Mechanical and Electrical Engineering Services



STS Crane Procurement

Needs Assessment Specifications Bid Packages Bid Evaluations Design Review

Manufacturing Review Commissioning Testing Acceptance Warranty



Other Container Cranes





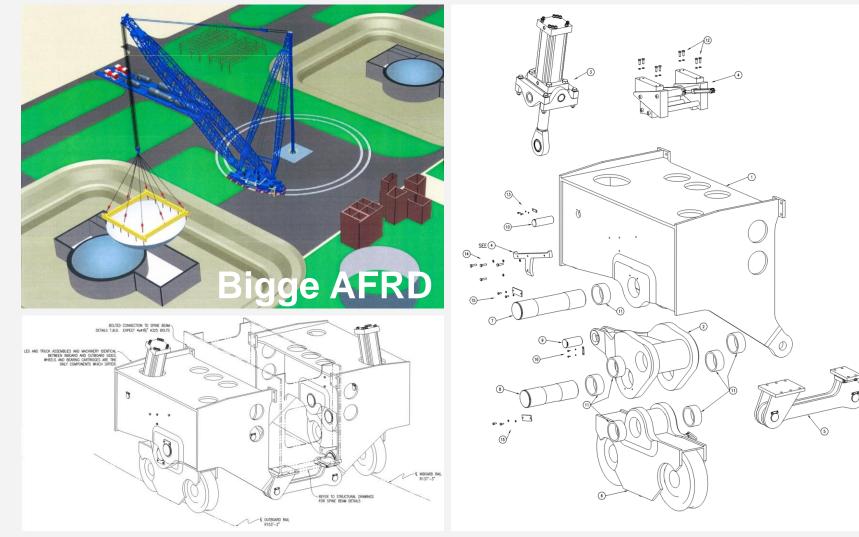


RTG RMG ASC

IYC MHC



Specialty Cranes



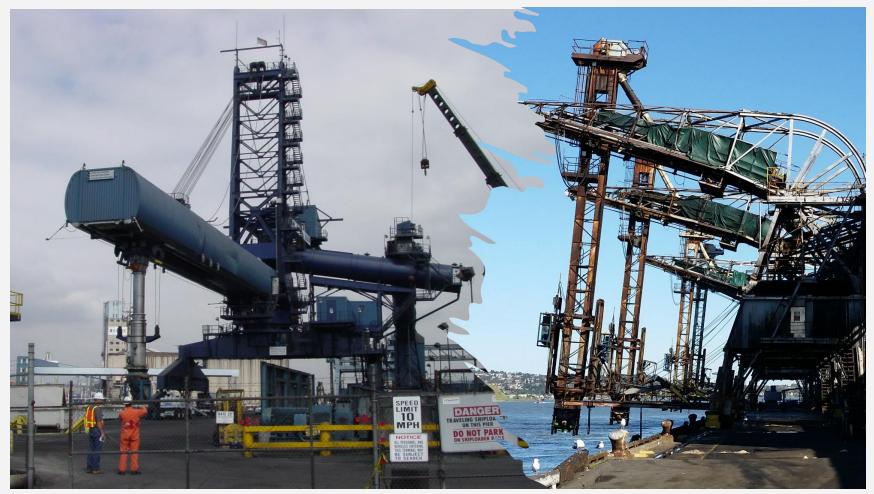


Floating Cranes





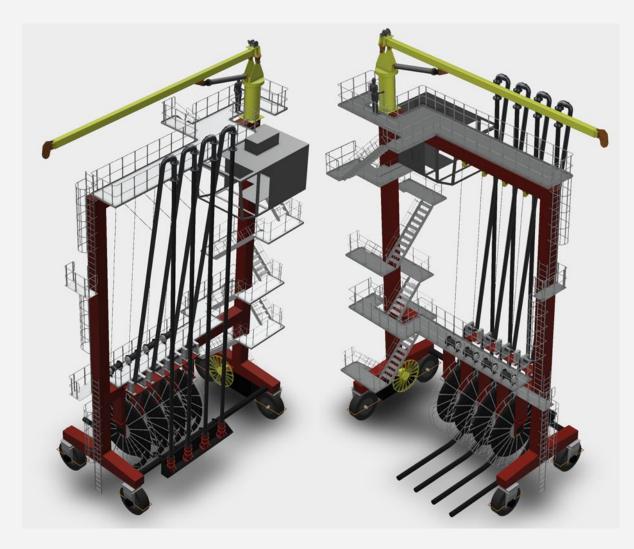
Dry Bulk Handling Equipment



Grab Bucket, Loaders, Unloaders, Stacker/Reclaimers



Liquid Bulk Equipment



Hose Towers

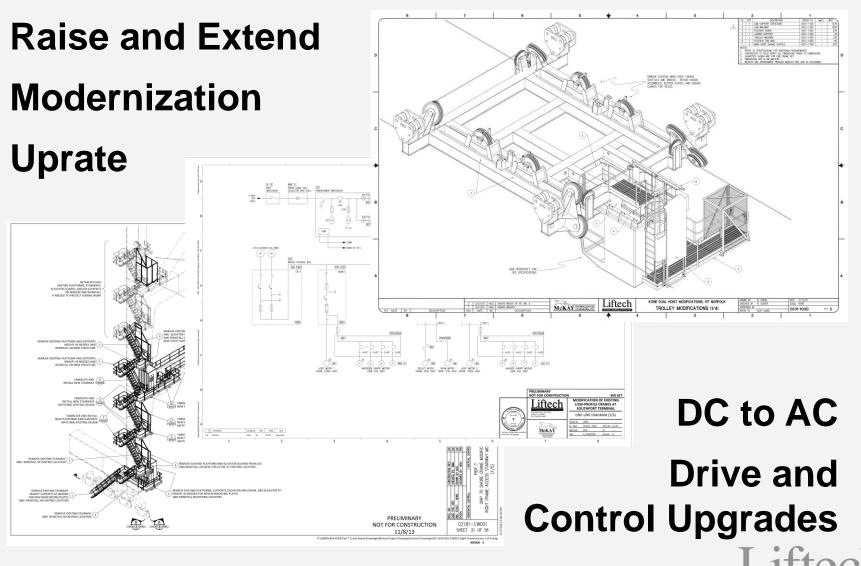
Mobile Equipment

Handling Cranes

POL and MOTEMS



Equipment Modifications



CONSULTANT

Concept Development & Design



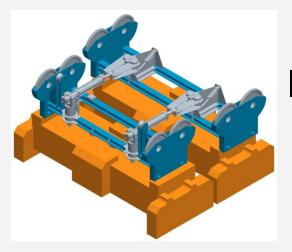


Concept Development & Design





