist.	$M_{crd}/M_y =$	3.24000	$M_{crd} = 253.7244$ kip-in		12 in
global	$M_{cre}/M_y =$	9.95000	$M_{cre} = 779.1845$ kip-in		120 in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 78.31 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.45 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 78.31 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.56 \quad (\text{distortional slenderness}) \\ M_{nd} = 78.31 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 78.31 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	16	GA		
	Strength:	50	KSI		
	$M_y =$	97.89	kip-in	Length:	
local	$M_{crf}/M_y =$	3.87000	$M_{crf} = 378.8343$ kip-in		2 in
dist.	$M_{crd}/M_y =$	2.60000	$M_{crd} = 254.514$ kip-in		12 in
global	$M_{cre}/M_y =$	7.96000	$M_{cre} = 779.2044$ kip-in		120 in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 97.89 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.51 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 97.89 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.62 \quad (\text{distortional slenderness}) \\ M_{nd} = 97.89 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 97.89 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	16	GA		
	Strength:	50	KSI		
	$M_y =$	117.47	kip-in	Length:	
local	$M_{crf}/M_y =$	3.23000	$M_{crf} = 379.4281$ kip-in		2 in
dist.	$M_{crd}/M_y =$	2.16000	$M_{crd} = 253.7352$ kip-in		12 in
global	$M_{cre}/M_y =$	6.63000	$M_{cre} = 778.8261$ kip-in		120 in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 117.47 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.56 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 117.47 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.68 \quad (\text{distortional slenderness}) \\ M_{nd} = 116.82 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 116.82 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	18	GA		
	Strength:	33	KSI		
	$M_y =$	51.55	kip-in	Length:	
local	$M_{crf}/M_y =$	3.80940	$M_{crf} = 196.37457$ kip-in		1 in
dist.	$M_{crd}/M_y =$	3.08000	$M_{crd} = 158.774$ kip-in		12 in
global	$M_{cre}/M_y =$	9.60000	$M_{cre} = 494.88$ kip-in		240 in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 51.55 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.51 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 51.55 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.57 \quad (\text{distortional slenderness}) \\ M_{nd} = 51.55 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 51.55 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	18	GA		
	Strength:	40	KSI		
	$M_y =$	62.49	kip-in	Length:	
local	$M_{crf}/M_y =$	3.14270	$M_{crf} = 196.38732$ kip-in		1 in
dist.	$M_{crd}/M_y =$	2.54000	$M_{crd} = 158.7246$ kip-in		12 in
global	$M_{cre}/M_y =$	7.93000	$M_{cre} = 495.5457$ kip-in		240 in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 62.49 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.56 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 62.49 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.63 \quad (\text{distortional slenderness}) \\ M_{nd} = 62.49 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 62.49 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	18	GA		
	Strength:	50	KSI		
	$M_y =$	78.11	kip-in	Length:	
local	$M_{crf}/M_y =$	2.51420	$M_{crf} = 196.38416$ kip-in		1 in
dist.	$M_{crd}/M_y =$	2.04000	$M_{crd} = 159.3444$ kip-in		12 in
global	$M_{cre}/M_y =$	6.34000	$M_{cre} = 495.2174$ kip-in		240 in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 78.11 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.63 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 78.11 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.70 \quad (\text{distortional slenderness}) \\ M_{nd} = 76.51 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 76.51 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	18	GA		
	Strength:	60	KSI		
	$M_y =$	93.73	kip-in	Length:	
local	$M_{crf}/M_y =$	2.09520	$M_{crf} = 196.3831$ kip-in		1 in
dist.	$M_{crd}/M_y =$	1.70000	$M_{crd} = 159.341$ kip-in		12 in
global	$M_{cre}/M_y =$	5.28000	$M_{cre} = 494.8944$ kip-in		240 in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 93.73 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.69 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 93.73 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.77 \quad (\text{distortional slenderness}) \\ M_{nd} = 87.15 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 87.15 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	20	GA		
	Strength:	33	KSI		
	$M_y =$	39.18	kip-in	Length:	
local	$M_{crf}/M_y =$	2.21990	$M_{crf} = 86.975682$ kip-in		1 in
dist.	$M_{crd}/M_y =$	2.33000	$M_{crd} = 91.2894$ kip-in		12 in
global	$M_{cre}/M_y =$	6.83000	$M_{cre} = 267.5994$ kip-in		240 in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 39.18 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.67 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 39.18 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.66 \quad (\text{distortional slenderness}) \\ M_{nd} = 39.18 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 39.18 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	20	GA		
	Strength:	40	KSI		
	$M_y =$	47.49	kip-in	Length:	
local	$M_{crf}/M_y =$	1.83150	$M_{crf} = 86.977935$ kip-in	1	in
dist.	$M_{crd}/M_y =$	1.92000	$M_{crd} = 91.1808$ kip-in	12	in
global	$M_{cre}/M_y =$	5.64000	$M_{cre} = 267.8436$ kip-in	240	in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 47.49 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.74 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 47.49 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.72 \quad (\text{distortional slenderness}) \\ M_{nd} = 45.74 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 45.74 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	20	GA		
	Strength:	50	KSI		
	$M_y =$	59.36	kip-in	Length:	
local	$M_{crf}/M_y =$	1.46520	$M_{crf} = 86.974272$ kip-in		1 in
dist.	$M_{crd}/M_y =$	1.54000	$M_{crd} = 91.4144$ kip-in		12 in
global	$M_{cre}/M_y =$	4.51000	$M_{cre} = 267.7136$ kip-in		240 in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 59.36 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.83 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 57.07 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.81 \quad (\text{distortional slenderness}) \\ M_{nd} = 53.55 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 53.55 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	20	GA		
	Strength:	60	KSI		
	$M_y =$	71.23	kip-in	Length:	
local	$M_{crf}/M_y =$	1.22100	$M_{crf} = 86.97183$ kip-in	1	in
dist.	$M_{crd}/M_y =$	1.28000	$M_{crd} = 91.1744$ kip-in	12	in
global	$M_{cre}/M_y =$	3.76000	$M_{cre} = 267.8248$ kip-in	240	in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 71.23 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.90 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 64.62 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.88 \quad (\text{distortional slenderness}) \\ M_{nd} = 60.53 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 60.53 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	22	GA		
	Strength:	33	KSI		
	$M_y =$	32.40	kip-in	Length:	
local	$M_{crf}/M_y =$	1.52840	$M_{crf} =$ 49.52016 kip-in		1 in
dist.	$M_{crd}/M_y =$	1.93000	$M_{crd} =$ 62.532 kip-in		12 in
global	$M_{cre}/M_y =$	5.57000	$M_{cre} =$ 180.468 kip-in		240 in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 32.40 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.81 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 31.57 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.72 \quad (\text{distortional slenderness}) \\ M_{nd} = 31.25 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 31.25 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	22	GA		
	Strength:	40	KSI		
	$M_y =$	39.27	kip-in	Length:	
local	$M_{crf}/M_y =$	1.26090	$M_{crf} = 49.515543$ kip-in		1 in
dist.	$M_{crd}/M_y =$	1.59000	$M_{crd} = 62.4393$ kip-in		12 in
global	$M_{cre}/M_y =$	4.60000	$M_{cre} = 180.642$ kip-in		240 in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 39.27 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.89 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 35.99 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.79 \quad (\text{distortional slenderness}) \\ M_{nd} = 35.78 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 35.78 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	22	GA		
	Strength:	50	KSI		
	$M_y =$	49.08	kip-in	Length:	
local	$M_{crf}/M_y =$	1.00870	$M_{crf} = 49.506996$ kip-in		1 in
dist.	$M_{crd}/M_y =$	1.27000	$M_{crd} = 62.3316$ kip-in		12 in
global	$M_{cre}/M_y =$	3.68000	$M_{cre} = 180.6144$ kip-in		240 in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 49.08 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.00 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 41.84 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.89 \quad (\text{distortional slenderness}) \\ M_{nd} = 41.60 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 41.60 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	2			
	Gage:	22	GA		
	Strength:	60	KSI		
	$M_y =$	58.90	kip-in	Length:	
local	$M_{crf}/M_y =$	0.84062	$M_{crf} = 49.512518$ kip-in		1 in
dist.	$M_{crd}/M_y =$	1.06000	$M_{crd} = 62.434$ kip-in		12 in
global	$M_{cre}/M_y =$	3.06000	$M_{cre} = 180.234$ kip-in		240 in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 58.90 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.09 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 47.26 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.97 \quad (\text{distortional slenderness}) \\ M_{nd} = 46.91 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 46.91 \text{ kip-in} \quad (\text{distortional controls})$$

8.4 Effective Width Method Calculations

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 16 GA
Strength: 33 ksi
Thickness: 0.0598 in.
Total Height: 2.120 in.
Radius: 0.2179 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000337 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.295 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000010 in.³

Guess $\bar{y}$: 1.096 in.

Stress in Flange: 33.000 ksi
k: 11.461
Fcr: 48.128 ksi
 λ : 0.828
 ρ : 0.887
Effective Width: 4.381 in.

δ : 1.037
Isp: 0.004 in.⁴
 γ : 41.366
 β : 3.025
kd: 6.605
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.090
Corners	0.244	0.205
Corners _{Stiff}	0.116	0.238
Bottom Flange	1.706	2.090
Web	2.050	1.060
Web _{Stiff}	0.564	0.215
Top Flange	4.381	0.083

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.090	9.956	20.808	--
Bottom Corner	6	1.463	1.915	2.801	5.363	0.002
Web	6	12.300	1.060	13.037	13.818	3.486
Top Corner	6	1.463	0.205	0.300	0.062	0.002
Top Flange	3	13.142	0.083	1.097	0.092	--
Bottom Flange	4	6.824	2.090	14.261	29.805	--
Low Corner _{Stiff}	4	0.466	1.882	0.877	1.650	0.000
Web _{Stiff}	4	2.254	1.905	4.294	8.179	0.015
High Corner _{Stiff}	4	0.466	1.452	0.677	0.983	0.000
Σ		43.142		47.299	80.758	3.506

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.096 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.096 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.938 in.⁴
 S_e = $I_x / \bar{y}$ = 1.768 in.³
Mn = Se * Fy = 58.33 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 16 GA
Strength: 40 ksi
Thickness: 0.0598 in.
Total Height: 2.120 in.
Radius: 0.2179 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000337 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.295 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000010 in.³

Guess $\bar{y}$: 1.116 in.

Stress in Flange: 40.000 ksi
k: 11.461
Fcr: 48.128 ksi
 λ : 0.912
 ρ : 0.832
Effective Width: 4.111 in.

δ : 1.037
Isp: 0.004 in.⁴
 γ : 41.366
 β : 3.025
kd: 6.605
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.090
Corners	0.244	0.205
Corners _{Stiff}	0.116	0.238
Bottom Flange	1.706	2.090
Web	2.050	1.060
Web _{Stiff}	0.564	0.215
Top Flange	4.111	0.083

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.090	9.956	20.808	--
Bottom Corner	6	1.463	1.915	2.801	5.363	0.002
Web	6	12.300	1.060	13.037	13.818	3.486
Top Corner	6	1.463	0.205	0.300	0.062	0.002
Top Flange	3	12.333	0.083	1.029	0.086	--
Bottom Flange	4	6.824	2.090	14.261	29.805	--
Low Corner _{Stiff}	4	0.466	1.882	0.877	1.650	0.000
Web _{Stiff}	4	2.254	1.905	4.294	8.179	0.015
High Corner _{Stiff}	4	0.466	1.452	0.677	0.983	0.000
Σ		42.333		47.232	80.753	3.506

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.116 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.116 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.887 in.⁴
 S_e = $I_x / \bar{y}$ = 1.692 in.³
Mn = Se * Fy = 67.66 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 16 GA
Strength: 50 ksi
Thickness: 0.0598 in.
Total Height: 2.120 in.
Radius: 0.2179 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000337 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.295 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000010 in.³

Guess $\bar{y}$: 1.139 in.

Stress in Flange: 50.000 ksi
k: 11.461
Fcr: 48.128 ksi
 λ : 1.019
 ρ : 0.769
Effective Width: 3.801 in.

