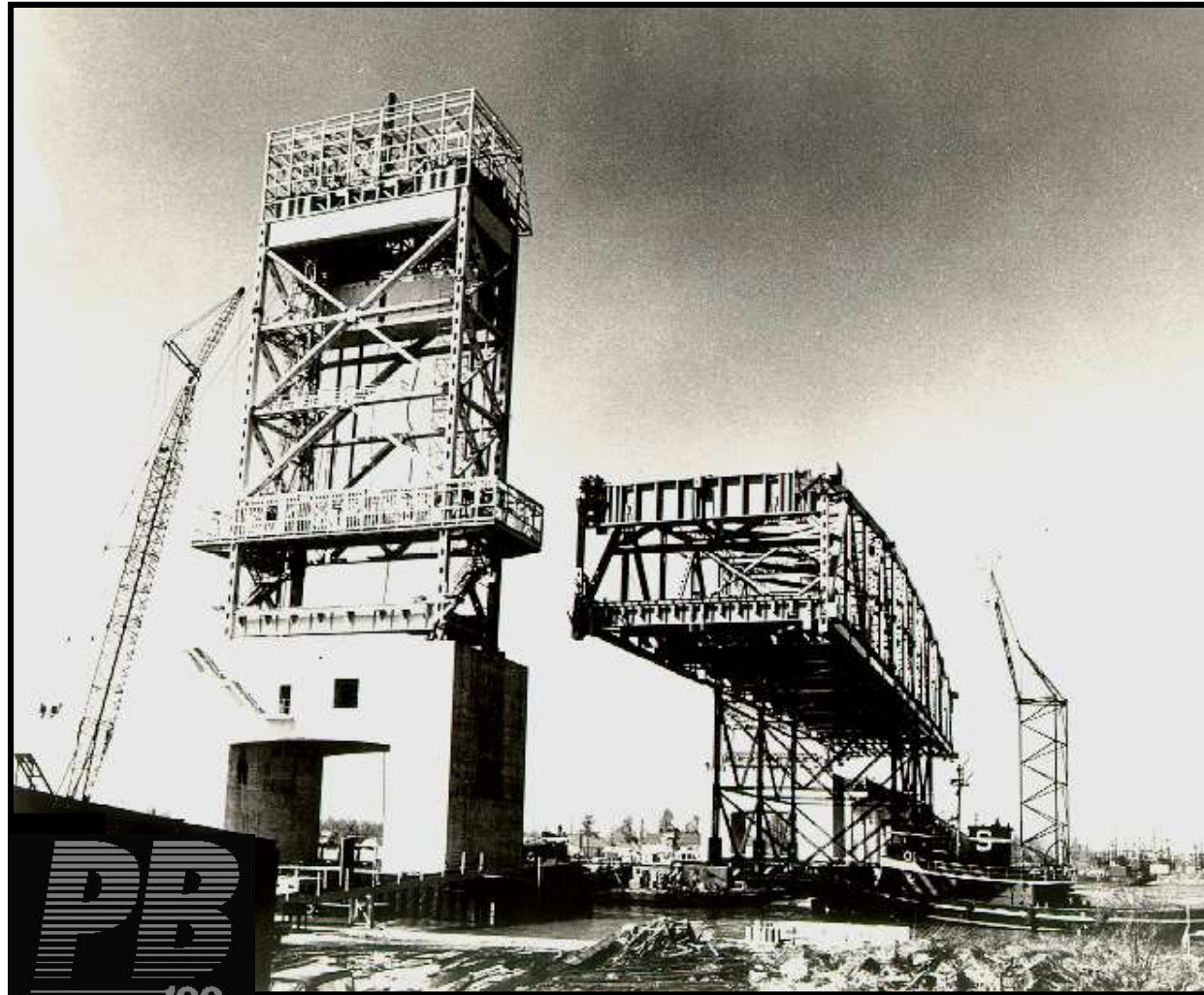


ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES



SCOTT SNELLING, EIT

OUTLINE

- ANATOMY
- ALIGNMENT OF COMPONENTS
- DEFLECTIONS
- SPAN ALIGNMENT
- ROPE LAY & CWT. TWIST

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ANATOMY OF VERTICAL LIFT BRIDGES



HALSTEAD STREET, CHICAGO

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ANATOMY OF VERTICAL LIFT BRIDGES