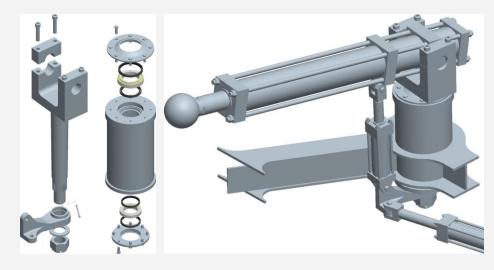
Concept Development & Design



Design Improvement

> **Concept** Validation

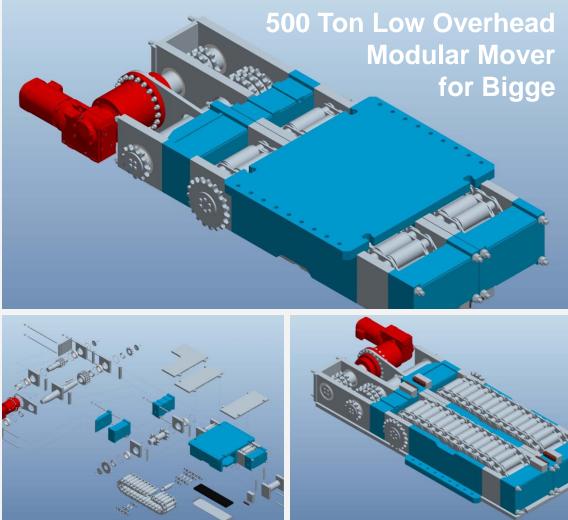








Specialty Equipment

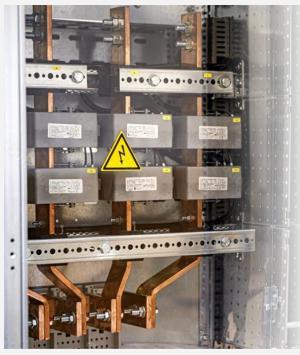


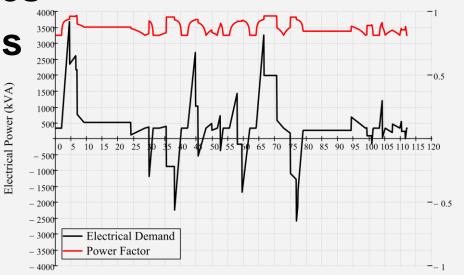
Rugged Designs Proven Components **3D Models Detailed Parts Assembly & Maintenance** Instructions



Electrical Infrastructure

Power Demand Studies Voltage Drop Analysis

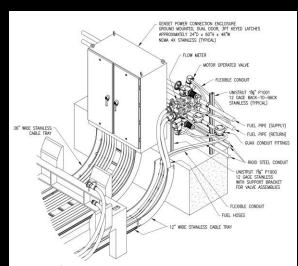


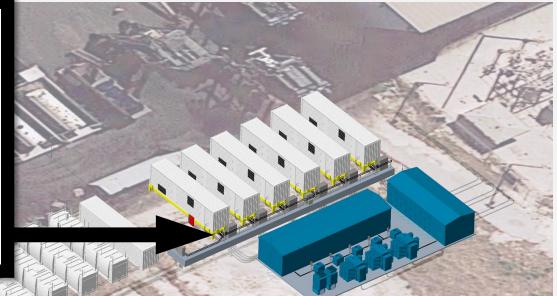


Regenerative Power Handling Circuit Protection Coordination Switchgear and Transformers Electrical Noise Mitigation



Electrical Power Systems





12 MW Diesel Genset Backup Power Plant Complete Electrical & Mechanical Design Full 3D Modeling with Conduit Routing Automatic Fail-Over and Automated Fueling



