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FLOOR ASSEMBLIES – PHASE II

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SUMMARY

This report presents the results of 53 fire resistance experiments conducted on full-scale floor assemblies as part of the collaborative industry-government research program investigating the effects of frame member type, frame member depth (solid wood joist), frame member spacing, wood I-joist type, parallel-chord wood truss size, parallel-chord wood truss orientation, parallel-chord wood truss web type, parallel-chord wood truss connection type, insulation type, insulation in floor cavity (none, partial and full cavity), insulation support (steel mesh), sub-floor deck type, number of sub-floor layers, number of Type X gypsum board ceiling layers, number of Type X gypsum board ceiling layers vs number of sub-floor layers, sub-floor topping, resilient channel installation, resilient channel spacing, load magnitude and test repeatability as well as assemblies with unique design. The results of the full-scale experiments showed that:

1. For a floor assembly with either solid wood joists or wood I-joists or steel C-joists or parallel-chord wood trusses spaced at 406 mm o.c. and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of Canadian softwood plywood (CSP) sub-floor (15.5 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the effect of frame type is insignificant.
2. For a floor assembly with two layers of Type X gypsum board (12.7 mm thick each), solid wood joists (89 mm wide and 235 mm deep) or steel C-joists (203 mm deep) spaced at 406 mm o.c. and resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, an assembly with solid wood joists provided 8% more fire resistance than an assembly with steel C-joists.
3. For a floor assembly with one layer of Type X gypsum board (15.9 mm thick), either steel C-joists (203 mm deep) or solid wood joists (235 mm deep) spaced at 406 mm o.c. and resilient channels spaced at 406 mm o.c., two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) and rock fibre insulation (89 mm thick) in the floor cavity, an assembly with solid wood joists provided 9% more fire resistance than an assembly with steel C-joists.
4. In a floor assembly with either solid wood joist (89 mm wide and 235 mm deep) or steel C-joists (203 mm deep) spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), two layers of softwood plywood (CSP) (15.5 mm thick each), resilient channels spaced at 406 mm o.c., an assembly with steel C-joist provided 17% more fire resistance than an assembly with solid wood joist and that is in part due to the larger thickness of the cellulose fibre insulation in the assembly with steel C-joists than in the assembly with solid wood joists.
5. For a floor assembly with either solid wood joists (89 mm wide and 235 mm deep) or wood I-joists (38 mm wide flanges and 241 mm deep) or wood trusses (89 mm wide and 305 mm deep) or steel C-joists (203 mm deep) spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) directly applied to the framing, one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and neither resilient channels nor

insulation in the floor cavity, the maximum difference in fire resistance among the four floor frames is 6 min 7s.

6. For a floor assembly with either solid wood joists (89 mm wide and 235 mm deep) or wood I-joists (241 mm deep) or parallel-chord wood trusses (89 mm wide and 305 mm deep) or steel C-joists (203 mm deep) spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and no insulation in the floor cavity, the effect of frame type on the fire resistance is insignificant.
7. For a floor assembly with solid wood joists (89 mm wide) and resilient channels spaced 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the effect of solid wood joist depth (184 mm vs 235 mm) on the fire resistance is insignificant.
8. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep), two layers of Type X gypsum board (12.7 mm thick each), resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick in assembly with joists spaced at 406 mm o.c. and 19 mm thick for joists spaced at 610 mm o.c.) and glass fibre insulation (89 mm thick) in the floor cavity, the effect of solid wood joists spacing, 406 mm o.c. vs 610 mm o.c., on the fire resistance is insignificant.
9. For a floor assembly with wood trusses (89 mm wide and 305 mm deep), two layers of Type X gypsum board (12.7 mm thick each) directly applied to parallel-chord wood trusses, with no insulation in the floor cavity and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick in assembly with trusses spaced at 406 mm o.c. and 19 mm thick for trusses spaced at 610 mm o.c.), the effect of wood truss spacing, 406 mm o.c. vs 610 mm o.c., on the fire resistance, unlike in the case for wood truss assemblies with resilient channels, is significant.
10. For a floor assembly with wood trusses (89 mm wide and 305 mm deep), two layers of Type X gypsum board (12.7 mm thick each), resilient channels spaced at 406 mm o.c., glass fibre insulation (89 mm thick) in the floor cavity and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick in assembly with trusses spaced at 406 mm o.c. and 19 mm thick for trusses spaced at 610 mm o.c.), the effect of wood truss spacing, 406 mm o.c. vs 610 mm o.c., on the fire resistance is insignificant.
11. For a floor assembly with steel C-joists (203 mm deep), two layers of Type X gypsum board (12.7 mm thick each), directly applied to steel C-joists with no insulation in the floor cavity and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), the effect of joist spacing, 406 mm o.c. vs 610 mm o.c., on the fire resistance is significant.
12. For a floor assembly with wood trusses (305 mm deep) of either nominal 4x2 (89 mm x 38 mm) or 3x2 (64 mm x 38 mm) components, and resilient channels spaced at 406 mm o.c., glass fibre insulation (89 mm thick) in the floor cavity, one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), the effect of wood truss size, nominal 4x2 (89 mm x 38 mm) vs 3x2 (64 mm x 38 mm), on the fire resistance is insignificant.
13. For a floor assembly with wood trusses (305 mm and 406 mm deep), two layers of Type X gypsum board (12.7 mm thick each), no insulation in the floor cavity, one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and wood trusses and resilient channels spaced at 406 mm o.c., the assembly with parallel-chord wood truss with chord and web members oriented horizontally (flat) provided 6% more fire resistance than an assembly where the chord and web members of the wood trusses were oriented vertically (on edge).
14. For a floor assembly with wood trusses (286 mm deep for metal-web and 330 mm deep for metal-plate-connected with wood-web) and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) glass fibre insulation (89 mm

thick) in the floor cavity and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), the effect of web type for parallel-chord wood trusses of either metal-web connected metal webs or metal-plate-connected wood-web on the fire resistance is insignificant.

15. For a floor assembly with wood trusses (305 mm deep for metal-plate-connection and 330 mm deep for glued-finger-connection) spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), and resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the effect of parallel-chord wood truss connection type (metal-plate-connection vs glued-finger-connection) on the fire resistance is insignificant.
16. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), the effect of insulation type (rock fibre vs glass fibre insulation, 89 mm thick) on the fire resistance is significant.
17. For a floor assembly with wood I-joists (58 mm wide flanges and 241 mm deep) spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) and resilient channels spaced at 305 mm o.c., the effect of insulation type (cellulose fibre insulation dry blown above steel mesh vs rock fibre insulation, full cavity) on the fire resistance is significant.
18. For a floor assembly with wood trusses (89 mm wide and 305 mm deep) and resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick) and one layer of softwood plywood (CSP) sub-floor (19 mm thick), the effect of insulation type (cellulose fibre insulation sprayed with water on the wood truss members and on the underside of the sub-floor vs glass fibre or rock fibre insulation) on the fire resistance is significant.
19. For a floor assembly with steel C-joists (203 mm deep) and resilient channels spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick) and two layers of softwood plywood sub-floor (15.5 mm thick each), the installation of either rock fibre insulation (178 mm thick) or cellulose fibre insulation sprayed with water (91 mm thick on the sub-floor underside and 112 mm thick on the joist sides) increased the fire resistance by 36% and 64%, respectively, compared to a similar assembly with no insulation in the floor cavity.
20. For a floor assembly with steel C-joists (203 mm deep) and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) and a concrete topping (51 mm thick) above a steel deck, the effect of insulation type (rock fibre vs glass fibre insulation, 89 mm thick) on the fire resistance is insignificant.
21. For a floor assembly with steel C- joists (203 mm deep) and resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) and one layer of softwood plywood (CSP) sub-floor (19 mm thick), the effect of insulation type (cellulose fibre insulation sprayed with adhesive vs glass fibre insulation, 89 mm thick) on the fire resistance is significant.
22. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), the effect of glass fibre insulation (89 mm thick) installation compared to a non insulated assembly on the fire resistance is insignificant.
23. For a floor assembly with wood trusses (89 mm wide and 305 mm deep) and resilient channels spaced 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), the installation of

glass fibre insulation (89 mm thick) reduced the fire resistance by 6% compared to an assembly with no insulation in the floor cavity.

24. For a floor assembly with steel C-joists (203 mm thick) and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) and concrete topping (51 mm thick) on a steel deck, the installation of rock fibre insulation (89 mm thick) reduced the fire resistance by 7% compared to an assembly with no insulation in the floor cavity.
25. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) spaced at 406 mm o.c. and resilient channels spaced at 203 mm o.c., one layer of Type X gypsum board (15.9 mm thick) and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), the installation of a steel mesh below the rock fibre insulation batts did not increase the fire resistance.
26. For a floor assembly with steel C-joists (203 mm deep) and resilient channels spaced at 406 mm o.c., glass fibre insulation (89 mm thick), two layers of Type X gypsum board (12.7 mm thick each) and concrete topping (51 mm thick) above a steel deck, the assembly with a steel deck had a 14% higher fire resistance than an assembly with one layer of softwood plywood (CSP) sub-floor.
27. In a floor assembly with solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (19 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the installation of an additional sub-floor layer slightly improved the fire resistance.
28. The installation of an additional Type X gypsum board layer (15.9 mm thick) to a floor assembly constructed with wood I-joists spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), resilient channels spaced at 305 mm o.c., two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each), floor cavity filled with rock fibre insulation, increased the fire resistance by 50%.
29. The installation of an additional Type X gypsum board layer (12.7 mm thick) in a floor assembly constructed with one layer of Type X gypsum board (12.7 mm thick), steel C-joist (203 deep) spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and resilient channels spaced at 406 mm o.c., increased the fire resistance by 90% compared to an assembly with two layers of sub-floor (15.5 mm thick each) and one layer of Type X gypsum board (12.7 mm thick). These results clearly indicate that it is much more beneficial for the fire resistance of a floor assembly with steel C-joists to use two layers of gypsum board and one layer of sub-floor than to use two layers of plywood sub-flooring and one layer of gypsum board.
30. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), the application of Gyp-Crete topping (25 mm thick) above the softwood plywood (CSP) sub-floor (15.5 mm thick) slightly improved the fire resistance compared to a similar assembly with no topping.
31. For a floor assembly with wood I-joists (241 mm deep) and resilient channels spaced at 406 mm o.c., 38 mm by 38 mm laminated veneer lumber (LVL) flanges with glass fibre insulation (89 mm thick), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), adding a concrete topping increased the fire resistance slightly (5%) compared to a similar assembly with no concrete topping.
32. For a floor assembly with wood trusses (305 mm deep) spaced at 406 mm o.c., glass fibre insulation (89 mm thick), resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and two layers of Type X gypsum board

(12.7 mm thick each), adding concrete topping (38 mm thick) increased the fire resistance by 7% compared to a similar assembly with no concrete topping.

33. For a floor assembly with wood trusses (89 mm wide and 305 mm deep) spaced at 610 mm o.c., with glass fibre insulation (89 mm thick), resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), adding concrete topping (51 mm thick) increased the fire resistance by 11% compared to a similar assembly with no concrete topping.
34. For a floor assembly with steel C-joists (203 mm deep) spaced at 610 mm o.c., neither resilient channels nor insulation in the floor cavity, two layers of Type X gypsum board (12.7 mm thick each), replacing a 19 mm thick softwood plywood (CSP) sub-floor with concrete topping (51 mm thick) on a steel deck increased the fire resistance by 20%.
35. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and no insulation in the floor cavity, the effect of resilient channel installation, at 406 mm o.c., did not impact the fire resistance significantly compared to a similar assembly with no resilient channels.
36. For a floor assembly with wood trusses (89 mm wide and 305 mm deep) spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and no insulation in the floor cavity, the installation of resilient channels spaced at 406 mm o.c. increased the fire resistance by 13% compared to a similar assembly with no resilient channels.
37. For a floor assembly with steel C-joists (203 mm deep) spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and no insulation in the floor cavity, the installation of resilient channels at 406 mm o.c. increased the fire resistance by 12% compared to a similar floor assembly with no resilient channels.
38. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) spaced at 406 mm o.c., no insulation in the floor cavity, one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and one layer of Type X gypsum board (12.7 mm thick), the effect of resilient channel spacing, 406 mm o.c. vs 203 mm o.c., on the fire resistance is insignificant.
39. For a floor assembly with wood trusses (89 mm wide and 305 mm deep) spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (19 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the fire resistance was reduced by 20% with the increase of the resilient channel spacing from 406 mm o.c. to 610 mm o.c.
40. For a floor assembly with steel C-joists (203 mm deep) spaced at 406 mm o.c. and two layers of Type X gypsum board (12.7 mm thick each), concrete topping (51 mm thick) above a steel deck and glass fibre insulation (89 mm thick) in the floor cavity, the increase in the resilient channel spacing from 406 mm o.c. to 610 mm o.c. reduced the fire resistance by 10%.
41. For a floor assembly with steel C-joists (203 mm deep) spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (19 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the effect of increasing the resilient channel spacing (406 mm o.c. vs 610 mm o.c.) on fire resistance is significant (24%).
42. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), one layer of Type X gypsum board (12.7 mm thick) and no insulation in the floor

cavity, the fire resistance decreased by 7% with an increase of structural load from 75% to 100% design load.

43. For two identical floor assemblies with wood trusses (89 mm wide and 305 mm deep) and resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick), two layers of Type X gypsum board (12.7 mm thick each) and glass fibre insulation (89 mm thick) in the floor cavity, the difference in fire resistance was approximately 2 minutes (3.7%).
44. A floor assembly with wood I-joists (38 mm thick by 44 mm wide flanges and 241 mm deep) and resilient channels spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), one layer of OSB sub-floor (15.5 mm thick) and rock fibre insulation (178 mm thick) in the floor cavity provided 39 min 31 s fire resistance.
45. A floor assembly with wood I-joists (38 mm thick by 65 mm wide and 241 mm deep) spaced at 610 mm o.c., resilient channels spaced at 305 mm o.c., one layer of Type X gypsum board (15.9 mm thick), two layers of OSB sub-floor (15.5 mm thick each) and rock fibre insulation (89 mm thick) in the floor cavity provided 50 min 17 s fire resistance.
46. An assembly with wood joists (89 mm wide by 235 mm deep) spaced at 406 mm o.c., resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and dry blown cellulose fibre insulation full cavity above steel mesh, provided 87 min 20 s fire resistance.
47. A floor assembly with steel C-joists (203 mm deep) spaced at 610 mm o.c., resilient channels spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), steel deck with concrete topping (51 mm thick) and wet sprayed cellulose fibre insulation (38 mm thick on the underside of steel deck and 89 mm thick on the sides of steel C-joists), provided 56 min 20 s fire resistance.
48. An assembly with wood trusses (89 mm wide and 305 mm deep) spaced at 406 mm o.c., resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (15.9 mm thick each), two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) and dry-blown cellulose fibre insulation filling the floor cavity above steel mesh, provided 99 min 14 s fire resistance.

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1.0 INTRODUCTION

Fire-rated floor assemblies formed with new materials and construction methodologies have been used increasingly in residential and non-residential buildings. Designers, architects and builders can select ready-to-use fire-rated floor assemblies from different sources, such as the listed assemblies by different testing laboratories or from the Part 9 Appendix “A” table of the National Building Code of Canada (NBCC) [1]. There are only 15 floor assemblies described in Table A-9.10.3.1.B in the latest edition of the NBCC (1995). The construction industry and others showed interest in increasing the number of floor assemblies listed in the NBCC table, so that building designers, architects, builders, building officials and code users can have a variety of ready-to-use assemblies. Also, there have been numerous efforts to improve the quality of residential building environments in North America, including efforts to meet public demands for better acoustic isolation. New construction materials have been developed and many construction practices and product specifications have changed over the past several years. In response to the changes noted above, the Institute for Research in Construction (IRC), National Research Council of Canada (NRC), in collaboration with industry and government partners, completed a major research program in 1998 on the fire resistance and acoustic performance of full-scale floor assemblies Phase I [2]. The results of the fire-resistance study and a parallel study on the acoustical performance in Phase I were used as the basis for the published update to the Part 9 Appendix A table of the NBCC. The update included more than 700 floor assemblies, with 177 of them having fire resistance ratings. The list of these assemblies was published by the NBCC, Tables A-9.10.3.1.B. (a part of the 4^{th} revisions to the NBC 1995, published in April 2002.).

In 2001, NRC, in collaboration with industry and government partners, started a second major research program on the fire resistance and acoustical performance of floor assemblies (Phase II) to study parameters that were not considered in Phase I. In this study (Phase II), 48 full-scale fire resistance tests were conducted to investigate the following parameters:

1. Framing member type,
2. Framing member depth,
3. Framing member spacing,
4. Wood I-joist type,
5. Wood truss size,
6. Parallel-chord wood truss chord orientation,
7. Parallel-chord wood truss web type,
8. Parallel-chord wood truss connection type,
9. Insulation type,
10. Floor cavity insulation (none, partial and full),
11. Steel mesh installation,
12. Sub-floor/deck type,
13. Number of sub-floor layers,
14. Number of gypsum board ceiling layers,
15. Number of gypsum board layers vs number of sub-floor layers,

16. Sub-floor topping,
17. Resilient channel installation,
18. Resilient channel spacing,
19. Load magnitude with wood joists, and
20. Test repeatability with wood trusses.

In addition to the 48 assemblies mentioned above, five floor assemblies, with unique design details, were tested to determine their fire resistance performance.

This report presents results of the full-scale fire resistance tests (Phase II). The results of the acoustic tests and the intermediate-scale fire resistance tests are presented in separate NRC client reports [3] and [4], respectively.

2.0 DESCRIPTION OF TEST ASSEMBLIES

Fifty-three full-scale test assemblies were constructed. Details on the assemblies are provided below.

2.1 Dimensions

Fifty-three, 4840 mm long by 3950 mm wide, floor assemblies were constructed: 15 with solid wood joists, 8 with wood I-joists, 16 with wood trusses and 14 with steel C-joists. The assemblies had various depths depending on the number of gypsum board layers, framing depth, sub-floor topping and sub-floor thickness and number of sub-floor layers. The specific dimensions for solid wood joists, wood I-joists, wood trusses and steel C-joists are shown in Appendices A, B, C and D, respectively.

2.2 Materials

Materials used in the assemblies were as follows:

2.2.1 Ceiling Finish

Type X gypsum boards, 12.7 mm thick, average density of 9.85 kg/m^2, and 15.9 mm thick, average density of 10.5 kg/m^2, conforming to the requirements of CAN/CSA-A82.27 [5], were used.

2.2.2 Framing

Four types of framing were used: solid wood joists, wood I-joists, wood trusses and steel C-joists. The solid wood joists were nominal 2x10 and 2x8 (38 mm wide by 235 mm deep and 38 mm wide by 184 mm deep, SPF, S-Dry) conforming to CSA 0141-1970 [6]. The wood I-joists were 241 mm deep. The wood I-joists used included: 38 mm wide by 38 mm deep laminated veneer lumber (LVL) flanges and 9.5 mm thick OSB web; 38 mm deep by 58 mm wide LVL flanges and 9.5 mm thick OSB web; 38 mm deep by 63 mm wide LVL flanges and 9 mm thick OSB web; 38 mm deep by 44 mm wide LVL flanges and 9.5 mm thick OSB web. The steel C-joists were 203 mm deep, 1.22 mm thick conforming to CAN/CGSB-7.1 [7].

2.2.3 Insulation

The insulation used in this study was:

- glass fibre batts with density 11.05 kg/m^3,
- rock fibre batts with density 36.74 kg/m^3,
- cellulose fibre insulation sprayed with water at density 48 kg/m^3,
- cellulose fibre sprayed with adhesive at density 35 kg/m^3, and
- blown-in cellulose fibre insulation with density 37 kg/m^3.

The thickness of the insulation for each assembly is given in Table 1 (nominal values for glass and rock fibre insulation and measured values for cellulose fibre insulation).

The glass, cellulose and rock fibre insulation used satisfied CSA A101 [8], CAN/ULC S703 [9] and CAN/ULC S702 [10], respectively.

2.2.4 Sub-Floor

The sub-floor materials used were softwood plywood (CSP) and OSB, tongue and groove panels, 15.5 mm and 19.0 mm thick.

2.2.5 Resilient Channels

The resilient channels used in the assemblies consisted of sections of 0.46 mm thick galvanized steel. The channels consisted of a 34 mm web and one flattened 18 mm flange lip.

2.2.6 Sub-Floor Topping

Two sub-floor topping materials were used: Gyp-Crete, 25.4 mm thick with a density of 2253 kg/m^3, and with strength of 24 MPA after 28 days; and normal weight concrete, 38 mm and 51 mm thick, with coarse aggregate with a density of 2335 kg/m^3 to 2387 kg/m^3. The slump during the pouring of the concrete was 75 mm. The concrete strength was 20 MPa to 26 MPa after 28 days.

2.3 Fabrication

Fifty-three floor assemblies were constructed in accordance with CAN/CSA-A82.31 [11]: 15 assemblies with solid wood joists, 8 with wood I-joists, 16 with wood trusses and 14 with steel C-joists. Details on these assemblies are given below and in Appendices A, B, C and D, respectively. In 7 floor assemblies (Assembly Nos. FF-31, FF-51, FF-54, FF-60, FF-62, FF-71 and FF-77), the Type X gypsum board ceiling finish was directly attached to the framing. In all other assemblies, the Type X gypsum board was attached to resilient channels. All screw heads on the fire-exposed side were covered with two layers of gypsum compound. All gypsum board joints on the fire-exposed side were covered with tape and two layers of gypsum compound.

2.3.1 Floor Assemblies with Solid Wood Joists

Fifteen floor assemblies were constructed using solid wood joists framing members: 6 assemblies with a single layer of Type X gypsum board (Assembly Nos. FF-30, FF-33, FF-34, FF-36, FF-49, and FF-66) and 9 assemblies with two layers of Type X gypsum board (Assembly Nos. FF-31, FF-32, FF-35, FF-64, FF-67, FF-68, FF-69, FF-70 and FF-73). Details of these assemblies are given in Table 1 and in Appendix A (Figures A-1 to A-124).

The framing member was constructed using nominal 2x10 (38 mm wide by 235 mm deep) joists in all assemblies except Assembly No. FF-32 where the joists were nominal 2x8 (38 mm wide by 184 mm deep). The joists were spaced at 406 mm o.c. in all solid wood joist assemblies except in Assembly Nos. FF-64, FF-67, FF-69 and FF-73, where the joists were spaced at 610 mm o.c. In all solid wood joist assemblies, one row of diagonal wood cross-bracing, 19 mm thick by 64 mm wide was placed at the centre of the assembly between the joists. Details of the joist layout for the above-mentioned assemblies are shown in Appendix A (Figures A-1, A-7, A-14, A-23, A-29, A-36, A-45, A-54, A-63, A-71, A-78, A-87, A-96, A-105 and A-114).

Tongue-and-groove softwood plywood (CSP) panels, 15.5 mm thick, were used in all assemblies with solid wood joists except in Assembly Nos. FF-64, FF-67 and FF-69 where the sub-floor was 19 mm thick. The sub-floor was attached to the wood joists with common nails, 64 mm long around the perimeter of the panels and 51 mm long in the field. The nail spacing was 300 mm o.c. in the panel field and edges and 150 mm o.c. at the panel butt ends and around the perimeter of the assembly. The sub-floor panel layouts and nail patterns for the above-mentioned assemblies are shown in Appendix A (Figures A-2, A-3, A-8, A-9, A-15, A-16, A-24, A-25, A-30, A-31, A-37, A-38, A-46 to A-49, A-55 to A-58, A-64, A-65, A-72, A-73, A-79, A-80, A-88, A-89, A-97, A-98, A-106, A-107 and A-115 to A-118. In Assembly No. FF-35, a layer of Gyp-Crete topping, 25 mm thick, was poured on top of the plywood sub-floor. The Gyp-Crete was a mix of Portland cement, sand, water and gypsum at a density of 1957 kg/m^3 and left to cure for 60 days.

All solid wood joist floor assemblies were constructed with resilient channels attached to the bottom of the joists except Assembly No. FF-31, where the gypsum board ceiling finish was attached directly to the joists. For assemblies with resilient channels, the channels were spaced at 406 mm o.c. except in Assembly Nos. FF-33 and FF-34, where the channels were spaced at 203 mm o.c. and in Assembly Nos. FF-64, FF-67, FF-68 and FF-70, where the channels were spaced at 610 mm o.c. Additional resilient channels were used, in the assemblies with one layer of Type X gypsum board, at the gypsum board butt ends to allow them to be fastened with screws 38 mm away from the board butt ends (Assembly Nos. FF-30, FF-33, FF-34, FF-36, FF-49, and FF-66). Resilient channel layouts for the above-mentioned assemblies are shown in Appendix A (Figures A-4, A-17, A-26, A-33, A-40, A-51, A-60, A-66, A-75, A-81, A-91, A-99, A-108 and A-120).

Assembly Nos. FF-30, FF-31, FF-33 and FF-64 were constructed with no insulation in the floor cavity, while Assembly Nos. FF-32, FF-35, FF-67, FF-68 and FF-73 were constructed with glass fibre insulation batts, 89 mm thick, placed above and supported by the resilient channels and between the joists. Assembly Nos. FF-34, FF-66 and FF-69 were constructed with rock fibre insulation batts, 89 mm thick, while Assembly No. FF-36 was constructed with two layers providing a total thickness of rock fibre insulation batts of 178 mm. The rock fibre insulation batts were placed above and supported by the resilient channels and between the joists. In Assembly No. FF-49, the cellulose fibre insulation was sprayed with water on the joist sides and underside of the sub-floor, 79 mm thick and 55 mm thick, respectively. The cellulose insulation was left to dry for 30 days prior to testing. It was not possible to measure the moisture content and, based on advice from the cellulose fibre insulation industry, the 30 days drying was sufficient to reduce the moisture content to 10%. Assembly No. FF-70 was constructed with a cellulose fibre insulation dry-blown full cavity, 235 mm thick. The insulation was held in place by a 25 mm hexagonal steel mesh installed above the resilient channels and stapled, with 50 mm long staples, to the wood joists. The insulation types and locations in the above-mentioned assemblies are shown in Appendix A (Figures A-18, A-32, A-39, A-50, A-59, A-74, A-82, A-90, A100, A-109 and A-119).

For the ceiling finish, Assembly Nos. FF-30 and FF-33 were constructed with one layer of Type X gypsum board, 12.7 mm thick; attached to the resilient channels with Type S screws, 32 mm long, spaced at 300 mm o.c. Assembly Nos. FF-34, FF-36, FF-49 and FF-66 were also constructed with one layer of Type X gypsum board, 15.9 mm thick, attached to the resilient channels with Type S screws 32 mm long. Assembly Nos. FF-31, FF-32, FF-35, FF-64, FF-68, FF-69, FF70 and FF-73 were constructed with two layers of Type X gypsum board (base and face layers), 12.7 mm thick, attached to the resilient channels with Type S screws, 32 mm long, for the base layer and 41 mm long for the face layer. The butt ends of the Type X gypsum board face layer were attached to the Type X gypsum board base layer with Type G screws, 38 mm long. In the assemblies with two layers of Type X gypsum board, the board joints for the face and base layers of gypsum board were staggered. The gypsum board joints (edges and butt ends) for the assemblies with one layer of Type X gypsum board and only the joints in the face layer of the gypsum board for the assemblies with two layers of Type X gypsum board were taped and finished with two layers of gypsum compound. All the gypsum board screw heads on the fire exposed gypsum board layer were covered with two layers of gypsum compound. The gypsum board layout and screw patterns for the above-mentioned assemblies are shown in Appendix A (Figures A-5, A-6, A-10 to A-13, A-19 to A-22, A-34, A-35, A-41 to A-44, A-52, A-53, A-61, A-62, A-67 to A-70, A-76, A-77, A-83 to A-86, A-92 to A-95, A-101 to A-104, A-110 to A-113 and A-121 to A-124).

2.3.2 Floor Assemblies with Wood I-joists

Eight floor assemblies were constructed using wood I-joists: 4 assemblies with one layer of gypsum board ceiling finish (Assembly Nos. FF-45, FF-57, FF-76 and FF-78) and 4 assemblies with a double layer of gypsum board (Assembly Nos. FF-55, FF-61, FF-77 and FF-81). Details of these assemblies are given in Table 1 and in Appendix B (Figures B-1 to B-78).

The framing members were constructed using 241 mm deep, 9 mm OSB web and 38 mm by 38 mm LVL flanges in Assembly Nos. FF-55, FF-61 and FF-77, 38 mm thick by 58 mm wide LVL flanges in Assembly Nos. FF-76, FF-78 and FF-81, 38 mm thick by 44 mm wide LVL flanges in Assembly No. FF-45 and 38 mm thick by 63 mm wide LVL flanges in Assembly No. FF-57. The joists were spaced 406 mm o.c. in Assembly Nos. FF-45, FF-61, FF-76 to FF-78 and FF-81 and at 610 mm o.c. in Assembly Nos. FF-55 and FF-57. Details of the joist layout of the above-mentioned assemblies are shown in Appendix B (Figures B-1, B-9, B-19, B-29, B-39, B-49, B-57 and B-67).

The sub-floor materials used were OSB panels, 15.9 mm thick, in Assembly Nos. FF-45 and FF-57 with joists spaced at 406 mm o.c. and 19 mm thick, in Assembly No. FF-55 with joists spaced at 610 mm o.c. Softwood plywood (CSP) panels, 15.5 mm thick, were used in Assembly Nos. FF-61, FF-76 to FF-78 and FF-81 with joists spaced at 406 mm o.c. The sub-floor panels were attached to the wood I-joist with adhesive (PL premium construction adhesive) and common nails, 64 mm long around the perimeter of the assemblies and 51 mm long in the field. The panel layout and nail patterns for the above-mentioned assemblies are shown in Appendix B (Figures B-3, B-4, B-11, B-12, B-21 to B-24, B-31, B-32, B-41 to B-44, B-51, B-52, B-59 to B-62 and B-69 to B-72). Details on the wood I-joist/end plate connections for the above-mentioned assemblies are shown in Appendix B (Figures B-2, B-10, B-20, B-30, B-40, B-50, B-

58 and B-68). Assembly No. FF-61 had a 38 mm thick concrete topping on the plywood sub-floor.

The assemblies had resilient channels except Assembly No. FF-77. The resilient channels were attached perpendicular to the joists and spaced at 406 mm in Assembly Nos. FF-45 and FF-55 and at 305 mm o.c. in Assembly Nos. FF-57, FF-76, FF-78 and FF-81. Additional resilient channels were used at the butt ends for assemblies with a single layer of Type X gypsum board to allow the boards to be fastened to the channels with screws 38 mm from the board butt ends in Assembly Nos. FF-45, FF-57, FF-76 and FF-78. Resilient channel layouts for the above-mentioned assemblies are shown in Appendix B (Figures B-6, B-14, B-26, B-34, B-46, B-64 and B-74).

Assembly No. FF-77 was constructed with no insulation in the floor cavity, while Assembly Nos. FF-45, FF-57, FF-78 and FF-81 were constructed with rock fibre insulation batts. Rock fibre insulation thickness was 89 mm thick in Assembly No. FF-57; 178 mm thick, in Assembly No. FF-45 and 267 mm thick in Assembly Nos. FF-78 and FF-81. The insulation batts were placed above and supported by the resilient channels and between the joists. Assembly No. FF-76 was constructed with a cellulose fibre insulation dry-blown full cavity. The insulation was held in place by a 25 mm hexagonal steel mesh, stapled with 30 mm long staples, to the wood I-joists. The insulation types and locations in the above-mentioned assemblies are shown in Appendix B (Figures B-5, B-13, B-25, B-33, B-45, B-63 and B-73).

For the ceiling finish, Assembly Nos. FF-45, FF-57, FF-76 and FF-78 were constructed with one layer of Type X gypsum board, 15.9 mm thick, attached to the resilient channels with Type S screws, 32 mm long. Assembly Nos. FF-55, FF-61 and FF-77 were constructed with two layers of Type X gypsum board (base and face layers), 12.7 mm thick each, and were attached to the resilient channels with Type S screws, 32 mm long for the base layer and 41 mm long for the face layer. Assembly No. FF-81 was constructed with two layers of Type X gypsum board (base and face layers), 15.9 mm thick each and were attached to the resilient channels with Type S screws, 32 mm long, for the base layer and 41 mm long for the face layer. The butt ends of the Type X gypsum board face layer were attached to the Type X gypsum board base layer with Type G screws, 38 mm long. In the assemblies with two layers of gypsum board, the board joints for the face and base layer of Type X gypsum board were staggered. The gypsum board joints (long edges and butt ends) for the assemblies with a single layer of Type X gypsum board and only the joints in the face layer of the gypsum board for assemblies with two layers of Type X gypsum board were taped and finished with two layers of gypsum compound. All the gypsum board screw heads on the fire exposed gypsum board layer were covered with two layers of Type X gypsum compound. The gypsum board layout and screw patterns for the above-mentioned assemblies are shown in Appendix B (Figures B-7, B-8, B-15 to B-18, B-27, B-28, B-35 to B-38, B-47, B-48, B-53 to B-56, B-65, B-66 and B-75 to B-78).

2.3.3 Floor Assemblies with Wood Trusses

Sixteen floor assemblies, 3950 mm wide by 4840 mm long, were constructed trusses. Assembly No. FF-63 was with metal-web parallel-chord wood and Assembly Nos. FF-41, FF-42, FF-46 to FF-48, FF-56, FF-59, FF-60, FF-63, FF-71, FF-72, FF-75, FF-79, FF-80 and FF-82 were with metal-plate-connected parallel-chord wood trusses. Assembly No. FF-58 was with finger joint trusses. All floor assemblies with wood trusses were constructed with a double layer of Type X gypsum board. Details of these assemblies are given in Table 1 and in Appendix C (Figures C-1 to C156).

The wood truss frames were constructed using metal-plate connected nominal 4x2, 305 mm deep by 89 mm wide by 38 mm thick chord; with metal-plate-connected-parallel-chord oriented horizontally on flat in Assembly Nos. FF-41, FF-42, FF-47, FF-48, FF-59, FF-60, FF-75, FF-79, FF-80 and FF-82. Assembly No. FF-56 was constructed with metal-plate-connected-parallel-chord nominal 4x2, 305 mm deep, 89 mm wide and 38 mm thick, oriented vertically on edge. Assembly No. FF-46 was constructed with metal-plate-connected-parallel-chord nominal 3x2, 305 mm deep by 64 mm wide by 38 mm thick, oriented horizontally. Assembly No. FF-63 was constructed with metal-web-parallel-chord nominal 4x2, 286 mm deep by 89 mm wide by 38 mm thick chord, oriented horizontally. Assembly No. FF-58 was constructed with finger-joint-connected-parallel-chord nominal 4x2 nominal, 330 mm deep by 89 mm wide by 38 mm thick chord, oriented horizontally. In Assembly Nos. FF-41, FF-42, FF-46, FF-47, FF-56, FF-58, FF-63 and FF-82, the trusses were spaced at 406 mm o.c. while in Assembly Nos. FF-48, FF-59, FF-71, FF-72, FF-75, FF-79 and FF-80 the trusses were spaced at 610 mm o.c. Details on the truss layout for the above-mentioned assemblies are shown in Appendix C (Figures C-1, C-10, C-20, C-30, C-40, C-50, C-59, C-69, C-79, C-87, C-97, C-105, C-115, C-125, C-135 and C-145).

The sub-floor consisted of one layer of softwood plywood (CSP) panels, 15.5 mm thick, for trusses spaced at 406 mm o.c. and 19 mm thick, for trusses spaced at 610 mm o.c. The sub-floor was attached to the truss top chords with common nails, 64 mm long around the perimeter of the assembly and 51 mm long in the field. The nail spacing was 300 mm o.c. in the panel field and 150 mm o.c. at the butt ends and around the perimeter of the assembly. In Assembly No. FF-82, the sub-floor consisted of two layers of softwood plywood (CSP), 15.5 mm thick that were attached to the upper wood truss chord with common nails, 64 mm long around the perimeter of the assembly and 51 mm long in the field of both the face and base layers of the sub-floor. The sub-floor plywood panel layout and nail patterns for the above-mentioned assemblies are shown in Appendix C (Figures C-3, C-4, C-12, C-13, C-22, C-23, C32, C-33, C-42, C-43, C-52, C-53, C-61, C-62, C-71, C-72, C-81, C-82, C-89, C-90, C-99, C-100, C-107, C-108, C-117, C-118, C-127, C-137, C138, C147 and C148). Assembly Nos. FF-47 and FF-75 had 38 mm thick concrete topping above the softwood plywood sub-floor. The concrete density was 2406 kg/m^3, the 28-day strength was 26 MPa and test day strength was 29 MPa.

All the assemblies with wood trusses had resilient channels except Assembly Nos. FF-60 and FF-71. The resilient channels were attached perpendicular to the trusses and spaced at 406 mm o.c. in Assembly Nos. FF-41, FF-42, FF-46 to FF-48, FF-56, FF-58, FF-63 and FF-82. In Assembly Nos. FF-59, FF-71, FF-75, FF-79 and FF-80, the resilient channels were spaced at 610 mm o.c. Resilient channel layouts for the above-mentioned assemblies are shown in Appendix C (Figures C-5, C-15, C-25, C-35, C-45, C-54, C-64, C-74, C-92, C-110, C-120, C-130, C-140 and C-151).

Assembly Nos. FF-41, FF-56, FF-60 and FF-71 were constructed with no insulation in the floor cavity. Assembly Nos. FF-42, FF-46 to FF-48, FF-58, FF-59, FF-63, FF-75 and FF-79 were constructed with glass fibre insulation batts, 89 mm thick, while Assembly No. FF-80 was constructed with rock fibre insulation, 89 mm thick. The insulation batts were placed above the resilient channels and between the trusses. Assembly No. FF-72 was constructed with cellulose fibre insulation sprayed with water, 64 mm thick and 66 mm thick, on the truss members and on the underside of the sub-floor, respectively. The cellulose insulation was left to dry for 30 days prior to testing. It was not possible to measure the moisture content and, based on advice from the cellulose fibre insulation industry, the 30 days drying was sufficient to reduce the moisture content to 10%. Assembly No. FF-82 was constructed with a cellulose fibre insulation dry-blown filling the floor cavity. The insulation was held in place by a 25 mm hexagonal steel mesh stapled, with 38 mm long staples, to the bottom of the lower truss chords. The insulation types and locations in the above-mentioned assemblies are shown in Appendix C (Figures C-14, C-24, C-47, C-44, C-63, C-73, C-91, C-109, C-119, C-129, C-139 and C-152).

For the ceiling finish, all assemblies with wood trusses were constructed with two layers of Type X gypsum board (base and face layers), 12.7 mm thick each, except Assembly No. FF-82 with two layers of Type X gypsum board (base and face layers), 15.9 mm thick each. The gypsum board base layer was attached to the resilient channels with Type S screws, 32 mm long, and the gypsum board face layer was attached to the base layer and resilient channels with Type S screws, 41 mm long. The butt ends of the gypsum board face layer were attached to the gypsum board base layer with Type G screws, 38 mm long. The gypsum board joints for the face and base layer were staggered. The gypsum board joints in the face layer were taped and finished with two layers of gypsum compound. All the gypsum board screw heads on the fire-exposed gypsum board layer were covered with two layers of gypsum compound. The gypsum board layout and screw patterns for the above-mentioned assemblies are shown in Appendix C (Figures C-6 to C-9, C-16 to C-19, C-26 to C-29, C-36 to C-39, C-46 to C-49, C-55 to C-58, C-65 to C-68, C-75 to C-78, C-83 to C-86, C-93 to C-96, C-101 to C-104, C-111 to C-114, C-121 to C-124, C-131 to C-134, C-141 to C-144 and C-153 to C-156).

2.3.4 Floor Assemblies with Steel C-Joists

Fourteen floor assemblies were constructed using steel C-joists: 6 assemblies with a single layer of Type X gypsum board (Assembly Nos. FF-37 to FF-39, FF-50, FF-65 and FF-74) and 8 assemblies with a double layer of Type X gypsum board (Assembly Nos. FF-40, FF-43, FF-44, FF-51 to FF-54 and FF-62). Details of these assemblies are given in Table 1 and in Appendix D (Figures D-1 to D-125).

The frames were constructed using steel C-joists (203 mm deep, 1.22 mm thick). The steel C-joists were spaced 406 mm o.c. in Assembly Nos. FF-37 to FF-40, FF-43, FF-44, FF-50, FF-51 and FF-53) and spaced 610 mm o.c. in Assembly Nos. FF-52, FF-62, FF-65 and FF-74. Details of the joist layout for these assemblies are shown in Appendix D (Figures D-1, D-10, D-20, D-30, D-38, D-47, D-56, D-66, D-74, D-94, D-101, D-109 and D-119). Details of steel C-joist/end connections and blocking as well as track joints are also shown in Appendix D (Figures D-2, D-11, D-21, D-39, D-40, D-48, D-57, D-67, D-75, D-76, D-86, D-95, D-102, D-110 and D-120).

Two layers of sub-floor softwood plywood (CSP) (tongue and groove), 15.5 mm thick, were used in Assembly Nos. FF-37 to FF-39 and FF-50. One layer of sub-floor (tongue and groove) softwood plywood (CSP), 15.5 mm thick, was used in Assembly No. FF-51 and softwood plywood (CSP), 19 mm thick, in Assembly Nos. FF-52, FF-62 and FF-65. The sub-floor was attached to the steel joists with No. 10 bugle head steel screws, 32 mm long. The plywood panel layout and screw pattern for these assemblies are shown in Appendix D (Figures D-3 to D-6, D-12 to D-15, D-22 to D-25, D-58 to D-61, D-68, D69, D-77, D-78, D-103, D-104, D-111 and D-112). Assembly Nos. FF-40, FF-43, FF-44, FF-53, FF-54 and FF-74 were constructed using corrugated steel deck, 0.38 mm thick, and concrete topping. The steel deck layout and screw pattern for these assemblies are shown in Appendix D (Figures D-32, D-40, D-49, D-87, D-96 and D-121). Regular-weight concrete, 51 mm thick, was poured above the steel deck. The assembly was stored for 3 months for the concrete to cure.

The assemblies that were constructed had resilient channels except for Assembly Nos. FF-54 and FF-62. The resilient channels were attached perpendicular to the joists spaced at 406 mm, except Assembly Nos. FF-44 and FF-65 where the resilient channels were spaced at 610 mm o.c. Additional resilient channels were used at the butt ends for assemblies with a single layer of Type X gypsum board to allow the board to be fastened to the channels with screws 38 mm from the board butt ends in Assembly Nos. FF-37 to FF-39, FF-50, FF-65 and FF-74. Resilient channel layouts for the above-mentioned assemblies are shown in Appendix D (Figures D-7, D-27, D-33, D-42, D-51, D-63, D-80, D-89, D-114 and D-123).

Assembly Nos. FF-37, FF-40, FF-51, FF-54 and FF-62 were constructed with no insulation in the floor cavity. Assembly Nos. FF-43, FF-44 and FF-52 were constructed with glass fibre insulation batts, 89 mm thick, while Assembly Nos. FF-38 and FF-53 were with rock fibre insulation, 178 mm and 89 mm thick, respectively. The insulation batts for both glass and rock fibre insulation were placed above the resilient channels and between the joists. Assembly Nos. FF-39, FF-50 and FF-74 were constructed with cellulose fibre insulation sprayed with water. In Assembly No. FF-39, the cellulose insulation thickness was 90 mm thick and 73 mm thick on the joist sides and underside of the sub-floor, respectively. In Assembly No. FF-50, the cellulose insulation thickness was 112 mm thick and 91 mm thick on the joist sides and underside of the sub-floor, respectively. While in Assembly No. FF-74, the cellulose insulation thickness was 89 mm thick and 38 mm thick on the joist sides and underside of the sub-floor, respectively. In all assemblies FF-39, FF-50 and FF-74, the bottom of the steel C-joists between the resilient channels were sprayed with wet cellulose fibre insulation, approximately 18 mm thick. The cellulose insulation was left to dry for 30 days prior to testing. It was not possible to measure the moisture content but, based on advice from the cellulose fibre insulation industry, the 30 days of drying was sufficient to reduce the moisture content to 10%. Assembly No. FF-65 was constructed with a cellulose fibre insulation sprayed with adhesive, 100 mm thick on the joist sides and 94 mm thick on the underside of the sub-floor. The bottom of the joists was sprayed with cellulose insulation, approximately 18 mm thick. The cellulose fibre insulation was left to dry for 30 days prior to testing and, based on advice from the cellulose fibre insulation industry, the 30 days were sufficient as drying time for the adhesive. The insulation types and locations in the above-mentioned assemblies are shown in Appendix D (Figures D-16, D-26, D-41, D-50, D-79, D-88, D-113 and D-122).

For the ceiling finish, Assembly Nos. FF-37 to FF-39, FF-50 and FF-74 were constructed with one layer of Type X gypsum board, 15.9 mm thick; attached to the resilient channels with Type S screws 32 mm long. Assembly Nos. FF-40, FF-43, FF-44, FF-51, FF-52, FF-53, FF-54, FF-62 and FF-65 were constructed with two layers of Type X gypsum board (base and face layers), 12.7 mm thick each and were attached to the resilient channels with Type S screws, 32 mm long for the base layer and 41 mm long for the face layer. In the assemblies with two layers of Type X gypsum board, the gypsum board joints were staggered and the butt ends of the gypsum board face layer were attached to the gypsum board base layer with Type G screws, 38 mm long. The gypsum board joints (long edges and butt ends) for the assemblies with a single layer of Type X gypsum board and only the joints in the face layer of gypsum board for assemblies with two layers of gypsum board (long edges and butt ends) were taped and finished with two layers of gypsum compound. All the gypsum board screw heads on the fire-exposed gypsum board layer were covered with two layers of gypsum compound. Details of the gypsum board layout and screw patterns for the above-mentioned assemblies are shown in Appendix D (Figures D-8, D-9, D-18, D-19, D-28, D-29, D-34 to D-37, D-43 to D-46, D-52 to D-55, D-64, D-65, D-70 to D-73, D-81 to D-84, D-90 to D-93, D-97 to D-100, D-105 to D-108, D-115 to D-118, D-124 and D-125).

3.0 INSTRUMENTATION

Type K (20 gauge) chromel-alumel thermocouples, with a thickness of 0.91 mm, were used for measuring temperatures at a number of locations throughout each assembly. The thermocouple locations inside the test assemblies are documented in References 12 to 15. Nine thermocouples were installed on the unexposed surface to measure the unexposed surface temperature for each assembly. The thermocouple locations on the unexposed surface are shown in Appendix E (Figure E-1).

The floor deflection was measured by 9 deflection gauges connected by wires to the unexposed surface at the locations shown in Appendix E (Figures E-2 and E-3). The deflections were recorded using the electro-mechanical method described in Reference 16.

4.0 LOADING SYSTEM

The loading device consisted of a steel frame with 30 hydraulics jacks. Each jack transferred the load to the specimen through 3 circular steel pads, 178 mm in diameter and 12.7 mm thick. Details of the loading system are presented in Reference 14. The loading frame was attached to the test assembly frame as shown in Appendix E (Figure E-6) for all assemblies, except in assemblies FF-54 and FF-74 where the load was relatively lower than the other assemblies and the loading frame was attached to the test assembly frame as shown in Appendix E (Figure E-7).

The partners provided the live load value used for each assembly, based on maximum strength load, to NRC. The load used for each assembly is given in Table 1.

5.0 TEST APPARATUS

The tested assemblies were exposed to heat using the propane-fire horizontal furnace shown in Appendix E (Figures E-4 and E-5). Details on the furnace are given in Reference 17. Each assembly was sealed at the edges against the furnace using ceramic fibre blankets. The furnace temperature was measured by 9 (20 gauge) shielded thermocouples in accordance with CAN/ULC-S101 [18]. The average of the 9-thermocouple temperatures was used to control the furnace temperature.

Three video cameras were used to record the test observations; two of which viewed the fire-exposed surface from the East and West ends of the furnace while the other viewed the unexposed surface.

6.0 TEST CONDITIONS AND PROCEDURE

6.1 Fire Exposure

The floor assemblies were exposed to heat in such a way that the average temperature of the floor furnace, recorded by 9 thermocouples located 305 mm below the exposed surface of the assembly followed as closely as possible the CAN/ULC-S101 [18] standard time-temperature curve. This time-temperature curve is similar to the ASTM E119 [19] time-temperature curve.

6.2 Failure Criteria

The failure criteria were derived from CAN/ULC-S101 [18]. The assembly was considered to have failed if a single point temperature reading measured by one of the 9 thermocouples under the insulation rose 180°C above the ambient temperature or the average temperature measured by the 9 thermocouples under insulating pads on the unexposed surface rose 140°C above the ambient temperature, or the test assembly was unable to sustain the applied load during the test without passage of flame or gases hot enough to ignite a cotton pad.

7.0 RECORDING OF RESULTS

The temperatures of the furnace and floor assemblies were recorded at 1 minute intervals using Labtech Notebook* data acquisition software and a Fluke Helios-I* data acquisition system. The temperature measurements inside the test assemblies and the average furnace temperature as well as the deflection measurements are given in Appendices F and G, respectively.

The average temperatures for the solid wood joist assemblies with one layer of Type X gypsum board were measured at the surface between the gypsum board and wood joists (SL/WJ), the gypsum board surface facing the cavity (SL/Cav), the joist mid-height surface (Mid. Jst), the sub-floor surface facing the cavity (SF/Cav), and the surface between sub-floor and wood joists (SF/WJ).

The average temperatures for the solid wood joist assemblies with two layers of Type X gypsum board were measured at the surface between the gypsum board face layer and base layer under the wood joists (FL/WJ), the surface between the gypsum board face layer and the base layer under the cavity (FL/Cav), the joist surface at mid-height (Mid. Jst), the surface between the gypsum board base layer and the wood joists (BL/WJ), the gypsum board surface facing the cavity (BL/Cav), the sub-floor surface facing the cavity (SF/Cav), and the surface between the sub-floor and the joists (SF/WJ).

The average temperatures for the wood I-joist assemblies with one layer of Type X gypsum board were measured at the surface between the gypsum board and wood I-joists (SL/WIJ), the gypsum board surface facing the cavity (SL/Cav), the joist surface at mid-height (Mid. Jst), the sub-floor surface facing the cavity (SF/Cav) and the surface between the sub-floor, and the wood I-joists (SF/WIJ).

The average temperatures for the wood I-joist assemblies with two layers of Type X gypsum board were measured at the surface between the gypsum board face layer and the base layer under the wood joists (FL/WIJ), the surface between the gypsum board face layer and the base layer under the cavity (FL/Cav), the joist mid-height (Mid. Jst), the surface between the gypsum board base layer and the wood I-joists (BL/WIJ), the gypsum board surface facing the cavity (BL/Cav), the sub-floor surface facing the cavity (SF/Cav), and the surface between the sub-floor and the wood I-joists (SF/WIJ).

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* Certain commercial products are identified in this report in order to adequately specify the experimental procedure. In no case does such identification imply recommendations or endorsement by the National Research Council, nor does it imply that the product or material identified is the best available for the purpose.

The average temperatures for the wood truss assemblies with two layers of Type X gypsum board were measured at the surface between the gypsum board face layer and the base layer under the wood truss (FL/WT), the surface between the gypsum board face layer and the base layer under the cavity (FL/Cav), the truss surface at the mid-height (Mid. Jst), the surface between the gypsum board base layer and the wood truss (BL/WT), the gypsum board surface facing the cavity (BL/Cav), the sub-floor surface facing the cavity (SF/Cav), and the surface between the sub-floor and the wood truss (SF/WT).

The average temperatures for the steel C-joist assemblies with one layer of Type X gypsum board were measured at the surface between the gypsum board and the steel C-joists (SL/SJ), the gypsum board surface facing the cavity (SL/Cav), the joist mid-height (Mid. Jst), the sub-floor surface facing the cavity (SF/Cav) and the surface between the sub-floor and the steel C-joists (SF/SJ).

The average temperatures for the steel C-joist assemblies with two layers of Type X gypsum board were measured at the surface between the gypsum board face layer and the base layer under the steel C-joists (FL/SJ), the surface between the gypsum board face layer and the base layer under the cavity (FL/Cav), the joist surface at mid-height (Mid. Jst), the surface between the gypsum board base layer and the steel C-joists (BL/SJ), the gypsum board surface facing the cavity (BL/Cav), the sub-floor surface facing the cavity (SF/Cav) and the surface between the sub-floor and the steel C-joists (SF/SJ).

8.0 RESULTS AND DISCUSSION

The results of the 53 full-scale fire resistance floor tests are summarized in Table 1, in which the fire resistance and mode of failure are given for each assembly. The results of Assembly No. FF-39 were not considered in the analysis below, as the data from this assembly for the unexposed surface temperature was not collected due to malfunction in the data acquisition system. Assembly No. FF-50 is a repeat test for Assembly No. FF-39. The average temperatures at different surfaces in each assembly and furnace average temperatures (Furnace Temp) as well as the unexposed surface temperatures (unExp) for the assemblies tested are plotted in Appendix F (Figures F-1 to F-53). The deflection measurements for all assemblies tested are plotted in Appendix G (Figures G-1 to G-53). The effects of different parameters on the fire resistance of floor assemblies are discussed below.

8.1 Effect of Framing Member Type

8.1.1 <u>Floor Assemblies with Two Layers of Gypsum Board, Resilient Channels and Glass Fibre Insulation</u>

8.1.1.1 Resilient channels and joists or trusses spaced at 406 mm o.c.

Four tests: Assembly Nos. FF-29 (Phase I, Ref. 2) with solid wood joists, FF-23 (Phase I, Ref. 2) with steel C-joists, FF-42 with wood trusses and FF-15 with wood I-joists (Phase I, Ref. 2) were conducted to examine the effect of framing type on the fire resistance. The assemblies had either solid wood joists or wood I-joists or steel C-joists or trusses spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and glass fibre insulation (89 mm thick in the floor cavity). The temperature and deflection distributions for Assembly No. FF-42 are given in Appendix F (Figure F-13) and in Appendix G

(Figure G-13), respectively. The temperature and deflection distributions for Assembly Nos. FF-15, FF-23 and FF-29 in the Phase I project are presented in Ref. 2.

Assembly No. FF-29 (Phase I, Ref. 2) with solid wood joists provided 65 min fire resistance; Assembly No. FF-23 (Phase I, Ref. 2) with steel C-joists provided 68 min fire resistance; Assembly No. FF-42 with wood trusses provided 65 min 41 s fire resistance; and Assembly No. FF-15 (Phase I, Ref. 2) with wood I-joists provided 64 min fire resistance. These results suggest that for floor assemblies with either solid wood joists (235 mm deep), or wood I-joists (241 mm deep) or steel C-joists (203 mm deep) or trusses (305 mm deep) and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the effect of frame type is insignificant.

8.1.1.2 Resilient channels and joists spaced at 610 mm o.c.

Two tests (Assembly No. FF-52 with steel C-joists and FF-67 with solid wood joists) were conducted to examine the effect of framing type on fire resistance. The assemblies had either steel C-joists or solid wood joists spaced on 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity.

In Assembly No. FF-52, the first piece of gypsum board face layer dropped into the furnace at 42 min 18 s, and most of the gypsum board face layer dropped at 46 min 22 s. Most of the gypsum board base layer dropped into the furnace at 50 min 17 s. The steel C-joists and the plywood sub-floor were exposed to direct furnace heat at 50 min 30 s. In Assembly No. FF-67, the first piece of gypsum board face layer dropped into the furnace at 47 min 29 s and most of the gypsum board face layer dropped at 51 min 9 s. Most of the gypsum board base layer dropped into the furnace at 52 min 39 s and, at that time, the solid wood joists were burning. The solid wood joists and the underside of the softwood plywood (CSP) sub-floor were exposed to direct furnace heat at 52 min 50 s. The temperature and deflection distributions for Assembly Nos. FF-52 and FF-67 are given in Appendix F (Figures F-23 and F-38) and in Appendix G (Figures G-23 and G-38), respectively.

Assembly No. FF-52 with steel C-joists provided 52 min 30 s fire resistance and Assembly No. FF-67 with solid wood joists provided 57 min 5 s fire resistance. These results showed that for the assembly with two layers of Type X gypsum board (12.7 mm thick each), either steel C-joists (203 mm deep) or solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) and glass fibre insulation (89 mm thick), the solid wood joist assembly provided 8% more fire resistance than the assembly with steel C-joists.

8.1.2 <u>Floor Assemblies with One Layer of Gypsum Board, Resilient Channels and Rock Fibre Insulation</u>

Two tests (Assembly Nos. FF-38 with steel C-joists and FF-36 with solid wood joists) were conducted to examine the effect of framing type on fire resistance. The assemblies had joists spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), resilient channels spaced at 406 mm o.c., two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) and rock fibre insulation (178 mm thick) in the floor cavity.

In Assembly No. FF-38, the first piece of gypsum board dropped into the furnace at 26 min 15 s, and most of the gypsum board dropped at 33 min 20 s. The steel C-joists and the underside of the plywood sub-floor were exposed to direct furnace heat at 42 min due to the sagging of the insulation batts' butt ends. In Assembly No. FF-36, the first piece of gypsum board dropped into the furnace at 31 min 30 s and most of the gypsum board dropped at 37 min and the wood joists were burning. The wood joists and the plywood sub-floor were exposed to direct furnace heat at 49 min 50 s due to the sagging of the rock fibre insulation batts' butt ends. The temperature and deflection distributions for Assembly Nos. FF-38 and FF-36 are given in Appendix F (Figures F-9 and F-7) and in Appendix G (Figures G-9 and G-7), respectively.

Assembly No. FF-38 with steel C-joists provided 53 min 38 s fire resistance and Assembly No. FF-36 with solid wood joists provided 58 min 49 s fire resistance. These results showed that for the assembly with one layer of Type X gypsum board (15.9 mm thick), either solid wood joists (89 mm wide and 235 mm deep) or steel C-joists (203 mm deep) and resilient channels spaced at 406 mm o.c., two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) and rock fibre insulation (178 mm thick), the solid wood joist assembly provided 9% more fire resistance than the assembly with steel C-joists.

8.1.3 Floor Assemblies with One Layer of Gypsum Board, Resilient Channels and Cellulose Fibre Insulation

Two tests (Assembly Nos. FF-50 with steel C-joists and FF-49 with solid wood joists) were conducted to examine the effect of framing type on fire resistance. The assemblies had joists spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), resilient channels spaced at 406 mm o.c., two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) and cellulose fibre insulation sprayed with water (55 mm thick on the underside of the sub-floor and 79 mm thick on the joists' sides in Assembly FF-49 with solid wood joists as well as 91 mm thick on the underside of the sub-floor and 112 mm thick on the joists' sides in Assembly FF-50 with steel C-joists).

In Assembly No. FF-50, the first piece of gypsum board layer dropped into the furnace at 34 min 17 s and most of the gypsum board dropped at 40 min 45 s. At that time, the steel C-joists and the underside of the plywood sub-floor were exposed to direct furnace heat. In Assembly No. FF-49, the first piece of gypsum board dropped into the furnace at 37 min 31 s. At that time, the solid wood joists and the underside of the plywood sub-floor were exposed to direct furnace heat. The temperature and deflection distributions for Assembly Nos. FF-50 and FF-49 are given in Appendix F (Figures F-20 and F-21) and in Appendix G (Figures G-20 and G-21), respectively.

Assembly No. FF-50 with steel C-joists provided 63 min 47 s fire resistance and Assembly No. FF-49 with solid wood joists provided 54 min 13 s fire resistance. These results showed that for the assembly with one layer of Type X gypsum board (15.9 mm thick), either steel C-joists (203 mm deep) or solid wood joists (235 mm deep) and resilient channels spaced at 406 mm o.c., two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) and cellulose fibre insulation sprayed wet, the steel C-joists assembly provided 17% more fire resistance than the assembly with solid wood joists and that is in part due to the larger thickness of the cellulose fibre insulation in the assembly with steel C-joists than in the assembly with solid wood joists.

8.1.4 Floor Assemblies with Two Layers of Gypsum Board, No Insulation and No Resilient Channels

Four tests (Assembly Nos. FF-31 with solid wood joists, FF-51 with steel C-joists, FF-60 with wood trusses and FF-77 with wood I-joists) were conducted to examine the effect of framing type on the fire resistance of floor assemblies with two layers of Type X gypsum board with neither resilient channels nor insulation in the floor cavity and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick).

In Assembly No. FF-31, the first piece of the gypsum board face layer dropped into the furnace at 56 min 50 s, and most of the gypsum board face layer had dropped by 60 min. The first piece of the gypsum board base layer dropped into the furnace at 65 min 33 s, and most of the gypsum board base layer had dropped by 66 min. In Assembly No. FF-51, the first piece of the gypsum board face layer dropped into the furnace at 51 min 10 s and most of the gypsum board face layer had dropped by 61 min. The first piece of the gypsum board base layer dropped into the furnace at 66 min 38 s and most of the gypsum board base layer had dropped by 66 min 50 s. In Assembly No. FF-60, the first piece of the gypsum board face layer dropped into the furnace at 43 min 16 s and most of the gypsum board face layer had dropped by 57 min 24 s. The first piece of the gypsum board base layer dropped into the furnace at 59 min 8 s and most of the gypsum board base layer had dropped by 61 min. In Assembly No. FF-77, the first piece of the gypsum board face layer dropped into the furnace at 52 min 22 s and most of the gypsum board face layer had dropped by 62 min. The first piece of the gypsum board base layer dropped into the furnace at 63 min 41 s and most of the gypsum board base layer had dropped by 63 min 50 s. The detail temperature distributions are shown in Appendix F (Figures F-2, F-22, F-31 and F-48) and the deflection distributions are shown in Appendix G (Figures G-2, G-22, G-31 and G-48).

Assembly No. FF-31, with solid wood joists provided 67 min 10 s fire resistance; Assembly No. FF-51 with steel C-joists provided 66 min 55 s fire resistance; Assembly No. FF-60 with wood trusses provided 61 min 3 s fire resistance; and Assembly No. FF-77 with wood I-joists provided 64 min 31 s fire resistance. These results showed that for a floor assembly with either solid wood joists (89 mm wide and 235 mm deep) or wood I-joists (38 mm wide flanges and 241 mm deep) or wood trusses (89 mm wide and 305 mm deep) or steel C-joists (203 mm deep), two layers of gypsum board (12.7 mm thick each), one layer softwood plywood (CSP) sub-floor (15.5 mm thick) and neither resilient channels nor insulation in the floor cavity, the maximum difference in fire resistance among the four types of floor framing is 6 min 7 s.

8.1.5 Assemblies with Two Layers of Gypsum Board, Resilient Channels and No Insulation

Four tests (Assembly Nos. FF-28 (Phase I, Ref. 2) with solid wood joists, FF-22 (Phase I, Ref. 2) with steel C-joists, FF-41 with wood trusses and FF-10 with wood I-joists (Phase I, Ref. 2)) were conducted to examine the effect of framing type (solid wood joists or wood I-joists or wood trusses or steel C-joists) spaced at 406 mm o.c. on the fire resistance of floor assemblies with two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and resilient channels spaced at 406 mm o.c. and no insulation in the floor cavity. The temperature and deflection distributions for Assembly No. FF-41 are given in Appendix F (Figure F-12) and in Appendix G (Figure G-12), respectively. The temperature and deflection distributions for Assembly Nos. FF-28, FF-22 and F-10 are given in Ref. 2 (Figures 133, 127, 115, 164, 158 and 146, respectively).

Assembly No. 28 with solid wood joists provided 69 min fire resistance; Assembly No. 22 with steel C-joists, provided 74 min fire resistance; Assembly No. FF-10 with wood I-joists provided 69 min fire resistance; and Assembly No. FF-41 with wood trusses provided 69 min 1 s fire resistance. These results suggest that for a floor assembly with either solid wood joists (89 mm wide and 235 mm deep) or wood I-joists (241 mm deep) or wood trusses (305 mm deep) or steel C-joists (203 mm deep) spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and no insulation in the floor cavity, the effect of frame type on the fire resistance is insignificant.

8.2 Effect of Framing Member Depth

Assembly No. FF-32 (with nominal 2x8 solid wood joists, 184 mm deep) and Assembly No. FF-29 (with nominal 2x10, 235 mm deep) (Phase I, Ref. 2) were tested to determine the effect of joist depth on the fire resistance of assemblies with two layers of Type X gypsum board (12.7 mm thick each), both the joists and resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and glass fibre insulation batts (89 mm thick) in the floor cavity. The temperature and deflection distributions for Assembly No. FF-32 are given in Appendix F (Figure F-3) and in Appendix G (Figure G-3), respectively. The temperature and deflection distributions for Assembly No. FF-29 in the Phase I project are presented in Figures 134 and 165 [2].

Assembly No. FF-32 provided 67 min, 15 s fire resistance while Assembly No. FF-29 provided 65 min fire resistance. These results suggest that for an assembly with solid wood joists and resilient channels spaced 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the effect of solid wood joists depth (184 mm vs 235 mm) on the fire resistance is insignificant.

8.3 Effect of Framing Member Spacing

8.3.1 <u>Floor Assemblies with Solid Wood Joists</u>

Assembly No. FF-68 with solid wood joists spaced at 406 mm o.c., one layer of CSP sub-floor (15.5 mm thick) and Assembly No. FF-67 with solid wood joists spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) were tested to determine the effect of solid wood joist spacing on the fire resistance of assemblies with two layers of Type X gypsum board (12.7 mm thick each) resilient channels spaced at 610 mm o.c., and glass fibre insulation batts (89 mm thick) in the floor cavity. The temperature and deflection distributions for Assembly Nos. FF-67 and FF-68 are given in Appendix F (Figures F-38 and F-39) and in Appendix G (Figures G-38 and G-39), respectively.

Assembly No. FF-67 provided 57 min, 5 s fire resistance while Assembly No. FF-68 provided 57 min 17 s fire resistance. These results suggest that for a floor assembly with solid wood joists (89 mm wide and 235 mm deep), two layers of Type X gypsum board (12.7 mm thick each), resilient channels spaced at 610 mm o.c. and glass fibre insulation (89 mm thick) in the floor cavity, the effect of solid wood spacing, 406 mm o.c. vs 610 mm o.c, on the fire resistance is insignificant.

8.3.2 Floor Assemblies with Wood Trusses

8.3.2.1 Assemblies with resilient channels and insulation in floor cavity

Assembly No. FF-42 with wood trusses spaced at 406 mm o.c. and Assembly No. FF-48 with wood trusses spaced at 610 mm o.c. were tested to determine the effect of truss spacing on the fire resistance of assemblies with two layers of Type X gypsum board (12.7 mm thick each) resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick in assembly with trusses spaced at 406 mm o.c. and 19 mm thick for trusses spaced at 610 mm o.c.) and glass fibre insulation (89 mm thick) in the floor cavity. The temperature and deflection distributions for Assembly Nos. FF-42 and FF-48 are given in Appendix F (Figures F-13 and F-19) and in Appendix G (Figures G-13 and G-19), respectively.

Assembly No. FF-42 provided 65 min 41 s fire resistance while Assembly No. FF-48 provided 68 min 18 s fire resistance. These results suggest that for assemblies with wood trusses (89 mm wide and 305 mm deep), two layers of Type X gypsum board (12.7 mm thick each), resilient channels spaced at 406 mm o.c. and glass fibre insulation (89 mm thick) in the floor cavity, the effect of truss spacing, 406 mm o.c. vs 610 mm o.c., on the fire resistance is insignificant.

8.3.2.2 Assemblies with neither resilient channels nor insulation in the floor cavity

Assembly No. FF-60 with wood trusses spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and Assembly No. FF-71 with wood trusses spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) were tested to determine the effect of truss spacing on the fire resistance of assemblies with two layers of Type X gypsum board (12.7 mm thick each) directly applied to the wood trusses and no insulation in the floor cavity. The temperature and deflection distributions for Assembly Nos. FF-60 and FF-71 are given in Appendix F (Figures F-31 and F-42) and in Appendix G (Figures G-31 and G-42), respectively.

Assembly No. FF-60 provided 61 min, 3 s fire resistance while Assembly No. FF-71 provided 56 min 16 s fire resistance. These results suggest that for a floor assembly with two layers of Type X gypsum board (12.7 mm thick each) directly applied to the wood trusses with no insulation in the floor cavity, the effect of truss spacing, 406 mm o.c. vs 610 mm o.c, on the fire resistance, unlike in the case for wood truss assemblies with resilient channels, is significant.

8.3.3 Floor Assemblies with Steel C-Joists

Assembly No. FF-51 with steel C-joists spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and Assembly No. FF-62 with steel C-joists spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) were tested to determine the effect of steel C-joist spacing on the fire resistance of assemblies with two layers of Type X gypsum board (12.7 mm thick each) directly applied to the steel joists and no insulation in the floor cavity. The temperature and deflection distributions for Assembly Nos. FF-51 and FF-62 are given in Appendix F (Figures F-22 and F-33) and in Appendix G (Figures G-22 and G-33), respectively.

Assembly No. FF-51 provided 66 min 55 s fire resistance while Assembly No. FF-62 provided 54 min 59 s fire resistance. These results suggest that for a floor assembly with steel

C-joists (203 mm deep), two layers of Type X gypsum board (12.7 mm thick each) directly applied to the steel C-joists with no insulation in the floor cavity and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), the effect of joist spacing, 406 mm o.c. vs 610 mm o.c, on the fire resistance is significant.

8.4 Effect of Wood I-joist Type

Three tests (Assembly Nos. FF-55, FF-17 (Phase I, Ref. 2) and FF-18 (Phase I, Ref. 2)) were conducted to determine the effect of wood-I type on fire resistance. These assemblies were with wood I-joists spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), resilient channels spaced at 406 mm o.c., glass fibre insulation (89 mm thick) and joists spaced at 610 mm o.c. The temperature and deflection distributions for Assembly No. FF-55 is given in Appendix F (Figure F-26) and in Appendix G (Figure G-26), respectively. The temperature and deflection distributions for Assembly No. FF-17 and FF-18 in the Phase I project are in Figures 123, 124, 154 and 155 (Ref 2).

In Assembly No. FF-55, a large piece of gypsum board face layer dropped at 48 min and also a large gypsum board segment from the base layer had dropped by 57 min. For Assembly No. FF-17, a large piece of the gypsum board face layer dropped at 60 min and also a large piece of gypsum board base layer dropped at 69 min. For Assembly No. FF-18, a large piece of the gypsum board face layer dropped at 61 min and also a large piece of the gypsum board base layer dropped at 68 min. After approximately an additional 2 min, the glass fibre insulation melted and the wood I-joists and underside of the sub-floor were exposed to direct furnace heat.

Assembly No. FF-55 provided 60 min 59 s fire resistance while Assembly Nos. FF-17 and FF-18 provided 75 min and 74 min fire resistance, respectively. Results of Assembly Nos. FF-17 and FF-18 in Phase I did not show any significant difference between wood I-joist types but Assembly No. FF-55 provided 18% less fire resistance than Assembly Nos. FF-17 and FF-18 due to the higher load in Assembly No. FF-55. The design load in Assembly No. FF-55 was 16% and 38% higher than in Assembly Nos. FF-17 and FF-18, respectively. In spite of these differences in the design load among the 3 different manufacturers of wood I-joist, the wood I-joist assemblies were tested with two layers of gypsum board (12.7 mm thick each), glass fibre (89 mm thick) and resilient channels at 406 mm o.c. Further tests are required to determine whether the type of wood I-joist has an effect on the fire resistance.

8.5 Effect of Parallel-Chord Wood Truss Size

Two tests (Assembly Nos. FF-42 and FF-46) were conducted to examine the effect of metal-plate-connected parallel-chord truss size (nominal 4x2 vs 3x2 SPF) on the fire resistance of a floor assembly with glass fibre (89 mm thick), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and two layers of Type X gypsum board (12.7 mm thick each). The wood trusses and resilient channels were spaced at 406 mm o. c.

In Assembly No. FF-42, a large piece of gypsum board face layer dropped at 54 min and also a large piece of the gypsum board base layer dropped into the furnace at 64 min. For Assembly No. FF-46, a large piece of the gypsum board face layer dropped at 55 min and also a large piece of the gypsum board base layer dropped at 65 min 37 s. After 2 min in both assemblies, the glass fibre insulation melted and trusses and the underside surface of the sub-floor were exposed to direct furnace heat. The temperature and deflection distributions for Assembly Nos. FF-42 and FF-46 are given in Appendix F (Figures F-13 and F-17) and in Appendix G (Figures G-13 and G17), respectively.

Assembly No. FF-42 with nominal 4x2 wood trusses provided 65 min 41 s fire resistance and Assembly No. FF-46 with nominal 3x2 wood trusses provided 67 min 36 s fire resistance. These results showed that for a floor assembly with wood trusses (305 mm deep) of either nominal 4x2 or 3x2, and resilient channels spaced at 406 mm o.c., glass fibre insulation (89 mm thick) in the floor cavity, one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), the effect of truss size, nominal 4x2 vs 3x2, on the fire resistance is insignificant.

8.6 Effect of Parallel-Chord Wood Truss Orientation

Two tests (Assembly Nos. FF-41 and No. FF-56) were conducted to determine the effect of the nominal 4x2 wood truss parallel-chord orientation (vertical and horizontal) on the fire resistance of an assembly with two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and no insulation in the floor cavity. The wood trusses and resilient channels were spaced at 406 mm o.c. In Assembly No. FF-56, the wood truss parallel-chords were oriented vertically (on edge) as shown in Appendix C (Figure C-51) while in Assembly No. FF-41, the wood truss parallel-chords were oriented horizontally as shown in Appendix C (Figure C-2).

In Assembly No. FF-41, a large piece of the gypsum board face layer dropped at 56 min 37 s and most of the gypsum board face layer had dropped into the furnace by 66 min. The first piece of the gypsum board base layer dropped at 65 min and most of the gypsum board base layer had dropped by 68 min 20 s. In Assembly No. FF-56, a large piece of the gypsum board face layer dropped at 53 min and most of the gypsum board face layer had dropped by 60 min. The first piece of the gypsum board base layer dropped at 61 min 51 s and most of the gypsum board base layer had dropped by 63 min 53 s. The temperature and deflection distributions for Assembly Nos. FF-41 and FF-56 are given in Appendix F (Figures F-12 and F-27) and in Appendix G (Figures G-12 and G-27), respectively.

Assembly No. FF-41, with nominal 4x2 wood truss parallel-chords and web members oriented horizontally, provided 69 min 1 s fire resistance and Assembly No. FF-56, with wood truss parallel-chords and web members oriented vertically, provided 65 min 5 s fire resistance. These results showed that for a floor assembly with wood trusses (305 mm and 406 mm deep) spaced 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), no insulation in the floor cavity, one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and resilient channels spaced at 406 mm o.c., the assembly with parallel-chord and web members wood trusses oriented horizontally provided slightly more (6%) fire resistance than the assembly where the parallel-chord and web members were oriented vertically (on edge).

8.7 Effect of Parallel-Chord Wood Truss Web Type

Two tests were carried out (Assembly No. FF-63 with metal-web wood trusses and Assembly No. FF-58 with metal-plate-connected wood-web trusses) to determine the effect of web type in a wood truss assembly on the fire resistance with two layers of Type X gypsum board (12.7 mm thick each) and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick). Both assemblies were constructed with glass fibre insulation (89 mm thick). The wood trusses and resilient channels were spaced at 406 mm o.c. The temperature and deflection distributions for Assembly Nos. FF-58 and FF-63 are given in Appendix F (Figures F-29 and F-34) and in Appendix G (Figures G-29 and G-34), respectively.

In Assembly No. FF-63 (with metal-web), the first piece of the gypsum board face layer dropped at 51 min and most of the gypsum board face layer had dropped by 57 min. The entire gypsum board base layer had dropped by 62 min 36 s and the glass fibre insulation melted. At that time, the wood trusses and the underside of the sub-floor were exposed to direct furnace heat. In Assembly No. FF-58 with metal-plate-connected wood-web trusses, the first piece of the gypsum board face layer dropped at 49 min and most of the gypsum board face layer had dropped by 53 min 30 s. The entire gypsum board base layer had dropped by 57 min and, after a few minutes, the glass fibre insulation melted at which time the wood trusses and the underside of the sub-floor were exposed to the furnace direct heat. The gypsum board for both the face and base layers had dropped into the furnace earlier in the assembly with the metal-plate-connected wood-web trusses than in the assembly with the metal-web wood trusses.

Assembly No. FF-63 (with metal-web wood trusses) provided 64 min 4 s fire resistance while Assembly No. FF-58 (with metal-plate-connected wood web wood trusses) provided 63 min 37 s fire resistance. These results indicated that for a floor assembly with wood trusses (286 mm deep for metal-web and 330 mm deep for metal-plate-connected wood-web) and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), glass fibre insulation (89 mm thick), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), the effect of web type of either metal-web or metal-plate-connected wood-web on the fire resistance is insignificant.

8.8 Effect of Parallel-Chord Wood Truss Connection Type

Two tests (Assembly Nos. FF-42 and FF-58) were conducted to determine the effect of the nominal 4x2 parallel-chord wood truss connection type (metal-plate-connected chord vs glued-finger-joint-connected chord) on the fire resistance of an assembly with two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity. Assembly No. FF-42 was with metal-plate-connection chord (305 mm deep) while Assembly No. FF-58 was with glued-finger-connection chord and slightly deeper trusses (330 mm deep).

In Assembly No. FF-42, a large piece of the gypsum board face layer dropped at 53 min 49 s and most of the gypsum board face layer had dropped by 56 min 36 s. The first piece of the gypsum board base layer dropped into the furnace at 60 min 56 s and most of the gypsum board base layer dropped by 64 min. In Assembly No. FF-58, a large piece of the gypsum board face layer dropped at 48 min 52 s and most of the gypsum board base layer dropped by 53 min 27 s. The first piece of the gypsum board base layer dropped into the furnace at 54 min 30 s and most of the gypsum board base layer had dropped by 57 min. The temperature and deflection distributions for Assembly Nos. FF-42 and FF-58 are given in Appendix F (Figures F-13 and F-29) and in Appendix G (Figures G13 and G-29), respectively.

Assembly No. FF-42, with nominal 4x2 parallel-chord-metal-plate-connected wood truss, provided 65 min 41 s fire resistance and Assembly No. FF-58, with parallel-chord-glued-finger-connected wood truss, provided 63 min 37 s fire resistance. These results showed that for a floor assembly with wood trusses (305 mm deep for metal-plate-connection and 330 mm deep for glued-finger-connection) spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the effect of wood truss connection type (metal-plate-connection vs glued-finger-connection) on the fire resistance is insignificant.

8.9 Effect of Insulation Type

The effect of insulation type: glass, rock and cellulose fibre insulation on the fire resistance of floor assemblies with solid wood joists, wood I-joists, wood trusses and steel C-joists are given below.

8.9.1 Floor Assemblies with Solid Wood Joists

8.9.1.1 Assemblies with rock and glass fibre insulation (joists and resilient channels spaced at 610 mm o.c.)

Two tests (Assembly Nos. FF-67 and FF-69) were conducted to determine the effect of insulation type (glass fibre vs rock fibre insulation, 89 mm thick) on the fire resistance of the floor assembly with solid wood joists spaced at 610 mm o.c., resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) and two layers of Type X gypsum board (12.7 mm thick each).

In Assembly No. FF-67 with glass fibre insulation, the first piece of the gypsum board face layer dropped into the furnace at 47 min and most of the gypsum board face layer had dropped by 51 min. The first piece of the gypsum board base layer dropped at 51 min 42 s and most of the gypsum board base layer had dropped by 52 min 39 s. For Assembly No. FF-69 with rock fibre insulation, the first piece of gypsum board dropped at 49 min 28 s and most of the gypsum board had dropped by 52 min. The first piece of gypsum board base layer dropped into the furnace at 52 min 38 s and, by 54 min 14 s, most of the gypsum board base layer had dropped into the furnace. The temperature and deflection distributions for Assembly Nos. FF-67 and FF-69 are given in Appendix F (Figures F-38 and F-40) and in Appendix G (Figures G-38 and G-40), respectively.

Assembly No. FF-67 with glass fibre insulation (89 mm thick) provided 57 min 5 s fire resistance while Assembly No. FF-69 with rock fibre insulation (89 mm thick) provided 63 min 33 s fire resistance. These results show that for a floor assembly with solid wood joists spaced at 610 mm o.c., two layers of layers of Type X gypsum board (12.7 mm thick each), the installation of rock fibre insulation batts (89 mm thick) above the resilient channels spaced at 610 mm o.c. provided more fire resistance than in a similar assembly with glass fibre insulation (89 mm thick). The rock fibre batts remained in place after the gypsum board fell off and protected the joist and the underside of the sub-floor while, in the case of the assembly with glass fibre insulation, the glass fibre melted in approximately 3 min when exposed to furnace heat after the gypsum board dropped into the furnace. These results showed that for a floor assembly with solid wood joists (89 wide and 235 mm deep) and resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick), two layers of Type X gypsum board (12.7 mm thick each), the effect of insulation type (rock fibre vs glass fibre) is significant.

8.9.2 Floor Assemblies with Wood I-Joists

8.9.2.1 Rock and cellulose fibre insulation (joists spaced at 460 mm o.c. and resilient channels spaced at 305 mm o.c.)

Two tests (Assembly Nos. FF-76 and FF-78) were conducted to compare the effect of insulation type (full cavity rock fibre insulation batts and full cavity cellulose fibre insulation dry-blown) on the fire resistance of floor assemblies with wood I-joists spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) and resilient channels spaced at 305 mm o.c. In the assembly with dry-blown cellulose fibre insulation, a steel mesh was used to keep the insulation in place.

In Assembly No. FF-76 with wood I-joists (58 mm by 38 mm flanges) and the cavity filled with dry-blown cellulose fibre insulation (241 mm thick), the first piece of gypsum board dropped into the furnace at 38 min 59 s, and most of the gypsum board had dropped by 44 min. For Assembly No. FF-78 with wood I-joists (58 mm by 38 mm flanges) and the cavity filled with compressed rock fibre insulation (267 mm thick), the first piece of gypsum board dropped at 29 min 7 s, and most of the gypsum board had dropped by 35 min. The temperature and deflection distributions for Assembly Nos. FF-76 and FF-78 are given in Appendix F (Figures F-47 and F-49) and in Appendix G (Figures G-47 and G-49), respectively.

Assembly No. FF-76 with cellulose fibre insulation dry blown full cavity provided 80 min 19 s fire resistance and Assembly No. FF-78 with rock fibre insulation full cavity provided 59 min 38 s fire resistance. Therefore, in the wood I-joist floor assembly with one layer of gypsum board, the installation of cellulose fibre insulation dry-blown full cavity above the steel mesh provided 33% more fire resistance, as the steel mesh kept the cellulose fibre insulation in place much longer than the assembly with rock fibre insulation without steel mesh. These results showed that for a floor assembly with wood I-joists (58 mm wide flanges and 241 mm deep) spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each), resilient channels spaced at 305 mm o.c. and full cavity insulation, the effect of insulation type (cellulose fibre vs rock fibre insulation) on the fire resistance is significant.

8.9.3 Floor Assemblies with Wood Trusses

8.9.3.1 Assemblies with two layers of gypsum board

Three tests (Assembly Nos. FF-59, FF-72 and FF-80) were conducted to determine the effect of insulation type (glass fibre insulation, rock fibre insulation and wet sprayed cellulose fibre insulation on the truss and the underside of the sub-floor) on the fire resistance of the floor assembly with wood trusses, one layer of softwood plywood (CSP) sub-floor (19 mm thick) and resilient channels spaced at 610 mm o.c, two layers of Type X gypsum board (12.7 mm thick).

In Assembly No. FF-59 with glass fibre insulation (89 mm thick), the first piece of the gypsum board face layer dropped into the furnace at 40 min 25 s and most of the gypsum board face layer had dropped by 49 min. The first piece of the gypsum board base layer dropped into the furnace at 49 min and most of the gypsum board base layer had dropped by 53 min. For Assembly No. FF-72 with wet sprayed cellulose fibre insulation (64 mm thick on wood truss members and 66 mm thick on the underside of the sub-floor), the first piece of the gypsum board face layer dropped at 49 min and most of the gypsum board face layer had dropped by 54 min. The first piece of the gypsum board base layer dropped into the furnace at 54 min 18 s and most of the gypsum board base layer had dropped at 57 min. For Assembly No. FF-80 with rock fibre insulation (89 mm thick), the first piece of the gypsum board face layer dropped at 22 min and most of the gypsum board layer had dropped by 37 min. The first piece of the gypsum board base layer dropped into the furnace at 38 min and, at 50 min, most of the gypsum board base layer had fallen from the assembly. Due to a wider spacing for resilient channels (610 mm o.c.), the rock fibre insulation batts fell into the furnace approximately 3 min after the gypsum board base layer fell into the furnace and, at that time, both the wood trusses and the plywood sub-floor were exposed to direct furnace heat. The temperature and deflection distributions for

Assembly Nos. FF-59, FF-72 and FF-80 are given in Appendix F (Figures F-30, F-43 and F-51) and in Appendix G (Figures G-30, G-43 and G-51), respectively.

Assembly No. FF-59 with glass fibre insulation provided 54 min 35 s fire resistance, while Assembly No. FF-72 with cellulose fibre insulation provided 77 min 12 s fire resistance and Assembly No. FF-80 with rock fibre insulation provided 59 min 34 s fire resistance. The installation of wet sprayed cellulose fibre insulation that covered all truss members, 64 mm thick on wood truss members and 66 mm thick on the underside of the sub-floor, provided more fire resistance compared to a similar assembly with either glass fibre or rock fibre insulation (89 mm thick). The assembly with cellulose fibre insulation provided 43% more fire resistance than the assembly with glass fibre insulation. The cellulose fibre remained in placed after the gypsum board had dropped from the assembly and protected the trusses and the underside of the sub-floor while, in the case of the assembly with glass fibre insulation, the glass fibre melted in approximately 3 min when exposed to furnace heat after the gypsum board had dropped from the assembly. Also, the assembly with cellulose fibre insulation provided 28% more fire resistance than the assembly with rock fibre insulation; however, the thickness of the cellulose fibre insulation was less than the glass and rock fibre insulation. These results showed that for a floor assembly with wood trusses (89 mm wide and 305 mm deep) and resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) and one layer of softwood plywood (CSP) sub-floor (19 mm thick), the effect of insulation type (wet sprayed cellulose fibre insulation on the wood truss members and on the underside of the sub floor vs glass fibre or rock fibre insulation) on the fire resistance is significant.

8.9.4 Floor Assemblies with Steel C-Joists

Fire resistance tests were conducted to determine the effect of insulation type for assemblies with steel C-joists protected with one or two layers of Type X gypsum board layers.

8.9.4.1 Floor assemblies with one layer of gypsum board

Three tests (Assembly Nos. FF-37 (no insulation), FF-38 with rock fibre insulation (178 mm thick) and FF-50 with cellulose fibre insulation (112 mm thick on the side of joists and 91 mm thick on the underside of the sub-floor)) were conducted to determine the effect of the installation of rock and wet sprayed cellulose fibre insulation on the fire resistance performance of a floor assembly with steel C-joists, one layer of Type X gypsum board (5.9 mm thick) and two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each). The temperature and deflection distributions for Assembly Nos. FF-37, FF-38 and FF-50 are given in Appendix F (Figures F-8, F-9 and F-21) and in Appendix G (Figures G-8, G-9 and G-21), respectively.

Unlike the non-insulated Assembly No. FF-37 in which the gypsum board had dropped at 37 min, large pieces of gypsum board dropped at 26 min in Assembly No. FF-38 and dropped at 34 min in Assembly No. FF-50. The installation of insulation in the floor cavity reduced the heat dissipation via the sub-floor boards to the ambient air and consequently, caused heat build-up in the gypsum board that led to earlier failure of the gypsum board in the insulated assemblies compared to the non-insulated assembly. When the gypsum board dropped from the assembly, the rock and cellulose fibre insulation continued to protect both the steel joists and sub-floor further from the direct furnace heat for the remaining time of the tests. From the temperature distributions shown in Figures F-8, F-9 and F-21, as the insulation provided protection to joists, the mid-joist (mid. Jst) temperature was much lower in the assembly with rock fibre insulation compared to a non-insulated assembly. Furthermore, from the deflection distributions shown in Figures G-8, G-9 and G-21, the joist deflection rate was more or less the same up to 30 min, however, the deflection rate was much higher in the non-insulated assembly after 30 min as the joist was not protected enough from heat compared to the assemblies with rock fibre and cellulose fibre insulation.

Assembly No. FF-37 with no insulation provided 38 min 49 s fire resistance; Assembly No. FF-38 with rock fibre insulation provided 53 min 38 s fire resistance; and Assembly No. FF-50 with wet sprayed cellulose fibre insulation provided 63 min 47 s fire resistance. These results showed that for a floor assembly with steel C-joists, one layer of Type X gypsum board (15.9 mm thick) and two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each), the installation of either rock fibre or cellulose fibre insulation of different thicknesses increased the fire resistance by 38% and 64%, respectively, compared to an assembly with no insulation in the floor cavity. Therefore, the installation of either rock or cellulose fibre insulation has significant effect on the fire resistance of an assembly with steel C-joists, one layer of Type X gypsum board and two layers of softwood plywood (CSP) sub-floor.

8.9.4.2 Floor assemblies with two layers of gypsum board

Glass fibre vs rock fibre insulation

Two tests (Assembly Nos. FF-43 with glass fibre insulation and FF-53 with rock fibre insulation) were conducted to determine the effect of insulation type (glass fibre vs rock fibre insulation) on the fire resistance of a floor assembly. The assemblies had steel C-joists and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board and concrete topping (51 mm thick) on a steel deck.

In Assembly No. FF-43 with glass fibre insulation (89 mm thick), the first piece of gypsum board face layer dropped into the furnace at 54 min 28 s and most of the gypsum board face layer had dropped by 55 min 45 s. The first piece of the gypsum board base layer dropped into the furnace at 60 min 10 s and most of the gypsum board base layer had dropped by 62 min 29 s. For Assembly No. FF-53 with rock fibre insulation (89 mm thick), the first piece of the gypsum board face layer dropped at 51 min 6 s and most of the gypsum board face layer had dropped by 57 min. The first piece of the gypsum board base layer dropped into the furnace at 57 min 47 s and, by 59 min 42 s, most of the gypsum board base layer had dropped into the furnace. The temperature and deflection distributions for Assembly Nos. FF-43 and FF-53 are given in Appendix F (Figures F-14 and F-24) and in Appendix G (Figures G-14 and G-24), respectively. The mid-joist temperature was lower in the assembly with glass fibre insulation than with rock fibre insulation and this was due to the protection provided by the rock fibre insulation.

Assembly No. FF-43 with glass fibre insulation provided 68 min 25 s fire resistance while Assembly No. FF-53 with rock fibre insulation provided 70 min fire resistance. Therefore, for a floor assembly with steel C-joists (203 mm deep) and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) and a steel deck with concrete topping (51 mm thick), the installation of rock fibre insulation batts (89 mm thick) above the resilient channels provided a slight increase in fire resistance compared to a similar assembly with glass fibre insulation (89 mm thick). The effect of insulation type (rock fibre vs glass fibre insulation) in floor assemblies with steel C-joists, two layers of Type X gypsum board and concrete topping (51 mm thick) on steel deck is insignificant.

Glass fibre vs cellulose fibre insulation with adhesive

Two tests (Assembly Nos. FF-52 with glass fibre insulation (89 mm thick) and FF-65 with cellulose fibre insulation sprayed with adhesive (100 mm thick on the side of joists and 94 mm thick on the underside of the sub-floor)) were conducted to determine the effect of insulation type (glass fibre vs cellulose fibre insulation sprayed with adhesive) on the fire resistance of a floor assembly. The assemblies had steel C-joists and resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) and two layers of Type X gypsum board (12.7 mm thick each).

In Assembly No. FF-52 with glass fibre insulation, the first piece of gypsum board face layer dropped into the furnace at 42 min 18 s, and most of the gypsum board face layer had dropped by 46 min 22 s. The first piece of the gypsum board base layer dropped into the furnace at 50 min and most of the gypsum board base layer had dropped by 50 min 17 s. For Assembly No. FF-65 with cellulose fibre insulation sprayed with adhesive, the first piece of the gypsum board face layer dropped at 48 min 45 s and most of the gypsum board face layer had dropped by 52 min 17 s. The first piece of the gypsum board base layer dropped into the furnace at 52 min 39 s and most of the gypsum board base layer had dropped by 54 min 26 s. The temperature and deflection distributions for Assembly Nos. FF-52 and FF-65 are given in Appendix F (Figures F-23 and F-36) and in Appendix G (Figures G-23 and G-36), respectively.

Assembly No. FF-52 with glass fibre insulation provided 52 min 30 s fire resistance, while Assembly No. FF-65 with cellulose fibre insulation sprayed with adhesive provided 68 min 55 s fire resistance. Therefore, for a floor assembly with steel C-joists (203 mm deep) and resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), and one layer of softwood plywood (CSP) sub-floor (19 mm thick), the installation of cellulose fibre insulation sprayed with adhesive provided 31% more fire resistance compared to a similar assembly with glass fibre insulation. The effect of insulation type (cellulose fibre sprayed with adhesive vs glass fibre) on the fire resistance is significant.

8.10 Effect of Insulation in Floor Cavity (none, partial and full)

8.10.1 Assemblies with Solid Wood Joists

Two tests (Assembly No. FF-64 (no insulation) and Assembly No. FF-67 with glass fibre insulation) were conducted to determine the effect of glass fibre insulation installation on the fire resistance of a floor assembly with solid wood joists and resilient channels spaced at 610 mm o.c, one layer of softwood plywood (CSP) sub-floor (19 mm thick) and two layers of Type X gypsum board (12.7 mm thick each). The temperature and deflection distributions for Assembly Nos. FF-64 and FF-67 are given in Appendix F (Figures F-35 and F-38) and in Appendix G (Figures G-35 and G-38), respectively.

In Assembly No. FF-64 with no insulation, the first piece of gypsum board face layer dropped into the furnace at 49 min 28 s and most of the gypsum board face layer had dropped by 51 min 4 s. All gypsum board for the base layer had dropped by 54 min 14 s. In Assembly No. FF-67 with glass fibre insulation, the first piece of the gypsum board face layer dropped at 47 min 29 s and most of the gypsum board face layer had dropped by 51 min 9 s. The entire gypsum board base layer had dropped by 52 min 39 s and, 2 min later, the glass fibre insulation melted. When the glass fibre insulation melted, the wood joists and the underside of the sub-floor were exposed to direct furnace heat.

The temperature distribution on the backside of the base layer gypsum board facing the floor cavity (GB-BL/Cav) was higher in the assembly with glass fibre insulation (Assembly No. FF-64) compared to the non-insulated assembly (Assembly No. FF-67). However, the mid (Mid. Jst) joist temperature was lower in the insulated assembly due to thermal protection provided by the insulation. Once the insulation melted, the mid-joist temperature rose as quickly in the insulated assembly as in the case of no insulation. The presence of insulation in the floor cavity caused the gypsum board to fail faster but did provide some protection to the joist until it melted. As the gypsum board remained in place much longer in the assembly with no insulation, it provided more thermal protection and consequently, less deflection.

Assembly No. FF-64 with no insulation in the floor cavity provided 58 min 55 s fire resistance and Assembly No. FF-67 with glass fibre insulation provided 57 min 5 s fire resistance. These results show that for a floor assembly with solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) and one layer of softwood plywood (CSP) sub-floor (19 mm thick), the effect of glass fibre insulation installation on the fire resistance is insignificant.

8.10.2 Assemblies with Wood Trusses

Two tests (Assembly Nos. FF-41 with no insulation and No. FF-42 with glass fibre insulation (89 mm thick)) were conducted to determine the effect of the installation of glass fibre insulation on the fire resistance of a floor assembly with wood trusses and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick) and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick). The temperature and deflection distributions for Assembly Nos. FF-41 and FF-42 are given in Appendix F (Figures F-12 and F-13) and in Appendix G (Figures G-12 and G-13), respectively.

In Assembly No. FF-41 with no insulation, the first piece of the gypsum board face layer dropped at 56 min 37 s and most of the gypsum board face layer had dropped by 66 min 46 s. The entire gypsum board base layer had dropped by 68 min 20 s. At that time, the wood trusses and the plywood sub-floor were exposed to direct furnace heat. In Assembly No. FF-42 with glass fibre insulation, the first piece of the gypsum board face layer dropped at 53 min 49 s and most of the gypsum board face layer had dropped by 56 min 36 s. The entire gypsum board base layer had dropped by 64 min and, after a few minutes, the glass fibre insulation melted. When the glass fibre insulation melted, the wood trusses and the underside of the sub-floor were exposed to direct furnace heat. The gypsum board for both the face and base layers dropped earlier in the assembly with glass fibre insulation than in the assembly with no insulation in the floor cavity.

Assembly No. FF-41 with no insulation in the floor cavity provided 69 min 1 s fire resistance and Assembly No. FF-42 with glass fibre insulation provided 65 min 41 s fire resistance. These results showed that the installation of glass fibre insulation (89 mm thick) in the floor assembly with wood trusses and resilient channels spaced 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and two layers of Type X gypsum board (12.7 mm thick each) reduced the fire resistance slightly by 6% compared to the assembly with no insulation in the floor cavity.

8.10.3 <u>Assemblies with Steel C-Joists</u>

8.10.3.1 Floor assemblies with no insulation and with cellulose fibre insulation

Two tests (Assembly Nos. FF-37 with no insulation and FF-50 with cellulose fibre insulation sprayed wet) were conducted to determine the effect of the installation of wet sprayed cellulose fibre insulation on the fire resistance of a floor assembly with steel C-joists and resilient channels spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick) and two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each). The temperature and deflection distributions for Assembly Nos. FF-37 and FF-50 are given in Appendix F (Figures F-8 and F-21) and in Appendix G (Figures G-8 and G-21), respectively.

Assembly No. FF-37 with no insulation provided 38 min 49 s fire resistance and Assembly No. FF-50 with wet sprayed cellulose fibre insulation (112 mm thick on the side of joists and 91 mm thick on the underside of the sub-floor) provided 63 min 47 s fire resistance. These results showed that for an assembly with steel C-joists (203 mm deep) and resilient channels spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick) and two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each), the installation of cellulose fibre insulation in a floor assembly increased the fire resistance by 61% compared to an assembly with no insulation in the floor cavity.

8.10.3.2 Floor assemblies with no insulation and with rock fibre insulation

Assemblies with one layer of gypsum board

Two tests (Assembly Nos. FF-37 (no insulation) and FF-38 with rock fibre) were conducted to determine the effect of the installation of rock fibre insulation on the fire resistance of a floor assembly with steel C-joists and resilient channels spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick) and two layers of softwood plywood (CSP) sub-floor, (15.5 mm thick each). The temperature and deflection distributions for Assembly Nos. FF-37 and FF-38 are given in Appendix F (Figures F-8 and F-9) and in Appendix G (Figures G-8 and G-9), respectively.

Assembly No. FF-37 with no insulation provided 38 min 49 s fire resistance and Assembly No. FF-38 with rock fibre insulation provided 53 min 38 s fire resistance. These results showed that for a floor assembly with steel C-joists (203 mm deep) and resilient channels spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick) and two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each), the installation of rock fibre insulation increased the fire resistance by 36% compared to an assembly with no insulation in the floor cavity.

Assemblies with two layers of gypsum board

Two tests (Assembly Nos. FF-40 with no insulation and FF-53 with rock fibre insulation (89 mm thick)) were conducted to determine the effect of the installation of rock fibre insulation on the fire resistance performance of the floor assembly with two layers of Type X gypsum board. The assemblies had steel C-joists and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) and concrete topping (51 mm thick) on a steel deck.

In Assembly No. FF-40, the first piece of gypsum board face layer dropped at 60 min 39 s and, by 65 min, most of the gypsum board face layer had dropped into the furnace. The first piece of the gypsum board base layer dropped at 72 min 35 s and, by 74 min 42 s, most of the gypsum board base layer had dropped into the furnace. In Assembly No. FF-53 with rock fibre insulation, the first piece of the gypsum board face layer dropped at 51 min and most of the gypsum board face layer had dropped by 51 min 30 s. The entire gypsum board base layer had dropped by 60 min and, after a few minutes, the rock fibre insulation melted and this was not noted in previous experiments with rock fibre insulation. When the rock fibre insulation melted, the steel joists and the underside of steel deck were exposed to direct furnace heat.

The temperature distributions on the backside of the base layer gypsum board facing the floor cavity (GB-BL/Cav) were higher in the assembly with rock fibre insulation (Assembly No. 53) compared to the non-insulated assembly (Assembly No. 40). However, the mid (Mid. Jst) joist temperature was lower in the insulated assembly due to thermal protection provided by the insulation. Once the insulation melted, the mid-joist temperature rose quickly in the insulated assembly as in the case of no insulation. The presence of rock fibre insulation in the floor cavity caused the gypsum board to fail faster but did provide some protection to the joist until it melted. As the gypsum board remained in place much longer in the assembly with no insulation, it provided more thermal protection and consequently, less deflection.

Assembly No. FF-40 with no insulation provided 75 min fire resistance and Assembly No. FF-53 with rock fibre insulation provided 70 min fire resistance. These results showed that for an assembly with steel C-joists (203 mm deep) and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) and concrete topping (51 mm thick) on a steel deck, the installation of rock fibre insulation (89 mm thick) reduced the fire resistance by 7% compared to an assembly with no insulation in the floor cavity.

8.11 Effect of Insulation Support in Assembly with Solid Wood Joists (steel mesh)

Two tests (Assembly Nos. FF-34 with no steel mesh and FF-66 with a steel mesh) were conducted to determine the effect of the installation of steel mesh on the fire resistance performance of a floor assembly with solid wood joists spaced at 406 mm o.c. and resilient channels spaced at 203 mm o.c., one layer of Type X gypsum board (15.9 mm thick) and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick). The temperature and deflection distributions for Assembly Nos. FF-34 and FF-66 are given in Appendix F (Figures F-5 and F-37) and in Appendix G (Figures G-5 and G-37), respectively.

In Assembly No. FF-34, the first piece of gypsum board dropped at 37 min 19 s and, by 40 min 45 s, most of the gypsum board had dropped into the furnace. In Assembly No. FF-66, the first piece of gypsum board dropped at 31 min and, by 41 min 24 s, most of the gypsum board had dropped into the furnace.

Assembly No. 34 with neither steel mesh nor insulation provided 54 min 11 s fire resistance and Assembly No. FF-66 with rock fibre insulation and steel mesh provided 50 min 24 s fire resistance. These results showed that for a floor assembly with solid wood joists (89 mm wide and 235 mm deep) spaced at 406 mm o.c. and resilient channels spaced at 203 mm o.c., one layer of Type X gypsum board (15.9 mm thick) and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), the installation of a steel mesh below the rock fibre batts did not increase the fire resistance compared to an assembly with no steel mesh, however, the gypsum board dropped earlier in the assembly with a steel mesh due to the formation of a big crack in the gypsum board. No similar crack was noticed in the assembly without the steel mesh.

8.12 Effect of Sub-floor/Deck Type (Steel vs Wood) with Steel C-Joists

Two tests (Assembly Nos. FF-43 with steel deck and FF-27 (Phase I, Ref. 2) with softwood plywood (CSP) sub-floor (15.5 mm thick)) were conducted to determine the effect of sub-floor/deck type (plywood vs steel) on the fire resistance of a floor assembly. The assemblies had steel C-joists and resilient channels spaced at 406 mm o.c. glass fibre insulation (89 mm thick), two layers of Type X gypsum board (12.7 mm thick each) and concrete topping on top of the deck. The concrete topping was 38 mm thick in Assembly No. FF-27 and 51 mm thick in Assembly No. FF-43. The temperature and deflection distributions for Assembly No. FF-43 are given in Appendix F (Figure F-14) and in Appendix G (Figures G-14), respectively. The temperature and deflection distributions for Assembly No. FF-27 can be found in Phase 1, Ref. 2.

In Assembly No. FF-43, a large piece of gypsum board face layer dropped at 54 min and also a large piece of gypsum board base layer dropped at 60 min. For Assembly No. FF-27 a large piece of the gypsum board face layer dropped at 49 min and also a large piece of gypsum board base layer dropped at 55 min. After approximately 2 min, the glass fibre insulation melted in both assemblies and joists and the underside of the deck was exposed to furnace heat.

Assembly No. FF-43 with a steel deck provided 68 min 25 s fire resistance and Assembly No. FF-27 with softwood plywood (CSP) sub-floor (15.5 mm thick) provided 60 min fire resistance. The results showed that for a floor assembly with steel C-joists (203 mm deep) and resilient channels spaced at 406 mm o.c., glass fibre insulation (89 mm thick), two layers of Type X gypsum board (12.7 mm thick each) and concrete topping (51 mm thick), the assembly with a steel deck had a higher fire resistance (14%) than an assembly with softwood plywood (CSP) sub-floor.

8.13 Effect of Sub-floor Number of Layers

Two tests (Assembly No. FF-67 with one layer of softwood plywood (CSP) sub-floor (19 mm thick) and Assembly No. FF-73 with two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each)) were conducted to examine the effect of sub-floor number of layers on the fire resistance of floor assemblies. The assemblies had two layers of Type X gypsum board (12.7 mm thick each), solid wood joists and resilient channels spaced at 610 mm o.c. and glass fibre insulation (89 mm thick) in the floor cavity.

In Assembly No. FF-67 with one layer of sub-floor, the first piece of the gypsum board face layer dropped at 47 min 30 s and most of the gypsum board face layer had dropped by 51 min. The entire gypsum board base layer had dropped by 52 min and, after a few minutes, the glass fibre insulation melted. For Assembly No. FF-73 with two layers of sub-floor, the first piece of the gypsum board face layer dropped at 48 min 11 s and most of the gypsum board face layer had dropped by 51 min 11 s. The entire gypsum board base layer had dropped by 53 min 44 s. A few minutes after the gypsum board base layer fell off, the glass fibre insulation melted at which time the wood joists and the underside of the plywood sub-floor were exposed to the furnace heat. The temperature distributions are shown in Appendix F (Figures F-38 and F-44) and the deflection distributions are shown in Appendix G (Figures G-38 and G-44).

Assembly No. FF-67 with one layer of softwood plywood (CSP) sub-floor (19 mm thick) provided 57 min 5 s fire resistance and Assembly No. FF-73 with two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) provided 58 min 43 s fire resistance. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor and glass fibre insulation (89 mm thick), the installation of an additional sub-floor layer slightly improved the fire resistance compared to an assembly with one layer of sub-floor.

8.14 Effect of Number of Gypsum Board Ceiling Layers (wood I-joists)

Two tests (Assembly No. FF-78 with one layer of Type X gypsum board (15.9 mm thick) and Assembly No. FF-81 with two layers of Type X gypsum board (15.9 mm thick each)) were conducted to determine the effect of gypsum board number of layers on the fire resistance of floor assemblies with wood joists spaced at 406 mm o.c., two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each), resilient channels spaced at 305 mm o.c. and cavity filled with compressed rock fibre insulation (267 mm thick). As the insulation thickness was larger (267 mm) than the floor cavity (241 mm), insulation was compressed inside the floor cavity.

In Assembly No. FF-78 with one layer of gypsum board, the first piece of the gypsum board layer dropped at 29 min 7 s and most of the gypsum board layer had dropped by 35 min. At that time, the bottom surface of the bottom wood-I flanges was exposed to furnace heat. For Assembly No. FF-81 with two layers of gypsum board, the first piece of the gypsum board face layer dropped at 56 min 43 s and most of the gypsum board face layer had dropped by 60 min. The entire gypsum board base layer had dropped by 67 min 30 s. At that time, the bottom surface of the bottom wood-I flanges was exposed to furnace heat. The temperature distributions are shown in Appendix F (Figures F-49 and F-52) and the deflection distributions are shown in Appendix G (Figures G-49 and G-52).

Assembly No. FF-78 with one layer of Type X gypsum board provided 59 min 38 s fire resistance and Assembly No. FF-81 with two layers of Type X gypsum board provided 90 min 19 s fire resistance. These results showed that the installation of an additional Type X gypsum board layer (15.9 mm thick) to a floor assembly constructed with wood I-joists spaced at 406 mm o.c., resilient channels spaced at 305 mm o.c., one layer of Type X gypsum board (15.9 mm thick), two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each), floor cavity filled with compressed 267 mm thick rock fibre insulation into 241 mm deep floor cavity increased the fire resistance by 50%.

8.15 Effect of Number of Gypsum Board Ceiling Layers vs Number of Sub-Floor Layers

8.15.1 Assemblies with Steel C-Joists

Assembly No. FF-37 with one layer of Type X gypsum board (15.9 mm thick) and two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) and Assembly No. FF-22 (Phase I, Ref. 2) with two layers of Type X gypsum board (12.7 mm thick each) and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) were tested to determine the effect of the number of gypsum board layers vs the number of sub-floor layers on the fire resistance of a steel C-joist assembly. In both assemblies, the steel C-joists and resilient channels were spaced at 406 mm o.c. and there was no insulation in the floor cavity.

In Assembly No. FF-37 with one layer of gypsum board, the first piece of the gypsum board layer dropped at 36 min 32 s and most of the gypsum board layer had dropped by 37 min. For Assembly No. FF-22 with two layers of gypsum board, the first piece of the gypsum board face layer dropped at 60 min and most of the gypsum board face layer had dropped by 64 min. The entire gypsum board base layer had dropped by 70 min. At that time, the joists and the underside of the sub-floor were exposed to furnace heat. The temperature distributions are shown in Appendix F (Figure F-8 and Figure 127 in Phase I, Ref. 2) and the deflection distributions are shown in Appendix G (Figures G-8 and Figure 158 in Phase I, Ref. 2).

Assembly No. FF-37 with one layer of Type X gypsum board and two layers of CSP plywood sub-floor provided 38 min 49 s fire resistance, while Assembly No. FF-22 with two layers of Type X gypsum board and one layer of CSP plywood sub-floor provided 74 min fire resistance. These results showed that the installation of an additional Type X gypsum board layer in a floor assembly constructed with one layer of Type X gypsum board, steel C-joists (203 mm deep) spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and resilient channels spaced at 406 mm o.c., increased the fire resistance by 90% compared to an assembly with two layers of softwood plywood (CSP) sub-floor (15.5 mm thick) and one layer of Type X gypsum board. These results clearly indicate that it is much more beneficial for the fire resistance of a floor assembly with steel C-joists to use two layers of Type X gypsum board and one layer of sub-floor than to use two layers of plywood sub-flooring and one layer of Type X gypsum board.

8.16 Effect of Sub-floor Topping

8.16.1 <u>Floor Assemblies with Wood Joists</u>

Assembly No. FF-35 with Gyp-Crete topping (25 mm thick) was tested to determine the effect of adding Gyp-Crete topping above softwood plywood (CSP) sub-floor (15.5 mm thick) on the fire resistance of assemblies with solid wood joists and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) compared to an Assembly No. FF-29 with no topping that was tested in Phase I [2]. The temperature distributions are shown in Appendix F (Figure F-6 and Figure 134 in Phase I, Ref. 2) and the deflection distributions are shown in Appendix G (Figures G-6 and Figures 134 and 165 in Phase I, Ref. 2).

Assembly No. FF-35 with Gyp-Crete topping (25 mm thick) provided 68 min 27 s fire resistance, while Assembly No. FF-29 without topping provided 65 min fire resistance. Thus, for a floor assembly with solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), the application of Gyp-Crete topping (25 mm thick) above softwood plywood (CSP) sub-floor (15.5 mm thick) slightly improved the fire resistance compared to a similar assembly with no topping.

8.16.2 <u>Floor Assemblies with Wood I-Joists</u>

Two tests (Assembly Nos. FF-61 with concrete topping (38 mm thick) and FF-15 (Phase I, Ref. 2) without concrete topping) were conducted to determine the effect of adding a concrete topping on the fire resistance. The assemblies had wood I-joists and resilient channels spaced at 406 mm o.c., 38 mm by 38 mm LVL flanges with glass fibre insulation (89 mm thick), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), and two layers of Type X gypsum board (12.7 mm thick each).

In Assembly No. FF-61, a large piece of gypsum board face layer dropped at 50 min 30 s and also a large piece of gypsum board from the base layer dropped off at 57 min 27 s. For Assembly No. FF-15, a large piece of the gypsum board face layer dropped at 54 min and also a large piece of the gypsum board base layer dropped at 58 min. After approximately a further 2 min, the glass fibre insulation melted in both assemblies and the joists and underside of the sub-floor were exposed to furnace heat. The temperature distributions are shown in Appendix F (Figure F-32 and Figure 120 in Phase I, Ref. 2) and the deflection distributions are shown in Appendix G (Figures G-32 and Figure 151 in Phase I, Ref. 2).

Assembly No. FF-15 without concrete topping provided 64 min fire resistance and Assembly No. FF-61 with concrete topping (38 mm thick) provided 66 min 58 s fire resistance. This result shows that for a floor assembly with wood I-joist (241 mm deep) and resilient channels spaced at 406 mm o.c., 38 mm by 38 mm LVL flanges with glass fibre insulation (89 mm thick), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), and two layers of Type X gypsum board (12.7 mm thick each), adding concrete topping (38 mm thick) slightly increased (5%) the fire resistance compared to a similar assembly with no concrete topping. A similar trend was shown in assemblies with wood trusses and solid wood joists.

8.16.3 <u>Floor Assemblies with Wood Trusses</u>

8.16.3.1 Assemblies with wood trusses and resilient channels spaced at 406 mm o.c.

Two tests (Assembly Nos. FF-47, with concrete topping (38 mm thick), and FF-46, without concrete topping) were conducted to determine the effect of adding a concrete topping in floor assemblies with wood trusses (64 mm wide chord in Assembly No. FF-46 and 89 mm wide chord in Assembly No. FF-47) spaced at 406 mm o.c. with glass fibre insulation (89 mm thick), resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and two layers of Type X gypsum board, 12.7 mm thick each, on the fire resistance.

In Assembly No. FF-47 with concrete topping, the first piece of gypsum board face layer dropped at 52 min 10 s and, by 56 min, most of the gypsum board face layer had dropped into the furnace. The first piece of gypsum board from the base layer dropped into the furnace at 60 min 2 s and, by 60 min 11 s, most of the gypsum board base layer had dropped into the furnace. For Assembly No. FF-46, without concrete topping, a large piece of the gypsum board face layer dropped at 55 min 18 s and, by 57 min 3 s, most of the gypsum board face layer had dropped into the furnace. A large piece of the gypsum board base layer dropped at 61 min 40 s and, by 65 min 37 s, most of the gypsum board base layer had dropped into the furnace. After approximately 2 min, the glass fibre insulation melted in both assemblies and the wood trusses and underside surface of the sub-floor were exposed to furnace heat. The temperature and deflection distributions for Assembly Nos. FF-46 and FF-47 are given in Appendix F (Figures F-17 and F-18) and in Appendix G (Figures G-17 and G-18), respectively.

Assembly No. FF-47 with concrete topping (38 mm thick) provided 72 min fire resistance and Assembly No. FF-46 without concrete topping provided 67 min 36 s fire resistance. This result shows that for a floor assembly with wood trusses (305 mm deep) spaced at 406 mm o.c. with glass fibre insulation (89 mm thick), resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), adding concrete topping (38 mm thick) increased the fire resistance slightly (7%) compared to a similar assembly with no concrete topping. A similar trend was shown in assemblies with wood I-joists and solid wood joists spaced at 406 mm o.c. and resilient channels spaced at 406 mm o.c.

8.16.3.2 Assemblies with wood trusses and resilient channels spaced at 610 mm o.c.

Two tests (Assembly Nos. FF-75 with concrete topping (38 mm thick), and FF-59, without concrete topping) were conducted to determine the effect of adding a concrete topping above the softwood plywood (CSP) sub-floor (19 mm thick) in floor assemblies with wood trusses spaced at 610 mm o.c., glass fibre insulation (89 mm thick), resilient channels spaced at 610 mm o.c. and two layers of Type X gypsum board (12.7 mm thick each) on the fire resistance.

In Assembly No. FF-75 with concrete topping, the first piece of gypsum board face layer dropped at 44 min 14 s and, by 49 min, most of the gypsum board face layer had dropped into the furnace. The first piece of gypsum board from the base layer dropped into the furnace at 50 min 29 s and, by 52 min, most of the gypsum board base layer had dropped into the furnace. For Assembly No. FF-59, without concrete topping, a large piece of the gypsum board face layer dropped at 42 min 25 s and, by 49 min 2 s, most of the gypsum board face layer had dropped into the furnace. A large piece of the gypsum board base layer dropped at 49 min 34 s and, by 53 min, most of the gypsum board base layer had dropped into the furnace. After approximately 2 min, the glass fibre insulation melted in both assemblies and the wood trusses and underside surface of the sub-floor were exposed to furnace heat. The temperature and deflection distributions for Assembly Nos. FF-75 and FF-59 are given in Appendix F (Figures F-46 and F-30) and in Appendix G (Figures G-46 and G-30), respectively.

Assembly No. FF-75 with concrete topping (38 mm thick) provided 60 min 55 s fire resistance and Assembly No. FF-59 without concrete topping provided 54 min 35 s fire resistance. This result shows that, for a floor assembly with wood trusses spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick), glass fibre insulation (89 mm thick), resilient channels spaced at 610 mm o.c. and two layers of Type X gypsum board (12.7 mm thick each), adding concrete topping (38 mm thick) slightly increased the fire resistance by 11% compared to a similar assembly with no concrete topping. A similar trend was shown in assemblies with wood I-joists and solid wood joists spaced at 406 mm o.c. and resilient channels spaced at 406 mm o.c.

8.16.4 Assemblies with Steel C-Joists

Two tests (Assembly No. FF-54 with concrete topping and Assembly No. FF-62 without concrete topping) were conducted to determine the effect of adding concrete topping (51 mm thick) above the steel deck. The assemblies had steel C-joists spaced at 610 mm o.c., no resilient channels and no insulation in the floor cavity, two layers of Type X gypsum board (12.7 mm thick each) and concrete topping (51 mm thick) above a steel deck sub-floor in Assembly FF-54 and softwood plywood (CSP) sub-floor (19 mm thick) in Assembly No FF-62.

In Assembly No. FF-54, a large piece of gypsum board face layer dropped at 37 min 40 s and, by 55 min 35 s, most of the gypsum board face layer had already dropped from the assembly. A large piece of gypsum board from the base layer dropped at 60 min 35 s and most of the gypsum board base layer had dropped by 63 min 33 s. For Assembly No. FF-62, a large piece of the gypsum board face layer dropped at 47 min 29 s and most of the gypsum board face layer had dropped from the assembly by 51 min 9 s. A large piece of the gypsum board base layer dropped at 52 min and most of the gypsum board base layer had dropped by 52 min

50 s. The temperature and deflection distributions for Assembly Nos. FF-54 and FF-62 are given in Appendix F (Figures F-16 and F-28) and in Appendix G (Figures G-16 and G-28), respectively.

Assembly No. FF-62 with no concrete topping provided 54 min 59 s fire resistance and Assembly No. FF-54 with concrete topping (51 mm thick) provided 66 min fire resistance. This result shows that, for a floor assembly with steel C-joists (203 mm deep) spaced at 610 mm o.c., neither resilient channels nor insulation in the floor cavity, two layers of Type X gypsum board (12.7 mm thick each), adding a concrete topping (51 mm thick) above a steel deck increased the fire resistance by 20% compared to a similar assembly with no concrete topping and softwood plywood (CSP) sub-floor (19 mm thick).

8.17 Effect of Resilient Channel Installation

8.17.1 Floor Assemblies with Wood Joists

Two assemblies (Assembly Nos. FF-31, without resilient channels and FF-28 (Phase I, Ref. 2) with resilient channels) were tested to investigate the effect of resilient channel installation on the fire resistance of assemblies with solid wood joists spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick). The temperature distributions are shown in Appendix F (Figure F-2 and Figure 133 in Ref. 2) and the deflection distributions are shown in Appendix G (Figure G-2 and Figure 164 in Ref. 2).

In Assembly No. FF-31 with no resilient channels, a large piece of gypsum board face layer dropped at 56 min 50 s and, by 60 min, most of the gypsum board face layer had already dropped from the assembly. Most of the gypsum board base layer had dropped from the assembly by 65 min 33. For Assembly No. FF-28 with resilient channels, a large piece of the gypsum board face layer dropped at 44 min 29 s and most of the gypsum board face layer had dropped from the assembly by 50 min. Most of the gypsum board base layer had dropped by 65 min.

Assembly No. FF-31 without resilient channels provided 67 min, 10 s fire resistance and Assembly No. FF-28 with resilient channels provided 69 min fire resistance. The deflection distribution was more or less the same in these 2 tests. These results showed that for a floor assembly with solid wood joists (89 mm wide and 235 mm deep) spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), two layers of Type X gypsum board (12.7 mm thick each) and no insulation in the floor cavity, the effect of resilient channel installation (406 mm o.c.) on the fire resistance is insignificant.

8.17.2 Floor Assemblies with Wood Trusses

Two tests (Assembly Nos. FF-41 with resilient channels and FF-60 without resilient channels) were conducted to determine the effect of installation of resilient channels on the fire resistance of a floor assembly with wood trusses spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), two layers of Type X gypsum board (12.7 mm thick each) and no insulation in the floor cavity.

In Assembly No. FF-41, a large piece of the gypsum board face layer dropped at 56 min 37 s and also a large gypsum board segment from the base layer dropped into the furnace at 65 min. In Assembly No. FF-60, a large piece of the gypsum board face layer dropped at 43 min and also a large piece of the gypsum board base layer dropped at 59 min. The temperature and deflection distributions for Assembly Nos. FF-41 and FF-60 are given in Appendix F (Figures F-12 and F-31) and in Appendix G (Figures G-12 and G-31), respectively.

Assembly No. FF-41 with resilient channels provided 69 min 1 s fire resistance and Assembly No. FF-60 without resilient channels provided 61 min 3 s fire resistance. These results showed that for a floor assembly with wood trusses (89 mm wide and 305 mm deep) spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), two layers of Type X gypsum board (12.7 mm thick each) and no insulation in the floor cavity, the installation of resilient channels spaced at 406 mm o.c. increased the fire resistance by 13% compared to a similar assembly without resilient channels.

8.17.3 <u>Assemblies with Steel C-Joists</u>

Two tests (Assembly Nos. FF-51 without resilient channels and FF-22 (Phase I, Ref. 2) with resilient channels) were conducted to determine the effect of resilient channel installation on the fire resistance of floor assemblies with steel C-joists spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), two layers of Type X gypsum board (12.7 mm thick each) and no insulation in the floor cavity. The temperature distributions are shown in Appendix F (Figure F-22 and Figure 127 in Phase I, Ref. 2) and the deflection distributions are shown in Appendix G (Figure G-22 and Figure 158 in Phase I, Ref. 2).

In Assembly No. FF-51, a large piece of the gypsum board face layer dropped at 51 min and also a large section of the gypsum board base layer dropped into the furnace at 66 min 38 s. In Assembly No. FF-22, a large piece of the gypsum board face layer dropped at 68 min and also a large piece of the gypsum board base layer dropped at 70 min.

Assembly No. FF-51 without resilient channels provided 66 min 55 s fire resistance and Assembly No. FF-22 with resilient channels provided 74 min fire resistance. These results showed that, for a floor assembly with steel C-joists (203 mm deep) spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), two layers of Type X gypsum board (12.7 mm thick each) and no insulation in the floor cavity, the installation of resilient channels at 406 mm o.c. increased the fire resistance by 12% compared to a similar floor assembly without resilient channels.

8.18 Effect of Resilient Channel Spacing

8.18.1 <u>Floor Assemblies with Solid Wood Joists</u>

Two tests (Assembly Nos. FF-30 with resilient channels spaced at 406 mm o.c. and FF-33 with resilient channels spaced at 203 mm o.c.) were carried out to determine the effect of resilient channel spacing on the fire resistance of non-insulated assemblies with solid wood joists spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and one layer of Type X gypsum board (12.7 mm thick).

In Assembly No. FF-30 with resilient channels spaced at 406 mm o.c., a large piece of gypsum board dropped at 40 min and, by 40 min 43 s, most of the gypsum board had already dropped from the assembly. For Assembly No. FF-33 with resilient channels spaced at 203 mm o.c., a large piece of the gypsum board face layer dropped at 39 min and most of the gypsum board had dropped from the assembly by 40 min. The temperature distributions are shown in

Appendix F (Figures F-1 and F-4) and deflection distributions are shown in Appendix G (Figures G-1 and G-4).

Assembly No. FF-30 with resilient channels spaced at 406 mm o.c. provided 40 min 49 s fire resistance and Assembly No. FF-33 with resilient channels spaced at 203 mm o.c. provided 39 min 55 s fire resistance. These results showed that, for a floor assembly with solid wood joists (89 mm wide and 235 mm deep) spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), no insulation in the floor cavity and one layer of Type X gypsum board (12.7 mm thick), the effect of resilient channels spacing (406 mm o.c. vs 203 mm o.c.) on the fire resistance is insignificant.

8.18.2 Floor Assemblies with Wood Trusses

Two tests (Assembly Nos. FF-48 with resilient channels spaced at 406 mm o.c. and FF-59 with resilient channels spaced at 610 mm o.c.) were conducted to examine the effect of resilient channels spacing on the fire resistance of a floor assembly with wood trusses spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick), two layers of Type X gypsum board (12.7 mm thick each) and glass fibre insulation (89 mm thick) in the floor cavity. The temperature distributions are shown in Appendix F (Figures F-19 and F-30) and the deflection distributions are shown in Appendix G (Figures G-19 and G-30).

In Assembly No. FF-48, a large piece of gypsum board face layer dropped at 54 min and also a large gypsum board section from the base layer dropped at 62 min. For Assembly No. FF-59, a large piece of the gypsum board face layer dropped at 41 min and also a large piece of the gypsum board base layer dropped at 50 min. After approximately a further 2 min, the glass fibre insulation melted in both assemblies and the trusses and the underside surface of the plywood sub-floor were exposed to furnace heat. From these results, it appears that the gypsum board face layer had dropped much faster when the resilient channels were spaced at 610 mm o.c. than in the case where they were spaced at 410 mm o.c.

Assembly No. FF-48 with resilient channels spaced at 406 mm o.c. provided 68 min 18 s fire resistance, while Assembly No. FF-59 with resilient channels spaced at 610 mm o.c. provided 54 min 35 s fire resistance. The fire resistance of Assembly No. FF-59 is lower than that of Assembly No. FF-48. This could be attributed to the use of fewer screws to support the gypsum board in the case of resilient channel spaced at 610 mm o.c. than in the case where the channels were spaced at 406 mm o.c. Thus, for a floor assembly with wood trusses (89 mm wide and 305 mm deep) spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (19 mm thick) and glass fibre insulation (89 mm thick), the fire resistance was reduced by 20% with the increase of the resilient channels spacing from 406 mm o.c. to 610 mm o.c.

8.18.3 Floor Assemblies with Steel C-Joists

8.18.3.1 Steel C-joists spaced at 406 mm o.c.

Two tests (Assembly Nos. FF-43 with resilient channels spaced at 406 mm o.c. and FF-44 with resilient channels spaced at 610 mm o.c.) were conducted to determine the effect of resilient channel spacing on the fire resistance of a floor assembly with glass fibre insulation (89 mm thick), two layers of Type X gypsum board (12.7 mm thick each), steel C-joists spaced at 406 mm o.c. and concrete topping (51 mm thick) on top of a steel deck. The temperature distributions are shown in Appendix F (Figures F-14 and F-15) and deflection distributions are shown in Appendix G (Figures G-14 and G-15).

In Assembly No. FF-43, a large piece of gypsum board face layer dropped at 54 min and also a large piece of the gypsum board base layer dropped at 60 min. For Assembly No. FF-44, a large piece of the gypsum board face layer dropped at 52 min and also a large piece of the gypsum board base layer dropped at 53 min. After approximately 2 min, the glass fibre insulation melted in both assemblies and the steel C-joists and the underside of the steel deck were exposed to furnace heat.

Assembly No. FF-43 with resilient channels spaced at 406 mm o.c. provided 68 min 25 s fire resistance and Assembly No. FF-44 with resilient channels spaced at 610 mm o.c. provided 61 min fire resistance. These results showed that, for a floor assembly with steel C-joist (203 mm deep) spaced at 406 mm o.c. and two layers of Type X gypsum board (12.7 mm thick each), concrete topping above a steel deck (51 mm thick) and glass fibre insulation (89 mm thick), the increase in the resilient channel spacing from 406 mm o.c. to 610 mm o.c. reduced the fire resistance by 10%. This could be attributed to the use of a fewer screws to support the gypsum board in the case of resilient channel spaced at 610 mm o.c.

8.18.3.2 Steel C-joists spaced at 610 mm o.c.

Two tests (Assembly Nos. FF-52 with resilient channels spaced at 610 mm o.c. and FF-24 (Phase I, Ref. 2) with resilient channels spaced at 406 mm o.c.) were conducted to determine the effect of resilient channel spacing on the fire resistance of a steel C-joist floor assembly with glass fibre insulation (89 mm thick), joists spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) and two layers of Type X gypsum board (12.7 mm thick each). The temperature distributions are shown in Appendix F (Figure F-23) and Figure 129 (Phase I, Ref. 2) and the deflection distributions are shown in Appendix G (Figure G-23) and Figure 160 (Phase I, Ref. 2).

In Assembly No. FF-52, a large piece of gypsum board face layer dropped into the furnace at 42 min and also a large piece of the gypsum board base layer dropped at 50 min. For Assembly No. FF-24, a large piece of the gypsum board face layer dropped at 57 min and also a large piece of the gypsum board base layer dropped at 64 min. After approximately a further 2 min, the glass fibre insulation melted in both assemblies, the joists and underside of the plywood sub-floor were exposed to furnace heat. From these results, the gypsum board face layer fell off much faster when the resilient channels were spaced at 610 mm o.c. than in the case where resilient channels were spaced at 406 mm o.c.

Assembly No. FF-52 with resilient channels spaced at 610 mm o.c. provided 52 min 30 s fire resistance while Assembly No. FF-24 with resilient channels spaced at 406 mm o.c. provided 69 min fire resistance. These results showed that for a floor assembly with steel C-joists (203 mm deep) spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) and one layer of softwood plywood (CSP) sub-floor (19 mm thick), the effect of increasing the resilient channel spacing from 406 mm o.c. to 610 mm o.c. reduced the fire resistance by 31% and thus, the effect of resilient channels spacing on the fire resistance is significant. This could be attributed to the use of fewer screws to support the gypsum board in the case of resilient channel spaced at 610 mm o.c.

8.19 Effect of Load Magnitude with Wood Joists

Two tests (Assembly Nos. FF-30 with 100% design load and FF-02A (Phase I, Ref. 2) with 75% design load) were carried out to determine the effect of load magnitude on the fire resistance of an assembly with solid wood joists and resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), one layer of Type X gypsum board (12.7 mm thick) and no insulation in the floor cavity. The temperature distributions are shown in Appendix F (Figure F-1) and Figure 106 (Phase I, Ref. 2) and the deflection distributions are shown in Appendix G (Figure G-1) and Figure 137 (Phase I, Ref. 2).

Assembly No. FF-30 with 100% design load provided 40 min 49 s fire resistance and Assembly No. FF-02A with 75% design load provided 45 min fire resistance. These results showed that, for a floor assembly with solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 406 mm o.c., one layer of Type X gypsum board (12.7 mm thick), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and no insulation in the floor cavity, the fire resistance decreased by 7% with the increase of structural load from 75% to 100% design load.

8.20 Test Repeatability with Wood Trusses

Two tests (Assembly Nos. FF-59 and FF-79) were conducted to examine the fire resistance test results repeatability of a similar construction floor assembly with wood trusses and resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick), one layer of softwood plywood (CSP) sub-floor (19 mm thick) and glass fibre insulation (89 mm thick). The temperature distributions are shown in Appendix F (Figures F-30 and F-50) and deflection distributions are shown in Appendix G (Figures G-30 and G-50).

In Assembly No. FF-59, the first piece of the gypsum board face layer dropped into the furnace at 40 min 25 s and most of the gypsum board face layer had dropped by 49 min. The first piece of the gypsum board base layer dropped into the furnace at 49 min 34 s and most of the gypsum board base layer had dropped by 53 min. In Assembly No. FF-79, the first piece of the gypsum board face layer dropped into the furnace at 45 min 32 s and most of the gypsum board face layer had dropped by 50 min. The first piece of the gypsum board base layer dropped into the furnace at 51 min 30 s and most of the gypsum board face layer had dropped by 54 min.

Assembly No. FF-59 provided 54 min 35 s fire resistance while Assembly No. FF-79 provided 56 min 24 s fire resistance. These results showed that for two identical construction floor assemblies with wood trusses (89 mm wide and 305 mm deep) and resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick), one layer of softwood plywood (CSP) sub-floor (19 mm thick) and glass fibre insulation (89 mm thick), the difference in fire resistance was approximately 2 min (3.7%).

8.21 Floor Assemblies with Unique Design

Five other floor assemblies were tested with specific details to determine their fire resistance.

1. Assembly No. FF-45 was tested with wood I-joists (38 mm thick by 44 mm wide flanges and 241 mm deep) and resilient channels spaced at 406 mm o.c., one layer of Type X gypsum

board (15.9 mm thick), one layer of OSB sub-floor (15.5 mm thick) and rock fibre insulation (178 mm thick) to determine whether this assembly could achieve a 1 h fire resistance.

In Assembly No. FF-45, a large piece of gypsum board dropped at 31 min 20 s and, by 37 min 40 s, most of the gypsum board had already dropped from the assembly. At that time, the rock fibre insulation started to melt and drop into the furnace and the wood I-joists and the underside surface of the plywood sub-floor were exposed to furnace heat. The temperature distributions are shown in Appendix F (Figure F-16) and the deflection distributions are shown in Appendix G (Figure G-16).

This assembly with wood I-joists (38 mm thick by 44 mm wide flanges and 241 mm deep) and resilient channels spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), one layer of OSB sub-floor (15.5 mm thick) and rock fibre insulation (178 mm thick) in the floor cavity provided 39 min 31 s fire resistance.

2. Assembly No. FF-57 was tested with wood I-joists (38 mm thick by 63 mm wide flanges and 241 mm deep) spaced at 610 mm o.c., resilient channels spaced at 305 mm o.c., one layer of Type X gypsum board (15.9 mm thick), two layers of OSB sub-floor (15.5 mm thick each) and rock fibre insulation (89 mm thick) in the floor cavity to determine whether this assembly could achieve a 1 h fire resistance.

In Assembly No. FF-57, a large piece of gypsum board dropped at 39 min 24 s and, by 43 min 41 s, most of the gypsum board had already dropped from the assembly. By 49 min, the rock fibre insulation had dropped into the furnace and, at that time, the wood I-joists and OSB underside surface of the sub-floor were exposed to furnace heat. The temperature distributions are shown in Appendix F (Figure F-28) and the deflection distributions are shown in Appendix G (Figure G-28).

This assembly with wood I-joists (38 mm thick by 63 mm wide flanges and 241 mm deep) spaced at 610 mm o.c., resilient channels spaced at 305 mm o.c., one layer of Type X gypsum board (15.9 mm thick), two layers of OSB sub-floor (15.5 mm thick each) and rock fibre insulation (89 mm thick) in the floor cavity provided 50 min 17 s fire resistance.

3. Assembly No. FF-70 was tested with solid wood joists (89 mm wide and 235 mm deep) spaced at 406 mm o.c., resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and dry-blown cellulose fibre insulation full cavity above a steel mesh, to determine whether this assembly could achieve a 1.5 h fire resistance.

In Assembly No. FF-70, a large piece of the gypsum board face layer dropped at 48 min 2 s and, by 52 min 3 s, most of the gypsum board face layer had already dropped from the assembly. A large piece of the gypsum board base layer dropped at 53 min 47 s and, by 55 min 41 s, most of the gypsum board base layer had already dropped from the assembly. The cellulose fibre insulation remained in place and protected the solid wood joists and underside surface of the plywood sub-floor for an additional 31 min until the assembly failed by the penetration of flame from the plywood joints due to structural failure. The temperature distributions are shown in Appendix F (Figure F-41) and the deflection distributions are shown in Appendix G (Figure G-41).

This assembly with solid wood joists (89 mm wide and 235 mm deep) spaced at 406 mm o.c., resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and dry-blown cellulose fibre insulation full cavity above a steel mesh provided 87 min 20 s fire resistance.

4. Assembly No. FF-74 was tested with steel C-joists (203 mm deep) spaced at 610 mm o.c., resilient channels spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), a steel deck with concrete topping (51 mm thick) and wet sprayed cellulose fibre insulation on the joist sides (89 mm thick) and the underside of the steel deck (38 mm thick), to determine whether this assembly could achieve a 1 h fire resistance.

In Assembly No. FF-74, a large piece of gypsum board dropped at 31 min 57 s and, by 40 min 15 s, most of the gypsum board had already dropped from the assembly. By 52 min, the cellulose fibre insulation had dropped into the furnace and, at that time, the steel C-joist and steel deck were exposed to furnace heat. The temperature distributions are shown in Appendix F (Figure F-45) and the deflection distributions are shown in Appendix G (Figure G-45).

This assembly with steel C-joists (203 mm deep) spaced at 610 mm o.c., resilient channels spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), a steel deck with concrete topping (51 mm thick) and wet sprayed cellulose fibre insulation on the joist sides (89 mm thick) and the underside of the steel deck (38 mm thick) provided 56 min 20 s fire resistance. The failure occurred by the ignition of cotton pad (see Section 6.2) at one of the cracks, 32 mm wide in the concrete topping.

5. Assembly No. FF-82 was tested with wood truss (89 mm wide and 305 mm deep) spaced at 406 mm o.c., resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (15.9 mm thick each), two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) and dry-blown cellulose fibre insulation full cavity above a steel mesh, to determine whether this assembly could achieve a 1.5 h fire resistance.

In Assembly No. FF-82, a large piece of gypsum board face layer dropped at 50 min 50 s and, by 62 min 37 s, most of the gypsum board face layer had already dropped from the assembly. A large piece of the gypsum board base layer dropped at 61 min 23 s and, by 68 min 12 s, most of the gypsum board base layer had already dropped from the assembly. The cellulose fibre insulation remained in place and protected the wood trusses and underside surface of the plywood sub-floor for an additional 31 min until the assembly failed by the penetration of flame from the plywood joints due to a structural failure. The temperature distributions are shown in Appendix F (Figure F-53) and the deflection distributions are shown in Appendix G (Figure G-53).

This assembly with wood trusses (89 mm wide and 305 mm deep) spaced at 406 mm o.c., resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (15.9 mm thick each), two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) and dry-blown cellulose fibre insulation full cavity above a steel mesh provided 99 min 14 s fire resistance.