TOWER SPAN DRIVE

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

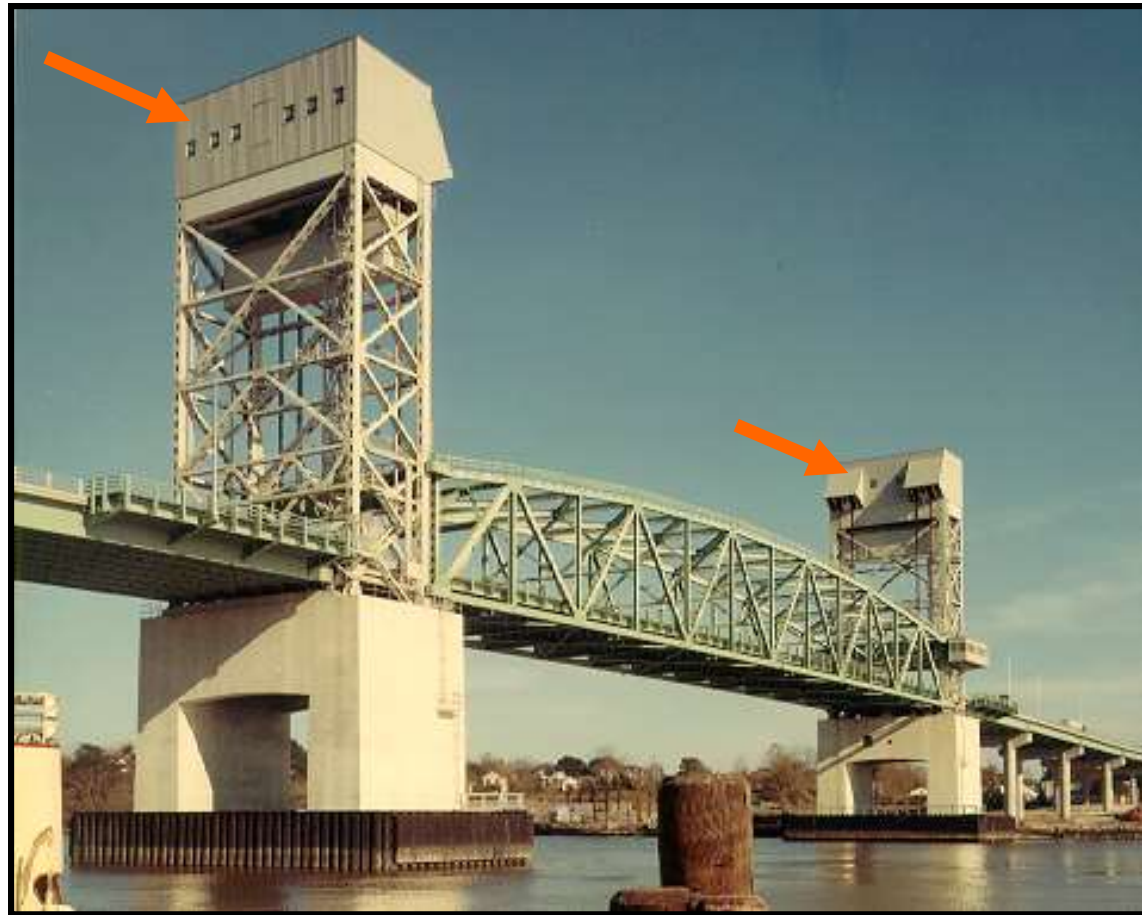
ANATOMY OF VERTICAL LIFT BRIDGES



SPAN DRIVE

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

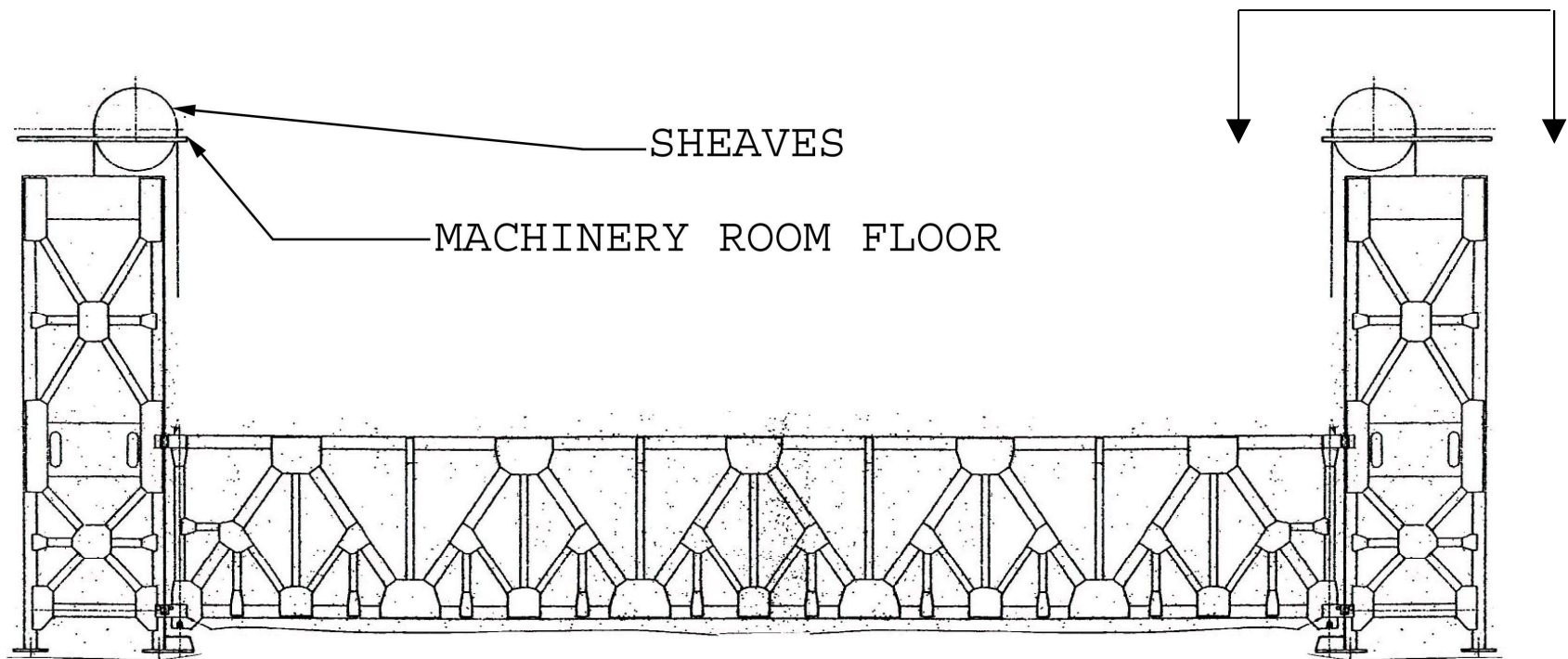
ANATOMY OF VERTICAL LIFT BRIDGES



TOWER DRIVE

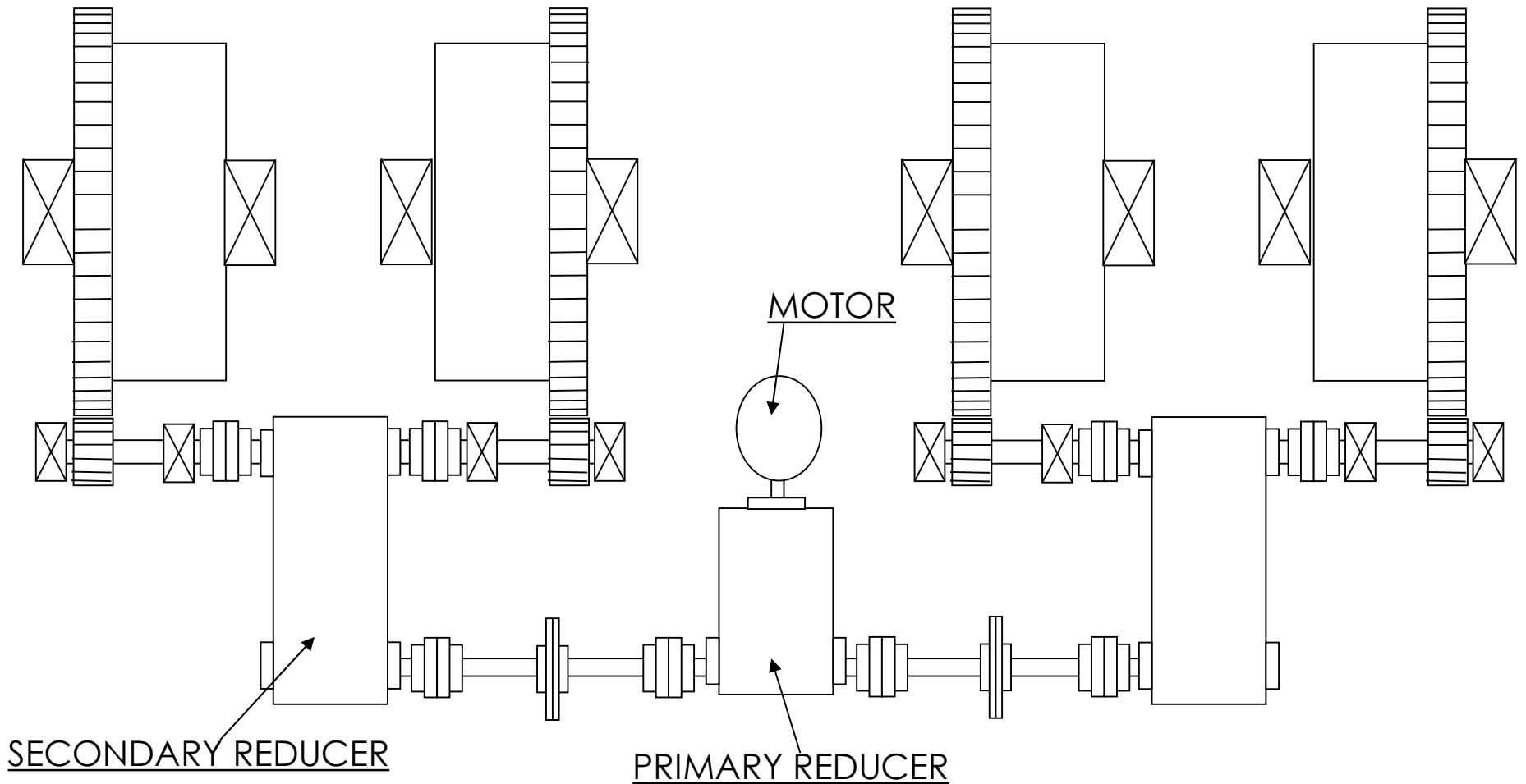
ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ANATOMY OF TOWER DRIVE VERTICAL LIFT BRIDGES



ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

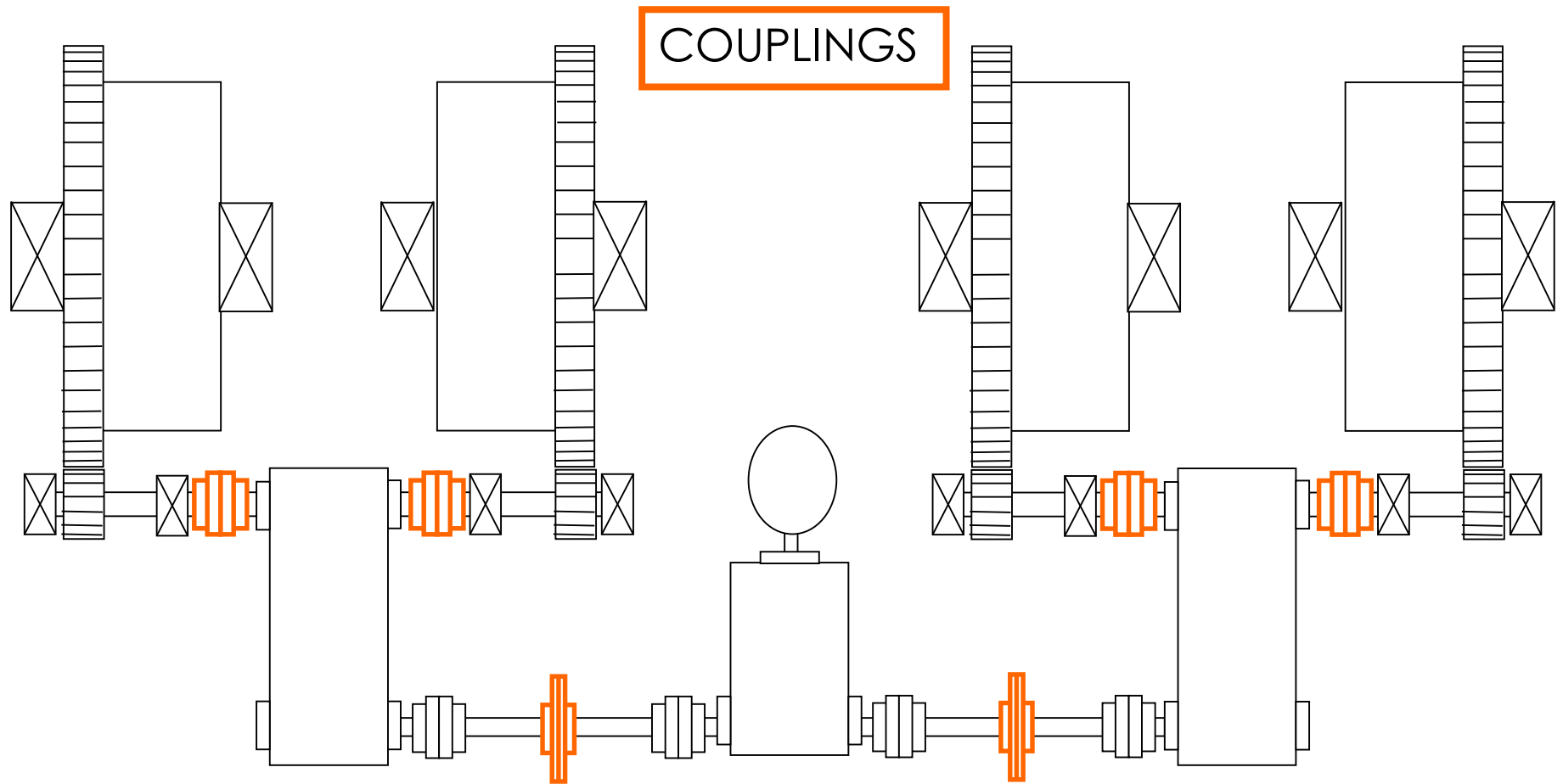
ANATOMY OF TOWER DRIVE BRIDGES



SAMPLE MACHINERY ROOM PLAN

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

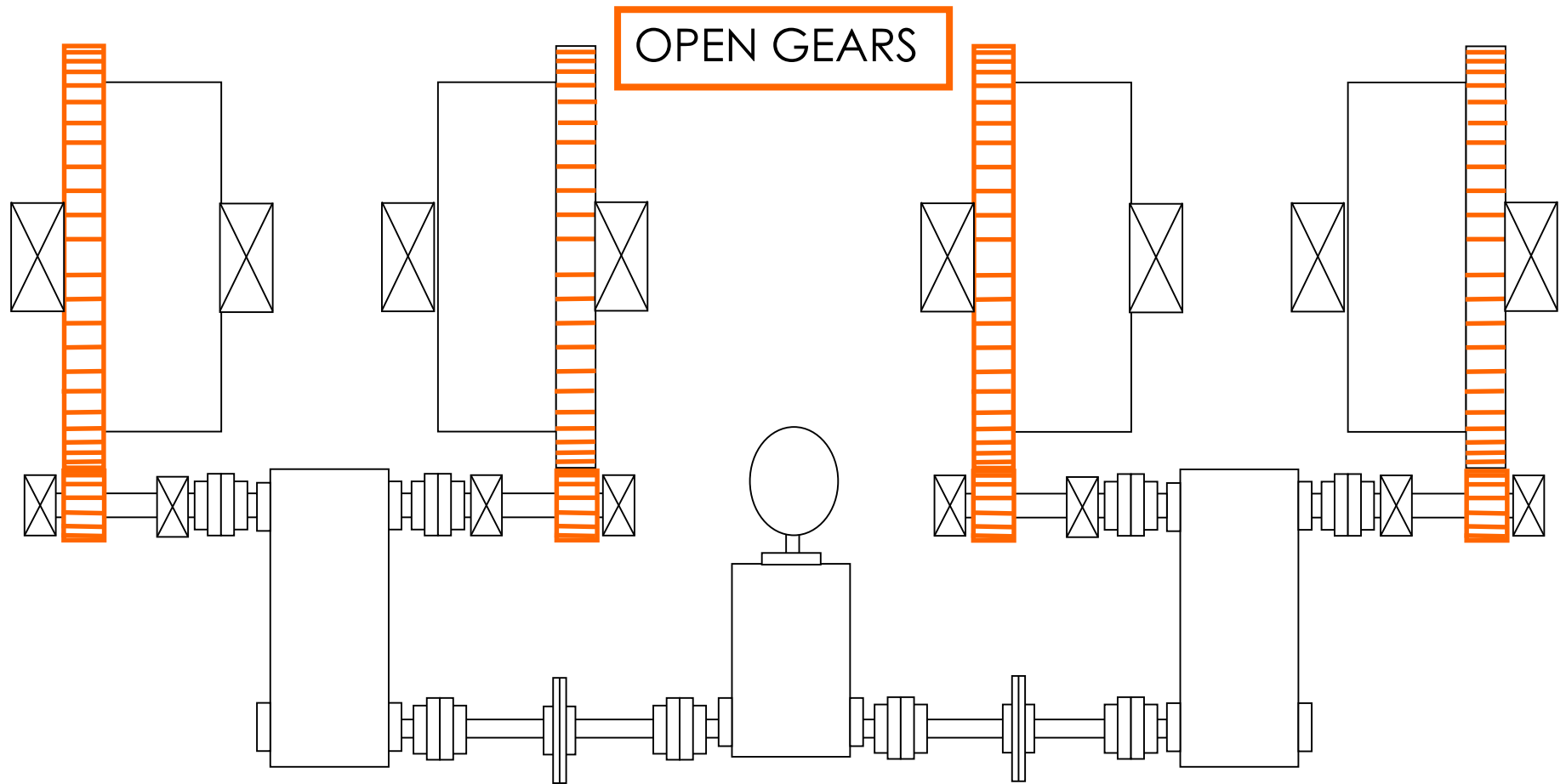
ANATOMY OF TOWER DRIVE BRIDGES



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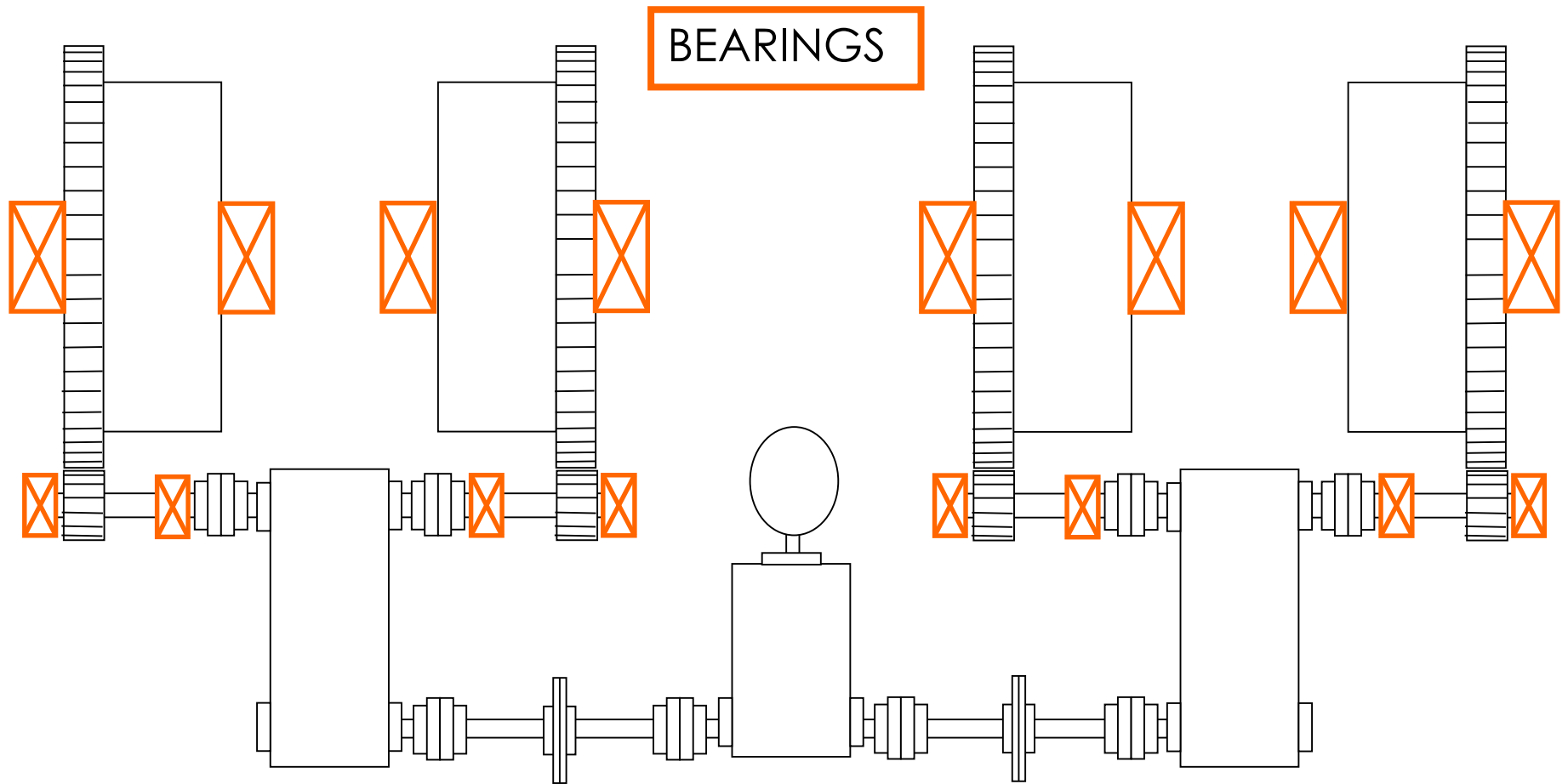
ANATOMY OF TOWER DRIVE BRIDGES



SAMPLE MACHINERY ROOM PLAN

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ANATOMY OF TOWER DRIVE BRIDGES



SAMPLE MACHINERY ROOM PLAN

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

OUTLINE

- ANATOMY
- **ALIGNMENT OF COMPONENTS**
- DEFLECTIONS
- SPAN ALIGNMENT
- ROPE LAY & CWT. TWIST

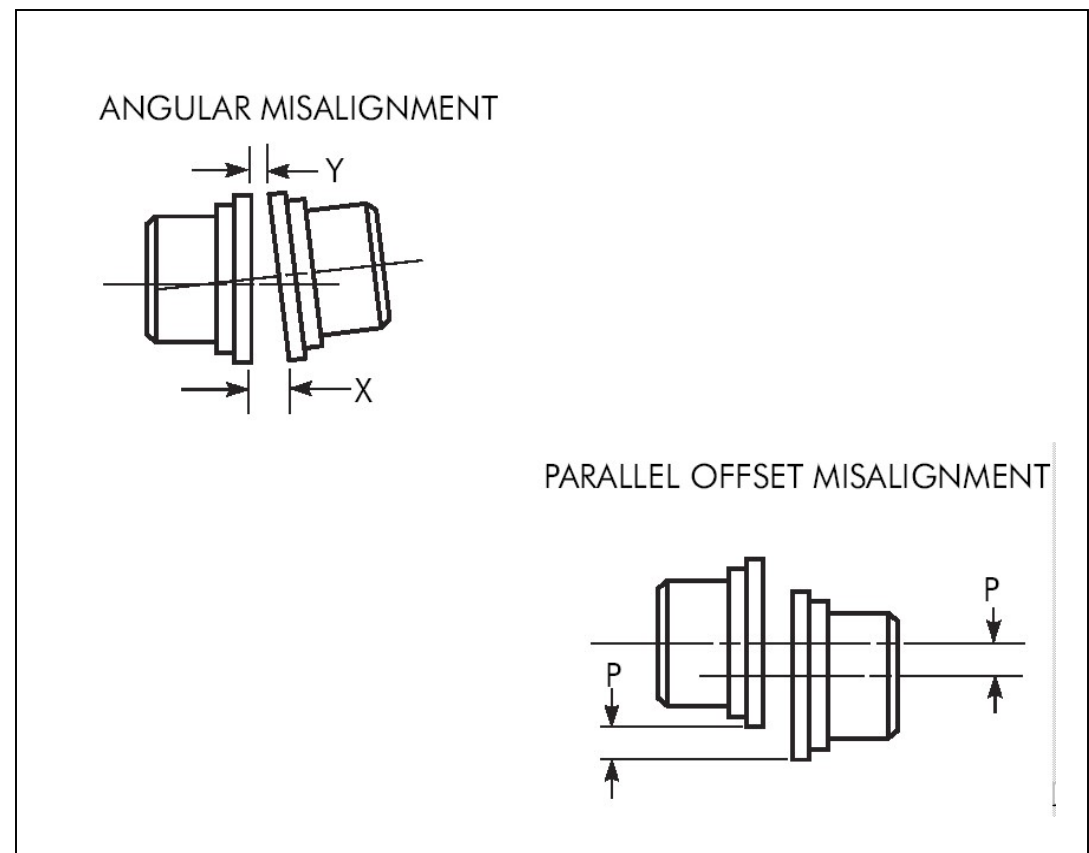
ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ALIGNMENT OF OPERATING MACHINERY COMPONENTS

● **COUPLINGS**

○ GEARING

○ BEARINGS



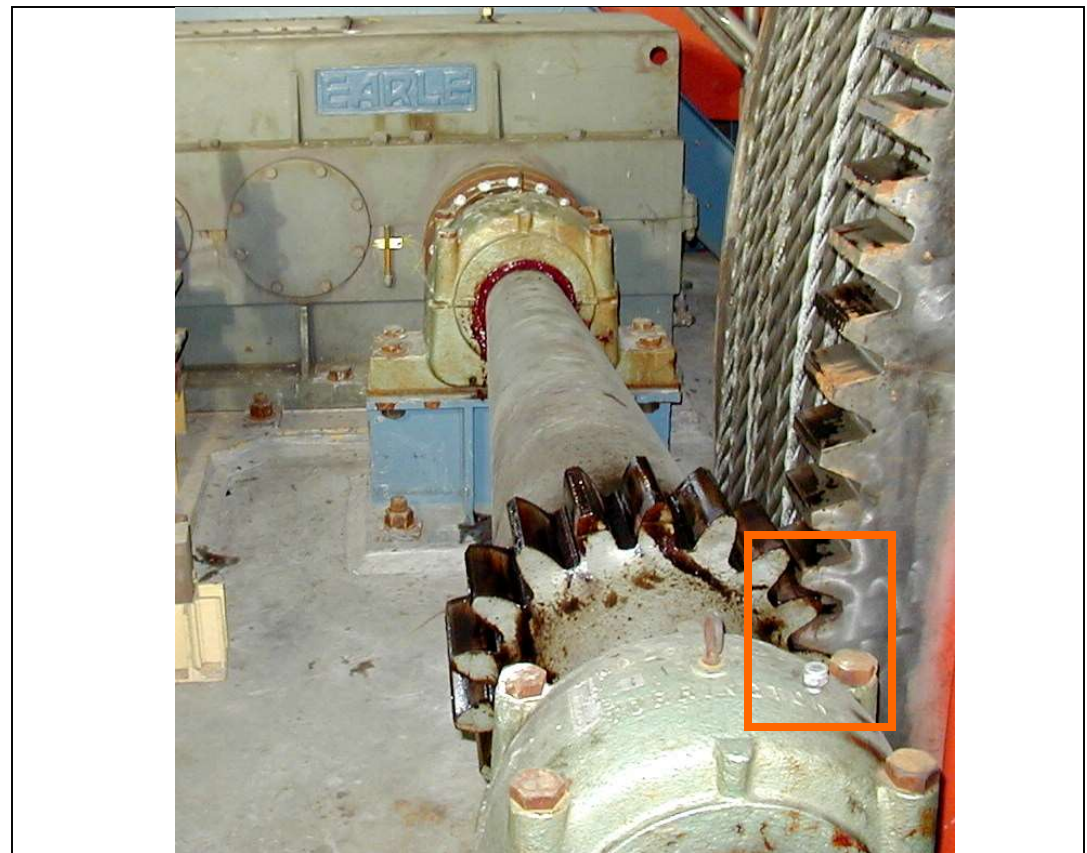
ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ALIGNMENT OF OPERATING MACHINERY COMPONENTS

