Appendix: New LRFD-based prestressed concrete bulb-tee girders in Colorado

Yail J. Kim and Thushara Siriwardanage

This appendix contains additional figures for "New LRFD-based Prestressed Concrete Bulb-Tee Girders in Colorado," by Yail J. Kim and Thushara Siriwardanage, which appears on pages 53–63 in the May–June 2020 issue of *PCI Journal*.

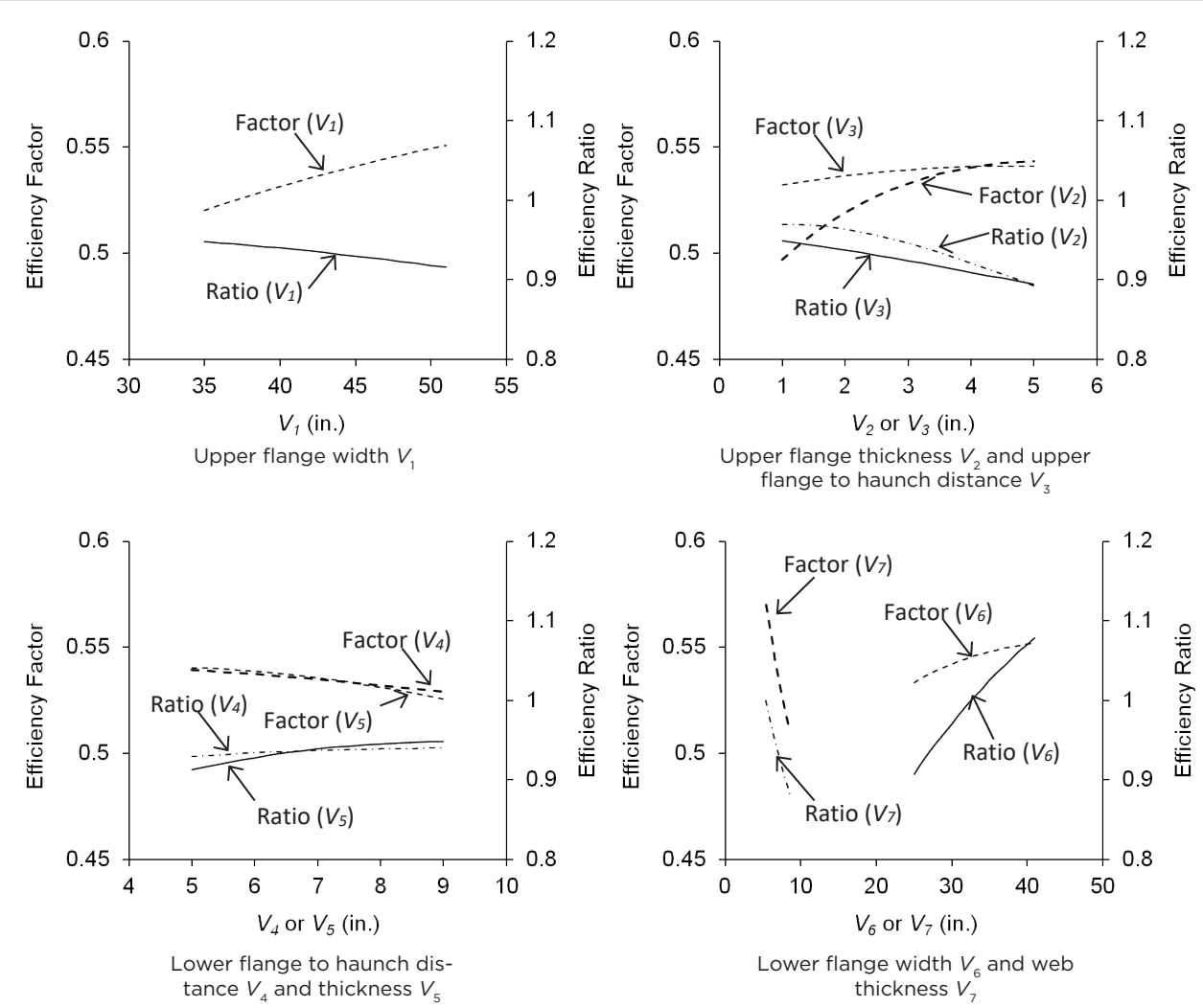

Figure A.1. Sensitivity analysis on girder dimensions based on BT618 at a depth of 54 in. for upper flange width V_1 and thickness V_2, upper flange to haunch distance V_3, lower flange to haunch distance V_4, lower flange thickness V_5 and width V_6, and web thickness V_7. Note: BT618 = standard Colorado girder type. 1 in. = 25.4 mm.