9.0 SUMMARY OF TEST RESULTS

In this report, the fire resistance results of 53 full-scale experiments, conducted to investigate various parameters on the fire resistance of floor assemblies are presented. The following is a summary of the experiments results:

1. For a floor assembly with either solid wood joists or wood I-joists or steel C-joists or parallel-chord wood trusses spaced at 406 mm o.c. and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of Canadian softwood plywood (CSP) sub-floor (15.5 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the effect of frame type is insignificant.
2. For a floor assembly with two layers of Type X gypsum board (12.7 mm thick each), solid wood joists (89 mm wide and 235 mm deep) or steel C-joists (203 mm deep) spaced at 406 mm o.c. and resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, an assembly with solid wood joists provided 8% more fire resistance than an assembly with steel C-joists.
3. For a floor assembly with one layer of Type X gypsum board (15.9 mm thick), either steel C-joists (203 mm deep) or solid wood joists (235 mm deep) spaced at 406 mm o.c. and resilient channels spaced at 406 mm o.c., two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) and rock fibre insulation (89 mm thick) in the floor cavity, an assembly with solid wood joists provided 9% more fire resistance than an assembly with steel C-joists.
4. In a floor assembly with either solid wood joist (89 mm wide and 235 mm deep) or steel C-joists (203 mm deep) spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), two layers of softwood plywood (CSP) (15.5 mm thick each), resilient channels spaced at 406 mm o.c., an assembly with steel C-joist provided 17% more fire resistance than an assembly with solid wood joist and that is in part due to the larger thickness of the cellulose fibre insulation in the assembly with steel C-joists than in the assembly with solid wood joists.
5. For a floor assembly with either solid wood joists (89 mm wide and 235 mm deep) or wood I-joists (38 mm wide flanges and 241 mm deep) or wood trusses (89 mm wide and 305 mm deep) or steel C-joists (203 mm deep) spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) directly applied to the framing, one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and neither resilient channels nor insulation in the floor cavity, the maximum difference in fire resistance among the four floor frames is 6 min 7s.
6. For a floor assembly with either solid wood joists (89 mm wide and 235 mm deep) or wood I-joists (241 mm deep) or parallel-chord wood trusses (89 mm wide and 305 mm deep) or steel C-joists (203 mm deep) spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and no insulation in the floor cavity, the effect of frame type on the fire resistance is insignificant.
7. For a floor assembly with solid wood joists (89 mm wide) and resilient channels spaced 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the effect of solid wood joist depth (184 mm vs 235 mm) on the fire resistance is insignificant.
8. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep), two layers of Type X gypsum board (12.7 mm thick each), resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick in assembly with joists spaced at 406 mm o.c. and 19 mm thick for joists spaced at 610 mm o.c.) and glass fibre insulation (89 mm thick) in the floor cavity, the effect of solid wood joists spacing, 406 mm o.c. vs 610 mm o.c., on the fire resistance is insignificant.
9. For a floor assembly with wood trusses (89 mm wide and 305 mm deep), two layers of Type X gypsum board (12.7 mm thick each) directly applied to parallel-chord wood trusses, with no insulation in the floor cavity and one layer of softwood plywood (CSP)

sub-floor (15.5 mm thick in assembly with trusses spaced at 406 mm o.c. and 19 mm thick for trusses spaced at 610 mm o.c.), the effect of wood truss spacing, 406 mm o.c. vs 610 mm o.c., on the fire resistance, unlike in the case for wood truss assemblies with resilient channels, is significant.

10. For a floor assembly with wood trusses (89 mm wide and 305 mm deep), two layers of Type X gypsum board (12.7 mm thick each), resilient channels spaced at 406 mm o.c., glass fibre insulation (89 mm thick) in the floor cavity and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick in assembly with trusses spaced at 406 mm o.c. and 19 mm thick for trusses spaced at 610 mm o.c.), the effect of wood truss spacing, 406 mm o.c. vs 610 mm o.c., on the fire resistance is insignificant.
11. For a floor assembly with steel C-joists (203 mm deep), two layers of Type X gypsum board (12.7 mm thick each), directly applied to steel C-joists with no insulation in the floor cavity and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), the effect of joist spacing, 406 mm o.c. vs 610 mm o.c., on the fire resistance is significant.
12. For a floor assembly with wood trusses (305 mm deep) of either nominal 4x2 (89 mm x 38 mm) or 3x2 (64 mm x 38 mm) components, and resilient channels spaced at 406 mm o.c., glass fibre insulation (89 mm thick) in the floor cavity, one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), the effect of wood truss size, nominal 4x2 (89 mm x 38 mm) vs 3x2 (64 mm x 38 mm), on the fire resistance is insignificant.
13. For a floor assembly with wood trusses (305 mm and 406 mm deep), two layers of Type X gypsum board (12.7 mm thick each), no insulation in the floor cavity, one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and wood trusses and resilient channels spaced at 406 mm o.c., the assembly with parallel-chord wood truss with chord and web members oriented horizontally (flat) provided 6% more fire resistance than an assembly where the chord and web members of the wood trusses were oriented vertically (on edge).
14. For a floor assembly with wood trusses (286 mm deep for metal-web and 330 mm deep for metal-plate-connected with wood-web) and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) glass fibre insulation (89 mm thick) in the floor cavity and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), the effect of web type for parallel-chord wood trusses of either metal-web connected metal webs or metal-plate-connected wood-web on the fire resistance is insignificant.
15. For a floor assembly with wood trusses (305 mm deep for metal-plate-connection and 330 mm deep for glued-finger-connection) spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), and resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the effect of parallel-chord wood truss connection type (metal-plate-connection vs glued-finger-connection) on the fire resistance is insignificant.
16. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), the effect of insulation type (rock fibre vs glass fibre insulation, 89 mm thick) on the fire resistance is significant.
17. For a floor assembly with wood I-joists (58 mm wide flanges and 241 mm deep) spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) and resilient channels spaced at 305 mm o.c., the effect of insulation type (cellulose fibre insulation dry blown above steel mesh vs rock fibre insulation, full cavity) on the fire resistance is significant.
18. For a floor assembly with wood trusses (89 mm wide and 305 mm deep) and resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick) and

one layer of softwood plywood (CSP) sub-floor (19 mm thick), the effect of insulation type (cellulose fibre insulation sprayed with water on the wood truss members and on the underside of the sub-floor vs glass fibre or rock fibre insulation) on the fire resistance is significant.

19. For a floor assembly with steel C-joists (203 mm deep) and resilient channels spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick) and two layers of softwood plywood sub-floor (15.5 mm thick each), the installation of either rock fibre insulation (178 mm thick) or cellulose fibre insulation sprayed with water (91 mm thick on the sub-floor underside and 112 mm thick on the joist sides) increased the fire resistance by 36% and 64%, respectively, compared to a similar assembly with no insulation in the floor cavity.
20. For a floor assembly with steel C-joists (203 mm deep) and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) and a concrete topping (51 mm thick) above a steel deck, the effect of insulation type (rock fibre vs glass fibre insulation, 89 mm thick) on the fire resistance is insignificant.
21. For a floor assembly with steel C- joists (203 mm deep) and resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) and one layer of softwood plywood (CSP) sub-floor (19 mm thick), the effect of insulation type (cellulose fibre insulation sprayed with adhesive vs glass fibre insulation, 89 mm thick) on the fire resistance is significant.
22. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), the effect of glass fibre insulation (89 mm thick) installation compared to a non insulated assembly on the fire resistance is insignificant.
23. For a floor assembly with wood trusses (89 mm wide and 305 mm deep) and resilient channels spaced 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), the installation of glass fibre insulation (89 mm thick) reduced the fire resistance by 6% compared to an assembly with no insulation in the floor cavity.
24. For a floor assembly with steel C-joists (203 mm thick) and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) and concrete topping (51 mm thick) on a steel deck, the installation of rock fibre insulation (89 mm thick) reduced the fire resistance by 7% compared to an assembly with no insulation in the floor cavity.
25. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) spaced at 406 mm o.c. and resilient channels spaced at 203 mm o.c., one layer of Type X gypsum board (15.9 mm thick) and one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), the installation of a steel mesh below the rock fibre insulation batts did not increase the fire resistance.
26. For a floor assembly with steel C-joists (203 mm deep) and resilient channels spaced at 406 mm o.c., glass fibre insulation (89 mm thick), two layers of Type X gypsum board (12.7 mm thick each) and concrete topping (51 mm thick) above a steel deck, the assembly with a steel deck had a 14% higher fire resistance than an assembly with one layer of softwood plywood (CSP) sub-floor.
27. In a floor assembly with solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (19 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the installation of an additional sub-floor layer slightly improved the fire resistance.

28. The installation of an additional Type X gypsum board layer (15.9 mm thick) to a floor assembly constructed with wood I-joists spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), resilient channels spaced at 305 mm o.c., two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each), floor cavity filled with rock fibre insulation, increased the fire resistance by 50%.
29. The installation of an additional Type X gypsum board layer (12.7 mm thick) in a floor assembly constructed with one layer of Type X gypsum board (12.7 mm thick), steel C-joist (203 deep) spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and resilient channels spaced at 406 mm o.c., increased the fire resistance by 90% compared to an assembly with two layers of sub-floor (15.5 mm thick each) and one layer of Type X gypsum board (12.7 mm thick). These results clearly indicate that it is much more beneficial for the fire resistance of a floor assembly with steel C-joists to use two layers of gypsum board and one layer of sub-floor than to use two layers of plywood sub-flooring and one layer of gypsum board.
30. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), the application of Gyp-Crete topping (25 mm thick) above the softwood plywood (CSP) sub-floor (15.5 mm thick) slightly improved the fire resistance compared to a similar assembly with no topping.
31. For a floor assembly with wood I-joists (241 mm deep) and resilient channels spaced at 406 mm o.c., 38 mm by 38 mm laminated veneer lumber (LVL) flanges with glass fibre insulation (89 mm thick), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), adding a concrete topping increased the fire resistance slightly (5%) compared to a similar assembly with no concrete topping.
32. For a floor assembly with wood trusses (305 mm deep) spaced at 406 mm o.c., glass fibre insulation (89 mm thick), resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), adding concrete topping (38 mm thick) increased the fire resistance by 7% compared to a similar assembly with no concrete topping.
33. For a floor assembly with wood trusses (89 mm wide and 305 mm deep) spaced at 610 mm o.c., with glass fibre insulation (89 mm thick), resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick) and two layers of Type X gypsum board (12.7 mm thick each), adding concrete topping (51 mm thick) increased the fire resistance by 11% compared to a similar assembly with no concrete topping.
34. For a floor assembly with steel C-joists (203 mm deep) spaced at 610 mm o.c., neither resilient channels nor insulation in the floor cavity, two layers of Type X gypsum board (12.7 mm thick each), replacing a 19 mm thick softwood plywood (CSP) sub-floor with concrete topping (51 mm thick) on a steel deck increased the fire resistance by 20%.
35. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and no insulation in the floor cavity, the effect of resilient channel installation, at 406 mm o.c., did not impact the fire resistance significantly compared to a similar assembly with no resilient channels.
36. For a floor assembly with wood trusses (89 mm wide and 305 mm deep) spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and no insulation in the floor cavity, the installation of resilient channels spaced at 406 mm o.c. increased the fire resistance by 13% compared to a similar assembly with no resilient channels.

37. For a floor assembly with steel C-joists (203 mm deep) spaced at 406 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and no insulation in the floor cavity, the installation of resilient channels at 406 mm o.c. increased the fire resistance by 12% compared to a similar floor assembly with no resilient channels.
38. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) spaced at 406 mm o.c., no insulation in the floor cavity, one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and one layer of Type X gypsum board (12.7 mm thick), the effect of resilient channel spacing, 406 mm o.c. vs 203 mm o.c., on the fire resistance is insignificant.
39. For a floor assembly with wood trusses (89 mm wide and 305 mm deep) spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (19 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the fire resistance was reduced by 20% with the increase of the resilient channel spacing from 406 mm o.c. to 610 mm o.c.
40. For a floor assembly with steel C-joists (203 mm deep) spaced at 406 mm o.c. and two layers of Type X gypsum board (12.7 mm thick each), concrete topping (51 mm thick) above a steel deck and glass fibre insulation (89 mm thick) in the floor cavity, the increase in the resilient channel spacing from 406 mm o.c. to 610 mm o.c. reduced the fire resistance by 10%.
41. For a floor assembly with steel C-joists (203 mm deep) spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each), one layer of softwood plywood (CSP) sub-floor (19 mm thick) and glass fibre insulation (89 mm thick) in the floor cavity, the effect of increasing the resilient channel spacing (406 mm o.c. vs 610 mm o.c.) on fire resistance is significant (24%).
42. For a floor assembly with solid wood joists (89 mm wide and 235 mm deep) and resilient channels spaced at 406 mm o.c., one layer of softwood plywood (CSP) sub-floor (15.5 mm thick), one layer of Type X gypsum board (12.7 mm thick) and no insulation in the floor cavity, the fire resistance decreased by 7% with an increase of structural load from 75% to 100% design load.
43. For two identical floor assemblies with wood trusses (89 mm wide and 305 mm deep) and resilient channels spaced at 610 mm o.c., one layer of softwood plywood (CSP) sub-floor (19 mm thick), two layers of Type X gypsum board (12.7 mm thick each) and glass fibre insulation (89 mm thick) in the floor cavity, the difference in fire resistance was approximately 2 minutes (3.7%).
44. A floor assembly with wood I-joists (38 mm thick by 44 mm wide flanges and 241 mm deep) and resilient channels spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), one layer of OSB sub-floor (15.5 mm thick) and rock fibre insulation (178 mm thick) in the floor cavity provided 39 min 31 s fire resistance.
45. A floor assembly with wood I-joists (38 mm thick by 65 mm wide and 241 mm deep) spaced at 610 mm o.c., resilient channels spaced at 305 mm o.c., one layer of Type X gypsum board (15.9 mm thick), two layers of OSB sub-floor (15.5 mm thick each) and rock fibre insulation (89 mm thick) in the floor cavity provided 50 min 17 s fire resistance.
46. An assembly with wood joists (89 mm wide by 235 mm deep) spaced at 406 mm o.c., resilient channels spaced at 610 mm o.c., two layers of Type X gypsum board (12.7 mm thick each) one layer of softwood plywood (CSP) sub-floor (15.5 mm thick) and dry blown cellulose fibre insulation full cavity above steel mesh, provided 87 min 20 s fire resistance.
47. A floor assembly with steel C-joists (203 mm deep) spaced at 610 mm o.c., resilient channels spaced at 406 mm o.c., one layer of Type X gypsum board (15.9 mm thick), steel deck with concrete topping (51 mm thick) and wet sprayed cellulose fibre insulation (38

mm thick on the underside of steel deck and 89 mm thick on the sides of steel C-joists), provided 56 min 20 s fire resistance.

48. An assembly with wood trusses (89 mm wide and 305 mm deep) spaced at 406 mm o.c., resilient channels spaced at 406 mm o.c., two layers of Type X gypsum board (15.9 mm thick each), two layers of softwood plywood (CSP) sub-floor (15.5 mm thick each) and dry-blown cellulose fibre insulation filling the floor cavity above steel mesh, provided 99 min 14 s fire resistance.

10.0 REFERENCES

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Table 1: Parameters and Results for Test Assemblies FF-30 to FF-82

Assembly Number	Test Date	Joist			Ceiling Finish			Sub-Floor			Cavity Insulation			Resilient Channels		Load	Load	Fire Resistance	Mode of Failure
		Type	Depth (mm)	Spacing (mm)	Type	Thickness (mm)	Layers	Type	Thickness (mm)	Layers	Type	Thickness (mm)	Location	Orientation	Spacing (mm)	(lb/ft^2)	(N/m^2)	(min,s)	
FF-30	06/04/2000	*WJ*	235	406	*X*	12.7	1	*Ply*	15.5	1	***	***	***	*Per*	406	107	5123	40,49	*Struct*
FF-31	09/05/2000	*WJ*	235	406	*X*	12.7	2	*Ply*	15.5	1	***	***	***	***	***	105	5027	67,10	*Struct*
FF-32	19/05/2000	*WJ*	184	406	*X*	12.7	2	*Ply*	15.5	1	*G1*	89	*B*	*Per*	406	69	3304	67,15	*Struct*
FF-33	01/06/2000	*WJ*	235	406	*X*	12.7	1	*Ply*	15.5	1	***	***	***	*Per*	203	107	5123	39,55	*Struct*
FF-34	07/07/2000	*WJ*	235	406	*X*	15.9	1	*Ply*	15.5	1	*R1*	89	*B*	*Per*	203	106	5075	54,11	*Struct*
FF-35	25/08/2000	*WJ*	235	406	*X*	12.7	2	*Ply/GC*	15.5/25.4	- - -	*G1*	89	*B*	*Per*	406	97	4644	68,27	*Struct*
FF-36	04/10/2000	*WJ*	235	406	*X*	15.9	1	*Ply*	15.5	2	*R1*	178	*B*	*Per*	406	104	4980	58,49	*Struct*
FF-37	03/11/2000	*SJ*	203	406	*X*	15.9	1	*Ply*	15.5	2	***	***	***	*Per*	406	70.3	3366	38,49	*Struct*
FF-38	15/11/2000	*SJ*	203	406	*X*	15.9	1	*Ply*	15.5	2	*R1*	178	*B*	*Per*	406	69.3	3318	53,38	*Struct*
FF-39	22/02/2001	*SJ*	203	406	*X*	15.9	1	*Ply*	15.5	2	*C1*	$73^{\alpha}/90^{\beta}$	*T*	*Per*	406	68.6	3285	----	----
FF-40	08/03/2001	*SJ*	203	406	*X*	12.7	2	*St/Con*	*51.0	- - -	***	***	***	*Per*	406	49.1	2351	75	*Struct*
FF-41	13/03/2001	*WT*[1]	305	406	*X*	12.7	2	*Ply*	15.5	1	***	***	***	*Per*	406	117	5602	69,01	*Struct*
FF-42	15/03/2001	*WT*[1]	305	406	*X*	12.7	2	*Ply*	15.5	1	*G1*	89	*B*	*Per*	406	117	5602	65,41	*Struct*
FF-43	05/06/2001	*SJ*	203	406	*X*	12.7	2	*St/Con*	*51.0	- - -	*G1*	89	*B*	*Per*	406	48.9	2341	68,25	*Struct*
FF-44	13/07/2001	*SJ*	203	406	*X*	12.7	2	*St/Con*	*51.0	- - -	*G1*	89	*B*	*Per*	610	48.9	2341	61,00	*Struct*
FF-45	31/05/2001	*WIJ*[1]	241	406	*X*	15.9	1	*OSB*	15.5	1	*R1*	178	*B*	*Per*	406	111	5315	39,31	*Struct*
FF-46	11/07/2001	*WT*[2]	305	406	*X*	12.7	2	*Ply*	15.5	1	*G1*	89	*B*	*Per*	406	88	4213	67,36	*Struct*
FF-47	28/08/2001	*WT*[1]	305	406	*X*	12.7	2	*Ply/Con*	15.5/38	- - -	*G1*	89	*B*	*Per*	406	107	5123	72,00	*Struct*
FF-48	28/06/2001	*WT*[1]	305	610	*X*	12.7	2	*Ply*	15.5	1	*G1*	89	*B*	*Per*	406	79	3783	68,18	*Struct*
FF-49	10/09/2001	*WJ*	235	406	*X*	15.9	1	*Ply*	15.5	2	*C1*	$55^{\alpha}/79^{\beta}$	*T*	*Per*	406	104	4980	54,13	*Struct*
FF-50	26/10/2001	*SJ*	203	406	*X*	15.9	1	*Ply*	15.5	2	*C1*	$91^{\alpha}/112^{\beta}$	*T*	*Per*	406	68.6	3285	63,47	*Struct*
FF-51	30/10/2001	*SJ*	203	406	*X*	12.7	2	*Ply*	15.5	1	***	***	***	***	***	69.8	3342	66,55	*Flame*
FF-52	14/11/2001	*SJ*	203	610	*X*	12.7	2	*Ply*	19	1	*G1*	89	*B*	*Per*	610	43.8	2097	52,30	*Struct*
FF-53	15/1/2002	*SJ*	203	406	*X*	12.7	2	*St/Con*	*51.0	- - -	*R1*	89	*B*	*Per*	406	48.9	0	70,00	*Struct*
FF-54	16/5/2002	*SJ*	203	610	*X*	12.7	2	*St/Con*	*51.0	- - -	***	***	***	***	***	23.6	0	66,00	*Struct*
FF-55	02/07/2002	*WIJ*[2]	241	610	*X*	12.7	2	*OSB*	19	1	*G1*	89	*B*	*Per*	406	72	3447	60,59	*Struct*
FF-56	13/5/2002	*WT*[3]	406	406	*X*	12.7	2	*Ply*	15.5	1	***	***	***	*Per*	406	118	5650	65,05	*Struct*
FF-57	03/07/2002	*WIJ*[3]	241	610	*X*	15.9	1	*OSB*	15.5	2	*R1*	89	*B*	*Per*	305	86	4118	50,17	*Struct*
FF-58	06/05/2002	*WT*[4]	330	406	*X*	12.7	2	*Ply*	15.5	1	*G1*	89	*B*	*Per*	406	143	6847	63,37	*Struct*
FF-59	29/11/2001	*WT*[1]	305	610	*X*	12.7	2	*Ply*	19	1	*G1*	89	*B*	*Per*	610	79	3783	54,35	*Struct*
FF-60	01/08/2002	*WT*[1]	305	406	*X*	12.7	2	*Ply*	15.5	1	***	***	***	***	***	117	5602	61,03	*Struct*

FF-39 (Malfunction in Data Acquisition System)
FF-50 (Repeat of Test No. FF-39)

Table 1: Parameters and Results for Test Assemblies FF-30 to FF-82

Assembly Number	Test Date	Joist			Ceiling Finish			Sub-Floor			Cavity Insulation			Resilient Channels		Load	Load	Fire	Mode
		Type	Depth (mm)	Spacing (mm)	Type	Thickness (mm)	Layers	Type	Thickness (mm)	Layers	Type	Thickness (mm)	Location	Orientation	Spacing (mm)	(lb/ft^2)	(N/m^2)	Resistance (min,s)	of Failure
FF-61	20/3/2002	*WIJ^{2}*	241	406	*X*	12.7	2	*Ply/Con*	15.5/38	- - -	*G1*	89	*B*	*Per*	406	96	4596	66,58	*Struct*
FF-62	18/4/2002	*SJ*	203	610	*X*	12.7	2	*Ply*	19	1	***	***	***	***	***	44.33	2123	54,59	*Struct*
FF-63	14/1/2003	*WT^{5}*	286	406	*X*	12.7	2	*Ply*	15.5	1	*G1*	89	*B*	*Per*	406	74	3543	64,04	*Struct*
FF-64	16/04/2003	*WJ*	235	610	*X*	12.7	2	*Ply*	19	1	***	***	***	*Per*	610	68	3256	58,55	*Struct*
FF-65	27/01/2004	*SJ*	203	610	*X*	12.7	2	*Ply*	19	1	*$C1^{2}$*	$94^{\alpha}/100^{\beta}$	*T*	*Per*	610	43.7	2092	68,55	*Struct*
FF-66	24/03/2004	*WJ*	235	406	*X*	15.9	1	*Ply*	15.5	1	*R1*	89	*B*	*Per*	406	109	5219	50,24	*Struct*
FF-67	30/8/2002	*WJ*	235	610	*X*	12.7	2	*Ply*	19	1	*G1*	89	*B*	*Per*	610	68	3256	57,05	*Struct*
FF-68	16/8/2002	*WJ*	235	406	*X*	12.7	2	*Ply*	15.5	1	*G1*	89	*B*	*Per*	610	105	5027	57,27	*Flame*
FF-69	10/08/2002	*WJ*	235	610	*X*	12.7	2	*Ply*	19	1	*R1*	89	*B*	*Per*	610	68	3256	63,33	*Struct*
FF-70	22/11/2002	*WJ*	235	406	*X*	12.7	2	*Ply*	15.5	1	*$C1^{1}$*	235	---	*Per*	610	104	4980	87,20	*Struct*
FF-71	19/6/2002	*WT^{1}*	305	610	*X*	12.7	2	*Ply*	19	1	***	***	***	***	***	79	3783	56,16	*Struct*
FF-72	09/11/2002	*WT^{1}*	305	610	*X*	12.7	2	*Ply*	19	1	*C1*	$66^{\alpha}/64^{\beta}$	*T*	*Per*	610	77	3687	77,12	*Struct*
FF-73	02/05/2003	*WJ*	235	610	*X*	12.7	2	*Ply*	15.5	2	*G1*	89	*B*	*Per*	610	67	3783	58,43	*Struct*
FF-74	04/08/2003	*SJ*	203	610	*X*	15.9	1	*St/Con*	*51.0	- - -	*C1*	$38^{\alpha}/89^{\beta}$	*T*	*Per*	406	24.2	3687	56,20	*Struct*
FF-75	11/07/2003	*WT^{1}*	305	610	*X*	12.7	2	*Ply/Con*	19/38	- - -	*G1*	89	*B*	*Per*	610	60	3208	60,55	*Struct*
FF-76	05/08/2003	*WIJ^{3}*	241	406	*X*	15.9	1	*Ply*	15.5	2	*$C1^{1}$*	241	---	*Per*	305	113	5410	80,19	*Struct*
FF-77	20/3/2003	*WIJ^{2}*	241	406	*X*	12.7	2	*Ply*	15.5	1	***	***	****	***	***	115	5506	64,31	*Struct*
FF-78	27/8/2003	*WIJ^{3}*	241	406	*X*	15.9	1	*Ply*	15.5	2	*R1*	267	*B*	*Per*	305	114	5458	59,38	*Struct*
FF-79	18/9/2003	*WT^{1}*	305	610	*X*	12.7	2	*Ply*	19	1	*G1*	89	*B*	*Per*	610	78	3735	56,24	*Struct*
FF-80	30/10/2003	*WT^{1}*	305	610	*X*	12.7	2	*Ply*	19	1	*R1*	89	*B*	*Per*	610	78	3735	59,34	*Struct*
FF-81	09/03/2003	*WIJ^{3}*	241	406	*X*	15.9	2	*Ply*	15.5	2	*R1*	267	*B*	*Per*	305	112	5363	90,19	*Struct*
FF-82	23/10/2003	*WT^{1}*	305	406	*X*	15.9	2	*Ply*	15.5	2	*$C1^{1}$*	305	---	*Per*	406	121	5793	99,14	*Struct*

Legend:

WJ - Wood Joist
WIJ^{1} - Wood I-Joist 44 mm wide LVL flanges
WIJ^{2} - Wood I-Joist 38 mm wide flanges
WIJ^{3} - Wood I-Joist 58 mm LVL flanges
WT^{1} - Wood Truss 89 wide
WT^{2} - Wood Truss 64 wide
WT^{3} - Wood Truss 38 wide
WT^{4} - Finger Jointed Wood Truss 64 wide
WT^{5} - Metal Web Wood Truss 63 wide
SJ - Steel Joist

Ply - Plywood
Ply/Con - Plywood/Concrete Composite
Ply/GC - Gypsum-Concrete Topping on Plywood Subfloor
St/Con - Steel Deck/Concrete Composite
OSB - Oriented Strandboard
* - depth of concrete only
Struct - Structural

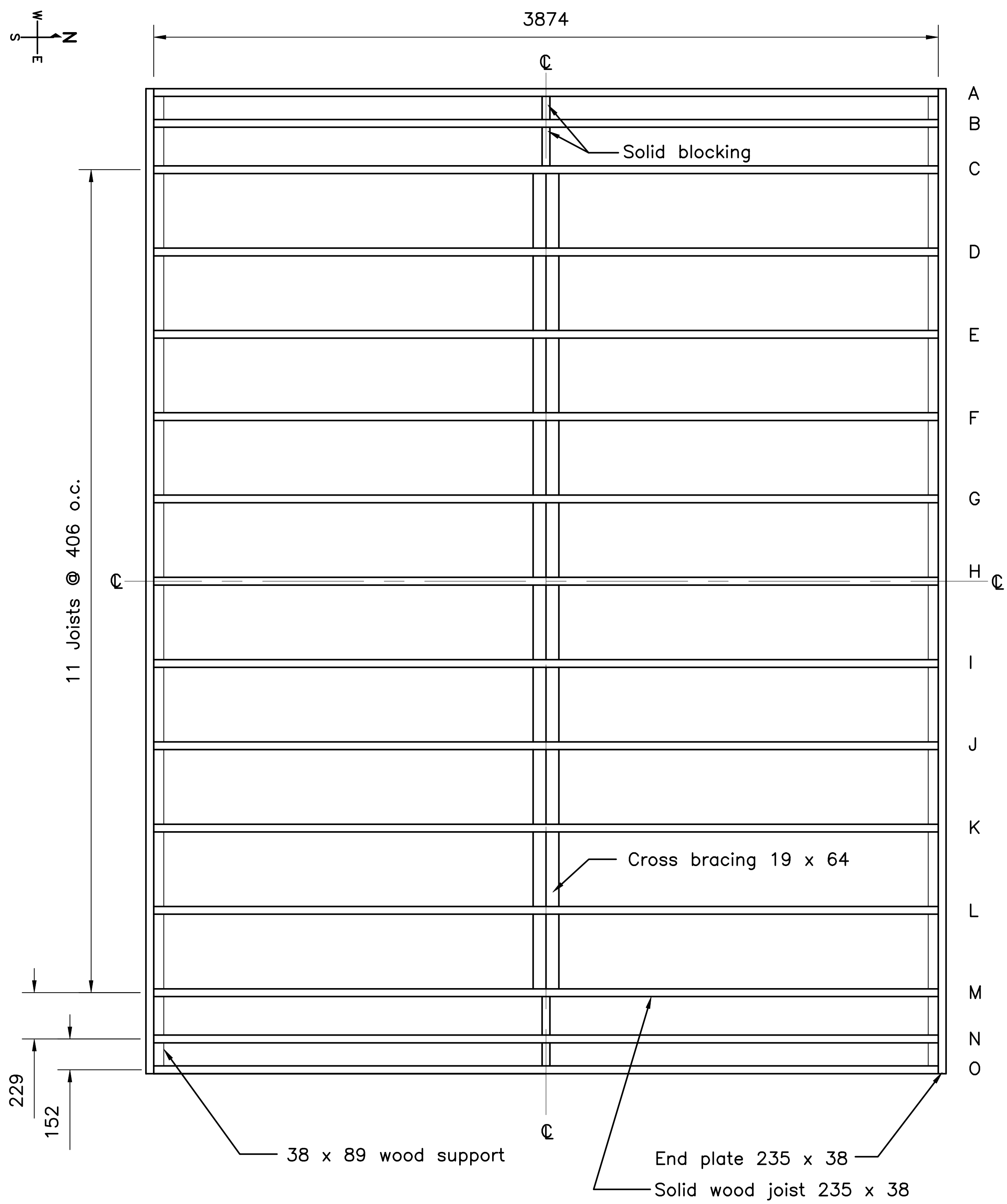
C1 - Cellulosic Fibre Insulation, Wet Sprayed
$C1^{1}$ - Cellulosic Fibre Insulation, Dry Blown
$C1^{2}$ - Cellulosic Fibre Insulation, Wet Sprayed with Adhesive
$^{\alpha}$ Cellulosic Insulation Thickness on Underside of Subfloor
$^{\beta}$ Cellulosic Insulation Thickness on Joist Sides
G1 - Glass Fibre Insulation Batts
R1 - Rock Fibre Insulation Batts
Per - Perpendicular to Joist/Truss

*** - Null Value
B - Bottom
T - Top
X - Type X
LVL- Laminated Veneer Lumber

Note: All WIJ web are made of 9.5 mm thick OSB and all flanges are LVL 38 mm thick

Appendix A

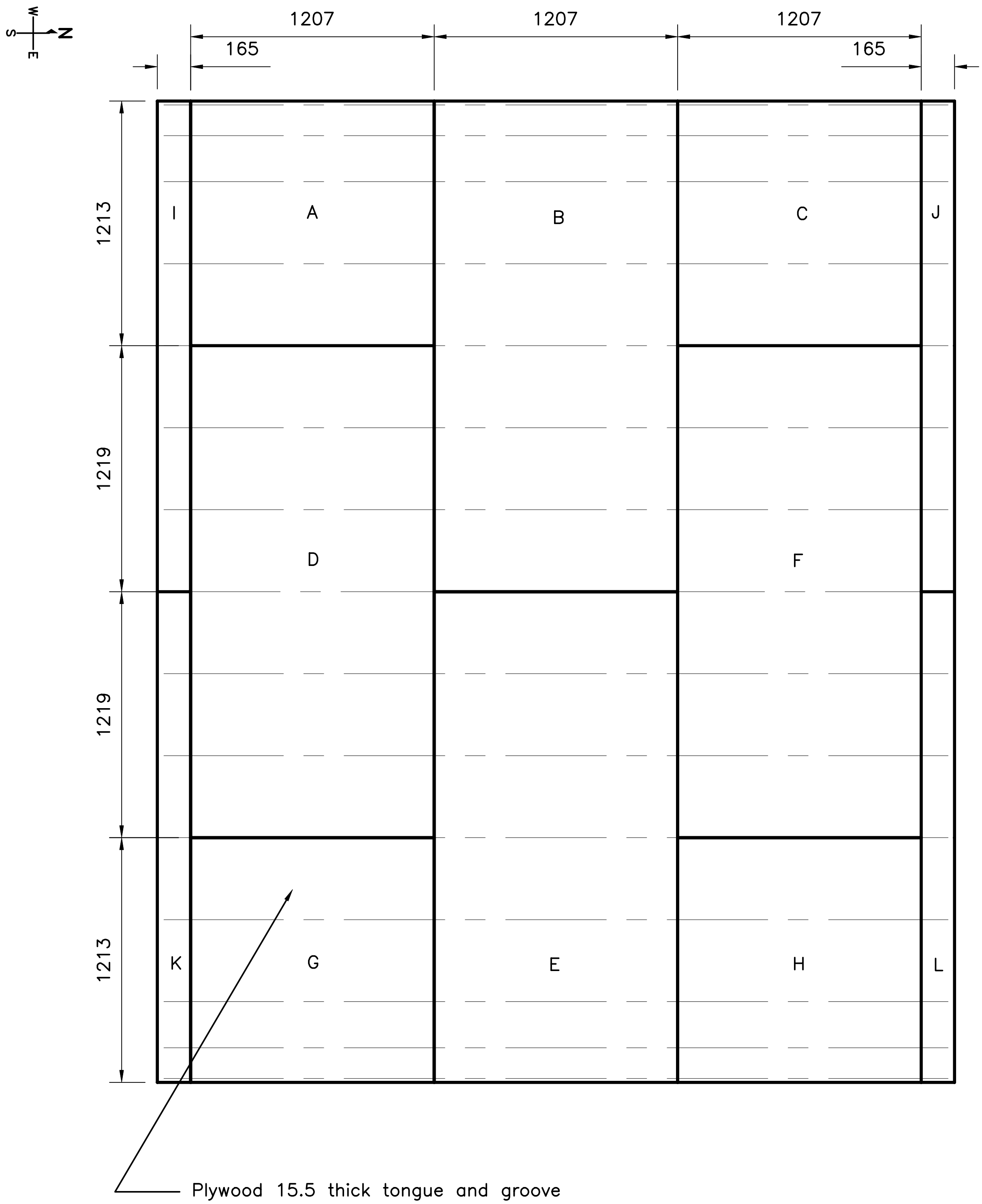
Design details for solid wood joist floor assemblies



(Dimensions are in millimetres)

(Assembly No. FF-30)

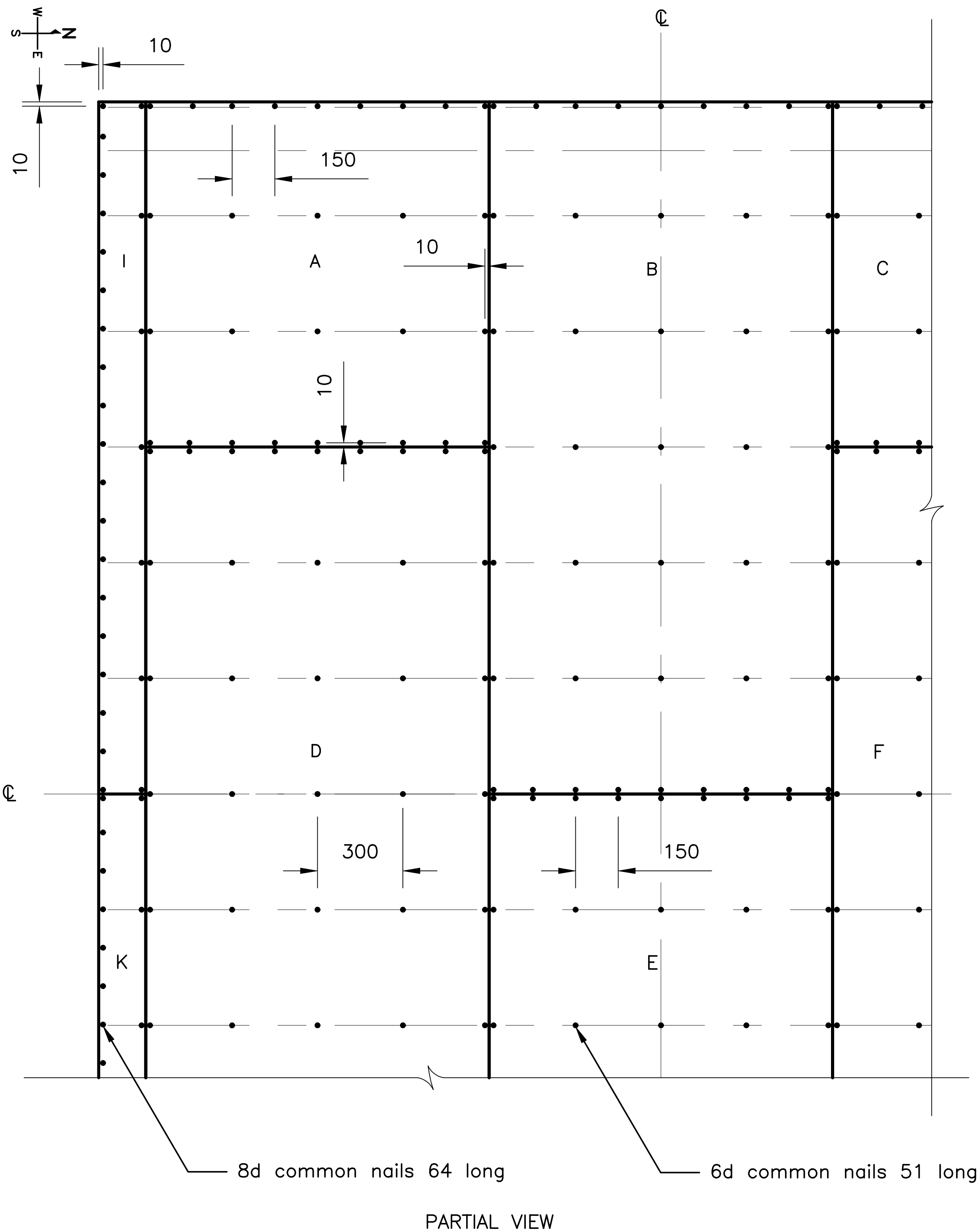
Figure A-1. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–30)

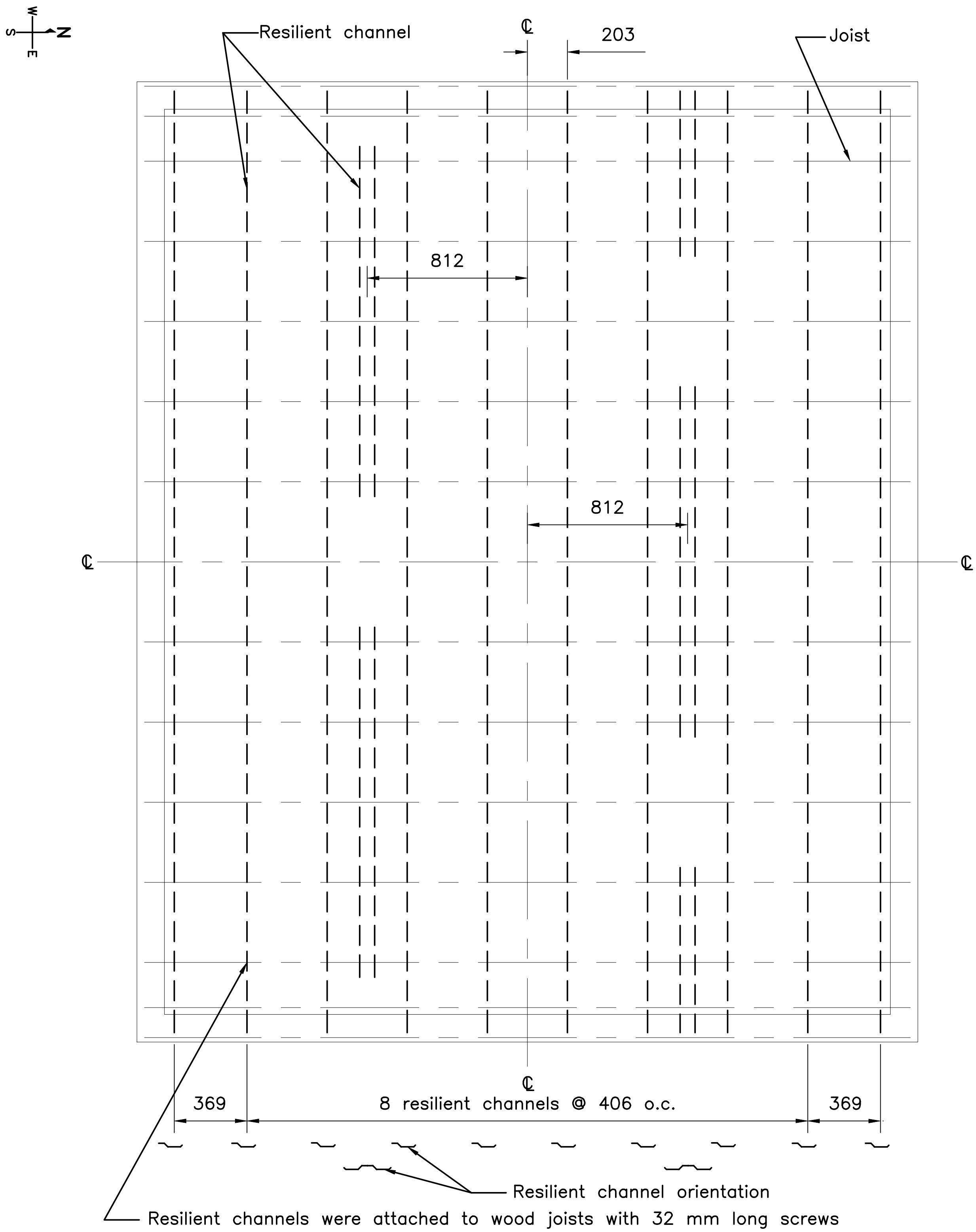
Figure A–2. Subfloor Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–30)

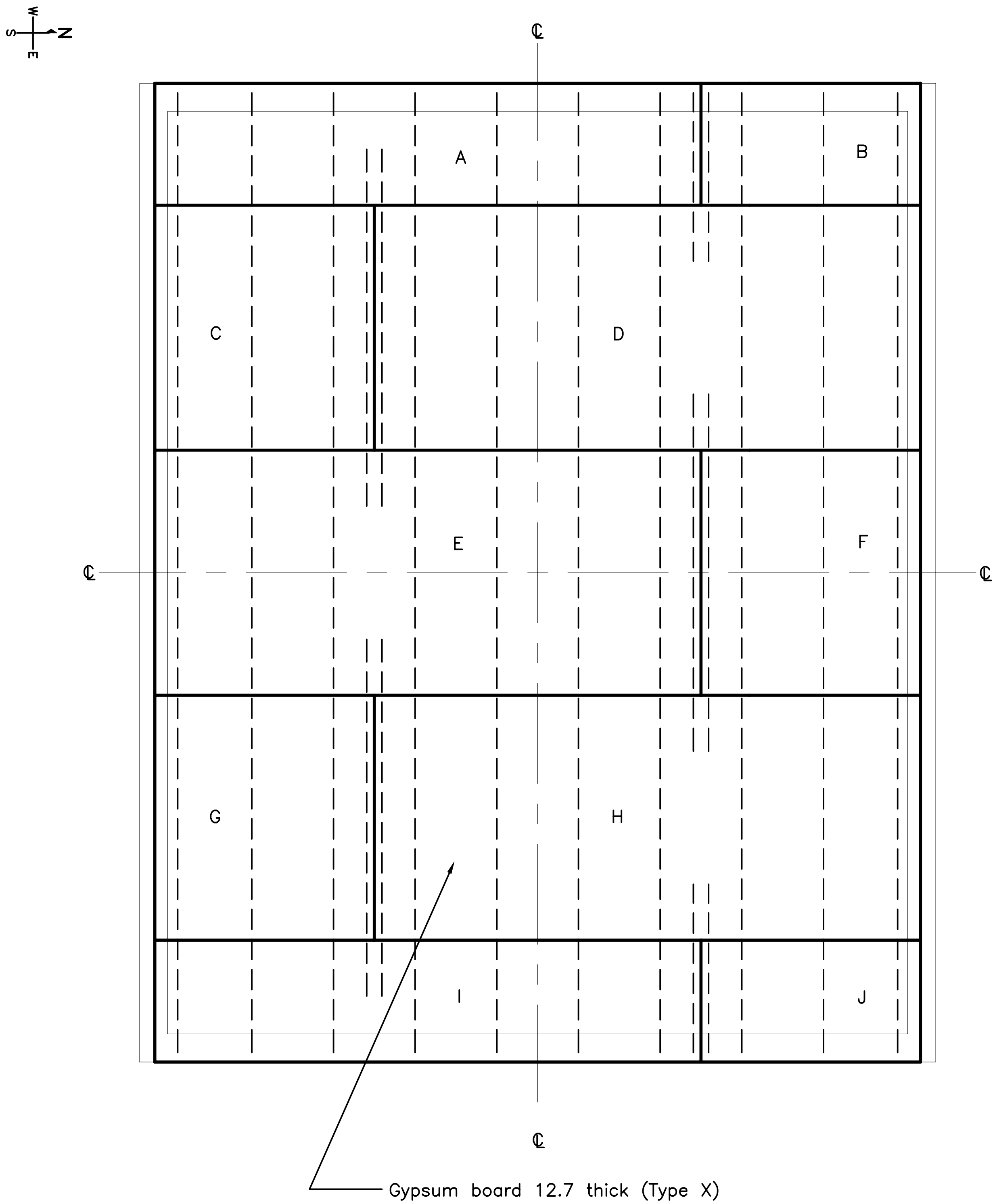
Figure A–3. Subfloor Nail Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–30)

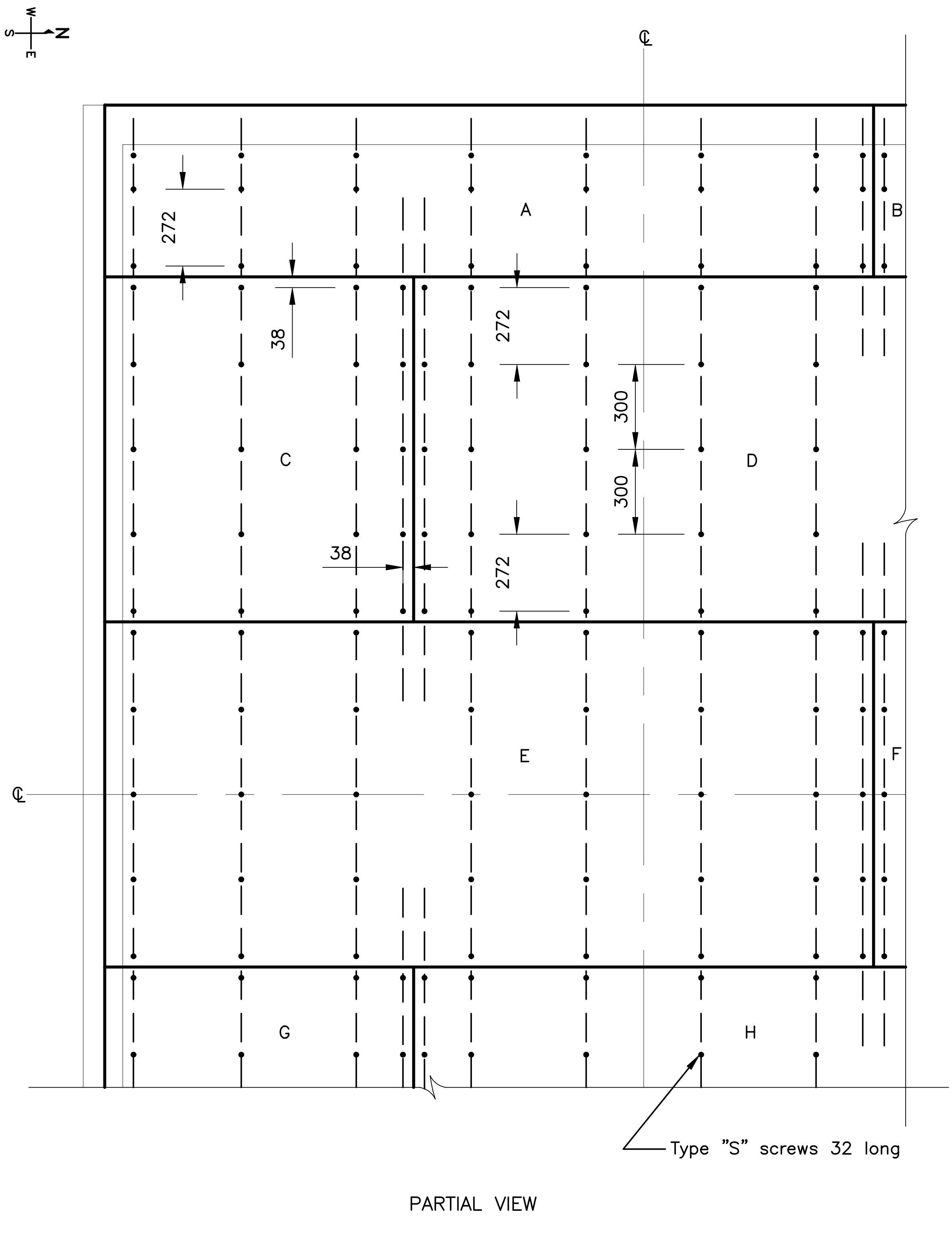
Figure A–4. Resilient Channel Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–30)

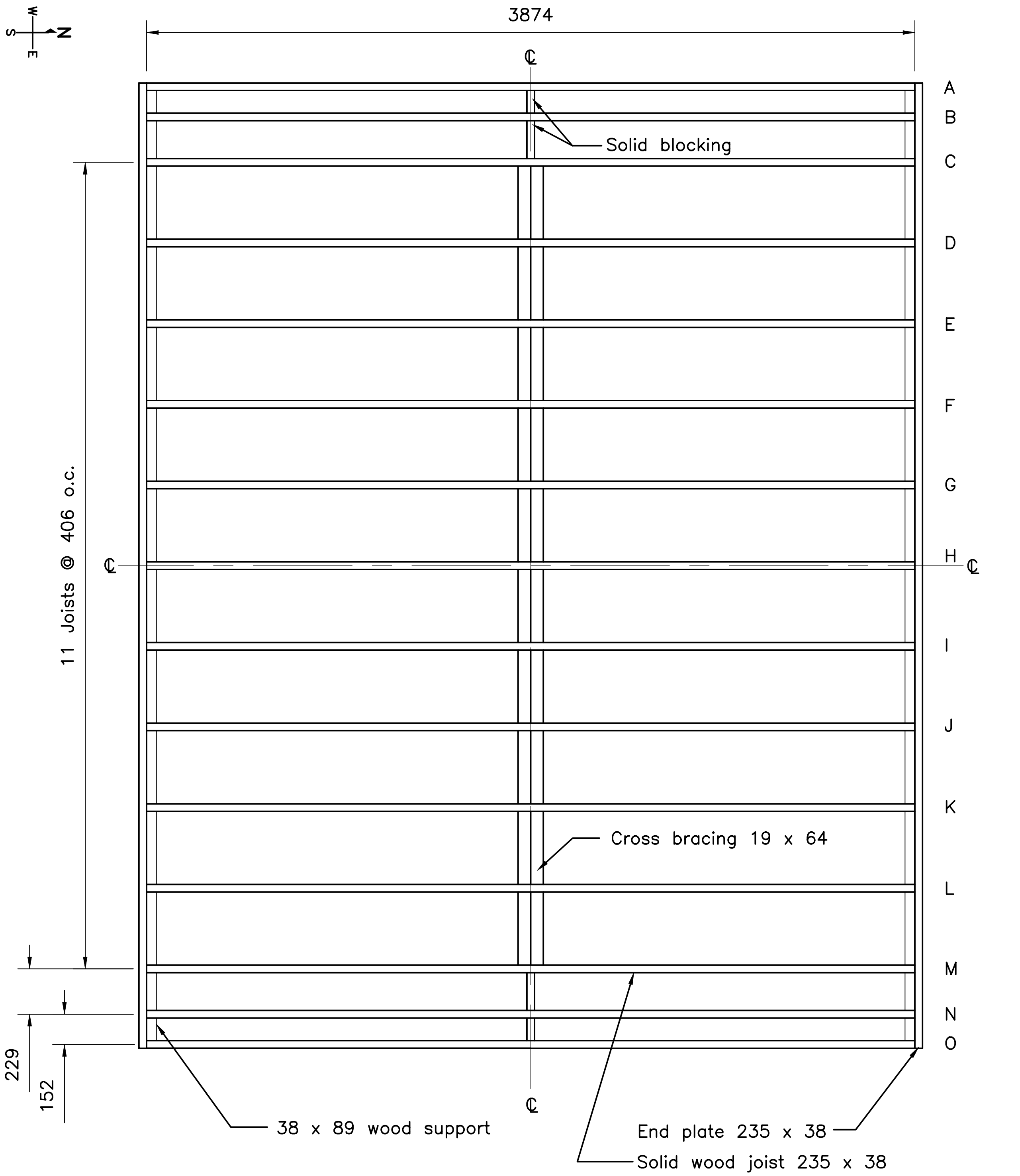
Figure A–5. Gypsum Board Single Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–30)

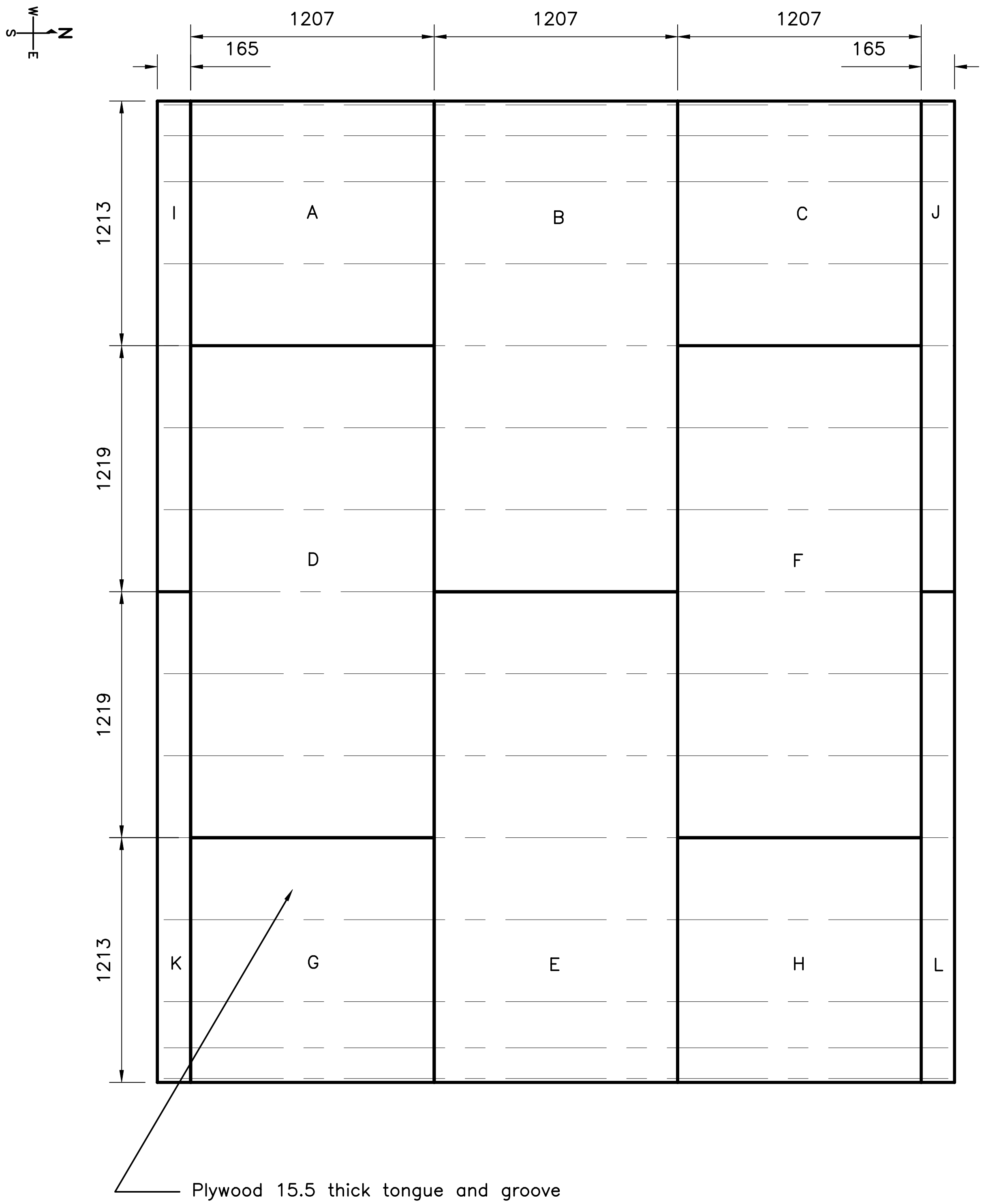
Figure A–6. Gypsum Board Single Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–31)

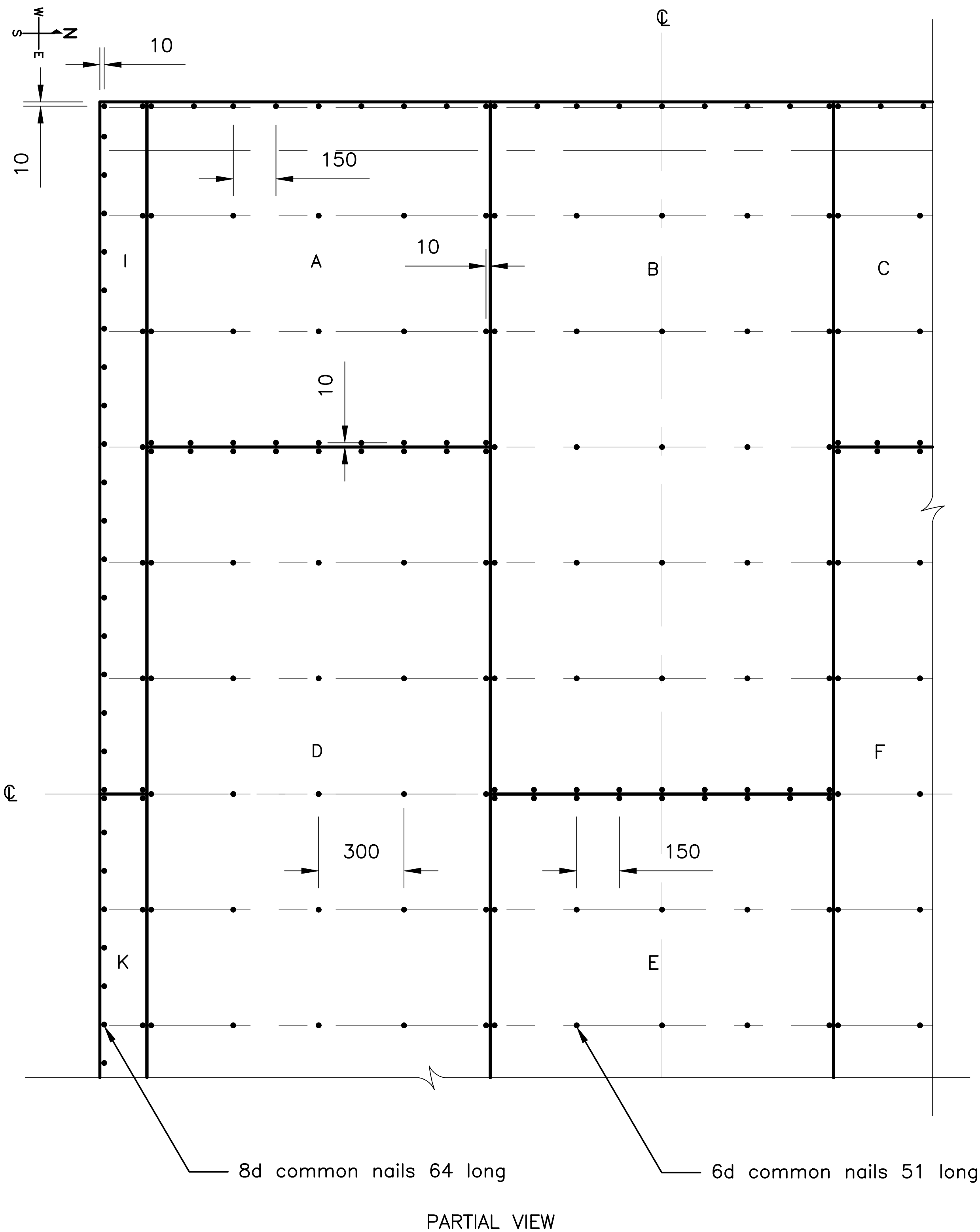
Figure A–7. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–31)

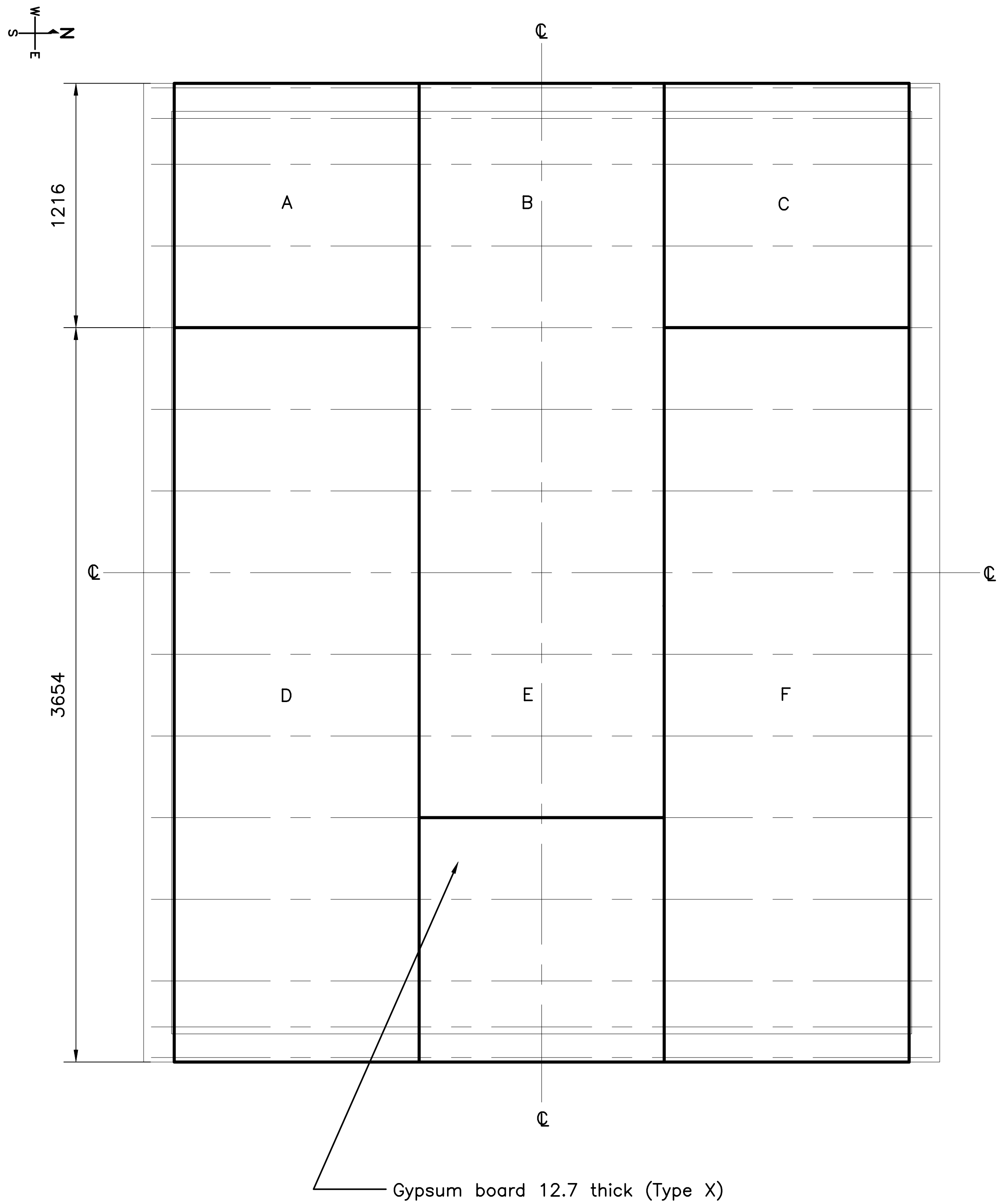
Figure A–8. Subfloor Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–31)

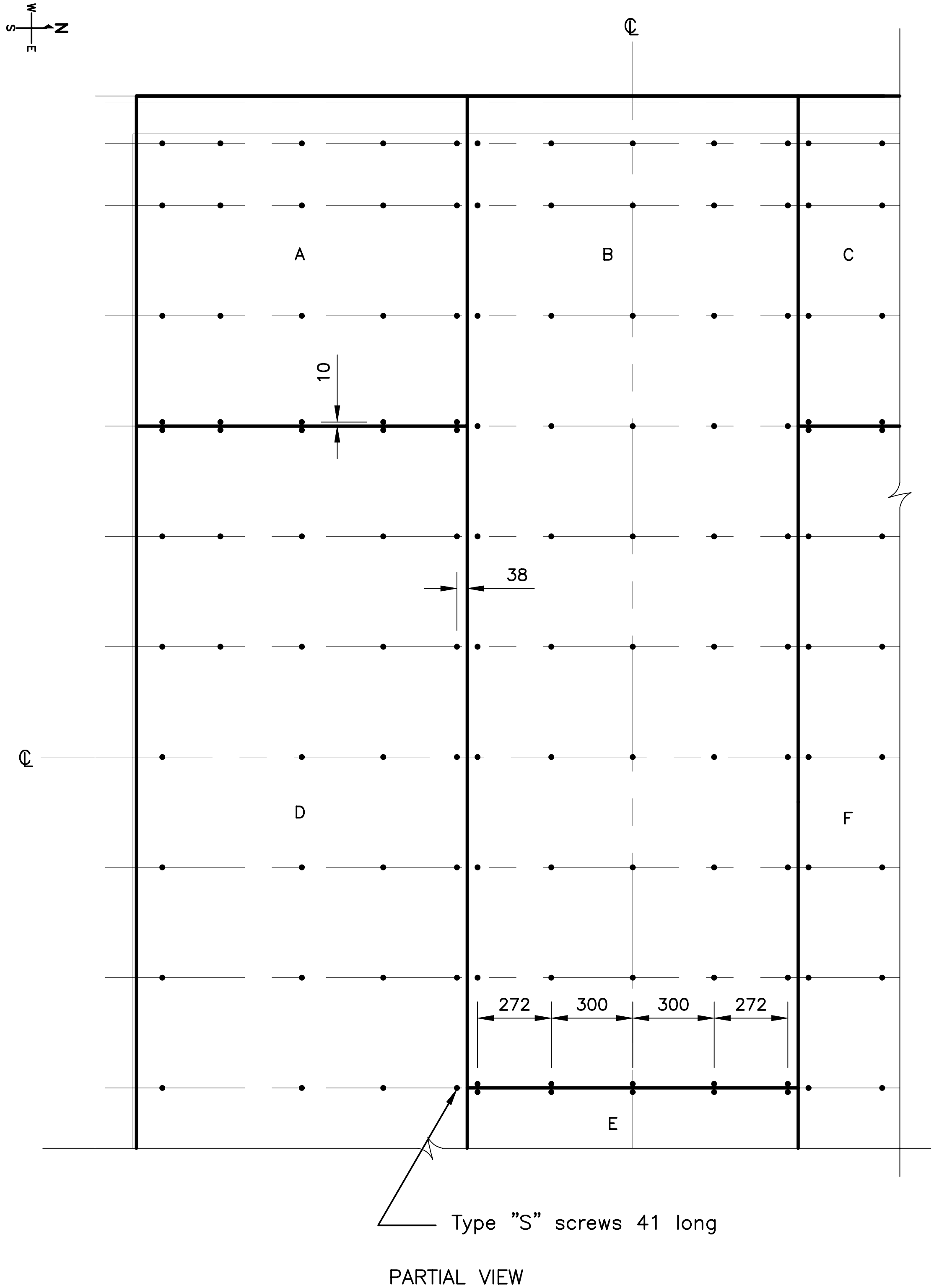
Figure A–9. Subfloor Nail Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–31)

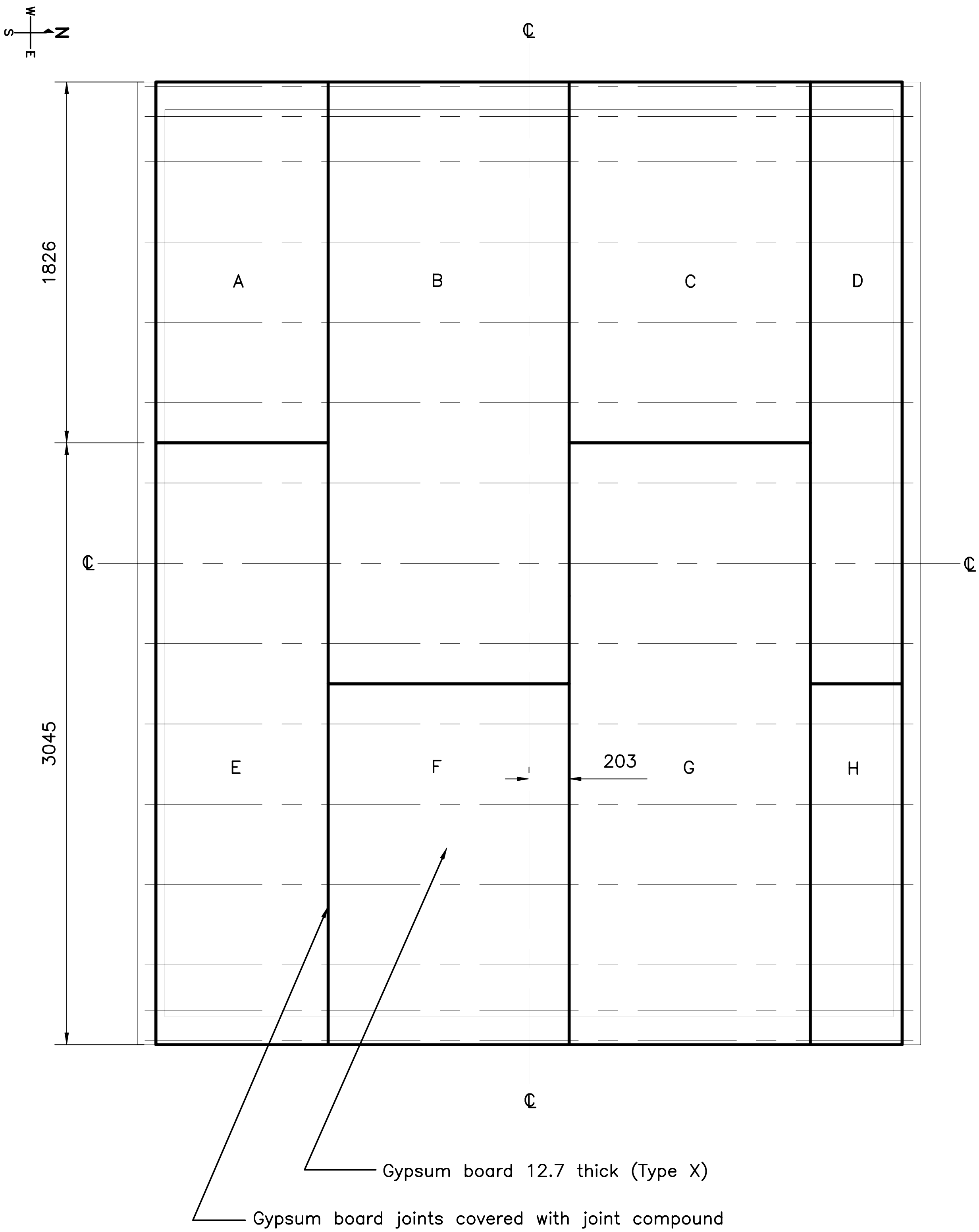
Figure A–10. Gypsum Board Base Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–31)

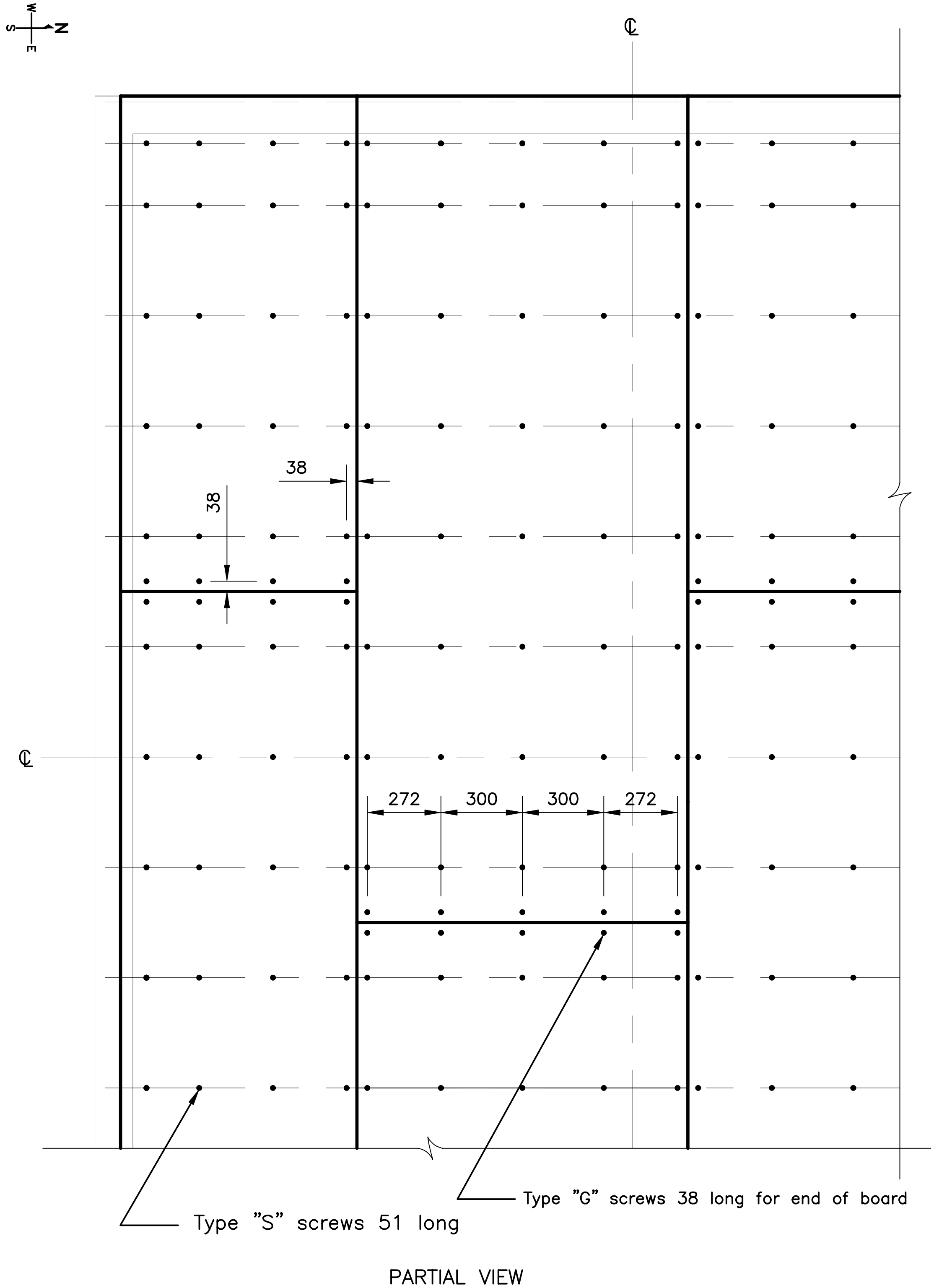
Figure A–11. Gypsum Board Base Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–31)

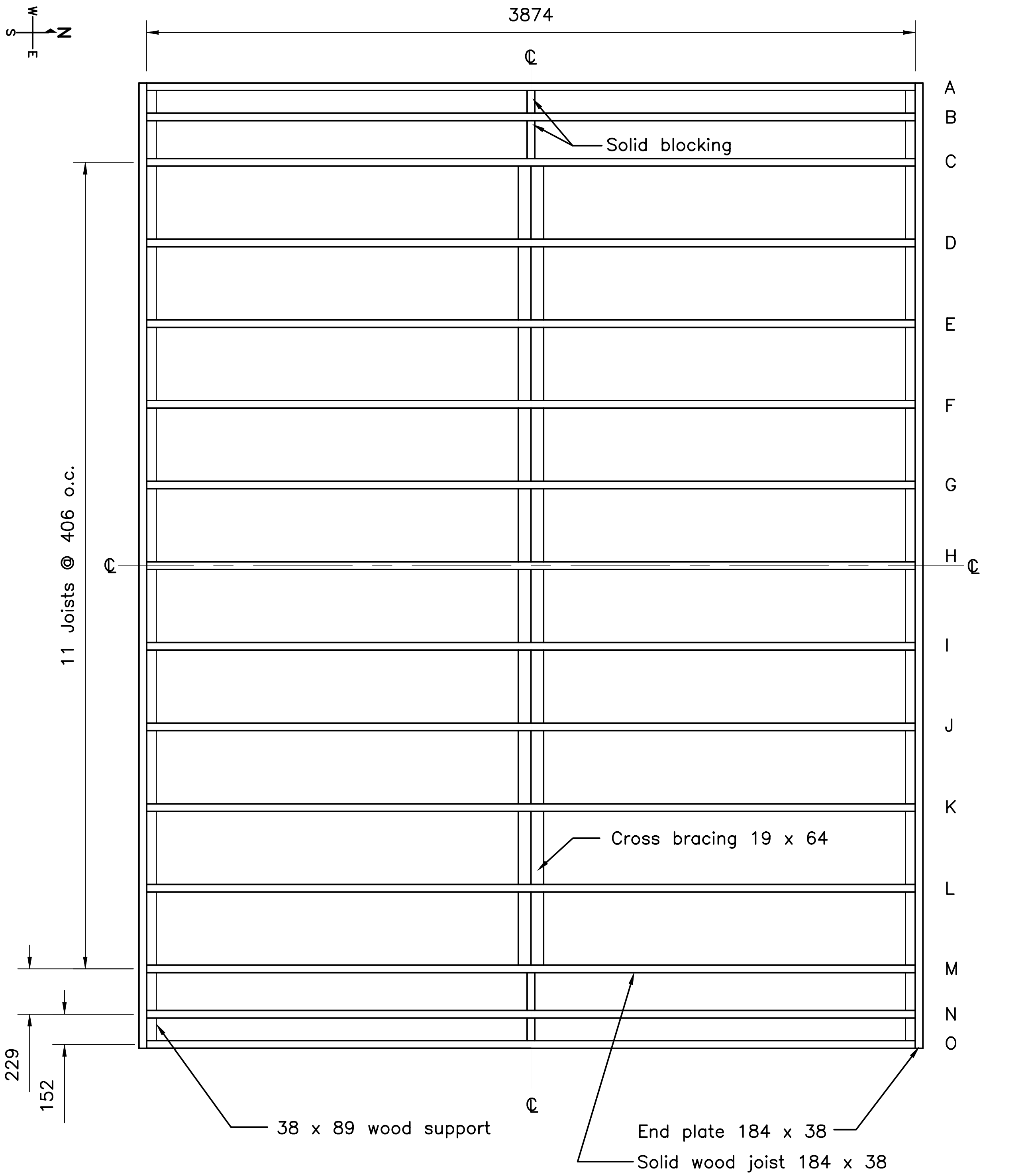
Figure A–12. Gypsum Board Face Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–31)

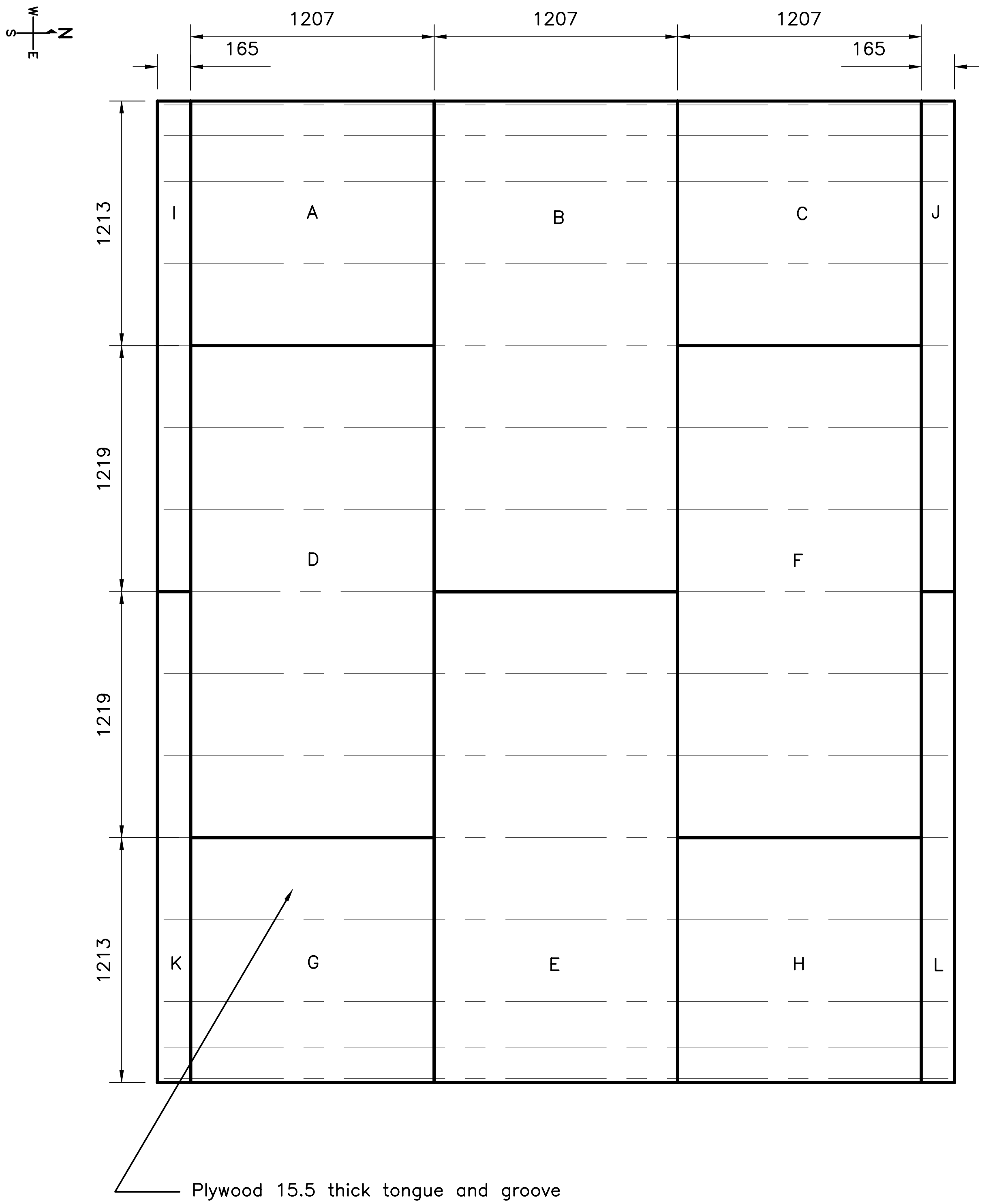
Figure A–13. Gypsum Board Face Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–32)

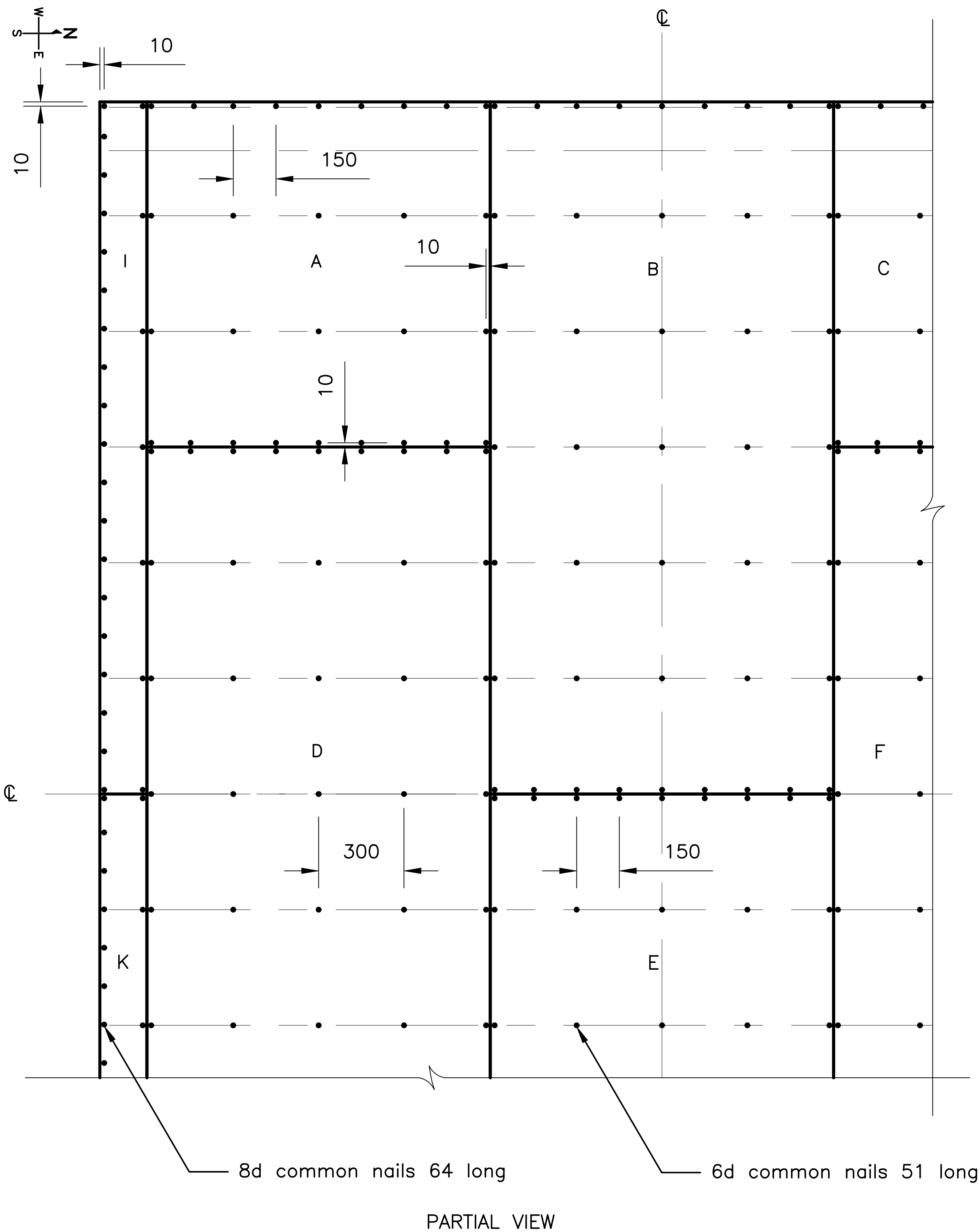
Figure A–14. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-32)

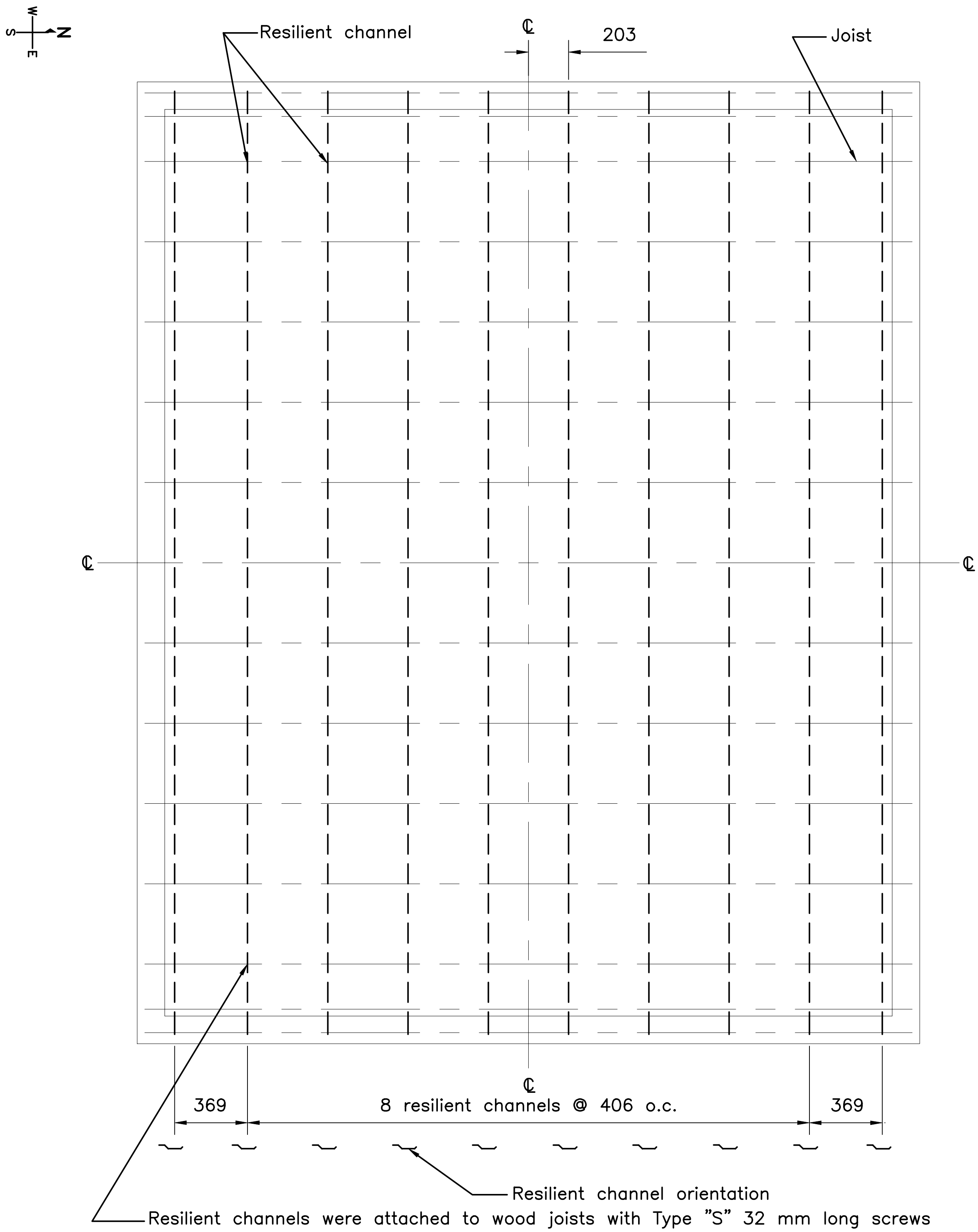
Figure A-15. Subfloor Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–32)

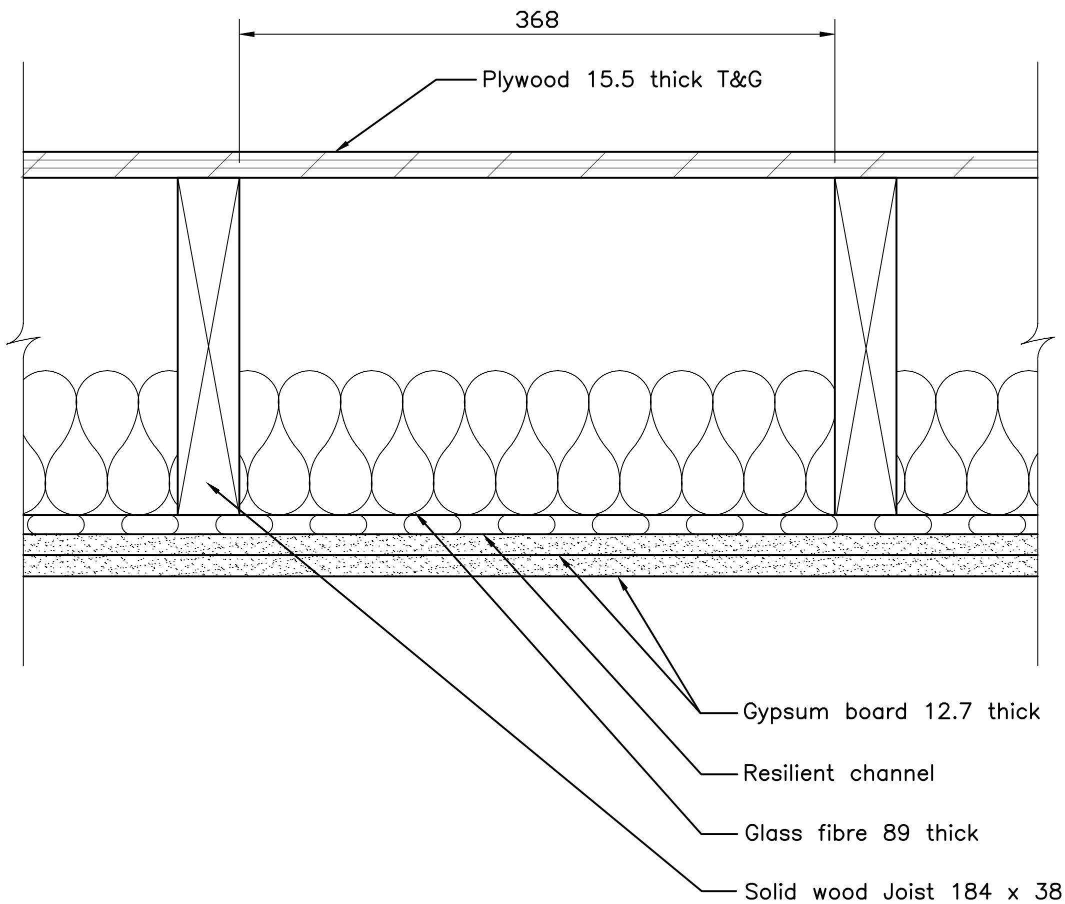
Figure A–16. Subfloor Nail Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–32)

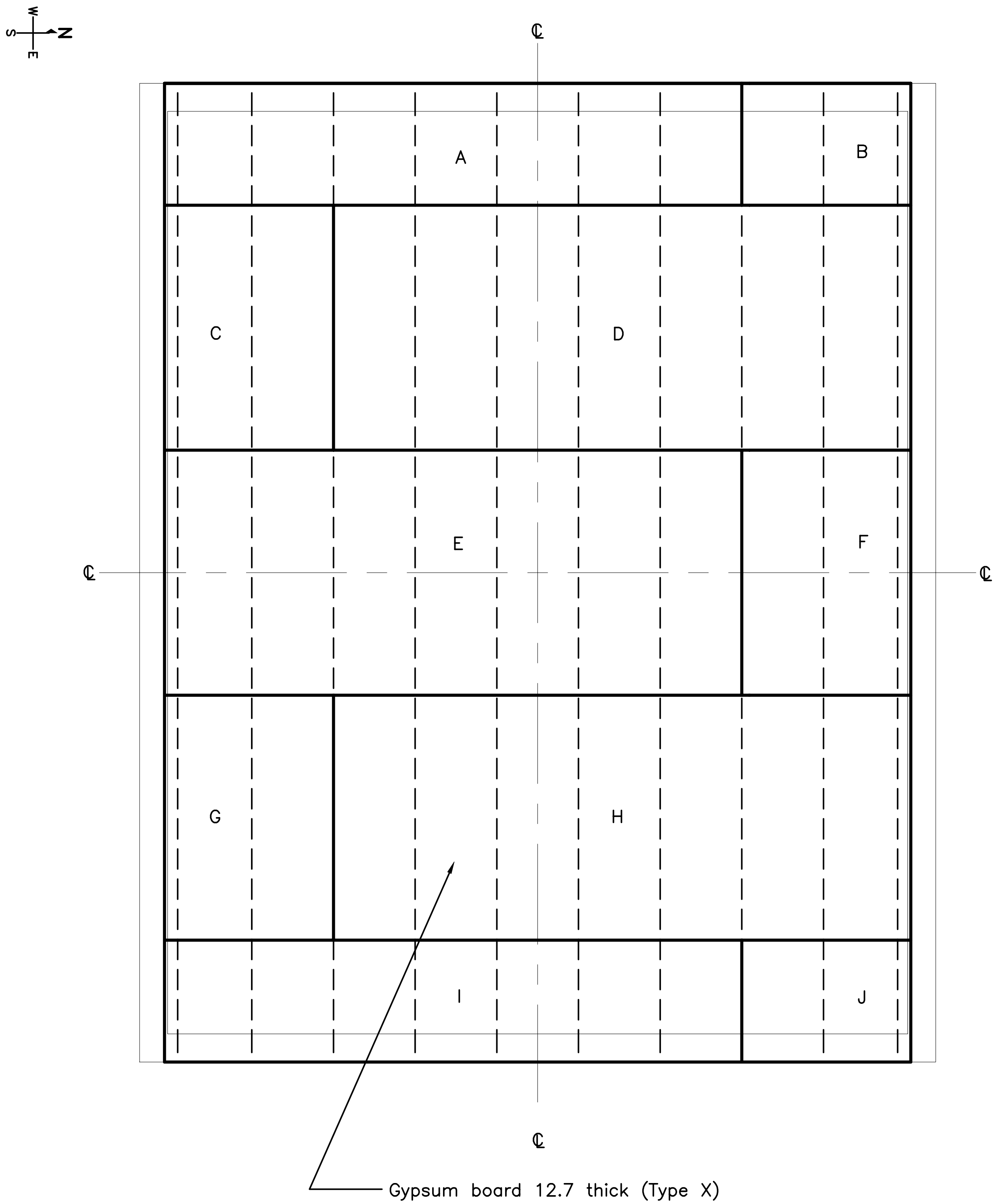
Figure A–17. Resilient Channel Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-32)

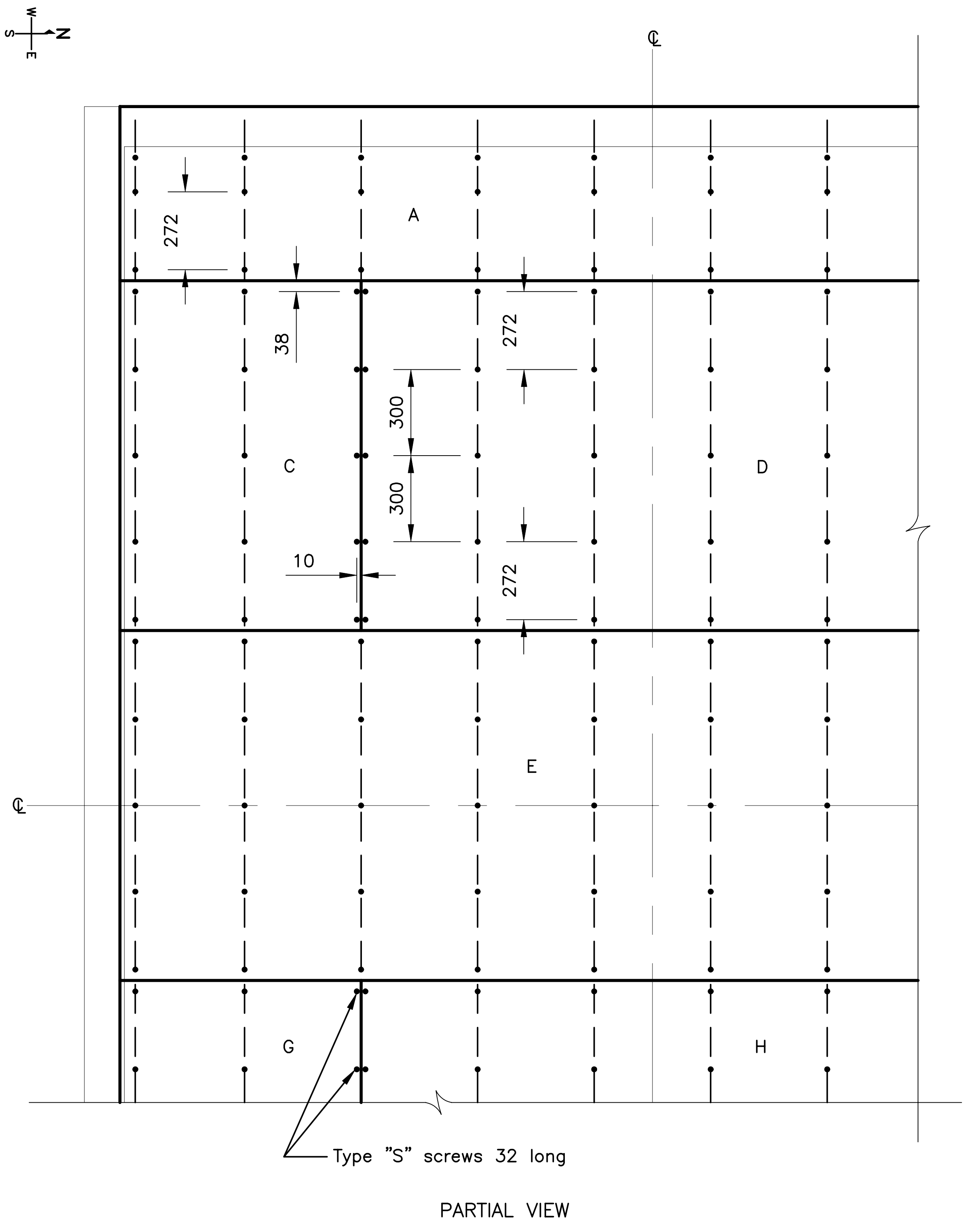
Figure A-18. Insulation Location (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–32)

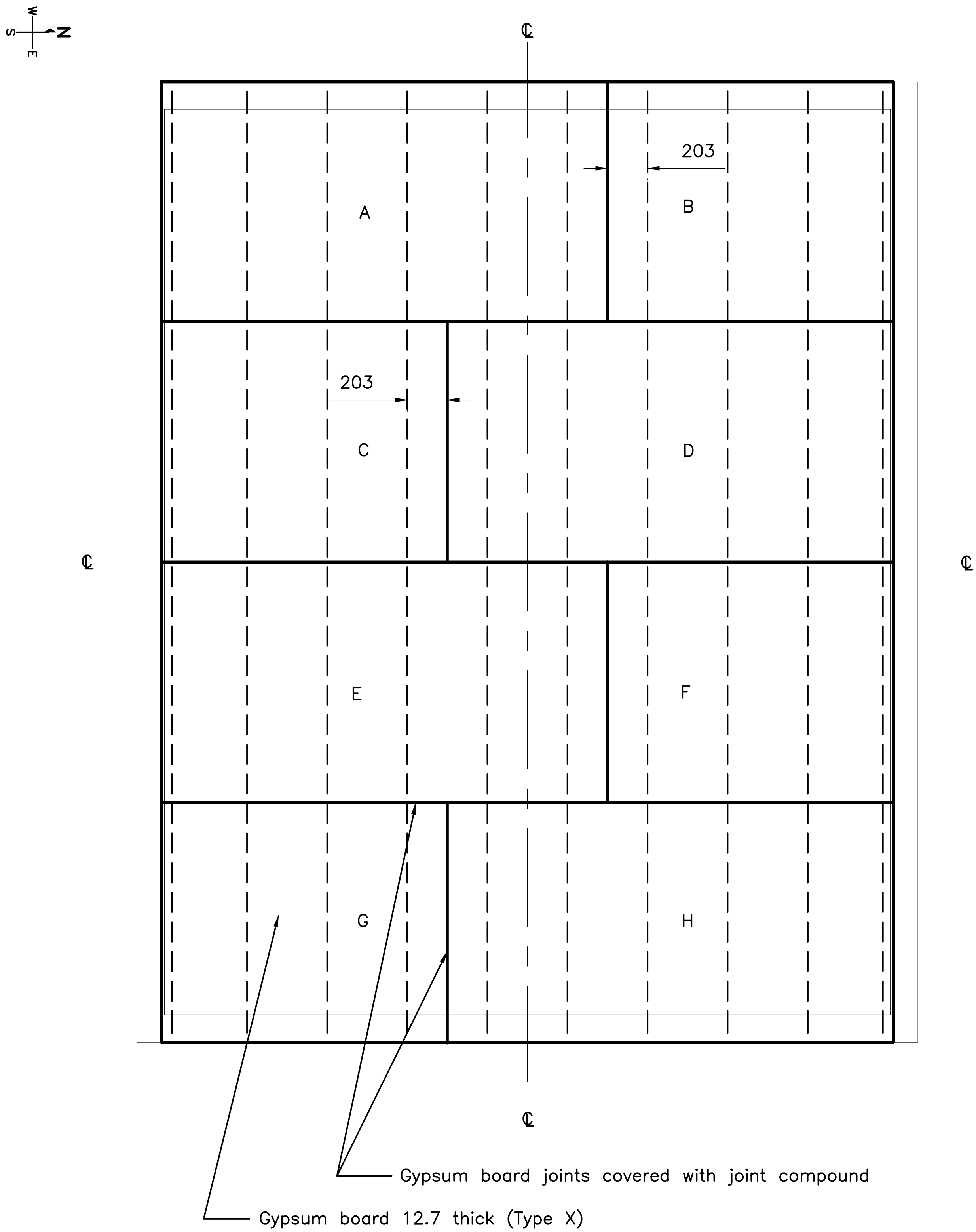
Figure A–19. Gypsum Board Base Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–32)

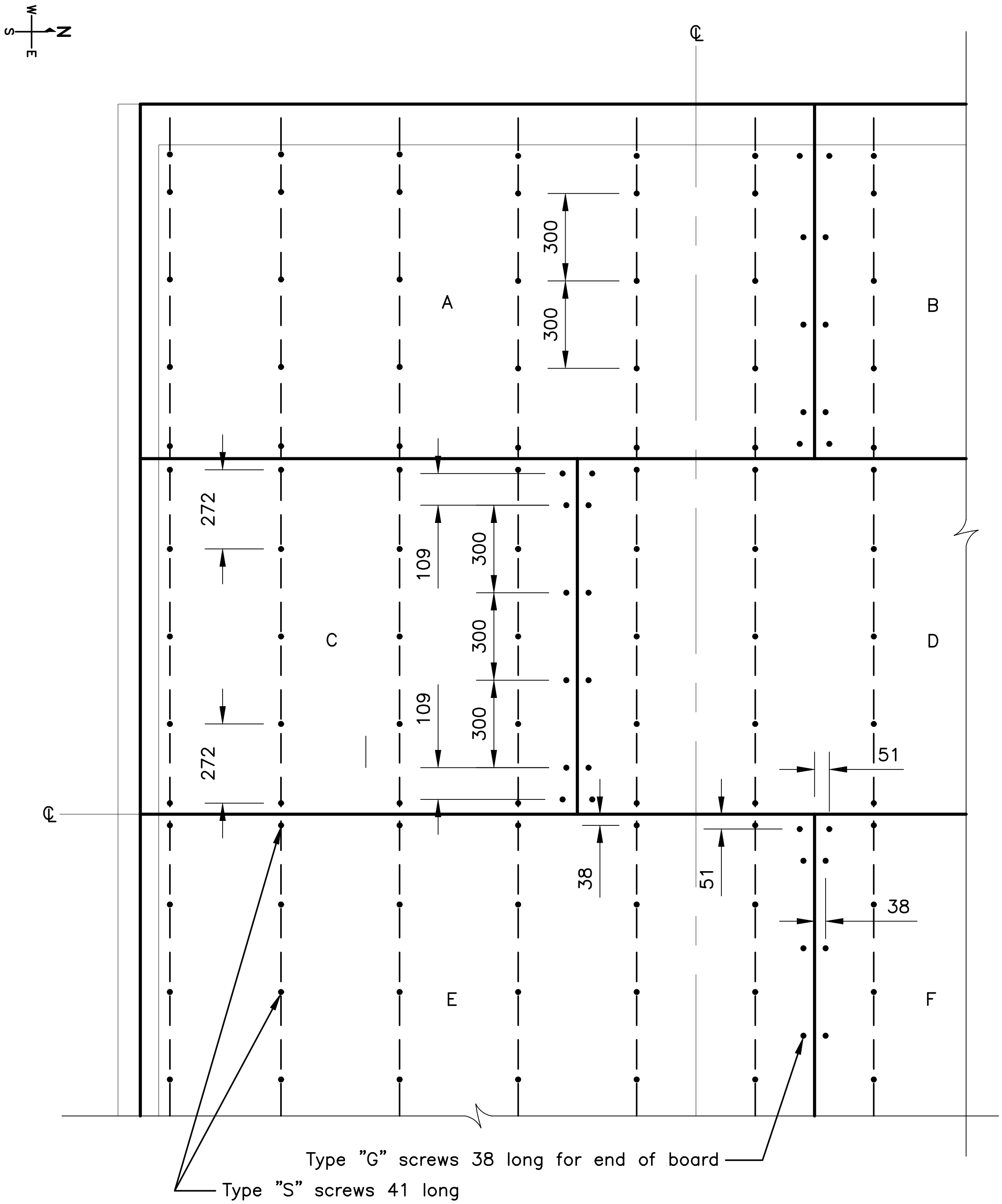
Figure A–20. Gypsum Board Base Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–32)

Figure A–21. Gypsum Board Face Layer Layout (Solid Wood Joist)

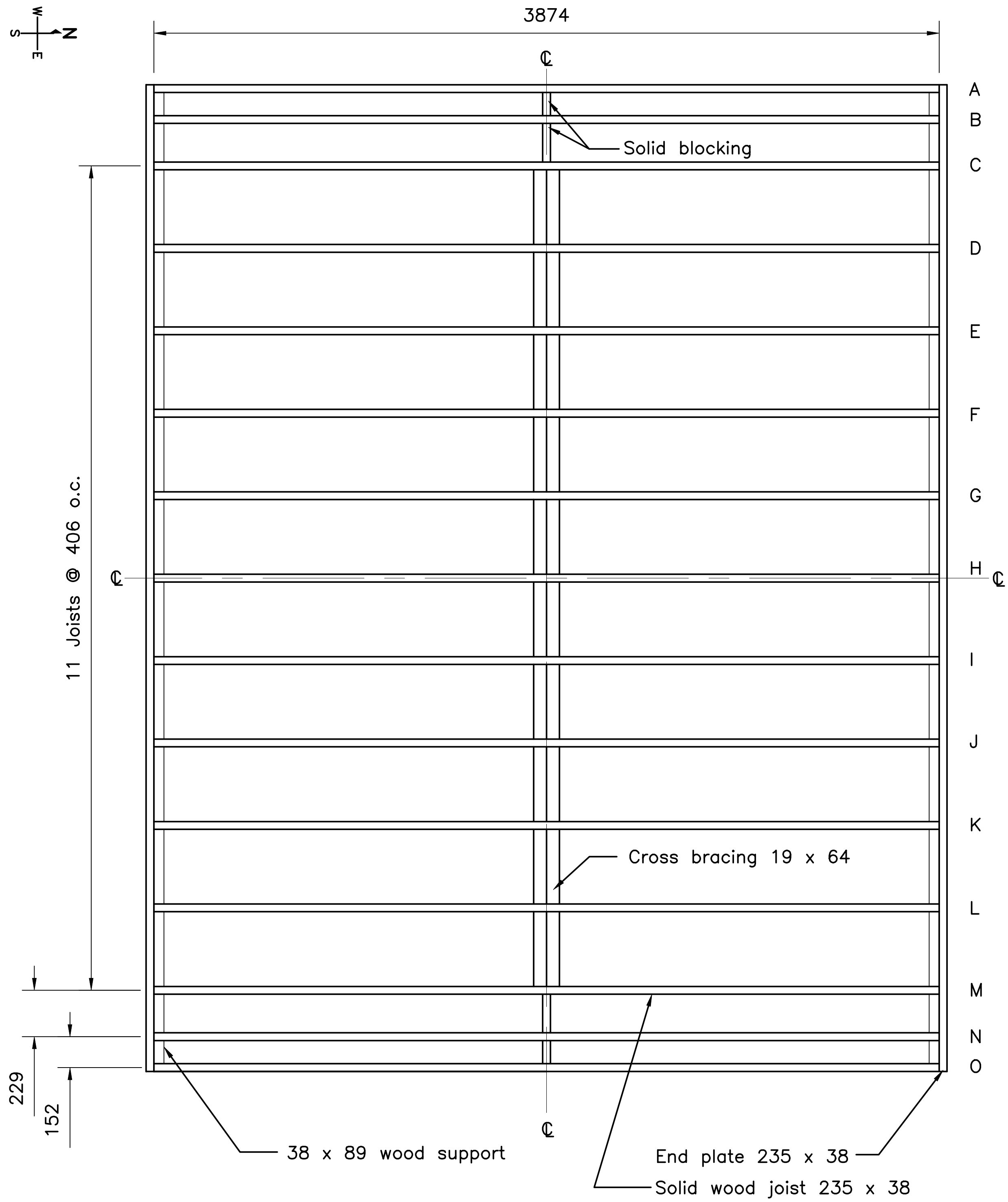


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF-32)

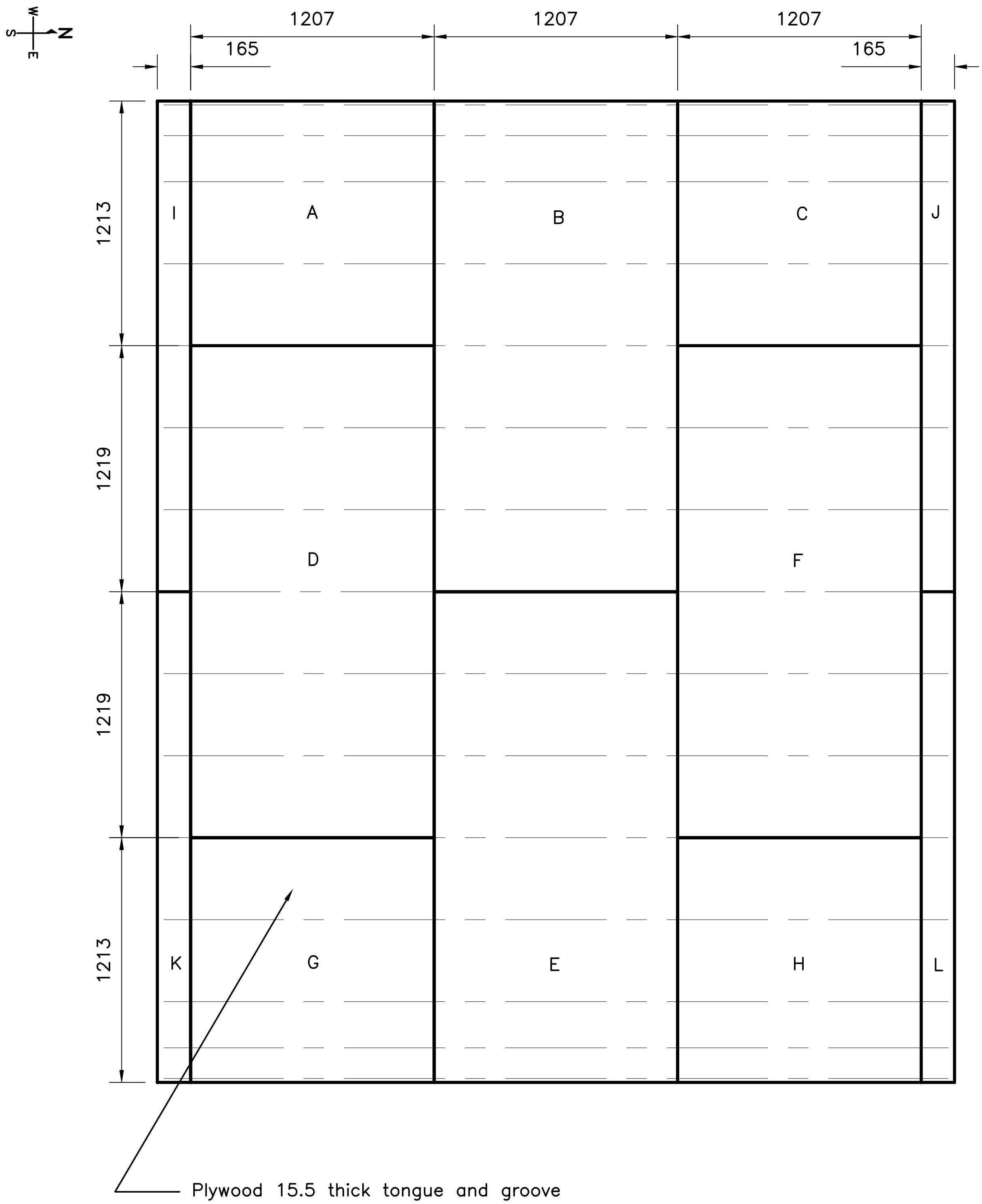
Figure A-22. Gypsum Board Face Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–33)

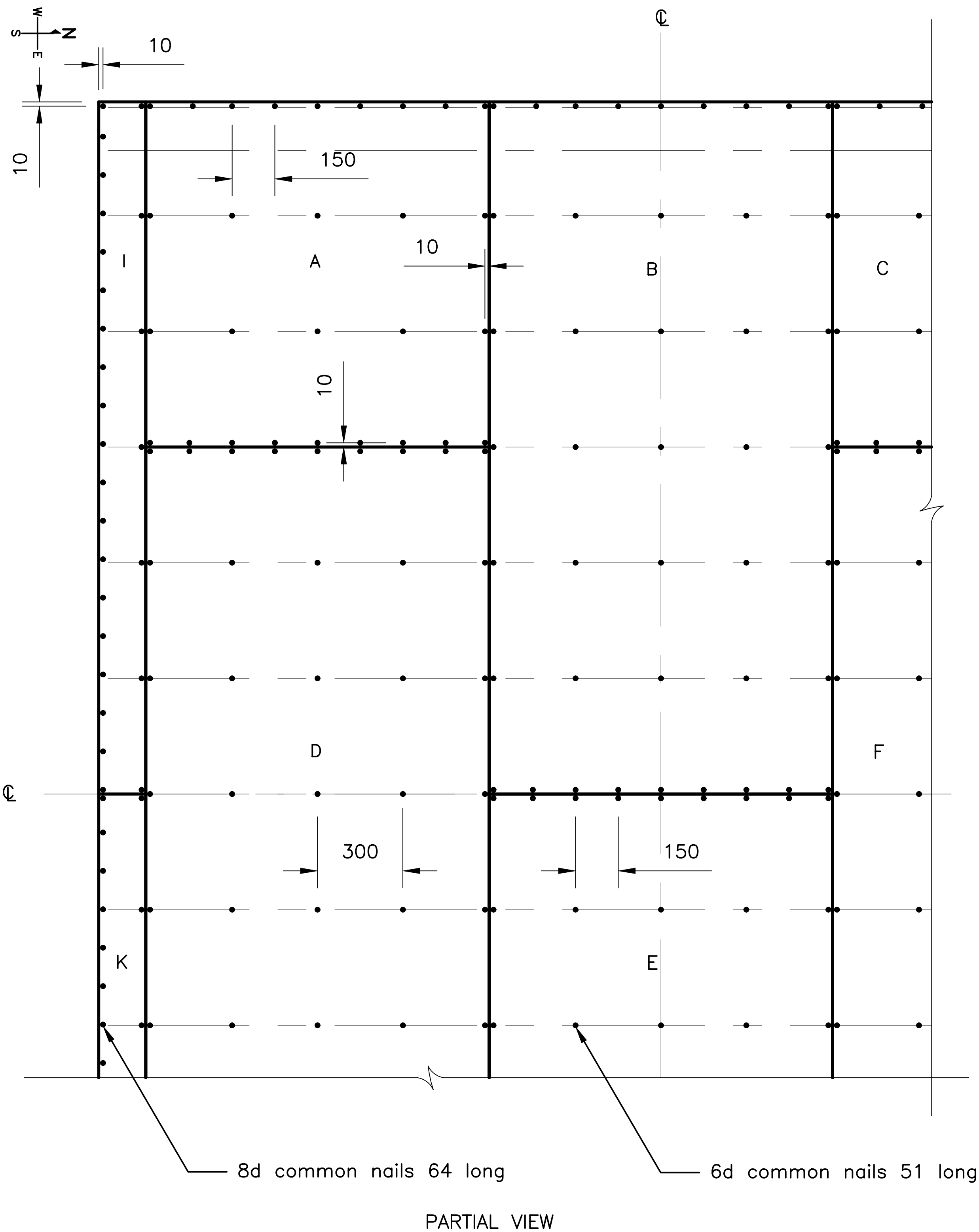
Figure A–23. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–33)

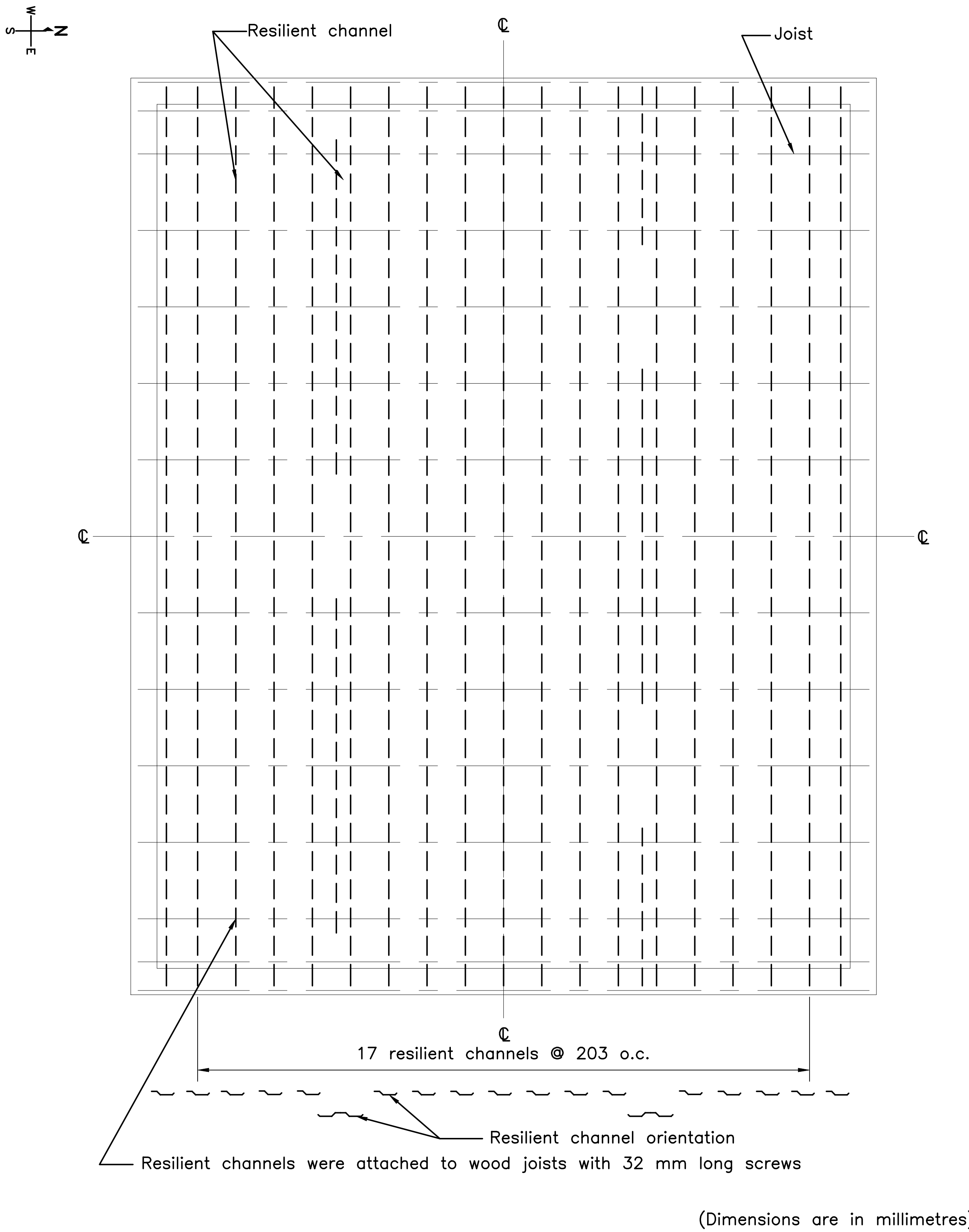
Figure A–24. Subfloor Layout (Solid Wood Joist)



(Dimensions are in millimetres)

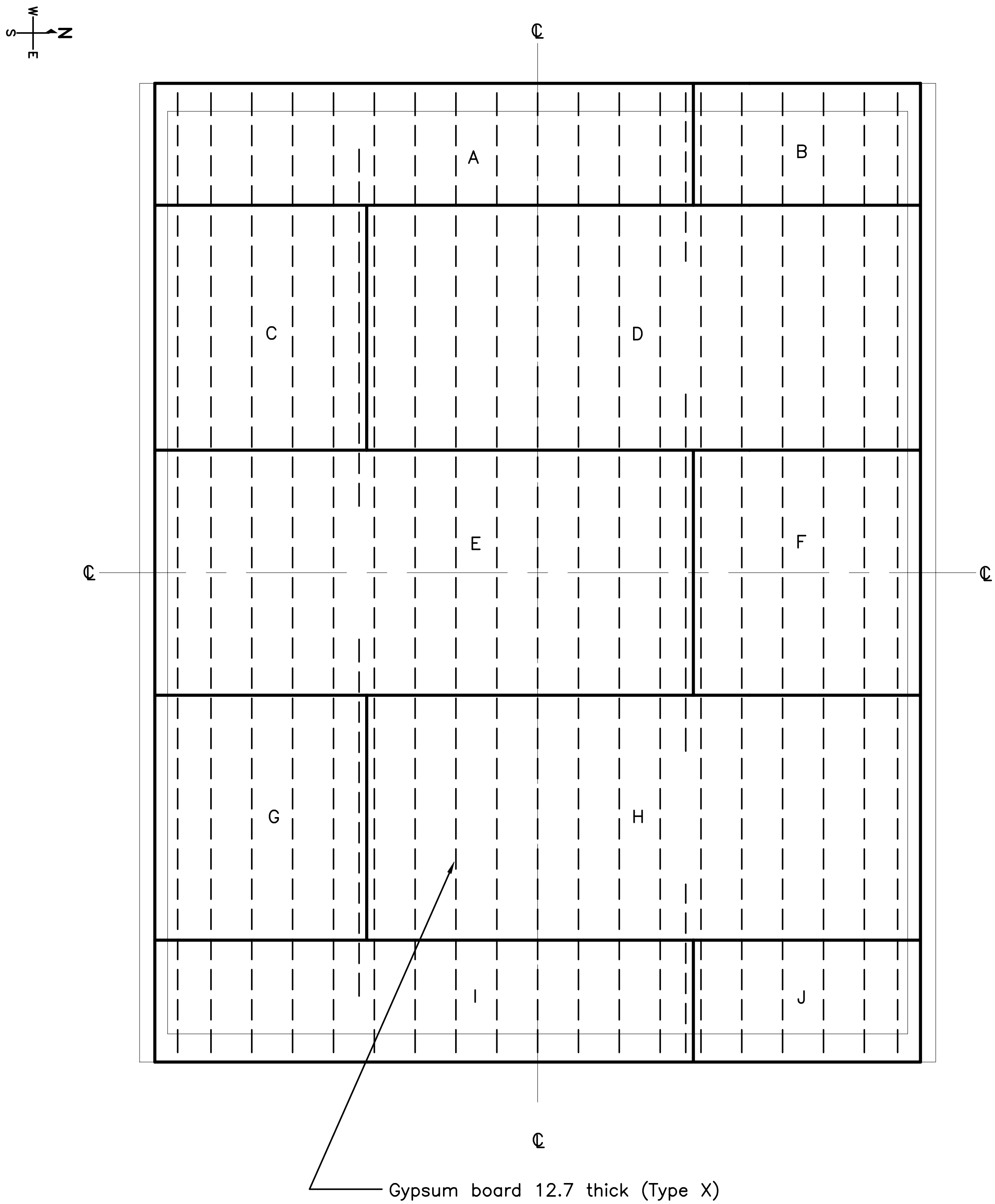
(Assembly No. FF–33)

Figure A–25. Subfloor Nail Pattern (Solid Wood Joist)



(Assembly No. FF-33)

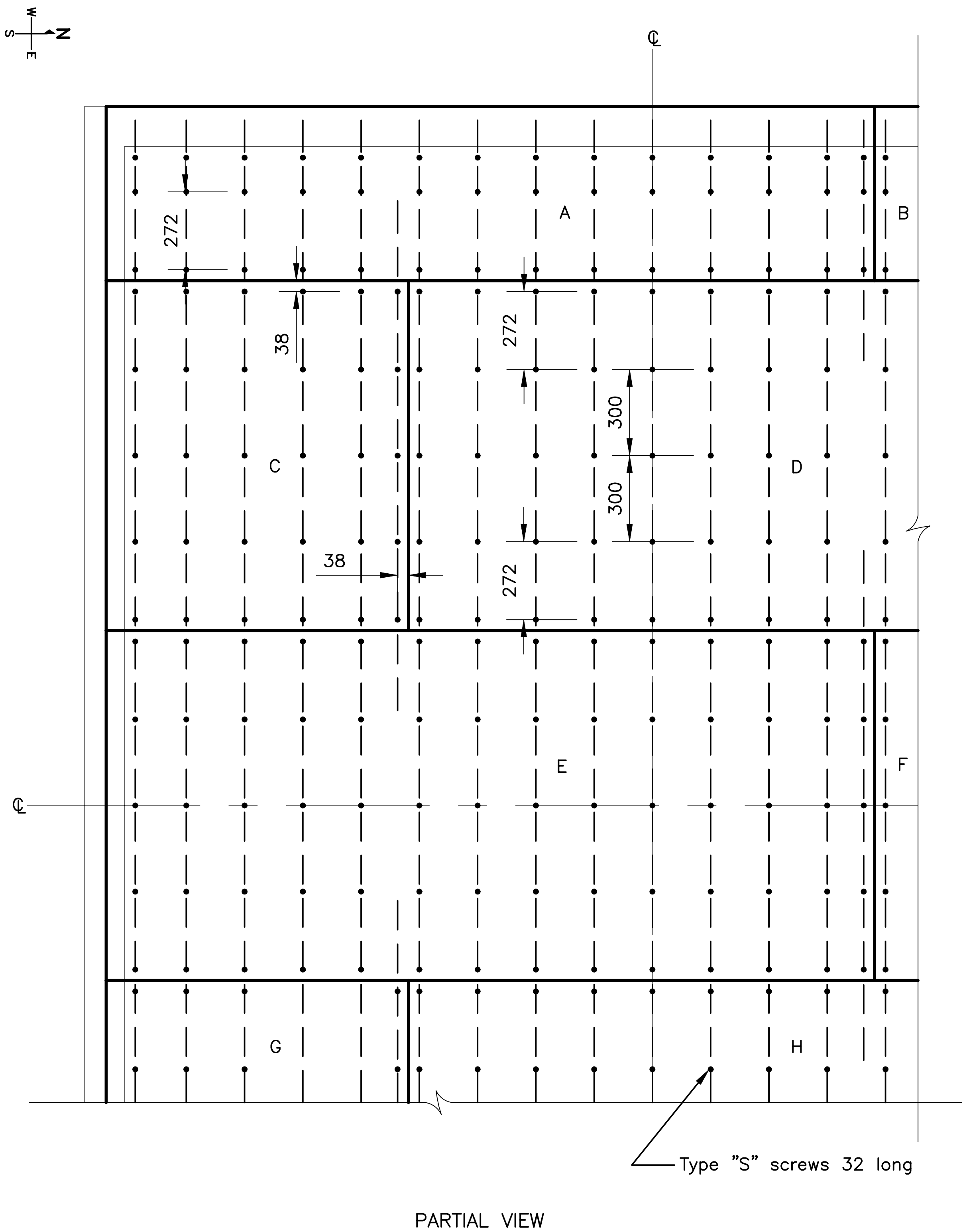
Figure A-26. Resilient Channel Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–33)

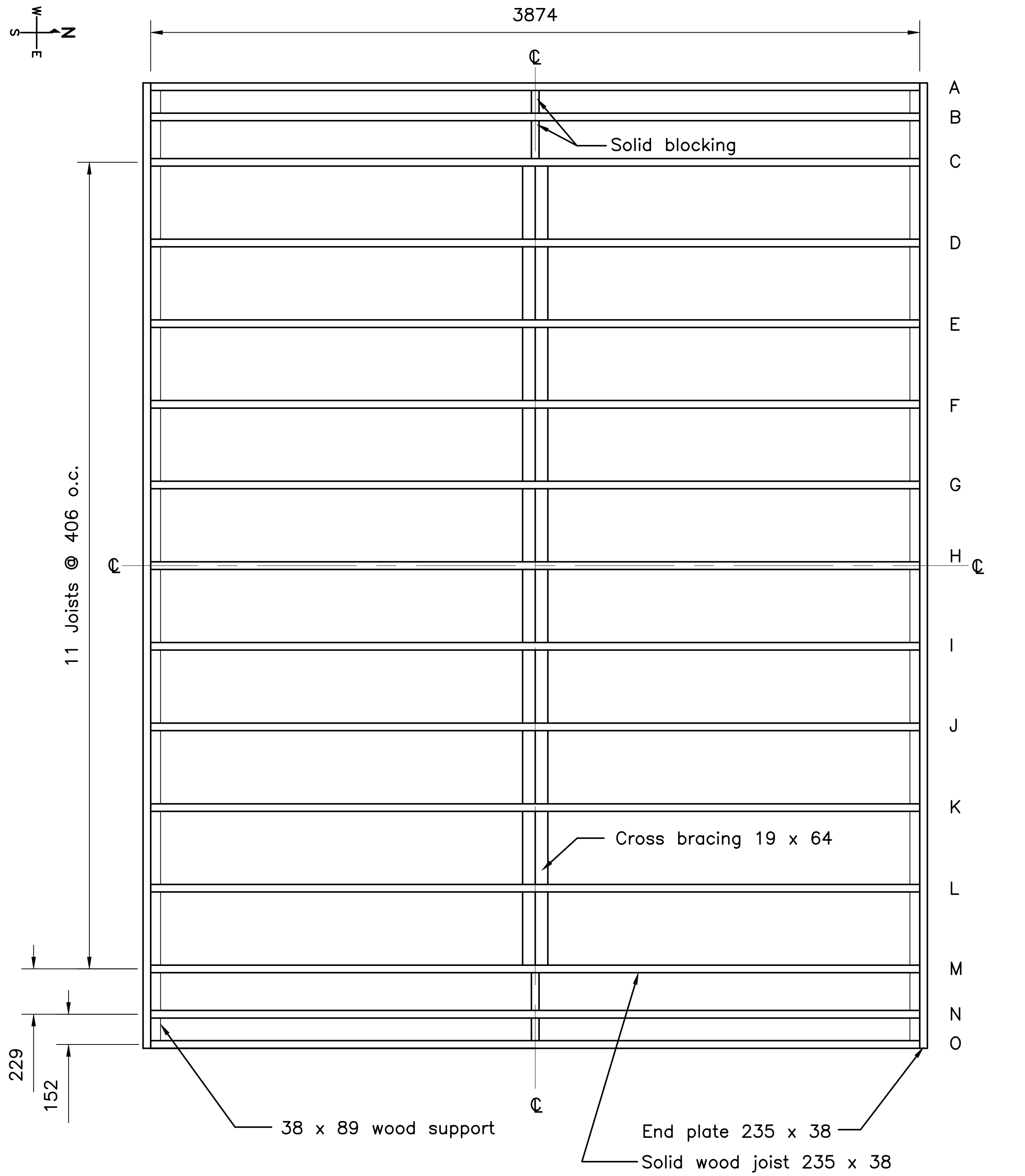
Figure A–27. Gypsum Board Single Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–33)

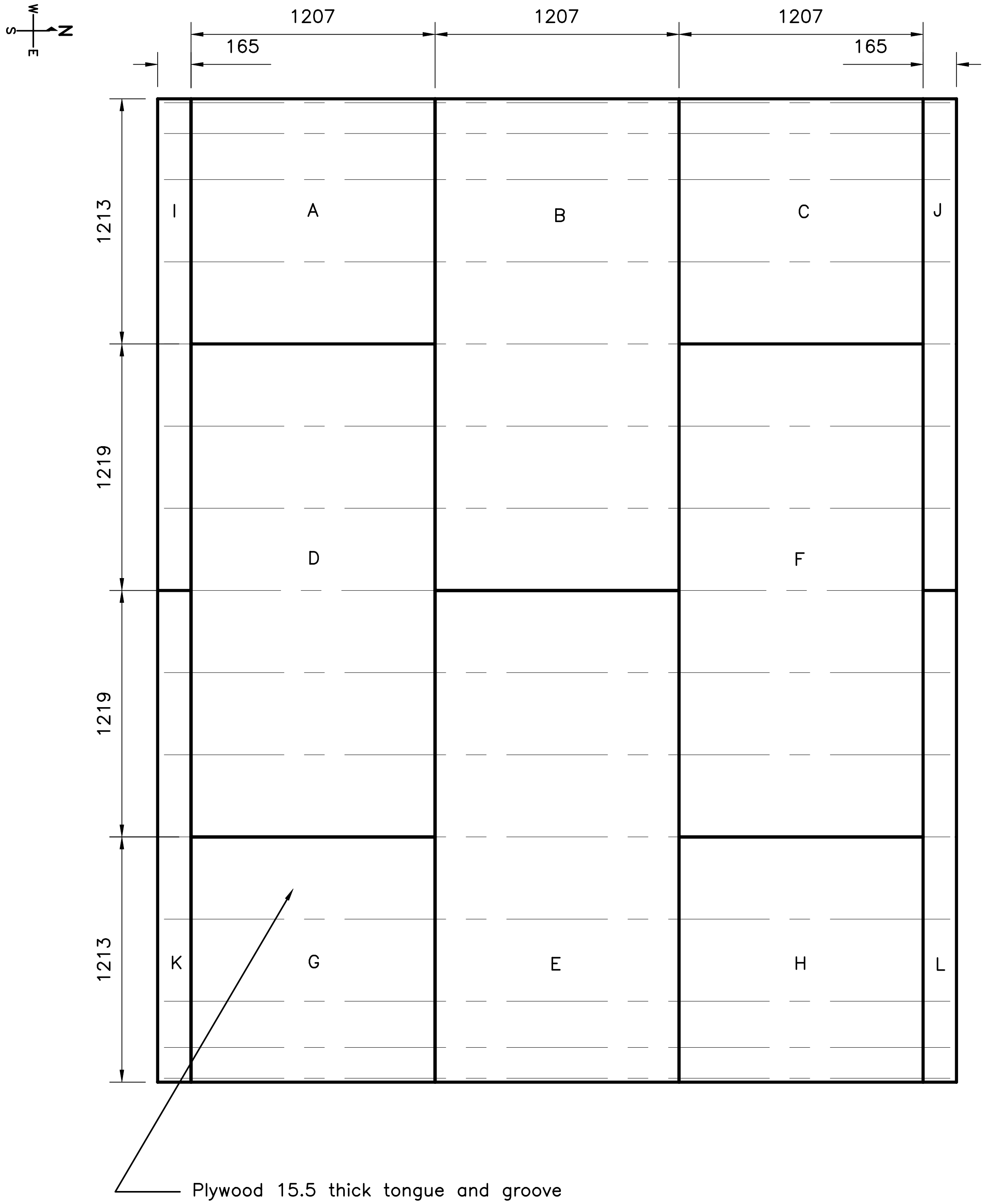
Figure A–28. Gypsum Board Single Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-34)

