Most Asked Action Alerts

	CMAA 70 & 74
	Section 1 – General Specifications
	1.2 Building Design Considerations
Q.	I am working on the structural frame that will support the rails for a top-running underslung bridge travelling crane. I understand that the CMAA #70 is applicable to top running bridge cranes, where the bridge girder is completely above the wheels, but is it also applicable to underslung cranes, where part of the bridge girder is actually below the top of the wheels?
A.	For a top-running double girder crane, bridge girders may extend below the top of the crane rail. Due to headroom restrictions, the trolley/hoist may run between the bridge girders on rails attached to the top of the lower flange of the girders. This style of crane will still be within the scope of CMAA Specification #70, "Specifications for Top Running & Gantry Type Multiple Girder Electric Overhead Traveling Cranes".
	1.3 Clearance
Q.	Section 1.3.2 (Spec 70) calls for clearance of 2" between crane and building obstructions in the horizontal plane. It does not state clearly whether that is an as-built requirement after installation, or whether it is deliberately called out to forewarn people to allow for approximately 2" in the first instance because that's typically how much the combined installation tolerances will require to ensure the crane doesn't actually clash with potential obstructions.
A.	The 2" clearance between the end of the crane and the building columns, knee braces or any other obstructions on the runway structure with the crane centered on the runway rails is an equipment clearance. Building tolerances would not be included in the equipment clearance.
Q.	CMAA Specification #70, Section 1.3.2, what is the 2" lateral clearance for? If the 2" lateral clearance is to eliminate a hand or foot pinch hazard when the crane is running is this in violation even though there is no hazard because the handrail and kick plate are set back and has more than 2" clearance to any building obstruction?
A.	Section 1.3 of the Crane Manufacturers Association of America (CMAA) Specification #70 states; "The clearance between the end of the crane and the building columns, knee braces or any other obstruction shall not be less tan 2 inches with the crane centered on the runway rails. Pipes, conduit, etc. must not reduce this clearance." This means the 2 inch clearance can be reduced by the crane bridge wheel float. The 2 inch lateral clearance is to assure the crane structure does not strike or interfere any

	obstruction on the building as the crane travels down the runway system. This clearance is considered on equipment clearance. Please contact OSHA if you need an interpretation to the requirements listed under 1910.179 (b)(6)(i).
Q.	Does Spec #70 – 1994 state the minimum clearance distance between the end truck rail and the bottom of the end truck? That is ½" for an 8" diameter wheel, 5/8" for a 12" diameter wheel, etc. You stated that the 1994 edition has been replaced. What about cranes that are manufactured, delivered, and installed under the 1994 edition.
A.	The CMAA Specifications do not identify minimum clearance requirements between the top of end truck rail and the bottom of the end truck structure. Cranes built to an earlier CMAA Specification are "Grandfathered".
	1.4 Runway
Q.	Are there any special provisions that can be employed for situations which require a gap greater than the standard 1/16" between rails?
A.	CMAA Specification 70 and 74 Revised 2004, Paragraph 1.4.2 (#70), 1.4.1.1.3 (#74) and 1.4.1.2.2. (#74) limit the gap between runway rails to 1/16". I would recommend that you minimize any gap in the runway or bridge rail. Minimizing the gap at the joints will extend the life of your crane wheels.
Q.	In Section 1.4.2, the standard specifies that rail joint separation should not exceed 1/16 in. It seems as though this should be allowed to vary with temperature or that larger gaps should be allowable for larger wheel sizes. Is this 1/16 in really the required gap at all temperatures and for all rail sizes?"
A.	Crane rails expand/contract uniformly, temperature expansion is accounted for at the ends of the entire runway rail. The gaps between individual rail sections should be as small as possible, or even welded with zero gap so as to avoid shock loading to crane wheel bearings and wearing of the joint edges.
Q.	We have a crane that we are looking at replacing the crane rail, but really cannot determine how bad we are. Does CMAA crane rail tolerance apply to ground rails as well as overhead crane rails and are the tolerances for new cranes any different than a crane that has been in operation for several years.
A.	Section 1.4 and related Table 1.4.2-1 of CMAA Specification 70 address required overhead crane runway rail tolerances. Maintaining these tolerances is recommended throughout the crane's operating life. Section 1.4.6 states, "Gantry and other types of cranes may require additional considerations". These considerations should be discussed with the crane manufacturer.

Q.	Does Spec 70 and Spec 74 address grinding on Crane Rail?
A.	CMAA Specification #70 Paragraph 1.4.2 and Specification #74 Paragraphs 1.4.1.1.3 and 1.4.1.2.2 limits the gap between runway rails to 1/16”. Neither specification addresses bridge rails for the trolley. However, I would recommend that you do not exceed 1/16” in either case. I would also recommend that you minimize any gap in the runway or the bridge rail. Minimizing the gap at the joints will extend the life of your crane wheels. Grinding the ends of the rail is a method available to minimize the gap at the joint between rails. Another method is to eliminate the joints in the runway of bridge rail. Flash butt welding is one method used to weld the ends of the rail together to eliminate any joints. If you are grinding the rails as a method of repair, grinding of rails is not a normal procedure and therefore not addressed by the CMAA Specifications. Misalignment of such rails on equipment that has been in service may be an indication of some other alignment or structural problems. The OEM or crane service/maintenance company should review such occurrences**.**
Q.	Spec 70, Table 1.4.2-1 – CMAA Crane Rail Tolerance: I understand the “maximum rate of change” (1/4” in 20’0”) but I am not clear on the “overall tolerance”. Are these tolerances over the length of the whole runway? Please explain how these tolerances are applied.
A.	CMAA Specification #70, Revised 2000, Table 1.4.2-1 is a guideline for crane runway rail tolerances. The overall tolerance is the maximum deviation (+ or -) allowed for the entire length of the runway rail. For example: If a runway is 75’-0” span, the allowable measured runway rail span deviation would be 74’-11¾” to 75’-0¼”. For straightness, each rail can be plus or minus 3/8”off of center. The runway must meet both criteria. You could measure a minus 3/8” straightness deviation on each rail and be within the straightness tolerance. If the minus 3/8” is at the same point at each runway rail, the runway rail span would measure 74’-11¼”. 74’-11¼” does not meet the minimum of 74’-11¾” for runway rail span and adjustments would have to be made to the runway. Rail to rail elevation and rail elevation must also be worked together as described above.
Q.	CMAA Spec #74, Revised 2000, Paragraph 1.4.1.1.4 discusses lateral deflection of

	runways for top-running cranes. Am I assuming correctly that “without impact” refers only to the determination of a design load based upon which the calculated lateral deflection should not exceed L/400?
A.	You are correct; the design load for which the lateral deflection is calculated is 10% of the maximum wheel load without VIF (Vertical Inertia Forces) or impact.
Q.	Is the lateral deflection limited to L/400 for all forces developed by the crane, including impact, within its rated load?
A.	No Forces other than 10% of the maximum wheel load without VIF, such as forces related to trolley accelerations, are not considered for this load case. Other load cases for which the runway is designed, such as the UBC (Univeral Building Code) or AISC (American Institute of Steel Construction) specifications, may consider other cases.
Q.	In Specification #70, section 1.4 Runway, you give tolerances for runway rails installation. After a number of years, those tolerances are not respected anymore. Do you have information on what criteria would be acceptable for rails for old runways?
A.	The runway rails shall be straight, parallel, level and at the same elevation. The distance, center to center and the elevation shall be within the tolerances given in Table 1.4.2-1. These tolerances shall not be compromised based on new or old rail or the age of the runway system.
Q.	Our issue is with a single girder, top running, 10 ton crane newly installed. The 30 lb rails are offset the vertical web of the railway girder by 1.5 inch – about the width of the30 lb. Rail. Attempts have been made to justify the soundness of this offset by referring Spec 74, section 1.4.1.1.1.4 (railway deflection). Are there more specific Guidelines for this type of deflections?
A.	Please refer to Table 1.4.1-1 of CMAA Specification #74, Revised 2000. If you review the straightness category, one could assume that the centerline shown is the same as the centerline of the web. You would then only be allowed a maximum offset from the center of the web of 0.375 inches. Section 1.4.1.1.4 of Specification #74 is meant to address simple lateral and vertical deflections and not torsional deflection due to eccentric loading conditions
Q.	We have three runway beams made of welded steel plate supporting a 7.5 ton under-running crane. The beams has to be made according CMAA 74 specification. We measure a tilt of the bottom flange of ¼”. The Article 1.4.1.2.1 of CMAA 74 says: “the wheel running surface shall have no transverse tilt. But the table 1.4.1.1 give a tolerance of ¼” on elevation. Also the code for structural element give ¼” for fabrication tolerance. Is it possible to accept the tilt and still be according to the CMAA-74 tolerance?
A.	CMAA Specification # 74, Revised 2000, paragraph 1.4.1.2.1 states that there is to be no transverse tilt in the lower flange. This is required so each wheel is loaded uniformly. If