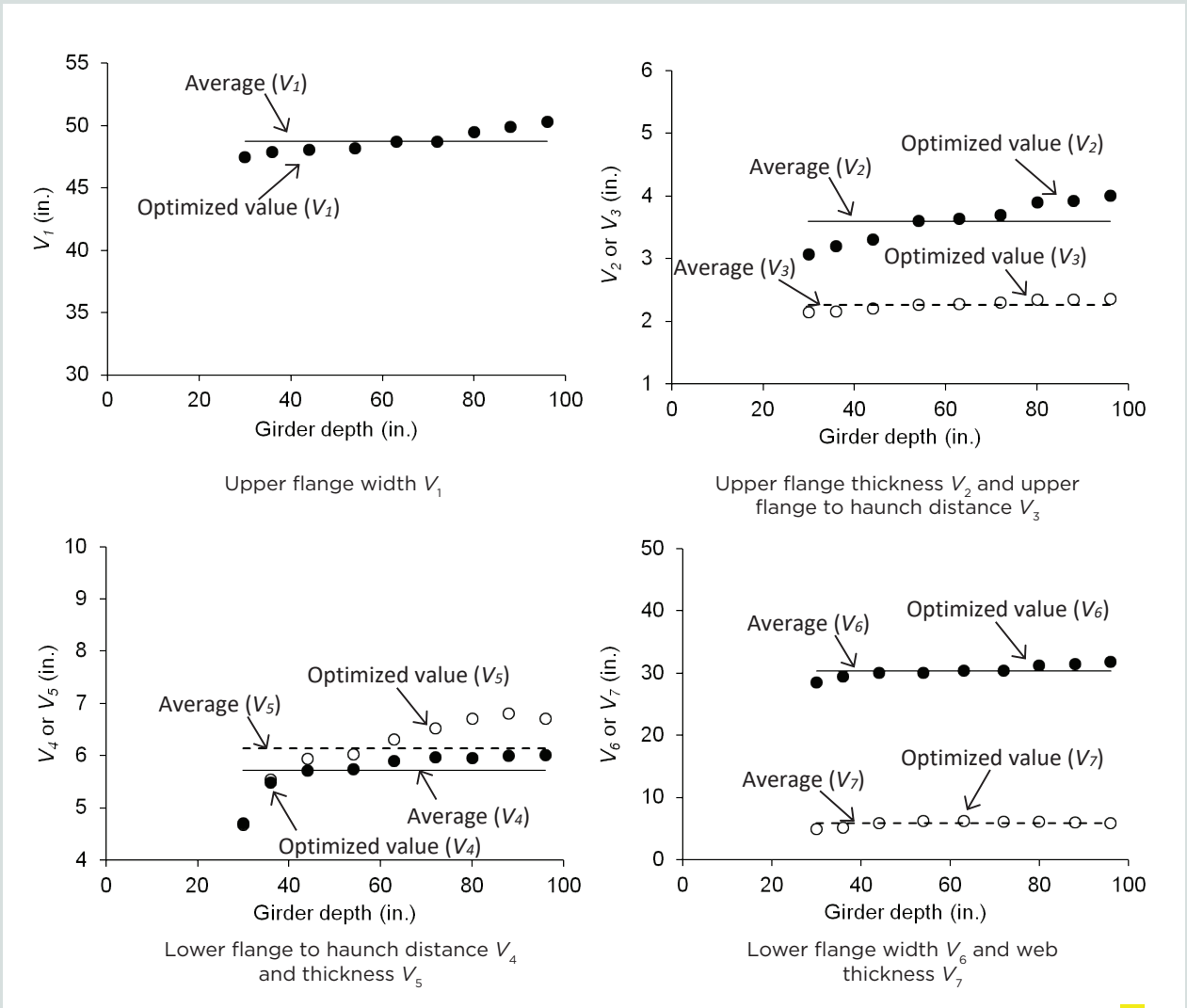

Figure A.2. Estimation for trial girder section based on optimization of BT618 for upper flange width V_1 and thickness V_2, upper flange to haunch distance V_3, lower flange to haunch distance V_4 and lower flange thickness V_5 and width V_6, and web thickness V_7. Note: BT618 = standard Colorado girder type. 1 in. = 25.4 mm.

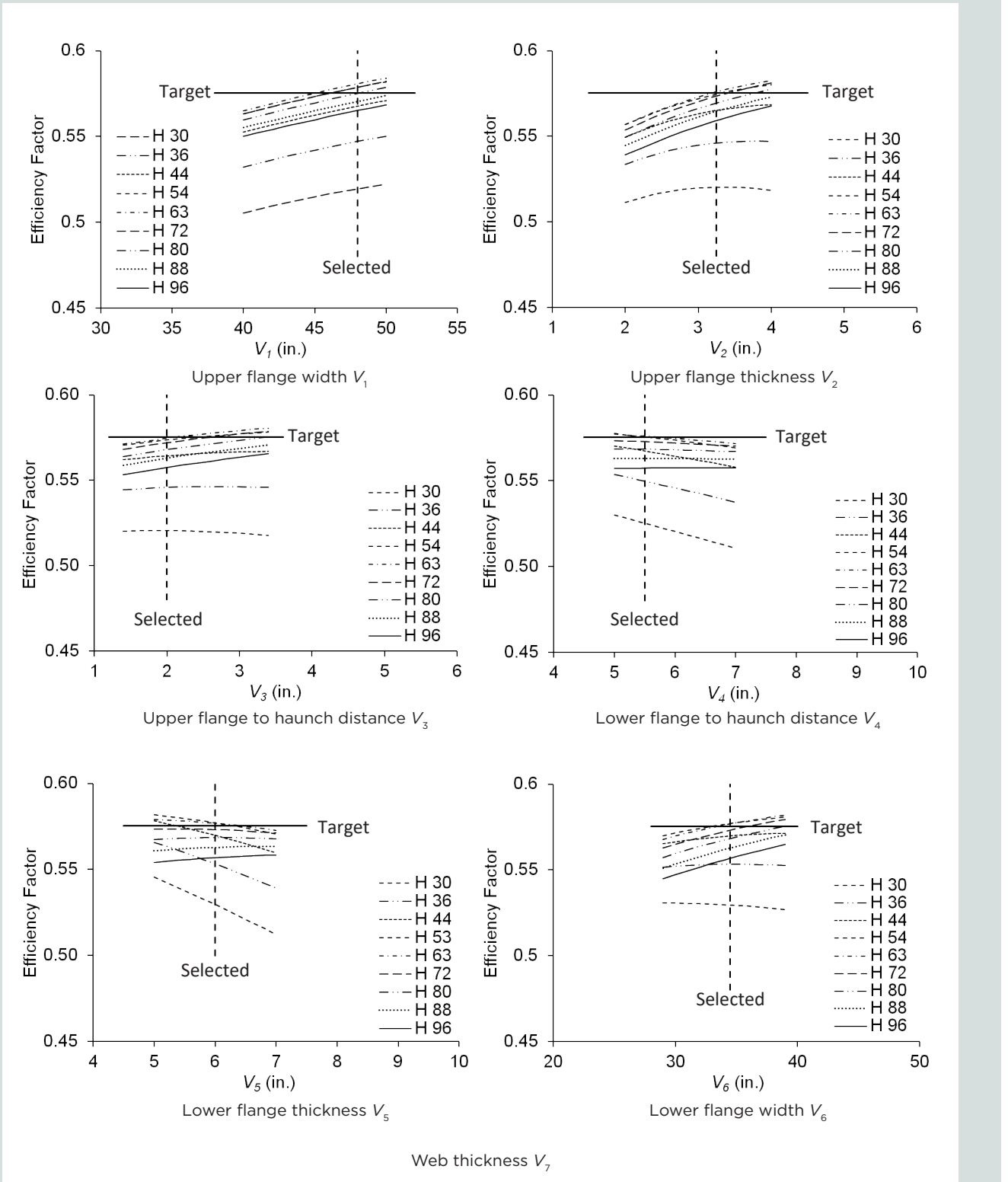

Figure A.3. Parametric investigation for upper flange width V_1 and thickness V_2, upper flange to haunch distance V_3, lower flange to haunch distance V_4, lower flange thickness V_5 and width V_6, and web thickness V_1. Note: H = depth of girder. 1 in. = 25.4 mm.

