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**APPENDIX B: FATIGUE PRONE DETAILS**

General Conditions	Situation	Kind of Stress	Stress Category	Illustrative Example (See Pgs 1-D-5 & 6)
Plain Member	Base metal with rolled or cleaned surface. Flame-cut edges with ANSI smoothness of 1,000 or less.	T or Rev <sup>a</sup>	A	1,2
Built-Up Members	Base metal and weld metal in members of built-up plates or shapes (without attachments) connected by continuous full penetration groove welds (with backing bars removed) or by continuous fillet welds parallel to the direction of applied stress.	T or Rev	B	3,4,5,7
	Base metal and weld metal in members of built-up plates or shapes (without attachments) connected by continuous full penetration groove welds with backing bars not removed, or by continuous partial penetration groove welds parallel to the direction of applied stress.	T or Rev	B'	3,4,5,7
	Calculated flexural stress at the toe of transverse stiffener welds on girder webs or flanges.	T or Rev	C	6
	Base metal at ends of partial length welded coverplates with high-strength bolted slip-critical end connections (see Note <sup>b</sup> )	T or Rev	B	22
	Base metal at ends of partial length welded coverplates narrower than the flange having square or tapered ends, with or without welds across the ends, or wider than the flange without welds across the ends.			
	(a) Flange thickness ≤ 0.8 in. (b) Flange thickness > 0.8 in.	T or Rev T or Rev	E E'	7 7
	Base metal at ends of partial length welded coverplates wider than the flange without welds across the ends.	T or Rev	E'	7
Groove Welded Connections	Base metal and weld metal in or adjacent to full penetration groove weld splices of rolled or welded sections having similar profiles when welds are ground flush with grinding in the direction of applied stress and weld soundness established by nondestructive inspection.	T or Rev	B	8,10
	Base metal and weld metal in or adjacent to full penetration groove weld splices with 2-foot radius transitions in width, when welds are ground flush with grinding in the direction of applied stress and weld soundness established nondestructive inspection.	T or Rev	B	13
	Base metal and weld metal in or adjacent to full penetration groove weld splices at transitions in width or thickness, with welds ground to provide slopes no steeper than 1 to 2½, with grinding in the direction of the applied stress, and weld soundness			



	established by nondestructive inspection:			
	(a) AASTHO M 270 Grades 100/100W (ASTM A 709) base metal	T or Rev	B'	11,12
	(b) Other base metals	T or Rev	B	11,12
	Base metal and weld metal in or adjacent to full penetration groove weld splices, with or without transitions having slopes no greater than 1 to 2½, when the reinforcement is not removed and weld soundness is established by nondestructive inspection.	T or Rev	C	8,10,11, 12
Groove Welded Attachments— Longitudinally Loaded <sup>c</sup>	Base metal adjacent to details attached by full or partial penetration groove welds when the detail length, L, in the direction of stress, is less than 2 inches.	T or Rev	C	6.15
	Base metal adjacent to details attached by full or partial penetration groove welds when the detail length, L, in the direction of stress, is between 2 inches and 12 times the plate thickness, but less than 4 inches.	T or Rev	D	15
	Base metal adjacent to details attached by full or partial penetration groove welds when the detail length, L, in the direction of stress, is greater than 12 times the plate thickness or greater than 4 inches:			
	(a) Detail thickness < 1.0 in.	T or Rev	E	15
	(b) Detail thickness ≥ 1.0 in.	T or Rev	E'	15
	Base metal adjacent to details attached by full or partial penetration groove welds with a transition radius, R, regardless of the detail length:			
	--With the end welds ground smooth	T or Rev		16
(a) Transition radius ≥ 24 in.		B		
(b) 24 in. > Transition radius ≥ 6 in.		C		
(c) 6 in. > Transition radius ≥ 2 in.		D		
(d) 2 in. > Transition radius ≥ 0 in.		E		
--For all transition radii without end welds ground smooth.	T or Rev	E	16	
Groove Welded Attachments— Transversely Loaded <sup>c,d</sup>	Detail base metal attached by full penetration groove welds with a transition radius, R, regardless of the detail length and with weld soundness transverse to the direction of stress established by nondestructive inspection:			
	--With equal plate thickness and reinforcement removed	T or Rev		16
	(a) Transition radius ≥ 24 in.		B	
	(b) 24 inc. > Transition radius > 6 in.		C	
	(c) 6 in. > Transition radius ≥ 2 in.		D	
(d) 2 in. > Transition radius ≥ 0 in.		E		
--With equal plate thickness and reinforcement not removed	T or Rev		16	
(a) Transition radius ≥ 6 in.		C		

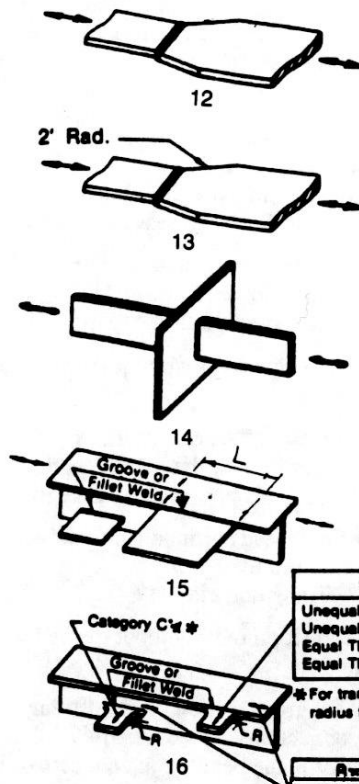
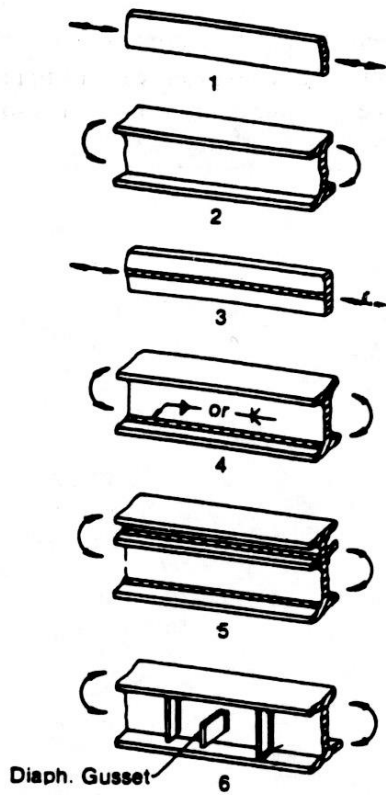


	(b) 6 in. > Transition radius $\geq$ 2 in.		D	
	(c) 2 in. > Transition radius $\geq$ 0 in.		E	
	--With unequal plate thickness and reinforcement removed	T or Rev		16
	(a) Transition radius $\geq$ 2 in.		D	
	(b) 2 in. > Transition radius $\geq$ 0 in.		E	
	--For all transition radii with unequal plate thickness and reinforcement not removed.	T or Rev	E	16
Fillet Welded Connections	Base metal at details connected with transversely loaded welds, with the welds perpendicular to the direction of stress:			
	(a) Detail thickness $\leq$ 0.5 in.	T or Rev	C	14
	(b) Detail thickness > 0.5 in.	T or Rev	See Note <sup>e</sup>	
	Base metal at intermittent fillet welds.	T or Rev	E	--
	Shear stress on throat of fillet welds.	Shear	F	9
Fillet Welded Attachments—Longitudinally Loaded	Base metal adjacent to details by fillet welds with length, L, in the direction of stress, is less than 2 inches and stud-type shear connectors.	T or Rev	C	15,17,18,20
	Base metal adjacent to details attached by fillet welds with length, L, in the direction of stress, between 2 inches and 12 times the plate thickness but less than 4 inches.	T or Rev	D	15,17
	Base metal adjacent to details attached by fillet welds with length, L, in the direction of stress, greater than 12 times the plate thickness or greater than 4 inches.			
	(a) Detail thickness < 1.0 in.	T or Rev	E	7,9,15,17
	(b) Detail thickness $\geq$ 1.0 in.	T or Rev	E'	7,9,15
	Base metal adjacent to details attached by fillet welds with a transition radius, R, regardless of the detail length:			
	--With the end welds ground smooth	T or Rev		16
	(a) Transition radius $\geq$ 2 in.		D	
	(b) 2 in. > Transition radius $\geq$ 0 in.		E	
	--For all transition radii without the end welds ground smooth.	T or Rev	E	16
Fillet Welded Attachments—Transversely Loaded with the Weld in the Direction of Principal Stress	Detail base metal attached by fillet welds with a transition radius, R, regardless of the detail length (shear stress on the throat of fillet welds governed by Category F):			
	--With the end welds ground smooth	T or Rev		16
	(a) Transition radius $\geq$ 2 in.		D	
	(b) 2 in. > Transition radius $\geq$ 0 in.		E	
	--For all transition radii without the end welds ground smooth.	T or Rev	E	16



