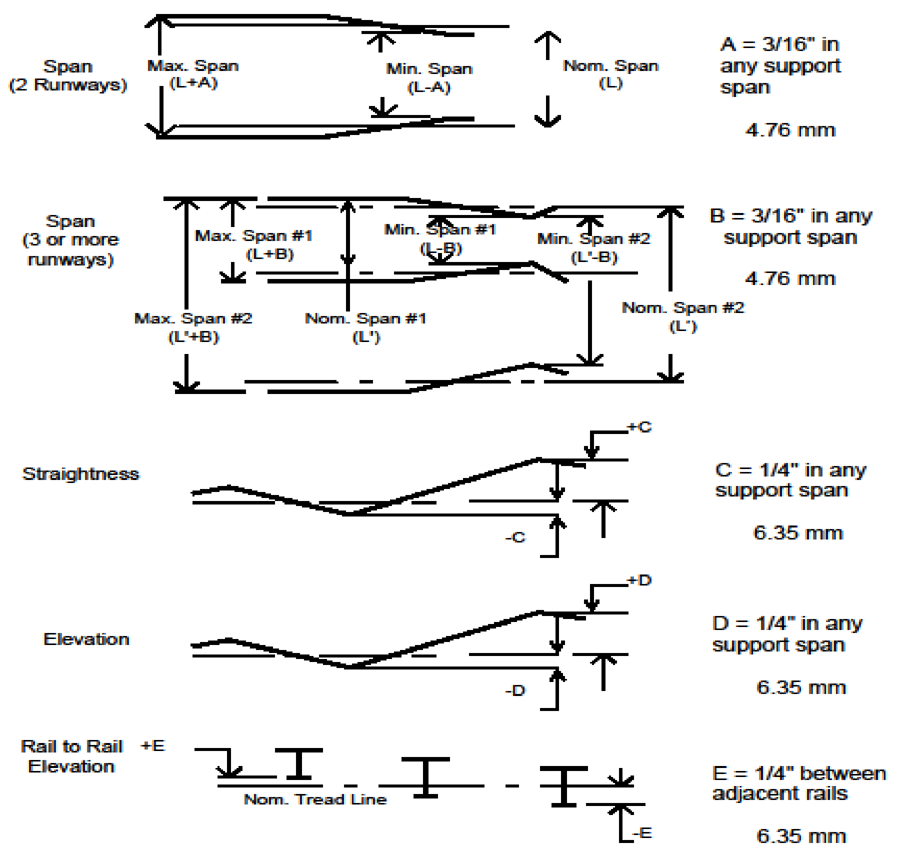
MMA Most Asked Action Alerts

	MMA – MH27.1
	Specifications for Patented Track Underhung Cranes and Monorail Systems
Q.	In Section 5.10, does the specification apply to what manufacturers call a “flexible” suspension system? Referenced Section 5.10: Track Straightness, center-to-center distance, and elevation shall be within the tolerance given in Figure 1, unless the system is operable with other tolerances as established by the manufacturer. Track running-surface misalignment at joints, following installation and adjustment, shall not exceed 1/32” (1 mm).  **Figure 1 – Runway Alignment Tolerance**
A.	Yes, this does apply to what manufacturers call a “flexible” suspension system.

Q.	Does MHIA recognize or address any specifications in reference to what manufacturers call a "flexible suspension system?
A.	Yes, MH27.1 still applies, because of the statement from Section 5, Paragraph 5.10, "unless the system is operable with other tolerances as established by the manufacturer". Referenced Paragraph 5.10: Track straightness, center-to-center distance, and elevation shall be within the tolerance given in Figure 1, unless the system is operable with other tolerances as established by the manufacturer. Track running-surface misalignment at joints, following installation and adjustment, shall not exceed 1/32" (1 mm).
Q.	Is the term "unless the system is operable with other tolerances as established by the manufacturer" intended to cover the aspect of a "flexible" suspension system?
A.	Yes, please contact the manufacturer of the track for a more specific recommendation.
Q.	Section 7, Paragraph 7.2 in reference to this portion of the specification are the "damaging lateral loads", loads that could cause damage to the suspension system (hanger rods) or loads that could damage the wheels on the crane? Referenced Paragraph 7.2: Where the track is suspended from hanger rods, the track shall be braced to restrain the track against damaging lateral and longitudinal movement.
A.	Primarily, it refers to the hanger rods.
Q.	In Section 6, Paragraph 6.1 of the Specification it states: "When considering horizontal forces on the track, they should be applied thru the shear center of the track section, unless the track is restrained torsionally." Should not the lateral load be applied at the bottom flange? Referenced Paragraph 6.1: Runway and monorail track shall be a specially rolled or fabricated section and shall be considered as a simple beam in determining capacity. In determining the capacity of the tracks, the load on the load-carrying (tension) flange shall be assumed to be at the point central within the wheel tread. Allowable wheel loads shall take into account the stress imposed on the lower load-carrying flange when a carrier transfers from one track to another. Where track sections are diagonally cut at transfers, the wheel loads shall be limited by the stress imposed on the lower load-carrying flange. When considering horizontal forces on the track, they should be applied through the shear center of the track section, unless track is restrained torsionally.
A.	Since Patented Track is designed as a runway, no it should not.

