Approved

ORNL WORK PLAN

Operations, Maintenance and Services

61113

Work Plan Name / Rev: MWP061113 / 0
Expiration Date: 4/1/2026

WORK SCOPE/DESCRIPTION	
Requester (Name/Badge/Division):	Moore, Andrew / 03022839 / X108
Location of work (Bldg/Rm/Other):	7930 / 305 / Room 302 and 305
Work Plan Title:	7930 High Bay Crane Repair/Modernization

Description of Service/Work Needed:
This work package will cover the work performed by ORNL personnel and sub-contractor (Deshazo) personnel in the effort to modernize the 7930 High Bay Crane.

The scope of work includes:
1. Demolition of existing motors, brake systems, controls, wiring, and other electrical components.
2. Installation of new motors, brake systems, controls, wiring, and other electrical components.
3. Lifting new parts and equipment to the 3rd floor and removed parts/waste to 1st floor.
4. Tie-in of electrical equipment to facility power, and Crane Disconnect replacement.
5. Functional testing crane.

Required permits and documentation include:

Hot-work Permit(s)
Lift Plan(s)
AHA
AWA(s)
7930-BOPM-252
USQD/REDC/25-002
USQD/REDC/25-006
USQD/REDC/25-007

Charge Number, if required:	
Work Plan Grade/Worktype:	1 / G
Author (Name/Badge):	Moore, Andrew / 03022839

File Attachments:

Badge	Name	Attachment Desc	File Name
03022839	Moore, Andrew	Spyder Crane Placement	Upper Level - Small Spider Crane Slab and Beam Check.pdf
03022839	Moore, Andrew	URW205 Spyder	URW205_Spec_Sheet_v.Sept2015.pdf
03022839	Moore, Andrew	URW 205 Spyder Crane	SKETCH 5 - URW-205 SPIDER CRANE LIFT ZONES (.pdf
03022839	Moore, Andrew	Boom Lift USQD	USQD_REDC_25-007_R0 Boom Lift for Crane Modernization (Final with Digital Signature) 03-27-2025.pdf
03116541	Carnahan, Corey	QEA	MWP061113 QEA 3.31.25.pdf

INSTRUCTIONS

Prerequisites/Precautions:

Does this work apply to a Hazard Category 1, 2, or 3 Nuclear Facility? If yes, do any of the following apply (as determined by a USQ-qualified person)?

1. Is it a physical change? Yes.

2. Is it a change to a procedure or program described in the documented safety analysis? No.

3. Is it a new or revised operation? No.

- If any of the above questions were answered yes, then initiate a USQD or USQD Screening Worksheet in accordance with Unreviewed Safety Question (USQ) Process for Nuclear and Facility.

- All work performed in, or in support of, a Category 1, 2, or 3 nuclear facility must be conducted in compliance with the nuclear facility Safety Analysis Report (SAR) and Technical Safety Requirements (TSR).

- Notify affected R&D personnel of work activity.

- Notify Facility Management of work activity.

- Plan/Schedule work with Building Supervision/Facility Management.

- Determine procurement requirements for materials or parts.

Directions:

- Proper PPE is to be used in performance of tasks.

- Notify Building Supervision/Facility Management prior to starting work.

- Waste generated is disposed of in accordance with established ORNL procedures.

- Ensure work area is clean and free of hazards during performance of work.

Post Work Testing:

Closeout:

- Ensure work area is clean and free of hazards prior to leaving it.

- Provide feedback to Building Supervision and Task Leader.

JOB HAZARD EVALUATION	
HAZARDS	PERMITS / CONTROLS
Asbestos/Man-Made Mineral Fibers: Existing crane wiring contains asbestos insulation.	ı Training - Asbestos O&M Training ı ORNL Asbestos Work Authorization and Disposal Request : as required ı PPE & Access - Respiratory protection: Specify. Follow applicable AWA ı PPE & Access - Gloves: Specify. Follow applicable AWA ı Approved HEPA Vacuum Cleaner
Deenergized Hazardous Energy Sources (LTV): L/T/V of High Bay Crane at MCC	ı ORNL-213, ORNL Lock/Tag/Verify Permit form OR ORNL-214, ORNL Lock/Tag/Verify Permit Continuation form OR ORNL-215, ORNL Lock/Tag/Verify Permit Temporary Suspension form: as required
Excavation/penetration (includes trenching and shoring): For replacement of Disconnect if needed	ı ORNL-648, Penetration Permit Form | Penetration Permit (PERX) ı Radiological Controls for materials from excavation or penetration: Specify. 3rd Floor is a Fixed Contamination Area and disconnect is in a Radiation Area
Hoisting and Rigging: For equipment hoisting into position for staging, and flying down from and up to	ı Contact the H&R Project Leader or H&R SME ı Lift Plans: Use Lift Classification exhibit

the crane.	- Hard hats - Safety shoes - Qualified personnel - Professional Riggers / Power Equipment Operator document maximum allowable load.
Lead: lead abatement as needed	- Exposure Assessment: Enter or attach justification to classify exposure scenario as low risk, qualitative exposure assessment (QEA), or requirement to conduct quantitative exposure monitoring (QEM)
Radiological Work: Work will be performed in 7930 3rd floor	- Radiological Work Permit (Enter RWP no.): Not expected, but if necessary consult facility RCT for appropriate permit. - Dosimetry Monitoring Requirements - Follow radiological posting, entry control & egress requirements - Respond to Abnormal Radiological Conditions and Alarms. Radiological alarms include: Continuous Air Monitor (CAM), Area Radiation Monitor (ARM), Electronic Pocket Dosimeter (EPD), Personnel Contamination Monitor (PCM).
Welding/burning/hot work: As required for welding and grinding tasks.	- Welding/Burning/Hot Work Permit: As required - Exposure Assessment: Enter or attach justification to classify exposure scenario as low risk, qualitative exposure assessment (QEA), or requirement to conduct quantitative exposure monitoring (QEM)
Electrical Equipment and Tools: Use of hand tools	- Listed by a nationally recognized testing laboratory (NRTL)
Elevated Work: Working on crane.	- Inspecting Ladders Guide [Step & Fixed] - Obtain Training - Fixed >10 feet; portable >3 feet - Fall Protection Training Requirements: Specify. - Aerial Lifts (Boom, Articulating, Telescoping, Scissor, Bucket, etc.) - Safety Harness/Fall Protection Equipment: Specify.

Manual Material Handling: Handling wiring, disconnect and other materials and equipment.	- Establish Controls (Guideline) [apply 30-50-30 criteria for a non-repetitive lifting task]
	  - Reduce weight
	  - Decrease load
	  - Design work area
	  - Facilitate access to material
	  - Optimum environment
	  - Reduce distance /Provide proper storage facilities
	  - Load storage
	  - Eliminate manual lifting/lowering
	  - Eliminate pushing/pulling – Use lifting aids
	  - Other instructions to staff
	- Apply hierarchy of controls approach
	- Team Lifting (Guideline)
	- Exposure Assessment: Enter or attach justification to classify exposure scenario as low risk, qualitative exposure assessment (QEA), or requirement to conduct quantitative exposure monitoring (QEM)

Mechanical Material Handling: Use of dollys, fork trucks, ets.	- Apply Guideline: Assess Hazards - Apply hierarchy of controls approach - Consider forklifts or powered industrial trucks: See Power Equipment hazard (formerly Lifting Aides)

Noise: Tool	ı Exposure Assessment: Enter or attach justification to classify exposure scenario as low risk, qualitative exposure assessment (QEA), or requirement to conduct quantitative exposure monitoring (QEM) ı Hearing protection (plugs or muffs): Selecting Hearing Protection: Ensure hearing protection is worn during activities that produce noise at or greater than 85 dBA.
Power Equipment: Operating Spyder crane, and personnel lifts	ı Qualified operator ı Perform pre-use check (Exhibit)
Chemical/Rec ID 1: Clorox Formula 409 (Rec ID: 81193)	ı Exposure Assessment: Enter or attach justification to classify exposure scenario as low risk, qualitative exposure assessment (QEA), or requirement to conduct quantitative exposure monitoring (QEM) ı Administrative controls: use only quantity needed to accomplish task. ı Gloves: Specify. Work Gloves or Nitrile ı Safety glasses: with side shields ı Job Specific Haz Com Training: Follow SDS Requirements
Respirable Crystalline Silica: Penetration of concrete walls for new disconnect if needed	ı Exposure Assessment: Enter or attach justification to classify exposure scenario as low risk, qualitative exposure assessment (QEA), or requirement to conduct quantitative exposure monitoring (QEM). Example: QEA required for respirable silica generating construction activities and where Respirable Silica is above action level. Specify. ı Staff Training: Respirable Crystalline Silica ı Wet methods: Specify. ı Approved HEPA Vacuum: Specify. ı PPE & Access - Gloves: Specify. ı PPE & Access - Safety glasses: Specify.

DOCUMENTATION REVIEW AUTHORIZATION (Approvals are certification of hazards assessment)		
Reviewer/Approver Roles	Signature	Date
Accountable Management (Service Provider, Line, Equipment Owner, or Facility Management)	Caverly, Donald	3/31/2025
Accountable Management (Service Provider, Line, Equipment Owner, or Facility Management)	Weaver, Roger	4/1/2025
Author	Moore, Andrew	3/31/2025
IS/IH	Carnahan, Corey	3/31/2025
Radiation Protection	Maldonado, Kimberly	3/31/2025
Review Team Member	Logan Nguyen, Vonny	3/31/2025
Safety Basis Engineer	Searles, Maureen	3/31/2025
System Engineer, Accountable Equipment Owner, or Facility Engineer	McFall, David	3/31/2025
Task Leader	Hinds, Steven Henry	3/31/2025
Work Package Concurrence		
Facility Manager		
Operations Supervisor		
Facility Manager Approval To Start Work		
Facility Manager		
Work Start Authorization		
Task Leader		
Work Acknowledged Complete		
Task Leader		

Worker Feedback:

Feedback File Attachments:

Badge	Name	Attachment Desc	File Name
03022839	Moore, Andrew	USQD Spyder Crane URW205	USQD_REDC_25-002_R0 Deshazo Spider Crane (Model URW205)(Final with Digital Signatures) 03-31-2025.pdf
03022839	Moore, Andrew	BOPM	7930-BOPM-252 Controls Overhaul 7930 5-50T Highbay Crane Rev 2.pdf
03022839	Moore, Andrew	USQD for BOPM	USQD_REDC_25-006_R0 7930 Building Crane Modernization Upgrades (Final with Digital Signatures) 04-04-2025 (1).pdf

FOR INFORMATION ONLY. WORK RELEASE AND SYSTEM HOLD POINTS

TASK DESCRIPTION	RESOURCES	DUR
[Hold Point] - Prior to introduction and use of Spyder Crane URW 205 inside of building 7930 ensure USQD/REDC/25-002 is authorized and included in this Work Package. Prior to introduction and use of the Boom Lift inside of building 7930 ensure USQD/REDC/25-007 is authorized and included in this work Package.	Project Leader	1
[Hold Point] - Prior to final placement of Spyder Crane URW205 contact Structural Engineering to ensure proper positioning. Note: if possible, gather input from Deshazo personnel regarding the practicality of the placement.	Project Leader	1
[Hold Point] - Ensure a signed off/approved copy of 7930-BOPM-252 is included in this Work Package prior to proceeding with work.	Project Leader	1
[Hold Point] - Prior to final mounting of Motors and Brakes, the pedestals shall be inspected by Structural Engineering for proper alignment and weld integrity. Note: All other work in step 11 with the exception above may be performed prior to completion of this Hold Point.	Project Leader	1
[Hold Point] - Ensure an approved, signed off copy of USQD/REDC/25-006 is included in this work package prior to energizing the High Bay Crane.	Project Leader	1

WORK DETAILS - Prerequisites/Precautions

Hazards	Permits/Controls	Resources	Dur
1) - Ensure that tasks performed using this work package have an associated "ready to work" work order assigned and the task is included on or added to the facility POD before beginning work.			
		Supervisor Project Leader	1
2) - Obtain daily work start authorization from the 7930 Hot Cell Operations Shift Supervisor. Document on the Work Log before beginning work.			
		Supervisor Project Leader	1
3) - Task Leader is to ensure compliance to ORNL safe work standards of all workers, including vendors. - Ensure vendor personnel have completed and are up to date on Rad Worker II. - Ensure vendor welders are certified per ORNL standard to perform welds as required.			

- Ensure all personnel have completed training on the use of the Spider Crane, Boom Lift, and Scissor lift.
- Ensure Vendor has provided an IS/IH approved AHA.

		ı Supervisor ı Project Leader	1

4) - Approved working hours are 6:00 am. to 7:00 pm.

- Notify vendor personnel that the HFIR pop-up barrier will be lowered at 6:00 am. and will be raised at 6:00 pm.

		ı Supervisor ı Project Leader	1

5) - Unless otherwise noted or associated with a Hold Point, Work steps may be completed out of sequence to ensure safety and efficiency per Task Lead discretion.

			1

6) - All hand tools used inside the High Bay Crane Area of 7930 are to be corded and non-lithium battery powered. For use of Lithium Ion battery powered tool gain approval from 7930 Operations Supervisor or delegate.

		ı Project Leader	1

WORK DETAILS - Directions

Hazards	Permits/Controls	Resources	Dur

1) - Conduct pre-job brief using NNFD-FRM-058 "PRE-JOB BRIEF" to identify scope of work, hazards, controls, etc. Include input from all personnel involved in performance of task such as appropriate crafts, vendors and facility operations personnel.

The following additional items shall be discussed during pre-job brief.

- Fall protection Requirements.

- Evacuation routes and Assembly Points.

- Task to be performed during shift and associated hazards and controls necessary to safely perform the work.

		ı Supervisor ı DEFAULT / ALL TRADES ı Project Leader	1

[Hold Point] - 2) - Prior to introduction and use of Spyder Crane URW 205 inside of building 7930 ensure USQD/REDC/25-002 is authorized and included in this Work Package.

Prior to introduction and use of the Boom Lift inside of building 7930 ensure USQD/REDC/25-007 is authorized and included in this work Package.

Signature: _____		ı Project Leader	1

3) - Staging of Material and Equipment:

Note that floor load capacities are as follows:
- 2nd Floor: 1000lbs/ft^2
- 3rd Floor Upper Level: 125lbs/ft^2
- 3rd Floor Lower Level: 2000lbs/ft^2

Material and Equipment Includes:

- Tools for Work to be done
- Custom AC Controls for Main Hoist and Motor Controls including Wired Pendant and Magnetek Remote Control

- Main / Aux Hoist and Bridge Brakes
- Trolley Components including Trolley Motor, Motor Coupling and Machined component to fit.
- Bridge Components including Coupling and Machined components.
- Aux Hoist Components including Motor Coupling, Machined Components, Motor Brake Base Material
- Main Hoist Components including Motor Coupling, Machined Components, Motor Brake Base Material
- Magnetek Festoon System for Bridge to Trolley Connections
- New Conductor Bar System for Main Conductors to Trolley, All bars, hangers, anchor assemblies, brackets, and collector shoes and associated wiring.
- Miscellaneous Electrical Wire, Steel for Motor Mounts, Motor Torque Arms, Nord Gearmotors.
- Boom Lift.
- Spyder Crane URW205. The Spyder Crane is to be positioned per attached Sketch 5.

Note: The Boom Lift and Spyder Crane URW205 will be lifted into the 3rd floor of 7930 using the High Bay Crane, ensure an approved lift plan is used during this lift. The Spyder Crane will be placed on the lower level of the third floor.

Stage Material and Designate Area to Receive Old components:

- The Spyder Crane URW205 is to be positioned on the 3rd floor lower level per approved sketch. (*See Hold Point step 3 prior to final placement)*
- The North side of the spider crane is to be used to stage the New components.
- The South side of the spider crane is to be used to fly Old components to.
- The Boom lift is to be positioned on the 3rd floor lower level.

Note: Spyder Crane URW205 is to have an approve lift plan prior to use.

			1

[Hold Point] - 4) - Prior to final placement of Spyder Crane URW205 contact Structural Engineering to ensure proper positioning.

Note: if possible, gather input from Deshazo personnel regarding the practicality of the placement.

Signature: _____		- Engineer - Project Leader	1

5) - Coordinate with Vendor to assure all material and equipment requiring the High Bay Crane is in position prior to L/T/V of the Crane.

		- Supervisor - Project Leader	1

6) - Perform Simple L/T/V on High Bay Crane:

This step is to be completed by ORNL personnel.

- Ensure All Equipment required to be lifted by the Crane is in position and the High Bay Crane is positioned according to the attached Floor Plan prior to de-energization.
- Place MCC#1 Bucket 2FL Breaker on the Open/Off position.

		- Supervisor - Electrician - Project Leader	1

7) - Prior to Spyder Crane use, ensure all radiological material has been moved to the North end of the facility.

		- Supervisor - Project Leader - Rigger/Ironworker - Technician	1

8) - Ensure all personnel are using approved and properly inspected Fall Protection equipment while positioned on / working from the High Bay Crane.

		ı Project Leader ı Health & Safety Professional	1

9) - ORNL Personnel: Remove all required wiring, including Asbestos wiring. Refer to approved AWA for removal of Asbestos wiring.

Note: All Asbestos work shall be performed by properly trained ORNL personnel.

Deshazo Personnel: Perform lead Abatement as required, per approve AHA process to prepare new components for installation.

			1

[Hold Point] - 10) - Ensure a signed off / approved copy of 7930-BOPM-252 is included in this Work Package prior to proceeding with work.

Signature: _____	ı Supervisor ı Project Leader	1

11) - Demolition of Existing Equipment:

ORNL personnel responsibilities:

- Perform RCT checks and Green Tag all items that can be removed from the 3rd floor.
- Size reduction and removal of demolition Items down the elevator for final disposal.

Note: Coordinate with NNFD Waste Operations for size reduction and storage locations.

Deshazo personnel responsibilities:

- Work in coordination with ORNL Task Lead/Management.
- Operating Spyder Crane, Boom Lift, and Scissor Lift to remove old components and "fly" them to the appropriate staging are for removal from facility.
- Demolition of old Control systems starting with Motor and brake removals on trolley.
- Demolition of Control Cabinets, Resistor Banks, electrical bus bar systems.

		ı Supervisor ı Electrician ı Project Leader	1

12) - Refer to 7930-BOPM-252 for additional information pertaining to Demolition and Installation of Crane Components.

		ı Project Leader	1

[Hold Point] - 13) - Prior to final mounting of Motors and Brakes, the pedestals shall be inspected by Structural Engineering for proper alignment and weld integrity.

Note: All other work in step 11 with the exception above may be performed prior to completion of this Hold Point.

Signature: _____	ı Engineer ı Project Leader	1

14) - Fitting of New Crane Components:

Deshazo Responsibilities:

Note: Vendor work requires and approved AHA prior to performing tasks.

- Deshazo will utilize the Spider Crane, Boom lift, and Scissor lift to position new components in place.
- Deshazo will Install all new components in no particular sequence including:

1. Installation of new electrical bus bar system, Trolley Control and power festoons, Gantry control and power festoons.
2. Installation and field routing of wiring from Control panels to festoon systems.
3. Installation and field routing of wiring from festoon systems to Motors.
4. Installation of Wiring from new fused disconnect switch to Main Power Bus Bars.
5. Installation of Motors and Brakes.

- Refer to 7930-BOPM-252 for additional information on components to be installed.
- This installation will require welding by Deshazo staff.

ORNL Responsibilities:

ORNL and Deshazo will work in coordination to Verify the proper grounding, continuity, and signal wiring between motors, controllers, and limit sensors with continuity meters to ensure proper installation.

- Installation of new 400 Amp (Fused to 200 Amps) Fused Disconnect Switch on East Wall of 7930 3rd floor.
- Routing of new wire from the Crane Disconnect to the Rails of the Crane.
- Final "tie-in" of electrical components.