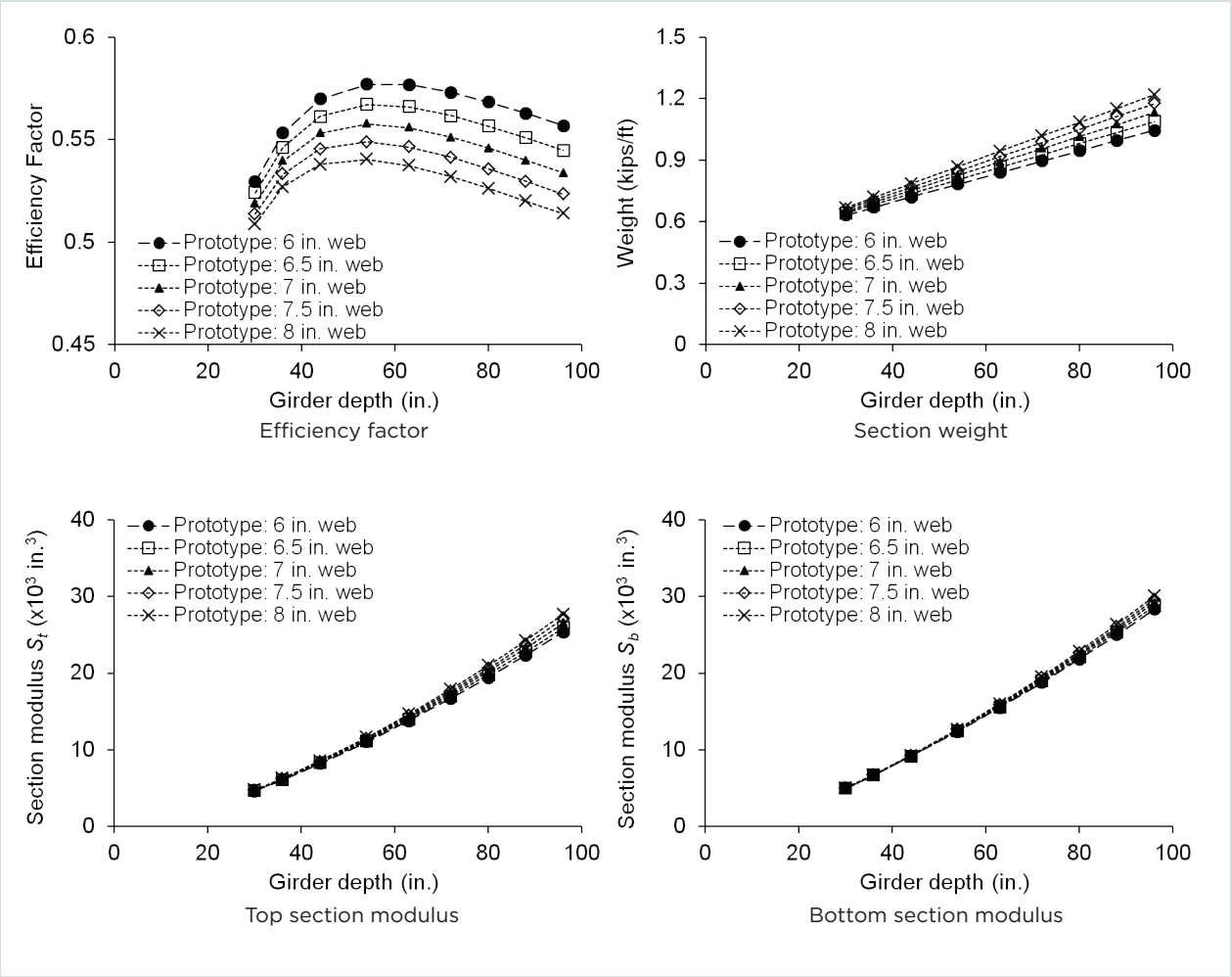

Figure A.4. Comparison of sectional properties with variable web thicknesses and span range from 90 to 215 ft for efficiency factor, section weight, top section modulus, and bottom section modulus. Note: 1 in. = 25.4 mm; 1 ft = 0.305 m; 1 in.^{3} = 16,390 mm^3; 1 kip/ft = 14.593 kN/m.

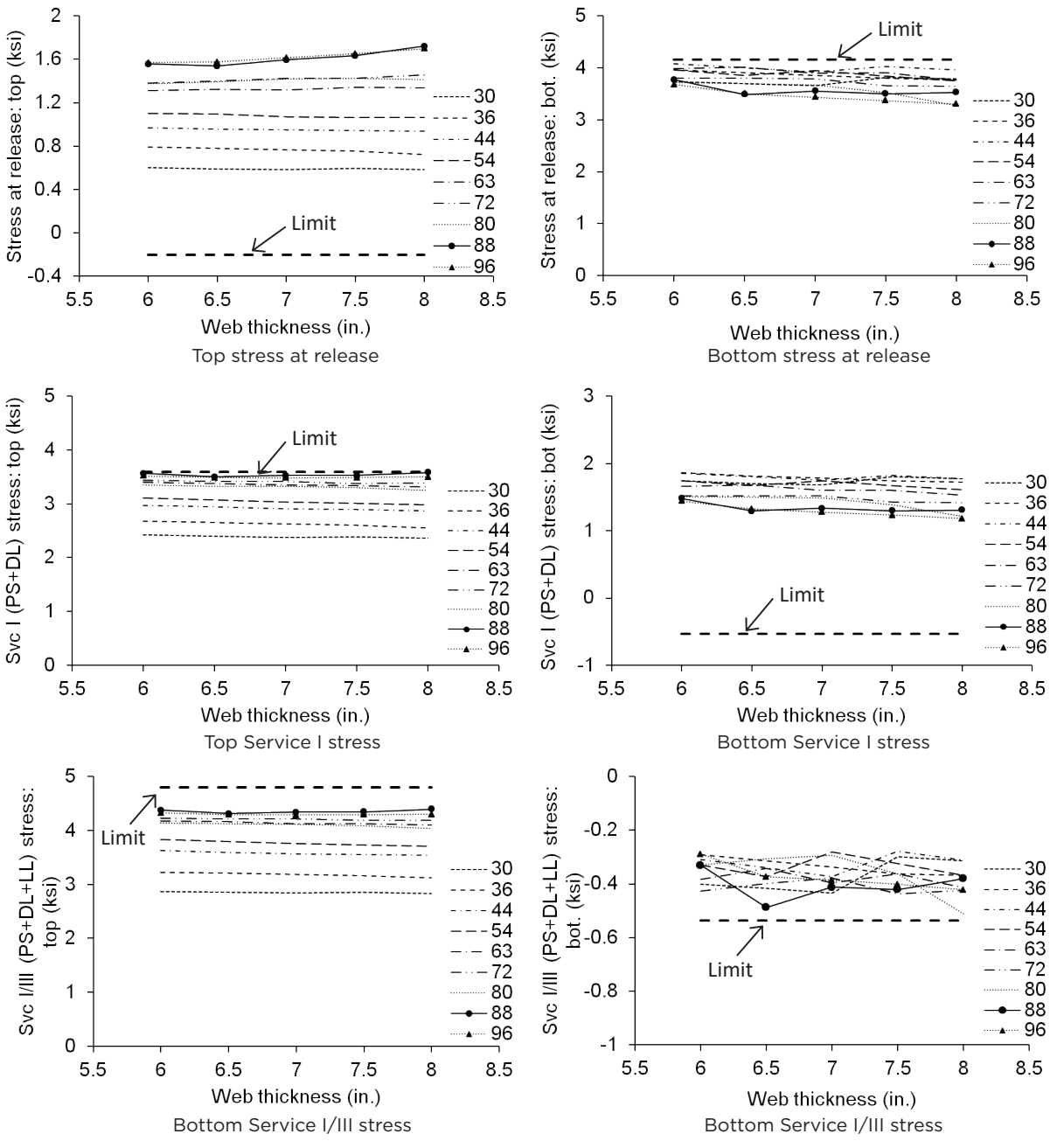

Figure A.5. Comparison of stress depending on web thickness with span range of 90 to 215 ft for top and bottom stress at release, top and bottom Service I stress, and top and bottom Service I/III stress. Note: negative stress = tension; positive deflection = downward deflection; positive stress = compression. DL = dead load; LL = live load; PS = prestressing force. 1 in. = 25.4 mm; 1 ksi = 6.895 MPa.

