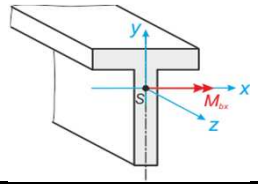
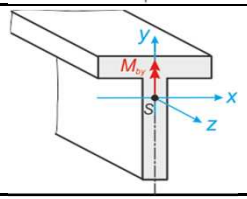
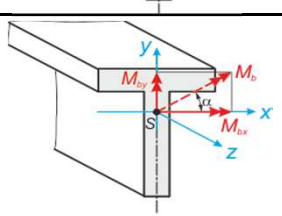
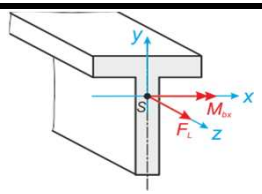
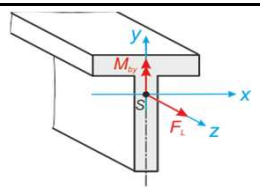
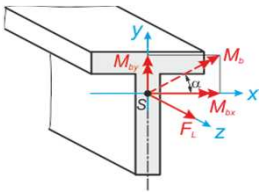
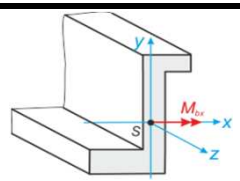
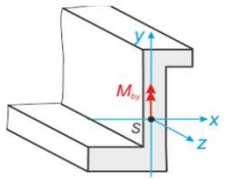
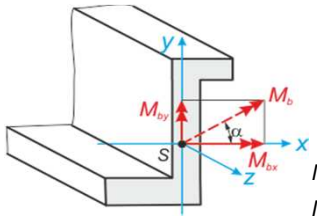
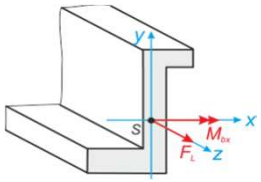
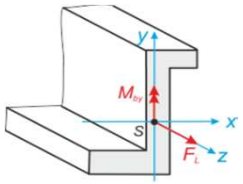
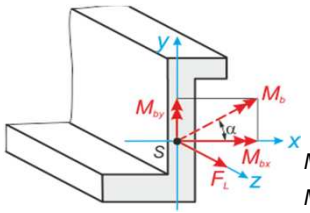
Biegespannung

I_{kl}	Schnittgrößen		Beispiel	Spannung	Spannungsnulllinie
$I_{xy} = 0$ I_{xx}, I_{yy}	$F_L = 0$	M_{bx}		$\sigma_{zz}(y,z) = \frac{M_{bx}}{I_{xx}} y$	$y = 0$
		M_{by}		$\sigma_{zz}(x,z) = -\frac{M_{by}}{I_{yy}} x$	$x = 0$
		M_{bx}, M_{by}	 $M_{bx} = M_b \cos\alpha$ $M_{by} = M_b \sin\alpha$	$\sigma_{zz}(x,y,z) = \frac{M_{bx}}{I_{xx}} y - \frac{M_{by}}{I_{yy}} x$	$y = \frac{M_{by}}{M_{bx}} \frac{I_{xx}}{I_{yy}} x$
	$F_L \neq 0$	M_{bx}		$\sigma_{zz}(y,z) = \frac{F_L}{A} + \frac{M_{bx}}{I_{xx}} y$	$y = -\frac{F_L}{M_{bx}} \frac{I_{xx}}{A}$
		M_{by}		$\sigma_{zz}(x,z) = \frac{F_L}{A} - \frac{M_{by}}{I_{yy}} x$	$x = \frac{F_L}{M_{by}} \frac{I_{yy}}{A}$
		M_{bx}, M_{by}	 $M_{bx} = M_b \cos\alpha$ $M_{by} = M_b \sin\alpha$	$\sigma_{zz}(x,y,z) = \frac{F_L}{A} + \frac{M_{bx}}{I_{xx}} y - \frac{M_{by}}{I_{yy}} x$	$y = -\frac{F_L}{M_{bx}} \frac{I_{xx}}{A} + \frac{M_{by}}{M_{bx}} \frac{I_{xx}}{I_{yy}} x$

$I_{xy} \neq 0$ I_{xx}, I_{yy}	$F_L = 0$	M_{bx}		$\sigma_{zz}(x,y,z) = \frac{I_{yy}\, y + I_{xy}\, x}{I_{xx}\, I_{yy} - I_{xy}^2} M_{bx}$	$y = -\frac{I_{xy}}{I_{yy}}\, x$
		M_{by}		$\sigma_{zz}(x,y,z) = -\frac{I_{xy}\, y + I_{xx}\, x}{I_{xx}\, I_{yy} - I_{xy}^2} M_{by}$	$y = -\frac{I_{xx}}{I_{xy}}\, x$
		M_{bx}, M_{by}	 $M_{bx} = M_b \cos\alpha$ $M_{by} = M_b \sin\alpha$	$\sigma_{zz}(x,y,z) = \frac{M_{bx}\, I_{yy} - M_{by}\, I_{xy}}{I_{xx}\, I_{yy} - I_{xy}^2} y + \frac{M_{bx}\, I_{xy} - M_{by}\, I_{xx}}{I_{xx}\, I_{yy} - I_{xy}^2} x$	$y = -\frac{M_{bx}\, I_{xy} - M_{by}\, I_{xx}}{M_{bx}\, I_{yy} - M_{by}\, I_{xy}} x$
	$F_L \neq 0$	M_{bx}		$\sigma_{zz}(x,y,z) = \frac{F_L}{A} + \frac{I_{yy}\, y + I_{xy}\, x}{I_{xx}\, I_{yy} - I_{xy}^2} M_{bx}$	$y = -\frac{I_{xy}}{I_{yy}}\, x - \frac{F_L}{M_{bx}} \frac{I_{xx}\, I_{yy} - I_{xy}^2}{A\, I_{yy}}$
		M_{by}		$\sigma_{zz}(x,y,z) = \frac{F_L}{A} - \frac{I_{xy}\, y + I_{xx}\, x}{I_{xx}\, I_{yy} - I_{xy}^2} M_{by}$	$y = -\frac{I_{xx}}{I_{xy}}\, x + \frac{F_L}{M_{by}} \frac{I_{xx}\, I_{yy} - I_{xy}^2}{A\, I_{xy}}$
		M_{bx}, M_{by}	 $M_{bx} = M_b \cos\alpha$ $M_{by} = M_b \sin\alpha$	$\sigma_{zz}(x,y,z) = \frac{F_L}{A} + \frac{M_{bx}\, I_{yy} - M_{by}\, I_{xy}}{I_{xx}\, I_{yy} - I_{xy}^2} y + \frac{M_{bx}\, I_{xy} - M_{by}\, I_{xx}}{I_{xx}\, I_{yy} - I_{xy}^2} x$	$y = -\frac{M_{bx}\, I_{xy} - M_{by}\, I_{xx}}{M_{bx}\, I_{yy} - M_{by}\, I_{xy}} x - \frac{F_L}{A} \frac{I_{xx}\, I_{yy} - I_{xy}^2}{M_{bx}\, I_{yy} - M_{by}\, I_{xy}}$