		• Supervisor • Electrician • Project Leader	1

[Hold Point] - 15) - Ensure an approved, signed off copy of USQD/REDC/25-006 is included in this work package prior to energizing the High Bay Crane.

Signature: _____		• Project Leader	1

16) - Post Installation:

These steps are to be completed in order.

1. ORNL and Deshazo will work in coordination to Verify the proper grounding, continuity, and signal wiring between motors, controllers, and limit sensors with continuity meters to ensure proper installation.
2. ORNL will remove LTV at MCC#1 Bucket 2FL Breaker and return it to the Closed/On position. Then energize Main Power at new Fused Disconnect Switch.
3. Deshazo and ORNL will Test Control limit switches, Motor phasing, and and additional control items to ensure proper operation of the HIGH Bay Crane.

		• Supervisor • Electrician • Project Leader	1

WORK DETAILS - Post Work Testing

Hazards	Permits/Controls	Resources	Dur

1) - Functional and Load Testing:

ORNL and Deshazo will perform testing by moving cranes and hoists to their maximum travel positions and them performing a lift test of a 50-ton Load at the truck bay area.

			1

WORK DETAILS - Closeout

Hazards	Permits/Controls	Resources	Dur
1) - Using an approved lift plan(s), hoist the Boom Lift and the URW205 Spyder Crane into the truck bay.			
		- Operations Supervisor - Project Leader - Rigger/Ironworker - Technician	1
2) - Clean Area and remove all material and equipment, ensure work space is left in a safe condition and free of debris.			
		- DEFAULT / ALL TRADES - Project Leader	1

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PRE-JOB SAFETY REVIEW GUIDE

ID: 61113

Scope of Work: Review work package/plan to ensure all participants understand the work activity.

Hazards: Review the hazards identified in Job Hazard Evaluation (JHE) / work plan (IOP).

- Since the work package / plan was written: 1) Have conditions changed? 2) Are there new hazards? Refer to Field Notes and Focus Areas.

Hazard Controls / Permits: Review:

- Written permits for the work activity.
- Precautions, step warnings, Hold Points ...
- Personal Protective Equipment (PPE)
- Work instructions for information - e.g., steps where hazards are introduced.
- ORNL subject area requirements - e.g., non-permit hazard controls.

Performing Work:

- Discuss group/individual responsibilities for safe & effective work.
- Follow work instructions & safety procedures.
- Availability/location of materials, tools, etc.
- Any previous experiences / lessons learned?
- Response if work cannot be performed as planned.
- What is the worst thing that could happen?
- Are there *Potential error traps* with the job? → →
- Take a minute before: work start & leaving work area.
- Work Hand-off / Turnover - workers & Task Leader

→ Potential Error Traps:

- Time pressures
- Distractive environment
- High workload
- First time evolution
- First day back
- Vague guidance
- Over confidence
- Imprecise communications
- Work stress

Abnormal Situation Response:

- *Stop Work*: Observe an unsafe act, activity or condition that creates an imminent danger.
- *Emergency Response*: Discuss egress paths or other responses if problems are encountered.

Field Notes and Focus Areas: (Use this area as a work space to record notes related to new hazards identified in the field or changed conditions. Record feedback in work package/plan information systems.)

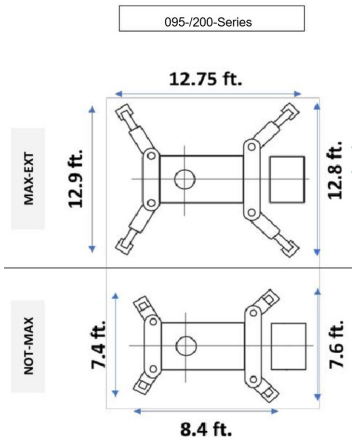
By signing below, I am indicating that I have been briefed on the potential hazards associated with completing this job.

Signature / Badge	Date	Signature / Badge	Date

Building 7930 Upper Level Capacity - Small Spider Crane

It is required to have a backup lifting plan in the 7930 High Bay should the primary lift be disabled. There is a finite timeframe for this work and extensions to the outage are not possible. ORNL has a small spider crane that can act as a backup in the event the large spider crane goes out of service during the high-bay crane rehab activities.

The allowable design floor loads for the upper level and taken from drawing S20998Y202 are either 125 psf or a 3-ton load distributed over a 2'x3' area, whichever is greater. (6000lb/(2'x3') = 1000 psf equivalent)



The heaviest item to be lifted during the crane refurbishment is a motor weighing 1280 lb.

The small Spyder crane weighs just under 4400 lb and has a maximum capacity of 1900 lb (in specific lift configurations). The crane has a footprint of 2'x4.6' when folded and 12.9'x12.75' when outriggers are fully extended. The boom has a length of 8.3' when retracted and a length of 28.4' when extended. The four outrigger pads are each 7"x4.5" and have a maximum point load of 152.2 psi. This equates to a (152.2psi)(7")(4.5") = 4794.3lb. This is much greater than the posted allowable.

$l_{crane} := 4.6\ \text{ft}$ $w_{crane} := 2\ \text{ft}$ $A_{mobile.footprint} := l_{crane} \cdot w_{crane} = 9.2\ \text{ft}^2$

$wt_{crane} := 4400\ \text{lbf}$ $wt_{capacity} := 1900\ \text{lbf}$

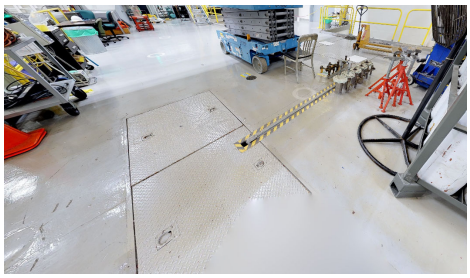
$$p_{transport} := \frac{wt_{crane}}{\left(l_{crane} \cdot w_{crane}\right)} = 478.261\ \text{psf} > 125\ \text{psf}$$

$P_{crane.max.foot.load} := 4794.3\ \text{lbf}$ $foot.spacing.L := 12.9\ \text{ft}$ $foot.spacing.W := 12.75\ \text{ft}$

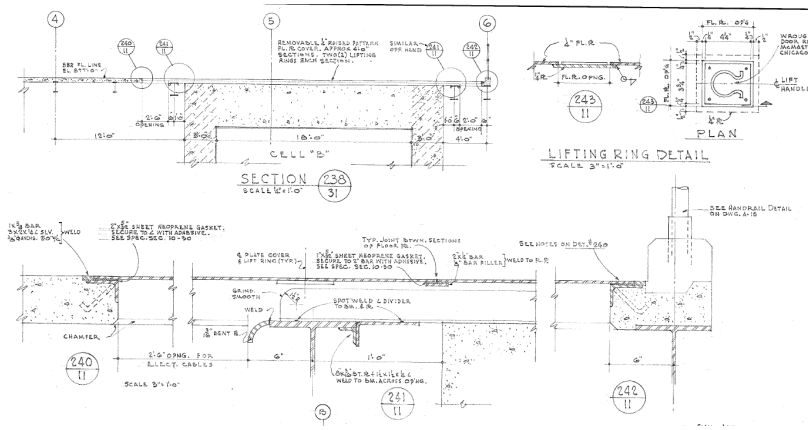
$l_{foot} := 7\ \text{in}$ $w_{foot} := 4.5\ \text{in}$ $A_{outrigger.footprint} := l_{foot} \cdot w_{foot} = 0.219\ \text{ft}^2$

The spider crane will be placed on the upper level of the third floor. The picture to the right shows the current configuration. From the elevator (upper left) eastward (to the left) is a suspended slab supported by steel framing below.

Beneath the overhead bridge crane and on the east side of the available area for crane setup, there is an electrical chase covered with 1/4" steel plate. This chase leads from the open second floor below into the cell.

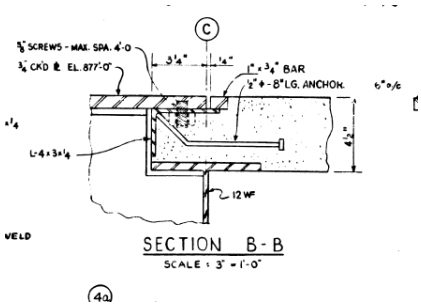


From Drawing A20998Y111

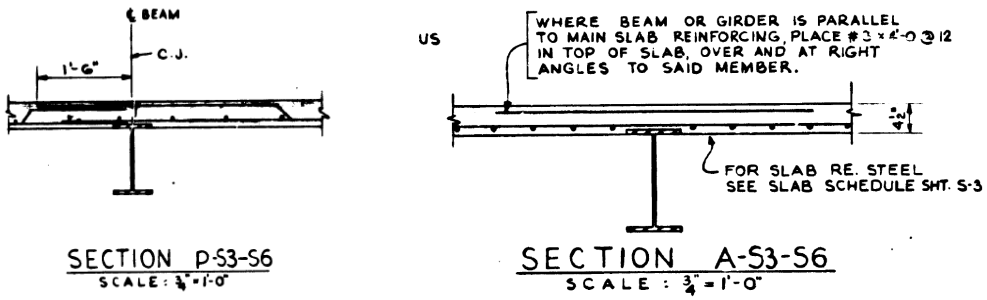


One the western end of the available crane setup area, next to the opening to the second floor below, there is an equipment hatch that opens into the airlock below. The hatch is constructed of a 3/4" checkered plate.

From Drawing S20998Y202



From Drawing S20998Y206

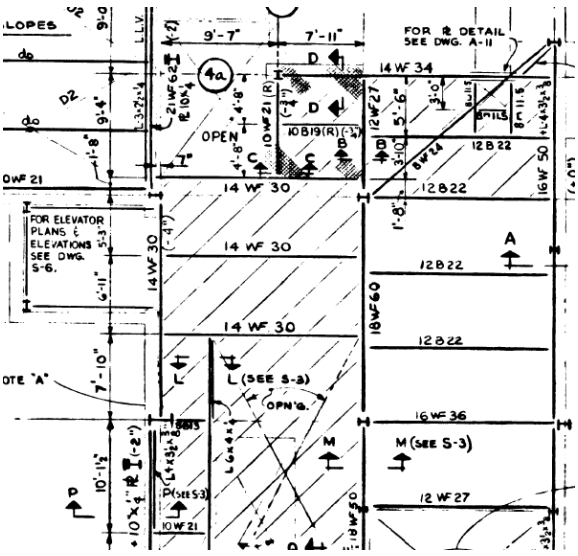


Per drawing S20998Y203, the upper level slab (MK 3S) is 4 ½" thick and reinforced with #4 bars @ 5" OC and spans range from 6'-9" to 7'-2". T&S steel is #3 @ 9" OC. The slab is supported by both wide flange beams (WF) and light beams (B). Over beams, there are #3 top bars @ 12" OC.

$t_{slab} := 4.5\ \text{in}$ Slab thickness

$b := 1\ \text{ft}$ Design based on one foot strip

From Drawing S20998Y206



The Spyder crane will be transported to the upper level via the freight elevator. Upon leaving the elevator, the crane will be centered across the 14WF30 beam over the slab sections with spans of 6'-11" on both sides.

Beyond the 14WF30, 12B22 beams spanning 6'-8" will carry the load.

Demand on continuous slabs

Parameters for spreadsheet:

$I_{slab\_strip} := \frac{b \cdot t_{slab}^{3}}{12} = 91.125\ \text{in}^4$ $wt_{conc} := 150\ \text{pcf}$

$\omega_{ud} := 1.2 \cdot wt_{conc} \cdot t_{slab} \cdot b = 67.5$ plf factored dead load on slab

$\omega_{ul} := 1.6 \cdot 125$ psf $\cdot b = 200$ plf factored live load on slab

$\omega_{ud} + \omega_{ul} = 0.268$ klf existing dead plus allowable live

Recall: $1.6 \cdot p_{transport} = 765.217$ psf $1.6 \cdot P_{crane.max.foot.load} = 7670.88$ lbf

Forces determined in spreadsheet scenarios as follows:

1) Moving spider crane across slab in travel mode

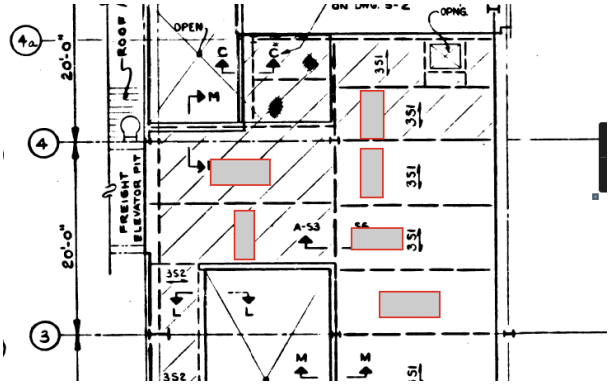
Recall:

$1.2 \cdot wt_{crane} = 5280$ lbf and $A_{mobile.footprint} = 9.2$ ft^2

Therefore, while moving across the floor, $1.6 \cdot p_{transport} = 765.217$ psf

The loading will be over $w_{crane} = 2$ ft or $l_{crane} = 4.6$ ft depending on orientation.

Possible travel locations are shown in the figure to the right. Each of these locations will be considered in the force spreadsheet. The worst case for each force will be conservatively considered to act concurrently when determining design forces. Note that the two continuous span types will be analyzed separately, denoted 1a and 1b for the two and five span sections, respectively.

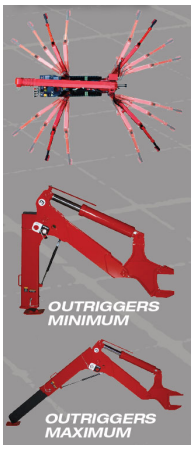


Scenario 1 Controlling Forces:

$V_{u\_1a} := 3.20$ kip $M_{u\_pos\_1a} := 4.02$ kip $\cdot$ ft $M_{u\_neg\_1a} := 3.55$ kip $\cdot$ ft

$V_{u\_1b} := 2.97$ kip $M_{u\_pos\_1b} := 2.37$ kip $\cdot$ ft $M_{u\_neg\_1b} := 4.32$ kip $\cdot$ ft

2) Outriggers fully engaged, maximum load hoisted



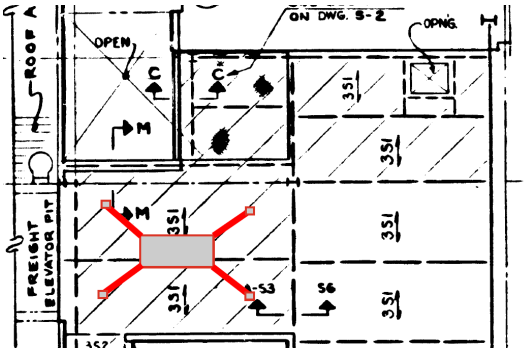
Recall:

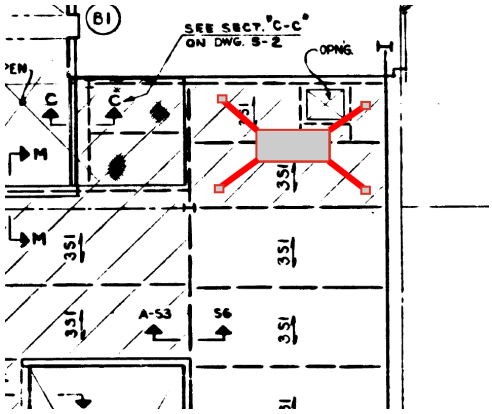
$wt_{capacity} = 1900\ \text{lbf}$ and the maximum part wt is $max\_wt := 850\ \text{lbf}$

$1.6 \cdot P_{crane.max.foot.load} = 7670.88\ \text{lbf}$ and $A_{outrigger.footprint} = 0.219\ \text{ft}^2$

with spacing of $foot.spacing.L = 12.9\ \text{ft}$ & $foot.spacing.W = 12.75\ \text{ft}$

Again two continuous spans will be considered with the controlling forces based on a conservative worst case scenario.





Scenario 2 Controlling Forces:

$V_{u\_2a} := 7.75\ \text{kip}$ $M_{u\_pos\_2a} := 3.59\ \text{kip} \cdot \text{ft}$ $M_{u\_neg\_2a} := 2.9\ \text{kip} \cdot \text{ft}$

$V_{u\_2b} := 7.57\ \text{kip}$ $M_{u\_pos\_2b} := 9.48\ \text{kip} \cdot \text{ft}$ $M_{u\_neg\_2b} := 5.47\ \text{kip} \cdot \text{ft}$

Analysis forces to determine slab adequacy:

$V_u := \max\left(V_{u\_1a}, V_{u\_1b}, V_{u\_2a}, V_{u\_2b}\right) = 7750\ \text{lbf}$

$M_{u\_pos} := \max\left(M_{u\_pos\_1a}, M_{u\_pos\_1b}, M_{u\_pos\_2a}, M_{u\_pos\_2b}\right) = 9480\ \text{lbf} \cdot \text{ft}$

$M_{u\_neg} := \max\left(M_{u\_neg\_1a}, M_{u\_neg\_1b}, M_{u\_neg\_2a}, M_{u\_neg\_2b}\right) = 5470\ \text{lbf} \cdot \text{ft}$

Check punching shear in the concrete slab

$f'_c := 3000$ psi — Initial Compressive strength of concrete (Construction Spec Section 5-08 A)

$E_c := 57000 \text{ psi} \cdot \sqrt{\frac{f'_c}{1 \text{ psi}}} = 3122.019$ ksi — ACI 318-14 Eq. 19.2.2.1.b

Section 5-07 B of the construction specification indicates the reinforcement is intermediate grade new billet steel conforming to ASTM A15-62T. Table 6-1 of FEMA 356 provides a historical minimum tensile strength of 70 ksi for intermediate grade bars.

$f_y := 70$ ksi

$E_s := 29000$ ksi — Modulus of elasticity for steel

$t_{slab} := 4.5$ in — Slab thickness

$d_{bar} := \frac{4}{8}$ in $\quad A_{bar} := 0.20 \text{ in}^2 \quad s_{bar} := 5$ in — #4 Bars @ 5" OC

$c_c := \frac{3}{4}$ in — Estimated clear cover - bottom steel

$d_b := d_{bar} = 0.5$ in $\quad s_b := s_{bar} = 5$ in — Bar diameter and spacing

$A_s := \frac{A_{bar} \cdot 12 \text{ in}}{s_b} = 0.48 \text{ in}^2$ per foot — Area of bar per foot

$d := t_{slab} - c_c - \frac{d_b}{2} = 3.5$ in

The two-way (punching) shear capacity of the slab will be compared with the concentrated load due to the outrigger foot. Analysis is per ACI 318-14 Section 22.6.1.

$\lambda := 1.0$ — Table 19.2.4.2, normal-weight concrete

Estimate table foot dimensions: $a_n := l_{foot} = 7$ in $\quad n_n := w_{foot} = 4.5$ in

$\beta := \frac{a_n}{n_n} = 1.556$ — Fig. R22.6.5.2

$b_o := 2\ (a_n + d) + 2\ (n_n + d) = 37\ \text{in}$

$\alpha_s := 40$ Sec. 22.6.5.3 for interior locations

$v_c := min\left(4 \cdot \lambda \cdot \sqrt{\frac{f'_c}{1\ \text{psi}}}, \left(2 + \frac{4}{\beta}\right) \cdot \lambda \cdot \sqrt{\frac{f'_c}{1\ \text{psi}}}, \left(2 + \frac{\alpha_s \cdot d}{b_o}\right) \cdot \lambda \cdot \sqrt{\frac{f'_c}{1\ \text{psi}}}\right) \cdot 1\ \text{psi} = 31.549\ \text{ksf}$

Table 22.6.5.2

$\phi_v := 0.75$ Table 21.2.1

$\phi V_{n.slab} := \phi_v \cdot v_c \cdot b_o \cdot d = 21.279\ \text{kip}$ $V_{u.sl} := 1.6 \cdot P_{crane.max.foot.load} = 7670.88\ \text{lbf}$

$DCR_{V.slab} := \frac{V_{u.sl}}{\phi V_{n.slab}} = 0.36$ < 1.0 OK therefore, punching shear is acceptable

The one way shear capacity will be determined in accordance with ACI 318-14. Note that capacity will be compared to the worst case forces as determined in the attached spreadsheet for indeterminate beams.

