Work Platform Deck Cost Comparison Study

Prepared

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Abstract

This report presents the findings of a cost comparison between three hypothetical work platforms utilizing different deck surfaces and framing shapes. The deck surfaces compared are ResinDek® panels over metal deck and concrete over metal deck. The framing shapes compared are cold-formed c-channels and hot-rolled wide flange beams. Two options with concrete decks were compared: one with cold-formed c-channel framing (Concrete Option 1) and one with hot-rolled wide flange framing (Concrete Option 2). The deck surfaces are to be installed on a 225' x 225' work platform located in Indianapolis, IN. The work platforms were designed for a live load of 125psf and the appropriate dead and seismic loads for each platform. The results of this comparison show that the cost of the platforms with the concrete decks is approximately 31% and 34% higher for Concrete Options 1 and 2, respectively, than the platform with the ResinDek® panel deck surface. The two largest variables influencing these results are the lower installed deck cost and the lower steel cost for the ResinDek® panel platform.

Introduction

There are several decking options that may be installed on top of work platforms. The most common options are: ResinDek® panels, concrete, bar grating, diamond plate, and plywood/OSB. There are many factors to consider when selecting a deck surface, some of which are: occupancy and usage, live and dead load rating, cost, durability requirements, and fire rating requirements. The purpose of this study is to compare the work platform cost of one platform decked with ResinDek® panels over cold-formed c-channels and two platforms with concrete decks; one over cold-formed c-channel framing (Concrete Option 1) and the other over hot-rolled wide flange framing (Concrete Option 2). For both concrete options a 3" concrete thickness above the 1 ½" corrugated deck ribs, resulting in a 4 ½" total deck thickness, was specified. The industry standard for live load deflection for work platforms is L/240, however, when the deck surface is concrete the deflection limit should be increased to L/360 to limit the deflection due to the concrete load and to help reduce the potential for concrete cracking.

The two platform options utilizing c-channel framing were designed with the goal of maximizing the most efficient joist spacing and member gauge. The platform utilizing wide flange framing was designed with the goal of maximizing the joist spacing by utilizing the maximum deck capacity of the specified deck.

Design Criteria

Location: Indianapolis, IN
Work Platform Specifications:

- 225' x 225' (50,625 sf)
- 25' x 15' column grid spacing
- 11'-0" Top of Deck
- Capacity:
    - Live Load=125psf
    - Dead Load=12psf (ResinDek® panel platform)
    - Dead Load = 55psf (concrete platform)

  See Table 1 below for description of dead loads.
- Cold-formed c-channel or hot-rolled wide flange framing
- Deflection limit: L/240 (ResinDek®), L/360 (concrete)

Footing Design Assumption:

- Soil bearing capacity = 2000psf
- Concrete strength = 3000psi
- Rebar yield strength = 60ksi

Concrete Deck Specifications:

- Metal deck: 20ga 1 ½" galvanized composite floor deck
- 3" concrete cover over the deck rib, 4 ½" total thickness
- #3 rebar 18" o.c. each way for crack control

Seismic Design Parameters

- Design Standard: ASCE 7-16
- Lateral Force Resisting System: Ordinary Moment Frame
- Risk Category II
- Site Soil Class: D-Stiff Soil
- Cs = 0.069

Table 1: Dead Load (psf)		
Component	**ResinDek® Panel Platform**	**Concrete Deck Platform (both options 1 and 2)**
ResinDek® Panels	3	NA
4 ½" Concrete (3" above the rib)	NA	43
1 ½" x 20ga Floor Deck	2	2
Framing	7	10
Total Dead Load (psf)	12	55

Method

The structures were designed using commercially available structural analysis software using the above specifications and assumptions. Three models were created, one for the platform with the ResinDek® panel surface and two for the platforms with concrete deck surfaces.

Three estimates were obtained for the concrete work (concrete over metal deck and footings). Costs were averaged and any extreme outliers were not used.

The steel cost and installation numbers were provided by companies whose primary focus is producing and installing work platforms.

Footings were sized and designed using generally accepted engineering principals.

Results

Platforms with Cold-Formed Framing — ResinDek® panels and Concrete Option 1:

Due to the increased dead load and the more stringent deflection limit for Concrete Option 1, it was necessary to add joists to this structure. The joist spacing went from a 30" o.c. joist spacing on the ResinDek® panel platform to a 20" o.c. joist spacing on Concrete Option 1 platform, because of this, the quantity of joists increased from (819) joists to (1224) joists, respectively. This resulted in an additional framing weight of 98,100 pounds and additional installation costs. In addition to the tighter joist spacing requirement on Concrete Option 1 platform, the column sizes also needed to be increased resulting in an additional steel weight of 9,300 pounds.

Platform with Wide Flange Framing — Concrete Option 2:

As with the requirements of Concrete Option 1, this platform had higher dead loads and an increased deflection limit due to the concrete deck surface. Since this platform was specified to maximize the deck capacity it required fewer joists ((279) joists at a spacing of 90" o.c.). However, these joists were significantly heavier than the joists on the ResinDek® panel or Concrete Option 1 platforms. Each joist on the Concrete Option 1 platform weighs approximately 1200 pounds compared with 250 pounds per joist on the other two platforms. This resulted in an additional framing weight of 55,050 pounds more than the ResinDek® panel platform. Like Concrete Option 1, this platform had larger columns resulting in an additional steel weight of 9,300 pounds.