δ : 1.037
Isp: 0.004 in.⁴
 γ : 41.366
 β : 3.025
kd: 6.605
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.090
Corners	0.244	0.205
Corners _{Stiff}	0.116	0.238
Bottom Flange	1.706	2.090
Web	2.050	1.060
Web _{Stiff}	0.564	0.215
Top Flange	3.801	0.083

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.090	9.956	20.808	--
Bottom Corner	6	1.463	1.915	2.801	5.363	0.002
Web	6	12.300	1.060	13.037	13.818	3.486
Top Corner	6	1.463	0.205	0.300	0.062	0.002
Top Flange	3	11.402	0.083	0.952	0.079	--
Bottom Flange	4	6.824	2.090	14.261	29.805	--
Low Corner _{Stiff}	4	0.466	1.882	0.877	1.650	0.000
Web _{Stiff}	4	2.254	1.905	4.294	8.179	0.015
High Corner _{Stiff}	4	0.466	1.452	0.677	0.983	0.000
Σ		41.401		47.154	80.746	3.506

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.139 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.139 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.827 in.⁴
 S_e = $I_x / \bar{y}$ = 1.604 in.³
Mn = Se * Fy = 80.19 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 16 GA
Strength: 60 ksi
Thickness: 0.0598 in.
Total Height: 2.120 in.
Radius: 0.2179 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000337 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.295 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000010 in.³

Guess $\bar{y}$: 1.158 in.

Stress in Flange: 60.000 ksi
k: 11.461
Fcr: 48.128 ksi
 λ : 1.117
 ρ : 0.719
Effective Width: 3.553 in.

δ : 1.037
lsp: 0.004 in.⁴
 γ : 41.366
 β : 3.025
kd: 6.605
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.090
Corners	0.244	0.205
Corners _{Stiff}	0.116	0.238
Bottom Flange	1.706	2.090
Web	2.050	1.060
Web _{Stiff}	0.564	0.215
Top Flange	3.553	0.083

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.090	9.956	20.808	--
Bottom Corner	6	1.463	1.915	2.801	5.363	0.002
Web	6	12.300	1.060	13.037	13.818	3.486
Top Corner	6	1.463	0.205	0.300	0.062	0.002
Top Flange	3	10.658	0.083	0.889	0.074	--
Bottom Flange	4	6.824	2.090	14.261	29.805	--
Low Corner _{Stiff}	4	0.466	1.882	0.877	1.650	0.000
Web _{Stiff}	4	2.254	1.905	4.294	8.179	0.015
High Corner _{Stiff}	4	0.466	1.452	0.677	0.983	0.000
Σ		40.657		47.092	80.741	3.506

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.158 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.158 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.776 in.⁴
 S_e = $I_x / \bar{y}$ = 1.533 in.³
Mn = Se * Fy = 92.01 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 18 GA
Strength: 33 ksi
Thickness: 0.0474 in.
Total Height: 2.107 in.
Radius: 0.2117 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000309 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.234 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000009 in.³

Guess $\bar{y}$: 1.116 in.

Stress in Flange: 33.000 ksi
k: 14.072
Fcr: 37.127 ksi
 λ : 0.943
 ρ : 0.813
Effective Width: 4.017 in.

δ : 1.037
lsp: 0.003 in.⁴
 γ : 65.203
 β : 3.386
kd: 8.110
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.084
Corners	0.237	0.194
Corners _{Stiff}	0.113	0.225
Bottom Flange	1.706	2.084
Web	2.050	1.054
Web _{Stiff}	0.564	0.209
Top Flange	4.017	0.077

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.084	9.927	20.684	--
Bottom Corner	6	1.421	1.913	2.719	5.204	0.002
Web	6	12.300	1.054	12.961	13.656	3.486
Top Corner	6	1.421	0.194	0.276	0.053	0.002
Top Flange	3	12.051	0.077	0.928	0.072	--
Bottom Flange	4	6.824	2.084	14.219	29.628	--
Low Corner _{Stiff}	4	0.453	1.882	0.852	1.603	0.000
Web _{Stiff}	4	2.254	1.899	4.280	8.126	0.015
High Corner _{Stiff}	4	0.453	1.465	0.663	0.971	0.000
Σ		41.941		46.824	79.997	3.505

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.116 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.116 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.480 in.⁴
 S_e = $I_x / \bar{y}$ = 1.326 in.³
Mn = Se * Fy = 43.75 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 18 GA
Strength: 40 ksi
Thickness: 0.0474 in.
Total Height: 2.107 in.
Radius: 0.2117 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000309 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.234 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000009 in.³

Guess $\bar{y}$: 1.137 in.

Stress in Flange: 40.000 ksi
k: 14.072
Fcr: 37.127 ksi
 λ : 1.038
 ρ : 0.759
Effective Width: 3.751 in.

δ : 1.037
lsp: 0.003 in.⁴
 γ : 65.203
 β : 3.386
kd: 8.110
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.084
Corners	0.237	0.194
Corners _{Stiff}	0.113	0.225
Bottom Flange	1.706	2.084
Web	2.050	1.054
Web _{Stiff}	0.564	0.209
Top Flange	3.751	0.077

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.084	9.927	20.684	--
Bottom Corner	6	1.421	1.913	2.719	5.204	0.002
Web	6	12.300	1.054	12.961	13.656	3.486
Top Corner	6	1.421	0.194	0.276	0.053	0.002
Top Flange	3	11.252	0.077	0.867	0.067	--
Bottom Flange	4	6.824	2.084	14.219	29.628	--
Low Corner _{Stiff}	4	0.453	1.882	0.852	1.603	0.000
Web _{Stiff}	4	2.254	1.899	4.280	8.126	0.015
High Corner _{Stiff}	4	0.453	1.465	0.663	0.971	0.000
Σ		41.141		46.763	79.993	3.505

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.137 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.137 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.438 in.⁴
 S_e = $I_x / \bar{y}$ = 1.265 in.³
Mn = Se * Fy = 50.62 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 18 GA
Strength: 50 ksi
Thickness: 0.0474 in.
Total Height: 2.107 in.
Radius: 0.2117 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000309 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.234 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000009 in.³

Guess $\bar{y}$: 1.160 in.

Stress in Flange: 50.000 ksi
k: 14.072
Fcr: 37.127 ksi
 λ : 1.160
 ρ : 0.698
Effective Width: 3.450 in.

δ : 1.037
lsp: 0.003 in.⁴
 γ : 65.203
 β : 3.386
kd: 8.110
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.084
Corners	0.237	0.194
Corners _{Stiff}	0.113	0.225
Bottom Flange	1.706	2.084
Web	2.050	1.054
Web _{Stiff}	0.564	0.209
Top Flange	3.450	0.077

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.084	9.927	20.684	--
Bottom Corner	6	1.421	1.913	2.719	5.204	0.002
Web	6	12.300	1.054	12.961	13.656	3.486
Top Corner	6	1.421	0.194	0.276	0.053	0.002
Top Flange	3	10.350	0.077	0.797	0.061	--
Bottom Flange	4	6.824	2.084	14.219	29.628	--
Low Corner _{Stiff}	4	0.453	1.882	0.852	1.603	0.000
Web _{Stiff}	4	2.254	1.899	4.280	8.126	0.015
High Corner _{Stiff}	4	0.453	1.465	0.663	0.971	0.000
Σ		40.239		46.693	79.987	3.505

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.160 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.160 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.389 in.⁴
 S_e = $I_x / \bar{y}$ = 1.197 in.³
Mn = Se * Fy = 59.86 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 18 GA
Strength: 60 ksi
Thickness: 0.0474 in.
Total Height: 2.107 in.
Radius: 0.2117 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000309 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.234 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000009 in.³

Guess $\bar{y}$: 1.180 in.

Stress in Flange: 60.000 ksi
k: 14.072
Fcr: 37.127 ksi
 λ : 1.271
 ρ : 0.650
Effective Width: 3.213 in.

δ : 1.037
lsp: 0.003 in.⁴
 γ : 65.203
 β : 3.386
kd: 8.110
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.084
Corners	0.237	0.194
Corners _{Stiff}	0.113	0.225
Bottom Flange	1.706	2.084
Web	2.050	1.054
Web _{Stiff}	0.564	0.209
Top Flange	3.213	0.077

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.084	9.927	20.684	--
Bottom Corner	6	1.421	1.913	2.719	5.204	0.002
Web	6	12.300	1.054	12.961	13.656	3.486
Top Corner	6	1.421	0.194	0.276	0.053	0.002
Top Flange	3	9.640	0.077	0.743	0.057	--
Bottom Flange	4	6.824	2.084	14.219	29.628	--
Low Corner _{Stiff}	4	0.453	1.882	0.852	1.603	0.000
Web _{Stiff}	4	2.254	1.899	4.280	8.126	0.015
High Corner _{Stiff}	4	0.453	1.465	0.663	0.971	0.000
Σ		39.530		46.638	79.983	3.505

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.180 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.180 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.349 in.⁴
 S_e = $I_x / \bar{y}$ = 1.144 in.³
Mn = Se * Fy = 68.61 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 20 GA
Strength: 33 ksi
Thickness: 0.0358 in.
Total Height: 2.096 in.
Radius: 0.2059 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000284 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.177 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 1.143 in.

Stress in Flange: 33.000 ksi
k: 18.169
Fcr: 27.345 ksi
 λ : 1.099
 ρ : 0.728
Effective Width: 3.596 in.

δ : 1.037
lsp: 0.002 in.⁴
 γ : 113.380
 β : 3.885
kd: 10.471
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.078
Corners	0.230	0.183
Corners _{Stiff}	0.110	0.214
Bottom Flange	1.706	2.078
Web	2.050	1.048
Web _{Stiff}	0.564	0.203
Top Flange	3.596	0.071

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.078	9.899	20.569	--
Bottom Corner	6	1.382	1.912	2.643	5.055	0.002
Web	6	12.300	1.048	12.889	13.507	3.486
Top Corner	6	1.382	0.183	0.254	0.047	0.002
Top Flange	3	10.789	0.071	0.767	0.054	--
Bottom Flange	4	6.824	2.078	14.180	29.464	--
Low Corner _{Stiff}	4	0.440	1.882	0.828	1.559	0.000
Web _{Stiff}	4	2.254	1.893	4.267	8.076	0.015
High Corner _{Stiff}	4	0.440	1.476	0.650	0.959	0.000
Σ		40.576		46.376	79.289	3.505

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.143 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.143 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.066 in.⁴
 S_e = $I_x / \bar{y}$ = 0.933 in.³
Mn = **Se * Fy =** **30.79 k-in.**

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 20 GA
Strength: 40 ksi
Thickness: 0.0358 in.
Total Height: 2.096 in.
Radius: 0.2059 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000284 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.177 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 1.164 in.

Stress in Flange: 40.000 ksi
k: 18.169
Fcr: 27.345 ksi
 λ : 1.209
 ρ : 0.676
Effective Width: 3.342 in.

δ : 1.037
lsp: 0.002 in.⁴
 γ : 113.380
 β : 3.885
kd: 10.471
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.078
Corners	0.230	0.183
Corners _{Stiff}	0.110	0.214
Bottom Flange	1.706	2.078
Web	2.050	1.048
Web _{Stiff}	0.564	0.203
Top Flange	3.342	0.071

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.078	9.899	20.569	--
Bottom Corner	6	1.382	1.912	2.643	5.055	0.002
Web	6	12.300	1.048	12.889	13.507	3.486
Top Corner	6	1.382	0.183	0.254	0.047	0.002
Top Flange	3	10.025	0.071	0.712	0.051	--
Bottom Flange	4	6.824	2.078	14.180	29.464	--
Low Corner _{Stiff}	4	0.440	1.882	0.828	1.559	0.000
Web _{Stiff}	4	2.254	1.893	4.267	8.076	0.015
High Corner _{Stiff}	4	0.440	1.476	0.650	0.959	0.000
Σ		39.811		46.322	79.286	3.505

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.164 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.164 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.034 in.⁴
 S_e = $I_x / \bar{y}$ = 0.889 in.³
Mn = Se * Fy = 35.56 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 20 GA
Strength: 50 ksi
Thickness: 0.0358 in.
Total Height: 2.096 in.
Radius: 0.2059 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000284 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.177 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 1.187 in.

Stress in Flange: 50.000 ksi
k: 18.169
Fcr: 27.345 ksi
 λ : 1.352
 ρ : 0.619
Effective Width: 3.059 in.

δ : 1.037
lsp: 0.002 in.⁴
 γ : 113.380
 β : 3.885
kd: 10.471
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.078
Corners	0.230	0.183
Corners _{Stiff}	0.110	0.214
Bottom Flange	1.706	2.078
Web	2.050	1.048
Web _{Stiff}	0.564	0.203
Top Flange	3.059	0.071

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.078	9.899	20.569	--
Bottom Corner	6	1.382	1.912	2.643	5.055	0.002
Web	6	12.300	1.048	12.889	13.507	3.486
Top Corner	6	1.382	0.183	0.254	0.047	0.002
Top Flange	3	9.177	0.071	0.652	0.046	--
Bottom Flange	4	6.824	2.078	14.180	29.464	--
Low Corner _{Stiff}	4	0.440	1.882	0.828	1.559	0.000
Web _{Stiff}	4	2.254	1.893	4.267	8.076	0.015
High Corner _{Stiff}	4	0.440	1.476	0.650	0.959	0.000
Σ		38.964		46.261	79.281	3.505

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.187 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.187 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.997 in.⁴
 S_e = $I_x / \bar{y}$ = 0.840 in.³
Mn = Se * Fy = 42.00 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 20 GA
Strength: 60 ksi
Thickness: 0.0358 in.
Total Height: 2.096 in.
Radius: 0.2059 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000284 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.177 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 1.206 in.