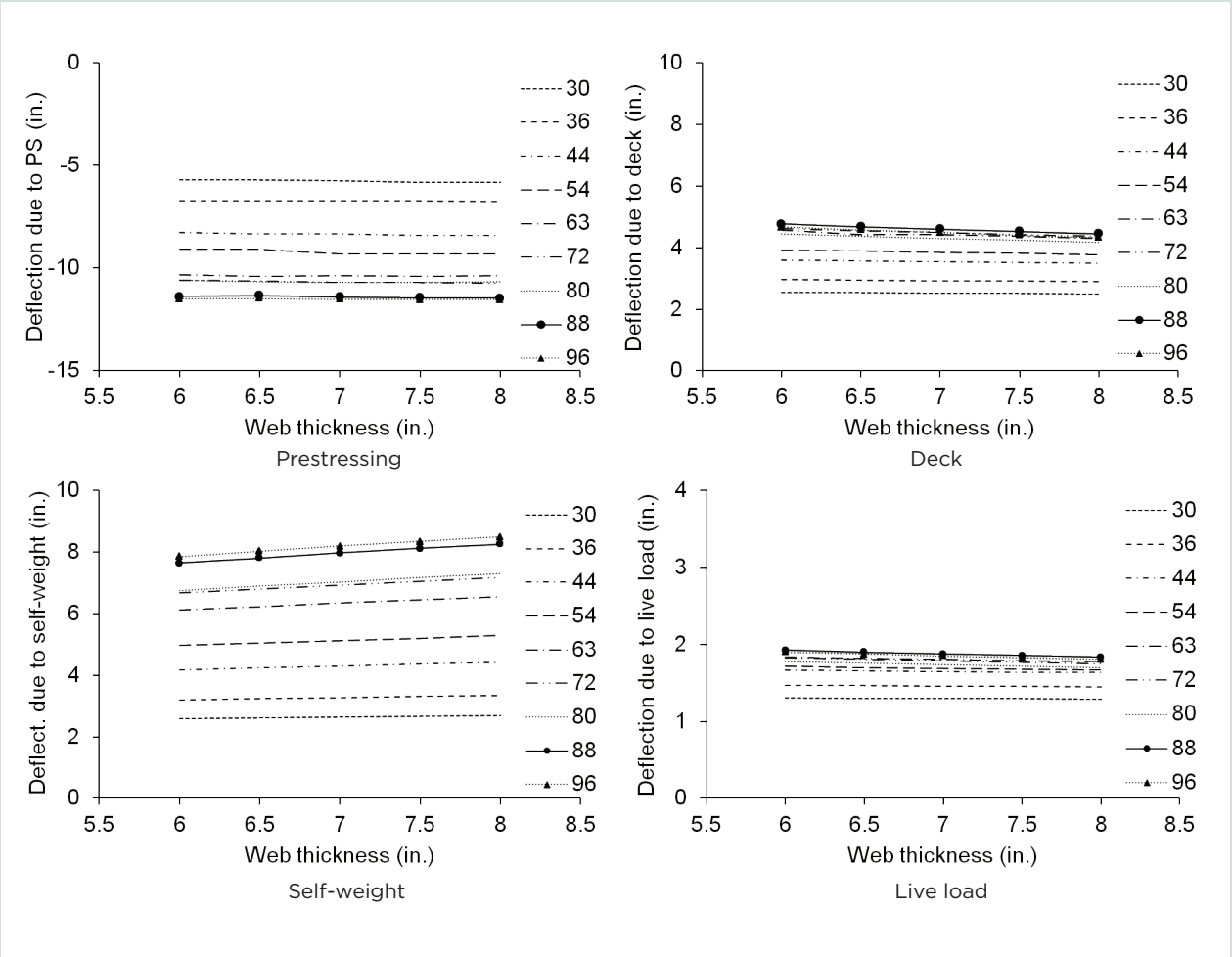

Figure A.6. Comparison of deflection depending on web thickness with a span range from 90 to 215 ft due to prestressing, deck, self-weight, and live load. Note: PS = prestressing force. 1 in. = 25.4 mm; 1 ft = 0.305 m.

