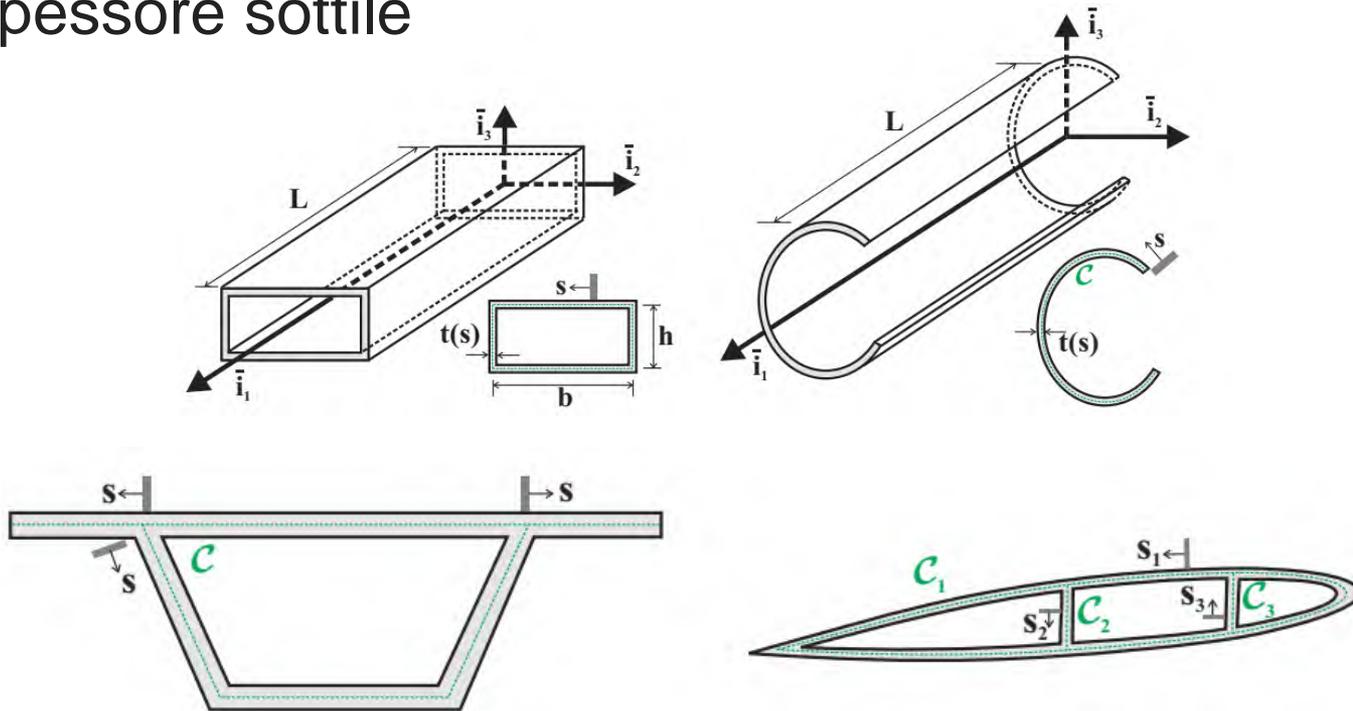


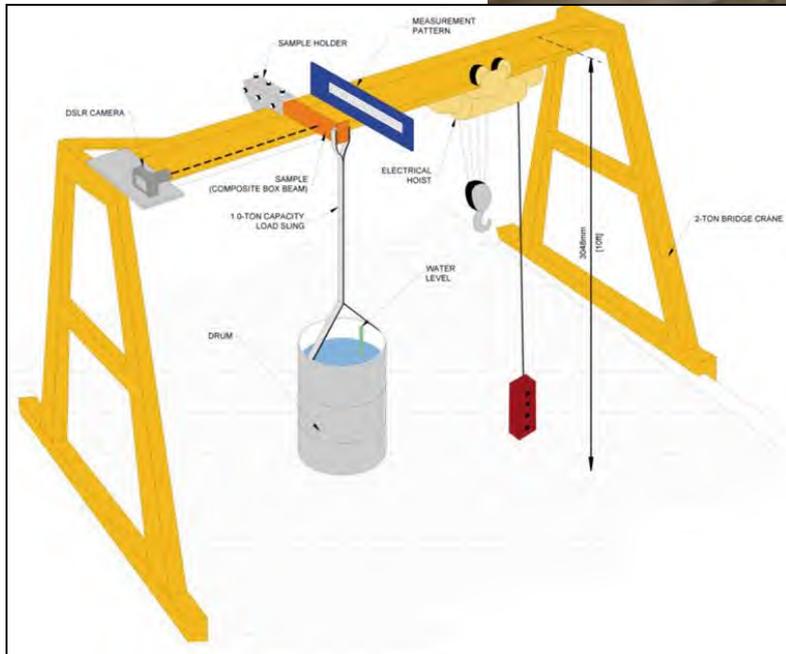
# Travi a parete sottile (Thin walled beams)