Mechanically Fastened Connections	Base metal at gross section of high-strength bolted slip-resistant connections, except at axially loaded joints which induce out-of-plane bending in connecting materials.	T or Rev	B	21
	Base metal at net section of high-strength bolted bearing-type connections.	T or Rev	B	21
	Base metal at net section of riveted connections.	T or Rev	D	21
Eyebars or Pin Plates	Base metal at the net section of eyebar head or pin plate	T	E	23,24
	Base metal in the shank of eyebars, or through the gross section of pin plates with:			
	(a) rolled or smoothly ground surfaces (b) flame-cut edges	T T	A B	23,24 23,24

- <sup>a</sup> "T" signifies range in tensile stress only. "Rev" signifies a range of stress involving both tension and compression during a stress cycle.
- <sup>b</sup> See Watter, Albrecht and Sahli, *Journal of Structural Engineering*, ASCE, Vol. III, No. 6, June 1985, pp. 1235-1249.
- <sup>c</sup> "Longitudinally Loaded" signifies direction of approved stress is parallel to the longitudinal axis of the weld. "Transversely Loaded" signifies direction of applied stress is perpendicular to the longitudinal axis of the weld.
- <sup>d</sup> Transversely loaded partial penetration groove welds are prohibited.
- <sup>e</sup> Allowable fatigue stress range on throat of fillet welds transversely loaded is a function of the effective throat and plate thickness. (See Frank and Fisher, *Journal of the Structural Division*, ASCE, Vo. 105, No. ST9, Sept. 1979).
- <sup>f</sup> Gusset plates attached to girder flange surfaces with only transverse fillet welds are prohibited.

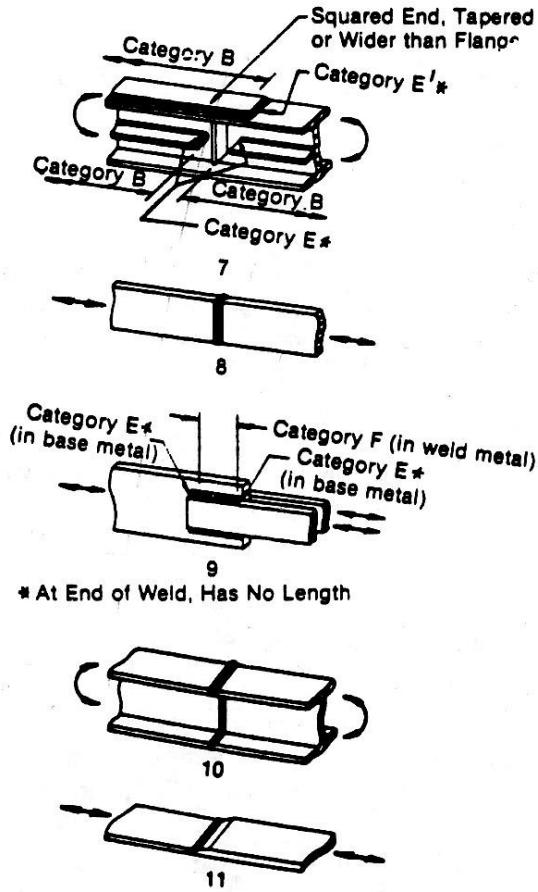


WELD CONDITION *	CAT.
Unequal Thickness - Reinf. in Place	E
Unequal Thickness - Reinf. Removed	D
Equal Thickness - Reinf. in Place	C
Equal Thickness - Reinf. Removed	B

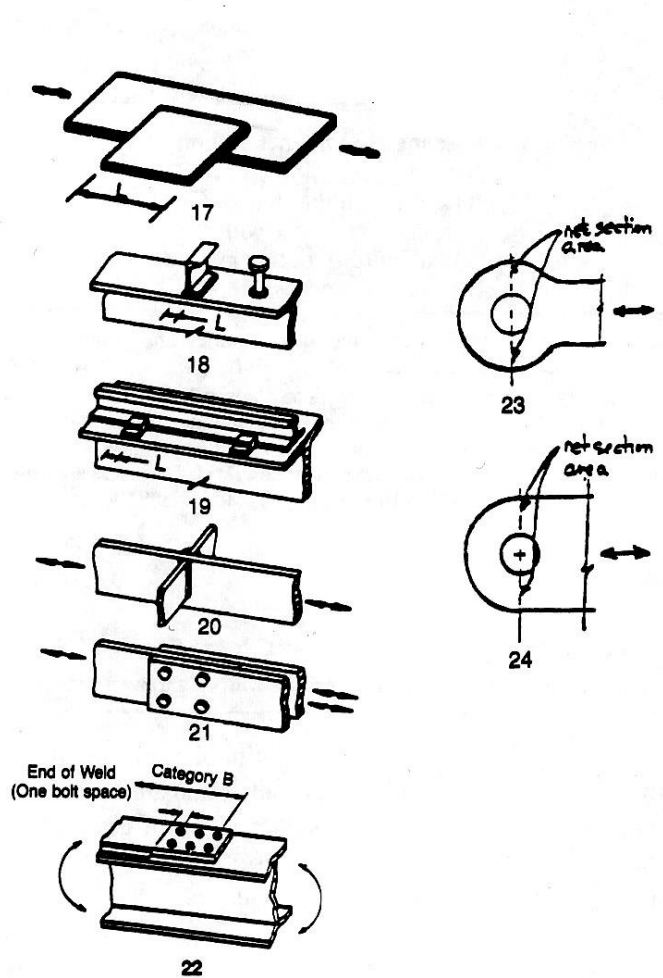
\* For transverse loading - check transition radius for possible lower category

R = #	CAT.	
	Fil	Gr.
R ≥ 24"	D	B
24" > R > 6"	D	C
6" > R > 2"	D	D
2" > R	E	E

\* Also applies to transverse loading



\* At End of Weld, Has No Length

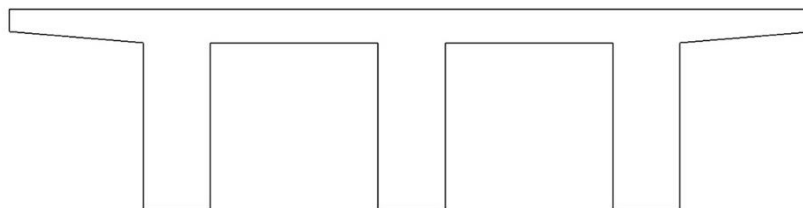
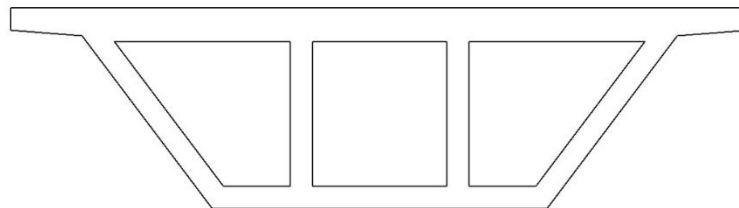
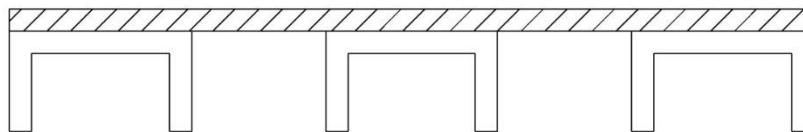
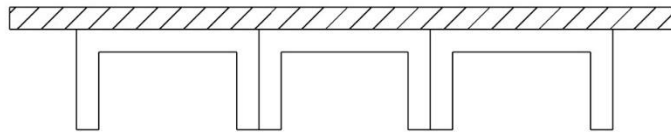




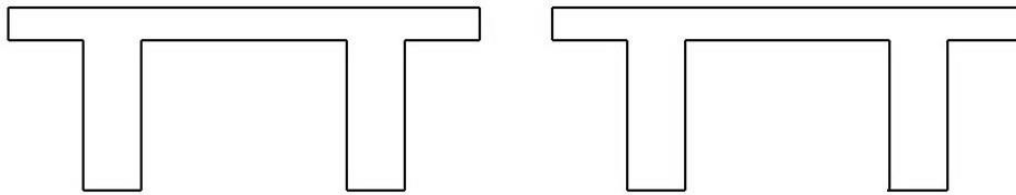
## APPENDIX C: STATE MEASUREMENT CONVENTIONS

### SECTION C.1 GIRDER MEASUREMENT CONVENTIONS

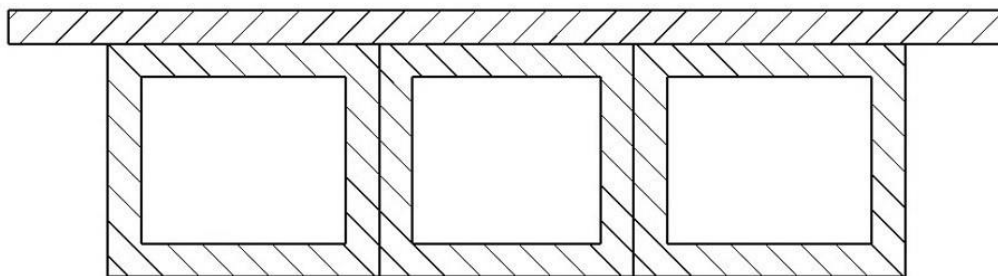
The “number of girders” for a bridge as carried in the management database can be determined using one of the following examples. The total quantity recorded is equal to the girder length multiplied by the number of girders.