$b := 1\ \text{ft}$ take a one foot strip (one-way action)

$d_{b\_NS} := \frac{4}{8}\ \text{in}$ $s_{b\_NS} := 5\ \text{in}$ Bar diameter and spacing - NS span

$d_{b\_EW} := \frac{3}{8}\ \text{in}$ $s_{b\_EW} := 9\ \text{in}$ Bar diameter and spacing - EW span (T&S)

$A_{\#4} := 0.20\ \text{in}^2$ $A_{\#3} := 0.11\ \text{in}^2$ bar cross-sectional area

$A_{s\_NS} := A_{\#4} \cdot \frac{12\ \text{in}}{s_{b\_NS}} = 0.48\ \text{in}^2$ $A_{s\_EW} := A_{\#3} \cdot \frac{12\ \text{in}}{s_{b\_EW}} = 0.147\ \text{in}^2$ Provided steel area per foot

$A_{s\_top} := A_{\#3} = 0.11\ \text{in}^2$ The steel over beams is #3 @ 12" OC

Capacity of continuous slabs (Ref. ACI 318-14)

$$a := A_{s\_NS} \cdot \frac{f_y}{0.85 \cdot f'_c \cdot b} = 1.098 \text{ in}$$

$$\beta_1 := \begin{cases} \text{if } 2500 \text{ psi} \le f'_c \le 4000 \text{ psi} \\ \quad \| \; 0.85 \\ \text{else if } 4000 \text{ psi} < f'_c < 8000 \text{ psi} \\ \quad \| \; 0.85 - \left(0.05 \cdot \frac{\left(f'_c - 4000 \text{ psi} \right)}{1000 \text{ psi}} \right) \\ \text{else} \\ \quad \| \; 0.65 \end{cases} = 0.85$$

Per ACI 318-14 Table 22.2.2.4.3

$$c := \frac{a}{\beta_1} = 1.292 \text{ in}$$

$$\varepsilon_t := 0.003 \cdot \frac{(d - c)}{c} = 0.005$$

Tensile strain

$$\varepsilon_{ty} := \frac{f_y}{E_s} = 0.002$$

Tensile yield strain

$$\phi := \begin{cases} \text{if } \varepsilon_t \ge 0.005 \\ \quad \| \; 0.9 \\ \text{else if } \varepsilon_{ty} \le \varepsilon_t < 0.005 \\ \quad \| \; 0.65 + \left(0.25 \cdot \frac{\left(\varepsilon_t - \varepsilon_{ty} \right)}{\left(0.005 - \varepsilon_{ty} \right)} \right) \\ \text{else} \\ \quad \| \; 0.65 \end{cases} = 0.9$$

ACI 318-14 Table 12.2.2

$$\phi M_n := \phi \cdot A_{s\_NS} \cdot f_y \cdot \left(d - \frac{a}{2} \right) = 7436.471 \text{ lbf} \cdot \text{ft}$$

$$DC_{bending} := \frac{M_{u\_pos}}{\phi M_n} = 1.275$$

< 1.0 ∴ the live load conditions must be modified in order for the crane plan to work.

Negative Moment

$a := A_{s\_top} \cdot \frac{f_y}{0.85 \cdot f'_c \cdot b} = 0.252 \text{ in}$ $c := \frac{a}{\beta_1} = 0.296 \text{ in}$

$\varepsilon_t := 0.003 \cdot \frac{(d-c)}{c} = 0.032$ $\varepsilon_{ty} := \frac{f_y}{E_s} = 0.002$

$$\phi := \begin{cases} 0.9 & \text{if } \varepsilon_t \geq 0.005 \\ 0.65 + \left(0.25 \cdot \frac{\langle \varepsilon_t - \varepsilon_{ty} \rangle}{\langle 0.005 - \varepsilon_{ty} \rangle}\right) & \text{else if } \varepsilon_{ty} \leq \varepsilon_t < 0.005 \\ 0.65 & \text{else} \end{cases} = 0.9$$

ACI 318-14 Table 12.2.2

$\phi M_n := \phi \cdot A_{s\_top} \cdot f_y \cdot \left(d - \frac{a}{2}\right) = 1948.591 \text{ lbf} \cdot \text{ft}$

$DC_{bending} := \frac{M_{u\_neg}}{\phi M_n} = 2.807$ > 1.0 ∴ the live load conditions must be modified in order for the crane plan to work.

Considering the live loads are restricted to zero in the two-span slab as the crane exits the elevator:

$M_{u\_neg\_controlled\_live\_1a} := 1.81 \text{ kip} \cdot \text{ft}$ See attached spreadsheet

$DC_{bending.1a} := \frac{M_{u\_neg\_controlled\_live\_1a}}{\phi M_n} = 0.929$ < 1.0 ∴ if the area is cleared and only the crane is allowed in the area outside the elevator, the slab can take the load.

$P_{crane.max.foot.load} := 4794.3 \text{ lbf}$ Recall max foot load

$wt_{crane} := 4400 \text{ lbf}$ Recall weight of crane

$P_{crane.max.foot.load.pick} := P_{crane.max.foot.load} \downarrow = 3694.3 \text{ lbf}$ Max load on foot due to max pick weight

$$P_{crane.max.reduced} := P_{crane.max.foot.load.pick} \cdot \frac{1280 \text{ lbf}}{1900 \text{ lbf}} + \frac{-\frac{wt_{crane}}{4}}{4} = 3588.792 \text{ lbf}$$

$1.6 \cdot P_{crane.max.reduced} = 5742.067 \text{ lbf}$ Max load on foot due to 1280 lb max pick weight

$M_{u\_neg\_reduced\_live\_2a} := 1.87\ \text{kip}\cdot\text{ft}$ See attached spreadsheet

$DC_{bending.2a.reduced} := \frac{M_{u\_neg\_reduced\_live\_2a}}{\phi M_n} = 0.96$ < 1.0 ∴ if the area is cleared and only the crane is allowed in the area outside the elevator, the slab can take the load.

Check 14WF30 beams for flexure and shear.

Steel Properties

Steel properties are defined in AISC 325 Table 2-4 for structural shapes, Table 2-5 for plates and bars and Table 2-6 for structural fasteners.

Steel A36-62T 7930 construction specification 9-05 Materials

$f_y := 36\ \text{ksi}$ $f_u := 58\ \text{ksi}$

$E := 29000\ \text{ksi}$

Member Properties

The member properties are based on AISC steel property tables and can be confirmed in AISC 325-15 Table 1-1 to 1-17.

$ID := \text{“W14X30”}$ Modern W14X30 is comparable to 14WF30, use additional multiplier SF to reduce expected capacity.

Excel Component Table from AISC for all Member Properties:

S_{wA}	S_{wB}	S_{wC}	S_{zA}	S_{zB}	S_{zC}	r_{ts}	h_o	P_A
–	–	–	–	–	–	4.24	42.2	132
–	–	–	–	–	–	4.20	42.0	131
–	–	–	–	–	–	4.17	41.9	131
–	–	–	–	–	–	4.13	41.7	130
–	–	–	–	–	–	4.71	40.1	132

$idx := \text{match}\left(ID, ID_e\right)_0 = 210$

$wt := wt_{e_{idx}} \cdot \frac{\text{lbf}}{\text{ft}} = 30\ \frac{\text{lbf}}{\text{ft}}$ $A_b := A_{e_{idx}} \cdot \text{in}^2 = 8.85\ \text{in}^2$

$d := d_{e_{idx}} \cdot \text{in} = 13.8\ \text{in}$ $b_f := bf_{e_{idx}} \cdot \text{in} = 6.73\ \text{in}$

$t_w := tw_{e_{idx}} \cdot \text{in} = 0.27\ \text{in}$ $t_f := tf_{e_{idx}} \cdot \text{in} = 0.385\ \text{in}$

$k := kdes_{e_{idx}} \cdot \text{in} = 0.785\ \text{in}$ $b_f\_2t_f := bf2tf_{e_{idx}} = 8.74$ $h\_t_w := ht_{e_{idx}} = 45.4$

$I_x := Ix_{e_{idx}} \cdot \text{in}^4 = 291\ \text{in}^4$ $Z_x := Zx_{e_{idx}} \cdot \text{in}^3 = 47.3\ \text{in}^3$

$S_x := Sx_{e_{idx}} \cdot \text{in}^3 = 42\ \text{in}^3$ $r_x := rx_{e_{idx}} \cdot \text{in} = 5.73\ \text{in}$

$I_y := Iy_{e_{idx}} \cdot \text{in}^4 = 19.6\ \text{in}^4$ $Z_y := Zy_{e_{idx}} \cdot \text{in}^3 = 8.99\ \text{in}^3$

$S_y := Sy_{e_{idx}} \cdot \text{in}^3 = 5.82\ \text{in}^3$ $r_y := ry_{e_{idx}} \cdot \text{in} = 1.49\ \text{in}$

$r_{ts} := rts_{e_{idx}} \cdot \text{in} = 1.77\ \text{in}$ $h_0 := ho_{e_{idx}} \cdot \text{in} = 13.4\ \text{in}$

$J := J_{e_{idx}} \cdot \text{in}^4 = 0.38\ \text{in}^4$ $C_w := cw_{e_{idx}} \cdot \text{in}^6 = 887\ \text{in}^6$

$T := T_{e_{idx}} \cdot \text{in} = 11.625\ \text{in}$ $WG := WG_{e_{idx}} \cdot \text{in} = 3.5\ \text{in}$

Check Flexure (Chapter F)

$\phi_b := 0.9$ $S_F := 0.75$ Conservative Safety Factor

$C_b := 1.0$ Conservative LTB modification factor

$L_b := 17.5\ \text{ft}$

Strong-Axis Bending

Doubly Symmetric Compact I shapes Bent about major axis (Section F2)

Yielding

$\phi M_{nx\_yield} := \phi_b \cdot f_y \cdot Z_x \cdot S_F = 95.783\ \text{kip} \cdot \text{ft}$

Lateral-Torsional Buckling

$L_p := 1.76 \cdot r_y \cdot \sqrt{\frac{E}{f_y}} = 6.202\ \text{ft}$ Eq. F2-5

$c := 1 = 1$

$L_r := 1.95 \cdot r_{ts} \cdot \frac{E}{0.7 \cdot f_y} \cdot \sqrt{\frac{J \cdot c}{S_x \cdot h_0} + \sqrt{\left(\frac{J \cdot c}{S_x \cdot h_0}\right)^2 + 6.76\left(\frac{0.7 \cdot f_y}{E}\right)^2}} = 18.23\ \text{ft}$ Eq. F2-6

$M_p := f_y \cdot Z_x = 141.9\ \text{kip} \cdot \text{ft}$

$$F_{cr} := \frac{C_b \cdot \pi^2 \cdot E}{\left(\frac{L_b}{r_{ts}}\right)^2} \cdot \sqrt{1 + 0.078 \cdot \left(\frac{J \cdot c}{S_x \cdot h_0} \cdot \left(\frac{L_b}{r_{ts}}\right)^2\right)} = 26.832 \text{ ksi}$$ Eq. F2-4

$$\phi M_{nx\_ltb} := \begin{cases} \text{if } L_b \le L_p \\ \quad \text{"Does Not Apply"} \\ \text{else if } L_p < L_b \le L_r \\ \quad \phi_b \cdot S_F \cdot min\left(C_b \cdot \left(M_p - \left(M_p - \left(0.7 \cdot f_y \cdot S_x\right) \cdot \left(\frac{L_b - L_p}{L_r - L_p}\right)\right)\right), M_p\right) \\ \text{else} \\ \quad \phi_b \cdot F_{cr} \cdot S_x \cdot S_F \end{cases} = 55.923 \text{ kip} \cdot \text{ft}$$ Eqs.F2-2 & F2-3

Capacity of member

$$\phi M_{nx} := min\left(\phi M_{nx\_yield}, \phi M_{nx\_ltb}\right) = 55.923 \text{ kip} \cdot \text{ft}$$

$M_{ux} := 29.36 \text{ kip} \cdot \text{ft}$ See attached single span spreadsheet

$$DCR_{strong\_axis\_bending} := \begin{cases} \text{if } \frac{M_{ux}}{\phi M_{nx}} < 1.0 \\ \quad \text{"OK"} \\ \text{else} \\ \quad \text{"NG"} \end{cases} = \text{"OK"}$$

$$\frac{M_{ux}}{\phi M_{nx}} = 0.525$$

Check Shear (Chapter G)

$\phi_v := 0.90$ $S_F := 0.75$ Conservative Safety Factor

$$C_{v1} := \begin{cases} \text{if } \frac{T}{t_w} \le 2.24 \cdot \sqrt{\frac{E}{f_y}} \\ \quad 1.0 \\ \text{else if } \frac{T}{t_w} > 2.24 \cdot \sqrt{\frac{E}{f_y}} \wedge \frac{T}{t_w} \le 1.10 \cdot \sqrt{\frac{5.34 \cdot E}{f_y}} \\ \quad 1.0 \\ \text{else if } \frac{T}{t_w} > 2.24 \cdot \sqrt{\frac{E}{f_y}} \wedge \frac{T}{t_w} > 1.10 \cdot \sqrt{\frac{5.34 \cdot E}{f_y}} \\ \quad \frac{1.10 \cdot \sqrt{\frac{5.34 \cdot E}{f_y}}}{\frac{T}{t_w}} \end{cases} = 1$$ Eqs. G2-2, G2-3, G2-4 & G2-5

$A_w := d \cdot t_w = 3.726 \text{ in}^2$

$\phi V_{nx} := \phi_v \cdot S_F \cdot 0.6 \cdot f_y \cdot A_w \cdot C_{v1} = 54.325 \text{ kip}$ Eq. G2-1

$V_{ux} := 10.08 \text{ kip}$ See attached single span spreadsheet

$$DCR_{strong\_axis\_shear} := \text{if} \left(\frac{V_{ux}}{\phi V_{nx}} < 1.0 \right) = \text{“OK”}$$

$$\text{“OK”}$$

$$\text{else}$$

$$\text{“NG”}$$

$$\frac{V_{ux}}{\phi V_{nx}} = 0.186$$

CONTINUOUS-SPAN BEAM ANALYSIS

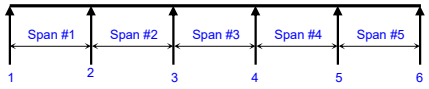
For Two (2) through Five (5) Span Beams
With Pinned or Fixed Beam Ends

Job Name:	Spyder Crane on 7930 Third Floor Upper Level	Subject:	Scenario 1a - 2-span, crane in transport	
Job Number:	Includes Allowable Live	Originator:	SEM	Checker:

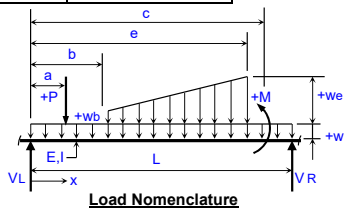
Input Data:

Beam Data:

No. Spans, N =	2	
Left End =	Pinned	Support #1
Right End =	Pinned	Support #3
Modulus, E =	3122	ksi



Span and Support Nomenclature



Load Nomenclature

Summary of Results for Entire 2-Span Beam:

Support Moments:

M1 =	0.00	ft-kips
M2 =	-3.55	ft-kips
M3 =	0.00	ft-kips
M4 =	---	ft-kips
M5 =	---	ft-kips
M6 =	---	ft-kips

Support Reactions:

R1 =	0.41	kips
R2 =	4.64	kips
R3 =	2.17	kips
R4 =	---	kips
R5 =	---	kips
R6 =	---	kips

Maximum Moments in Beam:

+M(max) =	4.02	ft-kips	@ x =	3.95 ft. (Span #2)
-M(max) =	-3.55	ft-kips	@ x =	6.92 ft. (Span #1)

Maximum Deflections in Beam:

-Δ(max) =	-0.105	in.	@ x =	3.72 ft. (Span #2)
+Δ(max) =	0.022	in.	@ x =	4.99 ft. (Span #1)
Δ(ratio) =	L/790			

Span Data and Loadings:

Span Data:	Span #1	Span #2	Span #3	Span #4	Span #5
Span, L =	6.9167 ft.	6.9167 ft.	0.0100 ft.	0.0100 ft.	
Inertia, I =	91.13 in.^4	91.13 in.^4	0.10 in.^4	0.10 in.^4	
Full Uniform:					
w =	0.2680 kpf	0.2680 kpf	0.0000 kpf	0.0000 kpf	

Distributed:	Start		End		Start		End		Start		End		Start		End		Start		End	
	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)
#1:					1.1584	0.7652	5.7584	0.7652												
#2:																				
#3:																				
#4:																				
#5:																				
#6:																				
#7:																				
#8:																				

Point Loads:	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)
#1:										
#2:										
#3:										
#4:										
#5:										
#6:										
#7:										
#8:										
#9:										
#10:										
#11:										
#12:										
#13:										
#14:										
#15:										

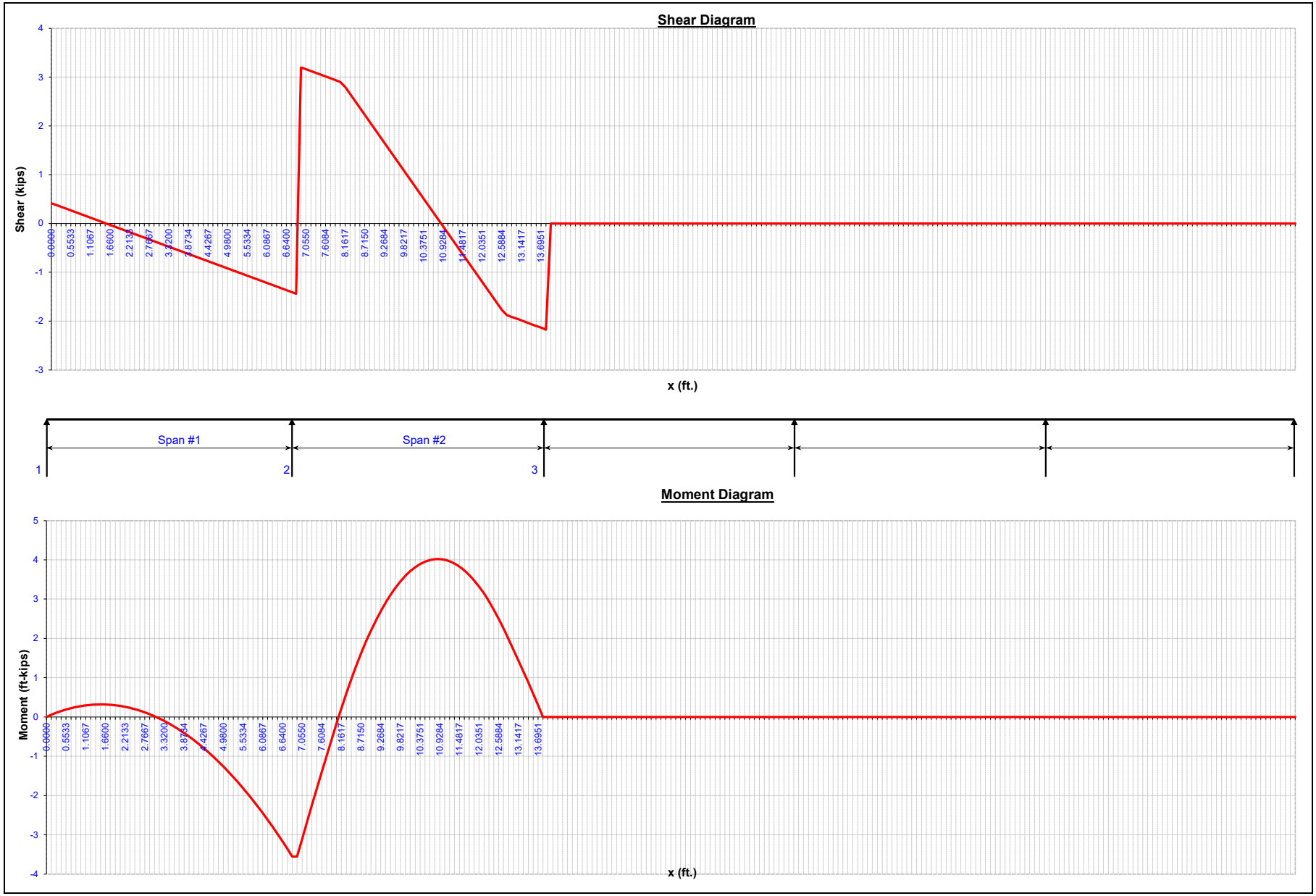
Moments:	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)
#1:										
#2:										
#3:										
#4:										

Left End Cantilever Shear = 0.00 kips Left End Cantilever Moment = 0.00 ft-kips Right End Cantilever Shear = 0.00 kips Right End Cantilever Moment = 0.00 ft-kips

Results:

End Shears:										
0.41 k	-1.44 k	3.20 k	-2.17 k	---	---	---	---	---	---	---

SLAB IS INADEQUATE FOR EXPECTED LOADING. NOT OKAY.