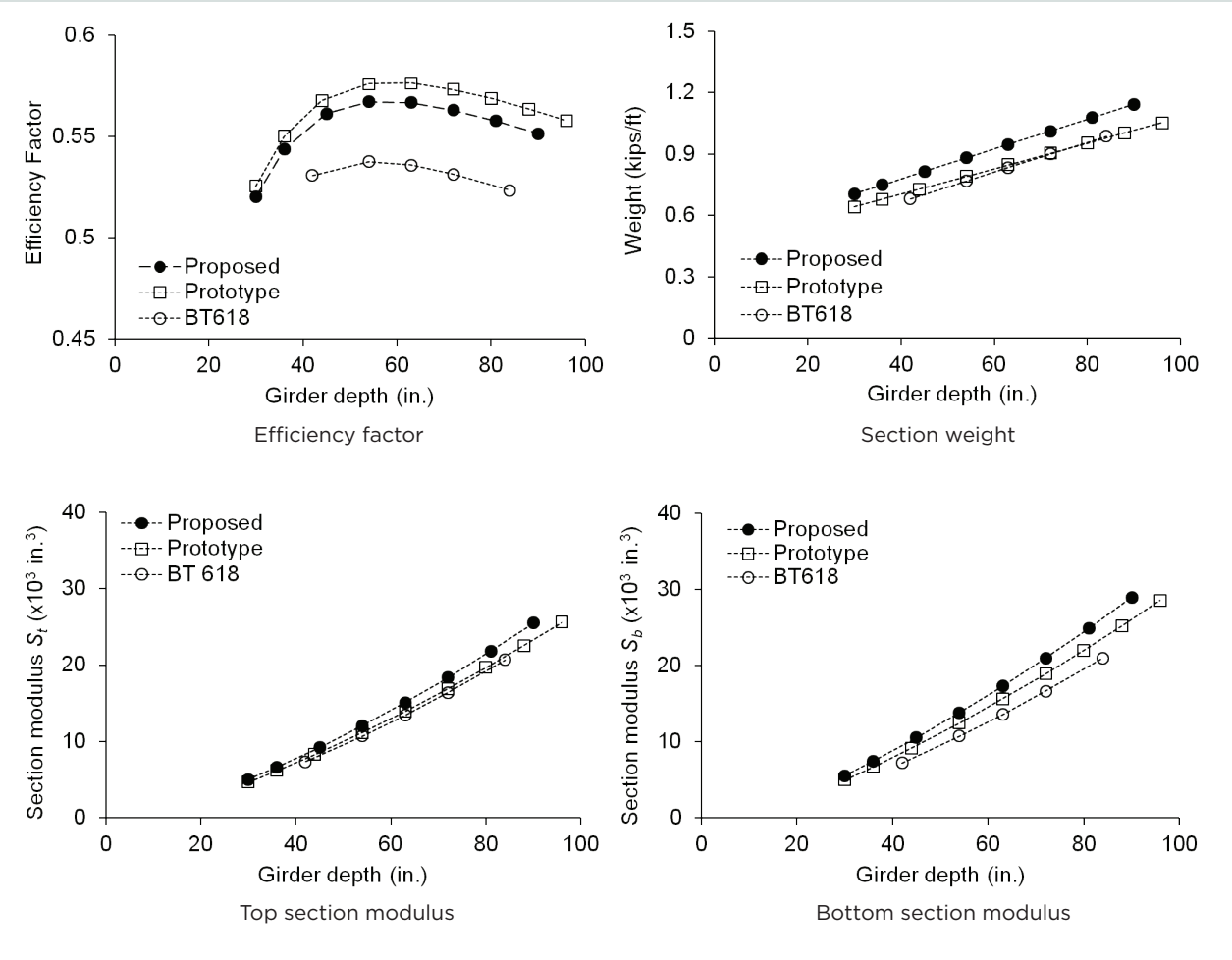

Figure A.7. Sectional properties of proposed girders for efficiency factor, section weight, and top and bottom section modulus. Note: BT618 = standard Colorado girder type. 1 in. = 25.4 mm; 1 in.3 = 16, 390 mm3; 1 kip/ft = 14.593 kN/m.

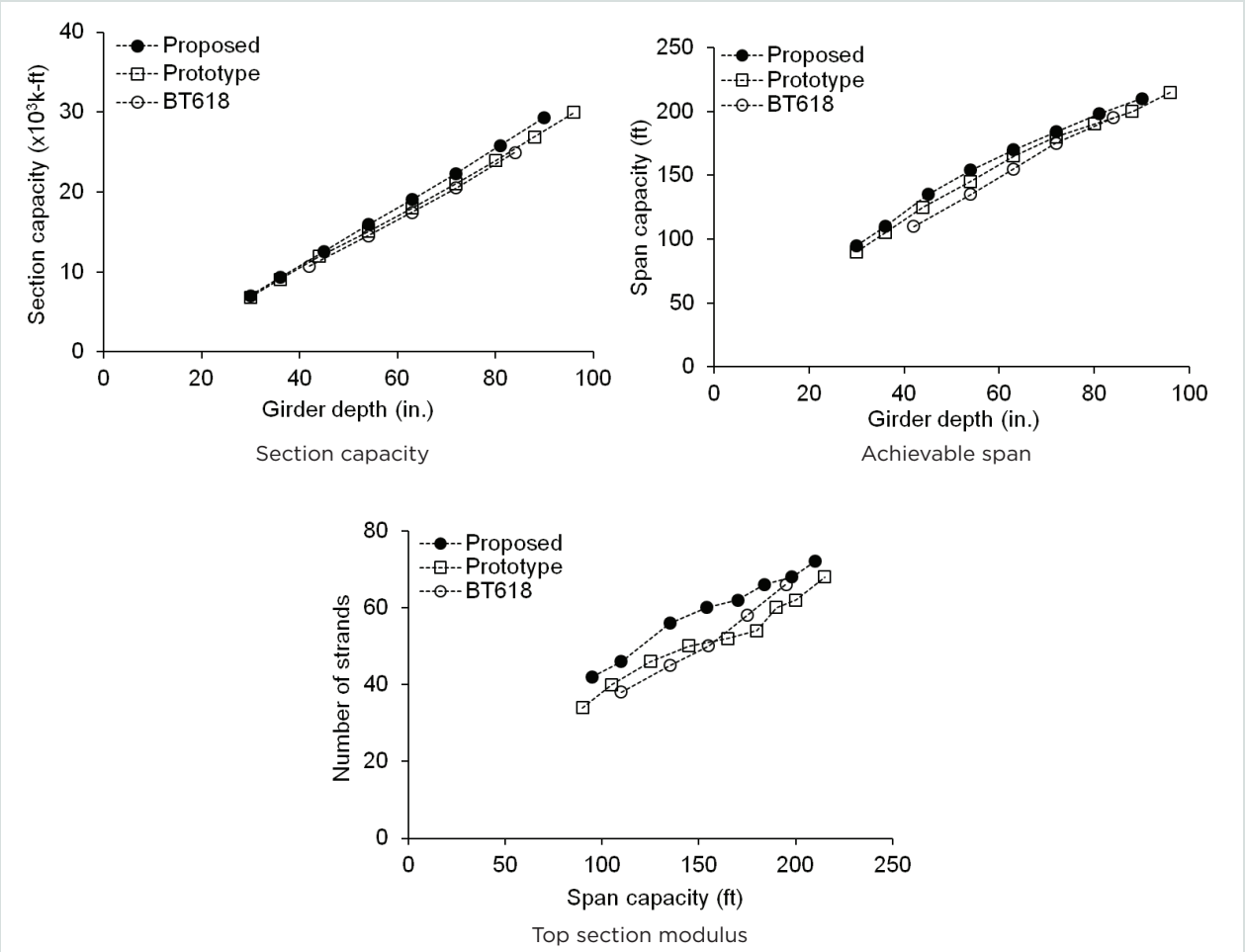

Figure A.8. Comparison of composite girders for section capacity, achievable span, and number of 0.6 in. diameter strands. Note: BT618 = standard Colorado girder type. 1 in. = 25.4 mm; 1 ft = 0.305 m; 1 kip-ft = 1.356 kN-m.

