Design Aids—Minimum Depth and Allowable Bending Stress

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DESIGN AIDS are presented for the everyday use of steel designers. They show in the form of tabulation, nomograph or diagram, relationships specified in the AISC *Specification for the Design, Fabrication & Erection of Structural Steel for Buildings* and its *Commentary*.

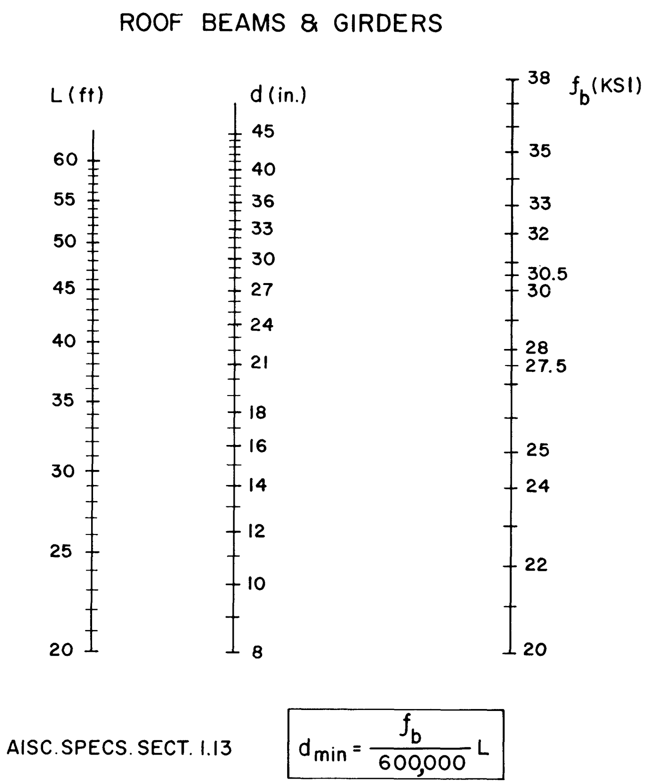

Fig. 1. Minimum depth of roof beams and girders supporting flat roofs

FIGURE 1

Figure 1 is a nomograph which gives the minimum depth of roof beams and girders supporting flat roofs. If the slope is less than 3 in 12, the roof is to be considered flat. The depth requirement is a function of the actual bending stress f_b according to the formula

$$d_{min} = (f_b/600{,}000)\, L$$

as specified in Section 1.13 of the Specification. For given depths the corresponding allowable bending stress can be found. See Fig. 4 for maximum f_b values.

FIGURE 2

Figure 2 is a nomograph showing minimum depth requirements for floor beams and girders. It is based on the relationship between the actual bending stress f_b and the span, allowing for the decrease in bending stress if

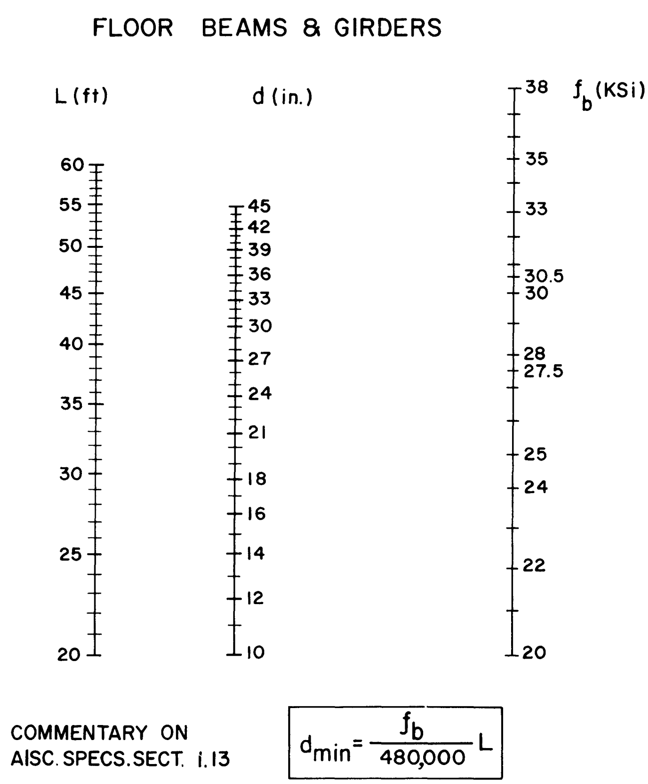

Fig. 2. Suggested minimum depth of floor beams and girders

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members of less depth are used. The formula is

$$d_{\min} = (f_b/480{,}000)\ L$$

which is derived from

$$d_{\min} = (F_y/800{,}000)\ L$$

as suggested in Section 1.13 of the Commentary on the AISC Specification. As in the case of roofs (Fig. 1), if the members are not stressed up to their capacity the bending stress f_b will be smaller, and correspondingly a shallower section can be selected. See Fig. 3 for maximum f_b values.

