

## Aluminum Bleacher Plank Load Analysis Eagle Aluminum DDB-139

### Abstract:

Eagle Aluminum DDB-139 Bleacher Plank was theoretically modeled and analyzed with physical testing to verify analysis results. The bleacher plank was found to perform within industry standards at interior spans at and below 6' 0" spacing. Load testing shows acceptable deflection of the bleacher plank for distributed loads. Given the strength of the aluminum shape, and typical application to be for stadium seating or bleachers, 6' 0" spacing is recommended as the optimal support spacing.

### Background/ Methodology:

Eagle Aluminum DDB-139 aluminum bleacher plank is approximately 1 3/4" deep and 9 1/2" wide intended to be placed flush with each other. (a depiction of the section is included below). The bleacher plank is proposed for live loading per typical code standards, with maximum 6' 0" support spacing. Each member will support imposed loads independently of other bleacher plank members.

Larger span bleacher plank like this results in the limiting factor being the deflection of the bleacher plank under load. This results in an additional factor of safety as the yield strength of the material greatly exceeds the allowed deflection. Analysis for load recommendations is typically done for one, two and three span results. This is not applicable for this style of bleacher plank as uniform loading over several spans could be atypical in practice, for example, if a group of people sat together. In this case, the bleacher plank would act as if it were single span. Therefore, for this analysis, single span loading with pinned ends is the only condition analyzed.

### Properties:

Material: 6063-T6 Aluminum  
Modulus of elasticity: 10,000ksi  
Yield Strength: 21ksi  
Ultimate Strength: 27ksi  
Shear Modulus: 3740ksi  
Fatigue Strength endurance limit: 10 ksi

Values derived from measurement of supplied bleacher plank

Cross Section Area: 0.76 in<sup>2</sup>  
Section Modulus: 0.66 in<sup>3</sup>  
Moment of inertia: 0.75 in<sup>4</sup>

### Bleacher Plank Shape:

Shown below is a cross section drawing of the bleacher plank shape



Figure 1: Bleacher plank shape not to scale.

The section is approximately 1 3/4" high and 9 1/2" wide.

**Analysis results:**

Table 1 outlines the result of the structural analysis of the aluminum bleacher plank.

The first column labelled Column A indicates the maximum load allowable limited by the bending strength of the bleacher plank. Column B indicates the maximum load allowable by a maximum deflection of L/240 for that span. Column C indicates the maximum load allowable by a maximum deflection of L/360 for that span. Column D shows the maximum concentrated load allowable limited by the bending strength of the bleacher plank. Note the unit change for columns D and E. Column E shows the maximum load allowable for a maximum deflection of L/240.

Table 1 Aluminum Bleacher Plank Load Table										
Allowable Live Loads in Pounds per Square Foot (psf)										
Span (in)	Column A Max. Load (psf) Deflection (in)		Column B Max. Load (psf) Deflection L/240		Column C Max. Load (psf) Deflection L/360		Column D Max. Load (lbs) Deflection (in)		Column E Max. Load (lbs) Deflection L/240	
60	5600	psf. 5.25 L/11	260	psf. .2438 L/246	178	psf. 0.167 L/360	920	lbs. 0.552 L/109	460	lbs. 0.2713 L/249
72	3800	psf. 7.39 L/10	150	psf. .291 L/247	100	psf. 0.194 L/370	770	lbs. 0.798 L/90	330	lbs. 0.298 L/241
84	2800	psf. 10.1 L/8	90	psf. .3241 L/259	64	psf. 0.124 L/364	660	lbs. 1.09 L/77	240	lbs. 0.3446 L/244

The bleacher plank shape was also analyzed using FEA analysis to determine potential failure at the support locations. Figure 2 shows a strongly exaggerated deformed shape of the bleacher plank with a 400lb concentrated load placed near the center of the member over a 2" x 2" area. Results show good resilience to the loading applied. There is a low chance of permanent deformation during normal use, and overall, the member is not at significant risk of failure due to yielding of the material.