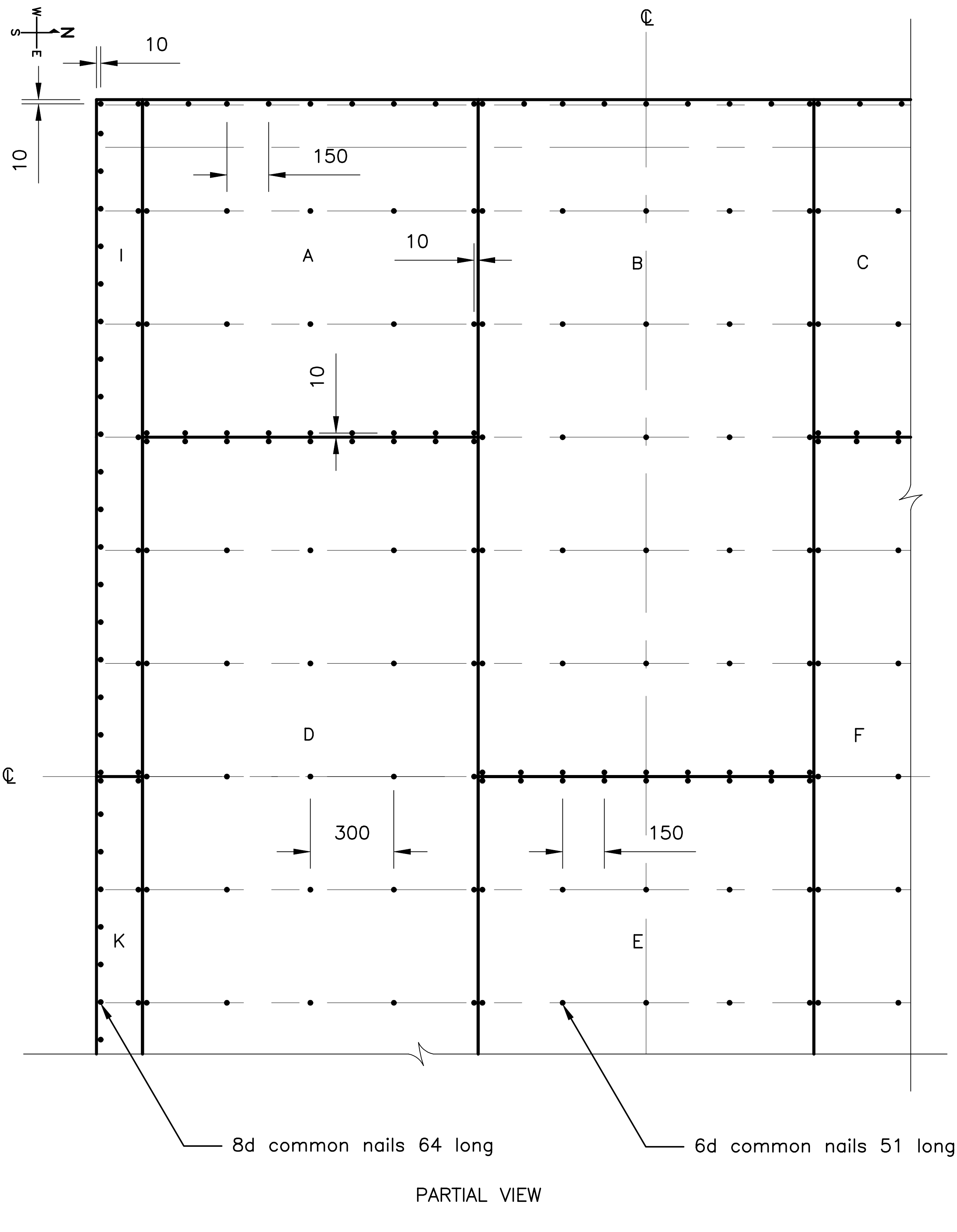
Figure A-29. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–34)

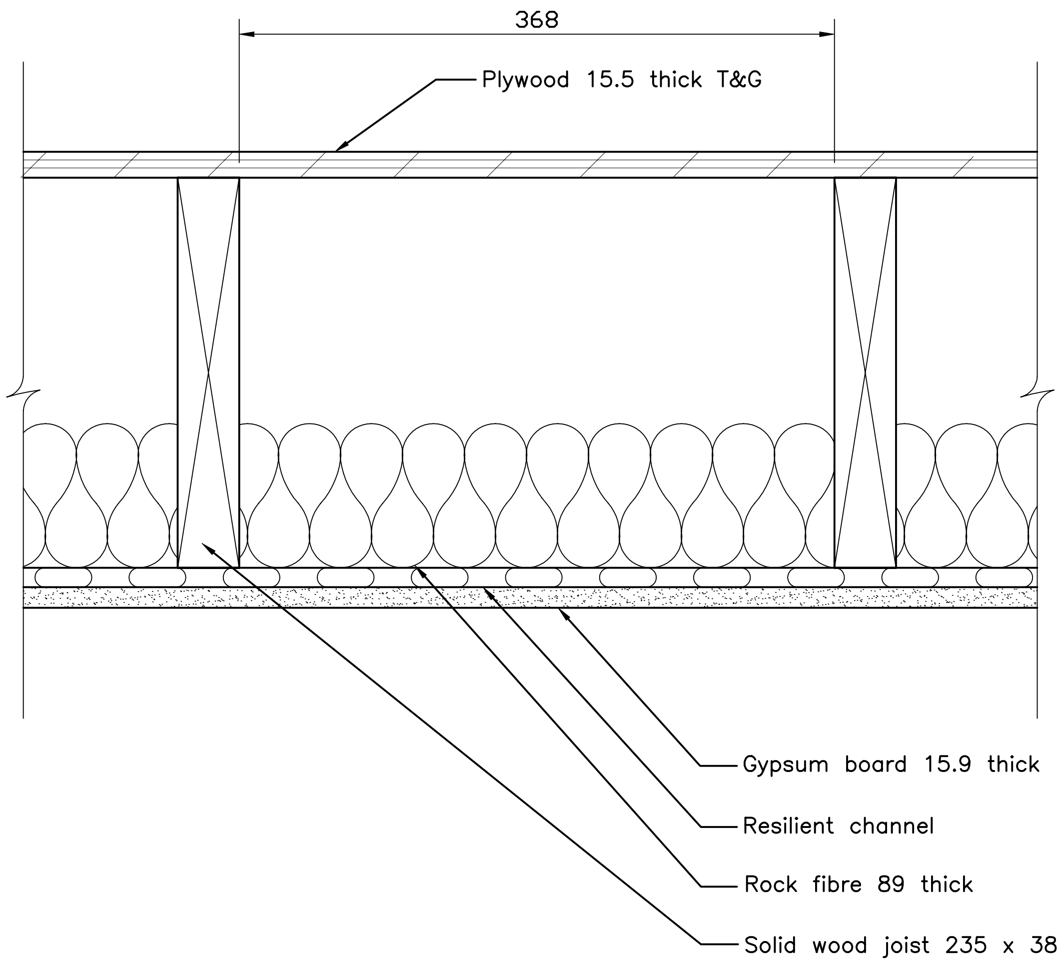
Figure A–30. Subfloor Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–34)

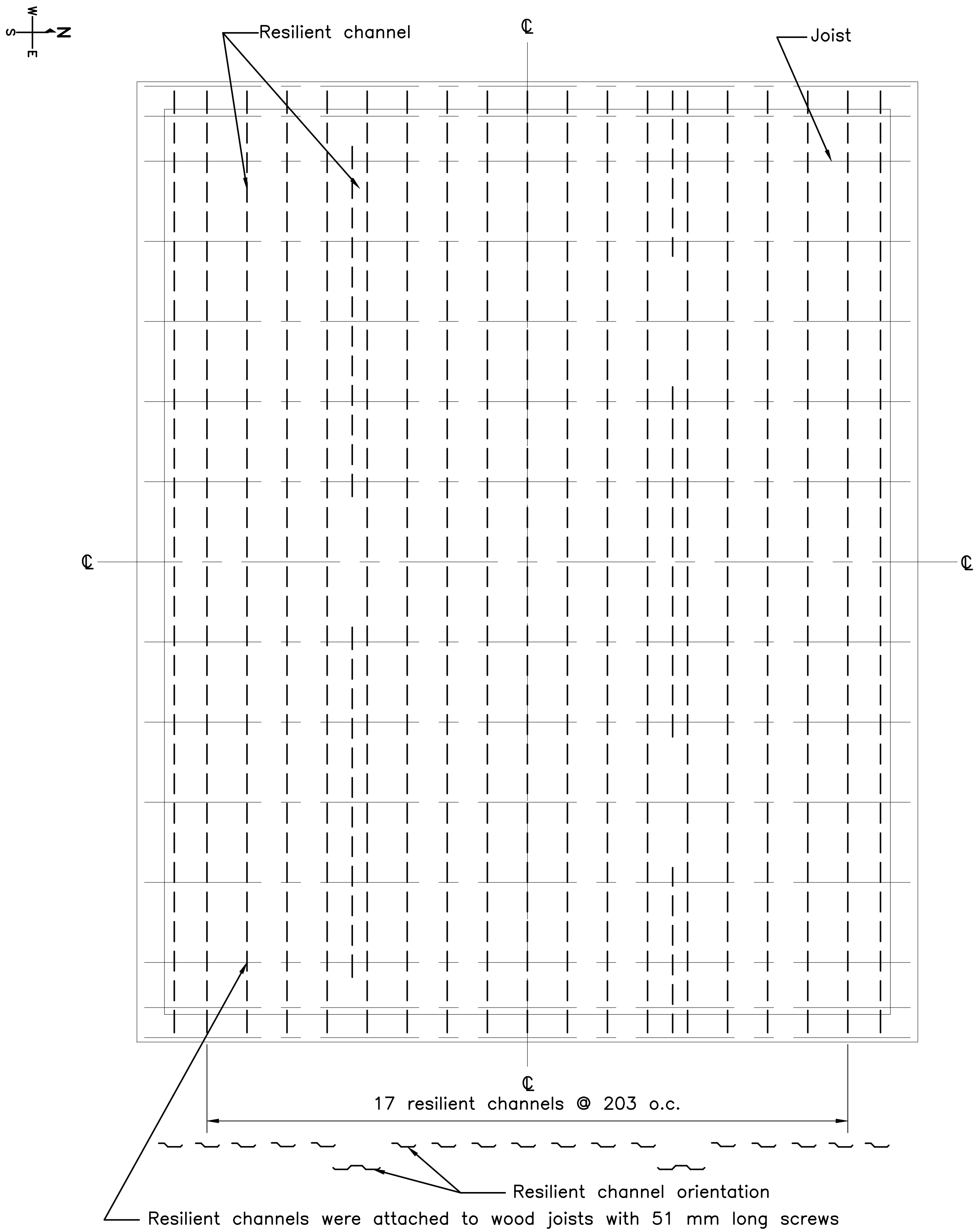
Figure A–31. Subfloor Nail Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–34)

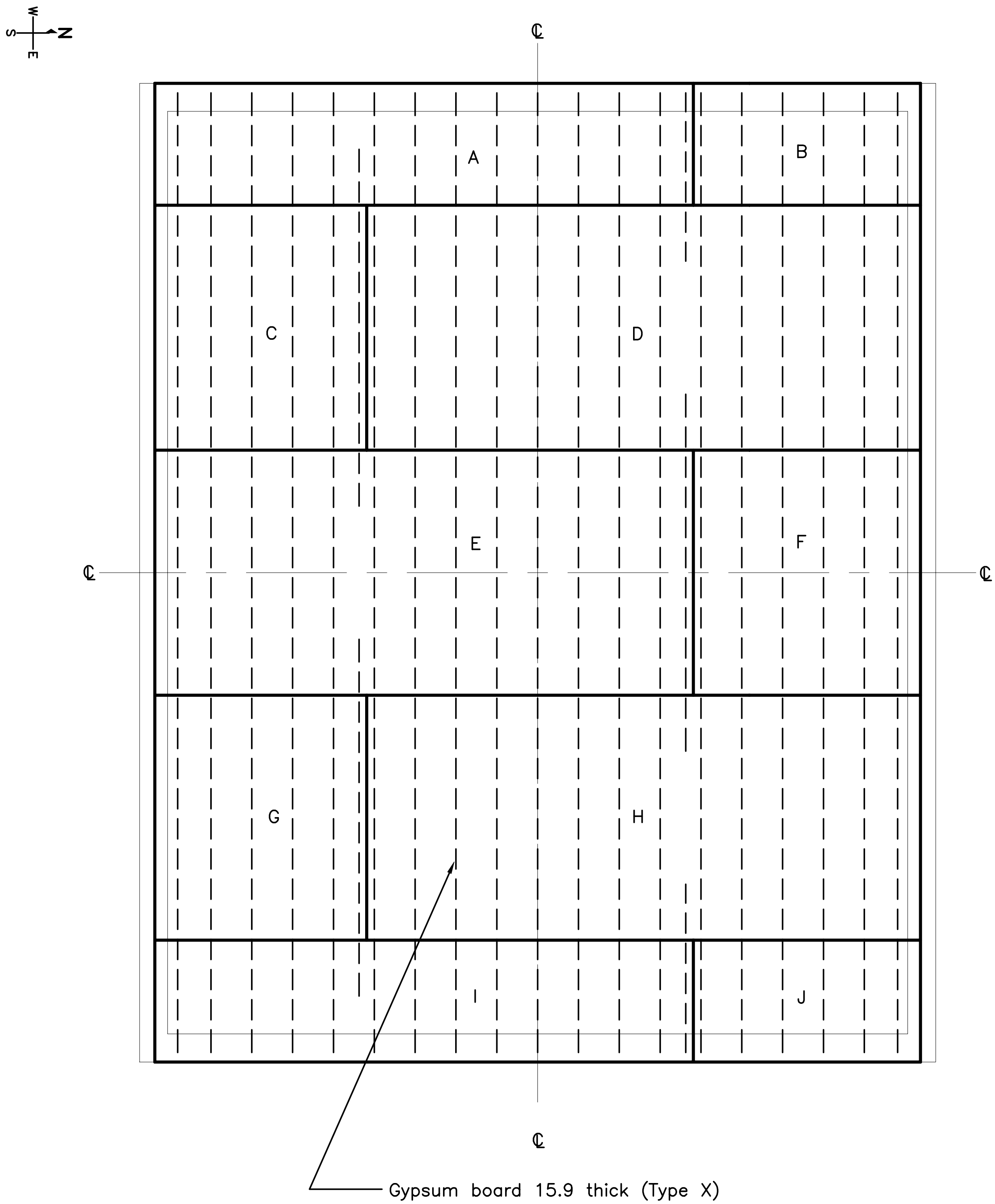
Figure A–32. Insulation Location (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF—34)

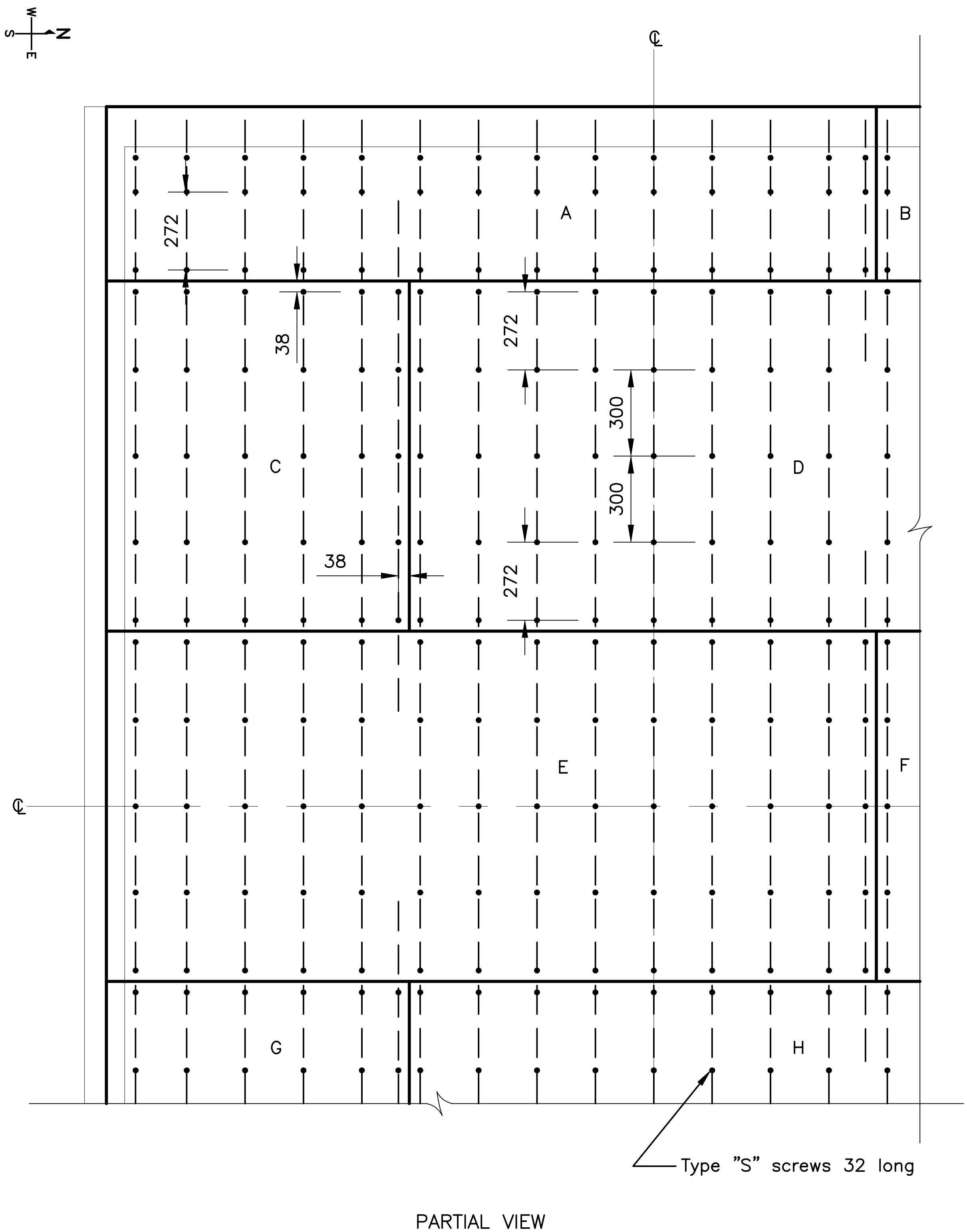
Figure A—33. Resilient Channel Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–34)

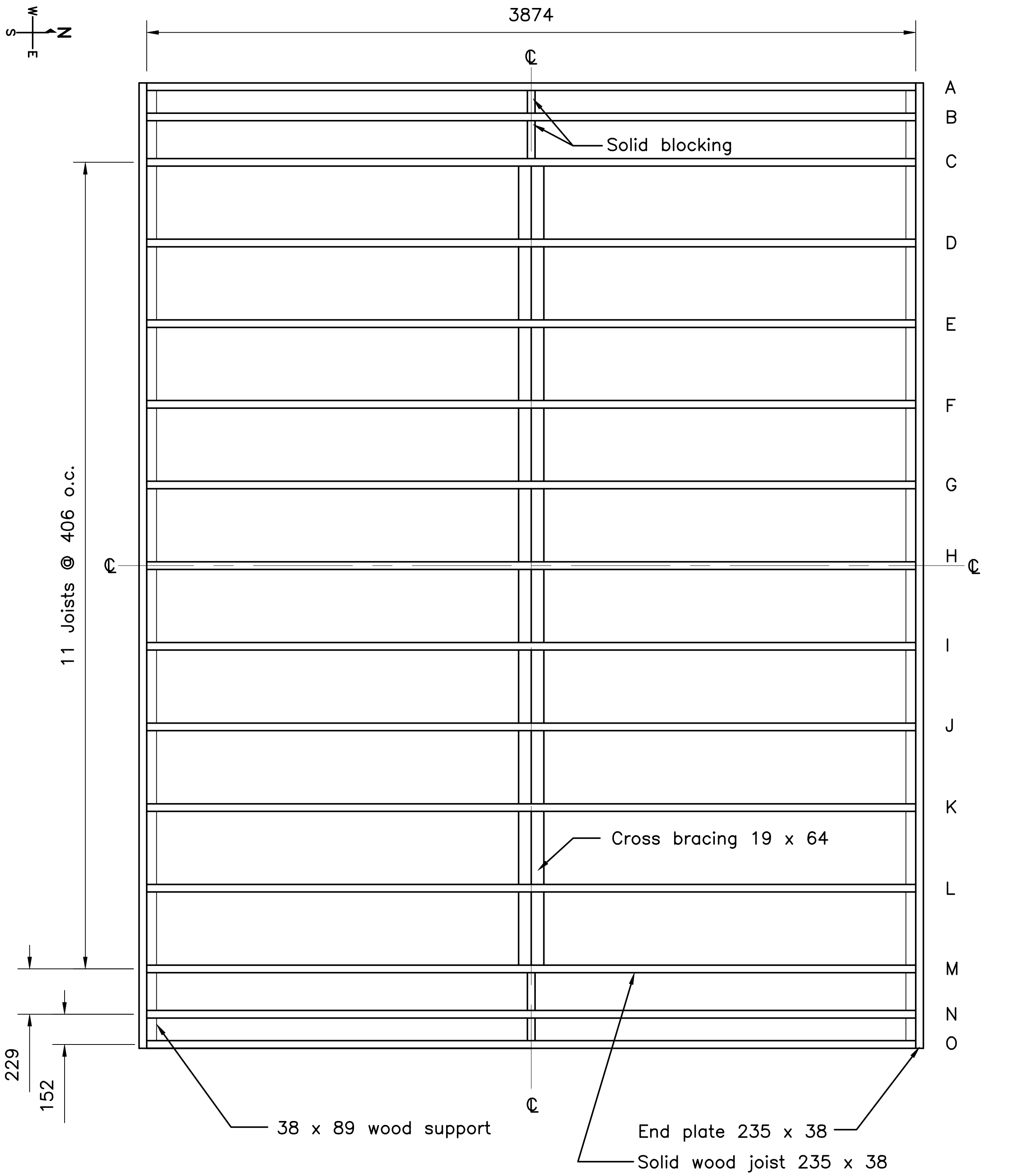
Figure A–34. Gypsum Board Single Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–34)

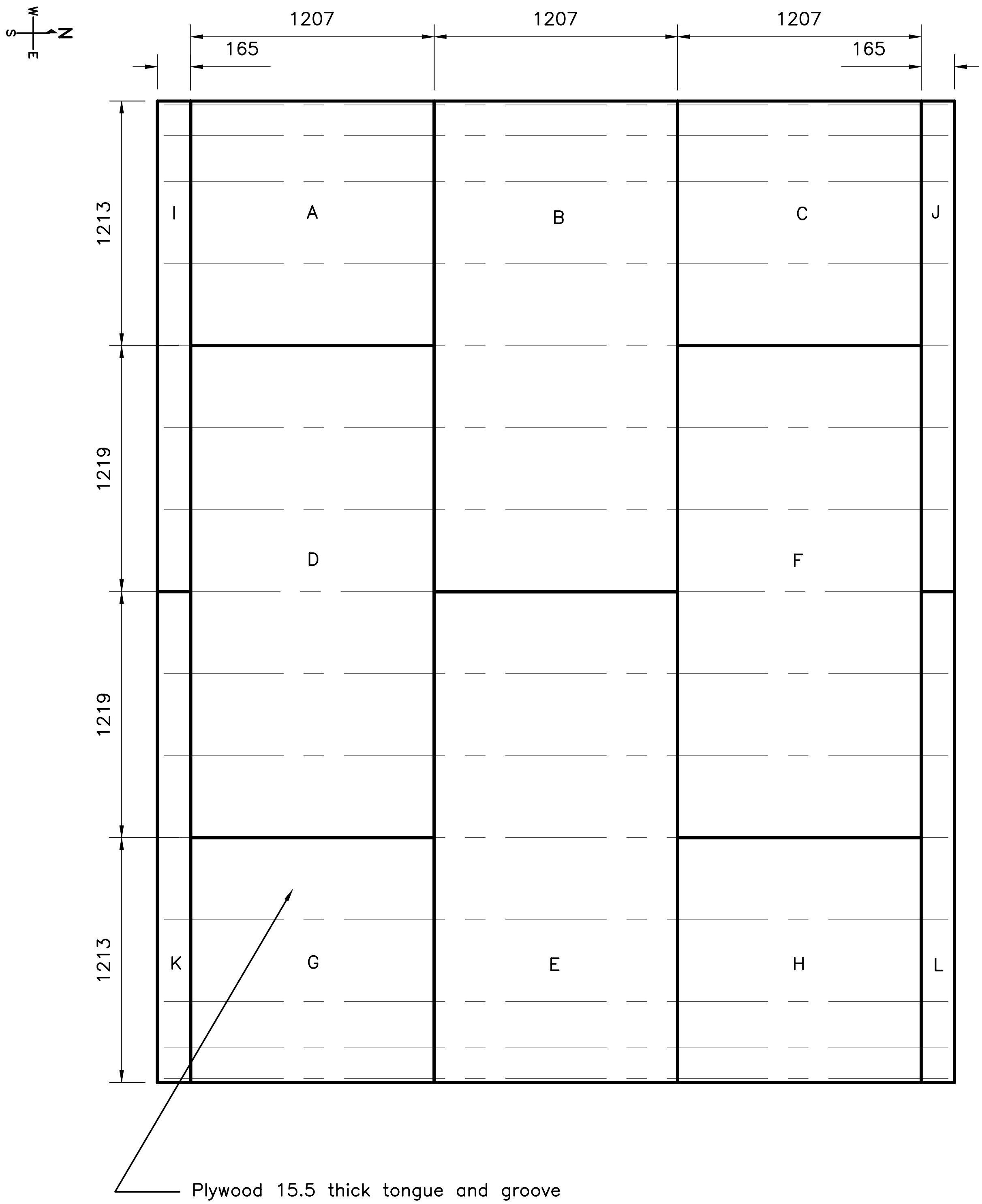
Figure A–35. Gypsum Board Single Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–35)

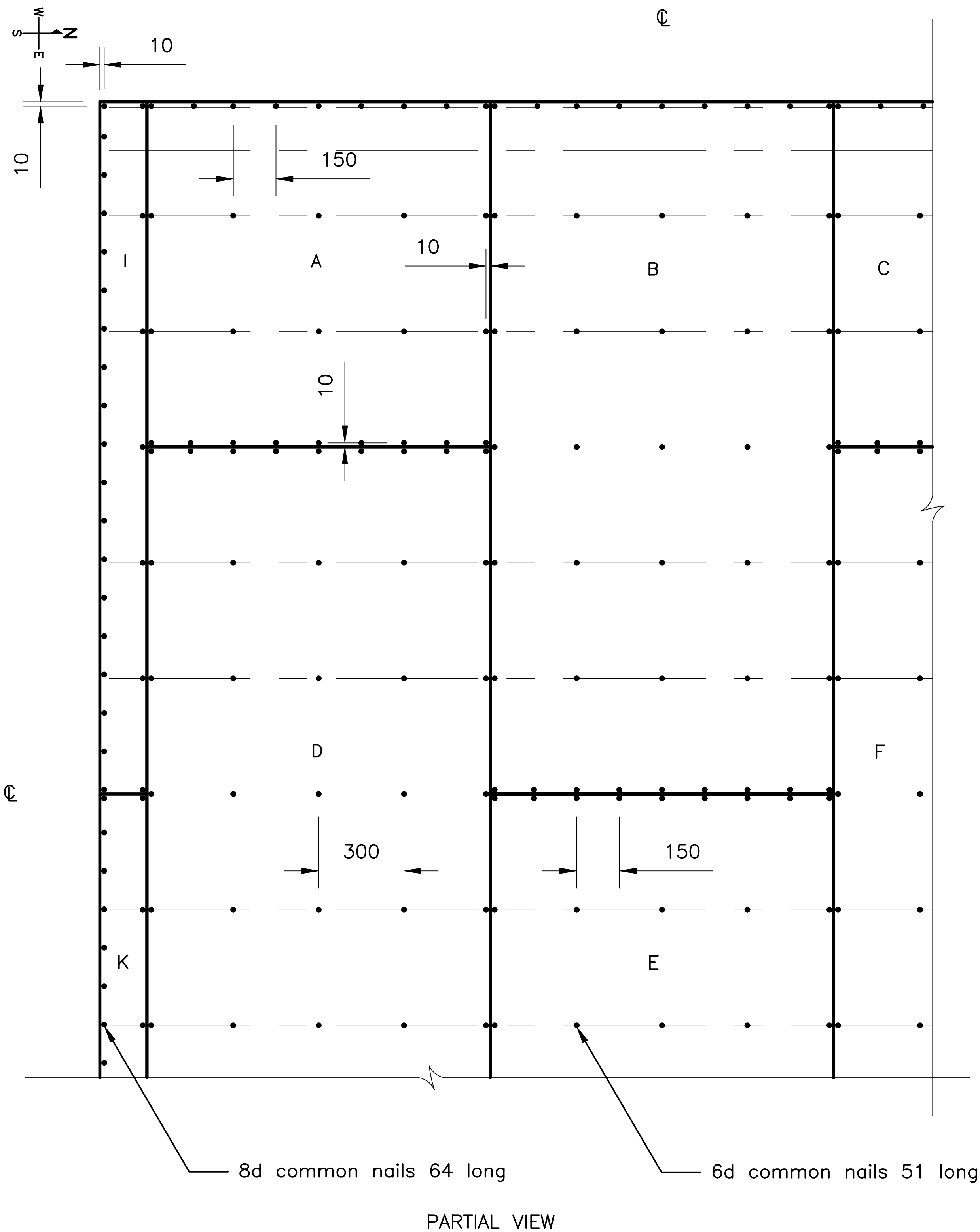
Figure A–36. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–35)

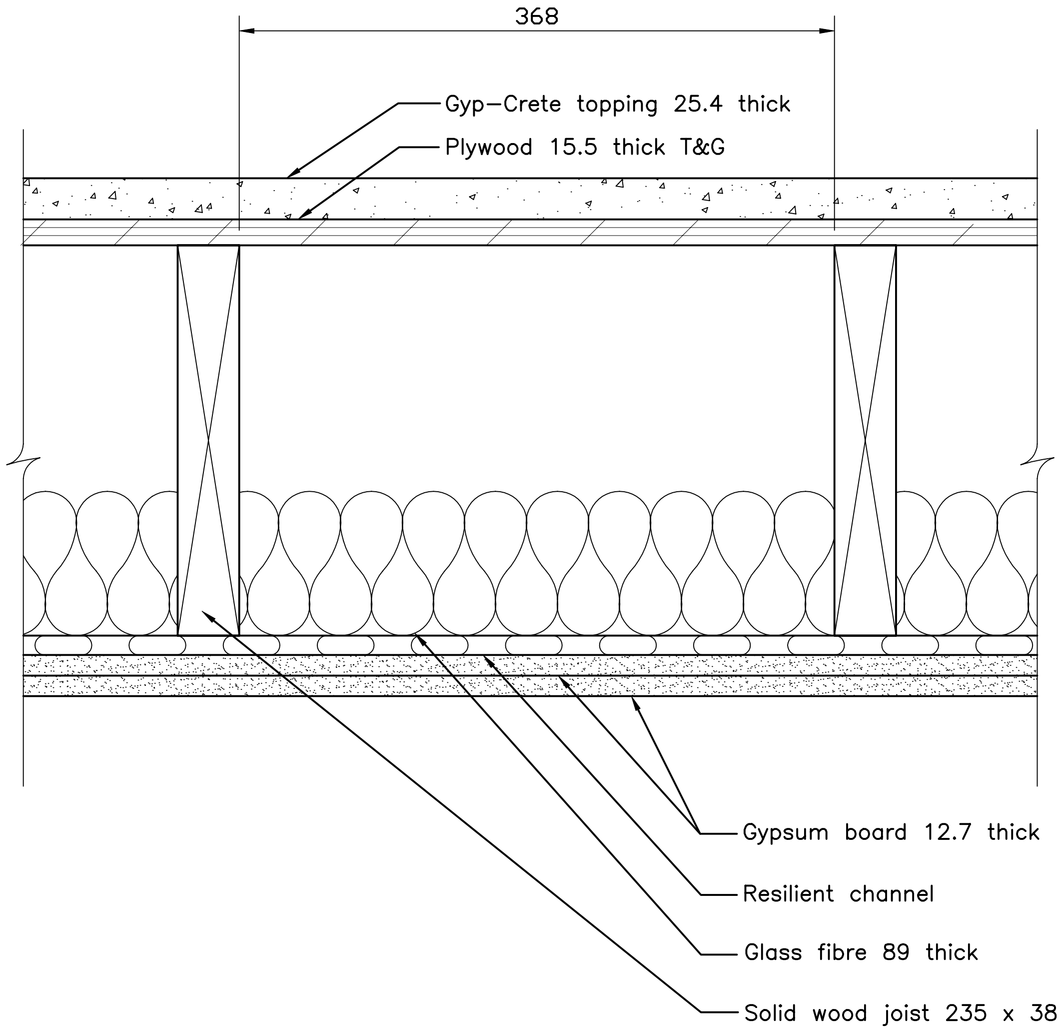
Figure A–37. Subfloor Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–35)

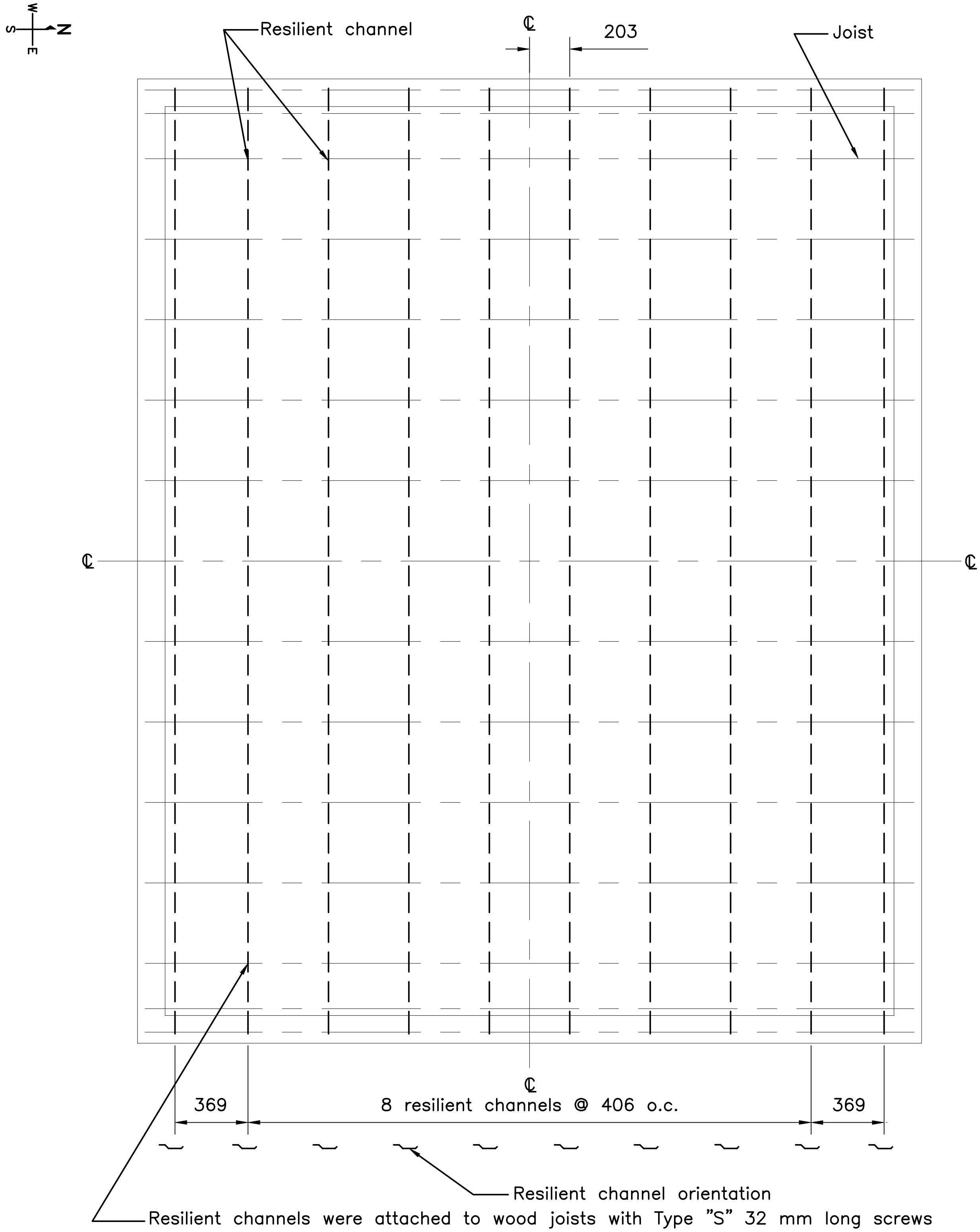
Figure A–38. Subfloor Nail Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF—35)

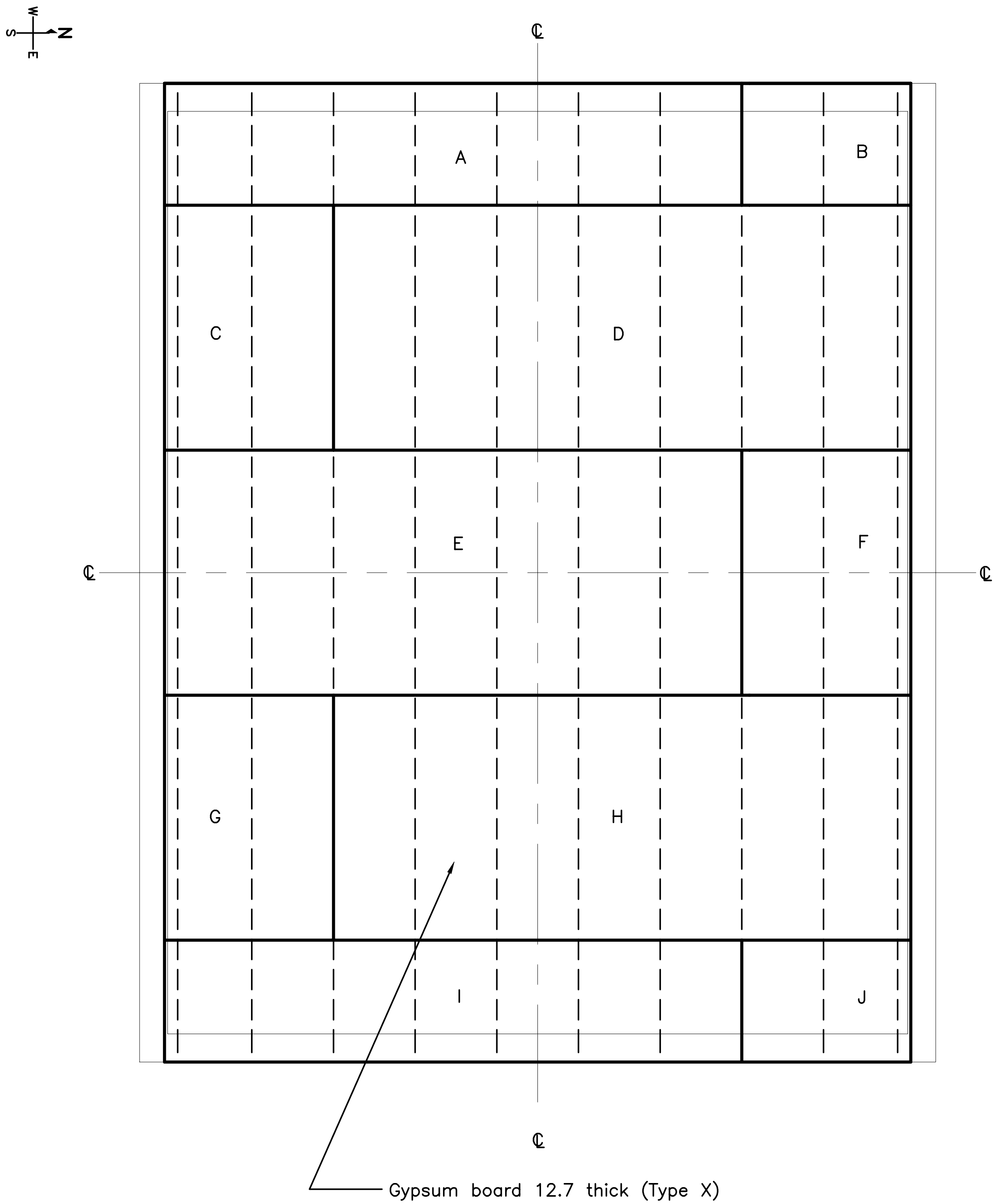
Figure A—39. Insulation Location (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–35)

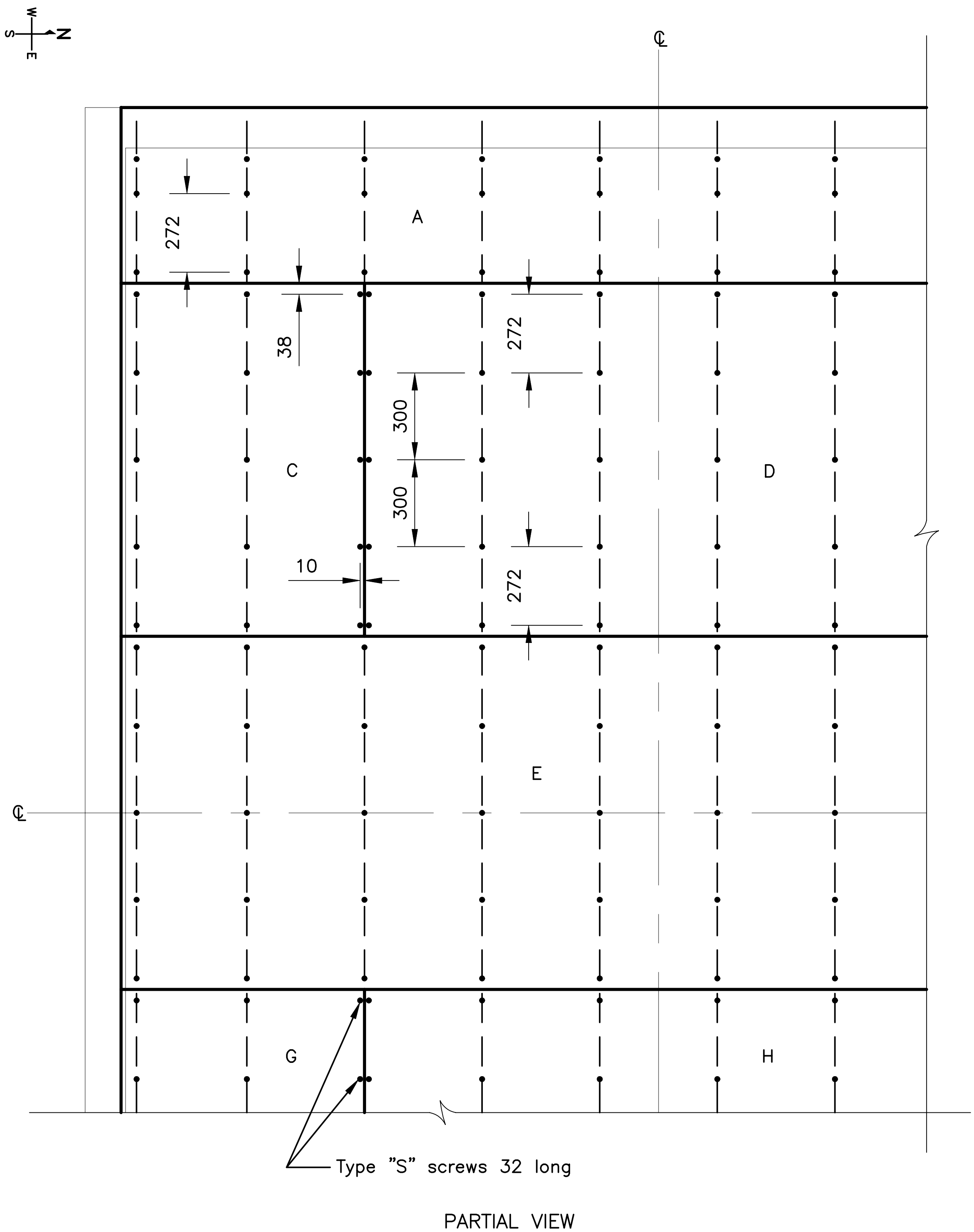
Figure A–40. Resilient Channel Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–35)

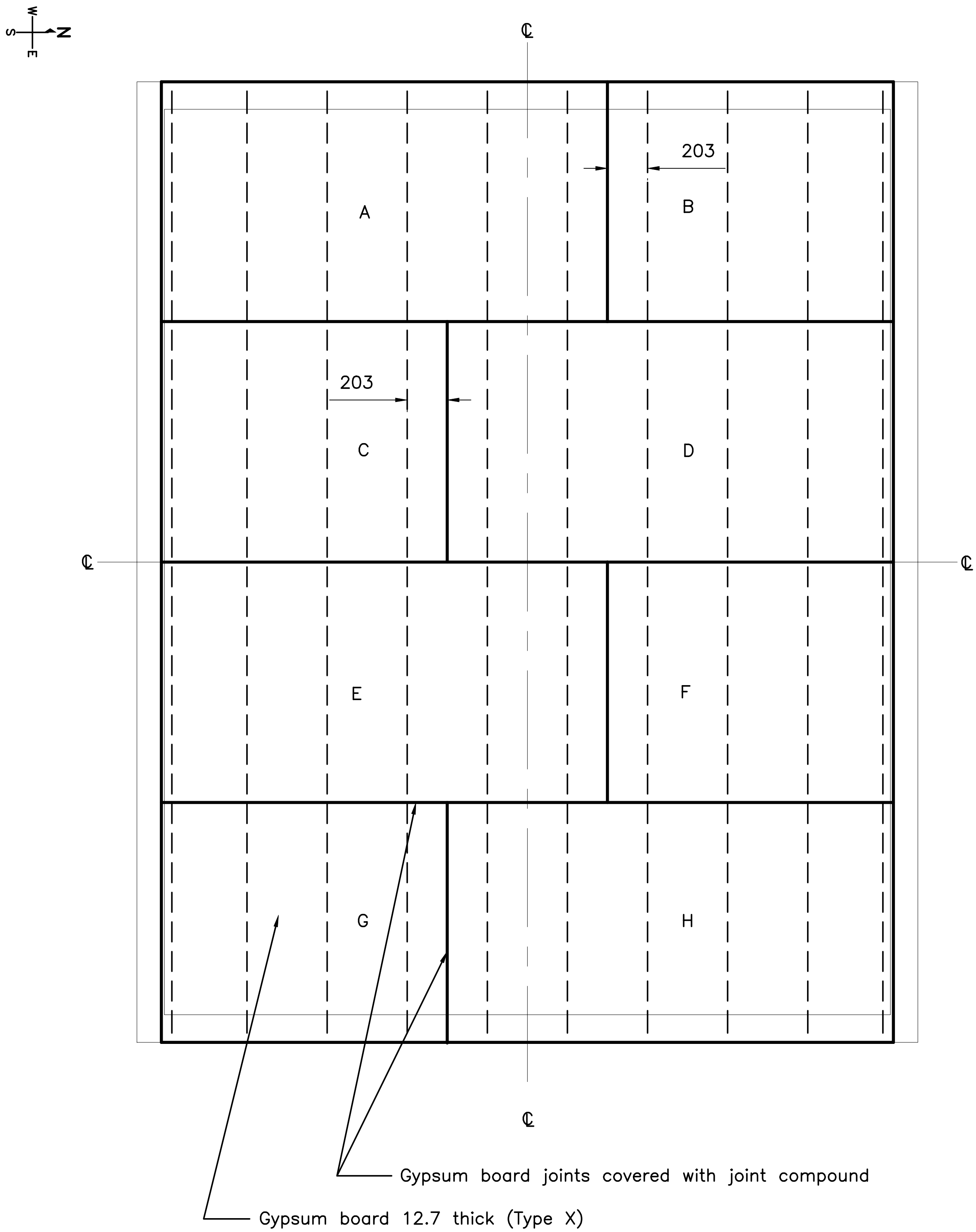
Figure A–41. Gypsum Board Base Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-35)

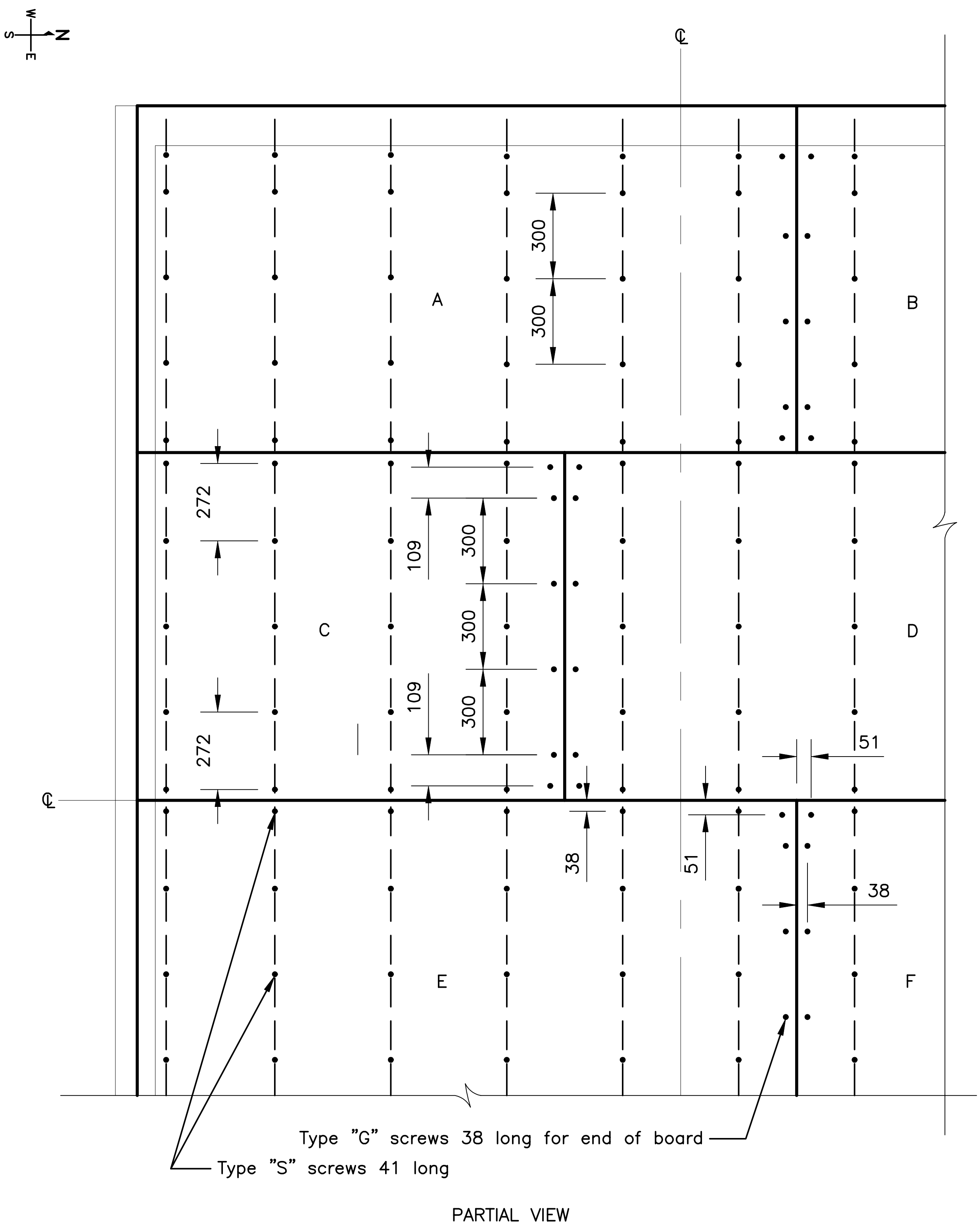
Figure A-42. Gypsum Board Base Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–35)

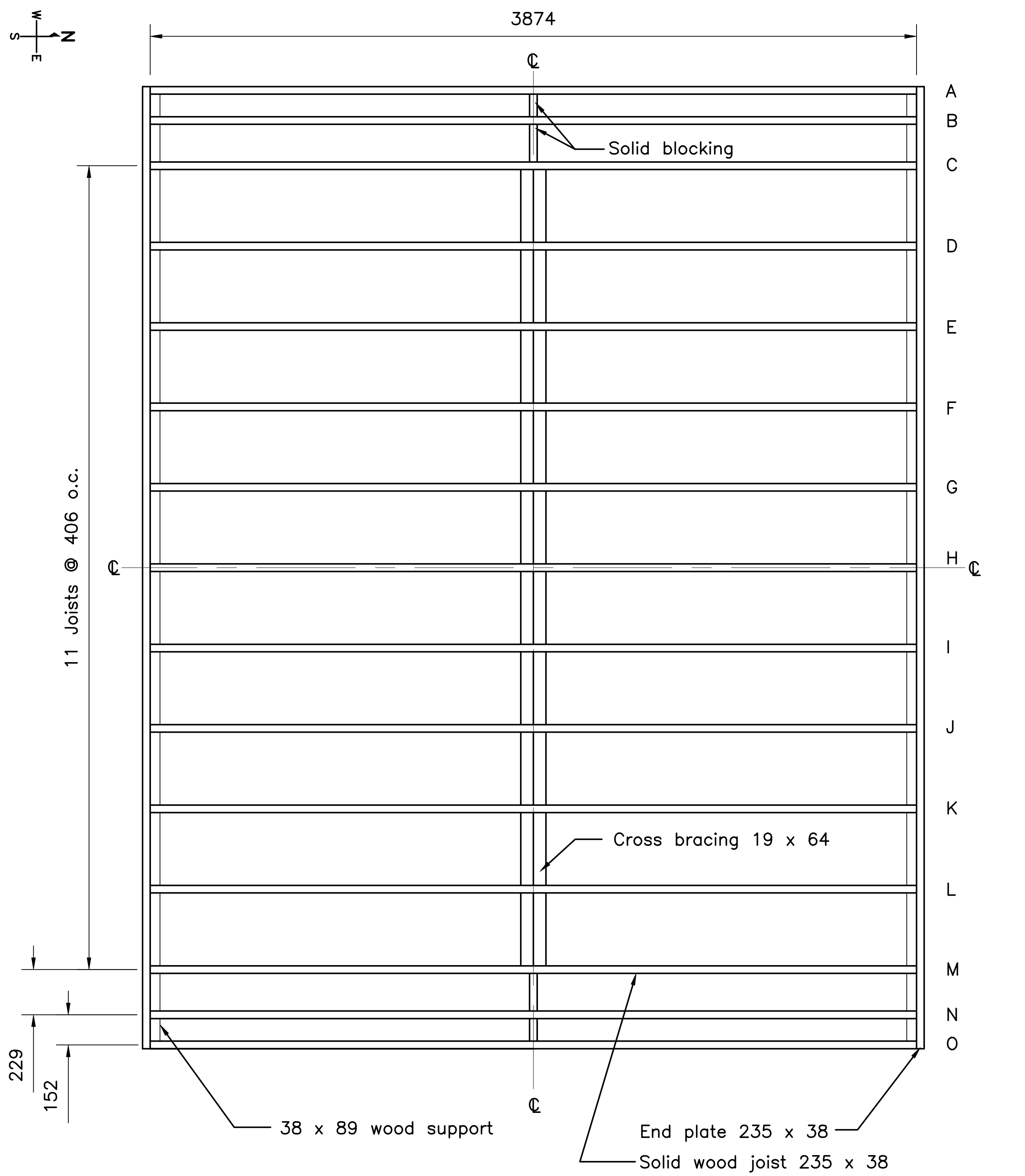
Figure A–43. Gypsum Board Face Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–35)

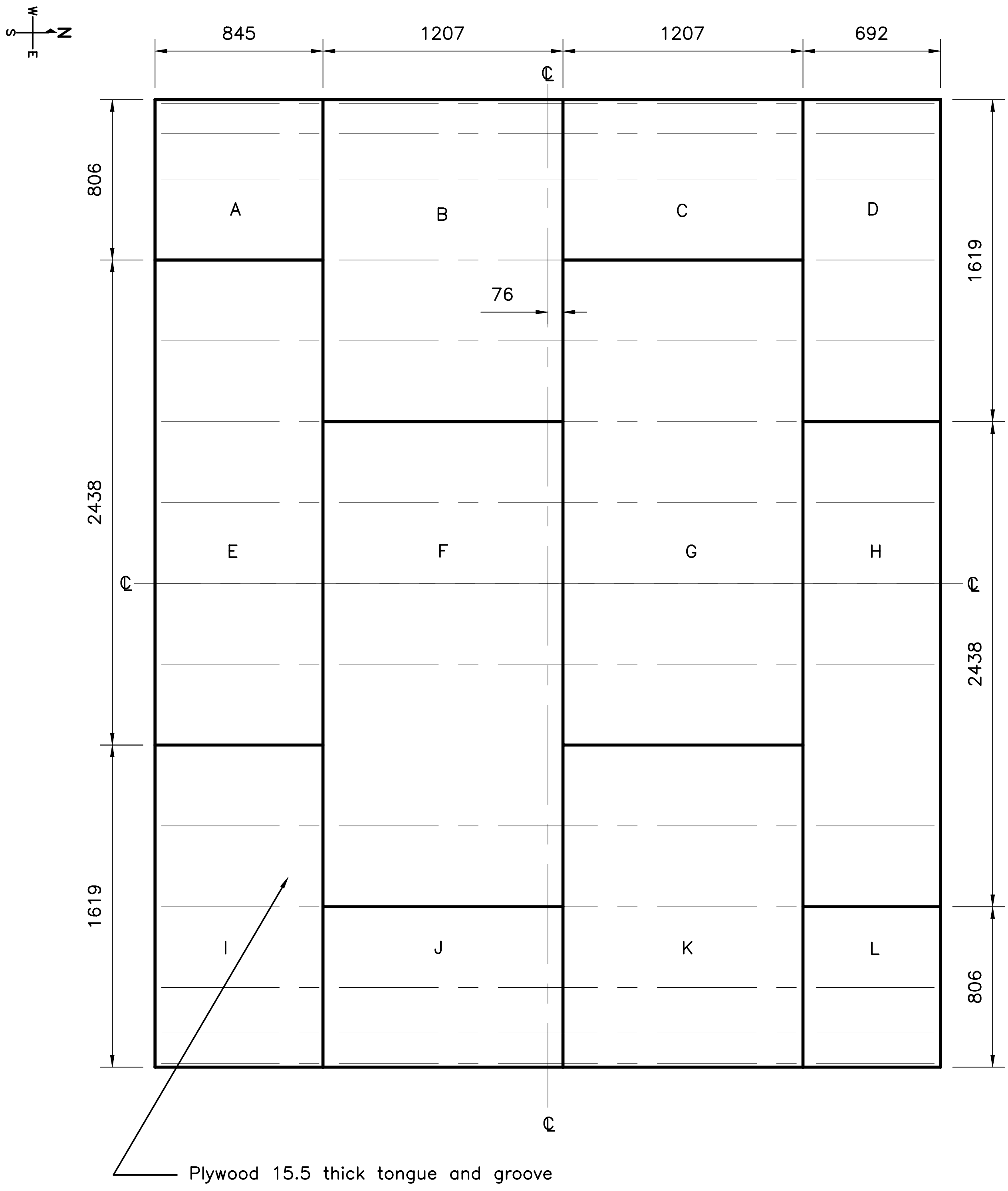
Figure A–44. Gypsum Board Face Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–36)

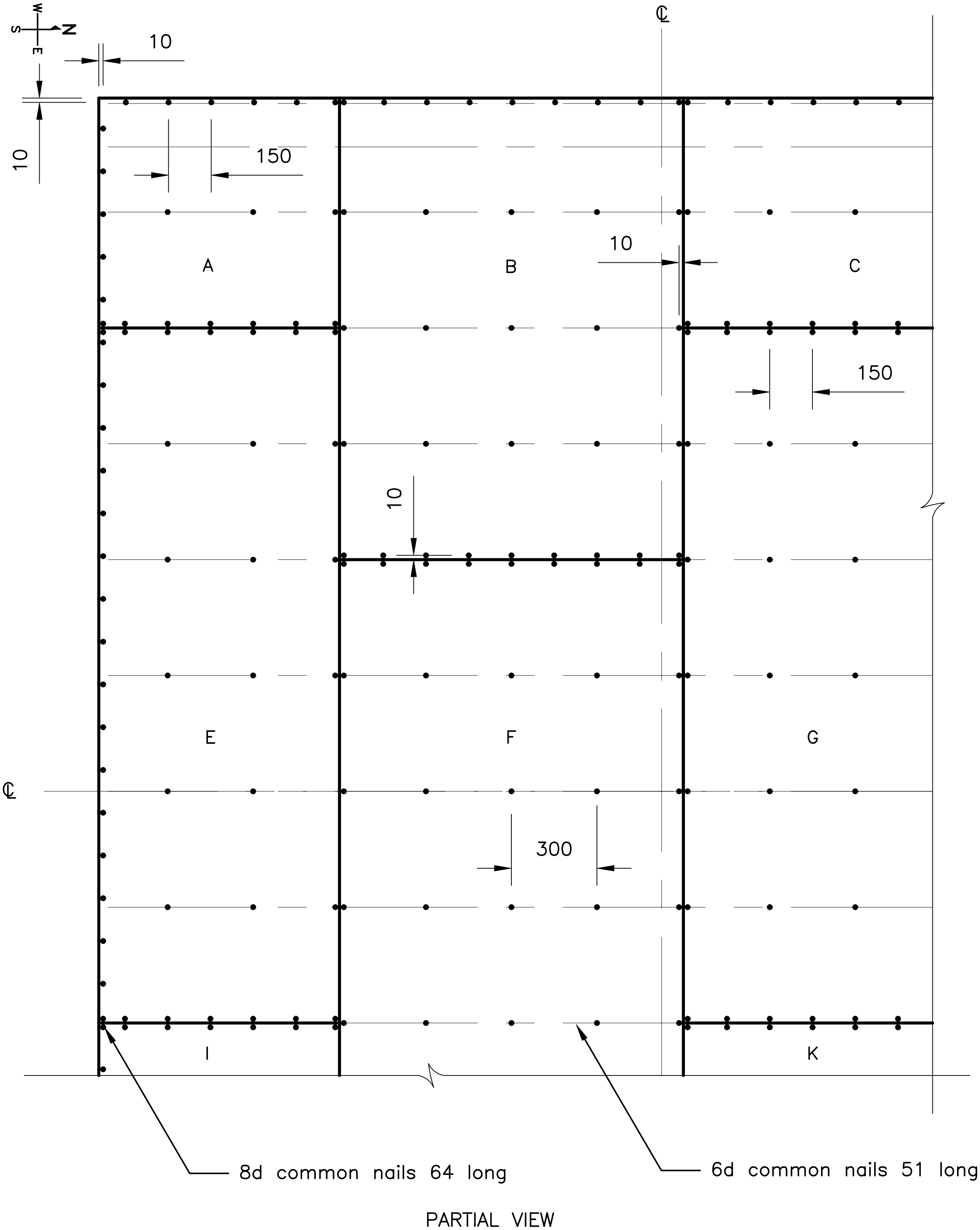
Figure A–45. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–36)

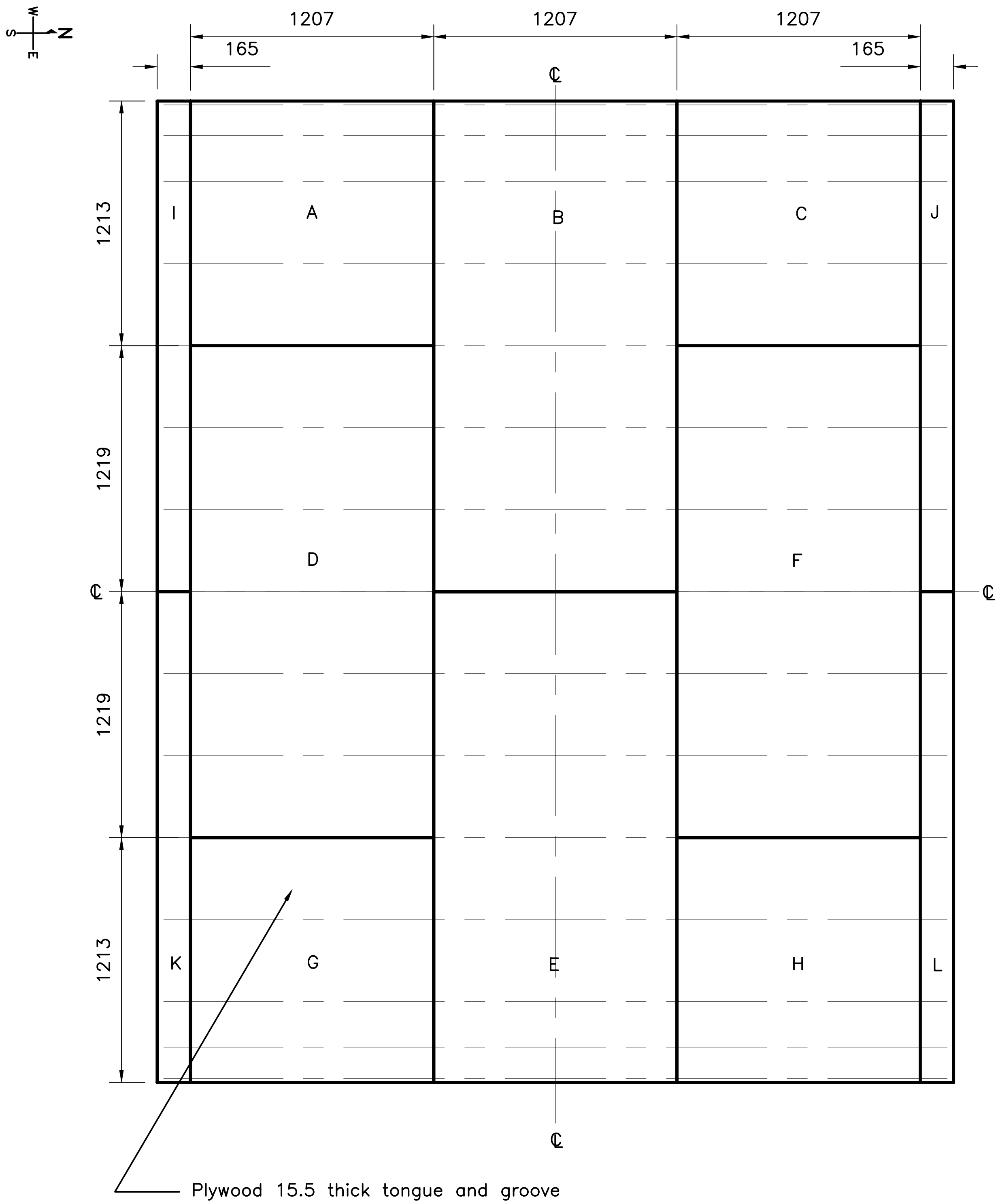
Figure A–46. Subfloor Layout Base Layer (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-36)

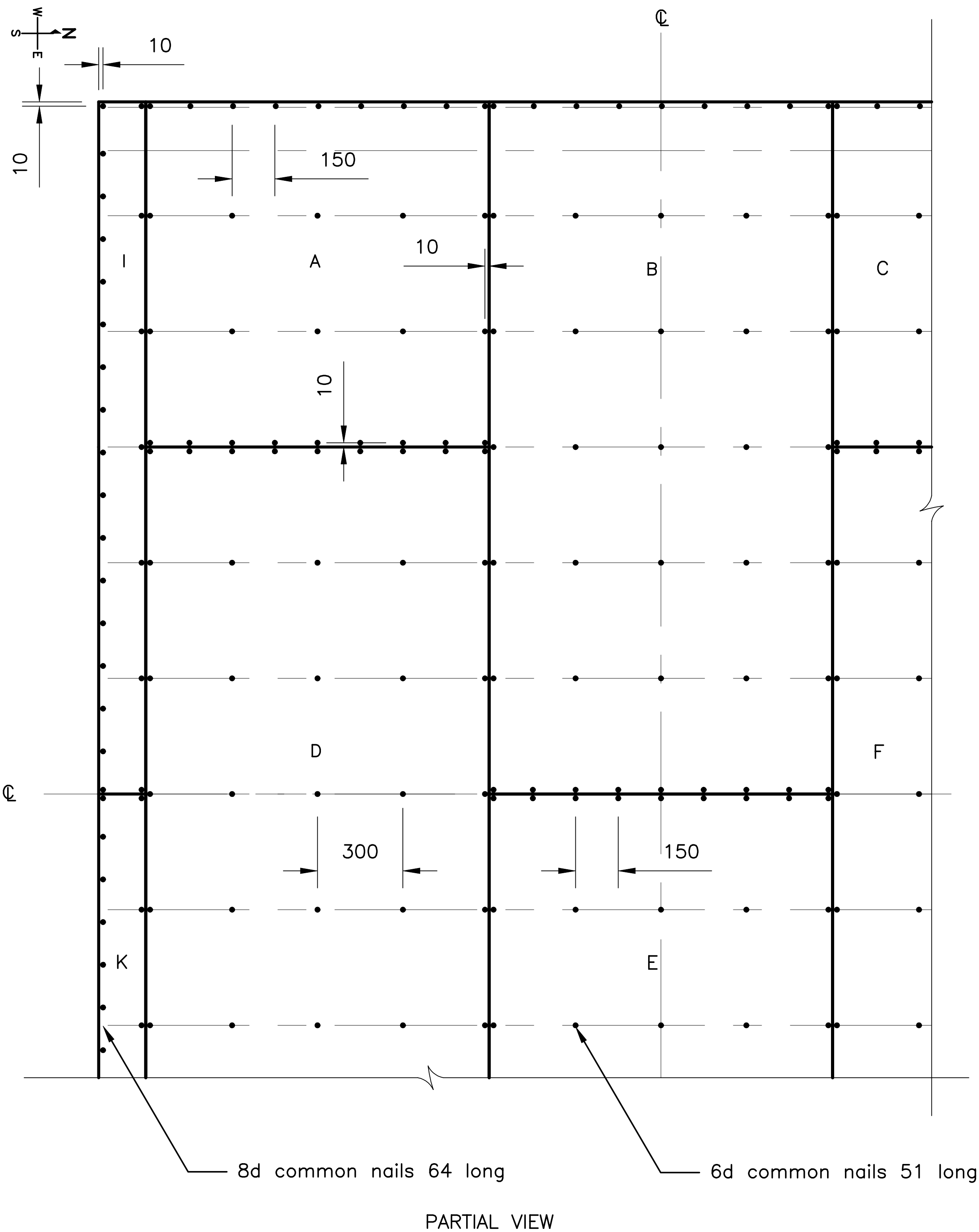
Figure A-47. Subfloor Nail Pattern Base Layer (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–36)

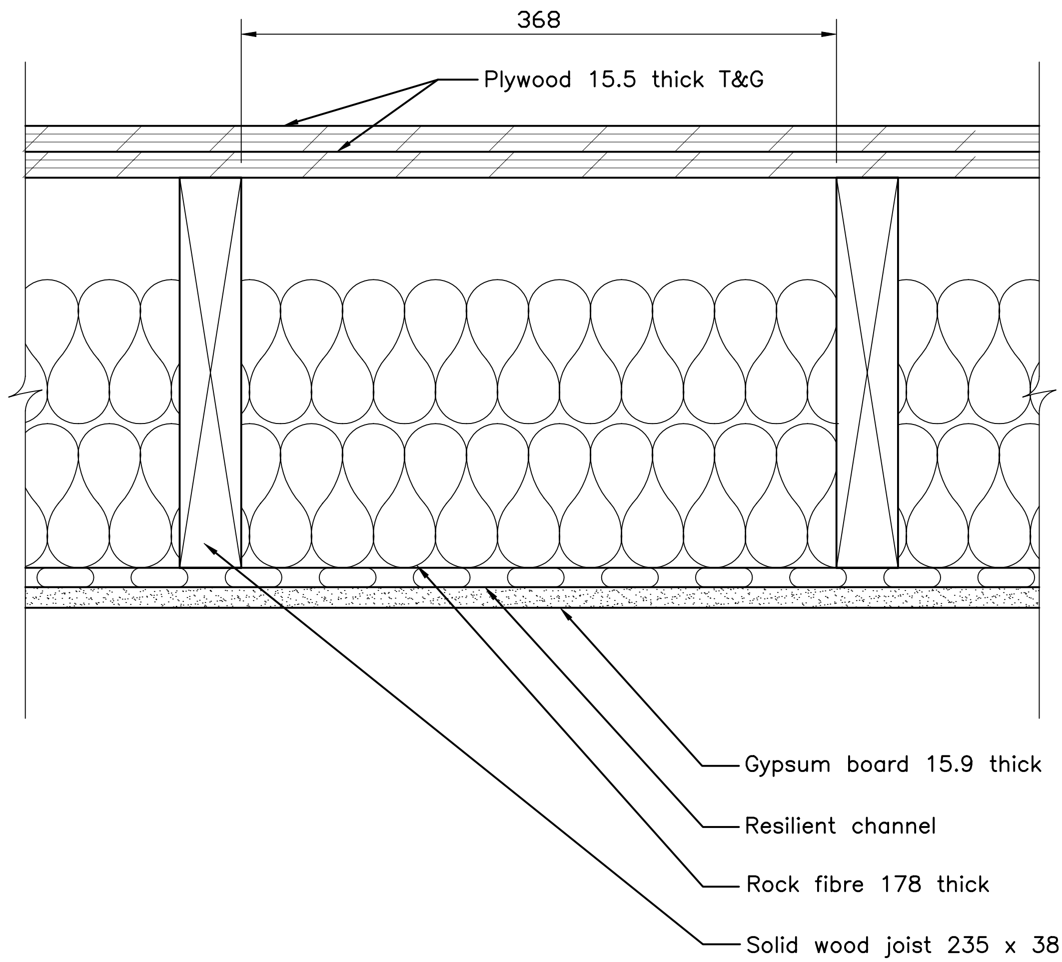
Figure A–48. Subfloor Layout Face Layer (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–36)

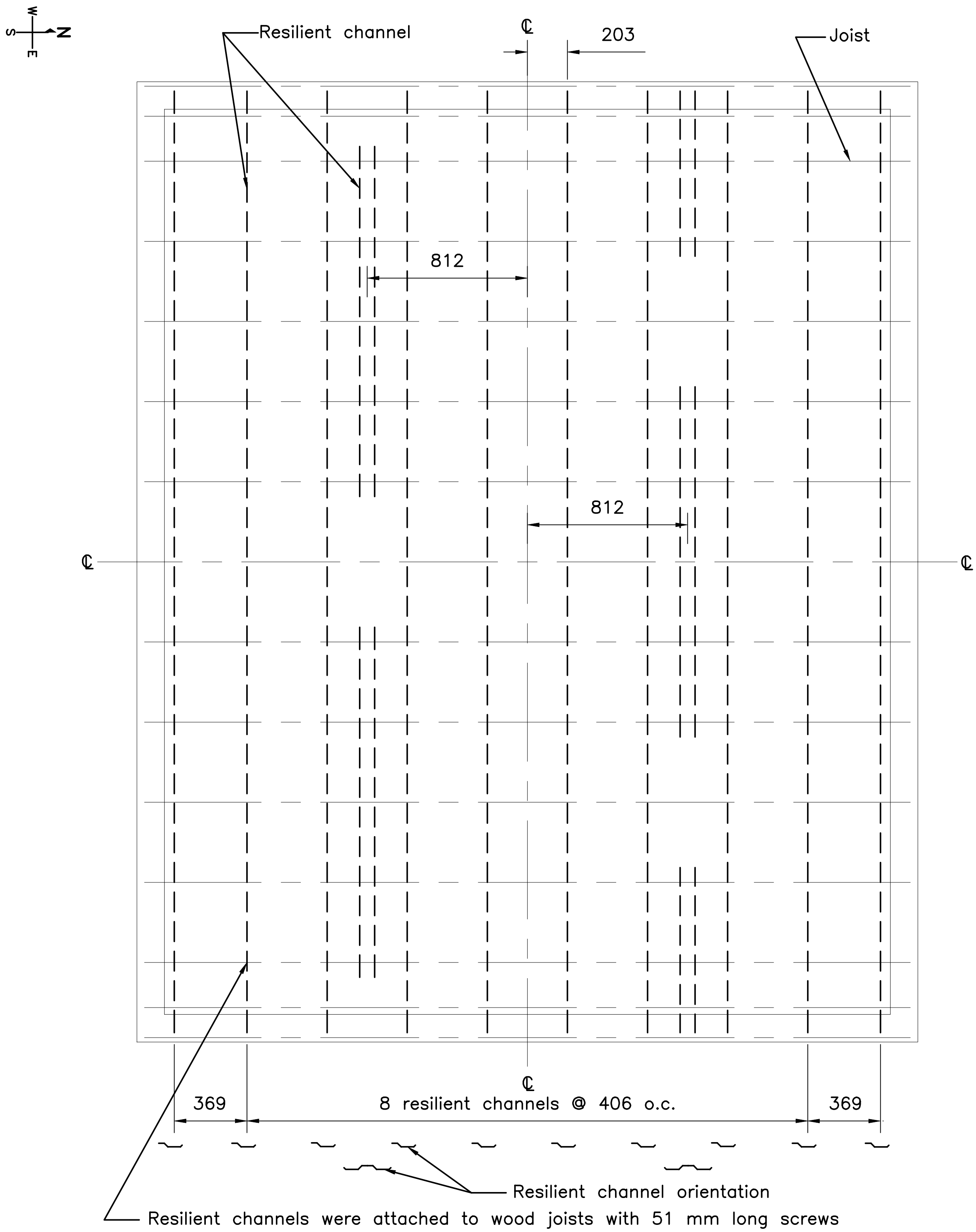
Figure A–49. Subfloor Nail Pattern Face Layer (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-36)

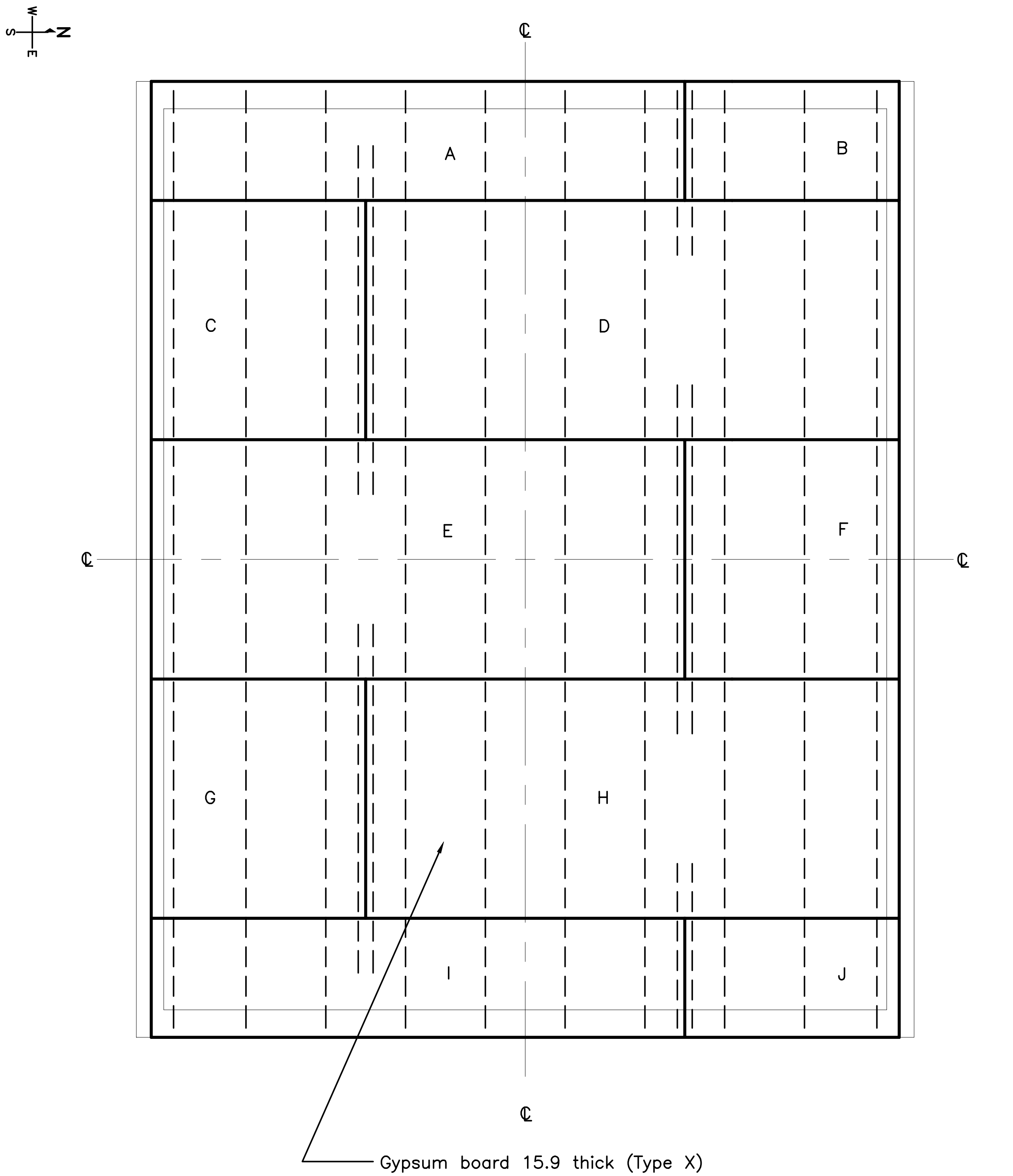
Figure A-50. Insulation Location (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–36)

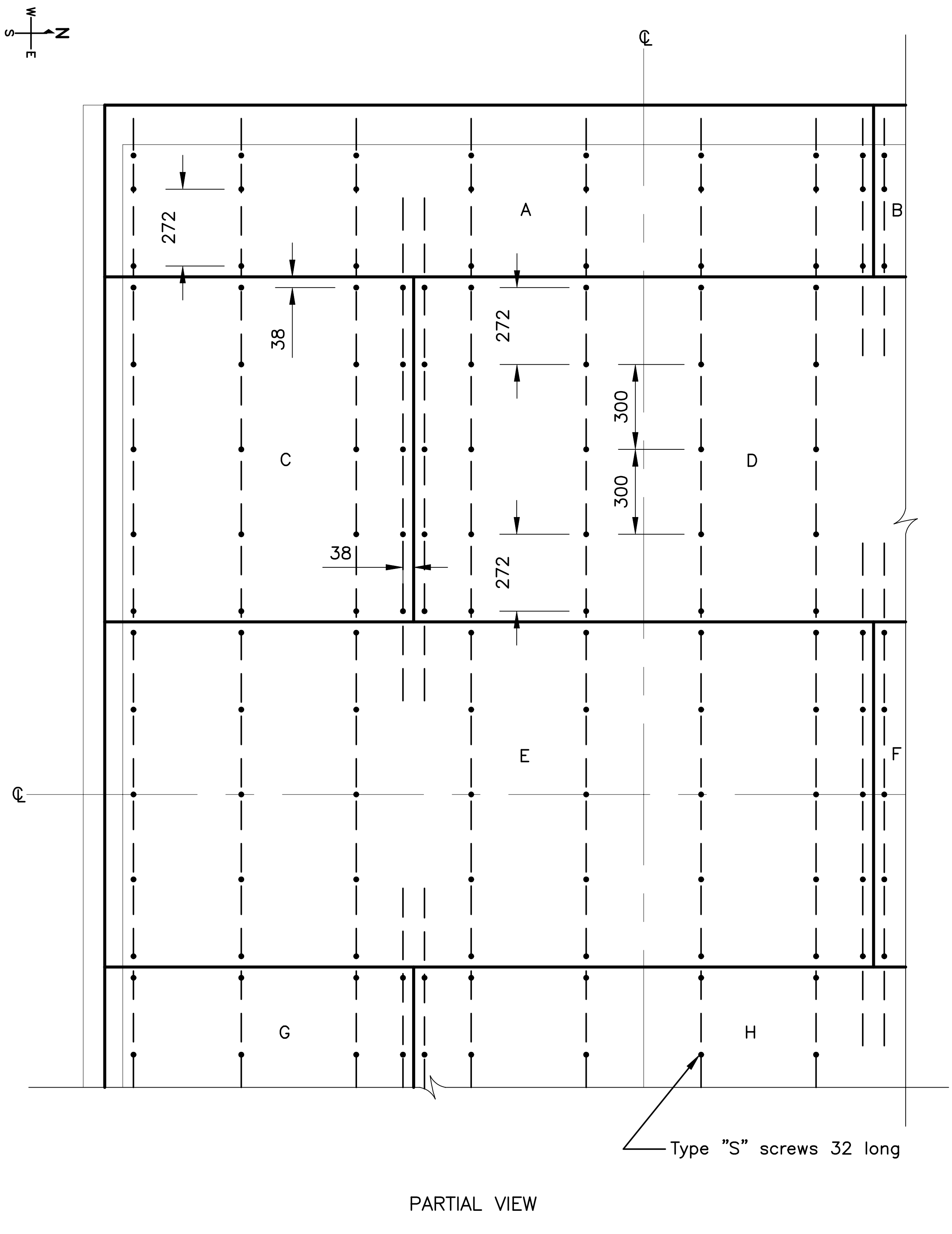
Figure A–51. Resilient Channel Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–36)

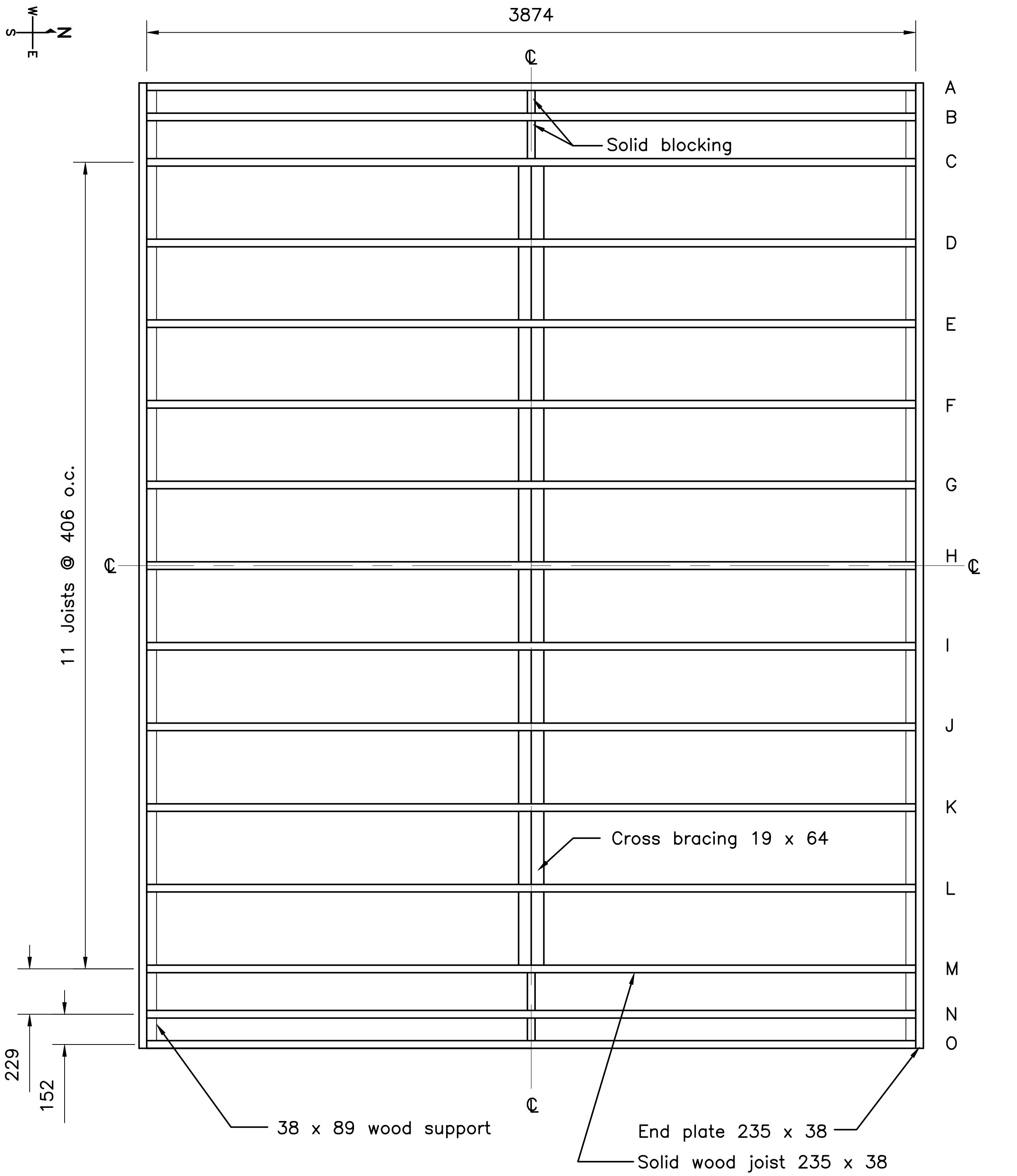
Figure A–52. Gypsum Board Single Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–36)

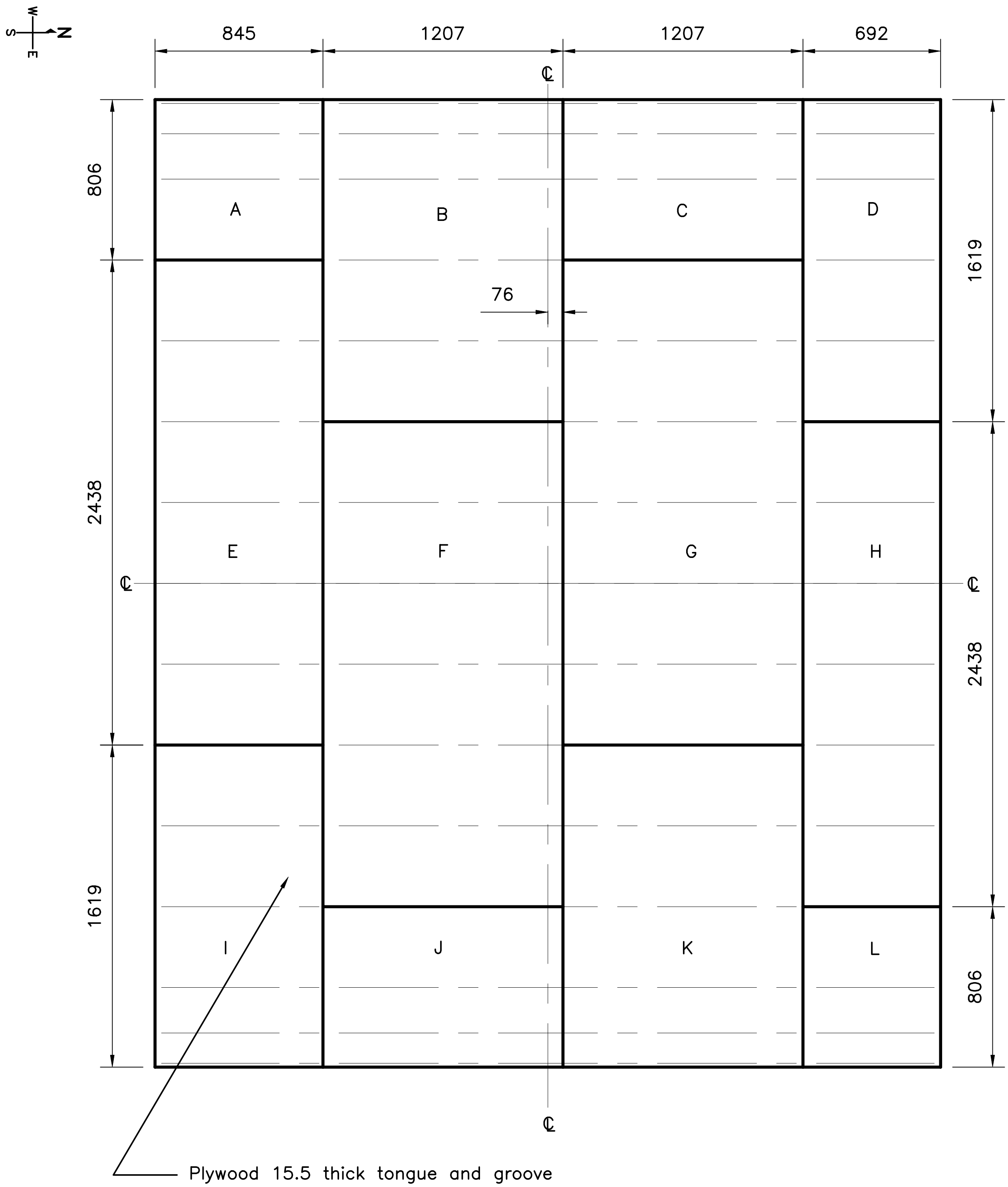
Figure A–53. Gypsum Board Single Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–49)

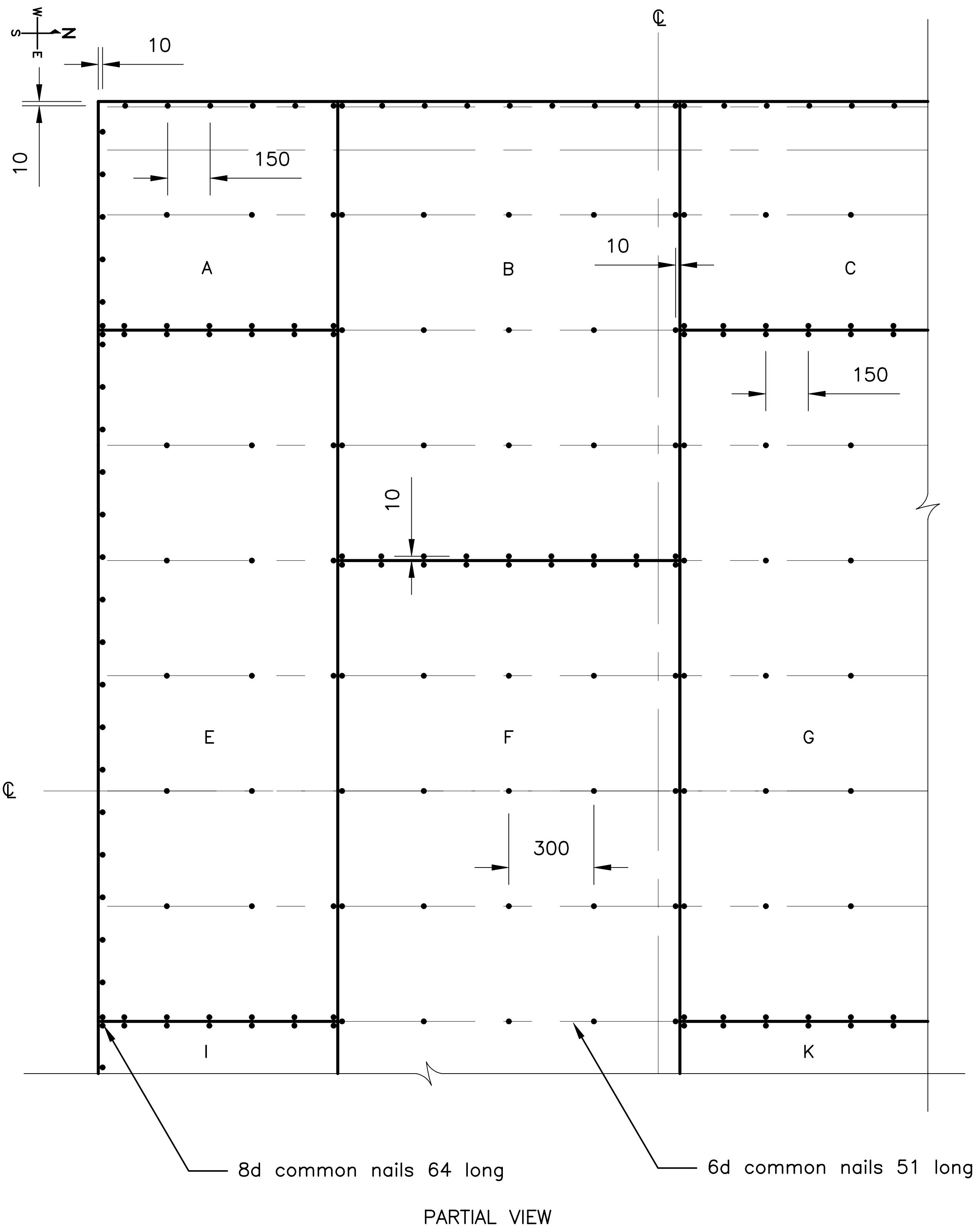
Figure A–54. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–49)

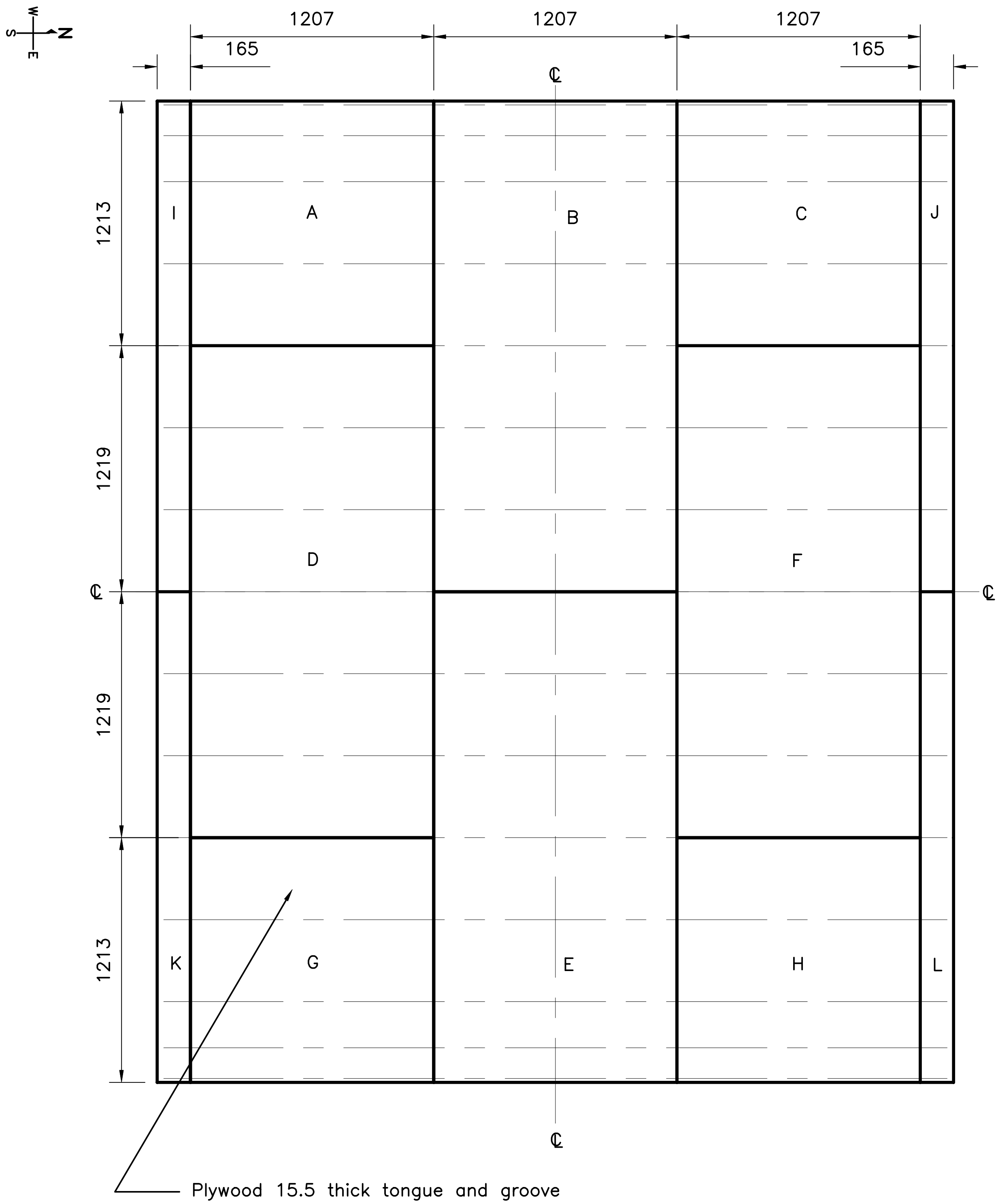
Figure A–55. Subfloor Layout Base Layer (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–49)

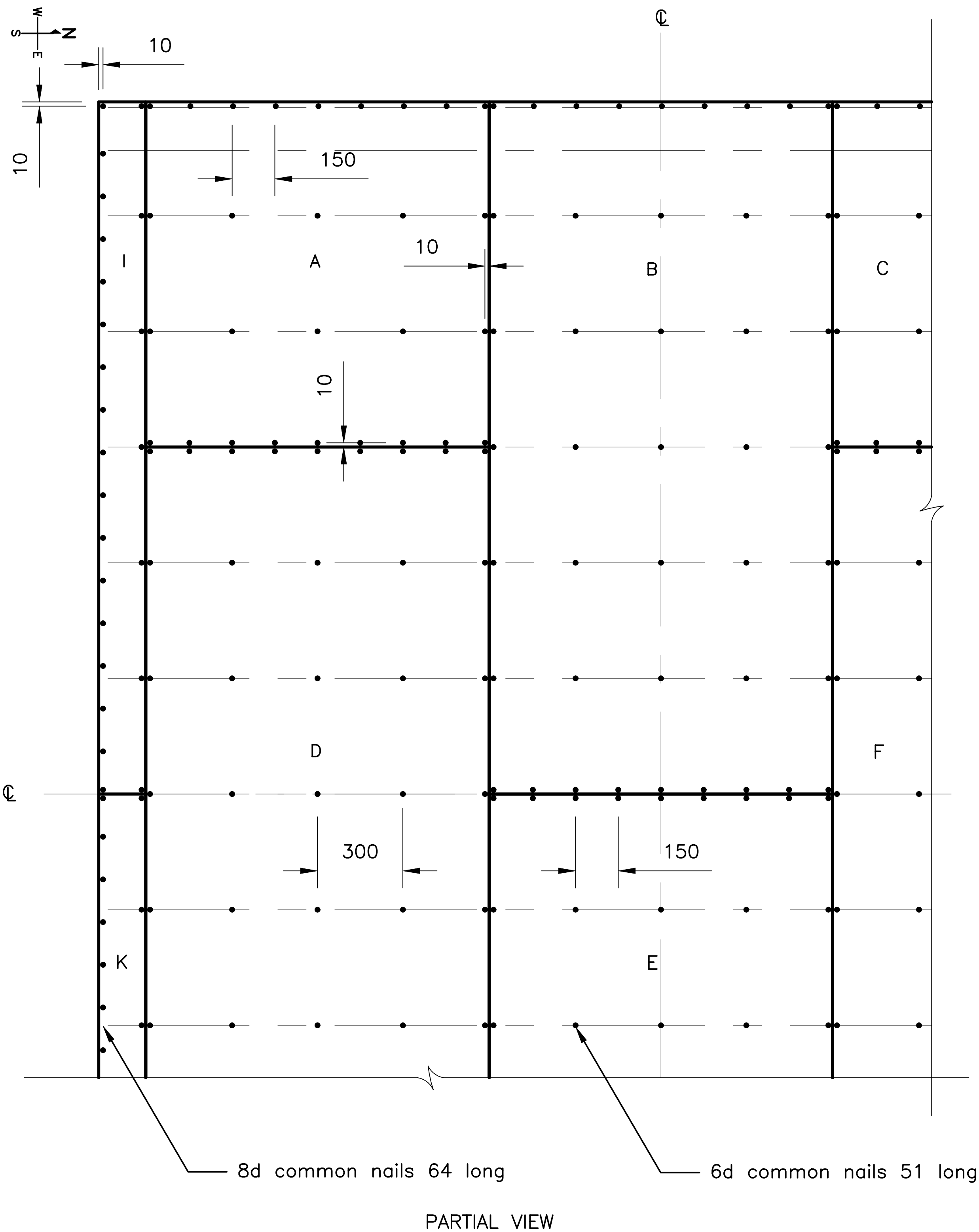
Figure A–56. Subfloor Nail Pattern Base Layer (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–49)

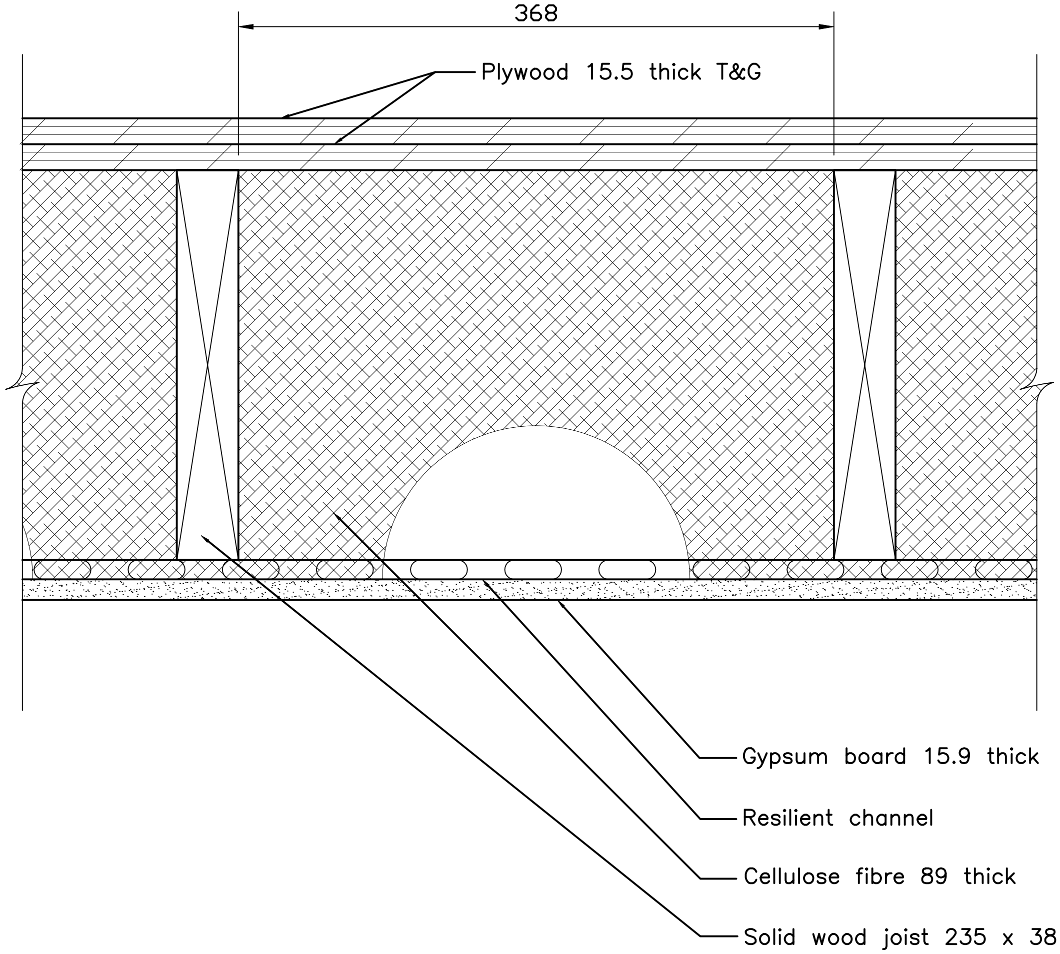
Figure A–57. Subfloor Layout Face Layer (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–49)

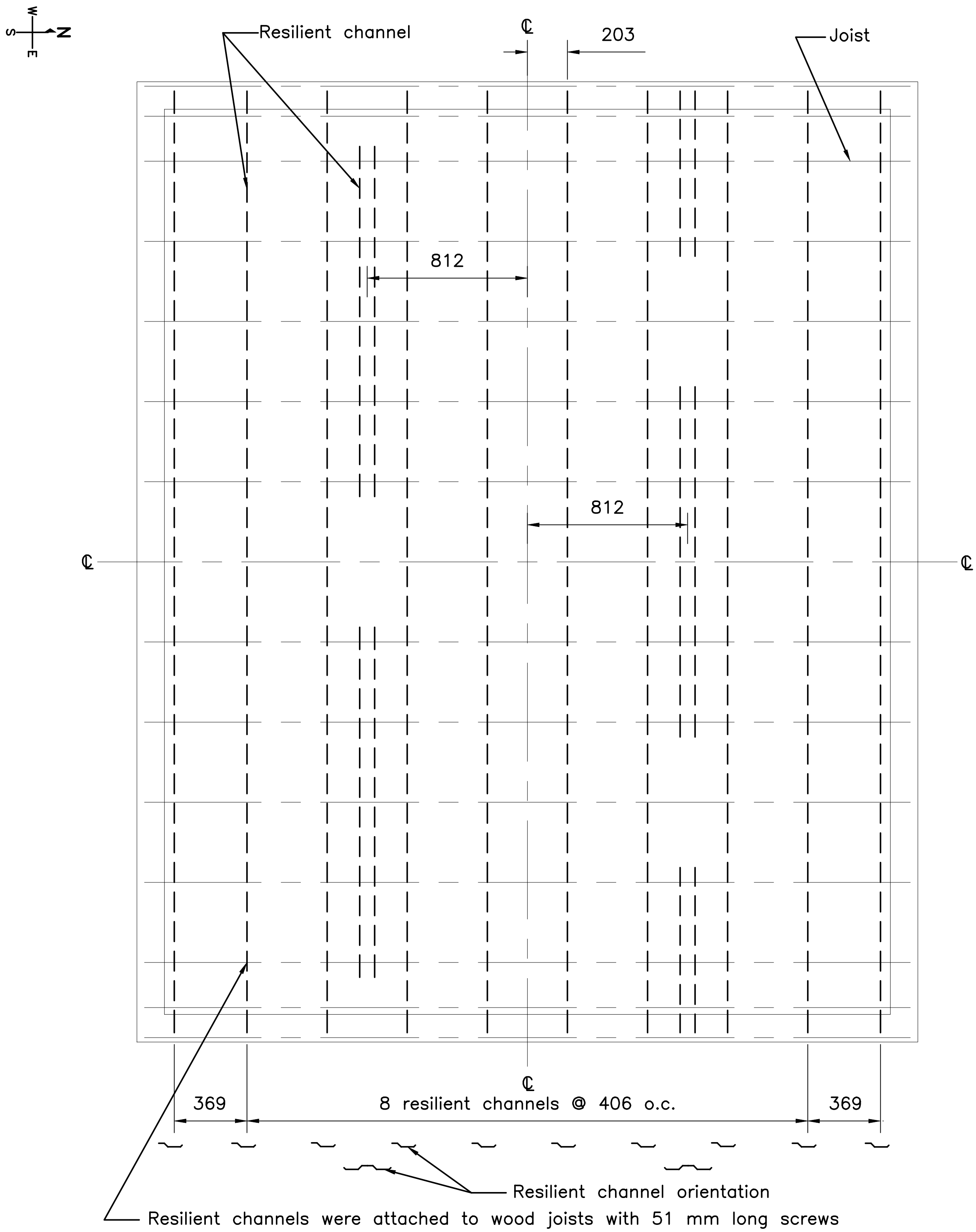
Figure A–58. Subfloor Nail Pattern Face Layer (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–49)

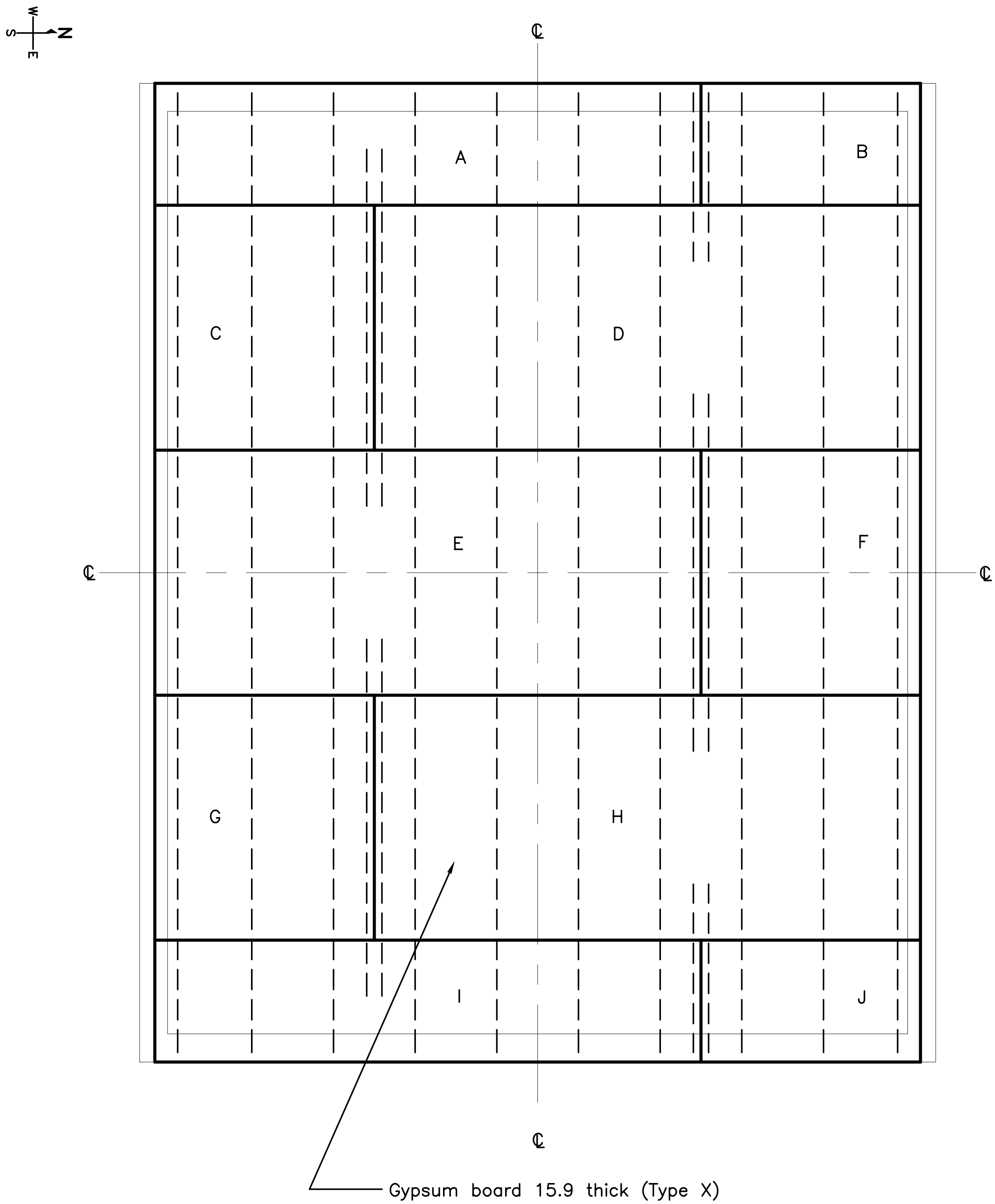
Figure A–59. Insulation Location (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–49)

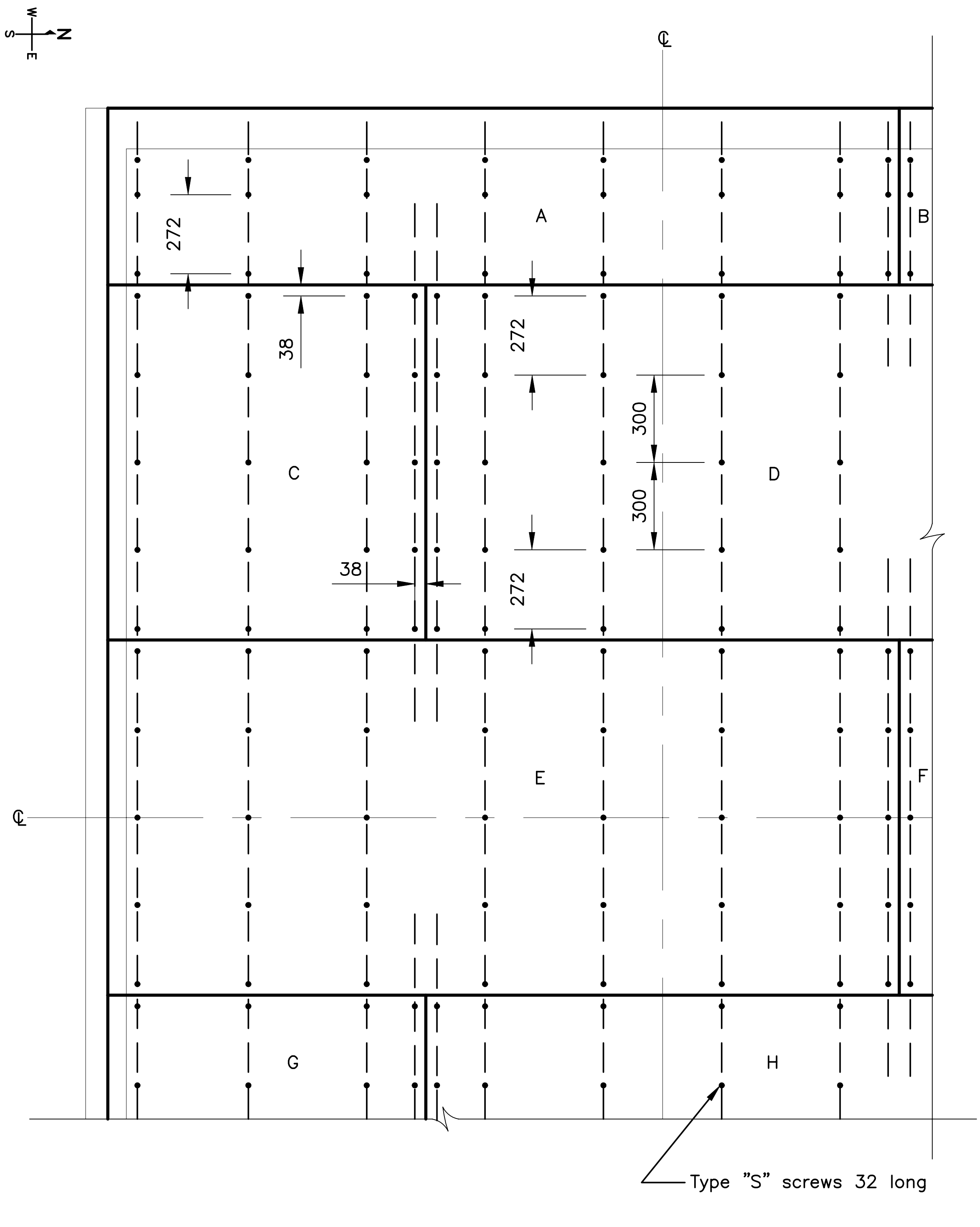
Figure A–60. Resilient Channel Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–49)

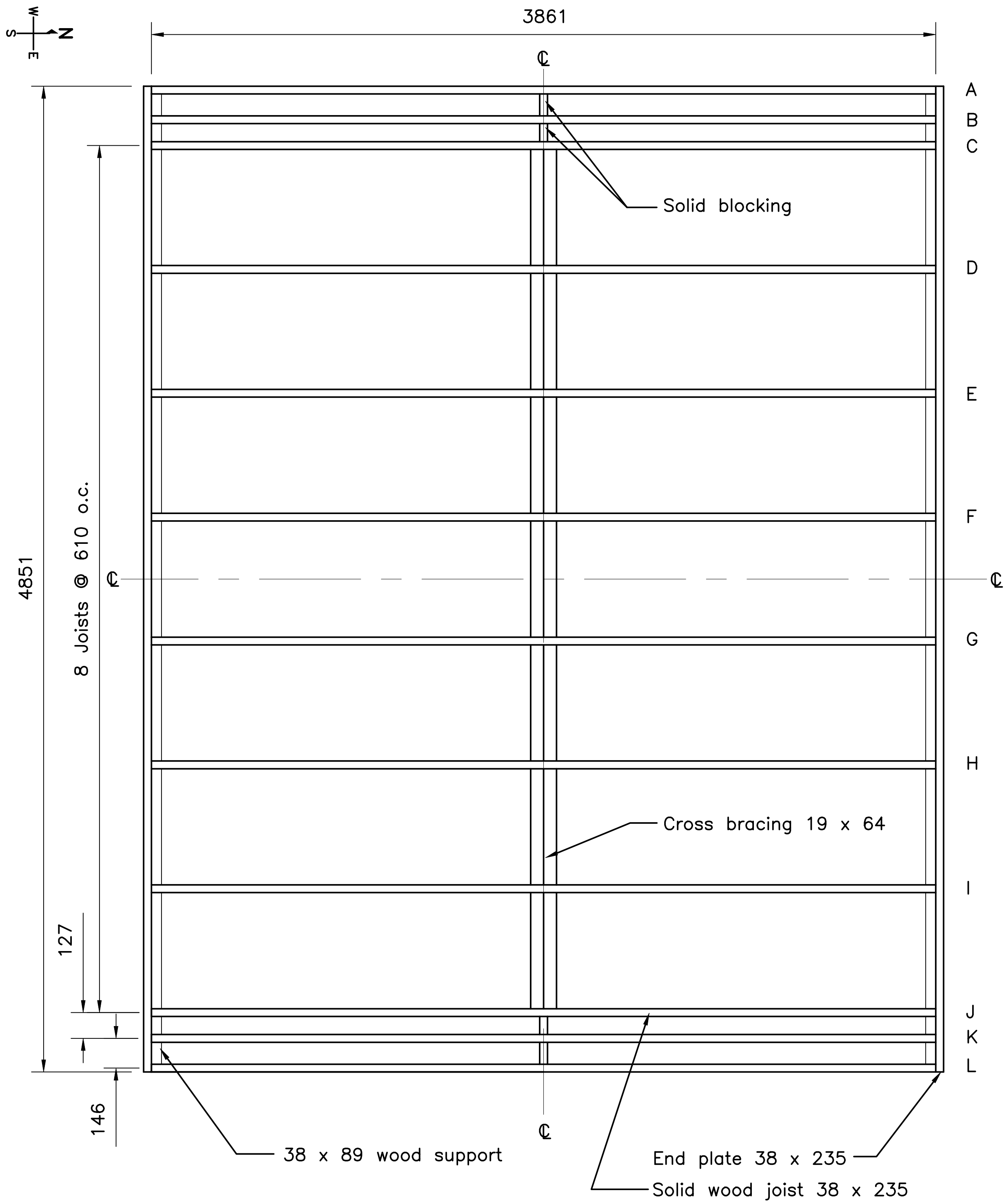
Figure A–61. Gypsum Board Single Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–49)

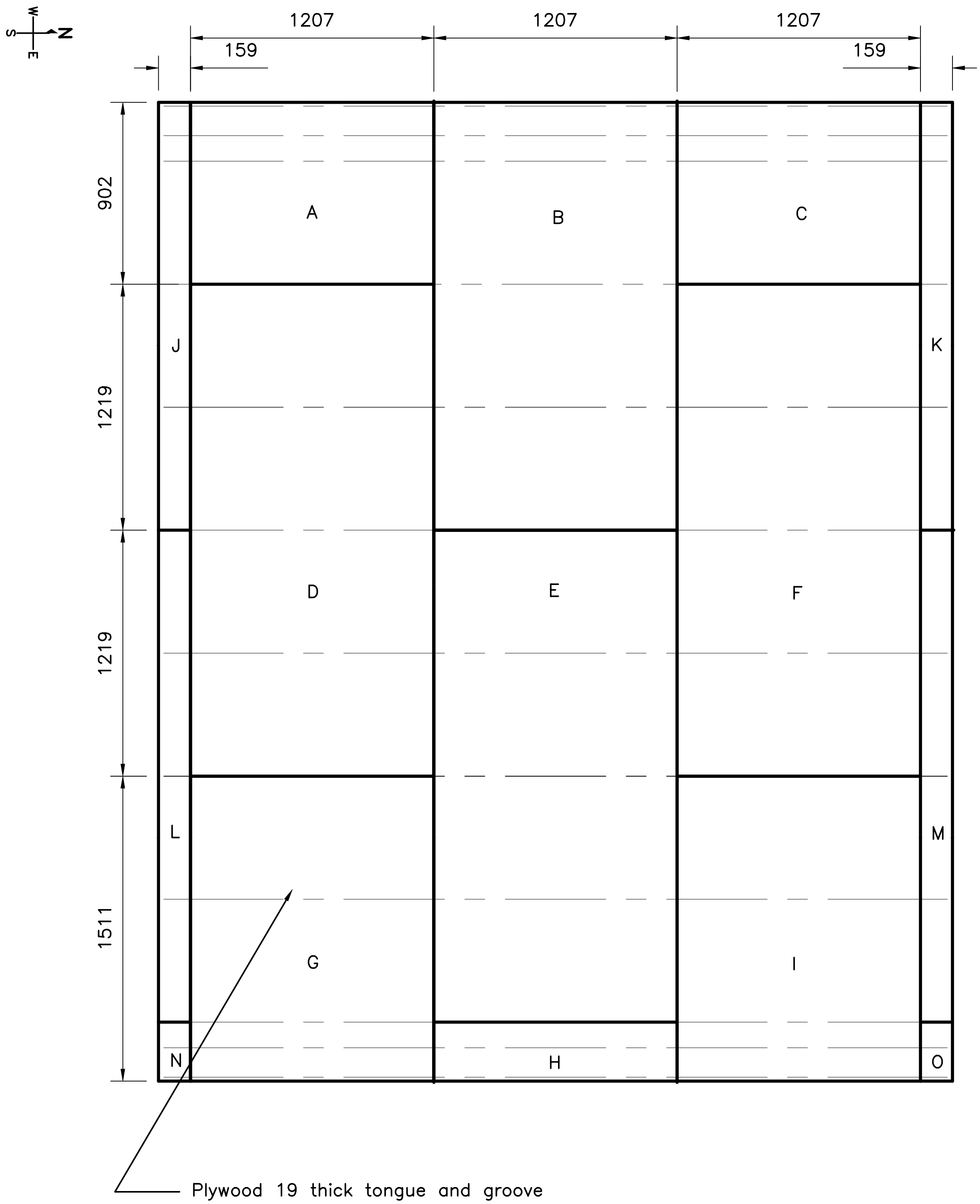
Figure A–62. Gypsum Board Single Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–64)

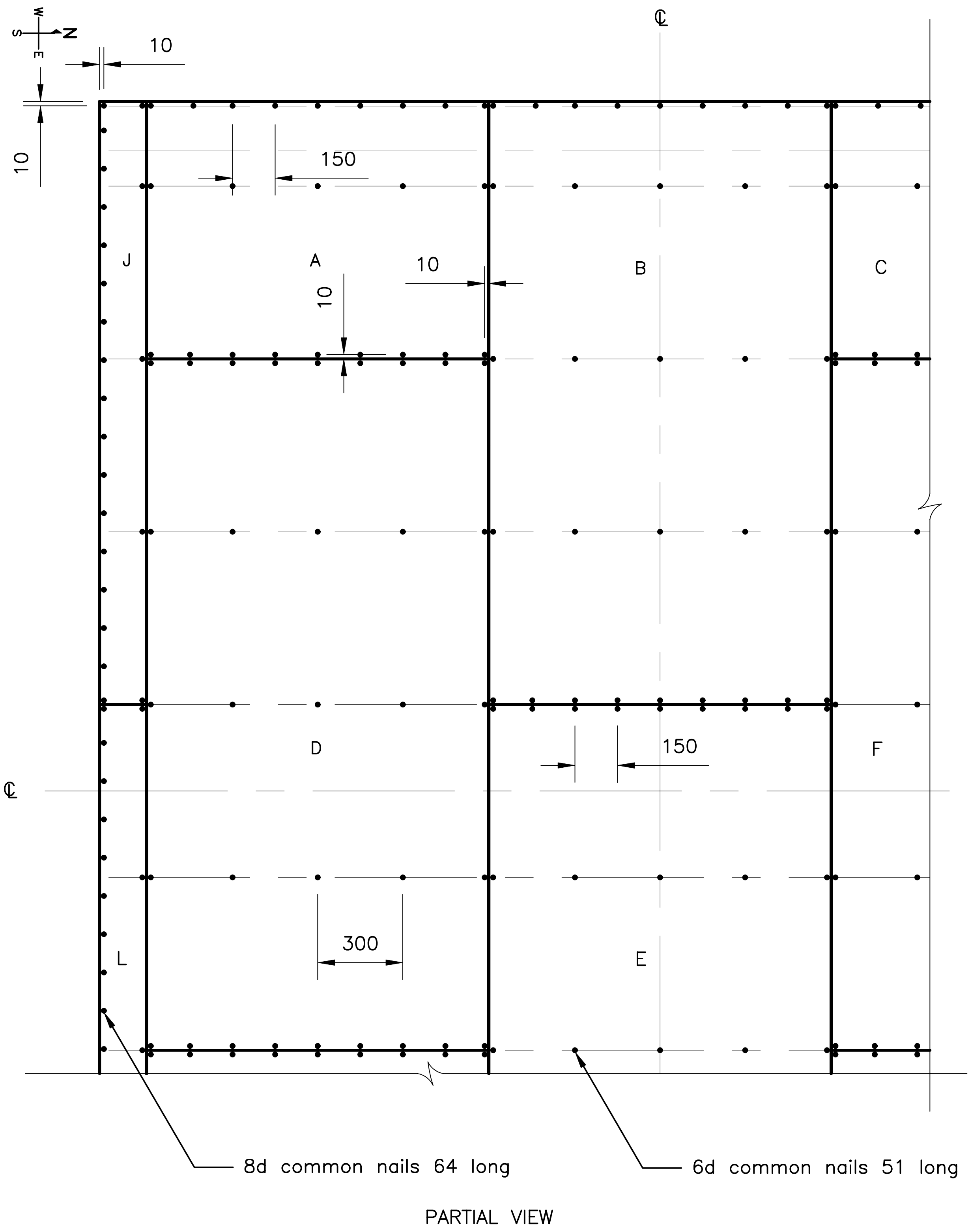
Figure A–63. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–64)

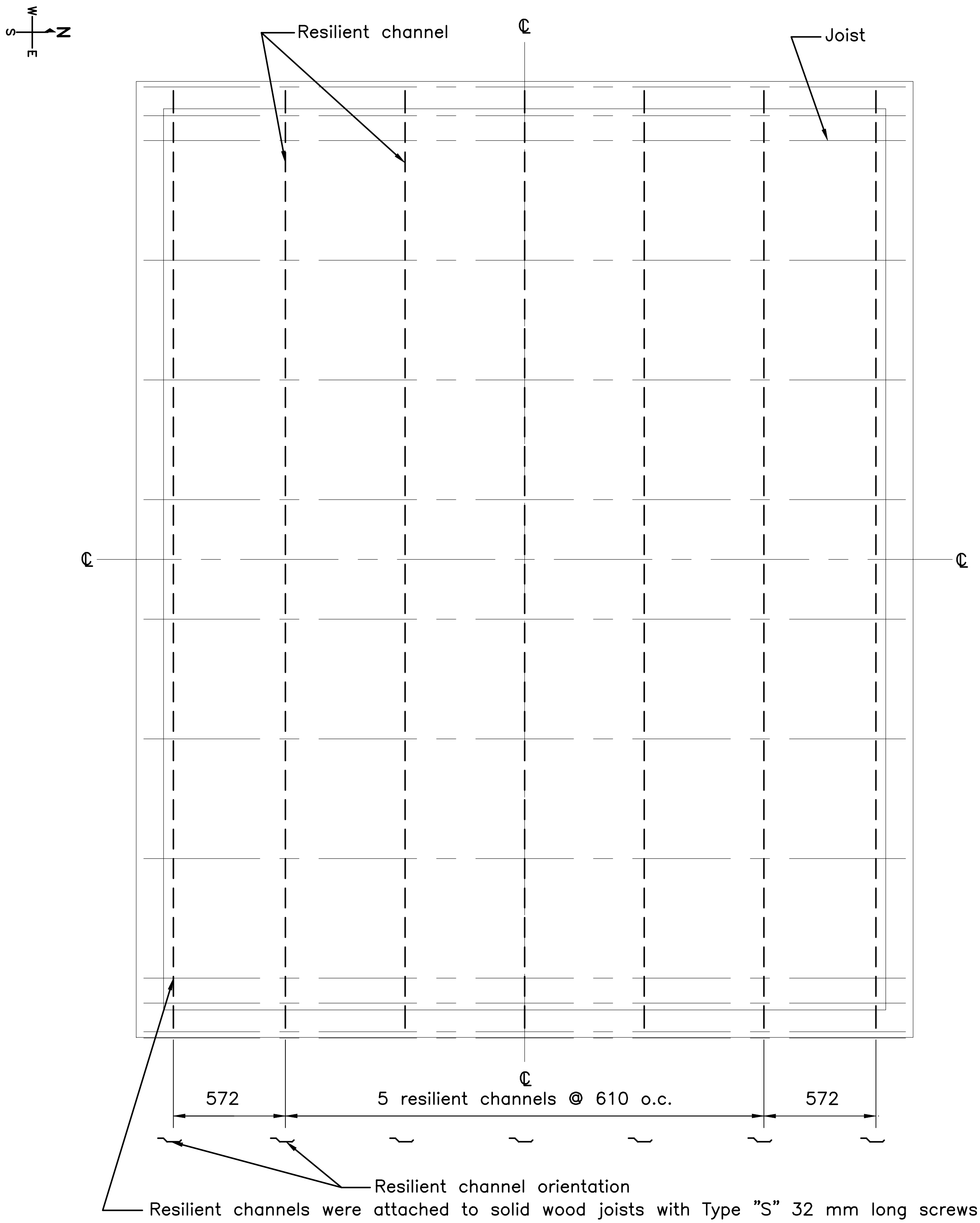
Figure A–64. Subfloor Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–64)

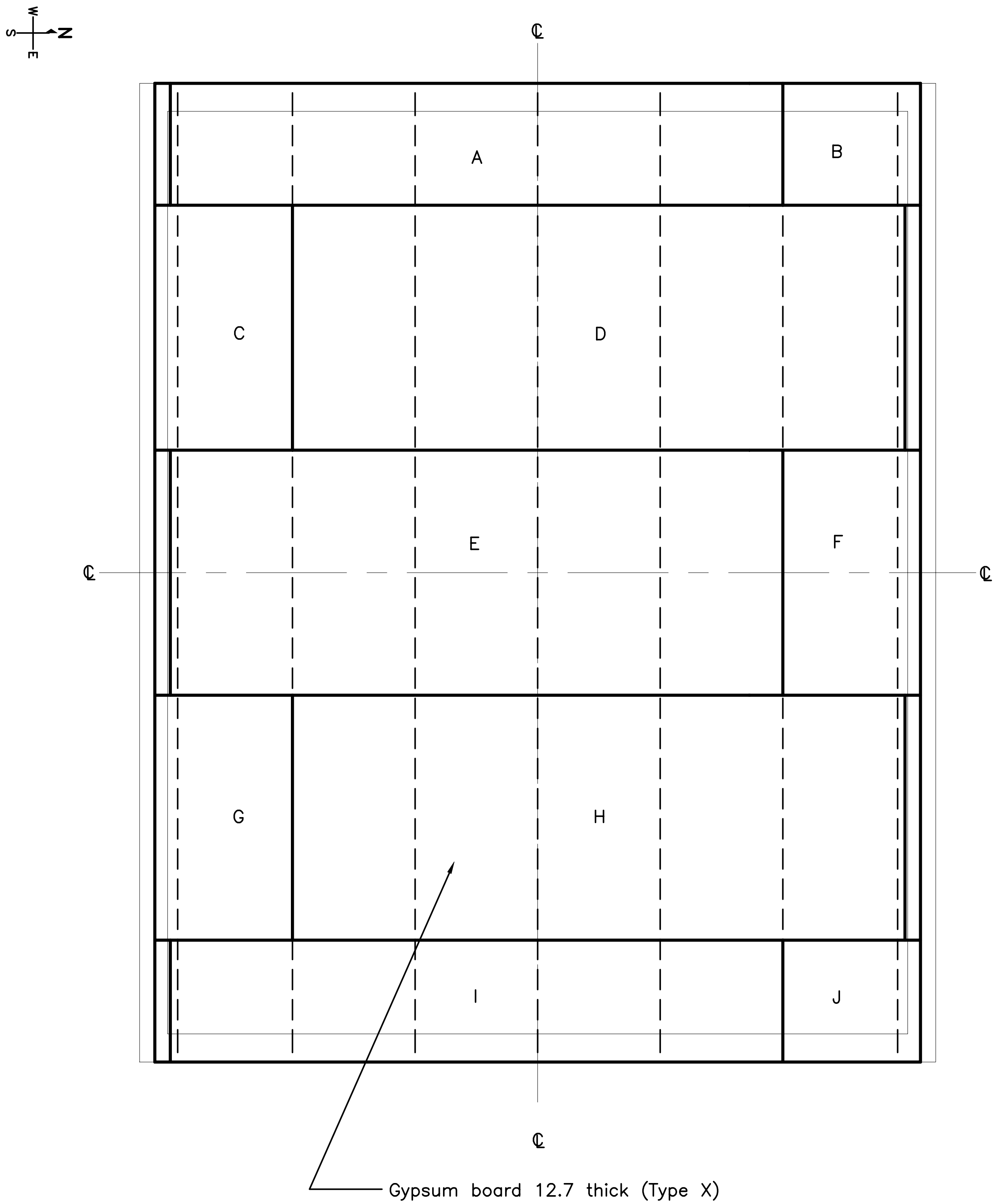
Figure A–65. Subfloor Nail Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-64)

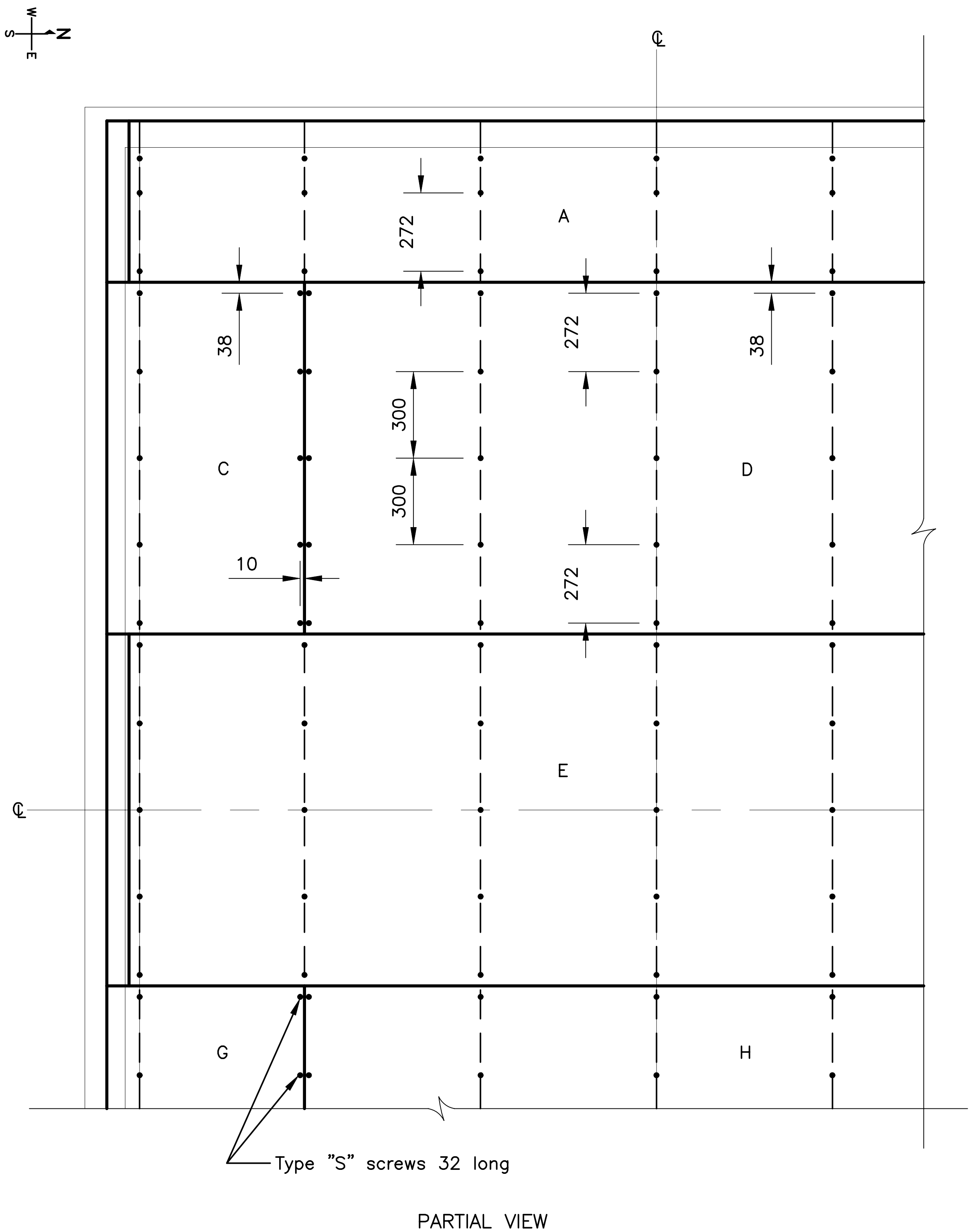
Figure A-66. Resilient Channel Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-64)