Stress in Flange: 60.000 ksi
k: 18.169
Fcr: 27.345 ksi
 λ : 1.481
 ρ : 0.575
Effective Width: 2.840 in.

δ : 1.037
lsp: 0.002 in.⁴
 γ : 113.380
 β : 3.885
kd: 10.471
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.078
Corners	0.230	0.183
Corners _{Stiff}	0.110	0.214
Bottom Flange	1.706	2.078
Web	2.050	1.048
Web _{Stiff}	0.564	0.203
Top Flange	2.840	0.071

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.078	9.899	20.569	--
Bottom Corner	6	1.382	1.912	2.643	5.055	0.002
Web	6	12.300	1.048	12.889	13.507	3.486
Top Corner	6	1.382	0.183	0.254	0.047	0.002
Top Flange	3	8.519	0.071	0.605	0.043	--
Bottom Flange	4	6.824	2.078	14.180	29.464	--
Low Corner _{Stiff}	4	0.440	1.882	0.828	1.559	0.000
Web _{Stiff}	4	2.254	1.893	4.267	8.076	0.015
High Corner _{Stiff}	4	0.440	1.476	0.650	0.959	0.000
Σ		38.306		46.215	79.278	3.505

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.206 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.206 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.968 in.⁴
 S_e = $I_x / \bar{y}$ = 0.802 in.³
Mn = Se * Fy = 48.12 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 22 GA
Strength: 33 ksi
Thickness: 0.0295 in.
Total Height: 2.090 in.
Radius: 0.20275 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000271 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.146 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 1.162 in.

Stress in Flange: 33.000 ksi
k: 21.736
Fcr: 22.212 ksi
 λ : 1.219
 ρ : 0.672
Effective Width: 3.321 in.

δ : 1.037
lsp: 0.002 in.⁴
 γ : 166.038
 β : 4.272
kd: 12.527
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.075
Corners	0.227	0.178
Corners _{Stiff}	0.108	0.208
Bottom Flange	1.706	2.075
Web	2.050	1.045
Web _{Stiff}	0.564	0.200
Top Flange	3.321	0.068

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.075	9.884	20.507	--
Bottom Corner	6	1.361	1.912	2.602	4.974	0.002
Web	6	12.300	1.045	12.850	13.425	3.486
Top Corner	6	1.361	0.178	0.242	0.043	0.002
Top Flange	3	9.964	0.068	0.675	0.046	--
Bottom Flange	4	6.824	2.075	14.158	29.375	--
Low Corner _{Stiff}	4	0.433	1.882	0.816	1.535	0.000
Web _{Stiff}	4	2.254	1.890	4.259	8.049	0.015
High Corner _{Stiff}	4	0.433	1.482	0.642	0.952	0.000
Σ		39.695		46.130	78.906	3.505

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.162 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.162 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.850 in.⁴
 S_e = $I_x / \bar{y}$ = 0.731 in.³
Mn = Se * Fy = 24.13 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 22 GA
Strength: 40 ksi
Thickness: 0.0295 in.
Total Height: 2.090 in.
Radius: 0.20275 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000271 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.146 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 1.183 in.

Stress in Flange: 40.000 ksi
k: 21.736
Fcr: 22.212 ksi
 λ : 1.342
 ρ : 0.623
Effective Width: 3.078 in.

δ : 1.037
lsp: 0.002 in.⁴
 γ : 166.038
 β : 4.272
kd: 12.527
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.075
Corners	0.227	0.178
Corners _{Stiff}	0.108	0.208
Bottom Flange	1.706	2.075
Web	2.050	1.045
Web _{Stiff}	0.564	0.200
Top Flange	3.078	0.068

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.075	9.884	20.507	--
Bottom Corner	6	1.361	1.912	2.602	4.974	0.002
Web	6	12.300	1.045	12.850	13.425	3.486
Top Corner	6	1.361	0.178	0.242	0.043	0.002
Top Flange	3	9.233	0.068	0.626	0.042	--
Bottom Flange	4	6.824	2.075	14.158	29.375	--
Low Corner _{Stiff}	4	0.433	1.882	0.816	1.535	0.000
Web _{Stiff}	4	2.254	1.890	4.259	8.049	0.015
High Corner _{Stiff}	4	0.433	1.482	0.642	0.952	0.000
Σ		38.964		46.080	78.903	3.505

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.183 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.183 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.823 in.⁴
 S_e = $I_x / \bar{y}$ = 0.696 in.³
Mn = Se * Fy = 27.85 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 22 GA
Strength: 50 ksi
Thickness: 0.0295 in.
Total Height: 2.090 in.
Radius: 0.20275 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000271 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.146 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 1.206 in.

Stress in Flange: 50.000 ksi
k: 21.736
Fcr: 22.212 ksi
 λ : 1.500
 ρ : 0.569
Effective Width: 2.810 in.

δ : 1.037
Isp: 0.002 in.⁴
 γ : 166.038
 β : 4.272
kd: 12.527
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.075
Corners	0.227	0.178
Corners _{Stiff}	0.108	0.208
Bottom Flange	1.706	2.075
Web	2.050	1.045
Web _{Stiff}	0.564	0.200
Top Flange	2.810	0.068

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.075	9.884	20.507	--
Bottom Corner	6	1.361	1.912	2.602	4.974	0.002
Web	6	12.300	1.045	12.850	13.425	3.486
Top Corner	6	1.361	0.178	0.242	0.043	0.002
Top Flange	3	8.429	0.068	0.571	0.039	--
Bottom Flange	4	6.824	2.075	14.158	29.375	--
Low Corner _{Stiff}	4	0.433	1.882	0.816	1.535	0.000
Web _{Stiff}	4	2.254	1.890	4.259	8.049	0.015
High Corner _{Stiff}	4	0.433	1.482	0.642	0.952	0.000
Σ		38.161		46.026	78.899	3.505

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.206 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.206 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.793 in.⁴
 S_e = $I_x / \bar{y}$ = 0.658 in.³
Mn = Se * Fy = 32.89 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 2
Gage: 22 GA
Strength: 60 ksi
Thickness: 0.0295 in.
Total Height: 2.090 in.
Radius: 0.20275 in.
 θ : 64.106 deg
 θ : 1.119 rad
Curve I'_x : 0.000271 in.³

bo: 4.765 in.
h: 2.050 in.
bp: 1.706 in.
Ag: 0.146 in.²
n: 1
 θ_{Stiff} : 30.625 deg
 θ_{Stiff} : 0.535 rad
Curve_{Stiff} I'_x : 0.000008 in.³

Guess $\bar{y}$: 1.225 in.

Stress in Flange: 60.000 ksi
k: 21.736
Fcr: 22.212 ksi
 λ : 1.644
 ρ : 0.527
Effective Width: 2.603 in.

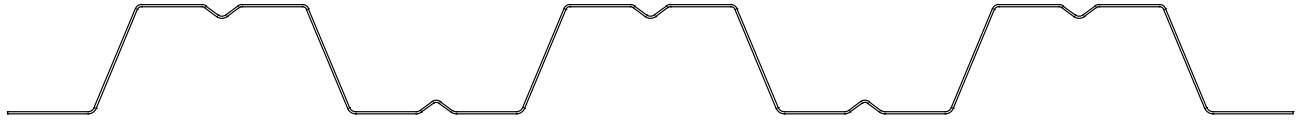
δ : 1.037
Isp: 0.002 in.⁴
 γ : 166.038
 β : 4.272
kd: 12.527
kloc: 31.205
R: 1.735

Element	L (in.)	y from top (in.)
Lip	2.382	2.075
Corners	0.227	0.178
Corners _{Stiff}	0.108	0.208
Bottom Flange	1.706	2.075
Web	2.050	1.045
Web _{Stiff}	0.564	0.200
Top Flange	2.603	0.068

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.764	2.075	9.884	20.507	--
Bottom Corner	6	1.361	1.912	2.602	4.974	0.002
Web	6	12.300	1.045	12.850	13.425	3.486
Top Corner	6	1.361	0.178	0.242	0.043	0.002
Top Flange	3	7.810	0.068	0.529	0.036	--
Bottom Flange	4	6.824	2.075	14.158	29.375	--
Low Corner _{Stiff}	4	0.433	1.882	0.816	1.535	0.000
Web _{Stiff}	4	2.254	1.890	4.259	8.049	0.015
High Corner _{Stiff}	4	0.433	1.482	0.642	0.952	0.000
Σ		37.541		45.984	78.896	3.505

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.225 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.225 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 0.769 in.⁴
 S_e = $I_x / \bar{y}$ = 0.628 in.³
Mn = Se * Fy = 37.68 k-in.

CHAPTER 9: ANALYSIS | 3 DECK (STIFFENED) | $\pm$ BENDING



9.0 Executive Summary

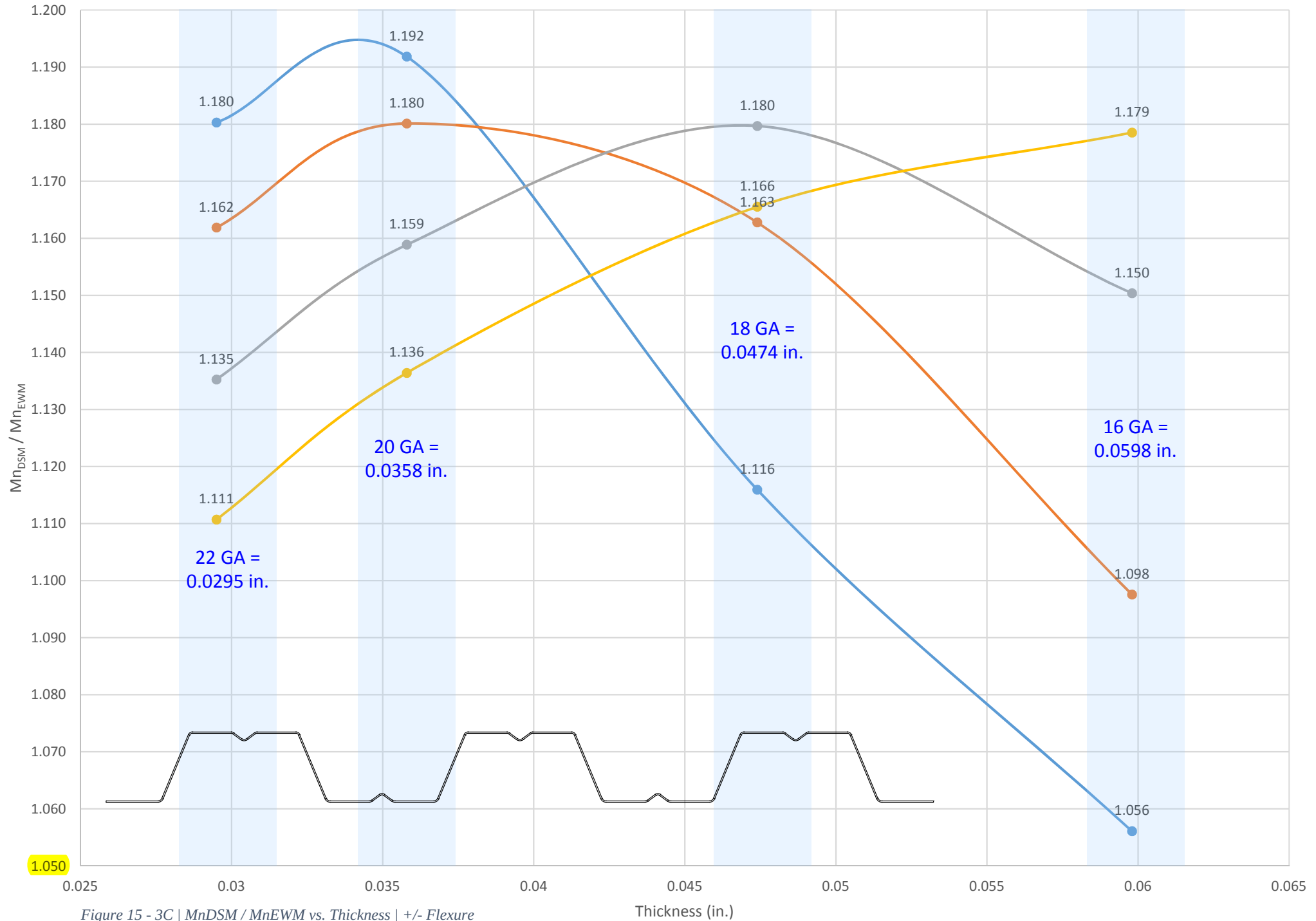
The Direct Strength Method predicted higher strengths for each of the 3C Deck sections undergoing positive and negative flexure. Similar to the stiffened 1.5B Deck, the 3C Deck is able to take advantage of the DSM with the compression flange stiffener breaking up and decreasing the flat width the compression element. The nominal moment capacity ratio (M_{nDSM}/M_{nEWM}) ranged between 1.056 and 1.192.