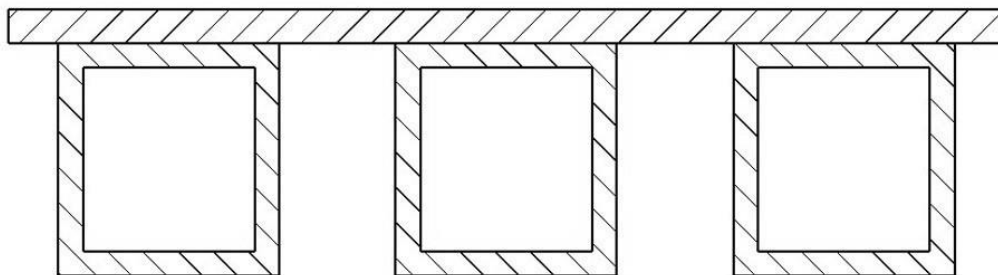




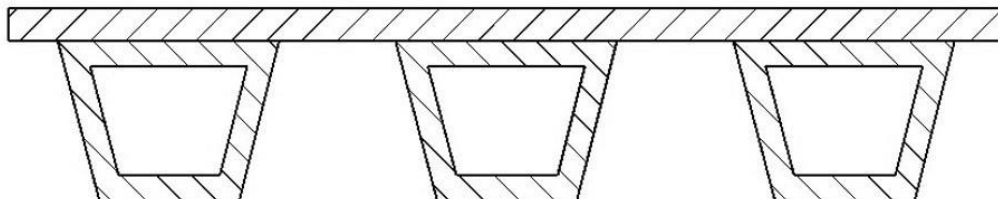
**2 GIRDERS**



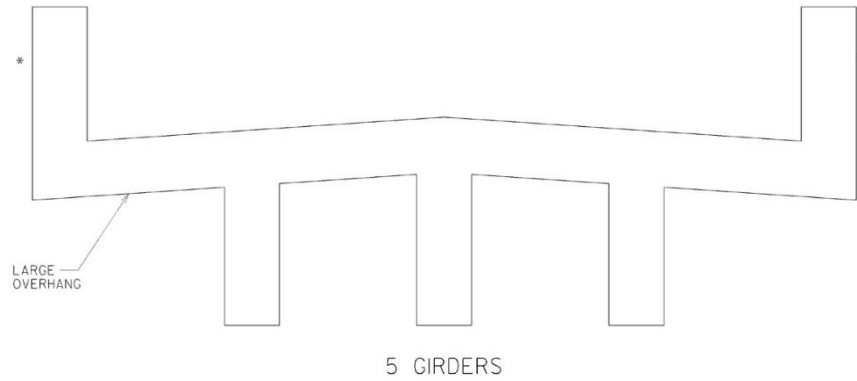
**3 GIRDERS**



**3 GIRDERS**

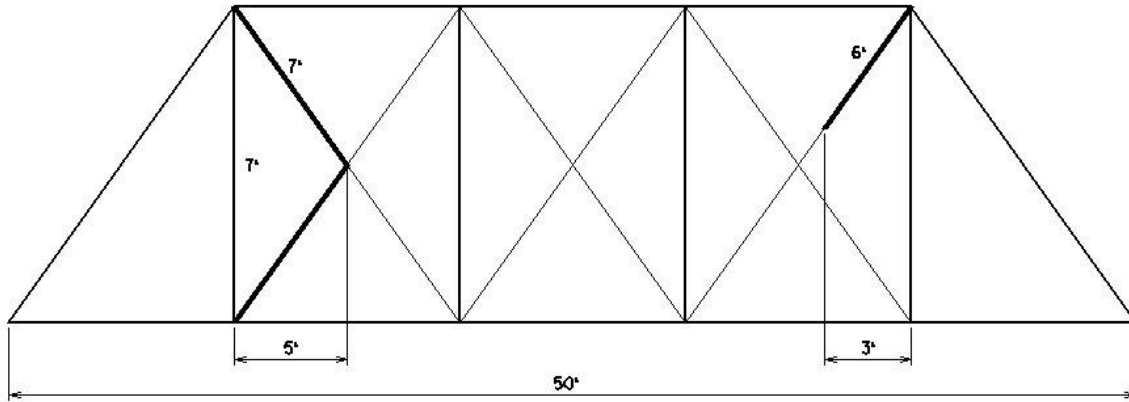


**3 GIRDERS**



**Figure C-1:** On old reinforced concrete deck girders with large overhangs, the rail will act as a girder if it is a solid rail.

**SECTION C.2 TRUSS MEASUREMENT CONVENTIONS**



**— DETERIORATED PARTS OF TRUSS**

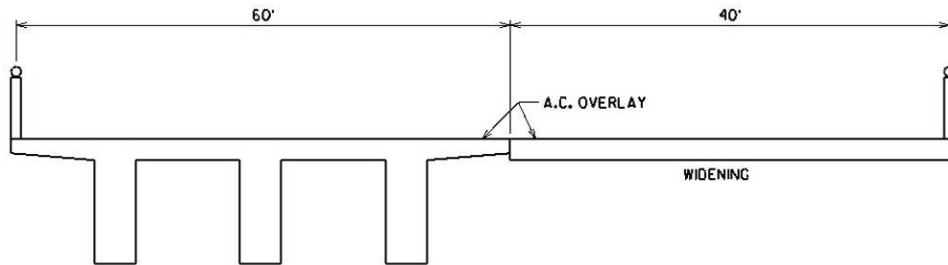
All measurements of a truss are along the horizontal projection, including the deterioration measurements. The total length of the above truss is 50 feet, while the recorded length of the deteriorated part of the truss is equal to 8 feet (5 feet + 3 feet).

The total quantity for the truss element for the above example bridge is 100 feet ( $50 * 2$ , since there is a truss on each side of the bridge).

The convention used for spandrel arches is similar to that used for trusses.



**SECTION C.3 DECK MEASUREMENT CONVENTIONS**



**TYPICAL SECTION**

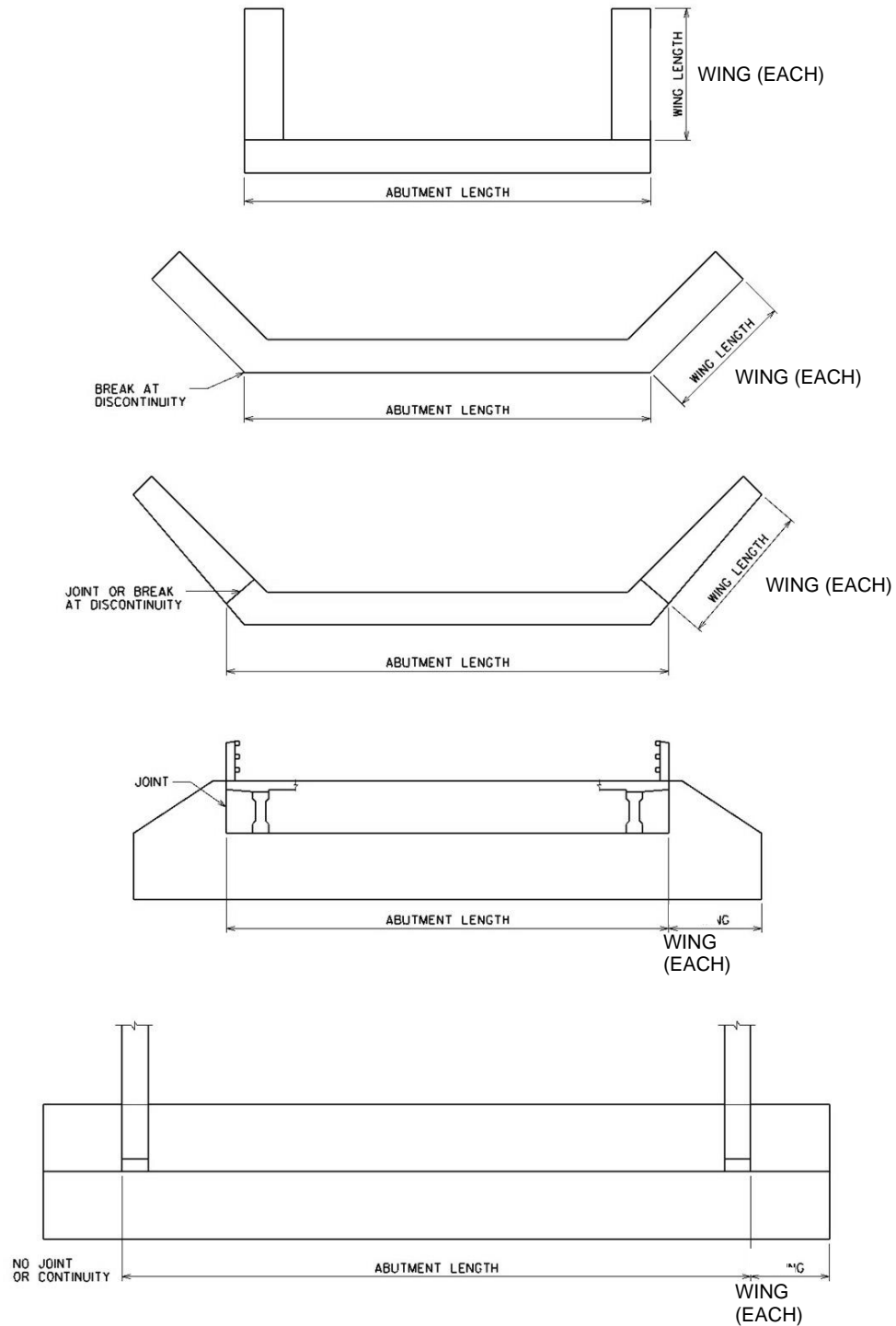
(Assumes a 100 foot long structure)