Emission Reduction Conversions

Zero Emission Studies

Power Demand Modeling

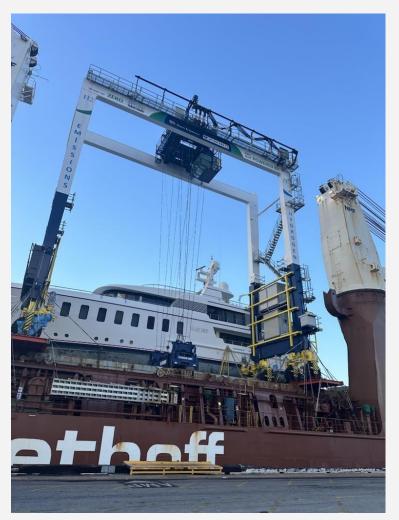
Diesel Hybrid Conversions

Battery Electric Systems

Charging Systems

H₂ Fuel Cells & Storage

Alternatives Investigation



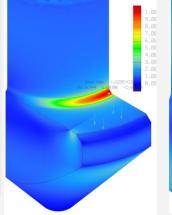


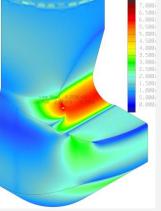
Failure Analysis

PARAMETERS											
.1 COORDINATE	E SYSTEM				\sim	\geq					
+X Direction, Tro +Y Direction, Ga +Z Direction, Hoi	antry to Operator										
1.2 PERFORMAN	NCE PARAMET	ERS			7 /						
Number of hours components	s of mechanical	$L_{mech} := 250001$	hr		*2 *2						
Number of move (double move du		$f_{moves} := 60 \div 1$	hr		≫+×		EF: Spec 1.6.14	$\mathbf{E_{40}}^{T} = (229 \ 1219) \mathrm{mm}$			
							EF: Spec 1.6.30	$E_{20}^{T} = (229 \ 610) \text{ mm}$			
Number of cycles	es required	$NA := L_{mech} f_m$	toves	REF: Spec Table	e 3.1	NA = 1500000	2	20			
.3 HEADBLOCK	K PARAMETER	s					18.005 <u>2</u> 8	STL = 120.4 t			
Longitudinal dista between twistloc		a := 5436mm	R	EF: As Built			1.6.29 and the motor to d drum, multiplied by 8 li	orque per lead line, taken ines at the headblock			
Lateral distance between twistloc		$b := 762 \mathrm{mm}$	R	EF: As Built			ons				
Weight of headbl	block	HB:= 6547kg	R	EF: As Built		HB = 6.5 t	ZPMC SUB NO: Vcal09 KG #42 "Calculation for	Snag Device"	DS		
							NG #42 Calculation for				
Headblock micro	o motion (x,y)	$E_{HR} := (0 \ 6)^T$	in R	EF: Spec 3.9.17	EHB	= (0 152.4) mm	KG #42 Calculation for	ener ener	FEM Case	² Overload	Fatigue
Headblock micro		$\mathbf{E}_{\mathbf{HB}} := (0 \ 6)^T$	n R	EF: Spec 3.9.17	E _{HB} ^T			-	FEM Case III, Snag [kN]	Overload	Fatigue [kN]
I.4 LOAD PARAM	METERS	110			110	= (0 152.4) mm		0000 cycles = Class B7	III, Snag	Overload	
.4 LOAD PARAM	METERS	110		EF: Spec 3.9.17 as their effects on th	110	= (0 152.4) mm	F.E.M. T.2.1.4.1.2., 1500	0000 cycles = Class B7	III, Snag [kN]	[kN]	[kN] 158.6
A LOAD PARAM	METERS ATT) and wind le	oading (WLO) are i	ignored, FEM Ca	as their effects on th	110	= (0 152.4) mm istlock are small.	E.M. T.2.1.4.1.2., 1500 T.2.1.4.4., Spectrum cl From E6 above World Guide to Equivale	0000 cycles = Class B7 ass = Class P2 ent	III, Snag [kN] 392.3	[kN]	[kN] 158.6 FATIGUE
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.4 LOAD PARAM ateral loading (LA Mechanism Exa Pat Headblock Shea Com	METERS ATT) and wind le	oading (WLO) are i	ignored, FEM Ca	as their effects on th se Overload	he load of the twi	= (0 152.4) mm istlock are small. FEM Classification	5.E.M. T.2.1.4.1.2., 1500 T.2.1.4.4., Spectrum cl From E6 above World Guide to Equivale ind Steels" 4th ed. Page China - 42CrMo"	0000 cycles = Class B7 ass = Class P2 ent	III, Snag [kN] 392.3 neadblock sile loadin	Overload [kN] 295.2 Consequer g.	[kN] 158.6 FATIGUE