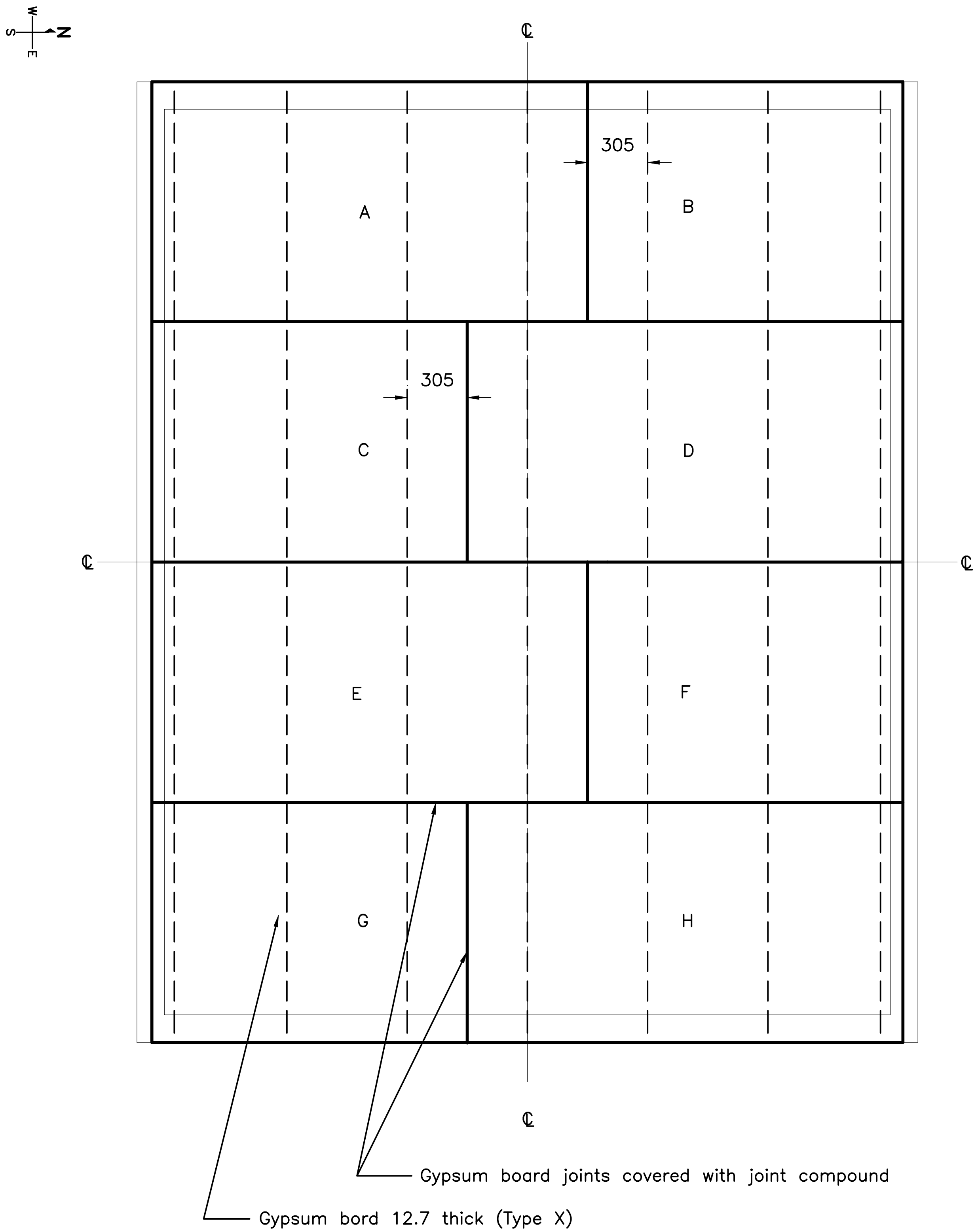
Figure A-67. Gypsum Board Base Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–64)

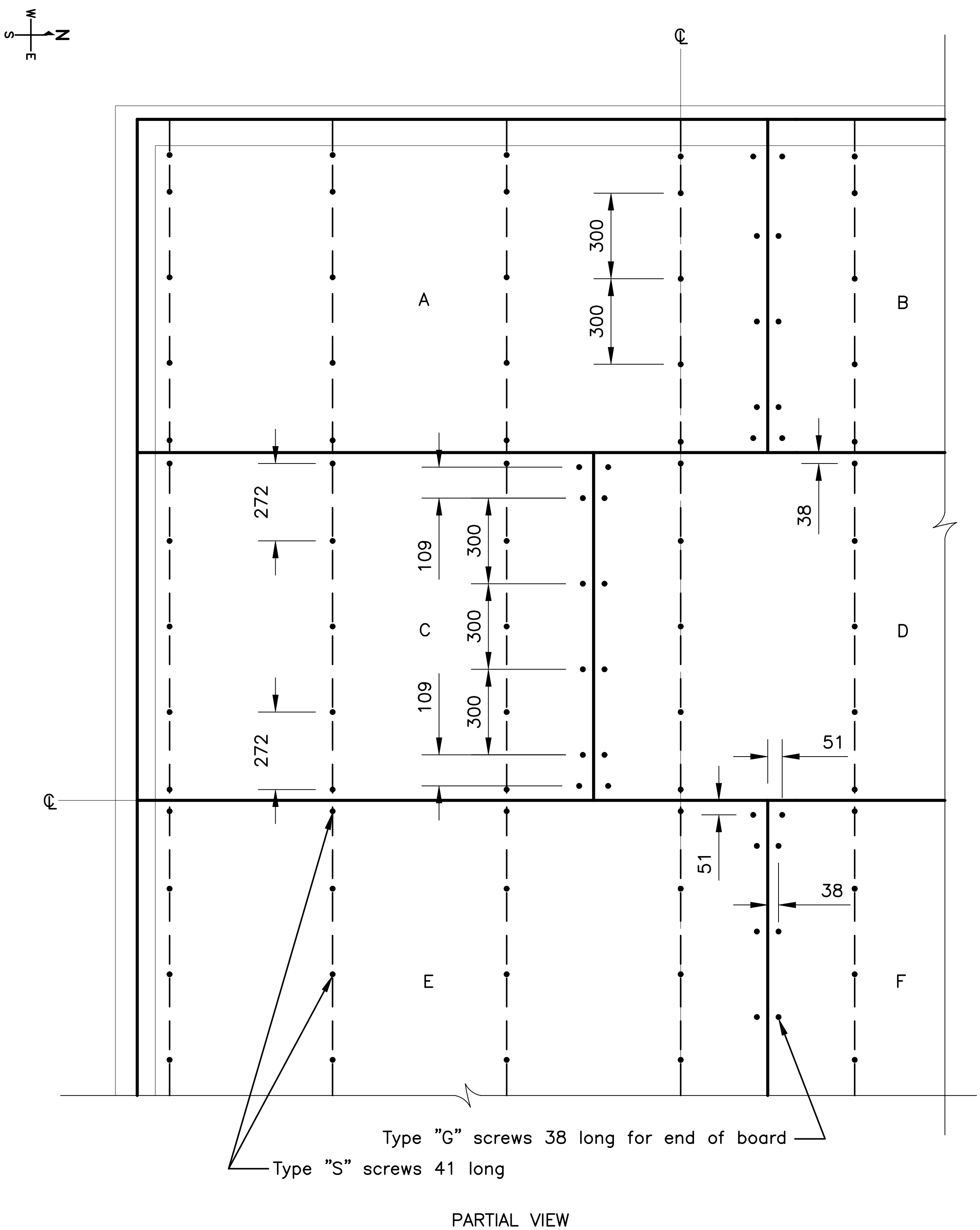
Figure A–68. Gypsum Board Base Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–64)

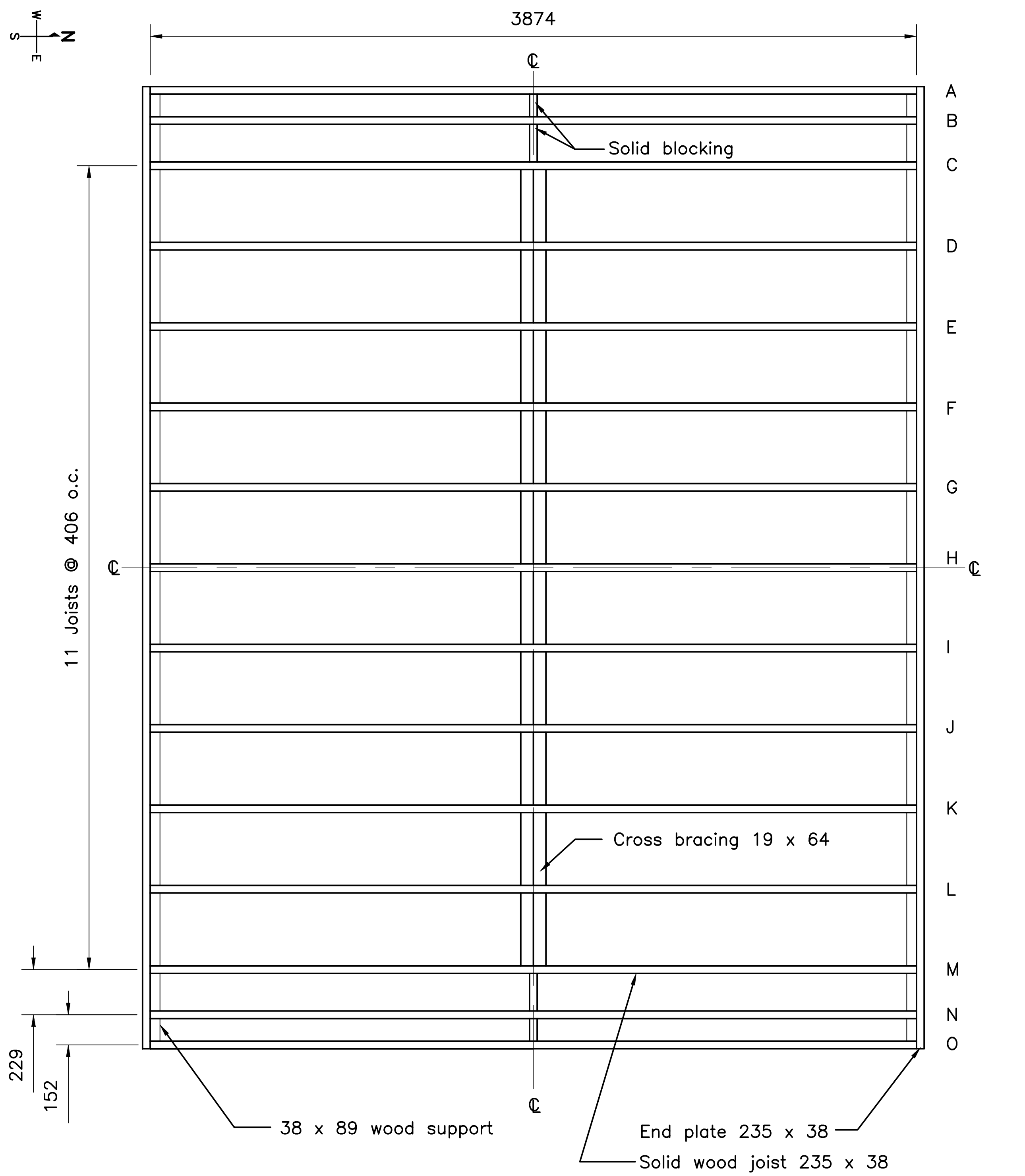
Figure A–69. Gypsum Board Face Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–64)

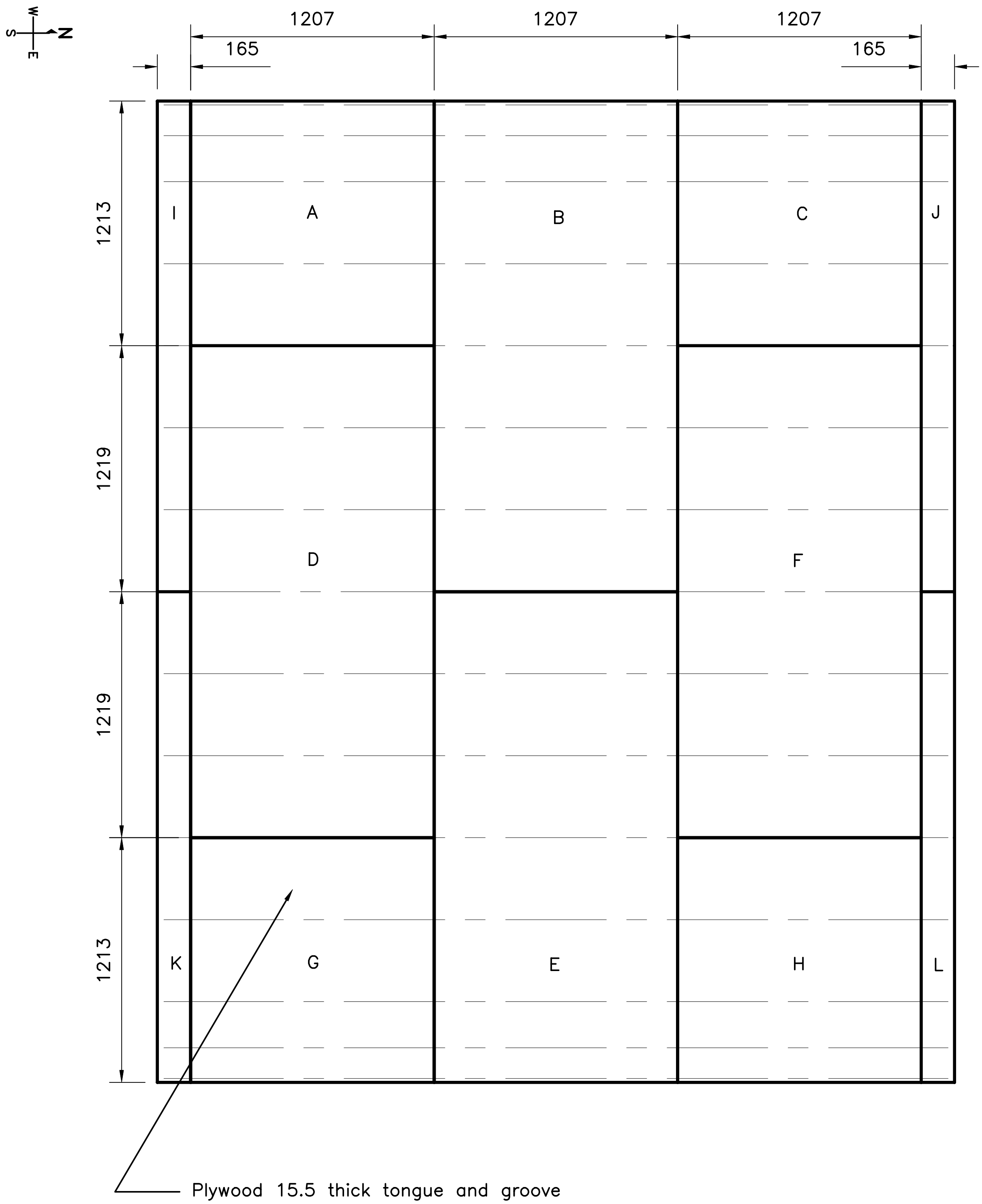
Figure A–70. Gypsum Board Face Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-66)

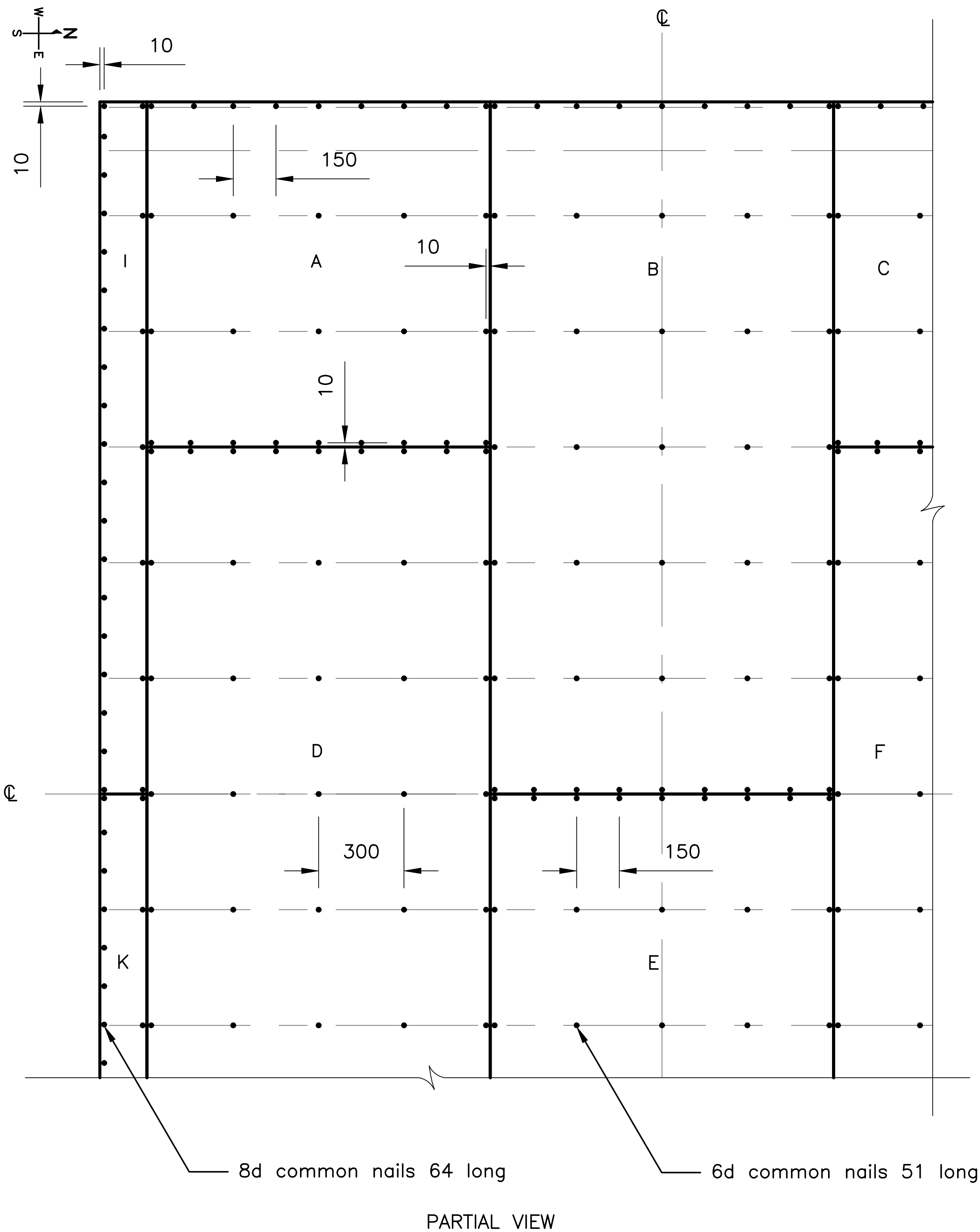
Figure A-71. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–66)

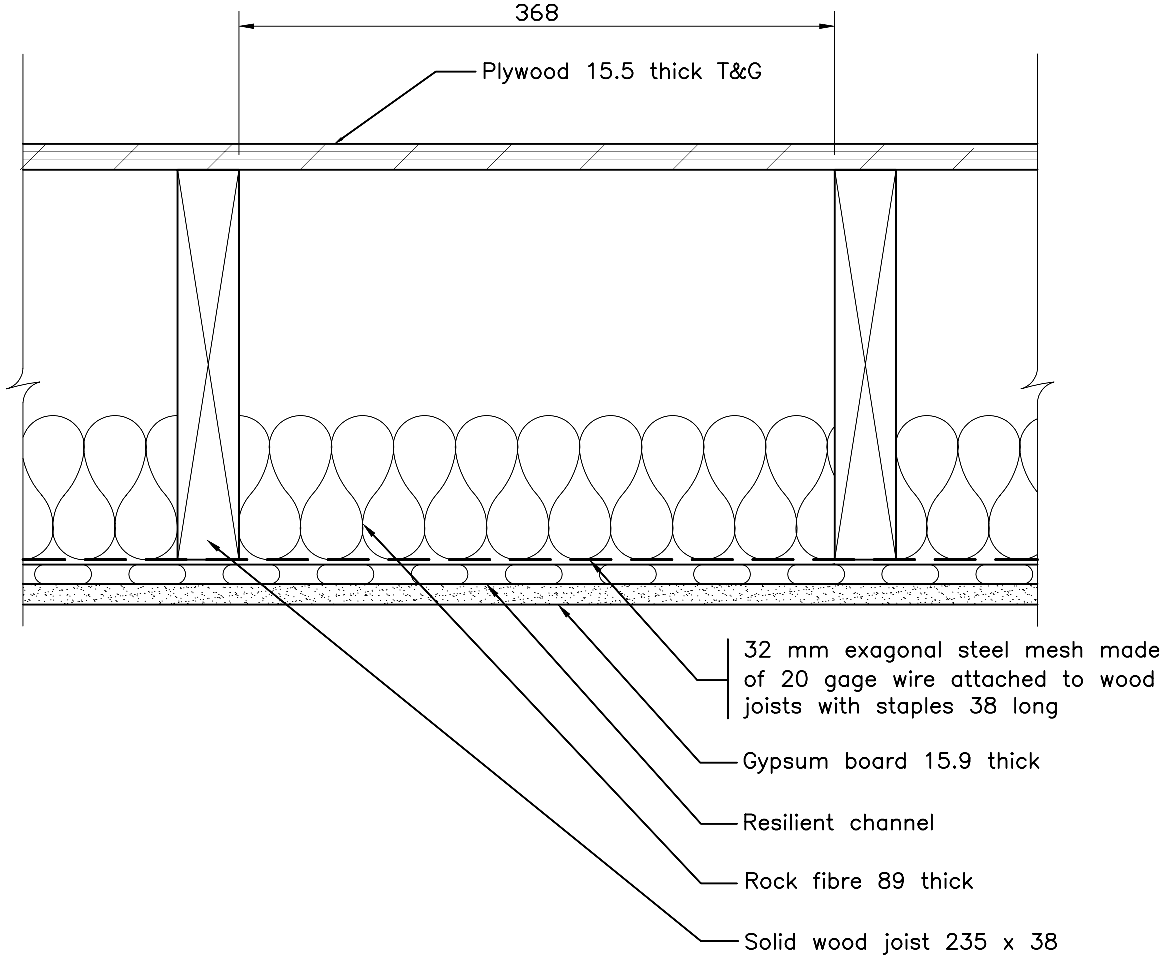
Figure A–72. Subfloor Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–66)

Figure A–73. Subfloor Nail Pattern (Solid Wood Joist)



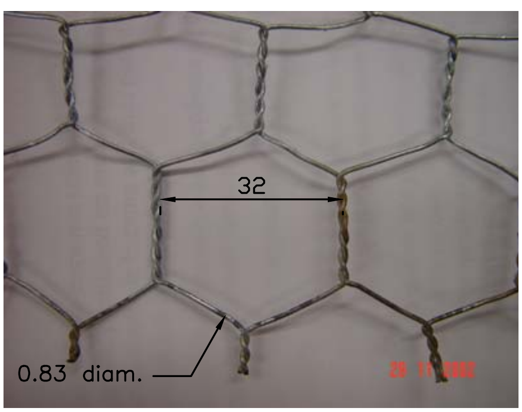


Photo of the steel mesh

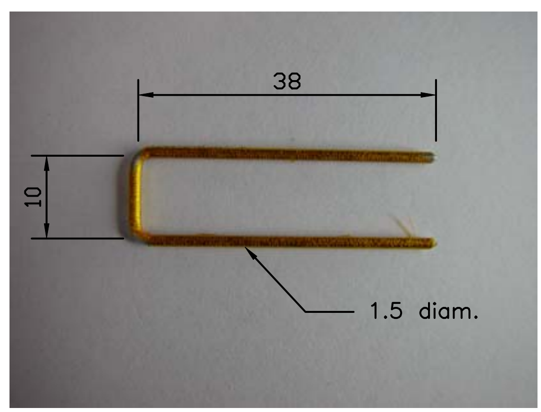
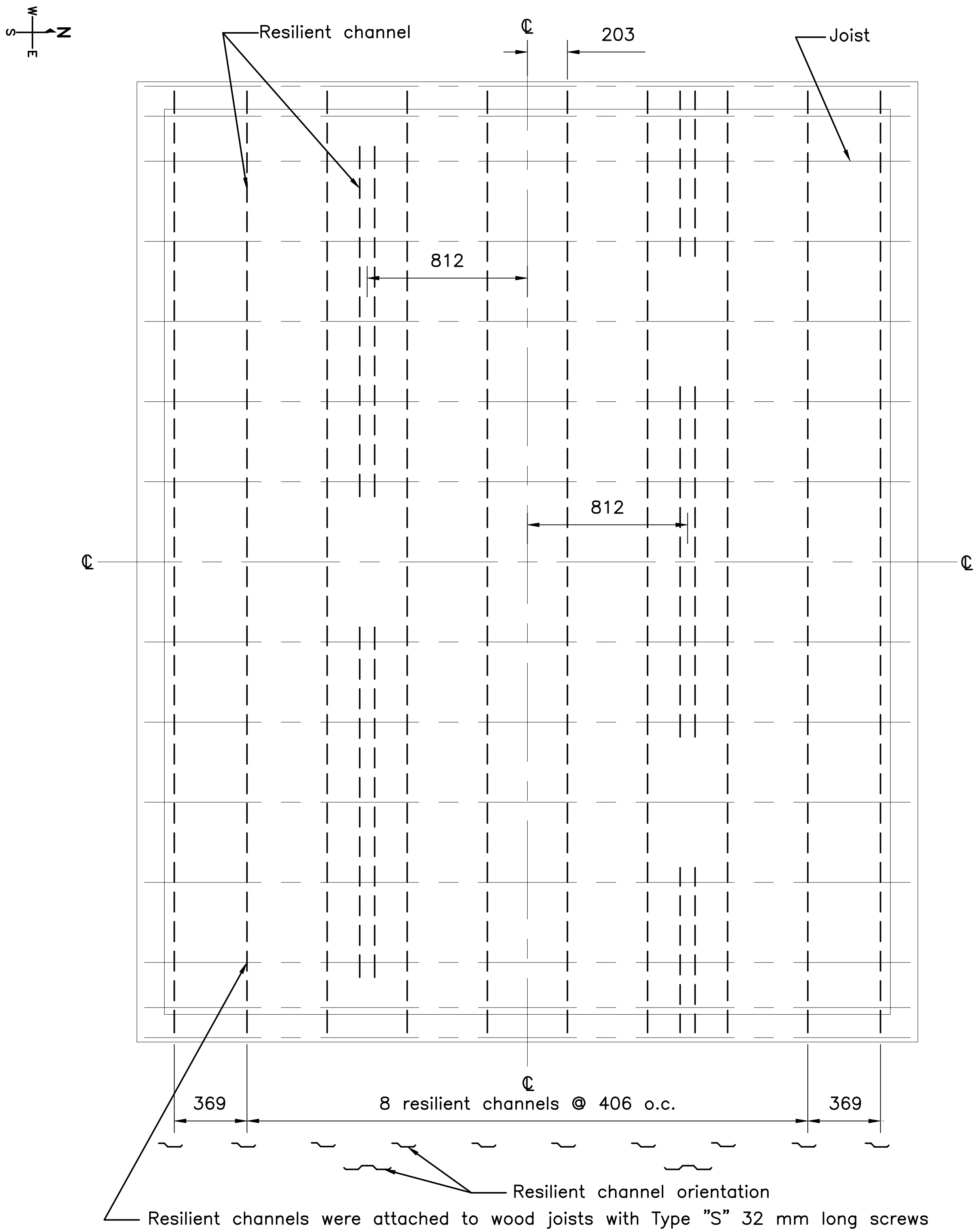


Photo of a staple used to secure the steel mesh to joists

(Dimensions are in millimetres)

(Assembly No. FF-66)

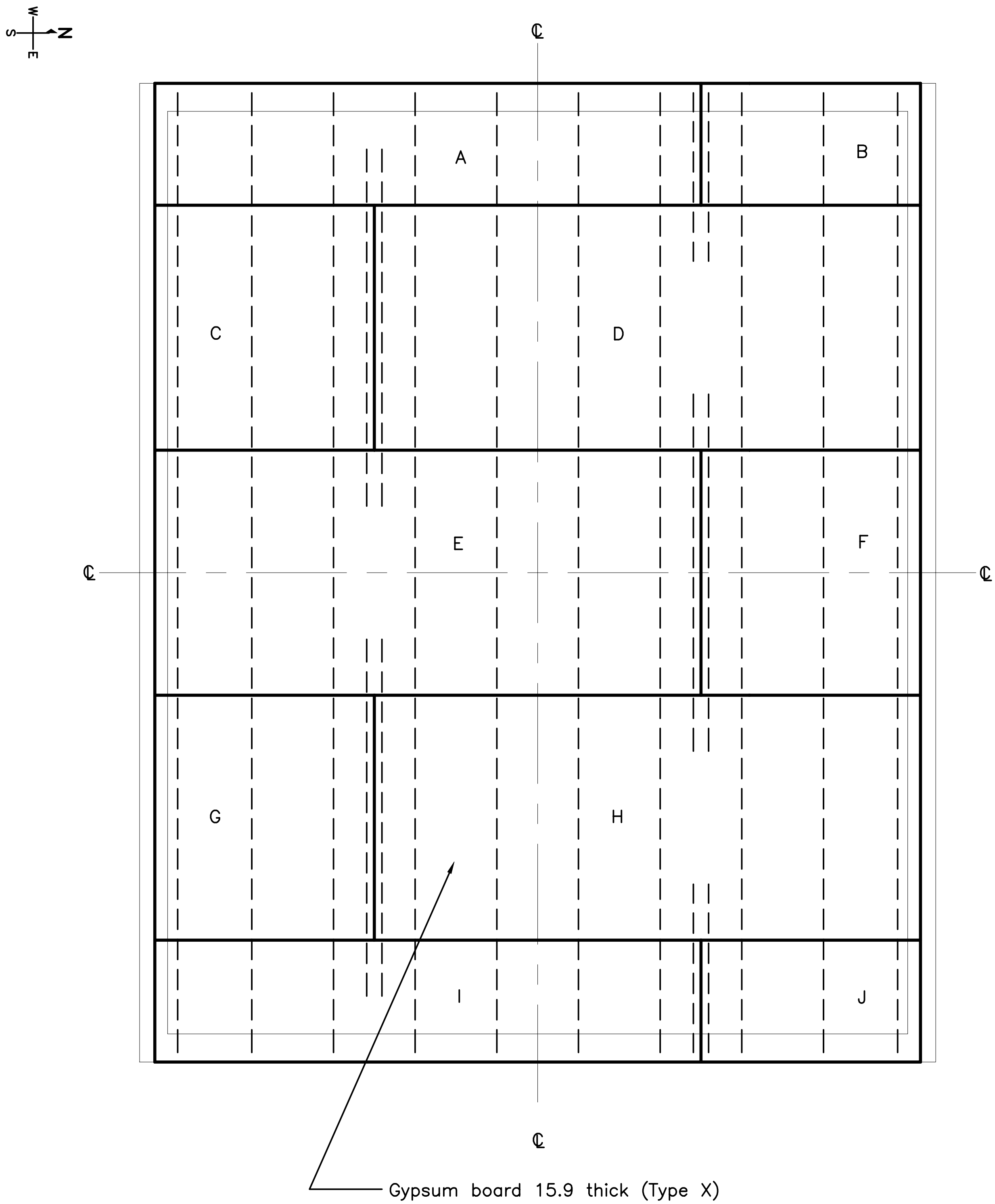
Figure A-74. Insulation Location (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–66)

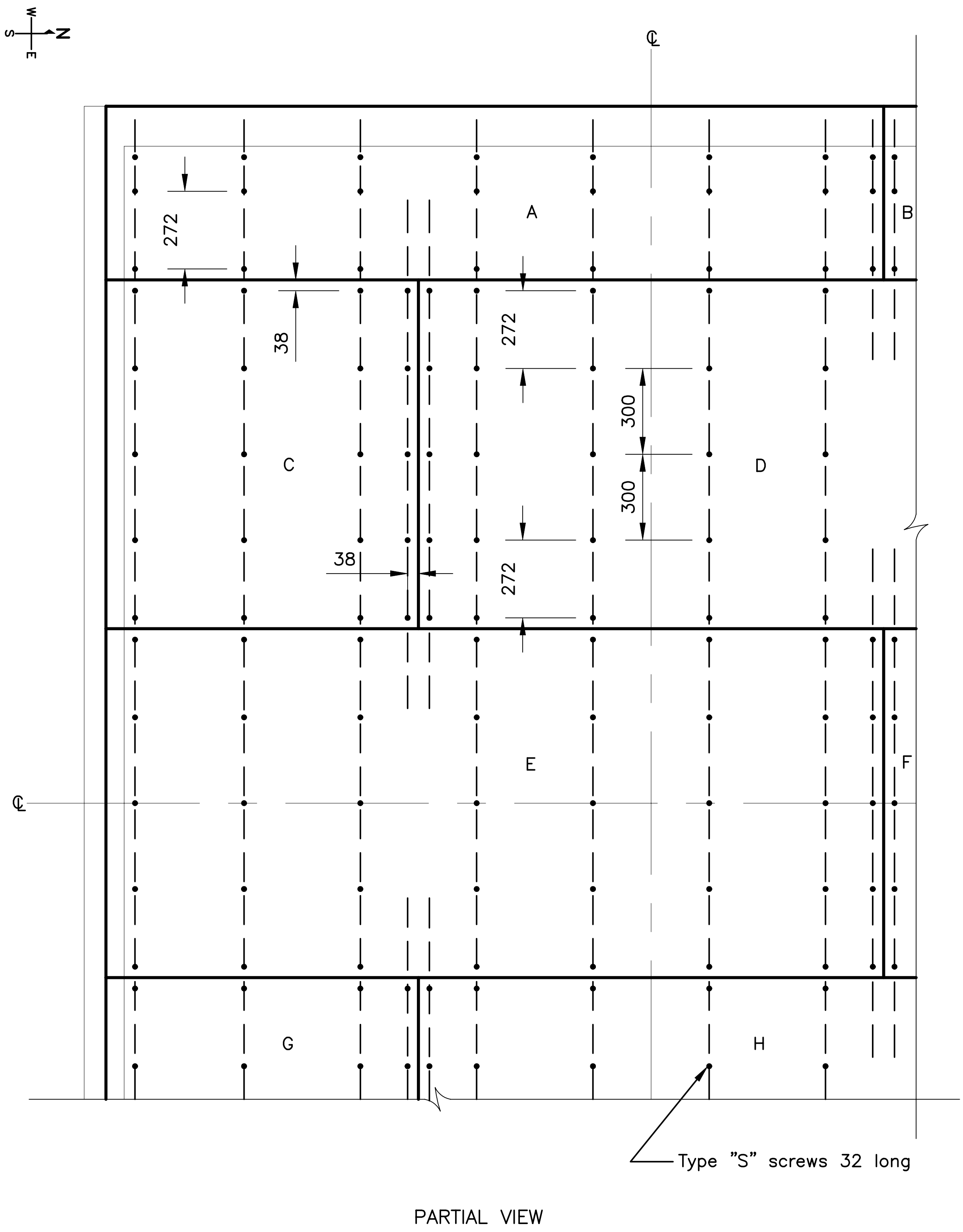
Figure A–75. Resilient Channel Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–66)

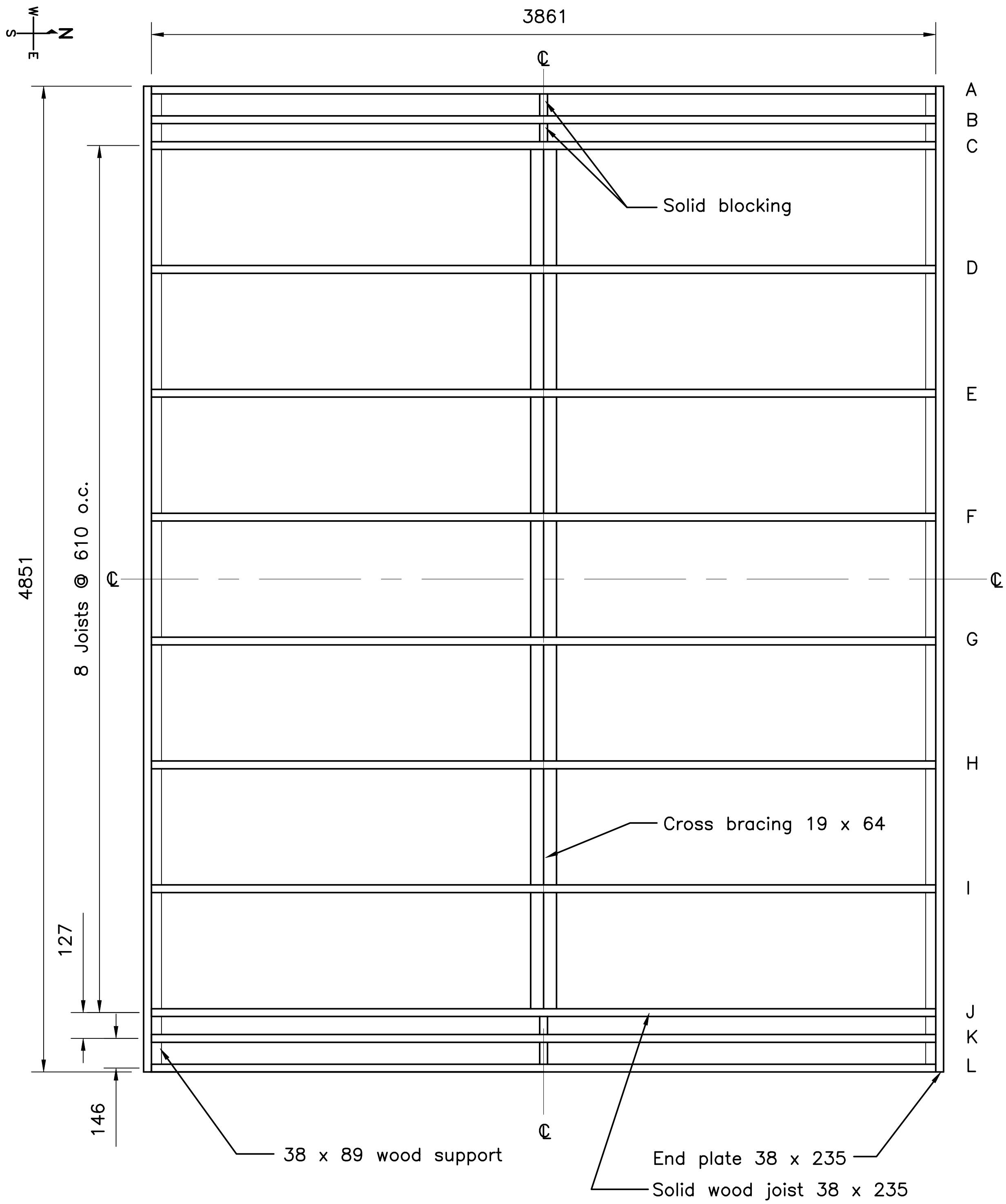
Figure A–76. Gypsum Board Single Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–66)

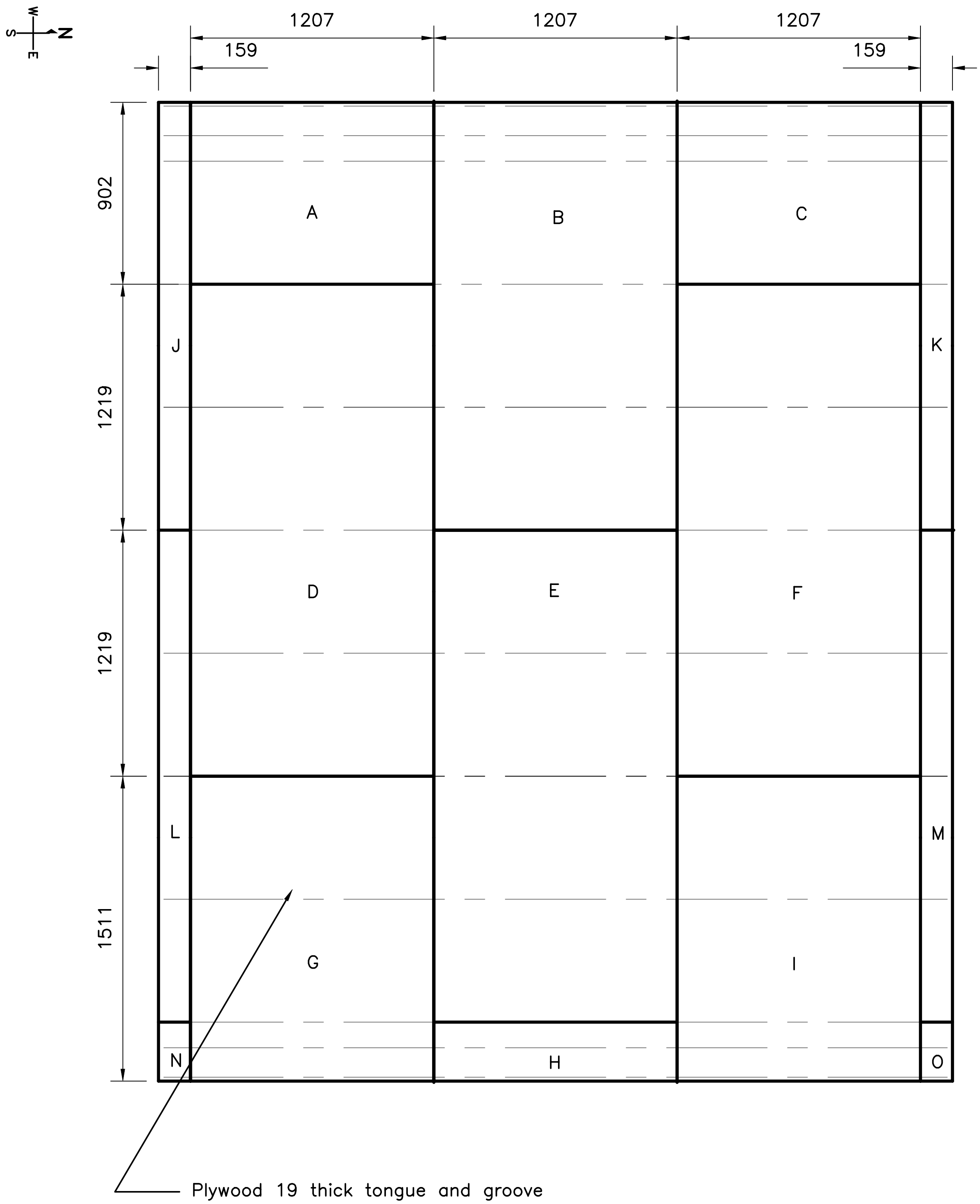
Figure A–77. Gypsum Board Single Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-67)

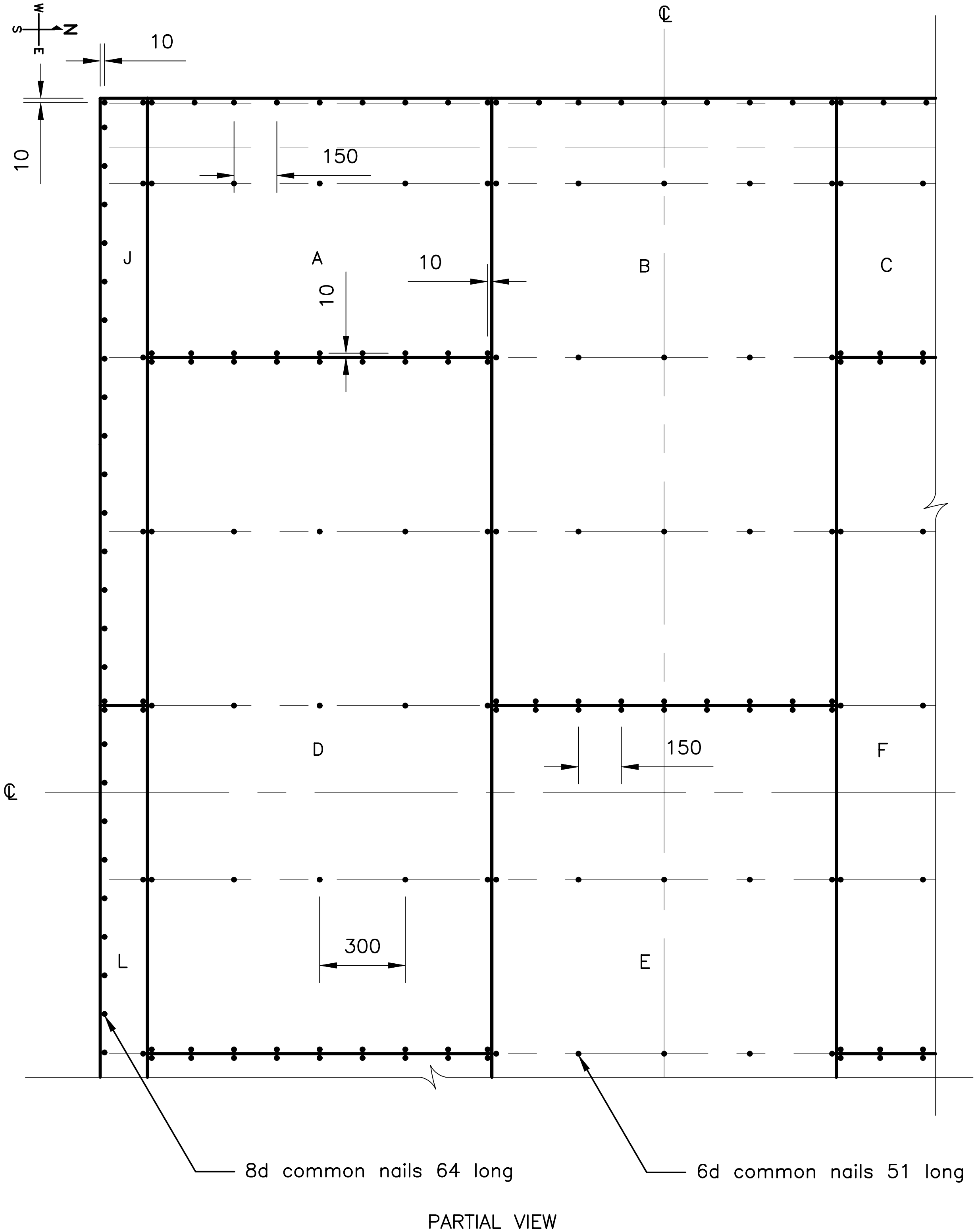
Figure A-78. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–67)

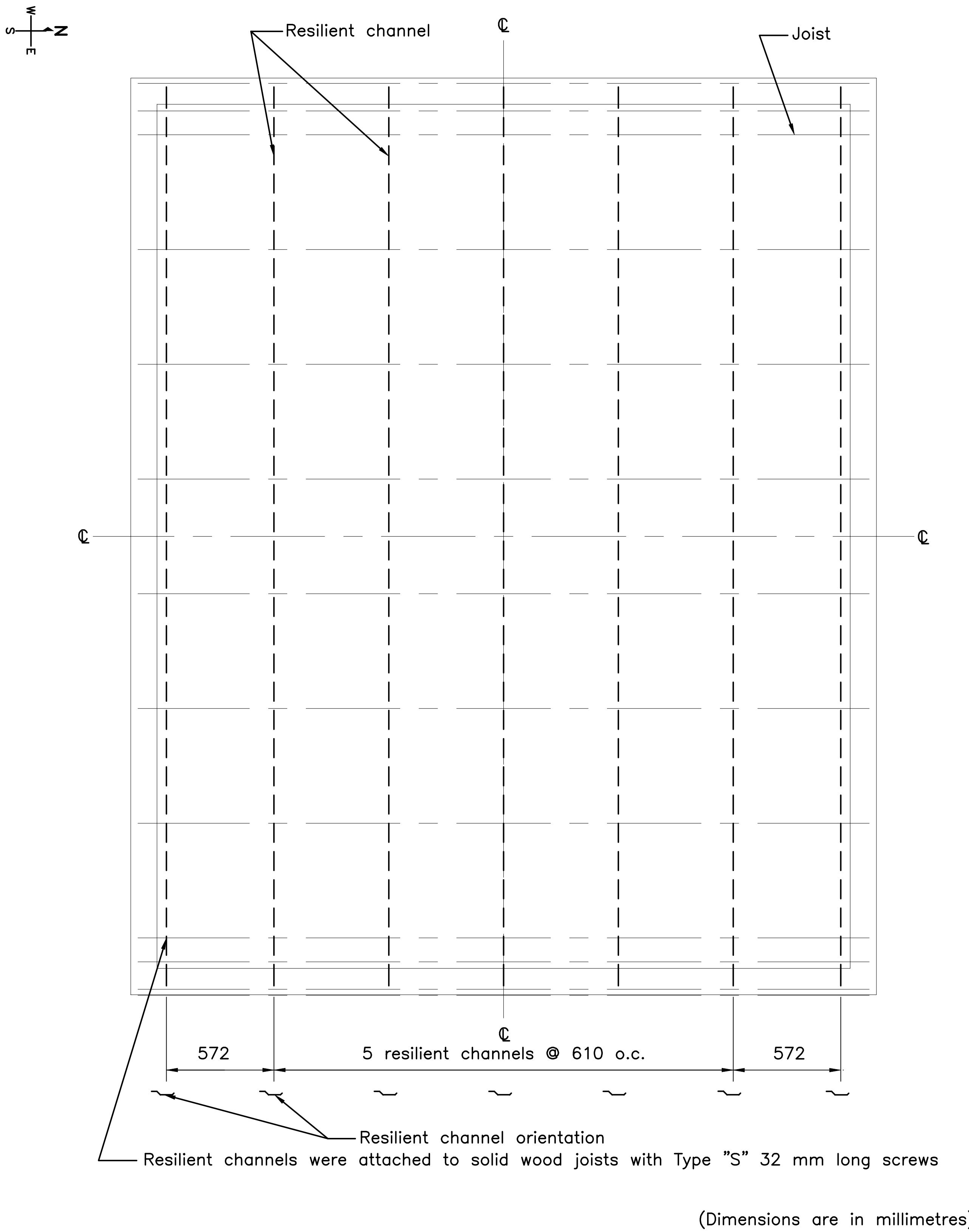
Figure A–79. Subfloor Layout (Solid Wood Joist)



(Dimensions are in millimetres)

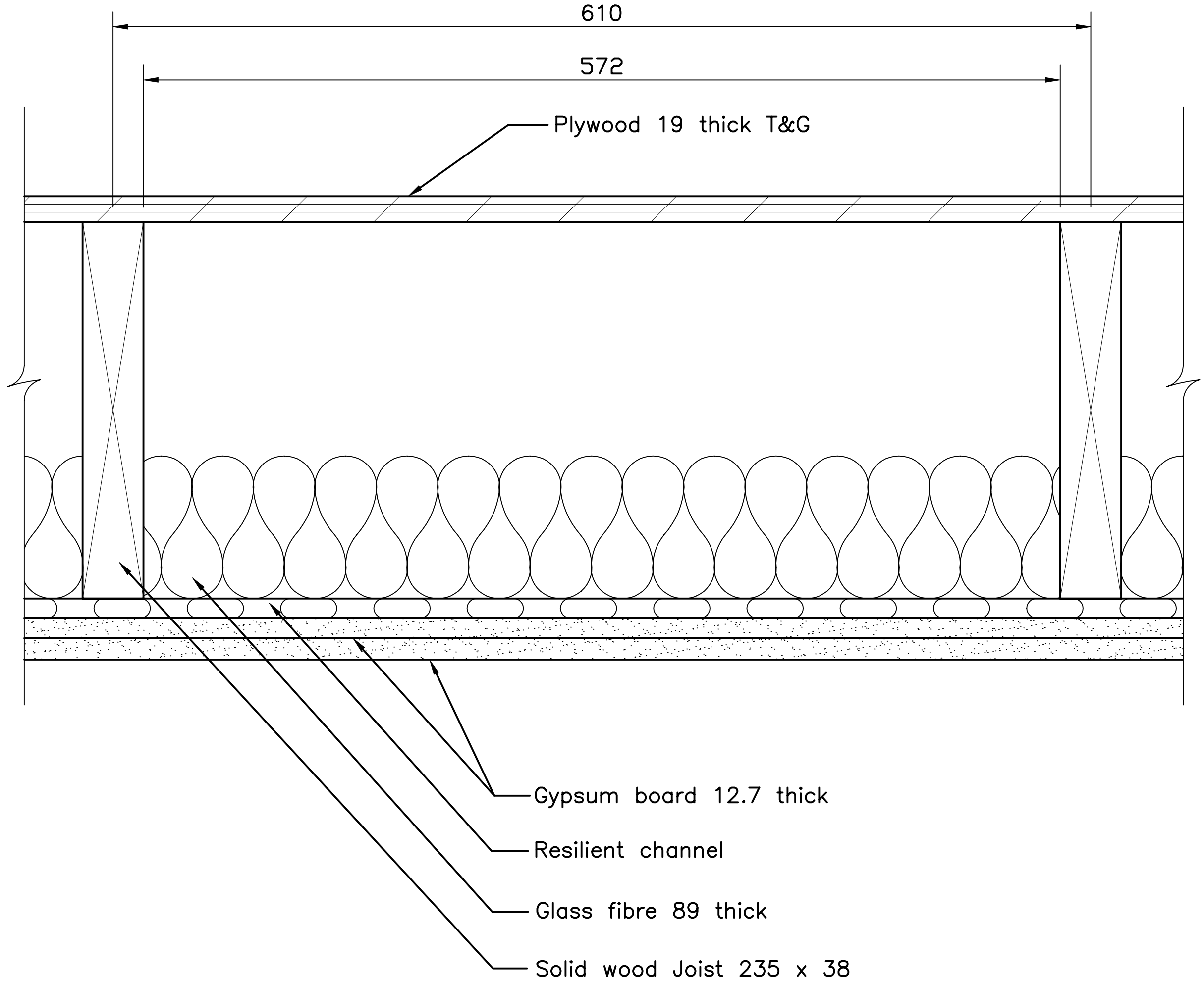
(Assembly No. FF–67)

Figure A–80. Subfloor Nail Pattern (Solid Wood Joist)



(Assembly No. FF–67)

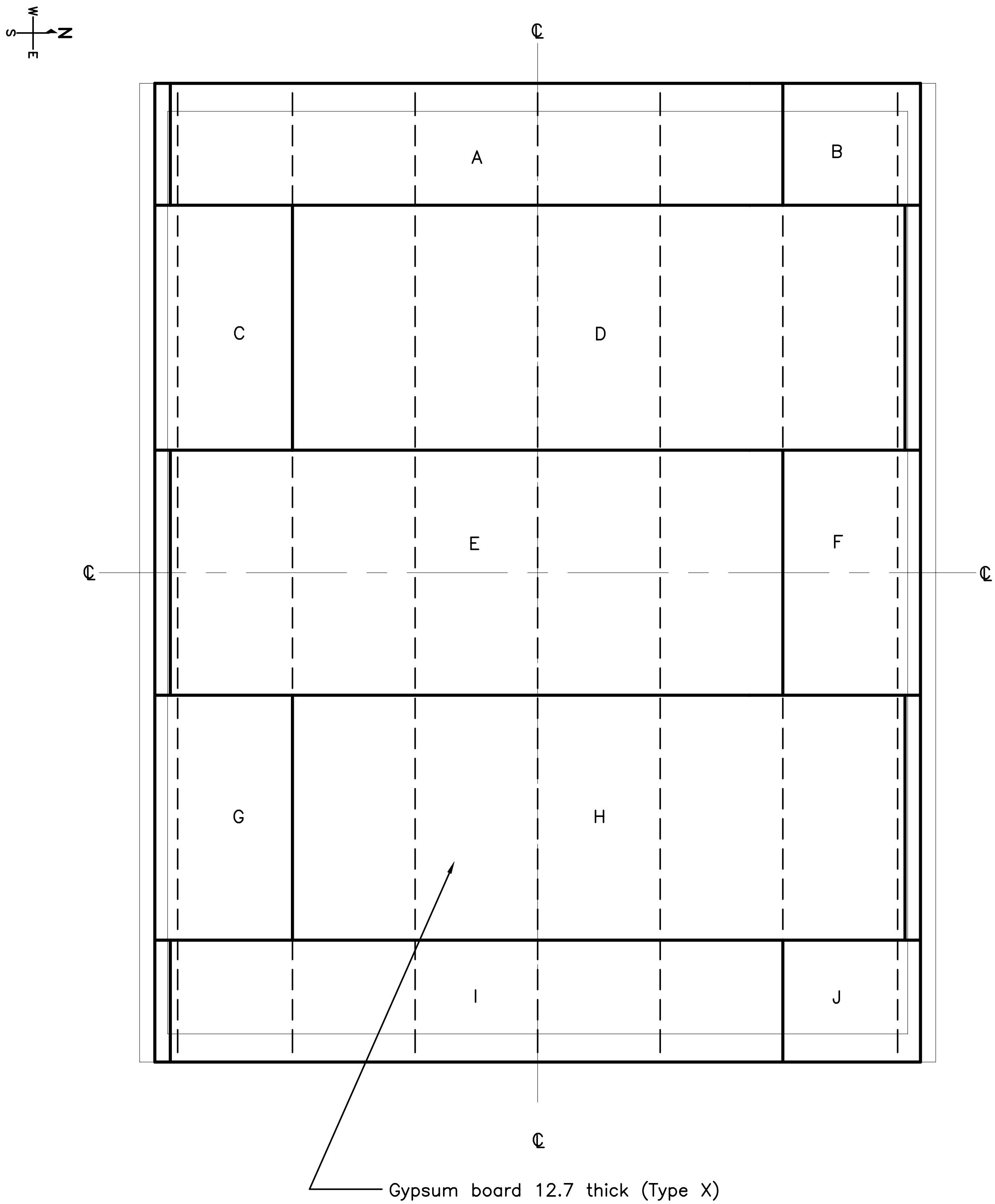
Figure A–81. Resilient Channel Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–67)

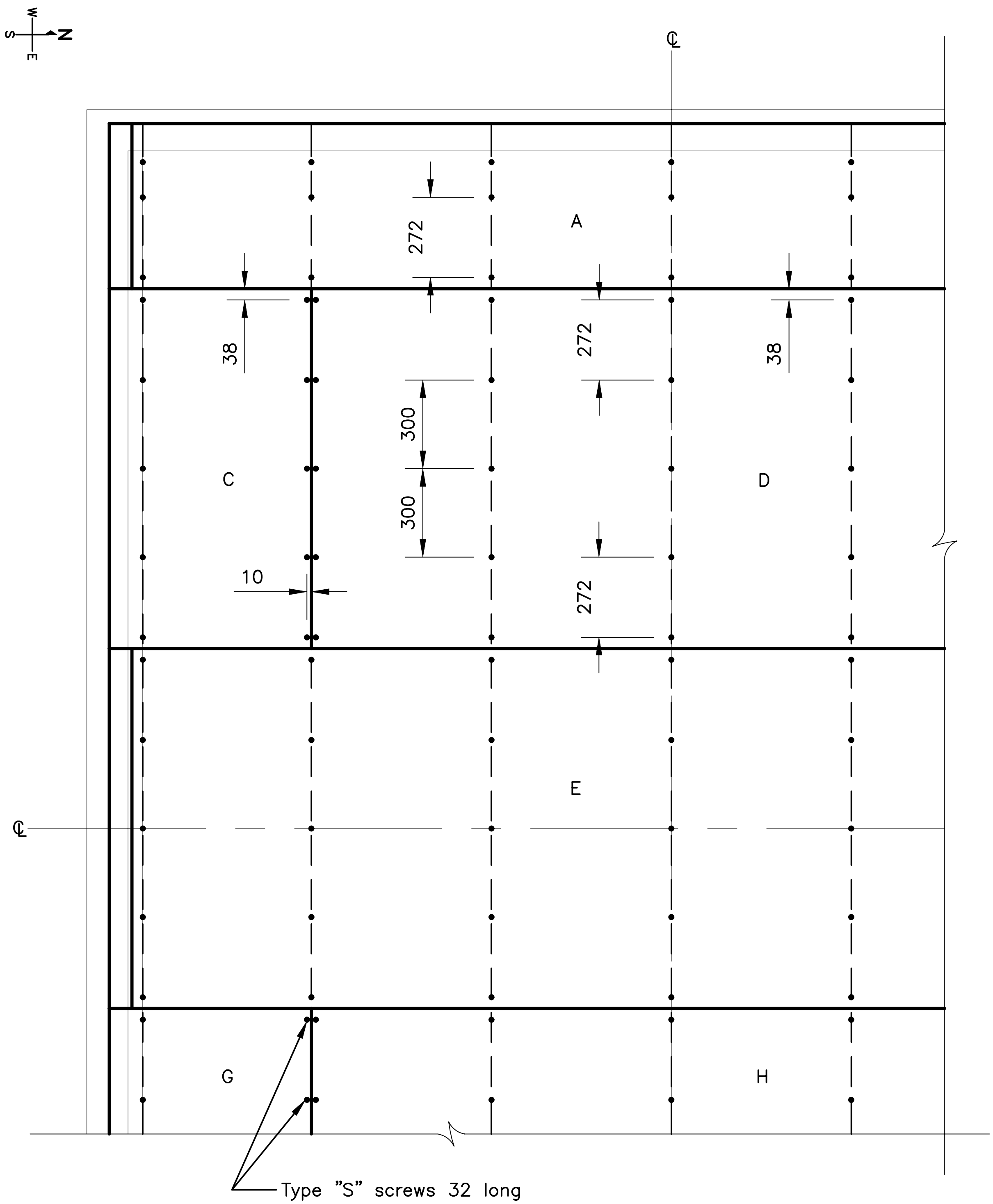
Figure A–82. Insulation Location (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-67)

Figure A-83. Gypsum Board Base Layer Layout (Solid Wood Joist)

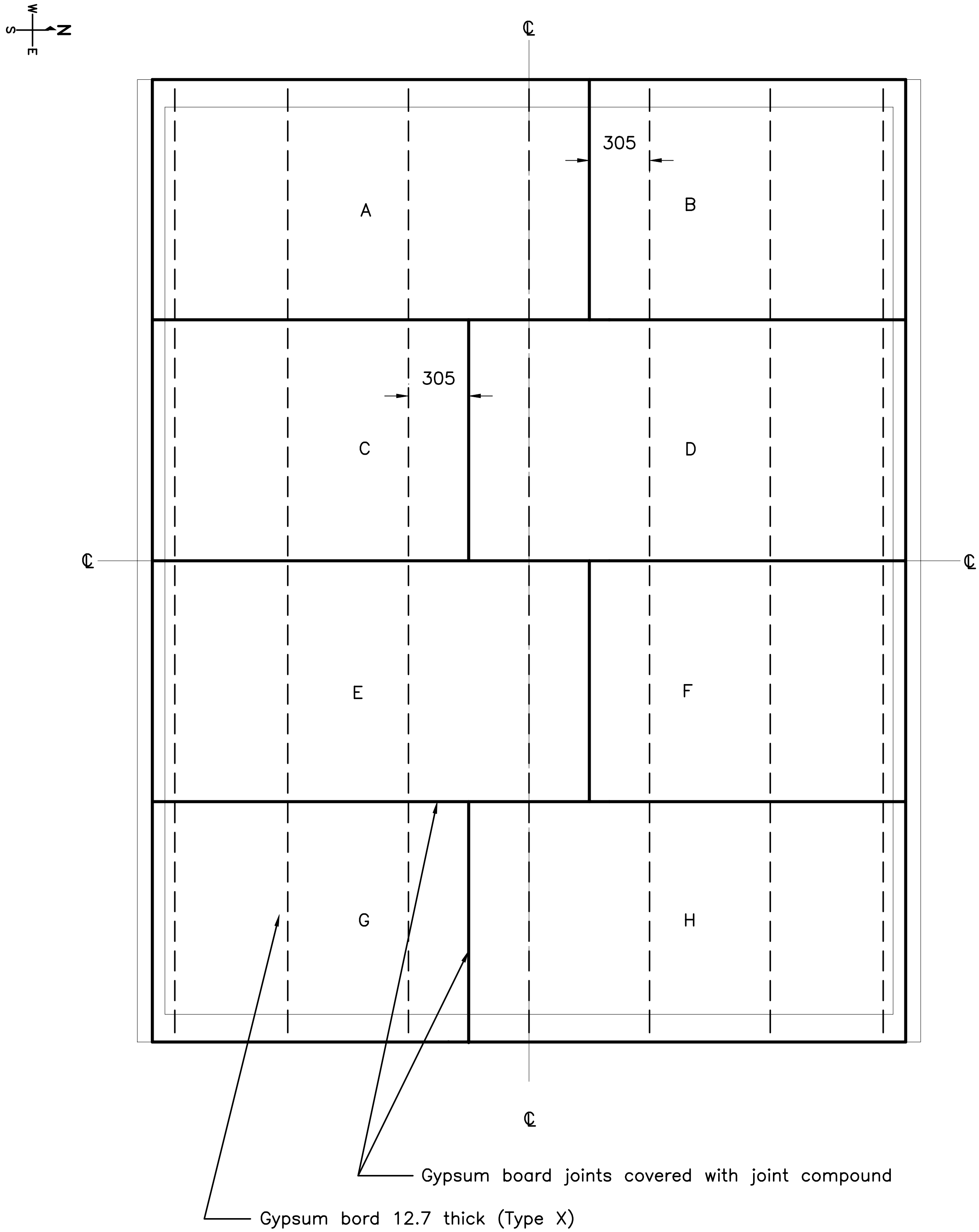


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF-67)

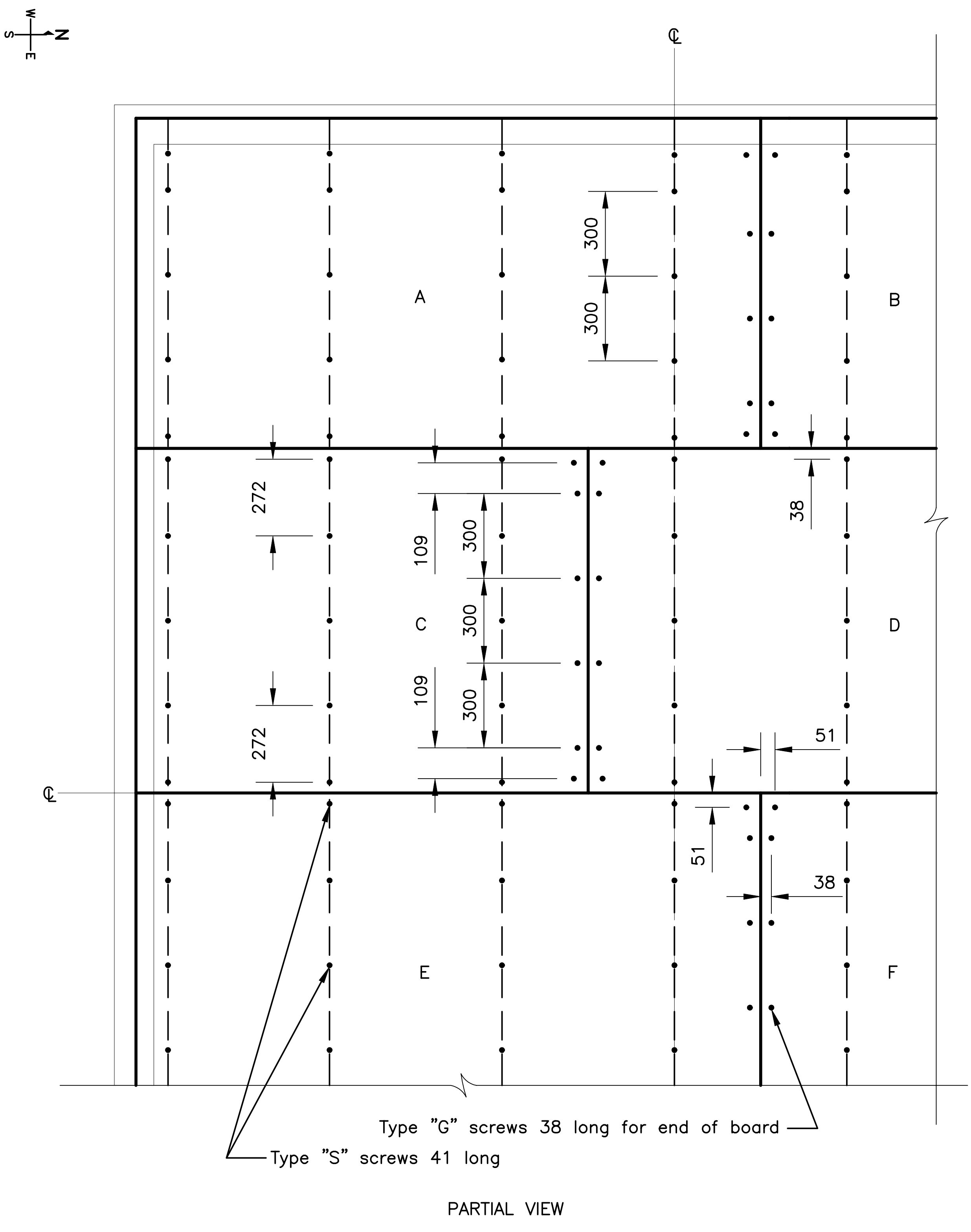
Figure A-84. Gypsum Board Base Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-67)

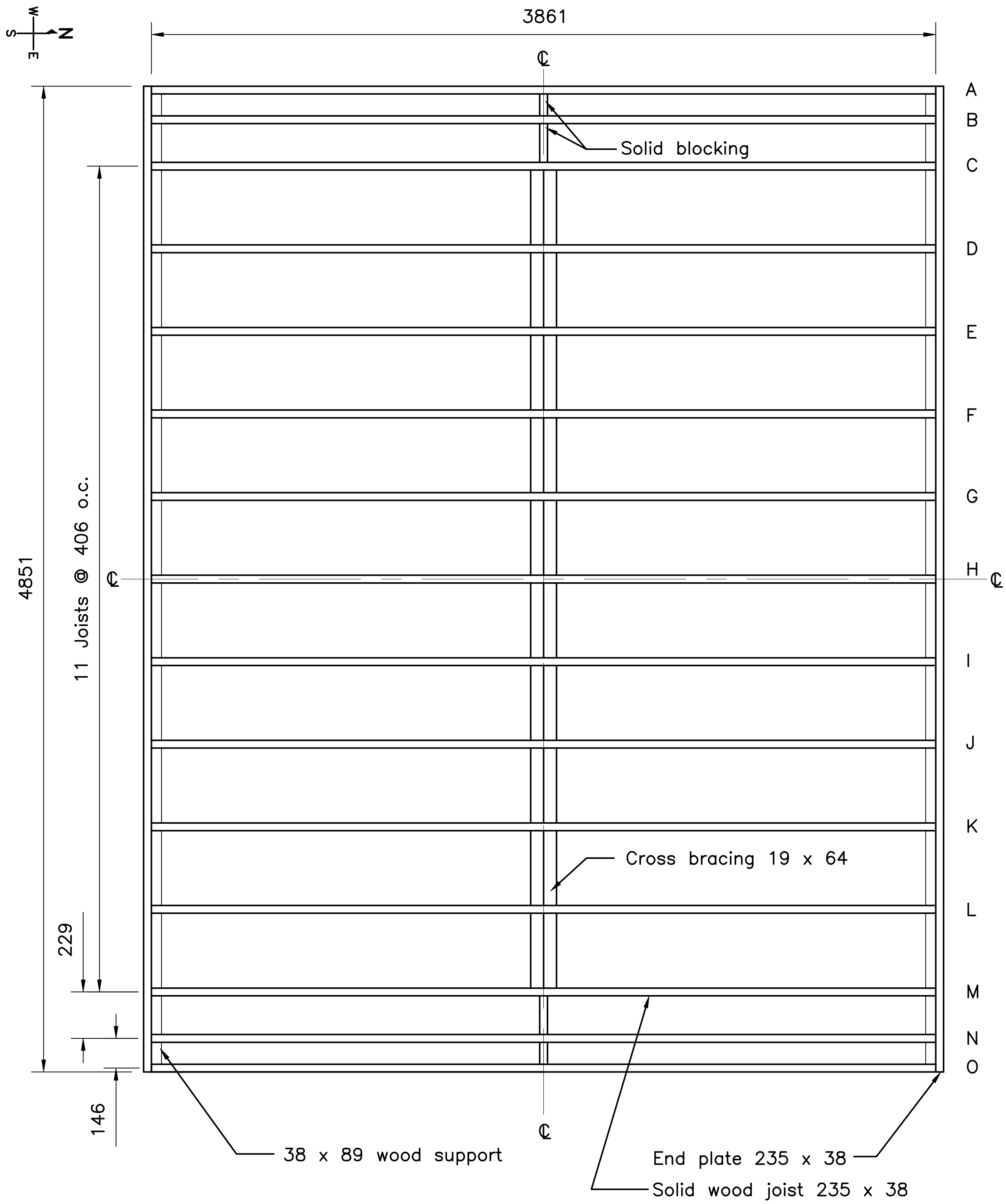
Figure A-85. Gypsum Board Face Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-67)

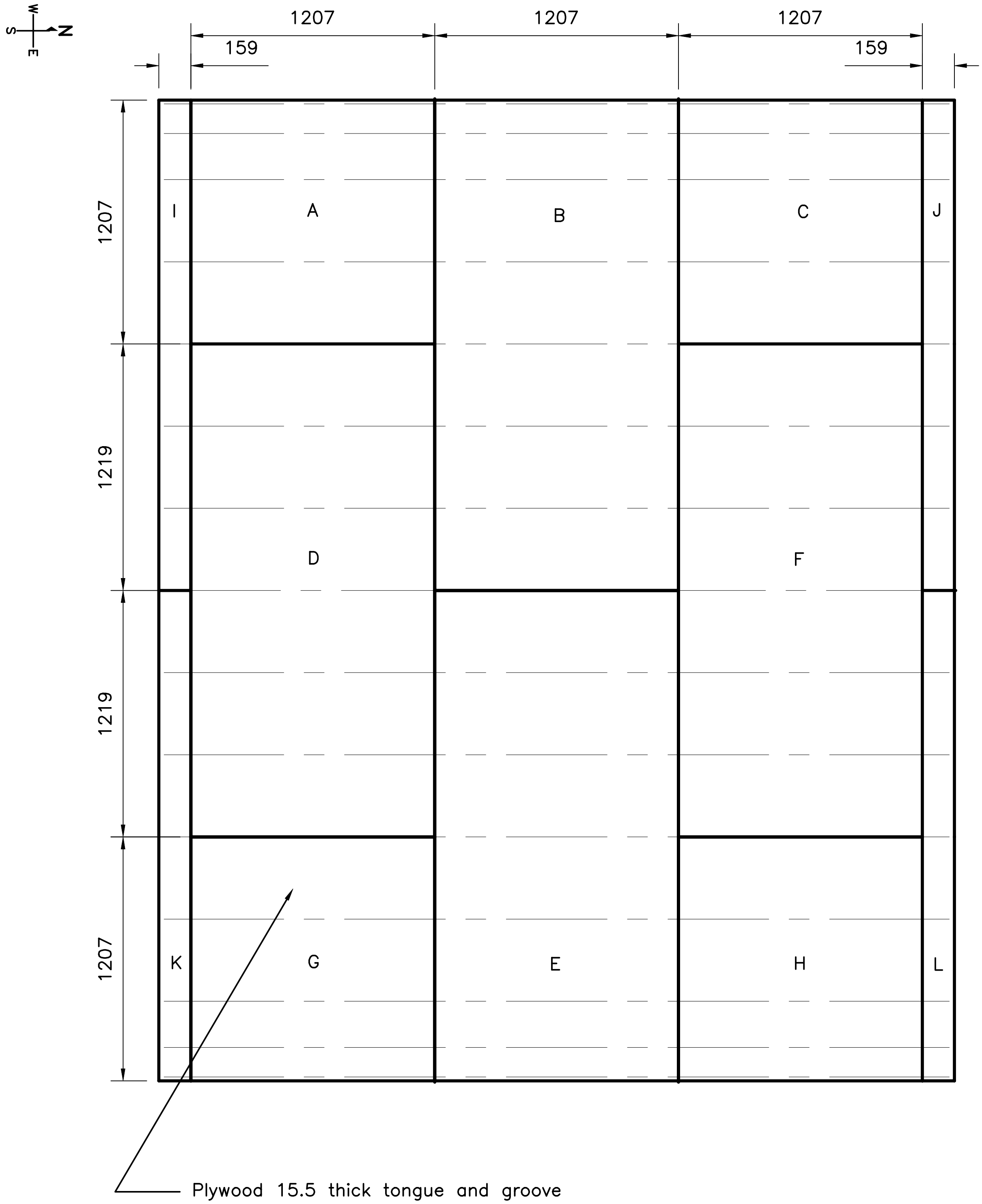
Figure A-86. Gypsum Board Face Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–68)

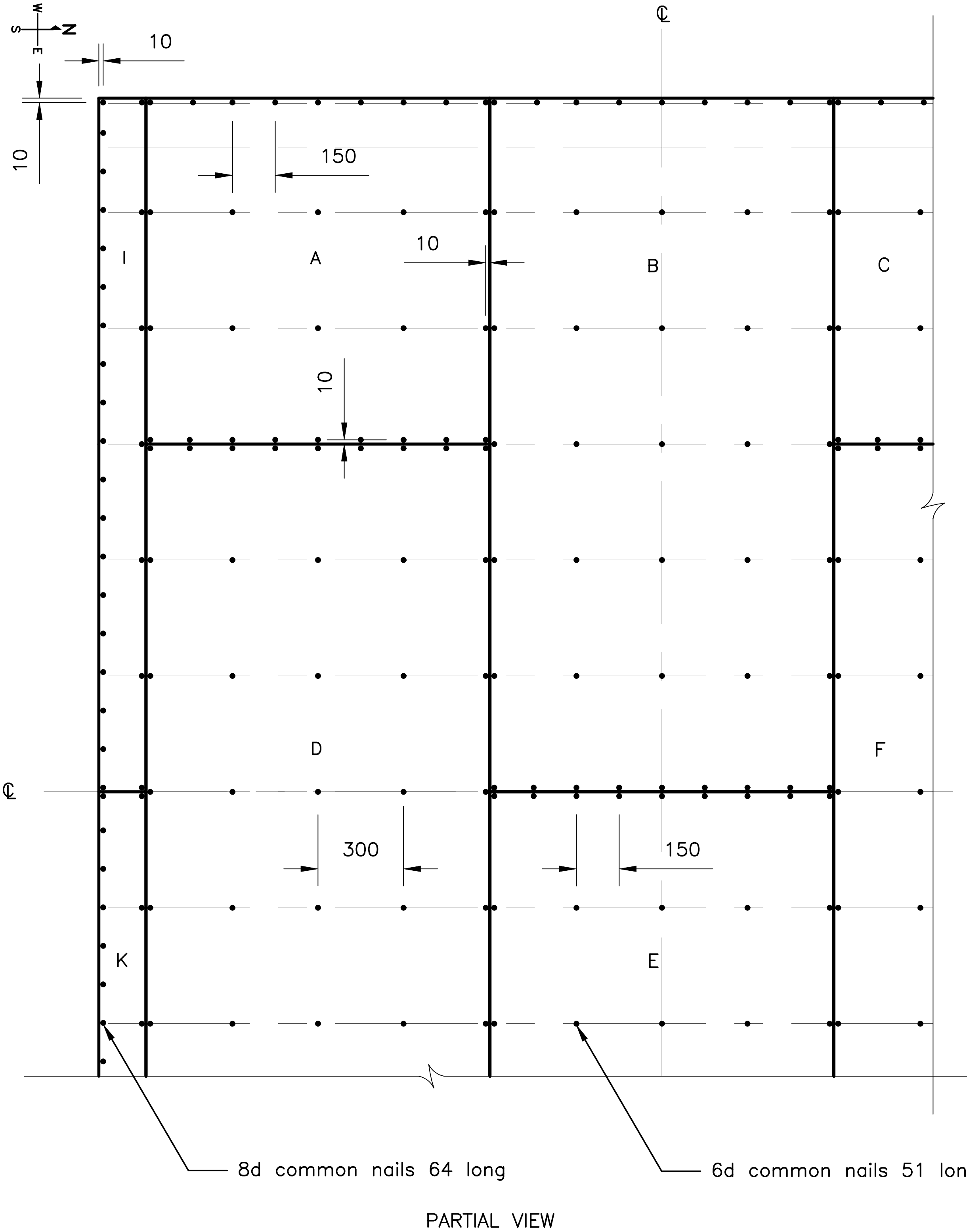
Figure A–87. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–68)

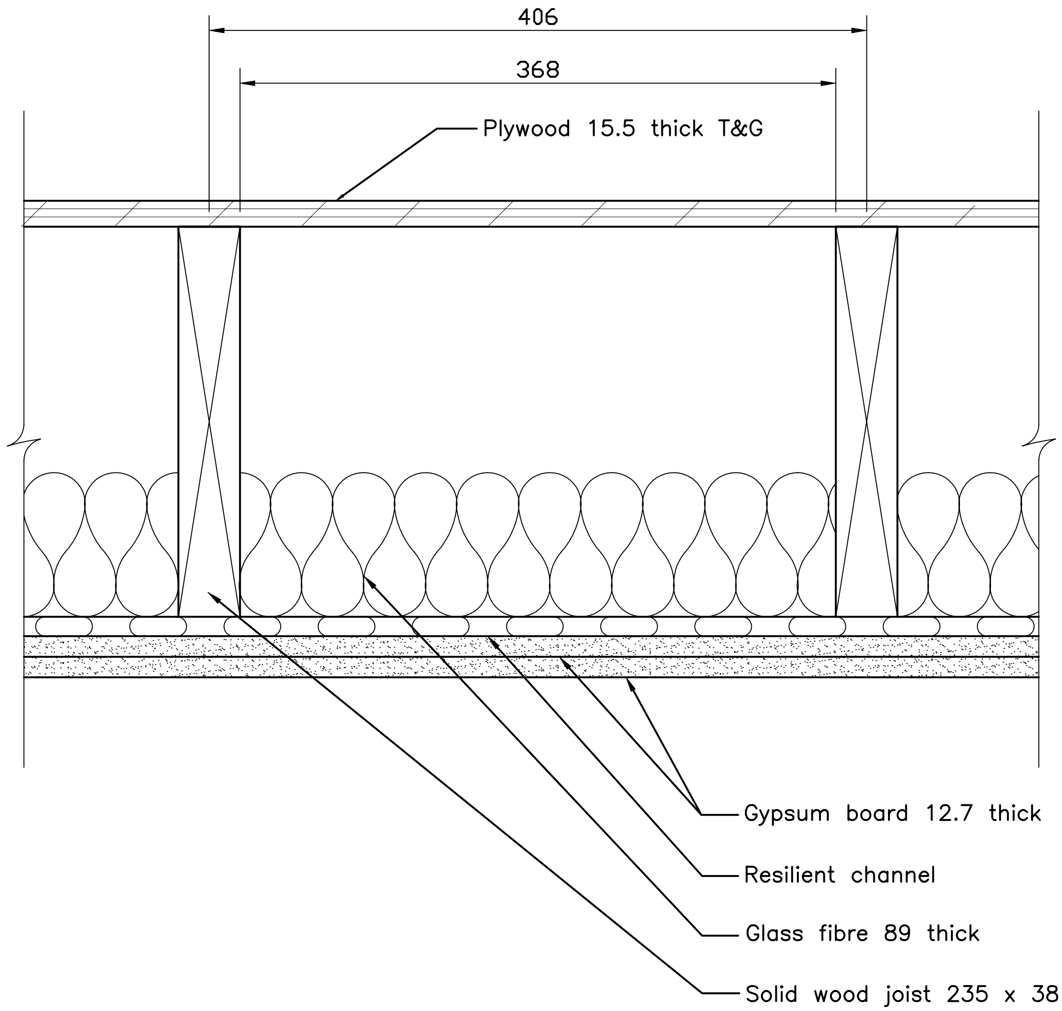
Figure A–88. Subfloor Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–68)

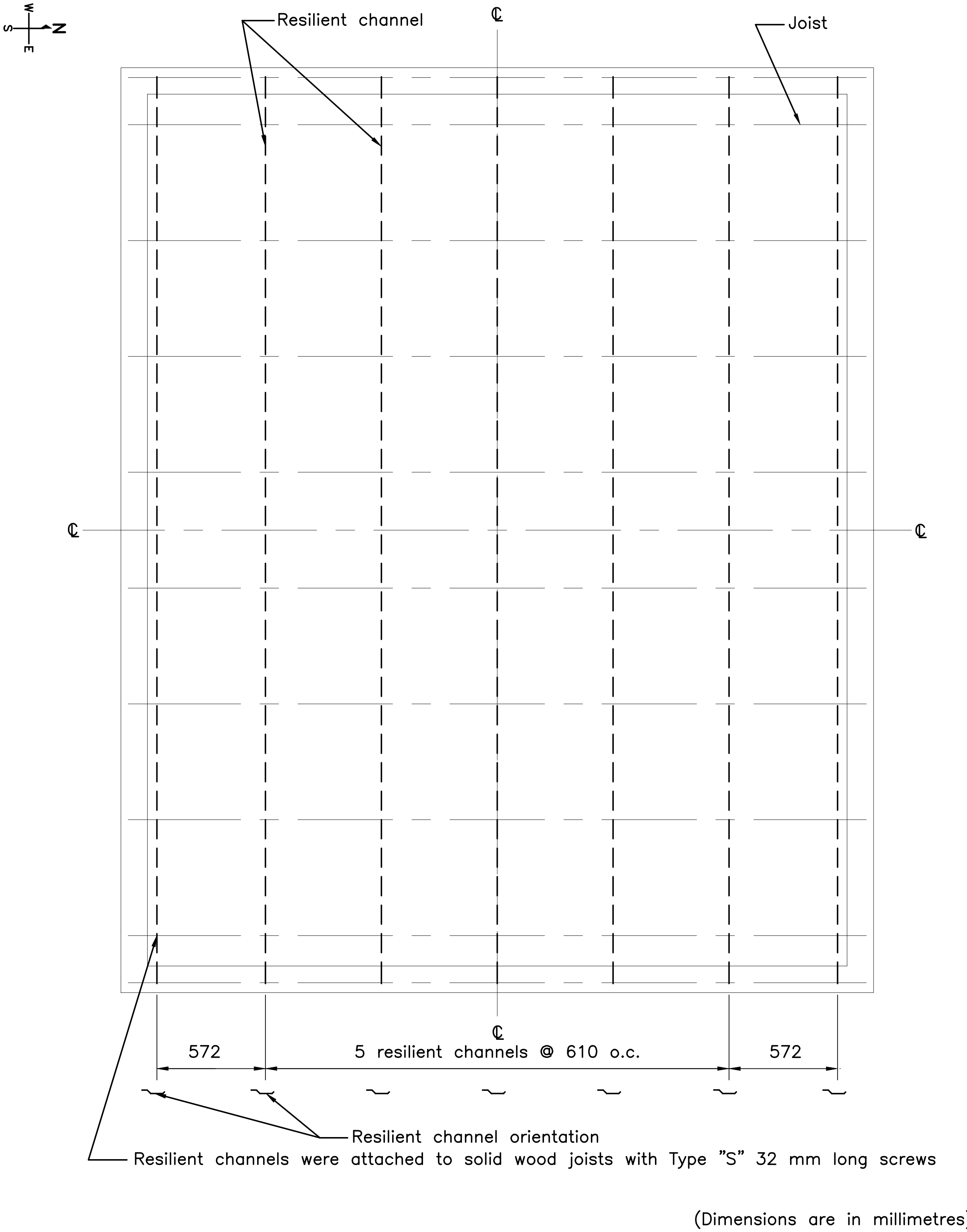
Figure A–89. Subfloor Nail Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

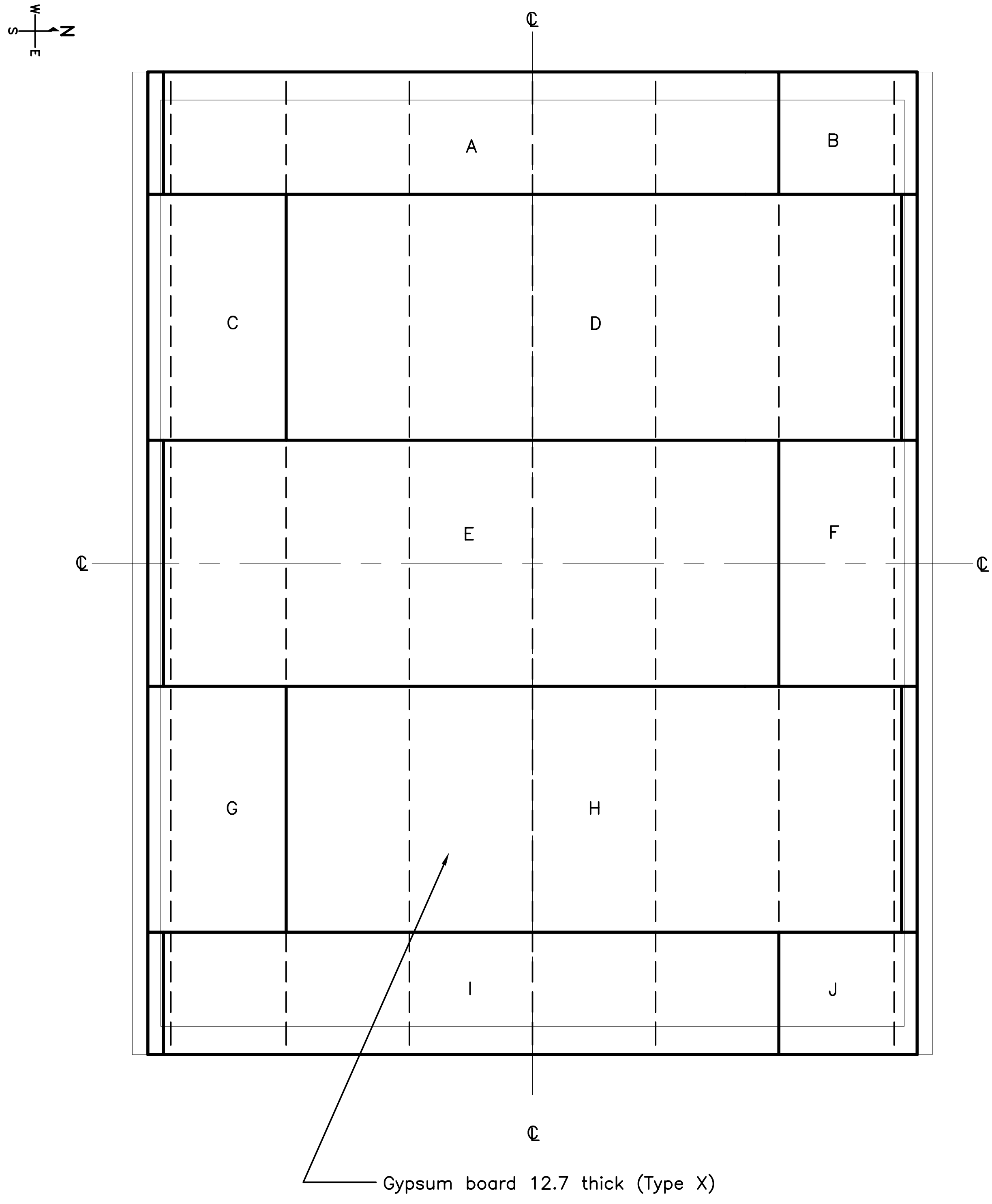
(Assembly No. FF–68)

Figure A–90. Insulation Location (Solid Wood Joist)



(Assembly No. FF–68)

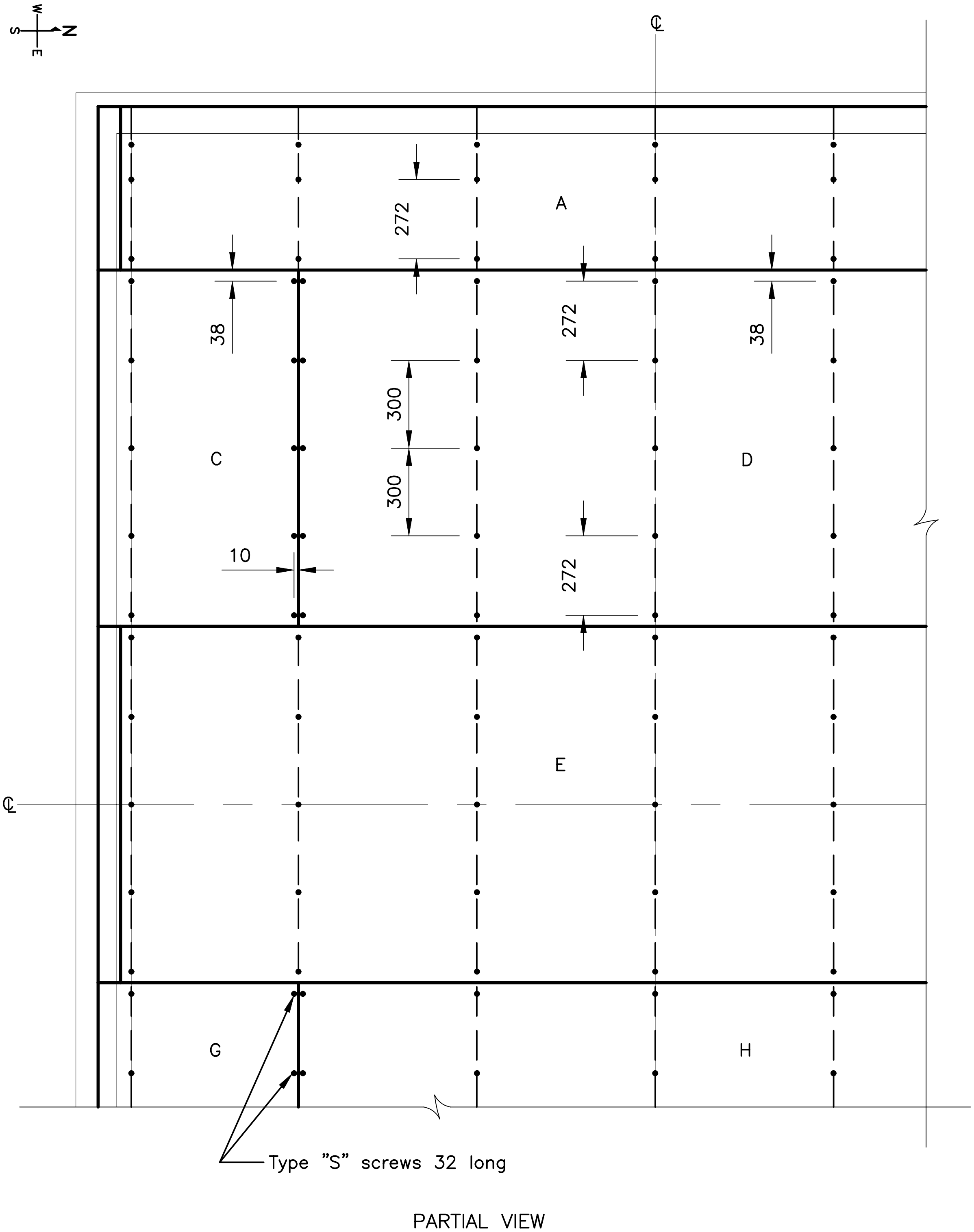
Figure A–91. Resilient Channel Layout (Solid Wood joist)



(Dimensions are in millimetres)

(Assembly No. FF–68)

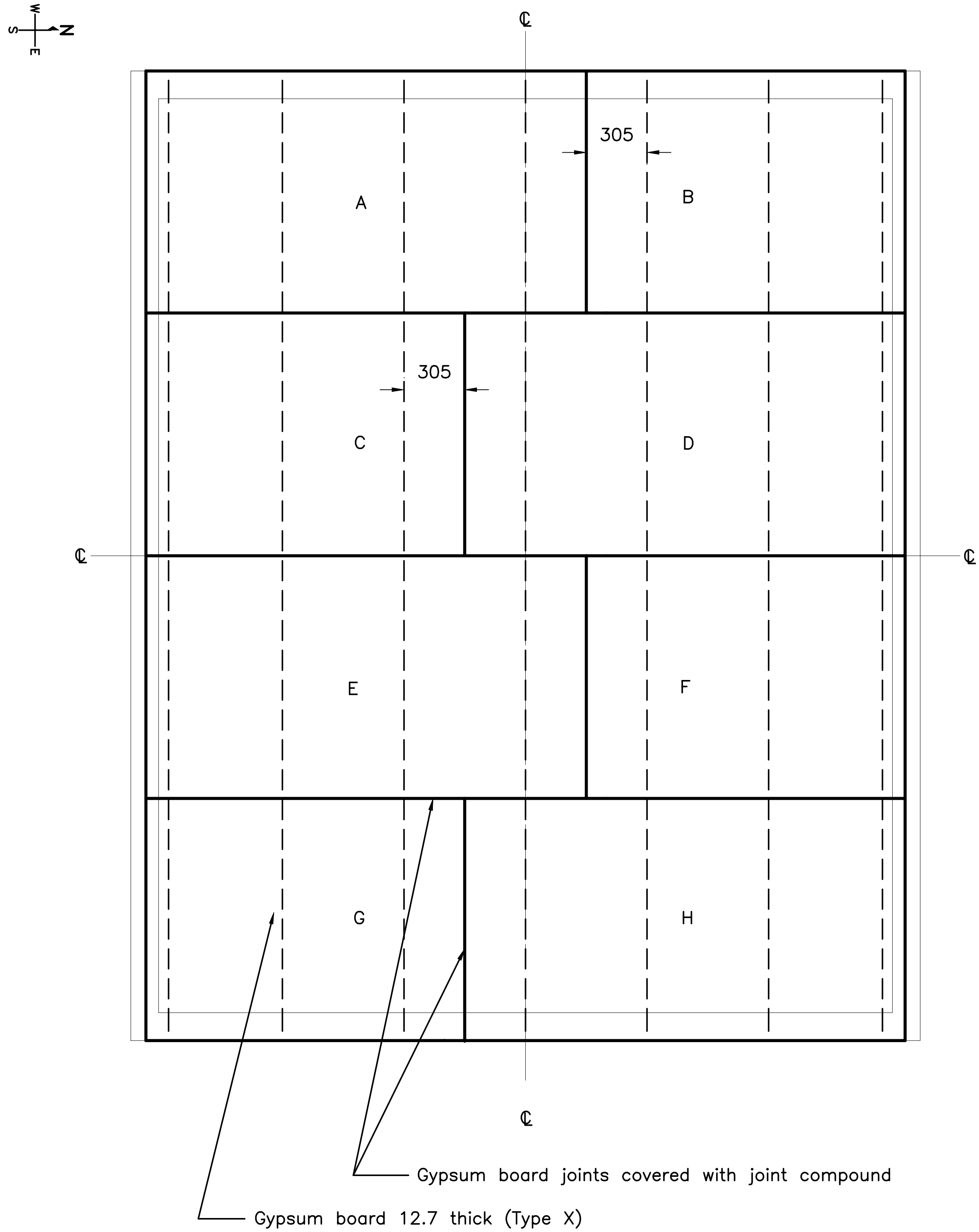
Figure A–92. Gypsum Board Base Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–68)

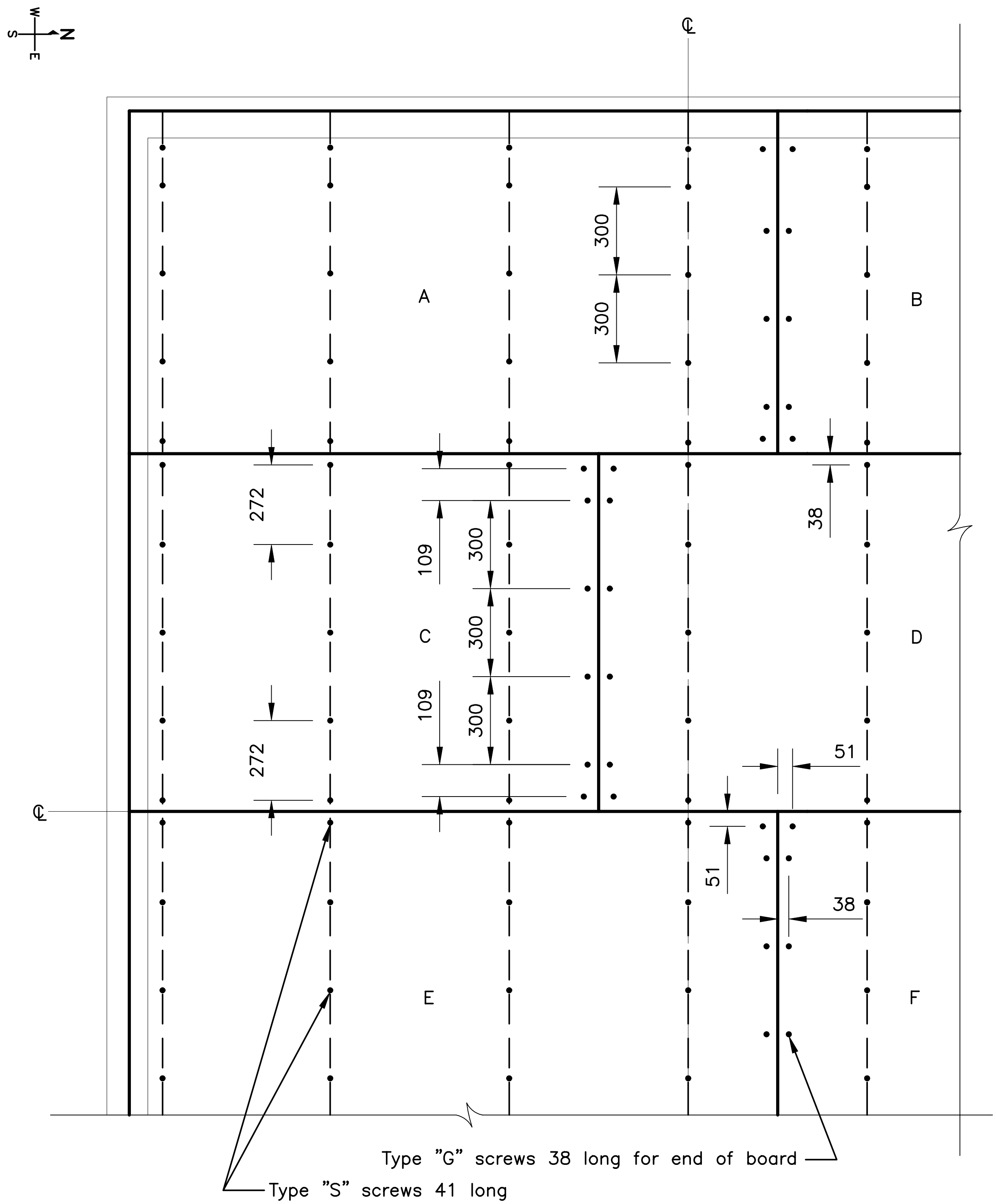
Figure A–93. Gypsum Board Base Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–68)

Figure A–94. Gypsum Board Face Layer Layout (Solid Wood Joist)

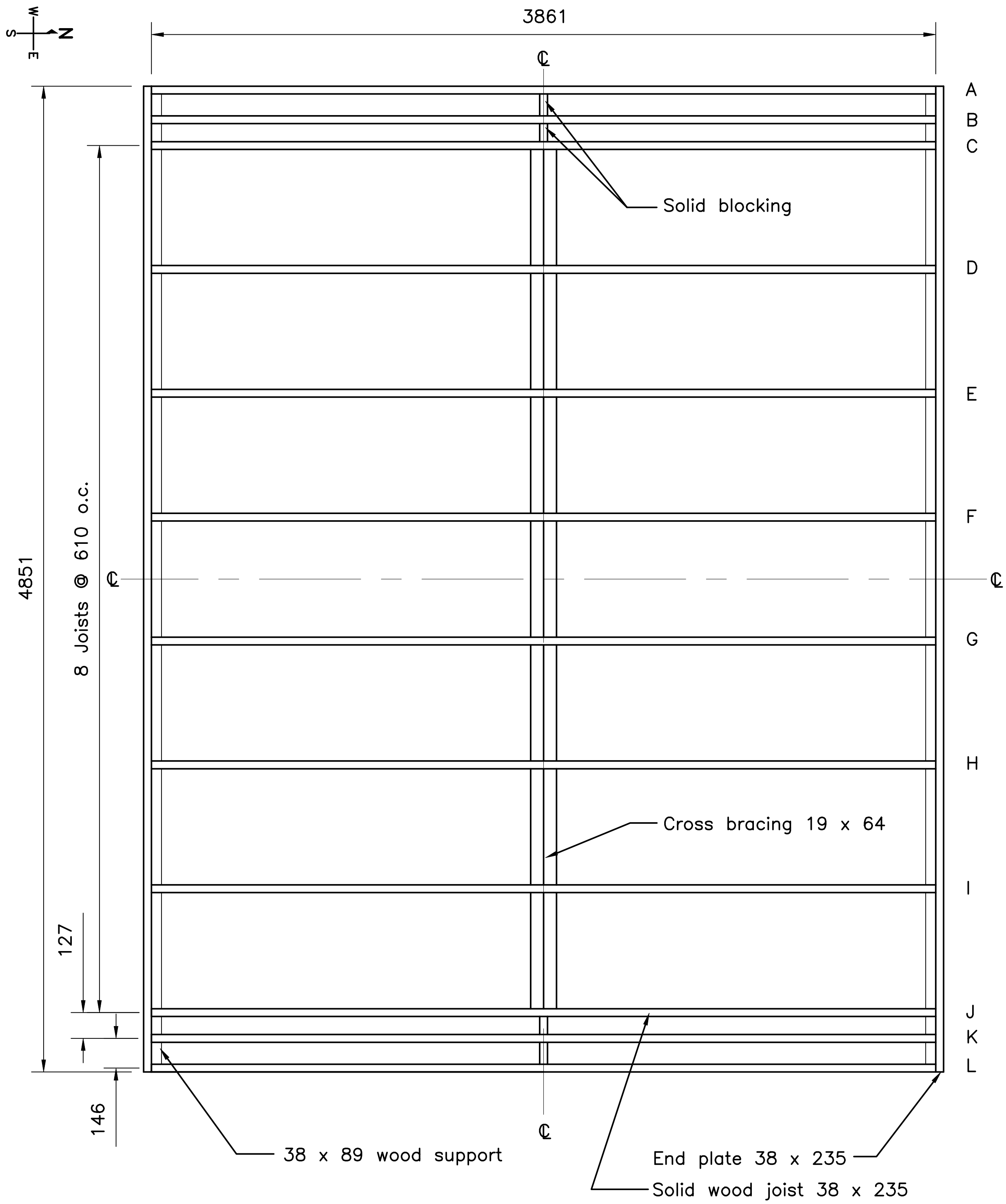


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF–68)

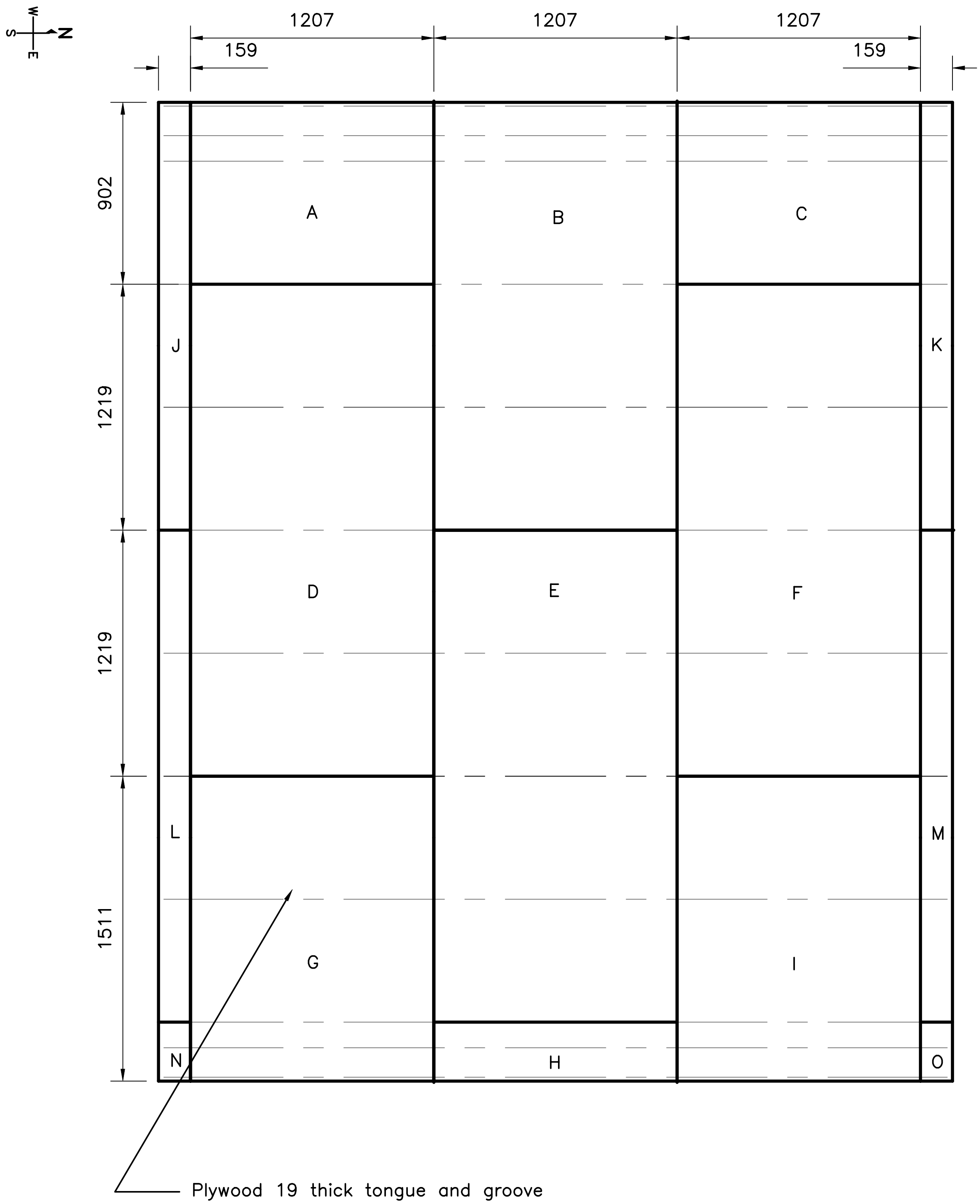
Figure A–95. Gypsum Board Face Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–69)

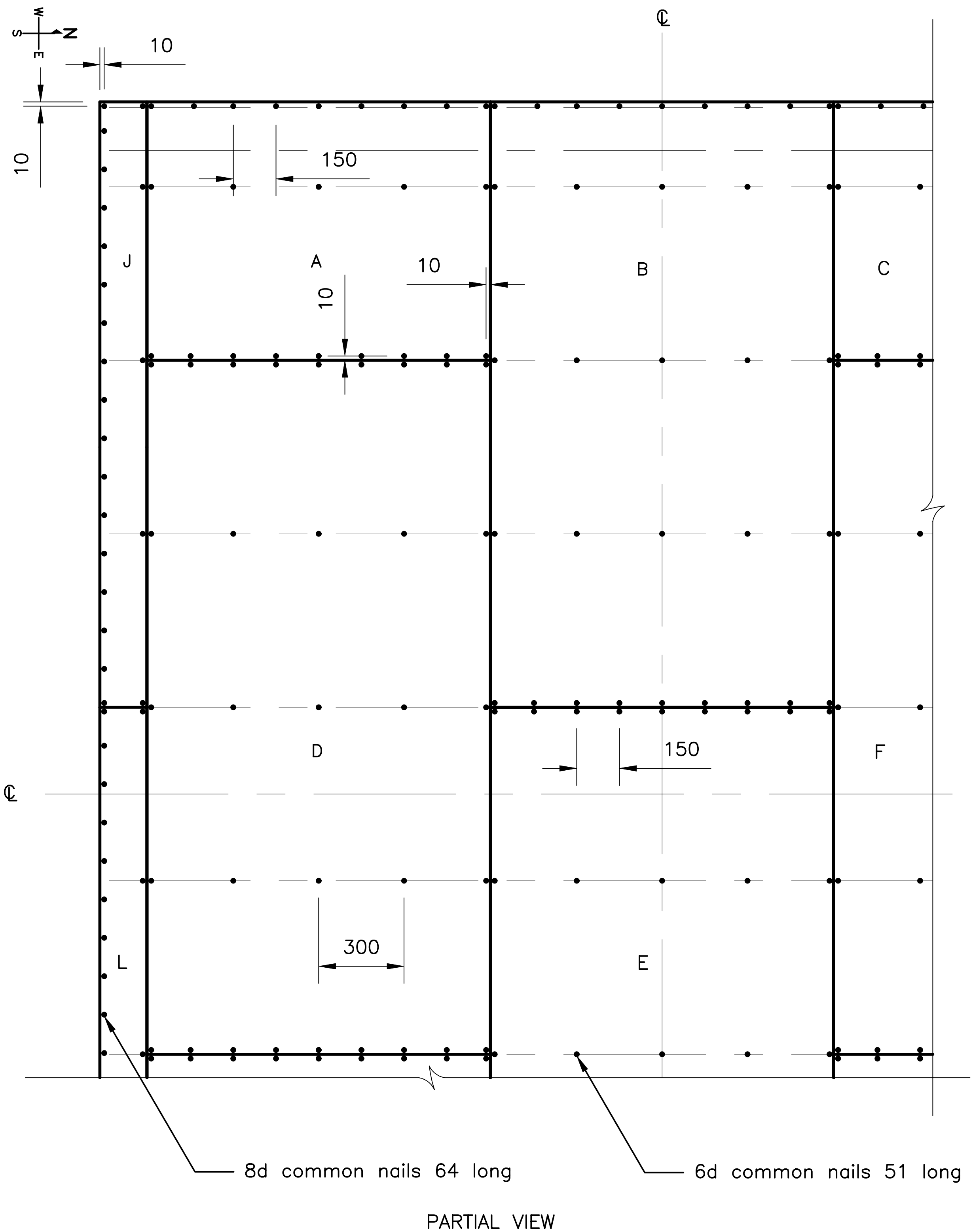
Figure A–96. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-69)

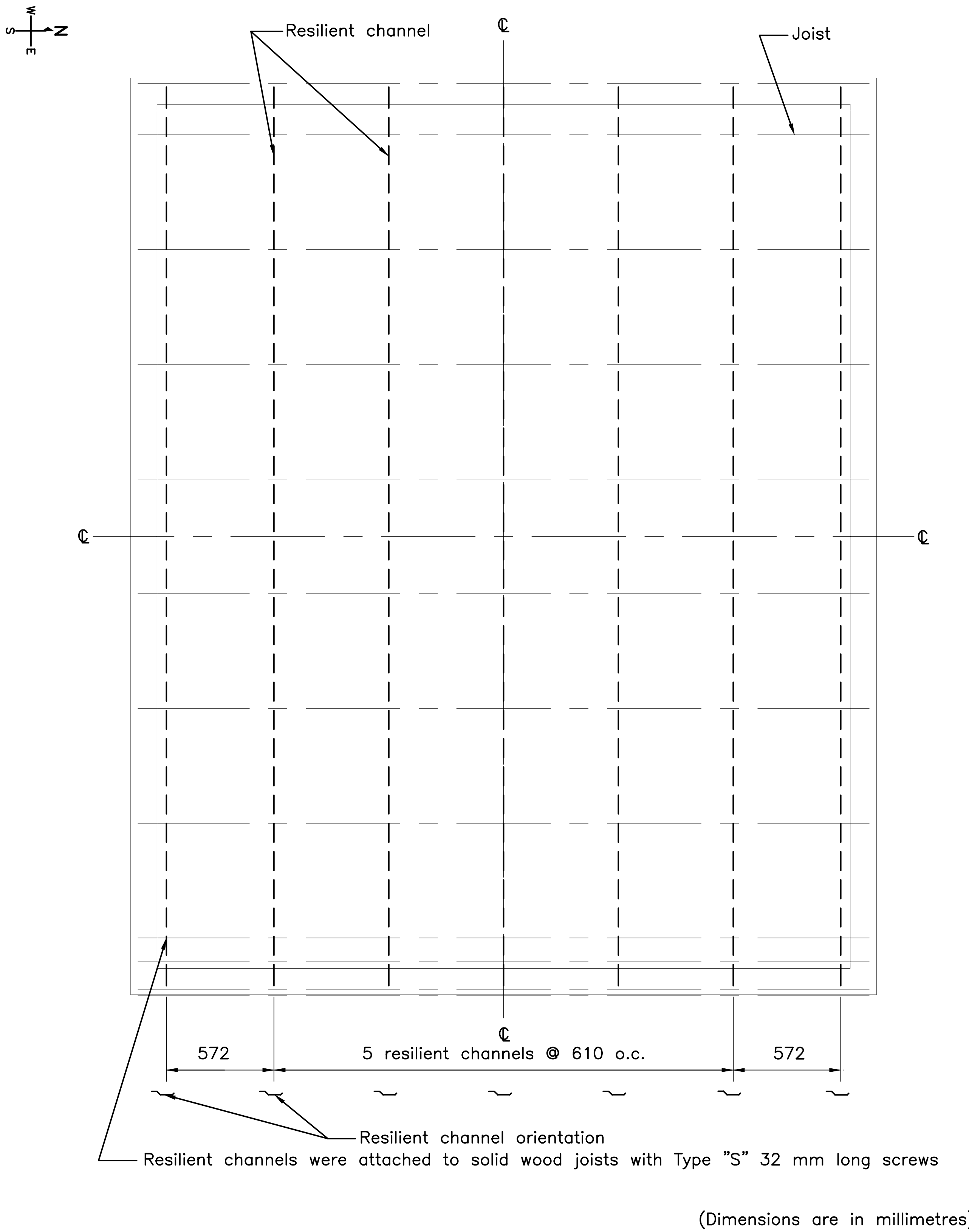
Figure A-97. Subfloor Layout (Solid Wood Joist)



(Dimensions are in millimetres)

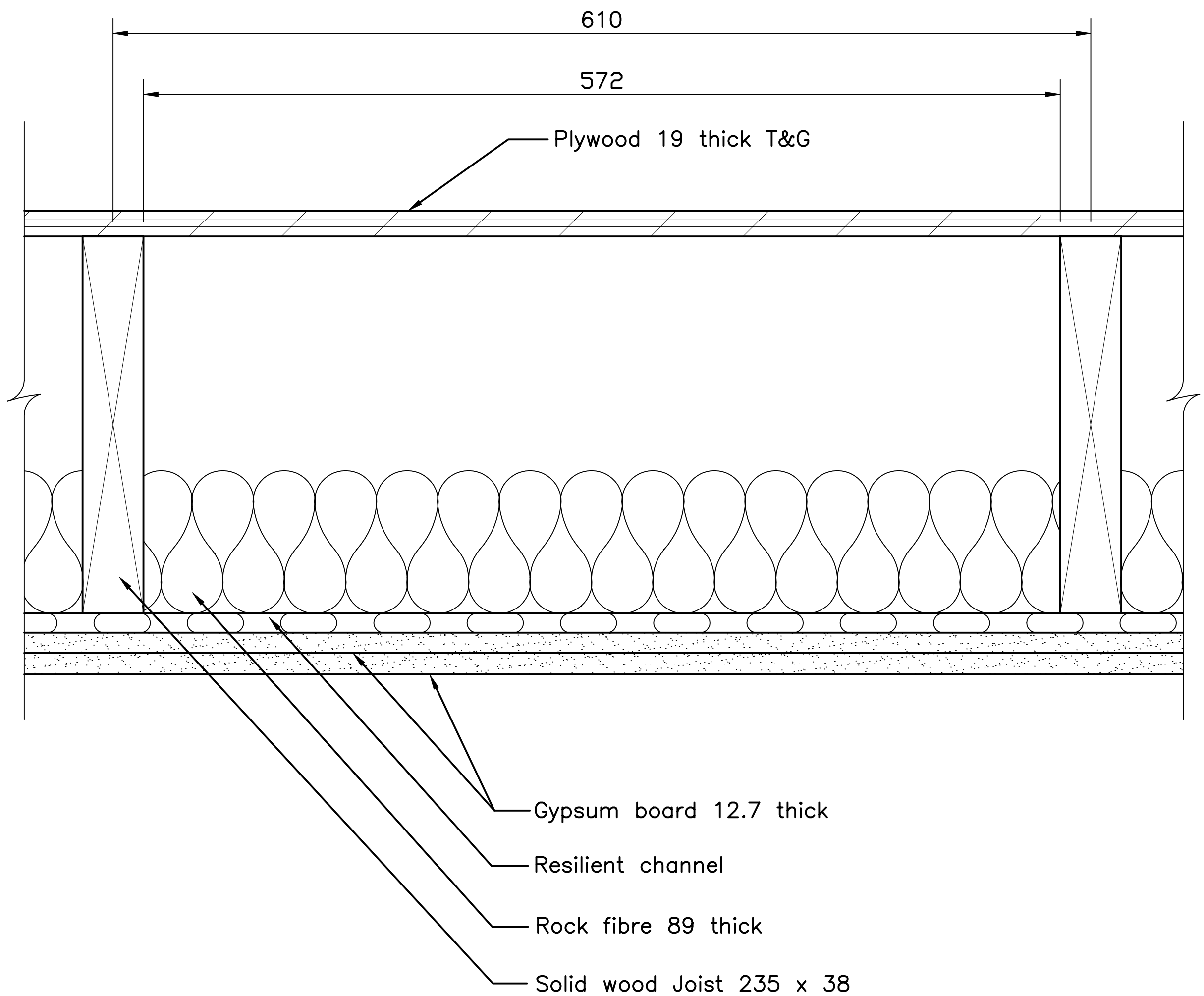
(Assembly No. FF–69)

Figure A–98. Subfloor Nail Pattern (Solid Wood Joist)



(Assembly No. FF-69)

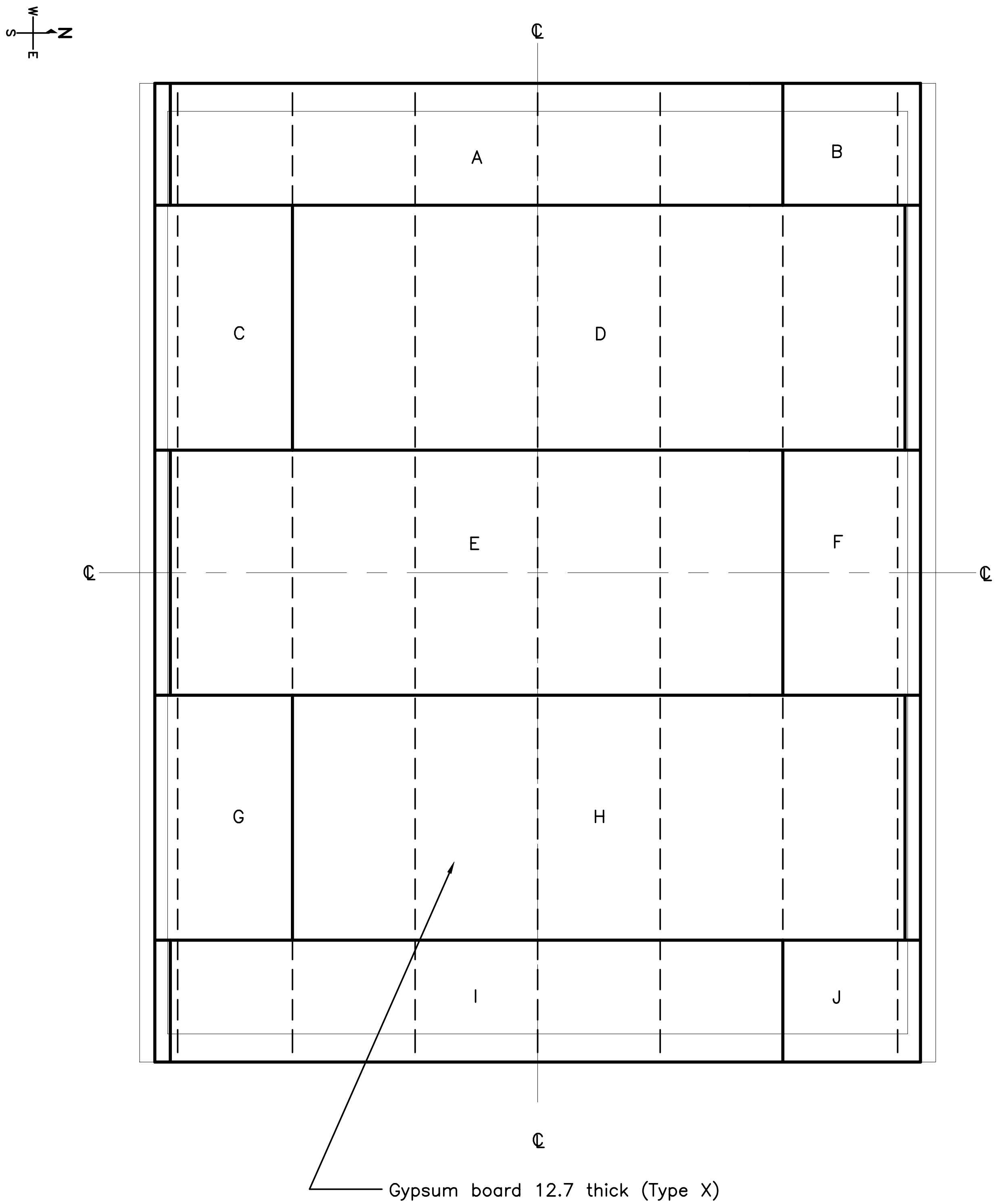
Figure A-99. Resilient Channel Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-69)

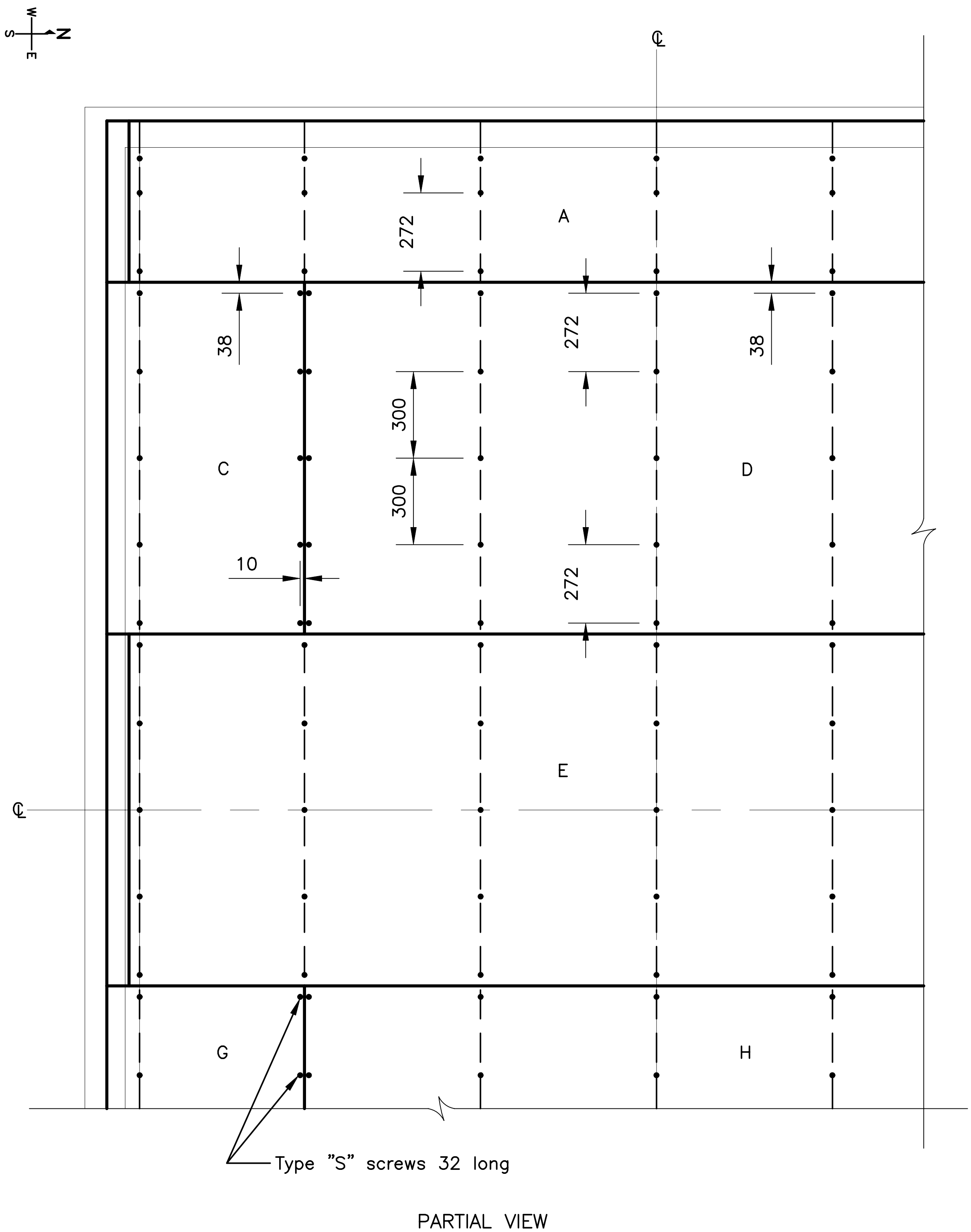
Figure A-100. Insulation Location (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–69)

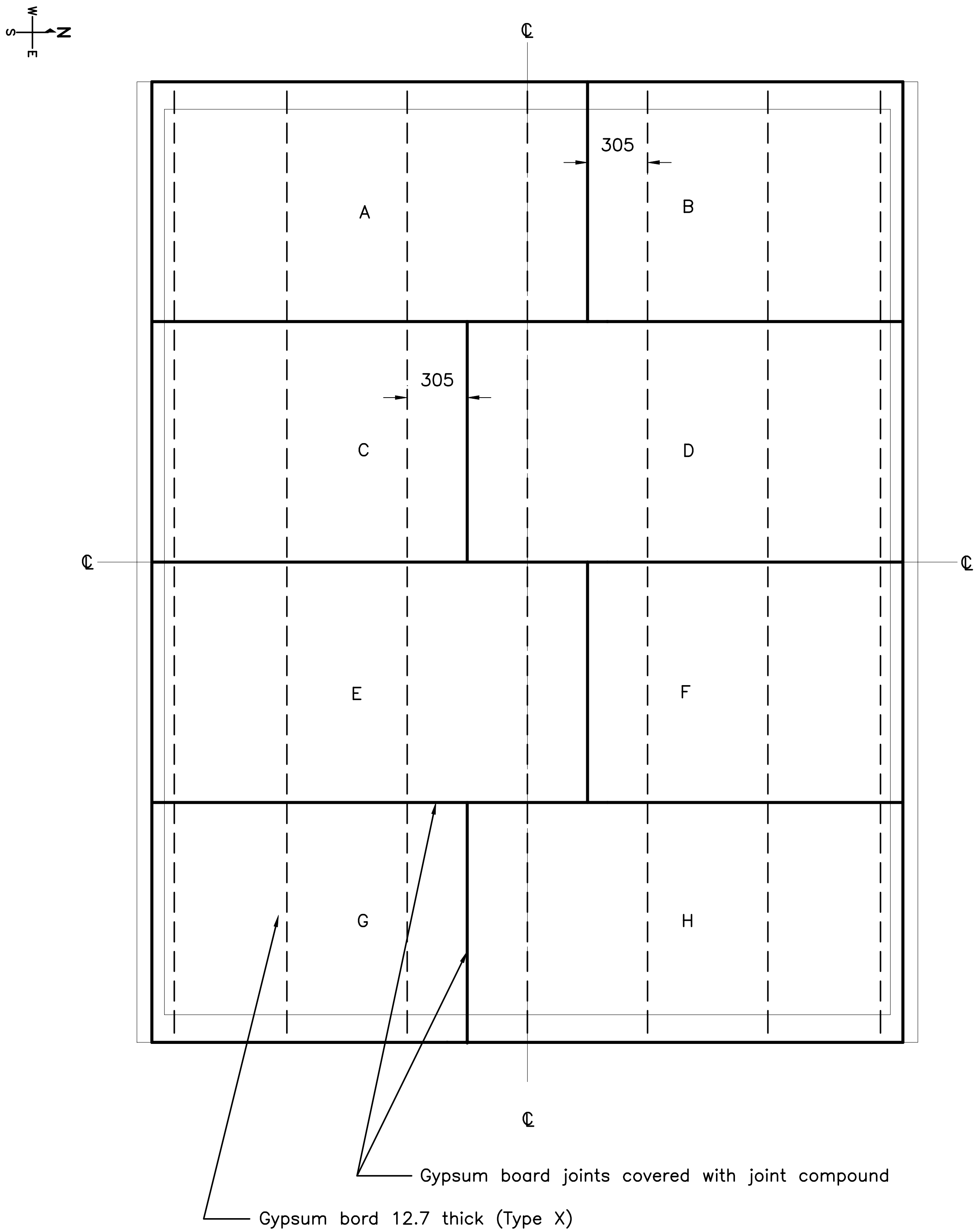
Figure A–101. Gypsum Board Base Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–69)

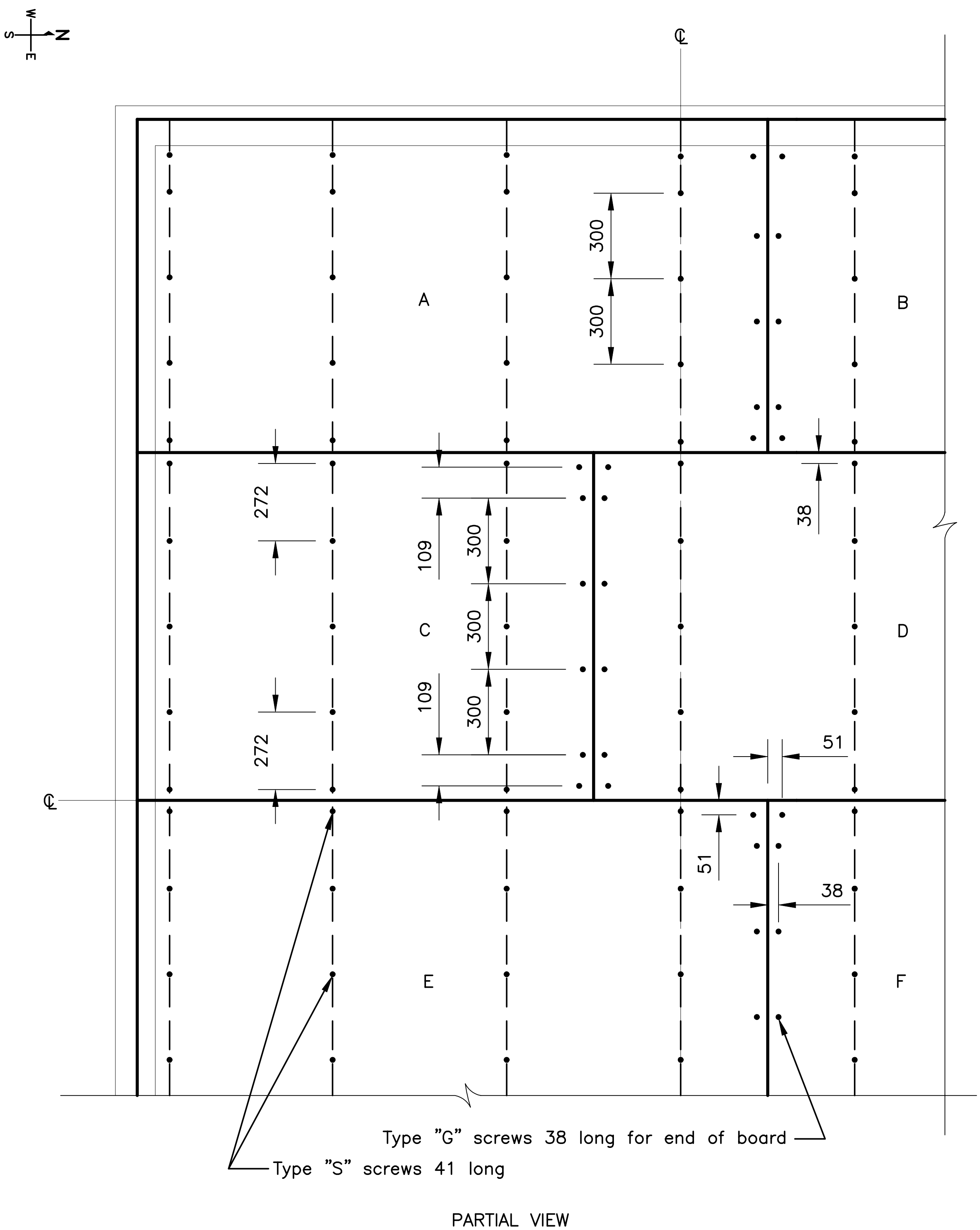
Figure A–102. Gypsum Board Base Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–69)

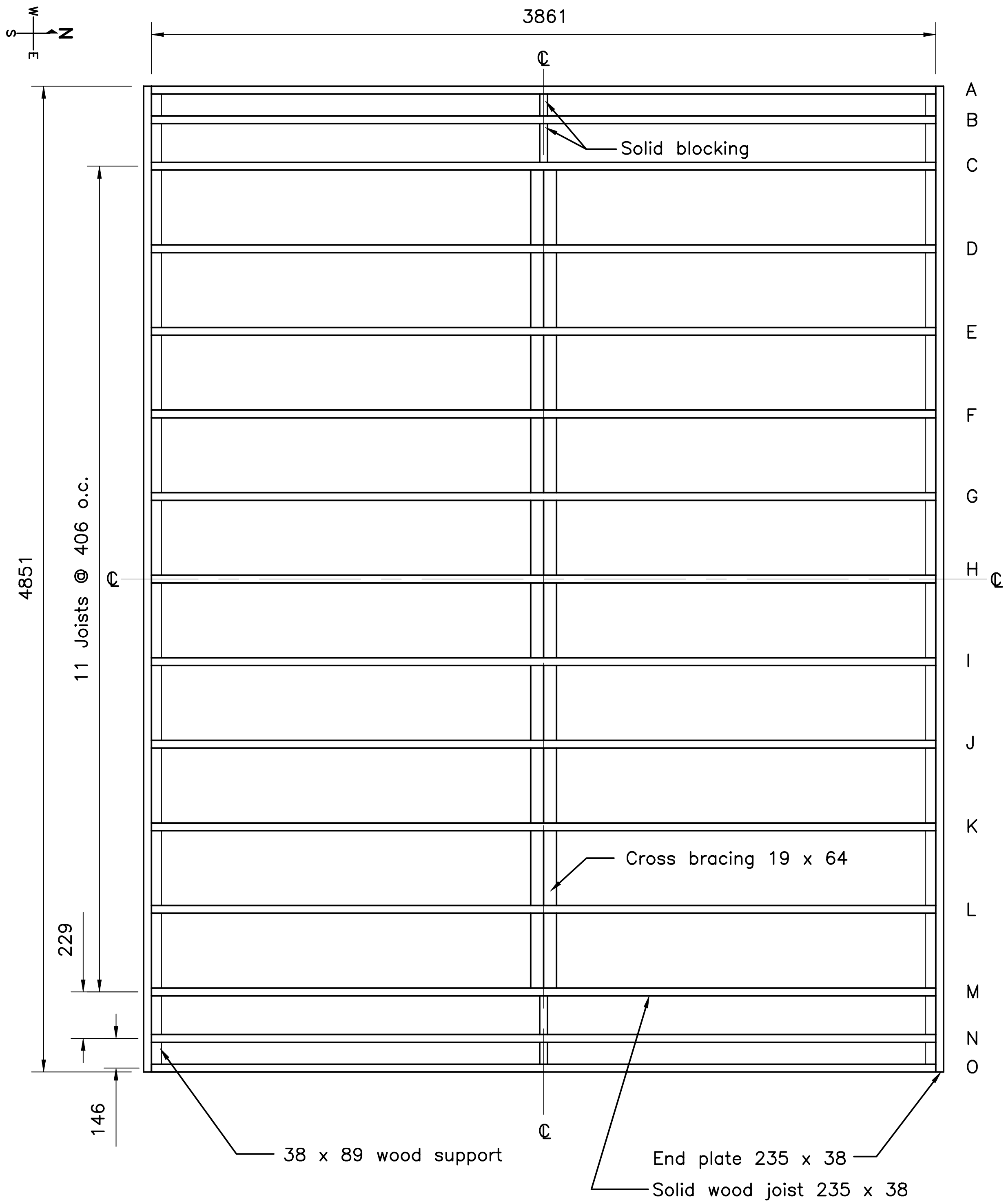
Figure A–103. Gypsum Board Face Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–69)