The unit for deck or slab elements is “square feet”. Thus, when a bridge has one deck/slab type, the quantity is the deck area. However, when a bridge has two different types of deck/slab elements (See the example below with Elements 12 and 38), the inspector should record a quantity equal to the deck area for each deck type element. The entire quantity for each deck or slab element is assigned to a single Condition State.

Element No.	Description	Quantity	Unit
12	Reinforced Concrete Deck	6,000	SF
38	Reinforced Concrete Slab	4,000	SF

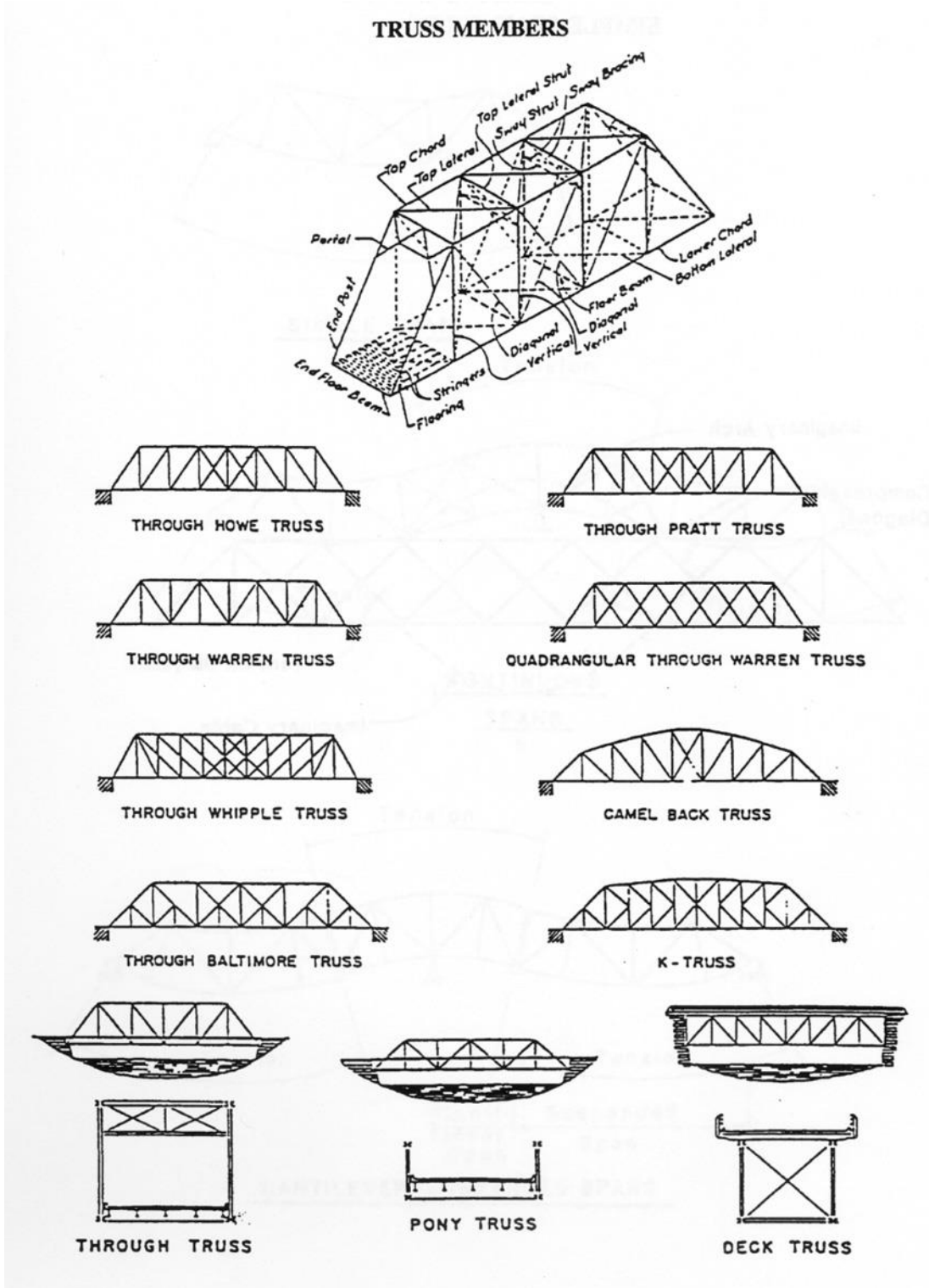