	the wheel assembly is only loaded on one side, the load doubles on that one wheel. This in turn will overload the axle, wheel bearings, truck structure, etc. Typically, the wheel assembly and end truck are not designed to withstand this type of loading. CMAA Specification # 74, Revised 2000, Table 1.4.1-1, Elevation, deals with the runway as a whole and does not pertain to the lower flange in isolation The CMAA cannot comment on other specifications, but it is important to remember that specifications have to apply to the application and situation. According to the CMAA, the tilt of the bottom flange of ¼" is an unacceptable condition
Q.	Is the "Maximum Rate of Change" criteria (per CMAA 70, Table 1.4.2.1 and CMAA 74, Table 1.4.1.1) defined as a maximum gradient tolerance (i.e. slope not to exceed .012" in 1 ft) or as a dimensional tolerance zone (i.e. over any 20' distance the measurements must be within a ¼" tolerance zone)?
A.	Table 1.4.2.1 in CMAA Specification #70 and table 1.4.1.1 in specification #74 indicates the maximum rate of change is ¼" between two points that are 20 feet apart. It is not meant to check variances every foot
Q	What is the definition of Lr in Section 1.4.3 of CMAA Spec #70?
A.	The definition of Lr in section 1.4.3 CMAA Spec #70 is the runway girder span being evaluated or the distance between runway support columns. As stated in section 1.4.3, "The lateral deflection should not exceed Lr /400 based on 10 percent of the maximum wheel load(s) without VIF".
Q.	On Page 7 (CMAA Spec#74), section 1.4.1.2.3, it shows the vertical delection should not exceed Lr/450 based on maximum wheel load(s) without VIF. Can you explain what Lr and VIF stand for? On page 20, it shows that L=unbraced length of compression member, and the r= radius of gyration of member. How do I determine each of these items?
A.	In CMAA Specification #74, Revised 2000, Paragraph 1.4.1.2.3, Lr is the distance between runway supports and is indicated in the top Figure in Table 1.4.1-1. VIF stands for "Vertical Inertia Force". VIF, as it applies to crane design, is described in Paragraph 3.3.2.1.1.4. In Paragraph 3.4.6.3, L = unbraced length of the compression member or to put it another way, the length of the member subject to compression that is not restrained to resist buckling in the member. In Paragraph 3.4.6.3, r = the radius of gyration of the member. "r" is determined by either classical methods or if you have a standard beam section, there are various publications with "r" determined.

	You can find additional information about buckling and radius of gyration in most strength of materials books or machine design books. An additional resource for standard beams is the AISE (American Institute of Steel Construction) "Steel Construction" manual.
Q.	Section 1.4 of Spec 70 and 74 give deflection limits for the crane runway beams. The vertical limit being Lr/600. For an eighty foot span the limit would be 1.6 inches. Table 1.4.2-1 gives much tighter tolerances for the distance between rails, rail straightness and rail elevation both longitudinally and differentially between rails. The two recommendations conflict significantly unless Table 1.4.2-1 is referring to an unloaded crane rail.
A.	The recommendations of Table 1.4.2-1 in CMAA Specification #70 and#74, are in reference to the crane runway rails prior to crane erection. Therefore, the recommendations are for unloaded (ie. Without crane dead weight or live load) runway systems.
Q.	Concerning CMAA 74 Section1.4 and Table 1.4.1-1 for the straightness and elevation overall tolerance, "B" and "C" is stated as 3/8" which would means 3/4" total overall. Can this requirement be revised to a tighter tolerance; say 3/16" and 3/8" total overall, and still be within conformance to CMAA regulations/requirements? Would this then require a change to the values shown in the 'Maximum Rate of Change' Is there a reference or requirement for rail twist?
A.	Table 1.4.1-1 in Specification #74 and Table 1.4.2-1 in Specification #70 shows tolerances for the runway rails. Crane manufacturers will design and build their cranes to satisfactorily travel along runways constructed to the specified tolerances. 1. Runways installed with tighter tolerances, remain in conformance, and exceed the CMAA specifications. This will have no bearing on the design and construction of the crane that is installed on the runway. 2. If straightness (B) and elevation (C) tolerances are tightened up, the maximum rate of change (1/4" in 20'-0") would not necessarily have to change. 3. Rail "twist" is not addressed in Specifications #70 and #74 because this is a manufacturing tolerance of the rail rather than an installation tolerance. It is assumed that the rail sections are delivered within the manufacturing tolerances specified by ASCE (American Society of Civil Engineers).
Q.	Does CMAA 74 or CMAA 70 apply to the design of structural supports for cranes such as trolley beams, runway girders or support platforms?

A.	The scope of CMAA #74 and #70 applies only to the design of cranes. Any references to runways are to maintain the operational standards of the crane. For the structural design of runways we refer you to the related reference documents in section 1.1.6, such as the American Institute of Steel Construction, (AISC).
	1.6 Rated Capacity
Q.	What is the proper way to rate the bridge capacity of Electric Overhead Traveling Cranes?
A.	You can find your answer by looking in "ASME B30.2, section 2.1.1 and section 2.3.2 and CMAA Specification 70 section 1.6."
	1.7 Design Stresses
Q.	We are upgrading a monorail from 700 to 2000 pound capacity. We have successfully performed testing at a load of about 125% of the 2000 pound load in accordance with ASME B30.11-2010 (Monorails and Underhung Cranes). Does CMAA No. 74 require the steel structure and/or the steel beam that the hoist/trolley travels along be analyzed for at least 5 times the rated capacity?
A.	CMAA No. 74 does not address monorail applications. It applies to single girder cranes that use an under running trolley hoist. If the interface of the hoist/trolley to the crane girder is the same as with a straight monorail beam, a correlation does exist. Required design factors are not listed as simple ratios in CMAA No. 74. Section 1.7.1 for Design Stresses states, "Structural parts shall be designed according to the appropriate limits as per chapter 74-3 of this specification." Section 74-3 discusses the following factors that contribute to the structural design of the beam: • Loads and forces • Allowable stresses • Fatigue • Buckling • Deflection • Compressive stress
	1.11 Testing
Q.	What is the CMAA acceptance testing criteria for new bridge cranes and hoists? Our project requires a new bridge crane, monorail hoist, and davit crane. We are particularly interested in the weight to be lifted by each of the hoists. –i.e., 125% of the rated capacity?
A.	CMAA Specification No. 70 does not address load testing. Its sister specification No. 78 references OSHA 1910.179, Overhead and Gantry Cranes, sections (k) (1) (i) and (k) (2). Load test requirements for monorail hoists can be found in ASME specification B30.16, Overhead Hoists (Underhung).These references generally require that test loads shall not be more than 125% of the rated load unless otherwise recommended by the manufacturer.

	Section 2 - Crane Classifications
	2.8 Crane Service Class in Terms of Load Class and Load Cycles
Q.	For crane service classification (Spec 70), Load Cycles are to be determined, and given a value of N. Has this value been defined? Over what period of time is N to be calculated?
A.	Load Cycle definition: One lift cycle with load plus one lift cycle without load. The Load Cycles in Spec 70, Section 2.8, represent ranges of absolute numbers of load cycles per class N1 through N4. They are not defined in relation to any particular time period, but rather in relation to the design life of the equipment. A projection of the total number of load cycles for an application, typical average values, will result in a finite number of load cycles within the range of one of the Load Cycle Classes. The combination of Load Cycle Class NX and Load Class LY will indicate the appropriate Crane Service Class. Example: Crane used in Single Shift operation, 8 hrs/day, 10 Load Cycles/hr, 250 days/year, expected design life = 10 years 10 cycles/hr x 8 hrs/day x 250 days/year x 10 years = 200,000 Load Cycles ► Load Cycle Class N2 ► If Load Class is L2, Crane Service Class + “C” Significant variations of usage parameters above could result in Load Cycle Class N1 or N3, and in Crane Service Class Rating of “B” or “D”, given the same Load Class.
Q.	I am marking up a government specification for a 1 metric ton bridge crane and need the HMI, CMAA 74 Class (H1, H2, H3,H4, or H5). The bridge will be used indoors in a non-hazardous environment. The hoist will be ASME HST 4M, Class C. Could you recommend the class I should put in the specification? The specification also request operating speeds. I have the speed for the hoist and trolley, but not the bridge. Does Spec #74 have a typical range of speeds? The runway is only 25 meters long. I don’t want to specify a speed that is going to require a specially designed bridge.
A.	CMAA Specification #74 for Top and Under Running Single Girder Cranes, identifies cranes classified into loading groups according to the service conditions of the most severely loaded part of the crane. The classifications are Class A, B, C or D. The HMI (Hoist Manufacturers Institute) classified hoists by Class H1, H2, H3, H4 and H5 dependent upon service conditions. Since there are four (4) classifications in the CMAA Specification and five (5) in the HMI Spec., there is no perfect, direct relationship between the CMAA and HMI service classifications.