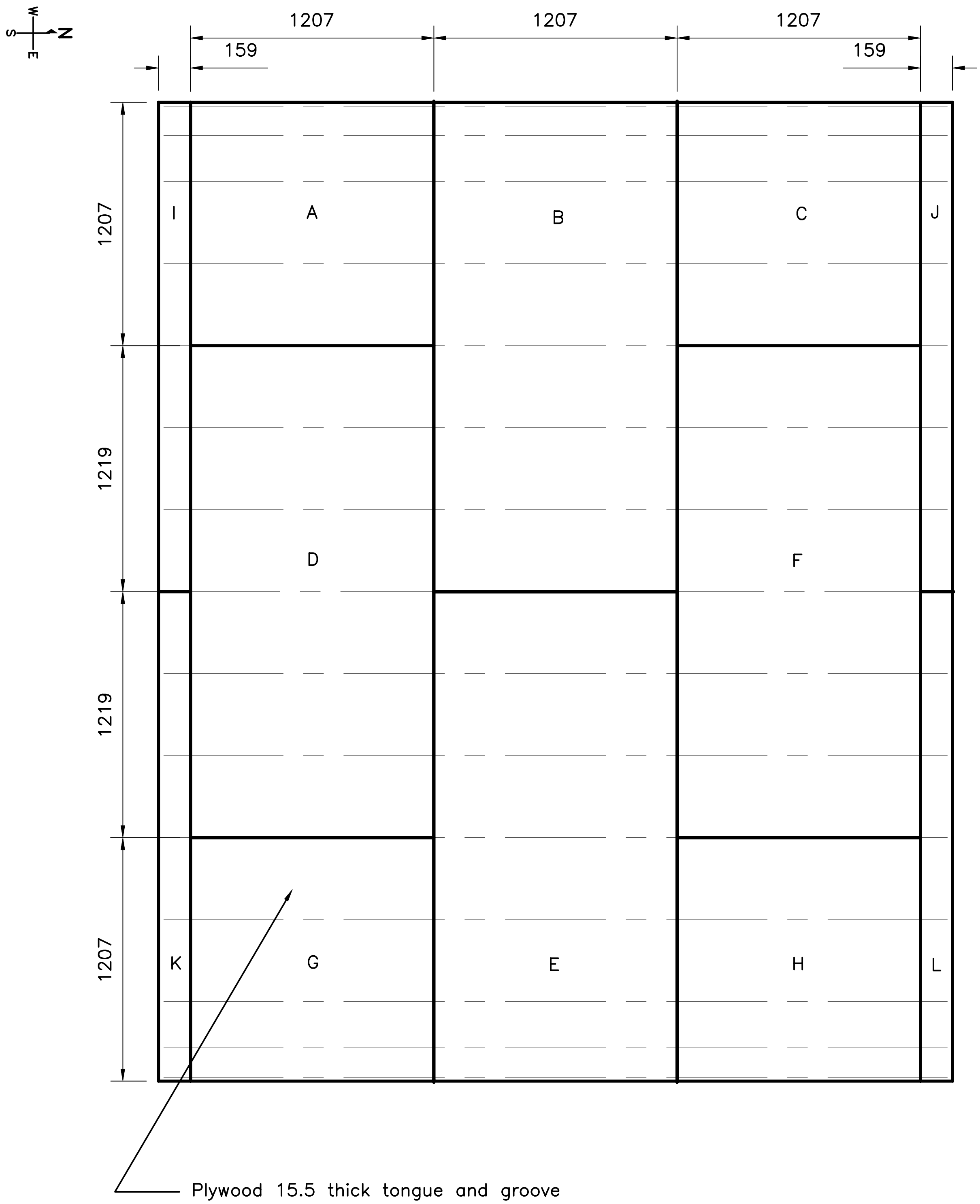
Figure A–104. Gypsum Board Face Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-70)

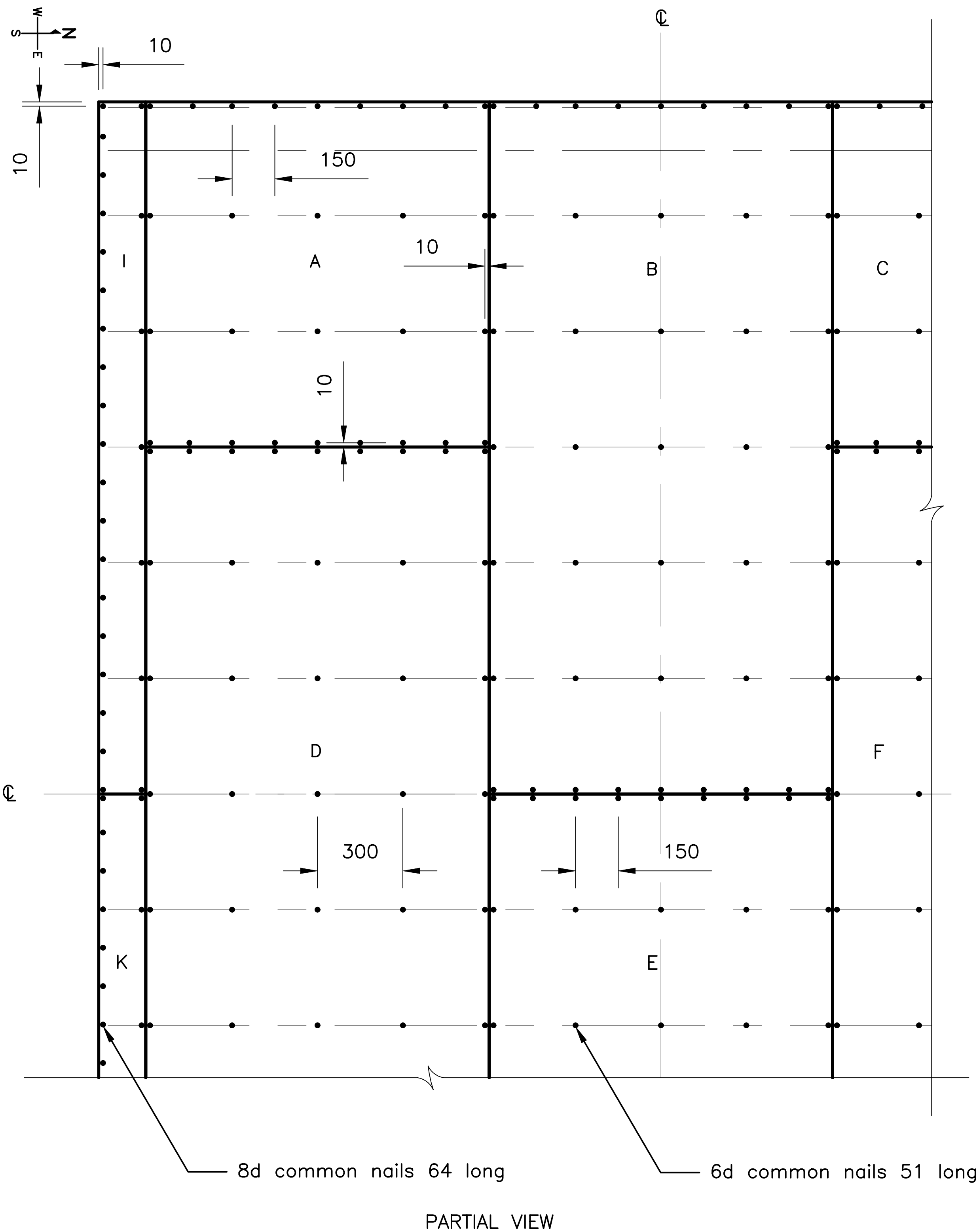
Figure A-105. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–70)

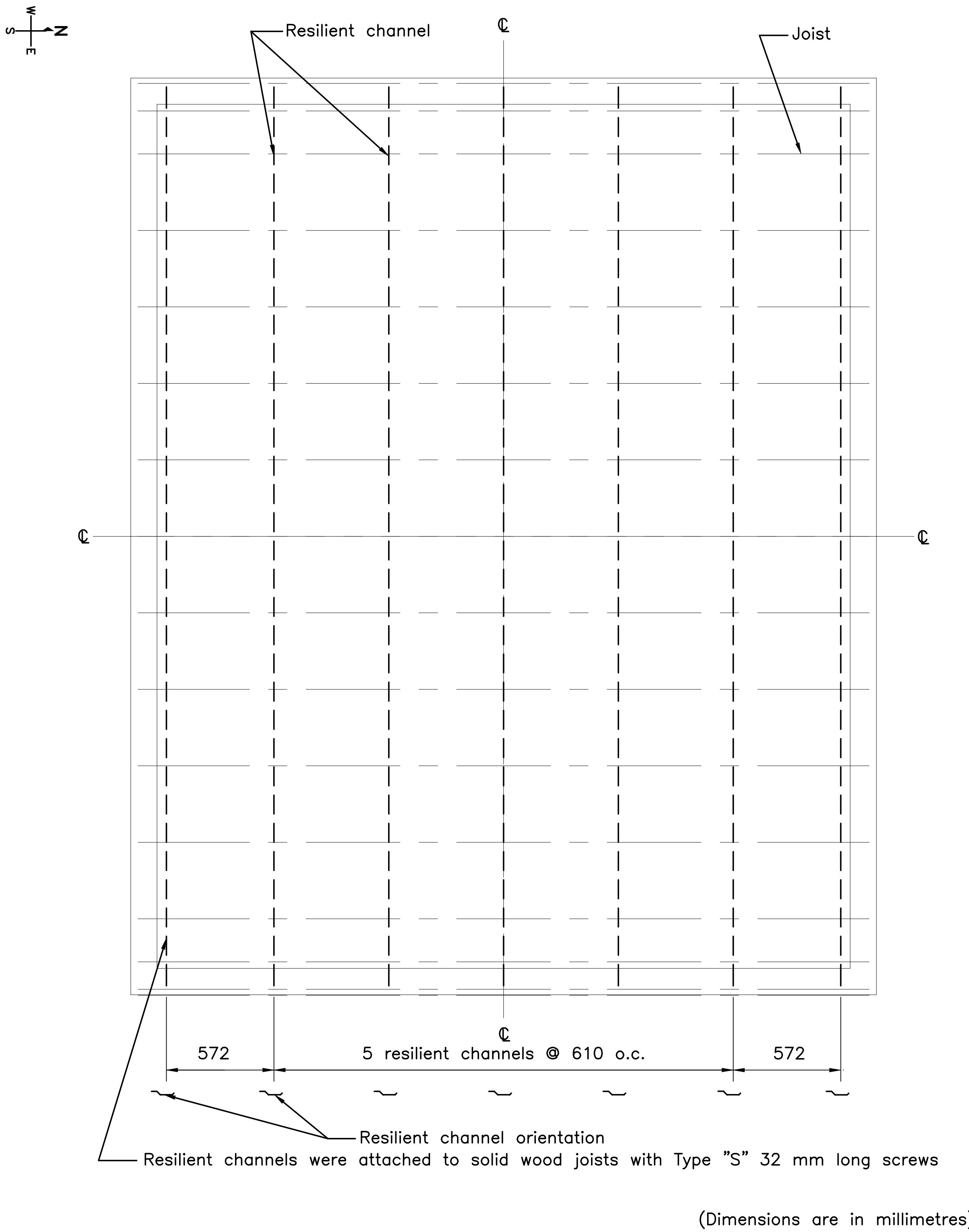
Figure A–106. Subfloor Layout (Solid Wood Joist)



(Dimensions are in millimetres)

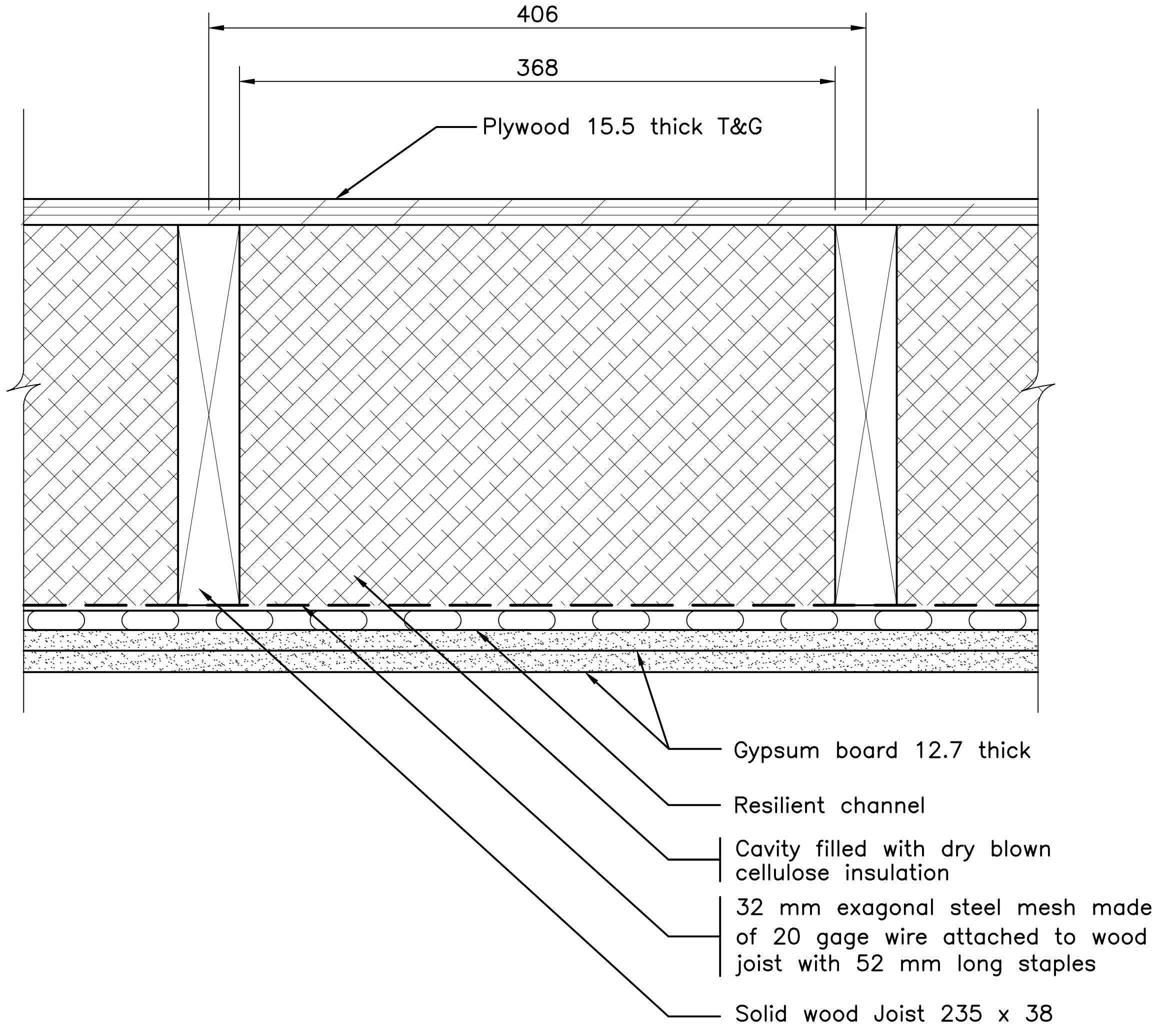
(Assembly No. FF–70)

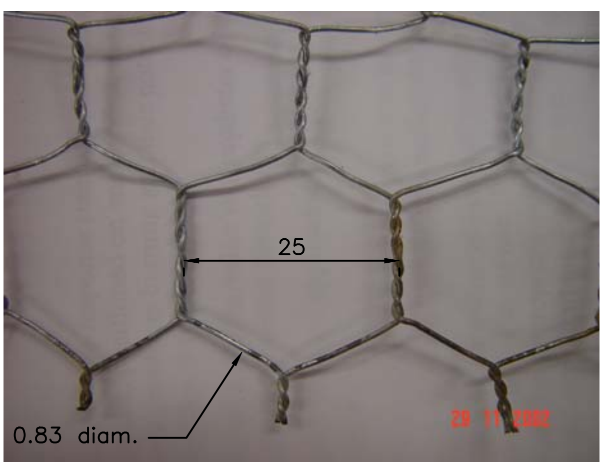
Figure A–107. Subfloor Nail Pattern (Solid Wood Joist)



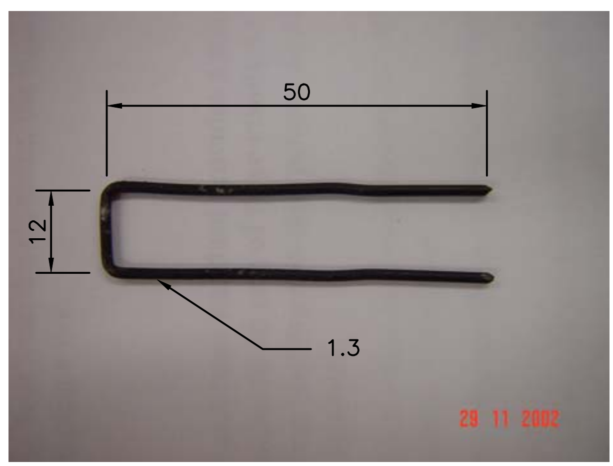
(Assembly No. FF–70)

Figure A–108. Resilient Channel Layout (Solid Wood Joist)





Steel mesh

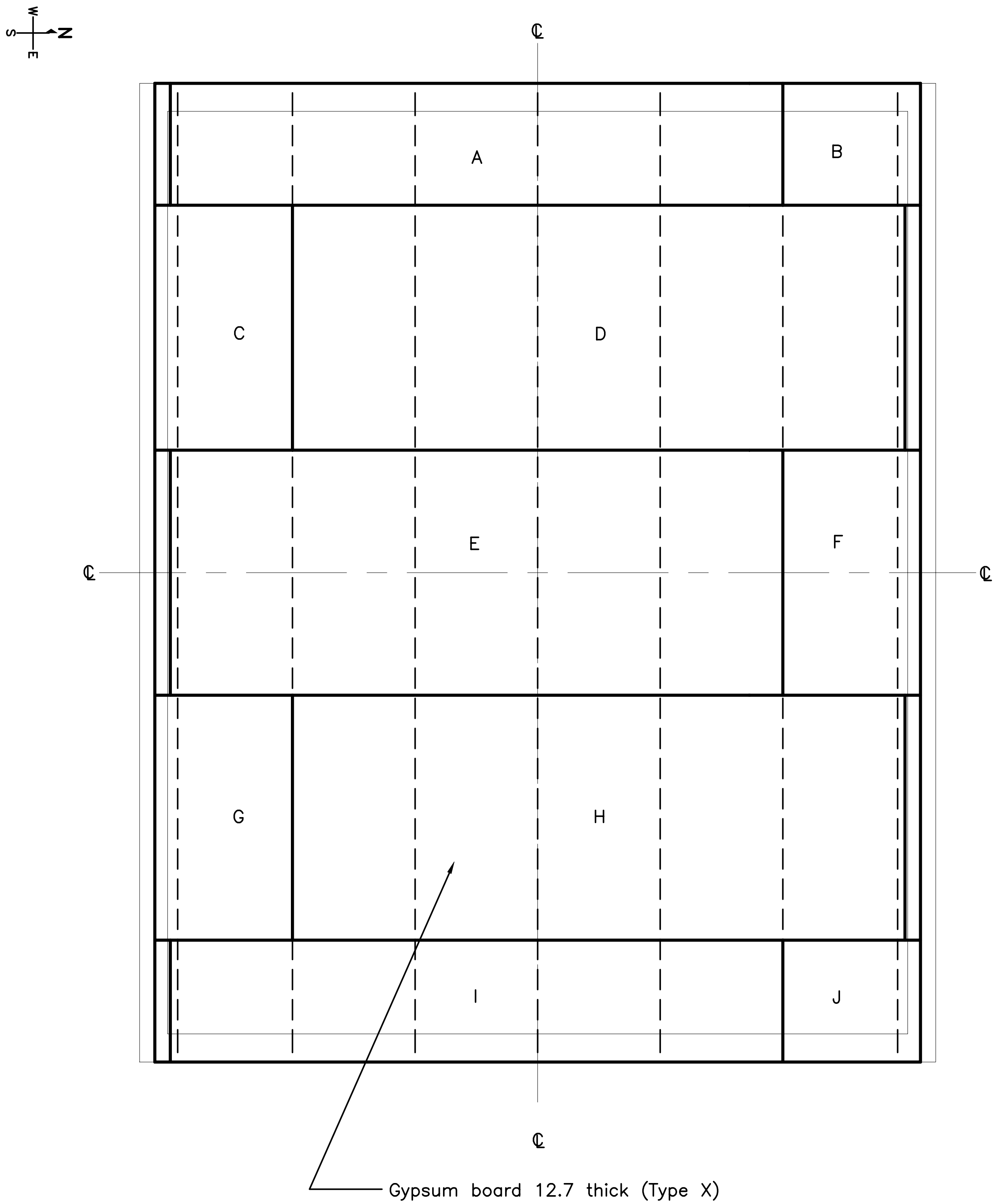


Staple used to secure the steel mesh to joists

(Dimensions are in millimetres)

(Assembly No. FF–70)

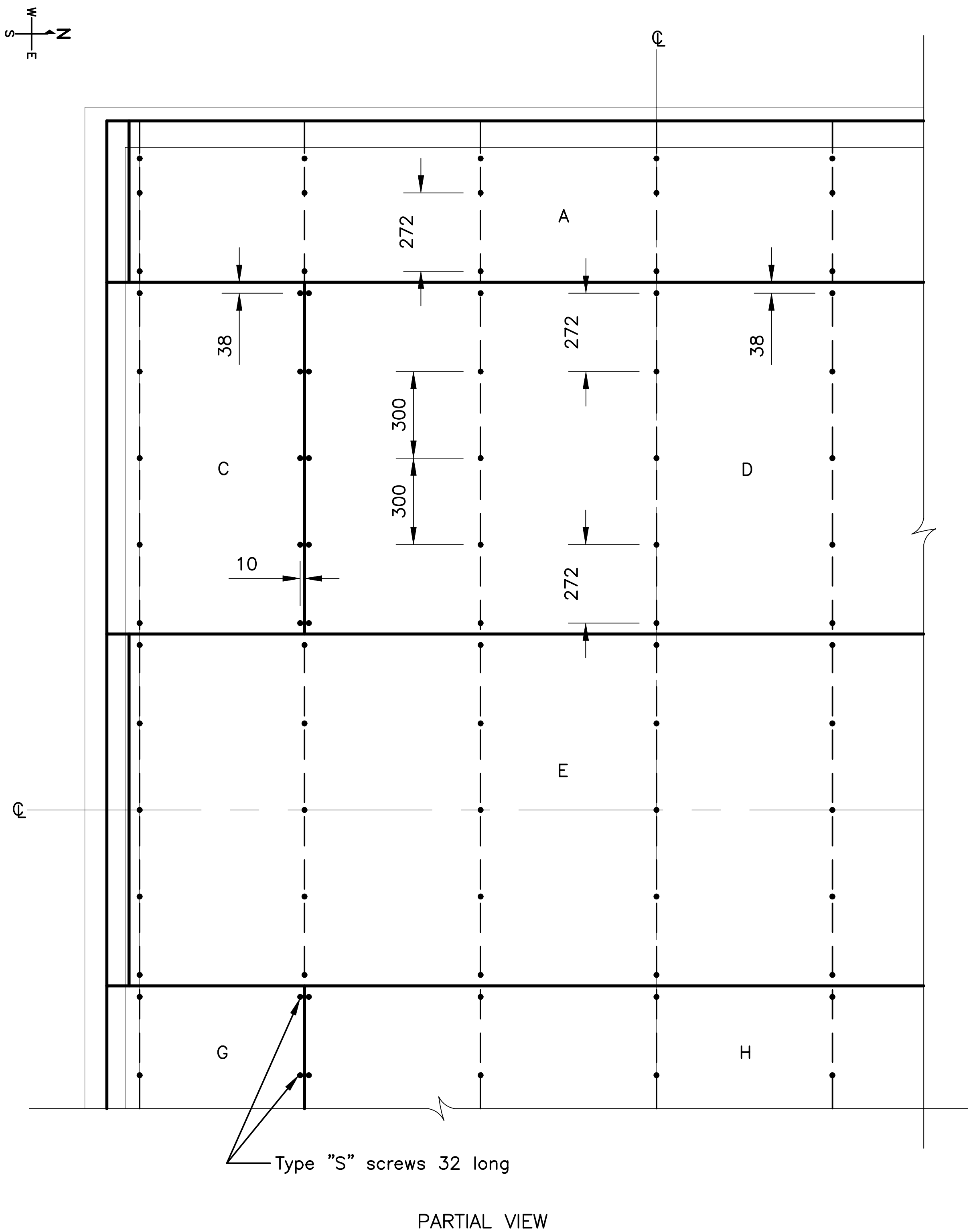
Figure A–109. Insulation Location (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–70)

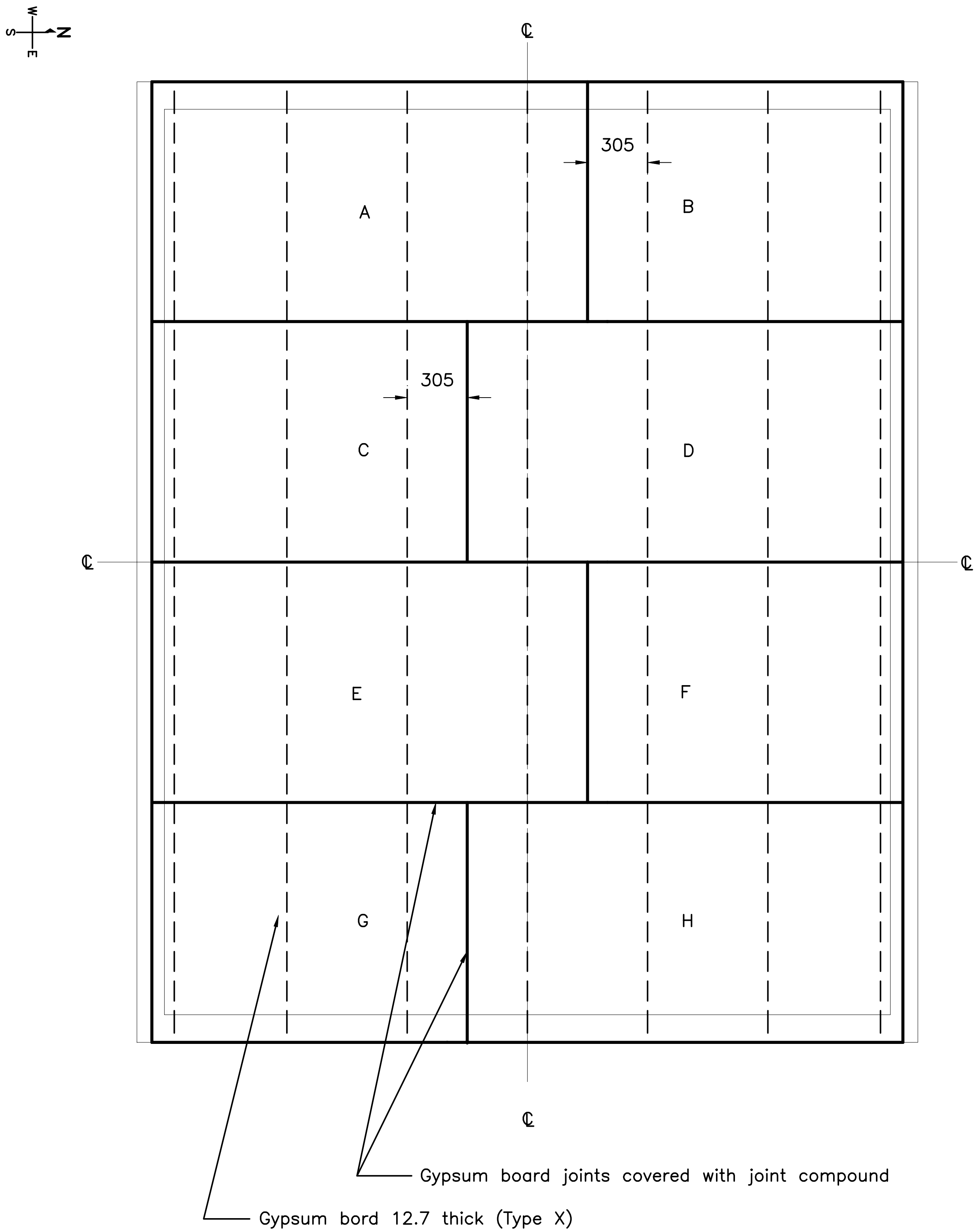
Figure A–110. Gypsum Board Base Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–70)

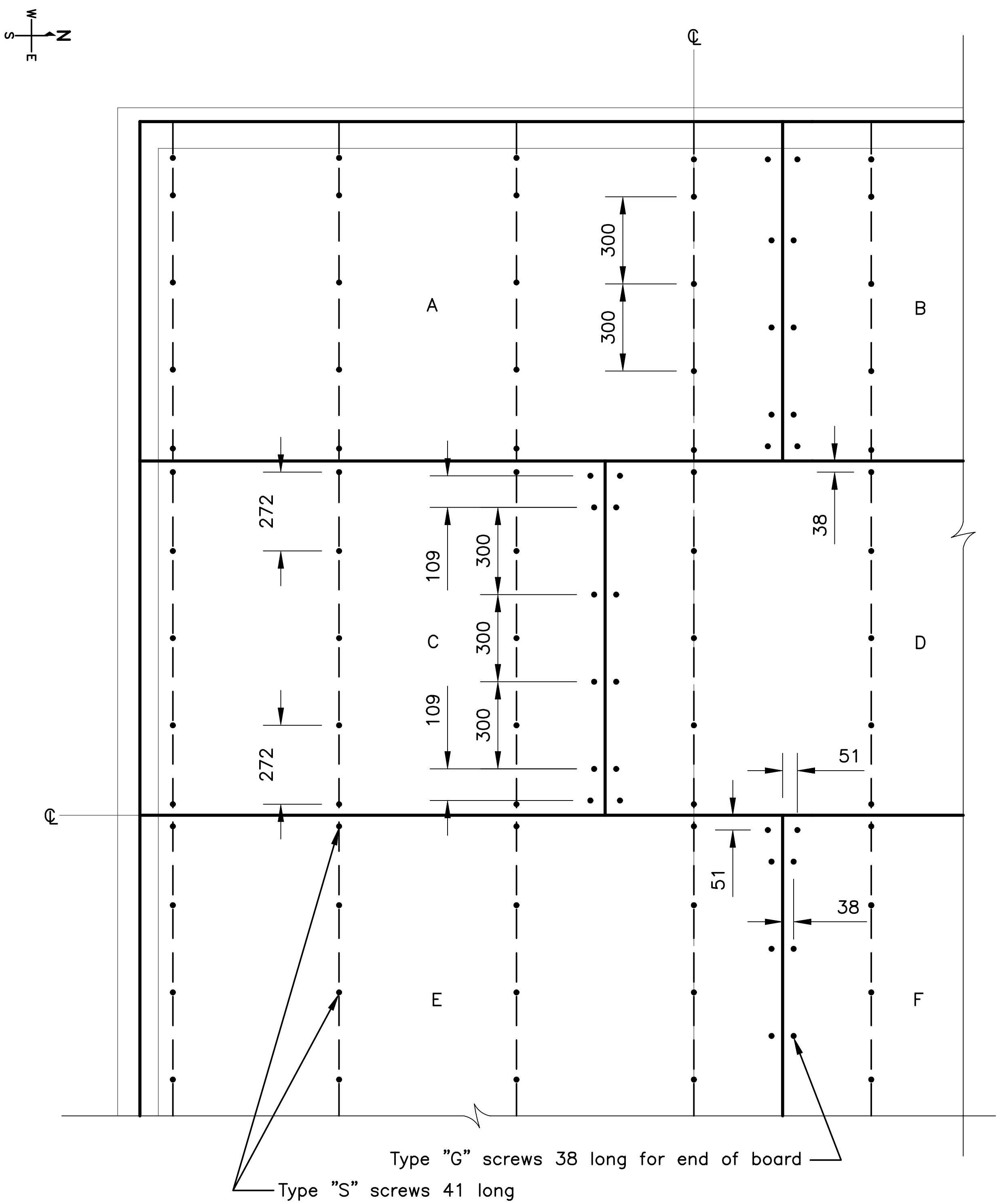
Figure A–111. Gypsum Board Base Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–70)

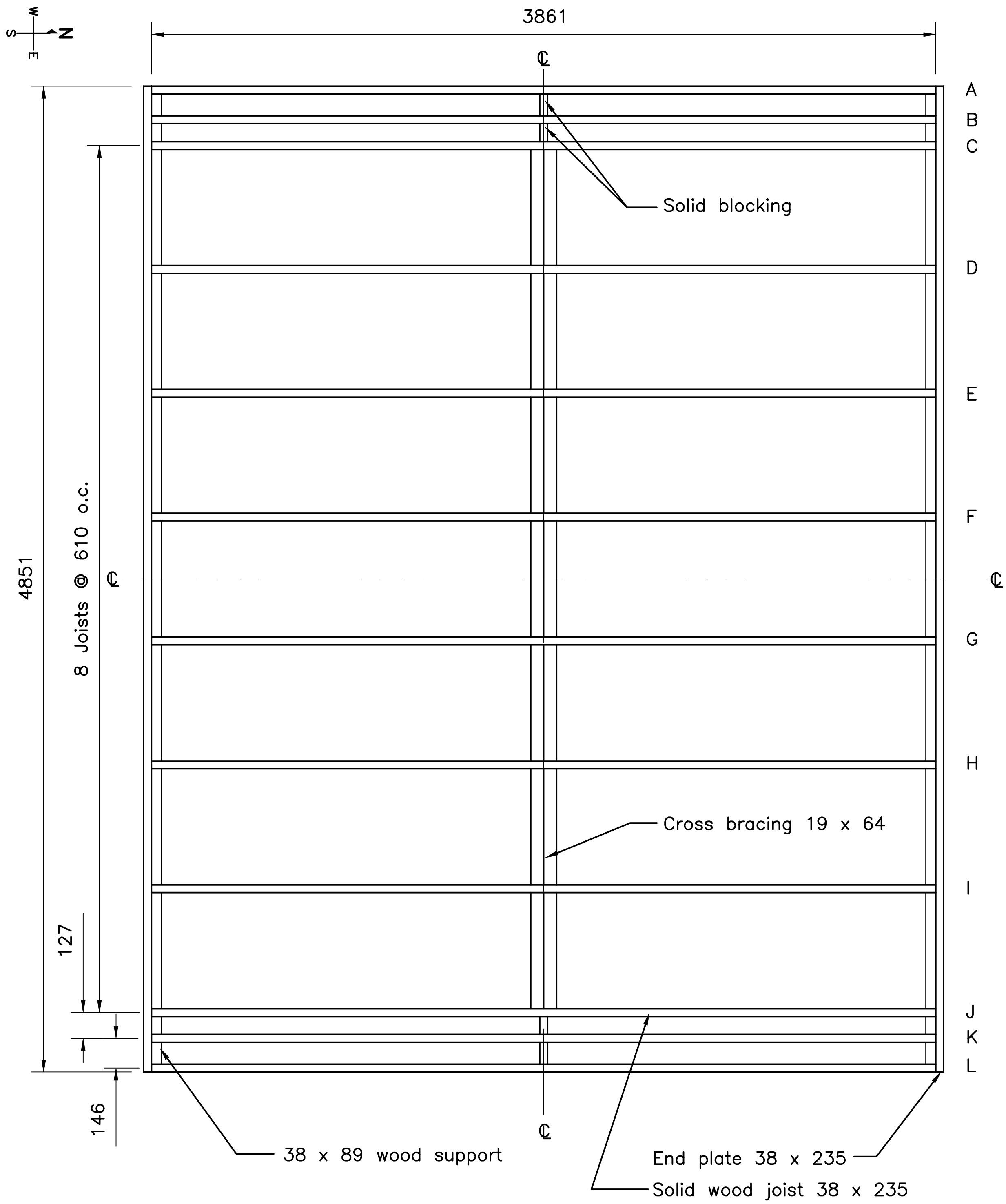
Figure A–112. Gypsum Board Face Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-70)

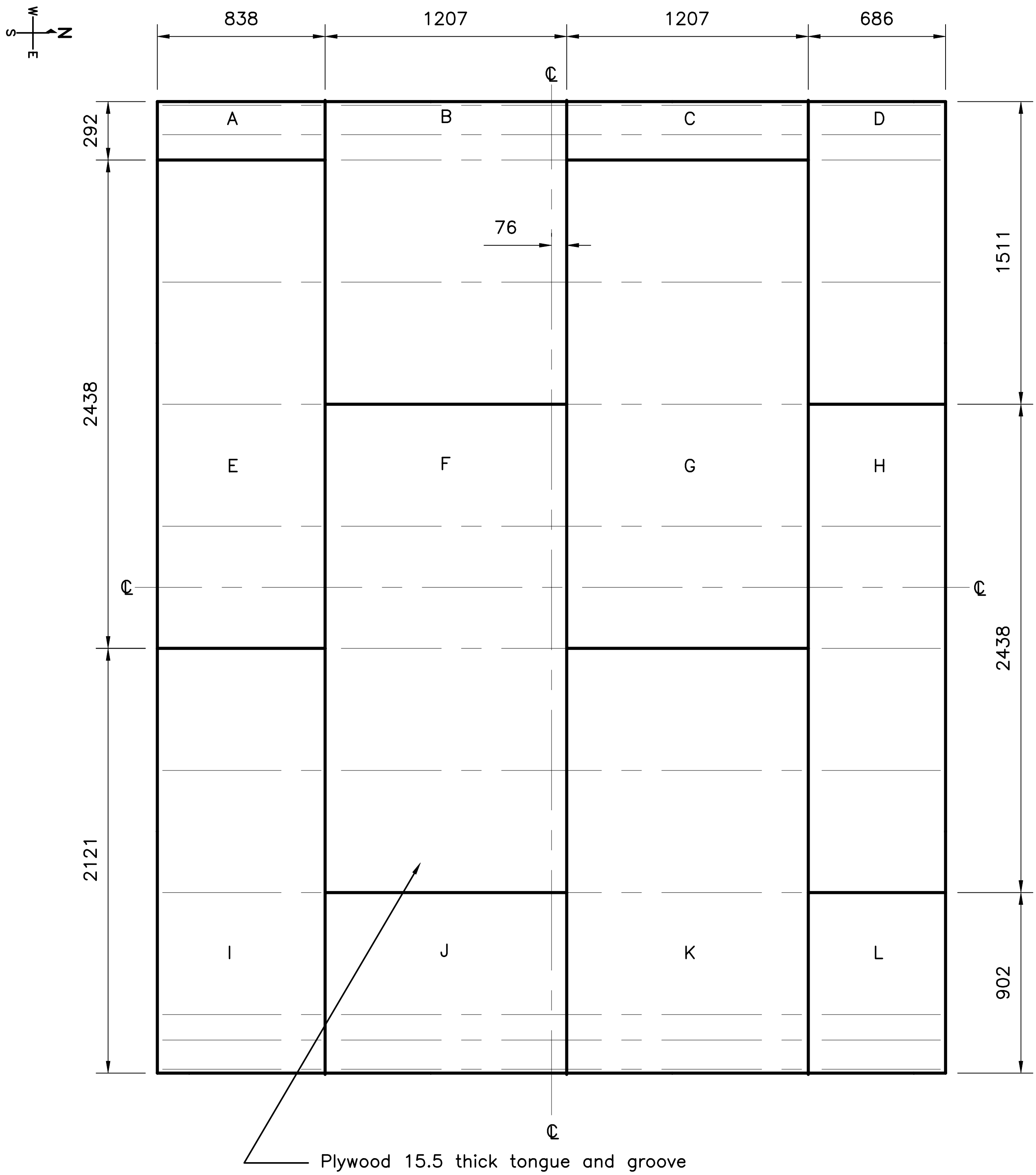
Figure A-113. Gypsum Board Face Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–73)

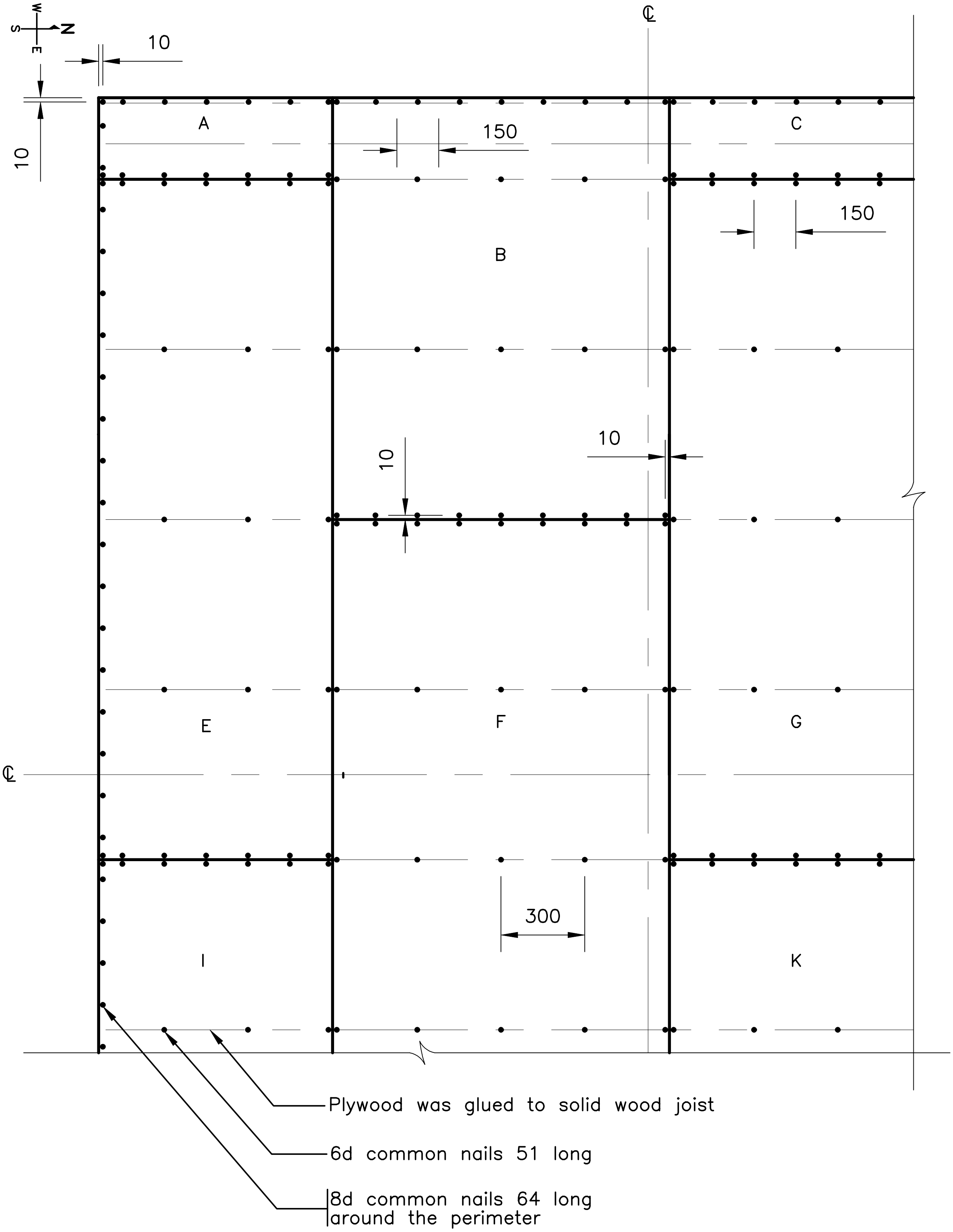
Figure A–114. Joist Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–73)

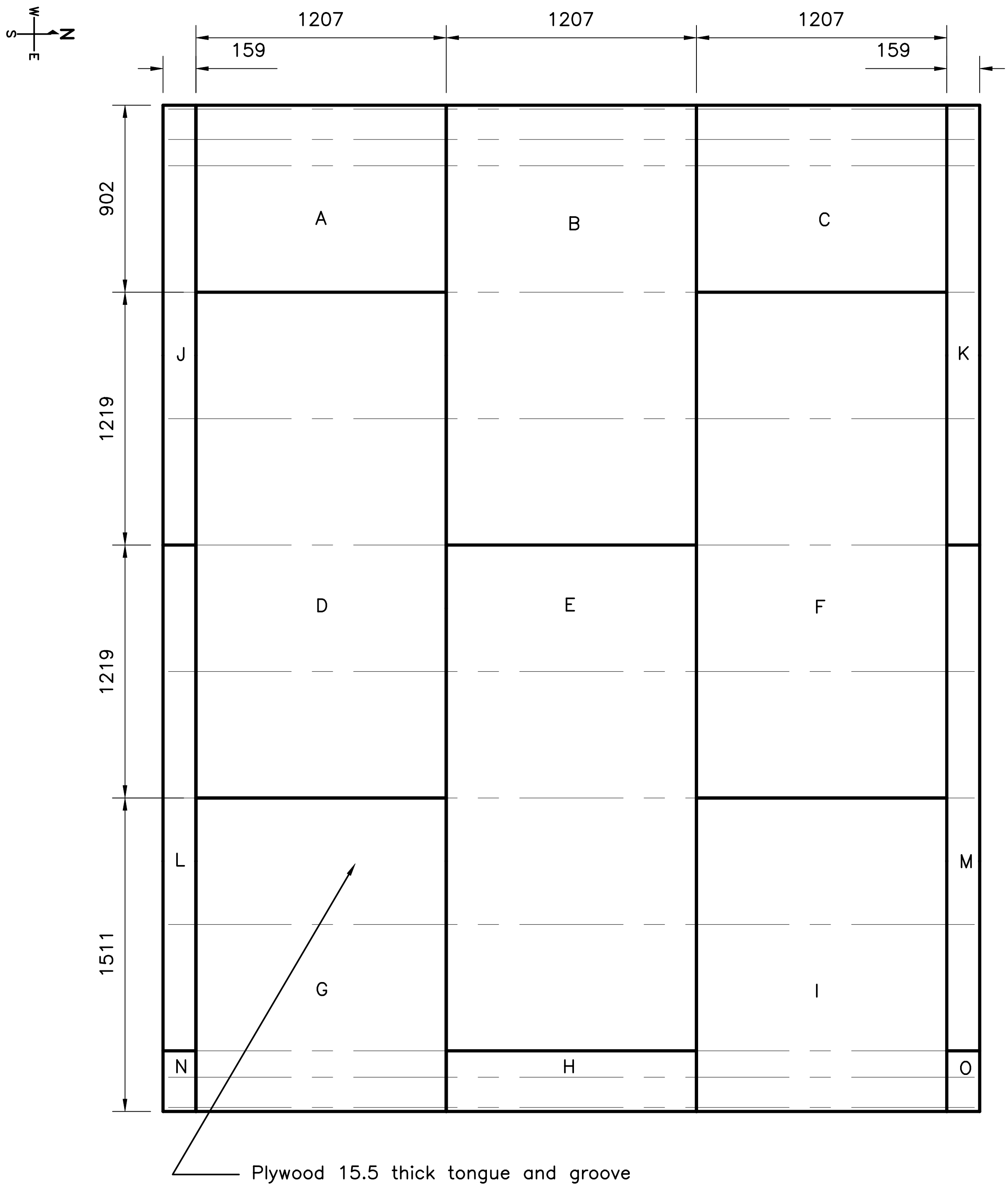
Figure A–115. Subfloor Layout Base Layer (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–73)

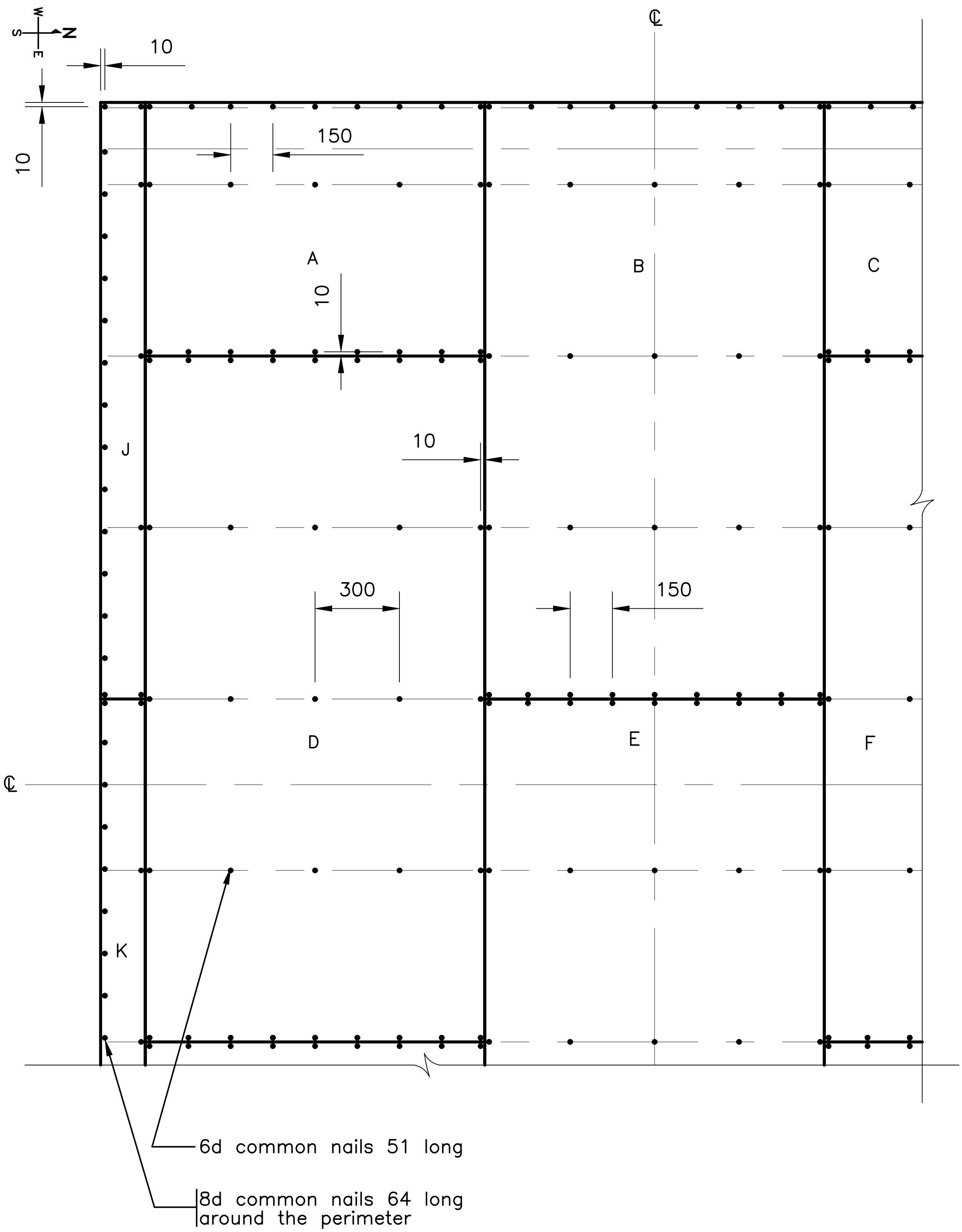
Figure A–116. Subfloor Nail Pattern Base Layer (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–73)

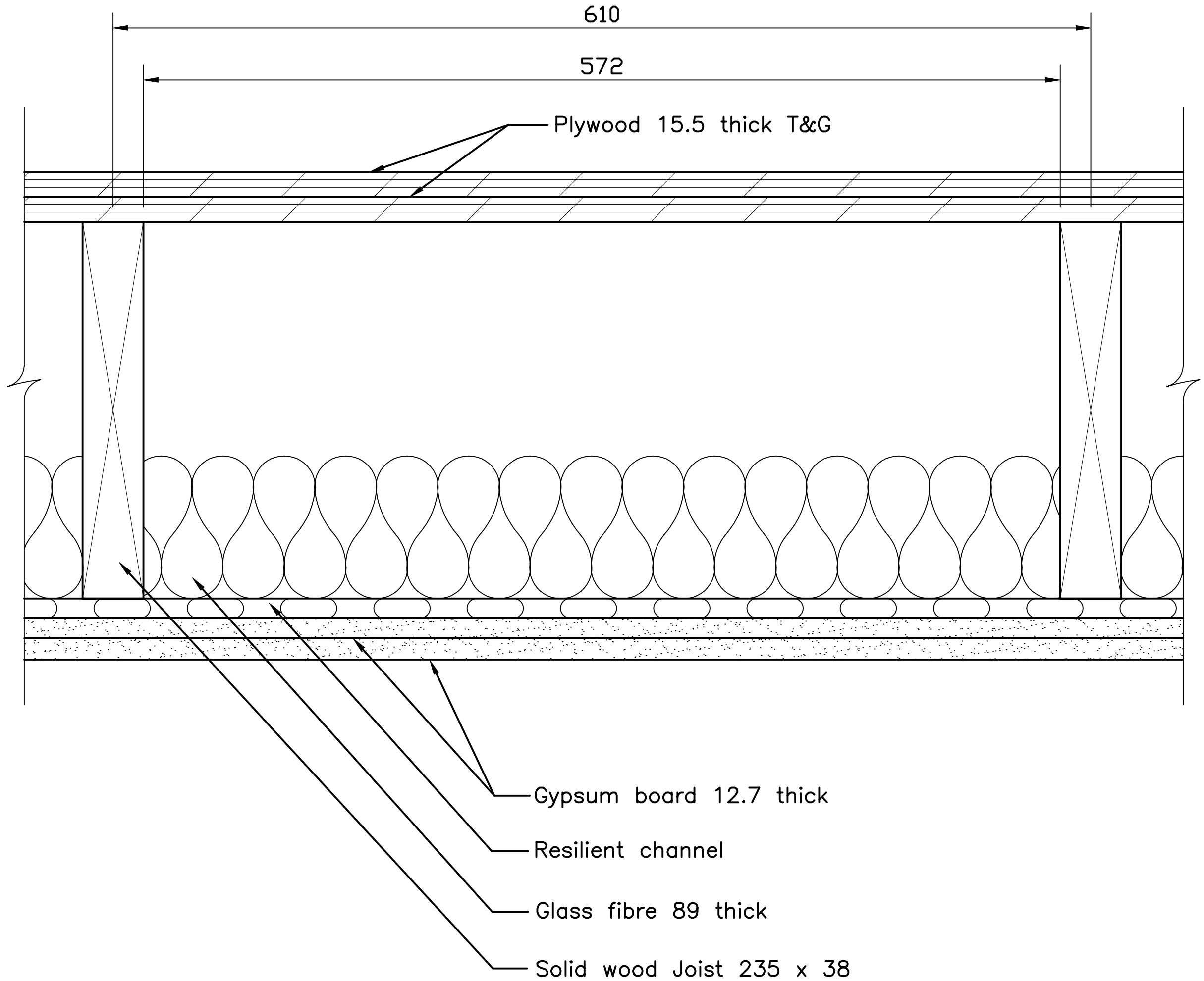
Figure A–117. Subfloor Layout Face Layer (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–73)

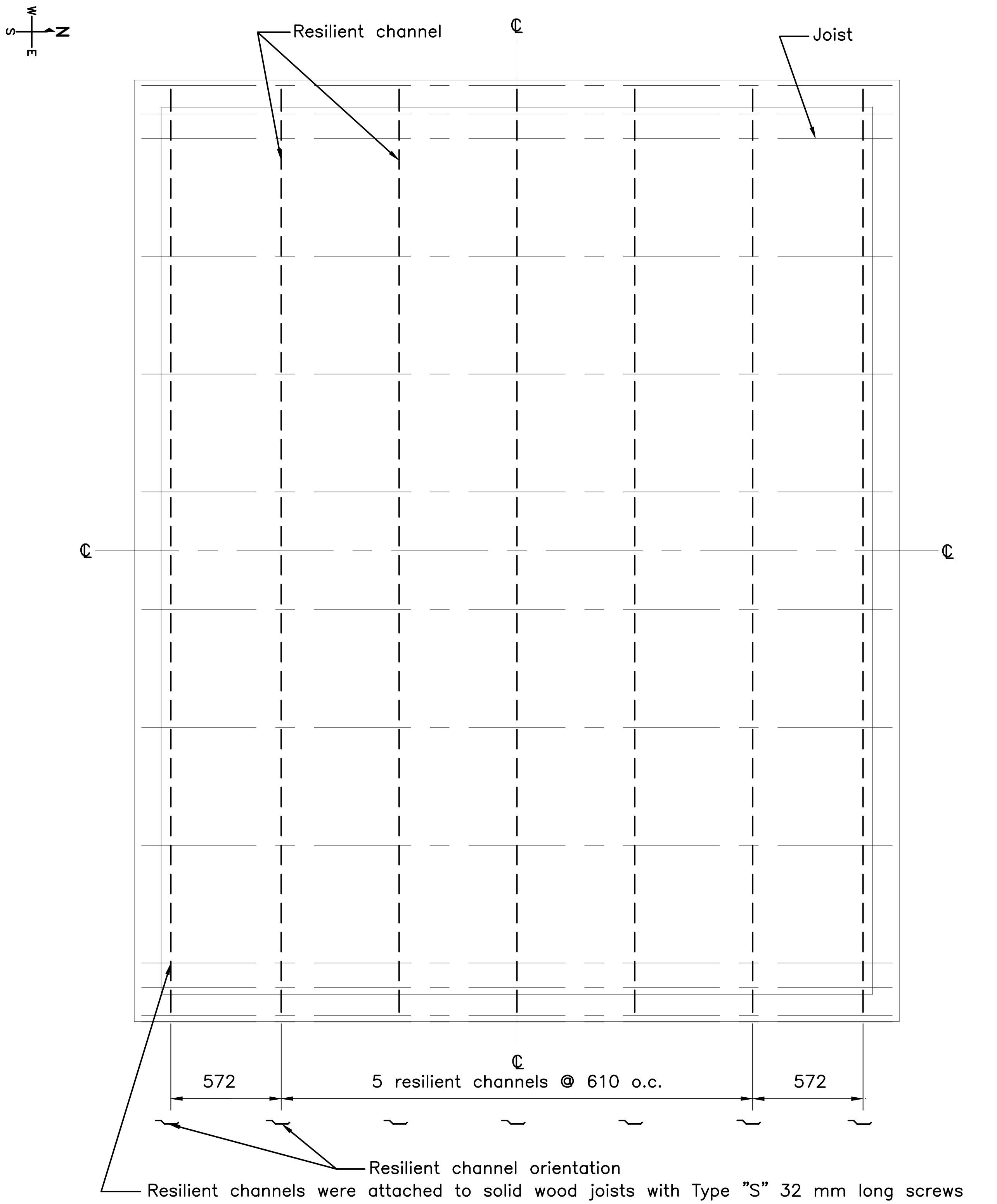
Figure A–118. Subfloor Nail Pattern Face Layer (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–73)

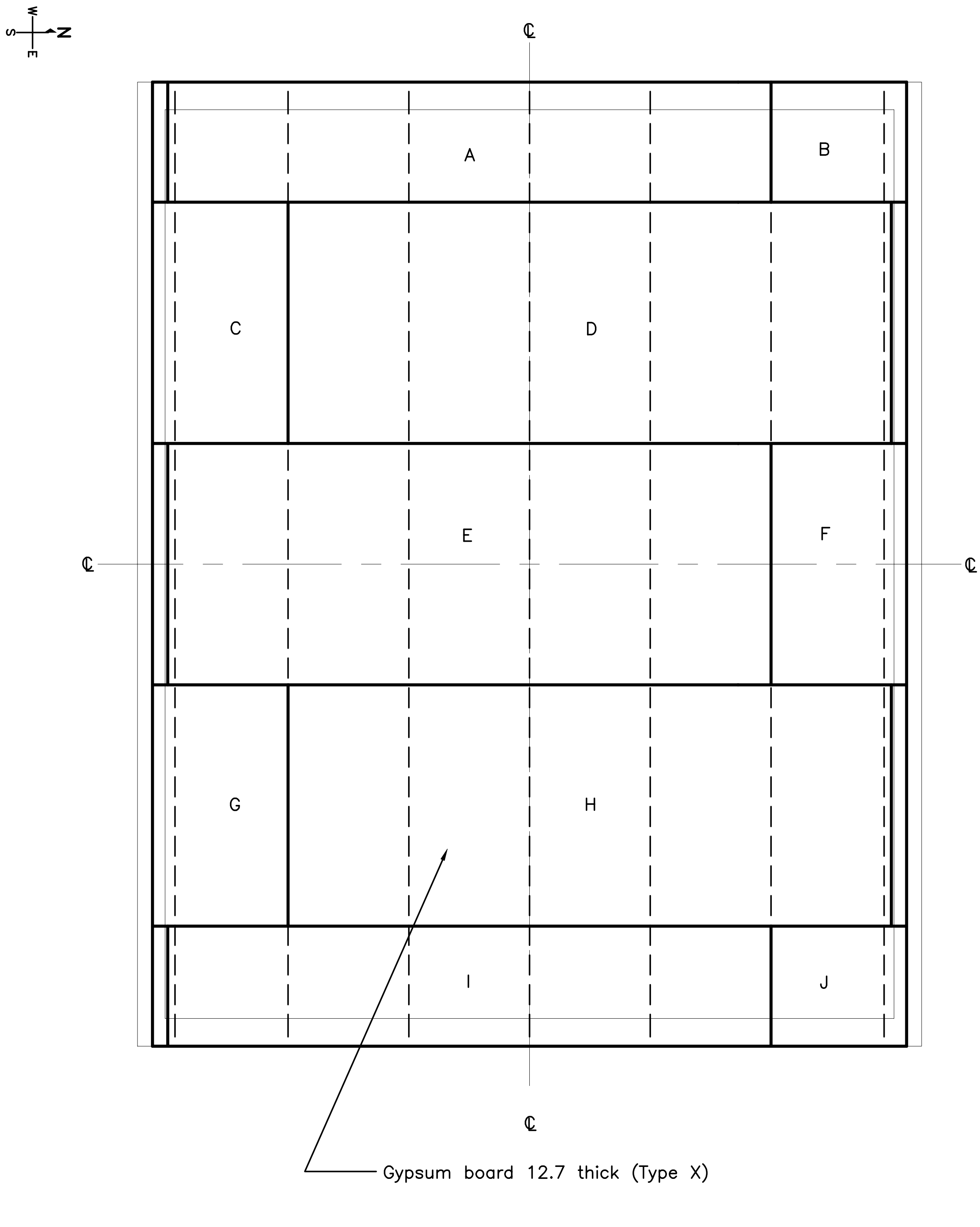
Figure A–119. Insulation Location (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–73)

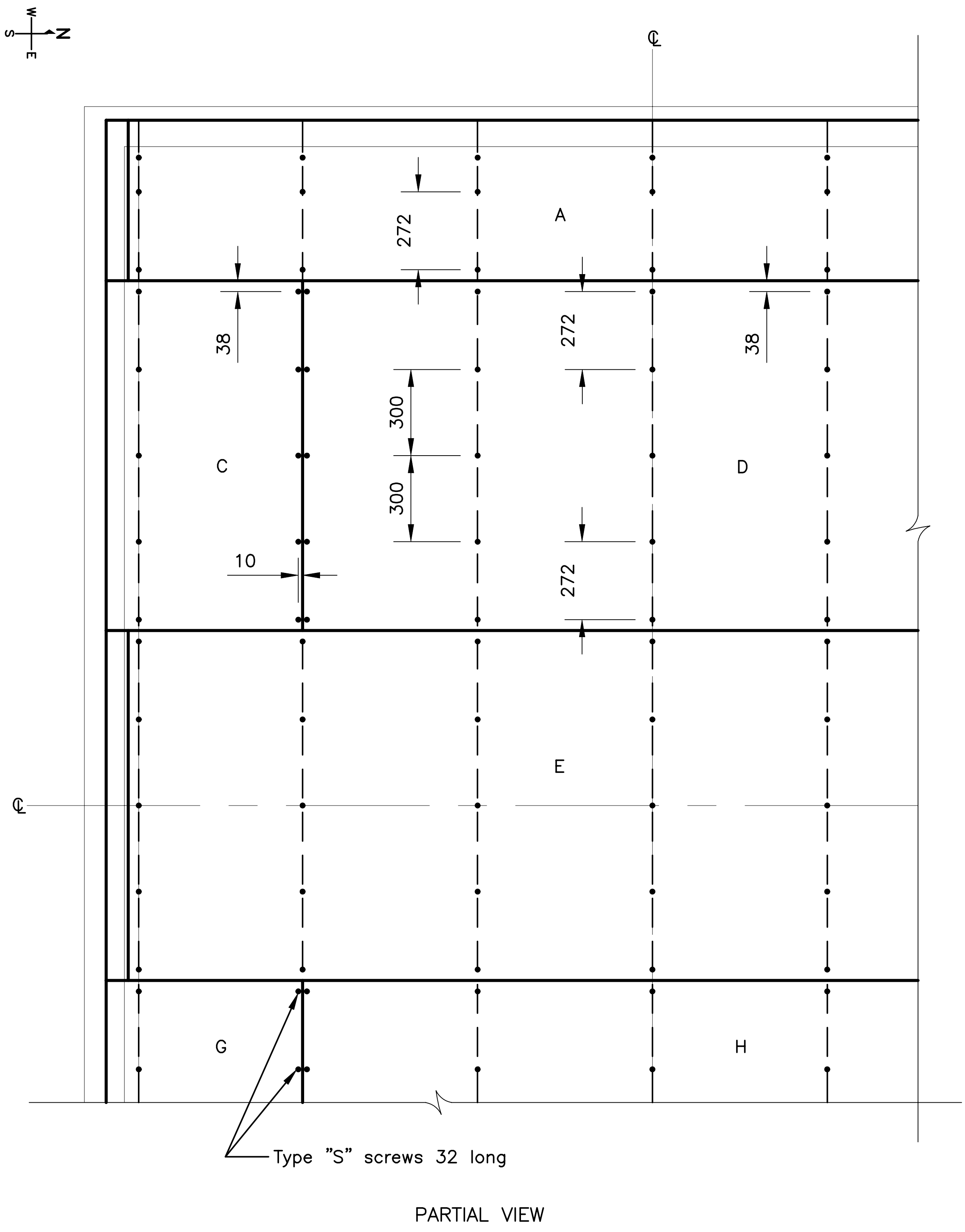
Figure A–120. Resilient Channel Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–73)

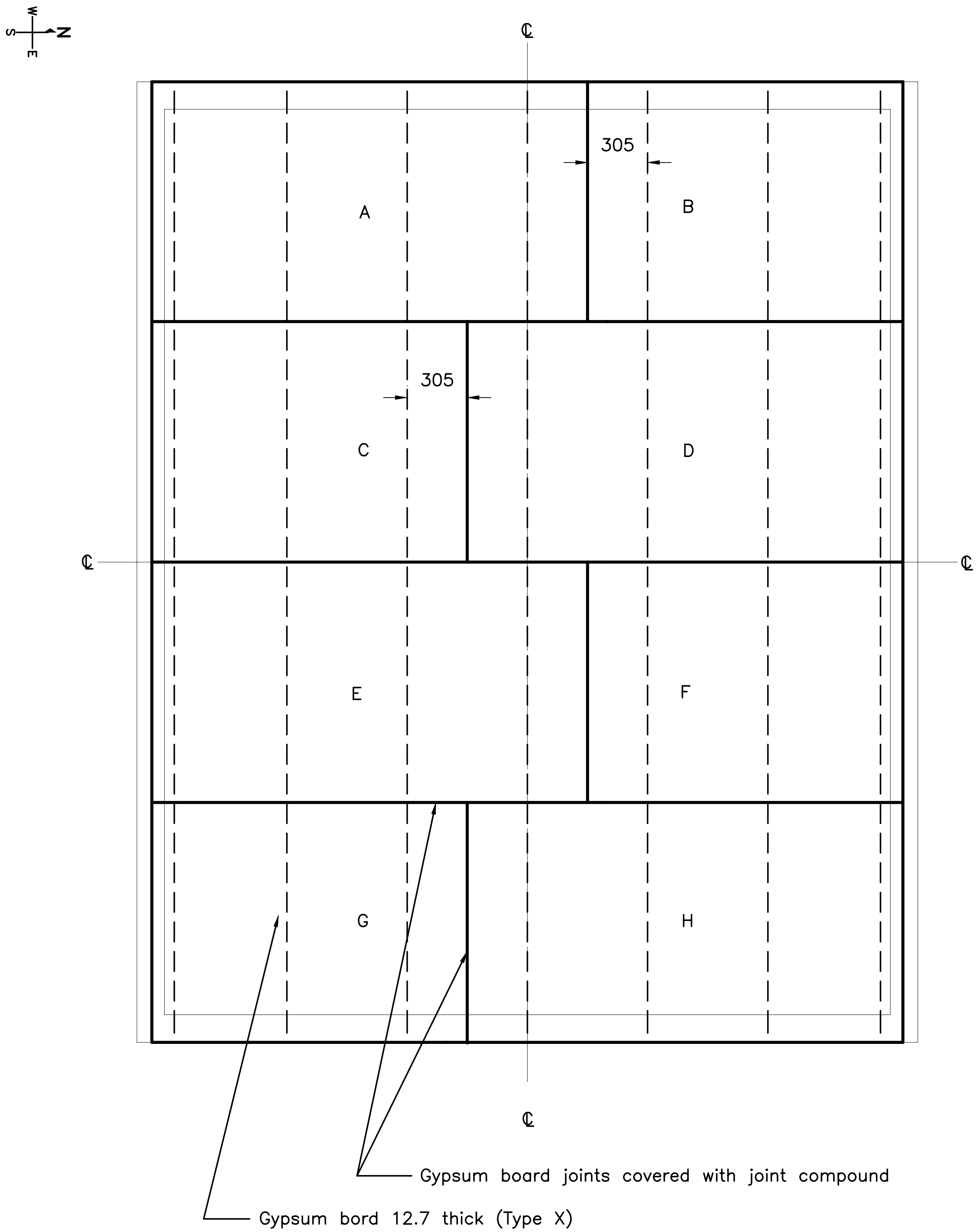
Figure A–121. Gypsum Board Base Layer Layout (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF-73)

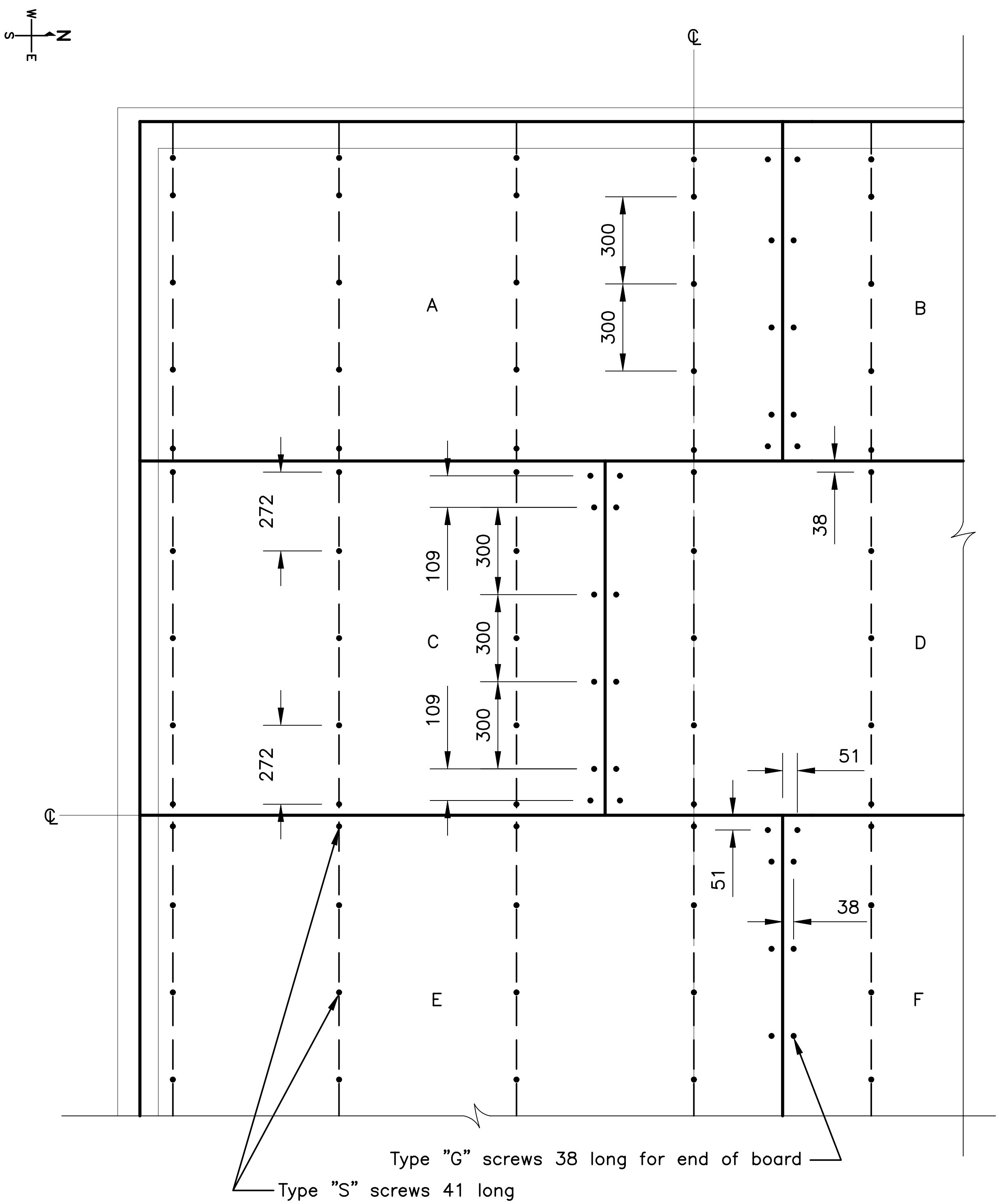
Figure A-122. Gypsum Board Base Layer Screw Pattern (Solid Wood Joist)



(Dimensions are in millimetres)

(Assembly No. FF–73)

Figure A–123. Gypsum Board Face Layer Layout (Solid Wood Joist)



PARTIAL VIEW

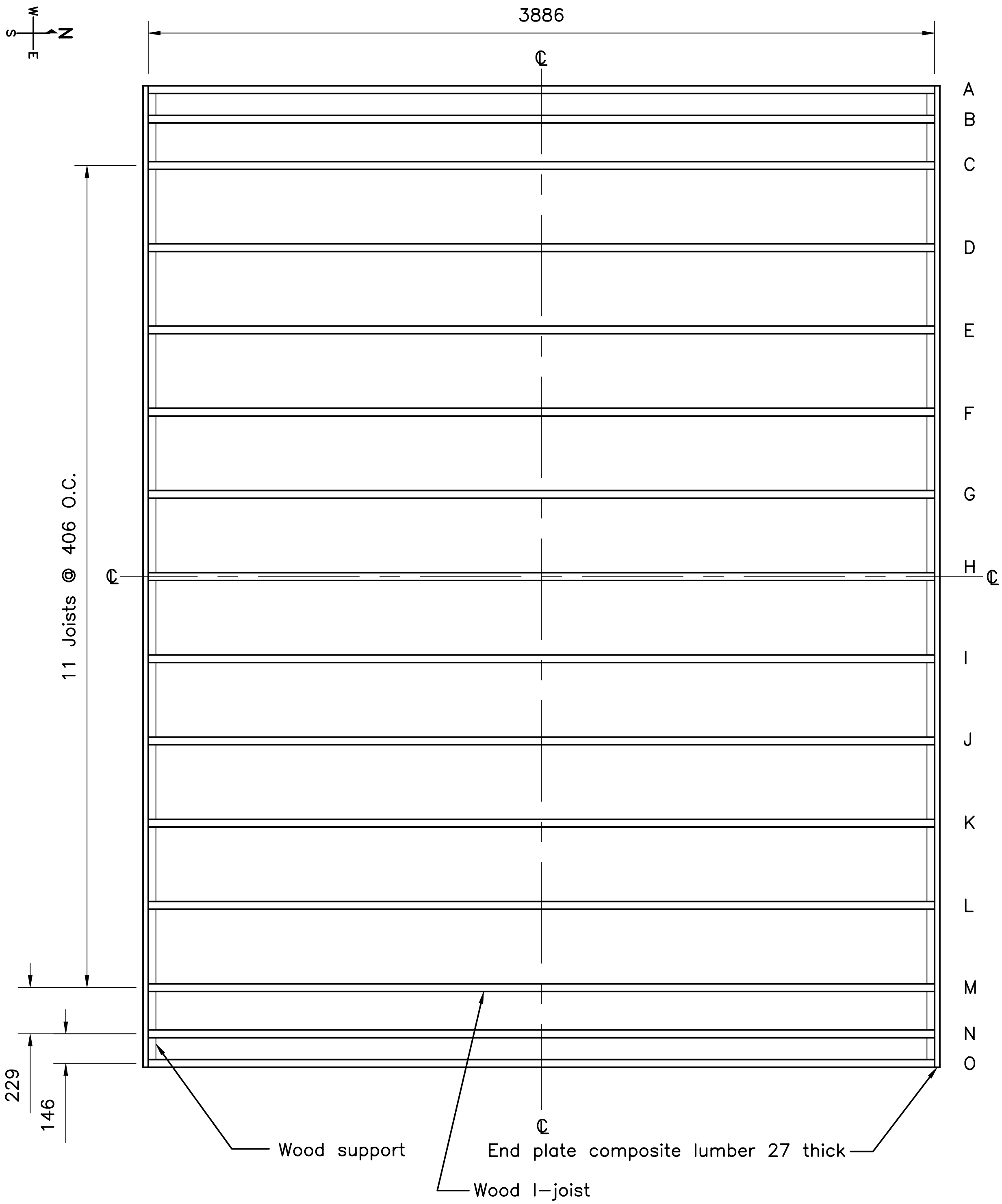
(Dimensions are in millimetres)

(Assembly No. FF-73)

Figure A-124. Gypsum Board Face Layer Screw Pattern (Solid Wood Joist)

Appendix B

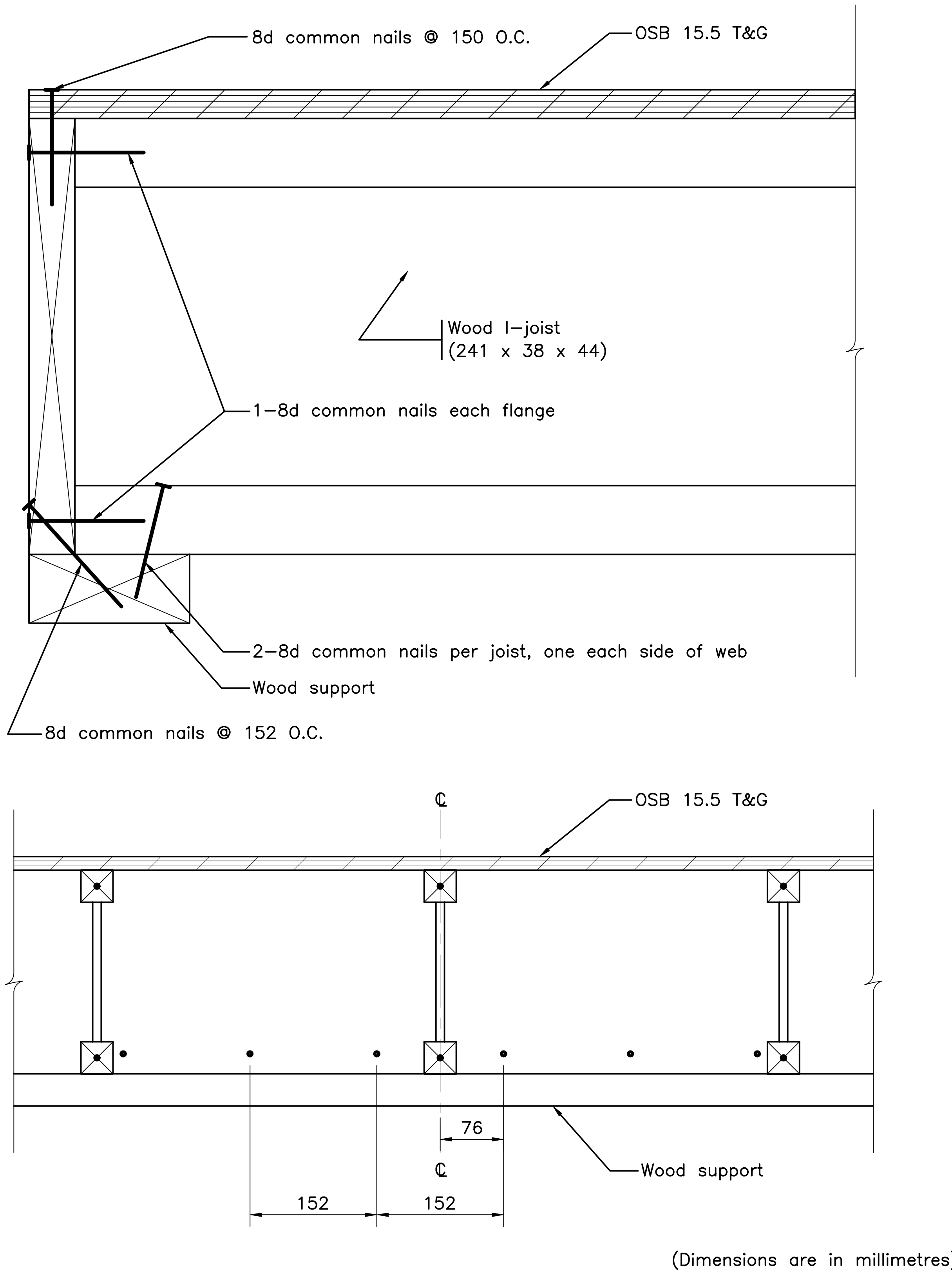
Design details for wood I-joist floor assemblies



(Dimensions are in millimetres)

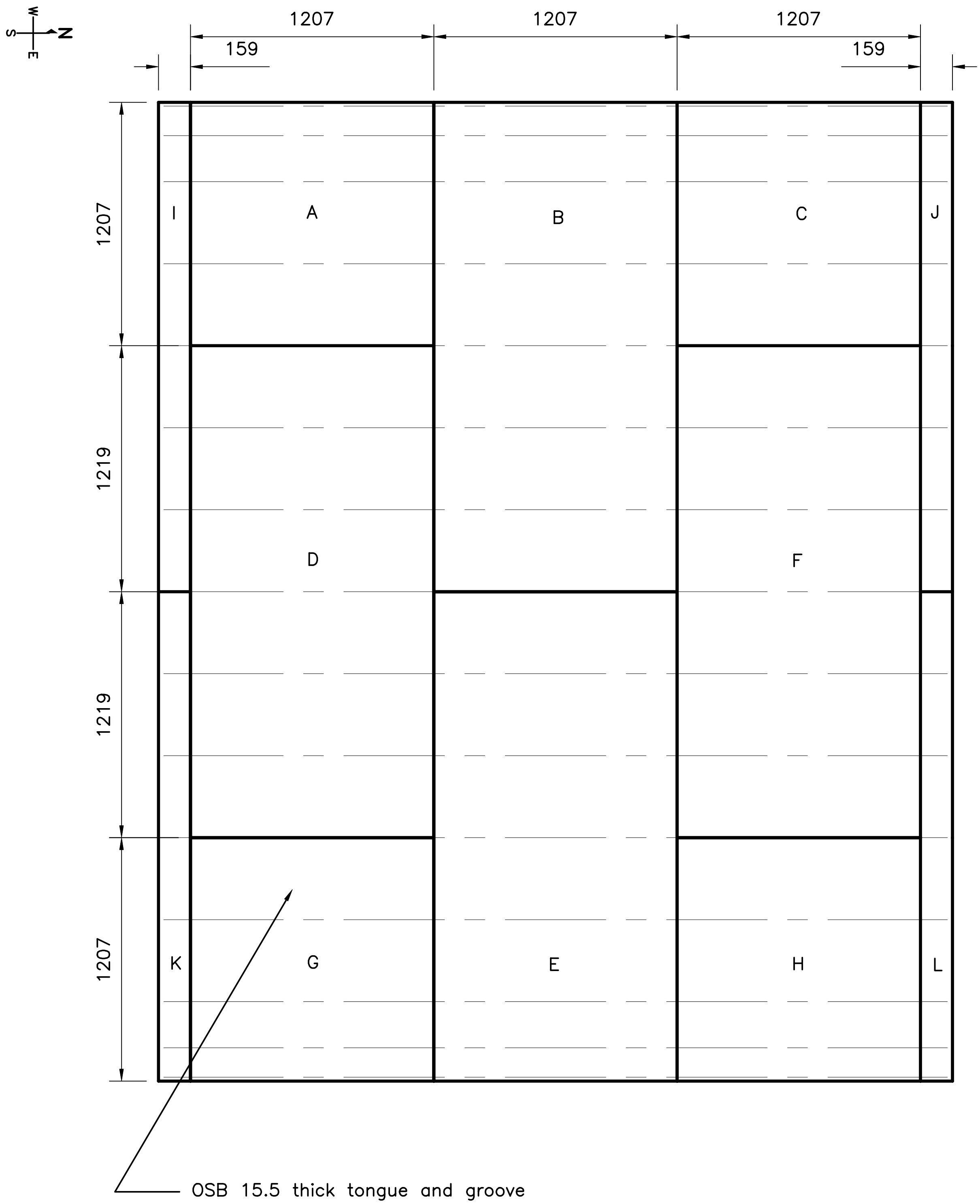
(Assembly No. FF–45)

Figure B–1. Joist Layout (Wood I–Joist)



(Assembly No. FF–45)

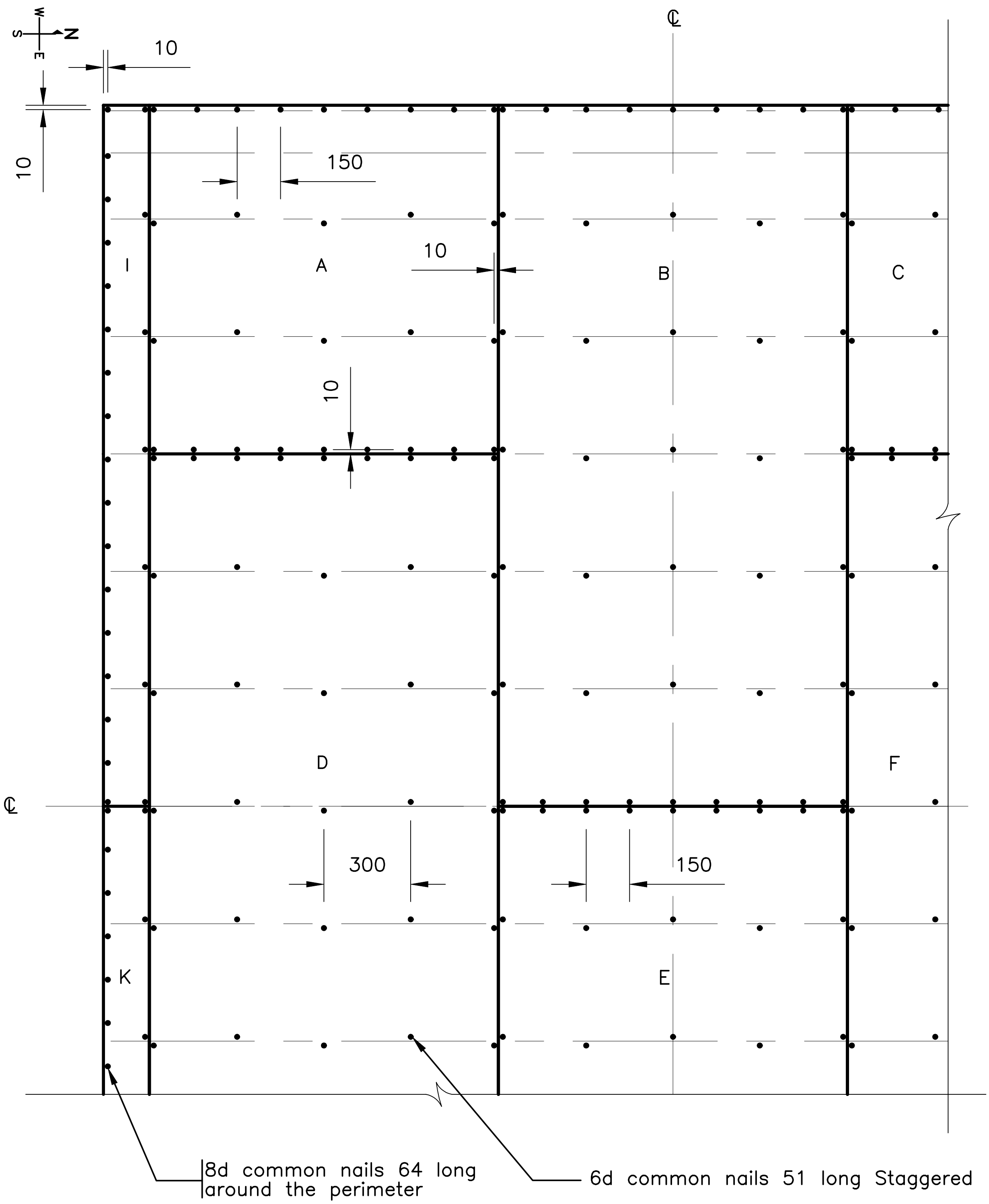
Figure B–2. Wood I–Joist End Connection Detail (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–45)

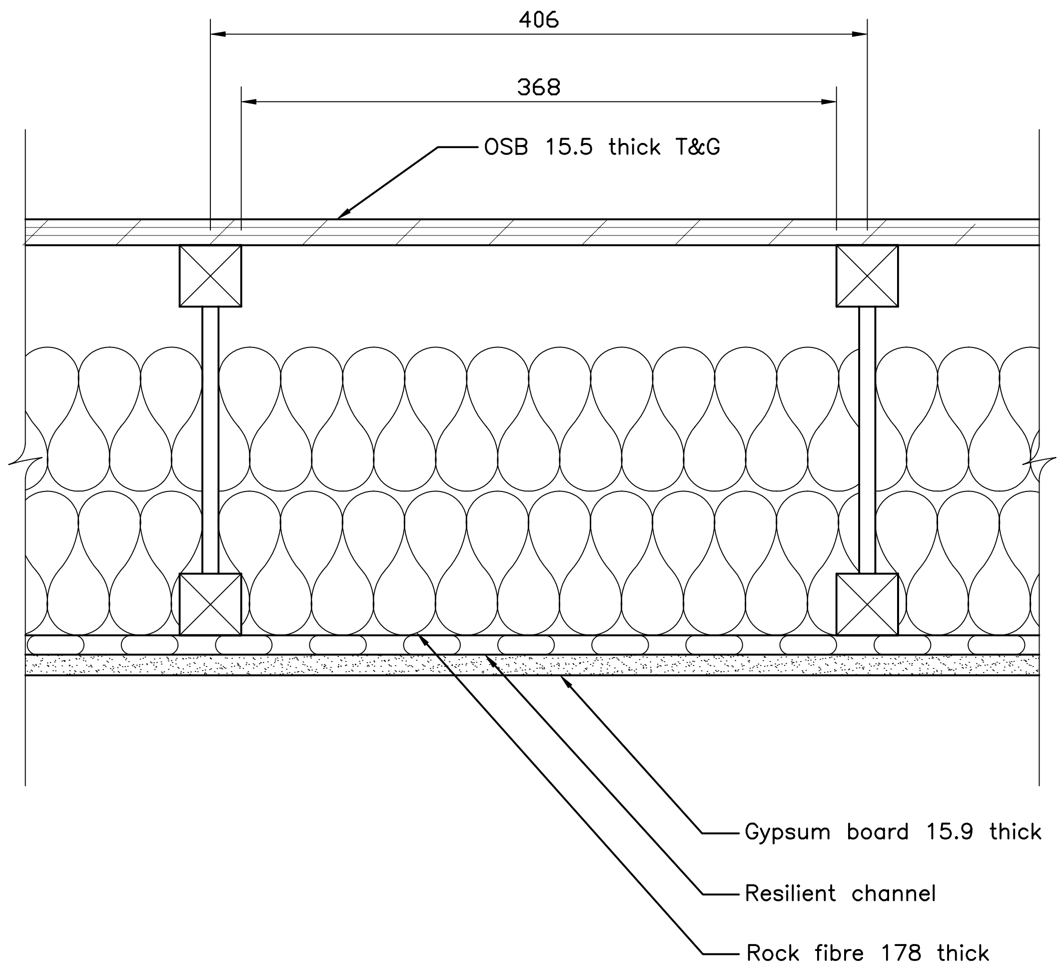
Figure B–3. Subfloor Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–45)

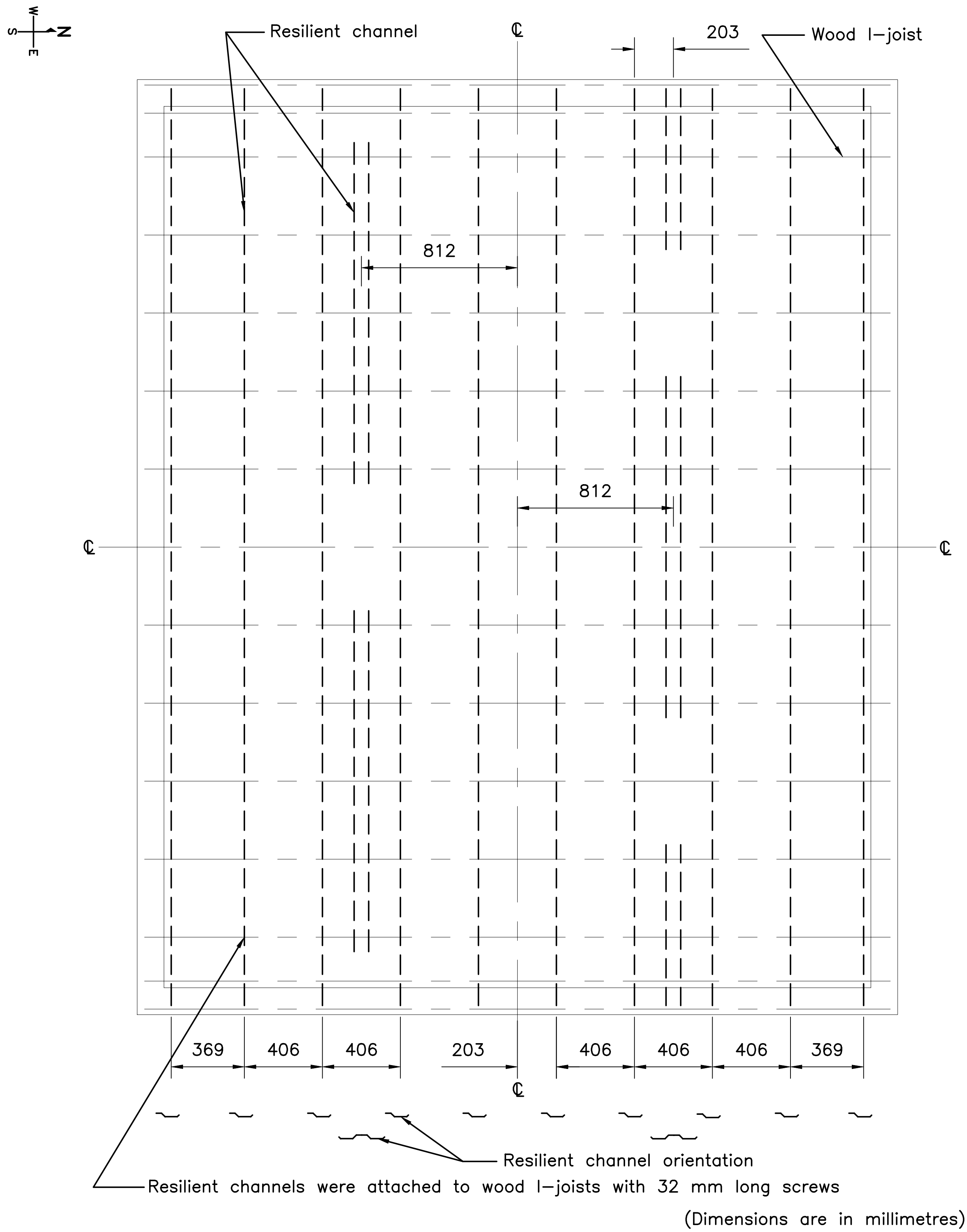
Figure B–4. Subfloor Nail Pattern (Wood I–Joist)



(Dimensions are in millimetres)

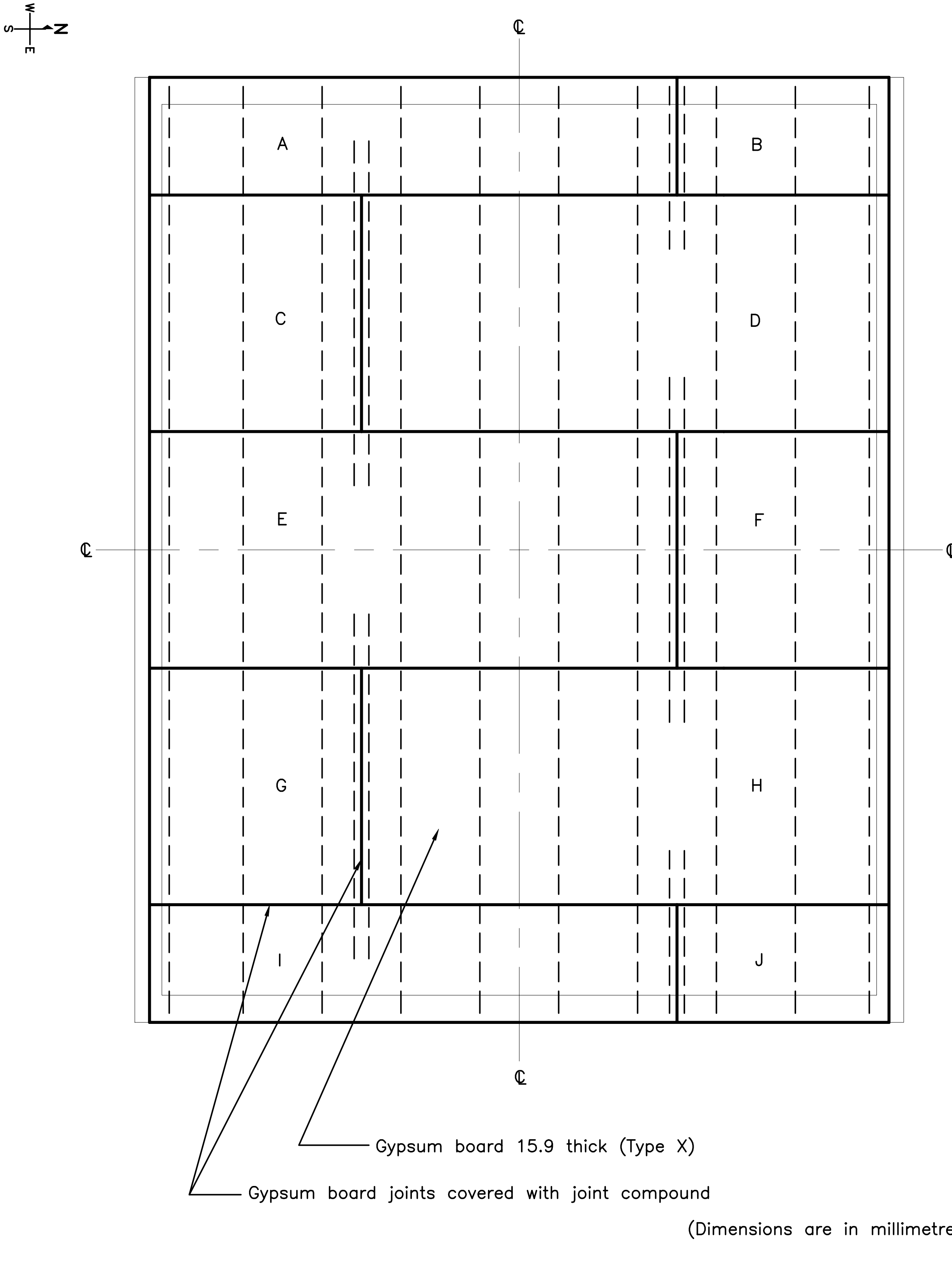
(Assembly No. FF-45)

Figure B-5. Insulation Location (Wood I-Joist)



(Assembly No. FF–45)

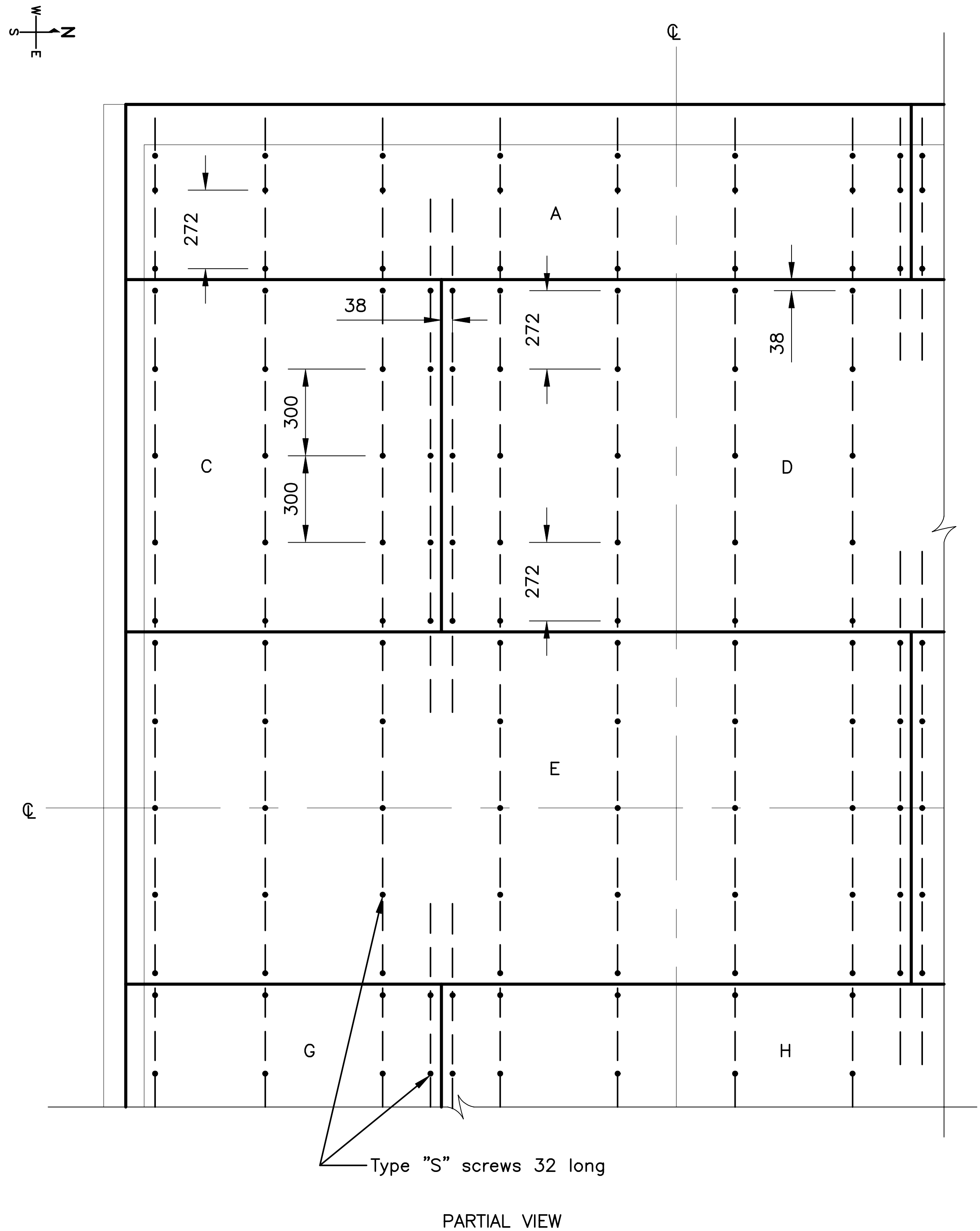
Figure B–6. Resilient Channel Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-45)

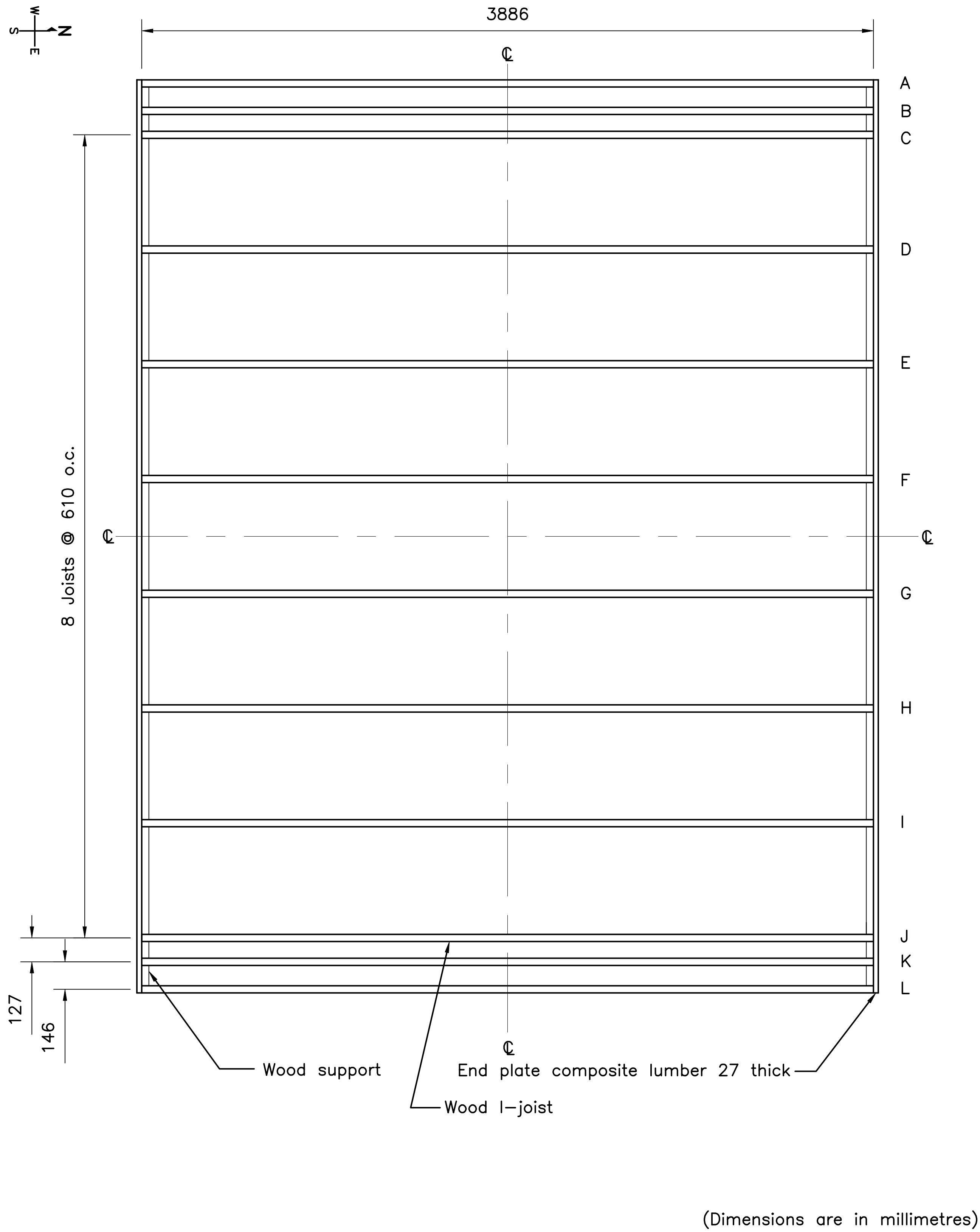
Figure B-7. Gypsum Board Single Layer Layout (Wood I-Joist)



(Dimensions are in millimetres)

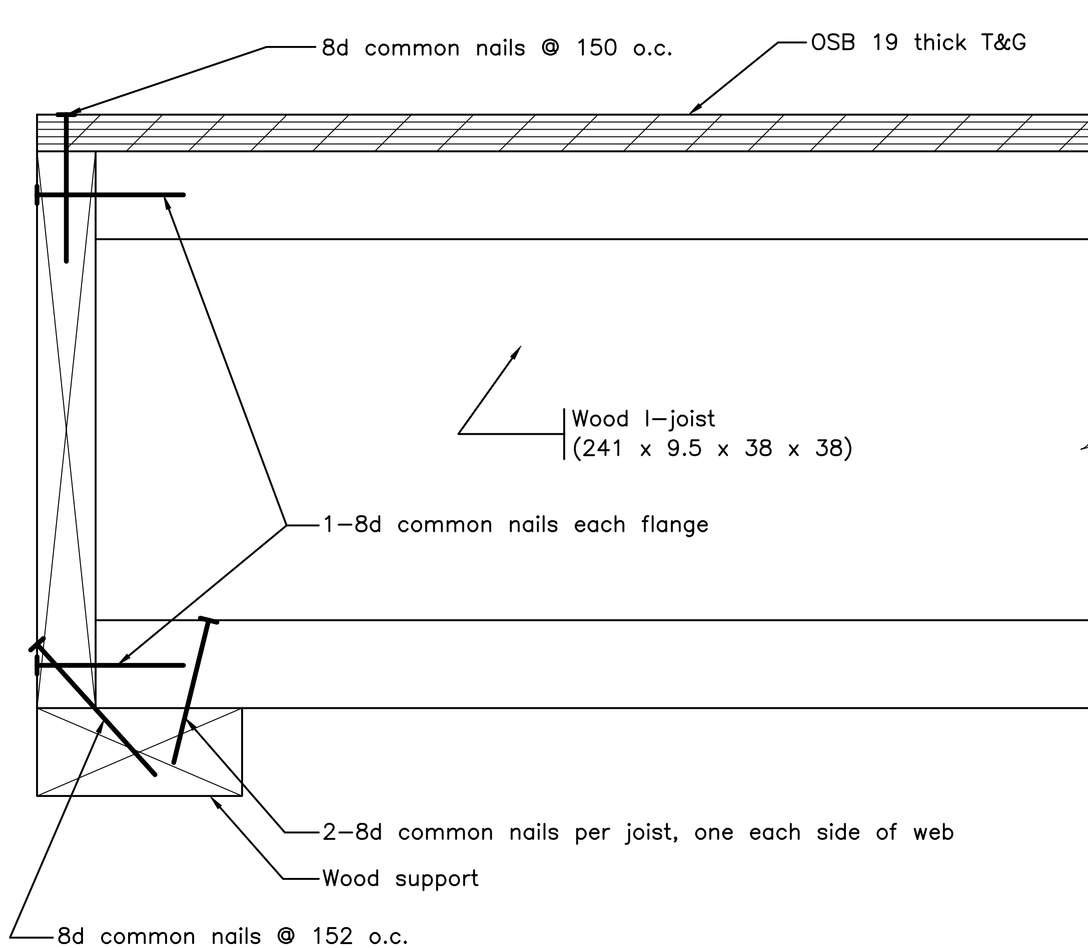
(Assembly No. FF-45)

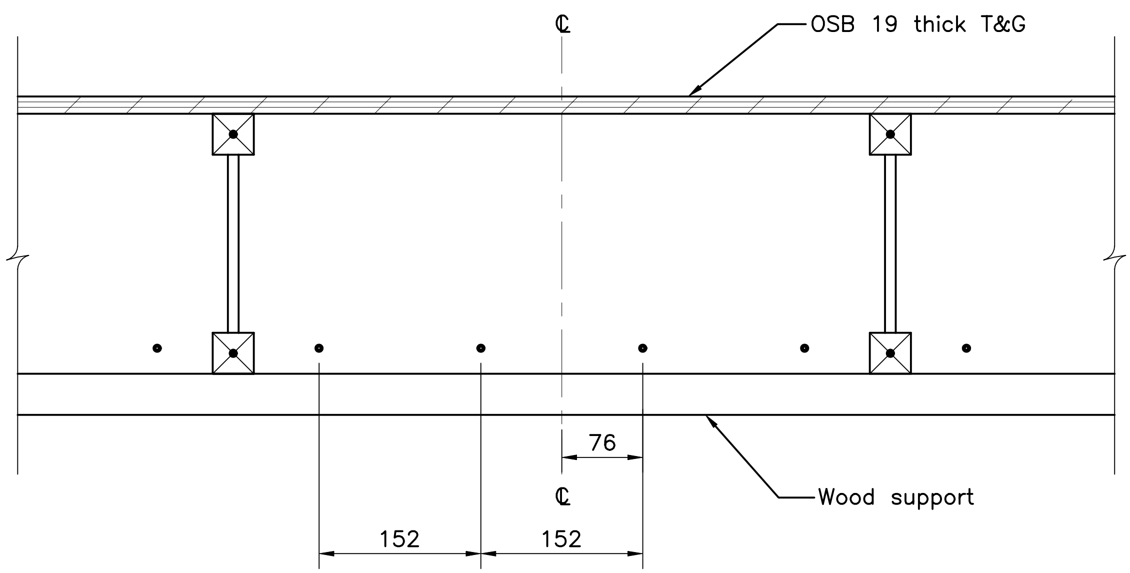
Figure B-8. Gypsum Board Single Layer Screw Pattern (Wood I-Joist)



(Assembly No. FF–55)

Figure B–9. Joist Layout (Wood I–Joist)

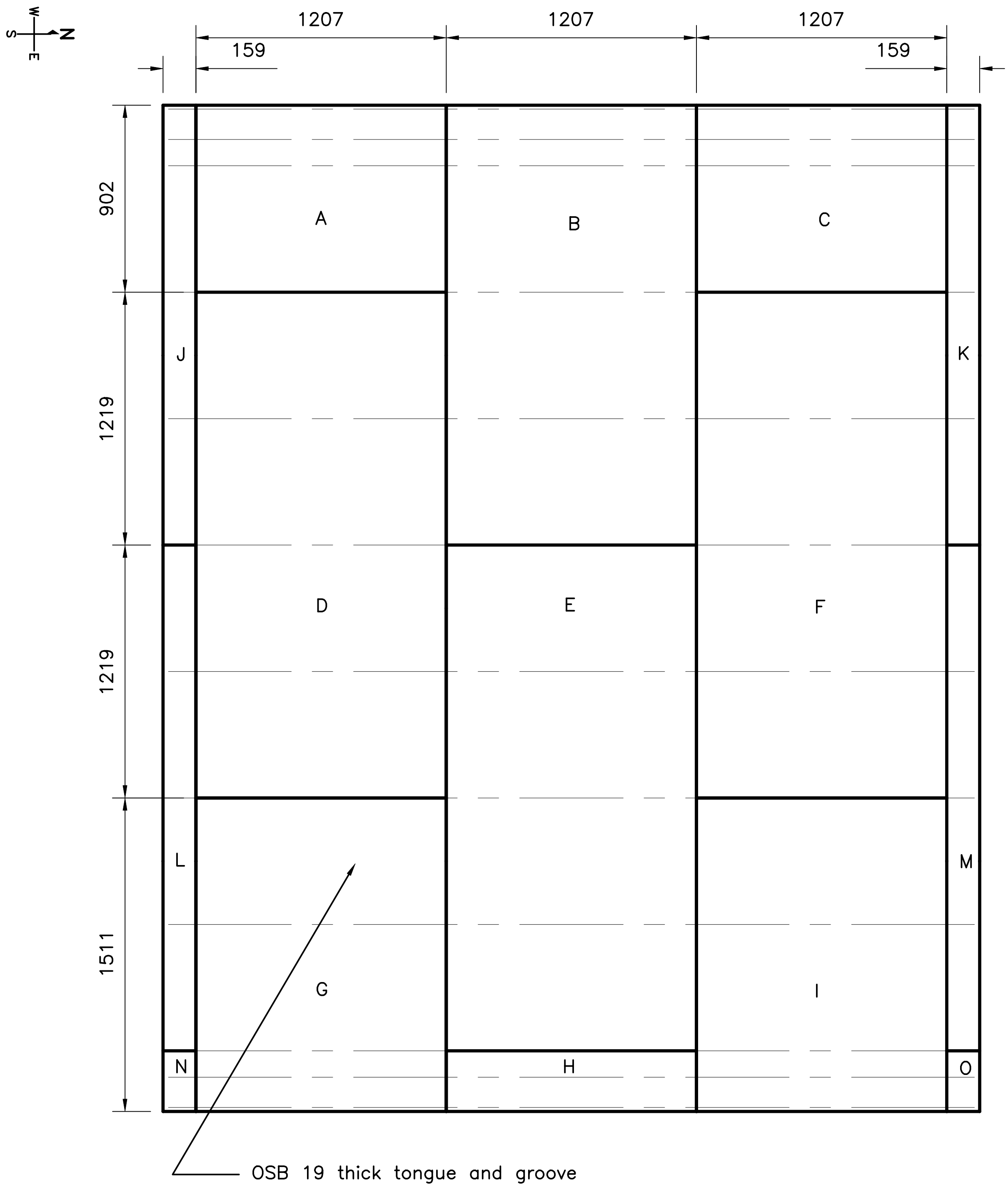




(Dimensions are in millimetres)

(Assembly No. FF–55)

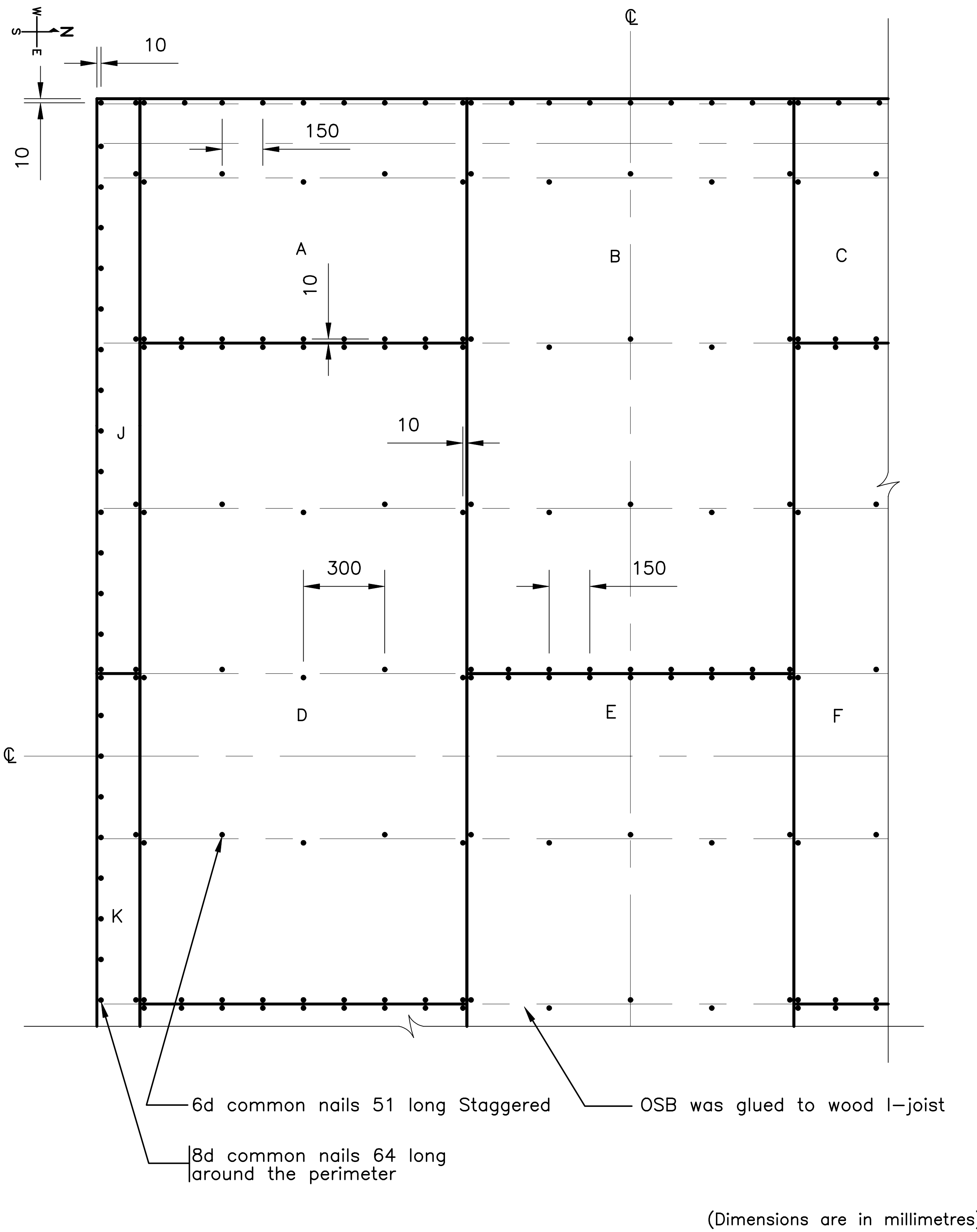
Figure B–10. Wood I–Joist End Connection Detail (Wood I–Joist)



(Dimensions are in millimetres)

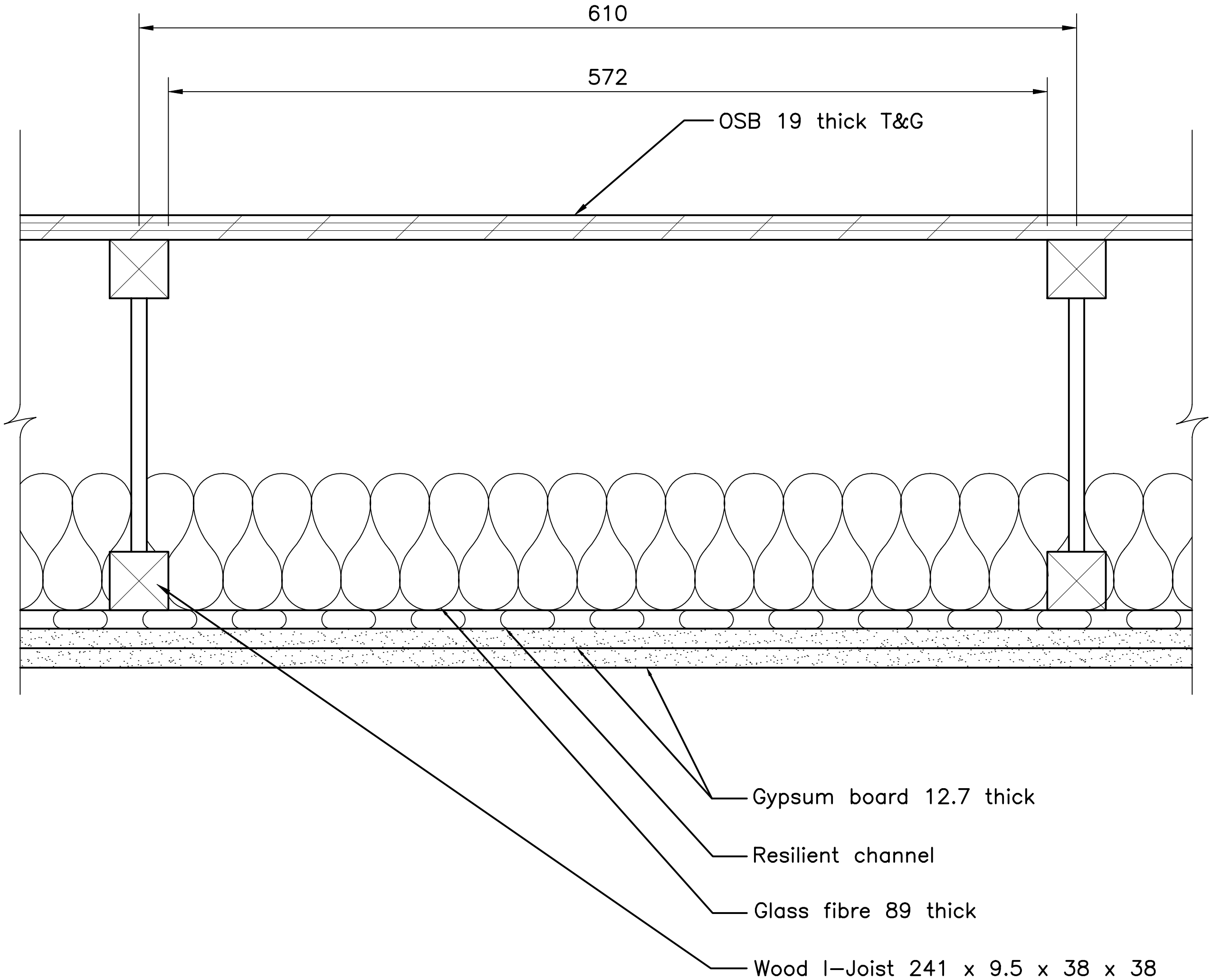
(Assembly No. FF–55)

Figure B–11. Subfloor Layout (Wood I–Joist)



(Assembly No. FF–55)

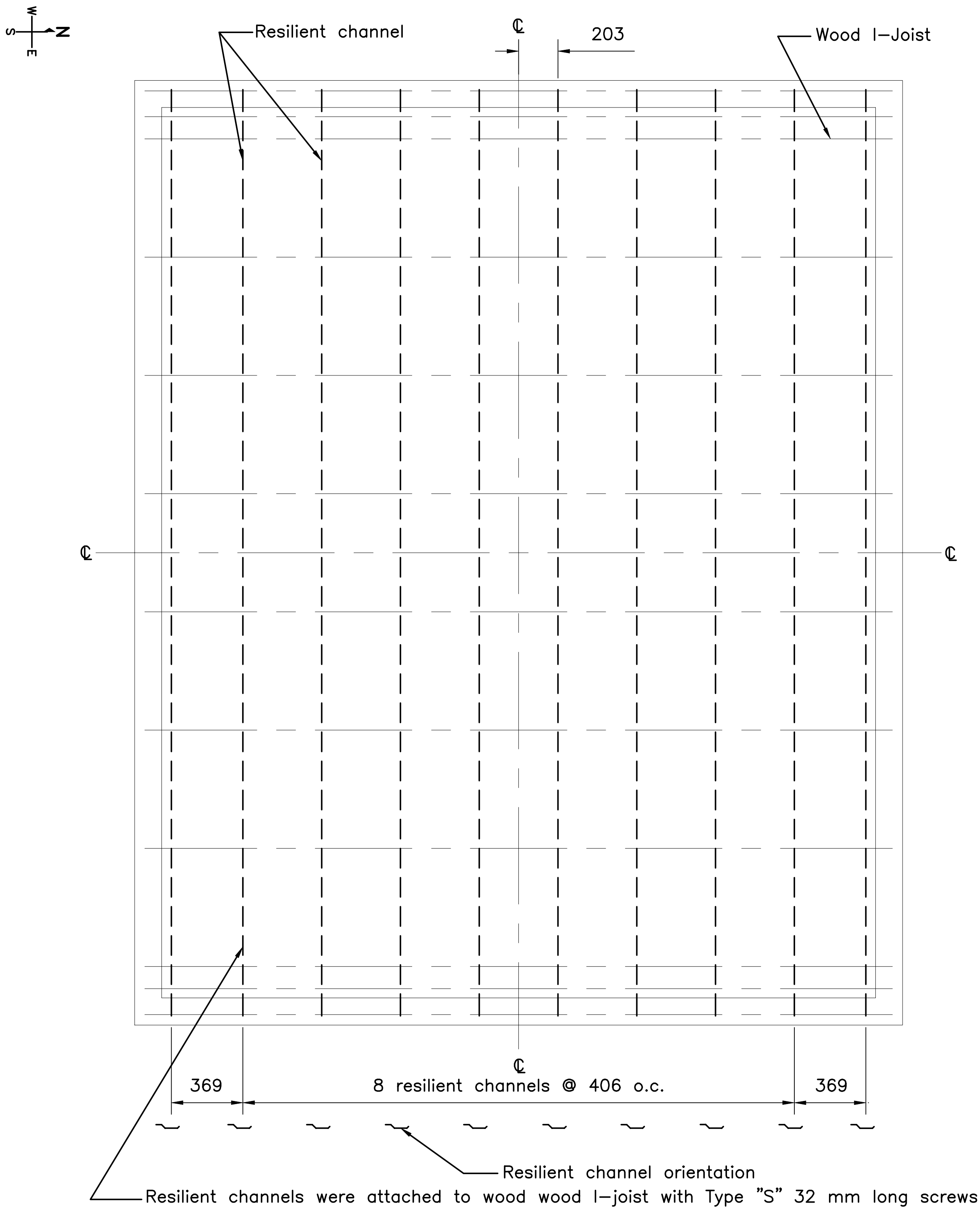
Figure B–12. Subfloor Nail Pattern (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–55)

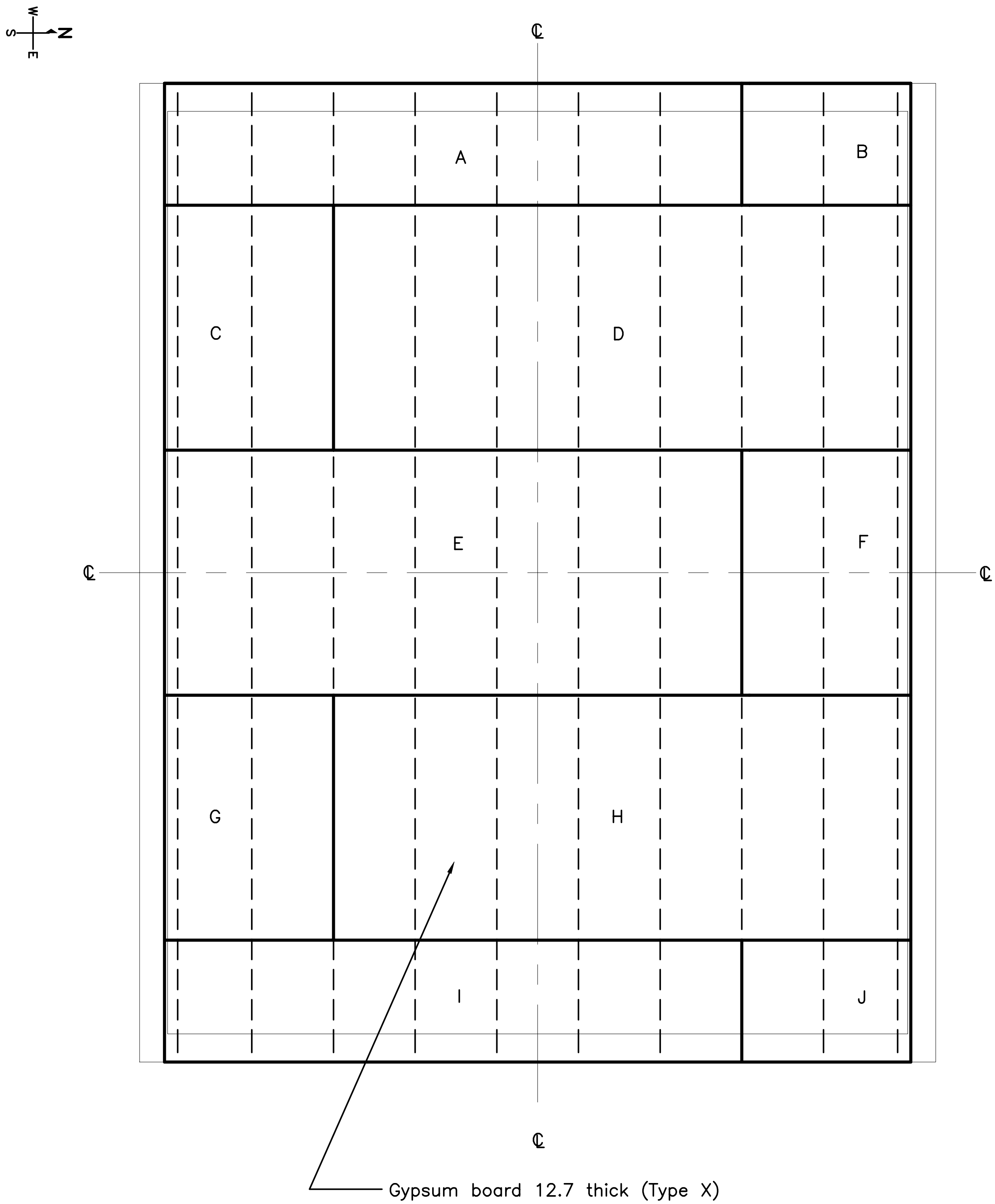
Figure B–13. Insulation Location (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–55)

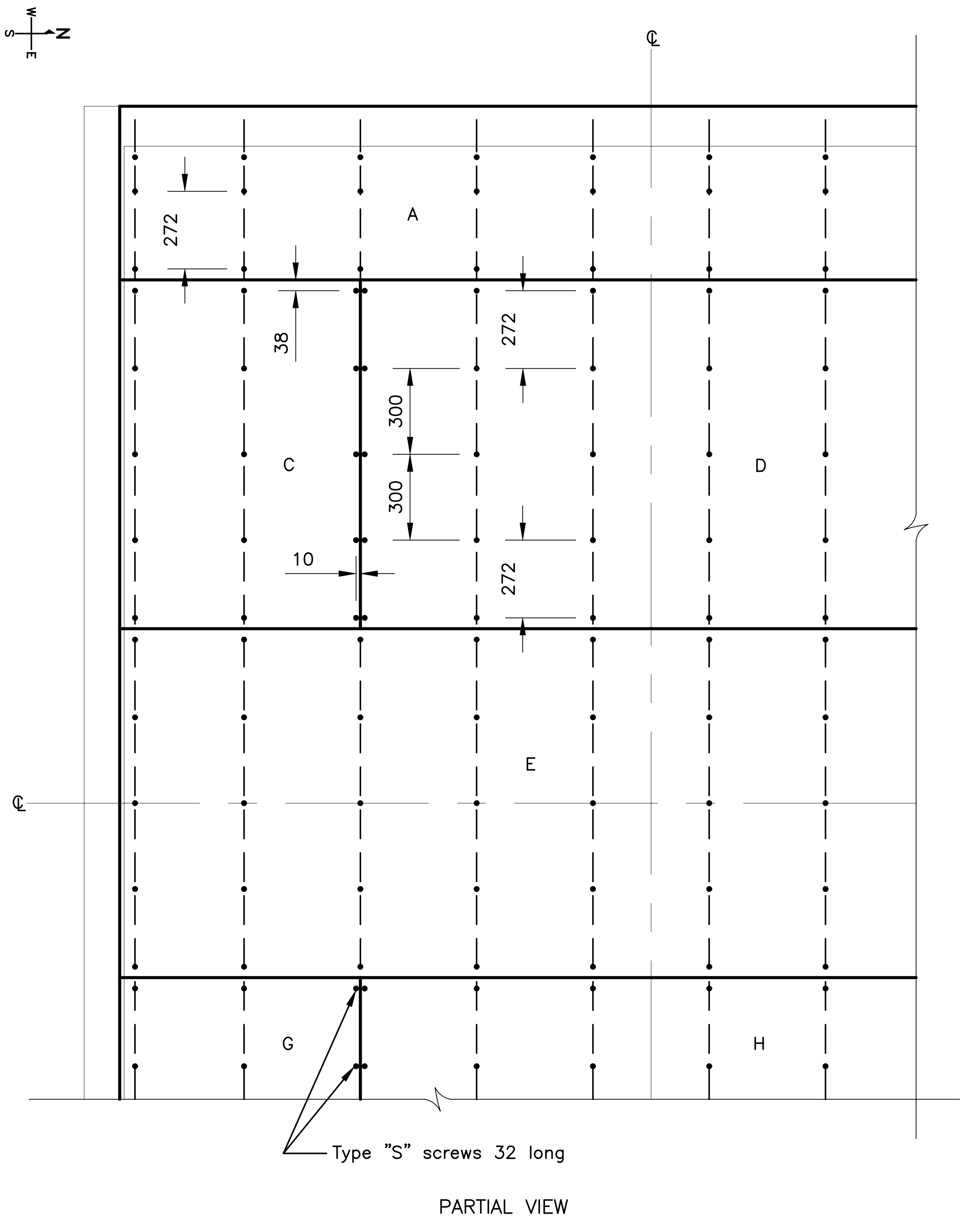
Figure B–14. Resilient Channel Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–55)

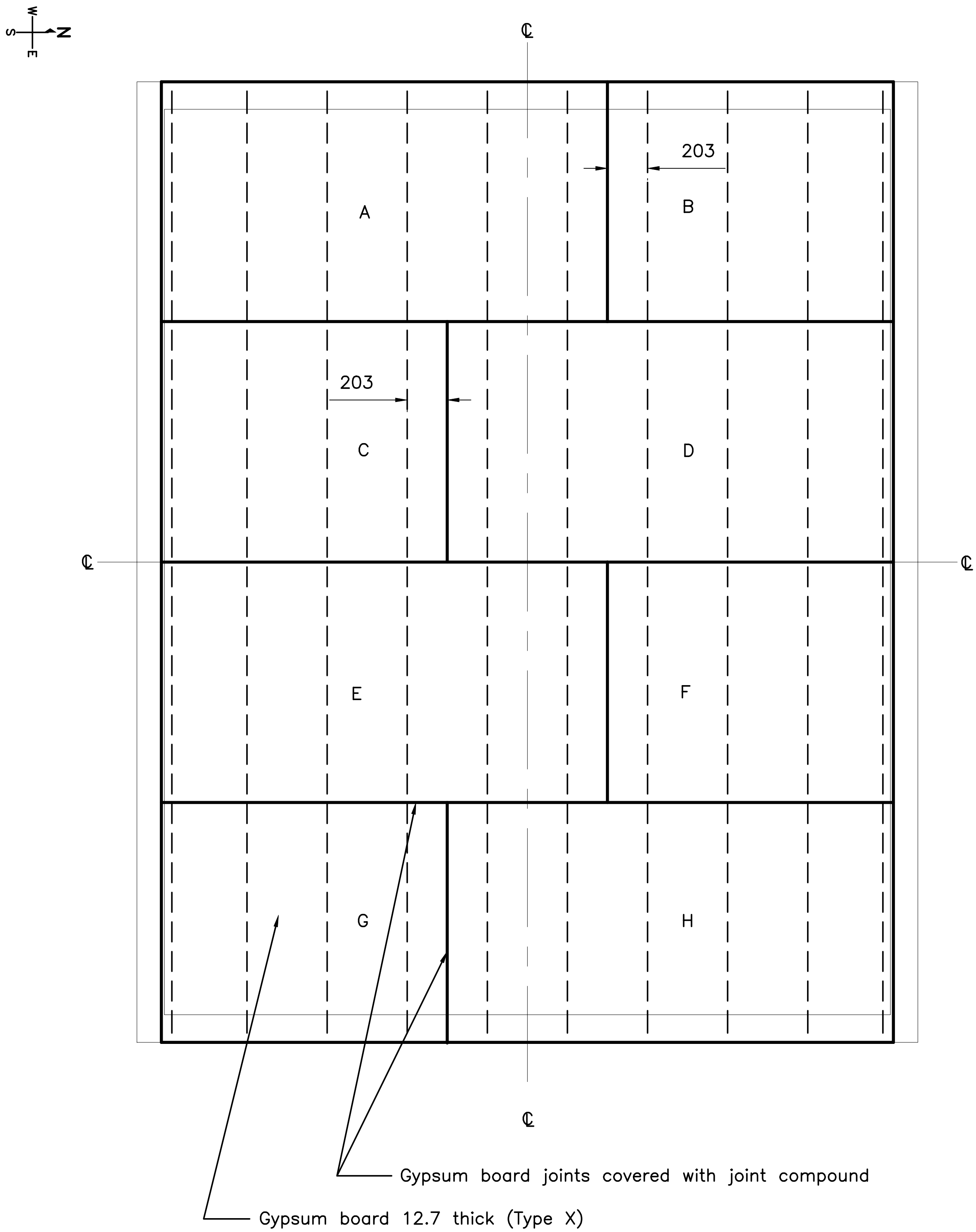
Figure B–15. Gypsum Board Base Layer Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–55)