- COUPLINGS

- **GEARING**

- BEARINGS



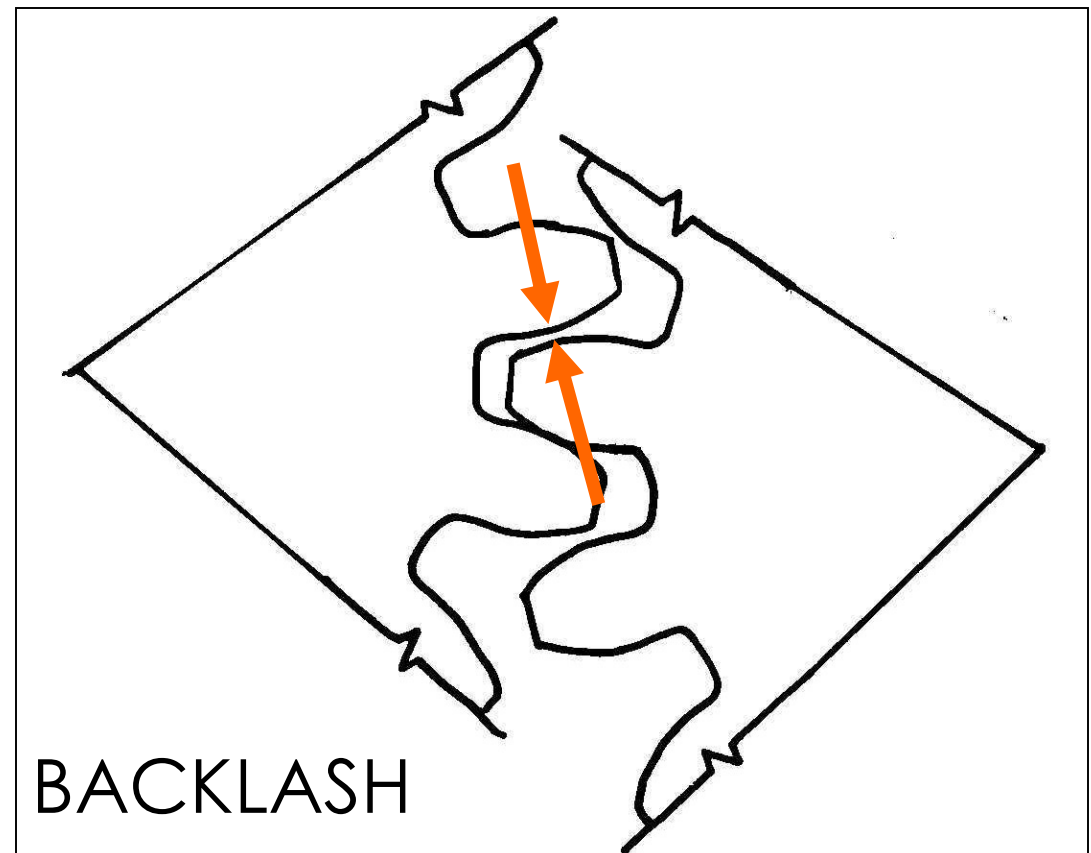
ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ALIGNMENT OF OPERATING MACHINERY COMPONENTS

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○ BEARINGS



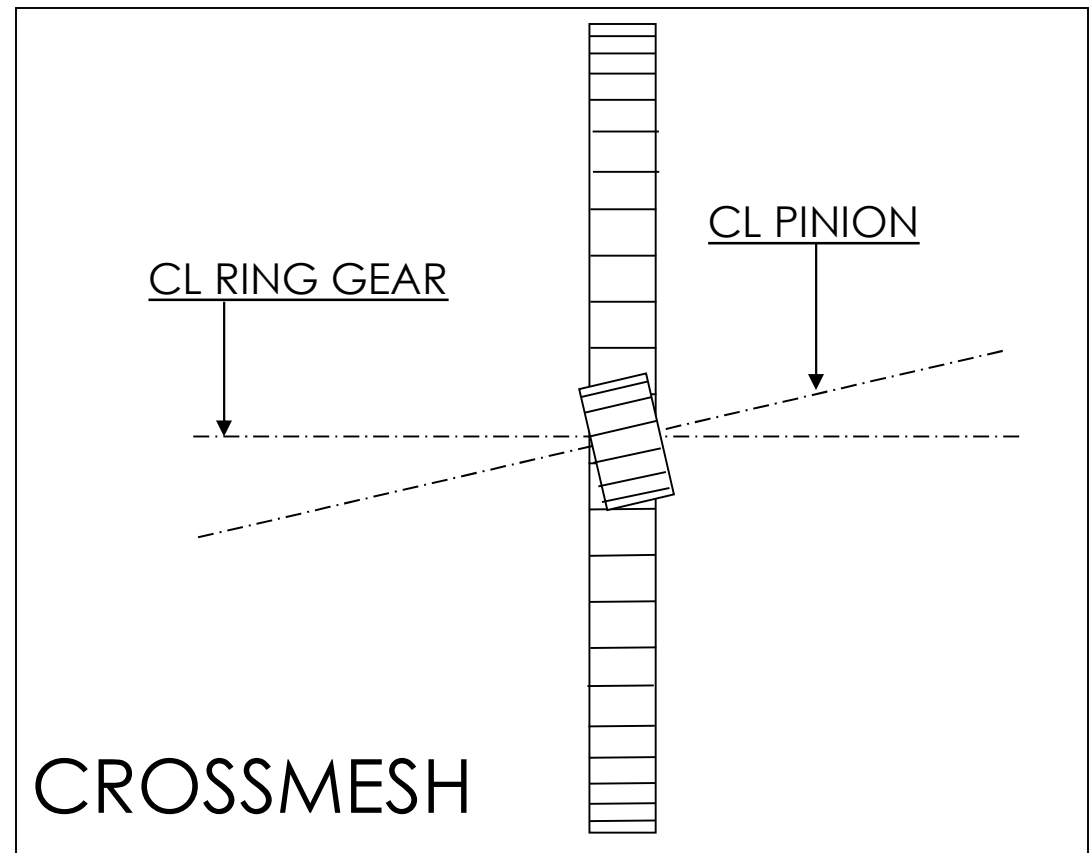
ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ALIGNMENT OF OPERATING MACHINERY COMPONENTS

○ COUPLINGS

● **GEARING**

○ BEARINGS



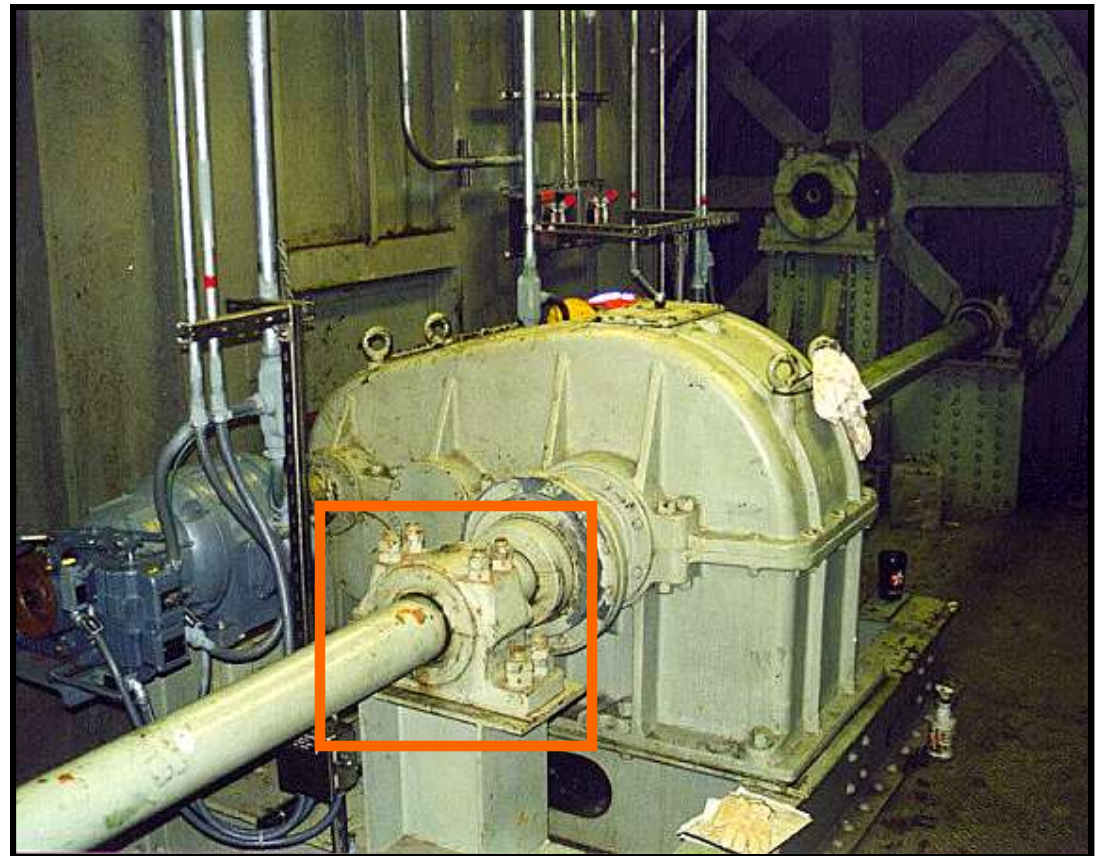
ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ALIGNMENT OF OPERATING MACHINERY COMPONENTS