	The suggested operating speed (in feet per minute) of floor controlled cranes 3 ton and under capacity is as follows: Hoist: Slow = 14 Medium = 35 Fast = 45 Trolley: Slow = 50 Medium = 80 Fast = 125 Bridge: Slow = 50 Medium = 115 Fast = 175
Q.	What are the CMAA Class requirements for cranes and how many different classes are there?
A.	You can find “Crane Classifications” as free download at www.mhia.org in the Bookstore.
Q	Is there a cross reference between CMAA duty classes and ISO or FEM equivalent machinery groups?
A.	There is no cross reference between CMAA duty classes and ISO or FEM equivalent machinery groups.
	Section 3 – Structural Design
	3.1 Material
Q.	Are there crane manufacturing standards that specify steel grades and dimensions?
A.	CMAA Specifications 70 and 74.
Q.	Does CMAA use different mill tolerances for crane runway beams than the standard mill tolerances listed in the American Institute of Steel Construction Manual of Steel Construction?
A.	The CMAA recommends use of the standard mill practice tolerances when purchasing W or HP shape beams as listed in the AISC (American Institute of Steel Construction) manual.
	3.3.2 Loadings
Q.	Has CMAA addressed the issue of specific design criteria for earthquake acceleration forces?
A.	CMAA Spec #70, Revised 2000, section 3.3.2, page 12 and CMAA Spec #74, Revised 2000, section 3.3.2.1, page 13 state the following: “Seismic forces are not considered in this design specification. However, if required, accelerations hall be specified at the crane rail elevation by the Owner or Specifier. The allowable stress levels under this condition of loading shall be agreed upon with the crane manufacturer.”
	3.3.2.2.2 Skewing Forces
Q.	CMAA Spec #70, 2000 version. When designing bearings for typical overhead double girder bridge or trolley wheel assemblies, is it common practice to use a thrust load (to

	account for skewing of the crane) along with a radial load to get an equivalent radial load? If so does CMAA recommend any amount (% of wheel load)? Is this too conservative? It seems that different crane manufacturers use different methods of determining this load for bearing design.
A.	Wheel thrust loading due to skewing is dependant upon the span to wheelbase ratio and is evaluated in paragraph 3.3.2.1.2.2 and ranges from 5 to 15 percent of the vertical load. However, this loading is considered an additional loading as described in paragraph 3.3.2.4.2 and is not part of the principal loading on the crane. Therefore, assuming that the skewing force is acting on the axle bearing 100% of the time would be conservative. On the other hand, the axle bearing should be able to sustain the skewing force without failing. Since the frequency of occurrence of skewing forces varies from crane to crane and user to user, it is left to the individual crane designer or manufacturer to properly evaluate the crane application and to size the axle bearings accordingly
Q.	I have a question regarding skewing force calculations, Spec #74, Section 3.3.2.1.2.2. Does multiplying the coefficient SsubSK by the wheel loads give the skewing forces perpendicular to the rails or instead the tractive effort parallel to the rails from which you can derive the skewing forces?
A.	The definition of skewing forces is as follows: Lateral forces on the bridge truck wheels caused by the bridge girders not running perpendicular to the runways. Some normal skewing occurs in all bridges. By multiplying the vertical load exerted on each wheel (or bogie) by the coefficient Ssk, you obtain the skewing force or force perpendicular to the runway rail.
Q..	Specification #70 calls for installing anti-skewing devices. Does this mean that if such devices are installed, any skewing forces that are usually imposed by the crane are eliminated? Could you please elaborate, by explaining what skewing forces are, and how they develop, and if they can be eliminated or reduced?
A.	As defined in the glossary of CMAA Specification #70, “skewing forces are lateral forces on the bridge truck wheels caused by the bridge girder not running perpendicular to the runways.” Skewing is mainly caused by the eccentric loading of the trolley and live load on the bridge. With the trolley and live load in it’s most extreme position, one end of the bridge tries to move ahead of the other end of the bridge. Other factors that may cause skewing are bridge dead load distribution, bridge speed, bridge drive balance (A4 drives) and environmental conditions such as snow, rain, ice, grease, etc. There are various mechanical and electrical methods to help reduce or avoid skewing

	however, these methods and discussions on specific anti-skewing devices are beyond the scope of the CMAA. The CMAA Engineering Committee is responsible for the interpretation and clarification of information contained in Specification #70 & #74.
Q.	Concerning the Ssk factor, (CMAA 74 section 3.3.2.1.2.2) is the chart shown minimum and maximum values regardless of how large or small the ratio becomes (i.e. minimum Ssk = 0.05 & maximum Ssk = 0.18) or is the maximum to be extrapolated for a ratio @@g?
A.	The chart in paragraph 3.3.2.1.2.2 gives you the coefficient Ssk based on the span to wheelbase ratio. 0.05 is the minimum coefficient required. 0.18 is the maximum coefficient based on the requirement in paragraph 3.6.1 which states that "The wheel base of the end truck shall be 1/8 of the span or greater." In other words, you cannot have a span to wheelbase ratio greater than 8.
	3.3.2.3 Extraordinary Loads
Q;.	In Section 74-3 (Spec 74/Revised 2000) Structural Design, part 3.3.2.3 Load Combination, the Load Cases discussed show a summation of the loads previously calculated. Not being familiar with the CMAA Standards, it seems to me that some of the loads being summed in these load cases are vertical loads (Dead Load, Lifted Load, etc.) and some of them would seem to be lateral loads (Inertia Forces from Drives Load, Skewing Loads, Collision Forces, etc.). I assume these loads are shown as a summation simply to represent that for a given load case, all applicable loads must be included, rather than the actual summation of these vertical and horizontal loads. In other words, are the load cases that would seem to be acting horizontally applied horizontally and those acting vertically acting vertically?
A.	CMAA Specification #74, Revised 2000, Paragraph 3.3.2.3 outlines how the combined stresses need to be calculated for different load cases. Each case (1,2 & 3) is a summation of different stresses. However, it is not uncommon for stresses normal to each other to be additive due to their sign. Keep in mind that stresses can be positive or negative depending on the point of application.
	3.3.2.5 / 3.3.2.6 Load Combination
Q.	Section 3.3.2.5 in CMAA #74 calls for "stresses", however DL, TL and LL are all described as forces in weight I would assume you take these point loads and divide them by the area of the beam to determine a stress?
A.	In reference to Section 3.3.2.5 in CMAA #74, the load cases define the load combinations that will be applied to the structure (lbs, lbs/ft, etc.). By definition these loads can take many different forms including point loads, distributed loads, eccentric loads etc. The calculations of stresses within the members of the structure are based upon the application of these load case combinations. The calculation of the stresses themselves however, are not simply found by P/A. Calculated stress formulas used should be based upon