Shear Diagram
Shear (kips)
x (ft.)
Span #1
Span #2
1
2
3
Moment Diagram
Moment (ft-kips)
x (ft.)

CONTINUOUS-SPAN BEAM ANALYSIS

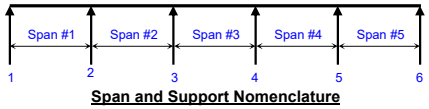
For Two (2) through Five (5) Span Beams
With Pinned or Fixed Beam Ends

Job Name:	Spyder Crane on 7930 Third Floor Upper Level	Subject:	Scenario 1b - 4-span, crane in transport - 5 configurations	
Job Number:	All Spans with Live Load	Originator:	SEM	Checker:

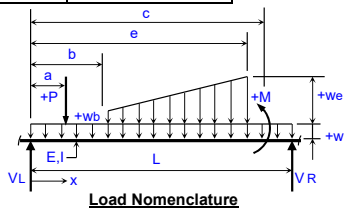
Input Data:

Beam Data:

No. Spans, N =	4	
Left End =	Fixed	Support #1
Right End =	Pinned	Support #5
Modulus, E =	3122	ksi



Span and Support Nomenclature



Load Nomenclature

Summary of Results for Entire 4-Span Beam:

Support Moments:

M1 =	-4.32	ft-kips
M2 =	-2.35	ft-kips
M3 =	-0.49	ft-kips
M4 =	-0.89	ft-kips
M5 =	0.00	ft-kips
M6 =	---	ft-kips

Support Reactions:

R1 =	2.97	kips
R2 =	3.60	kips
R3 =	1.32	kips
R4 =	1.71	kips
R5 =	0.58	kips
R6 =	---	kips

Maximum Moments in Beam:

+M(max) =	2.37	ft-kips	@ x =	3.73 ft. (Span #1)
-M(max) =	-4.32	ft-kips	@ x =	0.00 ft. (Span #1)

Maximum Deflections in Beam:

-Δ(max) =	-0.048	in.	@ x =	3.70 ft. (Span #1)
+Δ(max) =	0.008	in.	@ x =	1.45 ft. (Span #2)
Δ(ratio) =	L/1726			

Span Data and Loadings:

Span Data:	Span #1	Span #2	Span #3	Span #4	Span #5
Span, L =	6.9167 ft.	6.9167 ft.	5.5000 ft.	5.5000 ft.	0.0000 ft.
Inertia, I =	91.13 in.^4	91.13 in.^4	91.13 in.^4	91.13 in.^4	0.00 in.^4
Full Uniform:					
w =	0.2680 kpf	0.2680 kpf	0.2680 kpf	0.2680 kpf	0.0000 kpf

Distributed:	Start		End		Start		End		Start		End		Start		End		Start		End	
	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)
#1:	1.1584	0.7652	5.7584	0.7652																
#2:																				
#3:																				
#4:																				
#5:																				
#6:																				
#7:																				
#8:																				

Point Loads:	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)
#1:										
#2:										
#3:										
#4:										
#5:										
#6:										
#7:										
#8:										
#9:										
#10:										
#11:										
#12:										
#13:										
#14:										
#15:										

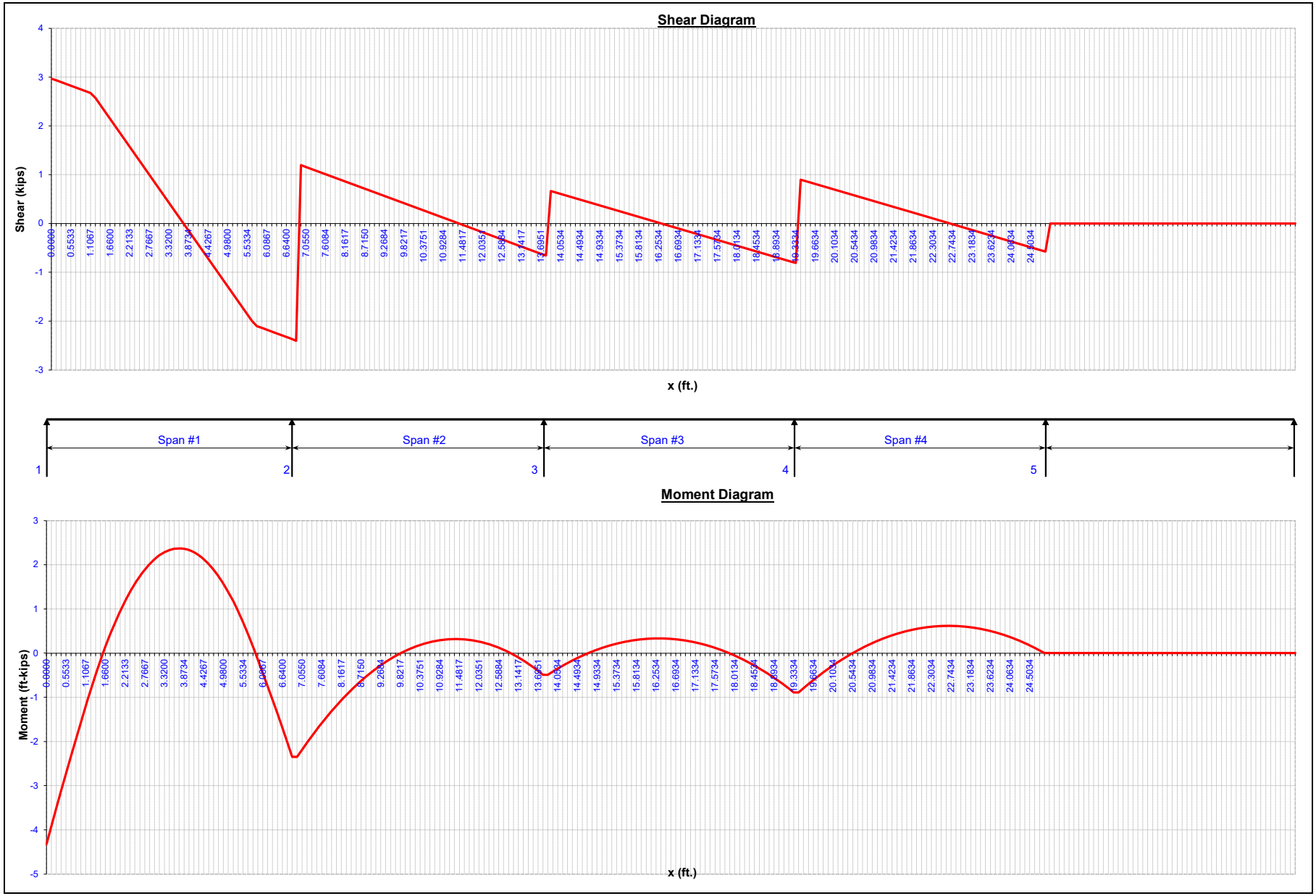
Moments:	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)
#1:										
#2:										
#3:										
#4:										

Left End Cantilever Shear = 0.00 kips Left End Cantilever Moment = 0.00 ft-kips Right End Cantilever Shear = 0.00 kips Right End Cantilever Moment = 0.00 ft-kips

Results:

End Shears:										
	2.97 k	-2.40 k	1.19 k	-0.66 k	0.66 k	-0.81 k	0.90 k	-0.58 k	---	---

SLAB IS INADEQUATE FOR EXPECTED LOADING. NOT OKAY.


Shear Diagram
Shear (kips)
x (ft.)
Span #1
Span #2
Span #3
Span #4
1
2
3
4
5
Moment Diagram
Moment (ft-kips)
x (ft.)

CONTINUOUS-SPAN BEAM ANALYSIS

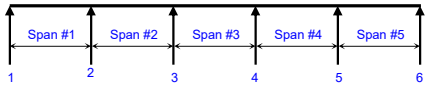
For Two (2) through Five (5) Span Beams
With Pinned or Fixed Beam Ends

Job Name:	Spyder Crane on 7930 Third Floor Upper Level	Subject:	Scenario 2a - 2-span, outriggers engaged		
Job Number:		Originator:	SEM	Checker:	

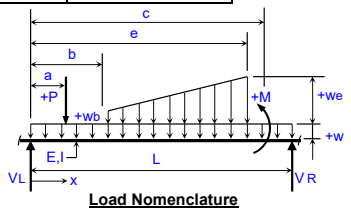
Input Data:

Beam Data:

No. Spans, N =	2	
Left End =	Pinned	Support #1
Right End =	Pinned	Support #3
Modulus, E =	3122	ksi



Span and Support Nomenclature



Load Nomenclature

Summary of Results for Entire 2-Span Beam:

Support Moments:

M1 =	0.00	ft-kips
M2 =	-2.90	ft-kips
M3 =	0.00	ft-kips
M4 =	---	ft-kips
M5 =	---	ft-kips
M6 =	---	ft-kips

Support Reactions:

R1 =	3.65	kips
R2 =	3.44	kips
R3 =	7.75	kips
R4 =	---	kips
R5 =	---	kips
R6 =	---	kips

Maximum Moments in Beam:

+M(max) =	3.59	ft-kips	@ x =	6.45 ft. (Span #2)
-M(max) =	-2.90	ft-kips	@ x =	6.92 ft. (Span #1)

Maximum Deflections in Beam:

-Δ(max) =	-0.066	in.	@ x =	4.26 ft. (Span #2)
+Δ(max) =	0.002	in.	@ x =	6.45 ft. (Span #1)
Δ(ratio) =	L/1256			

Span Data and Loadings:

Span Data:	**Span #1**	**Span #2**	**Span #3**	**Span #4**	**Span #5**
Span, L =	6.9167 ft.	6.9167 ft.	0.1000 ft.	0.1000 ft.	
Inertia, I =	91.13 in.^4	91.13 in.^4	0.10 in.^4	0.10 in.^4	
Full Uniform:					
w =	0.2680 kpf	0.2680 kpf	0.0000 kpf	0.0000 kpf	

Distributed:	Start		End		Start		End		Start		End		Start		End		Start		End	
	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)
#1:																				
#2:																				
#3:																				
#4:																				
#5:																				
#6:																				
#7:																				
#8:																				

Point Loads:	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)
#1:	0.4670	3.37	6.4500	7.77						
#2:										
#3:										
#4:										
#5:										
#6:										
#7:										
#8:										
#9:										
#10:										
#11:										
#12:										
#13:										
#14:										
#15:										

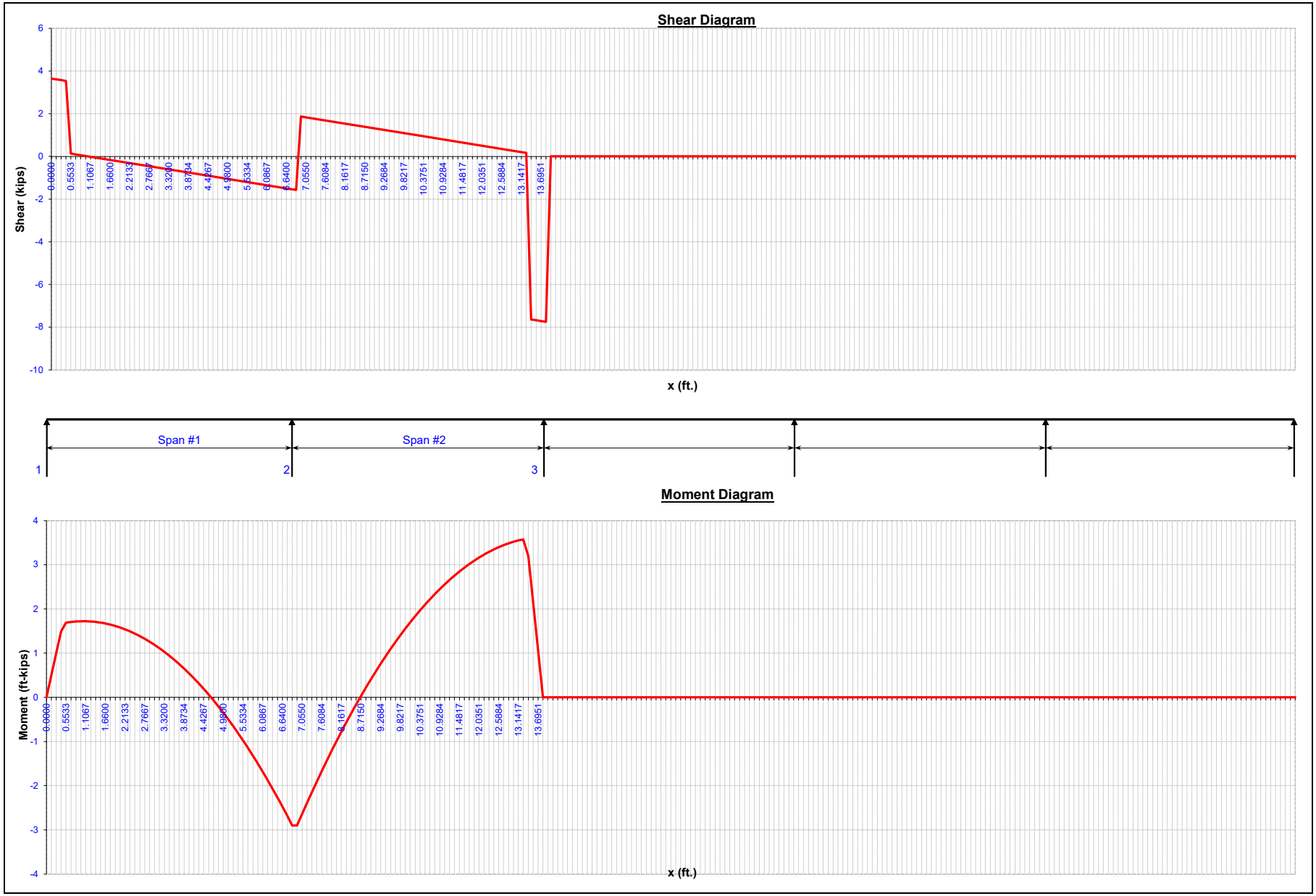
Moments:	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)
#1:										
#2:										
#3:										
#4:										

Left End Cantilever Shear = 0.00 kips Left End Cantilever Moment = 0.00 ft-kips Right End Cantilever Shear = 0.00 kips Right End Cantilever Moment = 0.00 ft-kips

Results:

End Shears:										
3.65 k	-1.57 k	1.87 k	-7.75 k	---	---	---	---	---	---	---

SLAB IS INADEQUATE FOR EXPECTED LOADING. NOT OKAY.


Shear Diagram
Shear (kips)
6
4
2
0
-2
-4
-6
-8
-10
0.0000
0.5533
1.1067
1.6600
2.2133
2.7667
3.3200
3.8734
4.4267
4.9800
5.5334
6.0867
6.6400
7.0550
7.6084
8.1617
8.7150
9.2684
9.8217
10.3751
10.9284
11.4817
12.0351
12.5884
13.1417
13.6951
x (ft.)
Span #1
Span #2
1
2
3
Moment Diagram
Moment (ft-kips)
4
3
2
1
0
-1
-2
-3
-4
x (ft.)

CONTINUOUS-SPAN BEAM ANALYSIS

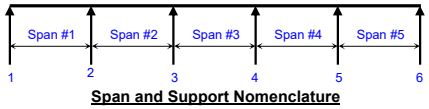
For Two (2) through Five (5) Span Beams
With Pinned or Fixed Beam Ends

Job Name:	Spyder Crane on 7930 Third Floor Upper Level	Subject:	Scenario 2b - 4-span, outriggers engaged	
Job Number:	All spans with Live Load	Originator:	SEM	Checker:

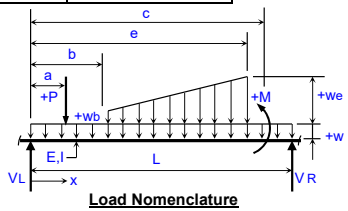
Input Data:

Beam Data:

No. Spans, N =	4	
Left End =	Fixed	Support #1
Right End =	Pinned	Support #5
Modulus, E =	3122	ksi



Span and Support Nomenclature



Load Nomenclature

Summary of Results for Entire 4-Span Beam:

Support Moments:

M1 =	1.08	ft-kips
M2 =	-5.37	ft-kips
M3 =	-5.15	ft-kips
M4 =	-0.75	ft-kips
M5 =	0.00	ft-kips
M6 =	---	ft-kips

Support Reactions:

R1 =	-0.01	kips
R2 =	6.31	kips
R3 =	6.64	kips
R4 =	1.86	kips
R5 =	7.57	kips
R6 =	---	kips

Maximum Moments in Beam:

+M(max) =	9.50	ft-kips	@ x =	3.77 ft. (Span #2)
-M(max) =	-5.37	ft-kips	@ x =	6.92 ft. (Span #1)

Maximum Deflections in Beam:

-Δ(max) =	-0.175	in.	@ x =	3.60 ft. (Span #2)
+Δ(max) =	0.062	in.	@ x =	2.68 ft. (Span #3)
Δ(ratio) =	L/473			

Span Data and Loadings:

Span Data:	Span #1	Span #2	Span #3	Span #4	Span #5
Span, L =	6.9167 ft.	6.9167 ft.	6.9167 ft.	5.5000 ft.	5.5000 ft.
Inertia, I =	91.13 in.^4	91.13 in.^4	91.13 in.^4	91.13 in.^4	91.13 in.^4
Full Uniform:					
w =	0.2680 kpf	0.2680 kpf	0.2680 kpf	0.2680 kpf	0.2680 kpf

Distributed:	Start		End		Start		End		Start		End		Start		End		Start		End	
	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)
#1:																				
#2:																				
#3:																				
#4:																				
#5:																				
#6:																				
#7:																				
#8:																				

Point Loads:	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)
#1:			3.7670	7.67			5.0000	7.67		
#2:										
#3:										
#4:										
#5:										
#6:										
#7:										
#8:										
#9:										
#10:										
#11:										
#12:										
#13:										
#14:										
#15:										