La sezione della trave è realizzata con elementi di spessore sottile

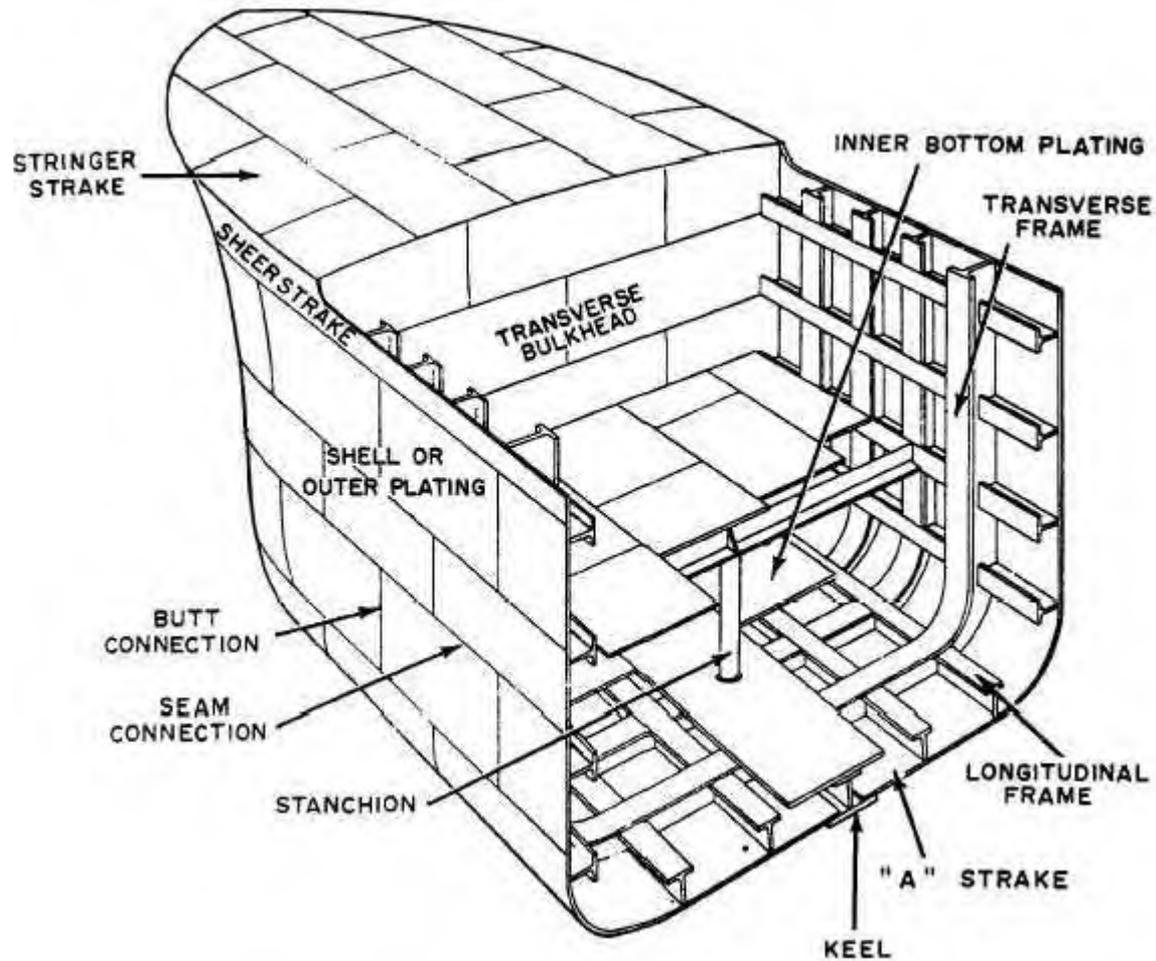


- La loro rigidezza flessionale per unità di massa è molto più elevata di quella di travi a sezione piena.
- Possono quindi essere ottenute travi molto rigide a flessione con minimo peso