Q. In Section 6, Paragraph 6.2, it states that "Standard designs shall be based on Case 1 (see below)." Since Case 1 consists of only vertical loads, standard designs would not consider any horizontal loads. If a standard design is used, it would not meet the provision of the AISC Specification for structural steel buildings which in Section A4-3 states that "The lateral force on crane runways to provide for the effect of moving crane trolleys shall be not less than 20% of the sum of weights of the lifted load and of the crane trolley, but exclusive of other parts of the crane." Since almost all building codes refer to AISC it seems that considering these horizontal forces would be a requirement of almost any crane runway design.

Referenced Paragraph 6.2

> Track is subjected to different loading conditions that vary with the application of the equipment and track. These loading conditions are divided into three different cases. Standard designs shall be based on Case 1. Designs that include considerations of Cases 2 and 3 shall be specified by the purchaser.
>
> Paragraph 6.2.1 Case 1 – Principal Loads
>
> Case 1 loading shall consist of applicable loads as follows:
>
> a) track dead load
> b) carrier dead load
> c) crane dead load
> d) lifted or live load, and
> e) lifted or live load impact factor

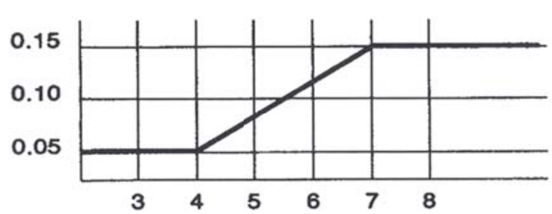
A. Standard designs are based on Case 1. Case 1 does not include horizontal loads. As will all specifications and general engineering practice sound engineering judgment needs to be applied to differentiate between Case 1, 2 & 3.

Q. Section 6, Paragraph 6.2.2.2 concerns skewing load. What causes the skewing load? Is this load considered as acting at 90 degrees to the runway beam?

Referenced Paragraph 6.2.2.2:

> Skewing Load
>
> Lateral load due to skewing forces that tend to skew the track shall be considered as an operating load. The horizontal force shall be obtained by multiplying the vertical load exerted on each wheel by the coefficient S_{sk} shown in Figure 2. for rigidly-supported track. The values shown in Figure 2 should be reduced by 50% for flexibly-supported track. The wheelbase is the distance between the outermost wheels for this calculation.

Figure 2 – Skewing Load



RATIO = $\dfrac{\textbf{SPAN}}{\textbf{WHEELBASE}}$

A.	A skewing load is developed when a cranes endtruck does not run true and parallel with the runway track. The wheel flanges or side guide rollers interact with the bottom flange of the track producing a skewing load. The skewing load acts at 90 degrees to the runway.
Q.	Paragraph 6.1 specifies that the track be considered as a simple beam in determining capacity. Referenced Paragraph 6.1: Runway and monorail track shall be a specially rolled or fabricated section and shall be considered as a simple beam in determining capacity. In determining the capacity of the tracks, the load on the load-carrying (tension) flange shall be assumed to be at the point central within the wheel tread. Allowable wheel loads shall take into account the stress imposed on the lower load-carrying flange when a carrier transfers from one track to another. Where track sections are diagonally cut at transfers, the wheel loads shall be limited by the stress imposed on the lower load-carrying flange. When considering horizontal forces on the track, they should be applied through the shear center of the track section, unless track is restrained torsionally.
A.	Track is considered as a simple beam when one is calculating the primary load carrying capacity of the track. The primary load generally consists of the crane or hoist dead load, live load, and impact. Secondary loads such as wind, seismic, inertial, collision, etc. are not specifically discussed in ANSI MH 27.1. ANSI MH27.1 is not intended to be an all inclusive specification. Secondary loads may need to be considered in combination with the primary load. Manufactures that make track in accordance with ANSI MH27.1 control the shape, size, and type of steel in the lower load carrying flange, as well as the wheel design and wheel loads.
Q.	We are trying to determine the proper safety factor, to use when calculating monorail capacities. We have both engineered track and standard I-Beams. The major portion of my question is in the area of Standard I-Beams which have a trolley and hoist hung from them.
A.	ANSI MH27.1, Specifications for Panted Track Cranes and Monorail Systems covers runway and monorail track that meets the following criteria: 1. “Patented Track shall be a specially rolled or fabricated section.” 2. “The minimum hardness of the lower load carrying (tension) flange shall be 195 Brinell.” 3. “The tread of the lower load carrying (tension) flange shall be flat.” The above three criteria generally exclude wide flange shapes, standard I-beam shapes and enclosed track. ANSI MH27.1 applies to a special rolled or fabricated track known as ‘patented track”.