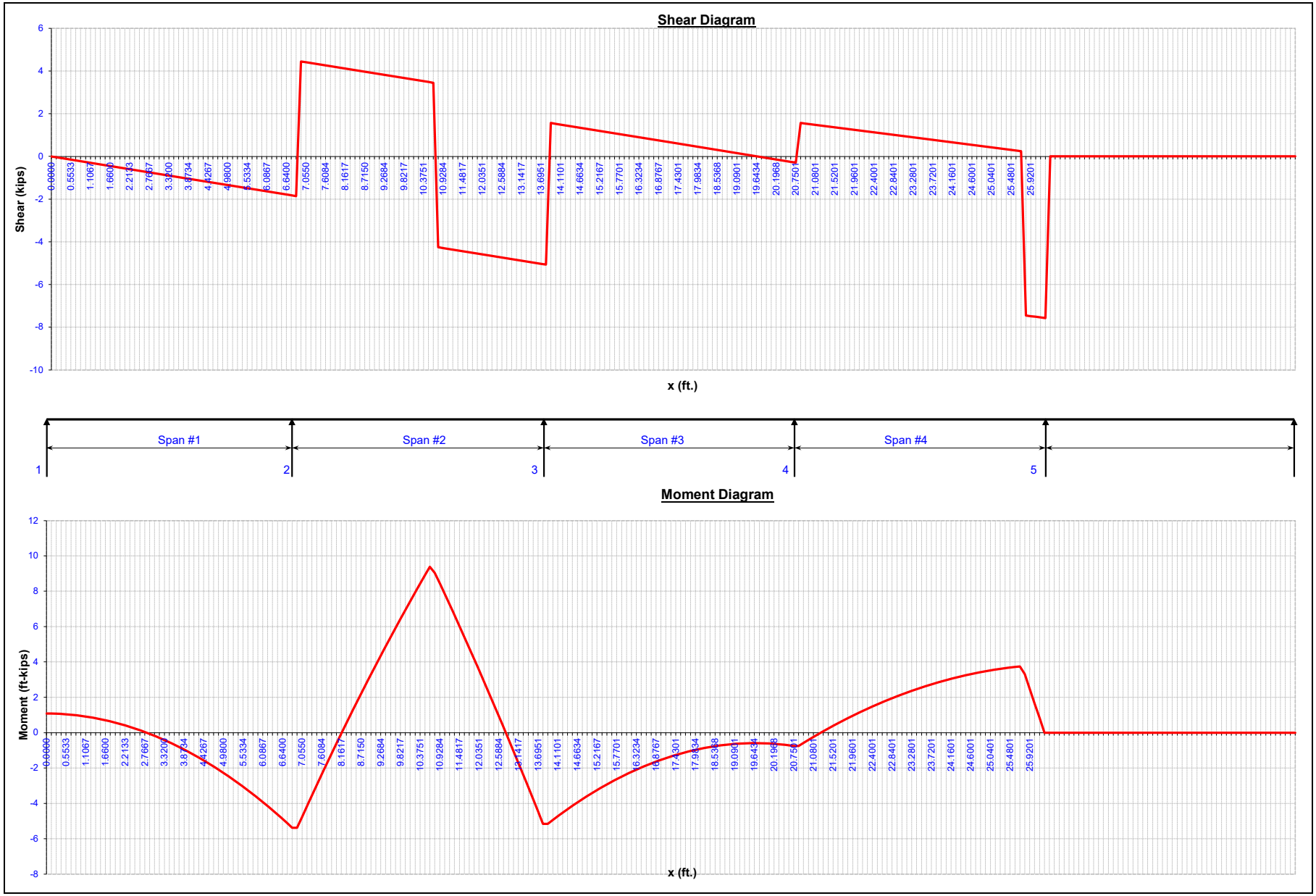
Moments:	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)
#1:										
#2:										
#3:										
#4:										

Left End Cantilever Shear = 0.00 kips Left End Cantilever Moment = 0.00 ft-kips Right End Cantilever Shear = 0.00 kips Right End Cantilever Moment = 0.00 ft-kips

Results:

End Shears:										
	-0.01 k	-1.86 k	4.45 k	-5.07 k	1.56 k	-0.29 k	1.57 k	-7.57 k	---	---

SLAB IS INADEQUATE FOR EXPECTED LOADING. NOT OKAY.


Shear Diagram
Shear (kips)
x (ft.)
Span #1
Span #2
Span #3
Span #4
1
2
3
4
5
Moment Diagram
Moment (ft-kips)
x (ft.)

CONTINUOUS-SPAN BEAM ANALYSIS

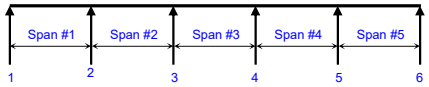
For Two (2) through Five (5) Span Beams
With Pinned or Fixed Beam Ends

Job Name:	Spyder Crane on 7930 Third Floor Upper Level	Subject:	Scenario 1a - 2-span, crane in transport	
Job Number:	No Allowable Live	Originator:	SEM	Checker:

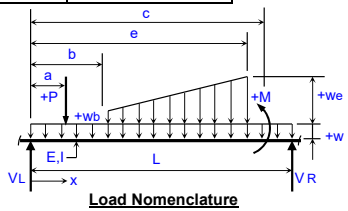
Input Data:

Beam Data:

No. Spans, N =	2	
Left End =	Pinned	Support #1
Right End =	Pinned	Support #3
Modulus, E =	3122	ksi



Span and Support Nomenclature



Load Nomenclature

Summary of Results for Entire 2-Span Beam:

Support Moments:

M1 =	0.00	ft-kips
M2 =	-2.35	ft-kips
M3 =	0.00	ft-kips
M4 =	---	ft-kips
M5 =	---	ft-kips
M6 =	---	ft-kips

Support Reactions:

R1 =	-0.11	kips
R2 =	2.91	kips
R3 =	1.65	kips
R4 =	---	kips
R5 =	---	kips
R6 =	---	kips

Maximum Moments in Beam:

+M(max) =	3.36	ft-kips	@ x =	3.87 ft. (Span #2)
-M(max) =	-2.35	ft-kips	@ x =	6.92 ft. (Span #1)

Maximum Deflections in Beam:

-Δ(max) =	-0.090	in.	@ x =	3.66 ft. (Span #2)
+Δ(max) =	0.032	in.	@ x =	4.21 ft. (Span #1)
Δ(ratio) =	L/920			

Span Data and Loadings:

Span Data:	**Span #1**	**Span #2**	**Span #3**	**Span #4**	**Span #5**
Span, L =	6.9167 ft.	6.9167 ft.	0.0100 ft.	0.0100 ft.	
Inertia, I =	91.13 in.^4	91.13 in.^4	0.10 in.^4	0.10 in.^4	
Full Uniform:					
w =	0.0675 kpf	0.0675 kpf	0.0000 kpf	0.0000 kpf	

Distributed:	Start		End		Start		End		Start		End		Start		End		Start		End	
	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)
#1:					1.1584	0.7652	5.7584	0.7652												
#2:																				
#3:																				
#4:																				
#5:																				
#6:																				
#7:																				
#8:																				

Point Loads:	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)
#1:										
#2:										
#3:										
#4:										
#5:										
#6:										
#7:										
#8:										
#9:										
#10:										
#11:										
#12:										
#13:										
#14:										
#15:										

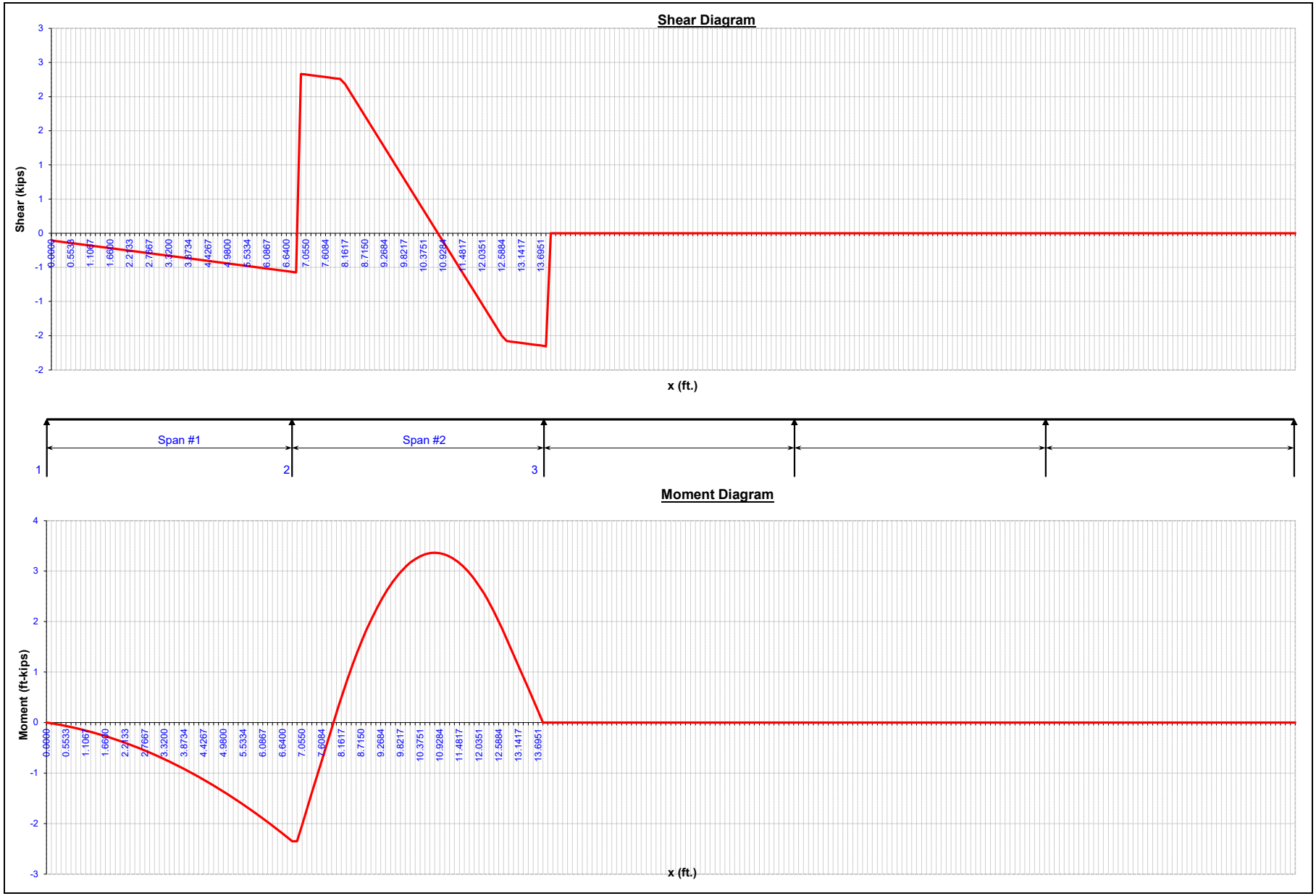
Moments:	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)
#1:										
#2:										
#3:										
#4:										

Left End Cantilever Shear = 0.00 kips Left End Cantilever Moment = 0.00 ft-kips Right End Cantilever Shear = 0.00 kips Right End Cantilever Moment = 0.00 ft-kips

Results:

End Shears:										
-0.11 k	-0.57 k	2.33 k	-1.65 k	---	---	---	---	---	---	---

SLAB IS INADEQUATE FOR EXPECTED LOADING. NOT OKAY.


Shear Diagram
Shear (kips)
x (ft.)
Span #1
Span #2
1
2
3
Moment Diagram
Moment (ft-kips)
x (ft.)

CONTINUOUS-SPAN BEAM ANALYSIS

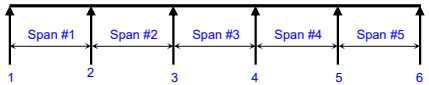
For Two (2) through Five (5) Span Beams
With Pinned or Fixed Beam Ends

Job Name:	Spyder Crane on 7930 Third Floor Upper Level	Subject:	Scenario 1a - 2-span, crane in transport	
Job Number:	Straddle Beam No Allowable Live	Originator:	SEM	Checker:

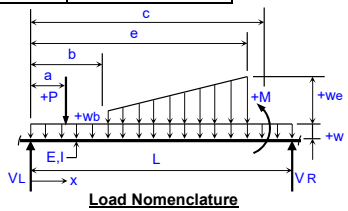
Input Data:

Beam Data:

No. Spans, N =	2	
Left End =	Pinned	Support #1
Right End =	Pinned	Support #3
Modulus, E =	3122	ksi



Span and Support Nomenclature



Load Nomenclature

Summary of Results for Entire 2-Span Beam:

Support Moments:

M1 =	0.00	ft-kips
M2 =	-1.81	ft-kips
M3 =	0.00	ft-kips
M4 =	---	ft-kips
M5 =	---	ft-kips
M6 =	---	ft-kips

Support Reactions:

R1 =	0.26	kips
R2 =	3.93	kips
R3 =	0.26	kips
R4 =	---	kips
R5 =	---	kips
R6 =	---	kips

Maximum Moments in Beam:

+M(max) =	0.52	ft-kips	@ x =	3.00 ft. (Span #2)
-M(max) =	-1.81	ft-kips	@ x =	6.92 ft. (Span #1)

Maximum Deflections in Beam:

-Δ(max) =	-0.013	in.	@ x =	3.33 ft. (Span #1)
+Δ(max) =	0.000	in.	@ x =	0.00 ft. (Span #1)
Δ(ratio) =	L/6194			

Span Data and Loadings:

Span Data:	Span #1	Span #2	Span #3	Span #4	Span #5
Span, L =	6.9167 ft.	6.9167 ft.	0.1000 ft.	0.1000 ft.	
Inertia, I =	91.13 in.^4	91.13 in.^4	91.13 in.^4	91.13 in.^4	
Full Uniform:					
w =	0.0675 kpf	0.0675 kpf	0.0000 kpf	0.0000 kpf	

Distributed:	Start		End		Start		End		Start		End		Start		End		Start		End	
	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)	b (ft.)	Wb (kips/ft.)	e (ft.)	We (kips/ft.)
#1:	4.6167	0.7652	6.9166	0.7652	0.0001	0.7652	2.3000	0.7652												
#2:	0.0010	0.0000	4.6166	0.0000	2.3001	0.0000	6.9167	0.0000												
#3:																				
#4:																				
#5:																				
#6:																				
#7:																				
#8:																				

Point Loads:	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)
#1:										
#2:										
#3:										
#4:										
#5:										
#6:										
#7:										
#8:										
#9:										
#10:										
#11:										
#12:										
#13:										
#14:										
#15:										

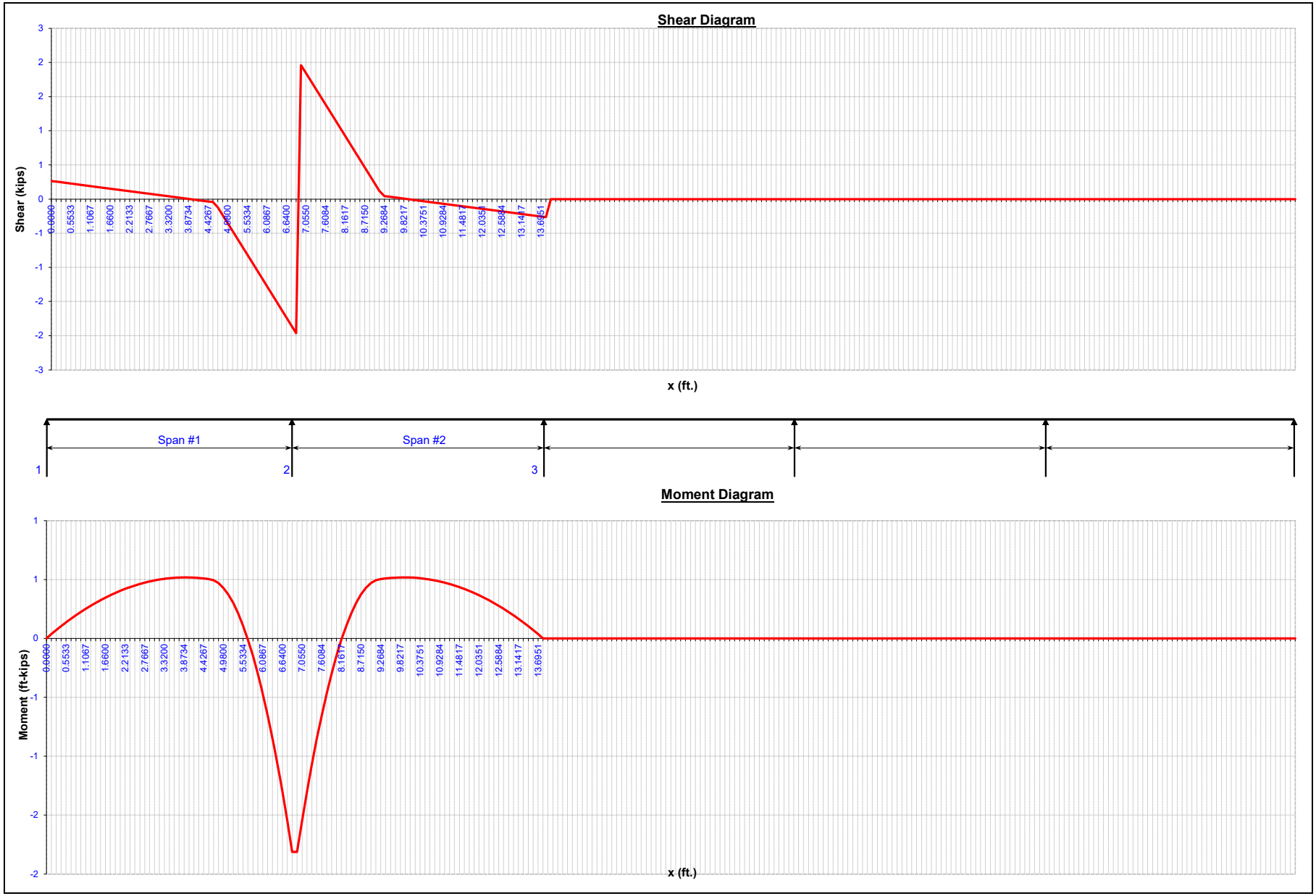
Moments:	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)
#1:										
#2:										
#3:										
#4:										

Left End Cantilever Shear = 0.00 kips Left End Cantilever Moment = 0.00 ft-kips Right End Cantilever Shear = 0.00 kips Right End Cantilever Moment = 0.00 ft-kips

Results:

End Shears:										
	0.26 k	-1.96 k	1.96 k	-0.26 k	---	---	---	---	---	---

SLAB IS ADEQUATE FOR EXPECTED LOADING.


Shear Diagram
Shear (kips)
x (ft.)
Span #1
Span #2
1
2
3
Moment Diagram
Moment (ft-kips)
x (ft.)