	engineering principles in mechanics of materials.
Q	In CMAA Spec. No. 74, I have not found any mention of how to handle a cantilevered bridge girder for an under running crane along with the bottom flange effects due to the trolley wheel loading. It covers the simple span case, but not the cantilever.
A.	CMAA No. 74 does not address monorail-type cranes where the hoist/trolley can transfer onto or off of the bridge girder.
	3.3.2.6 Local Bending of Flanges due to Wheel Loads
Q.	Section 3.3.2.6.2 (CMAA Spec 74) "The localized stress due to local bending effect imposed by wheel loads calculated at points 0 and 1 are to be combined with the stresses due to the Case 2 loading specified in paragraph 3.3.2.5.2 of this Specification." Are local bending stress in the beam flanges to be combined with Load Case 2 only? (i.e. Load Case 1 & 3 do not consider the effects of local bending stresses)
A.	It is CMAA recommendation that local bending stresses be combined as per section with load case 2 only which shall not exceed allowable case 2 stress level of 0.66 x yield stress but it is up to the designer to select which load case and allowable stress level. CMAA specifications are offered as information and guidelines only.
	3.4.4 Combined Stresses
Q.	Section 3.4.4.1 of the Specifications for Top Running & Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist (Spec 74) gives an equation for calculating the combined plane stress as follows: $\sigma\tau = \sqrt{(\sigma \chi)2 + (\sigma y)2 - \sigma\chi \ \sigma y + 3(\tau \chi y)2}$ Calculations for both $\sigma\chi$ and σy are provided in previous sections, however I can find no reference or equation on the calculation of $\tau \chi y$. How is $\tau \chi y$ determined for use in the above referenced equation?
A.	The shear stress Tau xy in simplified form, assuming WLO,IFD and SK=0 (for simplification) can be calculated for rolled beam from the following: Tau xy = (lifted load with HLF + trolley weight with DLFT + weight of girder with DLFB) / Web height x thickness of web) ksi. (Simplified)
Q.	Regarding Specification #74 (2000) page 19 section 3.4.4.1, I am unsure how to find the shear stress "Txy" involved in that equation. Are there sample calculations regarding Local Bending of Flanges due to wheel loading (3.3.2.4)?
A.	In CMAA Specification # 74, Revised 2000, Paragraph 3.4.4.1, page 19, shear is described by classical methods. As requested a sample calculation is attached, which may be of assistance to you when

dealing with CMAA Specfication # 74, Revised 2000, Paragraph 3.3.2.4

As an additional reference, I would suggest that you refer to FEM Specification 9.341, Local Girder Stresses.

CMAA®
CRANE MANUFACTURERS
ASSOCIATION OF AMERICA, INC.

Sheet 1 of 4
Date: 3-19-95
Revision 1 – 12/21/95

Disclaimer of Warranty

CRANE MANUFACTURER'S ASSOCIATION OF AMERICA, INC. (CMAA)

The Crane Manufacturer's Association of America, Inc. (CMAA) is an independent incorporated trade association affiliated with The Material Handling Institute Division of Material Handling Industry (MHI)

THE MATERIAL HANDLING INSTITUTE DIVISION (MHI)

MHI provides CMAA with certain services and, in connection with these Specifications, arranges for their production and distribution. Neither MHI, its officers, directors or employees have any other participation in the development and preparation of the information contained in the Specifications.

All inquiries concerning these Specifications should be directed in writing to the Chairman of the CMAA Engineering Committee, c/o Crane Manufacturer's Association of America, Inc., 8720 Red Oak Blvd., Suite 201, Charlotte, NC 28217.

SUBJECT: EXAMPLE CALCULATION

The following example calculation was developed by the Crane Manufacturer's Association of America (CMAA) to illustrate the application of lower flange bending stress. The emphasis of this example is the lower flange stress, the combining with basic structural stress and the determination of the allowable combined stress. This example is not intended to show how to determine basic structural stresses.

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DATE: 3 / 19 / 95

SUBJECT: EXAMPLE CALCULATION SHT # 2 of 4

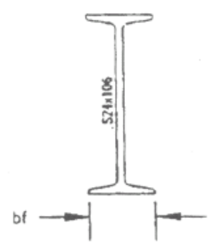
CMAA SPECIFICATION #74, REVISED 1994
SECTION 74-3, STRUCTURAL DESIGN Par. 3.3.2.4 (pg 16-19)
LOCAL FLANGE BENDING DUE TO UNDER RUNNING WHEEL LOADS.

CRANE: 5 TON CAPACITY (LL=10K.) SPAN: 36'-7" (L=439")
HOIST & TROLLEY WT. TL= 1.6 K. DLFb=DLFt= 1.1
HLF= 0.15 IFD= 0.0312
GIRDER: S24x106 ω= 106 #/FT
DL = ω (SPAN)/1000 = 3.88 K.

(A) CASE 2 LOAD COMBINATION PAR. 3.3.2.3.2 (pg 16)
DL(DLFb) = 3.88(1.1)= 4.27 K.
TL(DLFt)+LL(1+HLF) = 1.6(1.1)+10(1+.15)= 13.26 K.
IFD+WLO+SK = 0 (assume negligible for this example)

GIRDER MODELED AS A SIMPLE BEAM:
MLL = (PL)/4 = ((10K.)(439"))/4 = 1097.5 K"
MTL = (PL)/4 = ((1.6K.)(439"))/4 = 175.6 K"
MDL = $(\omega L^2)/8$= ((.106K.)(36.583)(439"))/8= 212.8 K"
ΣM = 1097.5K"+175.6K"+212.8K" = 1485.9 K."
M(horz) = IFD(Σ M) = (0.0312)1485.8
= 46.36 K"

GIRDER SECTION PROPERTIES: bf= 7.87"
Ixx= 2940 in^4 Iyy= 77.1 in^4
S1= 240 in^3 Sy= 19.6 in^3
AREA= 31.2 in^2



BASIC STRUCTURAL BEAM STRESSES:
σ(vten)= ((1+HLF)MLL+DLFt(MTL)+DLFb(MDL))/S1
= ((1+.15)1097.5+1.1(175.6+212.8))/240
= 7.04 KSI

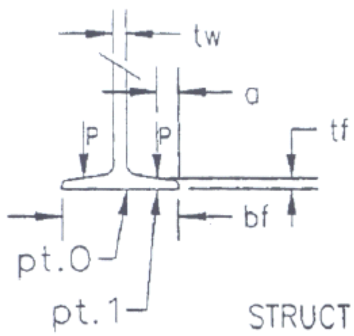
σ (horz) = M(horz)/Sy = 46.36/19.6
= 2.37 KSI

(over)

τ (avg) = (13.26+4.27)/(2x31.02) = 0.28 KSI (Simplified)

DATE: 3/19/95

SUBJECT: EXAMPLE CALCULATION SHT # 3 of 4



EXAMPLE CONDITIONS:

P = 1.45 K (given)
a = 0.75" (given)
tw = 0.62" (S24x106)
tf = 1.09"
bf = 7.87"

STRUCTURAL BEAM STRESSES @ pt0 & pt1:

$$\sigma(0) = \sigma(\text{vten}) + M(\text{horz})(tw/2)/(Iyy)$$
$$= 7.04 + 46.36(0.62/2)/77.1$$
$$= 7.23 \text{ KSI}$$

$$\sigma(1) = \sigma(\text{vten}) + M(\text{horz})(bf/2-a)/(Iyy)$$
$$= 7.04 + 46.36(7.87/2-.75)/77.1$$
$$= 8.96 \text{ KSI}$$

(B) PP 3.3.2.4.1 TAPERED FLANGE SECTION:

$$ta = tf-(bf/24)+(a/6)$$
$$= 1.09-(7.87/24)+(.75/6) = 0.887$$

$$\lambda = 2a/(bf-tw) = 2(.75)/(7.87-.62)$$
$$= 0.207$$

COEEFICIENTS; TAPERED FLANGE:

$$Cx0 = -1.096+1.095(.207)+0.192e^{(-6(.207))} = -0.814$$
$$Cx1 = 3.965-4.835(.207)-3.965e^{(-2.675(.207))} = 0.685$$
$$Cy0 = -0.981-1.479(.207)+1.120e^{(1.322(.207))} = 0.185$$
$$Cy1 = 1.810-1.150(.207)+1.060e^{(-7.70(.207))} = 1.787$$

LATERAL (x) & LONGITUDINAL (y) FLANGE BENDING STRESSES:

$$\sigma(x0) = Cx0(P)/ta^2 = -0.814(1.45)/0.887^2$$
$$= -1.50 \text{ KSI}$$

$$\sigma(y0) = Cy0(P)/ta^2 = 0.185(1.45)/0.887^2$$
$$= 0.34 \text{ KSI}$$

DATE: 3/19/95

SUBJECT: EXAMPLE CALCULATION SHT # 4 of 4

$\sigma(x1) = Cx1(P)/ta^2 = 0.685(1.45)/0.887^2$
$= 1.26$ KSI

$\sigma(y1) = Cy1(P)/ta^2 = 1.787(1.45)/0.887^2$
$= 3.29$ KSI

(C) PP 3.3.2.4.2 REDUCE FLANGE BENDING TO 75% AND COMBINE WITH CASE 2 LOADING (PART A) & COMBINE STRESSES:

POINT 0:
$\sigma(x) = 0.75(-1.50) = -1.13$ KSI
$\sigma(y) = 7.23 + 0.75(0.34) = 7.49$ KSI

$$\sigma(t) = \sqrt{\sigma(x)^2 + \sigma(y)^2 - \sigma(x)\sigma(y) + 3\tau(xy)^2} =$$

$$\sigma(t) = \sqrt{-1.13^2 + 7.49^2 - (-1.13)(7.49) + 3(0.28)^2}$$
$\sigma(t) = 8.13$ KSI $< 0.66(36) = 23.76$ KSI OK !!