SECTION C.4 ABUTMENT AND WINGWALL LENGTH MEASUREMENT CONVENTIONS

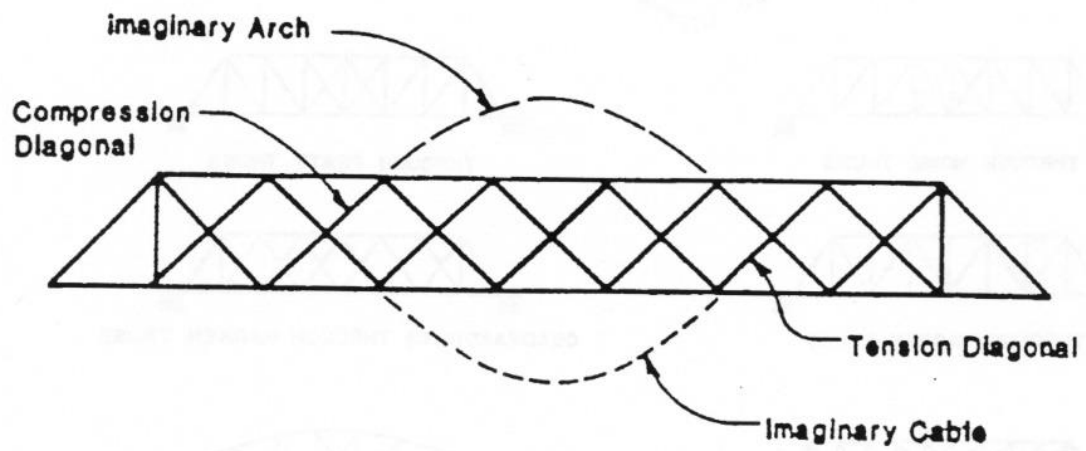




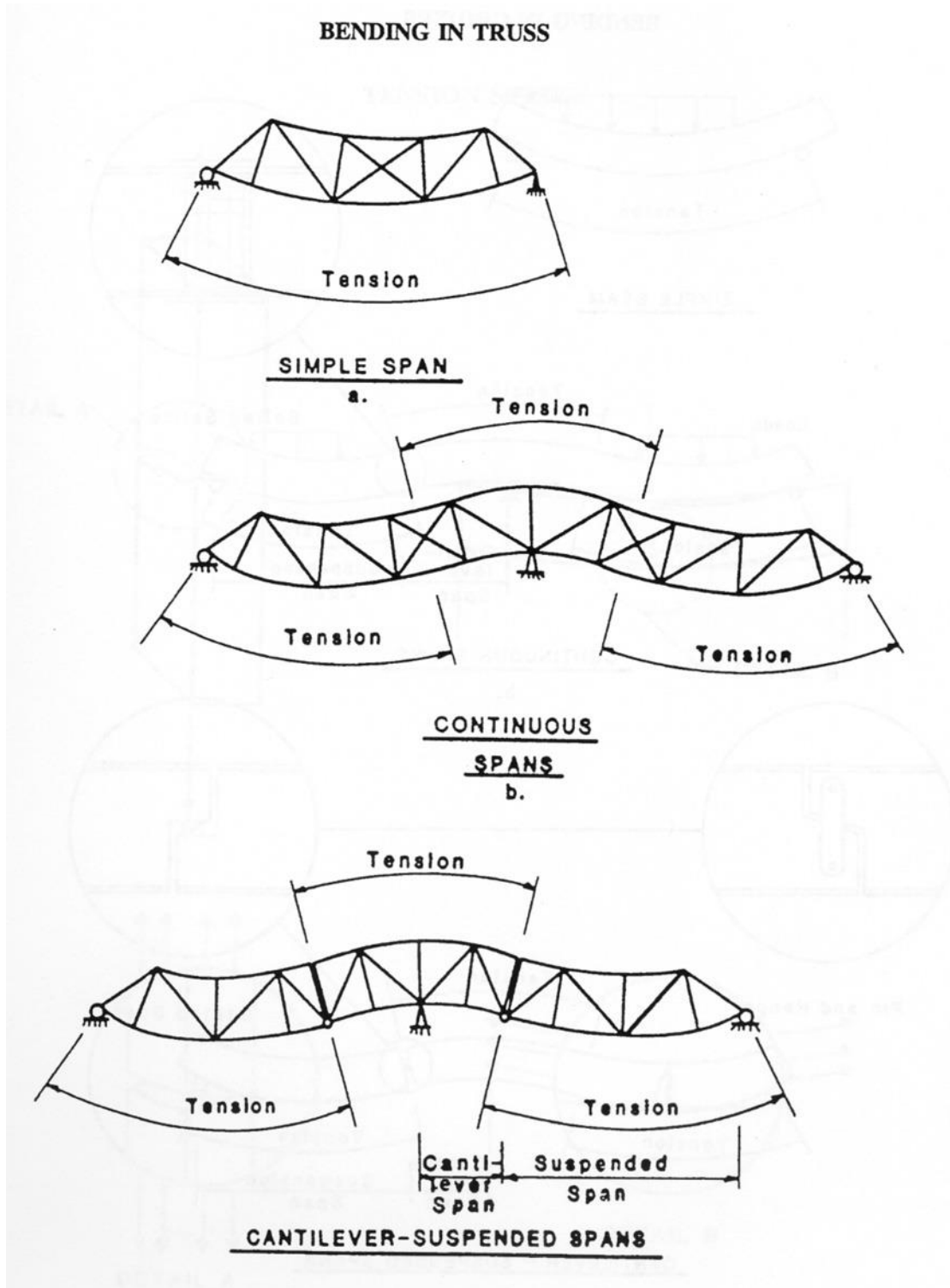
# APPENDIX D: Nonredundant Steel Tension Member (NSTM) DETAILS



### SIMPLE SPAN TRUSS

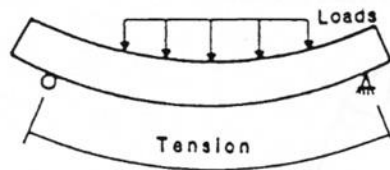


**BENDING IN TRUSS**

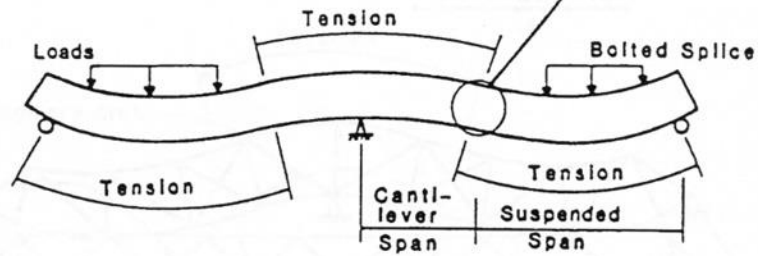
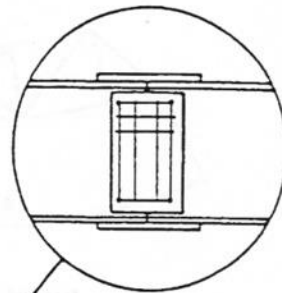




BENDING IN GIRDERS

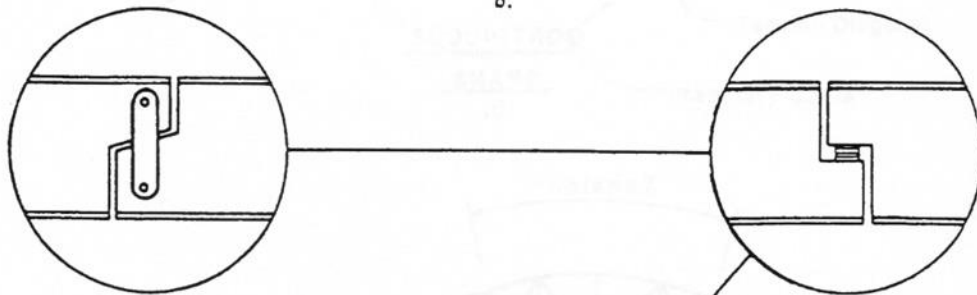


SIMPLE BEAM



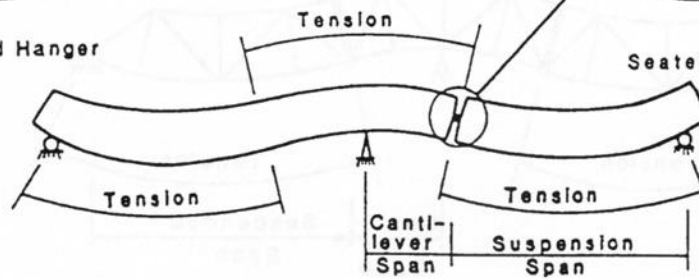
CONTINUOUS SPANS

b.



Pin and Hanger

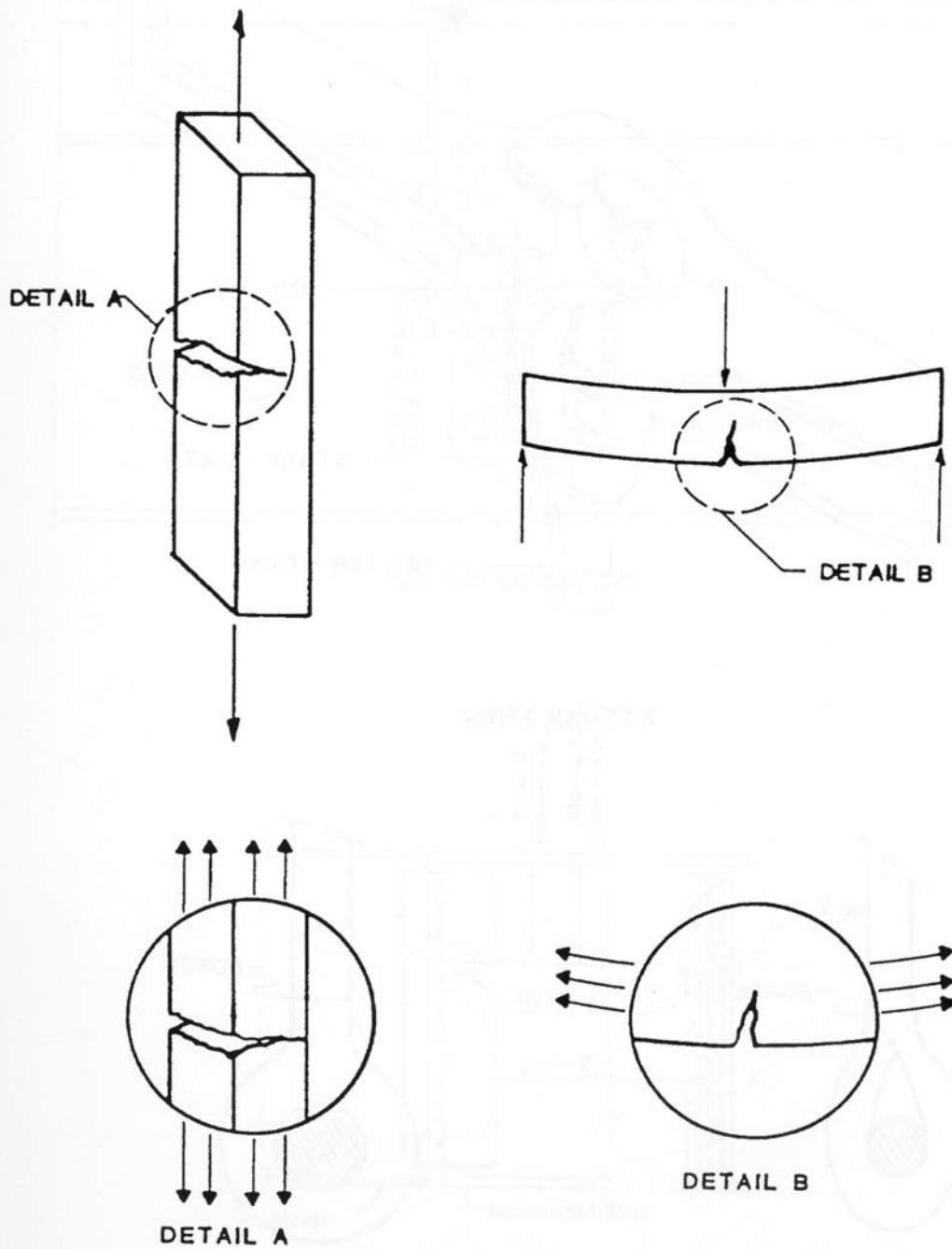
Seated Span



c.