Each platform consists of (112) interior columns and (48) perimeter columns. The interior column loads would be installed on footings while the perimeter columns would typically be installed directly on the concrete slab.

The column size, column load, and footing size for each platform is illustrated in Table 2 below:

Table 2: Column and Footing Comparison			
	ResinDek Platform Over Cold-Formed C-Channels	**Concrete Option 1: Concrete Platform Over Cold-Formed C-Channels**	**Concrete Option 2: Concrete Platform Over Hot-Rolled Wide Flange Framing**
Perimeter Column Size	HSS6x6x3/16	HSS6x6x1/4	HSS6x6x1/4
Perimeter Column Load (kips)	25.3	33.8	33.8
Interior Column Size	HSS8x8x1/4	HSS10x10x1/4	HSS10x10x1/4
Interior Column Load (kips)	50.6	67.5	68
Interior Column Footing Size	63"x63"x12" w/ #3 rebar	72"x72"x12" w/ #4 rebar	72"x72"x12" w/ #4 rebar

Freight weight and costs are similar for all platforms. Even though the concrete deck options do not have the ResinDek® panel shipping weight there are additional joists or heavier joists that are required which makes the shipping weight comparable to the ResinDek® panel platform weight.

Without taking concrete placement or ResinDek® panel installation into account, the installation cost for the ResinDek® panel platform is lower than the installation cost for either concrete deck platform option. Included in the deck cost for the ResinDek® panel and concrete options is the material (ResinDek® panels or concrete) and installation. Concrete Option 1 platform has (405) more joists than the ResinDek® panel platform which is the cause for most of the increased installation cost for that platform (larger columns account for a small portion of the increase). Concrete Option 2 platform has fewer joists than either of the other platforms, but they are much heavier, thus, significantly increasing the installation cost. Table 3, below, illustrates the overall cost comparison for each platform option.

Table 3: Cost Comparison			
	ResinDek Platform Over Cold-Formed C-Channels	**Concrete Option 1: Concrete Platform Over Cold-Formed C-Channels**	**Concrete Option 2: Concrete Platform Over Hot-Rolled Wide Flange Framing**
Interior Footings (Material and Installation)	$71,680	$84,000	$84,000
Columns, Joists, and Metal Floor Deck (Material)	$747,454	$992,550	$942,540
Columns, Joists, and Metal Floor Deck (Installation)	$194,400	$201,000	$280,000
Deck (ResinDek or Concrete-Material and Installation)	$114,645	$202,500	$202,500
Total Freight to Site for all Material	$16,559	$16,308	$17,214
Total Cost	$1,144,738	$1,496,358	$1,526,254
Cost/SF without Freight	$22.29	$29.24	$29.81

Conclusion

As shown in the above cost comparison chart it is evident that the ResinDek® panel platform is more cost effective than either concrete deck platform. The overall cost per square foot (not including freight) is 31% and 34% higher for Concrete Option 1 and 2, respectively. On a percentage basis, the largest contributor to this gap is the cost of the concrete with installation.

The concrete deck is 77% higher than the cost of the ResinDek® panel platform based on the installed cost.

Another significant factor contributing to this gap is the cost of the steel for each platform. The steel cost for the concrete deck platforms is 33% and 26% higher than the steel for the ResinDek® panel platform for Concrete Option 1 and Concrete Option 2, respectively. This is due to the requirement for more joists (Concrete Option 1) or fewer, but heavier joist (Concrete Option 2), and larger columns to support the additional weight of the concrete.

The steel installation for Concrete Option 1 is 3.4% higher than the cost of the ResinDek® panel platform, primarily due to the larger number of joists (1224 vs. 819) that need to be installed on the concrete deck platform. The steel installation for Concrete Option 2 is 44% higher than the ResinDek® panel platform due to the higher weight of each framing member being installed. When installing heavy framing members equipment with increased lift capacity, special rigging (straps, slings, etc.), and additional manpower is required.

The cost of the concrete platform interior footings, due to the larger footing and rebar size, are approximately 17% higher than the ResinDek® panel platform footings. Lastly, the freight cost for Concrete Option 1 platform is 1.5% lower than the ResinDek® panel platform. Freight cost for Concrete Option 2 platform is 4% higher than the ResinDek® panel platform. Freight costs differences between the ResinDek® panel are relatively small since the added steel weight of either concrete option is slightly more or less than the weight of the ResinDek® panel. Trucking cost for the concrete is included in the deck cost for the concrete platform.

Lastly, it should be noted that many different joist types, sizes and joists spacings were evaluated for this investigation. After several design iterations it was determined that the cold-formed c-channels at 30" o.c. joist spacing was the most economical design.

About the Author

Matt Rescorla is a registered professional engineer who holds licenses in Wisconsin, California, Nevada, Utah, Arizona, Missouri, Tennessee, Iowa, Delaware, Massachusetts, Texas, and Rhode Island. Rescorla is a thirty-year veteran in the material handling industry with a design focus on work platforms, mezzanines and related structures. Rescorla's education includes earning a Bachelor of Science in Civil Engineering degree from the University of Wisconsin and a Master of Science in Structural Engineering degree from the Milwaukee School of Engineering.