CHAPTER 9: ANALYSIS | 3 DECK (STIFFENED) | $\pm$ BENDING

9.1 M_{nDSM} / M_{nEWM} vs. Thickness Plot

Mn_{DSM} / Mn_{EWM} vs. Thickness

33 KSI 40 KSI 50 KSI 60 KSI



9.2 Analysis Results Summary

Table 9 - 3C | Analysis Results Summary | +/- Flexure

3 DECK - 33 KSI				
Gage	22	20	18	16
Thickness	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.2028	0.2059	0.2117	0.2179
I _G (CUFSM)	2.276	2.762	3.657	4.613
y-bar (CUFSM)	1.51607	1.51986	1.52684	1.53430
Sxx	1.501	1.817	2.395	3.007
My	49.53	59.96	79.03	99.23
Mn _{DSM}	46.61	59.77	79.03	99.23
Mn _{EWM}	39.49	50.15	70.82	93.96
% ERROR	15.276%	16.095%	10.388%	5.311%

3 DECK - 40 KSI				
Gage	22	20	18	16
Thickness	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.2028	0.2059	0.2117	0.2179
I _G (CUFSM)	2.276	2.762	3.657	4.613
y-bar (CUFSM)	1.51607	1.51986	1.52684	1.53430
Sxx	1.501	1.817	2.395	3.007
My	60.04	72.68	95.80	120.27
Mn _{DSM}	53.26	68.73	95.80	120.27
Mn _{EWM}	45.84	58.24	82.39	109.58
% ERROR	13.932%	15.263%	13.998%	8.888%

3 DECK - 50 KSI				
Gage	22	20	18	16
Thickness	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.2028	0.2059	0.2117	0.2179
I _G (CUFSM)	2.276	2.762	3.657	4.613
y-bar (CUFSM)	1.51607	1.51986	1.52684	1.53430
Sxx	1.501	1.817	2.395	3.007
My	75.05	90.85	119.75	150.34
Mn _{DSM}	61.86	80.24	115.68	150.34
Mn _{EWM}	54.49	69.24	98.06	130.69
% ERROR	11.914%	13.709%	15.232%	13.070%

3 DECK - 60 KSI				
Gage	22	20	18	16
Thickness	0.0295	0.0358	0.0474	0.0598
Curve Radius	0.2028	0.2059	0.2117	0.2179
I _G (CUFSM)	2.276	2.762	3.657	4.613
y-bar (CUFSM)	1.51607	1.51986	1.52684	1.53430
Sxx	1.501	1.817	2.395	3.007
My	90.06	109.02	143.69	180.41
Mn _{DSM}	69.74	90.64	131.68	177.64
Mn _{EWM}	62.79	79.76	112.98	150.73
% ERROR	9.966%	12.004%	14.201%	15.149%

3 DECK - 33 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
22	0.0295	46.61	39.49	1.180
20	0.0358	59.77	50.15	1.192
18	0.0474	79.03	70.82	1.116
16	0.0598	99.23	93.96	1.056

3 DECK - 40 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
22	0.0295	53.26	45.84	1.162
20	0.0358	68.73	58.24	1.180
18	0.0474	95.80	82.39	1.163
16	0.0598	120.27	109.58	1.098

3 DECK - 50 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
22	0.0295	61.86	54.49	1.135
20	0.0358	80.24	69.24	1.159
18	0.0474	115.68	98.06	1.180
16	0.0598	150.34	130.69	1.150

3 DECK - 60 KSI				
Thickness		Mn _{DSM}	Mn _{EWM}	Mn _{DSM} / Mn _{EWM}
22	0.0295	69.74	62.79	1.111
20	0.0358	90.64	79.76	1.136
18	0.0474	131.68	112.98	1.166
16	0.0598	177.64	150.73	1.179

9.3 Direct Strength Method Calculations

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	16	GA		
	Strength:	33	KSI		
	$M_y =$	99.23	kip-in	Length:	
local	$M_{crf}/M_y =$	5.58000	$M_{crf} = 553.7034$ kip-in		2 in
dist.	$M_{crd}/M_y =$	3.79000	$M_{crd} = 376.0817$ kip-in		10 in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} = 396.92$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 99.23 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.42 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 99.23 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.51 \quad (\text{distortional slenderness}) \\ M_{nd} = 99.23 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 99.23 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	16	GA		
	Strength:	40	KSI		
	$M_y =$	120.27	kip-in	Length:	
local	$M_{crf}/M_y =$	4.61000	$M_{crf} = 554.4447$ kip-in		2 in
dist.	$M_{crd}/M_y =$	3.12000	$M_{crd} = 375.2424$ kip-in		10 in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} = 481.08$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 120.27 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.47 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 120.27 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.57 \quad (\text{distortional slenderness}) \\ M_{nd} = 120.27 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 120.27 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	16	GA		
	Strength:	50	KSI		
	$M_y =$	150.34	kip-in	Length:	
local	$M_{crf}/M_y =$	3.68000	$M_{crf} = 553.2512$ kip-in		2 in
dist.	$M_{crd}/M_y =$	2.50000	$M_{crd} = 375.85$ kip-in		10 in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} = 601.36$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 150.34 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.52 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 150.34 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.63 \quad (\text{distortional slenderness}) \\ M_{nd} = 150.34 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 150.34 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	16	GA		
	Strength:	60	KSI		
	$M_y =$	180.41	kip-in	Length:	
local	$M_{crf}/M_y =$	3.07000	$M_{crf} = 553.8587$ kip-in		2 in
dist.	$M_{crd}/M_y =$	2.08000	$M_{crd} = 375.2528$ kip-in		10 in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} = 721.64$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 180.41 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.57 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 180.41 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.69 \quad (\text{distortional slenderness}) \\ M_{nd} = 177.64 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 177.64 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	18	GA		
	Strength:	33	KSI		
	$M_y =$	79.03	kip-in	Length:	
local	$M_{crf}/M_y =$	3.62000	$M_{crf} = 286.0886$ kip-in		2 in
dist.	$M_{crd}/M_y =$	2.95000	$M_{crd} = 233.1385$ kip-in		10 in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} = 316.12$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 79.03 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.53 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 79.03 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.58 \quad (\text{distortional slenderness}) \\ M_{nd} = 79.03 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 79.03 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	18	GA		
	Strength:	40	KSI		
	$M_y =$	95.80	kip-in	Length:	
local	$M_{crf}/M_y =$	2.99000	$M_{crf} = 286.442$ kip-in		2 in
dist.	$M_{crd}/M_y =$	2.43000	$M_{crd} = 232.794$ kip-in		10 in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} = 383.2$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 95.80 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.58 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 95.80 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.64 \quad (\text{distortional slenderness}) \\ M_{nd} = 95.80 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 95.80 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	18	GA		
	Strength:	50	KSI		
	$M_y =$	119.75	kip-in	Length:	
local	$M_{crf}/M_y =$	2.39000	$M_{crf} = 286.2025$ kip-in		2 in
dist.	$M_{crd}/M_y =$	1.94000	$M_{crd} = 232.315$ kip-in		10 in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} = 479$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 119.75 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.65 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 119.75 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.72 \quad (\text{distortional slenderness}) \\ M_{nd} = 115.68 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 115.68 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	18	GA		
	Strength:	60	KSI		
	$M_y =$	143.69	kip-in	Length:	
local	$M_{crf}/M_y =$	1.99000	$M_{crf} = 285.9431$ kip-in		2 in
dist.	$M_{crd}/M_y =$	1.62000	$M_{crd} = 232.7778$ kip-in		10 in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} = 574.76$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 143.69 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.71 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 143.69 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.79 \quad (\text{distortional slenderness}) \\ M_{nd} = 131.68 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 131.68 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	20	GA		
	Strength:	33	KSI		
	$M_y =$	59.96	kip-in	Length:	
local	$M_{crf}/M_y =$	2.13000	$M_{crf} = 127.7148$ kip-in	2	in
dist.	$M_{crd}/M_y =$	2.18000	$M_{crd} = 130.7128$ kip-in	12	in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} = 239.84$ kip-in	-	in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 59.96 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.69 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 59.96 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.68 \quad (\text{distortional slenderness}) \\ M_{nd} = 59.77 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 59.77 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	20	GA		
	Strength:	40	KSI		
	$M_y =$	72.68	kip-in	Length:	
local	$M_{crf}/M_y =$	1.76000	$M_{crf} = 127.9168$ kip-in		2 in
dist.	$M_{crd}/M_y =$	1.80000	$M_{crd} = 130.824$ kip-in		12 in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} = 290.72$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 72.68 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.75 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 72.68 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.75 \quad (\text{distortional slenderness}) \\ M_{nd} = 68.73 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 68.73 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	20	GA		
	Strength:	50	KSI		
	$M_y =$	90.85	kip-in	Length:	
local	$M_{crf}/M_y =$	1.40000	$M_{crf} =$ 127.19 kip-in		2 in
dist.	$M_{crd}/M_y =$	1.44000	$M_{crd} =$ 130.824 kip-in		12 in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} =$ 363.4 kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 90.85 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.85 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 86.10 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.83 \quad (\text{distortional slenderness}) \\ M_{nd} = 80.24 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 80.24 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	20	GA		
	Strength:	60	KSI		
	$M_y =$	109.02	kip-in	Length:	
local	$M_{crf}/M_y =$	1.17000	$M_{crf} = 127.5534$ kip-in		2 in
dist.	$M_{crd}/M_y =$	1.20000	$M_{crd} = 130.824$ kip-in		12 in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} = 436.08$ kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 109.02 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.92 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 97.54 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.91 \quad (\text{distortional slenderness}) \\ M_{nd} = 90.64 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 90.64 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	22	GA		
	Strength:	33	KSI		
	$M_y =$	49.53	kip-in	Length:	
local	$M_{crf}/M_y =$	1.47000	$M_{crf} =$ 72.8091 kip-in		2 in
dist.	$M_{crd}/M_y =$	1.77000	$M_{crd} =$ 87.6681 kip-in		12 in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} =$ 198.12 kip-in		- in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 49.53 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.82 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 47.67 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.75 \quad (\text{distortional slenderness}) \\ M_{nd} = 46.61 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 46.61 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	22	GA		
	Strength:	40	KSI		
	$M_y =$	60.04	kip-in	Length:	
local	$M_{crf}/M_y =$	1.22000	$M_{crf} =$ 73.2488 kip-in	2	in
dist.	$M_{crd}/M_y =$	1.46000	$M_{crd} =$ 87.6584 kip-in	12	in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} =$ 240.16 kip-in	-	in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 60.04 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.91 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 54.45 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.83 \quad (\text{distortional slenderness}) \\ M_{nd} = 53.26 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 53.26 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	22	GA		
	Strength:	50	KSI		
	$M_y =$	75.05	kip-in	Length:	
local	$M_{crf}/M_y =$	0.97344	$M_{crf} = 73.056672$ kip-in	2	in
dist.	$M_{crd}/M_y =$	1.17000	$M_{crd} = 87.8085$ kip-in	12	in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} = 300.2$ kip-in	-	in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 75.05 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.01 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 63.23 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.92 \quad (\text{distortional slenderness}) \\ M_{nd} = 61.86 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 61.86 \text{ kip-in} \quad (\text{distortional controls})$$

Date: 11/26/14

calc by: RKD
check by: TS

Deck Strength Calculations using the Direct Strength Method of Appendix 1

Given:	Deck:	3			
	Gage:	22	GA		
	Strength:	60	KSI		
	$M_y =$	90.06	kip-in	Length:	
local	$M_{crf}/M_y =$	0.81120	$M_{crf} = 73.056672$ kip-in	2	in
dist.	$M_{crd}/M_y =$	0.98000	$M_{crd} = 88.2588$ kip-in	12	in
global	$M_{cre}/M_y =$	4.00000	$M_{cre} = 360.24$ kip-in	-	in

Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

$$\text{for } M_{cre} < 0.56M_y \\ M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

$$\text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} = \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

$$\text{for } M_{cre} > 2.78M_y \\ M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 90.06 \text{ kip-in}$$

Local buckling nominal flexural strength per DSM 1.2.2.2

$$\text{for } \lambda_\ell \leq 0.776 \\ M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

$$\text{for } \lambda_\ell > 0.776 \\ M_{n\ell} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 1.11 \quad (\text{local-global slenderness}) \\ M_{n\ell} = 71.40 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

Distortional buckling nominal flexural strength per DSM 1.2.2.3

$$\text{for } \lambda_d \leq 0.673 \\ M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

$$\text{for } \lambda_d > 0.673 \\ M_{nd} = \left(1 - 0.22 \left(\frac{M_{crd}}{M_y} \right)^{0.5} \right) \left(\frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 1.01 \quad (\text{distortional slenderness}) \\ M_{nd} = 69.74 \text{ kip-in} \quad (\text{distortional reduction})$$

Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 69.74 \text{ kip-in} \quad (\text{distortional controls})$$

9.4 Effective Width Method Calculations

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
 calc by: RKD
 check by: TS

Deck: 3
 Gage: 16 GA
 Strength: 33 ksi
 Thickness: 0.0598 in.
 Total Height: 3.060 in.
 Radius: 0.2179 in.
 θ : 67.38 deg
 θ : 1.176 rad
 Curve I'_x : 0.000424 in.³

bo: 4.499 in.
 h: 3.000 in.
 bp: 1.687 in.
 Ag: 0.281 in.²
 n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
 Curve_{Stiff} I'_x : 0.000023 in.³

Guess $\bar{y}$: 1.573 in.