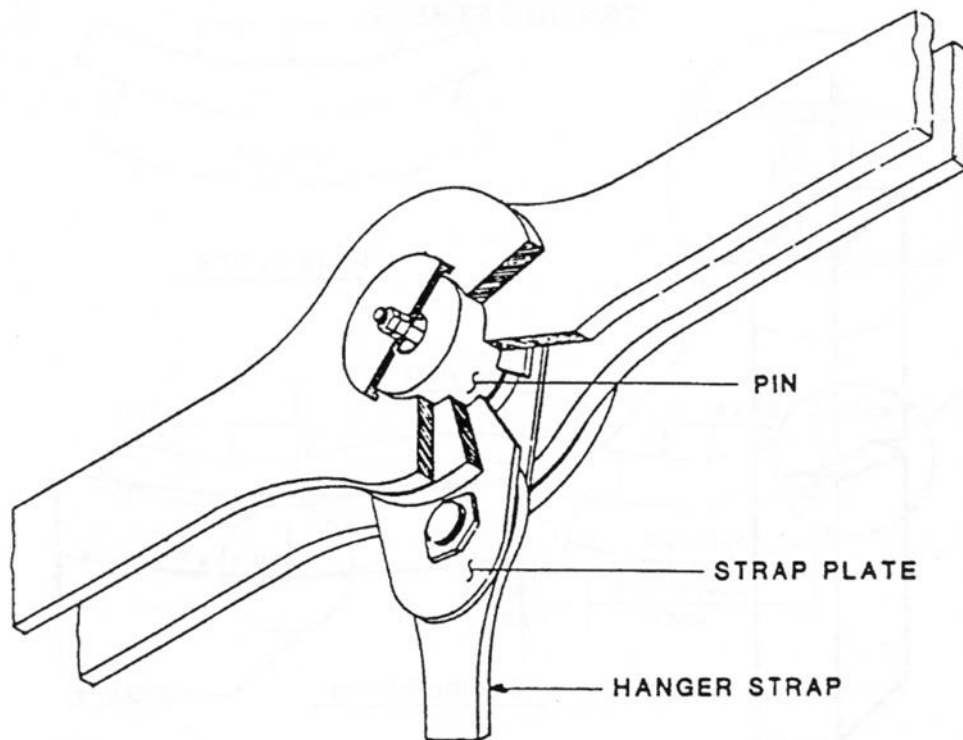
CANTILEVER - SUSPENDED SPANS

TENSION STRESS

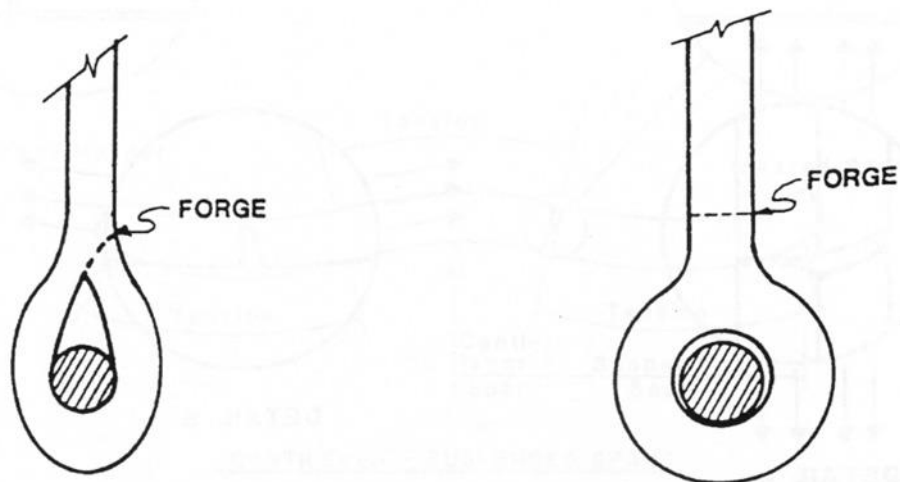


Cracks being pulled open by tensile forces.

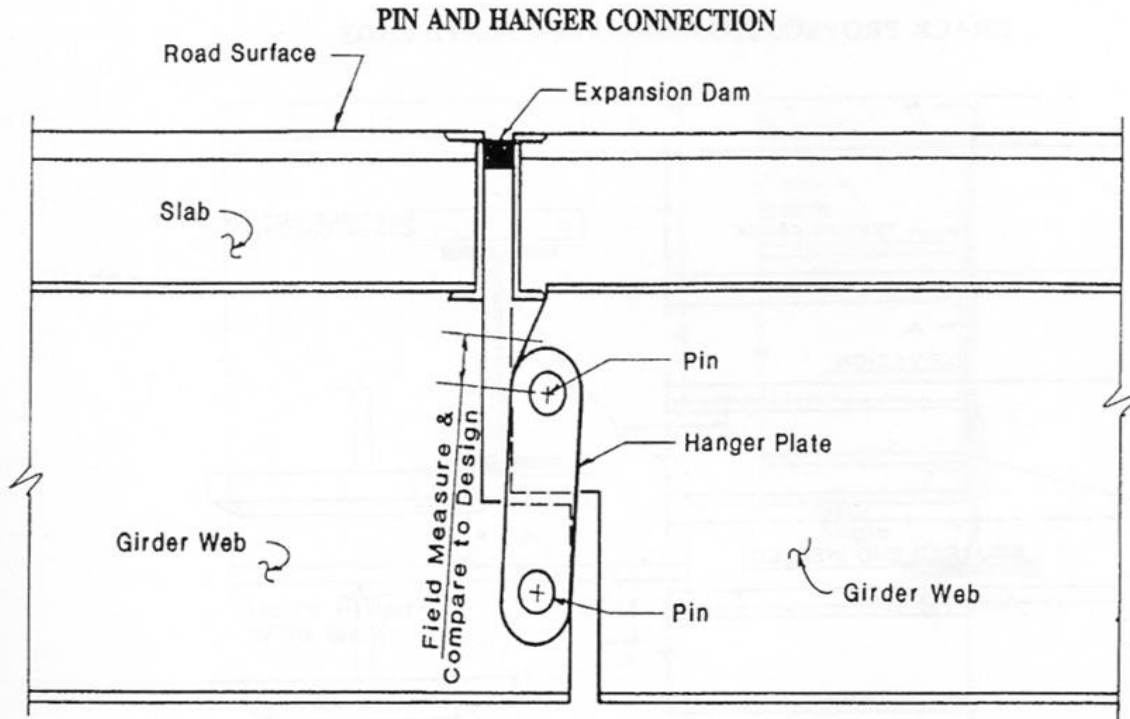
EYEBAR HANGER CONNECTION



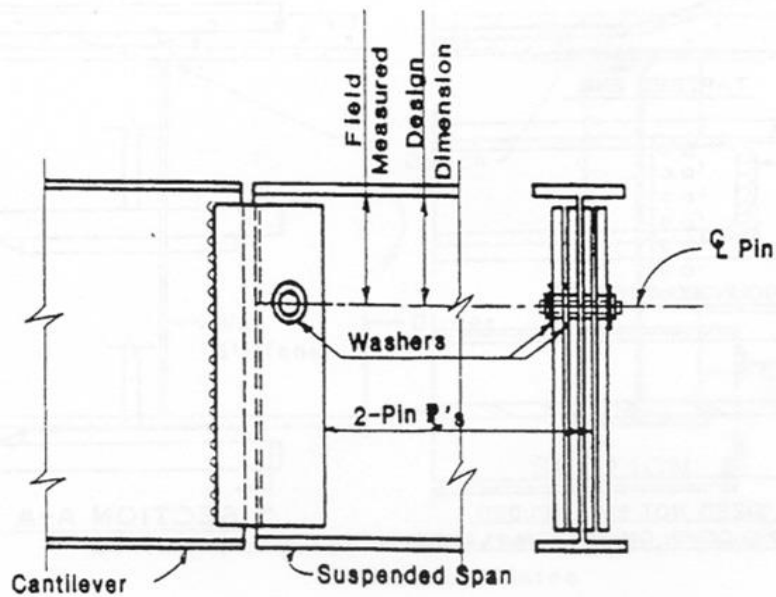
EYEBAR ENDS



Fatigue Categories A, B (on eyebar body), or E (on net section of eyebar head)