CONTINUOUS-SPAN BEAM ANALYSIS

For Two (2) through Five (5) Span Beams

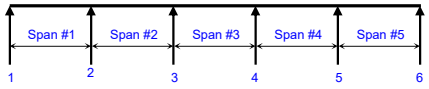
With Pinned or Fixed Beam Ends

Job Name:	Spyder Crane on 7930 Third Floor Upper Level	Subject:	Scenario 2a - 2-span, outriggers engaged	
Job Number:	No Allowable Live	Originator:	SEM	Checker:

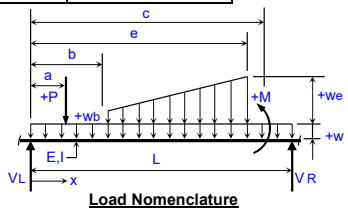
Input Data:

Beam Data:

No. Spans, N =	2	
Left End =	Pinned	Support #1
Right End =	Pinned	Support #3
Modulus, E =	3122	ksi



Span and Support Nomenclature



Load Nomenclature

Summary of Results for Entire 2-Span Beam:

Support Moments:

M1 =	0.00	ft-kips
M2 =	-1.87	ft-kips
M3 =	0.00	ft-kips
M4 =	---	ft-kips
M5 =	---	ft-kips
M6 =	---	ft-kips

Support Reactions:

R1 =	5.28	kips
R2 =	1.86	kips
R3 =	5.27	kips
R4 =	---	kips
R5 =	---	kips
R6 =	---	kips

Maximum Moments in Beam:

+M(max) =	2.72	ft-kips	@ x =	6.40 ft. (Span #2)
-M(max) =	-1.87	ft-kips	@ x =	6.92 ft. (Span #1)

Maximum Deflections in Beam:

-Δ(max) =	-0.037	in.	@ x =	4.51 ft. (Span #2)
+Δ(max) =	0.000	in.	@ x =	0.00 ft. (Span #1)
Δ(ratio) =	L/2274			

Span Data and Loadings:

Span Data:	**Span #1**	**Span #2**	**Span #3**	**Span #4**	**Span #5**
Span, L =	6.9167 ft.	6.9167 ft.	0.1000 ft.	0.1000 ft.	
Inertia, I =	91.13 in.^4	91.13 in.^4	0.10 in.^4	0.10 in.^4	
Full Uniform:					
w =	0.0675 kpf	0.0675 kpf	0.0000 kpf	0.0000 kpf	

Distributed:	Start	End	Start	End	Start	End	Start	End	Start	End
	b (ft.) / Wb (kips/ft.)	e (ft.) / We (kips/ft.)	b (ft.) / Wb (kips/ft.)	e (ft.) / We (kips/ft.)	b (ft.) / Wb (kips/ft.)	e (ft.) / We (kips/ft.)	b (ft.) / Wb (kips/ft.)	e (ft.) / We (kips/ft.)	b (ft.) / Wb (kips/ft.)	e (ft.) / We (kips/ft.)
#1:										
#2:										
#3:										
#4:										
#5:										
#6:										
#7:										
#8:										

Point Loads:	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)	a (ft.)	P (kips)
#1:	0.5100	5.74	6.4000	5.74						
#2:										
#3:										
#4:										
#5:										
#6:										
#7:										
#8:										
#9:										
#10:										
#11:										
#12:										
#13:										
#14:										
#15:										

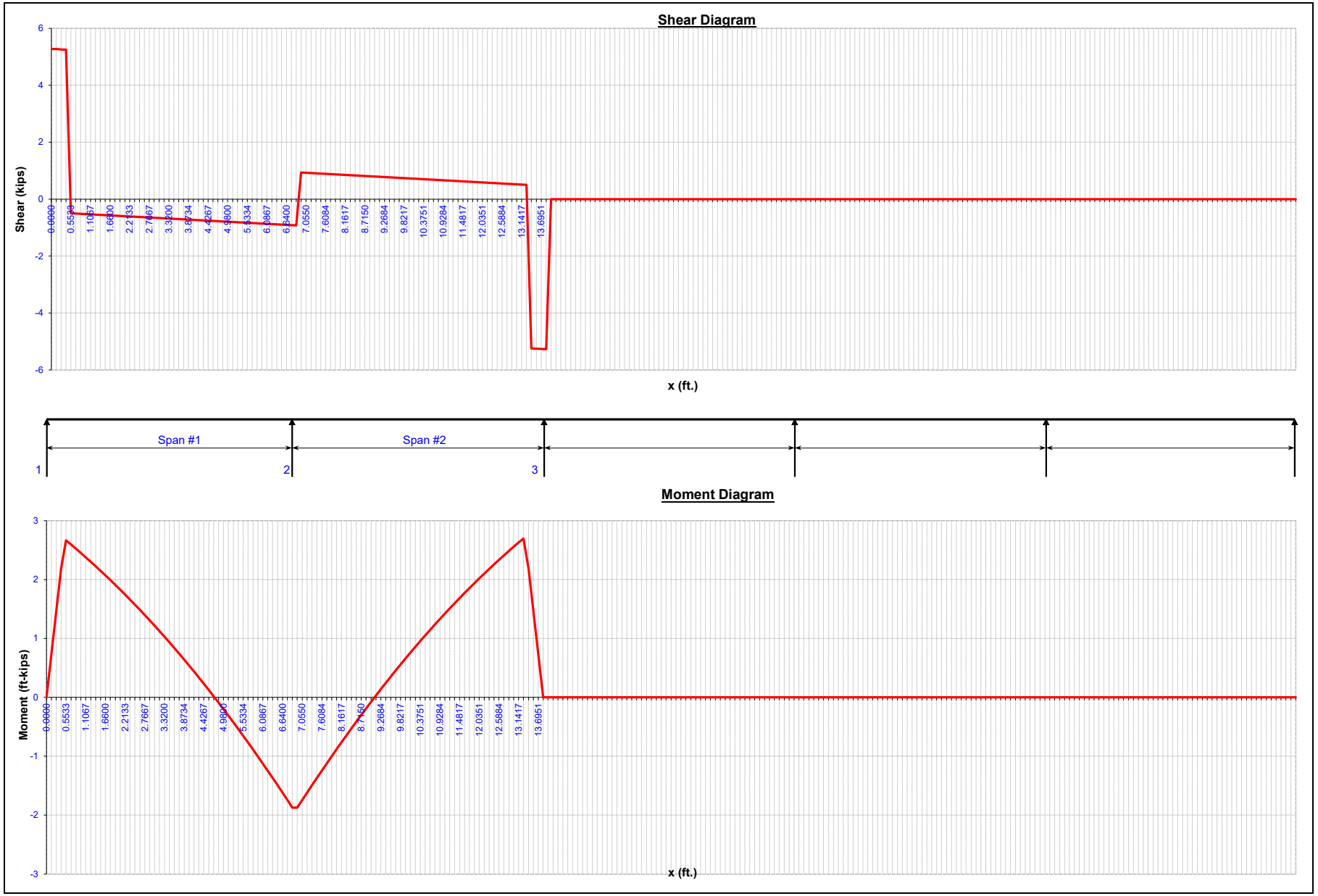
Moments:	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)	c (ft.)	M (ft-kips)
#1:										
#2:										
#3:										
#4:										

Left End Cantilever Shear = 0.00 kips Left End Cantilever Moment = 0.00 ft-kips Right End Cantilever Shear = 0.00 kips Right End Cantilever Moment = 0.00 ft-kips

Results:

End Shears:										
	5.28 k	-0.93 k	0.93 k	-5.27 k	---	---	---	---	---	---

SLAB IS ADEQUATE FOR EXPECTED LOADING.


Shear Diagram
Shear (kips)
6
4
2
0
-2
-4
-6
0.0000
0.5533
1.1067
1.6600
2.2133
2.7667
3.3200
3.8734
4.4267
4.9800
5.5334
6.0867
6.6400
7.0550
7.6084
8.1617
8.7150
9.2684
9.8217
10.3751
10.9284
11.4817
12.0351
12.5884
13.1417
13.6951
x (ft.)
Span #1
Span #2
1
2
3
Moment Diagram
Moment (ft-kips)
3
2
1
0
-1
-2
-3
x (ft.)

SINGLE-SPAN BEAM ANALYSIS

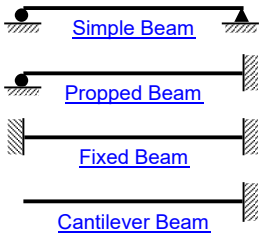
For Simple, Propped, Fixed, or Cantilever Beams

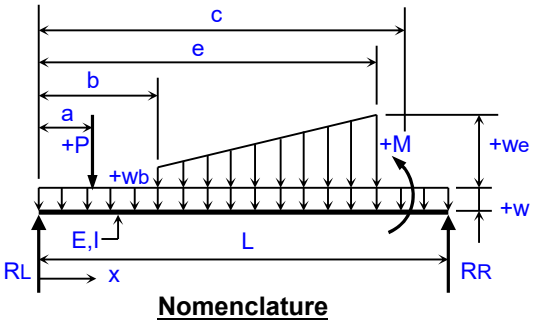
Job Name:	Spyder Crane on 7930 Third Floor Upper Lev	Subject:	Outriggers Engaged over Beams		
Job Number:	No Allowable Live	Originator:	TWB	Checker:	

Input Data:

Beam Data:

Span Type?	Simple	
Span, L =	17.5000	ft.
Modulus, E =	3605	ksi
Inertia, I =	391.00	in.^4





Nomenclature

Beam Loadings:

Full Uniform:

w = 0.4960 kips/ft.

Distributed:	Start b (ft.)	Wb (kips/ft.)	End e (ft.)	We (kips/ft.)
#1:				
#2:				
#3:				
#4:				
#5:				
#6:				
#7:				
#8:				

Point Loads:	a (ft.)	P (kips)
#1:	2.3750	5.74
#2:	15.1250	5.74
#3:		
#4:		
#5:		
#6:		
#7:		
#8:		
#9:		
#10:		
#11:		
#12:		
#13:		
#14:		
#15:		

Moments:	c (ft.)	M (ft-kips)
#1:		
#2:		
#3:		
#4:		

Results:

Reactions:

RL =	10.08 k	RR =	10.08 k
ML =	N.A.	MR =	N.A.

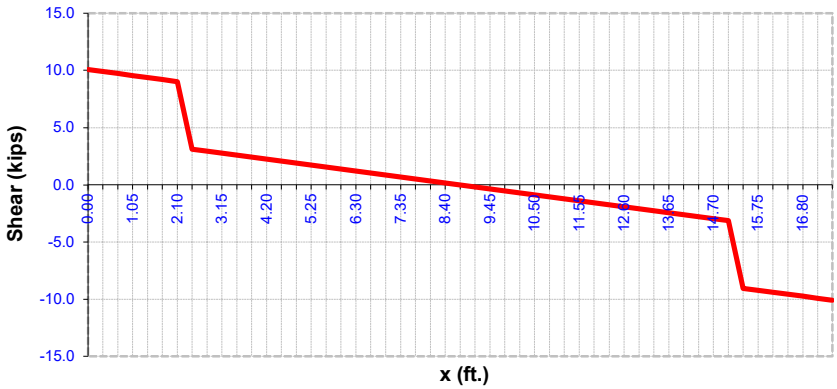
Maximum Moments:

+M(max) =	32.62 ft-k	@ x =	8.75 ft.
-M(max) =	0.00 ft-k	@ x =	0.00 ft.

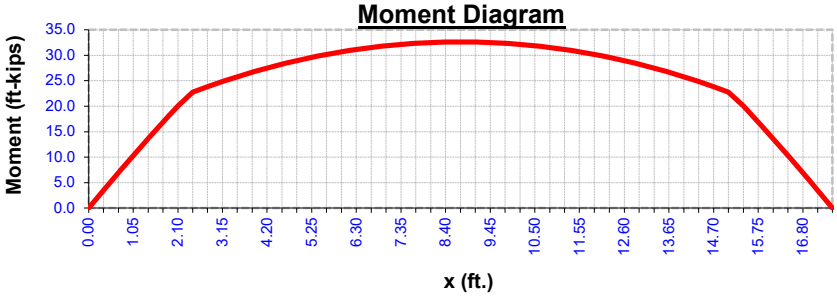
Maximum Deflections:

-Δ(max) =	-1.367 in.	@ x =	8.75 ft.
+Δ(max) =	0.000 in.	@ x =	0.00 ft.
Δ(ratio) =	L/154		

Shear Diagram



Moment Diagram



BEAM IS ADEQUATE FOR EXPECTED LOADING.

Tabulation of Single-Span Beam Shear, Moment, Slope, and Deflection for 50 Equal Segments					
Point #	x (ft.)	Shear (k)	Moment (ft-k)	Slope or Rotation (deg.)	Deflection (in.)
1	0.0000	10.08	0.00	-1.2518	0.0000
2	0.3500	9.91	3.50	-1.2482	-0.0917
3	0.7000	9.73	6.93	-1.2375	-0.1828
4	1.0500	9.56	10.31	-1.2198	-0.2729
5	1.4000	9.39	13.63	-1.1953	-0.3615
6	1.7500	9.21	16.88	-1.1640	-0.4480
7	2.1000	9.04	20.07	-1.1262	-0.5320
8	2.4500	3.12	22.78	-1.0819	-0.6129
9	2.8000	2.95	23.84	-1.0341	-0.6905
10	3.1500	2.78	24.84	-0.9843	-0.7645
11	3.5000	2.60	25.78	-0.9324	-0.8348
12	3.8500	2.43	26.67	-0.8787	-0.9012
13	4.2000	2.26	27.49	-0.8232	-0.9635
14	4.5500	2.08	28.25	-0.7661	-1.0218
15	4.9000	1.91	28.94	-0.7075	-1.0758
16	5.2500	1.74	29.58	-0.6475	-1.1255
17	5.6000	1.56	30.16	-0.5863	-1.1707
18	5.9500	1.39	30.68	-0.5240	-1.2114
19	6.3000	1.22	31.13	-0.4607	-1.2475
20	6.6500	1.04	31.53	-0.3965	-1.2789
21	7.0000	0.87	31.86	-0.3315	-1.3056
22	7.3500	0.69	32.13	-0.2660	-1.3275
23	7.7000	0.52	32.35	-0.1999	-1.3446
24	8.0500	0.35	32.50	-0.1335	-1.3568
25	8.4000	0.17	32.59	-0.0668	-1.3642
26	8.7500	0.00	32.62	0.0000	-1.3666
27	9.1000	-0.17	32.59	0.0668	-1.3642
28	9.4500	-0.35	32.50	0.1335	-1.3568
29	9.8000	-0.52	32.35	0.1999	-1.3446
30	10.1500	-0.69	32.13	0.2660	-1.3275
31	10.5000	-0.87	31.86	0.3315	-1.3056
32	10.8500	-1.04	31.53	0.3965	-1.2789
33	11.2000	-1.22	31.13	0.4607	-1.2475
34	11.5500	-1.39	30.68	0.5240	-1.2114
35	11.9000	-1.56	30.16	0.5863	-1.1707
36	12.2500	-1.74	29.58	0.6475	-1.1255
37	12.6000	-1.91	28.94	0.7075	-1.0758
38	12.9500	-2.08	28.25	0.7661	-1.0218
39	13.3000	-2.26	27.49	0.8232	-0.9635
40	13.6500	-2.43	26.67	0.8787	-0.9012
41	14.0000	-2.60	25.78	0.9324	-0.8348
42	14.3500	-2.78	24.84	0.9843	-0.7645
43	14.7000	-2.95	23.84	1.0341	-0.6905
44	15.0500	-3.12	22.78	1.0819	-0.6129
45	15.4000	-9.04	20.07	1.1262	-0.5320
46	15.7500	-9.21	16.88	1.1640	-0.4480
47	16.1000	-9.39	13.63	1.1953	-0.3615
48	16.4500	-9.56	10.31	1.2198	-0.2729
49	16.8000	-9.73	6.93	1.2375	-0.1828
50	17.1500	-9.91	3.50	1.2482	-0.0917
51	17.5000	-10.08	0.00	1.2518	0.0000

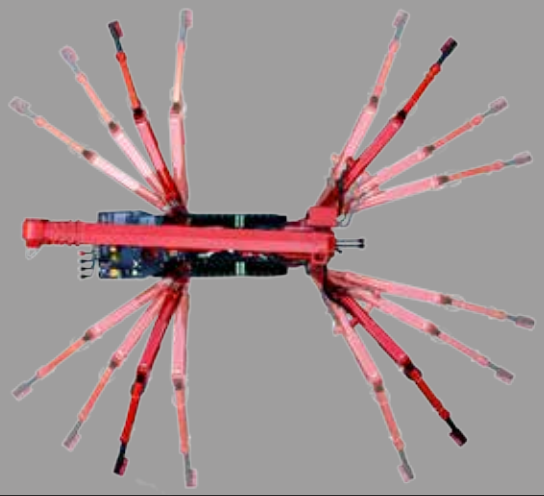
UNIC SPYDERCRANE

URW205 MINI-CRAWLER CRANE

Formerly URW295CURS-1

- Only 24" wide
- Full-function wireless radio remote controls
- Centrally located infinite variable controls - Automatic throttle
- Onboard self-diagnostic computer system
- Anti-two block system
- Automatic hook stow system
- UNIC patented outrigger overturn monitoring system to allow 52 outrigger configurations.
- 360 Degree continuous rotation

52 OUTRIGGER POSITIONS



OUTRIGGERS MINIMUM

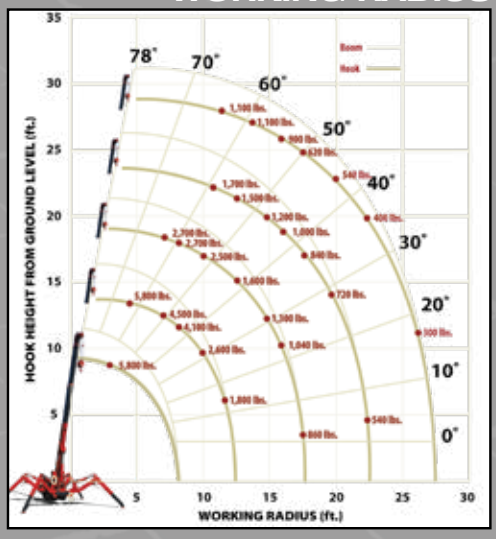
OUTRIGGERS MAXIMUM

LOAD CHART

Lifting capacity varies depending on outrigger configuration and boom length and angle.

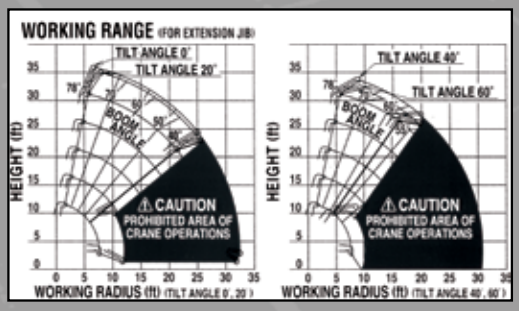
BOOM SECTION 1 EXTENDED | BOOM SECTION 1 + 2 EXTENDED										
Working Radius (ft.)	3	4.5	5	6	7	8	10	11	13	
Outriggers Maximum (lbs.)	5,800	5,800	5,800	5,040	4,595	3,715	2,940	2,275	2,055	
Outriggers Minimum (lbs.)	4,485	4,485	4,485	3,270	2,500	1,505	1,150	840	620	
BOOM SECTION 1 + 2 + 3 EXTENDED										
Working Radius (ft.)	7	8	9	10	11	13	15	16	18	
Outriggers Maximum (lbs.)	3,050	3,050	3,050	2,830	2,275	1,835	1,500	1,215	1,015	
Outriggers Minimum (lbs.)	1,835	1,500	1,240	1,170	905	685	555	420	330	
BOOM SECTION 1 + 2 + 3 + 4 EXTENDED										
Working Radius (ft.)	11	12	13	15	16	18	20	21	23	
Outriggers Maximum (lbs.)	1,945	1,945	1,725	1,390	1,170	995	860	775	665	
Outriggers Minimum (lbs.)	995	815	730	620	485	375	290	245	200	
BOOM SECTION 1 + 2 + 3 + 4 + 5 EXTENDED										
Working Radius (ft.)	12	13	15	16	18	20	21	23	26	28
Outriggers Maximum (lbs.)	1,280	1,280	1,060	885	750	665	575	510	400	355
Outriggers Minimum (lbs.)	840	705	620	510	420	355	290	220	155	135

WORKING RADIUS



Rated Load for Extension Jib in lbs.