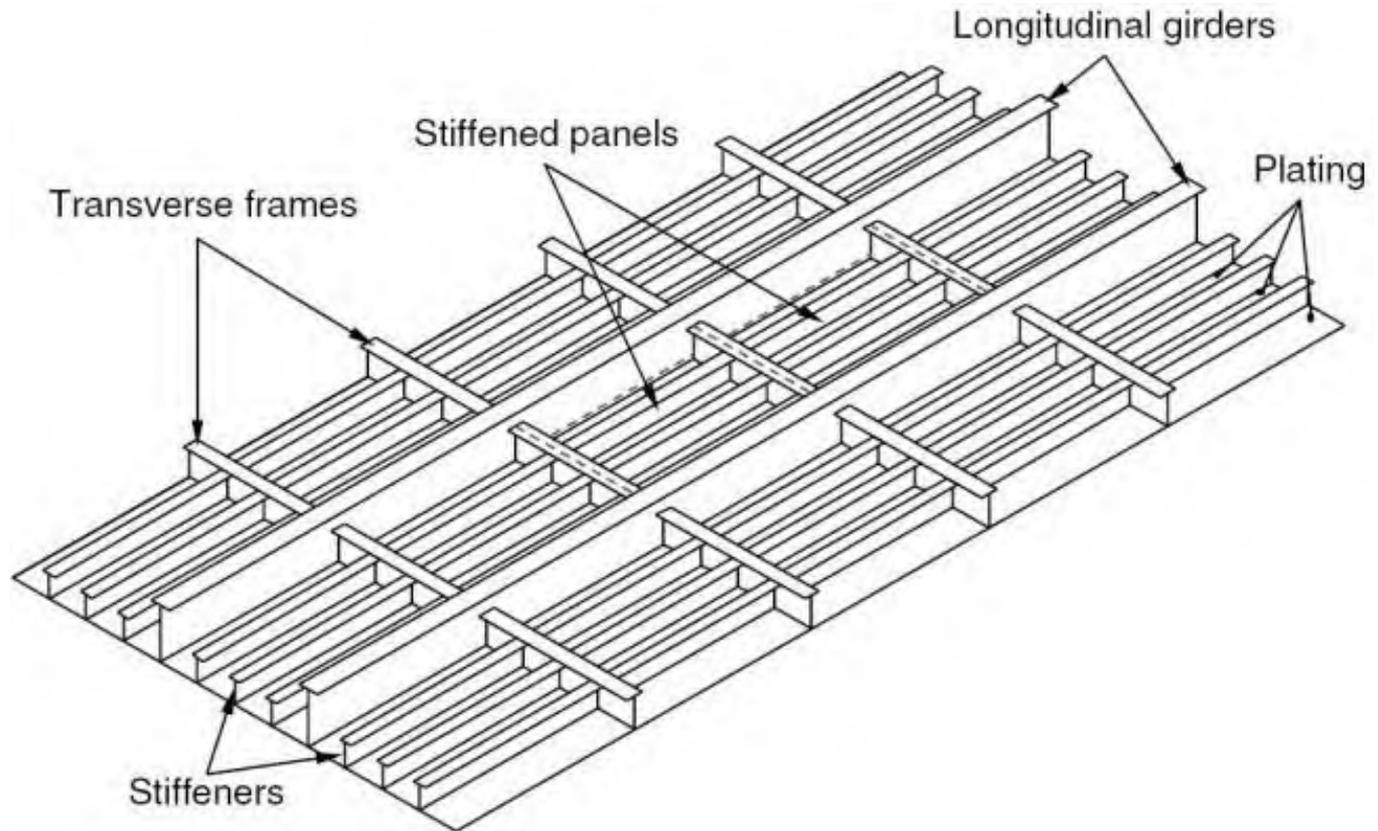
# Travi a parete sottile



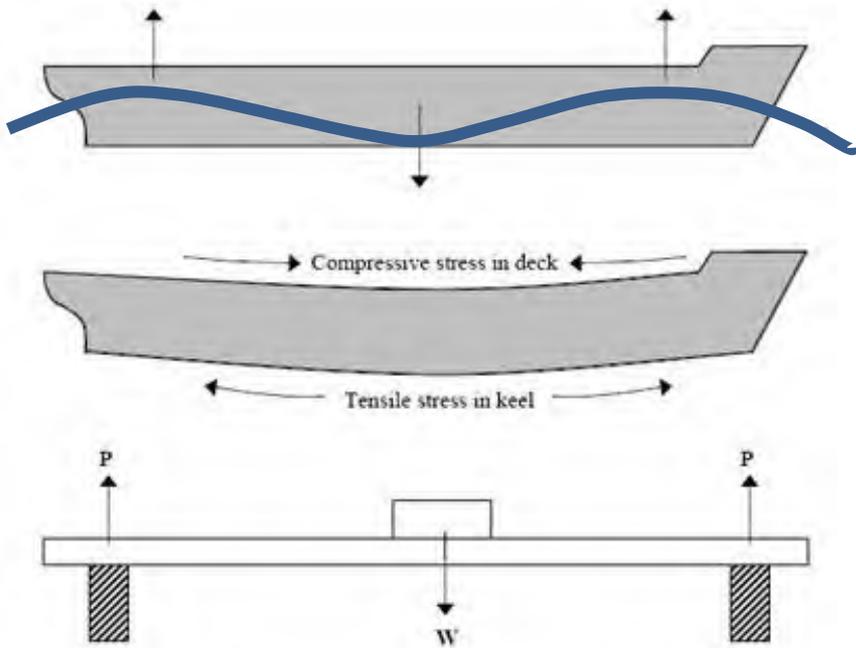
# Travi a parete sottile (campo nautico)