.4 LOAD PARAM ateral loading (LA Mechanism Exa Pat Headblock Shea Com	METERS ATT) and wind le amples in Load th wave Pins, Spreader muccions &	FEM Cases 1 & II	ignored, FEM Ca III STL SN	as their effects on the	Fatigue	= (0 152.4) mm istlock are small. FEM Classification	F.E.M. T.2.1.4.1.2., 1500 T.2.1.4.4., Spectrum cl Fom E6 above World Guide to Equivale und Steels" 4th ed. Page	0000 cycles = Class B7 ass = Class P2 ant o	III, Snag [kN] 392.3 headblock sile loadin	Overload [kN] 295.2 Consequer g.	[kN] 158.6 FATIGUE
4 LOAD PARAM ateral loading (L4 Mechanism Exa Pat Headblock Shea Con Tivit	METERS ATT) and wind le amples in Load th wave Pins, Spreader muccions &	Doading (WLO) are i FEM Cases 1&11 LS + LLE + LATT + WLO Table 3.2: Mecha	ignored, FEM Ca III SN snical Load	as their effects on th se Overload STL	Fatigue	= (0 152.4) mm istlock are small. FEM Classification + M8	5.E.M. T.2.1.4.1.2., 1500 T.2.1.4.4., Spectrum cl From E6 above World Guide to Equivale ind Steels" 4th ed. Page China - 42CrMo"	0000 cycles = Class B7 ass = Class P2 ent	III, Snag [kN] 392.3 headblock sile loadin	Consequer G. Conse	[kN] 158.6 FATIGUE ntly, the
4 LOAD PARAM ateral loading (L4 Mechanism Exa Pat Headblock Shea Con Tivit	METERS ATT) and wind le amples in Load th wave Pins, Spreader muccions &	FEM Cases I & II LS + LLE + LATT + WLO	ignored, FEM Ca III SN snical Load	as their effects on the	Fatigue	= (0 152.4) mm istlock are small. FEM Classification	5.E.M. T.2.1.4.1.2., 1500 T.2.1.4.4., Spectrum cl From E6 above World Guide to Equivale ind Steels" 4th ed. Page China - 42CrMo"	0000 cycles = Class B7 ass = Class P2 ant o	III, Snag [kN] 392.3 neadblock sile loadin FT INTE Case Ov inag Ioa 0.0 108	Consequer g. RFACE er Fatigue d* σ 0.0 1080.0	[kN] 158.6 FATIGUE ntly, the Fatigue T 080.0
.4 LOAD PARAN ateral loading (L/ Mechanism Exa Pad Headblock Shea Con Twrit Lifting system	METERS ATT) and wind le amples in Load th wave Pins, Spreader muccions &	Doading (WLO) are i FEM Cases 1&11 LS + LLE + LATT + WLO Table 3.2: Mecha	FEM Ca III STL SN mical Load	as their effects on th se Overload STL	Fatigue	= (0 152.4) mm istlock are small. FEM Classification + M8	5.E.M. T.2.1.4.1.2., 1500 T.2.1.4.4., Spectrum cl From E6 above World Guide to Equivale ind Steels" 4th ed. Page China - 42CrMo"	0000 cycles = Class B7 ass = Class P2 ant o	III, Snag [kN] 392.3 neadblock, sile loadin FT INTE Case Ov inag loa 0.0 108 0.0 75:	Consequer 295.2 Consequer 3. RFACE er Fatigue d* σ 0.0 1080.0 3.3 161.6	[kN] 158.6 FATIGUE atty, the Fatigue τ (1080.0 93.3