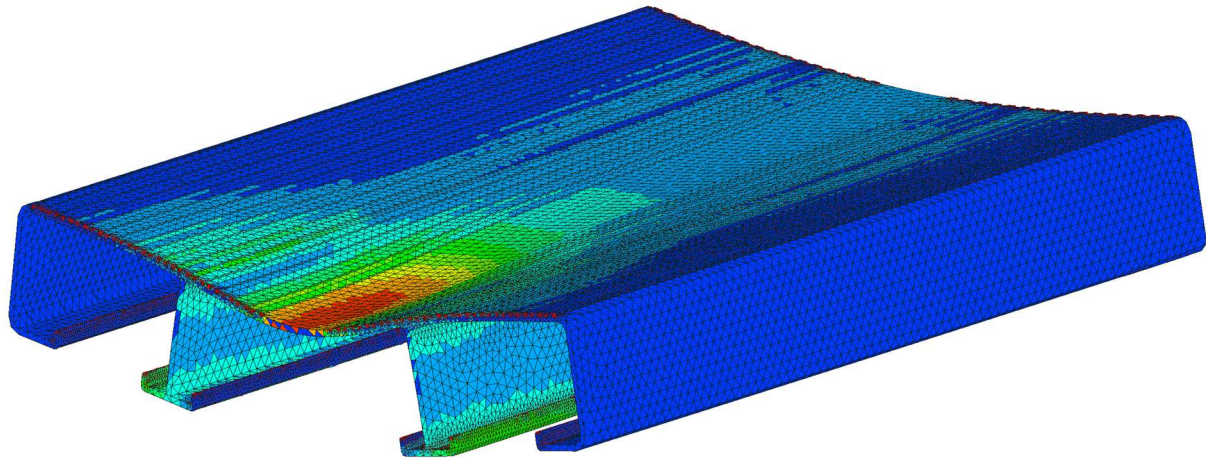
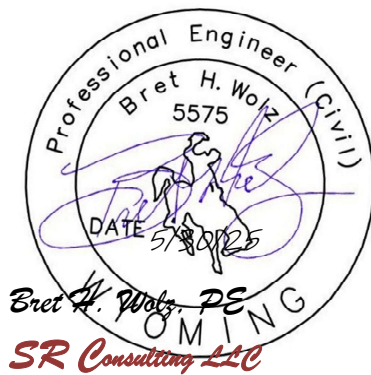


Figure 2 Bleacher plank colored for von mises stress of the bleacher plank and exaggerated deflection for a concentrated load. Max stress is 20 ksi loading is typical of a worst- case scenario of an individual running on the extruded shape.

**Recommendations:**

It is not recommended that the bleacher plank have a span greater than 6' 0" limited by a L/240 deflection with 100 psf distributed load. In this case, the deflection would be L/370. However, if the span is increased to 7' 0" the maximum distributed load drops to 90 psf to meet the L/240 criteria. The bleacher plank easily meets typical deflection criteria by required live loads in the IBC 2021 under any condition, and it is at a low risk of failure due to yield or fatigue of the material.

Should you have any questions please do not hesitate to call.

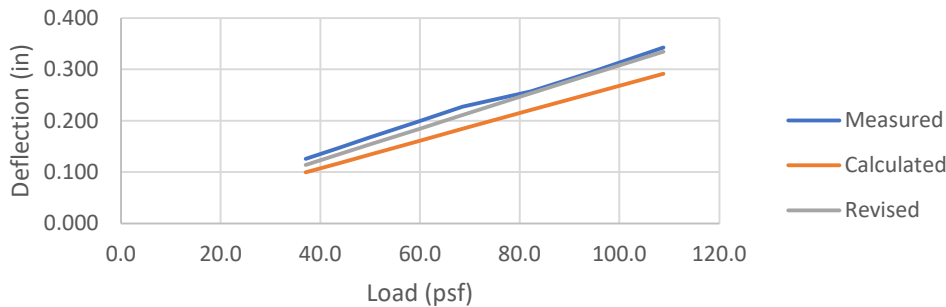




**Eagle Aluminum DDB-139  
 Aluminum Bleacher Plank**

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**Distributed Load 6' 0" Span**



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 Aluminum  
 Modulus of elasticity:  
 10,000ksi  
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 Shear Strength: 22ksi  
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 Fatigue Strength: 10 ksi

**Point Load 6' 0" Span**