1st TO 4th BOOM SECTIONS													
Boom Angle		78°	75°	70°	65°	60°	55°	50°	40°	30°	20°	10°	0°
Tilt Angle	0°	1,580	1,580	1,580	1,140	810	590	590	PROHIBITED AREA OF CRANE OPERATIONS				
	20°	1,580	1,580	1,580	1,140	810	590	590					
	40°	1,580	1,580	1,580	1,140	810							
	60°	1,580	1,580	1,580	1,140	810							
5th BOOM SECTION ONLY													
Boom Angle		78°	75°	70°	65°	60°	55°	50°	40°	30°	20°	10°	0°
Tilt Angle	0°	920	920	920	590	480	370	260	PROHIBITED AREA OF CRANE OPERATIONS				
	20°	920	920	920	590	480	370	260					
	40°	920	920	920	590	480							
	60°	920	920	920	590	480							



Rated Load for Searcher Hook in lbs.

1st TO 4th BOOM SECTIONS												
Working Radius (ft.)	12.5	13	15	16	18	20	21	23	26	27.5		
Outriggers Maximum (lbs.)	1,560	1,560	1,060	940	740	570	520	410	310	240		
Outriggers Minimum (lbs.)	560	460	330	280	190	120	110	PROHIBITED AREA OF CRANE OPERATIONS				
5th BOOM SECTION ONLY												
Working Radius (ft.)	12.5	13	15	16	18	20	21	23	26	30	32.5	
Outriggers Maximum (lbs.)	1,120	1,010	870	740	670	570	510	410	310	220	130	
Outriggers Minimum (lbs.)	560	460	330	280	190	120	110	PROHIBITED AREA OF CRANE OPERATIONS				

1 Part line - 2,100 lbs | 2 Part line - 4,100 lbs | 3 Part line - 5,000 lbs | 4 Part line - 5,800 lbs

UNIC SPYDERCRANE

URW205 MINI-CRAWLER CRANE

Formerly URW295CURS-1

SPECIFICATIONS

	URW205CURS & URW205CURS/P	URW205CUMRS & URW205CUMRS/P	URW205CUBRS	URW205C1URS	URW205C1UMRS
Engine / Motor	GASOLINE / PROPANE POWER	GASOLINE / Electric / Electric / PROPANE POWER	Battery Powered	DIESEL	DIESEL Electric
Engine Manufacturer:	Mitsubishi (Gas)	Mitsubishi (Gas)	DC	Kubota	Kubota (Diesel)
Maximum Output:	Gasoline - 13HP Propane - 11.7HP	Gasoline - 13HP Propane - 11.7HP Electric - 5HP/220V (Single Phase)	48V Battery 110V Electric	7.2kw	Diesel- 7.2kw Electric - 5HP/220V (Single Phase)
Tank Capacity:	1.85 gal	1.85 gal		1.85 gal	1.85 gal
Starting Method	Electric and Recoil Start as Standard		N/A	Electric Start	
Crane Capacity	5,800 lbs @4.6ft				
Max Working Radius	1.4 - 28.0 ft				
Tip Height	31 ft (37 ft with Jib)				
Turning Radius	Turns within its dimensions				
Dimensions when Folded (ft.)	2.0 x 4.6 x 9.0 (W x H x L)			2.0 x 4.6 x 9.1 (W x H x L)	2.0 x 4.6 x 9.0 (W x H x L)
Weight	4,200 lbs	4,380 lbs	4,360 lbs	4,245 lbs	4,525 lbs
Outrigger Point Loading	152.2 psi on standard outrigger pads (7" x 4.5") (Specific point landing available upon request)				
Winch Speed	Capacity: 2,250 lbs. at 4th layer | Single-Line				
	131 ft/min at 4th layer	131 ft/min at 4th layer Electric: 89 ft/min at 4th layer	131 ft/min at 4th layer	131 ft/min at 4th layer	131 ft/min at 4th layer Electric: 89 ft/min at 4th layer
Telescopic System	Boom Length: 8.3 ft (retracted) to 28.4 ft (extended) Boom Type: 5-Section hydraulically telescoping boom, with hexagonal box construction				
Telescoping Speed	20 ft / 20 seconds				
Boom Lift Speed	0° – 78° / 11 sec	Gas: 0° – 78° / 11 sec Electric: 0° – 78° / 15 sec	0° – 78° / 15 sec	0° – 78° / 11 sec	Diesel: 0° – 78° / 11 sec Electric: 0° – 78° / 15 sec
Traction System	Travel Speed: 0-1.43 mph				
	Gradability: 20°				
	Track Ground Pressure: 6.96 psi				
Accessories & Options	• SPYDERWEB 5-Axis fixed Glass Manipulator - Attaches directly to boom for rigid application • 6 ft offsettable Jib with Searcher Hook and Single-Line Swivel Ball • Custom SPYDERCRANE Trailer - Includes Track Mats, Tool Box, Outrigger Pads and Fuel Containers		• Auxilliary Winch Kit - 2,000 lb Single-Line Pull, 330 ft., 5/16" Wire Rope, 90 FPM • MYLAR Non-Marking Tracks • Single-Part Reeving and Two-Part Reeving capability		

UNIC SPYDERCRANE

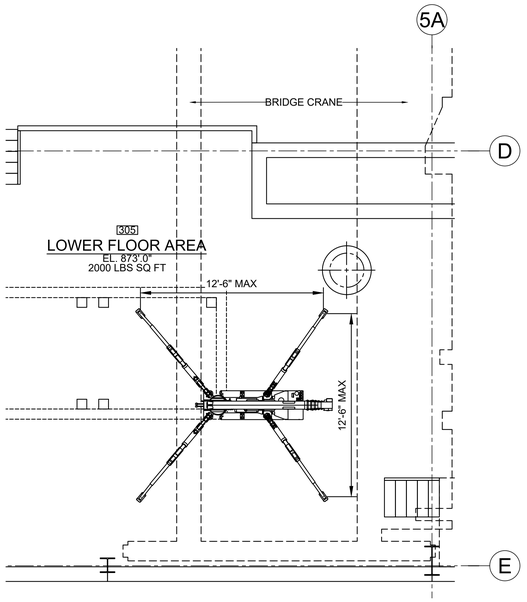
Visit us on the web at SPYDERCRANE.COM

A Division of Smiley Lifting Solutions

5326 W. Mohave St | Phoenix, AZ 85043

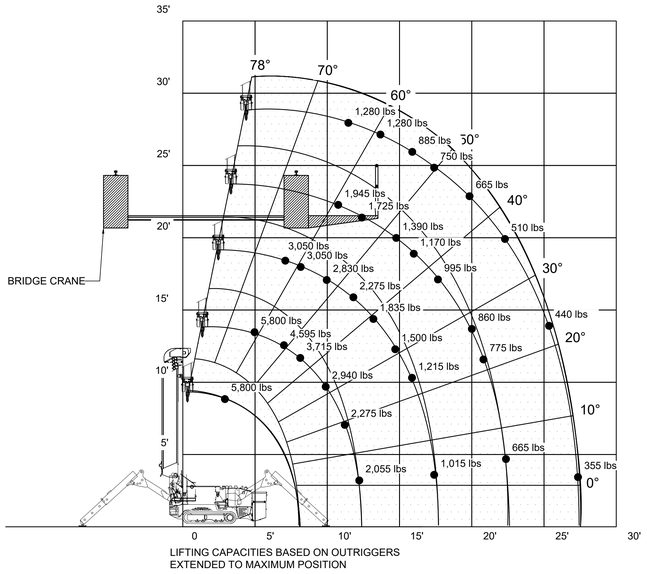
844.264.8994

Product specifications are subject to change without notice. No specific training or license is required to operate the SPYDERCRANE in most areas, but operators are responsible for knowing and meeting all safety requirements and regulations.



SPIDER CRANE (LOWER FLOOR) - PLAN

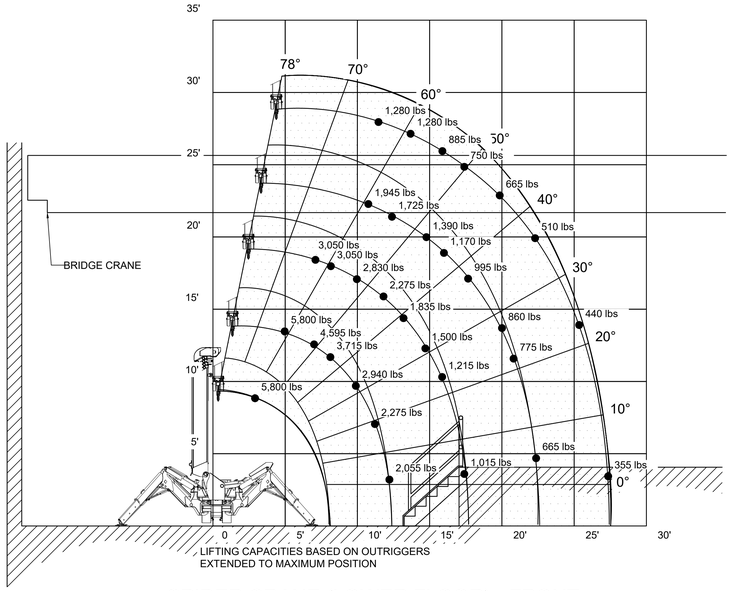
SCALE: NONE



LIFTING CAPACITIES BASED ON OUTRIGGERS EXTENDED TO MAXIMUM POSITION

SPIDER CRANE (LOWER FLOOR) - SIDE

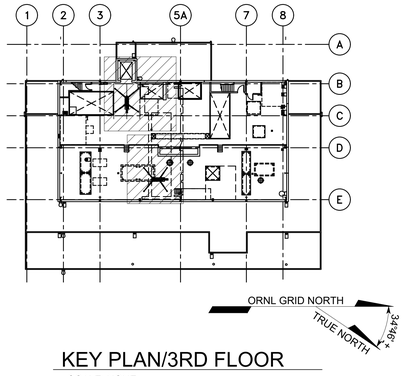
SCALE: NONE



LIFTING CAPACITIES BASED ON OUTRIGGERS EXTENDED TO MAXIMUM POSITION

SPIDER CRANE (LOWER FLOOR) - FRONT

SCALE: NONE

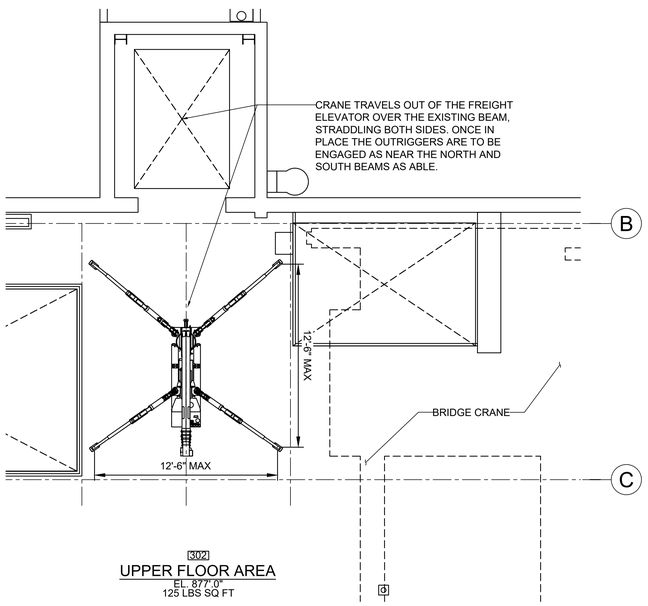


KEY PLAN/3RD FLOOR

SCALE: NONE

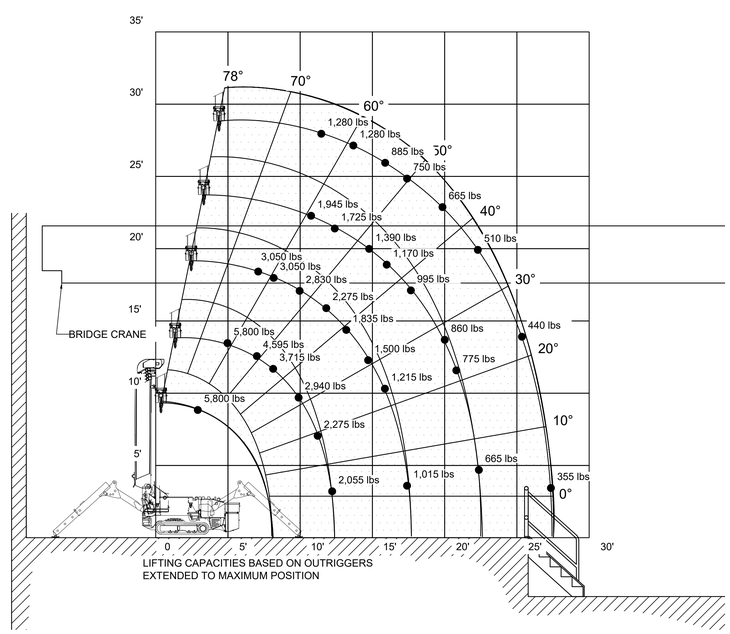
SPIDER CRANE NOTES:

1. DO NOT EXCEED MANUFACTURER'S RECOMMENDED LIFT LOAD AND RANGE, AS SHOWN ON THIS SHEET.
2. SPIDER CRANE SHALL NOT BE OPERATED UNTIL PROPERLY SET UP, WITH OUTRIGGERS EXTENDED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.



SPIDER CRANE (UPPER FLOOR) - PLAN

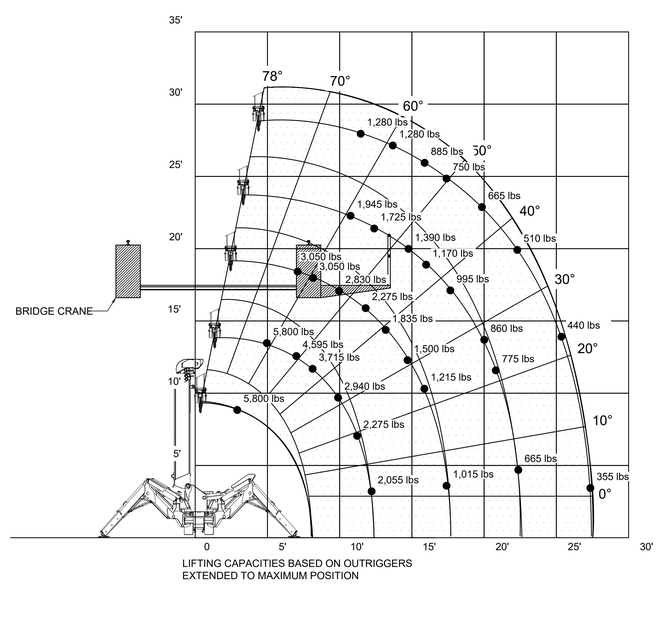
SCALE: NONE



LIFTING CAPACITIES BASED ON OUTRIGGERS EXTENDED TO MAXIMUM POSITION

SPIDER CRANE (UPPER FLOOR) - SIDE

SCALE: NONE



LIFTING CAPACITIES BASED ON OUTRIGGERS EXTENDED TO MAXIMUM POSITION

SPIDER CRANE (UPPER FLOOR) - FRONT

SCALE: NONE

DRAFT- 02

THIS DRAWING
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THIS DOCUMENT CONTROLLED BY
NNFD - SAFETY, ENGINEERING & SUPPORT

DRAWING ON WHICH ELEVATION, SECTION, OR DETAIL IS TAKEN. — NUMBER OR LETTER FOR ELEVATION, SECTION, OR DETAIL — DRAWING ON WHICH ELEVATION, SECTION, OR DETAIL IS SHOWN.

REV	DESCRIPTION	BY	DSNR	CHK	DR	TL	ESDH	REQ	FAC	DATE	SR1	SR2	SR3	SR4	QR
	REVISION OR ISSUE PURPOSE	REVISION APPROVALS													

DEFAULT STANDARDS UNLESS OTHERWISE SPECIFIED

TOLERANCES
FRACTIONS ± 1/8
XX DECIMALS ± 0.00
XXX DECIMALS ± 0.00
ANGLES ± 0°-30'
BREAK SHARP EDGES (.03) MAX.
FINISH =

ALL DIMENSIONS ARE IN INCHES

WHENEVER A MANUFACTURER'S NAME OR CATALOG NUMBER IS INDICATED, AN APPROVED EQUAL MAY BE SUBSTITUTED

THIS DRAWING CREATED IN ACCORDANCE WITH ANSI Y14.5M-1994

DRAWN BY	
C. CAMPBELL	##########
CHECKED BY	
T. BRUMIT	##########
APPROVED BY	
T. HELTON	##########
SENIOR REVIEWER	
N/A	
TASK LEADER	
N/A	
ENGINEERING SUPPORT DEPT. HEAD	
N/A	
RESPONSIBLE	
N/A	
FACILITY MANAGER/DESIGNEE	
N/A	
OPERATIONAL REVIEW	
N/A	
OPERATIONAL REVIEW	
N/A	
OPERATIONAL REVIEW	
N/A	
DRAWING APPROVALS	DATE

NONREACTOR NUCLEAR FACILITIES DIVISION
OAK RIDGE NATIONAL LABORATORY
UT-BATTELLE
Operated by UT-Battelle for the Department of Energy under U.S. Government contract DE-AC05-00OR22725 • Oak Ridge, Tennessee

URW-205 SPIDER CRANE LIFT ZONES

7930 HIGH BAY BRIDGE CRANE

1	48	49	50	PLANT	BLDG	FL	SHEET	OF	TYPE
3	M	E	U	ORNL	7930	3	1	1	S

CLASS	SCALE	ID		REV
U	AS NOTED	A24-0049	SKETCH-5	0

FILE NAME:

USQD Number: USQD/REDC/25-007
Revision Number: 0

UNREVIEWED SAFETY QUESTION DETERMINATION (USQD) CHANGE PACKAGE

Part I - Introduction

1. **Facility:** Radiochemical Engineering Development Center (REDC) Building 7930

2. **Subject of evaluation:** Use of Boom Lift on Building 7930 Third Floor for Crane Modernization

3. **Description of the change:**

The Building 7930 building crane (50 ton overhead bridge crane) requires repair. A telescoping boom lift will be used to aid in the east wall bus bar replacement as part of the overhead crane refurbishment activities. The boom lift will be used to reach and replace the crane bridge bus bars along the east wall of the third floor high bay area. The boom lift will be a Genie Z-34/22 DC, an electric rechargeable lead-acid battery powered lift with a hydraulic operated articulating boom capable of extending the work platform approximately 25 ft horizontally and just under 40 ft vertically. The boom lift, which weighs approximately 11,500 lbs., will be raised from the truck bay to the third floor using the Building 7930 building crane. The boom lift will be operated on the lower level of the third floor as necessary. Empty casks and other movable items on the third floor may be relocated to make room for the boom lift. The boom lift will be operated throughout the lower level of third floor area on top of the cell roofs. The boom lift will be positioned near the point of work with the workers and needed equipment on the work platform. The work platform will be positioned near the point of work by operating the controls on a panel on the vehicle and/or on the work platform to move it into the desired position. The work platform will be repositioned as necessary and, when required, the boom lift will be moved to other areas of the lower level of the third floor. The boom lift batteries will be recharged as necessary by plugging into 120 V receptacles in the third floor area. This maintenance activity is addressed in Maintenance Work Plan (MWP) no., MWP061113.

4. **Primary safety basis documents:**

1. ORNL/7930/SAR Rev. 19, *Safety Analysis Report, Radiochemical Engineering Development Center Building 7930.*

2. ORNL/7930/TSR Rev. 12, Change No. 1, Change No. 2, *Technical Safety Requirements, Radiochemical Engineering Development Center Building 7930.*

3. ORNL/NNFD/SSAR Rev. 21, *Oak Ridge National Laboratory Standardized Safety Analysis Report for Nonreactor Nuclear Facilities*.