A LOAD PARAM ateral loading (LA Mechanism Exa Headblock: Shea Con Twiti Lifting system Lifting load	METERS ATT) and wind it amples in Load th save Pins, Spreader metcloss & stillocks	FEM Cases FEM Cases ISI ISI ISI ISI ISI ISI ISI IS	FEM Ca III SN anical Load	as their effects on th see Overload STL d Combinations REF: Spec 1.6.16 REF: Spec 1.6.13	Fatigue	= (0 152.4) mm stlock are small. FEM Classification + MI LS = 10.5 t LL = 50.8 t	5.E.M. T.2.1.4.1.2., 1500 T.2.1.4.4., Spectrum cl From E6 above World Guide to Equivale ind Steels" 4th ed. Page China - 42CrMo"	0000 cycles = Class B7 ass = Class P2 ant o	III, Snag [kN] 392.3 neadblock sile loadin FT INTE Case Ov inag Ioa 0.0 108	Consequer 3. Consequer 3. Consequer 4. a b c c c c c c c c c c	[kN] 158.6 FATIGUE ttly, the τ (1080.0 93.3 32.6
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A LOAD PARAM Lateral loading (LA Mechanism Exa Pat Headblock Shea Com	METERS ATT) and wind k amples in Load the the spreader methods titleds	FEM Cases FEM Cases ISI ISI ISI ISI ISI ISI ISI IS	ignored, FEM Ca III SN anical Load	as their effects on th see Overload STL d Combinations REF: Spec 1.6.16 REF: Spec 1.6.13	Fatigue	= (0 152.4) mm stlock are small. FEM Classification + MI LS = 10.5 t LL = 50.8 t	5.E.M. T.2.1.4.1.2., 1500 T.2.1.4.4., Spectrum cl From E6 above World Guide to Equivale ind Steels" 4th ed. Page China - 42CrMo"	ood cycles = Class B7 ass = Class P2 ant vistlock	III, Snag [kN] 392.3 Beadblock sile loadin FT INTE Case Ov inag loa 0.0 108 0.0 75 7.6 26 11 4. 73 2.1	Consequer g. RFACE er Fatigue d* a 0.0 1080.0 3.3 161.6 1.6 1.3 18.42 8 2.76	[kN] 158.6 FATIGUE ttly, the Fatigue 1 080.0 93.3 32.6 33.16 2.86 FATIGUE
A LOAD PARAM ateral loading (L/ Mechanism Exa Headblock Sea Con Trei Lifting system Lifting load Eccentric lifted load	METERS ATT) and wind k amples in Load the the spreader methods titleds	FEM Cases FEM Cases 18.1 15+11E+LATT+ W10 Table 32: Mecha LS := 375001b - LL := 50LT LL := 50LT LLE_40:= 40LT	ignored, FEM Ca III SN anical Load	as their effects on th see Overload TL 4 Combinations REF: Spec 1.6.16 REF: Spec 1.6.13 REF: Spec 1.6.14	Fatigue	C = (0 152.4) mm stlock are small. $\frac{\text{FEM}}{\text{Classification}} + \frac{\text{MS}}{\text{MS}}$ LS = 10.5 t LL = 50.8 t LLE = 400 c	E.M. T.2.1.4.12, 1500 T.2.1.4.4., Spectrum ol Form E6 above World Guide to Equivalina ind Steela ⁴ He d. Page Drina - 42CrMo ⁴ Sample Tv Sample Tv C Achinery's Handbook 2 8 & 1789 Fig. 3	2000 cycles = Class B7 ass = Class P2 ant wistlock B B B C7th Ed.	III, Snag [kN] 392.3 neadblock. sile loadin KFT INTE Case 00 30.0 108 0.0 76 11 4.73 2.1 set forth l	Consequer 3- Conse	[kN] 158.6 FATIGUE ttly, the Fatigue t 1080.0 93.3 32.6 2.86 FATIGUE FATIGUE the Spec.