Stress in Flange: 33.000 ksi
 k: 11.662
 Fcr: 54.932 ksi
 λ : 0.775
 ρ : 0.924
 Effective Width: 4.339 in.

δ : 1.044
 lsp: 0.003 in.⁴
 γ : 35.413
 β : 2.911
 kd: 6.137
 kloc: 28.449
 R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.030
Corners	0.256	0.201
Corners _{Stiff}	0.139	0.233
Bottom Flange	1.687	3.030
Web	3.000	1.530
Web _{Stiff}	0.564	0.215
Top Flange	4.339	0.077

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.030	13.635	41.311	--
Bottom Corner	6	1.538	2.859	4.396	12.566	0.003
Web	6	18.000	1.530	27.538	42.131	11.503
Top Corner	6	1.538	0.201	0.309	0.062	0.003
Top Flange	3	13.017	0.077	0.998	0.076	--
Bottom Flange	4	6.748	3.030	20.446	61.949	--
Low Corner _{Stiff}	4	0.555	2.826	1.569	4.436	0.000
Web _{Stiff}	4	2.254	2.845	6.412	18.243	0.021
High Corner _{Stiff}	4	0.555	2.397	1.331	3.189	0.000
Σ		48.705		76.633	183.963	11.529

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.573 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.573 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 4.480 in.⁴
 S_e = $I_x / \bar{y}$ = 2.847 in.³
Mn = Se * Fy = 93.96 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
 calc by: RKD
 check by: TS

Deck: 3
 Gage: 16 GA
 Strength: 40 ksi
 Thickness: 0.0598 in.
 Total Height: 3.060 in.
 Radius: 0.2179 in.
 θ : 67.38 deg
 θ : 1.176 rad
 Curve I'_x : 0.000424 in.³

bo: 4.499 in.
 h: 3.000 in.
 bp: 1.687 in.
 Ag: 0.281 in.²
 n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
 Curve_{Stiff} I'_x : 0.000023 in.³

Guess $\bar{y}$: 1.597 in.

Stress in Flange: 40.000 ksi
 k: 11.662
 Fcr: 54.932 ksi
 λ : 0.853
 ρ : 0.870
 Effective Width: 4.084 in.

δ : 1.044
 lsp: 0.003 in.⁴
 γ : 35.413
 β : 2.911
 kd: 6.137
 kloc: 28.449
 R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.030
Corners	0.256	0.201
Corners _{Stiff}	0.139	0.233
Bottom Flange	1.687	3.030
Web	3.000	1.530
Web _{Stiff}	0.564	0.215
Top Flange	4.084	0.077

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.030	13.635	41.311	--
Bottom Corner	6	1.538	2.859	4.396	12.566	0.003
Web	6	18.000	1.530	27.538	42.131	11.503
Top Corner	6	1.538	0.201	0.309	0.062	0.003
Top Flange	3	12.253	0.077	0.939	0.072	--
Bottom Flange	4	6.748	3.030	20.446	61.949	--
Low Corner _{Stiff}	4	0.555	2.826	1.569	4.436	0.000
Web _{Stiff}	4	2.254	2.845	6.412	18.243	0.021
High Corner _{Stiff}	4	0.555	2.397	1.331	3.189	0.000
Σ		47.941		76.575	183.959	11.529

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.597 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.597 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 4.376 in.⁴
 S_e = $I_x / \bar{y}$ = 2.740 in.³
Mn = Se * Fy = 109.58 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 3
Gage: 16 GA
Strength: 50 ksi
Thickness: 0.0598 in.
Total Height: 3.060 in.
Radius: 0.2179 in.
 θ : 67.38 deg
 θ : 1.176 rad
Curve I'_x : 0.000424 in.³

bo: 4.499 in.
h: 3.000 in.
bp: 1.687 in.
Ag: 0.281 in.²
n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
Curve_{Stiff} I'_x : 0.000023 in.³

Guess $\bar{y}$: 1.626 in.

Stress in Flange: 50.000 ksi
k: 11.662
Fcr: 54.932 ksi
 λ : 0.954
 ρ : 0.806
Effective Width: 3.787 in.

δ : 1.044
lsp: 0.003 in.⁴
 γ : 35.413
 β : 2.911
kd: 6.137
kloc: 28.449
R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.030
Corners	0.256	0.201
Corners _{Stiff}	0.139	0.233
Bottom Flange	1.687	3.030
Web	3.000	1.530
Web _{Stiff}	0.564	0.215
Top Flange	3.787	0.077

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.030	13.635	41.311	--
Bottom Corner	6	1.538	2.859	4.396	12.566	0.003
Web	6	18.000	1.530	27.538	42.131	11.503
Top Corner	6	1.538	0.201	0.309	0.062	0.003
Top Flange	3	11.361	0.077	0.871	0.067	--
Bottom Flange	4	6.748	3.030	20.446	61.949	--
Low Corner _{Stiff}	4	0.555	2.826	1.569	4.436	0.000
Web _{Stiff}	4	2.254	2.845	6.412	18.243	0.021
High Corner _{Stiff}	4	0.555	2.397	1.331	3.189	0.000
Σ		47.049		76.507	183.954	11.529

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.626 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.626 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 4.250 in.⁴
 S_e = $I_x / \bar{y}$ = 2.614 in.³
Mn = Se * Fy = 130.69 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 3
Gage: 16 GA
Strength: 60 ksi
Thickness: 0.0598 in.
Total Height: 3.060 in.
Radius: 0.2179 in.
 θ : 67.38 deg
 θ : 1.176 rad
Curve I'_x : 0.000424 in.³

bo: 4.499 in.
h: 3.000 in.
bp: 1.687 in.
Ag: 0.281 in.²
n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
Curve_{Stiff} I'_x : 0.000023 in.³

Guess $\bar{y}$: 1.650 in.

Stress in Flange: 60.000 ksi
k: 11.662
Fcr: 54.932 ksi
 λ : 1.045
 ρ : 0.755
Effective Width: 3.547 in.

δ : 1.044
lsp: 0.003 in.⁴
 γ : 35.413
 β : 2.911
kd: 6.137
kloc: 28.449
R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.030
Corners	0.256	0.201
Corners _{Stiff}	0.139	0.233
Bottom Flange	1.687	3.030
Web	3.000	1.530
Web _{Stiff}	0.564	0.215
Top Flange	3.547	0.077

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.030	13.635	41.311	--
Bottom Corner	6	1.538	2.859	4.396	12.566	0.003
Web	6	18.000	1.530	27.538	42.131	11.503
Top Corner	6	1.538	0.201	0.309	0.062	0.003
Top Flange	3	10.642	0.077	0.816	0.063	--
Bottom Flange	4	6.748	3.030	20.446	61.949	--
Low Corner _{Stiff}	4	0.555	2.826	1.569	4.436	0.000
Web _{Stiff}	4	2.254	2.845	6.412	18.243	0.021
High Corner _{Stiff}	4	0.555	2.397	1.331	3.189	0.000
Σ		46.330		76.451	183.949	11.529

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.650 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.650 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 4.145 in.⁴
 S_e = $I_x / \bar{y}$ = 2.512 in.³
Mn = Se * Fy = 150.73 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 3
Gage: 18 GA
Strength: 33 ksi
Thickness: 0.0474 in.
Total Height: 3.047 in.
Radius: 0.2117 in.
 θ : 67.38 deg
 θ : 1.176 rad
Curve I'_x : 0.000389 in.³

bo: 4.499 in.
h: 3.000 in.
bp: 1.687 in.
Ag: 0.223 in.²
n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
Curve_{Stiff} I'_x : 0.000021 in.³

Guess $\bar{y}$: 1.600 in.

Stress in Flange: 33.000 ksi
k: 14.296
Fcr: 42.308 ksi
 λ : 0.883
 ρ : 0.850
Effective Width: 3.993 in.

δ : 1.044
Isp: 0.002 in.⁴
 γ : 55.839
 β : 3.258
kd: 7.524
kloc: 28.449
R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.024
Corners	0.249	0.190
Corners _{Stiff}	0.135	0.221
Bottom Flange	1.687	3.024
Web	3.000	1.524
Web _{Stiff}	0.564	0.209
Top Flange	3.993	0.070

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.024	13.607	41.142	--
Bottom Corner	6	1.494	2.858	4.268	12.197	0.002
Web	6	18.000	1.524	27.427	41.790	11.503
Top Corner	6	1.494	0.190	0.284	0.054	0.002
Top Flange	3	11.978	0.070	0.841	0.059	--
Bottom Flange	4	6.748	3.024	20.404	61.695	--
Low Corner _{Stiff}	4	0.539	2.826	1.525	4.308	0.000
Web _{Stiff}	4	2.254	2.839	6.398	18.163	0.021
High Corner _{Stiff}	4	0.539	2.409	1.299	3.130	0.000
Σ		47.546		76.053	182.539	11.529

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.600 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.600 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 3.433 in.⁴
 S_e = $I_x / \bar{y}$ = 2.146 in.³
Mn = Se * Fy = 70.82 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 3
Gage: 18 GA
Strength: 40 ksi
Thickness: 0.0474 in.
Total Height: 3.047 in.
Radius: 0.2117 in.
 θ : 67.38 deg
 θ : 1.176 rad
Curve I'_x : 0.000389 in.³

bo: 4.499 in.
h: 3.000 in.
bp: 1.687 in.
Ag: 0.223 in.²
n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
Curve_{Stiff} I'_x : 0.000021 in.³

Guess $\bar{y}$: 1.625 in.

Stress in Flange: 40.000 ksi
k: 14.296
Fcr: 42.308 ksi
 λ : 0.972
 ρ : 0.796
Effective Width: 3.737 in.

δ : 1.044
Isp: 0.002 in.⁴
 γ : 55.839
 β : 3.258
kd: 7.524
kloc: 28.449
R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.024
Corners	0.249	0.190
Corners _{Stiff}	0.135	0.221
Bottom Flange	1.687	3.024
Web	3.000	1.524
Web _{Stiff}	0.564	0.209
Top Flange	3.737	0.070

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.024	13.607	41.142	--
Bottom Corner	6	1.494	2.858	4.268	12.197	0.002
Web	6	18.000	1.524	27.427	41.790	11.503
Top Corner	6	1.494	0.190	0.284	0.054	0.002
Top Flange	3	11.211	0.070	0.787	0.055	--
Bottom Flange	4	6.748	3.024	20.404	61.695	--
Low Corner _{Stiff}	4	0.539	2.826	1.525	4.308	0.000
Web _{Stiff}	4	2.254	2.839	6.398	18.163	0.021
High Corner _{Stiff}	4	0.539	2.409	1.299	3.130	0.000
Σ		46.779		75.999	182.535	11.529

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.625 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.625 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 3.346 in.⁴
 S_e = $I_x / \bar{y}$ = 2.060 in.³
Mn = Se * Fy = 82.39 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 3
Gage: 18 GA
Strength: 50 ksi
Thickness: 0.0474 in.
Total Height: 3.047 in.
Radius: 0.2117 in.
 θ : 67.38 deg
 θ : 1.176 rad
Curve I'_x : 0.000389 in.³

bo: 4.499 in.
h: 3.000 in.
bp: 1.687 in.
Ag: 0.223 in.²
n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
Curve_{Stiff} I'_x : 0.000021 in.³

Guess $\bar{y}$: 1.654 in.