	Patented track cranes and monorails should be designed in accordance with ANSI MH27.1. The design factor varies for shear, tension, compression, buckling, etc. Specifically, the allowable compression flange stress has one design factor, while the tension stress in the lower load carrying flange has an entirely different design factor.
Q.	These three Sections of ANSI MH27.1 appear to disallow the use of commonly hot rolled S shapes or wide flange shapes as monorail track sections. Many monorails currently in use do not meet these criteria. Is this the intention of the Monorail Manufacturer's Association? Subject: Section 6.1 – Track shall be specially rolled or fabricated section. Section 3.2 – The minimu hardness of the lower load carry (tension) flange shall Be 195 Brinell. Section 3.3 – The tread of the lower load carrying (tension) flanges shall be flat.
A.	ANSI MH27.1 only applies to patented track underhung cranes and monorails. MMA defines patented track as follows: PATENTED TRACK – A generic term referring to track used as crane girders, crane runways, and monorails; whose related equipment operates on the external lower operating or running flange of such track. The track section is either a high-carbon, high-manganese rolled steel shape; or a composite fabricated steel section having a high-carbon, high manganese rolled steel tee-section lower operating or running flange. All patented track, regardless of size or depth, incorporate a lower operating or running flange shape, having proprietary shape dimensions dependent upon the individual patented track manufacturer. Structural S shapes and wide flange shapes are a common component in the design and construction of monorails, and in such applications, ANSI MH27.1 does not apply except as for sections as may be deemed appropriate by the monorail designer. The method and design basis to design track and track supports are dependent upon the monorail type being considered. The appropriate standard, specification, or method to use as criteria are based upon the experience of the system designer and therefore is the responsibility of the system designer.
Q.	Does ANSI MH 27.1 cover continuous beams?
A.	ANSI MH27.1, as with most specifications, does not address how an engineer analyzes real world conditions such as type of supports, support settlement, thermal conditions, etc. Further, ANSI MH27.1 is not an all inclusive specification. It addresses track that is simply supported and defines the allowable tensile and compressive stresses. For conditions not specifically addressed in ANSI MH27.1, the engineer needs to follow general engineering practices and sound engineering judgment.
Q.	ANSI MH27.1 does not reference the inter-action equation used by AISC?
A.	ANSI MH27.1 does not include the inter-action equation used by AISC. There are many methods one can use to combine stresses. Again, the use of sound engineering practices

	and judgment is required.
Q	Clarify Section 5, Paragraph 5.10 that states “Track running-surface misalignment at joints, following installation and adjustment, shall not exceed 1/32” (1 mm).” Referenced Paragraph 5.10: Track straightness, center-to-center distance, and elevation shall be within the tolerance given in Figure 1, unless the system is operable with other tolerances as established by the manufacturer. Track running-surface misalignment at joints, following installation and adjustment, shall not exceed 1/32" (1 mm).
A.	The intent of paragraph 5.10 is that the 1/32” is to be met by adjustment of the rails at the joint during field installation. Patented track monorails are installed to align the track-running surfaces, not the top or bottom of the track. For systems using hanger rods, such adjustment is accomplished by adjustment of the hanger rods. If the system is direct bolted to superstructure steel, the adjustment is made using shims at the joint supports. The intent of paragraph 5.10 is that the 1/32” is to be met with or without grinding as stated by the manufacturer of the track.
Q.	Is Grinding and feathering of the joint permissible?
A.	Yes. For specific details, the track manufacturer should be contacted.
Q.	Is grinding considered an adjustment required in the field for providing a smooth transition from rail to rail?
A.	Yes. For specific details, the track manufacturer should be contacted.
Q.	Is the 1/32” misalignment permitted after grinding?
A.	Yes; however it depends upon the amount of misalignment prior to grinding. For specific details, the track manufacturer should be contacted. In regards to track manufactured by one of the members of MMA, they feel that if misalignment is less than 1/16”, grinding is acceptable; and if misalignment is greater than 1/16”, readjustment is required.
Q.	When designing a multi-span monorail system with a patented track rail, should the sizing of the monorail beam be assumed as a simple span, or should it be designed as a continuous multiple span beam? If it should be designed as a multiple span beam, should the negative bending moment be considered on a non-loaded span adjacent to a loaded span? This negative bending moment causes compression on the lower flange, which is typically less than 1” thick and less than 5” wide. The beam sections are designed with larger top flange for the usual compressive stress on the top, not on the smaller lower flange.
A.	Yes, the beam should be sized using simple span calculations. However, the support loads need to be calculated as a continuous, multiple span.
Q.	Section 5, Paragraph 5.2 requires a minimum Brinell hardness of 195 and Paragraph 5.3