POINT 1:
$\sigma(x) = 0.75(1.26) = 0.05$ KSI
$\sigma(y) = 8.96 + 0.75(3.29) = 11.43$ KSI

$$\sigma(t) = \sqrt{\sigma(x)^2 + \sigma(y)^2 - \sigma(x)\sigma(y) + 3\tau(xy)^2}$$

$$\sigma(t) = \sqrt{0.95^2 + 11.43^2 - (0.95)(11.43) + 3(0.28)^2}$$
$\sigma(t) = 11.0$ KSI $< 0.66(36) = 23.76$ KSI OK !!

Q.	Section 3.4.4.1 & 3.4.4.2 (CMAA Spec 74). Are the tensile and shear stress equations given in these sections used for calculating the local flange bending combined stresses only?
A	No, the equations shown in these sections are used to calculate where any state of combined plane stresses exist.
Q;	I am using CMAA Spec 70 to design a crane. I have a question on the acceptance criteria in section 3.4.4 Combined Stresses. The formula in section 3.4.4.1 states that the combined stress (sigma_t) must be less than or equal to sigma_all. Sigma_all is not defined in the text to my knowledge. Are the allowables for each individual case

	(tension, compression, and shear given in the table of section 3.4) to be combined in the given formula to calculate an allowable stress for the particular state of stress. What is the allowable weld stress based on in section 3.4.4.2. Generally allowable weld stresses are given as percentages of the ultimate tensile strength of the filler metal. Does this formula deal with the filler metal properties or the base metal properties?
A.	The formula in section 3.4.4.1 utilizes the allowable stress values from section 3.4. For allowable stress values for the formula in section 3.4.4.2, please refer to paragraph 3.2, titled "Welding". Additional reference can be obtained from AWS D14.1 and D1.1.
Q.	We are performing a monorail assessment and rating survey and require clarification with regards to the CMAA Specification #74 revised 2000. Please provide clarification for the following clauses under Section 74-3 Structural Design: Clause 3.4 This clause states that case 1 allowable stresses are lower than case 2 allowable stresses, however, case 2 with wind load and skewing = 0 = load case 1. Clause 3.3.2.4.2 states that local bending stresses due to wheel loads shall be combined with case 2 stresses and compared to case 2 allowable stresses. Since case 2 with wind load and skewing = 0 = load case 1 and to use case 2 allowable stresses. What instance would require using the loader case 1 allowable stress? Also since the flange bending stress calculated in clause 3.3.2.4.1 are already diminished to 75% of the calculated value when combined with the case 2 stresses why is the allowable combined stress increased from the case 1 value? Clause 3.4.4.1 Is Tau = to horizontal shear or horizontal + vertical + torsional shear?
A.	CMAA Specifications do not cover monorail applications. CMAA Specification #74, Revised 2000, Paragraph 3.3.2.4, Local Bending of Flanges Due to Wheel Loads, applies to Top Running & Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist. For an application as described in Specification #74, I have attached a sample calculation for reference. If you would like an additional reference, you could refer to FEM Specification 9.341, Local Girder Stresses. CMAA Specification #74, Revised 2000, Paragraph 3.4.4.1, Tau (τ) is the summation of all shears at the point of interest.

CMAA SPECIFICATION #74. REVISED 1994
SECTION 74-3, STRUCTURAL DESIGN Par. 3.3.2.4 (pg 16-19)
LOCAL FLANGE BENDING DUE TO UNDER RUNNING WHEEL LOADS

CRANE CAPACITY	$LL := 10 \cdot kip$
SPAN	$L := 439 \cdot in$
HOIST AND TROLLEY WEIGHT	$TL := 1.6 \cdot kip$
DEAD LOAD FACTOR BRIDGE	$DLFb := 1.1$
DEAD LOAD FACTOR TROLLEY	$DLFt := 1.1$
HOIST LOAD FACTOR	$HLF := 0.15$
INERTIAL FORCE FROM DRIVE	$IFD := 0.0312$
GIRDER : S24 X 106	$\omega := 106 \cdot \frac{lbf}{ft}$

$DL := \omega \cdot \frac{L}{1000}$ $\qquad DL = 3.878 \times 10^{-3} \, kip$

(A) CASE 2 LOAD COMBINATION PAR 3.3.2.3.2 (pg 16)

$DL \cdot DLFb = 4.266 \times 10^{-3} \, kip$

$TL \cdot DLFt + LL \cdot (1 + HLF) = 13.26 kip$

IFD+WLO+SK = 0 (assume negligible for this example)

GIRDER MODELED AS SIMPLE BEAM

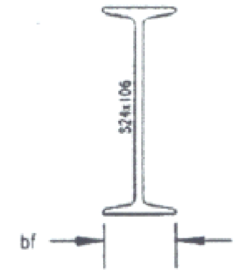
$MLL := \frac{LL \cdot L}{4}$ $\qquad MLL = 1.097 \times 10^{3} \, kip \cdot in$

$MTL := TL \cdot \frac{L}{4}$ $\qquad MTL = 175.6 kip \cdot in$

$MDL := \frac{\left(\omega \cdot L^{2}\right)}{8}$ $\qquad MDL = 212.796 kip \cdot in$

$\Sigma M := MLL + MTL + MDL$ $\qquad \Sigma M = 1.486 \times 10^{3} \, kip \cdot in$

$M_{horz} := IFD \cdot \Sigma M$ $\qquad M_{horz} = 46.36 kip \cdot in$



GIRDER SECTION PROPERTIES:

$Ixx := 2940\,in^4$ $\qquad Iyy := 77.1 \cdot in^4$ $\qquad bf := 7.87 \cdot in$

$S1 := 240 \cdot in^3$ $\qquad Sy := 19.6\,in^3$ $\qquad AREA := 31.2 \cdot in^2$

"h:\dwagner\al\3"

BASIC STRUCTURAL BEAM STRESSES:

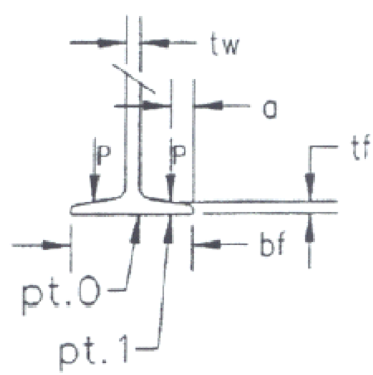
$$\sigma_{vten} := \frac{[(1 + HLF) \cdot MLL + DLFt \cdot (MTL) + DLFb \cdot (MDL)]}{S1} \qquad \sigma_{vten} = 7.039 ksi$$

$$\sigma_{horz} := \frac{M_{horz}}{Sy} \qquad \sigma_{horz} = 2.365 ksi$$

$$\tau_{avg} := \frac{[TL \cdot DLFt + LL \cdot (1 + HLF)] + (DL \cdot DLFb)}{2 \cdot AREA}$$

$\tau_{avg} = 0.213 ksi$ $\qquad$ OVER SIMPLIFIED

EXAMPLE CONDITIONS:



$P := 1.45\,kip$ $\qquad$ given

$a := 0.75\,in$ $\qquad$ given

$tw := 0.62 \cdot in$ $\qquad$ S24 x 106

$tf := 1.09\,in$

$bf := 7.87 \cdot in$

"h:\dwagner\al\2"

STRUCTURAL BEAM STRESSES @ pt0 & pt1:

$$\sigma_0 := \sigma_{vten} + M_{horz} \cdot \frac{\left(\frac{tw}{2}\right)}{Iyy} \qquad \sigma_0 = 7.225\text{ksi}$$

$$\sigma_1 := \sigma_{vten} + M_{horz} \cdot \frac{\left(\frac{bf}{2} - a\right)}{Iyy} \qquad \sigma_1 = 8.954\text{ksi}$$