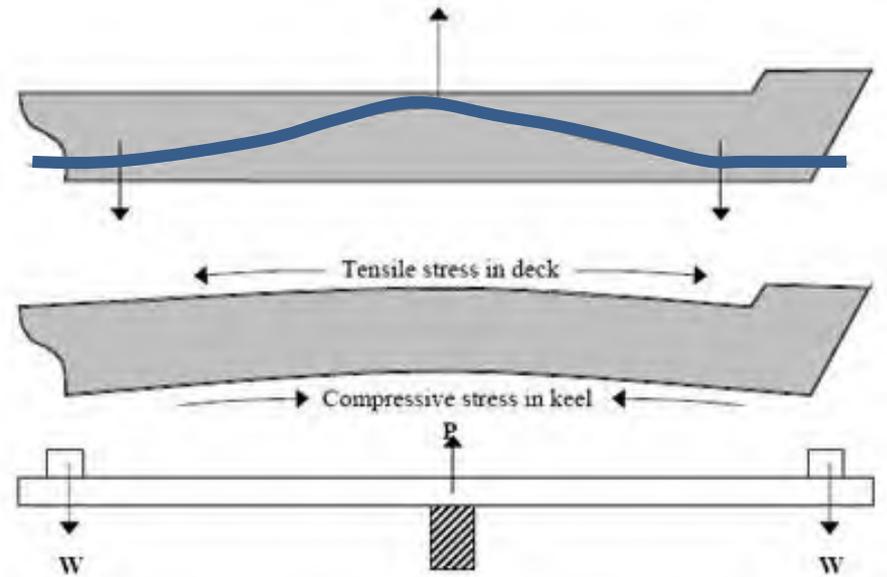
# Travi a parete sottile



# Travi a parete sottile

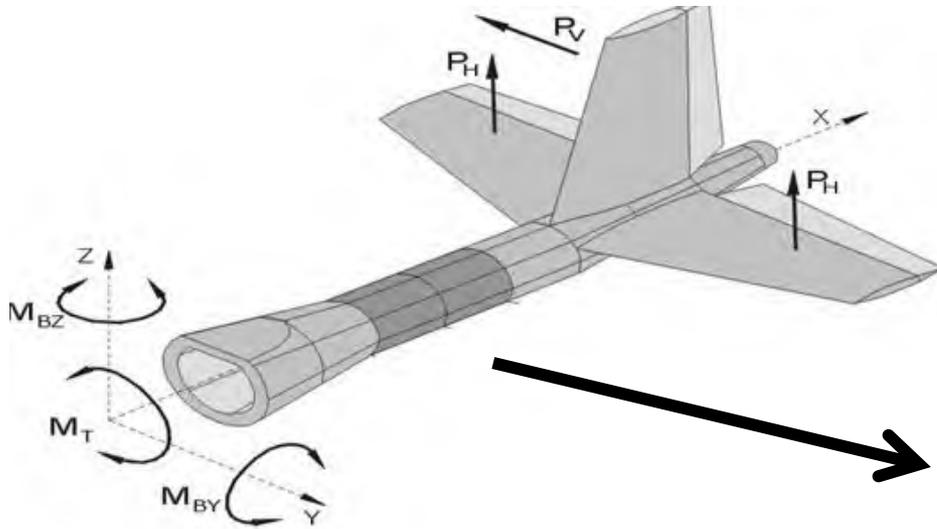


**HOGGING**

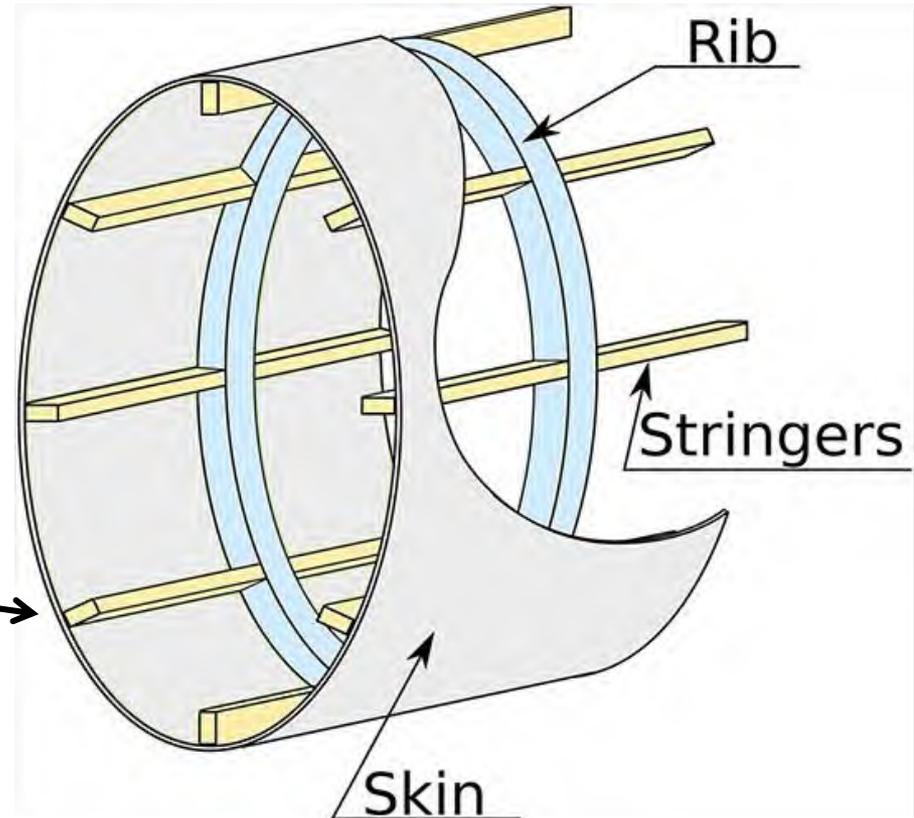


**SAGGING**

# Travi a parete sottile (campo aeronautico)

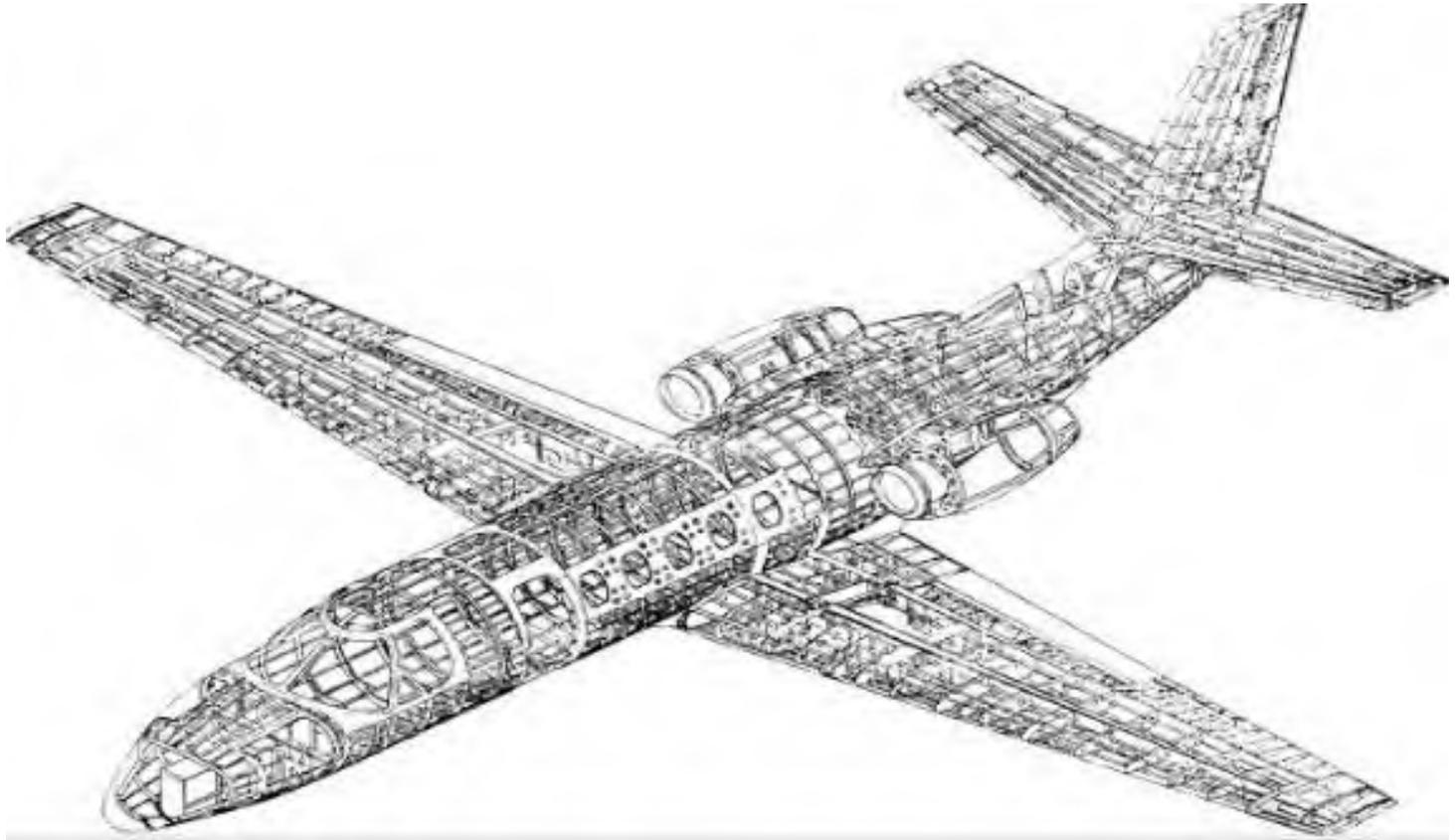


**Rinforzo trasversale:**  
Ordinate  
(frames, ribs)

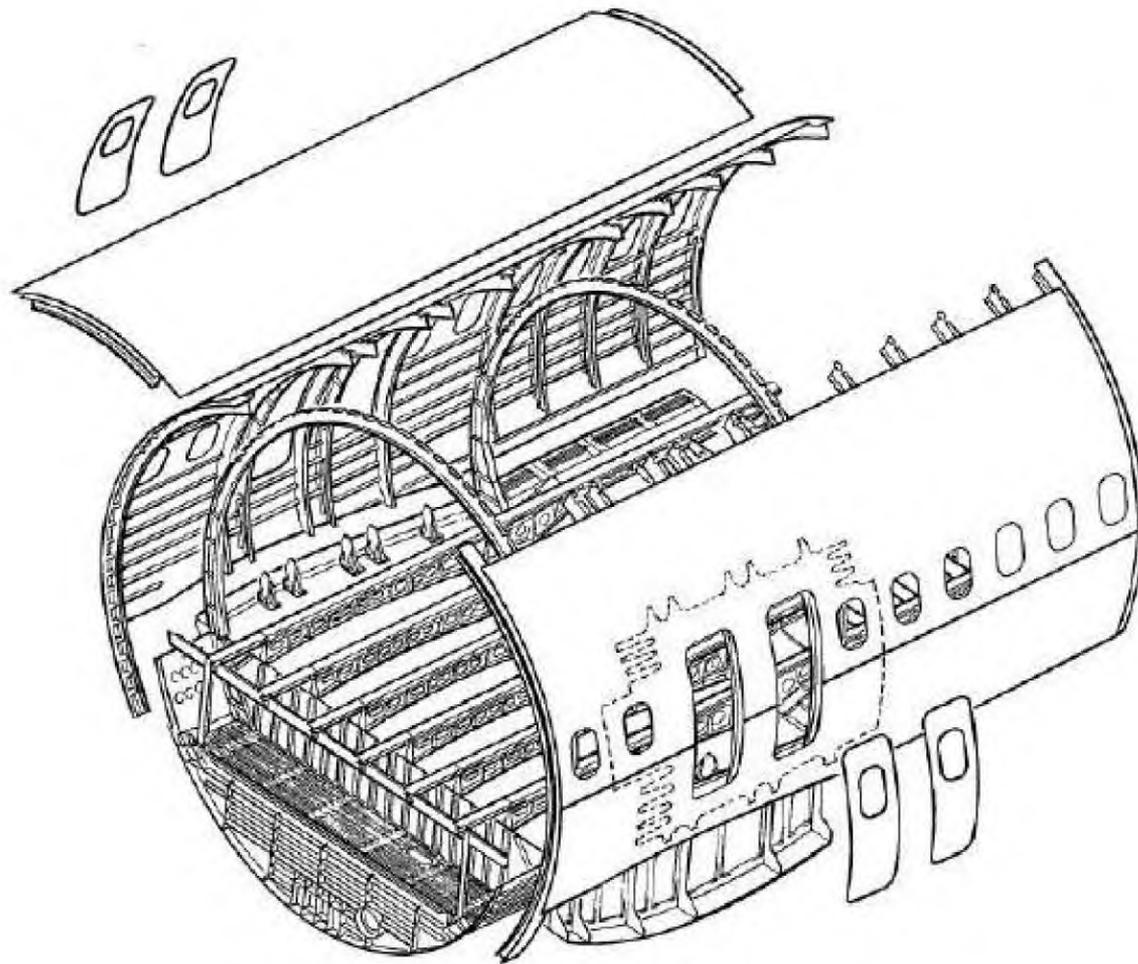


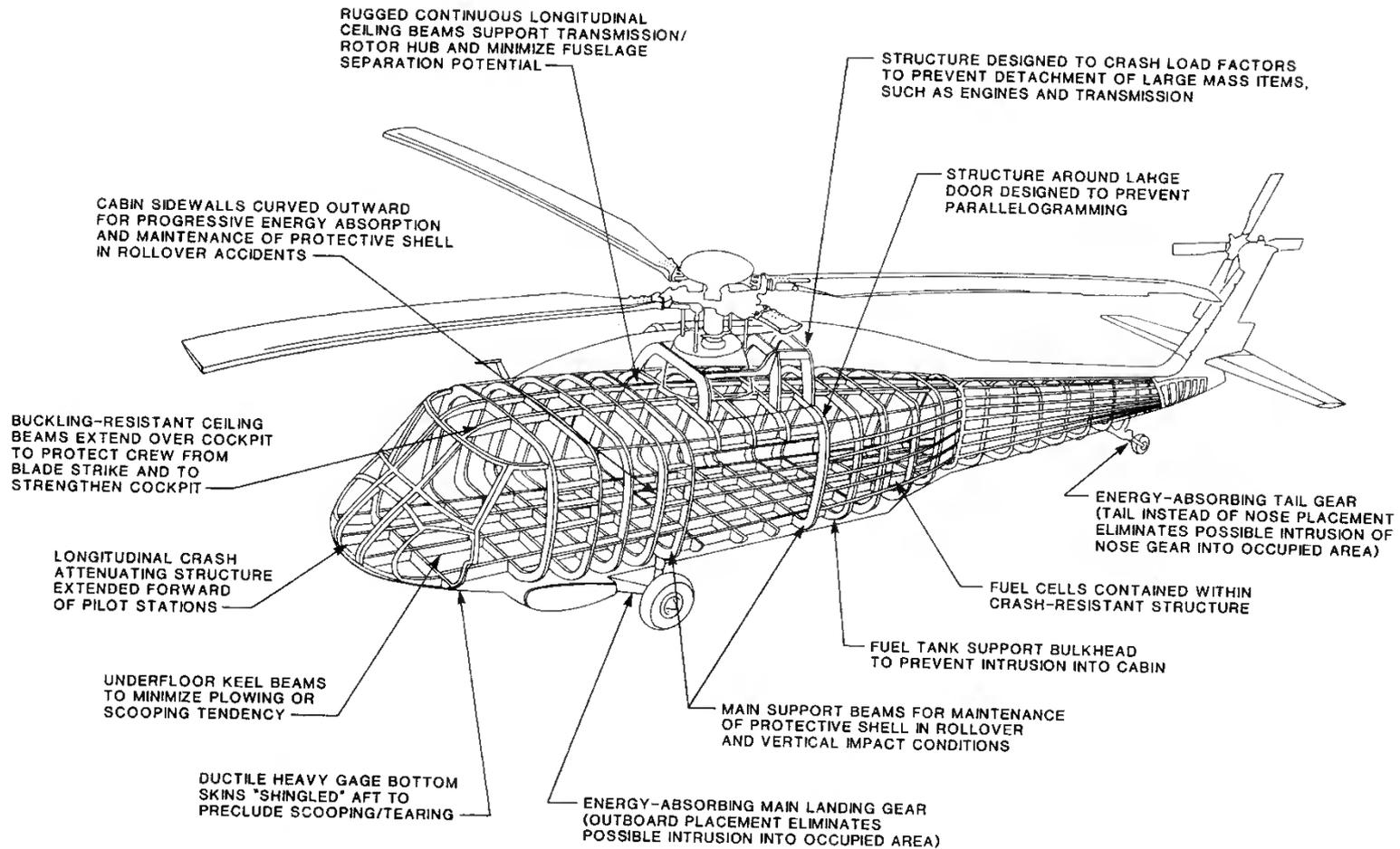
**Rinforzo longitudinale:**  
Longherone o corrente  
(stringer)

# Travi a parete sottile



# Travi a parete sottile





RUGGED CONTINUOUS LONGITUDINAL CEILING BEAMS SUPPORT TRANSMISSION/ ROTOR HUB AND MINIMIZE FUSELAGE SEPARATION POTENTIAL

STRUCTURE DESIGNED TO CRASH LOAD FACTORS TO PREVENT DETACHMENT OF LARGE MASS ITEMS, SUCH AS ENGINES AND TRANSMISSION

CABIN SIDEWALLS CURVED OUTWARD FOR PROGRESSIVE ENERGY ABSORPTION AND MAINTENANCE OF PROTECTIVE SHELL IN ROLLOVER ACCIDENTS