	requires the lower load carrying flange to be flat. Most trolleys I have seen fit standard S-beams and the catalogs for monorails I have specify A-36 material. The flanges are not flat and the Brinell hardness is no 195 for A36 material. They do no appear to meet this criteria, is it mandatory and what is the reasoning for these sections? Referenced Paragraphs:: 5.2 The minimum hardness of the lower load carrying (tension) flange of patented track shall be 195 Brinell. 5.3 The tread of the lower load carrying (tension) flange shall be flat.
A.	It is mandatory for "patented" track only. See definition of Track, Patented below. Patented Track was developed for extended track and wheel life. PATENTED TRACK – A generic term referring to track used as crane girders, crane runways, and monorails; whose related equipment operates on the external lower operating or running flange of such track. The track section is either a high-carbon, high-manganese rolled steel shape; or a composite fabricated steel section having a high-carbon, high manganese rolled steel tee-section lower operating or running flange. All patented track, regardless of size or depth, incorporate a lower operating or running flange shape, having proprietary shape dimensions dependent upon the individual patented track manufacturer.
Q.	Section 5, Paragraph 5.7, is there a defined "normal walking speed?" Referenced Paragraph 5.7: Stops shall be provided at the ends of the carrier and crane travel. Stops or forks shall be provided at open ends of tracks, such as: interlocking cranes, track openers and track switches. Stops shall be provided to resist impact forces of a fully loaded carrier or crane traveling at a normal walking speed or at 50% of the rated full load speed, if the carrier or crane is motor driven.
A.	Normal walking speed is 150 FPM (46 meters per minute).
Q.	Section 6.2.1.5, implies there is no live load impact factor for manual chain hoists, is this correct? Referenced Paragraph 6.2.1.5: Lifted or live load impact factor This factor applies to powered hoists only and shall be included in the design of all components of the crane or monorail system. The impact factor shall be 1/2% of the hoist rated or working load for each foot per minute (1.6% of rated or working load for each meter per minute) of hoisting speed with minimum factor value of 15% and a maximum factor value of 50%. For bucket and magnet applications, a factor value of 50% shall be used.
A.	Yes.
Q.	Does the simple beam analysis in 6.1 apply just to the calculation of stresses, or does it

	apply to deflections also? The clarification that I would like to have is this: in paragraph 6.1, does “simple beam” mean a single-span beam, or can it mean a simply-supported continuous beam? Can I use “simply-supported continuous beam” analysis to calculate both stresses and deflections? Referenced Paragraph 6.1: Runway and monorail track shall be a specially rolled or fabricated section and shall be considered as a simple beam in determining capacity. In determining the capacity of the tracks, the load on the load-carrying (tension) flange shall be assumed to be at the point central within the wheel tread. Allowable wheel loads shall take into account the stress imposed on the lower load-carrying flange when a carrier transfers from one track to another. Where track sections are diagonally cut at transfers, the wheel loads shall be limited by the stress imposed on the lower load-carrying flange. When considering horizontal forces on the track, they should be applied through the shear center of the track section, unless track is restrained torsionally.
A.	No. A simple beam means (1) span. Continuous- means (2) or more spans (per AISC). MH 27.1, paragraph 6.1, states the capacity is based on a simple beam calculation.
Q.	Concerning paragraph 6.3.1.2: if I want to reinforce the compression flange with a cover plate, am I required to reinforce the entire span between the two supports, or can I reinforce just the region where the compression stresses exceed F= allowable stress? Referenced Paragraph 6.3.1.2: The allowable stress in the compression flange shall be determined by the formula: $F = \frac{12x10^{6}}{ld/A_f} \leq$ 60% of the yield strength of the material used. Where: l = Unbraced span between track supports in inches (mm). Cantilever lengths require special considerations. d = Depth of track in inches (mm). A_f = Area of compression flange in square inches (square mm). F = Allowable stress in psi. This formula is applicable when the compression flange is solid and approximately rectangular in cross-section and is not less than that of the tension flange. For other conditions, refer to AISC manual for steel construction. The computed stress shall not be greater than .6 of the yield strength of the material used.
A.	It is only necessary to add the reinforcement for the compression flange in the region where the compression stresses are exceeded.
Q.	Is it considered best practice to design a large oversize top flange along the entire span so that the entire beam cross section will satisfy the requirements of 6.3.1.2, or do some designers reinforce the bottom flange with a local cover plate when the bending moment

	changes sign (which occurs in the vicinity of the supports)?
A.	Yes.