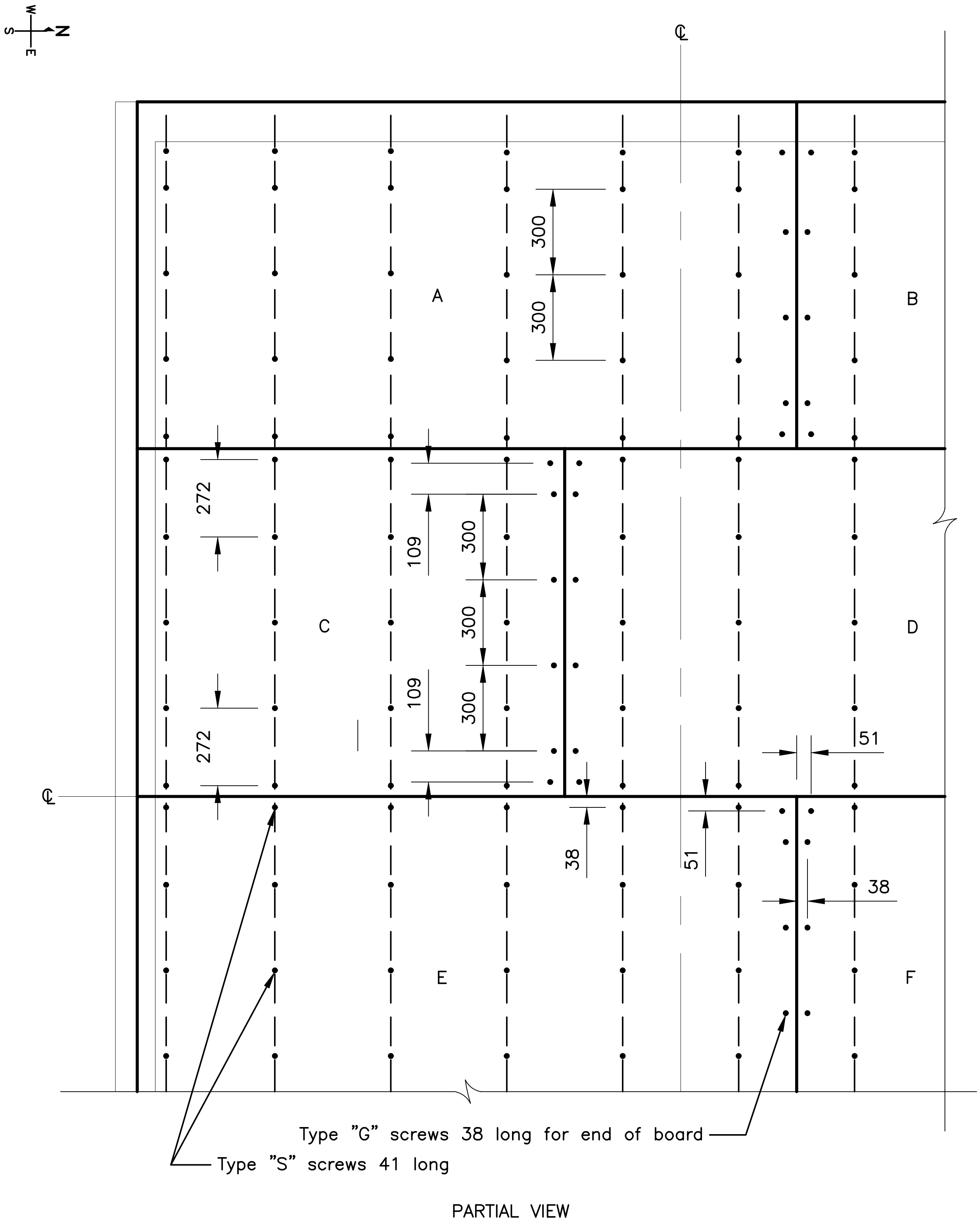
Figure B–16. Gypsum Board Base Layer Screw Pattern (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–55)

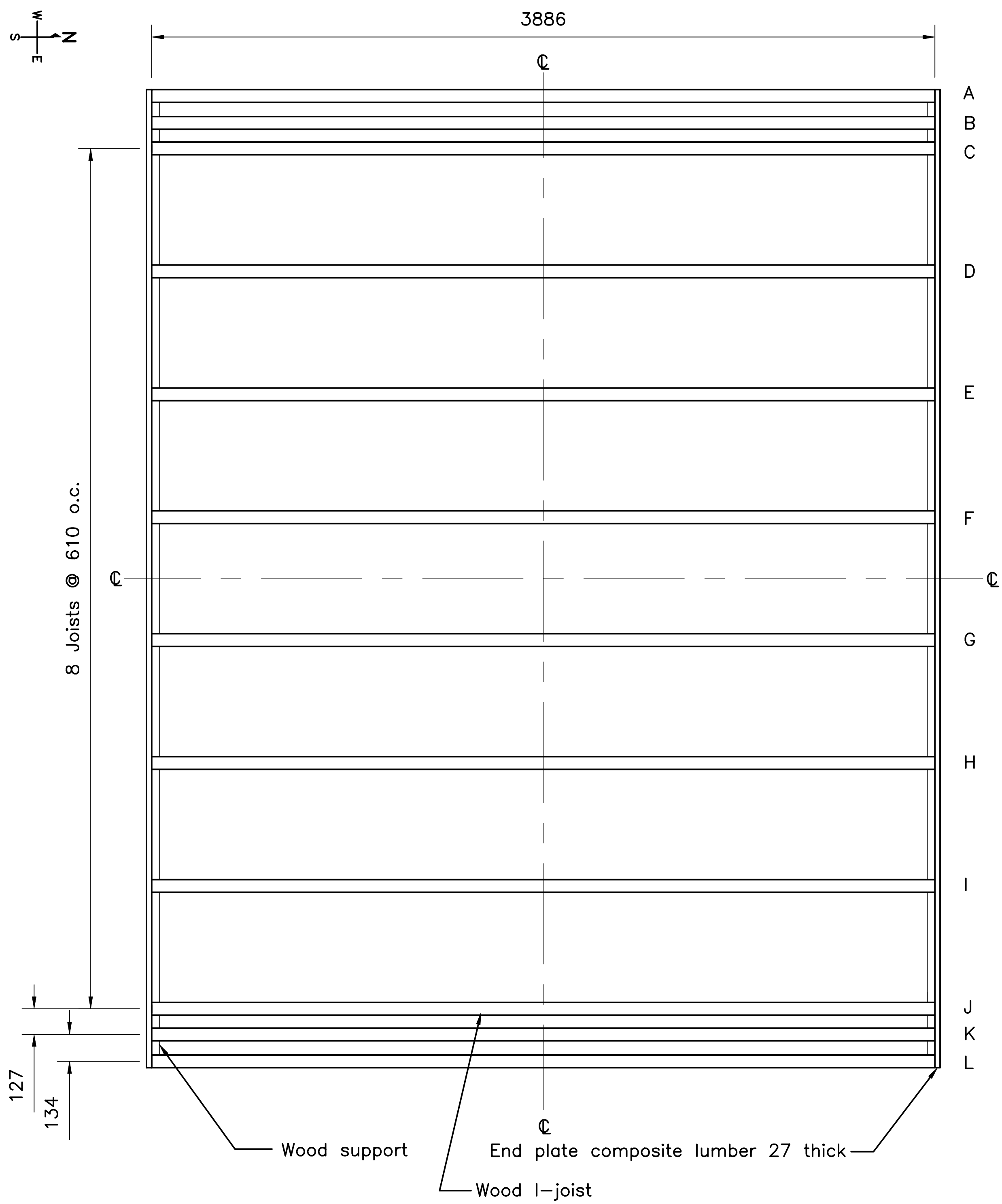
Figure B–17. Gypsum Board Face Layer Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF−55)

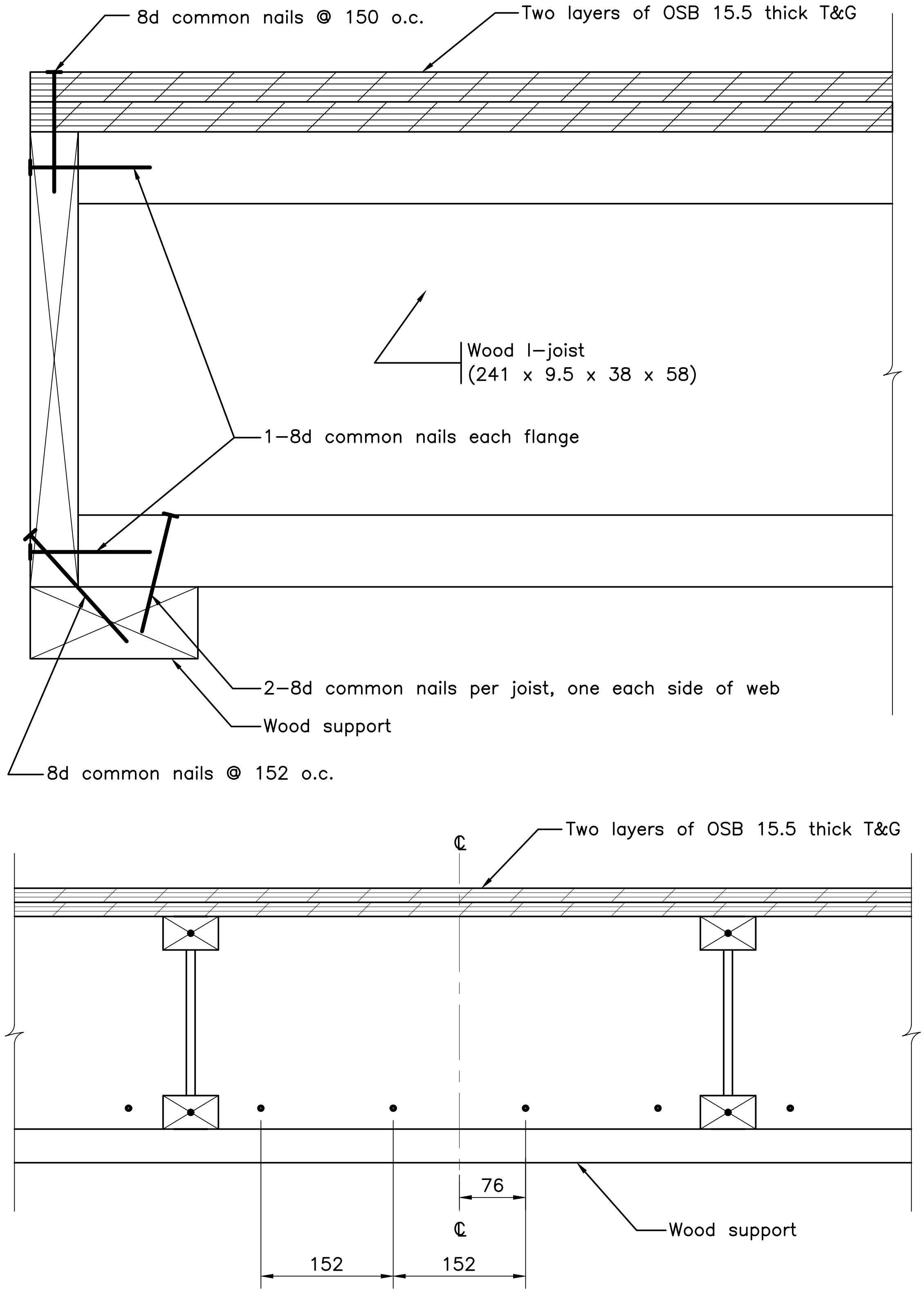
Figure B−18. Gypsum Board Face Layer Screw Pattern (Wood I−Joist)



(Dimensions are in millimetres)

(Assembly No. FF-57)

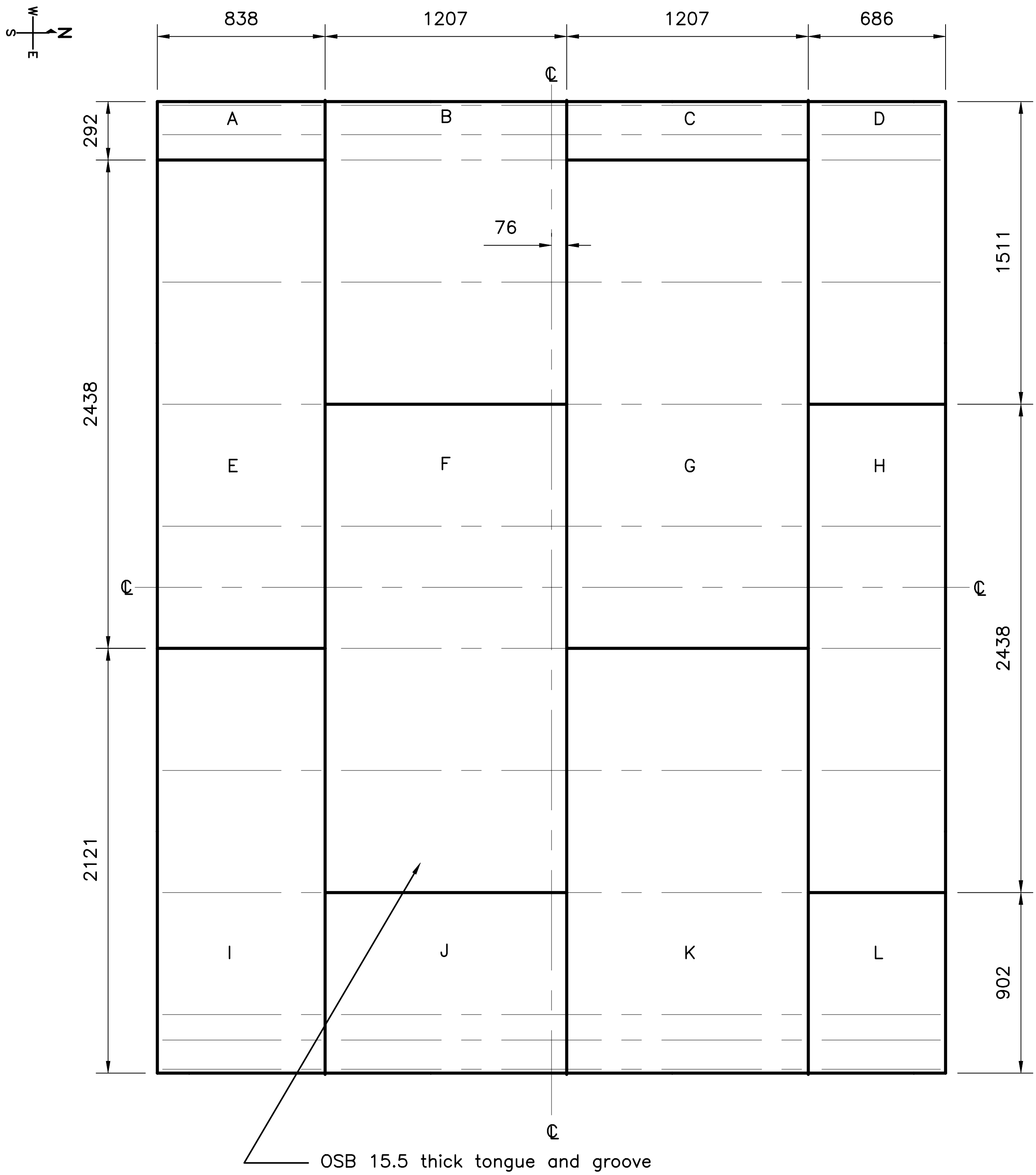
Figure B-19. Joist Layout (Wood I-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–57)

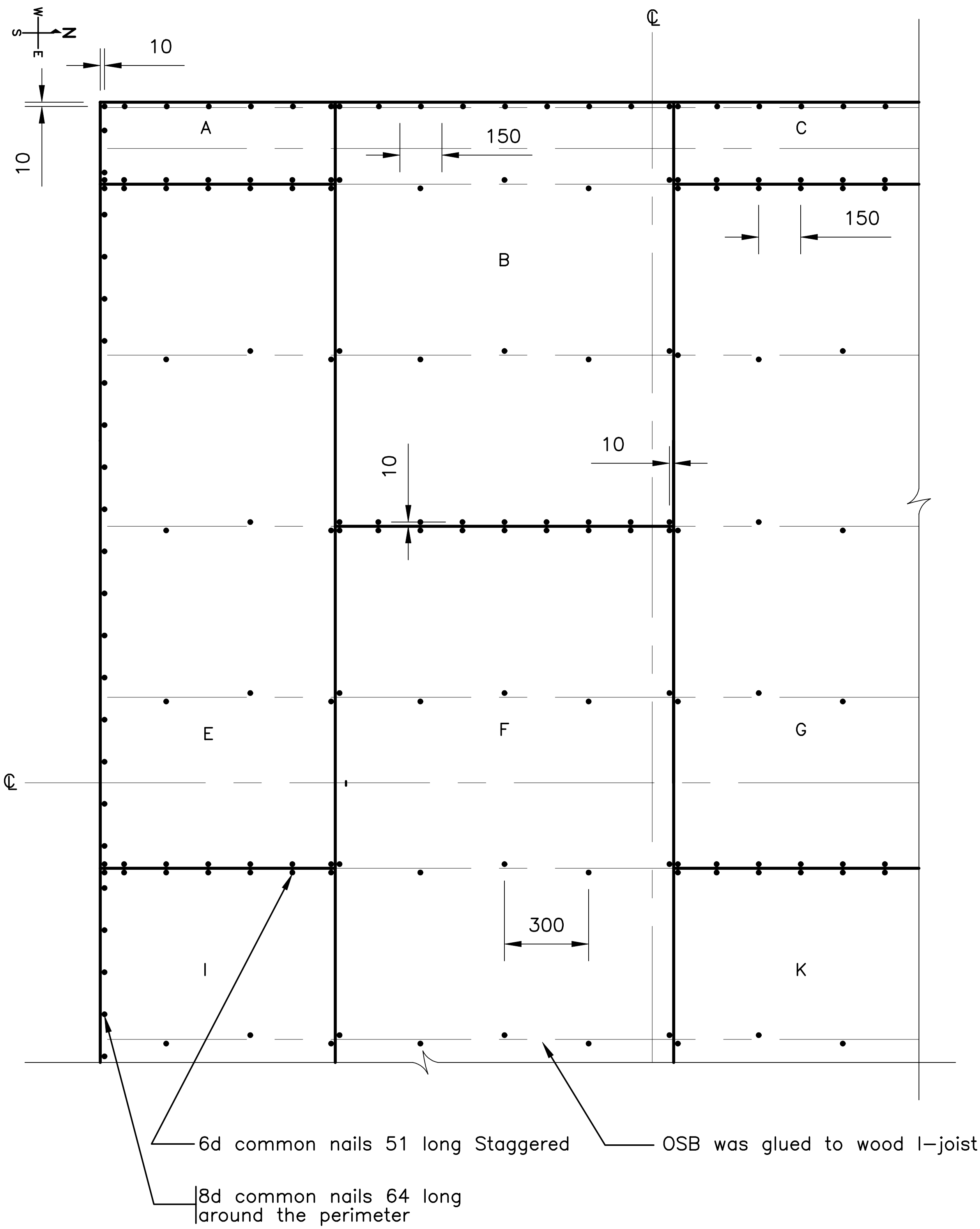
Figure B–20. Wood I–Joist End Connection Detail (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–57)

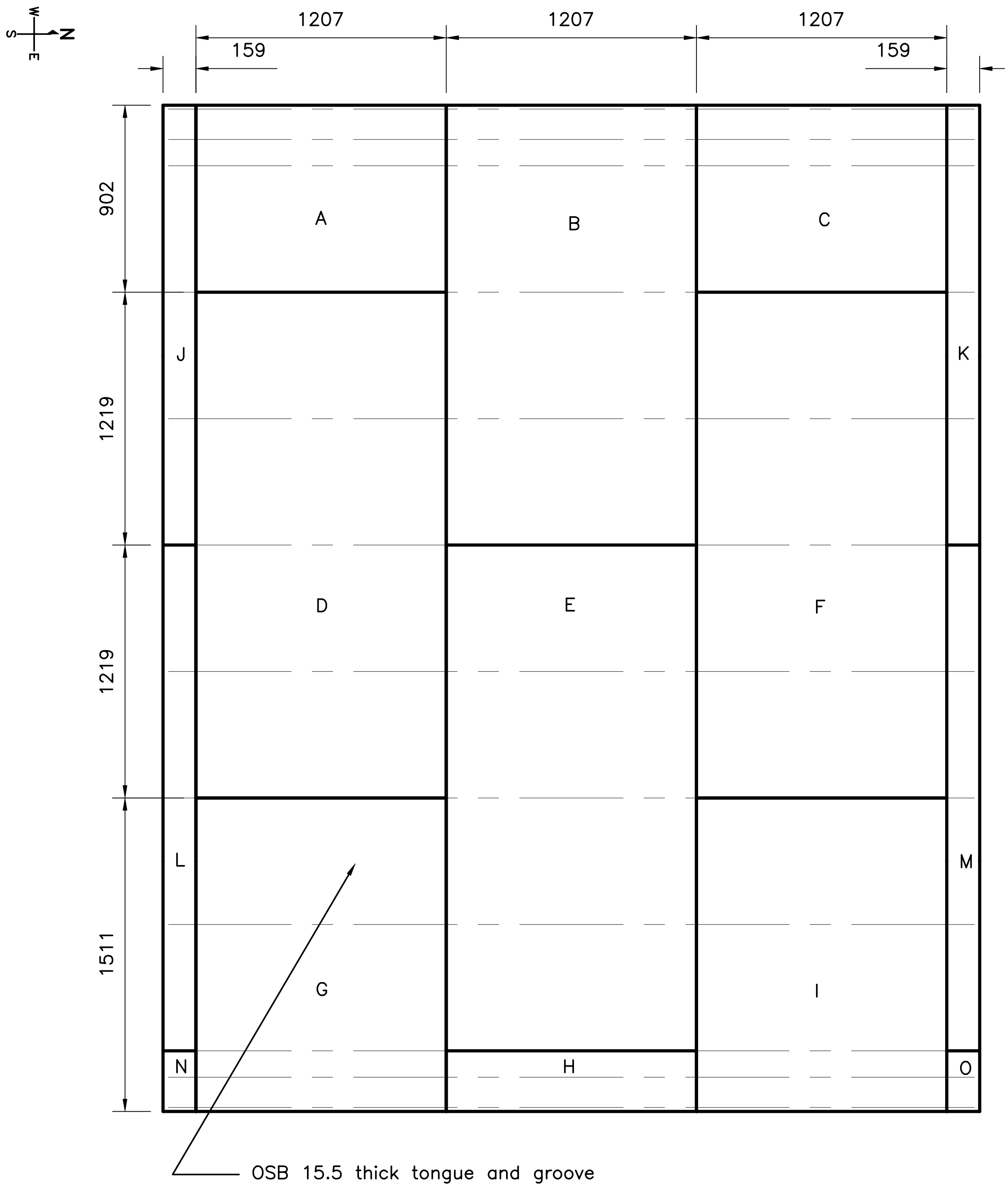
Figure B–21. Subfloor Layout Base Layer (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–57)

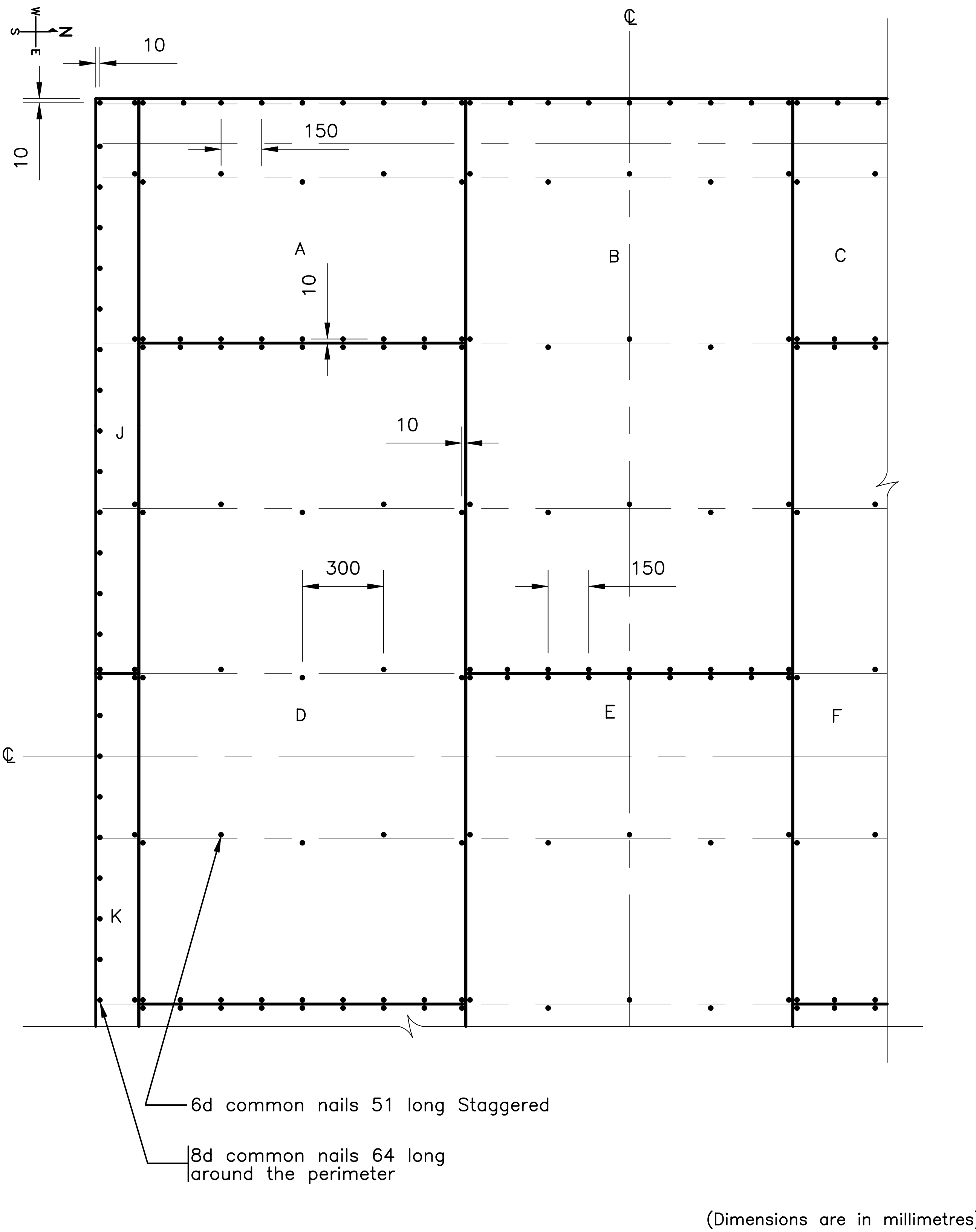
Figure B–22. Subfloor Nail Pattern Base Layer (Wood I–Joist)



(Dimensions are in millimetres)

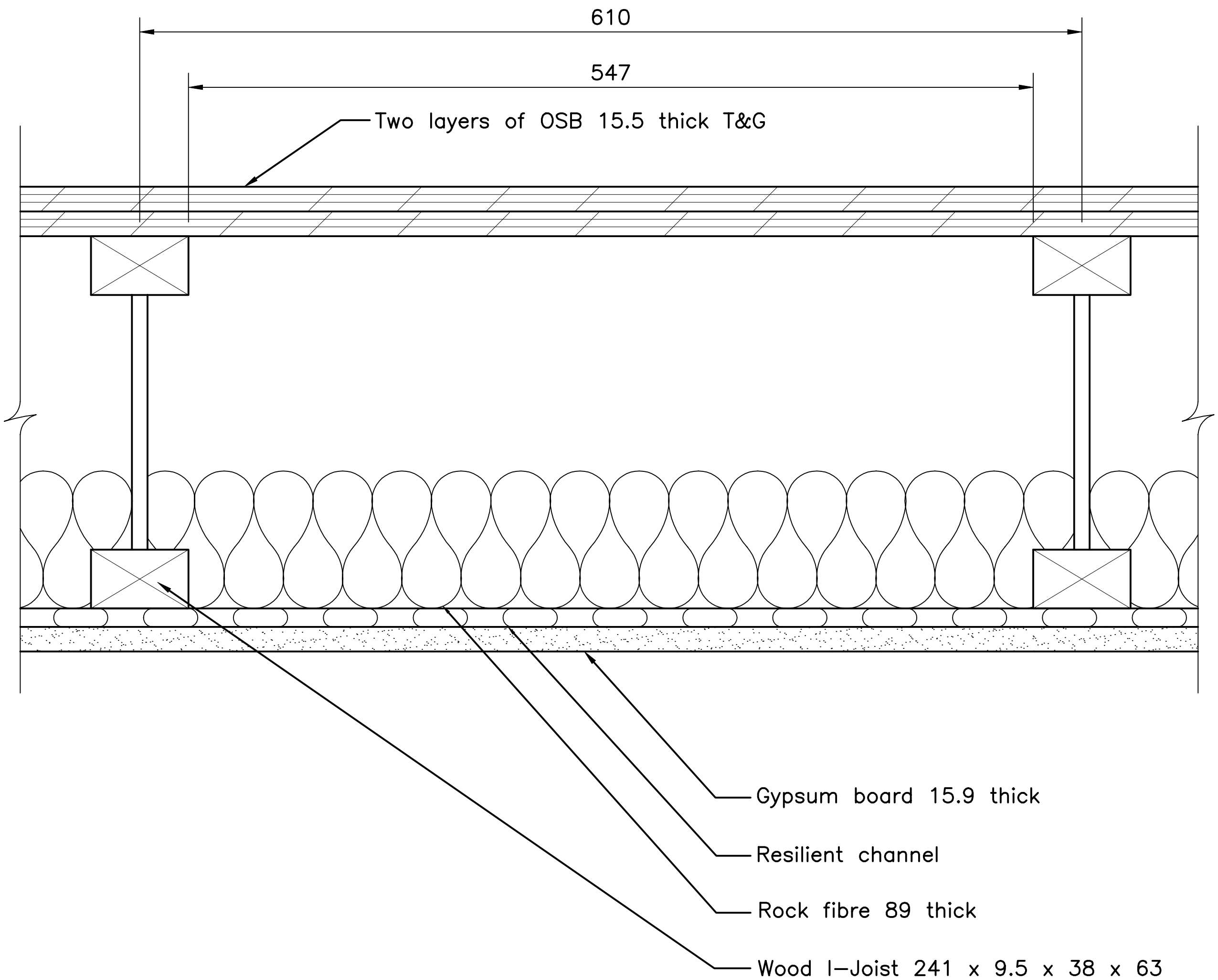
(Assembly No. FF–57)

Figure B–23. Subfloor Layout Face Layer (Wood I–Joist)



(Assembly No. FF–57)

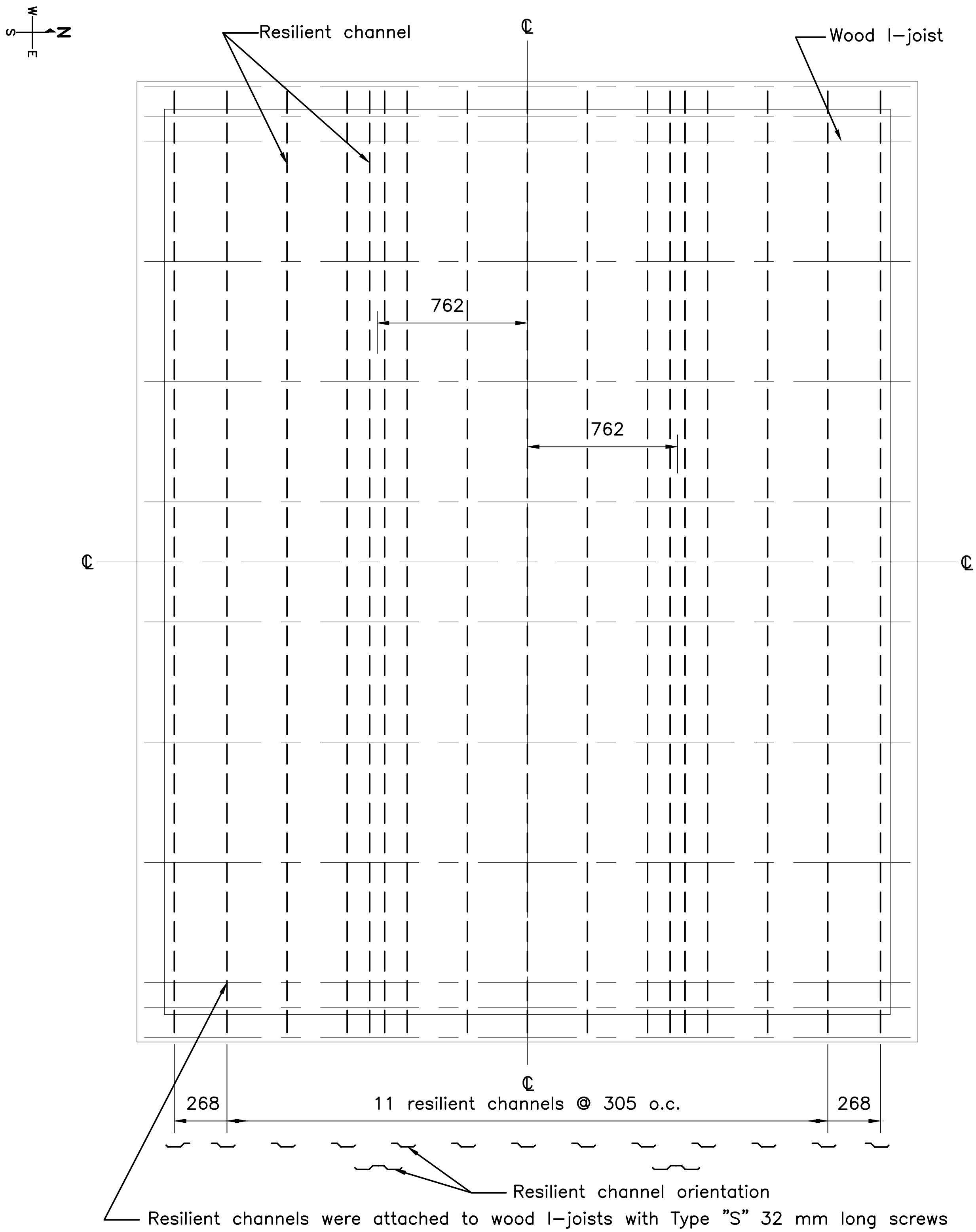
Figure B–24. Subfloor Nail Pattern Face Layer (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-57)

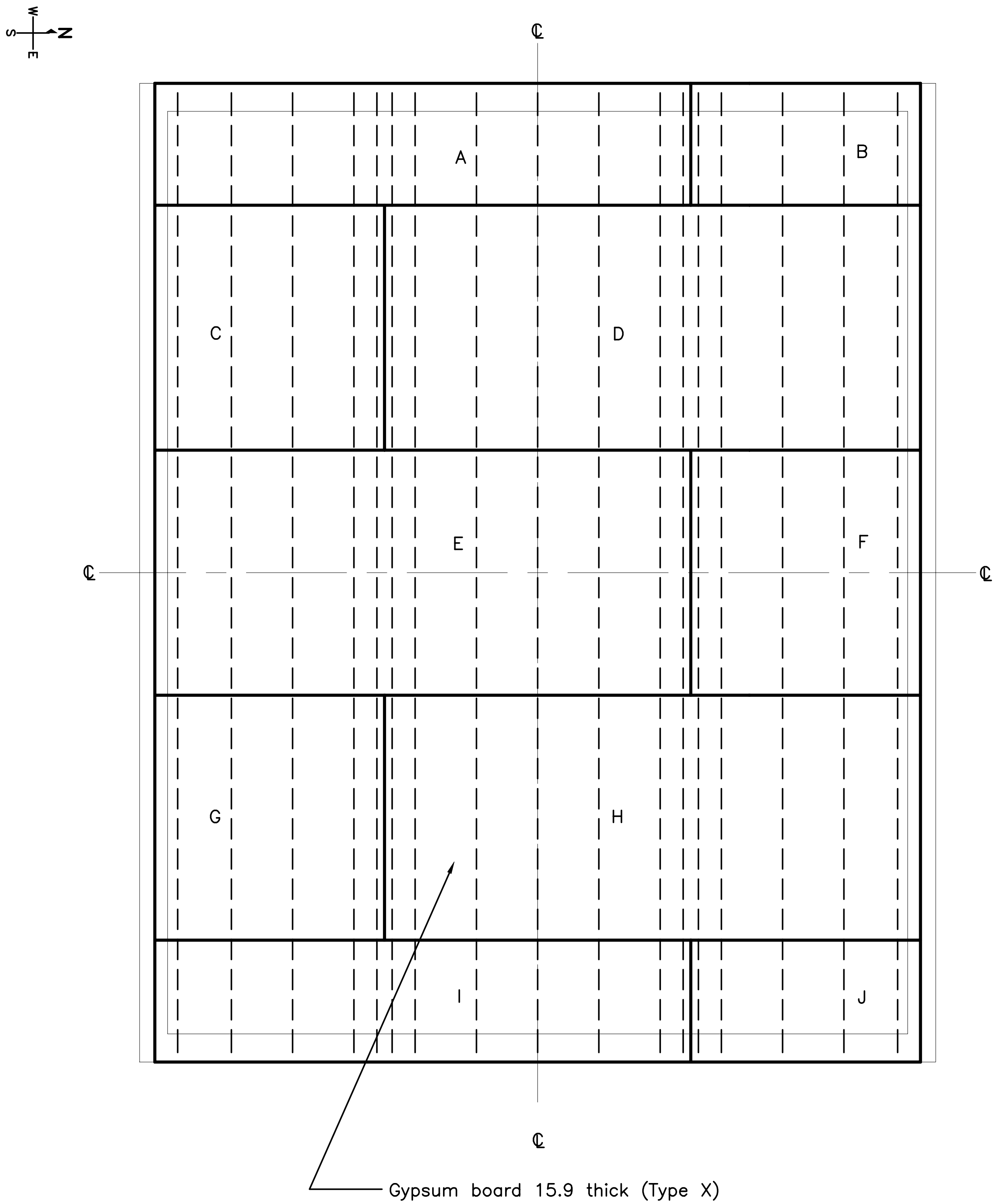
Figure B-25. Insulation Location (Wood I-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–57)

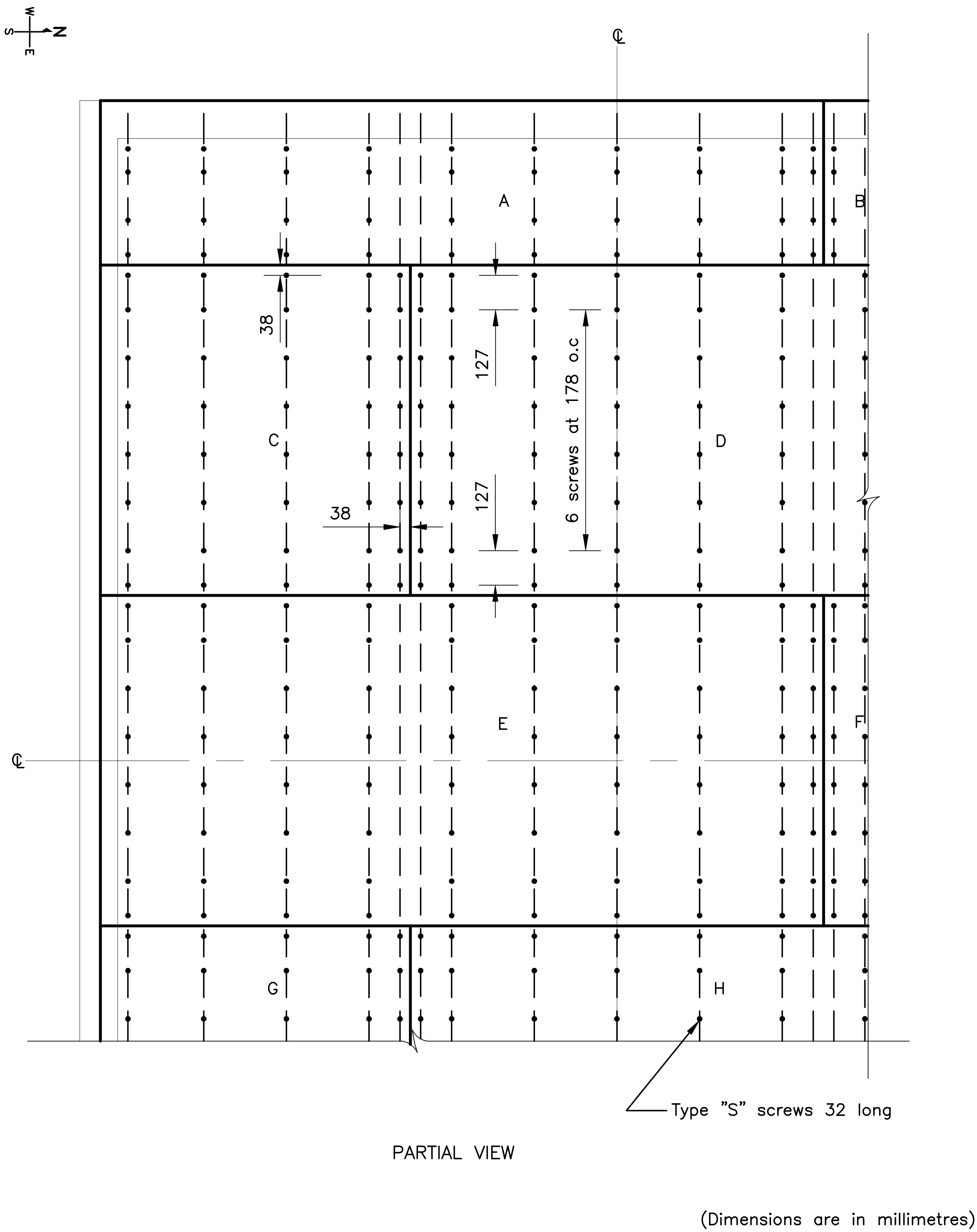
Figure B–26. Resilient Channel Layout (Wood I–Joist)



(Dimensions are in millimetres)

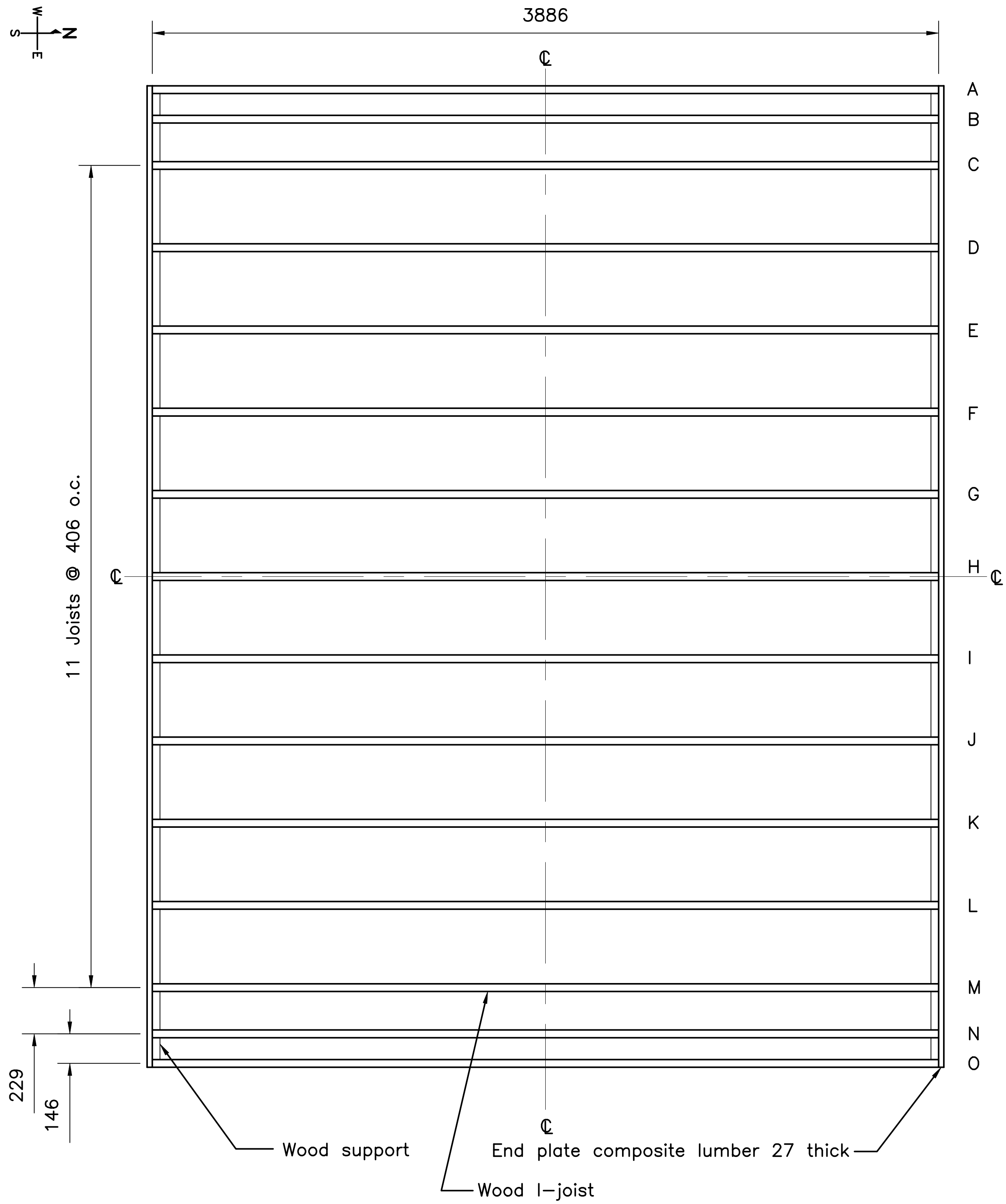
(Assembly No. FF–57)

Figure B–27. Gypsum Board Single Layer Layout (Wood I–Joist)



(Assembly No. FF–57)

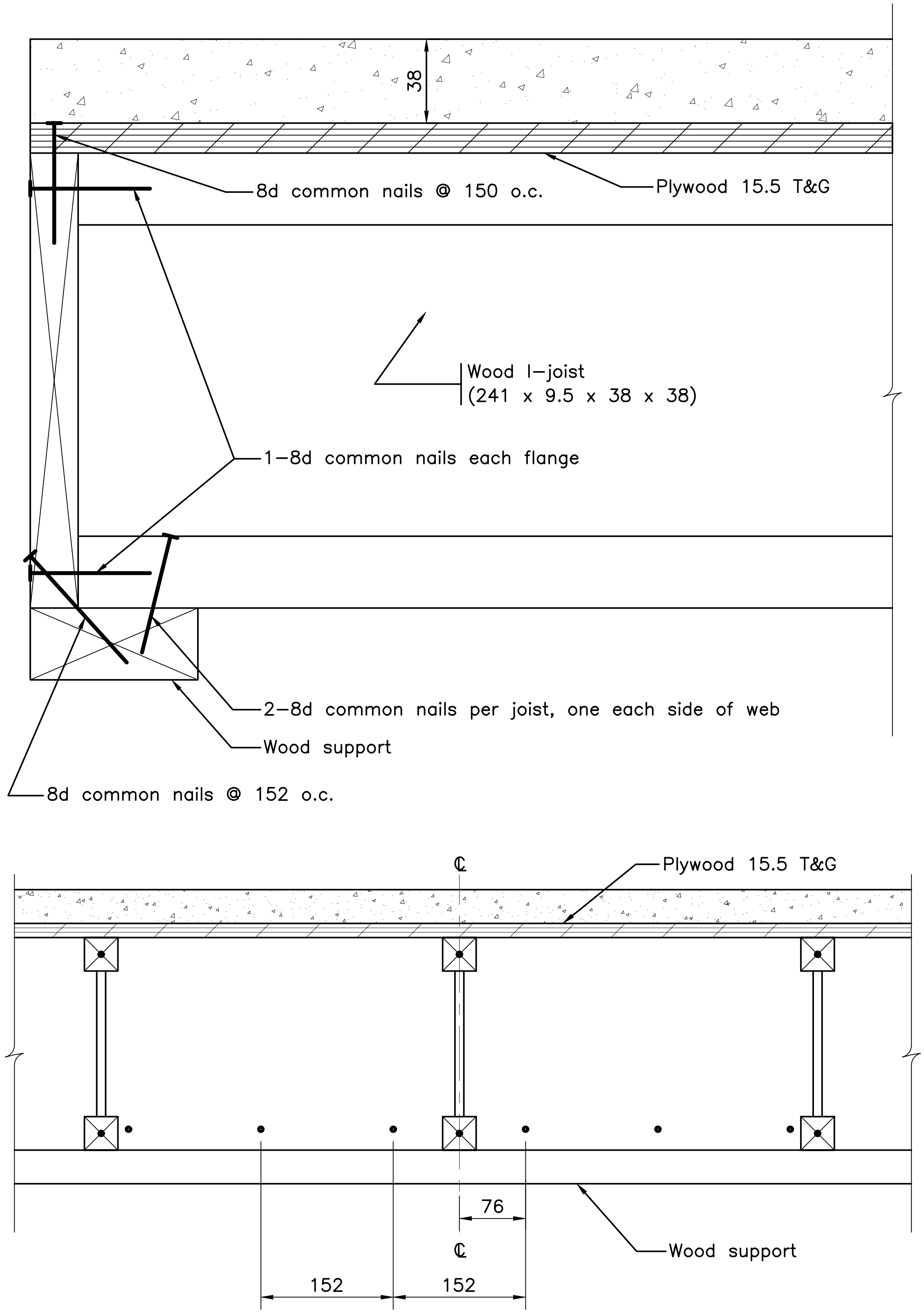
Figure B–28. Gypsum Board Single Layer Screw Pattern (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–61)

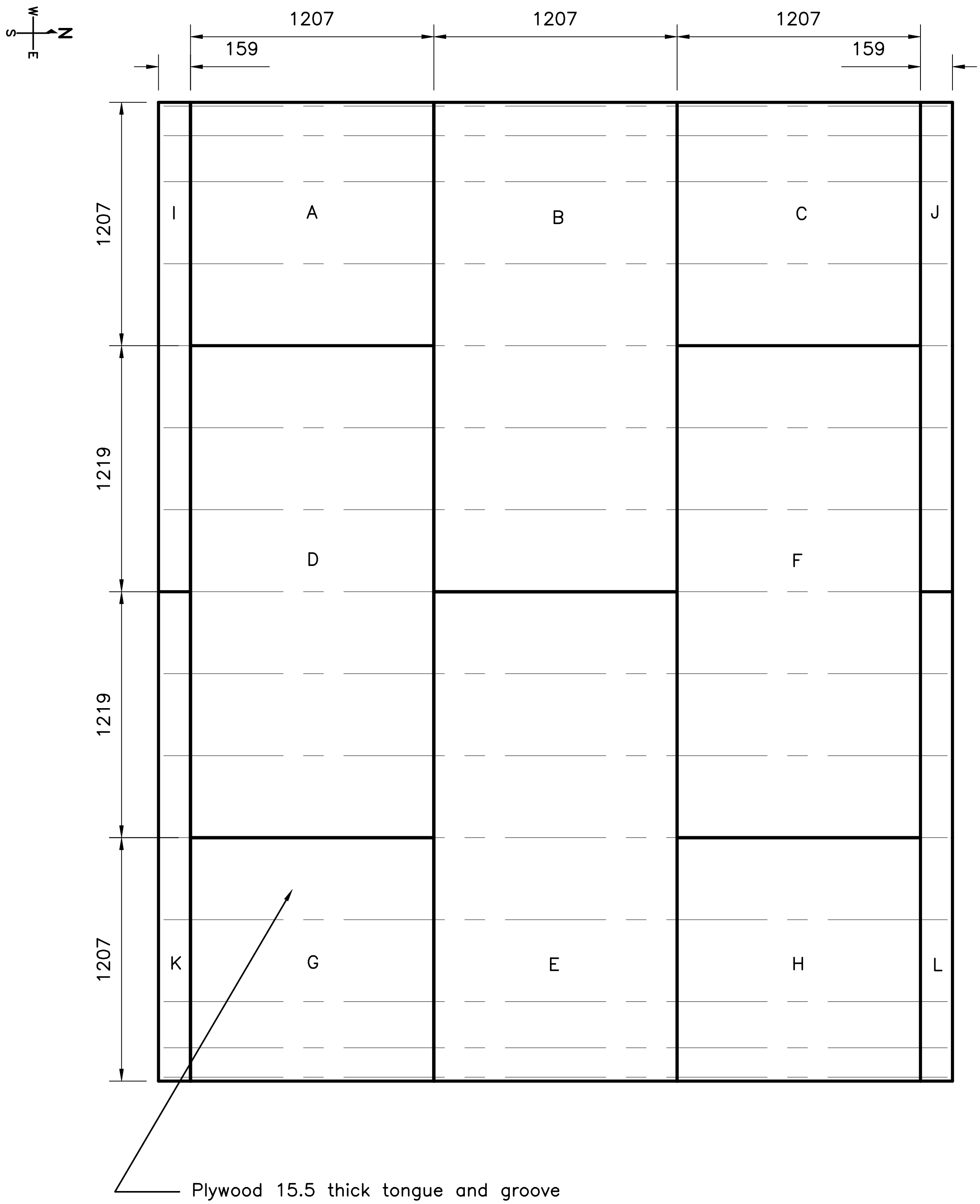
Figure B–29. Joist Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-61)

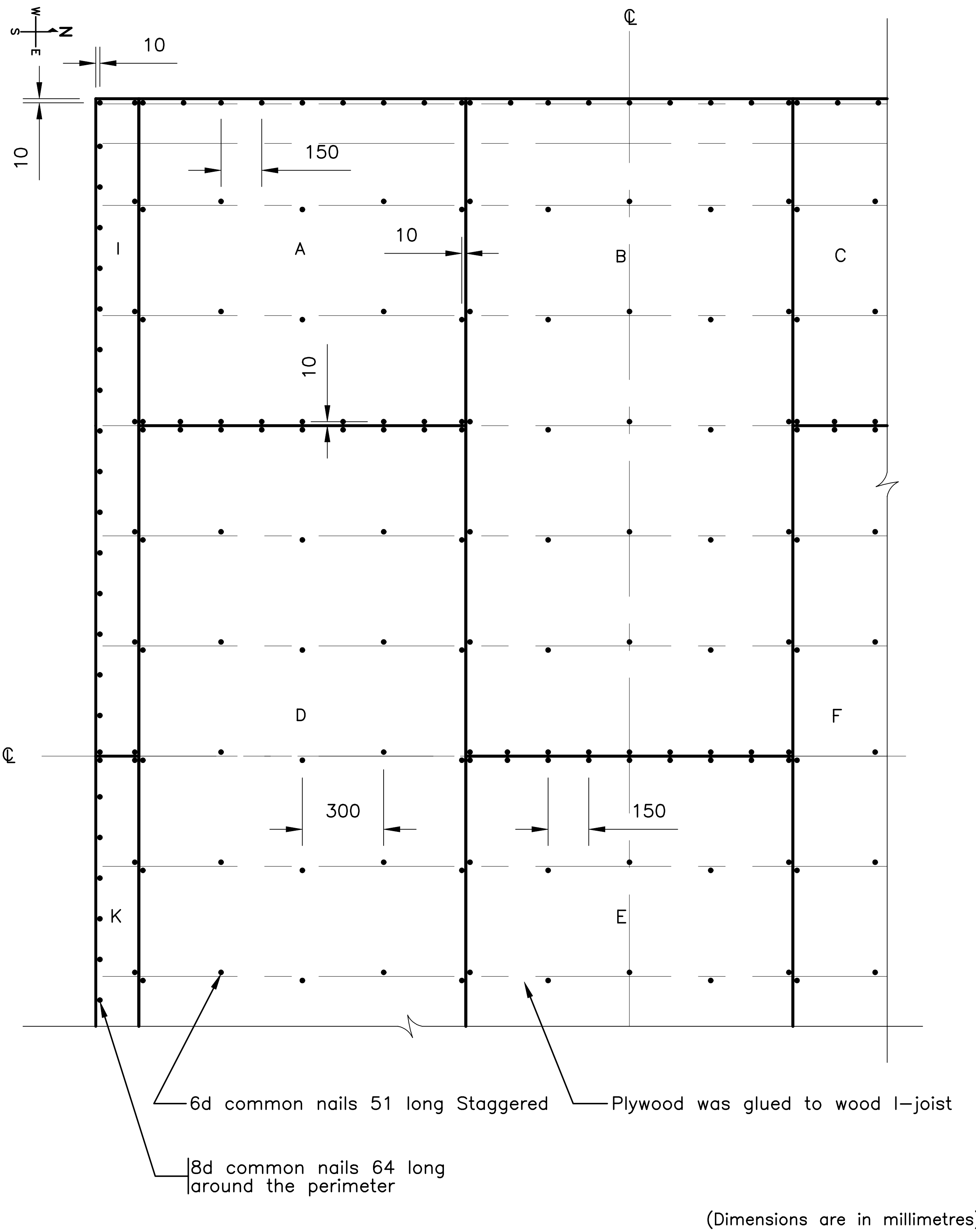
Figure B-30. Wood I-Joist End Connection Detail (Wood I-Joist)



(Dimensions are in millimetres)

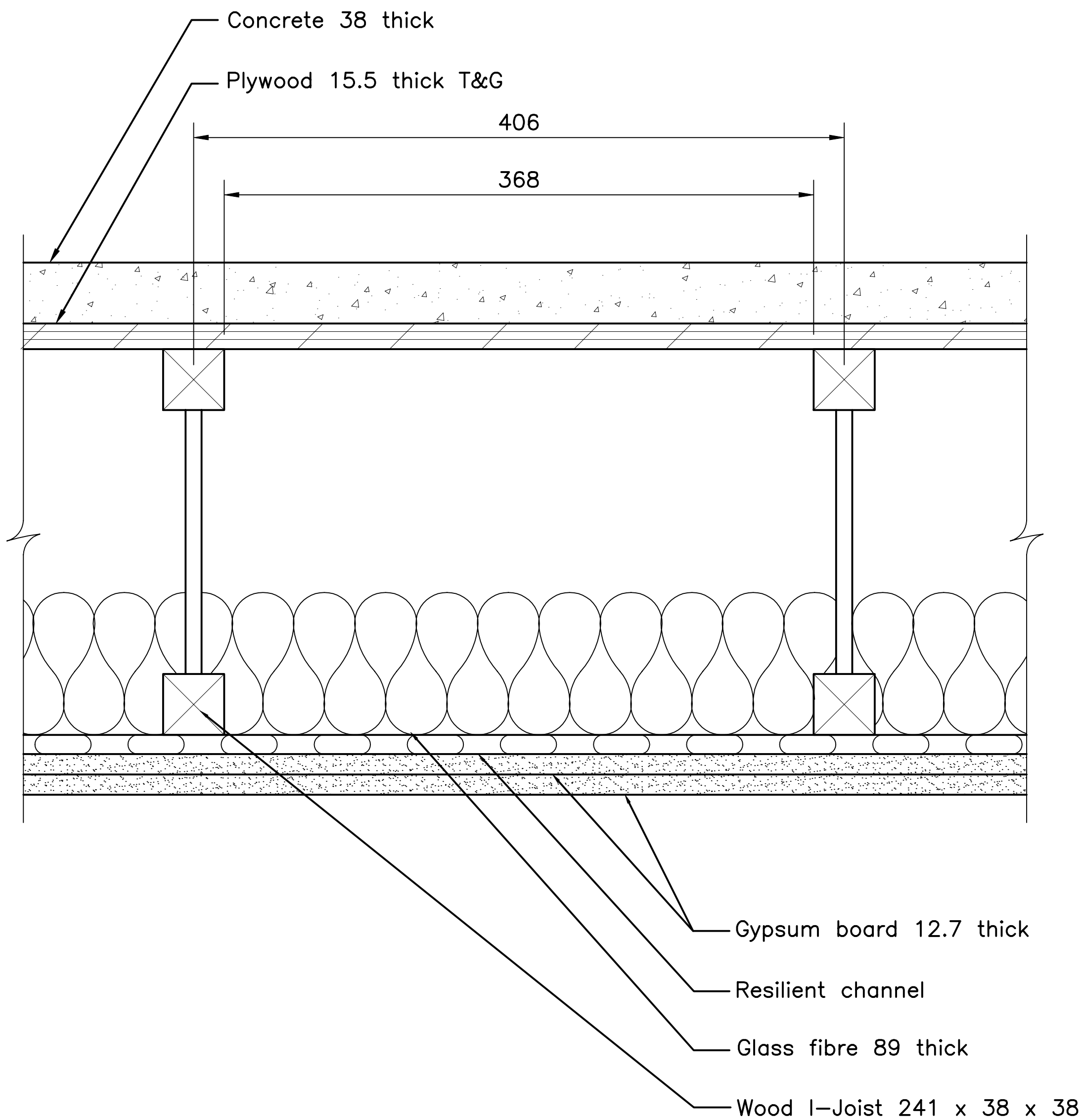
(Assembly No. FF–61)

Figure B–31. Subfloor Layout (Wood I–Joist)



(Assembly No. FF–61)

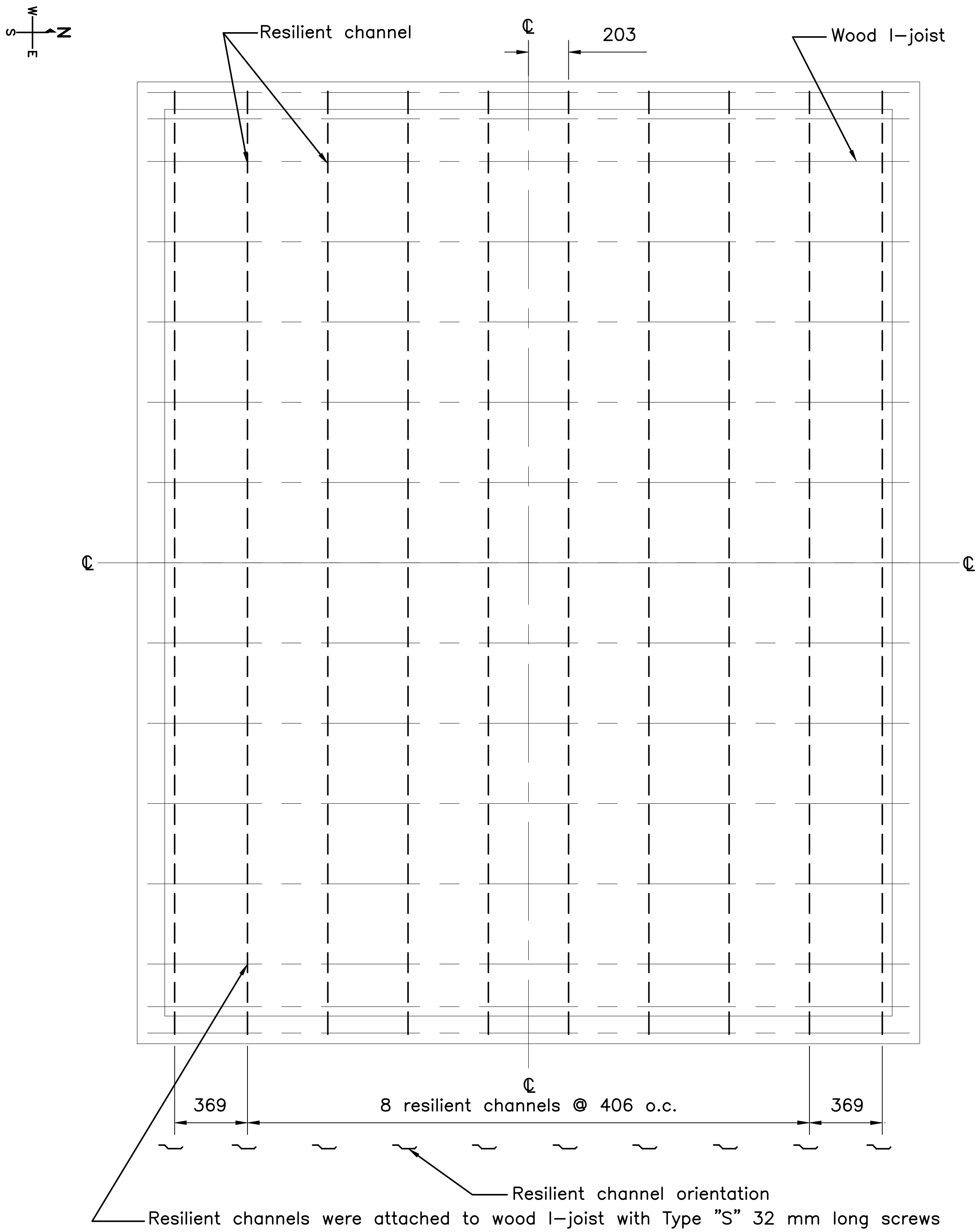
Figure B–32. Subfloor Nail Pattern (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–61)

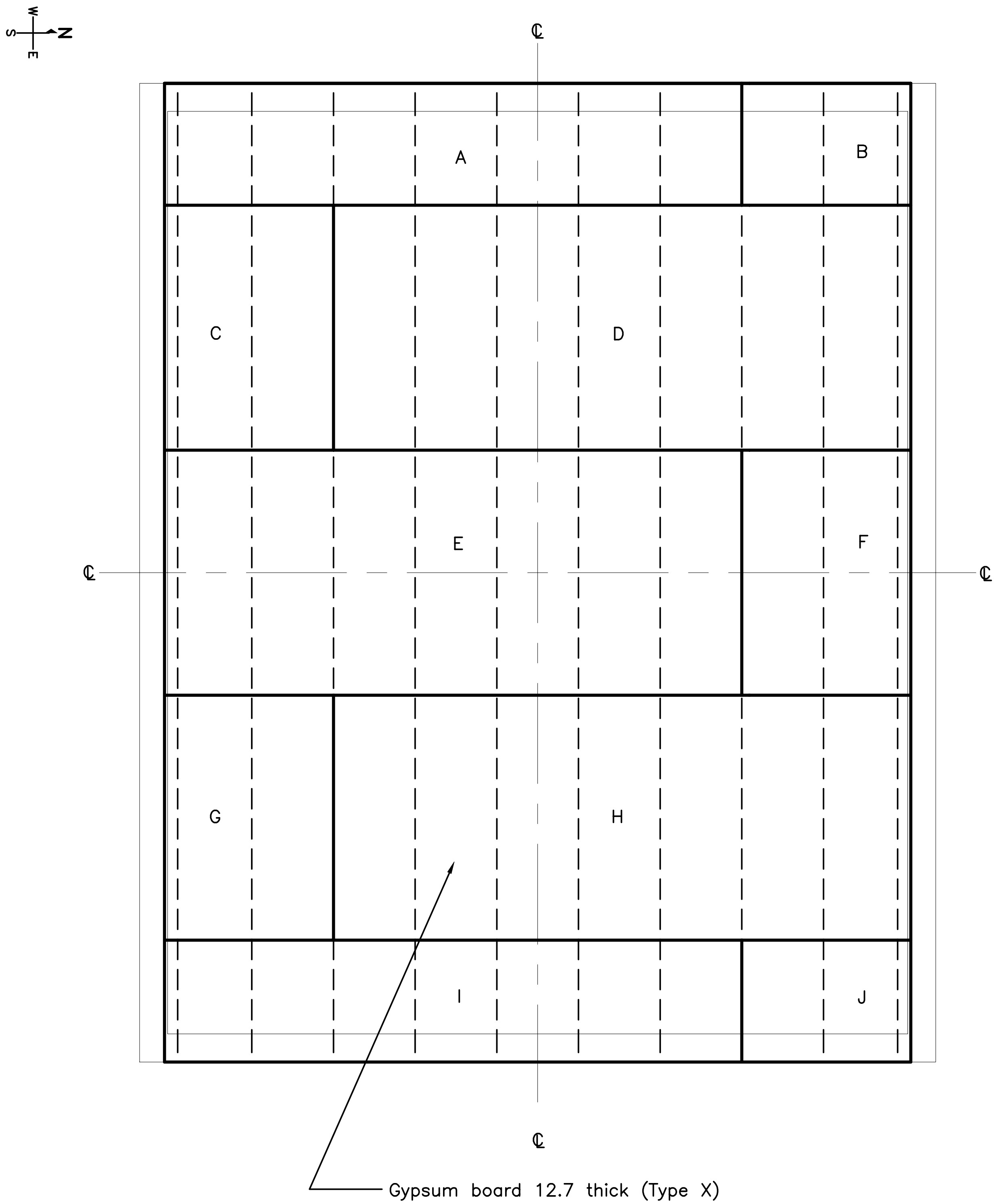
Figure B–33. Insulation Location (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–61)

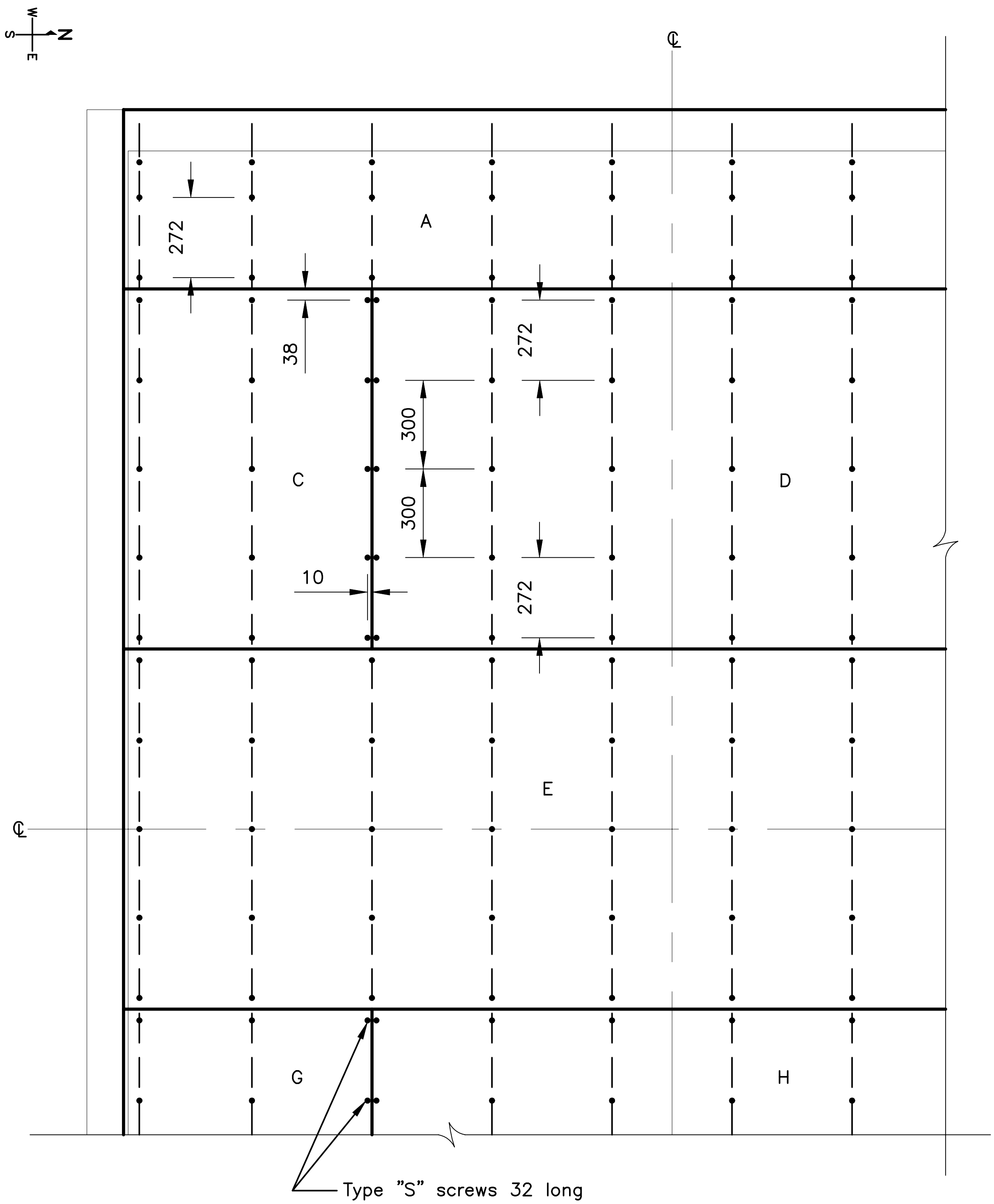
Figure B–34. Resilient Channel Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–61)

Figure B–35. Gypsum Board Base Layer Layout (Wood I–Joist)

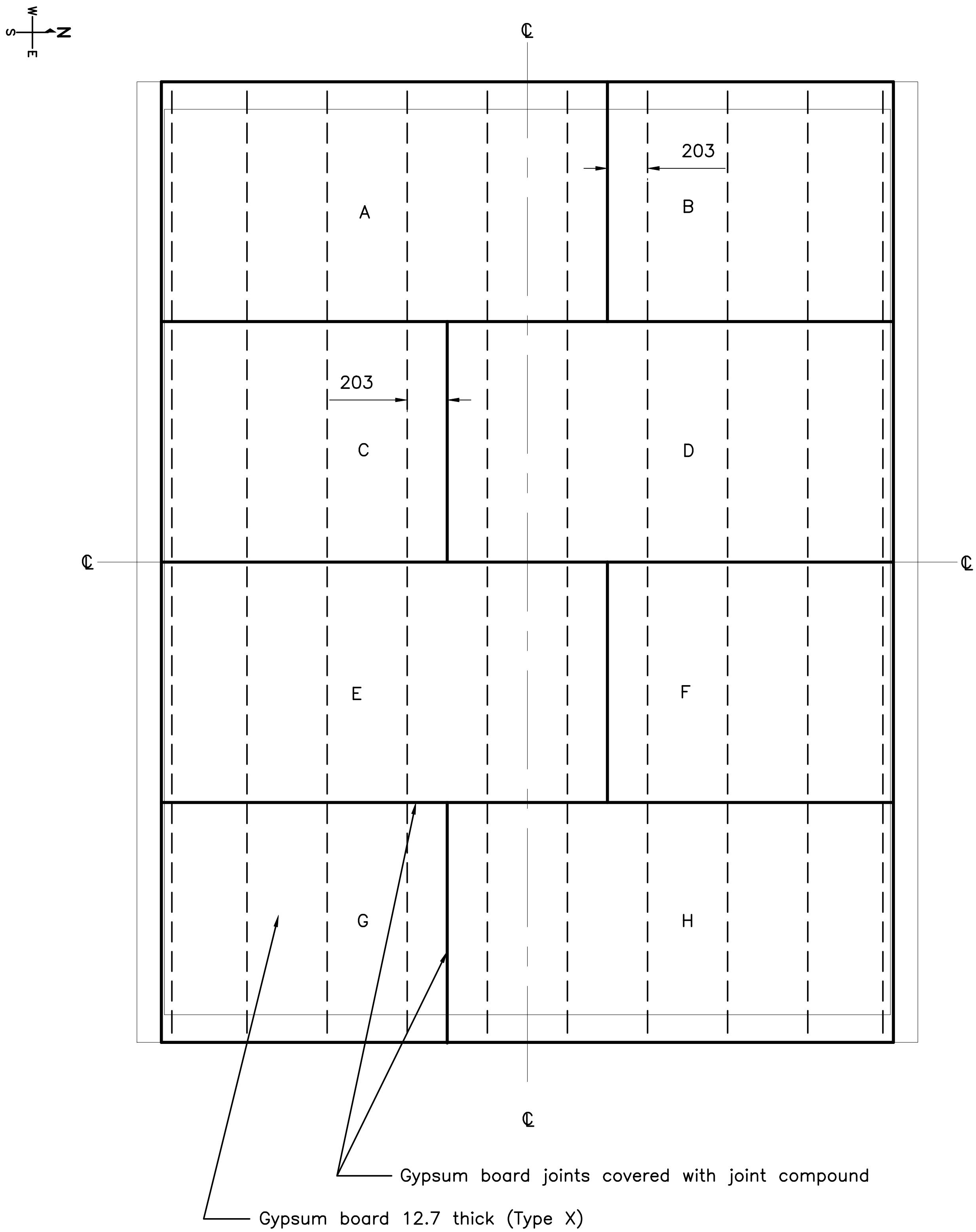


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF-61)

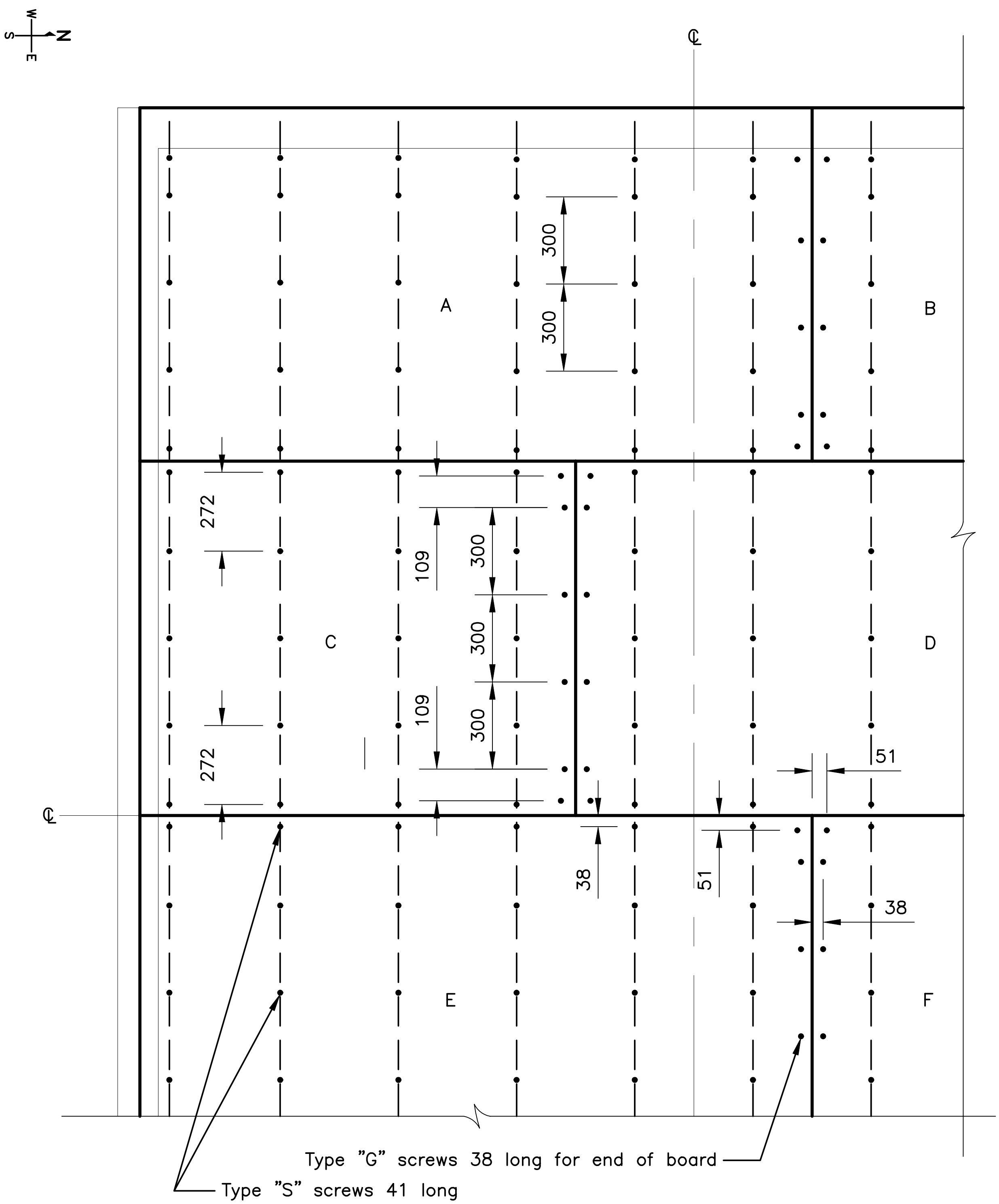
Figure B-36. Gypsum Board Base Layer Screw Pattern (Wood I-Joist)



(Dimensions are in millimetres)

(Assembly No. FF-61)

Figure B-37. Gypsum Board Face Layer Layout (Wood I-Joist)

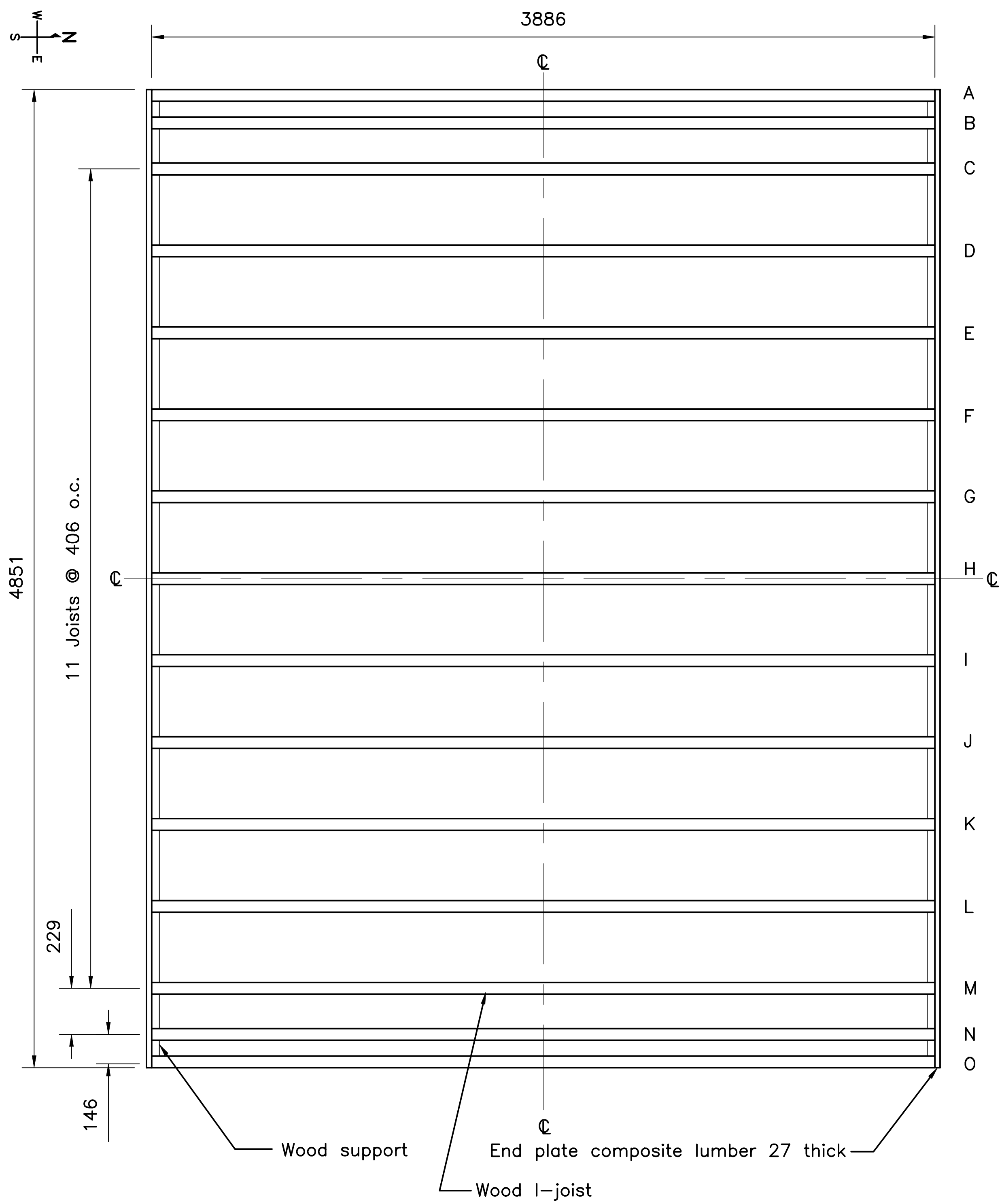


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF–61)

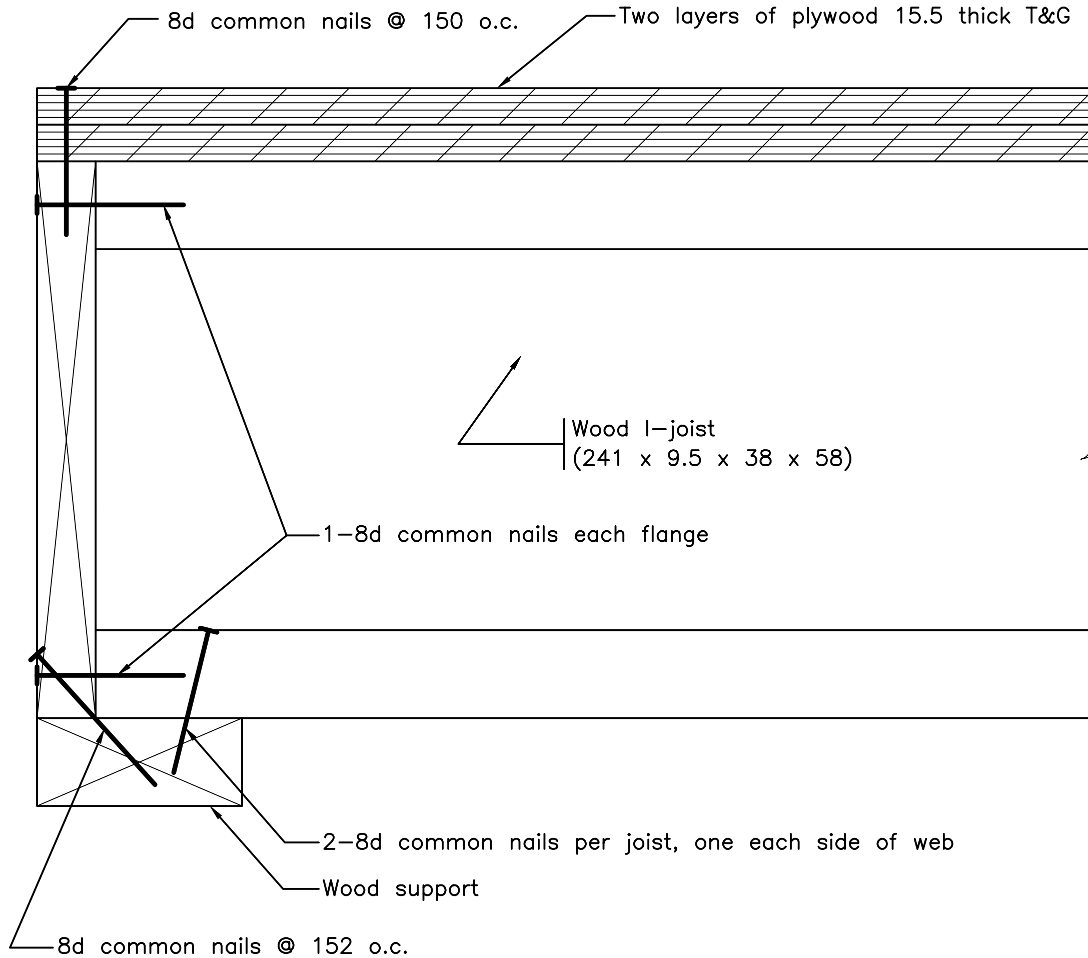
Figure B–38. Gypsum Board Face Layer Screw Pattern (Wood I–Joist)

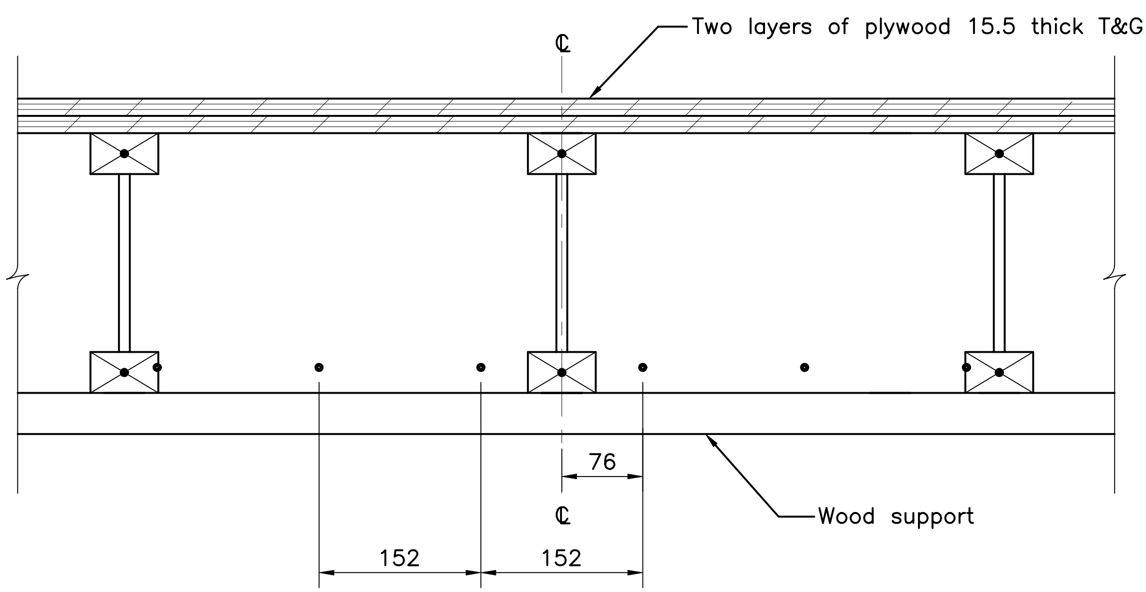


(Dimensions are in millimetres)

(Assembly No. FF–76)

Figure B–39. Joist Layout (Wood I–Joist)

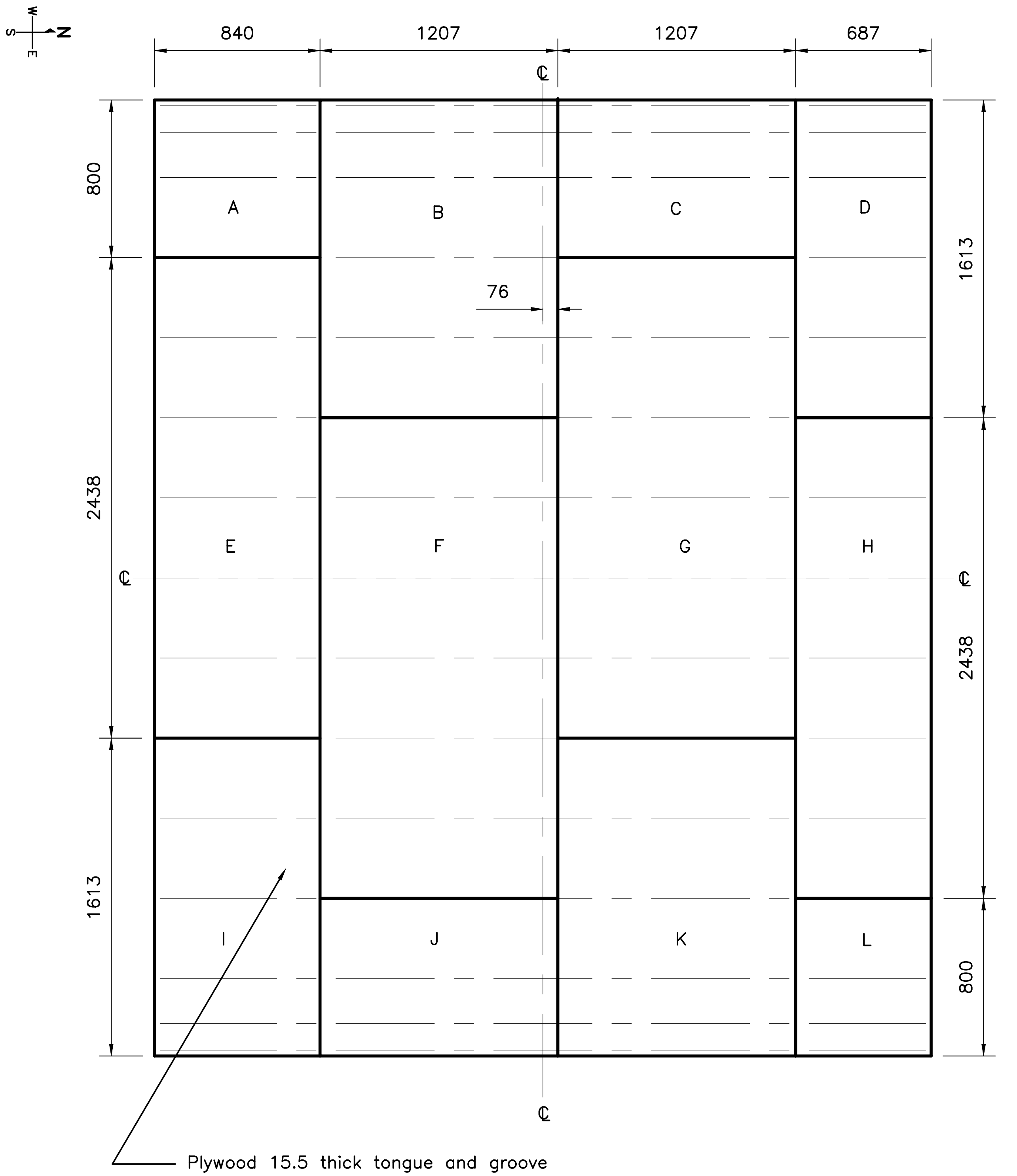




(Dimensions are in millimetres)

(Assembly No. FF–76)

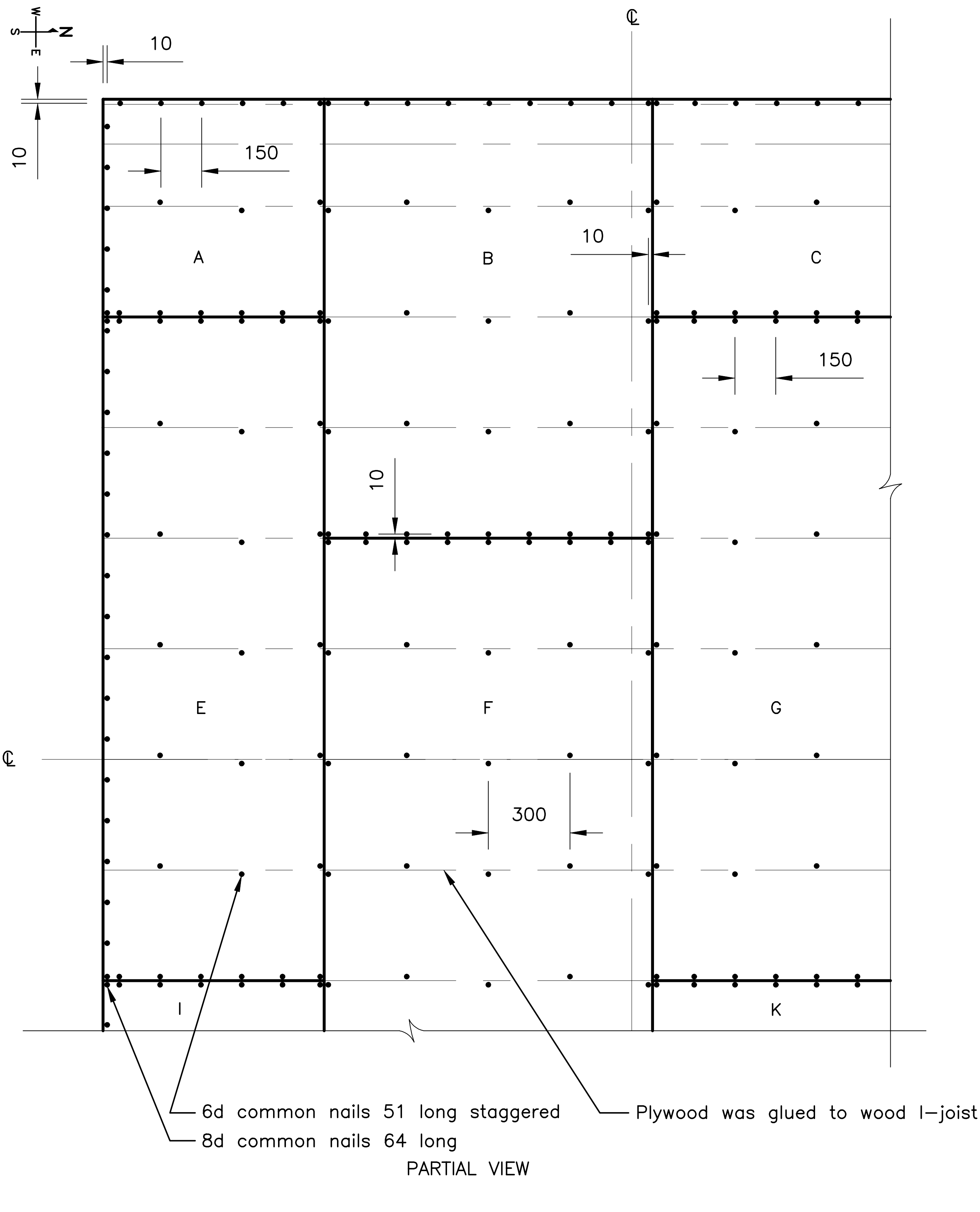
Figure B–40. Wood I–Joist End Connection Detail (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–76)

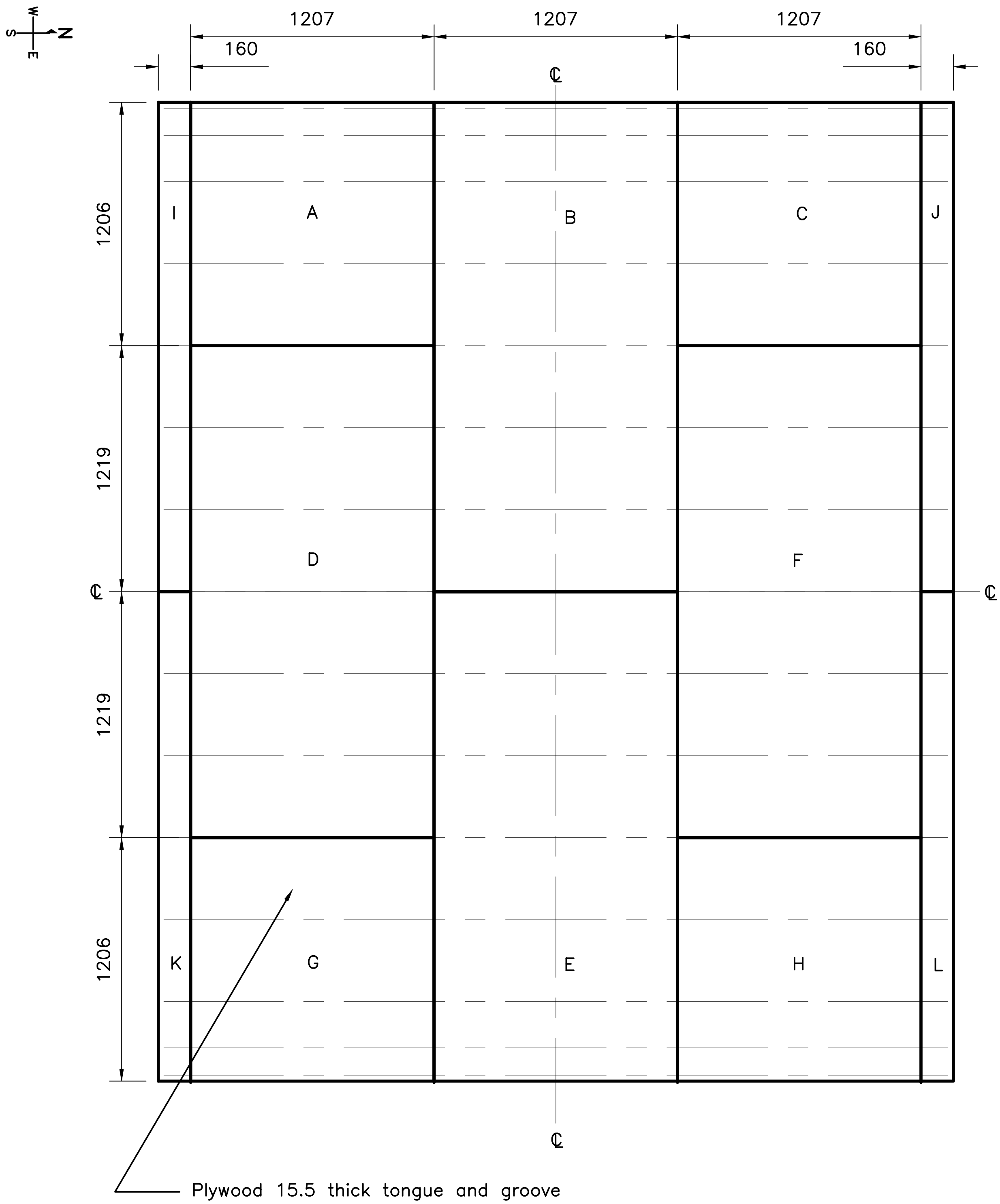
Figure B–41. Subfloor Layout Base Layer (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–76)

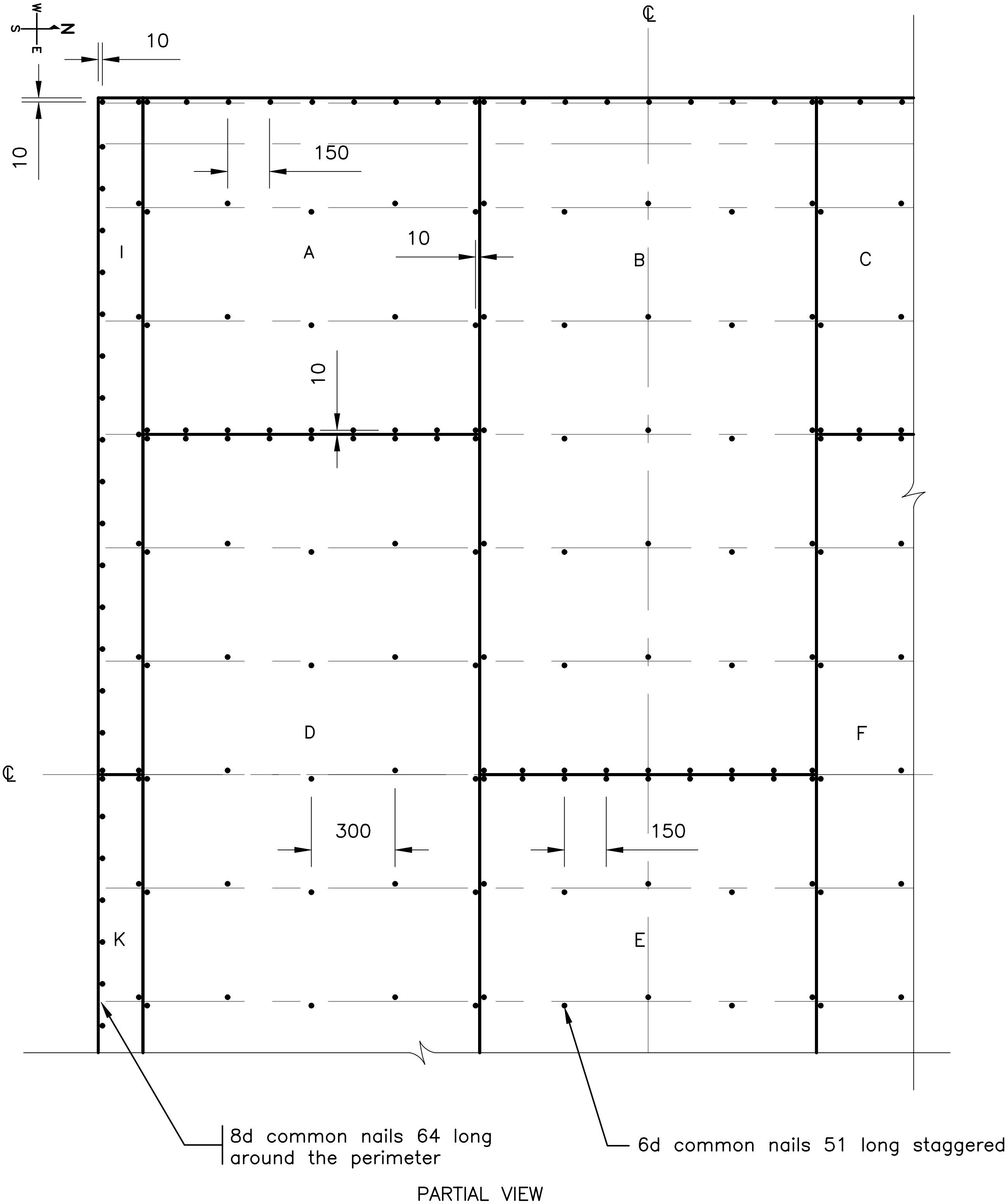
Figure B–42. Subfloor Nail Pattern Base Layer (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–76)

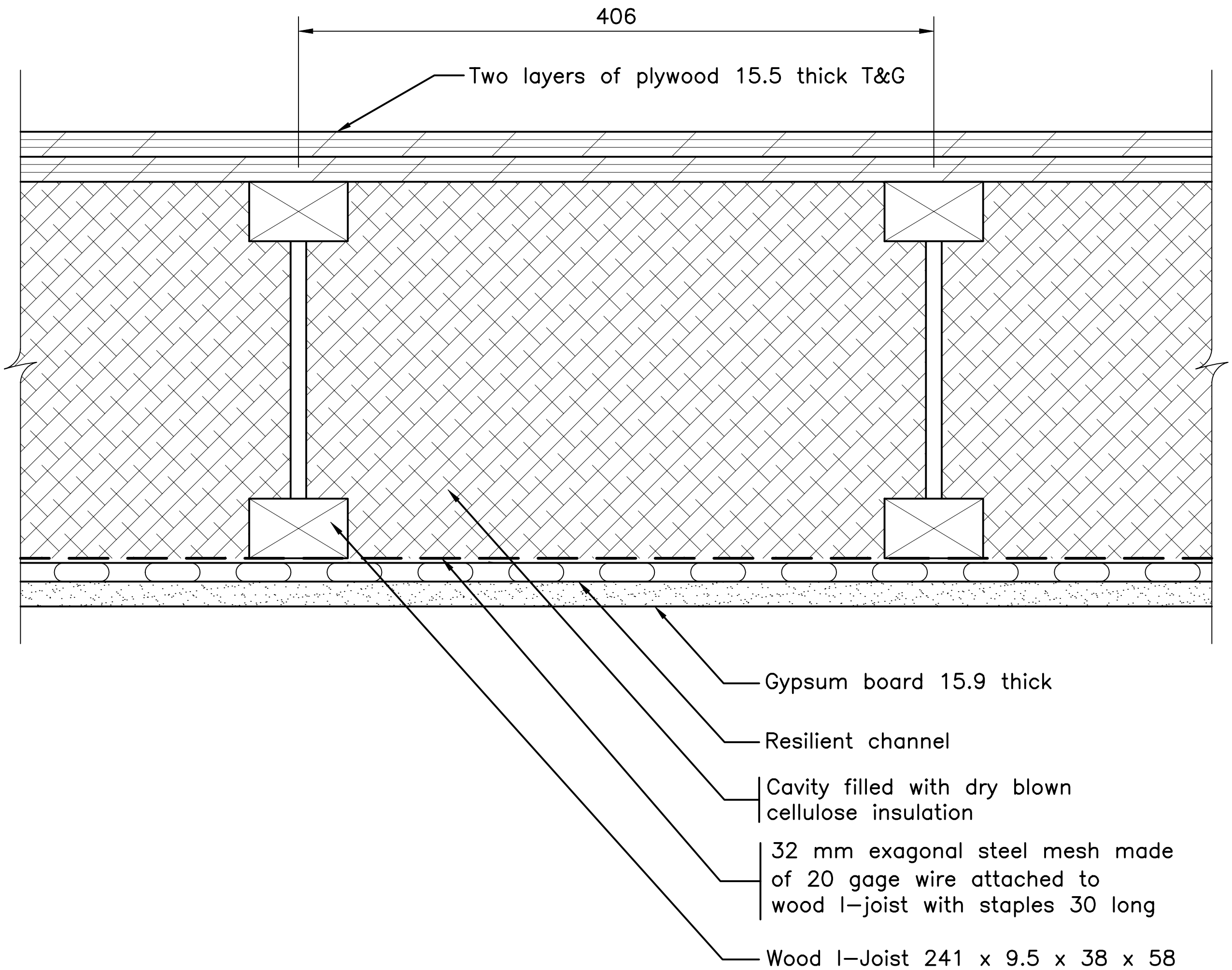
Figure B–43. Subfloor Layout Face Layer (Wood I–Joist)

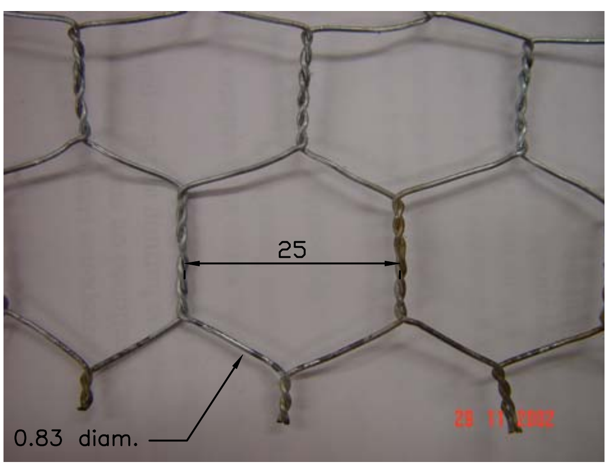


(Dimensions are in millimetres)

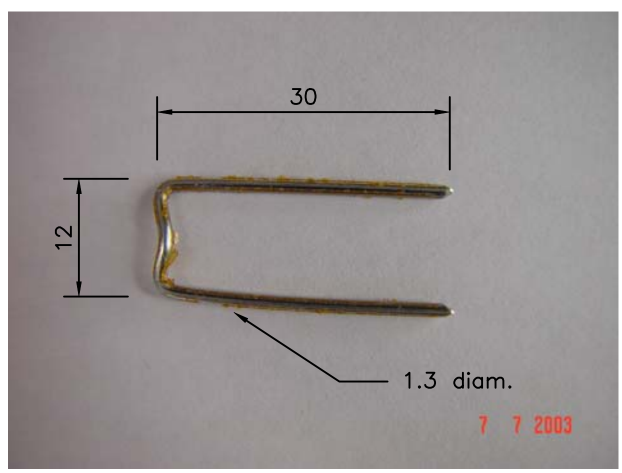
(Assembly No. FF–76)

Figure B–44. Subfloor Nail Pattern Face Layer (Wood I–Joist)





Steel mesh

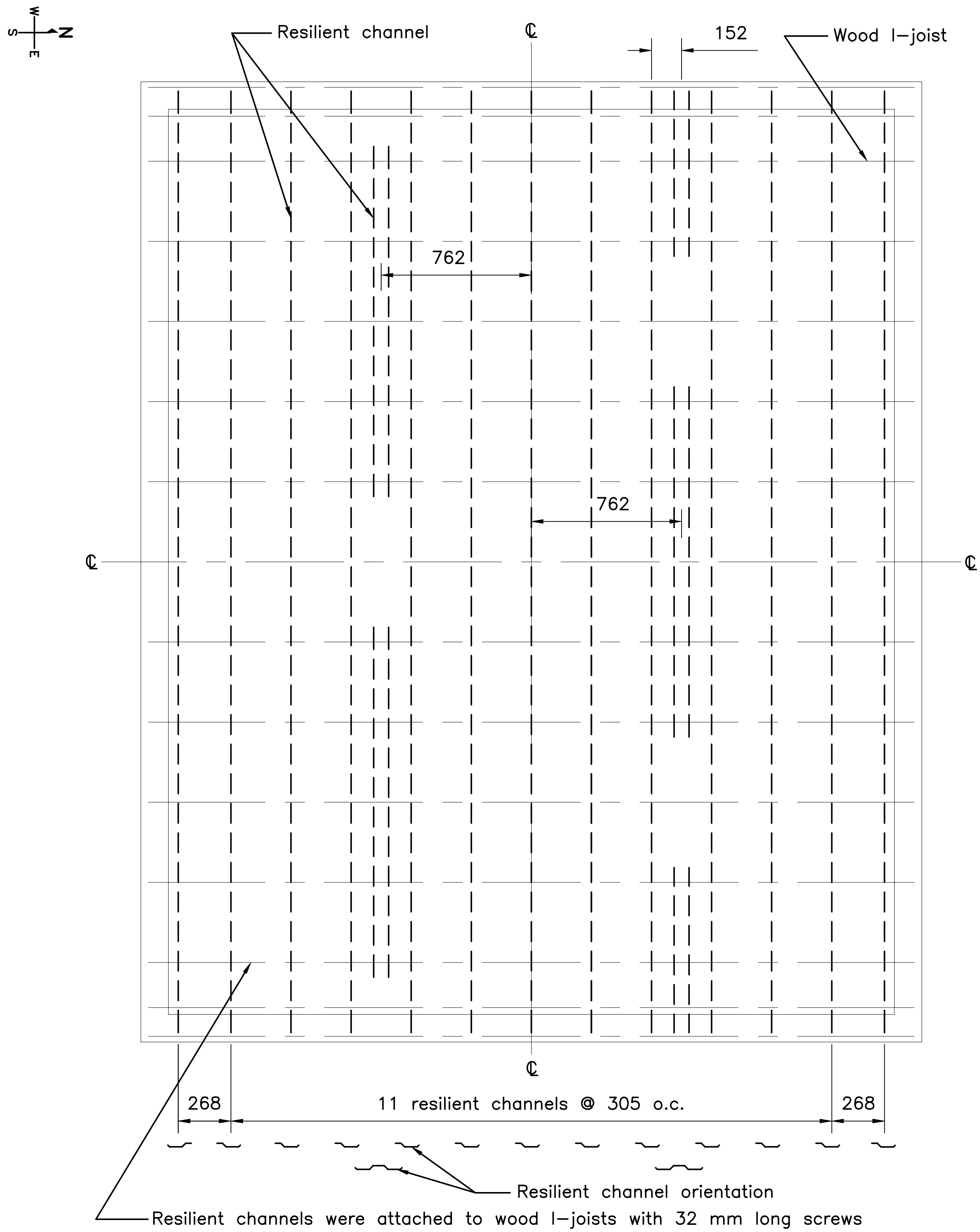


Staple used to secure the steel mesh to wood I–joists

(Dimensions are in millimetres)

(Assembly No. FF–76)

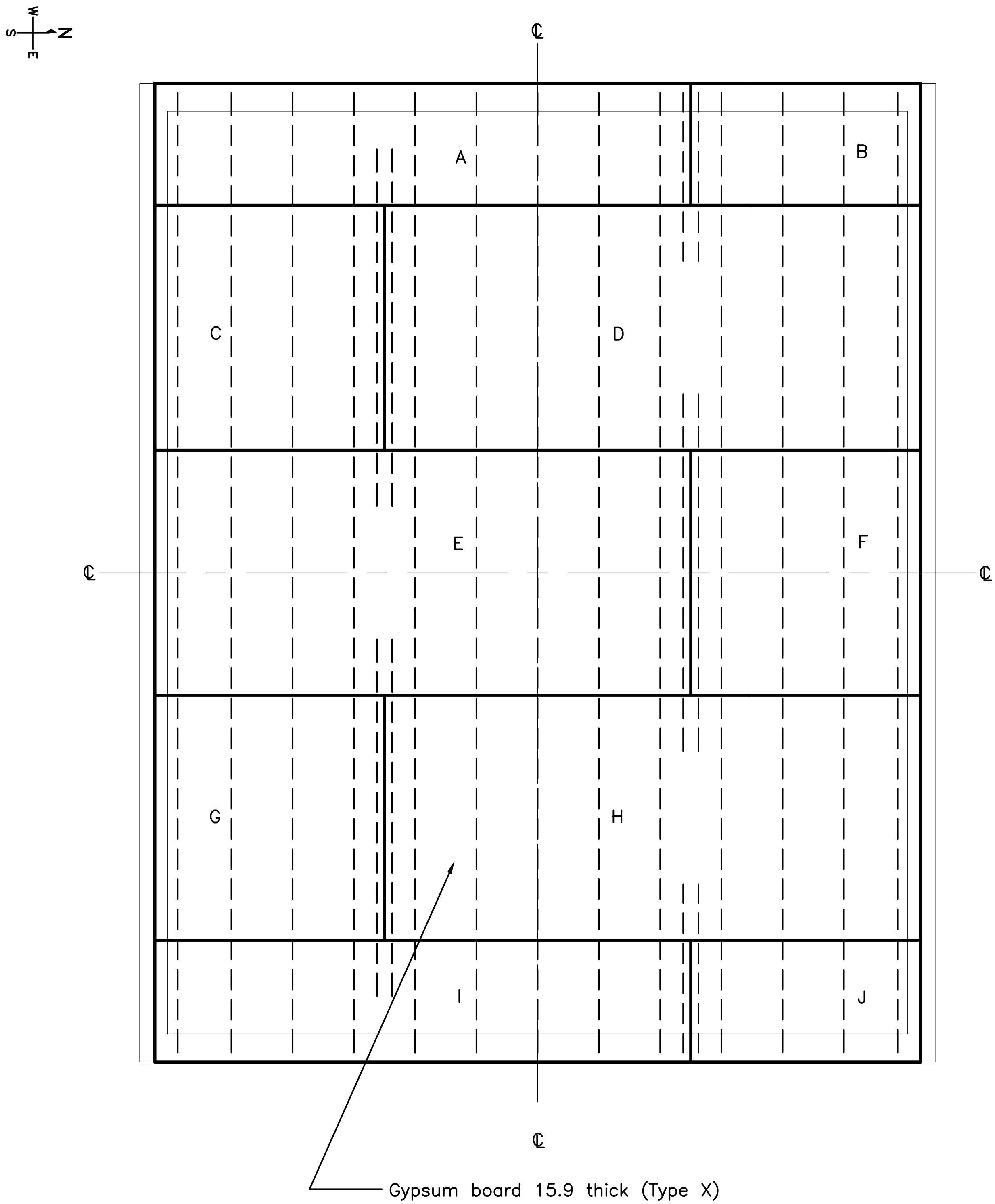
Figure B–45. Insulation Location (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–76)

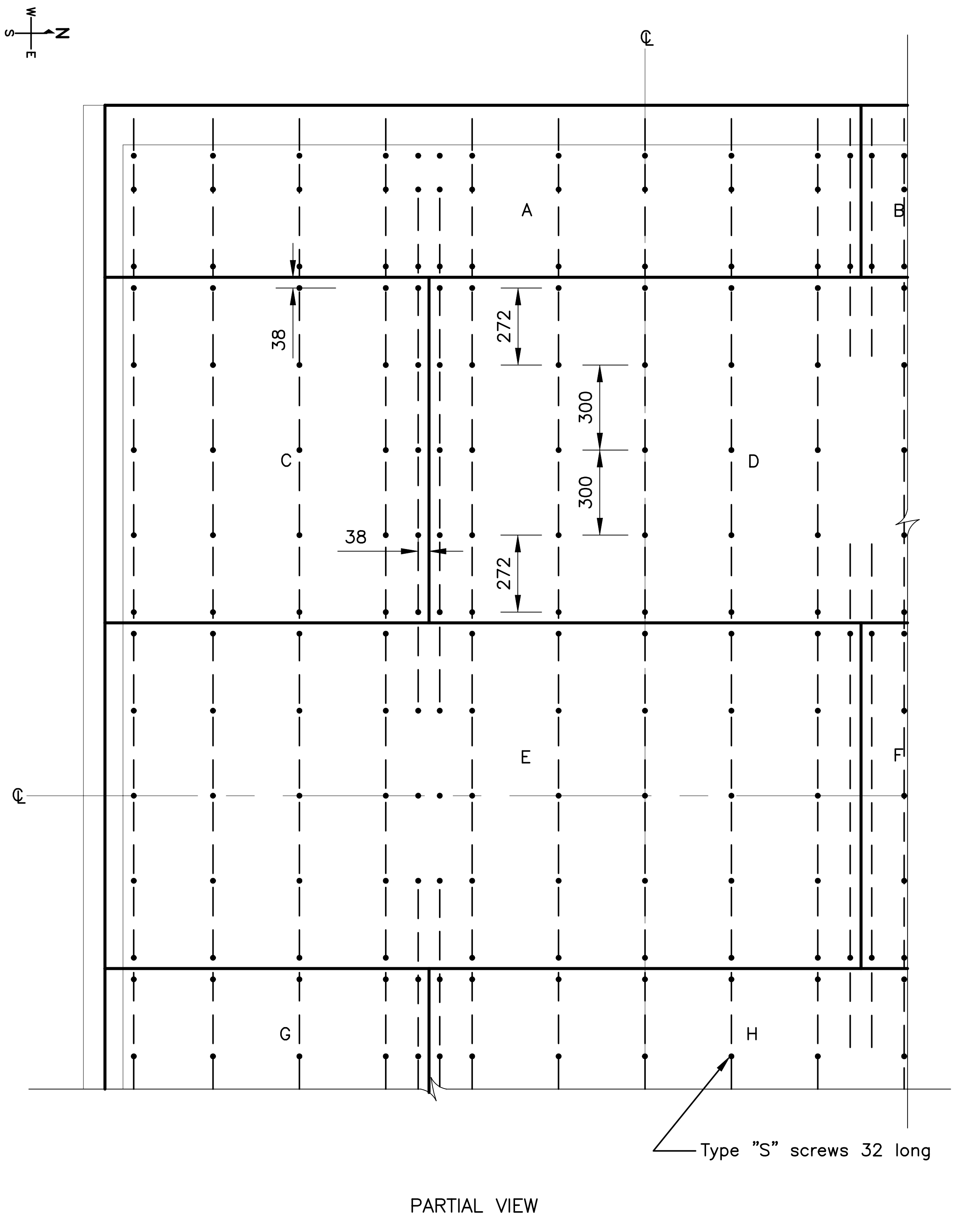
Figure B–46. Resilient Channel Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–76)

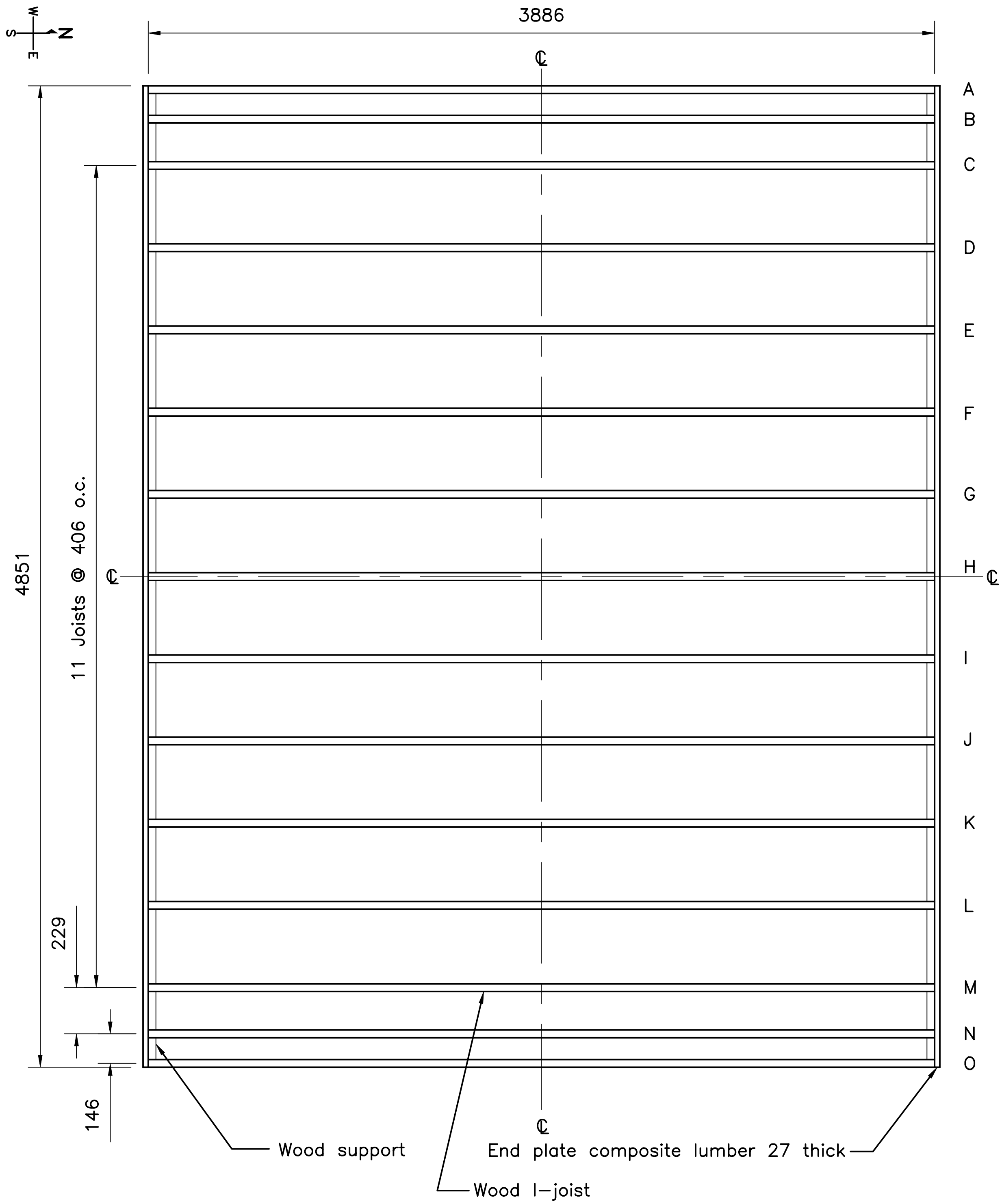
Figure B–47. Gypsum Board Single Layer Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–76)

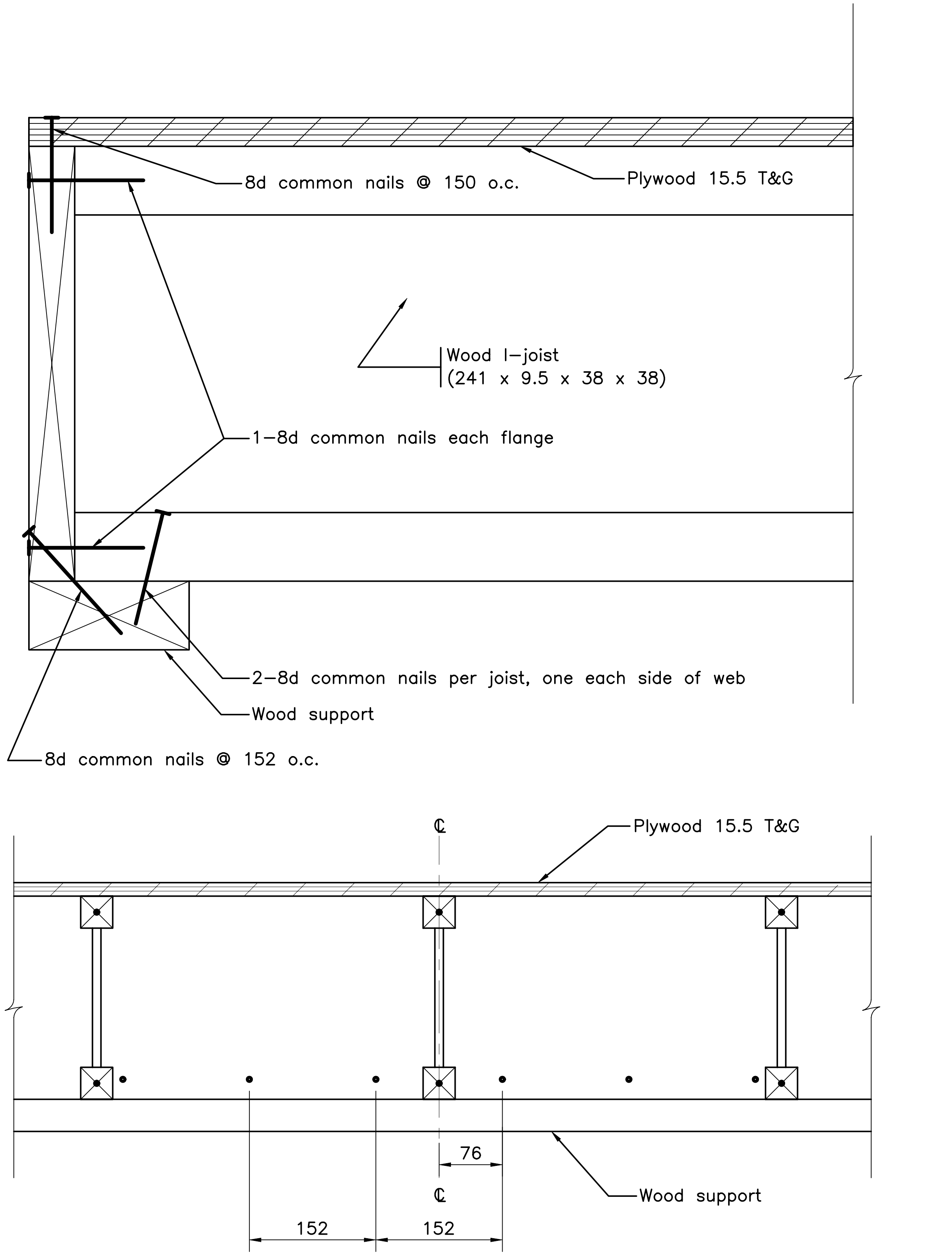
Figure B–48. Gypsum Board Single Layer Screw Pattern (Wood I–Joist)



(Dimensions are in millimetres)

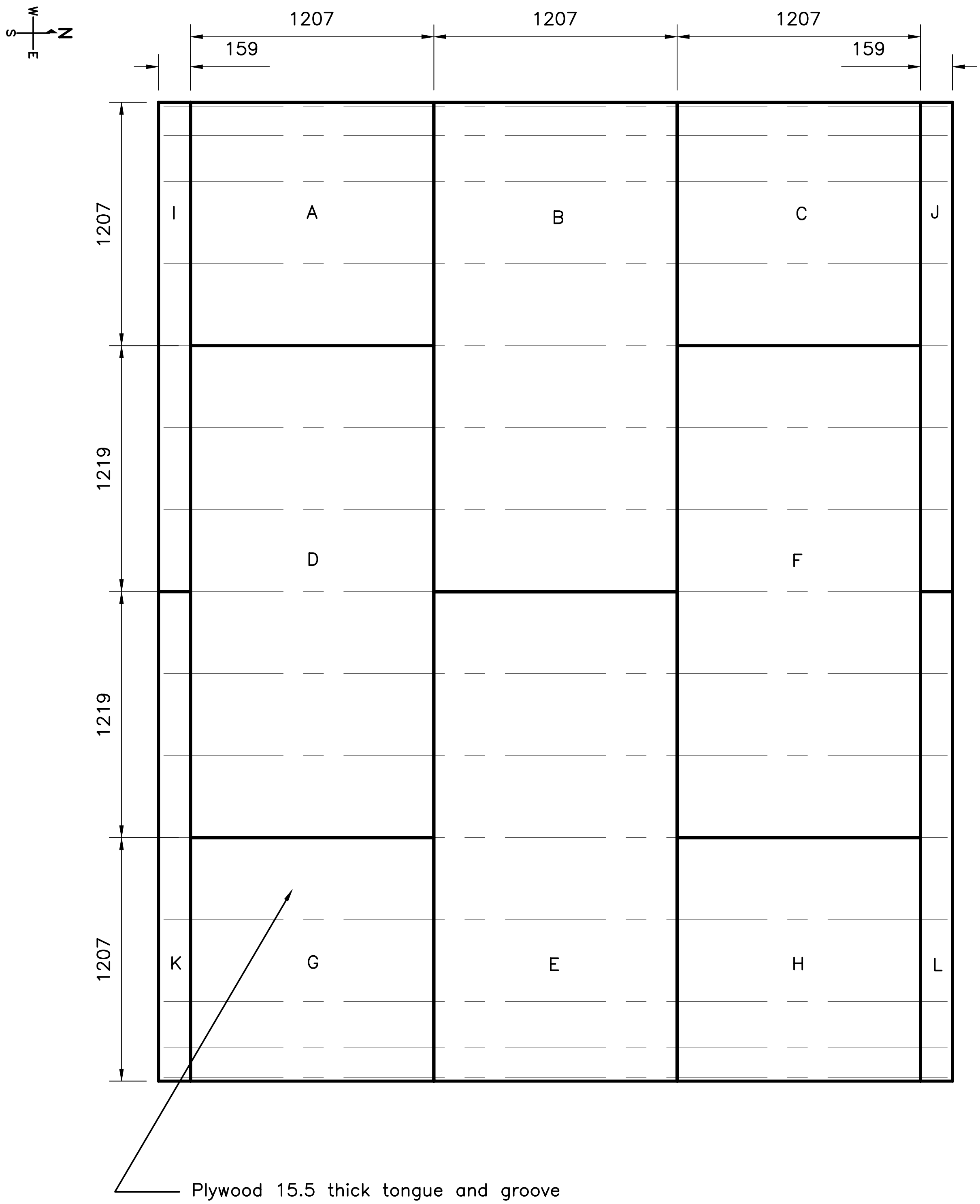
(Assembly No. FF–77)

Figure B–49. Joist Layout (Wood I–Joist)



(Assembly No. FF–77)

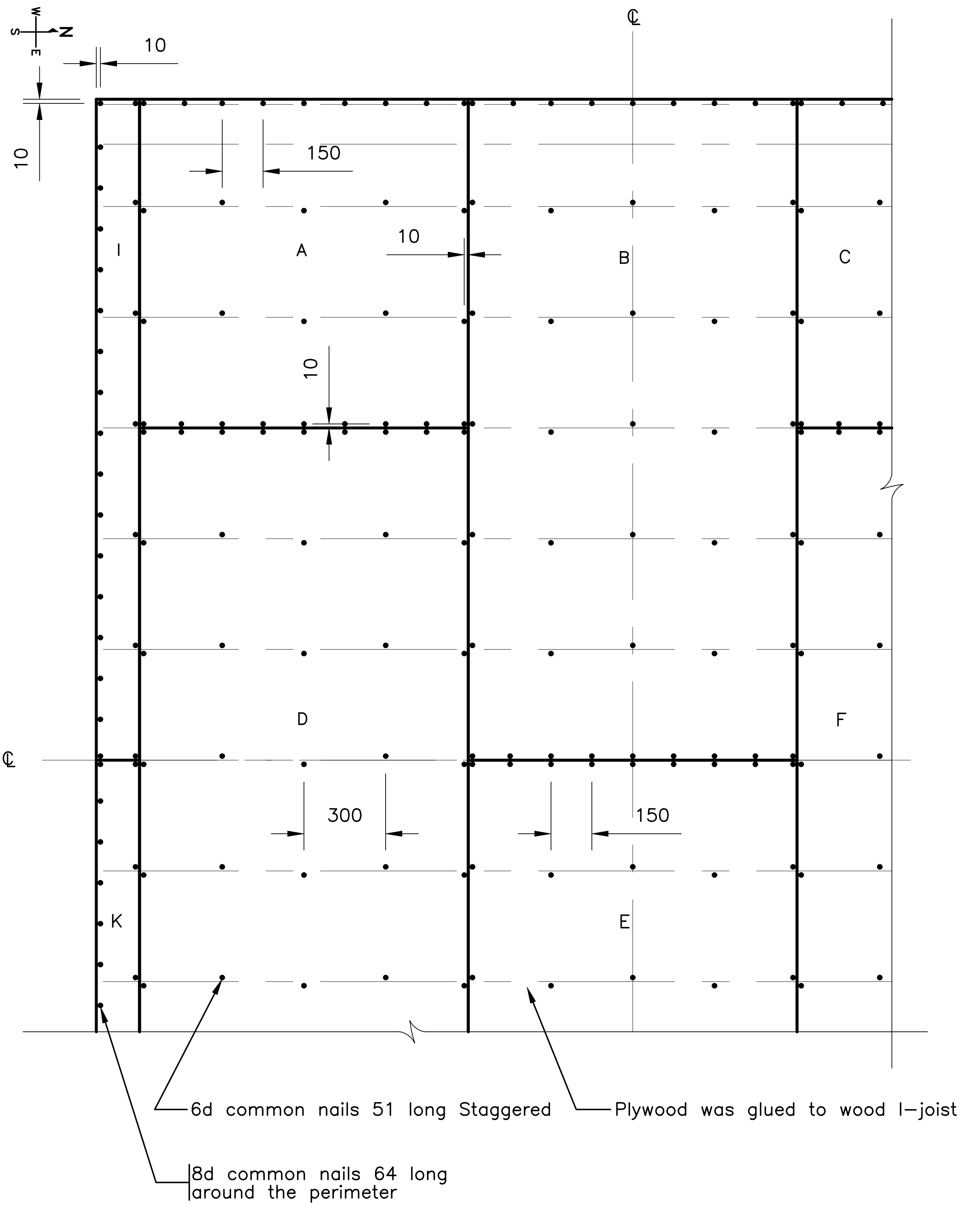
Figure B–50. Wood I–Joist End Connection Detail (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–77)

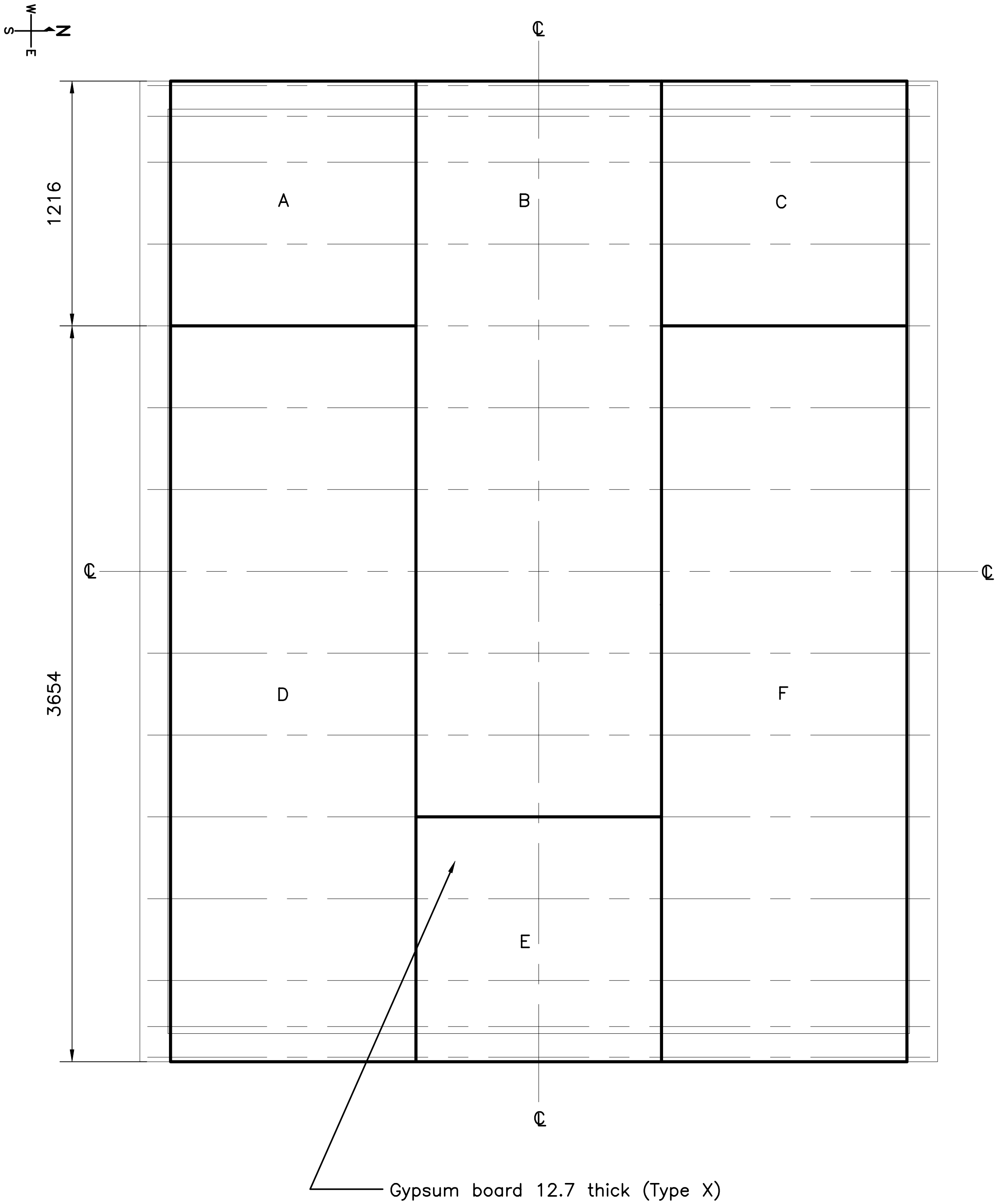
Figure B–51. Subfloor Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-77)