(B) PP 3.3.2.4.1 TAPERED FLANGE SECTION:

$$ta := tf - \left(\frac{bf}{24}\right) + \frac{a}{6} \qquad ta = 0.887\text{in}$$

$$\lambda := 2 \cdot \frac{a}{(bf - tw)} \qquad \lambda = 0.207$$

COEFICIENTS: TAPERED FLANGE

$$Cx0 := -1.096 + 1.095.207 + 0.192 e^{-6 \cdot 0.207} \qquad Cx0 = -0.814$$

$$Cx1 := 3.965 - 4.835 0.207 - 3.965 e^{-2.675 \cdot 0.207} \qquad Cx1 = 0.685$$

$$Cy0 := -0.981 - 1.479 0.207 + 1.120 e^{1.322 \cdot 0.207} \qquad Cy0 = 0.185$$

$$Cy1 := 1.810 - 1.150 0.207 + 1.060 e^{-7.7 \cdot .207} \qquad Cy1 = 1.787$$

LATERAL (X) & LONGITUDINAL (Y) FLANGE BENDING STRESSES

$$\sigma_{x0} := Cx0 \frac{P}{ta^2} \qquad \sigma_{x0} = -1.5\text{ksi}$$

$$\sigma_{y0} := Cy0 \cdot \frac{P}{ta^2} \qquad \sigma_{y0} = 0.342\text{ksi}$$

$$\sigma_{x1} := Cx1 \cdot \frac{P}{ta^2} \qquad \sigma_{x1} = 1.262\text{ksi}$$

$$\sigma_{y1} := Cy1 \cdot \frac{P}{ta^2} \qquad \sigma_{y1} = 3.293\text{ksi}$$

(C) PP 3.3.2.4.2 REDUCE FLANGE BENDING TO 75% AND COMBINE WITH CASE 2 LOADING (PART A) & COMBINE STRESSES:

$$\sigma_{yield} := 36 \cdot \text{ksi} \qquad \sigma_{allow} := .66\,\sigma_{yield}$$

POINT 0:

$$\sigma_x := 0.75 \cdot \sigma_{x0} \qquad \sigma_x = -1.125\text{ksi}$$

$$\sigma_y := \sigma_0 + 0.75 \cdot \sigma_{y0} \qquad \sigma_y = 7.482\text{ksi}$$

$$\sigma_t := \sqrt{\sigma_x^{\ 2} + \sigma_y^{\ 2} - \sigma_x \cdot \sigma_y + 3 \cdot \tau_{avg}^{\ 2}} \qquad \sigma_t = 8.111\text{ksi}$$

$$\sigma_{allow} = 23.76\text{ksi}$$

$$\text{Point\_0} := \begin{cases} \text{"Okay"} & \text{if } \sigma_t \le \sigma_{allow} \\ \text{"N.G"} & \text{otherwise} \end{cases} \qquad \text{Point\_0} = \text{"Okay"}$$

POINT 1:

$$\sigma_x := 0.75 \cdot \sigma_{x1} \qquad \sigma_x = 0.947\text{ksi}$$

$$\sigma_y := \sigma_1 + 0.75 \cdot \sigma_{y1} \qquad \sigma_y = 11.424\text{ksi}$$

$$\sigma_t := \sqrt{\sigma_x^{\ 2} + \sigma_y^{\ 2} - \sigma_x \cdot \sigma_y + 3 \cdot \tau_{avg}^{\ 2}} \qquad \sigma_t = 10.988\text{ksi}$$

$$\sigma_{allow} = 23.76\text{ksi}$$

$$\text{Point\_1} := \begin{cases} \text{"Okay"} & \text{if } \sigma_t \le \sigma_{allow} \\ \text{"N.G"} & \text{otherwise} \end{cases} \qquad \text{Point\_1} = \text{"Okay"}$$

	3.4.6. Compression Member
Q.	For the allowable flexural stress values referenced in 3.4.6.3, the specification shows: σ_B = compressive bending stress that will be permitted if bending moment alone existed. Is this value the same as the Allowable Compression Stress that would apply in Table 3.4-1?
A.	This is the value that would be applied in Table 3.4-1.
	3.5.5 Deflection and Camber
Q.	Spec 74, Section 3.5.5.1 states a deflection limit of L/600 for Section 3.5.5.2 states a limit deflection of L/888. Is there a reduction in the deflection limit at the cantilevered ends for cantilever box girders? Example, a gantry crane with span of 105 ft consisting of a middle span of 63 ft, and 21 ft cantilevers at the ends.
A.	CMAA has no different criteria for deflection limit for cantilevered ends of you box girder other than mentioned in section 3.5.5.2 for cambered crane girder.
Q.	What are the CMAA deflection recommendations for the bridges and for fixed monorails?
A.	You can find this in CMAA Specification 74, section 3.5.5, page 31.
Q.	CMAA Spec #74, Revised 1999, Could you please clarify for us the intent of the Deflection Criteria given in paragraph 3.5.5? We fabricate most crane bridges of any length with camber of dead load plus ½ live load plus allowance for welding to ensure that they are not built with any noticeable “sag” or negative camber. This being the case we use the 1/888 criteria. This results in a girder with significantly more moment of inertia than one designed for 1/600. As we read the spec it would appear that if we were content to produce crane bridges that were uncambered we would only have to generate a moment of inertia sufficient to meet the 1/600 criteria. There would be a significant savings in material but there would also be a noticeable sag or deflection from level when in use which would undoubtedly raise concerns with our customers. Could you please comment and clarify this issue?
A.	CMAA Specification #74, Revised 2000, Paragraph 3.5.5 defines the maximum vertical deflection and required camber for crane girders. The maximum deflection is 1/600 of the span for uncambered girders and 1/888 of the span for cambered girders. Either method is acceptable. However, girder sag in uncambered girders could have a negative affect on the crane machinery (such as the trolley drive) and how the end user may perceive noticeable sag. Please note that when using the 1/600 of span criteria for maximum allowable deflection, the dead load of the bridge must be included in the calculation for actual deflection.

Q.	In CMAA Spec # 70, it states that 1/1000" of deflection is allowed for every 1 inch of span on the bridges of a crane. My question is: On an underhung crane with three or more runways is this span for the entire length of the crane or just for adjacent runways?
A.	CMAA Specification #70 is titled " Top Running Bridge & Gantry Type Multiple Girder Cranes". I would suggest referring to CMAA Specification #74 titled "Top Running and Under Running Single Girder Cranes". Section 3.5.5 of CMAA Specification #74 clearly defines the deflection and camber of crane girders. It is as follows: 3.5.5 Deflection and Camber 3.5.5.1 The maximum vertical girder deflection of uncambered girders produced By the dead load, the weight of the hoist, trolley and the rated load shall not exceed 1/600 of the span. Vertical inertia forces shall not be considered in determining deflection 3.5.5.2 The maximum vertical deflection of cambered girders produced by the weight of the hoist, trolley and the rated load shall not exceed 1/888 of the span. Vertical inertia forces shall not be considered in determining deflection.
Q.	Where is deflection measured from at full load condition?
A.	In Spec #74, Revised 2000, it is addressed directly and indirectly. 3.5.5.1 this paragraph defines the maximum vertical deflection of uncambered girders, the value of which cannot exceed 1/6000 of the span. The calculation aspect of this is a straight forward matter. The field check of the actual deflection for this case is slightly more complicated. When the crane is erected, the dead weight deflection of the girder has already occurred, so the dead weight deflection must be calculated and subtracted from the maximum allowable deflection (1/600 of the span) before measuring the actual deflection in the field. 3.5.5.2 This Paragraph defines the maximum vertical deflection of cambered girders, the value of which cannot exceed 1/888 of the span. Again, the calculation aspect of this is a straight forward matter and since the dead load of the girder is not included in the calculation, the field measurement of the actual deflection does not require and additional calculation and can be measured directly.
Q.	I need to determine the current condition of a crane manufactured in 1927. Part of the structural assessment involves load rating of the bridge girder assembly. When evaluating deflection, do current standards #70 & #74 for allowable limits match the allowable limits used in 1927?
A.	CMAA and EOCI (Electric Overhead Crane Institute) records are only available back to 1949. In the 1949 spec, the clause for girder deflection reads:

	"The maximum vertical deflection of the girder, produced by the dead load, the weight of the trolley, and the rated load, shall not exceed 0.00125 inches per inch of span. Impact shall not be considered in determining deflection." The 1961 edition of the EOCI specification has the exact same statement. The current edition (2010) of CMAA Specification #70 states in clause 3.5.5.1: "The maximum vertical deflection of the girder produced by the weight of the hoist, trolley and the rated load shall not exceed 1/888 of the span. Vertical inertia forces shall not be considered in determining deflection." Note that while 1/888 (or 0.00113" per inch of span) seems to be less allowable deflection, we no longer include the dead weight of the girder itself.
Q.	In CMAA specification 74 section 3.5.5, the maximum vertical deflection of uncambered girders produced by the dead load, the weight of the hoist trolley and the rated load shall not exceed 1/600 of the span, does the dead load refer to the weight of the bridge beam? And do we need to include the weight of the bridge (in addition to the hoist, trolley, and rated load) when calculating the deflection of an uncambered bridge girder?
A.	Yes, when using the 1/600 of span criteria for maximum allowable deflection of uncambered girders, the dead load of the bridge must be included in the calculation for actual deflection.
	3.5.7 Single Web Girders
.Q.	My question pertains to the compression formula in CMAA Specification #70 and #74 with regard to single web girders. The formula in #70 is located on page 20 in section 3.5.7 and in #74 is located on page 32 in section 3.5.6. The formula is as follows: Compression (ksi) = 12,000/(Ld/Af) with a maximum of 0.6 of yield. How was the constant 12,000 derived? Were Euler or J.B. Johnson formulas used? Would they apply?
A.	CMAA Specification #70 & #74, Revised 2000, Paragraph 3.5.7 defines the maximum allowable tension and compressive stress. The allowable compressive stress formula uses a constant of 12,000. The formula and the constant (12,000) has been in use since 1961. CMAA was knows as Electric Overhead Crane Institute (EOCI). Unfortunately, there are no records or commentaries dating back that far, so I don't know what reference material they may have been looking at. However, the American Institute of Steel Construction (AISC), Eighth Edition, Paragraph 1.5.1.4.5, Page 5-22, Formula (1.5-7) use the same formula and constant. You will also find a commentary on Page 5-112.

	3. 6 Bridge End Truck
Q.	Does CMAA Specification #70 & #74 reference the "sweep" of the end truck? What portion of the crane rail is the "sweep" required to cover? Is it acceptable to have the sweep just above the crane rail?
A.	CMAA Specification #70 & #74, Revised 2000, Paragraph 3.6.3 refers to an end truck guard that is required in front of each outside wheel. The guard is to project below the top of the runway rail. CMAA does not make recommendations as to how far below the rail the guard should extend. I would suggest that you reference ASME B30.2c-2001 (or later if available), Overhead and Gantry Cranes, Section 2-1,9: Rail Sweeps, for more specific guidelines.
Q.	Paragraph 3.6.3 states, "Provisions shall be made to prevent the end truck from dropping more than one inch in case of axle failure." Paragraph 3.6.4 states, "Load combinations and basic allowable stresses are to be in accordance with Sections 3.3.2.6 and 3.4." Likewise, paragraphs 3.9.2 and 3.9.3 state similar requirements for the trolley frame in case of trolley axle failure. What case and allowable stress should be used to design or analyze the bridge end truck and trolley frame under the condition of axle failure? Is it allowable for the bridge end truck or trolley frame to have a stress that is greater than the ultimate strength or yield strength of the material in case of axle failure?
A.	The CMAA specifications do not specifically address this scenario. However the Structural Subcommittee consensus is that the critical load carrying components should remain within load case 3 allowables with the resulting dynamic loads imposed. We consider local deformation at the drop lug as an exception and deformation in that area would be acceptable if it does not affect the integrity/operation of the crane after the crane is put back in service.
	3. 10 Bridge Rails
Q.	Does "bar type rail", such as that from standard steel bar stock meet the intent of Section 3.10?
A.	CMAA does not specifically address the use of square/rectangular bar for bridge rails. CMAA does not preclude the use of square/rectangular bar in crane construction by allowance of other commercially rolled sections. However, design requirements (i.e. bending strength, wear, wheel loading and wheel contact, etc.) for square/rectangular bar are not addressed and the acceptability per application is the responsibility of the manufacturer.
	Section 4 – Mechanical Design
Q.	I am looking for some information concerning the CMAA specifications as it relates to crane hoist design. What sections in the CMAA specifications house these general

	requirements?
A.	Regarding “hoist design general requirements”, Specification #70 (covering top running bridge and gantry multiple girder cranes) has in-depth discussion on hoist mechanical design in section 4. Section 4 did not appreciably change between the 2004 and 2010 revisions. Specification #74 covers single girder cranes, both top running and under running. This specification does not address the hoist unit because these cranes use hoists that are covered by ASME specification B30.16 (Overhead Hoists- Underhung) or B30.17 (Overhead and Gantry Cranes -Top Running Bridge, Single Girder, Underhung Hoist). Refer to the ASME specifications if your crane is a single girder type.
	4.1 Mean Effective Load
Q.	In Specification #70, the clause 4.1.1 what does the “maximum load” include? I understand that it includes the crane’s rated load and considers the hook approach but does it include the dead weight of the bridge and trolley? The “minimum load” includes the bridge and trolley weight, that’s clear, but where is the hoist positioned? In the center?
A.	In paragraph 4.1.1 of CMAA Specification #70, the maximum load is to include all dead weight of the entire crane as well as the live load rating of the crane. This is verified in paragraph 4.1.2.2 and 4.1.2.3 shown on the same page of the specification. Regarding the minimum load, the live load is omitted and in the case of the bridge factor, the trolley is to positioned so as to induce minimum loading into the component being evaluated. It should be noted that the maximum load is also effected by block elevation when single reeved hoists are used.
	4.2 Load Blocks
Q.	The minimal clearance between the crane and the roof support structure won't allow us to attach a structural anchorage point to the overhead roof structure. Does the CMAA specifications allow for the connection of a fall hazard personal protection system to the hook of the crane?
A.	CMAA specifically does not cover personnel suspended from the hoist rope system of a crane. Due to numerous known and unknown factors, CMAA does not recommend the practice of using the hook as a tie-off or anchorage point. Applications of this nature could be considered a “special event” that could be discussed with the manufacturer of the crane.
	4.8 Bearings
Q.	In CMAA 70 references (e.g. 4.8.2) are made to “anti-friction” bearings. This term is not defined in CMAA 70. What are anti-friction bearings?

A.	The following paragraph is taken from "Mechanical Engineering Design", Fifth Edition, Shigley and Mischke: "The terms rolling-contact bearing, anti-friction bearing and rolling bearing are all used to describe that class of bearing in which the main load is transferred through elements in rolling contact rather than in sliding contact. In rolling bearing the starting friction is about twice the running friction, but still it is negligible in comparison with the starting friction of a sleeve bearing. Load, speed and the operating viscosity of the lubricant do affect the frictional characteristics of a rolling bearing. It is probably a mistake to describe a rolling bearings as "anti-friction," but the term is used generally throughout the industry."
	4.13 Sizing of Wheels and Rails
Q.	I want to determine the allowable durability wheel load per the formulas and tables shown on pages 44–48 of Specification 70, Revised 1988. Everything in the formulas are clear except for the Class of Crane Service Factor (Table 4.13.3-3). Per the formula for the equivalent allowable wheel load, the higher the service class of the crane, the higher the allowable wheel load is. For example, the factor for Class A (Standby or Infrequent Service) is .8 (Sm), but the factor for a Class F (Continuous Severe Service) crane is 1.45. As this factor (Sm) is multiplied by the other factors to determine the allowable wheel load, the more severe service factor (F) would allow for a higher wheel load than the least severe service factor (A). Is this correct?
A.	Per CMAA Spec 70, Revised 2004, section 4.13.3 (pages 47–50) regarding sizing of wheels for overhead cranes. Table 4.13.3-3 is correct for wheel service factor Sm for CMAA class of service A which is 0.8 and 1.45 for class F service. Referring to section 4.13.3.3, the wheel service factor SM is equal to 1.25 times the machinery service factor Cd and Cd is shown in table 4.1.3-1. The section 4.13.3.4 shows how to calculate the bridge wheel coefficient Kwi. and the equivalent durability wheel load Pe equal to maximum wheel load x Kwi and the equivalent durability wheel load Pe shall not exceed wheel load in table 4.13.3-4 which are recommended durability wheel loads for different wheel hardness and size in combination with different rail size, for detail description see section 4.13.3. Yes, the equivalent durability wheel load calculated in section 4.13.3.4 will be higher for class F crane than class A for same wheel load and same size wheel. But it shall not exceed recommended wheel load as shown in table 4.13.3-4 or section 4.13.3 assuming same rail and same hardness on wheel.
Q.	Is it required to use double flanged wheels on bridge crane trolleys and bridge trucks? When can single flange wheels be used? It is ever permissible to use an unflanged (plain) wheel on one side of the crane bridge and flanged wheel on the other side?
A.	For top running crane wheels (bridge and trolley), paragraph 4.13.1 of CMAA Specification #70 states: "Unless other means of restricting lateral movement are provided, wheels shall be double flanged with treads accurately machined. …When