○ COUPLINGS

○ GEARING

● **BEARINGS**



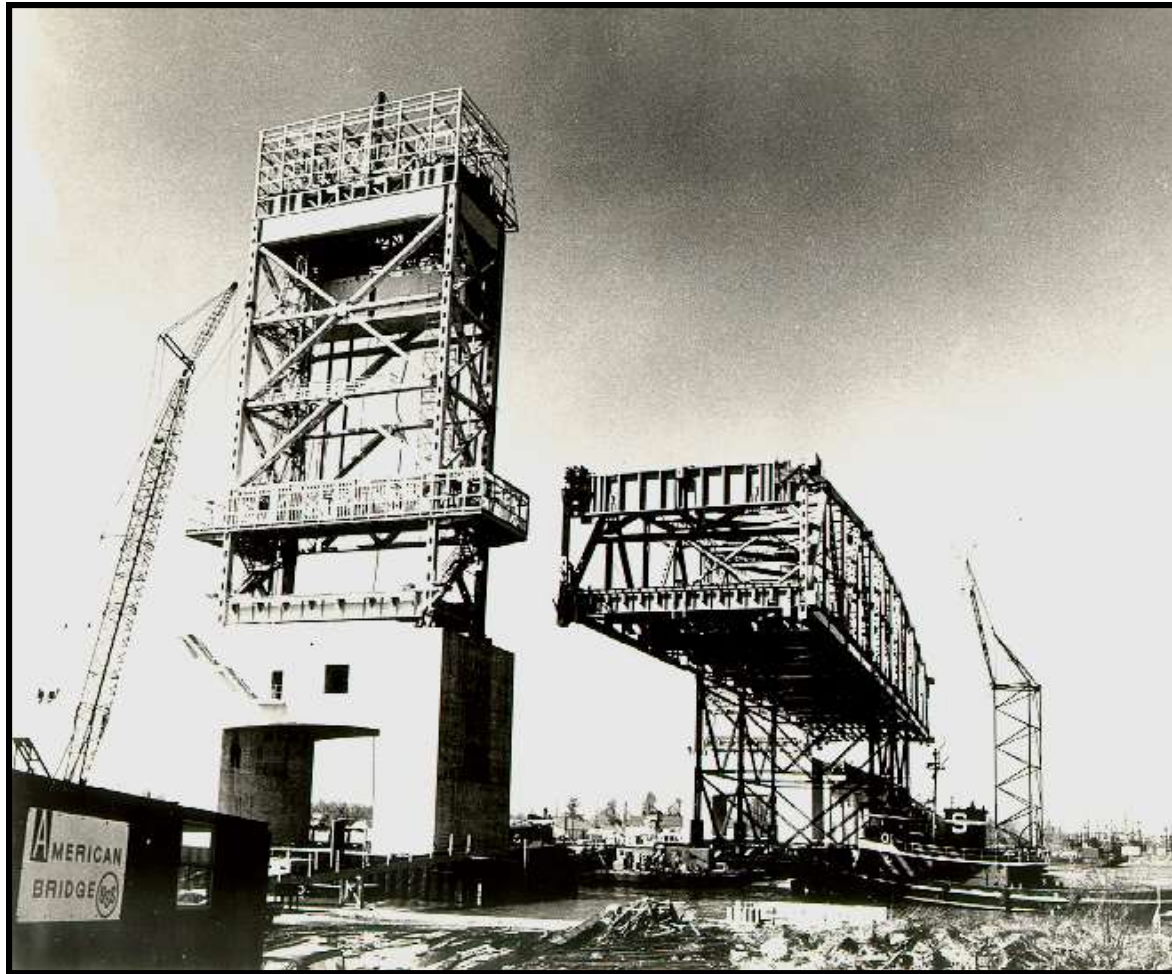
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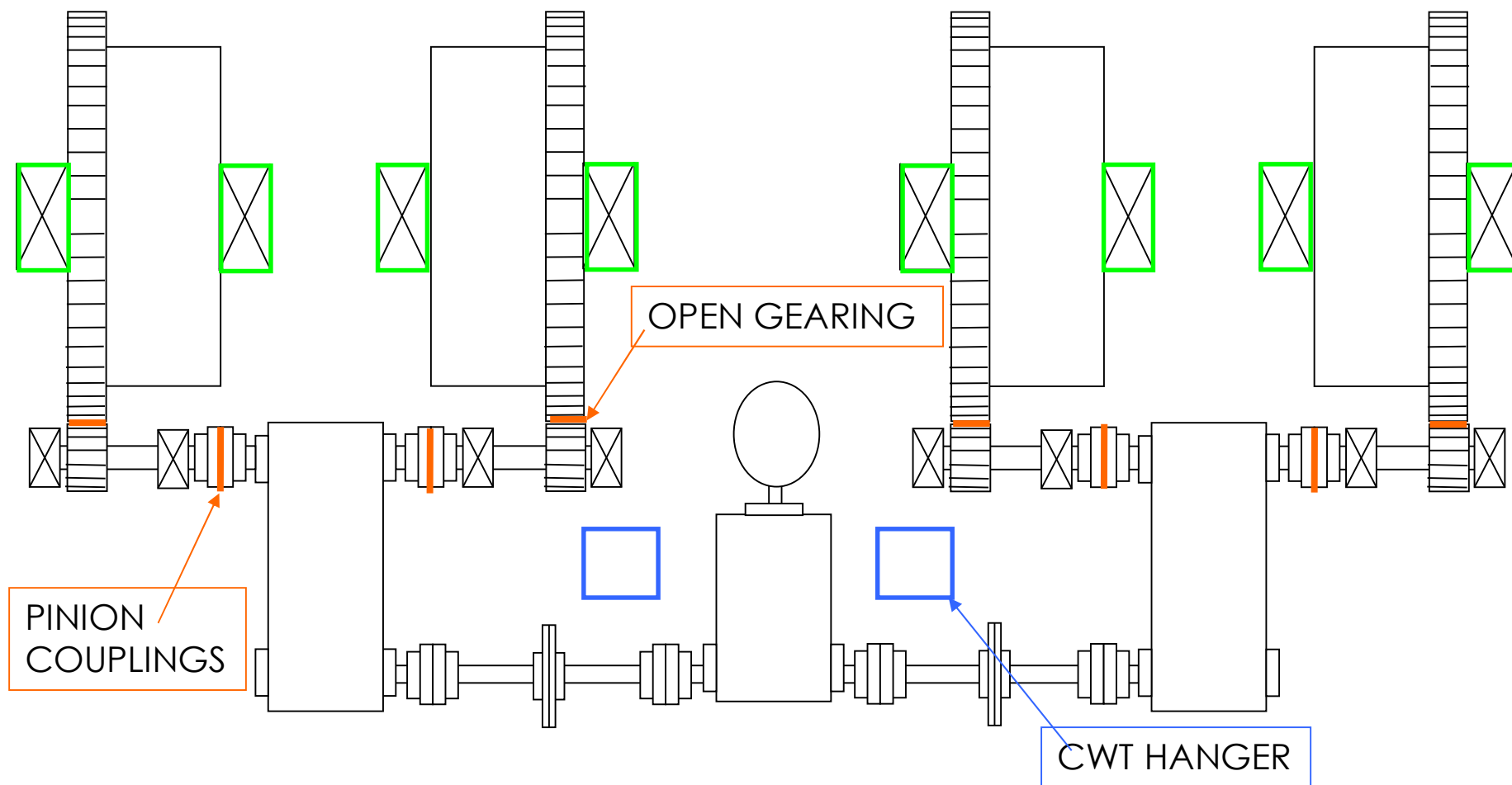
MISALIGNMENTS DUE TO DEFLECTIONS



CAUSE OF DEFLECTIONS

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

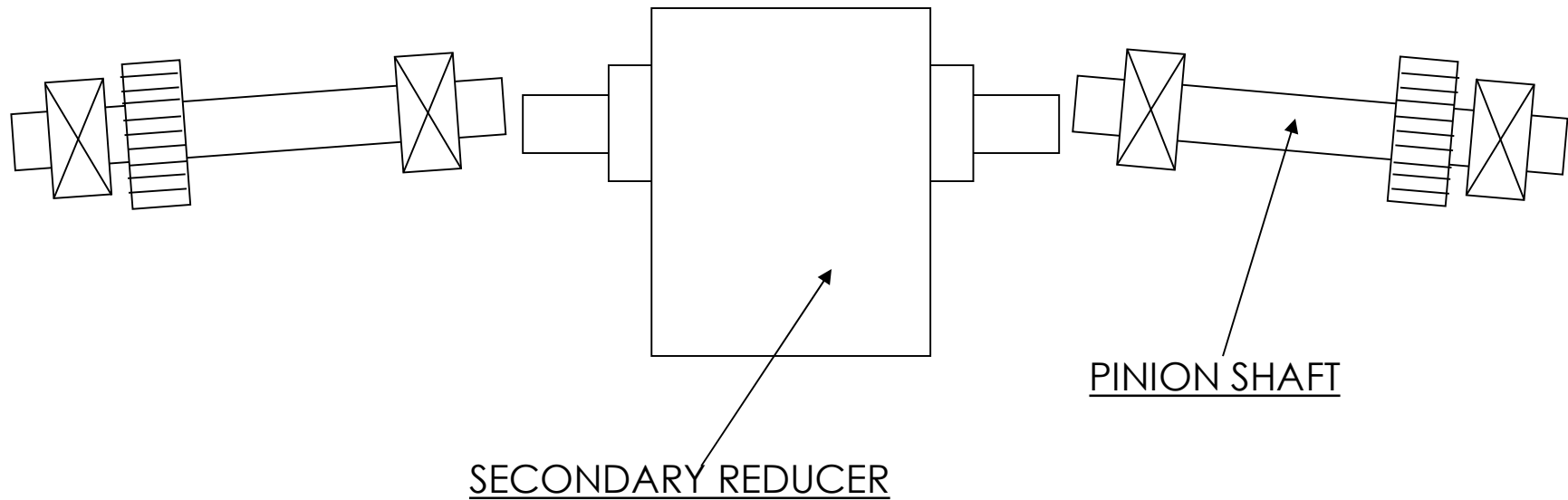
MISALIGNMENTS DUE TO DEFLECTIONS



EFFECTED MACHINERY COMPONENTS

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

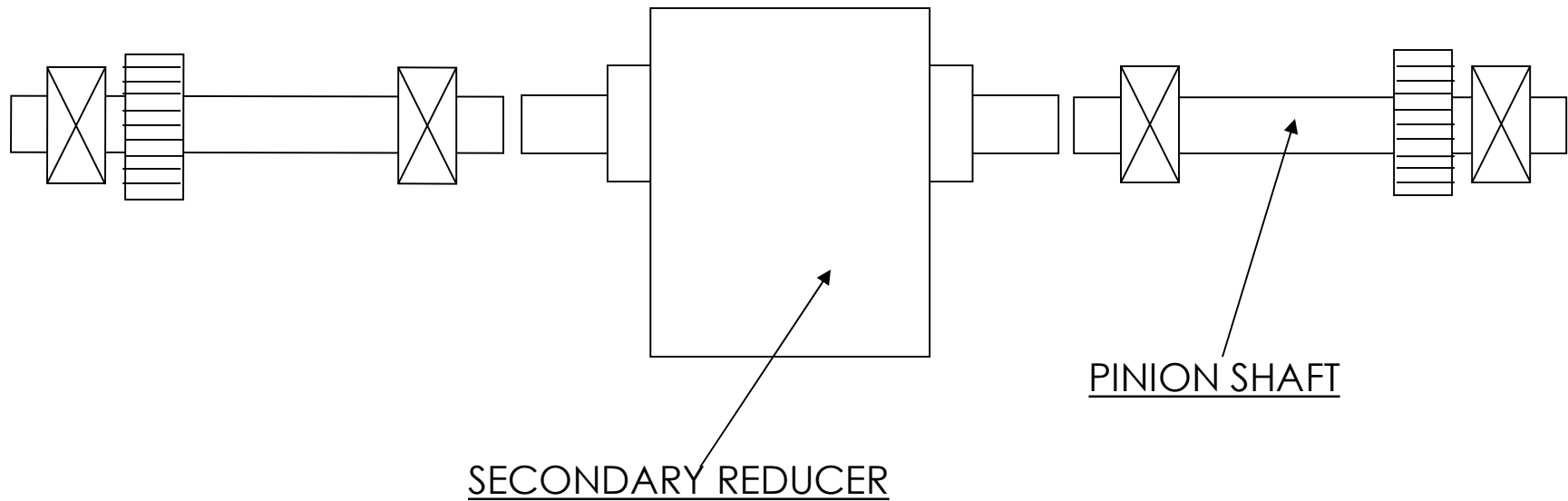
EFFECT OF DEFLECTIONS ON PINION COUPLING