A LOAD PARAM ateral loading (L/ Mechanism Exa Headblock Sea Con Trei Lifting system Lifting load Eccentric lifted load	METERS ATT) and wind k amples in Load the the spreader methods titleds	FEM Cases FEM Cases 18.1 15+11E+LATT+ W10 Table 32: Mecha LS := 375001b - LL := 50LT LL := 50LT LLE_40:= 40LT	ignored, FEM Ca III SN anical Load	as their effects on th see Overload TL 4 Combinations REF: Spec 1.6.16 REF: Spec 1.6.13 REF: Spec 1.6.14	Fatigue	C = (0 152.4) mm stlock are small. $\frac{\text{FEM}}{\text{Classification}} + \frac{\text{MS}}{\text{MS}}$ LS = 10.5 t LL = 50.8 t LLE = 400 c	E.M. T.2.1.4.12, 1500 T.2.1.4.4., Spectrum ol Form E6 above World Guide to Equivalina ind Steela ⁴ He d. Page Drina - 42CrMo ⁴ Sample Tv Sample Tv C Achinery's Handbook 2 8 & 1789 Fig. 3	ood cycles = Class B7 ass = Class P2 ant vistlock	III, Snag [kN] 392.3 neadblock. sile loadin KFT INTE Case 00 30.0 108 0.0 76 11 4.73 2.1 set forth l	Consequer 295.2 Consequer RFACE er Fatigue d* d.0.0 3.3 161.6 58.6 13 2.76 or	[kN] 158.6 FATIGUE ttly, the Fatigue t 1080.0 93.3 32.6 2.86 FATIGUE FATIGUE the Spec.
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L4 LOAD PARAM	METERS ATT) and wind is amples in Load the amples in Load mentions is mentione	FEM Cases FEM Cases 18.1 15+11E+LATT+ W10 Table 32: Mecha LS := 375001b - LL := 50LT LL := 50LT LLE_40:= 40LT	ignored, FEMCa SN antcalLasc HB	as their effects on th as Overload TL d Combinations REF: Spec 1.6.16 REF: Spec 1.6.13 REF: Spec 1.6.14 REF: Spec 1.6.14 Interime Section Interior Distance from CL to	Pres	$\begin{array}{c} = (0 152.4)\mathrm{mm} \\ = (0 152.4)\mathrm{mm} \\ = \\ \begin{array}{c} \mathrm{statics} \\ static$	FEM.T2.1.4.12, 1500 T.2.1.4.4, Spectrum of Form E6 above World Guide to Equival ind Steles ¹⁴ Hed. Page Drina - 42CrMo ² Sample Tw Comparison of the second second Aschinery's Handbook 7 8 & 1789 Fig. 3 Petersion. Stress Conce 5.6 'Bott and Nut.' REF: Solid Model, Appen	2000 cycles = Class B7 ass = class P2 ant bristlock B	III, Snag [kN] 392.3 noadblock. sle loading FT INTE Case On noa 0.0 106 0.0 75 7.6 26 1.1 4. 7.3 2.1 nation. DED SH EM Case III, Snag	Grant Grant <th< td=""><td>[kN] 158.6 FATIGUE ttp://the ntly, the 100.0 93.3 32.6 33.16 2.86 FATIGUE re Spec. prmalized</td></th<>	[kN] 158.6 FATIGUE ttp://the ntly, the 100.0 93.3 32.6 33.16 2.86 FATIGUE re Spec. prmalized