	flangeless wheel and side roller assemblies are provided, they shall be of a type and design recommended by the crane manufacturer.” Under running bridge wheels would follow paragraph 4.7.2.2 of CMAA Specification #74 which states: “When flangeless wheels are used they and the side roller arrangement shall be the crane manufacturer’s standard.”
Q.	CMAA #70, Section 4, Table 4.13.3-4 1. How does the hardness of the wheel relate to the hardness of the Rail?
A.	Rail sizes> 115lb/yd have a minimum brinell hardness of 269. Heat treated rail (>115 lb/yd) has a hardness range of 321-388. As shown in CMAA Specification #70 & #74, Revised 2000, crane wheel hardness can range from 200 to BHN to 58 Rc. Please note that per footnote 2 in table 4.13.3-4 in Specification #70 and Table 4.7.1-4 in Specification #74, that when a wheel is hardened to 58 Rc, the loads listed in the tables are based on the rail being heat treated.
Q.	For the 171# rail, is 217 kips the maximum wheel load that the rail can be designed for? Can this rail be hardened further to except higher wheel loads? And what is the maximum that the rail can except?
A.	217 kips is the maximum a 36” diameter crane wheel can be designed for. As indicated in A1 above, the loads listed in the tables are based on the rail being heat treated when using a crane wheel at 58 Rc.
Q.	How are the maxload to the rail derived, are the rails designed for shear loads from a wheel point load? Or are other factors involved from industry practice and history?
A.	CMAA does not specifically address the analysis of the rail other than the point of contact between the wheel and rail and as noted in paragraph 3.3.2.3 in CMAA Specification #70, Revised 2000. I have listed some reference material below that may be of interest to you in this matter.
Q.	We are investigating the use of low profile cranes and the wheel load on the landside crane beam will be exceeding 300 kips. Do you have data on the wheel load capacity for the A150 rail?
A.	CMAA does not recognize the European “A” rail at this time. Possible reference material: “Wrought Steel Wheels”, American Iron & Steel Institute (AISE), February 1955 “AISE Reference Handbook for EOT Cranes”, American Iron & Steel Institute (AISE) 1995.
	4.14 Bumpers
Q.	CMAA Spec #70 (Revised 2000) for Top Running Bridge “EOT” Cranes says that end

	truck bumpers “shall be provided” and that they have “energy absorbing (or dissipating) capacity” I take this to mean that they are required and should be made of rubber or some like substance at a minimum. CMAA Spec #74 (my copy is dated 1974) for Top Running and Under Running Single Girder “EOT” Cranes says that end truck bumpers “should be provided” and does not mention “energy absorbing (or dissipating) capacity”. I take this to mean that they are not required and the end stops and end truck contact can be plain steel-to-steel if desired by manufacturer. Am I correct in these interpretations?
A.	CMAA Specification #70 for Top Running Cranes, Section 4.14.1 indicates “A crane shall be provided with bumpers or other means providing equivalent effect”. The energy absorbing (or dissipating) capacity and rate of deceleration allowed are indicated in Sections 4.14.1.1 and 4.14.1.2. Additionally, Section 4.15.3 indicates “Stops engaging the tread of the wheel are not recommended”. CMAA Specification #74 for Top and Under Running Single Girder Cranes, Section 4.8.1 indicates “When provided, bridge bumpers shall be rigidly mounted…”. The energy absorbing (or dissipating) capacity and the rate of deceleration allowed are indicated in Section 4.8.2. Additionally, Section 4.8.4 states “Runway stops engaging tope running wheels are not recommended”. Therefore, although not mandatory by CMAA Spec #74, actual requirements for bridge bumpers on single girder overhead crane could be made by the owner, the crane specifier, the crane manufacturer and state or local codes. Please refer to ASME B30.11 “Monorails and Underhung Cranes”, paragraph 11-1.3.1 (g) for monorail end stop requirements. This specification is referenced in both CMAA Specifications, paragraph 1.8.2..
Q.	CMAA 70 and CMAA 74 very clearly indicate that the load block and lifted load shall not be included when determining the deceleration rate. However it appears that the same is not true for determining the minimum energy absorption (or dissipation) required in the selection of bridge and trolley bumpers. Is the weight of the load block and lifted load to be included when determining the minimum amount of energy to be absorbed or dissipated by the bridge and trolley bumpers?
A.	This question refers to Sections 4.14.1.1 and 4.14.1.2 and Sections 4.8.1 and 4.8.2 in Specifications #70 and #74 respectively, about bumpers and respective deceleration rates, taking 3.3.2.3.2 into consideration, which shows the actual formula for the energy released as result of a collision between two cranes, or a crane and a fixed object, states, “load suspended from the lifting equipment and free oscillating load *need not* be taken into consideration”, when calculating the energy absorption of the bumpers.

	As long as the load, bottom block & other load handling devices are not guided and are suspended freely oscillating, they do not need to be considered for calculating impact force and energy to be absorbed.
	Section 5 – Electrical Equipment
	5.2.7 Motor Time Ratings
Q.	I am not a Electrical Engineer, would you please explain “motor time ratings” (Specification 74, Paragraph 5.2.7).
A.	CMAA Specification #74, Revised 2000, Paragraph 5.2.7 is a brief guideline for selecting a motor’s minimum time rating. Motor Time Rating is the time the motor can deliver rated horsepower at rated speed continuously and not exceeding a temperature rise greater than the insulation temperature rating. To get a better feel for what that definition says, let’s look at a couple of different applications, conveyor motors and crane motors. In general, a conveyor motor will be turned on once in the morning and then will run continuously the rest of the day. The motor is only subjected to one instance of inrush current (inrush current will cause motor heating). The conveyor motor can run continuously from that point on, the rest of the day, without over heating. On a crane, the motor is applied differently. The motor will be subjected to multiple inrushes of current, such as when an operator “jogs” the crane into position. The motor reverses, sometime before it has had a chance to completely stop turning. The motor may be run at a slow RPM for an extended period of time. This intermittent operation of the crane motor is obviously quite different than the conveyor application I described. The motor manufacturers change the designs (insulation, frame size, etc.) of their motors depending on the application: continuous, 30-minute, 60-minute, etc.
	5.2.9.1.2 Bridge & Trolley Drives
Q.	Specification 70, 2000 Edition., 5.2.9.1.2 Bridge & Trolley Drives Cr = Rotational Inertia Factor. WK2 of Crane & Load….Do you have a definition of WK2 or a sample calculation showing how this works?
A.	The Cr factor in the equation in paragraph 5.2.9.1.2.1 of CMAA Specifications 70 and 74, Revised 2000, is rotational inertia factor reflected at the motor. The definition of WK2 is the Weight of the body times the square of the radius of gyration (K). The accumulation of the information required to calculate the WK2 of an entire crane system can be very time consuming. It is not unusual to default to the alternate equation

	for Cr; Cr = 1.05+(a/7.5).
	Section 6 – Inquiry Data Sheets and Speeds
	Figure 6.2 – 6. 4 Operating Speeds
Q.	Referencing Figure 6.3 in CMAA Spec 70, what direction (hoisting or lowering), what load (no load, rated load, % load), and what speed point (1”. Or 5”.) is being used to determine the speeds in the charts? It would also help to know if the loading and speed conditions are the same for forward and reverse on the trolley and bridge speeds in the chart?
A.	CMAA Specification #70, Revised 2000, Figure 6.3, Suggested Operating Speeds, Feet Per Minute, Cab Controlled Cranes. All of the suggested speeds shown are based on full load (100% load, hoisting) at full speed (highest speed point on the master). The type of the crane control will determine how much variance you get at no load full speed. I have listed several generalized guidelines for your consideration: AC Contactor Control – The full load, full speed will not differ greatly compared to the no load, full speed. DC Contactor Control (Series Motors) – The full load, full speed will differ compared to the no load full speed. The no load, full speed can range from 150% to 300%+ as compared to the full load, full speed. This type of characteristic can be useful in a high production area. AC or DC Static – Today’s static controls are sophisticated enough that you can have either of the above control characteristics incorporated. This applies to any of the crane motions. An awareness of the maximum speeds the crane and control can attain is important when considering your process and the safety of the personnel in the process area.

and employees from any and all liability in tort, contract or other liability.