ELEVATION

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

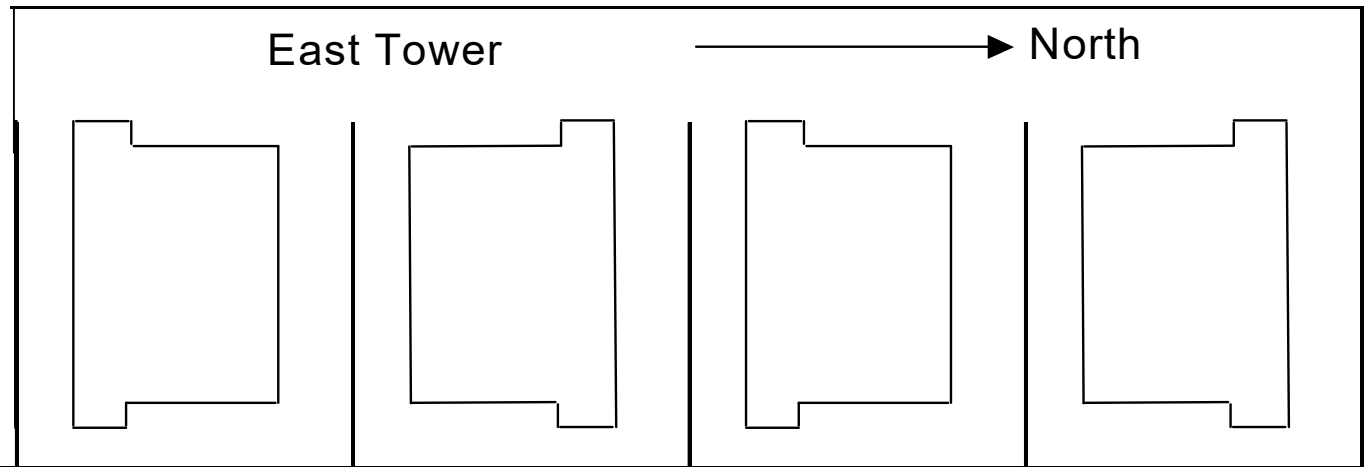
EFFECT OF DEFLECTIONS ON PINION COUPLING



ELEVATION

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

EFFECT OF DEFLECTIONS ON BACKLASH



Sheave Number	4		3		2		1	
Side of Tooth	S	N	S	N	S	N	S	N
Tuesday No Load on Sheaves	95	110	124	116	79	80	125	110
Wednesday Load on Sheaves	48	60	139	119	152	155	104	88
Change Due to Deflections	-47.00	-50.00	15.00	3.00	73.00	75.00	-21.00	-22.00
	tighter		looser		looser		tighter	

* All Measurements in thousandths of an inch - The specifications called for a backlash of 90 plus or minus 10.

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

OUTLINE

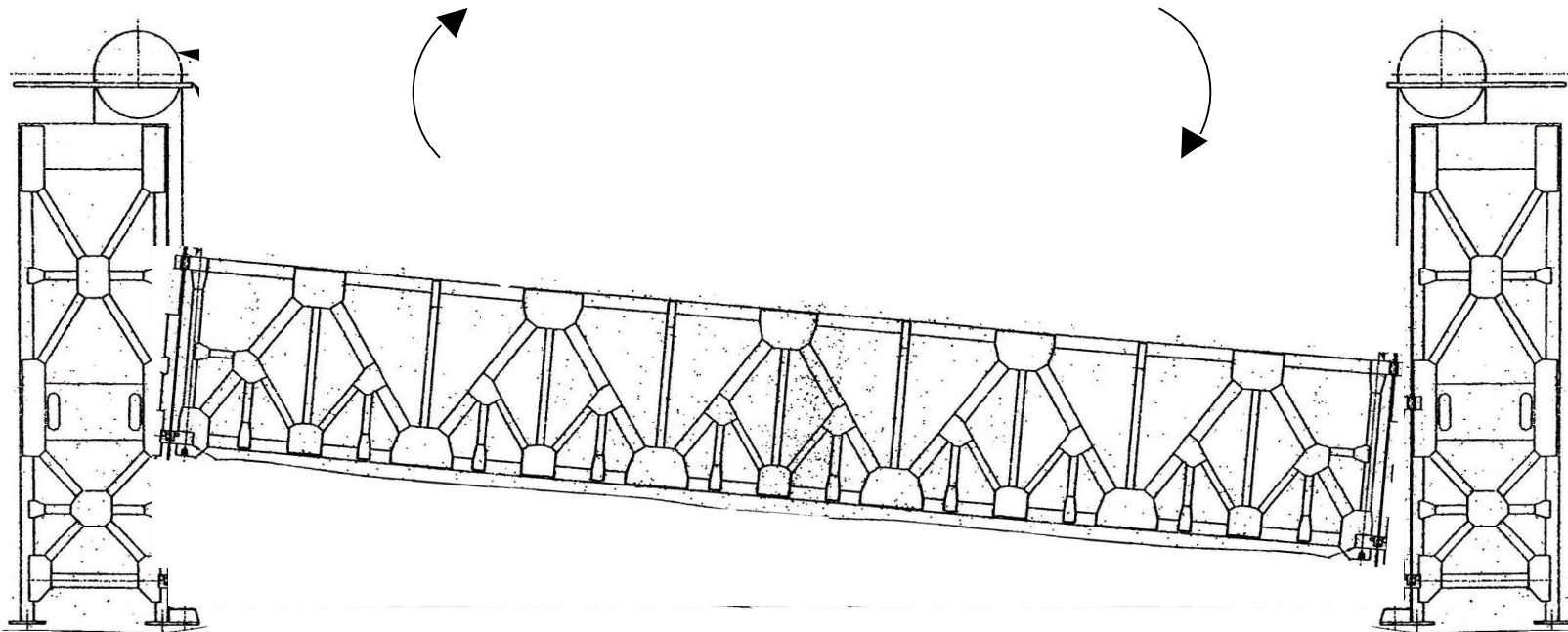
- ANATOMY
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ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ADJUSTING SPAN ALIGNMENT