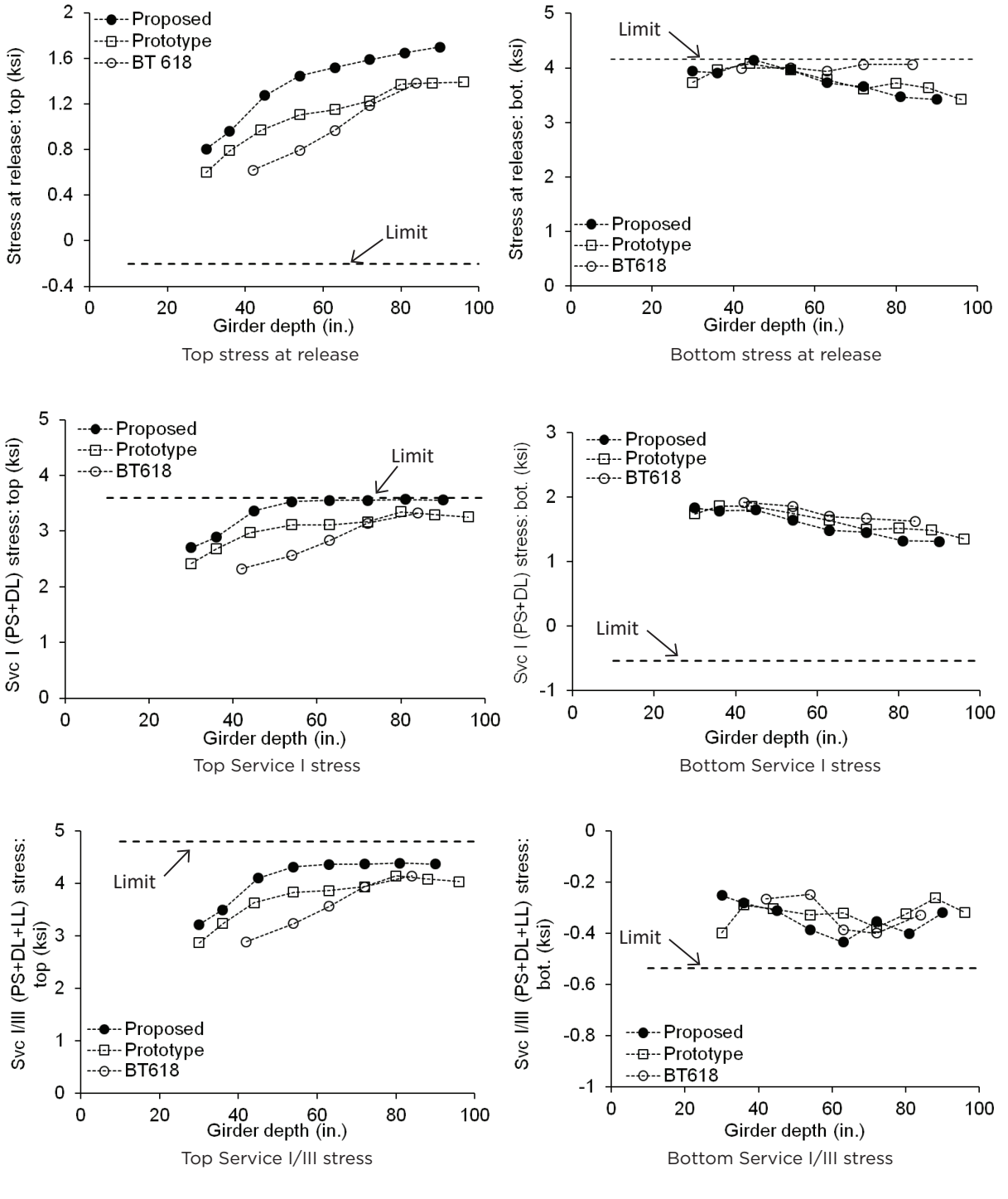

Figure A.9. Comparison of stress for top and bottom stress at release, top and bottom Service I stress, and top and bottom Service I/III stress. Note: negative stress = tension; positive deflection = downward deflection; positive stress = compression. bot. = bottom; BT618 = standard Colorado girder type; DL = dead load; LL = live load; PS = prestressing force; Svc = service. 1 in. = 25.4 mm; 1 ft = 0.305 m;1 ksi = 6.895 MPa.