STRUCTURE AROUND LARGE DOOR DESIGNED TO PREVENT PARALLELOGRAMMING

BUCKLING-RESISTANT CEILING BEAMS EXTEND OVER COCKPIT TO PROTECT CREW FROM BLADE STRIKE AND TO STRENGTHEN COCKPIT

ENERGY-ABSORBING TAIL GEAR (TAIL INSTEAD OF NOSE PLACEMENT ELIMINATES POSSIBLE INTRUSION OF NOSE GEAR INTO OCCUPIED AREA)

LONGITUDINAL CRASH ATTENUATING STRUCTURE EXTENDED FORWARD OF PILOT STATIONS

FUEL CELLS CONTAINED WITHIN CRASH-RESISTANT STRUCTURE

UNDERFLOOR KEEL BEAMS TO MINIMIZE PLOWING OR SCOOPING TENDENCY

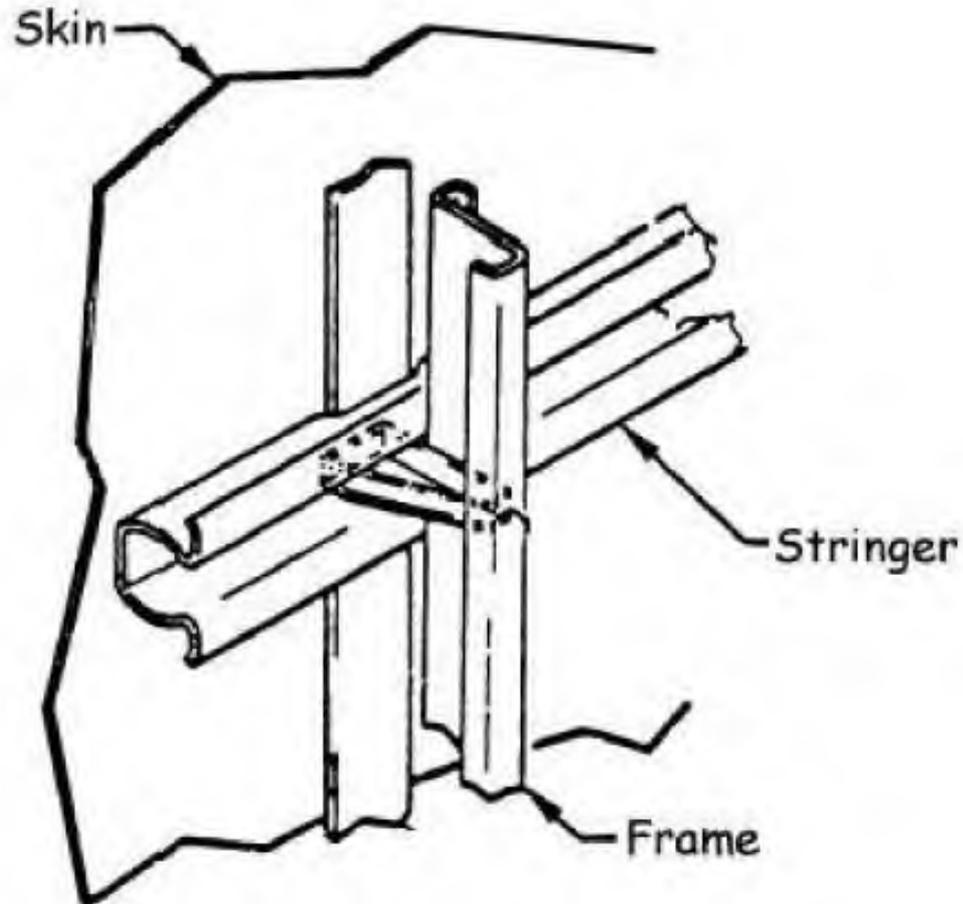
FUEL TANK SUPPORT BULKHEAD TO PREVENT INTRUSION INTO CABIN

DUCTILE HEAVY GAGE BOTTOM SKINS "SHINGLED" AFT TO PRECLUDE SCOOPING/TEARING

MAIN SUPPORT BEAMS FOR MAINTENANCE OF PROTECTIVE SHELL IN ROLLOVER AND VERTICAL IMPACT CONDITIONS

ENERGY-ABSORBING MAIN LANDING GEAR (OUTBOARD PLACEMENT ELIMINATES POSSIBLE INTRUSION INTO OCCUPIED AREA)

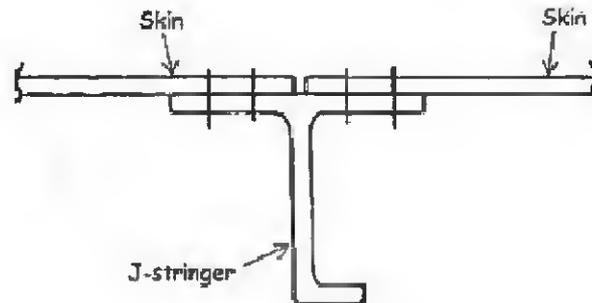
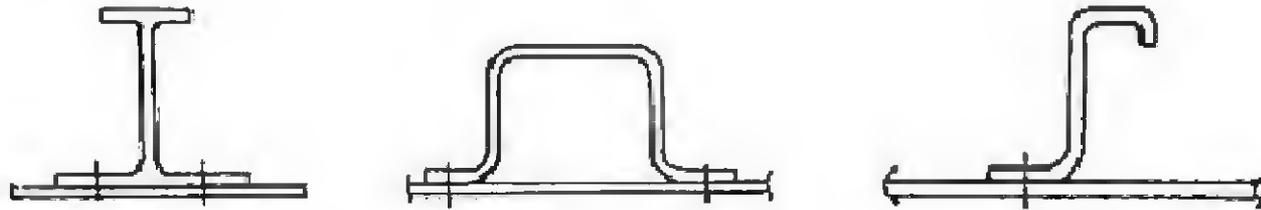
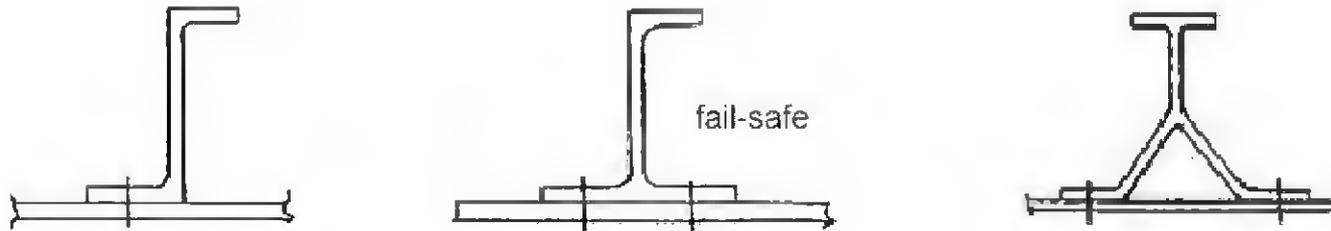
# Travi a parete sottile