● **SKEW**

○ WARP

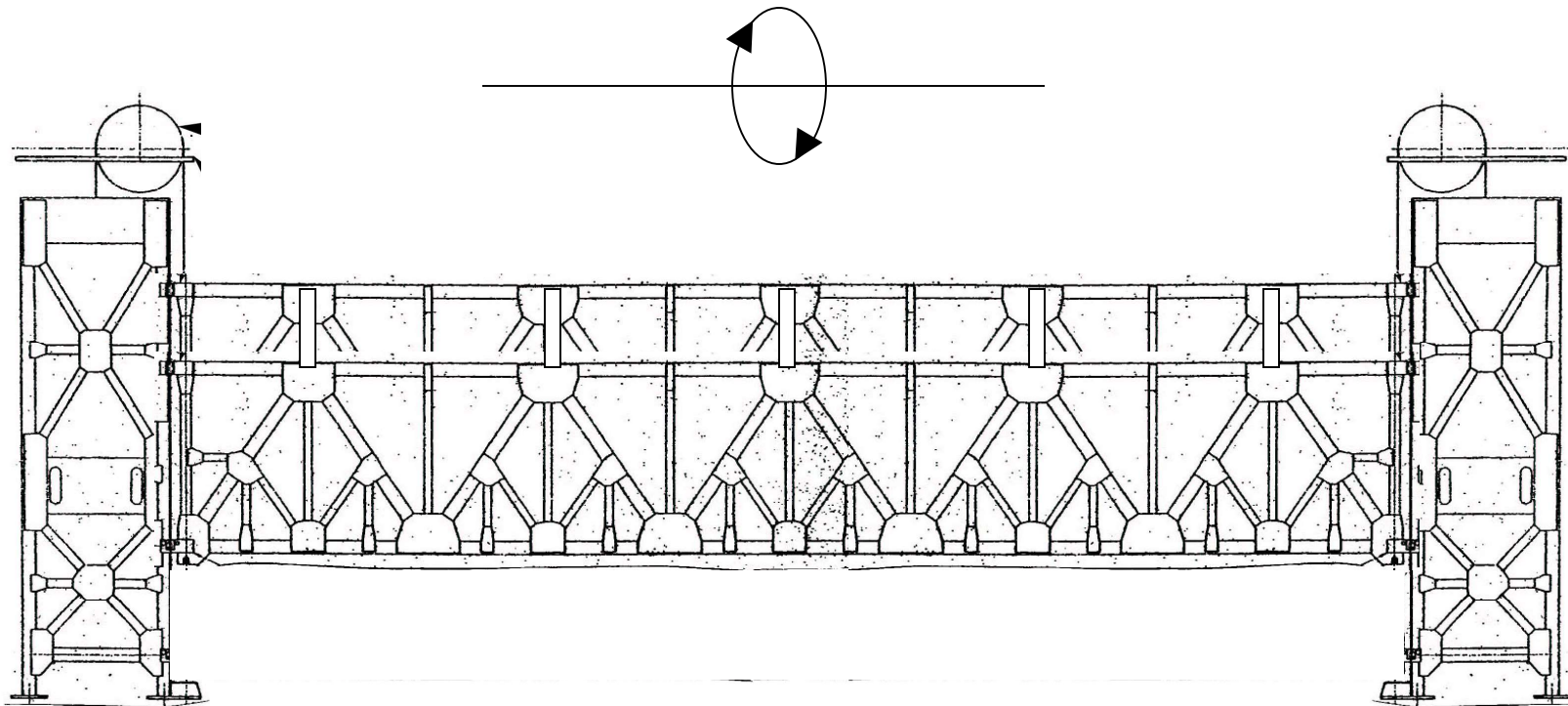


ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ADJUSTING SPAN ALIGNMENT

○ SKEW

● **WARP**



ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

GOALS OF SPAN ADJUSTMENT

- SHEAVES DRIVEN WITH EQUAL POWER
- LIVE LOAD SHOES WITH EQUAL LOAD

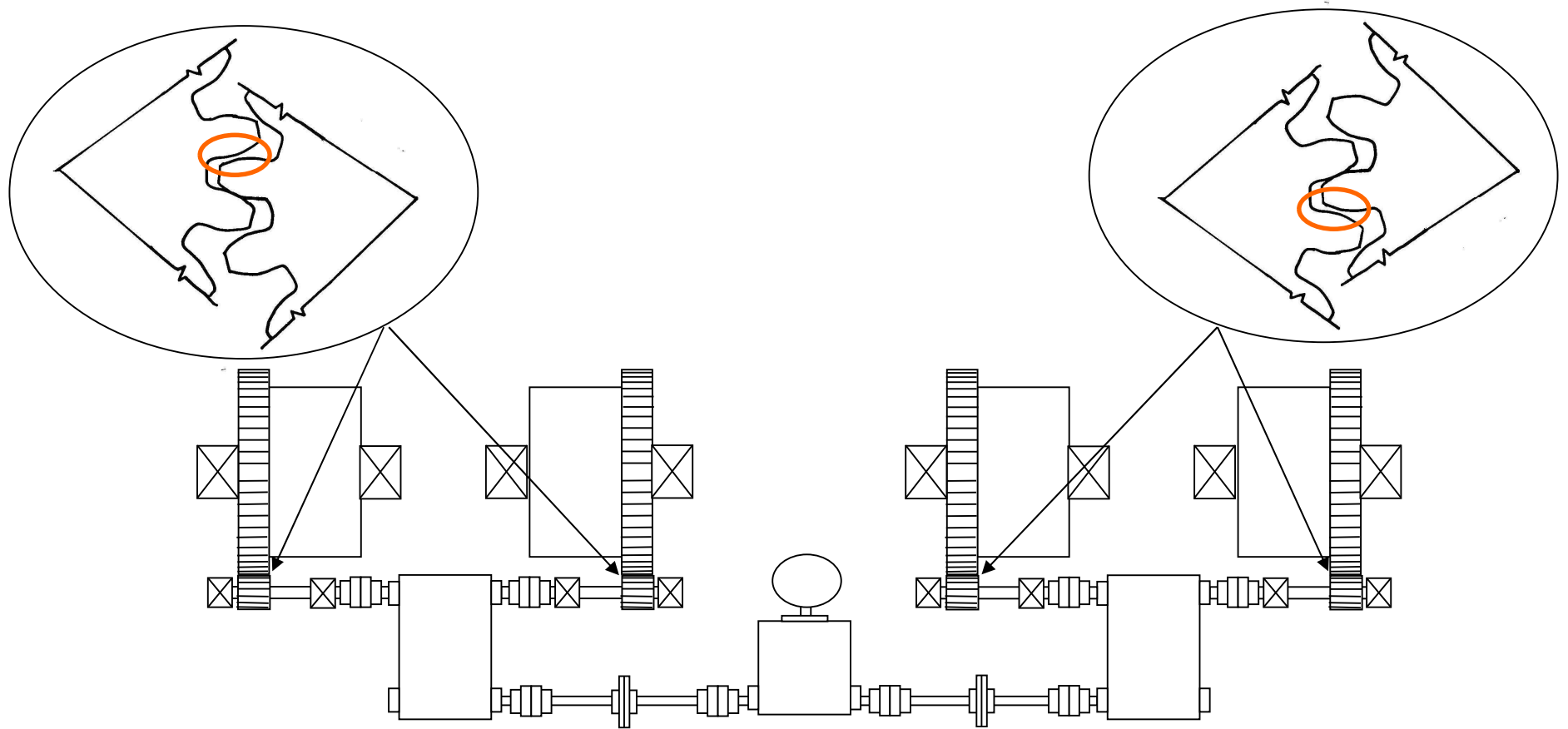
ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

CONDITIONS FOR NO WARP

- SEATS FOR LIVE LOAD SHOES AT PROPER ELEVATIONS
- TRANSVERSE BALANCE
- WARP ADJUSTMENT CLUTCH ADJUSTED

INDICATORS OF WARP

- ANOMOLIES IN BACKLASH
- A LIVE LOAD SHOE DOESN'T SEAT



ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

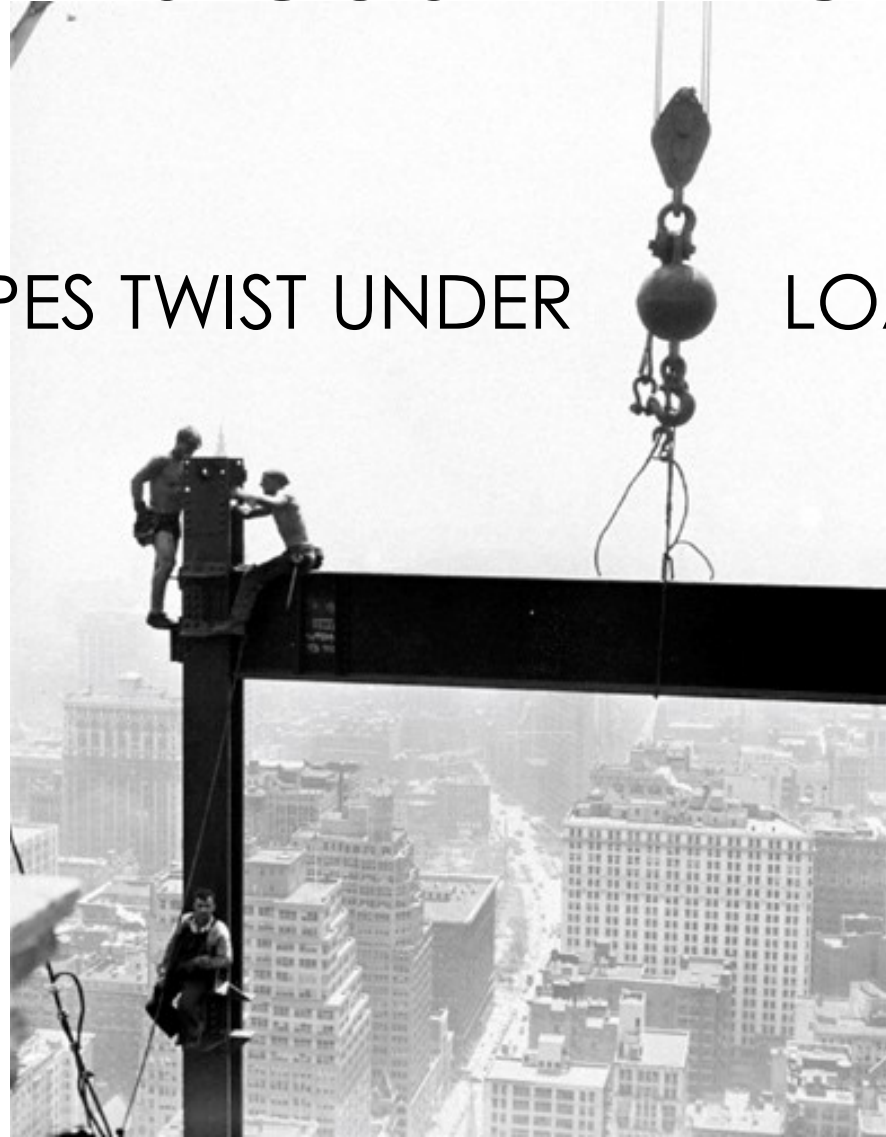
OUTLINE

- ANATOMY
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- **ROPE LAY & CWT. TWIST**

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

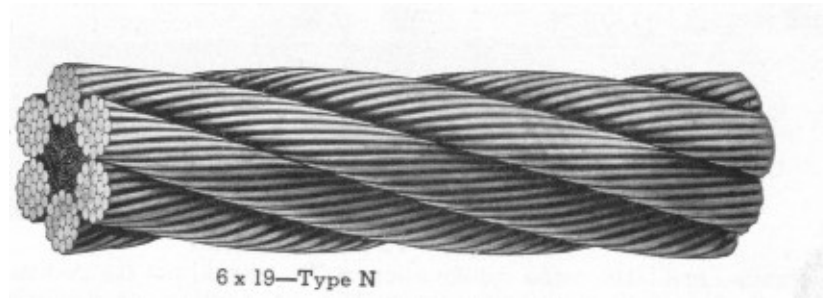
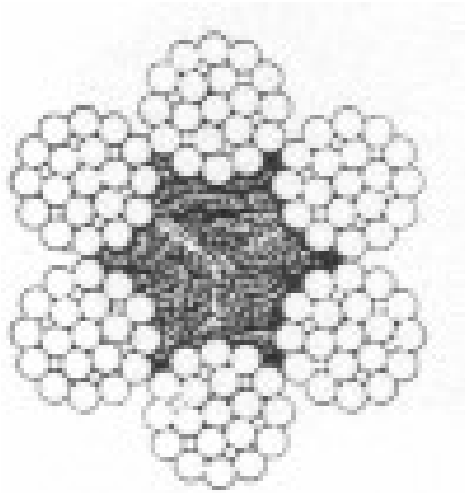
ROPE LAY & COUNTERWEIGHT TWIST

WIRE ROPES TWIST UNDER LOAD



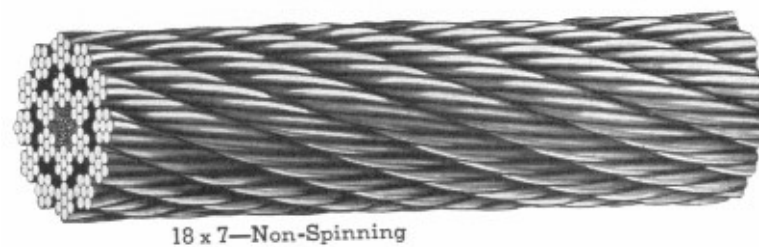
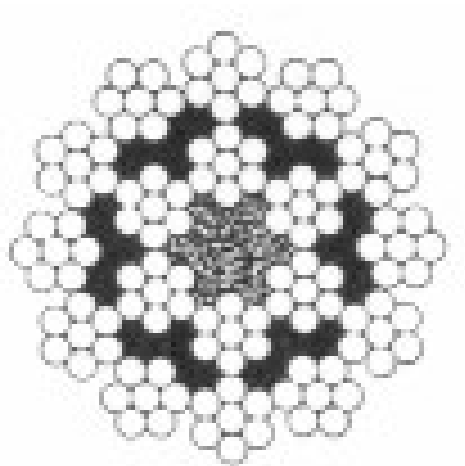
ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ROPE LAY & COUNTERWEIGHT TWIST



