lar loads under restricted speed, will carry engines weighing in excess of the engines now in use to about the extent indicated below:

16 and 24-Wheel Articulated Engines.....	30 per cent.
10-Coupled	39 per cent.
Mikado, 12 and 20-Wheel Articulated, Atlantic, Consolidation and 12-Wheel Type Engines	52 per cent.
Pacific and Decapod	62 per cent.
Prairie	70 per cent.
Electric .....79 to	88 per cent.

It will be seen from the above that loads which strain an E-60 bridge to its regular service capacity can be operated occasionally over an E-50 bridge, and even regularly when speed is restricted.

Have Present Bridges Sufficient Strength?

In view of past experience, it is perhaps reasonable to assume that some of the heavy types indicated in Table 5 as developing the full regular service capacity of an E-50 bridge

Table 4.—Relative Stresses Produced by Heaviest Locomotives—Spans 10 Ft. to 100 Ft.

Class.	Actual Weight.	Proportional Weight.	Proportional Stress.	
			From	To
E-50	225,000	1.00	1.00	1.00
Atlantic	214,800	0.96	0.83	1.15
Prairie	244,700	1.09	0.88	1.03
Consolidation	260,100	1.16	0.99	1.14
12 Wheel	262,000	1.17	1.00	1.14
Decapod	267,000	1.19	0.96	1.07
Pacific	270,000	1.20	0.93	1.08
Mikado	305,000	1.36	1.02	1.16
12 Wheel Articulated	334,500	1.49	0.98	1.15
10 Coupled	361,000	1.60	1.00	1.26
20 Wheel Articulated.....	478,000	2.12	1.01	1.14
16 Wheel Articulated.....	493,000	2.19	1.26	1.34
24 Wheel Articulated	616,000	2.74	1.15	1.33
12 Wheel Electric Motor.....	300,400	1.33	0.83	0.98
16 Wheel Electric Motor.....	320,000	1.42	0.84	0.93

may probably be operated regularly over heavy grade divisions, but experience with the present heaviest locomotives does not indicate that still heavier types will ever be proper and economical on low-grade divisions. But suppose they should be operated regularly on all divisions, whether high or low grade, then an E-50 American Railway Engineering Association Specification bridge will have ample capacity to take care of them.

It is less reasonable to assume that the still heavier types of Table 6 required for developing the full regular service capacity of an E-60 bridge will ever be operated even on high-grade divisions, unless gauge of track is increased and greater clearances made, both laterally and vertically, in tunnels and bridges and the right-of-way probably also increased, or, in other words, unless all present standards are abandoned and the railway practically reconstructed.

But suppose such types can be constructed and placed in operation without changing standard gauge and clearances, they surely would not be operated regularly on low-grade divisions, and if their regular operations should be confined to high-grade divisions, then E-50 bridges on low-grade territory would have ample capacity to enable these types being transferred to and from these high-grade territories.

It appears, therefore, that an E-50 bridge is a good and economical type and provides for increased loading above the heaviest now in service to a sufficient extent to justify the railways which consider it a proper standard on all divisions until such time as conditions require practically a complete reconstruction of the railway.

It is, of course, admitted that an E-60 bridge is heavier, stronger and stiffer than an E-50 bridge. It will stand more abuse and more neglect, but it will cost from 12 per cent. to 15 per cent. more for its construction. While a number of roads have adopted this class of bridge for all divisions and others are contemplating its adoption, the justification therefor is not apparent in many cases. The mere fact that one or two roads started a somewhat radical change by building E-60 bridges should not in itself be sufficient excuse for other roads to do likewise, thereby apparently playing the youthful game of "follow your leader."

Table 5.—Full Regular Service Traffic Capacity for E-50 Bridges Based on an Overload of 50 Per Cent.

Locomotives.	Weight.	Wheel Base.	Average Axle Load.	Percentage of Increase.†
Cooper's E-75	337,500	23.00	75,000	50.0
*Atlantic	280,000	30.79	82,400	31.0
Prairie	356,300	34.25	82,600	46.0
Consolidation	342,300	26.50	75,600	32.0
12-Wheel	344,800	27.08	73,000	32.0
Decapod	374,300	29.83	66,400	40.0
Pacific	375,000	35.20	81,700	39.0
Mikado	394,200	35.00	77,900	29.0
12-Wheel Articulated ..	436,200	30.66	72,600	30.0
10-Coupled	429,800	43.50	71,700	19.0
20-Wheel Articulated...	629,000	59.80	70,800	32.0
16-Wheel Articulated..	552,000	40.17	62,800	12.0
24-Wheel Articulated...	695,000	65.92	62,000	13.0
12-Wheel Electric	460,000	38.50	78,800	53.0
16-Wheel Electric	516,000	44.22	64,500	61.0

*The Atlantic type applies to spans under 15 ft.; for greater spans the weight of this class of engine would run over 60 per cent. in excess of the heaviest type now in service.

†Percentages of increase in column 5 represent the approximate increase in weight of locomotives and driving loads in excess of the maximum weights now in actual use.

This tendency toward the adoption of E-60 loading is perhaps influenced more by precedent than by good, sound reason and judgment, and is being stimulated by the bridge companies, who profit by a greater tonnage of metal used in construction.

Table 6.—Full Regular Service Traffic Capacity for E-60 Bridges Based on an Overload of 50 Per Cent.

Locomotives.	Weight.	Wheel Base.	Average Axle Load.	Percentage of Increase.†
Cooper's E-90	405,000	23.00	90,000	50.0
*Atlantic	336,000	31.79	98,800	57.0
Prairie	427,600	34.25	99,100	75.0
Consolidation	411,000	26.50	90,700	58.0
12-Wheel	413,500	27.08	87,600	58.0
Decapod	449,400	29.83	79,500	68.0
Pacific	450,000	35.20	98,000	67.0
Mikado	473,000	35.00	93,500	55.0
12-Wheel Articulated...	523,800	30.66	87,100	56.0
10-Coupled	515,800	43.50	86,000	43.0
20-Wheel Articulated...	754,800	59.80	85,000	58.0
16-Wheel Articulated...	662,500	40.17	75,400	34.0
24-Wheel Articulated...	834,000	65.92	74,400	35.0
12-Wheel Electric	552,000	38.50	94,600	84.0
16-Wheel Electric	619,200	44.22	77,400	94.0

*The Atlantic type applies to spans under 15 ft.; for greater spans the weight of this class of engine would run over 90 per cent. in excess of the heaviest type now in service.

†Percentages of increase in column 5 represent the approximate increase in weight of locomotives and driving-axle loads in excess of the maximum weights now in actual use.

The writer hopes it will not be inferred that he condemns E-60 bridges as unreasonably heavy and extravagant and, therefore, not consistent with economical construction. They are better bridges than the E-50 class, and those who are in a position to justify them in paying more for the stronger structure, or who honestly believe this reserve strength will be required in the future, should not be classed with the extravagant, since at the most it is a case of foresight and judgment.