Stress in Flange: 50.000 ksi
k: 14.296
Fcr: 42.308 ksi
 λ : 1.087
 ρ : 0.734
Effective Width: 3.446 in.

δ : 1.044
Isp: 0.002 in.⁴
 γ : 55.839
 β : 3.258
kd: 7.524
kloc: 28.449
R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.024
Corners	0.249	0.190
Corners _{Stiff}	0.135	0.221
Bottom Flange	1.687	3.024
Web	3.000	1.524
Web _{Stiff}	0.564	0.209
Top Flange	3.446	0.070

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.024	13.607	41.142	--
Bottom Corner	6	1.494	2.858	4.268	12.197	0.002
Web	6	18.000	1.524	27.427	41.790	11.503
Top Corner	6	1.494	0.190	0.284	0.054	0.002
Top Flange	3	10.337	0.070	0.726	0.051	--
Bottom Flange	4	6.748	3.024	20.404	61.695	--
Low Corner _{Stiff}	4	0.539	2.826	1.525	4.308	0.000
Web _{Stiff}	4	2.254	2.839	6.398	18.163	0.021
High Corner _{Stiff}	4	0.539	2.409	1.299	3.130	0.000
Σ		45.905		75.937	182.531	11.529

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.654 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.654 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 3.244 in.⁴
 S_e = $I_x / \bar{y}$ = 1.961 in.³
Mn = Se * Fy = 98.06 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 3
Gage: 18 GA
Strength: 60 ksi
Thickness: 0.0474 in.
Total Height: 3.047 in.
Radius: 0.2117 in.
 θ : 67.38 deg
 θ : 1.176 rad
Curve I'_x : 0.000389 in.³

bo: 4.499 in.
h: 3.000 in.
bp: 1.687 in.
Ag: 0.223 in.²
n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
Curve_{Stiff} I'_x : 0.000021 in.³

Guess $\bar{y}$: 1.678 in.

Stress in Flange: 60.000 ksi
k: 14.296
Fcr: 42.308 ksi
 λ : 1.191
 ρ : 0.685
Effective Width: 3.215 in.

δ : 1.044
Isp: 0.002 in.⁴
 γ : 55.839
 β : 3.258
kd: 7.524
kloc: 28.449
R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.024
Corners	0.249	0.190
Corners _{Stiff}	0.135	0.221
Bottom Flange	1.687	3.024
Web	3.000	1.524
Web _{Stiff}	0.564	0.209
Top Flange	3.215	0.070

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.024	13.607	41.142	--
Bottom Corner	6	1.494	2.858	4.268	12.197	0.002
Web	6	18.000	1.524	27.427	41.790	11.503
Top Corner	6	1.494	0.190	0.284	0.054	0.002
Top Flange	3	9.645	0.070	0.677	0.048	--
Bottom Flange	4	6.748	3.024	20.404	61.695	--
Low Corner _{Stiff}	4	0.539	2.826	1.525	4.308	0.000
Web _{Stiff}	4	2.254	2.839	6.398	18.163	0.021
High Corner _{Stiff}	4	0.539	2.409	1.299	3.130	0.000
Σ		45.213		75.889	182.528	11.529

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.678 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.678 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 3.161 in.⁴
 S_e = $I_x / \bar{y}$ = 1.883 in.³
Mn = Se * Fy = 112.98 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 3
Gage: 20 GA
Strength: 33 ksi
Thickness: 0.0358 in.
Total Height: 3.036 in.
Radius: 0.2059 in.
 θ : 67.38 deg
 θ : 1.176 rad
Curve I'_x : 0.000358 in.³

bo: 4.499 in.
h: 3.000 in.
bp: 1.687 in.
Ag: 0.168 in.²
n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
Curve_{Stiff} I'_x : 0.000019 in.³

Guess $\bar{y}$: 1.634 in.

Stress in Flange: 33.000 ksi
k: 18.401
Fcr: 31.065 ksi
 λ : 1.031
 ρ : 0.763
Effective Width: 3.584 in.

δ : 1.044
lsp: 0.002 in.⁴
 γ : 96.807
 β : 3.735
kd: 9.684
kloc: 28.449
R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.018
Corners	0.242	0.180
Corners _{Stiff}	0.131	0.210
Bottom Flange	1.687	3.018
Web	3.000	1.518
Web _{Stiff}	0.564	0.203
Top Flange	3.584	0.064

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.018	13.581	40.985	--
Bottom Corner	6	1.453	2.856	4.150	11.853	0.002
Web	6	18.000	1.518	27.322	41.472	11.503
Top Corner	6	1.453	0.180	0.261	0.047	0.002
Top Flange	3	10.751	0.064	0.690	0.044	--
Bottom Flange	4	6.748	3.018	20.365	61.459	--
Low Corner _{Stiff}	4	0.525	2.826	1.483	4.189	0.000
Web _{Stiff}	4	2.254	2.833	6.385	18.089	0.021
High Corner _{Stiff}	4	0.525	2.420	1.270	3.072	0.000
Σ		46.208		75.506	181.211	11.528

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.634 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.634 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 2.483 in.⁴
 S_e = $I_x / \bar{y}$ = 1.520 in.³
Mn = Se * Fy = 50.15 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 3
Gage: 20 GA
Strength: 40 ksi
Thickness: 0.0358 in.
Total Height: 3.036 in.
Radius: 0.2059 in.
 θ : 67.38 deg
 θ : 1.176 rad
Curve I'_x : 0.000358 in.³

bo: 4.499 in.
h: 3.000 in.
bp: 1.687 in.
Ag: 0.168 in.²
n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
Curve_{Stiff} I'_x : 0.000019 in.³

Guess $\bar{y}$: 1.660 in.

Stress in Flange: 40.000 ksi
k: 18.401
Fcr: 31.065 ksi
 λ : 1.135
 ρ : 0.710
Effective Width: 3.336 in.

δ : 1.044
lsp: 0.002 in.⁴
 γ : 96.807
 β : 3.735
kd: 9.684
kloc: 28.449
R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.018
Corners	0.242	0.180
Corners _{Stiff}	0.131	0.210
Bottom Flange	1.687	3.018
Web	3.000	1.518
Web _{Stiff}	0.564	0.203
Top Flange	3.336	0.064

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.018	13.581	40.985	--
Bottom Corner	6	1.453	2.856	4.150	11.853	0.002
Web	6	18.000	1.518	27.322	41.472	11.503
Top Corner	6	1.453	0.180	0.261	0.047	0.002
Top Flange	3	10.008	0.064	0.642	0.041	--
Bottom Flange	4	6.748	3.018	20.365	61.459	--
Low Corner _{Stiff}	4	0.525	2.826	1.483	4.189	0.000
Web _{Stiff}	4	2.254	2.833	6.385	18.089	0.021
High Corner _{Stiff}	4	0.525	2.420	1.270	3.072	0.000
Σ		45.465		75.458	181.207	11.528

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.660 in.
 $\bar{y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.660 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 2.416 in.⁴
 S_e = $I_x / \bar{y}$ = 1.456 in.³
Mn = Se * Fy = 58.24 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 3
Gage: 20 GA
Strength: 50 ksi
Thickness: 0.0358 in.
Total Height: 3.036 in.
Radius: 0.2059 in.
 θ : 67.38 deg
 θ : 1.176 rad
Curve I'_x : 0.000358 in.³

bo: 4.499 in.
h: 3.000 in.
bp: 1.687 in.
Ag: 0.168 in.²
n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
Curve_{Stiff} I'_x : 0.000019 in.³

Guess $\bar{y}$: 1.689 in.

Stress in Flange: 50.000 ksi
k: 18.401
Fcr: 31.065 ksi
 λ : 1.269
 ρ : 0.652
Effective Width: 3.060 in.

δ : 1.044
lsp: 0.002 in.⁴
 γ : 96.807
 β : 3.735
kd: 9.684
kloc: 28.449
R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.018
Corners	0.242	0.180
Corners _{Stiff}	0.131	0.210
Bottom Flange	1.687	3.018
Web	3.000	1.518
Web _{Stiff}	0.564	0.203
Top Flange	3.060	0.064

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.018	13.581	40.985	--
Bottom Corner	6	1.453	2.856	4.150	11.853	0.002
Web	6	18.000	1.518	27.322	41.472	11.503
Top Corner	6	1.453	0.180	0.261	0.047	0.002
Top Flange	3	9.179	0.064	0.589	0.038	--
Bottom Flange	4	6.748	3.018	20.365	61.459	--
Low Corner _{Stiff}	4	0.525	2.826	1.483	4.189	0.000
Web _{Stiff}	4	2.254	2.833	6.385	18.089	0.021
High Corner _{Stiff}	4	0.525	2.420	1.270	3.072	0.000
Σ		44.636		75.405	181.204	11.528

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.689 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.689 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 2.339 in.⁴
 S_e = $I_x / \bar{y}$ = 1.385 in.³
Mn = Se * Fy = 69.24 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
 calc by: RKD
 check by: TS

Deck: 3
 Gage: 20 GA
 Strength: 60 ksi
 Thickness: 0.0358 in.
 Total Height: 3.036 in.
 Radius: 0.2059 in.
 θ : 67.38 deg
 θ : 1.176 rad
 Curve I'_x : 0.000358 in.³

bo: 4.499 in.
 h: 3.000 in.
 bp: 1.687 in.
 Ag: 0.168 in.²
 n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
 Curve_{Stiff} I'_x : 0.000019 in.³

Guess $\bar{y}$: 1.713 in.

Stress in Flange: 60.000 ksi
 k: 18.401
 Fcr: 31.065 ksi
 λ : 1.390
 ρ : 0.606
 Effective Width: 2.844 in.

δ : 1.044
 I_{sp} : 0.002 in.⁴
 γ : 96.807
 β : 3.735
 kd: 9.684
 kloc: 28.449
 R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.018
Corners	0.242	0.180
Corners _{Stiff}	0.131	0.210
Bottom Flange	1.687	3.018
Web	3.000	1.518
Web _{Stiff}	0.564	0.203
Top Flange	2.844	0.064

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.018	13.581	40.985	--
Bottom Corner	6	1.453	2.856	4.150	11.853	0.002
Web	6	18.000	1.518	27.322	41.472	11.503
Top Corner	6	1.453	0.180	0.261	0.047	0.002
Top Flange	3	8.532	0.064	0.548	0.035	--
Bottom Flange	4	6.748	3.018	20.365	61.459	--
Low Corner _{Stiff}	4	0.525	2.826	1.483	4.189	0.000
Web _{Stiff}	4	2.254	2.833	6.385	18.089	0.021
High Corner _{Stiff}	4	0.525	2.420	1.270	3.072	0.000
Σ		43.989		75.363	181.201	11.528

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.713 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.713 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 2.277 in.⁴
 S_e = $I_x / \bar{y}$ = 1.329 in.³
Mn = Se * Fy = 79.76 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 3
Gage: 22 GA
Strength: 33 ksi
Thickness: 0.0295 in.
Total Height: 3.030 in.
Radius: 0.20275 in.
 θ : 67.38 deg
 θ : 1.176 rad
Curve I'_x : 0.000341 in.³

bo: 4.499 in.
h: 3.000 in.
bp: 1.687 in.
Ag: 0.139 in.²
n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
Curve_{Stiff} I'_x : 0.000018 in.³

Guess $\bar{y}$: 1.659 in.

Stress in Flange: 33.000 ksi
k: 21.996
Fcr: 25.214 ksi
 λ : 1.144
 ρ : 0.706
Effective Width: 3.315 in.

δ : 1.044
lsp: 0.002 in.⁴
 γ : 141.818
 β : 4.107
kd: 11.576
kloc: 28.449
R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.015
Corners	0.238	0.174
Corners _{Stiff}	0.129	0.204
Bottom Flange	1.687	3.015
Web	3.000	1.515
Web _{Stiff}	0.564	0.200
Top Flange	3.315	0.061

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.015	13.566	40.899	--
Bottom Corner	6	1.431	2.856	4.085	11.666	0.002
Web	6	18.000	1.515	27.266	41.300	11.503
Top Corner	6	1.431	0.174	0.249	0.043	0.002
Top Flange	3	9.946	0.061	0.606	0.037	--
Bottom Flange	4	6.748	3.015	20.344	61.331	--
Low Corner _{Stiff}	4	0.517	2.825	1.460	4.125	0.000
Web _{Stiff}	4	2.254	2.830	6.378	18.049	0.021
High Corner _{Stiff}	4	0.517	2.426	1.253	3.041	0.000
Σ		45.343		75.207	180.490	11.528

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.659 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.659 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.985 in.⁴
 S_e = $I_x / \bar{y}$ = 1.197 in.³
Mn = Se * Fy = 39.49 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 3
Gage: 22 GA
Strength: 40 ksi
Thickness: 0.0295 in.
Total Height: 3.030 in.
Radius: 0.20275 in.
 θ : 67.38 deg
 θ : 1.176 rad
Curve I'_x : 0.000341 in.³

bo: 4.499 in.
h: 3.000 in.
bp: 1.687 in.
Ag: 0.139 in.²
n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
Curve_{Stiff} I'_x : 0.000018 in.³

Guess $\bar{y}$: 1.684 in.