6 x 25 FIBER CORE

$T=kDW$



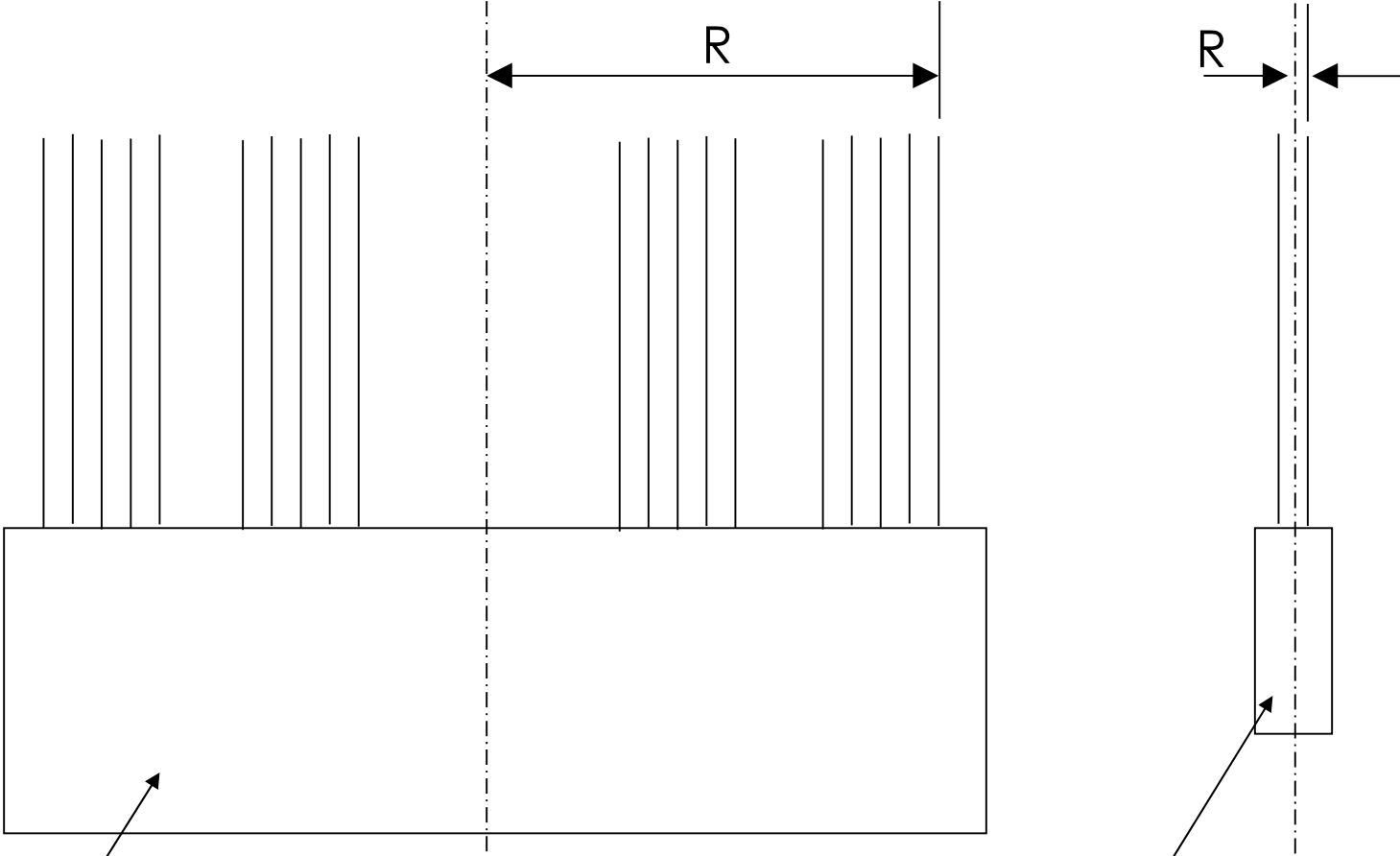
NON-TWISTING ROPE

$T=\sim 0$

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ROPE LAY & COUNTERWEIGHT TWIST

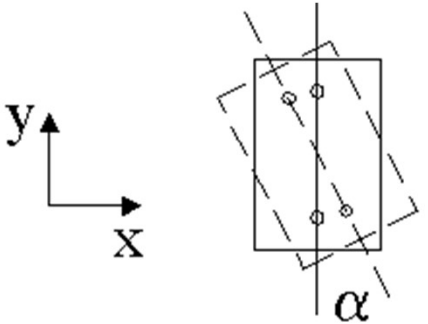
EXPERIENCE SHOWS:



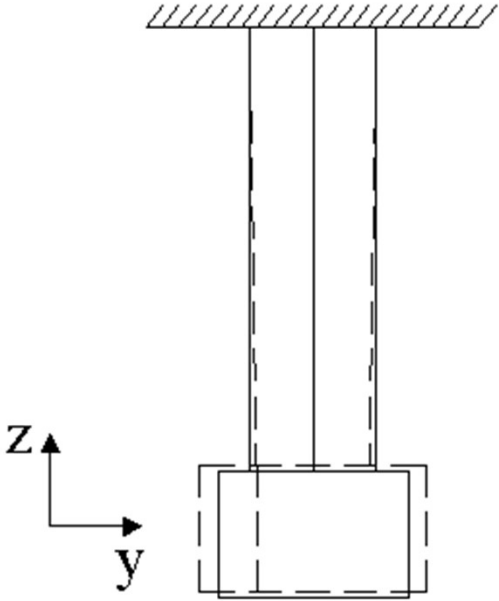
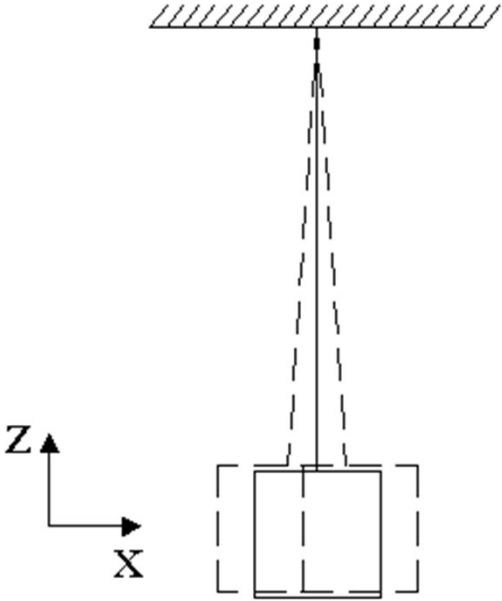
MAIN CWT'S DON'T TWIST, AUXILIARY CWT'S DO

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ROPE LAY & COUNTERWEIGHT TWIST



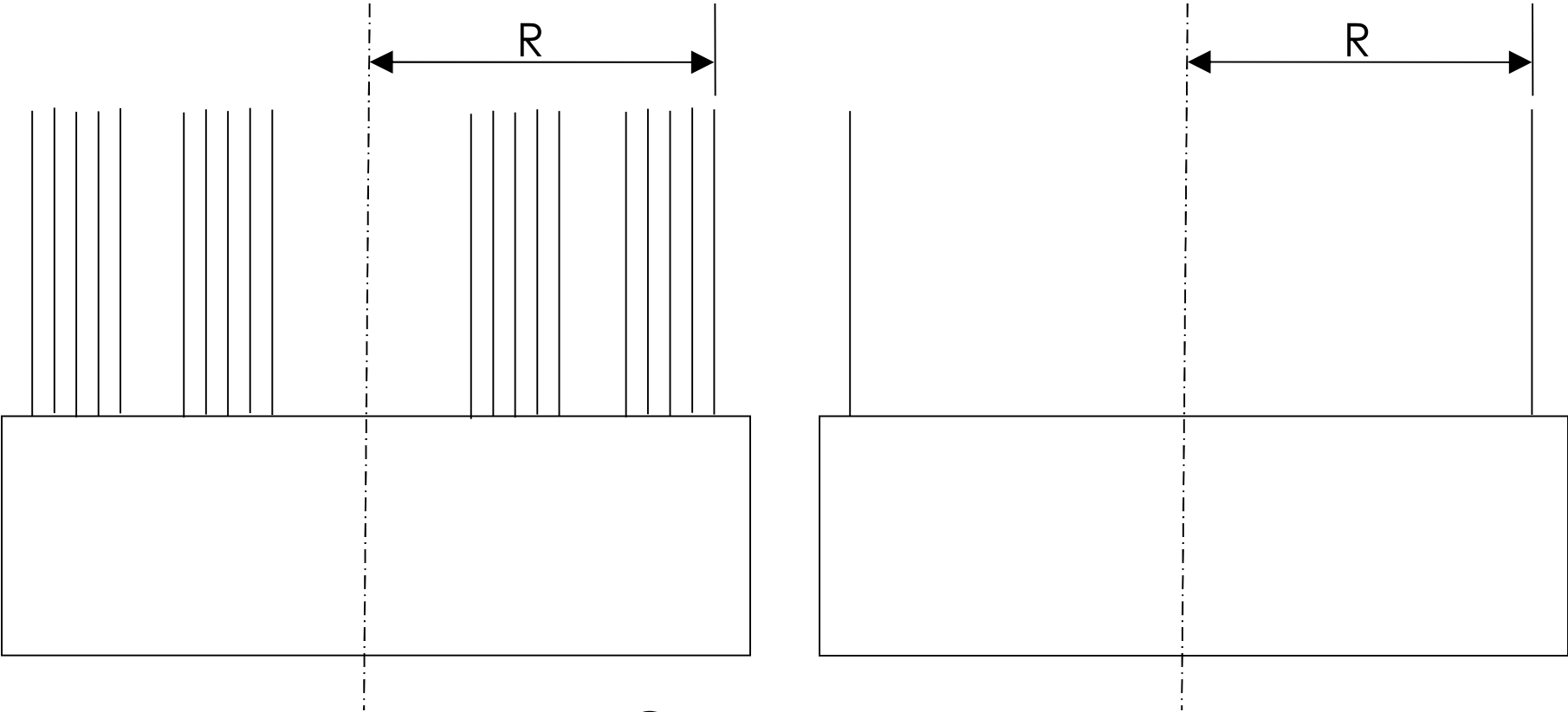
- $\uparrow \alpha$ \uparrow Weight
- $\uparrow \alpha$ \uparrow Rope Diam
- $\uparrow \alpha$ \uparrow Rope Free Length
- $\downarrow \alpha$ \uparrow Dist Between Ropes



ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ROPE LAY & COUNTERWEIGHT TWIST

ASSUMPTION:



EQUIVALENT

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ROPE LAY & COUNTERWEIGHT TWIST

ANALYSIS RESULTS:

	MAIN CWT.	AUXILIARY CWT.
WEIGHT	3 100 000 LB.	13 000 LB.
ROPE DIAM	2 ¼ IN.	0.875 IN.
ROPE TO CL (R)	450 IN.	3 IN.
TORQUE	52 000 FT-LB	85 FT-LB
TWIST (α)	0.02°	+90°

ALIGNMENT OF THE MACHINERY FOR TOWER DRIVE VERTICAL LIFT BRIDGES

ROPE LAY & COUNTERWEIGHT TWIST



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