Report

Check AISC-2010 Example D.1

W-shape tension member

|  |
| --- |
|  |

|  |  |
| --- | --- |
| Prepared by: | Prepared for: |
| SDC Verifier |  |
|  |  |

|  |  |
| --- | --- |
| Engineer: | Andriy Bezushko |
| Customer: |  |
| Project Number: |  |
| Version: | 1 |
| Date: | 13 Jun 2014 |

# Preface

In this document we’ve compared results of calculation of tensile yielding and recommended slenderness limit according to SDC Verifier and Design Examples of AISC (official version 14.1). Our goal was a testing of SDC Verifier and reaching correct results according to Specification for Structural Steel Buildings (ANSI/AISC 360-10 chapter D).

This document is generated with SDC Verifier 3.6 and calculated with FEMAP v11.0.0

Model File: D:\Bezushko\Examples check\W8x21.modfem

Project File: D:\Bezushko\Examples check\Full.sdcv

Report Profile: 1..Report Designer (Full) 1

For further questions on the program contact us:

tel: +31 15 30 10 310  
email: support@sdcverifier.com  
Zijlvest 25  
2011VB Haarlem  
Netherlands

Femap and SDC Verifier models coincide. Checked information is presented below:

|  |  |  |
| --- | --- | --- |
| Entity | Femap Model Entities Count | SDC Verifier Model Entities Count |
| Elements | 11 | 11 |
| Elements | 10 | 10 |
| Materials | 1 | 1 |
| Property | 1 | 1 |

# Design Examples AISC, version 14.1





# Model Entities

This paragraph shows detailed or brief model overview.

## Materials

This paragraph contains materials information.

All units of measurement were chosen according to British metric system (lb, in, lb/in^3, lb/in^2).

### Materials Summary

|  |  |  |  |
| --- | --- | --- | --- |
| Title | Element(s) | Mass | Gravity Center |
| 1..A992 Steel | 10 | 522.98 | [150.00; 0.00; 0.00] |

### 1..A992 Steel

|  |  |
| --- | --- |
| Property | Value |
| Elements | 10 |
| Mass | 522.98 |
| Gravity Center | [150.00; 0.00; 0.00] |
| X [Min;Max] | [0.00; 300.00] |
| Y [Min;Max] | [0.00; 0.00] |
| Z [Min;Max] | [0.00; 0.00] |

|  |  |  |
| --- | --- | --- |
|  | Property | Value |
| FEM Relevant | Young Modulus | 2.96e+07 |
|  | Shear Modulus | 0.00 |
|  | Poisson Ratio | 0.32 |
|  | Shear | 0.00 |
|  | Mass Density | 0.28 |
| SDC Verifier Relevant | Tensile Strength | 0 |
|  | Yield Stress | 0.05e+6 |
|  | | | |

## Properties

This paragraph contains properties information.

### Properties Summary

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Title | Element(s) | Material | Mass | Gravity Center |
| 1..W8x21 | 10 | 1..A992 Steel | 522.98 | [150.00; 0.00; 0.00] |

### 1..W8x21

|  |  |
| --- | --- |
| Property | Value |
| Elements | 10 |
| Type | Beam |
| Material | 1..A992 Steel |
| Mass | 522.98 |
| Gravity Center | [150.00; 0.00; 0.00] |
| X [Min;Max] | [0.00; 300.00] |
| Y [Min;Max] | [0.00; 0.00] |
| Z [Min;Max] | [0.00; 0.00] |
| Moment I1 or Izz | 9.77 |
| Moment I2 or Iyy | 75.3 - *moment of inertia is modified manually (section is used without fillets).* |
| Moment I3 or Izy | 0.00 |
| Area A | 6.16 - *area is modified manually (section is used without fillets).* |
| Z Shear Area | 1.93 |
| Y Shear Area | 3.84 |
| Torsional Constant J | 0.26 |
| Nonstructural Mass Length | 0.00 |
| Warping Constant | 0.00 |
| Perimeter | 37.14 |
| Y Neutral Axis Offset | 0.00 |
| Z Neutral Axis Offset | 0.00 |

|  |  |
| --- | --- |
|  |  |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| Geometry Property | Value | Points Of Interest | Value |
| Height | 8.28 | Point 1 | [-2.64 ; -4.14] |
| Width | 5.27 | Point 2 | [2.64 ; -4.14] |
| h | 8.28 | Point 3 | [2.64 ; 4.14] |
| a | 5.27 | Point 4 | [-2.64 ; 4.14] |
| b | 5.27 |  |  |
| c | 0.40 |  |  |
| d | 0.25 |  |  |
| t | 0.40 |  |  |
|  | | | | |
| **Example from AISC Design Examples**      **Note**: *I-beam was created in Femap (built-up section) with area A = 6.06 in^2 (fillets of rolled section weren’t taken into account), but in SDC Verifier area was changed to A = 6.16 in^2 according to the input data of the example.* | | | | |
|  | | | | |

## FEM Loads

This paragraph contains information about applied loads to model.