Stress in Flange: 40.000 ksi
k: 21.996
Fcr: 25.214 ksi
 λ : 1.260
 ρ : 0.655
Effective Width: 3.077 in.

δ : 1.044
lsp: 0.002 in.⁴
 γ : 141.818
 β : 4.107
kd: 11.576
kloc: 28.449
R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.015
Corners	0.238	0.174
Corners _{Stiff}	0.129	0.204
Bottom Flange	1.687	3.015
Web	3.000	1.515
Web _{Stiff}	0.564	0.200
Top Flange	3.077	0.061

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.015	13.566	40.899	--
Bottom Corner	6	1.431	2.856	4.085	11.666	0.002
Web	6	18.000	1.515	27.266	41.300	11.503
Top Corner	6	1.431	0.174	0.249	0.043	0.002
Top Flange	3	9.231	0.061	0.562	0.034	--
Bottom Flange	4	6.748	3.015	20.344	61.331	--
Low Corner _{Stiff}	4	0.517	2.825	1.460	4.125	0.000
Web _{Stiff}	4	2.254	2.830	6.378	18.049	0.021
High Corner _{Stiff}	4	0.517	2.426	1.253	3.041	0.000
Σ		44.628		75.163	180.488	11.528

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.684 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.684 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.930 in.⁴
 S_e = $I_x / \bar{y}$ = 1.146 in.³
Mn = **Se * Fy =** **45.84 k-in.**

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
calc by: RKD
check by: TS

Deck: 3
Gage: 22 GA
Strength: 50 ksi
Thickness: 0.0295 in.
Total Height: 3.030 in.
Radius: 0.20275 in.
 θ : 67.38 deg
 θ : 1.176 rad
Curve I'_x : 0.000341 in.³

bo: 4.499 in.
h: 3.000 in.
bp: 1.687 in.
Ag: 0.139 in.²
n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
Curve_{Stiff} I'_x : 0.000018 in.³

Guess $\bar{y}$: 1.713 in.

Stress in Flange: 50.000 ksi
k: 21.996
Fcr: 25.214 ksi
 λ : 1.408
 ρ : 0.599
Effective Width: 2.814 in.

δ : 1.044
lsp: 0.002 in.⁴
 γ : 141.818
 β : 4.107
kd: 11.576
kloc: 28.449
R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.015
Corners	0.238	0.174
Corners _{Stiff}	0.129	0.204
Bottom Flange	1.687	3.015
Web	3.000	1.515
Web _{Stiff}	0.564	0.200
Top Flange	2.814	0.061

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.015	13.566	40.899	--
Bottom Corner	6	1.431	2.856	4.085	11.666	0.002
Web	6	18.000	1.515	27.266	41.300	11.503
Top Corner	6	1.431	0.174	0.249	0.043	0.002
Top Flange	3	8.441	0.061	0.514	0.031	--
Bottom Flange	4	6.748	3.015	20.344	61.331	--
Low Corner _{Stiff}	4	0.517	2.825	1.460	4.125	0.000
Web _{Stiff}	4	2.254	2.830	6.378	18.049	0.021
High Corner _{Stiff}	4	0.517	2.426	1.253	3.041	0.000
Σ		43.838		75.115	180.485	11.528

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.713 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.713 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.868 in.⁴
 S_e = $I_x / \bar{y}$ = 1.090 in.³
Mn = Se * Fy = 54.49 k-in.

EFFECTIVE WIDTH METHOD
POSITIVE BENDING
CFS Floor & Roof Deck Sections

date: 12/11/2014
 calc by: RKD
 check by: TS

Deck: 3
 Gage: 22 GA
 Strength: 60 ksi
 Thickness: 0.0295 in.
 Total Height: 3.030 in.
 Radius: 0.20275 in.
 θ : 67.38 deg
 θ : 1.176 rad
 Curve I'_x : 0.000341 in.³

bo: 4.499 in.
 h: 3.000 in.
 bp: 1.687 in.
 Ag: 0.139 in.²
 n: 1
 θ_{Stiff} : 36.501 deg
 θ_{Stiff} : 0.637 rad
 Curve_{Stiff} I'_x : 0.000018 in.³

Guess $\bar{y}$: 1.737 in.

Stress in Flange: 60.000 ksi
 k: 21.996
 Fcr: 25.214 ksi
 λ : 1.543
 ρ : 0.556
 Effective Width: 2.610 in.

δ : 1.044
 I_{sp} : 0.002 in.⁴
 γ : 141.818
 β : 4.107
 kd: 11.576
 kloc: 28.449
 R: 1.900

Element	L (in.)	y from top (in.)
Lip	2.250	3.015
Corners	0.238	0.174
Corners _{Stiff}	0.129	0.204
Bottom Flange	1.687	3.015
Web	3.000	1.515
Web _{Stiff}	0.564	0.200
Top Flange	2.610	0.061

Element	Quantity	ΣL	y from top fiber	ΣLy (in. ²)	ΣLy^2 (in. ³)	$\Sigma I'_x$ (in. ³)
Lip	2	4.500	3.015	13.566	40.899	--
Bottom Corner	6	1.431	2.856	4.085	11.666	0.002
Web	6	18.000	1.515	27.266	41.300	11.503
Top Corner	6	1.431	0.174	0.249	0.043	0.002
Top Flange	3	7.830	0.061	0.477	0.029	--
Bottom Flange	4	6.748	3.015	20.344	61.331	--
Low Corner _{Stiff}	4	0.517	2.825	1.460	4.125	0.000
Web _{Stiff}	4	2.254	2.830	6.378	18.049	0.021
High Corner _{Stiff}	4	0.517	2.426	1.253	3.041	0.000
Σ		43.227		75.078	180.483	11.528

Solved $\bar{y}$ = $\Sigma Ly / \Sigma L$ = 1.737 in.
 $\bar{Y}_{EXTREME FIBER}$ = $\max(\bar{y}, h - \bar{y})$ = 1.737 in.
 I_x = $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$ = 1.818 in.⁴
 S_e = $I_x / \bar{y}$ = 1.046 in.³
Mn = **Se * Fy =** 62.79 k-in.

CHAPTER 10: RESULTS

10.0 Comparison of Data

After running the DSM and EWM analyses, we have compared a couple of sets of data to observe trends between the various deck sections. The first data comparison plot shows the nominal moment capacity ratio of DSM to EWM, M_{nDSM} / M_{nEWM} , vs. the flat width of the compression flange over the thickness, b/t . The second data comparison plot shows the same relationship but now normalizing the nominal moment capacity ratio by the yield stress, $(M_{nDSM} / M_{nEWM}) / F_y$.

10.1 Comments on Results

From the first data comparison, we can see that DSM starts to predict lower strengths than EWM when b/t ratios exceed the 40-70 range for unstiffened deck sections. For the stiffened deck sections we see that the b/t ratio tops out around 55. DSM is able to take advantage of the lower range of b/t ratios and predict higher strengths than EWM. In the second data comparison with the normalized nominal moment capacity ratio, we can see the same decrease in DSM strength around the 40-70 b/t range. We can gather that DSM performs well for lower b/t ratios. We also saw that for certain cases, DSM predicted fully effective sections where the EWM did not.

10.2 Recommendations

To take advantage of the slight increase in strength with the DSM, consider using compression element stiffeners. By adding the stiffener to the compression element, the b/t ratio

is reduced and as we have seen in this study, DSM predicts higher strengths than EWM for lower b/t ratios.

10.3 Future Work

The next step would be to conduct laboratory testing to verify the DSM strength results. Once our results are backed up with physical testing, potential enhancements to new deck profiles that may take advantage of DSM can be developed.

Mn_{DSM} / Mn_{EWM} vs. Compression Flange Width / Thickness

1F (33 KSI) 1F (40 KSI) 1F (50 KSI) 1F (60 KSI) 1.5B (33 KSI) 1.5B (40 KSI)
 1.5B (50 KSI) 1.5B (60 KSI) 1.5B (-33 KSI) 1.5B (-40 KSI) 1.5B (-50 KSI) 1.5B (-60 KSI)

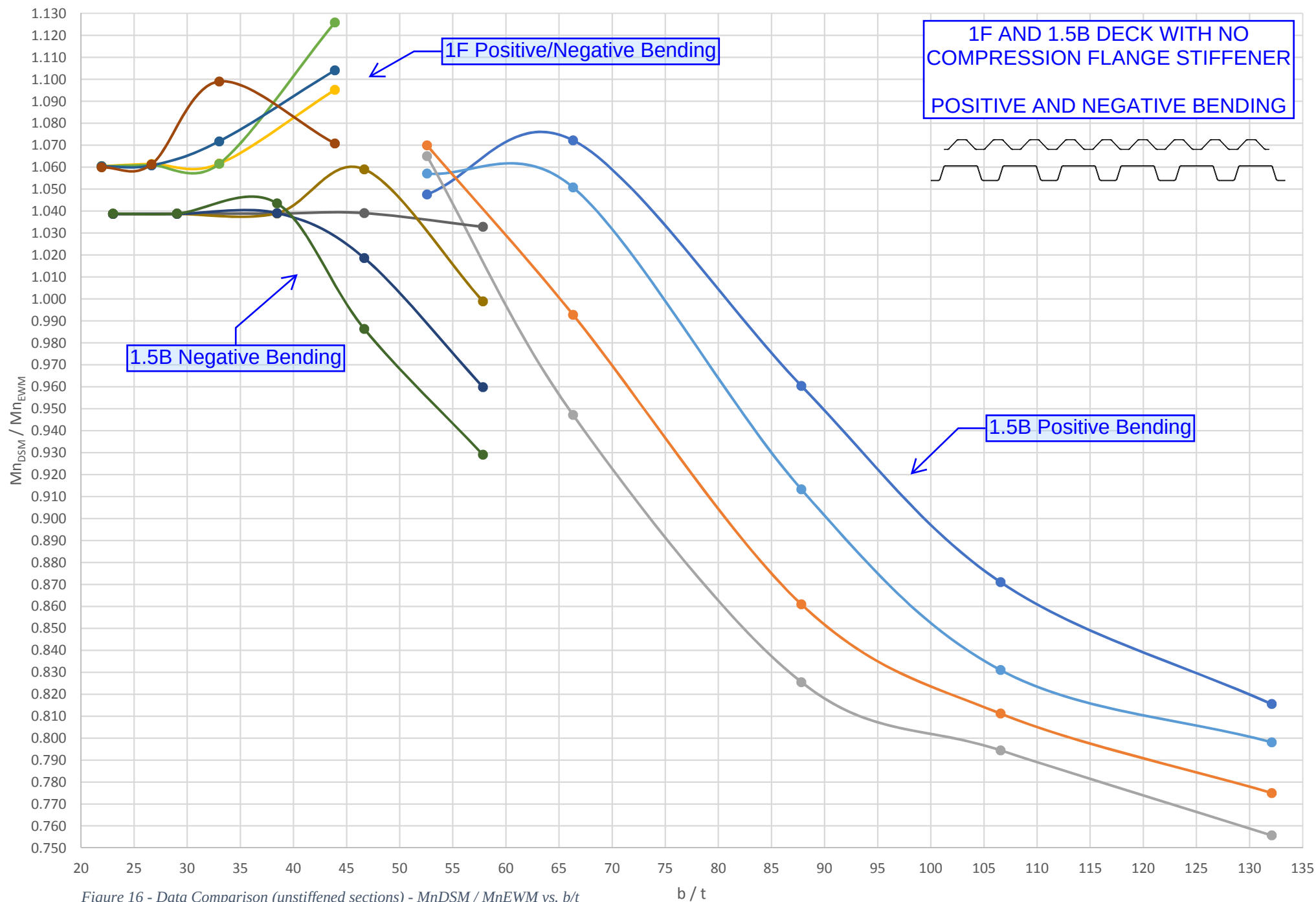


Figure 16 - Data Comparison (unstiffened sections) - Mn_{DSM} / Mn_{EWM} vs. b/t

Mn_{DSM} / Mn_{EWM} vs. Compression Flange Width / Thickness [POSITIVE BENDING]

1.5B (33 KSI) 1.5B (40 KSI) 1.5B (50 KSI) 1.5B (60 KSI) 2 (33 KSI) 2 (40 KSI)
 2 (50 KSI) 2 (60 KSI) 3 (33 KSI) 3 (40 KSI) 3 (50 KSI) 3 (60 KSI)