5. **Safety analysis:**

This change involves using a boom lift on the lower level of the third floor of Building 7930. The boom lift will be operated on the lower level of the third floor on top of the cells. The hazards associated with the use of the boom lift are presented in Table 1 of this USQD. The hazards identified are: (1) a toxic, corrosive, reactive material hazard associated with the lead-acid batteries, small amount of hydraulic fluid (~4 gallons), and small amounts of lubricating oils/grease in the boom lift, (2) a flammable material hazard associated with the potential for generation of hydrogen gas during charging of the lead-acid batteries (potential for a localized deflagration and rupture of batteries), (3) an electrical energy hazard associated with standard power supplies on the boom lift equipment and its controls, (4) a thermal energy hazard associated with hot components/surfaces on electrical/mechanical components of the boom lift, (5) a kinetic energy hazard associated with the moving boom lift and its moving hydraulic boom/work platform, hydraulic pump, motors, and hydraulic pistons, and (6) a potential energy hazard associated with pressurized hydraulics (up to 2800 psi maximum) on the boom lift and elevated loads. All these hazards are below screening criteria and are considered routine/insignificant hazards

that are considered only for their ability to initiate an accident involving unusual hazards that may be in or near the area.

Relocating empty containers and equipment on the third floor and raising and lowering equipment between the third floor and the truck bay using the building crane are all routine activities currently performed in the facility. Lifting and moving the boom lift around the third floor poses no more risk than crane movements of casks and other equipment on the third floor lower level area on top of the cell roofs. The floor loading of the boom lift was determined to be within the loading requirements for the third floor. Other than the kinetic energy hazard associated with extending the boom and moving the work platform, the hazards associated with using the boom lift are all of the same types and magnitudes as those already considered and evaluated in the Building 7930 safety basis (SB) documentation for the third floor area.

The boom on the boom lift may collapse or the boom lift tip over and impact equipment important to safety in the third floor area (e.g., building exhaust fans). However, the likelihood and damage from these failures will be bounded by impacts from other existing third floor activities and equipment. The only other safety-class, safety-significant, or defense-in-depth SSC affected by this change is the defense-in-depth building confinement structure. The building confinement structure is identified as defense-in-depth in Table 3.5 of the SAR and is considered equipment important to safety. The extension and movement of the boom lift work platform has the potential to impact the exterior walls and the ceiling of the third floor, which are part of the building confinement structure. The boom lift is standard industrial equipment and similar boom lifts have been used on the third floor in the past. Operation of the equipment is not complex. Because the equipment is relatively simple to operate, and moves relatively slowly, mis-operations that would result in the boom lift striking the wall or roof are expected to be infrequent and those that would cause any significant damage to be even less likely. Therefore, the frequency of the boom lift causing any significant damage to the facility is estimated to be *Unlikely.* It is not expected that a structural collapse of the facility would be caused by the boom lift striking the building confinement structure. However, in a worst case, it is assumed that the boom lift could cause some portions of the wall or a roof panel to fall inside the facility to the floor, possibly striking radioactive materials stored there. Falling debris/falling loads in the third floor high bay area are previously evaluated events (SAR, Appendix H Table H.2, Events 13, 14, and 15 and Appendix J Table J.1, Event 8). The frequencies of these events range from *Anticipated* to *Unlikely.* The bounding consequences associated with these events are *Negligible* to *Low* for the worker and *Low* for all other receptors. As discussed previously, the likelihood of the boom lift causing significant damage is estimated to be *Unlikely.* Therefore, there is no adverse impact on the estimated frequencies of the previously evaluated events. There are no changes to the type, form or quantity of radioactive materials that may be in the high bay area associated with this change and the debris that could be generated by the damage done by the boom lift striking the building confinement boundary would not be expected to be larger or capable of causing any more damage than estimated in the SAR. The consequences of the SAR events would bound any consequence due to the accidents involving the boom lift. Based on the above, there is no impact to any evaluations of accidents due to the boom lift striking the building confinement structure or other structures or equipment in the high bay area.

Therefore, this change will not (1) create any new types of accident events, (2) create any new types of malfunctions of SSCs, (3) affect the probability or consequences of any accident events, or (4) affect the probability or consequence of malfunction of any SSCs. This is a temporary activity and would not require any changes to the Building 7930 SB documentation. There are no Technical Safety Requirements (TSRs) associated with the operations in the third floor area. Additionally, this change will have no adverse impact on the hazard and accident analysis or any safety-class, safety-significant, or defense-in-depth SSCs. Therefore, no new TSRs or any changes to any existing TSRs would be required.

6. **Does the proposed change require revision of Technical Safety Requirements (TSR) or affect a U.S. Department of Energy (DOE) Condition of Approval?** Yes__ No_X_
If yes, then DOE approval is required.

7. **Does the change make any changes to the documented safety analysis?** Yes__ No X
   If yes, specify changes and attach.

Part II - USQD

1. **Could the change increase the probability of occurrence of an accident previously evaluated in the documented safety analysis?** Yes__ No X
   Justification:
   This change involves using a boom lift on the lower level of the third floor of Building 7930. This change does not involve any changes to or new types of activities or hazardous materials or energy sources other than use of the boom lift. The extension and movement of the boom lift work platform has the potential to impact the exterior walls and the ceiling of the third floor, which are part of the building confinement structure. In a worst case, it is assumed that the boom lift could cause some portions of the wall or a roof panel to fall inside the facility to the floor, possibly striking radioactive materials stored there. Falling debris/falling loads in the third floor high bay area are previously evaluated events (SAR, Appendix H Table H.2, Events 13, 14, and 15 and Appendix J Table J.1, Event 8). The frequencies of these events range from *Anticipated* to *Unlikely.* As discussed in the safety analysis, the frequency of the boom lift causing any significant damage to the facility is estimated to be *Unlikely.* Therefore, there is no adverse impact on the estimated frequencies of the previously evaluated events. This change would not affect any preventive or mitigative controls or preventive or mitigative SSCs credited in the SAR. Also, there are no changes to accident initiating events associated with this change. Therefore, this change will not increase the probability of occurrence of any accidents previously evaluated in the documented safety analysis.

2. **Could the change increase the consequences of an accident previously evaluated in the documented safety analysis?** Yes__ No X
   Justification:
   This change involves using a boom lift on the lower level of the third floor of Building 7930. This change does not involve any changes to or new types of activities or hazardous materials or energy sources other than use of the boom lift. The extension and movement of the boom lift work platform has the potential to impact the exterior walls and the ceiling of the third floor, which are part of the building confinement structure. In a worst case, it is assumed that the boom lift could cause some portions of the wall or a roof panel to fall inside the facility to the floor, possibly striking radioactive materials stored there. Falling debris/falling loads in the third floor high bay area are previously evaluated events (SAR, Appendix H Table H.2, Events 13, 14, and 15 and Appendix J Table J.1, Event 8). The bounding consequences associated with these events are *Negligible* to *Low* for the worker and *Low* for all other receptors. There are no changes to the type, form or quantity of radioactive materials that may be in the high bay associated with this change and the debris that could be generated by the damage done by the boom lift striking the building confinement boundary would not be expected to be larger or capable of causing any more damage than estimated in the SAR. The SAR evaluation considers multiple release paths, including through openings in the building confinement structure. Therefore, a release through the opening caused by the impact would not introduce a new pathway. The consequences of the SAR events would bound any consequence due to the accidents involving the boom lift. This change would not have the potential to affect any preventive or mitigative controls, or preventive or mitigative SSCs credited in the SAR. Also, there are no changes to accident initiating events, materials at risk, airborne release fractions, or release paths associated with this change. Therefore, this change will not increase the consequences of any accidents previously evaluated in the documented safety analysis.

3. **Could the change increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the documented safety analysis?** Yes__ No X
   Justification:

USQD Number: USQD/REDC/25-007
Revision Number: 0

This change involves using a boom lift on the lower level of the third floor of Building 7930. This change does not involve any changes to or new types of activities or hazardous materials or energy sources other than use of the boom lift. Additionally, this change does not involve new or different types of configurations, manipulations, or operations of any SSCs other than the boom lift. The boom on the boom lift may collapse or the boom lift tip over and impact equipment important to safety in the third floor area (e.g., building exhaust fans). However, the likelihood and damage from these failures will be bounded by impacts from other existing third floor activities and equipment. The only other safety-class, safety-significant, or defense-in-depth SSC affected by this change is the defense-in-depth building confinement structure. Although there are events in the Building 7930 SAR involving failure of the building confinement structure, there are no events that are initiated by a failure of the equipment important to safety (i.e., the building confinement structure) itself. The events range from natural phenomena hazards (e.g., earthquake, SAR, App J. Table J.1, Event 5) to a vehicle/equipment impact on the facility structure (SAR, App J. Table J.1 Event 8) with frequencies ranging from *Unlikely* to *Extremely Unlikely.* As discussed in the safety analysis, the probability of the boom lift causing significant damage to the building confinement structures is *Unlikely.* This change would not affect any preventive or mitigative controls or preventive or mitigative SSCs credited in the SAR. Also, there are no changes to accident initiating events associated with this change. Therefore, this change will not increase the probability of occurrence of malfunction of equipment important to safety previously evaluated in the documented safety analysis.

4. Could the change increase the consequences of a malfunction of equipment important to safety previously evaluated in the documented safety analysis? Yes__ No_X_

Justification:

This change involves using a boom lift on the lower level of the third floor of Building 7930. This change does not involve any changes to or new types of activities or hazardous materials or energy sources other than use of the boom lift. Additionally, this change does not involve new or different types of configurations, manipulations, or operations of any SSCs other than the boom lift. The boom on the boom lift may collapse or the boom lift tip over and impact equipment important to safety in the third floor area (e.g., building exhaust fans). However, the likelihood and damage from these failures will be bounded by impacts from other existing third floor activities and equipment. The only other safety-class, safety-significant, or defense-in-depth SSC affected by this change is the defense-in-depth building confinement structure. Although there are events in the Building 7930 SAR involving failure of the building confinement structure, there are no events that are initiated by a failure of the equipment important to safety (i.e., the building confinement structure) itself. The SAR event evaluations consider multiple release paths, including through openings in the building confinement structure. Therefore, a release through the opening caused by the impact would not introduce a new pathway. The consequences of the SAR events involving a failure of the building confinement structure would bound any consequence due to the accidents involving the boom lift. This change would not affect any preventive or mitigative controls or preventive or mitigative SSCs credited in the SAR. Also, there are no changes to accident initiating events, materials at risk, airborne release fractions, or release paths associated with this change. Therefore, this change will not increase the consequences of a malfunction of equipment important to safety previously evaluated in the documented safety analysis.

5. Could the change create the possibility of a different type of accident than any previously evaluated in the documented safety analysis? Yes__ No_X_

Justification:

This change involves using a boom lift on the lower level of the third floor of Building 7930. This change does not involve any changes to or new types of activities or hazardous materials or energy sources other than use of the boom lift. There are no unique hazards associated with the boom lift and the potential event initiated by the boom lift is bounded by exiting events in the SAR, as discussed in question 1. This change would not affect any preventive or mitigative controls or preventive or mitigative SSCs credited in the SAR. Therefore, this change will not create the possibility of a different type of accident than any previously evaluated in the documented safety analysis.

6. Could the change create the possibility of malfunction of equipment important to safety of a different type than any previously evaluated in the documented safety analysis? Yes__ No X

Justification:

This change involves using a boom lift on the lower level of the third floor of Building 7930. This change does not involve any changes to or new types of activities or hazardous materials or energy sources other than use of the boom lift. Additionally, this change does not involve new or different types of configurations, manipulations, or operations if any SSCs other than the boom lift. The boom on the boom lift may collapse or the boom lift tip over and impact equipment important to safety in the third floor area (e.g., building exhaust fans). However, the likelihood and damage from these failures will be bounded by impacts from other existing third floor activities and equipment. The only other safety-class, safety-significant, or defense-in-depth SSC affected by this change is the defense-in-depth building confinement structure. Although there are events in the Building 7930 SAR involving failure of the building confinement structure, there are no events that are initiated by a failure of the equipment important to safety (i.e., the building confinement structure) itself. There are no unique hazards associated with the boom lift and the potential event initiated by the boom lift is bounded by exiting events in the SAR, as discussed in question 3. This change would not affect any preventive or mitigative controls or preventive or mitigative SSCs credited in the SAR. Therefore, this change will not create the possibility of malfunction of equipment important to safety of a different type than any previously evaluated in the documented safety analysis.

USQD Number: USQD/REDC/25-007
Revision Number: 0

Part III - Conclusion and Approval

Based on the responses above, the change:

X does NOT constitute an unreviewed safety question
__ does constitute an unreviewed safety question

Maureen Searles Digitally signed by Maureen Searles Date: 2025.03.26 13:36:42 -04'00'

Preparer: M. A. Searles Date

Michael A. Green Digitally signed by Michael A. Green Date: 2025.03.26 14:50:27 -04'00'

Independent Reviewer: M. A. Green Date

Approvals:

Douglas Keener for RJ Weaver Digitally signed by Douglas Keener for RJ Weaver Date: 2025.03.27 10:18:39 -04'00'

D. E. Keener for Date
R. J. Weaver, REDC Facility Manager

Not Applicable

N. L. Blair Date
Nuclear Safety Group Leader
Nuclear Facility Safety Division

Attachment 1

Table 1. Hazard Identification and Screening

HAZARD	SCREENOUT MEASURE	ACTION	ACTION DECISION BASIS
Radioactive Materials (Including Fissionable Materials)	<RQ value in Title 40 CFR Part 302.4 Appendix B and <250 g 235U fissionable equivalent mass	N/A	Amounts of radioactive and fissionable materials in the areas around the equipment will be within limits established in current Building 7930 SB documentation.
X-Ray	Meets ANSI X-Ray standards	N/A	
Lasers	Not Class III nonenclosed beam and/or Class IV	N/A	
Other Non-Ionizing Radiation Generating Equipment	≤10mW/cm^2 for ≥0.1 h or ≤1mW/cm^2-h for 0.1 h	N/A	
Toxic, Corrosive, Reactive Materials	≤RQ value in Title 40 CFR Part 302.4	Screen out	Small amounts associated with the lead-acid batteries, small amount of hydraulic fluid (~4 gallons), and small amounts of lubricating oils/grease in the boom lift
Flammable Materials	≤3000 ft^3 of flammable gases, ≤110 gal of flammable liquids, or ≤10 lbs of other flammable solids	Screen out	Potential for generation of hydrogen gas during charging of lithium-ion batteries (potential for a localized deflagration and rupture of batteries)
Explosive Materials	Not High/Class A or B, ≤10 oz. of Class C, or ≤10 lbs of other explosive material	N/A	
Electrical Energy	≤600V, ≤25mA output, or ≤50 J stored energy	Screen out	Boom lift batteries (48V); standard electrical equipment on boom lift
Thermal Energy	Not unusual or unique with only contact burns	Screen out	Hot components/surfaces associated with electrical/mechanical components on boom lift
Kinetic Energy	Not unusual or unique high energy	Screen out	Movement of the boom lift and its hydraulic boom/work platform, hydraulic pump, motors, and hydraulic pistons
Pressurized Gases and Fluids	≤3000 psig or ≤0.1 lb TNT equivalent	Screen out	Hydraulic fluid (2800 psi)
Other Potential Energy	Not unusual or unique high energy	Screen out	Elevated loads associated with boom lift
Biohazard	Not special controls required	N/A	
Asphyxiants	Does not affect large number of or any unsuspecting persons	N/A	
Other or Unknown		N/A	

Form 1 of 1	Qualitative Exposure Assessment – Multiple Hazard Form

☐ No QEA is required based upon a review of the types(s) of hazards associated with this activity/task

☐ QEA could not be conducted at the time the RSS/Workplan was reviewed/approved due to inadequate information provided by the PI, Work Planner/Package author on some or all agent(s)/hazard(s).

List the agent(s) for which a QEA could not be conducted:	N/A
Discuss controls incorporated into Work control to assure EA is conducted in the future:	N/A

Process/Task	7930 High Bay Crane Repair/Modernization	**Facility #:**	7930	**Room/Lab/Shop #:**	3rd Floor
Work Description	7930 High Bay Crane Repair/Modernization	**Organization:**	NNFD	**RSS/Work Plan #:**	MWP061113

Agents and Control Information

	Process/Task	REC ID	Hazardous Agent	Quantity Magnitude	Primary Exposure Forms	Exposure Duration	Eng. & Adm. Controls	OEL
1	Formula 409 Antibacterial All-Purpose Cleaner	81193	Lauramine Oxide	32oz	Liquid	<1/2 hour	T, L/P, P, GV	N/A
2	Lead (paint/ potential airborne)	N/A	Lead	Variable	Particle	1/2-2 hours	T, P, GV	.05 mg/m3
3	Noise	N/A	Noise	>85 dBA	Noise	Variable	T, L/P, P, LT	85 dBA
4	Manual Material Handling	N/A	Ergonomic Strain	Variable	Other	Variable	T, P W/R	Task Dependant
5	Respirable Crystalline Silica	N/A	Respirable Crystalline Silica	Variable	Particle	<1/2 hour	GV, W, T, L/P, P	.025 mg/m3R
6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Routes of Entry Codes: Inh – Inhalation, P – Penetration, Ing – Ingestion, S – Splash, A – Absorption

Engineering Control Codes: GB – Glovebox, GV – General Ventilation, Hood – Other LEV Hood, I/E – Isolate or Enclosed Hazard, LH – Lab Hood, S – Shielding, W – Wet Methods

Administrative Control Codes: T – Training, L/P – Labeling or Posting, P – Written Procedure/Plan, LT – Limited Stay Time, W/R – Modified Work/Rest Cycle, BEI – Biological Monitoring, MS – Medical Surveillance

	Health Severity Rating	Exposure Rating 1-4	Certainty Rating 1-3	QEA Rating 1-24	Exposure Decision
1	1	2	1	3	3
2	4	2	1	6	6
3	3	2	2	10	10
4	2	2	1	4	4
5	3	2	2	10	10
6	N/A	N/A	N/A	#VALUE!	#VALUE!
7	N/A	N/A	N/A	#VALUE!	#VALUE!

QEA Rating= (Health Severity Rating + Exposure Rating) x Certainty Rating
Exposure Decision: Acceptable (2-7) Uncertain (8-15) Unacceptable (16-24)

QHSP Approver:	Corey Carnahan
Date:	3/31/2025

Exposure Decision and Follow-up

	Was Risk Acceptable?	Describe justification for classification	Uncertain & Unacceptable Exposures: Follow-up Priority	Monitoring Required?	Reccomendations
1	Yes	Clear, green, thin liquid with a floral, citru odor. Used as a cleaning agent in cell. No exposure.	Low	No	N/A
2	Yes	Wet methods or HEPA vacuum will be used if drilling into painted surfaces or disturbing other surfaces having potential lead contamination. A minimum of Lead Level I training is required. Gloves and safety glasses will be worn for work activities, as required. Wet methods will not be used in areas on or near energized electrical components.	Low	No	N/A
3	No	Hierarchy of controls will be used to reduce noise exposure that exceed 85 dBA. Hearing protection with a NRR capable attenuating noise exposure below 85 dBA/8H TWA are required when working in environments exceeding 85 dBA. See work control documents &/or postings for specific controls or contact IS/IH for further evaluation & controls.	Low	No	N/A
4	Yes	Personnel will apply 30-50-30 criteria for non-repetitive lifting tasks and will use proper lifting techniques. For awkward loads or those exceeding 50 lbs., lifting aids or two-person lifts will be used, where feasible. There is no intended repetitive or production-type two-handed mono-lifting task associated with the work activities, therefore, the TLVs do not apply.	Low	No	N/A
5	No	Approved integrated HEPA tool attachments shall be used when drilling into masonry surfaces and work activities shall meet the Respirable Crystalline Silica Exclusion guidelines in SBMS. Personnel are silica trained. Gloves and safety glasses are required when performing work activities. Wet methods or HEPA vacuum will be used as needed. Contact IS/IH if requirements can't be met.	Low	No	N/A