FIGURE 3

Figure 3 shows the maximum allowable f_b values of the different steel grades according to their yield points, for laterally supported compact sections ($f_{b\max} = 0.66\ F_y$) and for other members ($f_{b\max} = 0.60\ F_y$).

F_y	f_b	
	.60Fy	.66 Fy
33	20	22
36	22	24
42	25	28
46	27.5	30.5
50	30	33

Fig. 3. Maximum f_b values for different steel grades

FIGURE 4

Figure 4 is a diagram showing minimum depths of different yield point floor beams and girders which are subject to shock or vibration, such as the framing of elevators, escalators, etc. It is based on the formula

$$d_{\min} = (F_y/650{,}000)\ L$$

as suggested in Section 1.13 of the Commentary on the AISC Specification.

FIGURE 5

Figure 5 is a tabulation of the C_b values to be used in Formula (4) of Section 1.5.1.4.5 in determining the allowable compression stresses on the extreme fibers of structural sections. It shows the commonly encountered moment-unbraced length relationships together with the derivations.

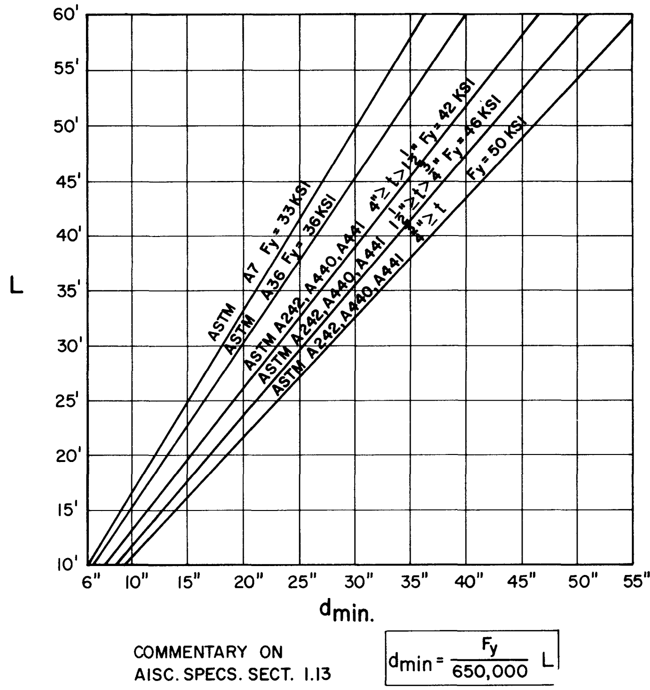

Fig. 4. Suggested minimum depth of floor beams and girders subject to shock or vibration

MOMENT UNBRACED LENGTH RELATIONSHIP	$\frac{M_1}{M_2}$	C_b	$C_b = 1.75 - 1.05\left(\frac{M_1}{M_2}\right) + .3\left(\frac{M_1}{M_2}\right)^2$ BUT NOT MORE THAN 2.3
l	+1	1.0	$1.75 - 1.05(+1) + .3(+1)^2 = 1.0$
$M_1 = 0$, M_2, l	0	1.75	$1.75 - 1.05(0) + .3(0)^2 = 1.75$
M_1, M_2, l	POS.	< 1.75	BY FORMULA $C_b =$ FROM FIG. 1.5.1.4.5 IN APPENDIX $\frac{M_1}{M_2}$, C_b
$-M_2$, $+M_1$, l	NEG	$1.75 \le C_b \le 2.3$	Do
$-M_1$, $+M_2$, l	NEG.	Do	Do
$\pm M_2$, $M_1 = 0$, l	0	1.75	$1.75 - 1.05(0) + .3(0)^2 = 1.75$
l, l, l	$M_{INT} > M_{END}$	1.0	SEE AISC SECT 1.5.1.4.5
$\pm M$, l	+1	1.0	$1.75 + 1.05(+1) + .3(+1)^2 = 1.0$

Fig. 5. Determination of C_b values (AISC Specification Sect. 1.5.1.4.5)