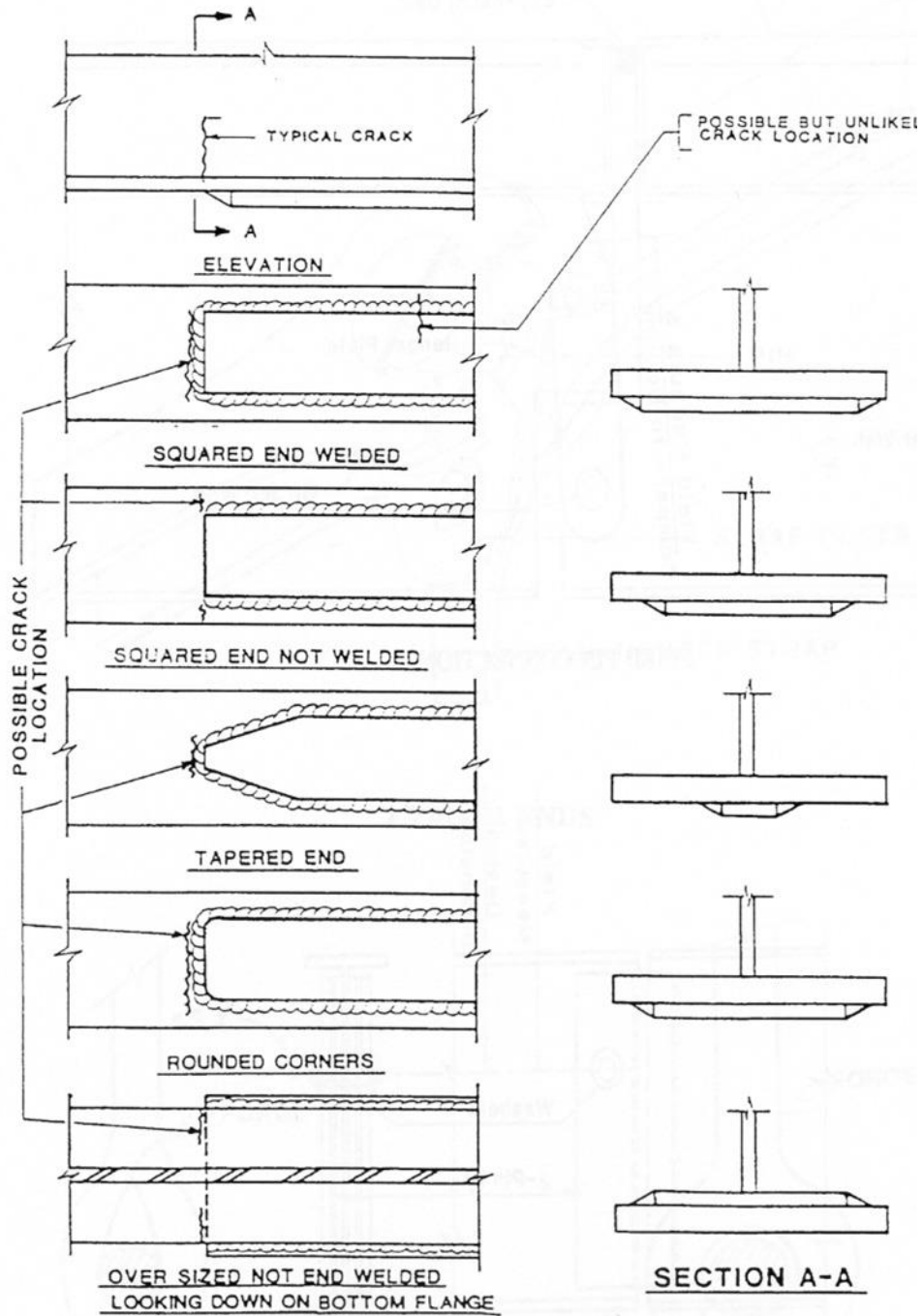


**FIXED PIN CONNECTION**

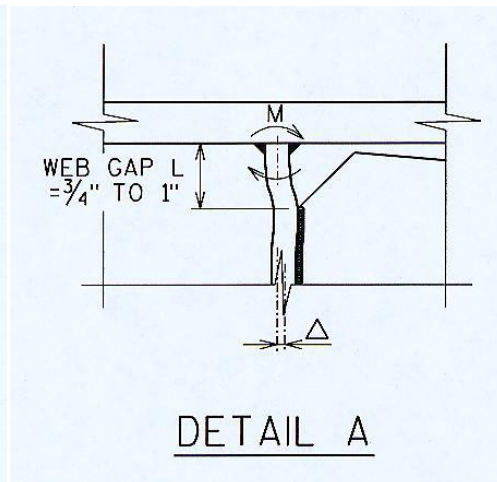
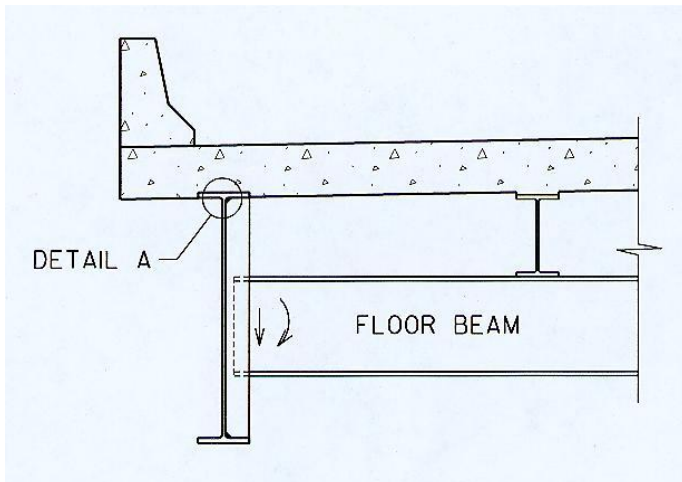
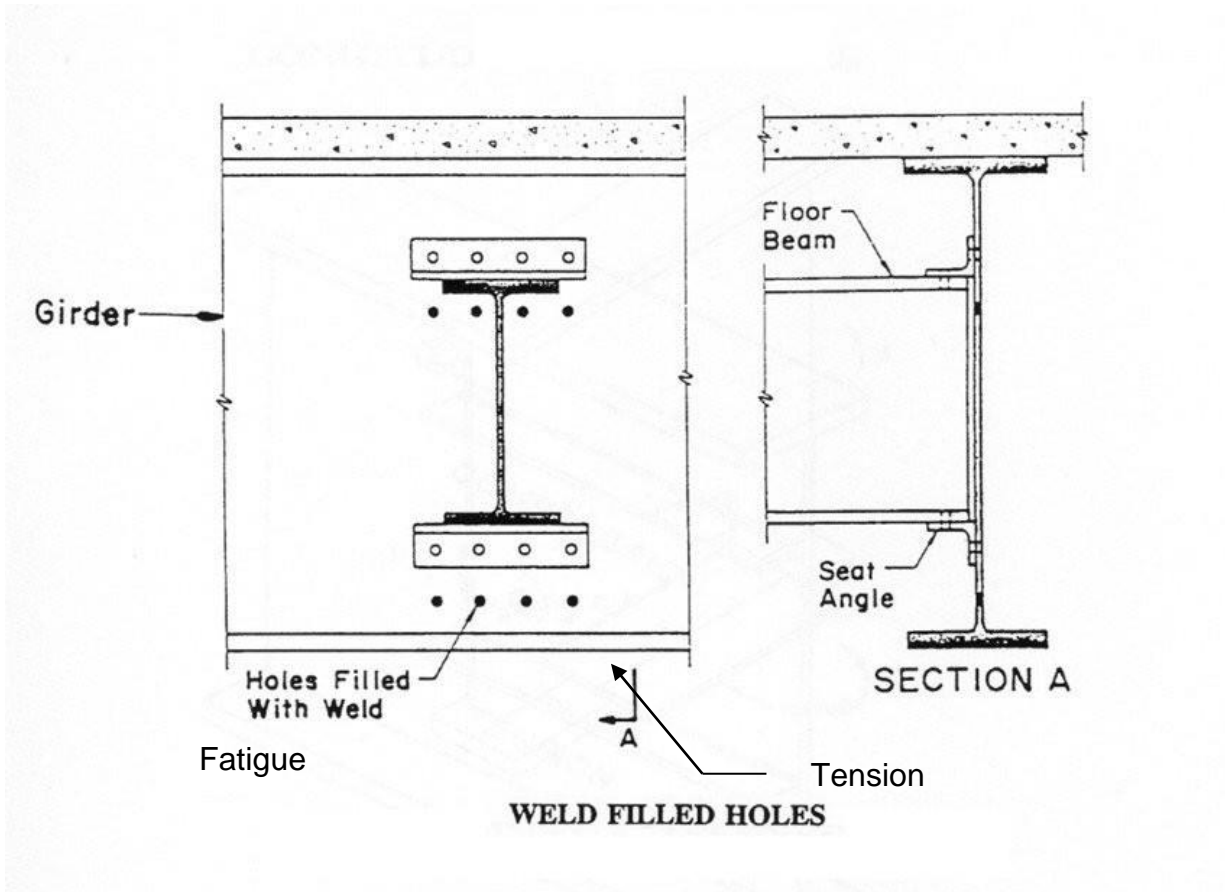