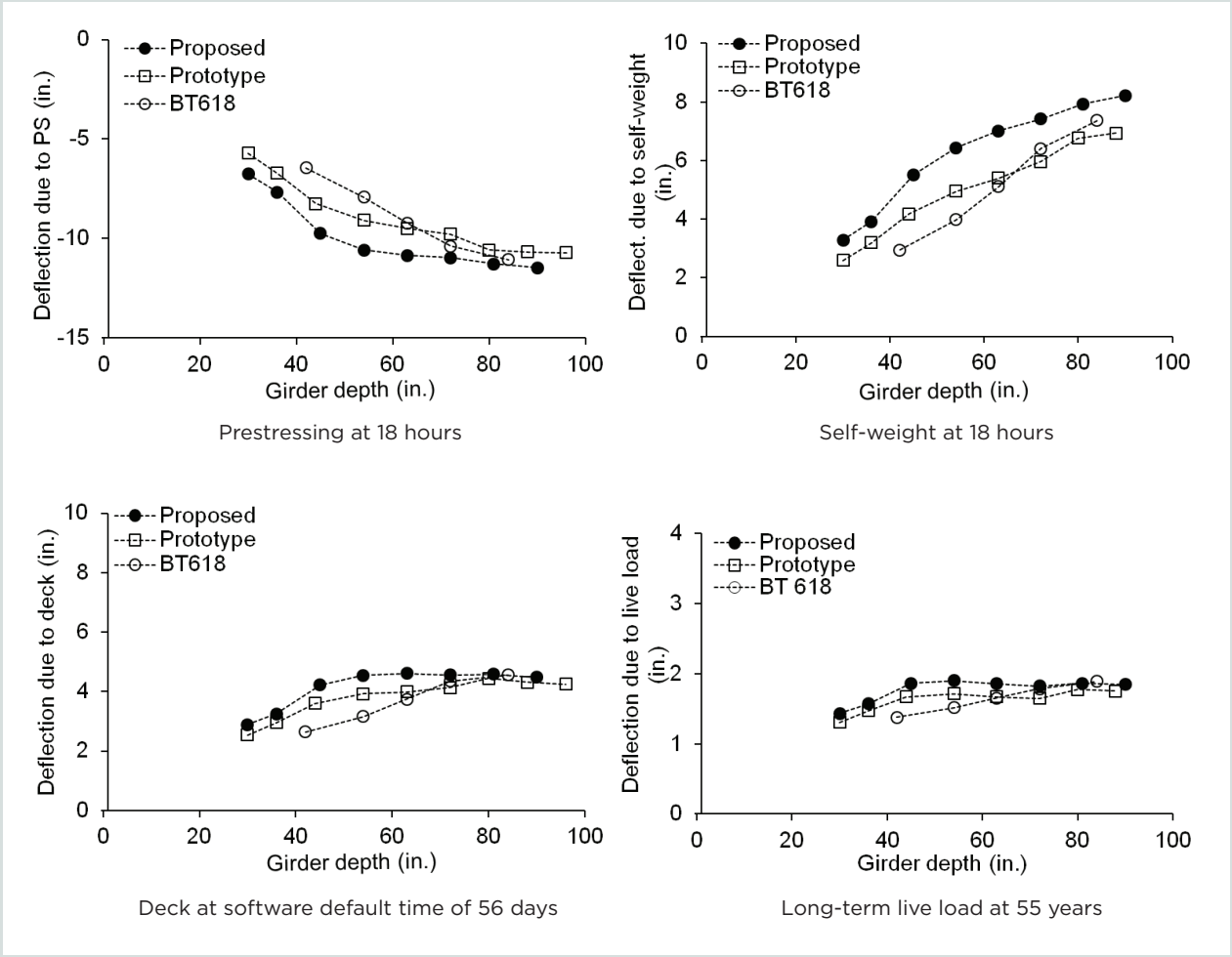

Figure A.10. Comparison of deflection due to prestressing at 18 hours, self-weight at 18 hours, deck at software default time of 56 days, and long-term live load at 55 years. Note: BT618 = standard Colorado girder type; PS = prestressing force; 1 in. = 25.4 mm.

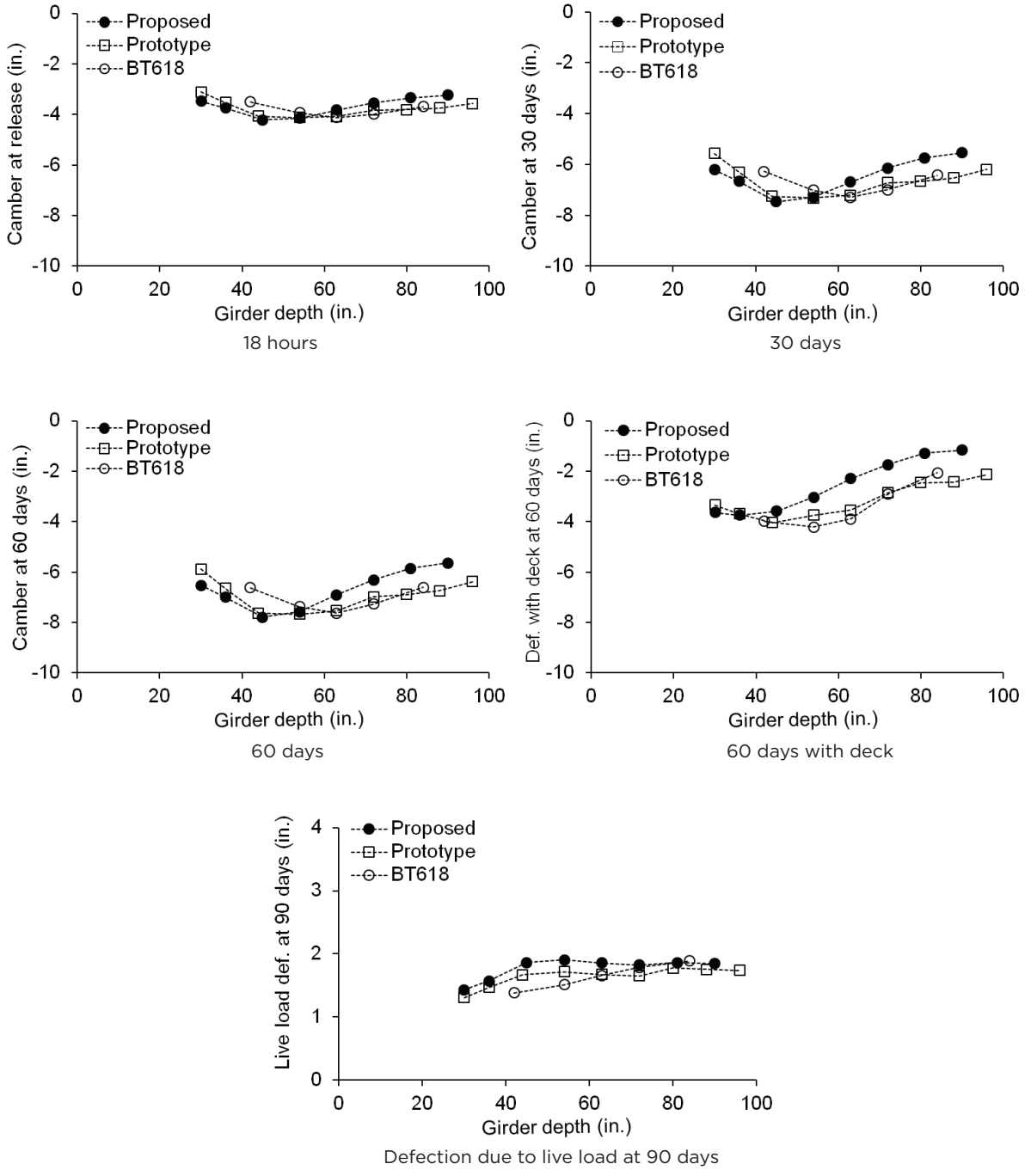

Figure A.11. Time-dependent camber variation at release at 18 hours, 30 days, 60 days, and 60 days with a deck and for deflection due to live load at 90 days. Note: BT618 = standard Colorado girder type. 1 in. = 25.4 mm.

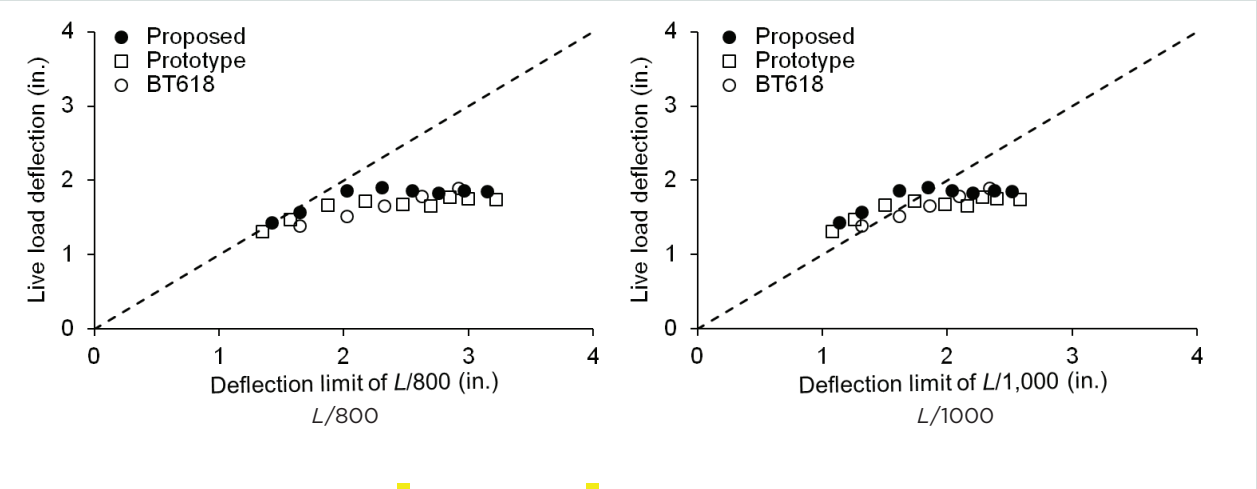

Figure A.12. Deflection limit for *L*/800 and *L*/1000. Note: BT618 = standard Colorado girder type; *L* = span length. 1 in. = 25.4 mm.