### 2..Dead load 30 kips

|  |  |  |  |
| --- | --- | --- | --- |
| Definition Title | Load Type | Applied on | Value(s) |
| 1..Force on Node | Force | Node: 11 | (30000;0;0) |

### 3..Live load 90 kips

|  |  |  |  |
| --- | --- | --- | --- |
| Definition Title | Load Type | Applied on | Value(s) |
| 1..Force on Node | Force | Node: 11 | (90000;0;0) |

## Constraints

This paragraph contains information about constrainted parts of the model.

### 1..Fixed

|  |  |  |
| --- | --- | --- |
| Definition | Count | Type (DOF) |
| 1..Constraint on Node | 1 node(s) | Tx Ty Tz Rx Ry Rz |
|  | | | |

# Standards

This paragraph shows detailed information about applied standards.

## 1..ANSI / AISC LRFD 360-10

### Checks

This paragraph contains checks descriptions with their results.

#### 1..Beam Characteristics

|  |  |
| --- | --- |
| Property | Value |
| Category | Elemental Custom Check |
| Selection | 18 PropertyShape(s) |
| Parameters | 6 |
| Alias (Parameter) | Rg\_y (Radius of Gyration Y) |
| All | sqrt(Izz / Area) |
| Alias (Parameter) | Rg\_z (Radius of Gyration Z) |
| All | sqrt(Iyy / Area) |
| Alias (Parameter) | Slenderness\_Y (Slenderness Ratio Y) |
| All | (Ky \* Ly) / Rg\_y |
| Alias (Parameter) | Slenderness\_Z (Slenderness Ratio Z) |
| All | (Kz \* Lz) / Rg\_z |
| Alias (Parameter) | Fe\_y (Elastic Buckling Stress Y) |
| Description | Formula (E3-4) |
| All | pow(PI, 2) \* Young / pow(Slenderness\_Y, 2) |
| Alias (Parameter) | Fe\_z (Elastic Buckling Stress Z) |
| Description | Formula (E3-4) |
| All | pow(PI, 2) \* Young / pow(Slenderness\_Z, 2) |

All (LS1, All Entities)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Check | 1..Beam Characteristics | | | Load Set | | 1..Load Set 1 | | |
| Direction | All | | | Selection | | All Entities | | |
| Extreme | Radius of Gyration Y | Radius of Gyration Z | Slenderness Ratio Y | | Slenderness Ratio Z | | Elastic Buckling Stress Y | Elastic Buckling Stress Z | |
| Minimum |  |  |  | |  | |  |  | |
| Value | 1.26 | 3.50 | 238.25 | | 85.81 | | 0.01e+6 | 0.04e+6 | |
| Element ID | 1 | 1 | 1 | | 1 | | 1 | 1 | |
| Maximum |  |  |  | |  | |  |  | |
| Value | 1.26 | 3.50 | 238.25 | | 85.81 | | 0.01e+6 | 0.04e+6 | |
| Element ID | 1 | 1 | 1 | | 1 | | 1 | 1 | |
| Absolute Maximum |  |  |  | |  | |  |  | |
| Value | 1.26 | 3.50 | 238.25 | | 85.81 | | 0.01e+6 | 0.04e+6 | |
| Element ID | 1 | 1 | 1 | | 1 | | 1 | 1 | |



#### 2..Axial

All (LS1, 17 PropertyShape(s))

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Check | 8..Axial | | | Load Set | | | 1..Load Set 1 | | |
| Direction | All | | | Selection | | | 17 PropertyShape(s) | | |
| Extreme | Net Reduction Factor | Critical Stress Y | Critical Stress Z | | Nominal Compressive Strength | Design Tensile Strength | | Axial Force | Utilization Factor | |
| Minimum |  |  |  | |  |  | |  |  | |
| Value | 1.00 | 4513.8 | 29506.4 | | 23634.23 | 277200.00 | | 180000.00 | 0.65 | |
| Element ID | 1 | 1 | 1 | | 1 | 1 | | 1 | 1 | |
| Maximum |  |  |  | |  |  | |  |  | |
| Value | 1.00 | 4513.8 | 29506.4 | | 23634.23 | 277200.00 | | 180000.00 | 0.65 | |
| Element ID | 1 | 1 | 1 | | 1 | 1 | | 1 | 1 | |
| Absolute Maximum |  |  |  | |  |  | |  |  | |
| Value | 1.00 | 4513.8 | 29506.4 | | 23634.23 | 277200.00 | | 180000.00 | 0.65 | |
| Element ID | 1 | 1 | 1 | | 1 | 1 | | 1 | 1 | |





# Conclusion

Comparing results of calculation in SDC Verifier and in Example D.1 we can see that values completely match.

Tensile yielding stress is 277 kips > required tensile stress is 180 kips.

Slenderness ratio Y is 238 < maximum slenderness limit for members in tension is 300 (AISC 360-10 chapter D.1).