Advanced Analysis and FEA Design Improvement







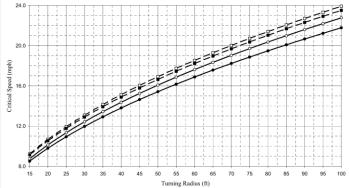


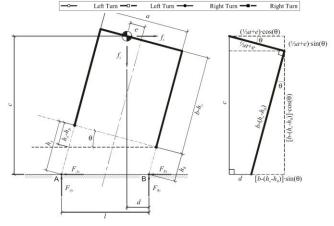
Mechanical Failure Investigation

Accident Investigation Mechanical Failure Analysis Root Cause Identification Expert Witness



Stability Comparison Between





The heights of the suspension can be expressed in deltas instead of absolute values. The deltas are defined as:

$$\Delta h_A = h_A - h_o$$
 $\Delta h_B = h_B - h_o$

Notice that a negative value indicates compression of the suspension system. The angle of roll can be defined as a function of these deflections:

$$\theta(\Delta h_A, \Delta h_B) := \operatorname{atan}\left(\frac{\Delta h_A - \Delta h_B}{a}\right)$$

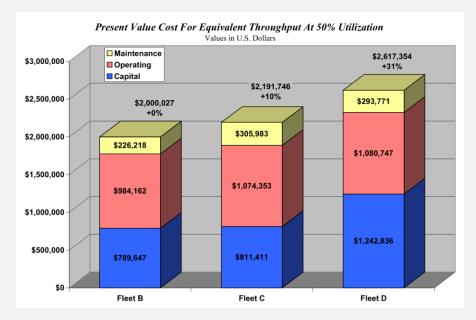


Electrical Failure Investigation

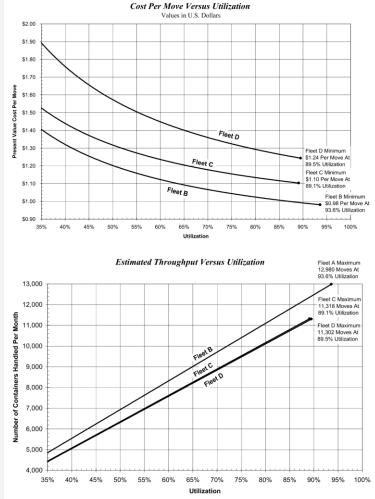
Circuit Protection Fuse Coordination Root Cause Identification Mitigation Recommendations



Engineering Studies









Thank You

More information is available on our website:

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