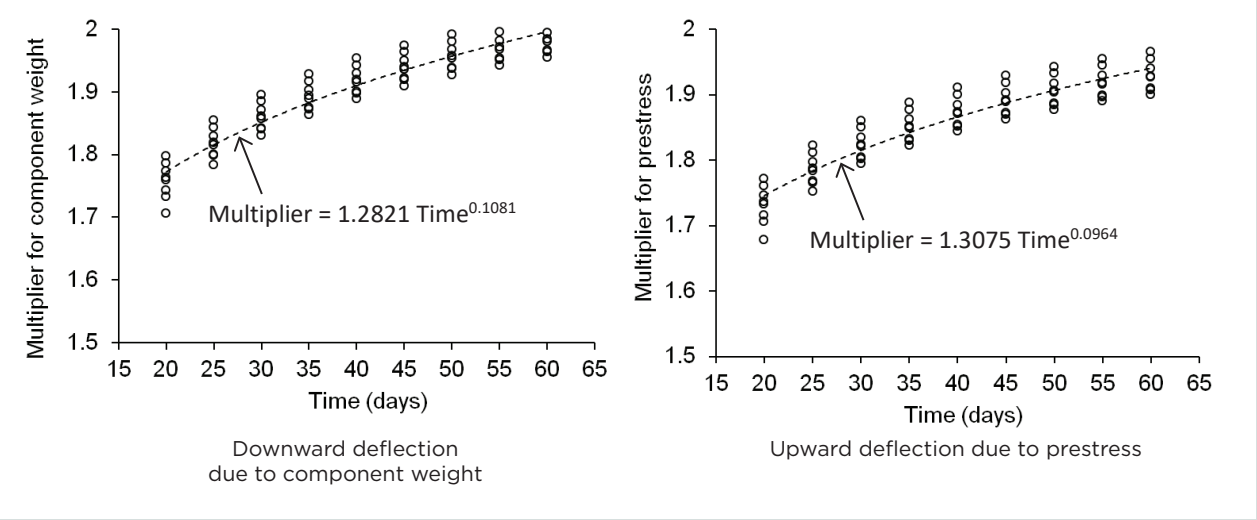

Figure A.13. Multipliers for time-dependent deflection at erection for downward deflection due to component weight and upward deflection due to prestress.

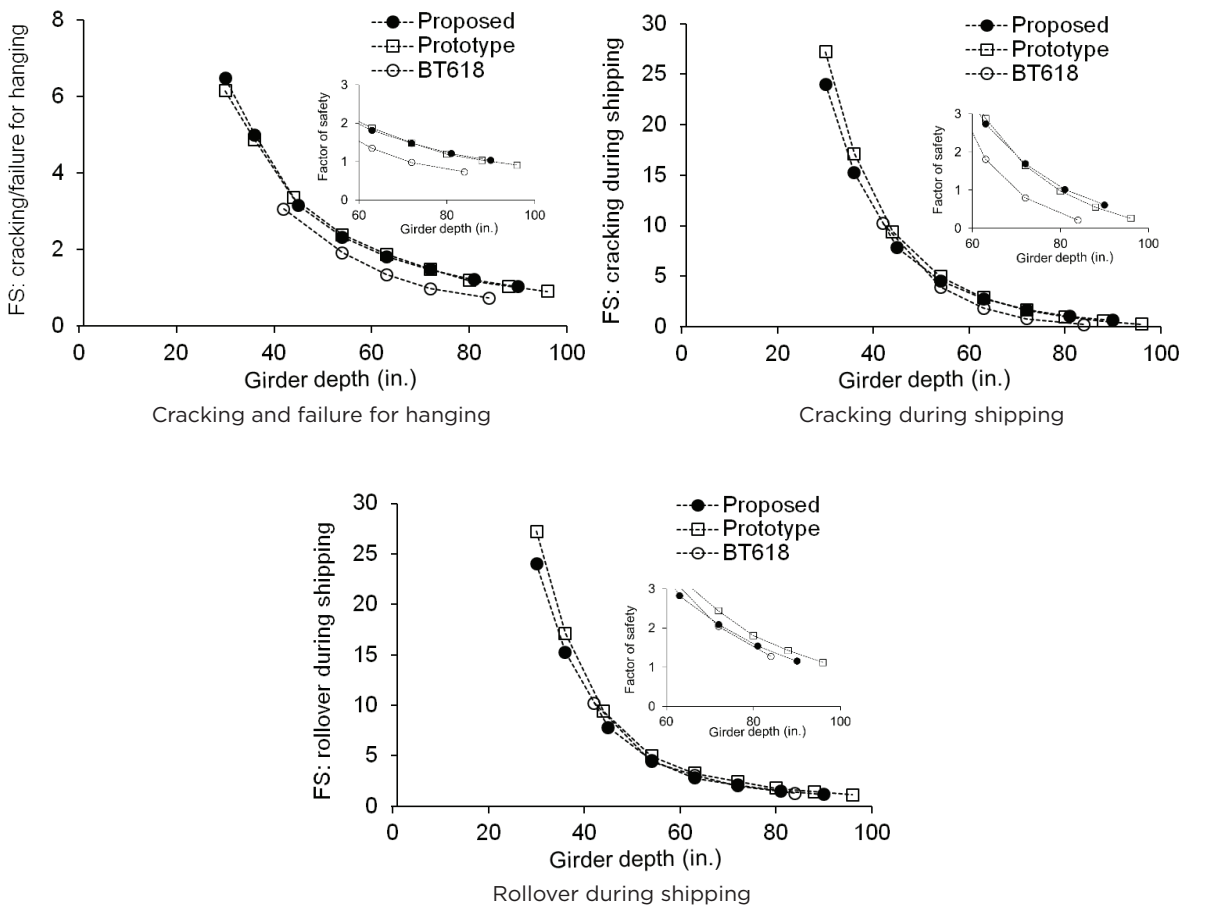

Figure A.14. Assessment of lateral stability for cracking and failure for hanging, cracking during shipping, and rollover during shipping. Note: BT618 = standard Colorado girder type; FS = factor of safety. 1 in. = 25.4 mm.