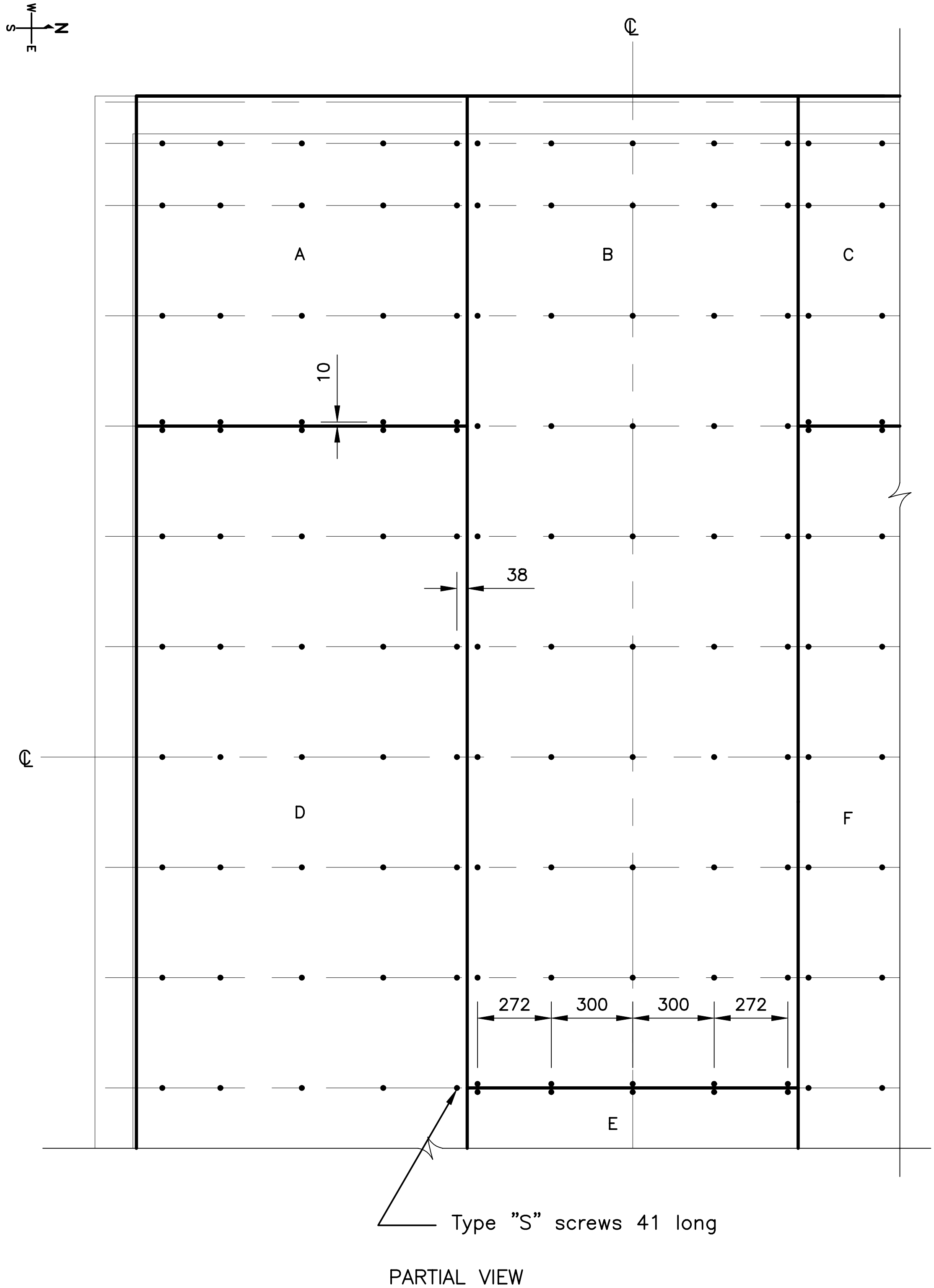
Figure B-52. Subfloor Nail Pattern (Wood I-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–77)

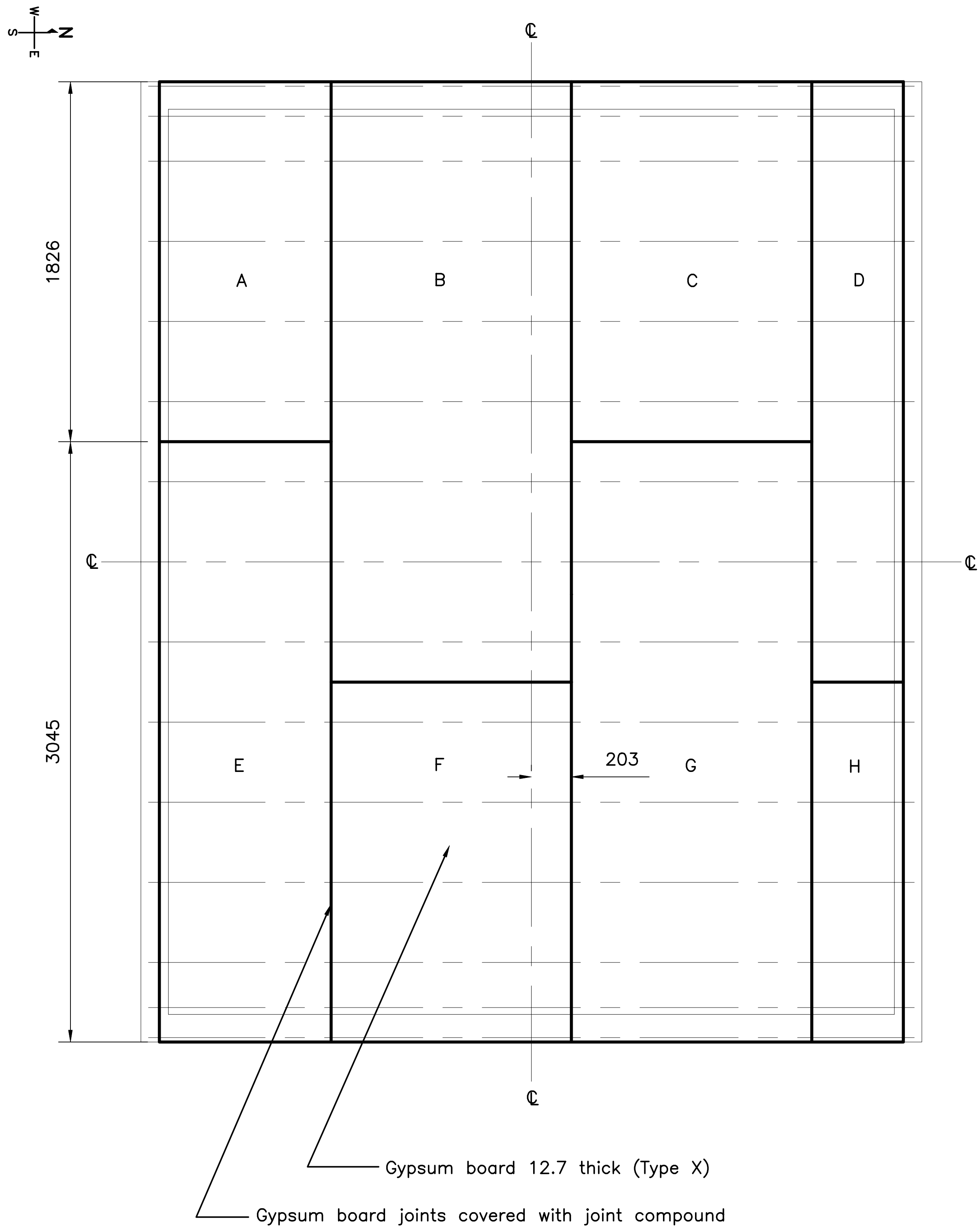
Figure B–53. Gypsum Board Base Layer Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-77)

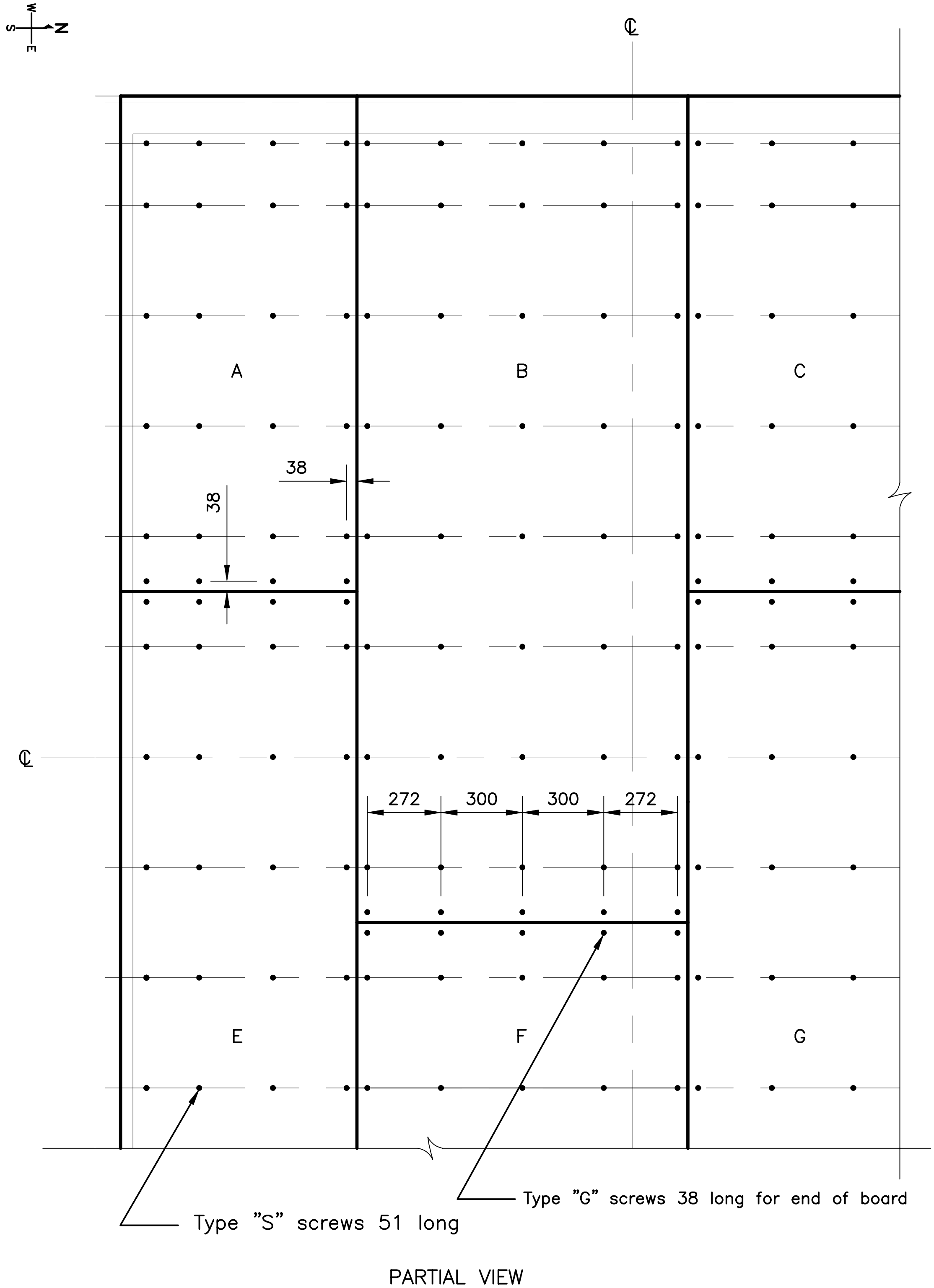
Figure B-54. Gypsum Board Base Layer Screw Pattern (Wood I-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–77)

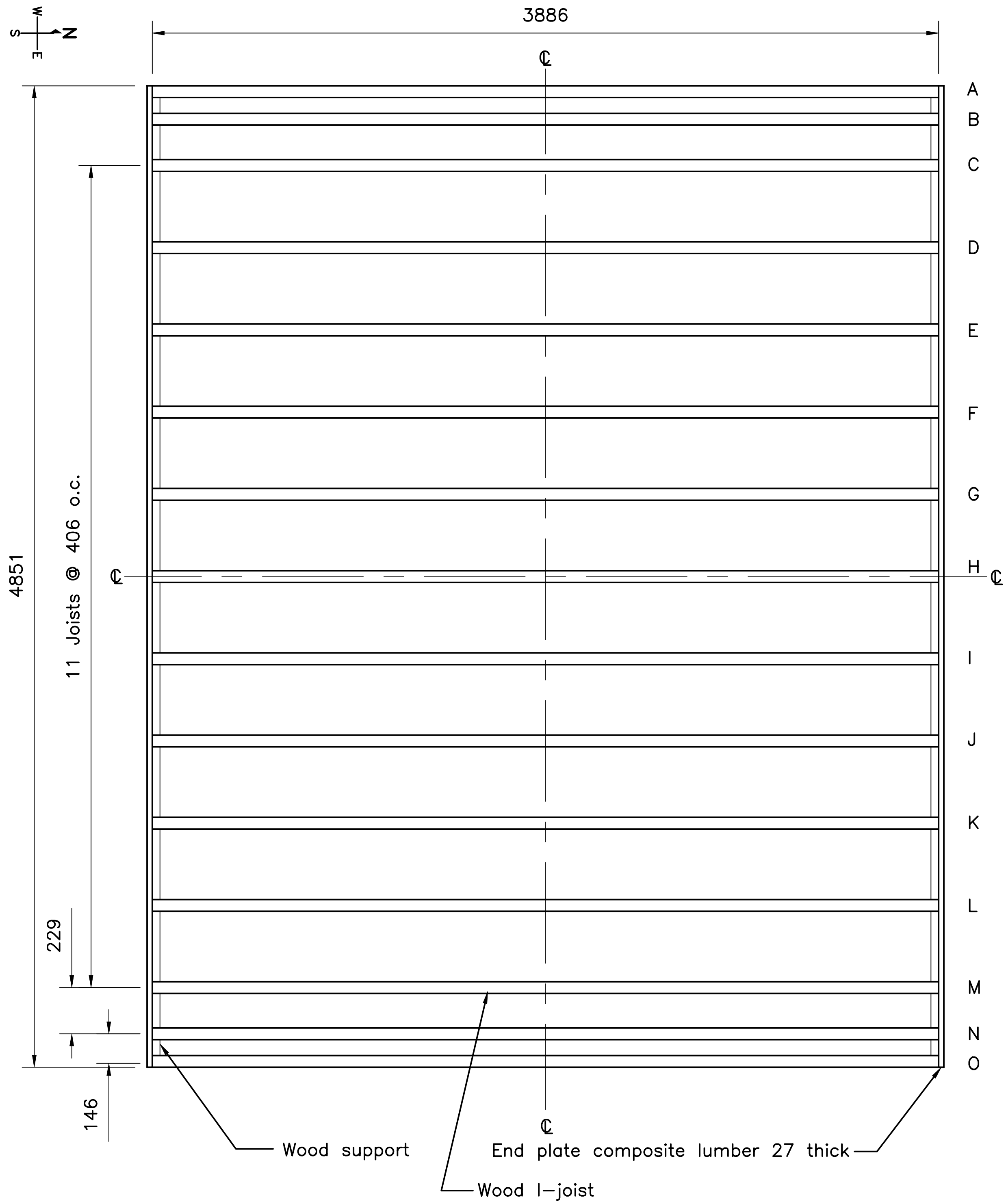
Figure B–55. Gypsum Board Face Layer Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-77)

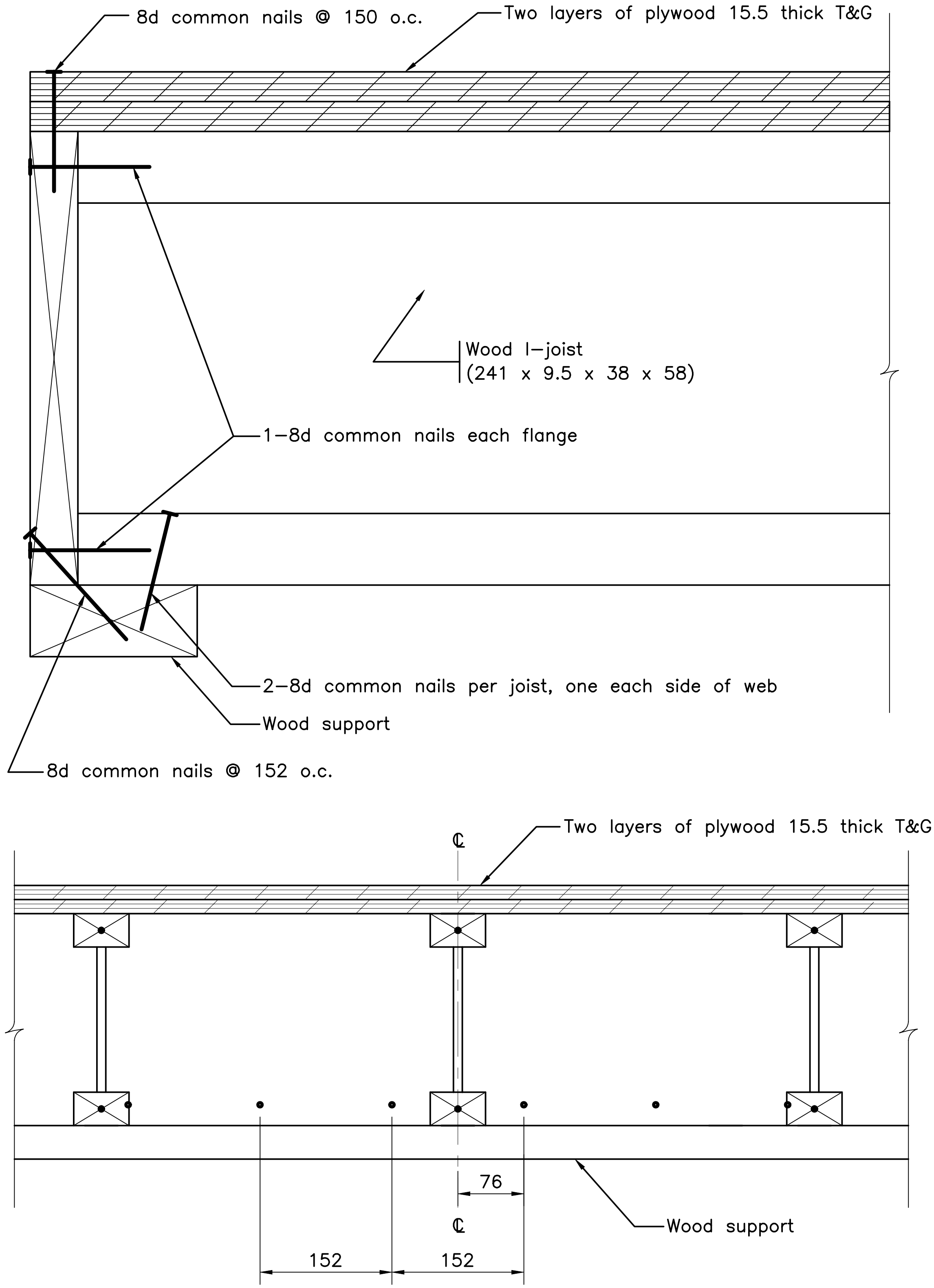
Figure B-56. Gypsum Board Face Layer Screw Pattern (Wood I-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–78)

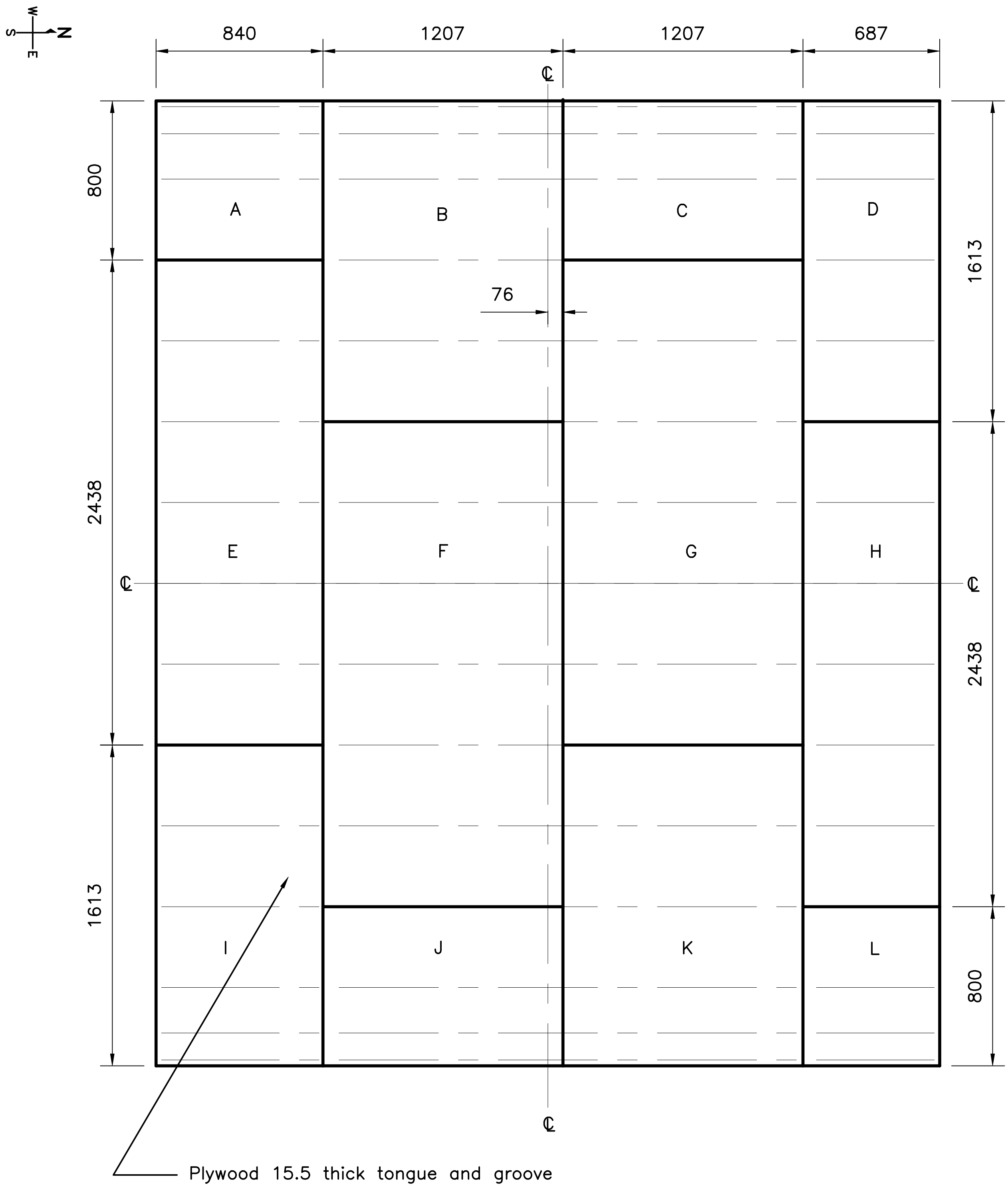
Figure B–57. Joist Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–78)

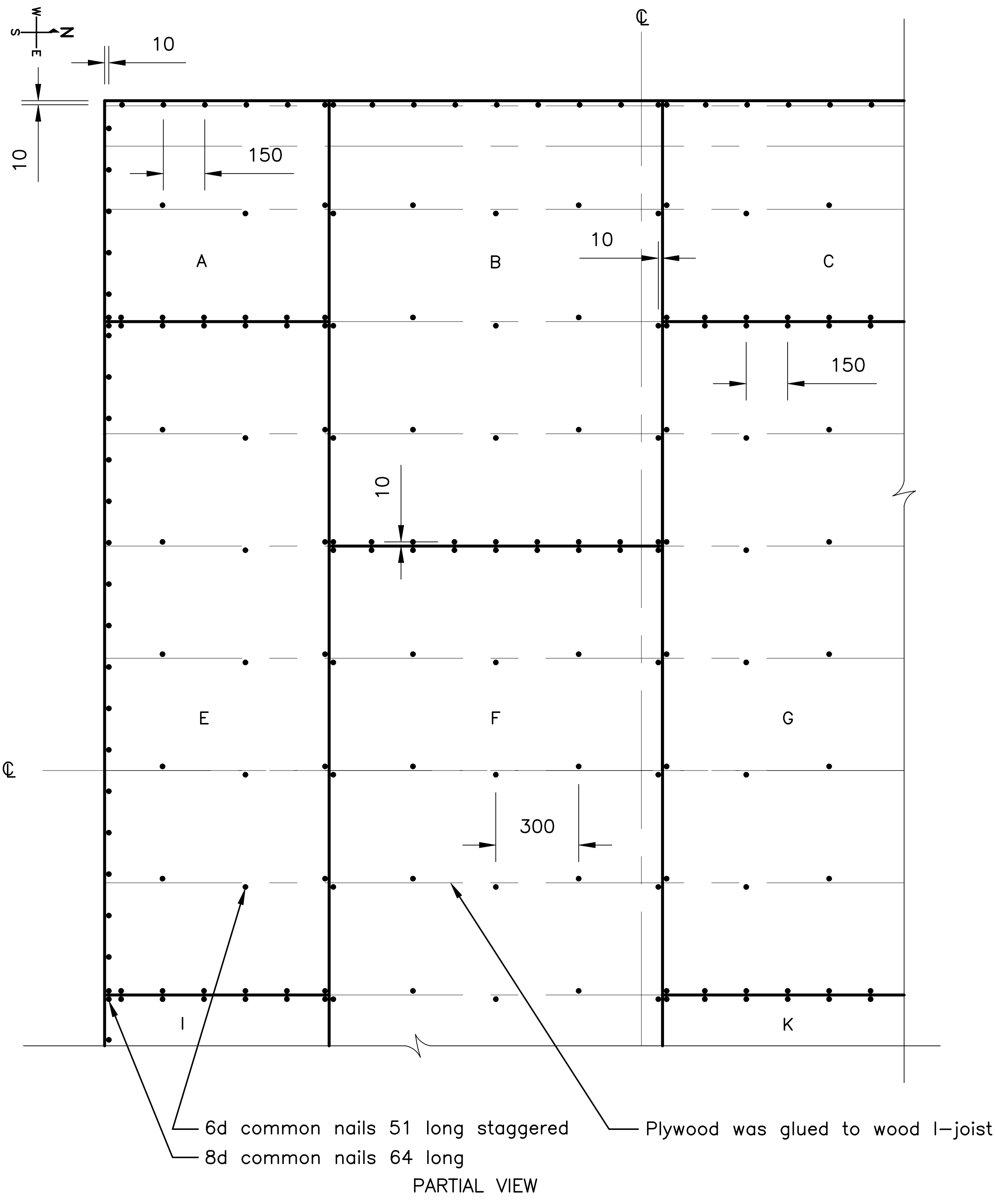
Figure B–58. Wood I–Joist End Connection Detail (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–78)

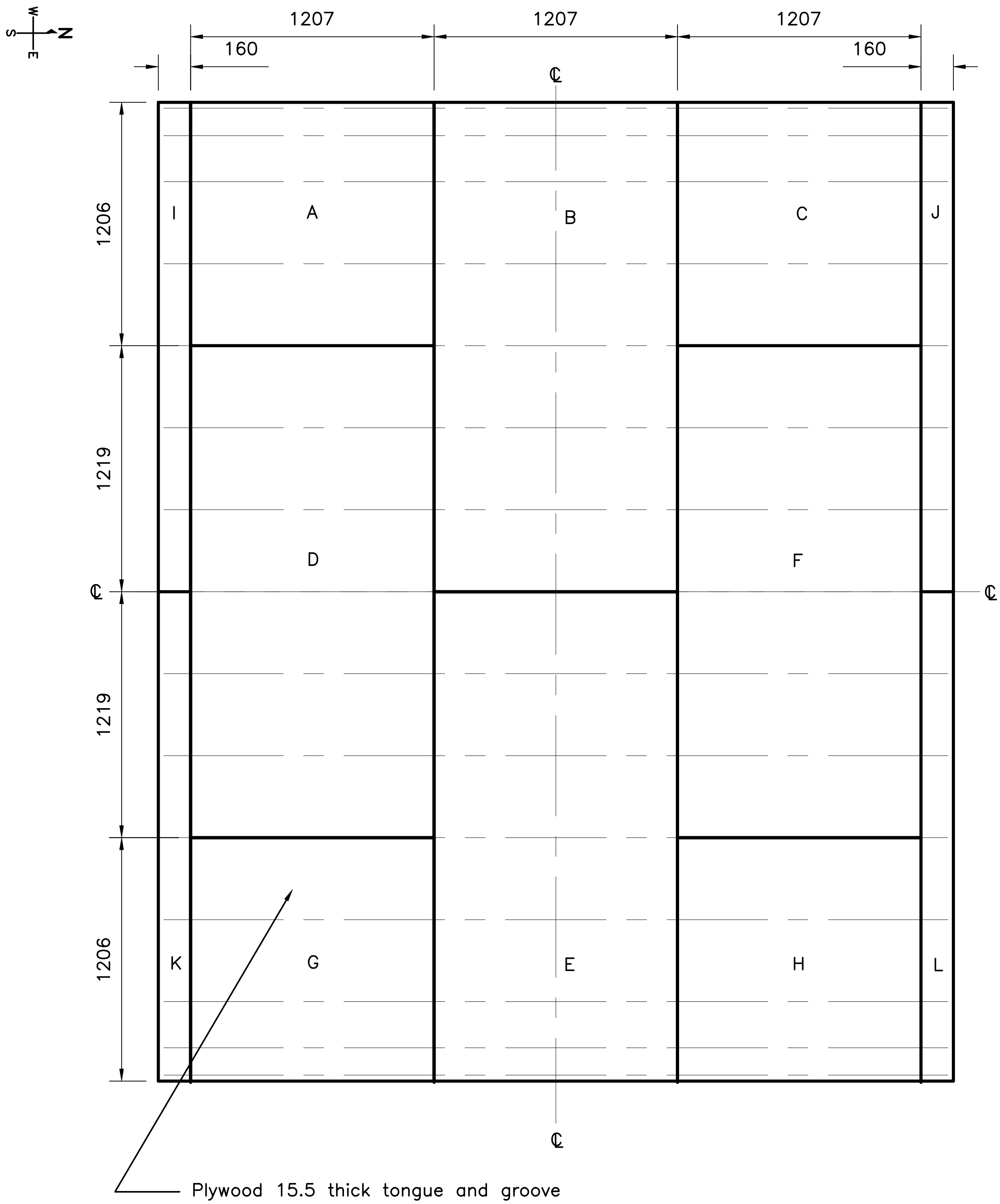
Figure B–59. Subfloor Layout Base Layer (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–78)

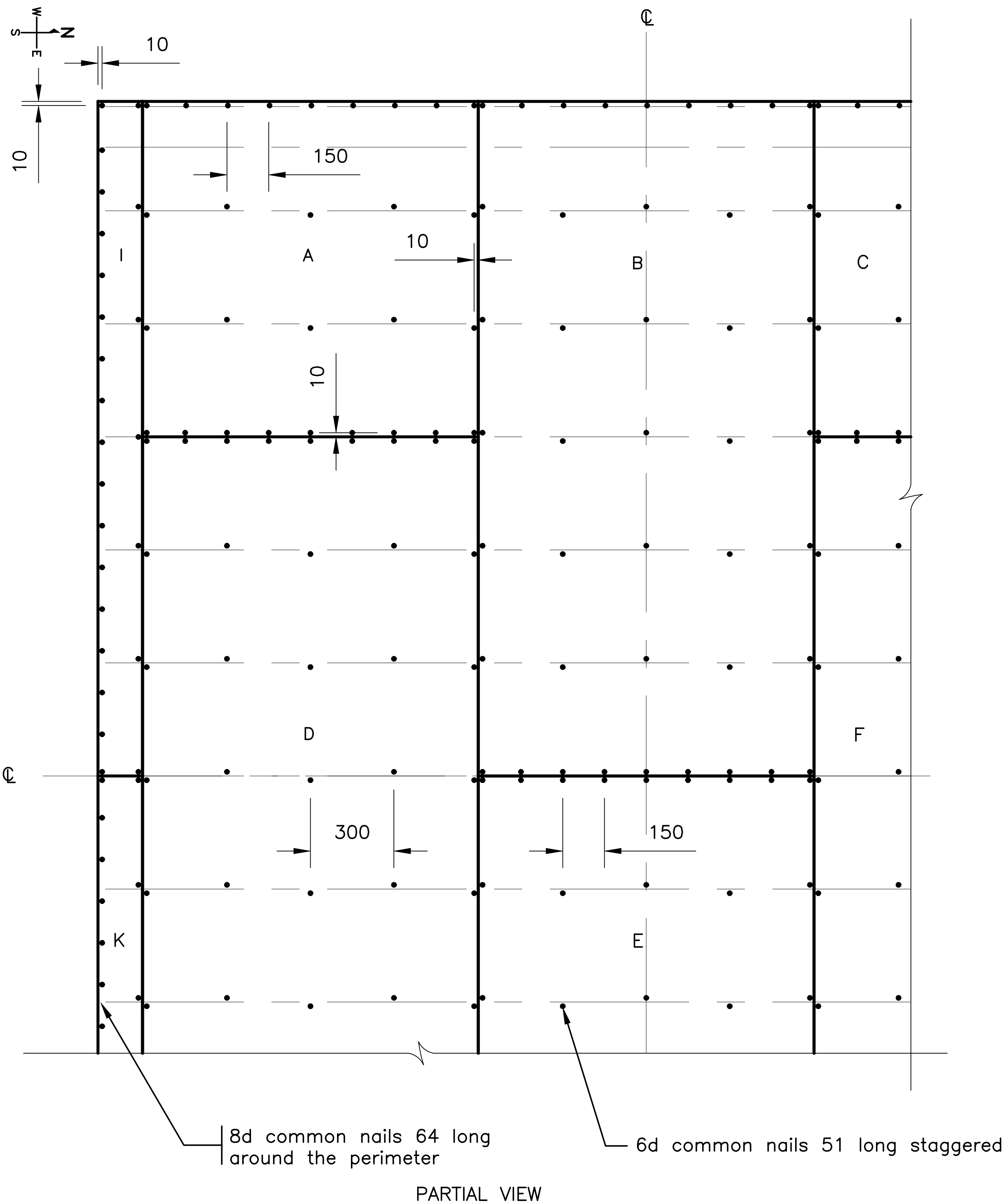
Figure B–60. Subfloor Nail Pattern Base Layer (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–78)

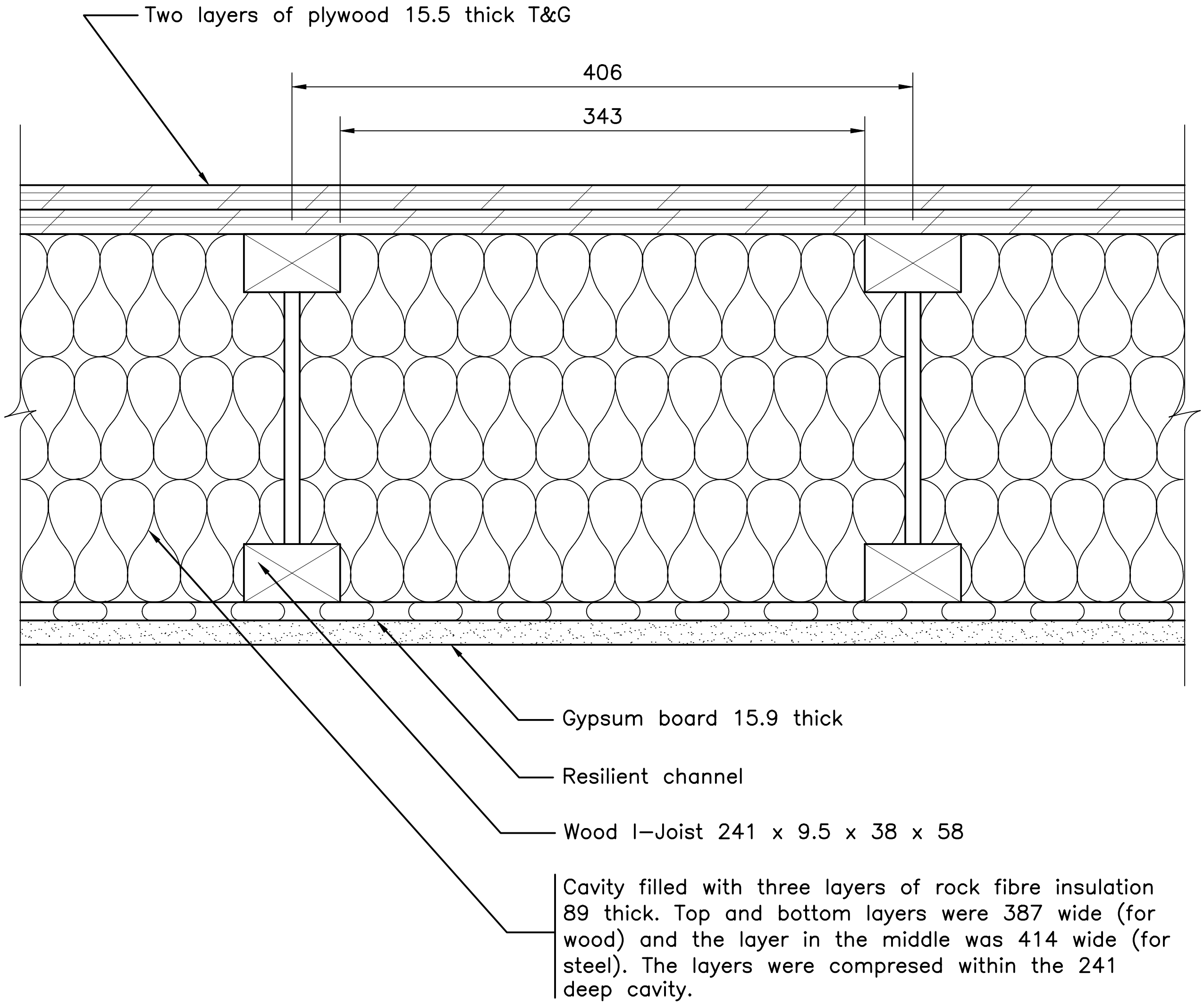
Figure B–61. Subfloor Layout Face Layer (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–78)

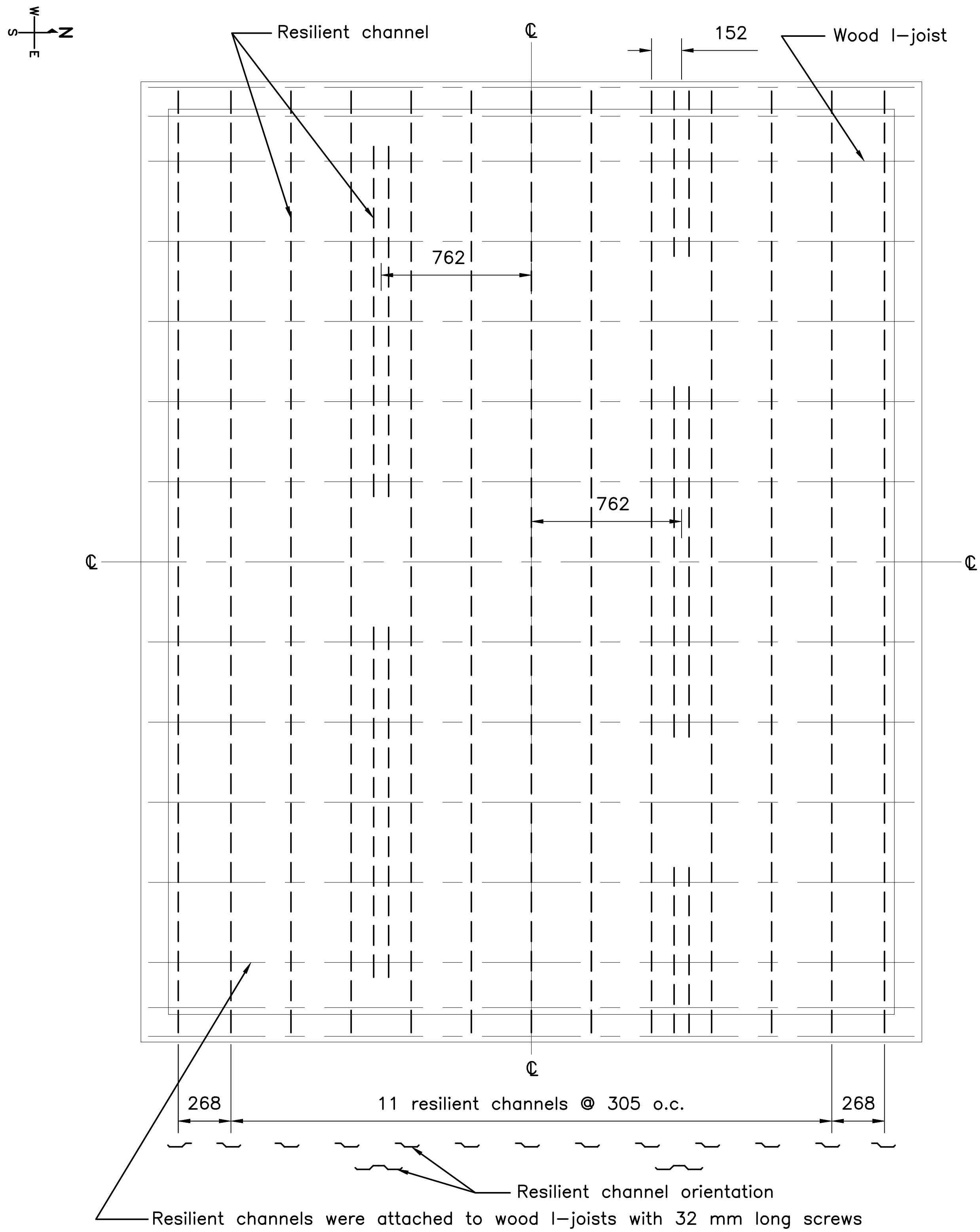
Figure B–62. Subfloor Nail Pattern Face Layer (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–78)

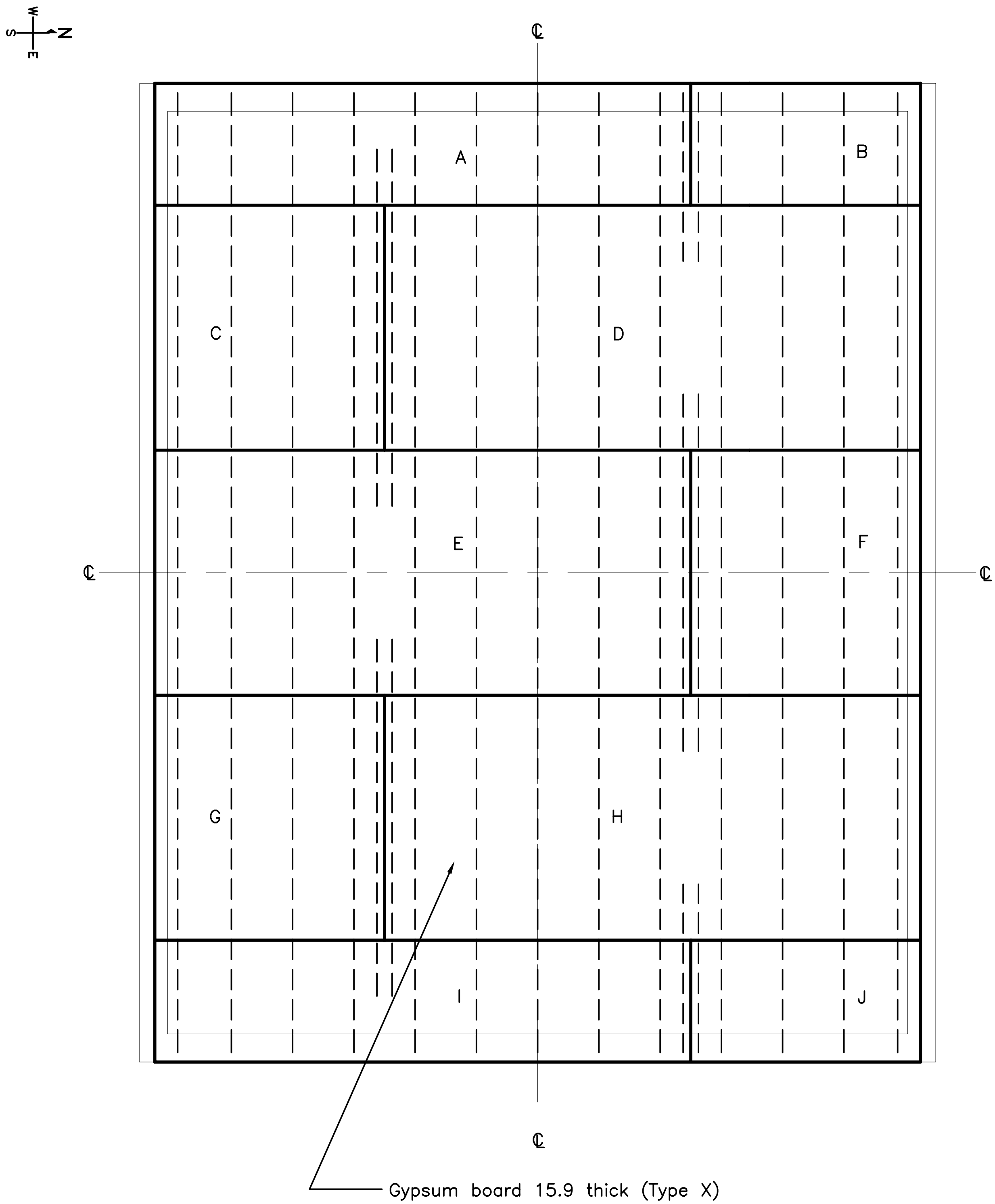
Figure B–63. Insulation Location (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–78)

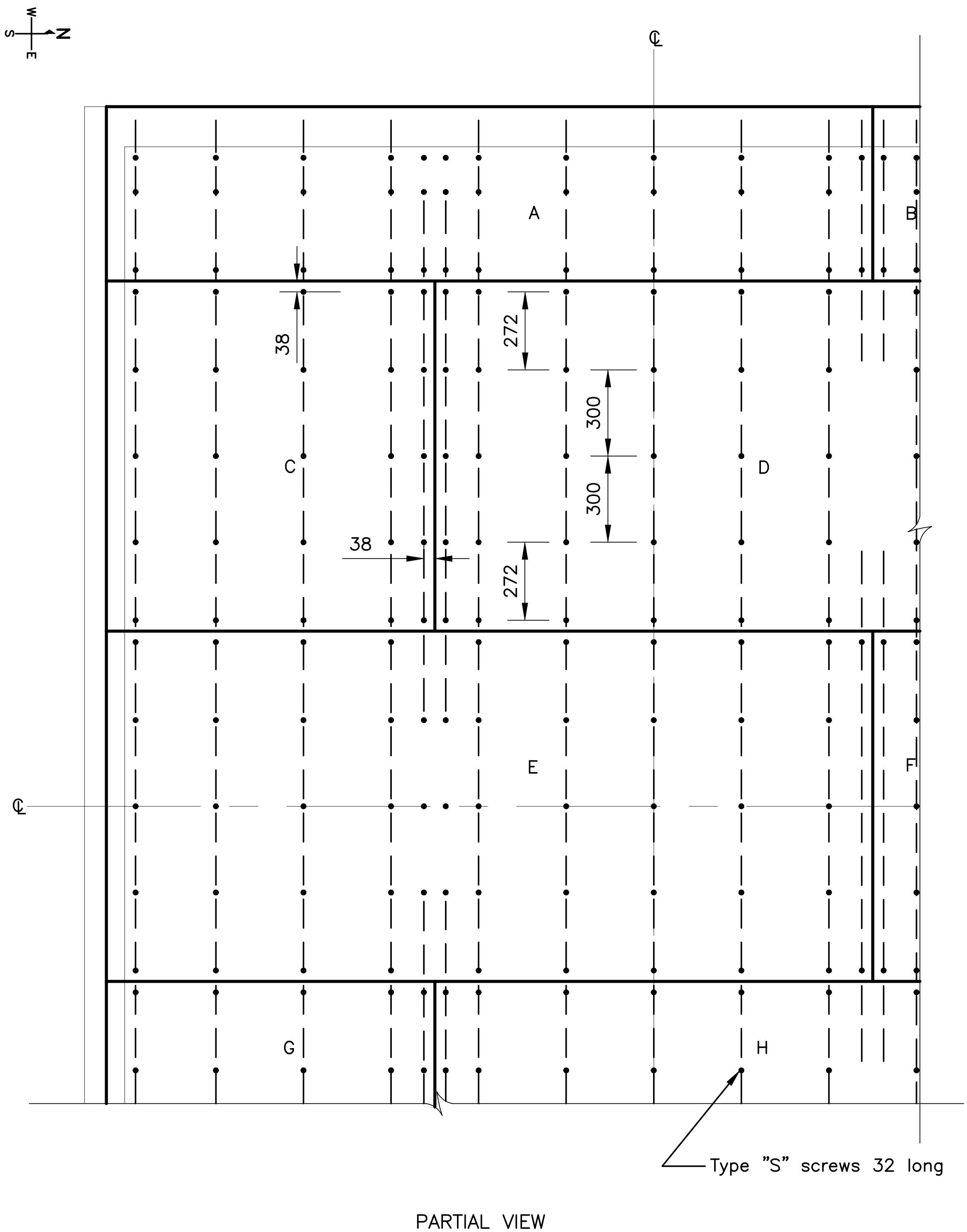
Figure B–64. Resilient Channel Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–78)

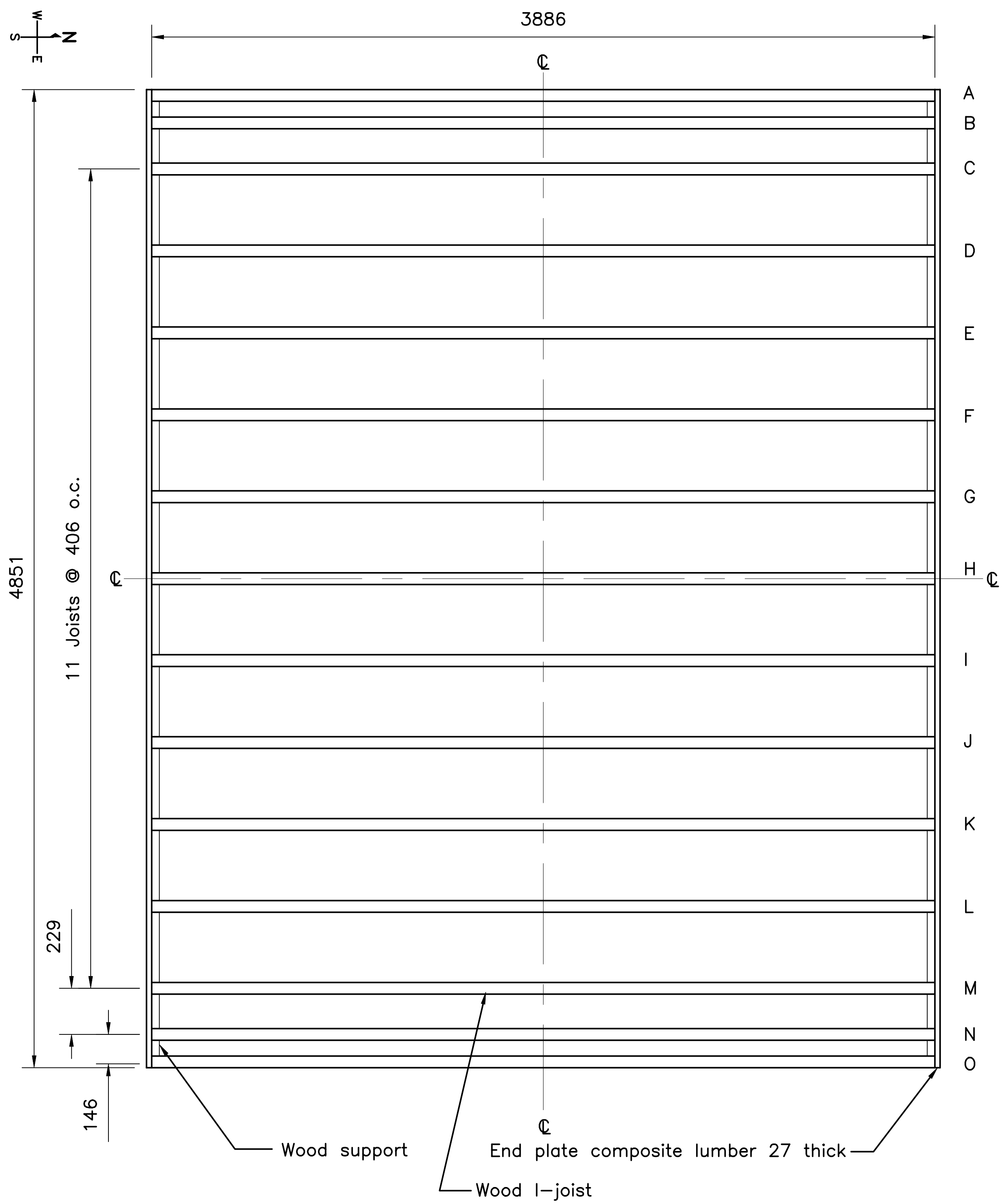
Figure B–65. Gypsum Board Single Layer Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–78)

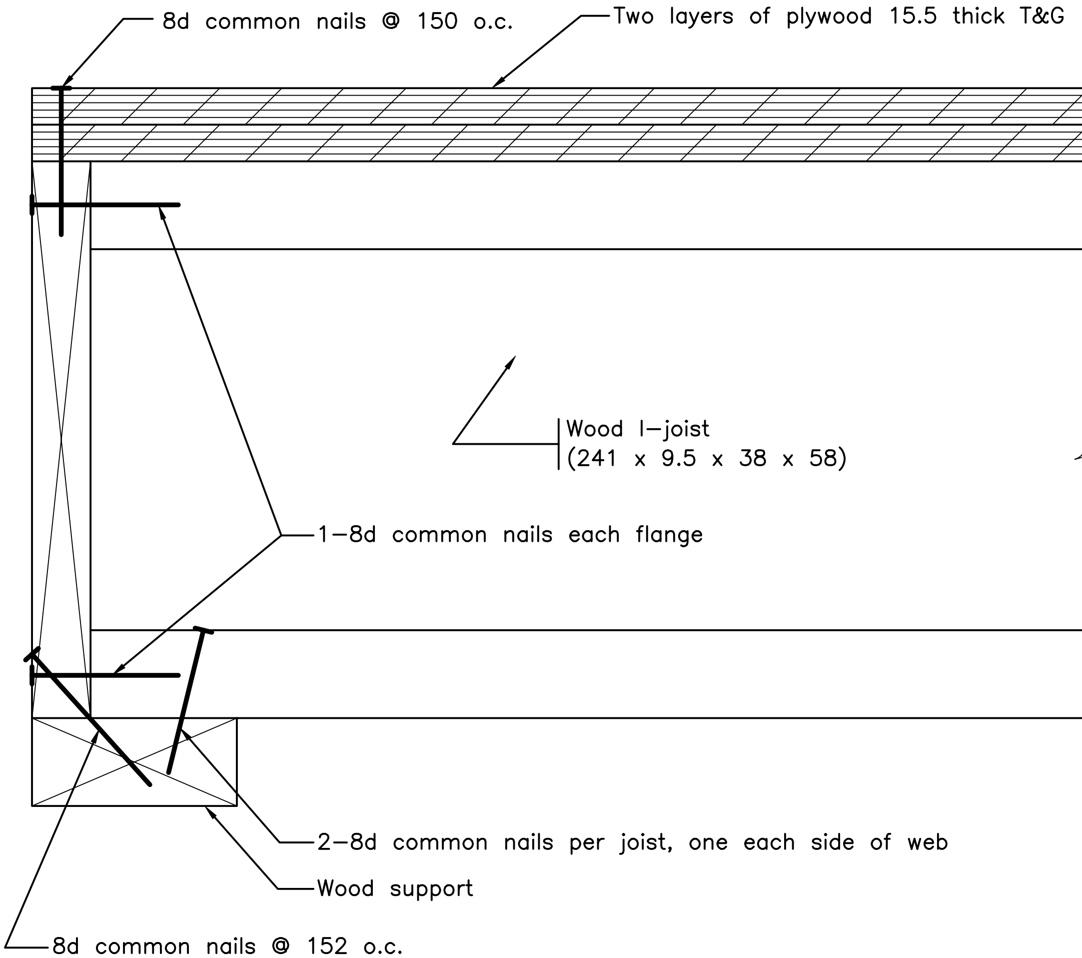
Figure B–66. Gypsum Board Single Layer Screw Pattern (Wood I–Joist)

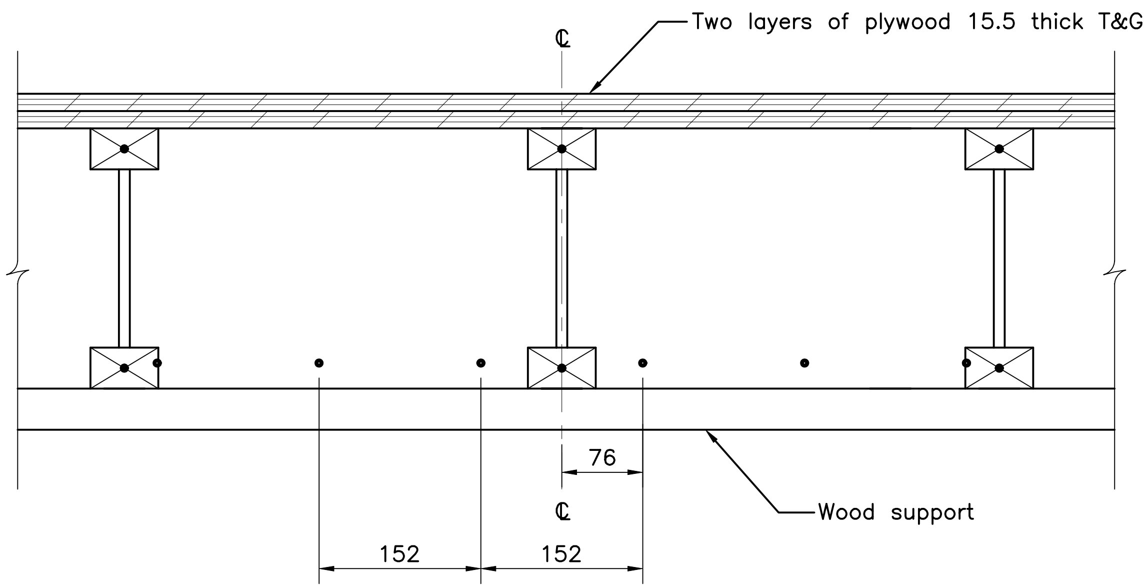


(Dimensions are in millimetres)

(Assembly No. FF–81)

Figure B–67. Joist Layout (Wood I–Joist)

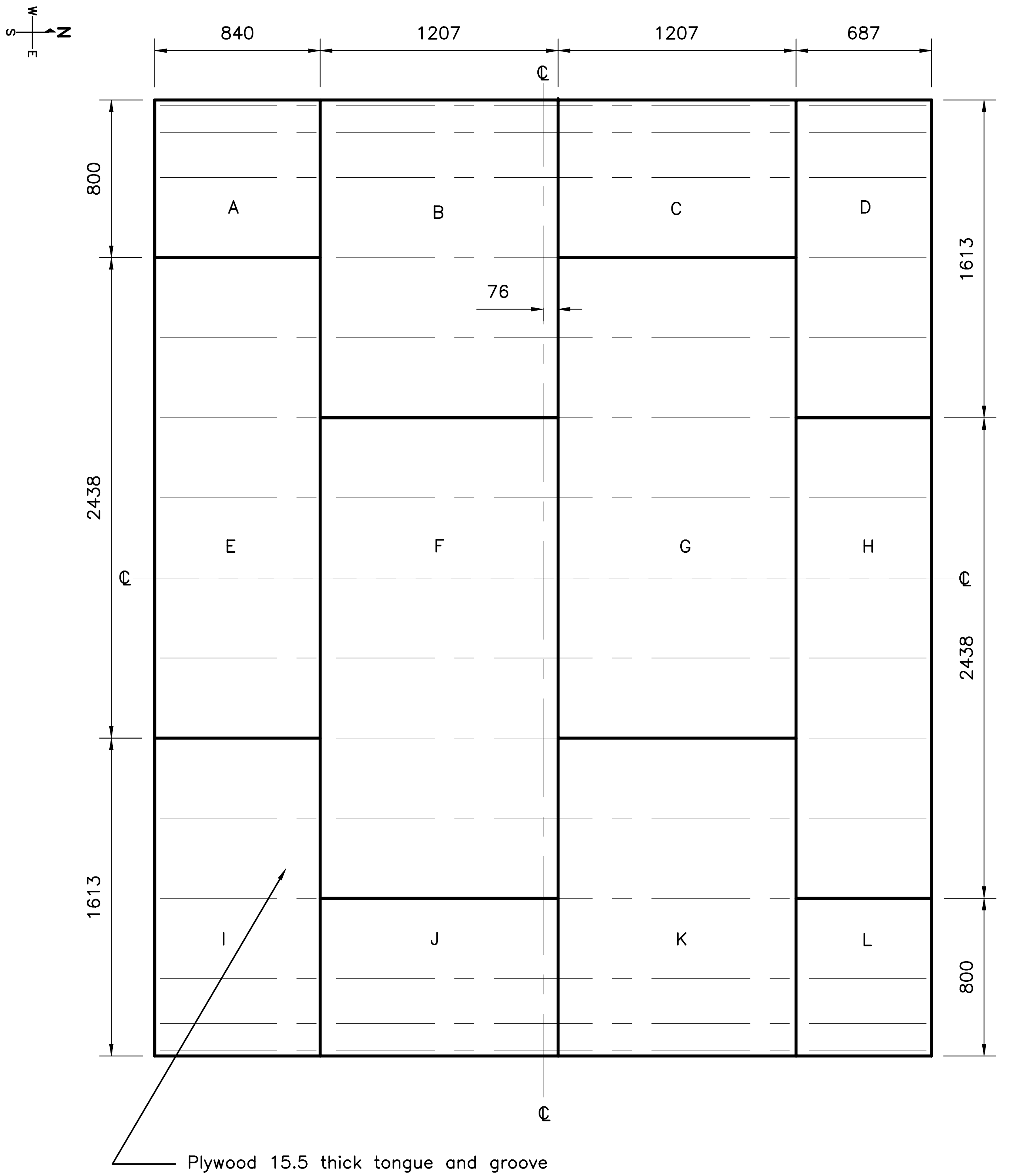




(Dimensions are in millimetres)

(Assembly No. FF-81)

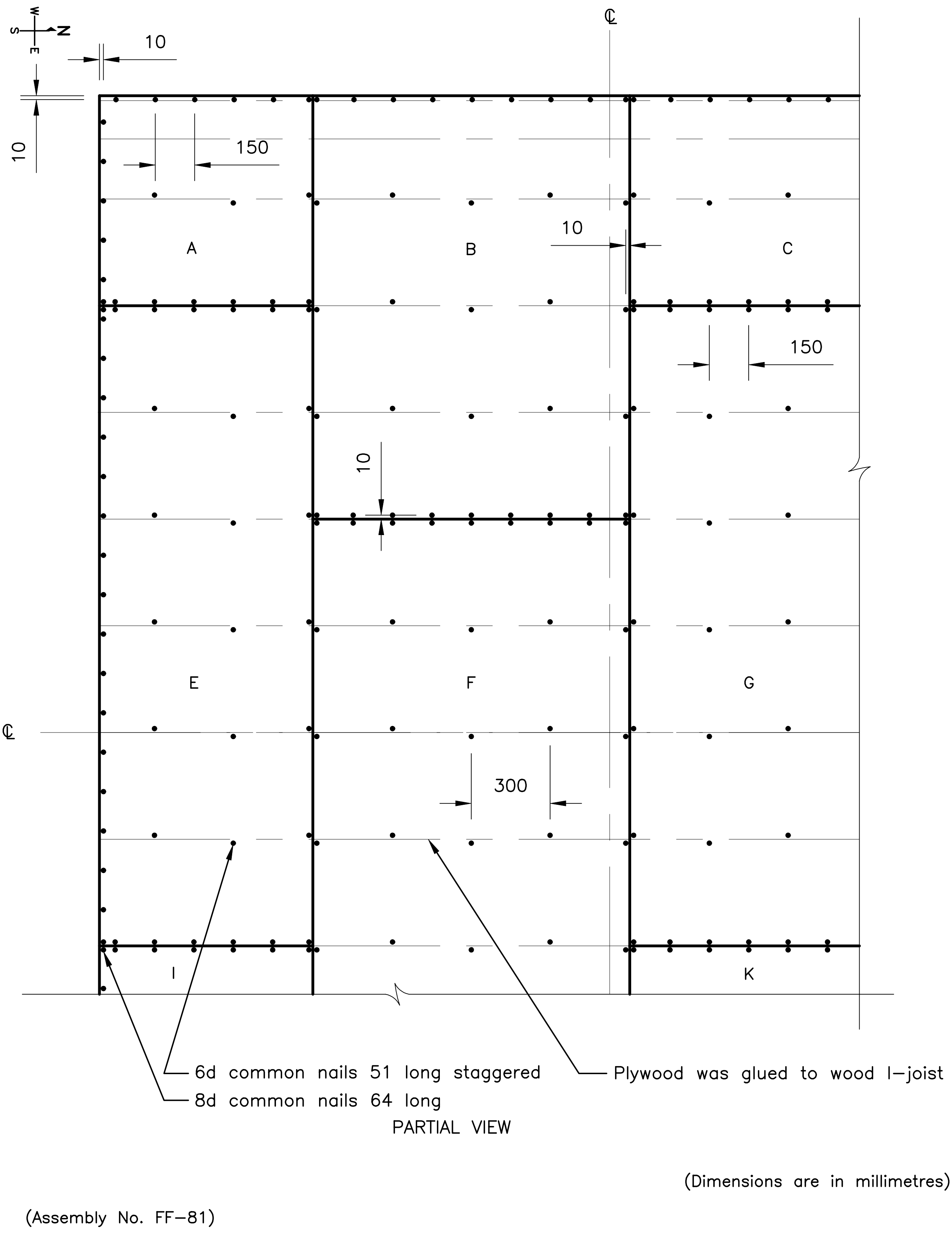
Figure B-68. Wood I-Joist End Connection Detail (Wood I-Joist)



(Dimensions are in millimetres)

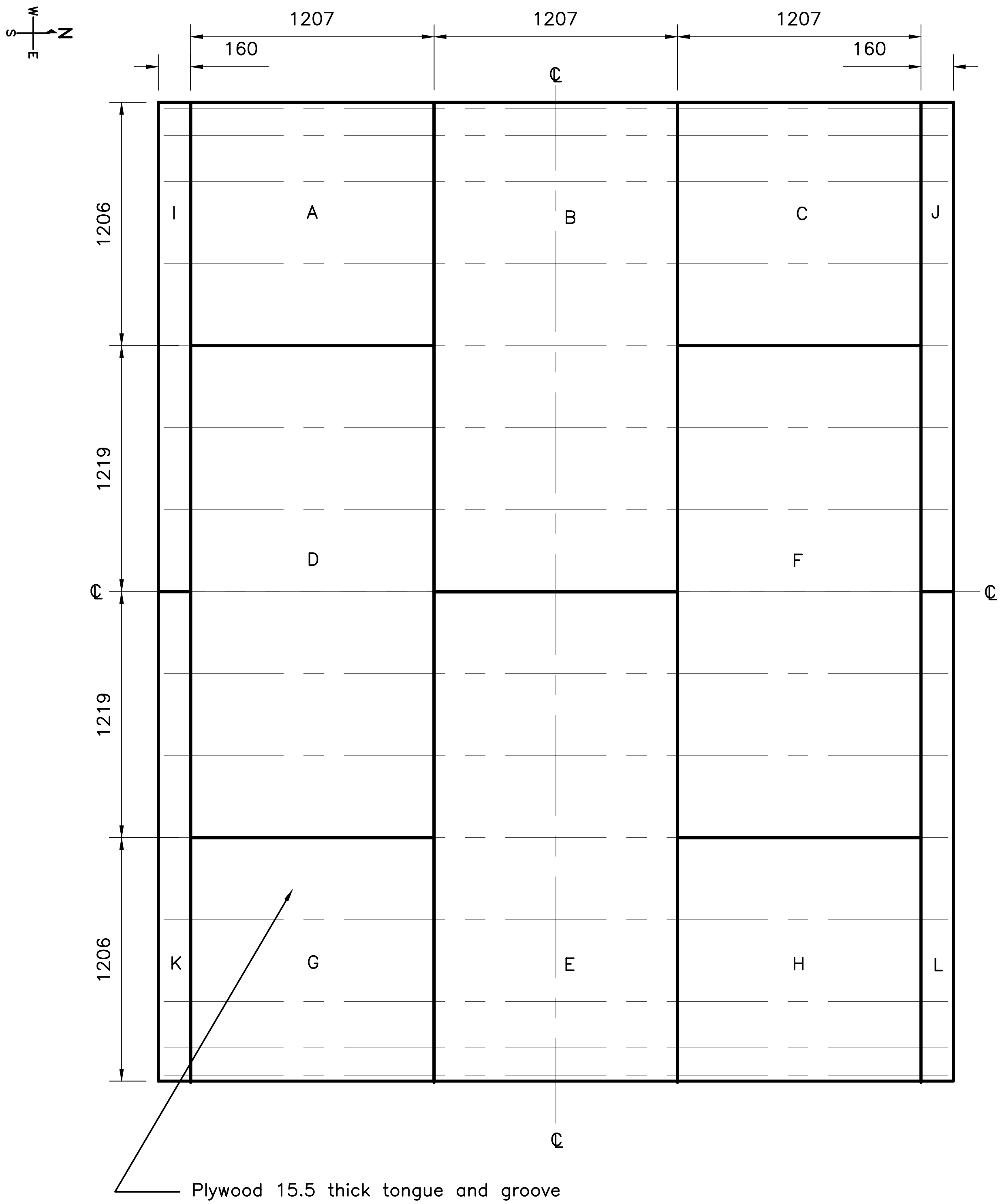
(Assembly No. FF–81)

Figure B–69. Subfloor Layout Base Layer (Wood I–Joist)



(Assembly No. FF–81)

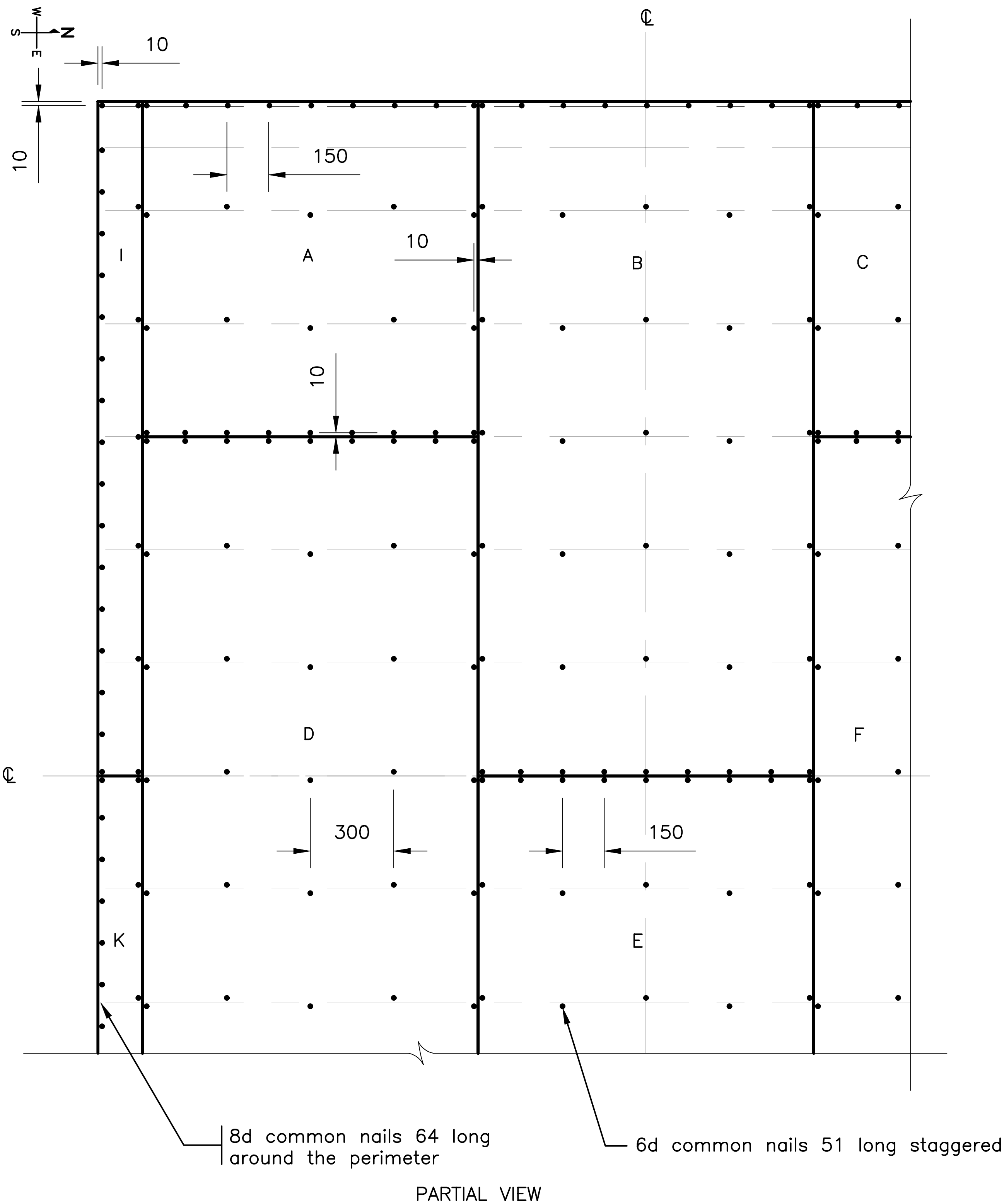
Figure B–70. Subfloor Nail Pattern Base Layer (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–81)

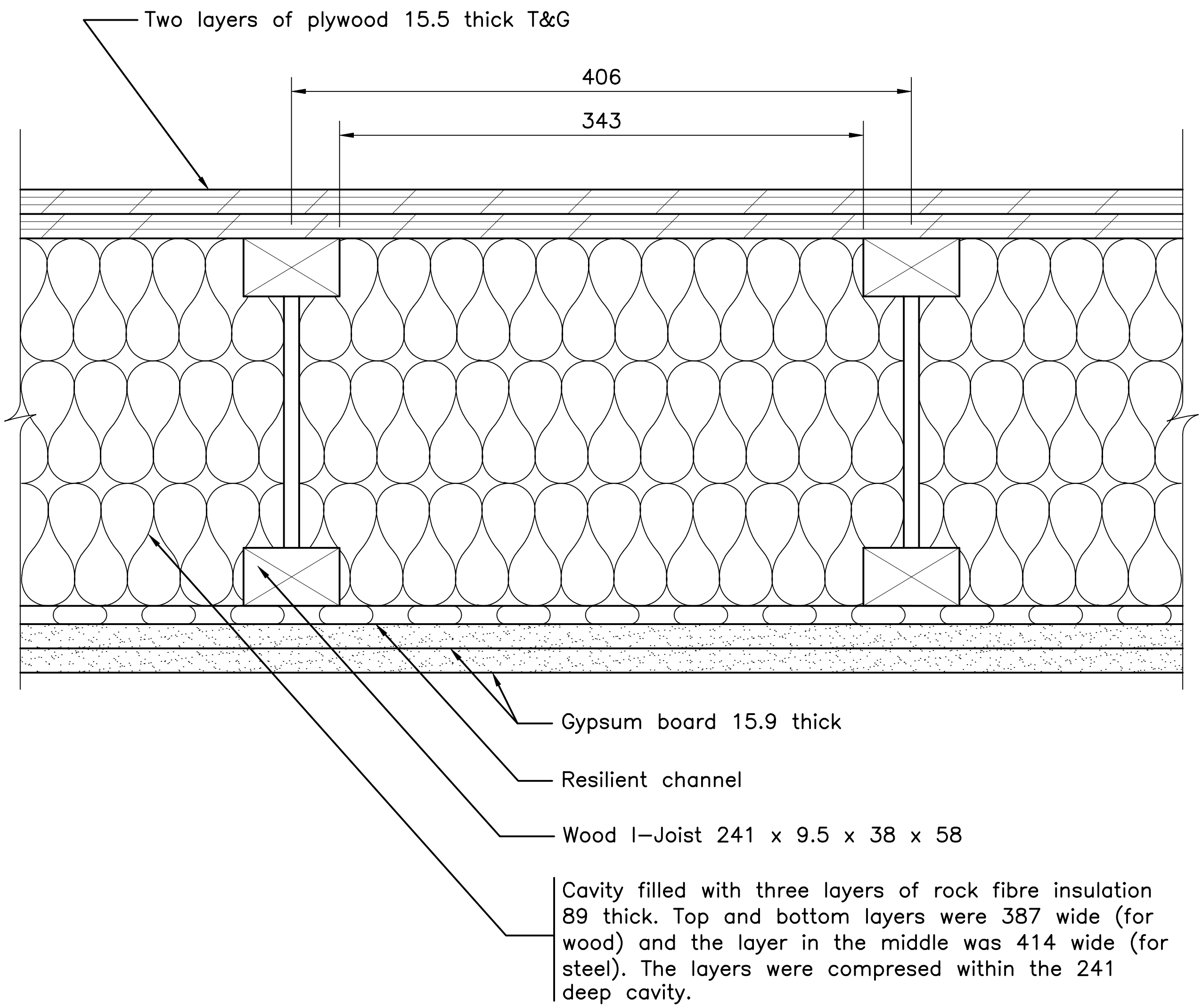
Figure B–71. Subfloor Layout Face Layer (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–81)

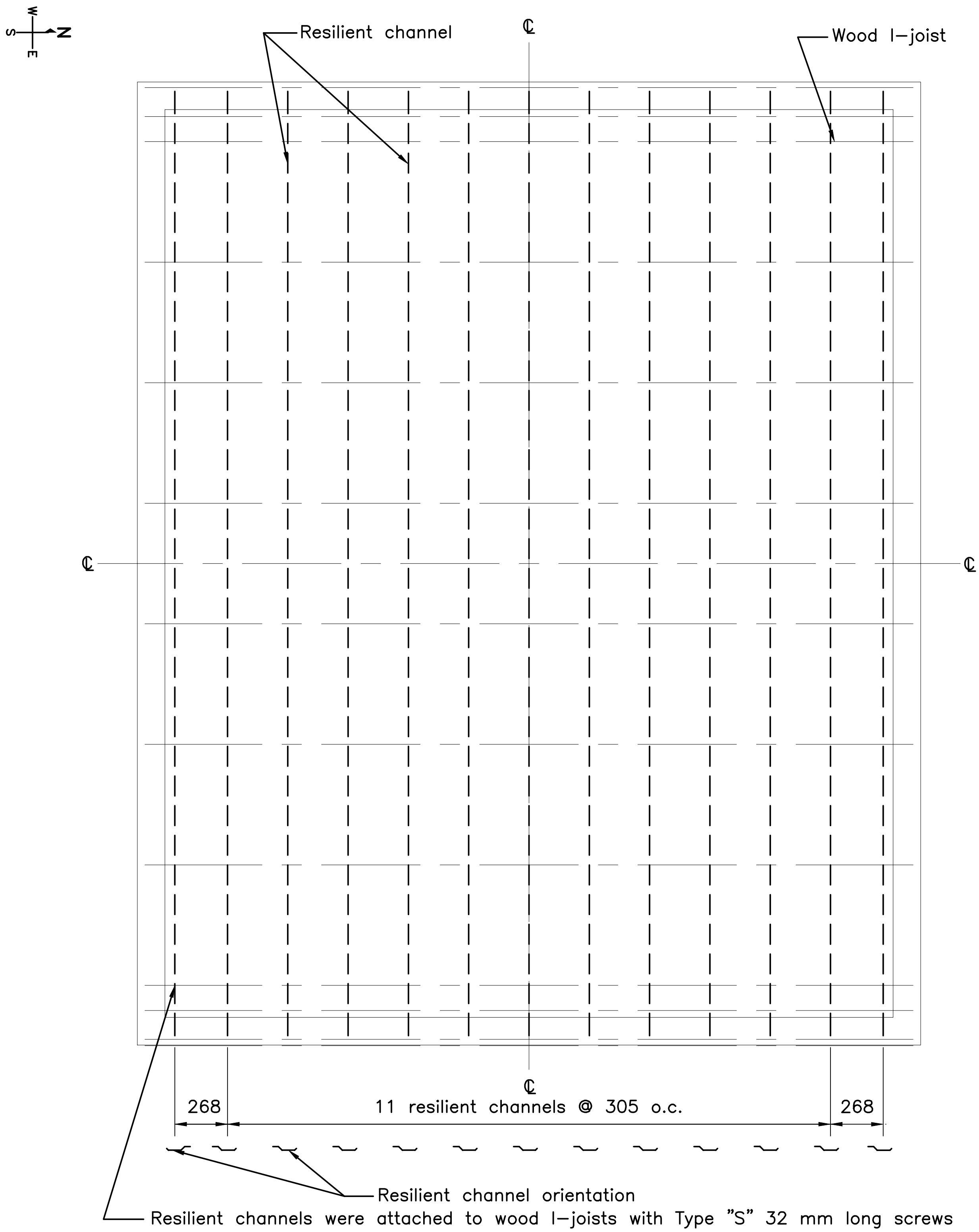
Figure B–72. Subfloor Nail Pattern Face Layer (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF—81)

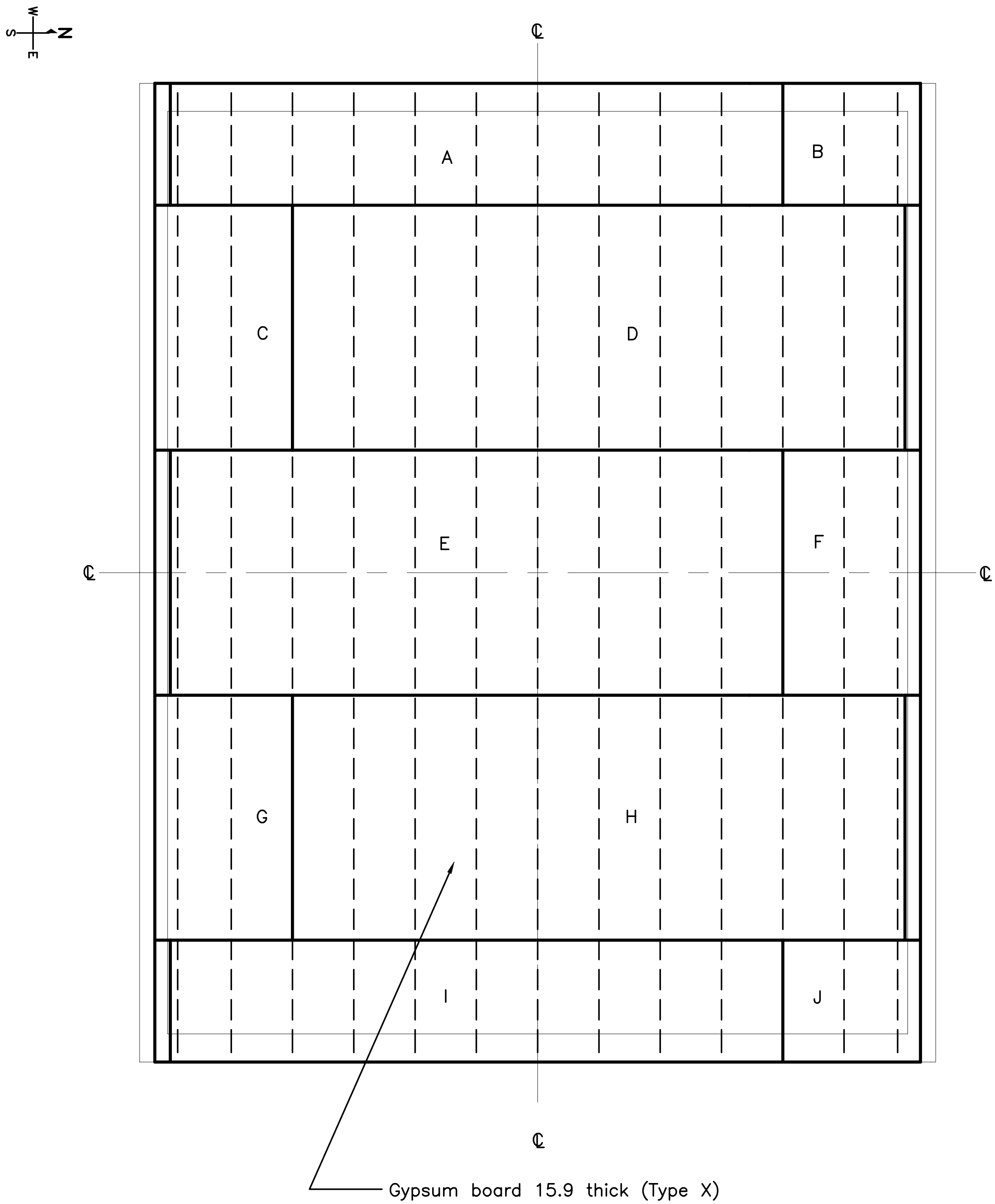
Figure B—73. Insulation Location (Wood I—Joist)



(Dimensions are in millimetres)

(Assembly No. FF–81)

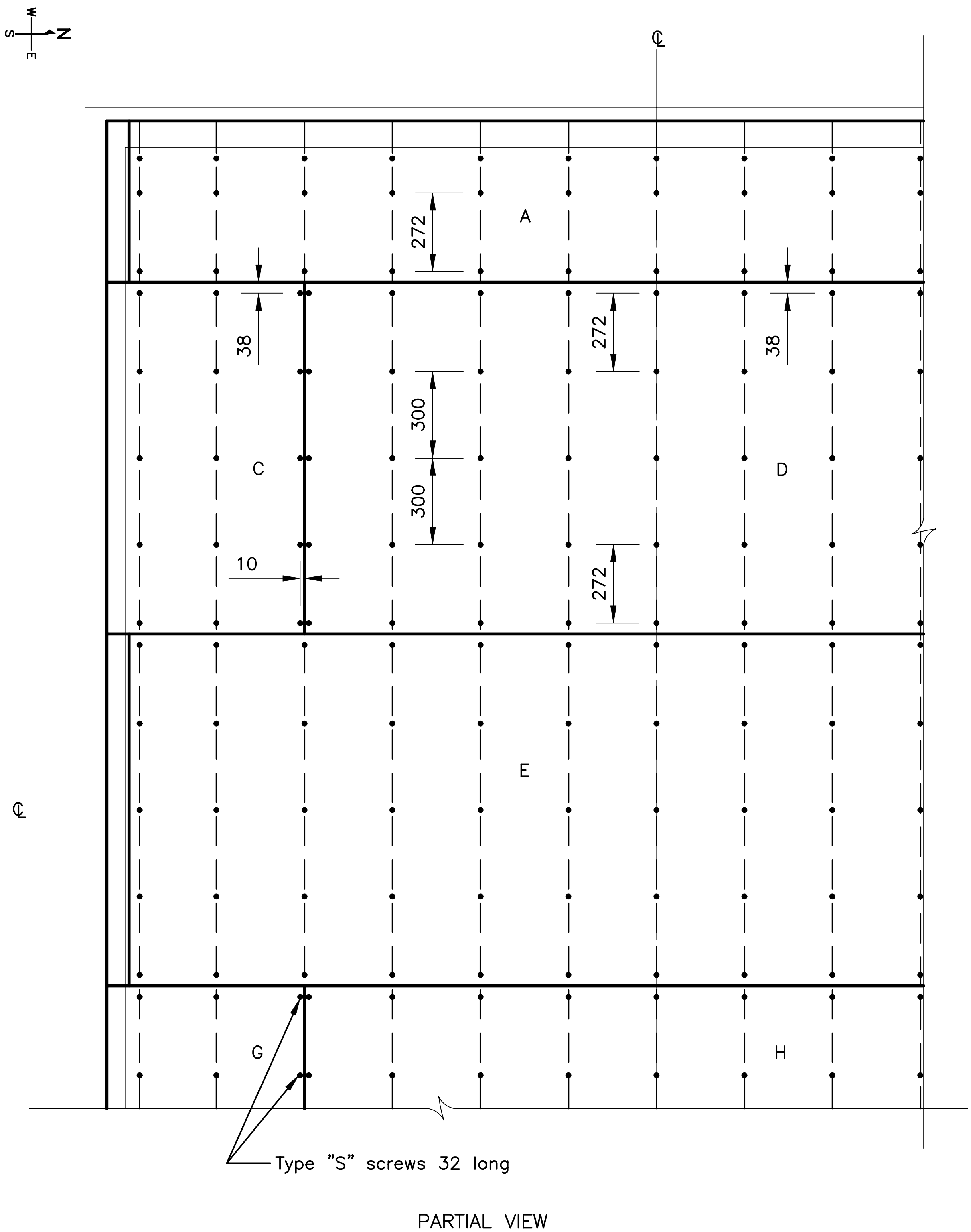
Figure B–74. Resilient Channel Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–81)

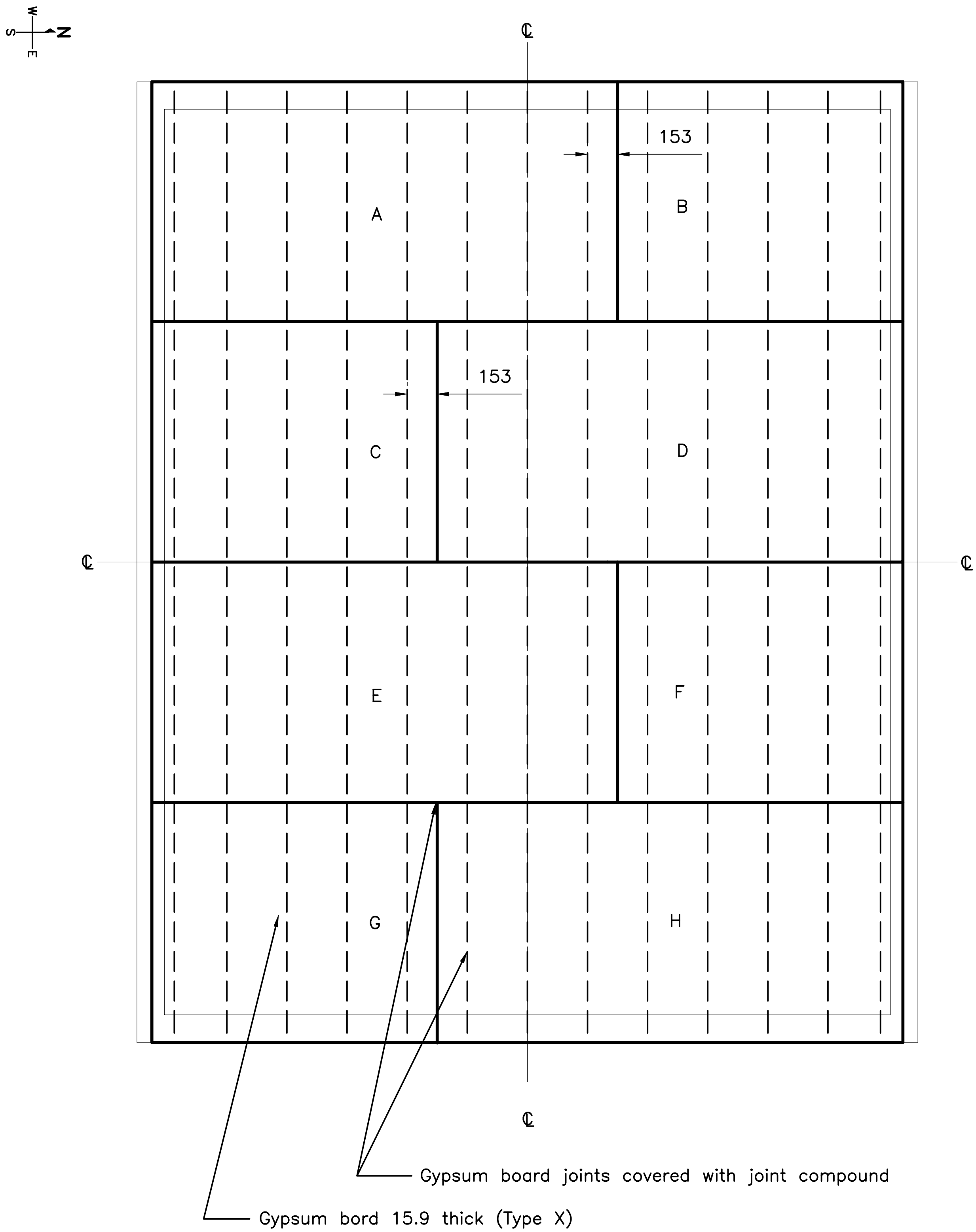
Figure B–75. Gypsum Board Base Layer Layout (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–81)

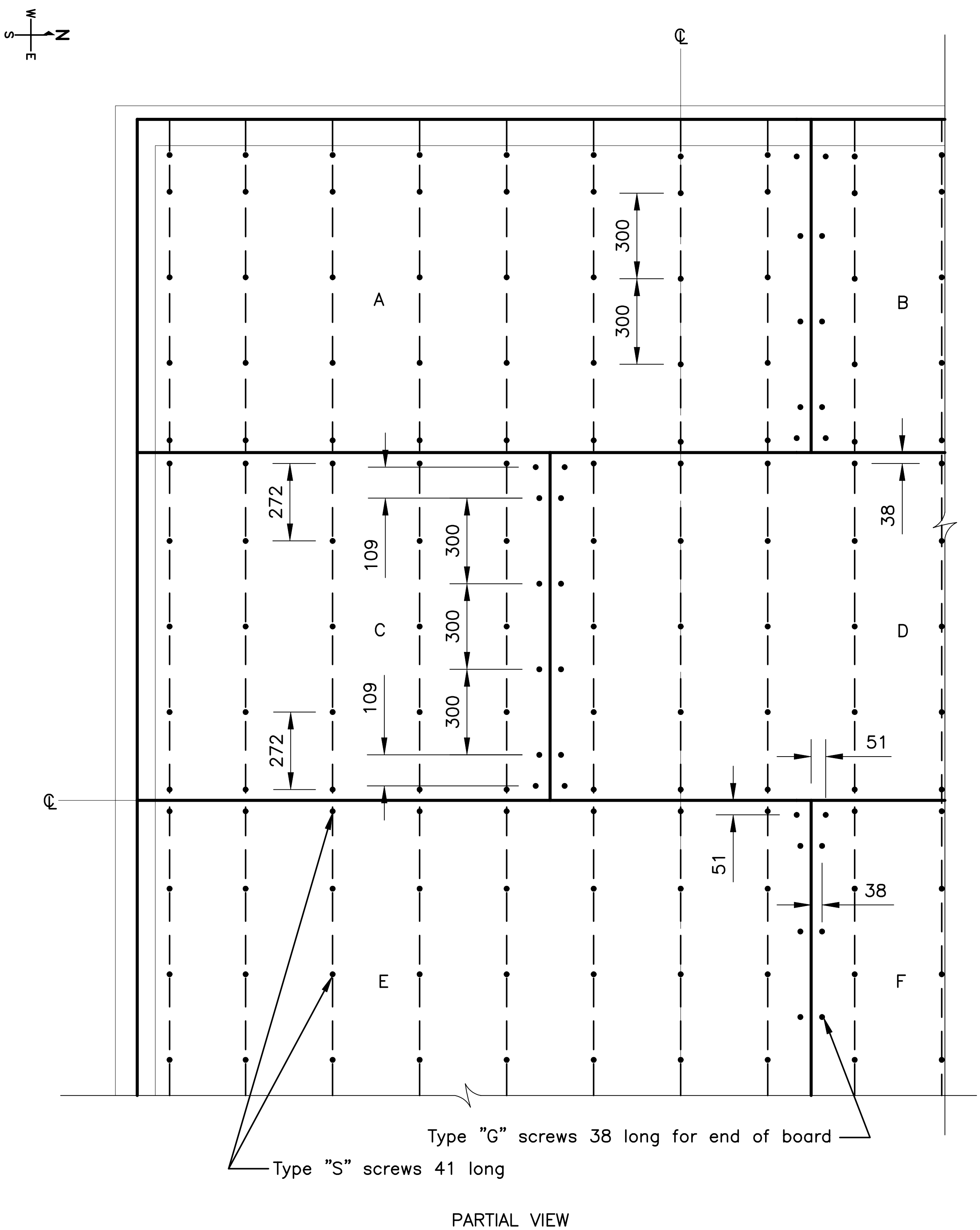
Figure B–76. Gypsum Board Base Layer Screw Pattern (Wood I–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–81)

Figure B–77. Gypsum Board Face Layer Layout (Wood I–Joist)



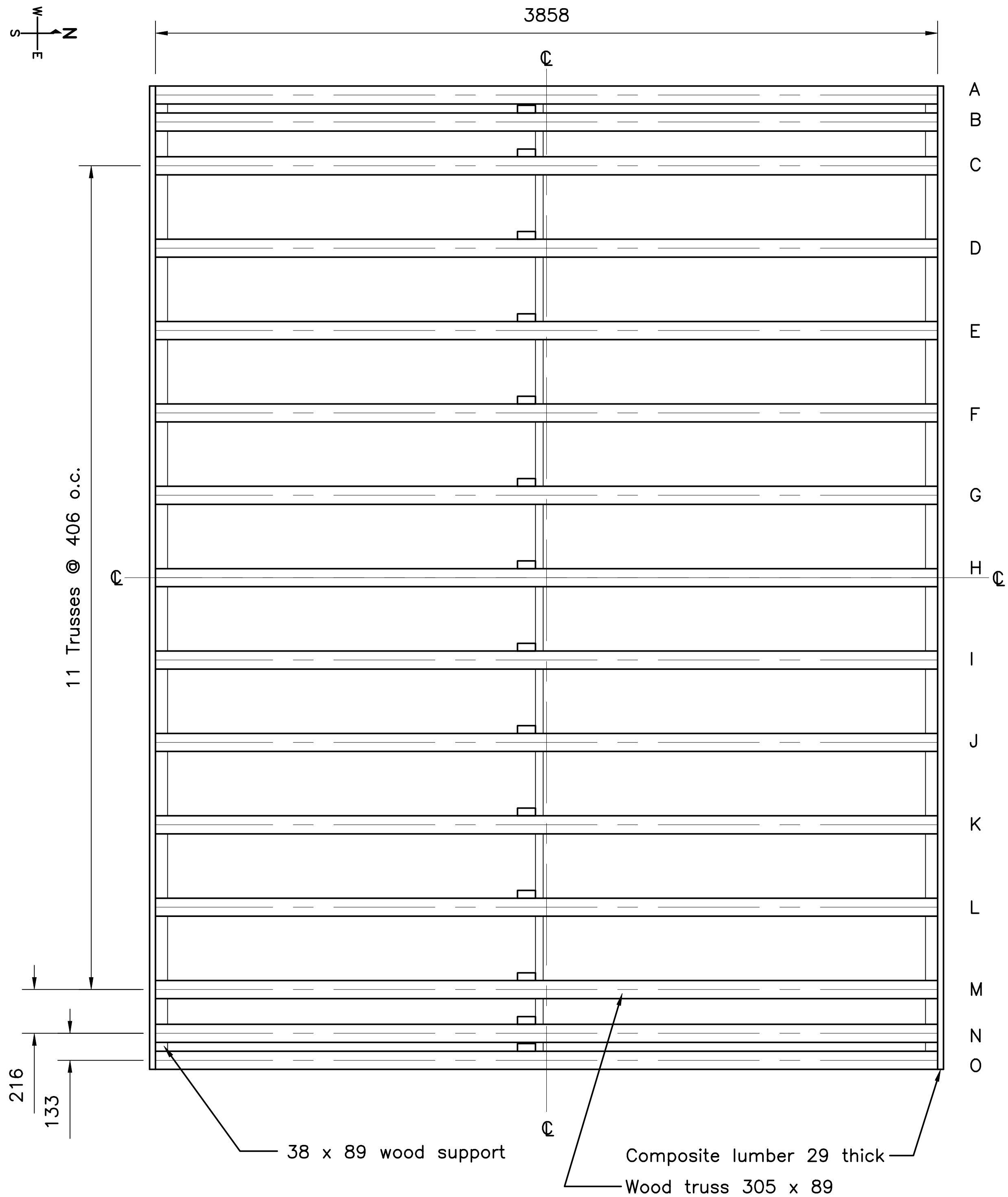
(Dimensions are in millimetres)

(Assembly No. FF-81)

Figure B-78. Gypsum Board Face Layer Screw Pattern (Wood I-Joist)

Appendix C

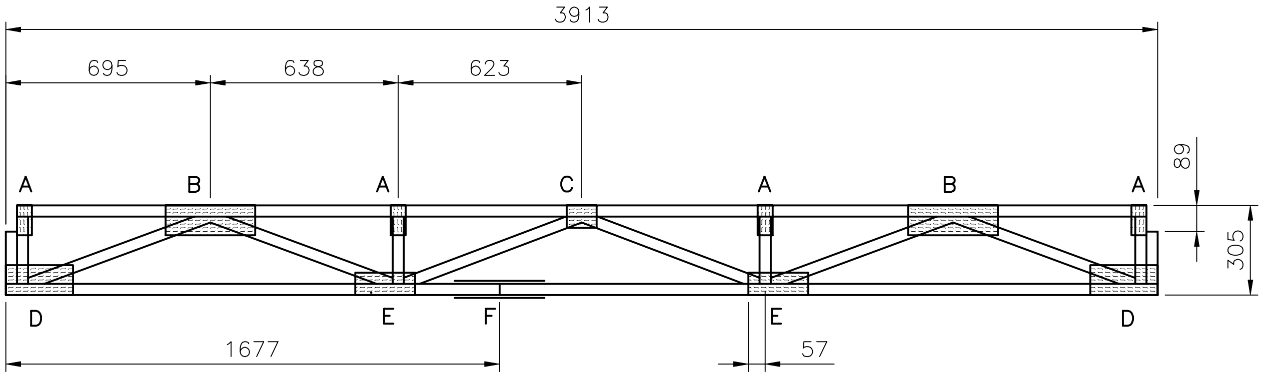
Design details for wood truss floor assemblies



(Dimensions are in millimetres)

(Assembly No. FF-41)

Figure C-1. Truss Layout (Wood Truss)



Truss members:
Truss members are made of solid wood lumber 38 x 89 Spruce–Pine–Fir #2 S–DRY O.L.M.A.® 152

Plates:
TEE–LOK 20 plates 0.9 mm thick with 8 long teeth.
The number of teeth on the plate = plate area in mm² ÷ 80.645
All plates are centered in the middle of the joint except plates E, see drawing for details

Plate size and location

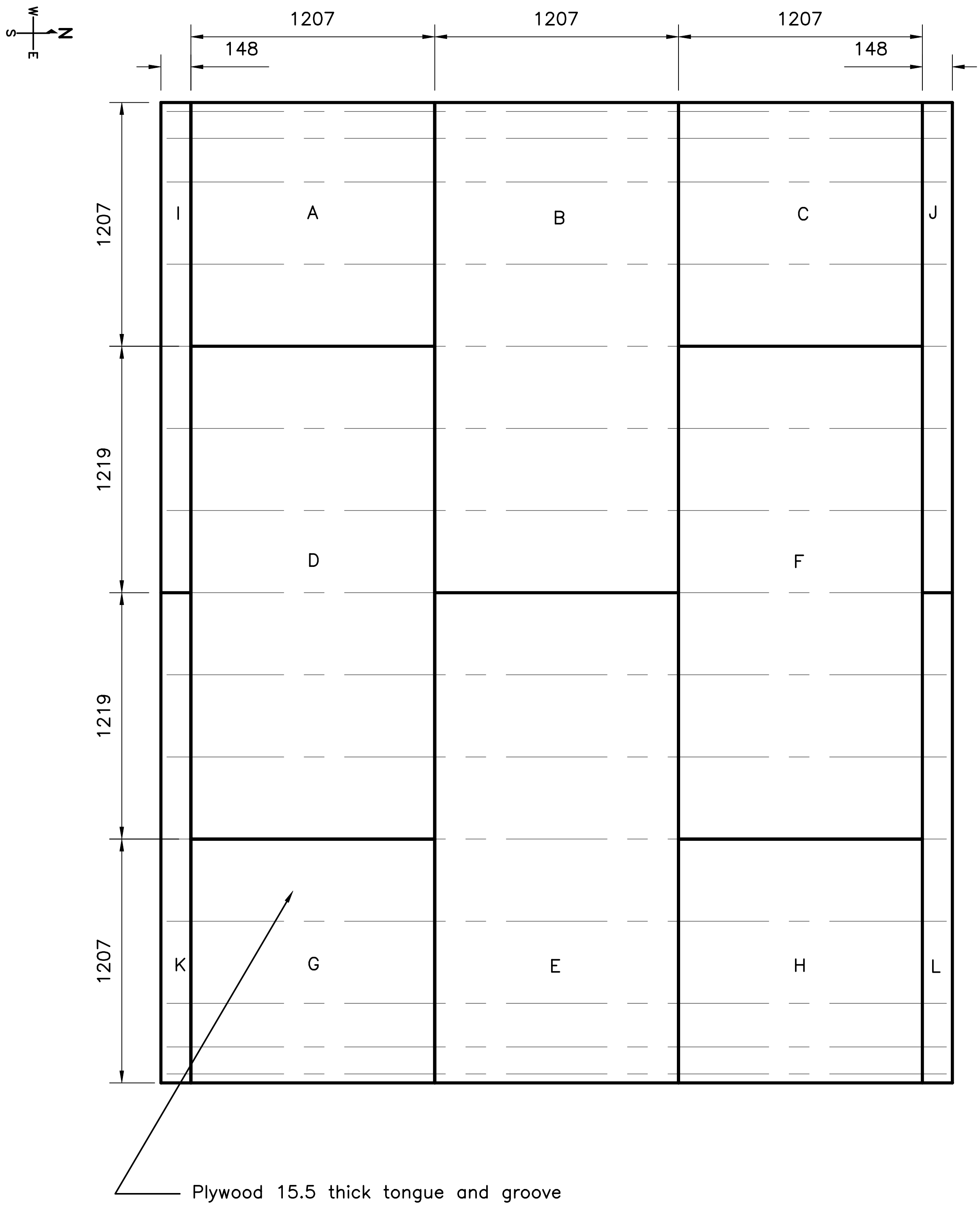
A 50.8 x 101.6 both sides
B 304.8 x 101.6 both sides
C 76.2 x 101.6 both sides
D 228.6 x 101.6 both sides
E 203.2 x 101.6 both sides
F 304.8 x 76.2 both sides of bottom flange

Note:
Trusses were made too long to fit in the testing frame, it has been corrected by removing both vertical members located at each end of the trusses

(Dimensions are in millimetres)

(Assembly No. FF–41)

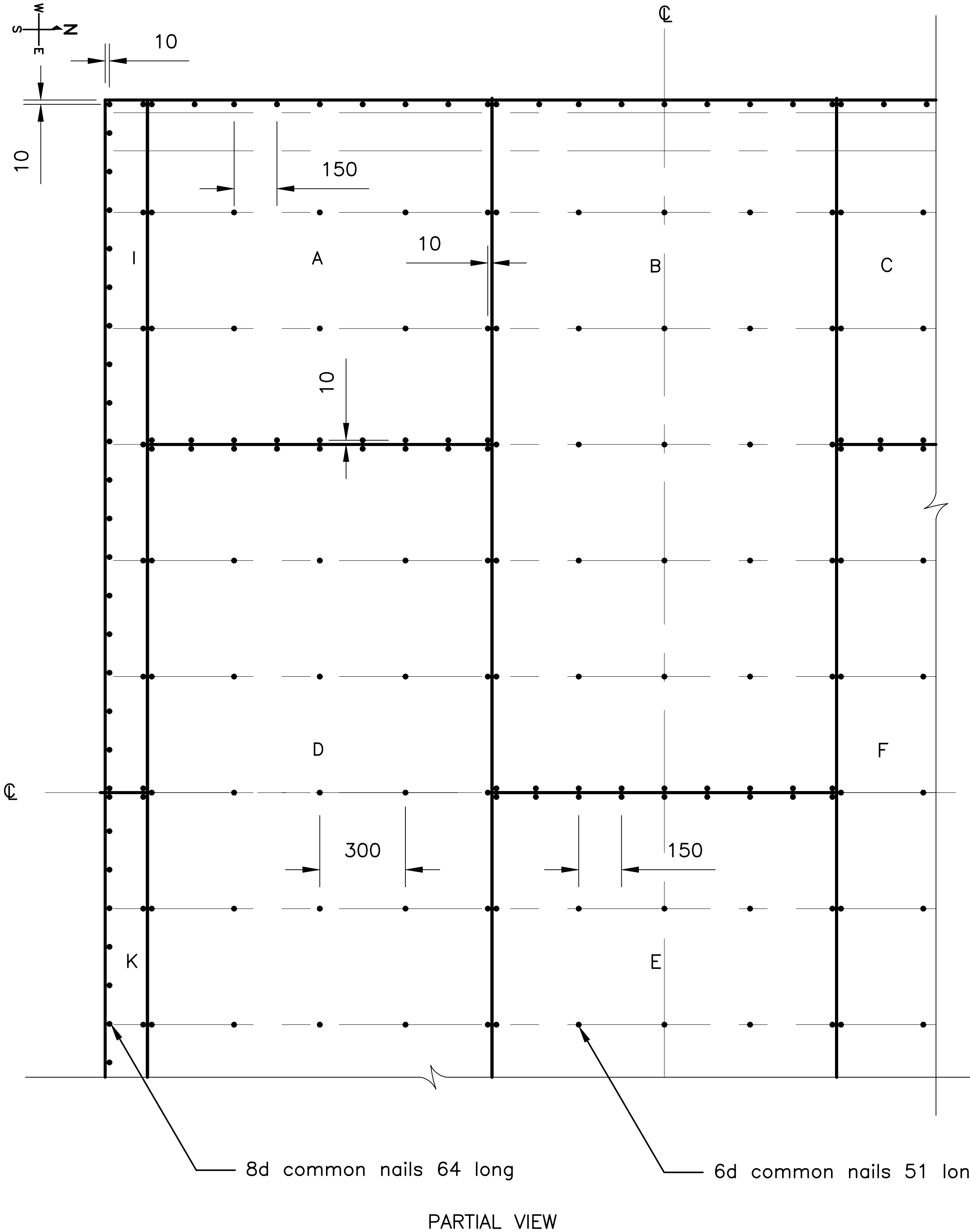
Figure C–2. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–41)

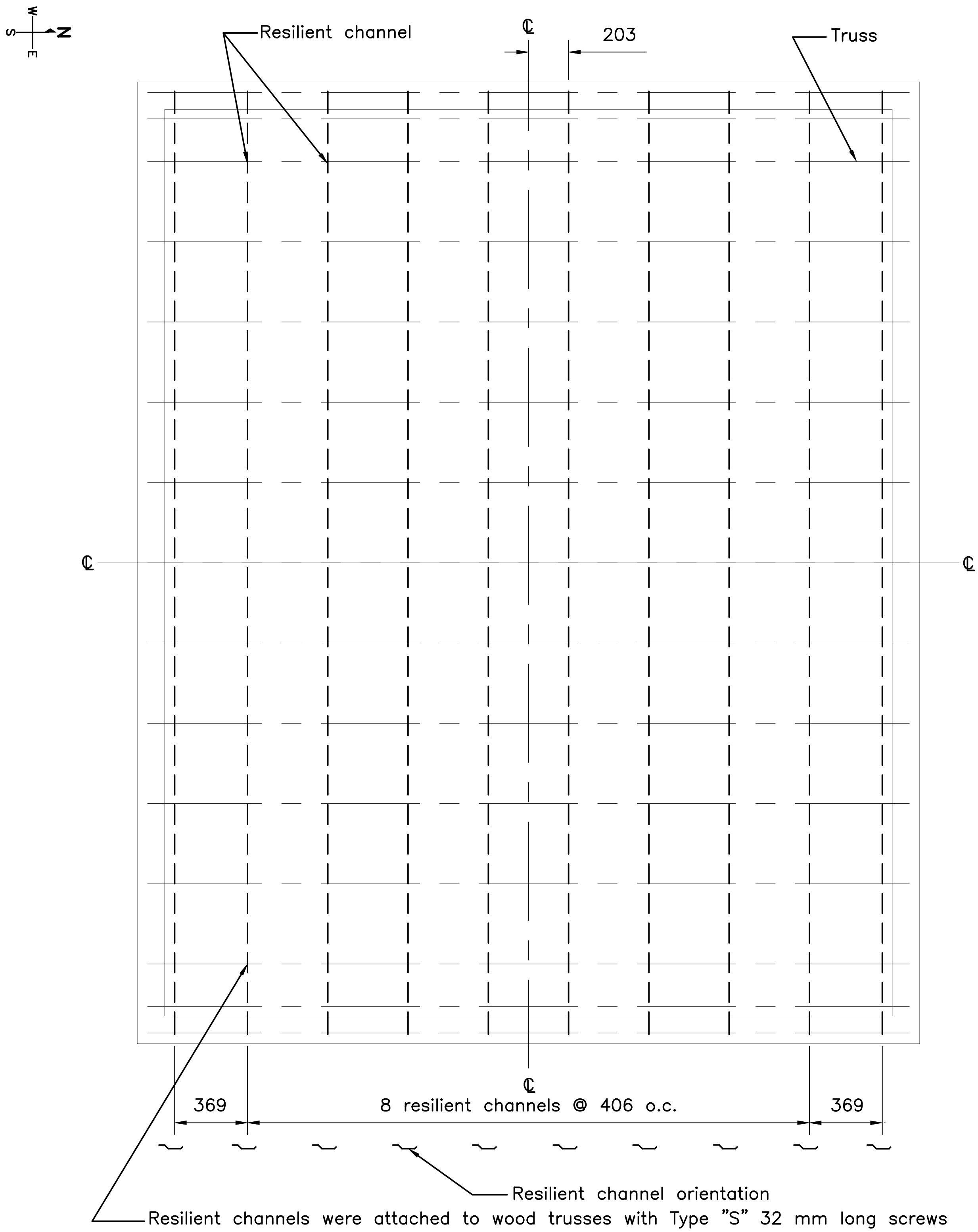
Figure C–3. Subfloor Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-41)

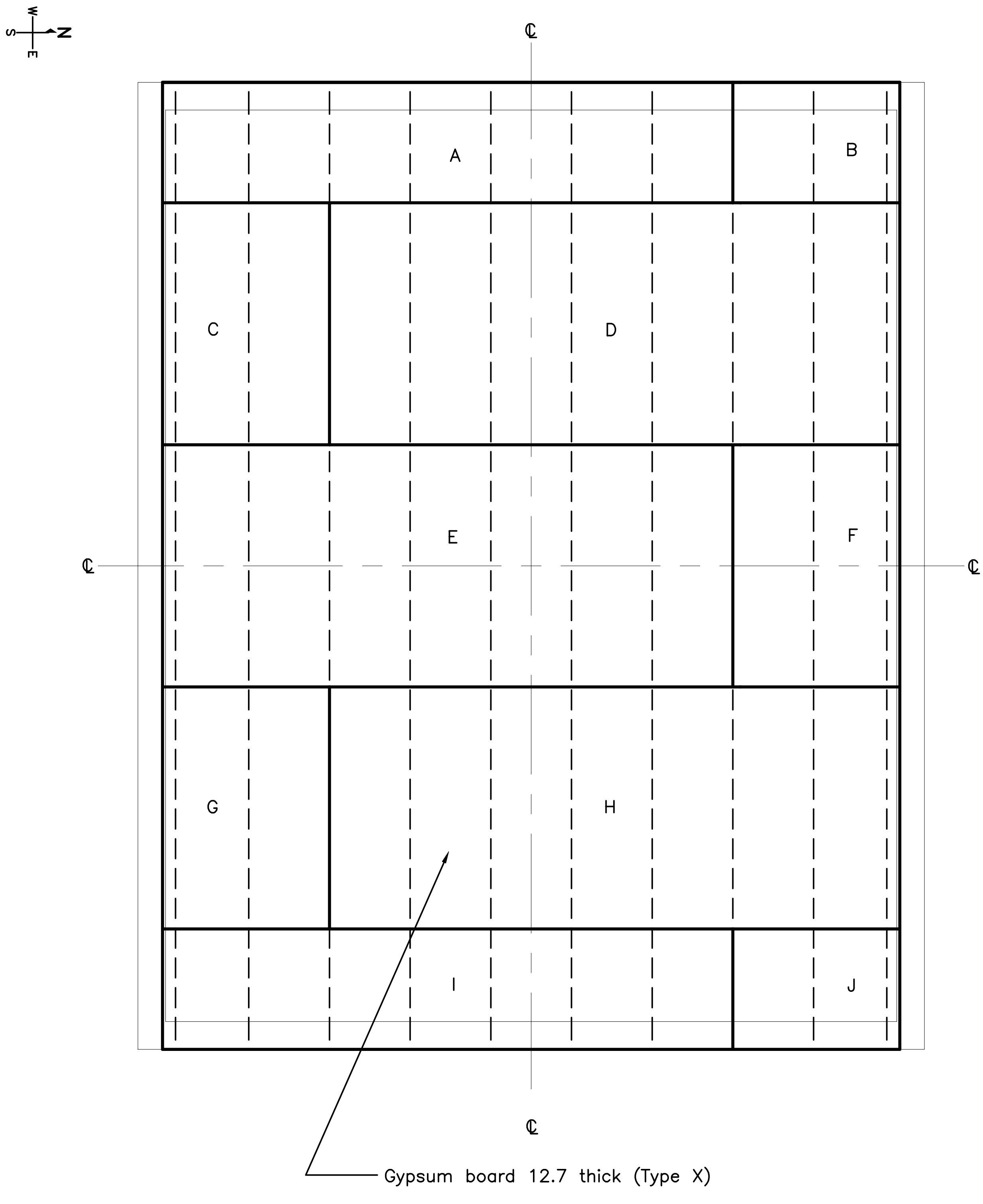
Figure C-4. Subfloor Nail Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–41)

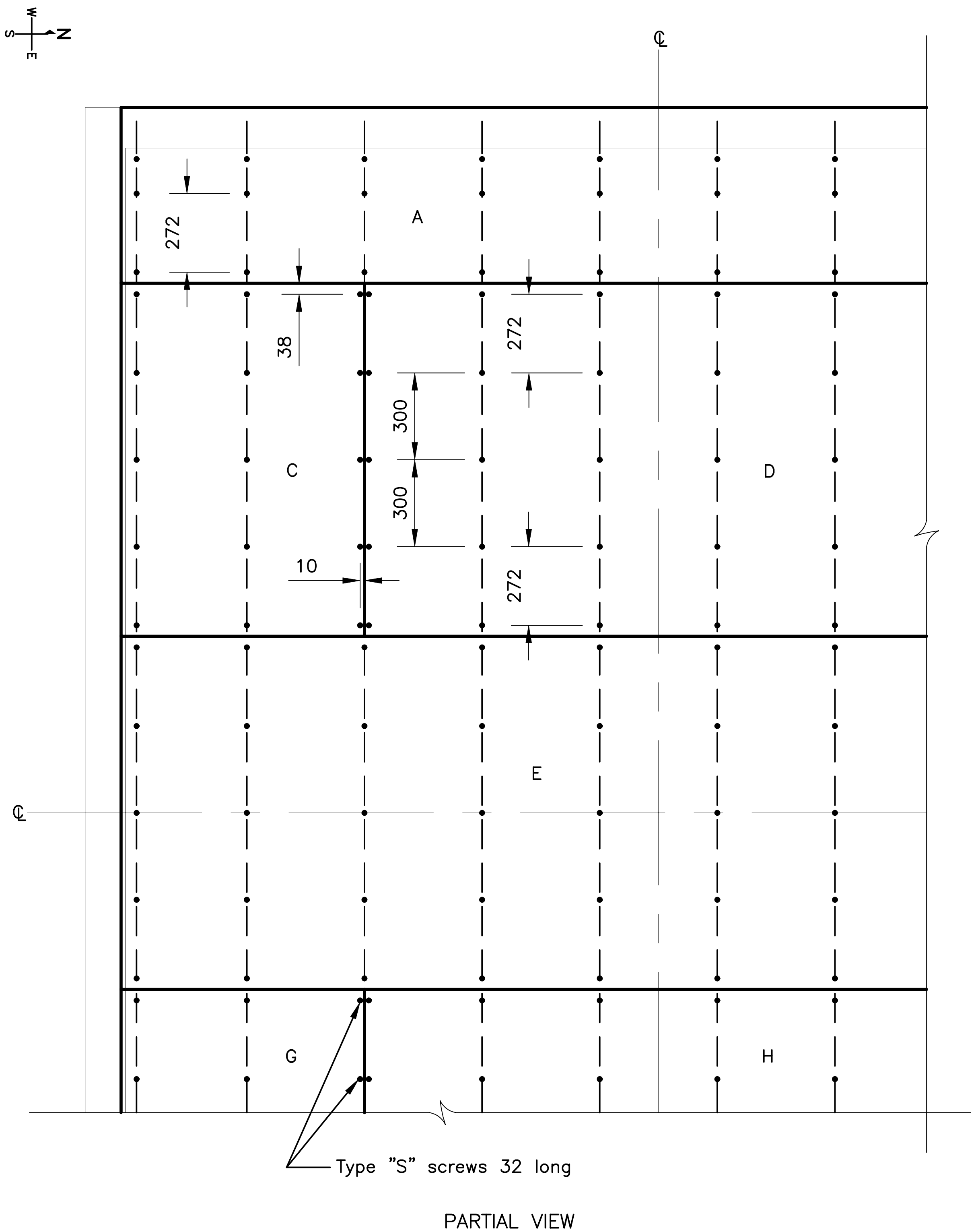
Figure C–5. Resilient Channel Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–41)

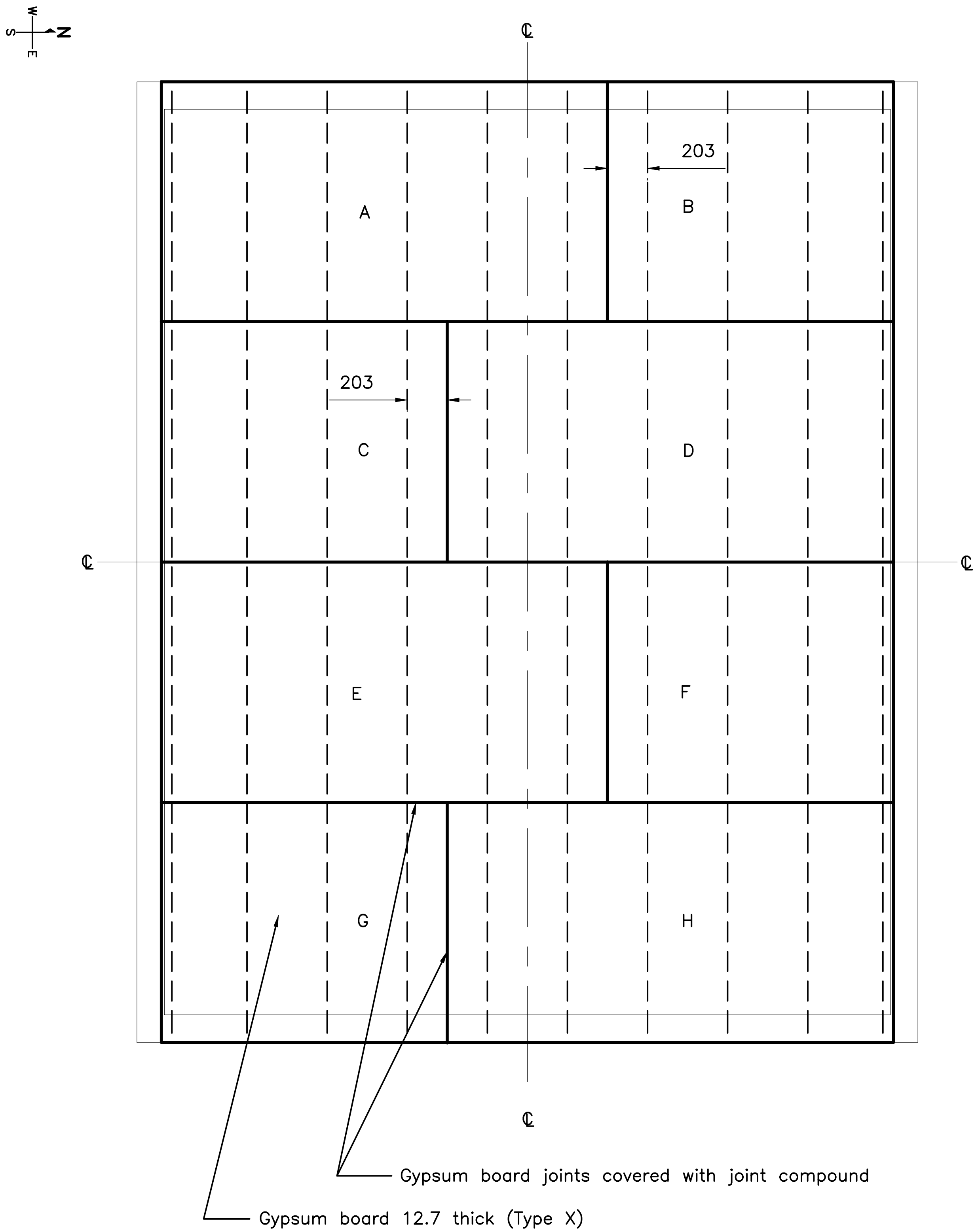
Figure C–6. Gypsum Board Base Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-41)

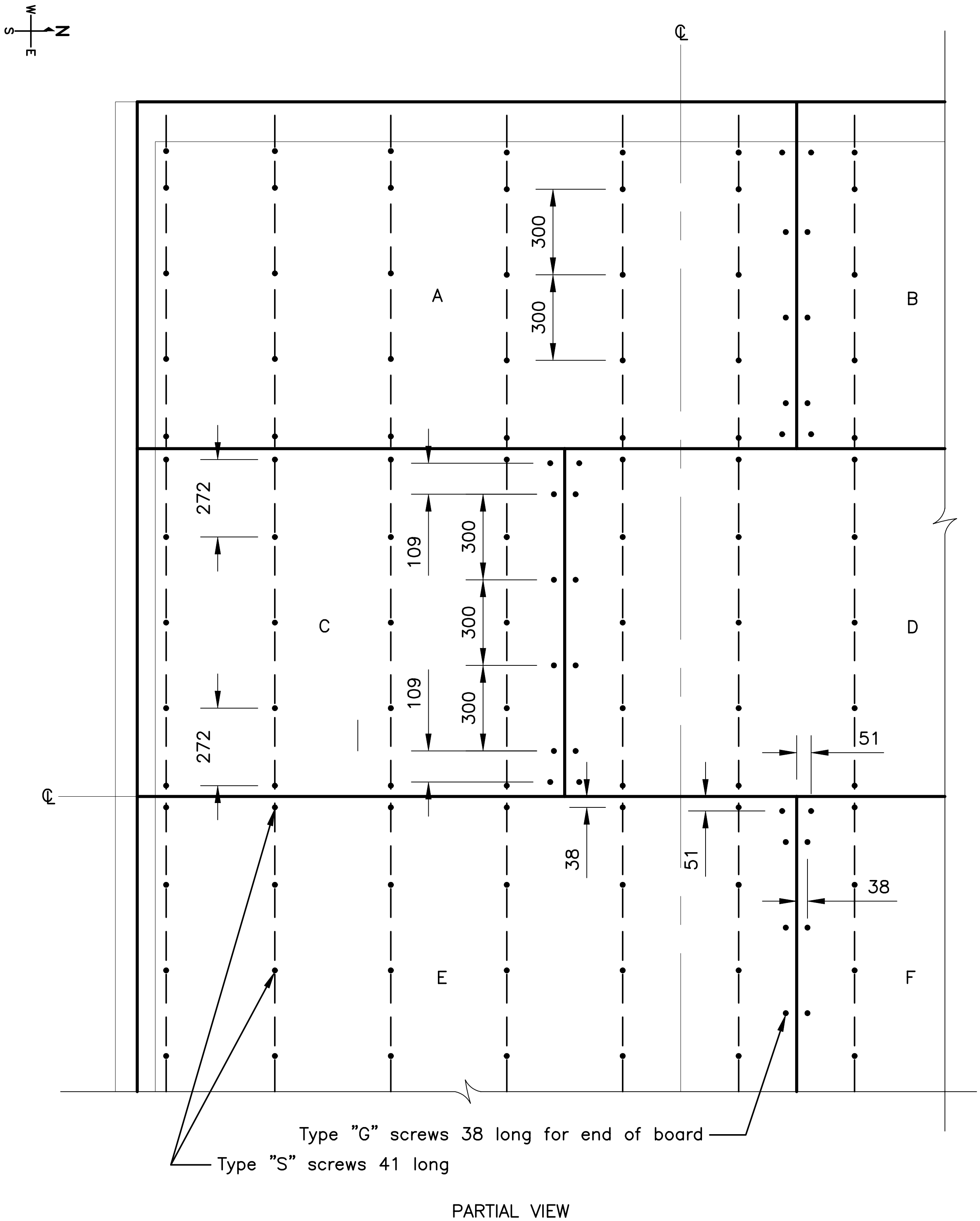
Figure C-7. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–41)

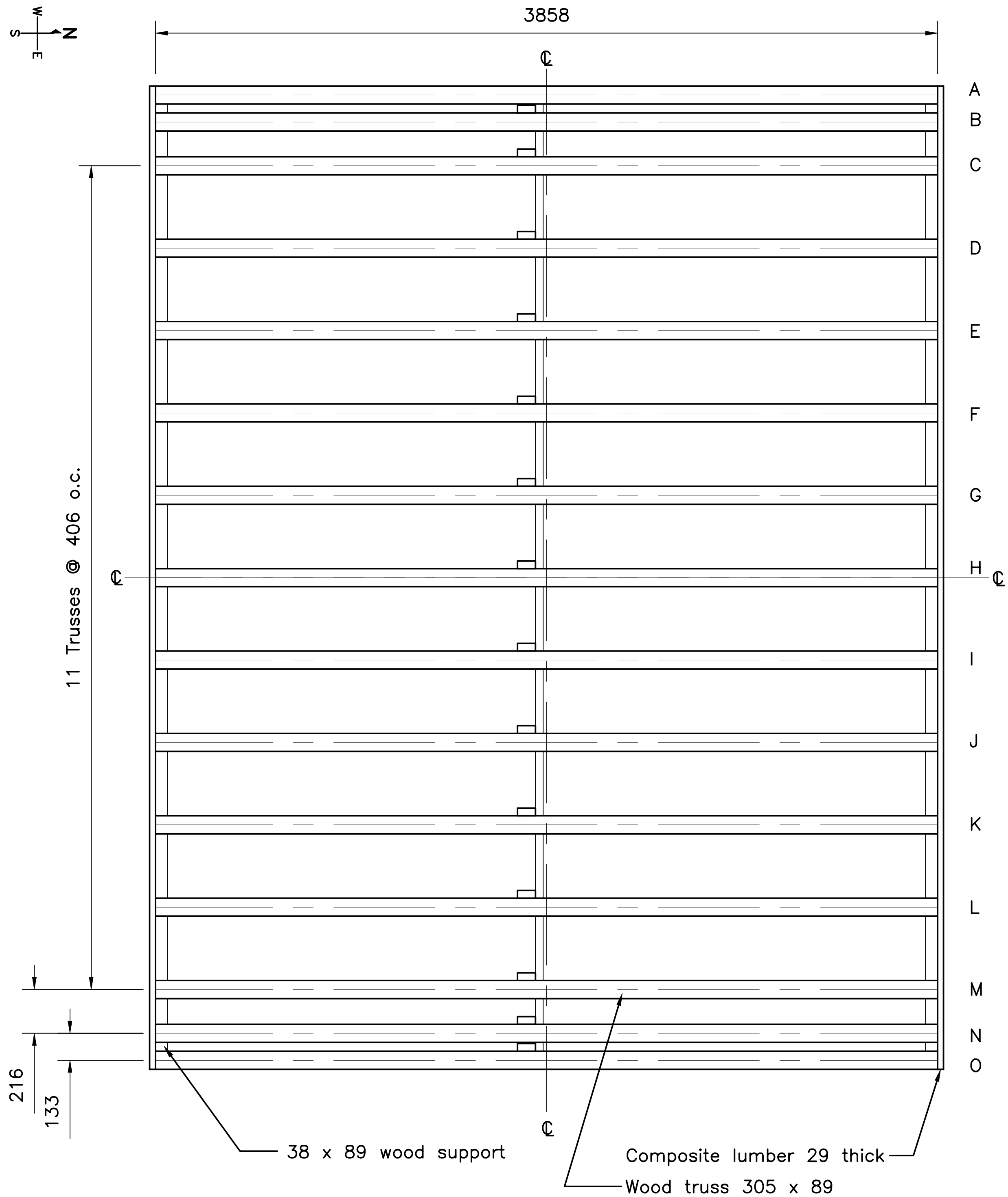
Figure C–8. Gypsum Board Face Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-41)

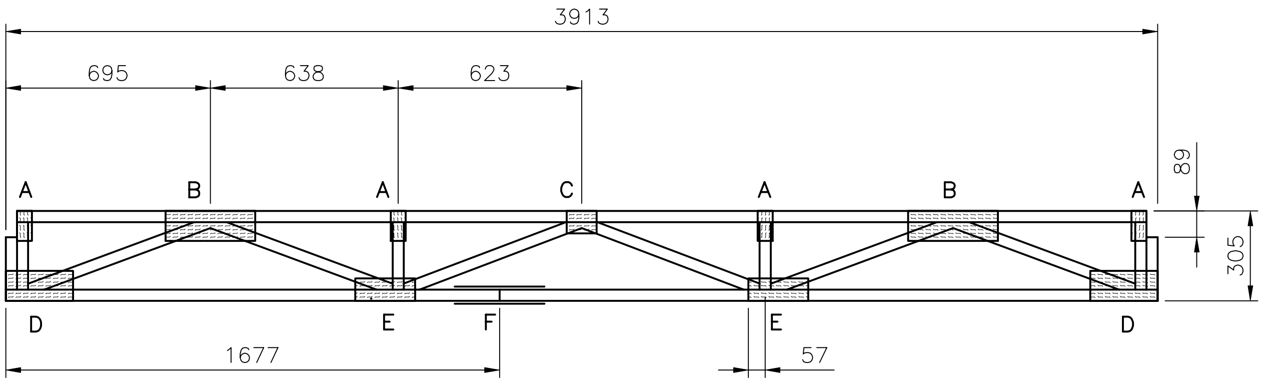
Figure C-9. Gypsum Board Face Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–42)

Figure C–10. Truss Layout (Wood Truss)



Truss members:
Truss members are made of solid wood lumber 38 x 89 Spruce–Pine–Fir #2 S–DRY O.L.M.A.® 152

Plates:
TEE–LOK 20 plates 0.9 mm thick with 8 long teeth.
The number of teeth on the plate = plate area in mm² ÷ 80.645
All plates are centered in the middle of the joint except plates E, see drawing for details

Plate size and location

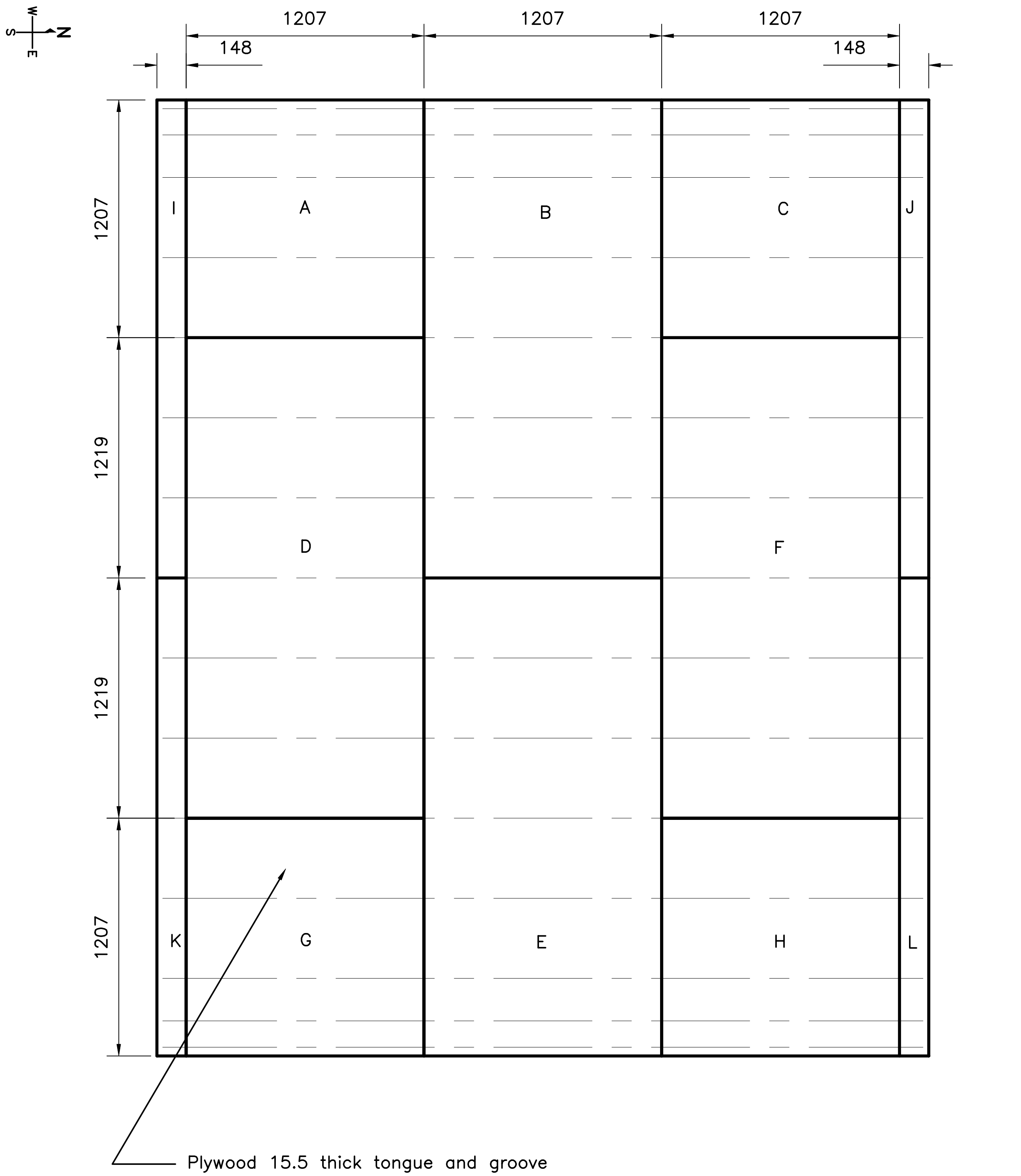
A 50.8 x 101.6 both sides
B 304.8 x 101.6 both sides
C 76.2 x 101.6 both sides
D 228.6 x 101.6 both sides
E 203.2 x 101.6 both sides
F 304.8 x 76.2 top and bottom

Note:
Trusses were made too long to fit in the testing frame, it has been corrected by removing both vertical members located at each end of the trusses

(Dimensions are in millimetres)

(Assembly No. FF–42)

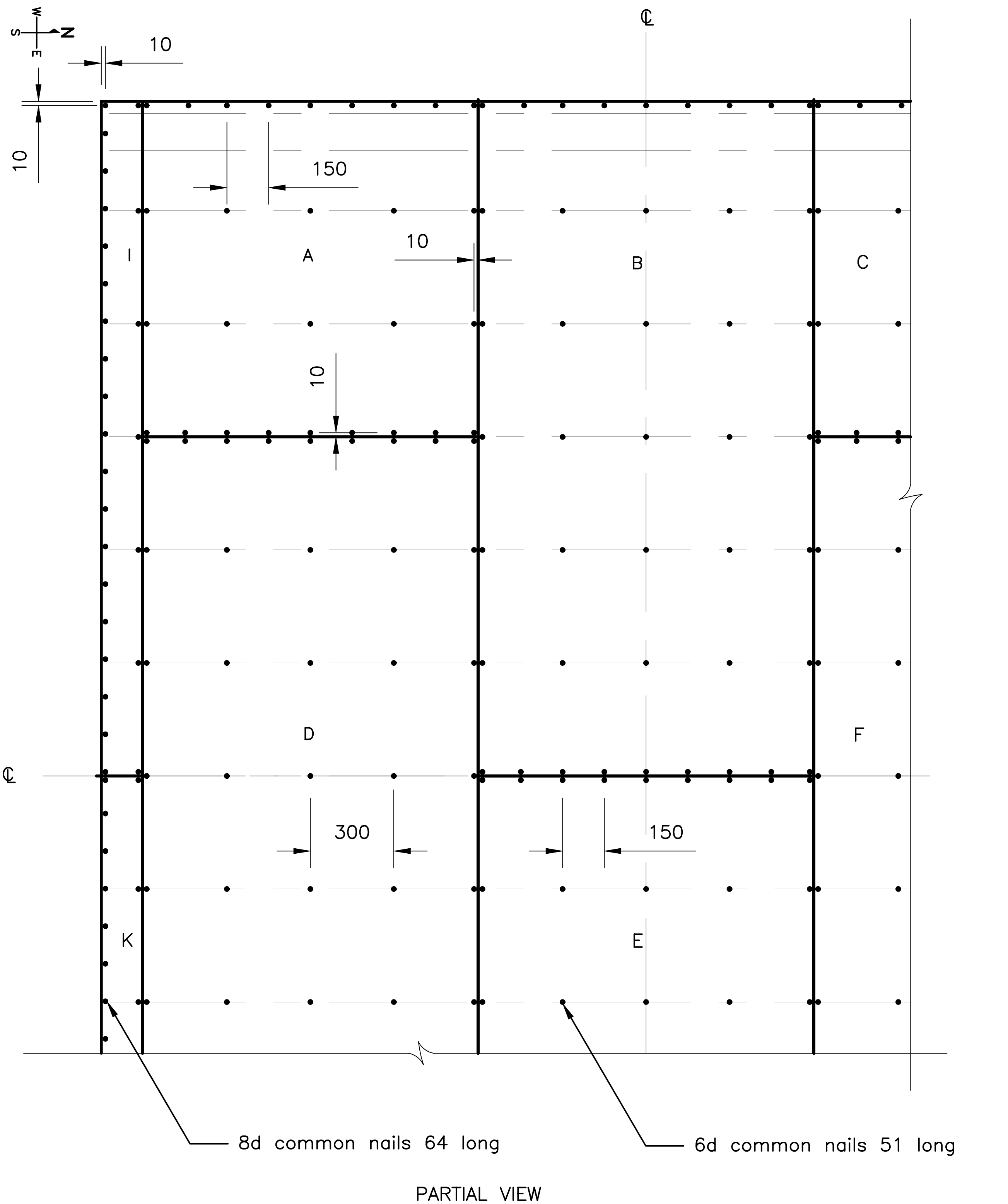
Figure C–11. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–42)