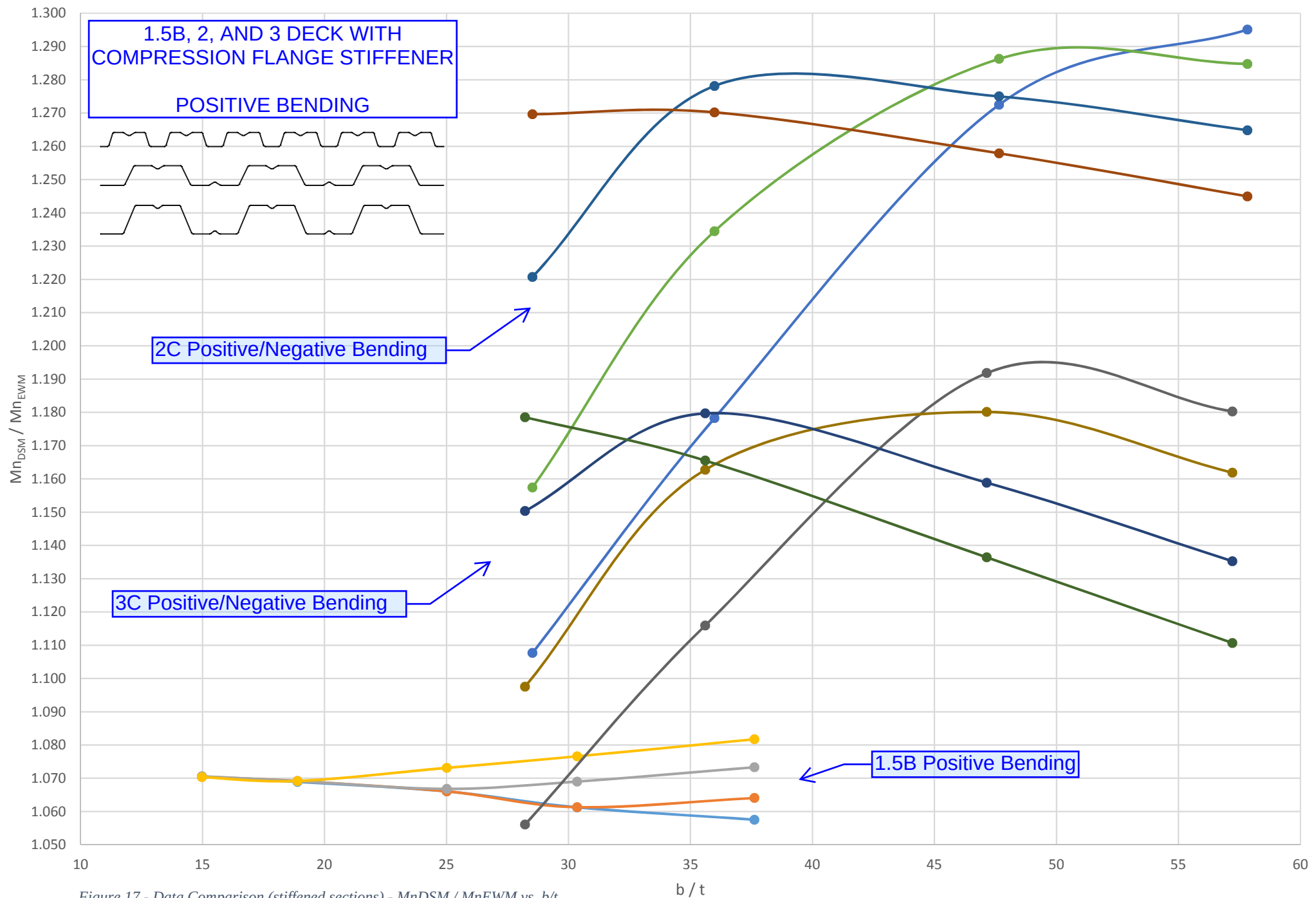


Figure 17 - Data Comparison (stiffened sections) - Mn_{DSM} / Mn_{EWM} vs. b/t

$Mn_{DSM} / Mn_{EWM} / Fy$ vs. b/t

● 1C (33 KSI) ● 1C (40 KSI) ● 1C (50 KSI) ● 1C (60 KSI) ● 1.5B (33 KSI) ● 1.5B (40 KSI)
● 1.5B (50 KSI) ● 1.5B (60 KSI) ● 1.5B (-33 KSI) ● 1.5B (-40 KSI) ● 1.5B (-50 KSI) ● 1.5B (-60 KSI)

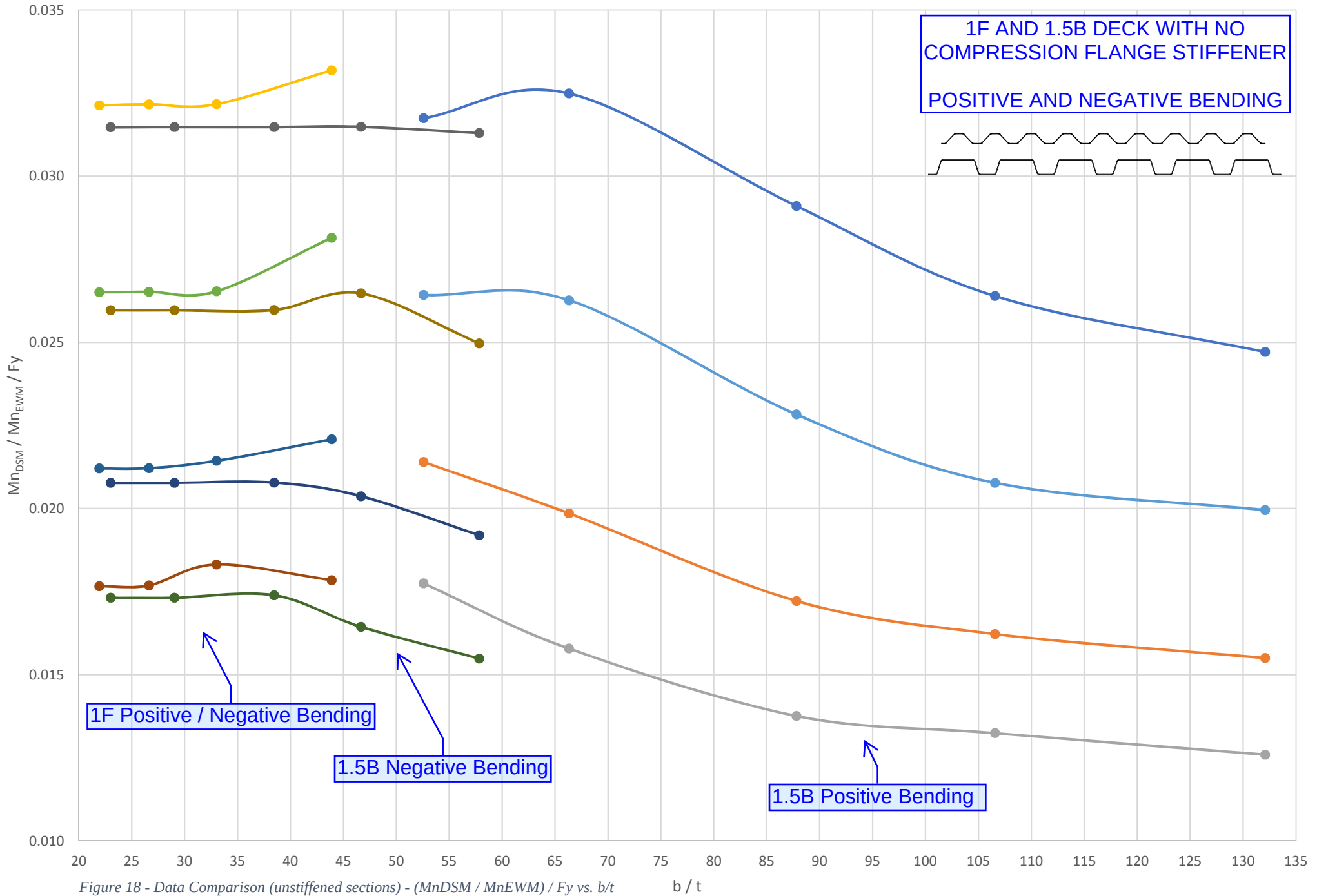


Figure 18 - Data Comparison (unstiffened sections) - $(Mn_{DSM} / Mn_{EWM}) / Fy$ vs. b/t

Mn_{DSM} / Mn_{EWM} vs. Compression Flange Width / Thickness [POSITIVE BENDING]

1.5B (33 KSI) 1.5B (40 KSI) 1.5B (50 KSI) 1.5B (60 KSI) 2 (33 KSI) 2 (40 KSI)
 2 (50 KSI) 2 (60 KSI) 3 (33 KSI) 3 (40 KSI) 3 (50 KSI) 3 (60 KSI)

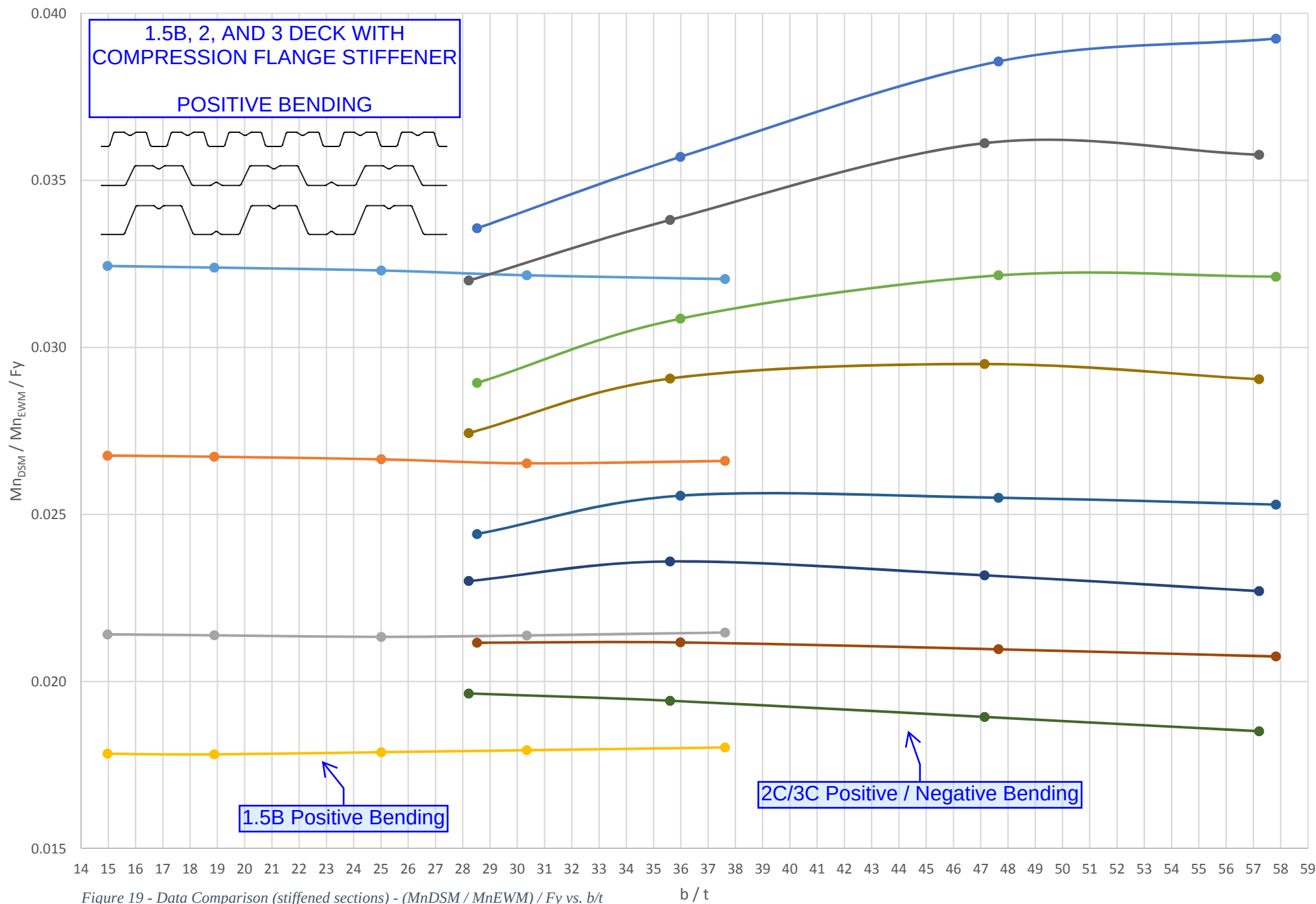


Figure 19 - Data Comparison (stiffened sections) - (Mn_{DSM} / Mn_{EWM}) / Fy vs. b/t



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