Fatigue Category A, B (on hanger plate body), or E (on net section of hanger or pin plate)

CRACK PROPAGATION AT COVER PLATE ENDS

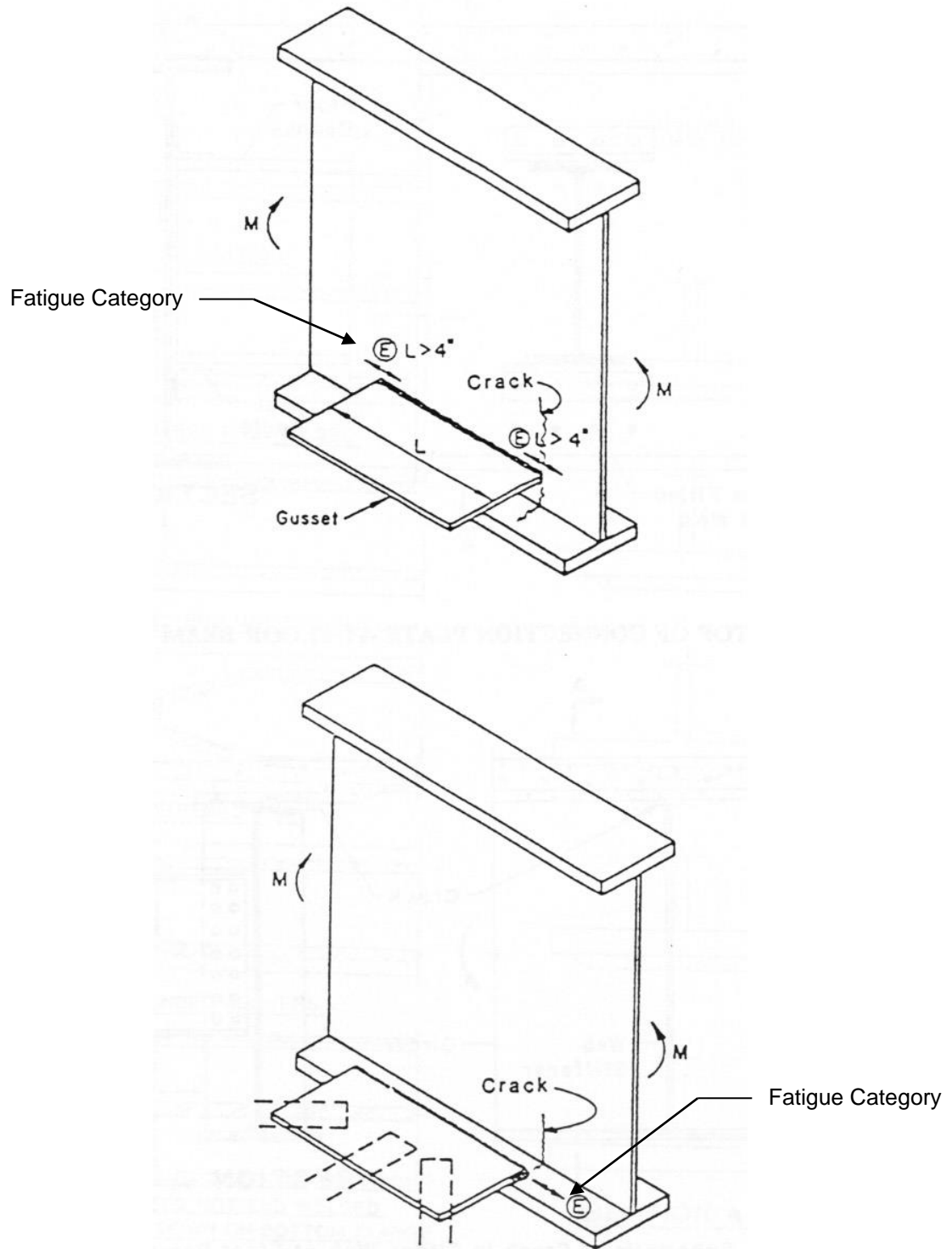


Fatigue Categories E and E'



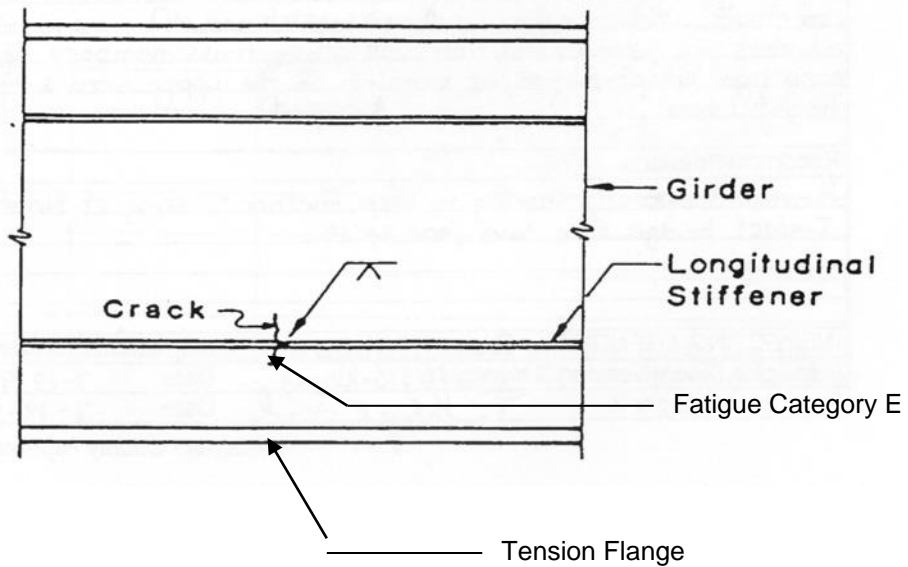
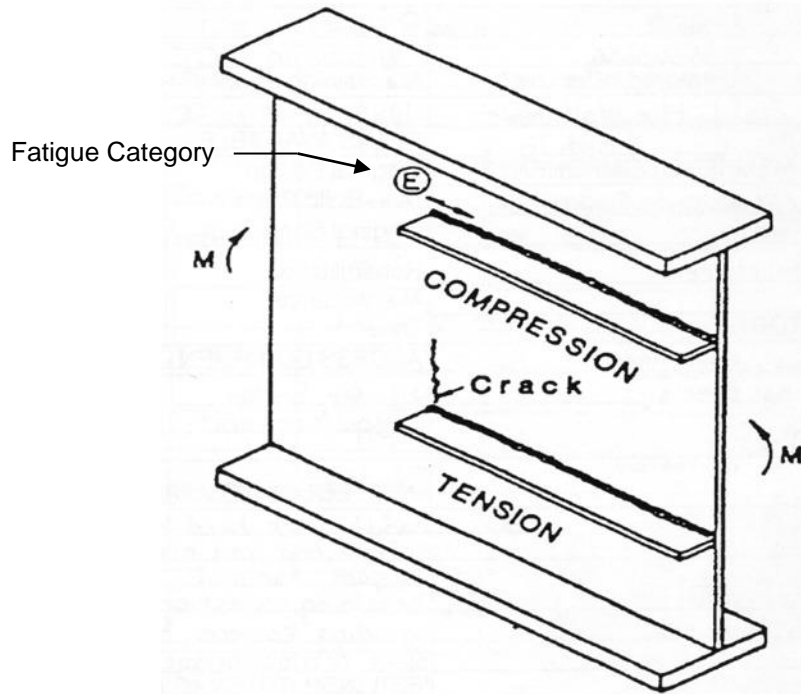
Web Out-of-Plane Bending at Floor Beam Connection Plate

FLANGE AND WEB ATTACHMENTS





**LONGITUDINAL STIFFENERS**







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