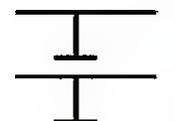


# Travi a parete sottile

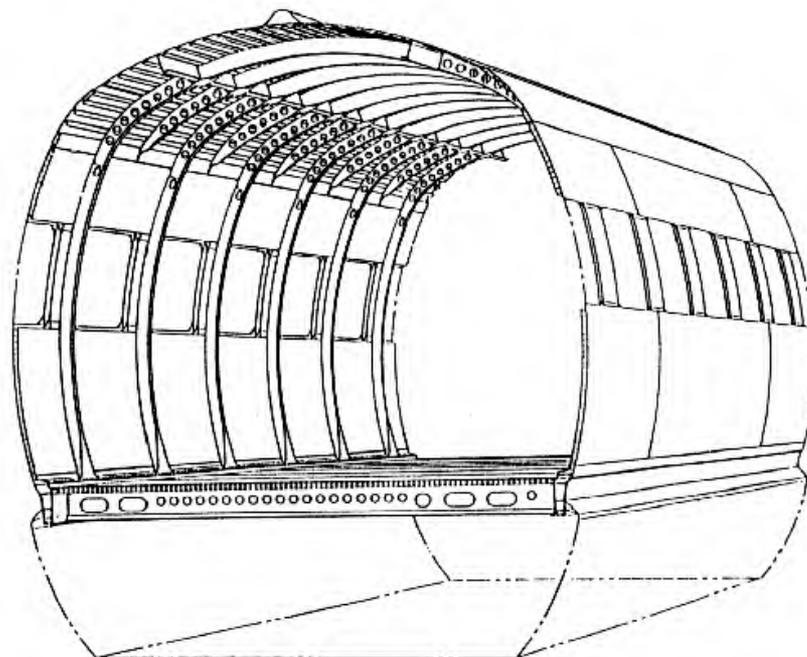
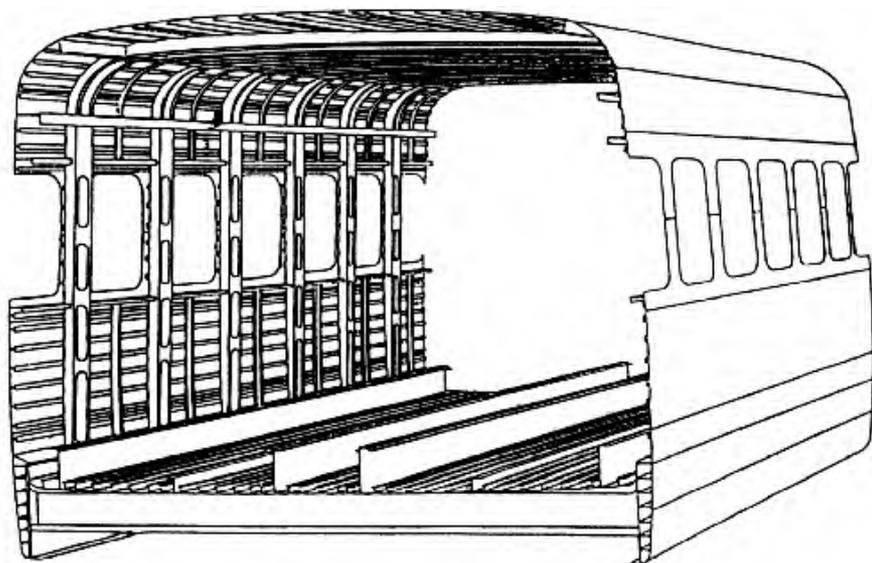


# Travi a parete sottile



Type Aircraft	Skin	Type structure	Material	Shape	
F100	upper lower	stringer stringer	7075-T6 2024-T3		
MD-90	upper lower	stringer stringer	7075-T6 2024-T3		
B 747	upper lower	stringer stringer	7075-T6 2024-T3		
A-300	upper lower	stringer stringer	7075-T6 2024-T3		
C-5A	upper lower	integral integral	7075-T6 7075-T6		

# Travi a parete sottile (campo ferroviario)



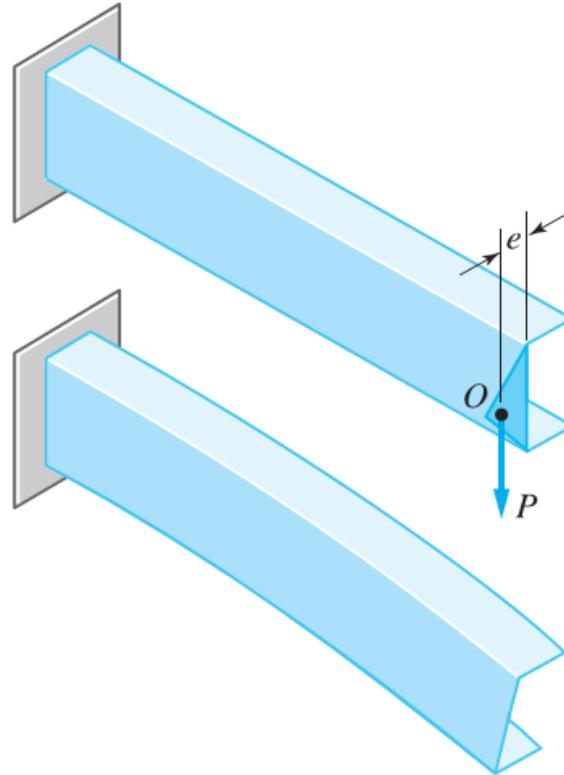
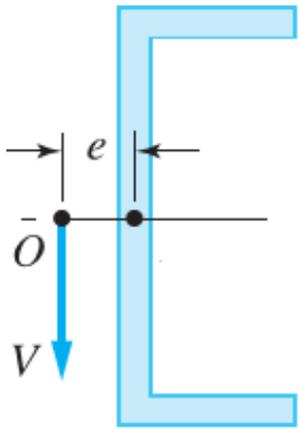
Shinkansen 300 (270 km/h)



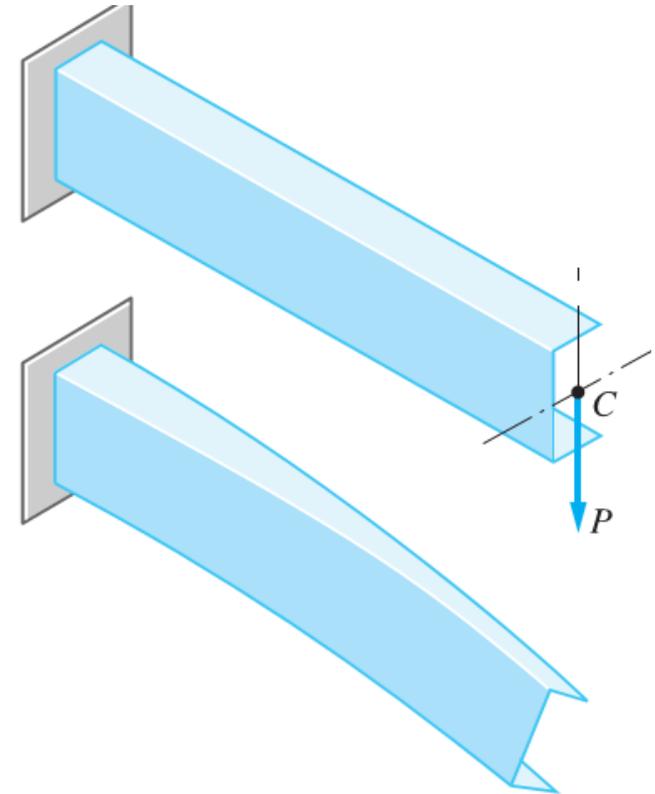
Shinkansen 500 (320 km/h)

## Travi a parete sottile

- Sforzi tangenziali  $\tau$  dovuti al taglio  $T$
- Centro di taglio e Torsione spuria
- Sforzi tangenziali  $\tau$  dovuti al momento torcente  $M_t$



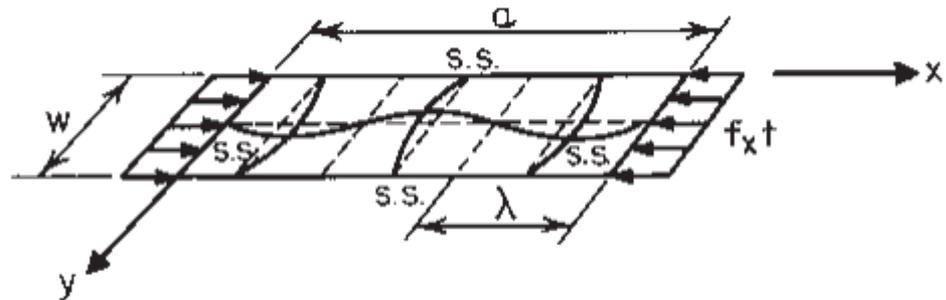
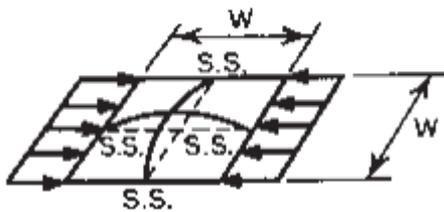
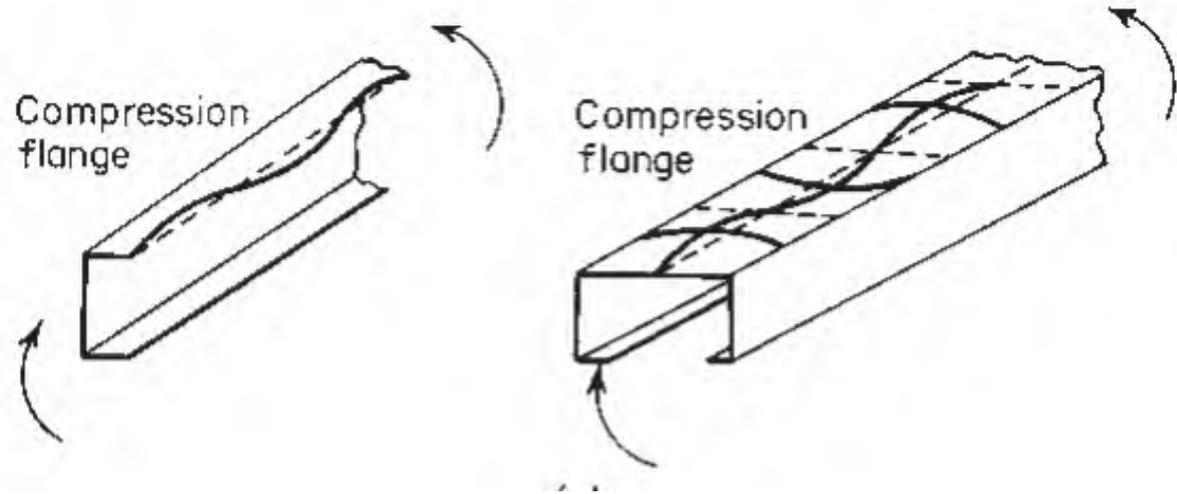
AZIONE T PASSANTE  
PER IL CENTRO DI TAGLIO  
- FLESSIONE -



AZIONE T **NON** PASSANTE  
PER IL CENTRO DI TAGLIO  
- FLESSIONE + **TORSIONE** -

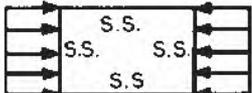
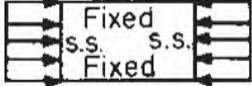
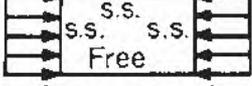
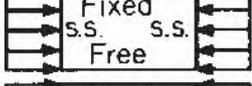
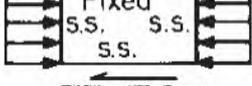
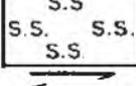
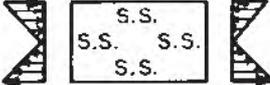
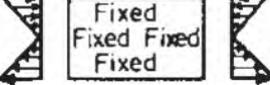
# LOCAL BUCKLING (INSTABILITA')

Flangia soggetta  
a compressione



# SFORZO CRITICO DI BUCKLING

$$f_{cr} = k \frac{\pi^2 E}{12(1 - \mu^2) (w/t)^2}$$

Case	Boundary Condition	Type of Stress	Value of $k$ for Long Plate
(a)		Compression	4.0
(b)		Compression	6.97
(c)		Compression	0.425
(d)		Compression	1.277
(e)		Compression	5.42
(f)		Shear	5.34
(g)		Shear	8.98
(h)		Bending	23.9
(i)		Bending	41.8