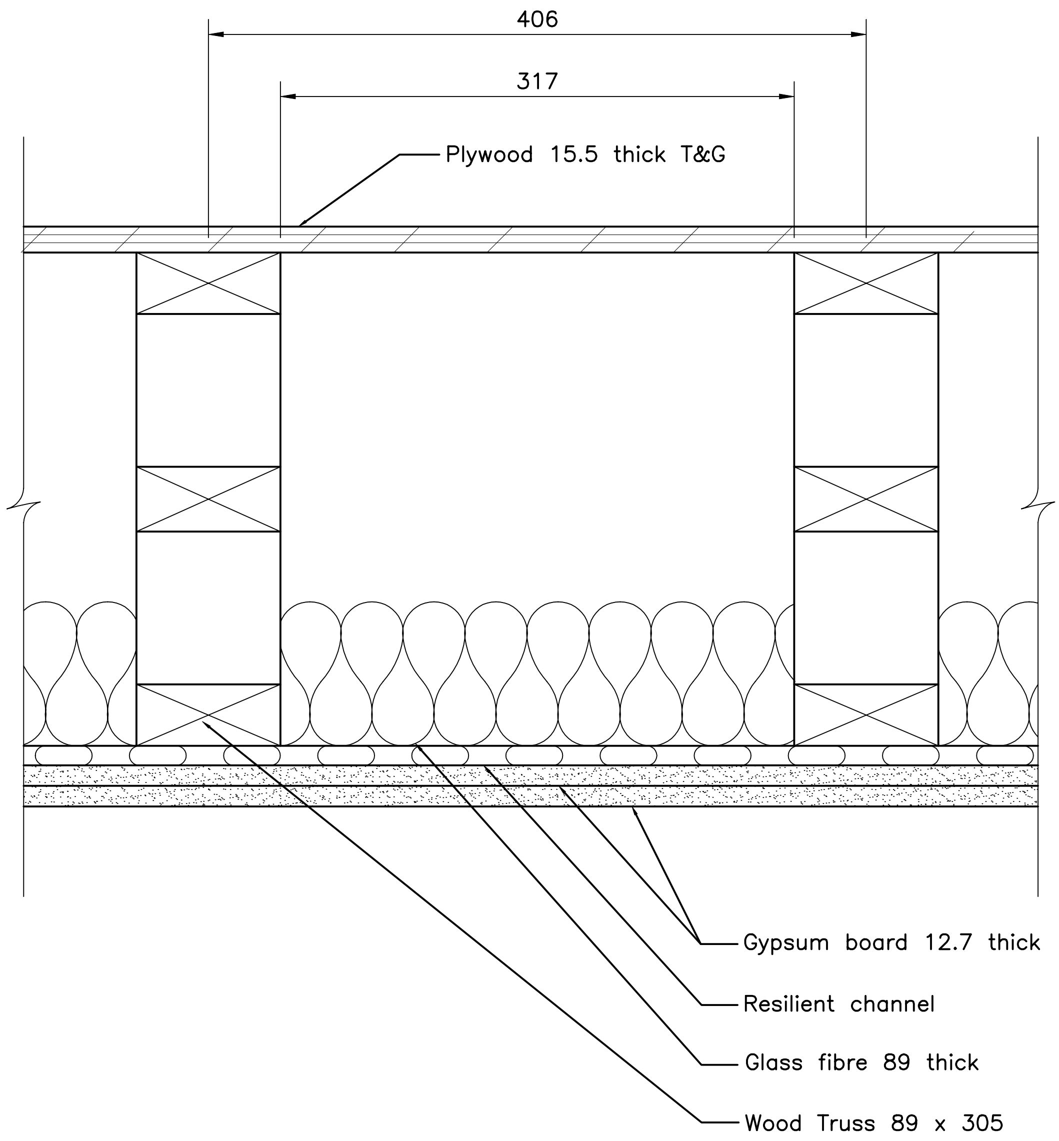
Figure C–12. Subfloor Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–42)

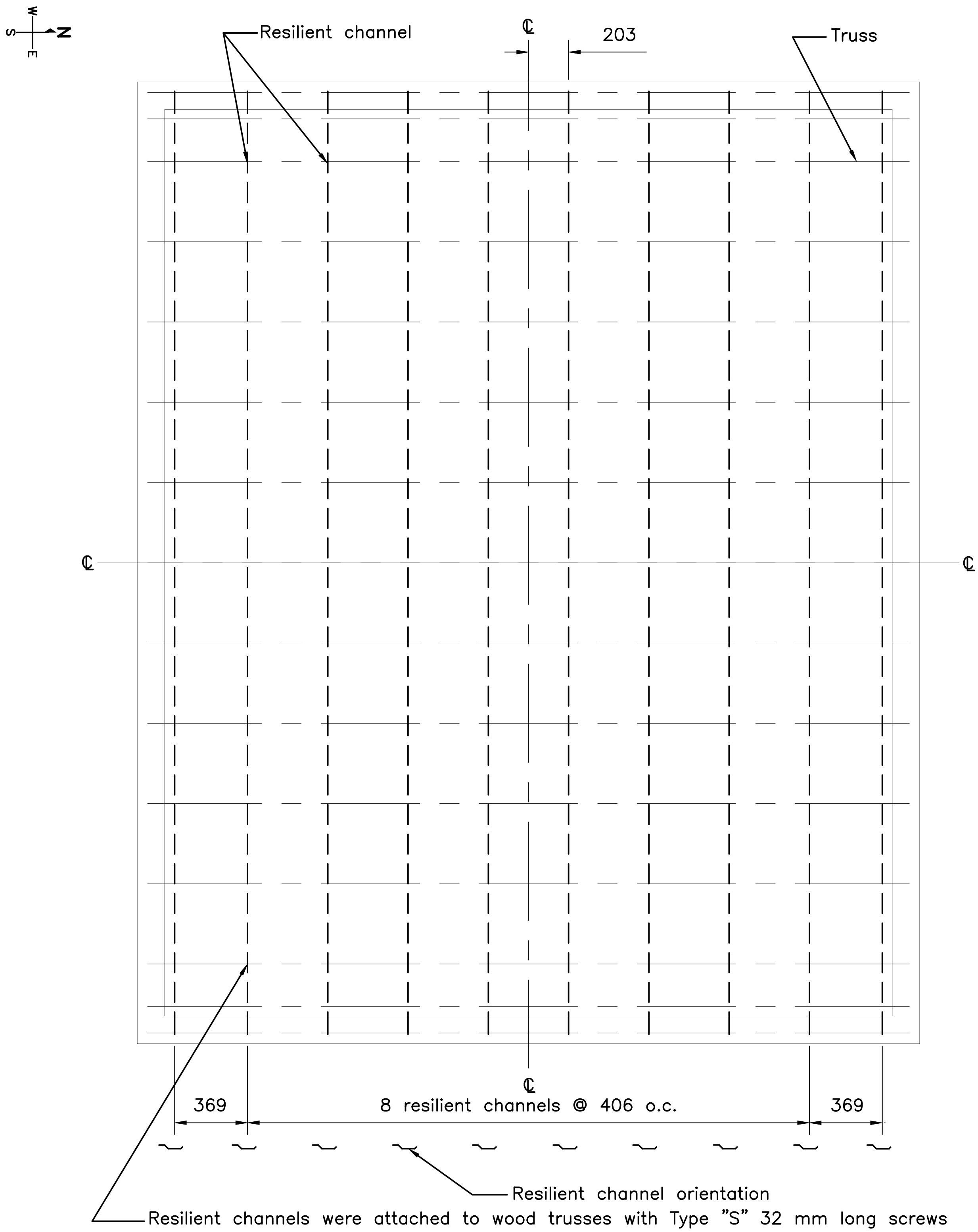
Figure C–13. Subfloor Nail Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–42)

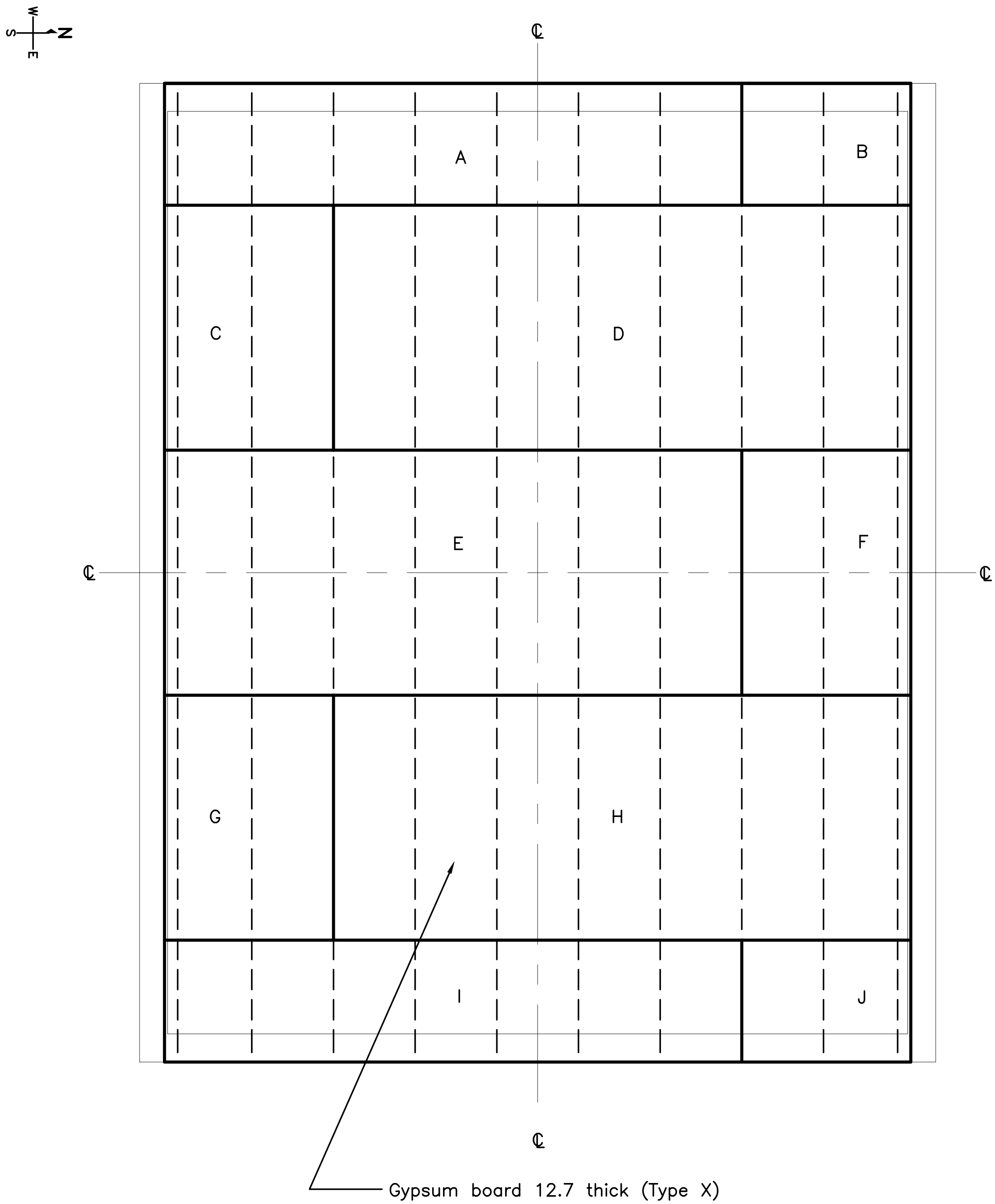
Figure C–14. Insulation Location (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–42)

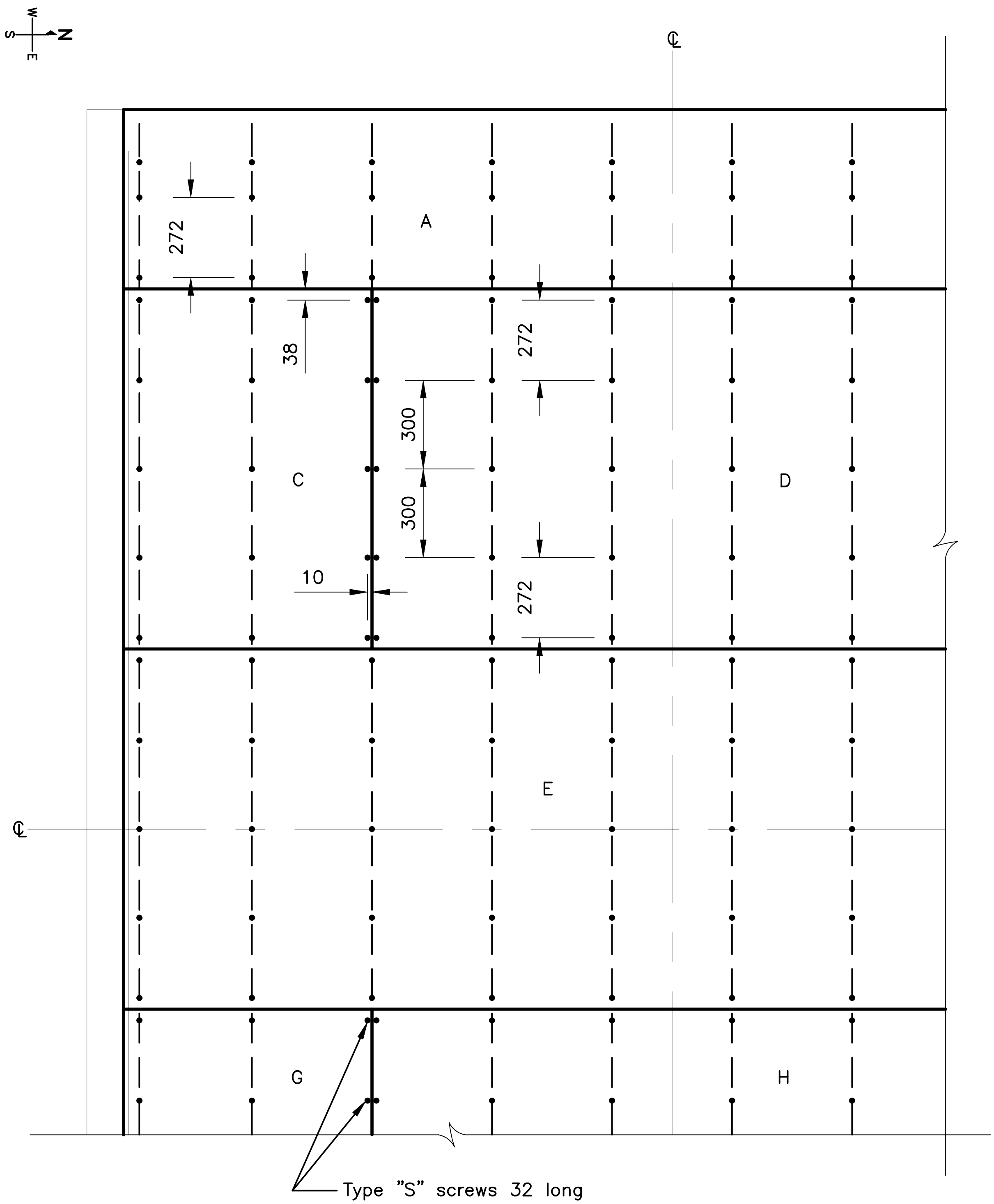
Figure C–15. Resilient Channel Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-42)

Figure C-16. Gypsum Board Base Layer Layout (Wood Truss)

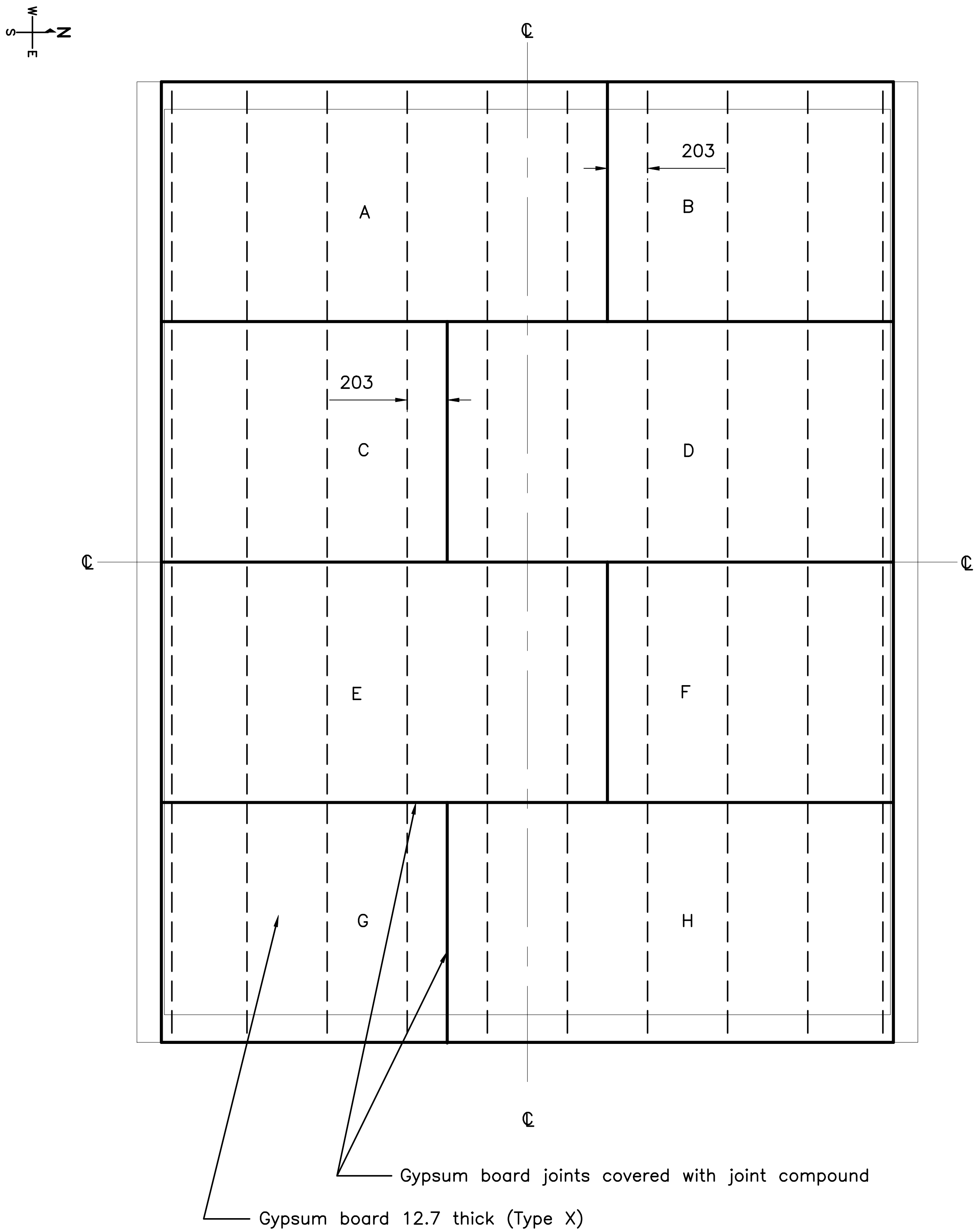


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF–42)

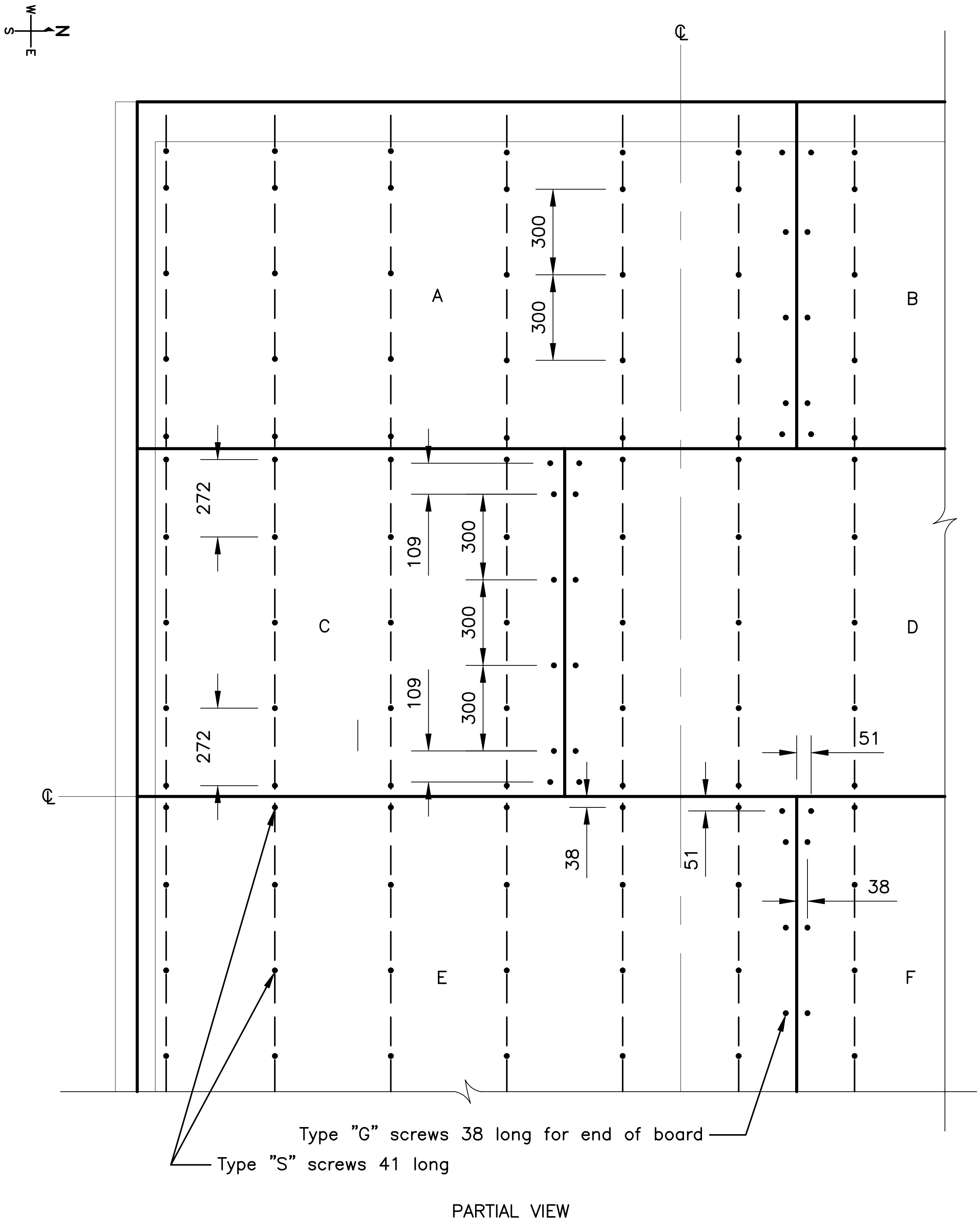
Figure C–17. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–42)

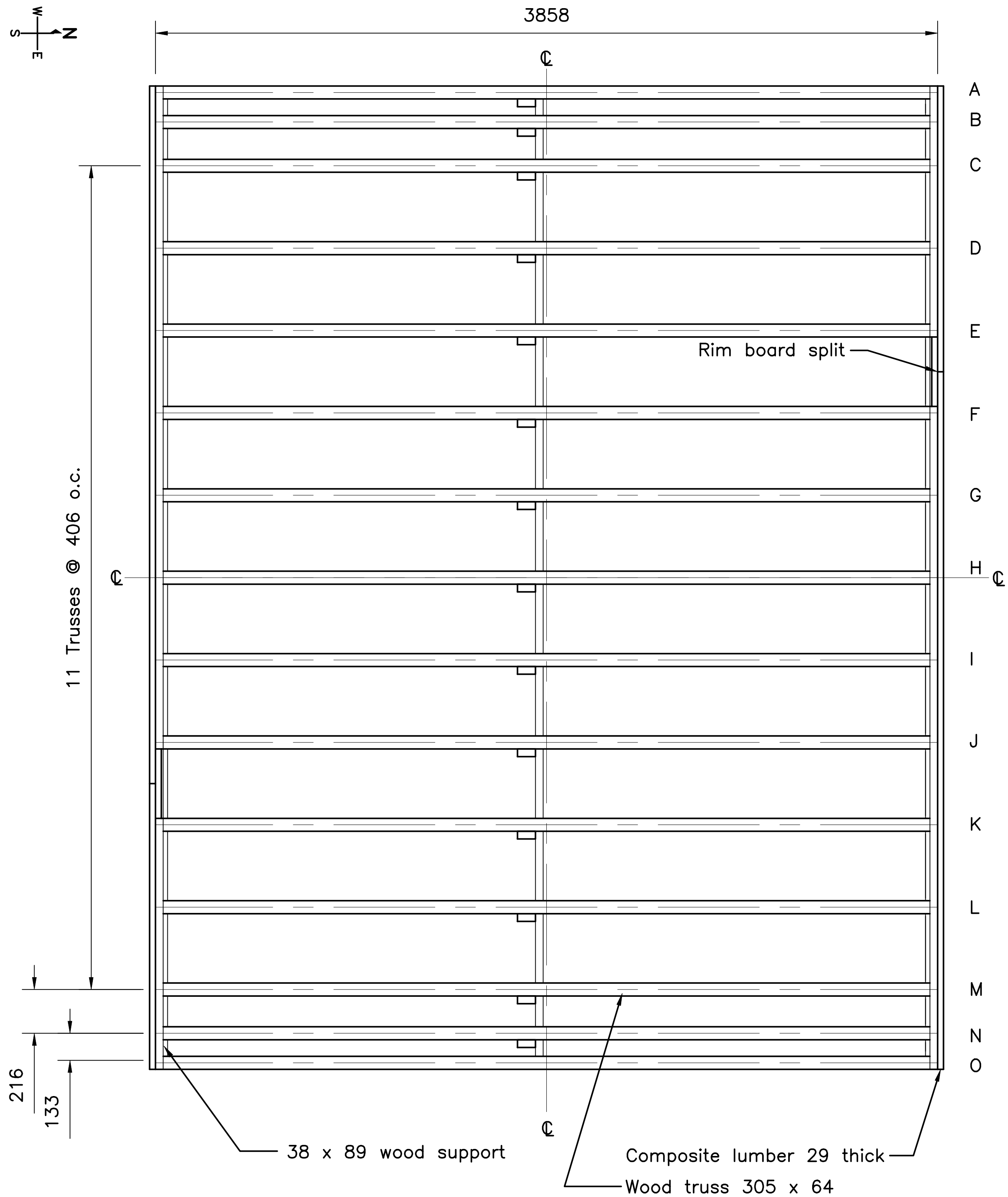
Figure C–18. Gypsum Board Face Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–42)

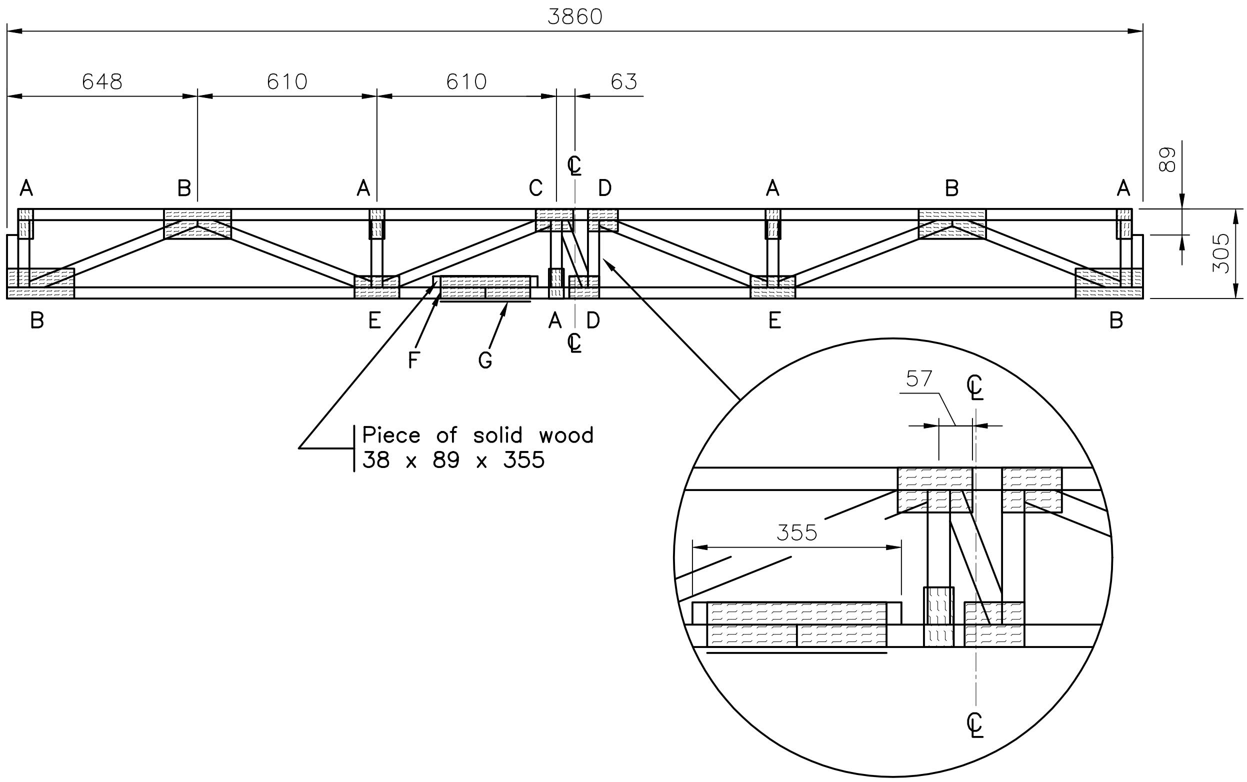
Figure C–19. Gypsum Board Face Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–46)

Figure C–20. Truss Layout (Wood Truss)



Truss members:
Truss members are made of solid wood lumber 38 x 64 Spruce-Pine-Fir #2 S-DRY from two different suppliers CL®A 123 and MSR 437/1650 Fb 1.5E.

Plates:
TEE-LOK 20 plates 0.9 mm thick with 8 long teeth.
The number of teeth on the plate = plate area in mm² ÷ 80.645
All plates are centered in the middle of the joint except plates C, see drawing for details.

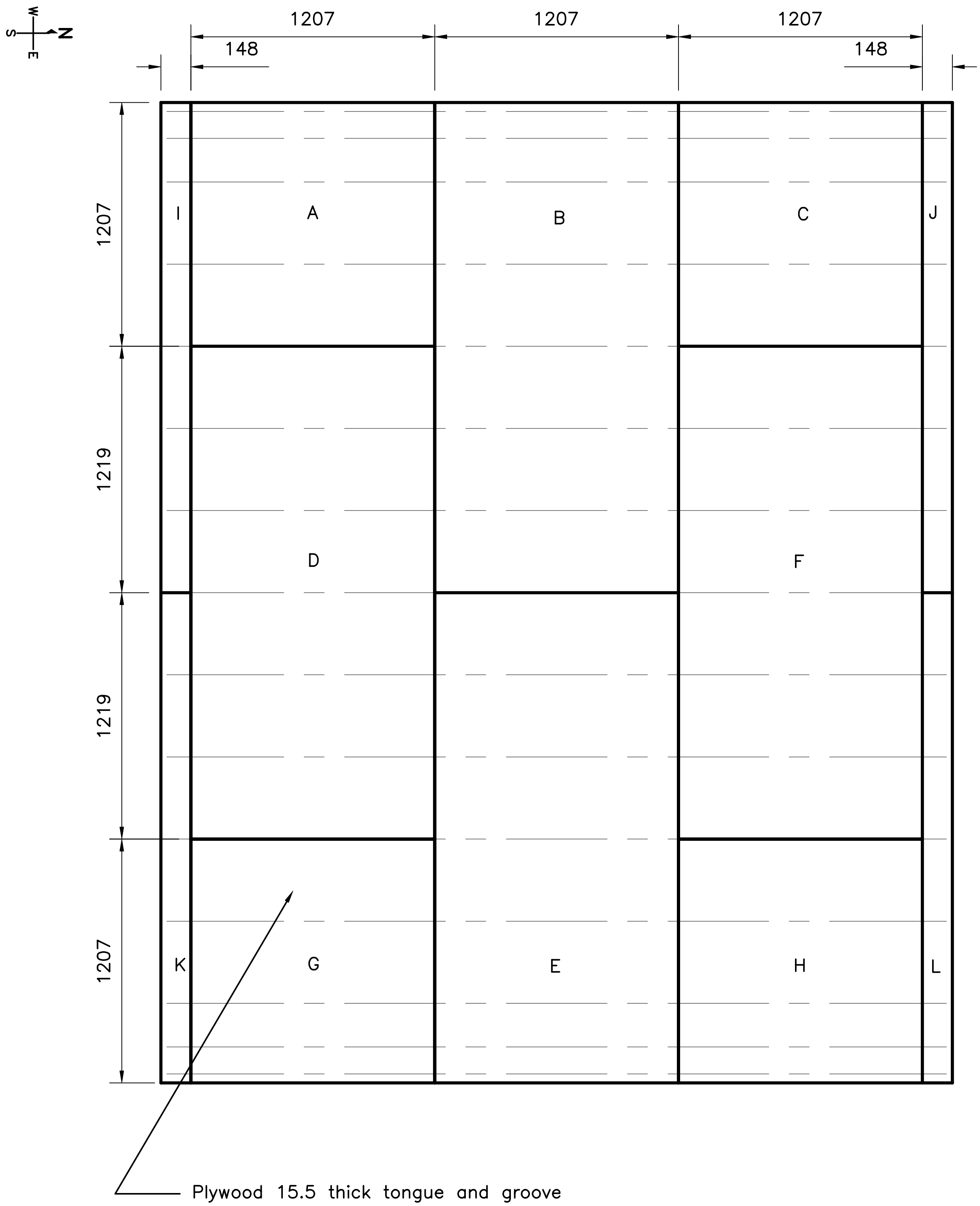
Plate size and location

A 50.8 x 101.6 both sides
B 228.6 x 101.6 both sides
C 127 x 76.2 both sides
D 101.6 x 76.2 both sides
E 152.4 x 76.2 both sides
F 304.8 x 76.2 both sides
G 304.8 x 50.8 both sides of bottom flange

(Dimensions are in millimetres)

(Assembly No. FF-46)

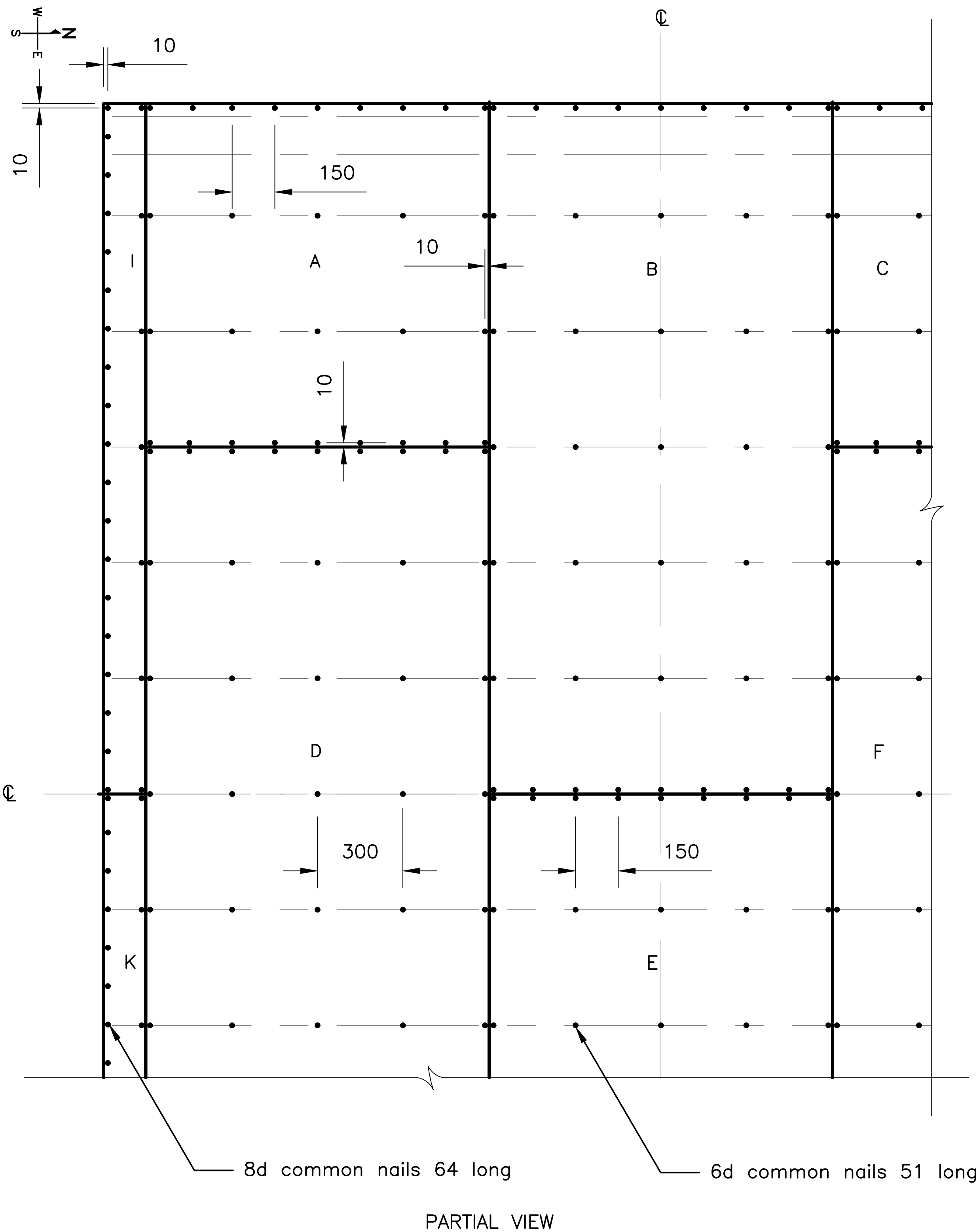
Figure C-21. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–46)

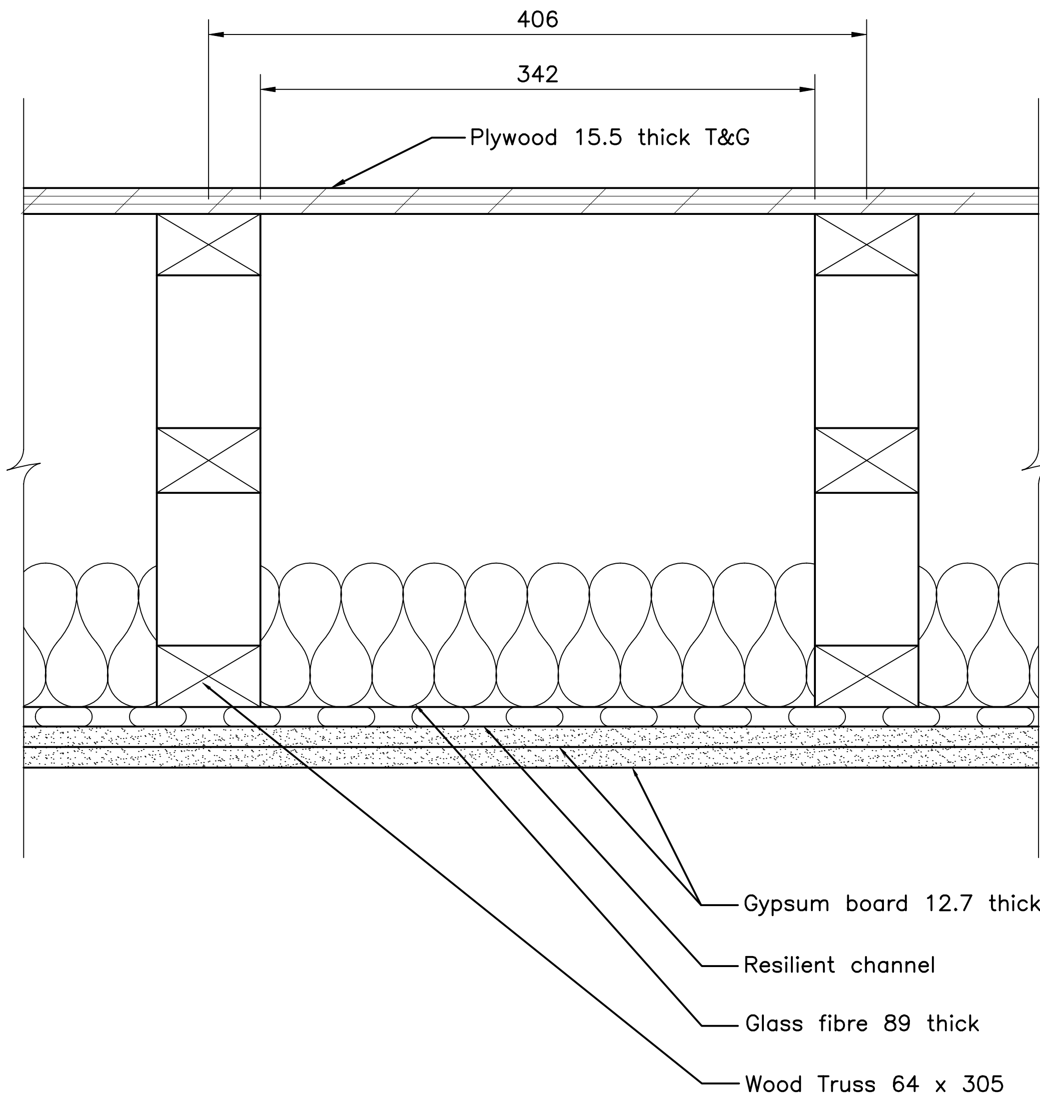
Figure C–22. Subfloor Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–46)

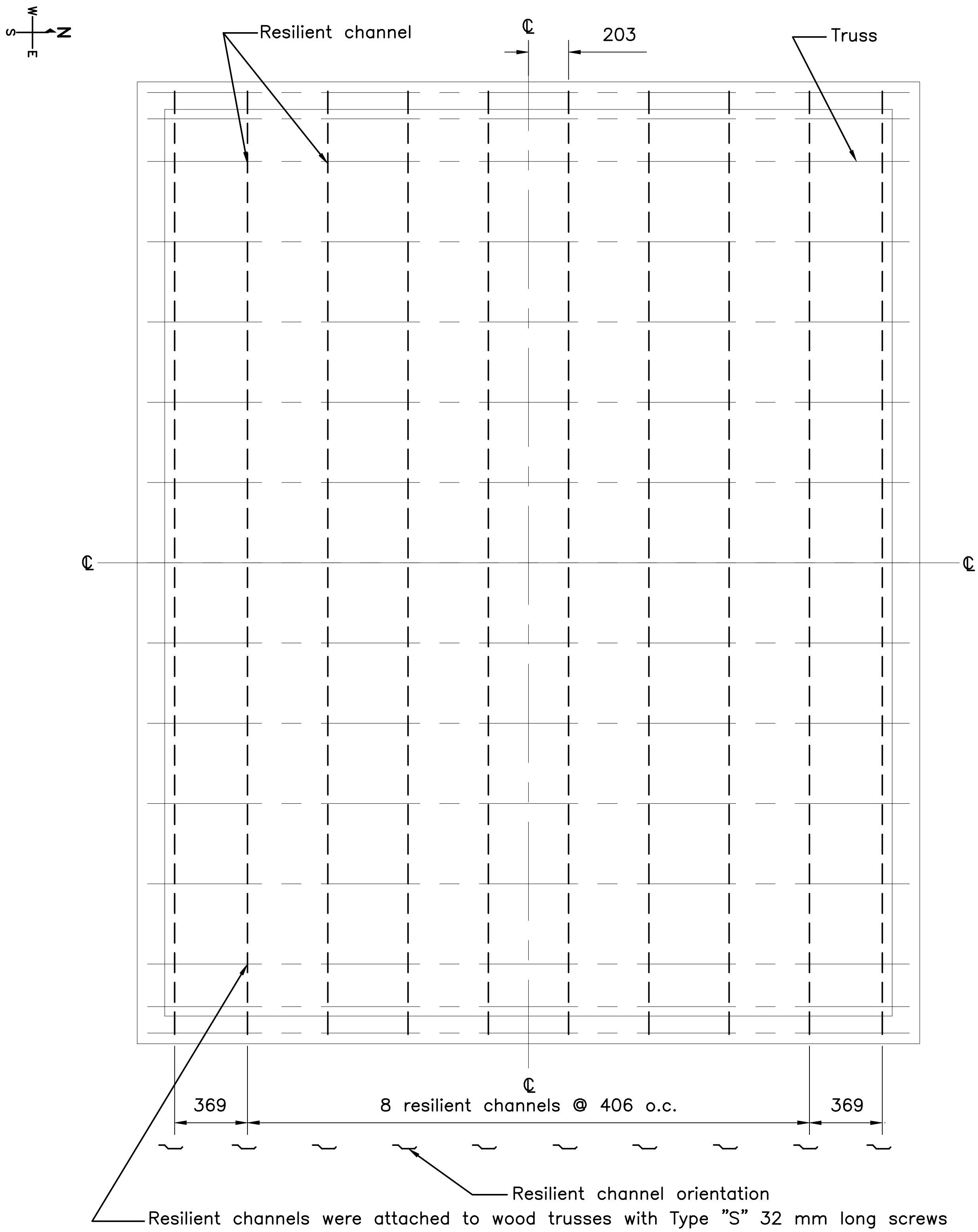
Figure C–23. Subfloor Nail Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-46)

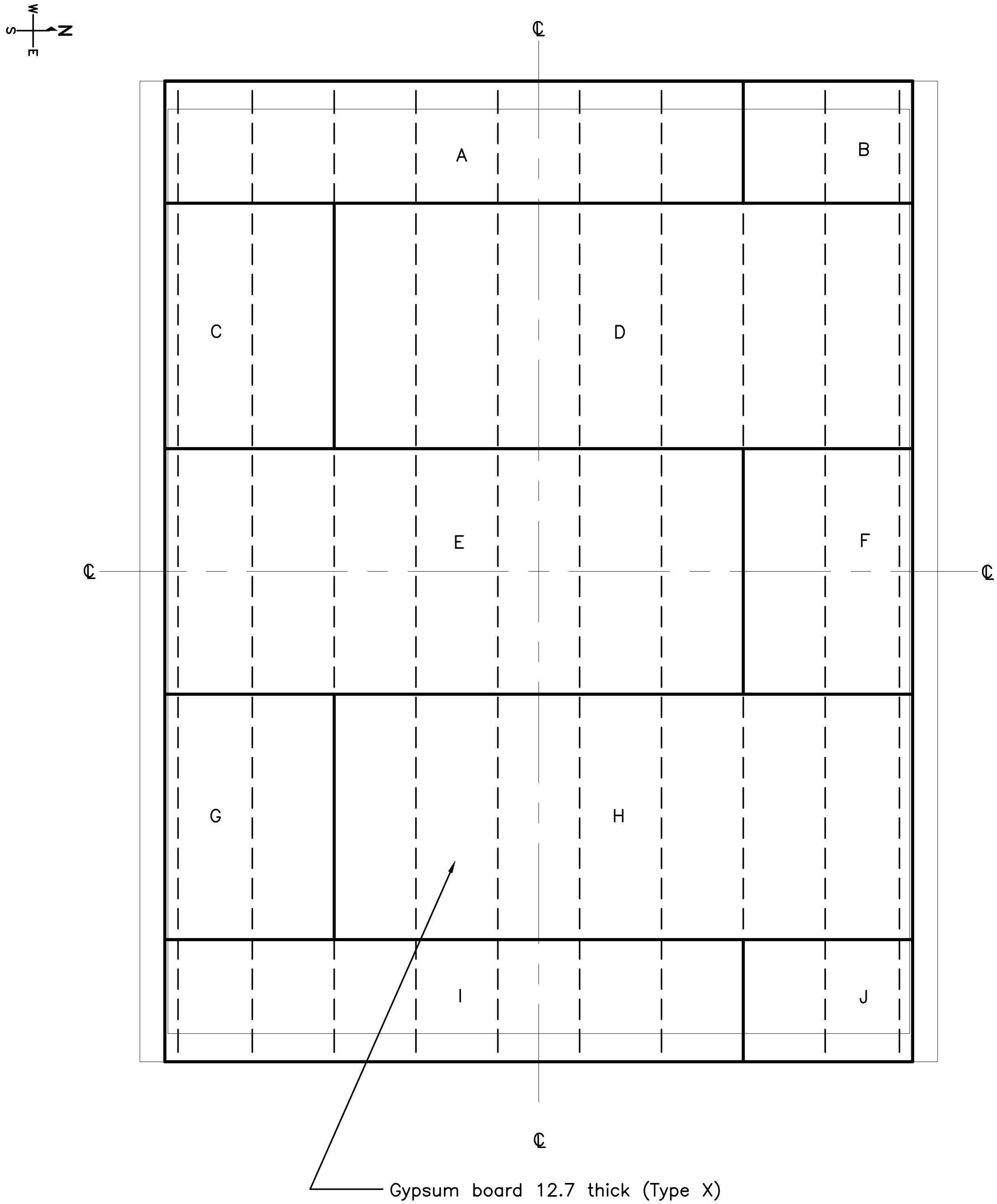
Figure C-24. Insulation Location (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-46)

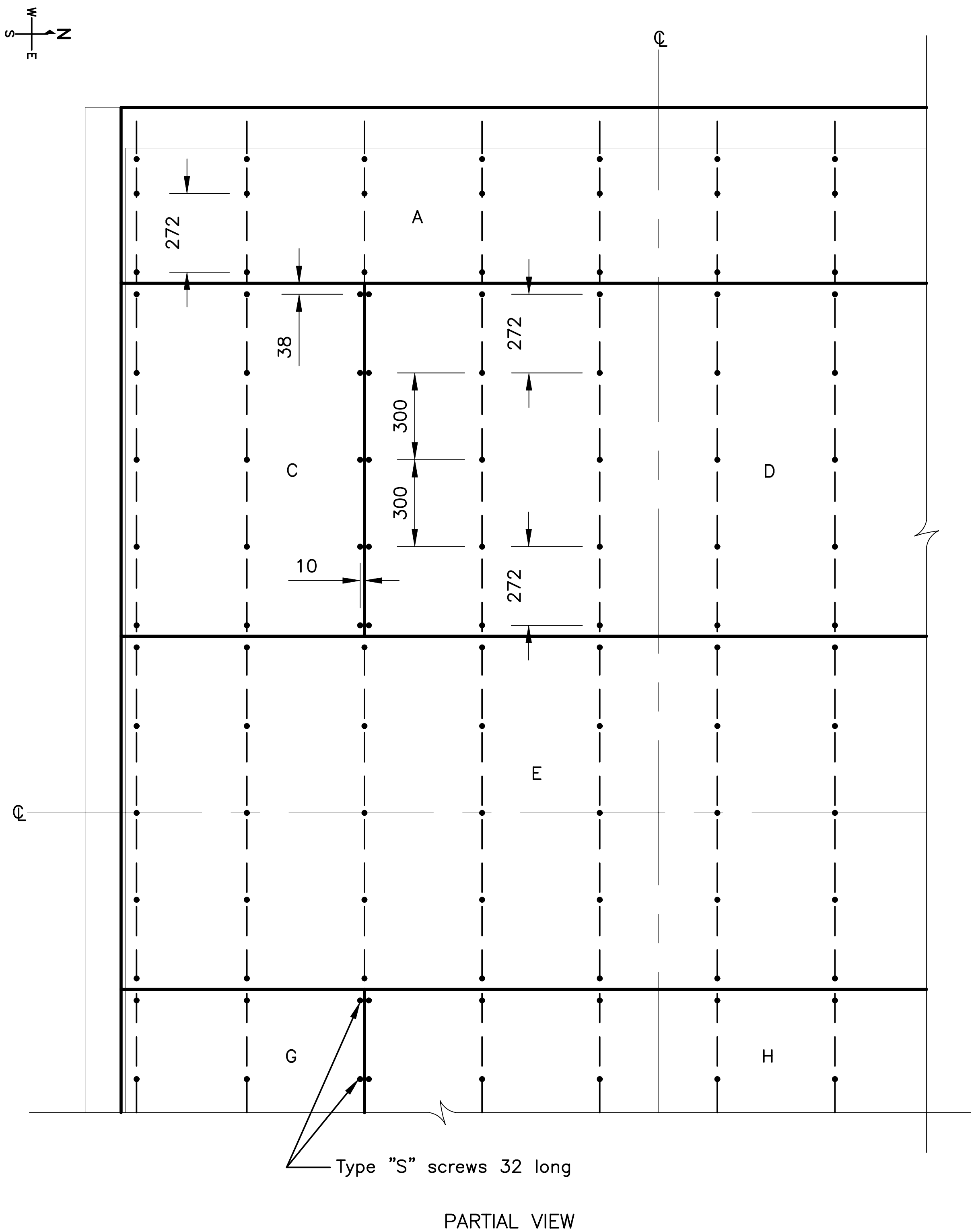
Figure C-25. Resilient Channel Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–46)

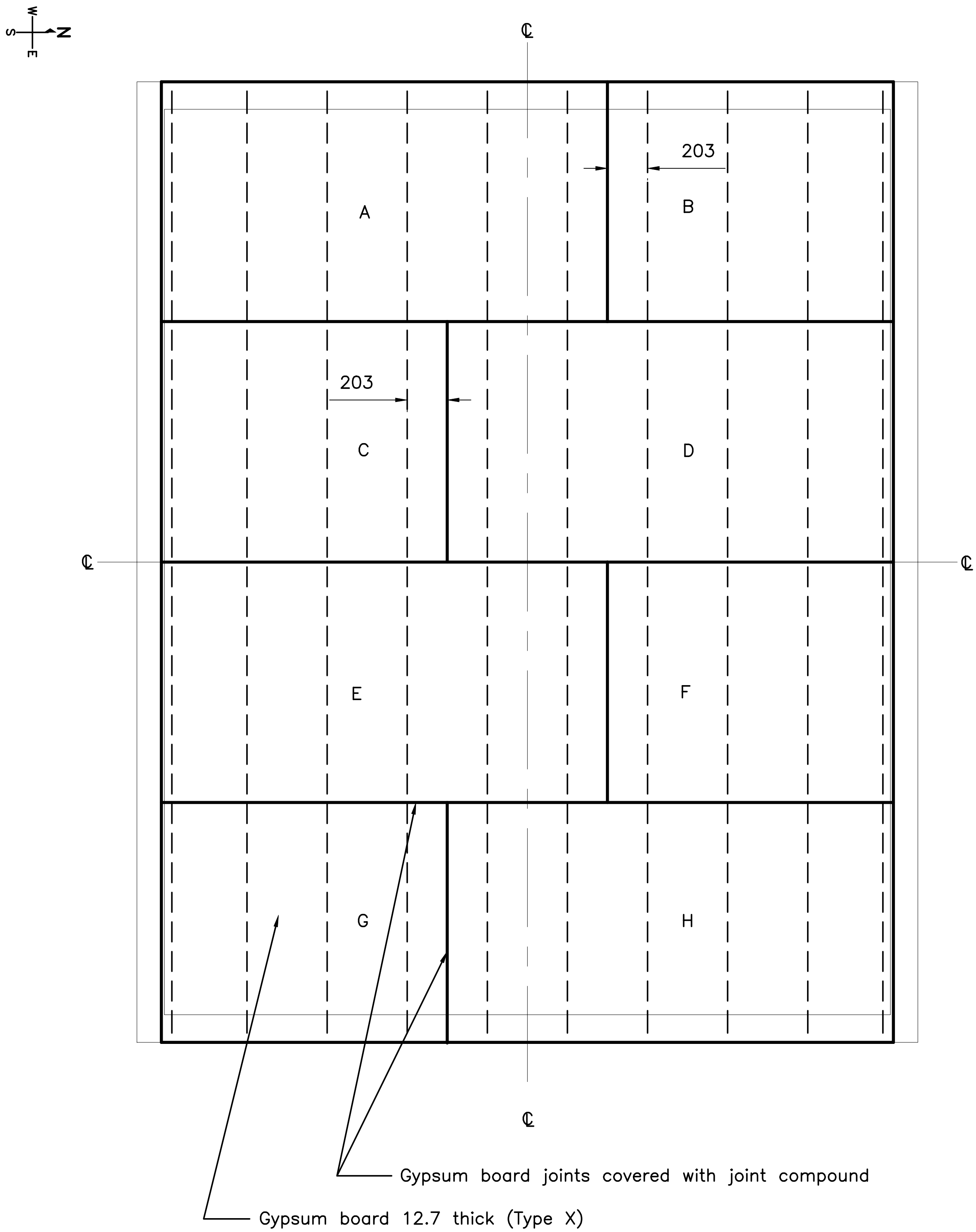
Figure C–26. Gypsum Board Base Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–46)

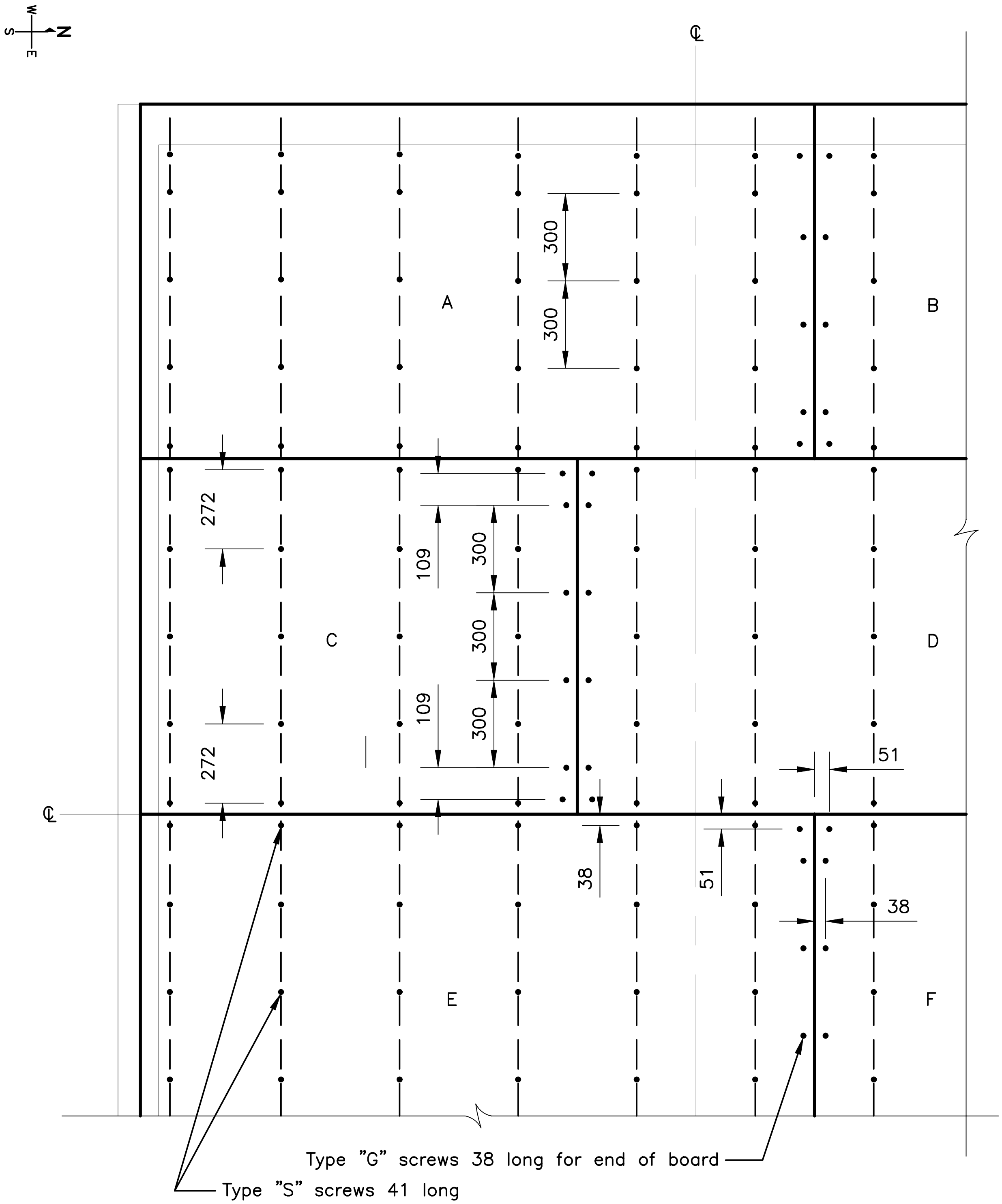
Figure C–27. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–46)

Figure C–28. Gypsum Board Face Layer Layout (Wood Truss)

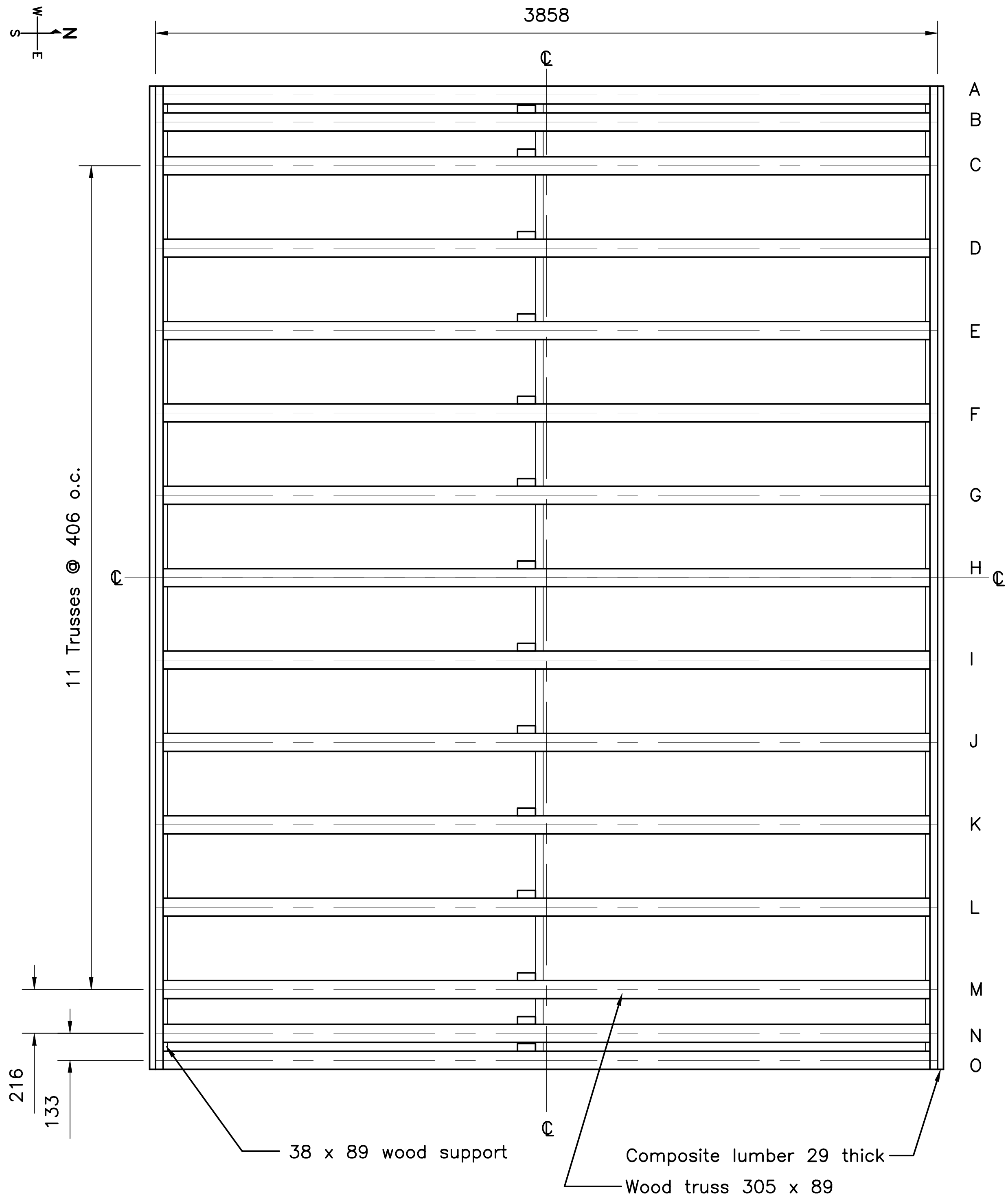


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF–46)

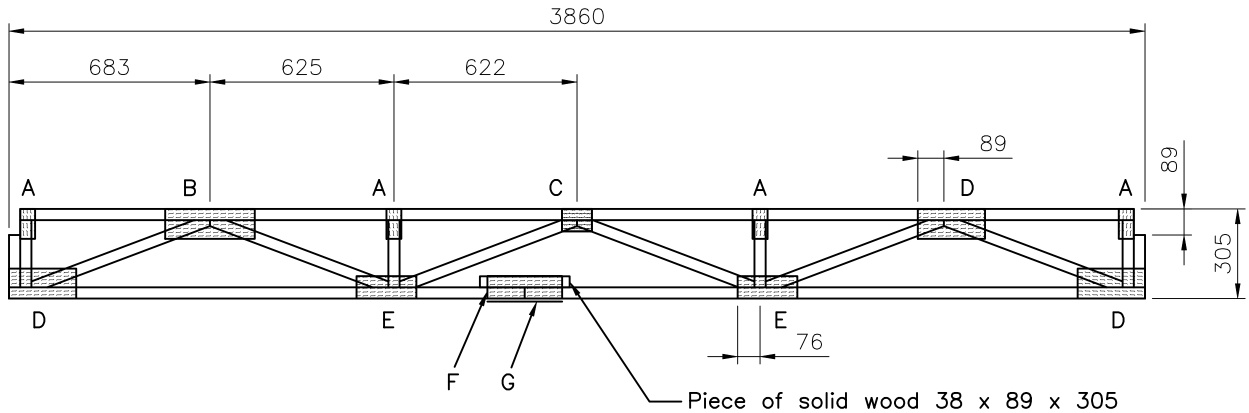
Figure C–29. Gypsum Board Face Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–47)

Figure C–30. Truss Layout (Wood Truss)



Truss members:
Truss members are made of solid wood lumber 38 x 89 Spruce–Pine–Fir #2 S–DRY O.L.M.A® 21 and NFP Mill #151 I.D. #2241

Plates:
TEE–LOK 20 plates 0.9 mm thick with 8 mm long teeth.
The number of teeth on the plate = plate area in $mm^2 \div 80.645$
All plates are centered in the middle of the joint except plates E and one of the plate D, see drawing for details.

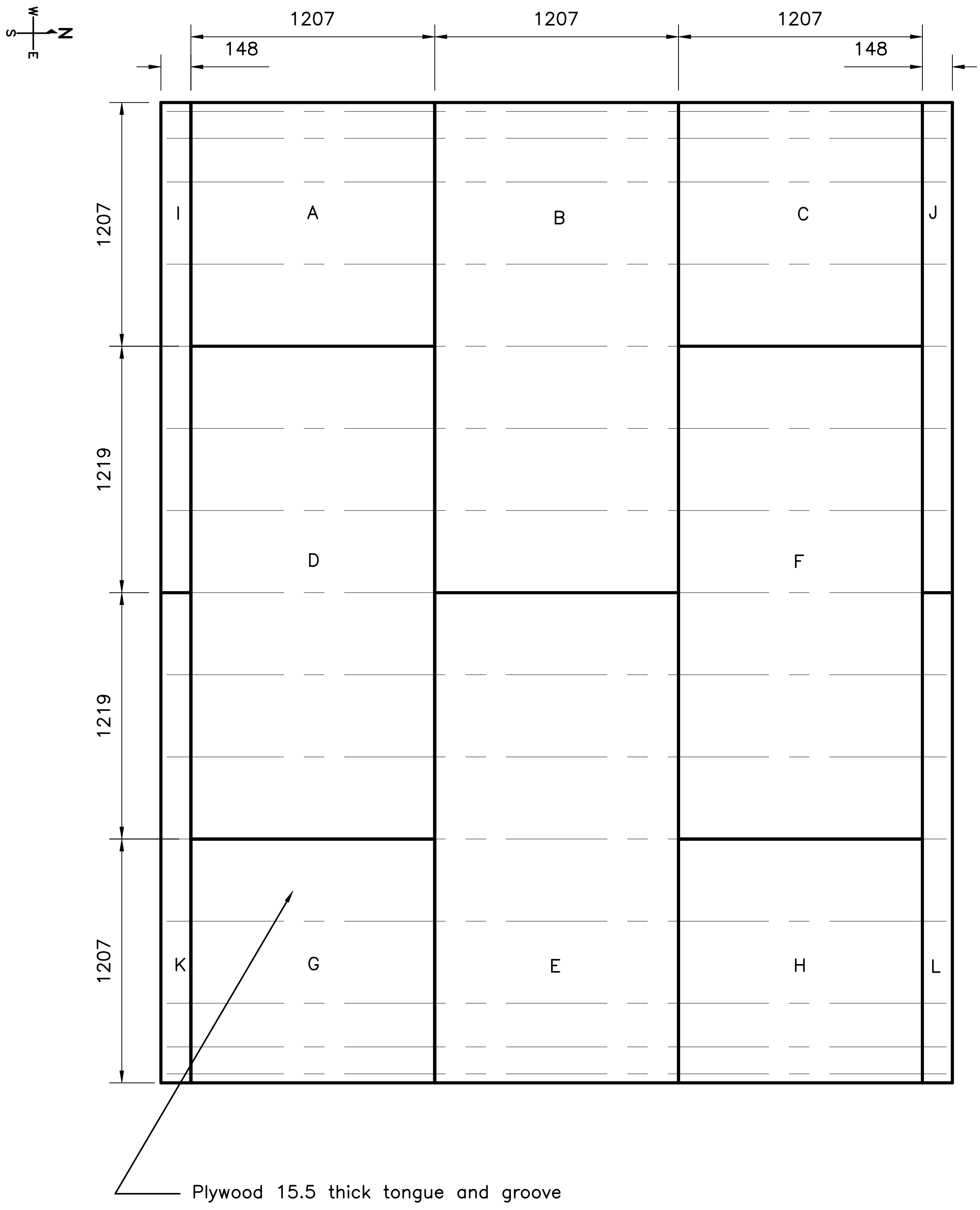
Plate size and location

A 50.8 x 101.6 both sides
B 304.8 x 101.6 both sides
C 101.6 x 76.2 both sides
D 228.6 x 101.6 both sides
E 203.2 x 76.2 both sides
F 254 x 76.2 both sides
G 254 x 76.2 both sides of bottom flange

(Dimensions are in millimetres)

(Assembly No. FF–47)

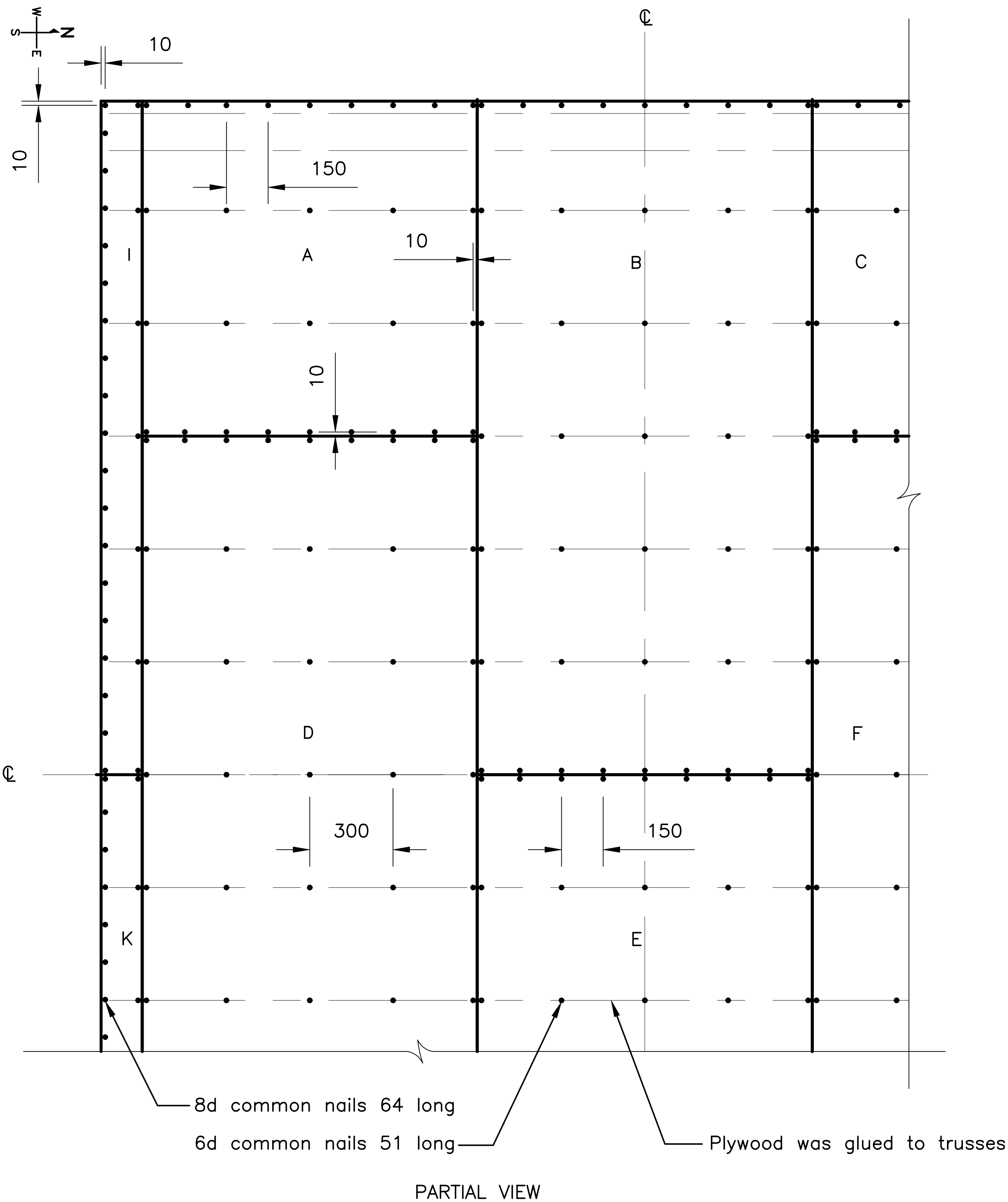
Figure C–31. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-47)

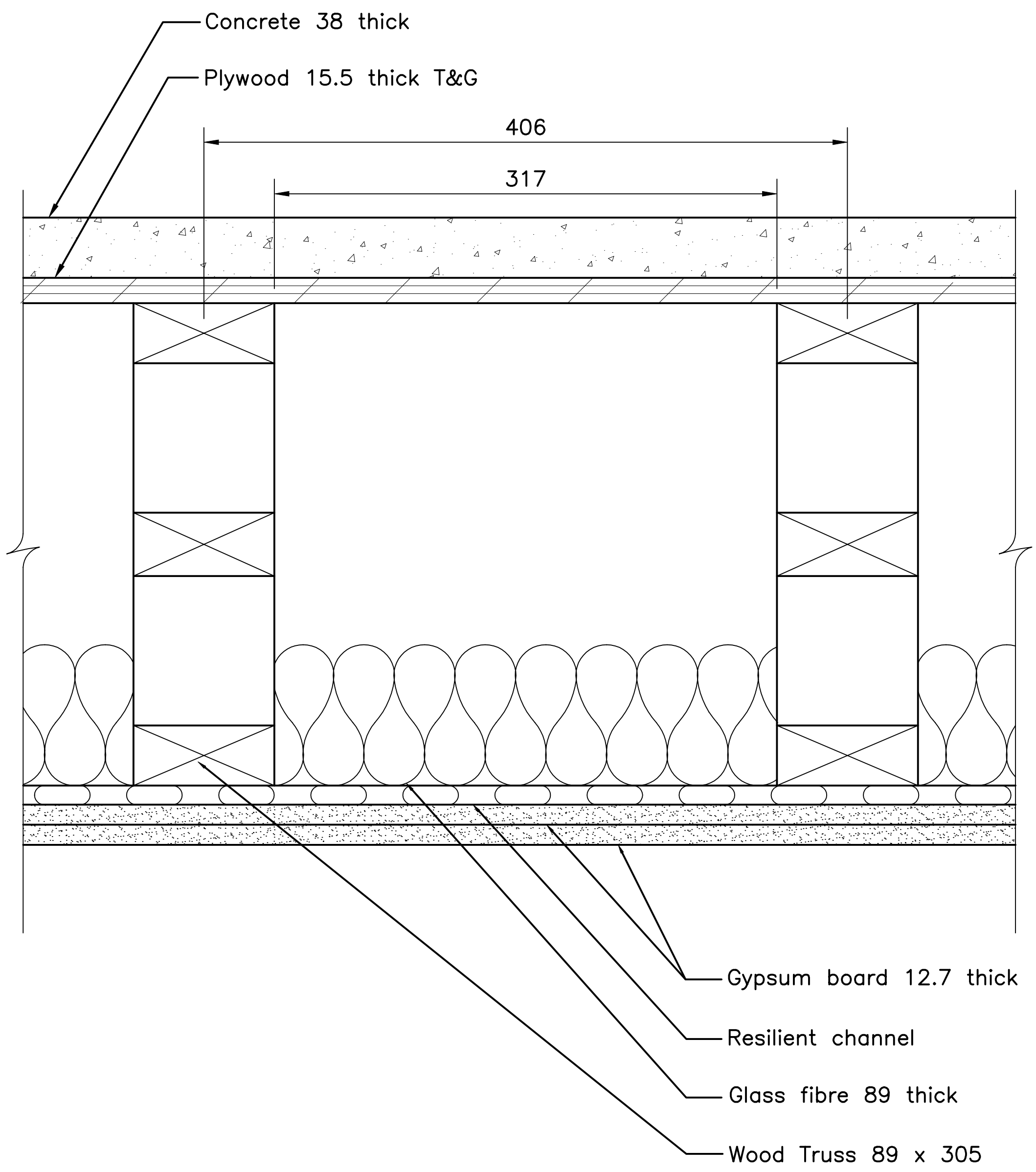
Figure C-32. Subfloor Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–47)

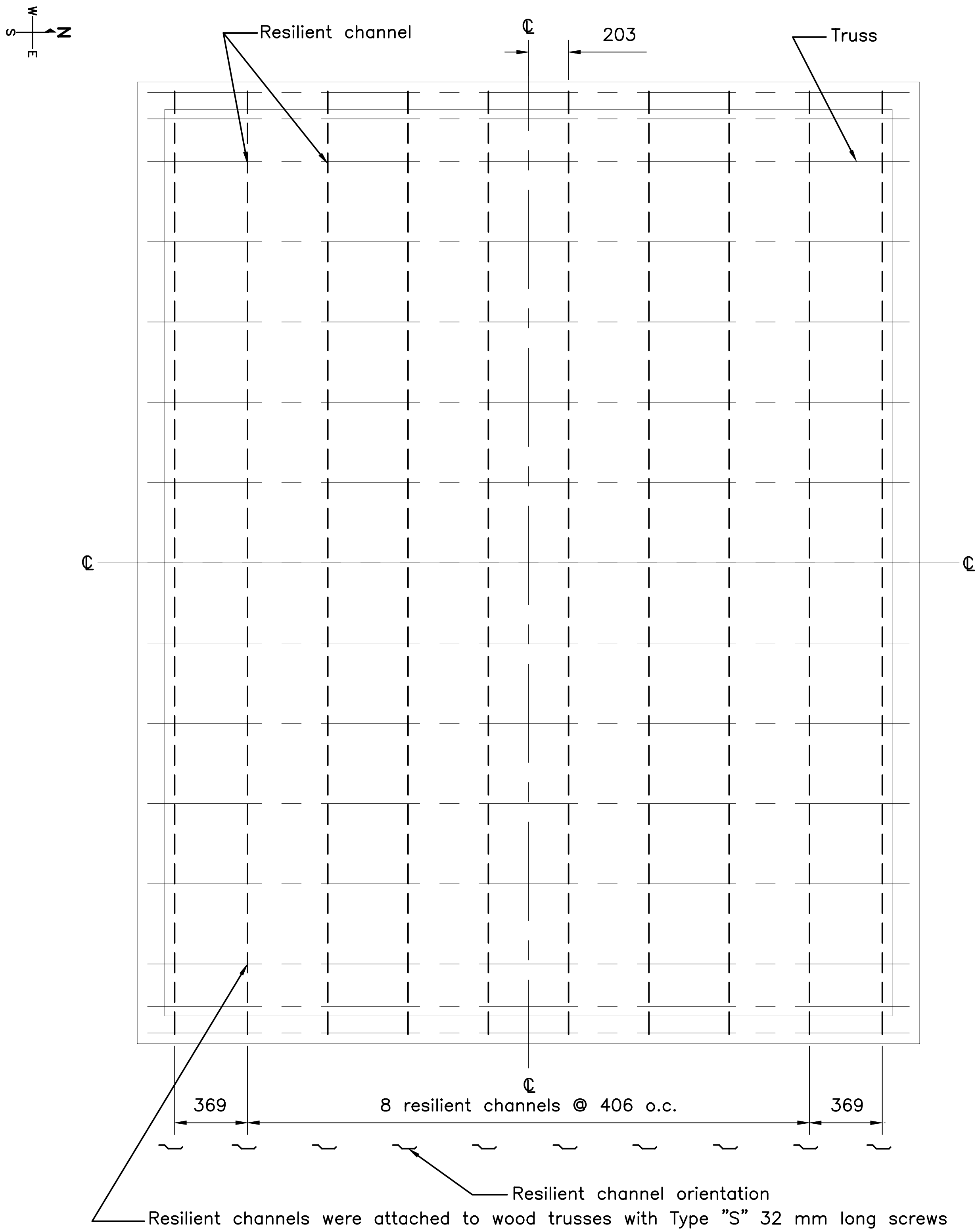
Figure C–33. Subfloor Nail Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-47)

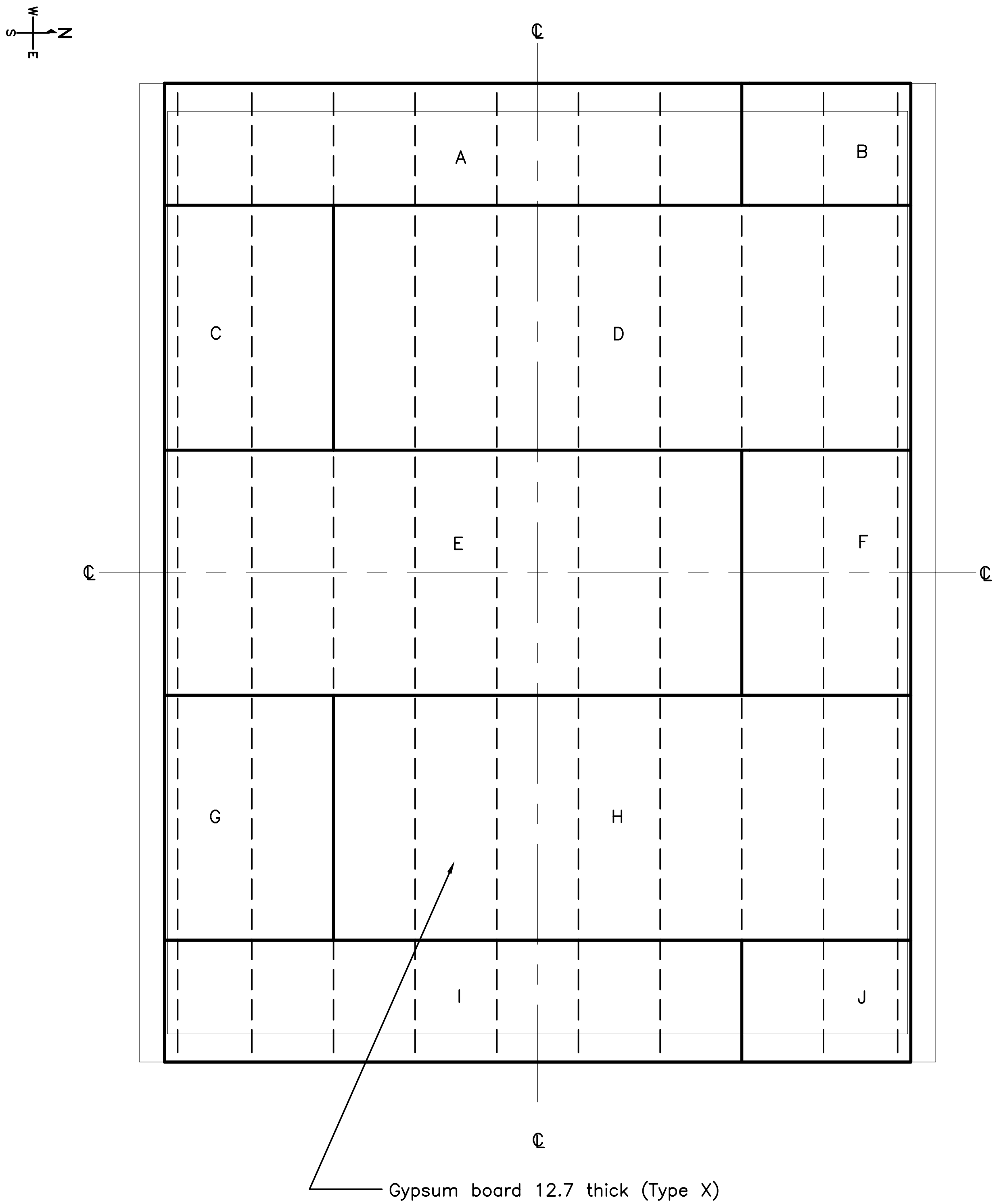
Figure C-34. Insulation Location (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–47)

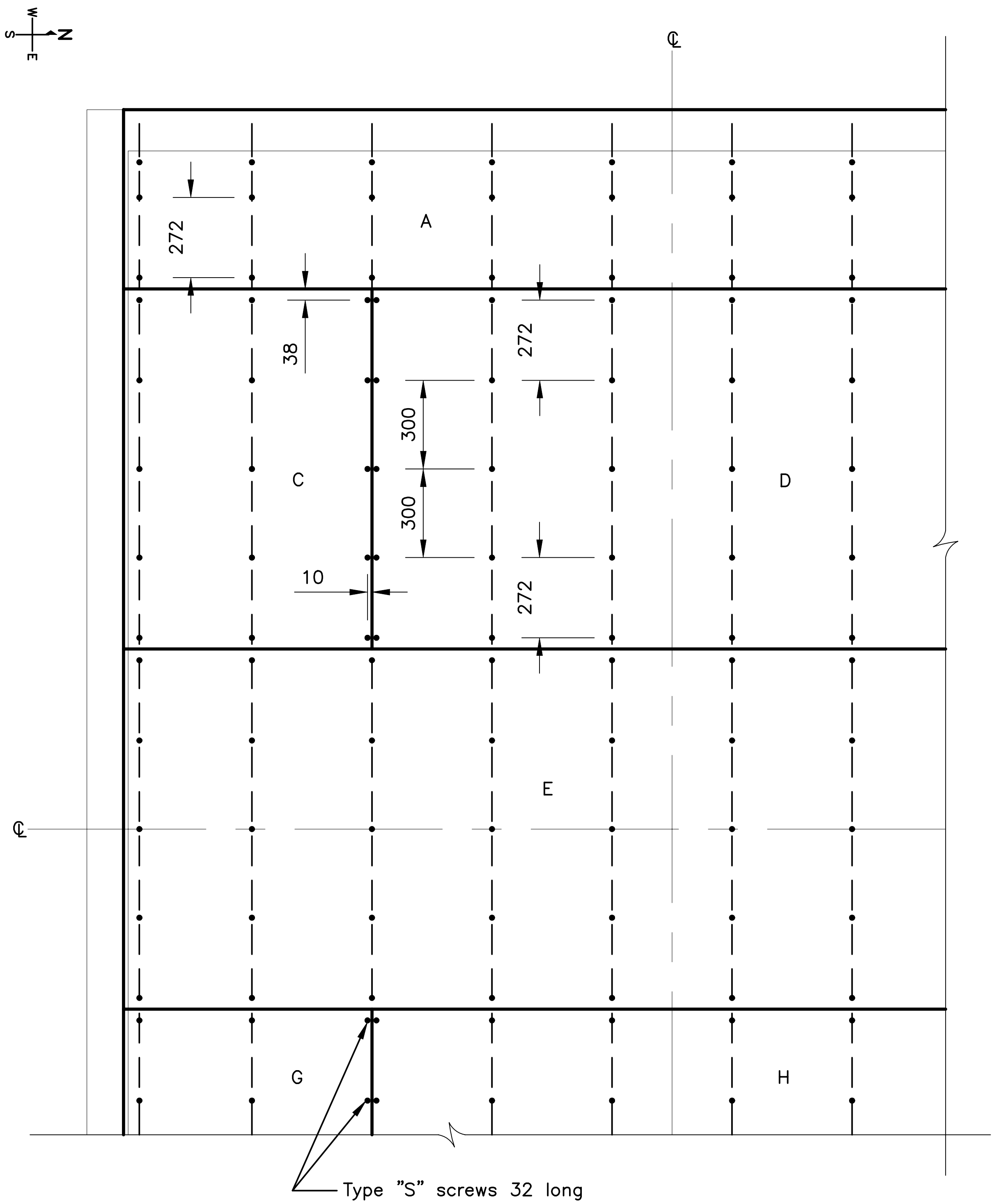
Figure C–35. Resilient Channel Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–47)

Figure C–36. Gypsum Board Base Layer Layout (Wood Truss)

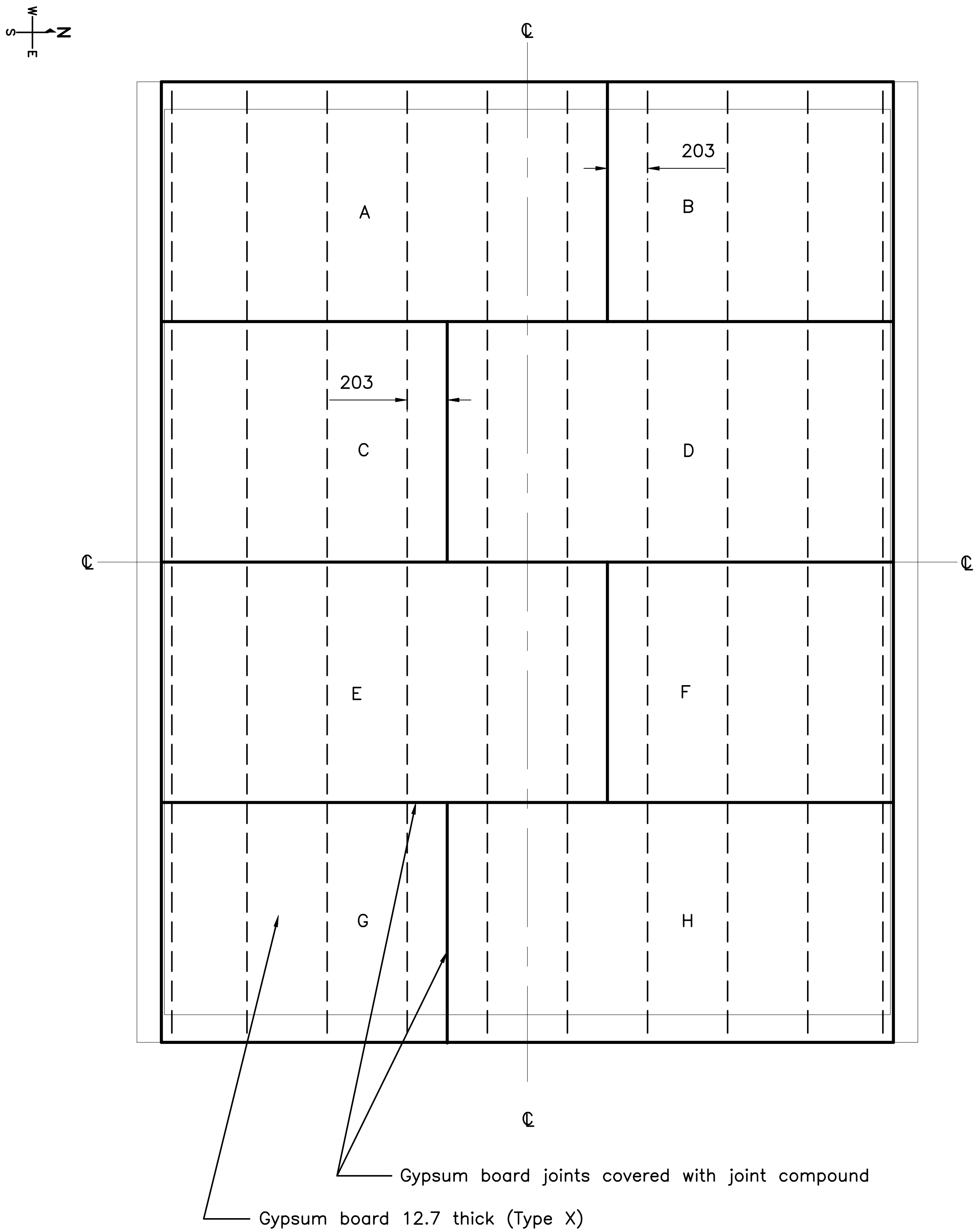


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF-47)

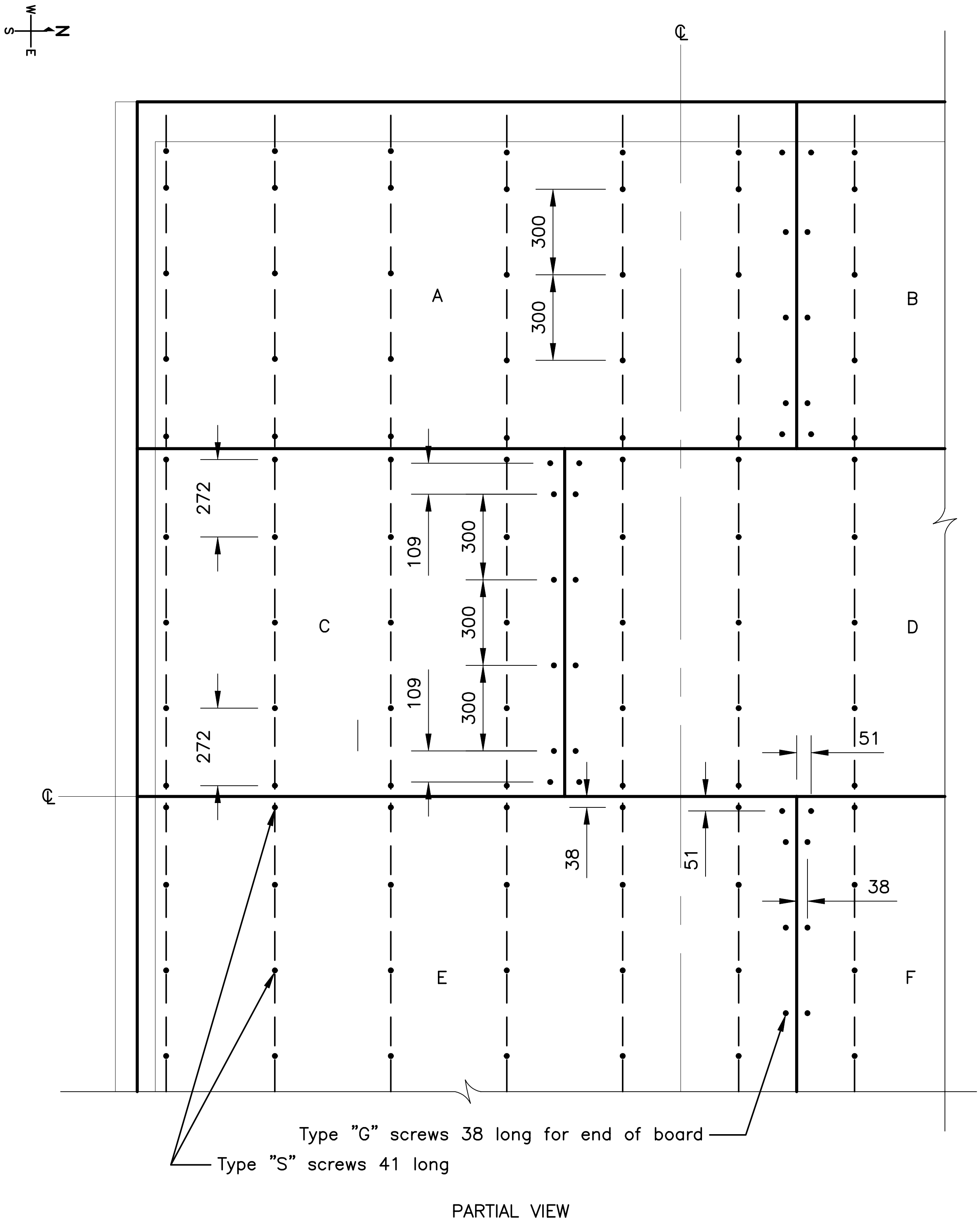
Figure C-37. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–47)

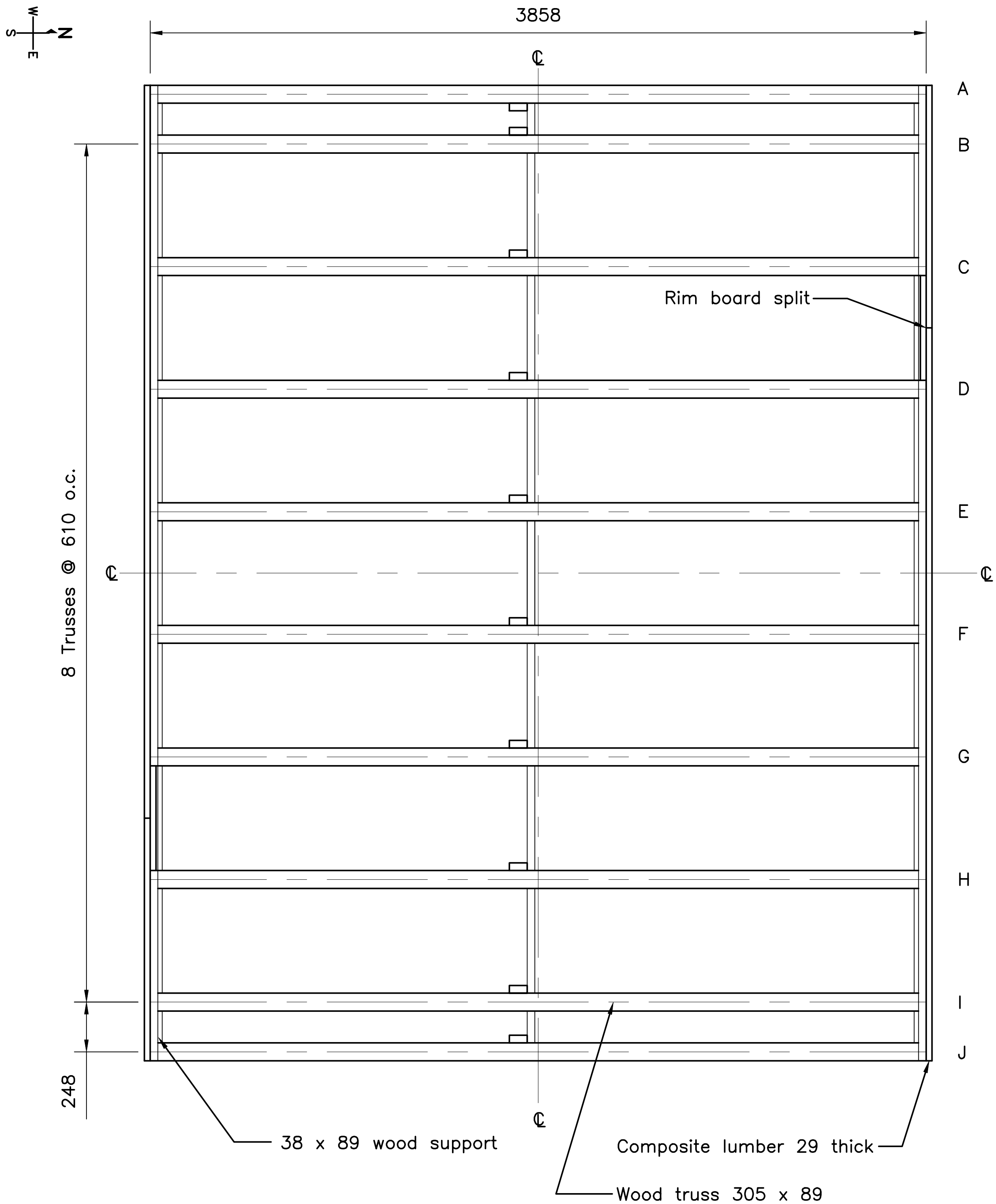
Figure C–38. Gypsum Board Face Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-47)

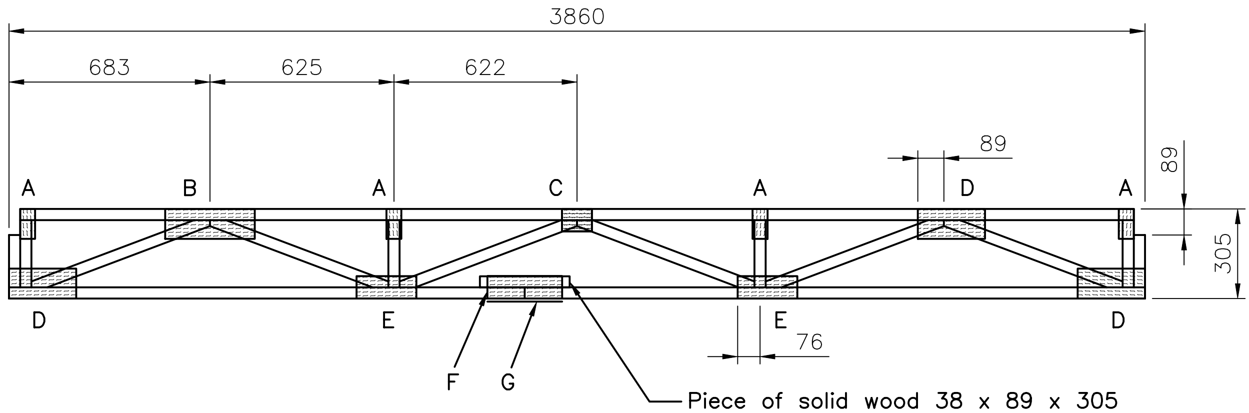
Figure C-39. Gypsum Board Face Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-48)

Figure C-40. Truss Layout (Wood Truss)



Truss members:
Truss members are made of solid wood lumber 38 x 89 Spruce–Pine–Fir #2 S–DRY O.L.M.A® 21 and NFP Mill #151 I.D. #2241

Plates:
TEE–LOK 20 plates 0.9 mm thick with 8 mm long teeth.
The number of teeth on the plate = plate area in mm² ÷ 80.645
All plates are centered in the middle of the joint except plates E and one of the plate D, see drawing for details.

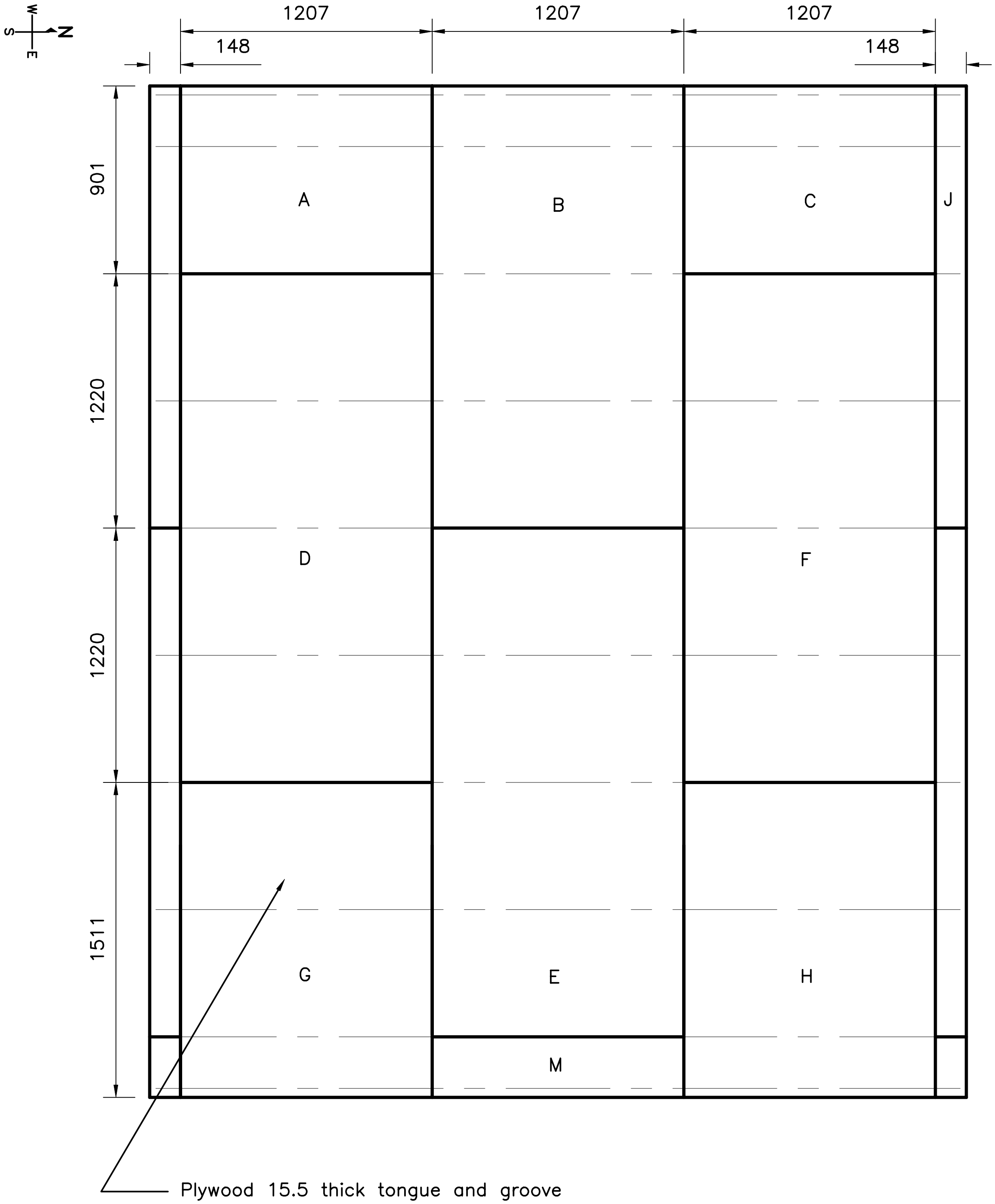
Plate size and location

A 50.8 x 101.6 both sides
B 304.8 x 101.6 both sides
C 101.6 x 76.2 both sides
D 228.6 x 101.6 both sides
E 203.2 x 76.2 both sides
F 254 x 76.2 both sides
G 254 x 76.2 both sides of bottom flange

(Dimensions are in millimetres)

(Assembly No. FF–48)

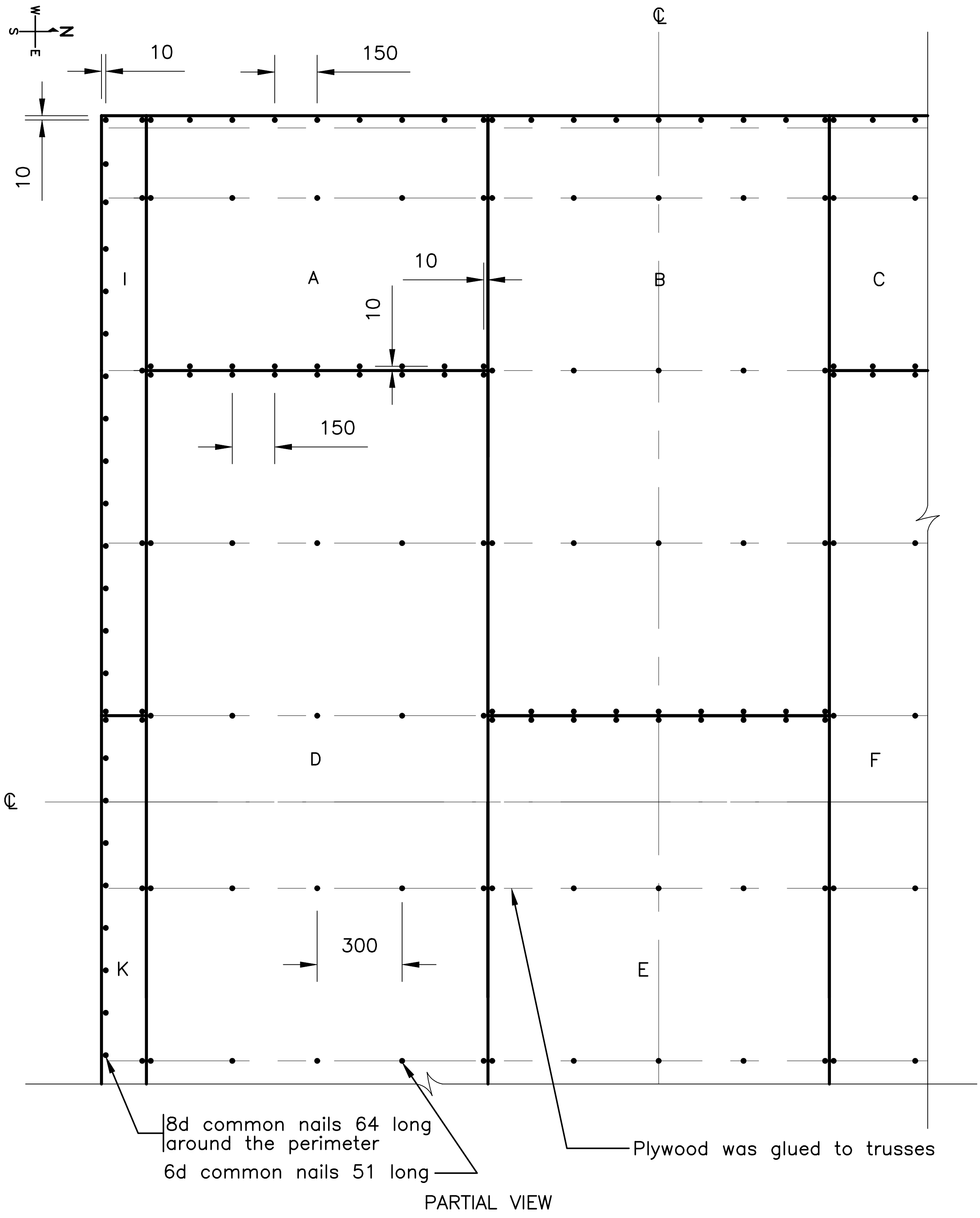
Figure C–41. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-48)

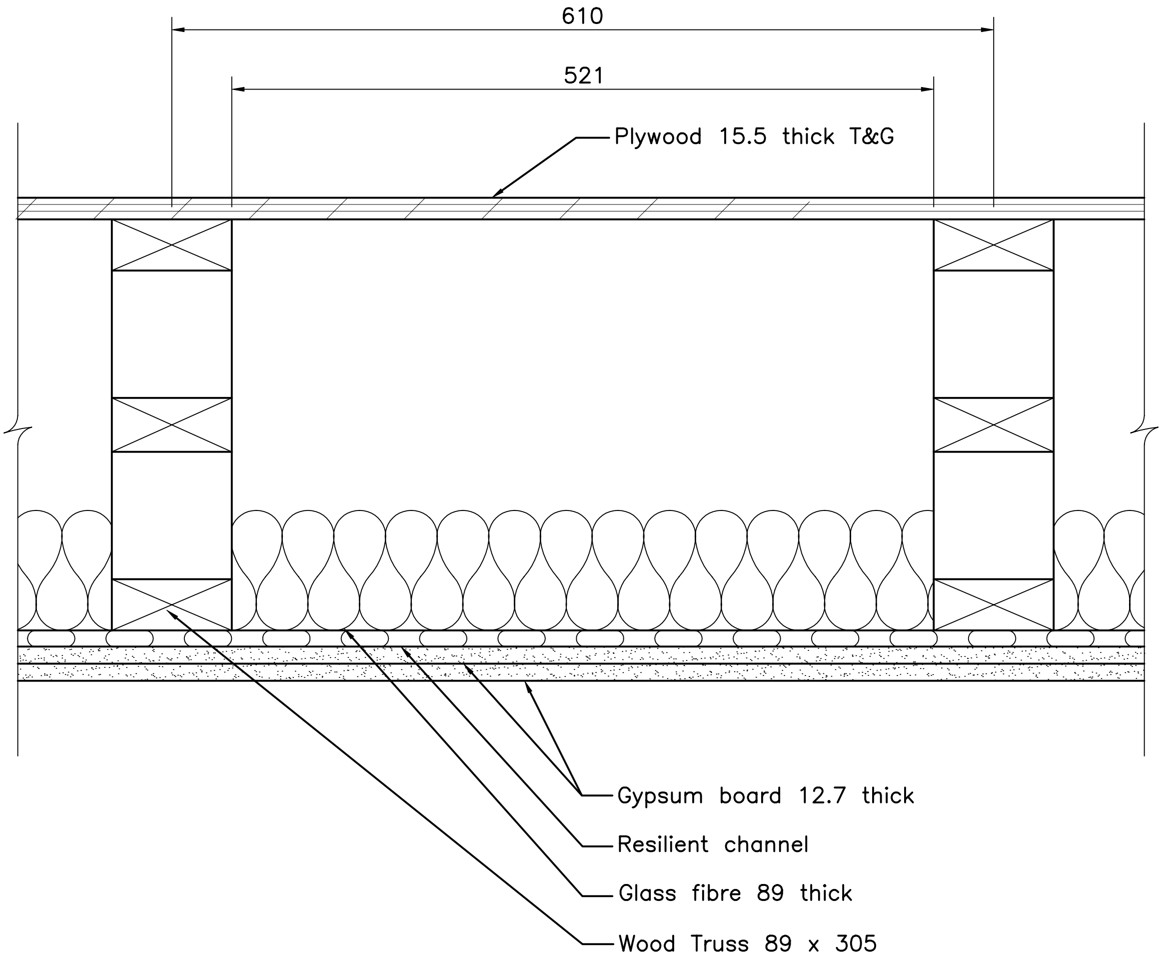
Figure C-42. Subfloor Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–48)

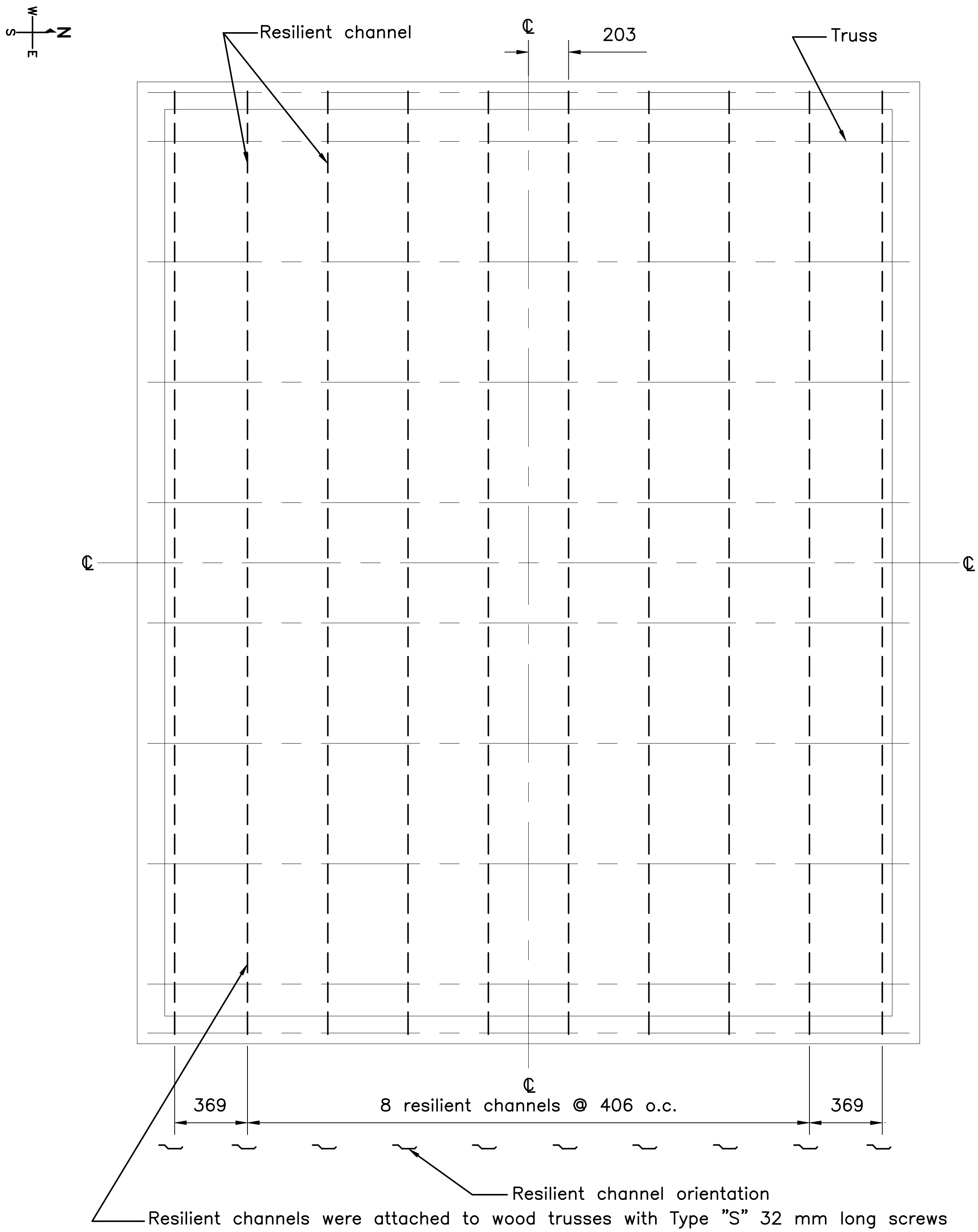
Figure C–43. Subfloor Nail Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–48)

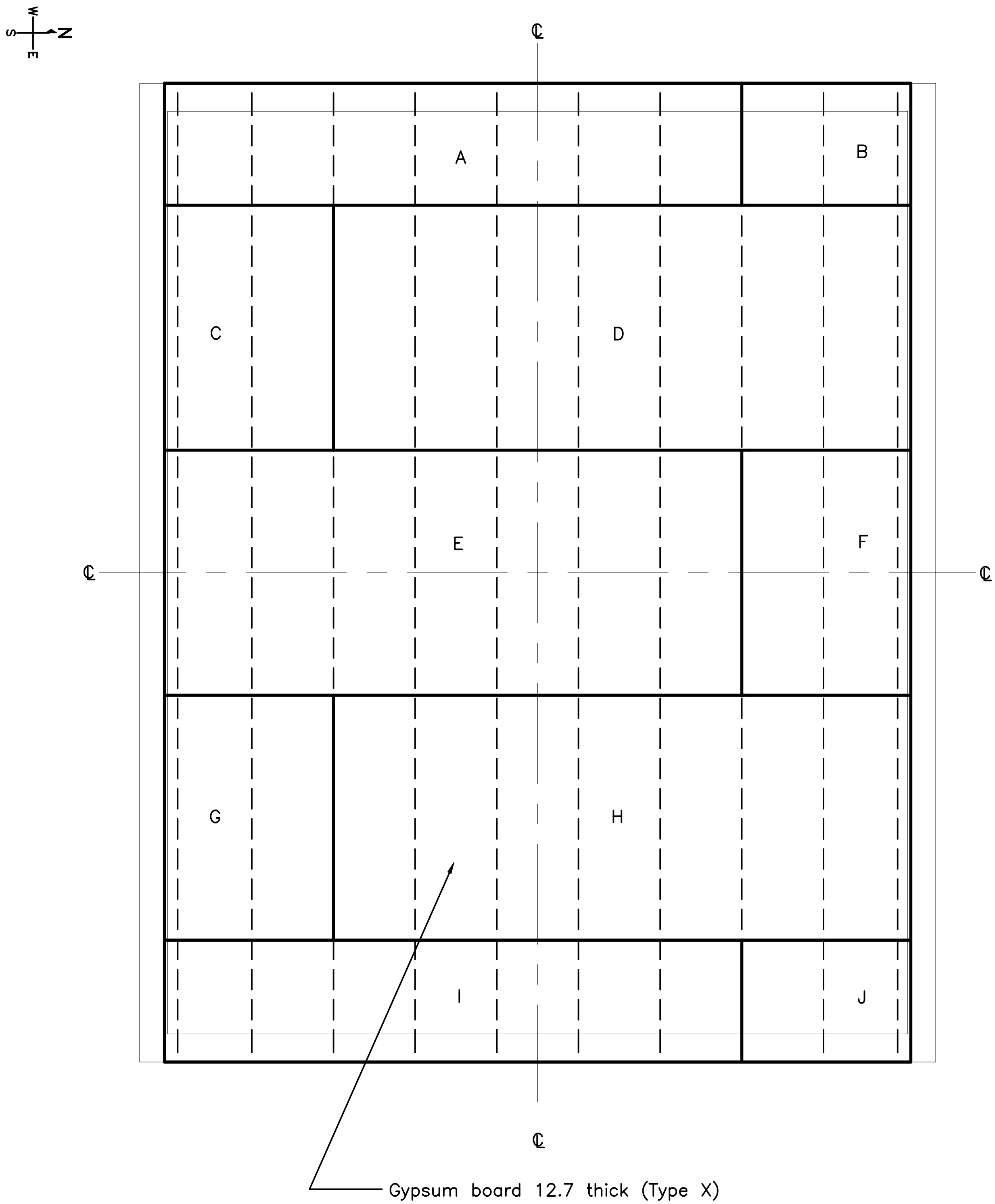
Figure C–44. Insulation Location (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–48)

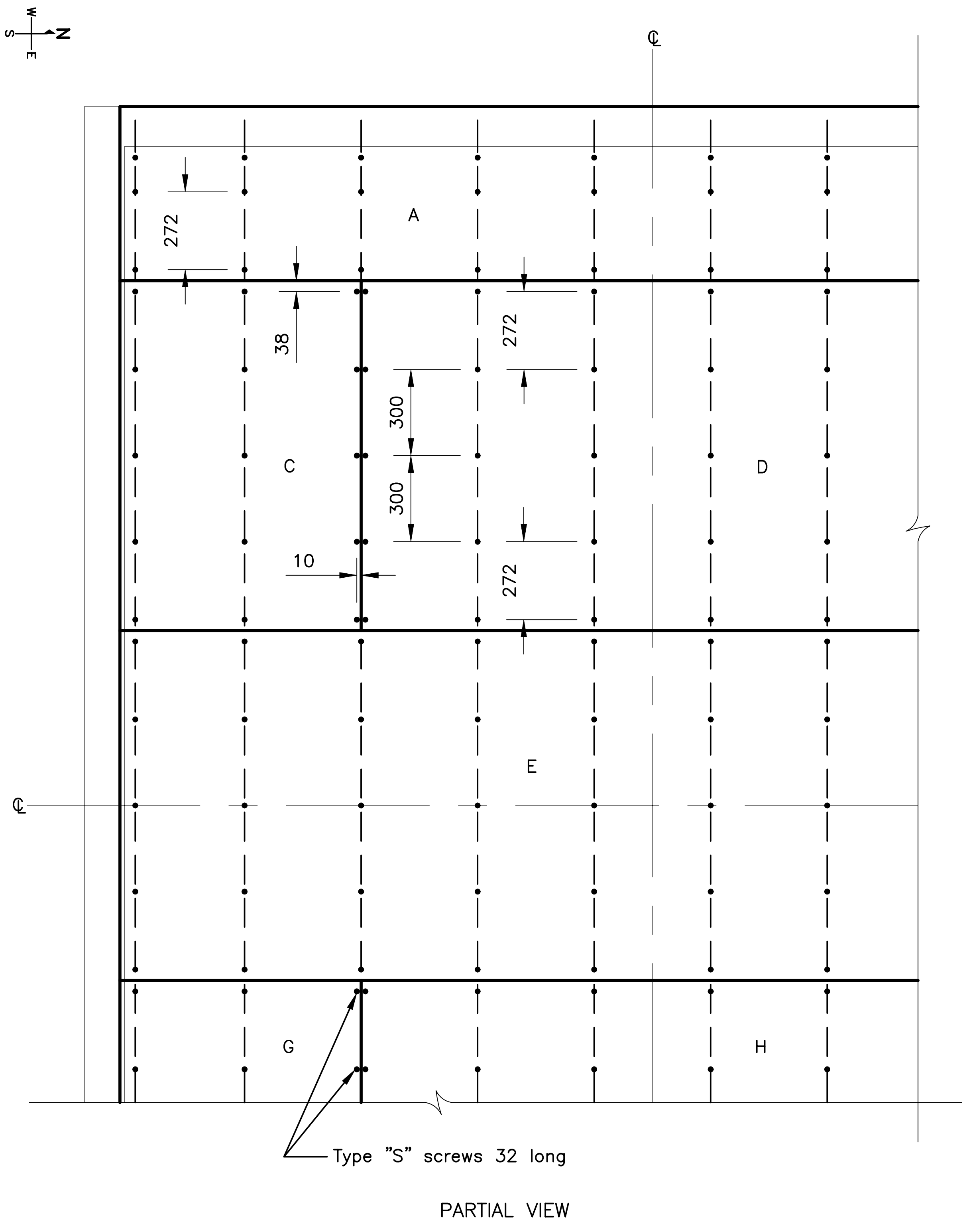
Figure C–45. Resilient Channel Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-48)

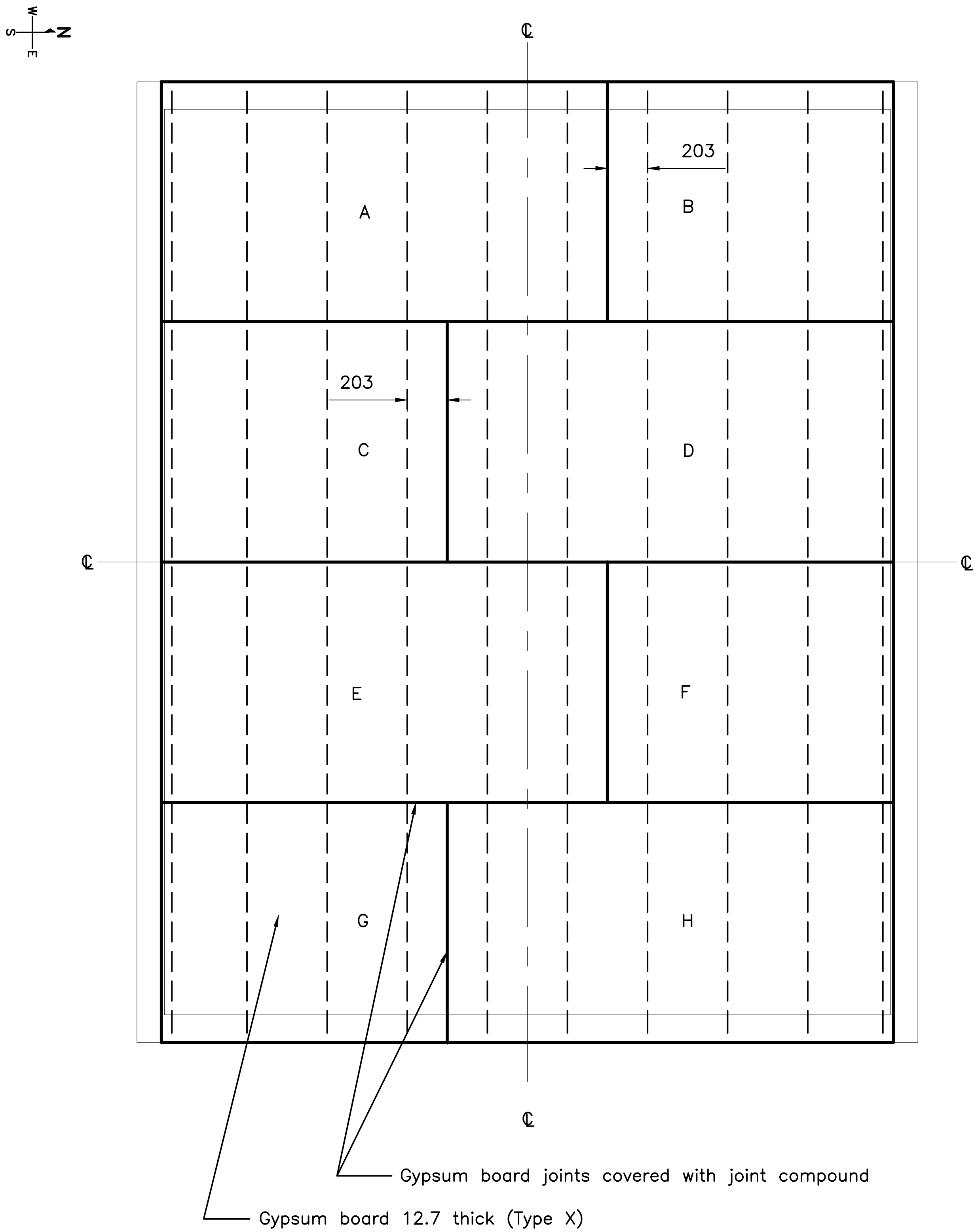
Figure C-46. Gypsum Board Base Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–48)

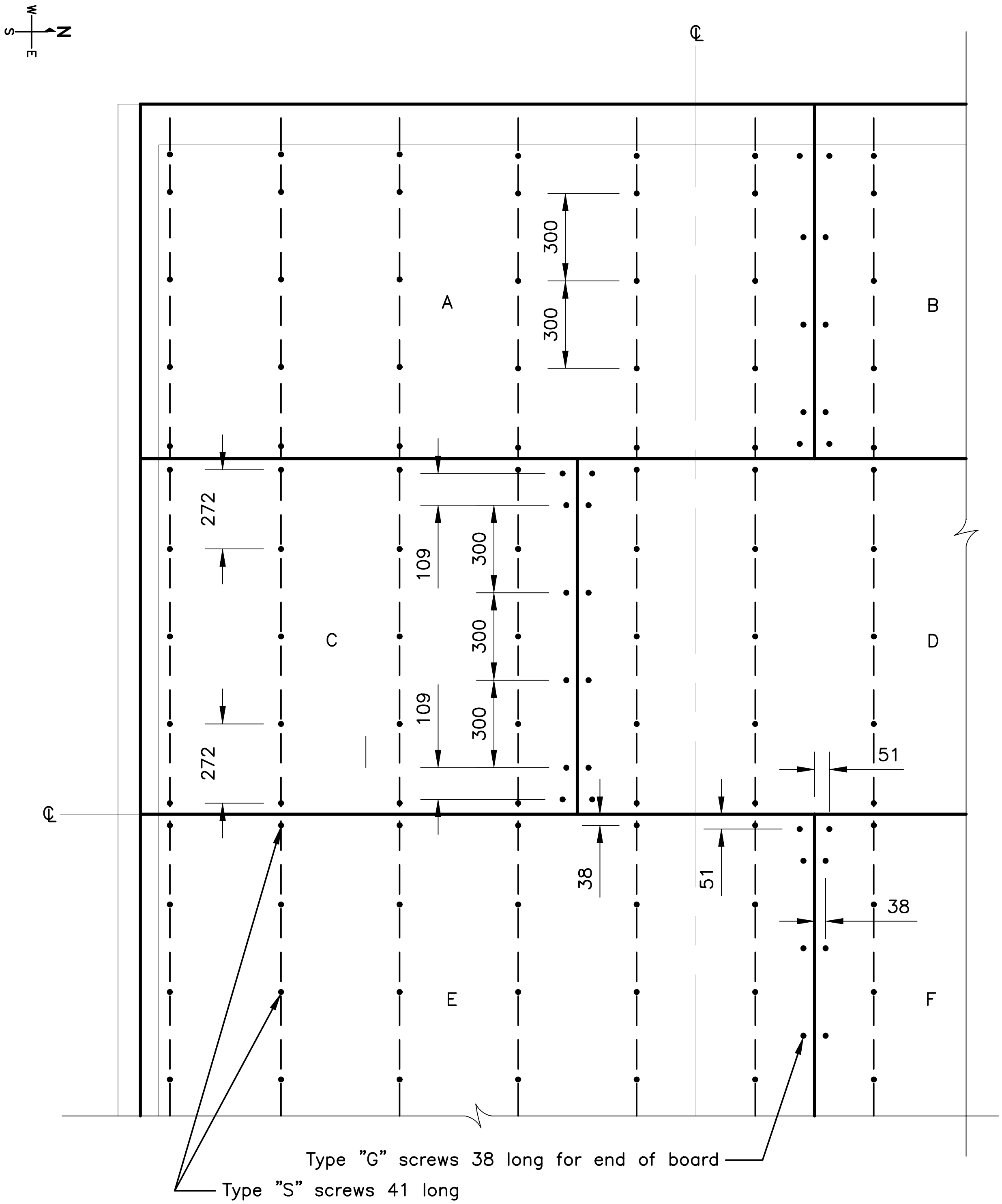
Figure C–47. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–48)

Figure C–48. Gypsum Board Face Layer Layout (Wood Truss)

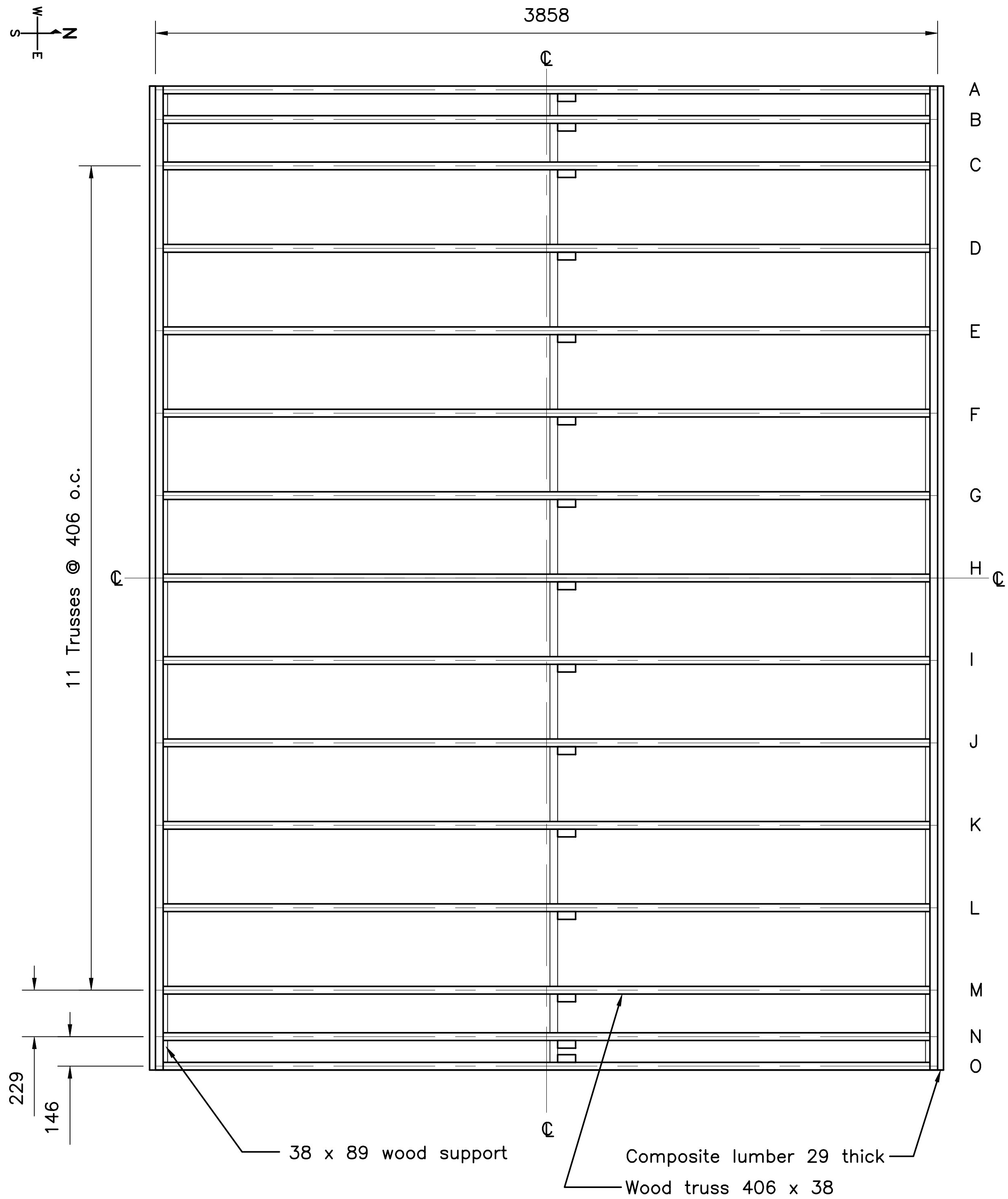


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF–48)

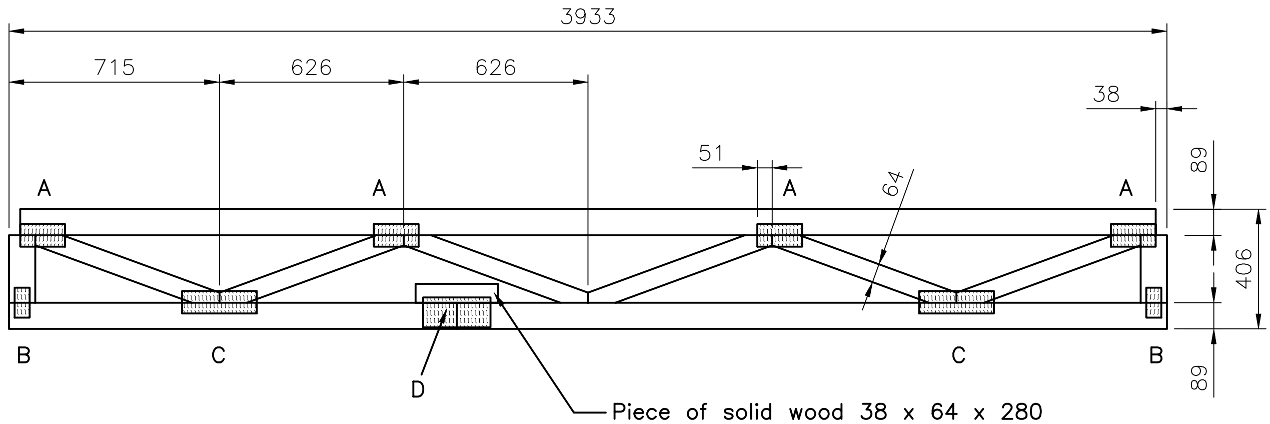
Figure C–49. Gypsum Board Face Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–56)

Figure C–50. Truss Layout (Wood Truss)



Truss:
The truss width is 38 mm

Truss members:
Truss members are made of solid wood lumber 38 x 64 Spruce–Pine–Fir #2 S–DRY O.L.M.A® 134

Plates:
TEE–LOK 20 plates 0.9 mm thick with 8 mm long teeth.
The number of teeth on the plate = plate area in mm² ÷ 80.645
All plates are centered in the middle of the joints except two of the plates A, see drawing for details.

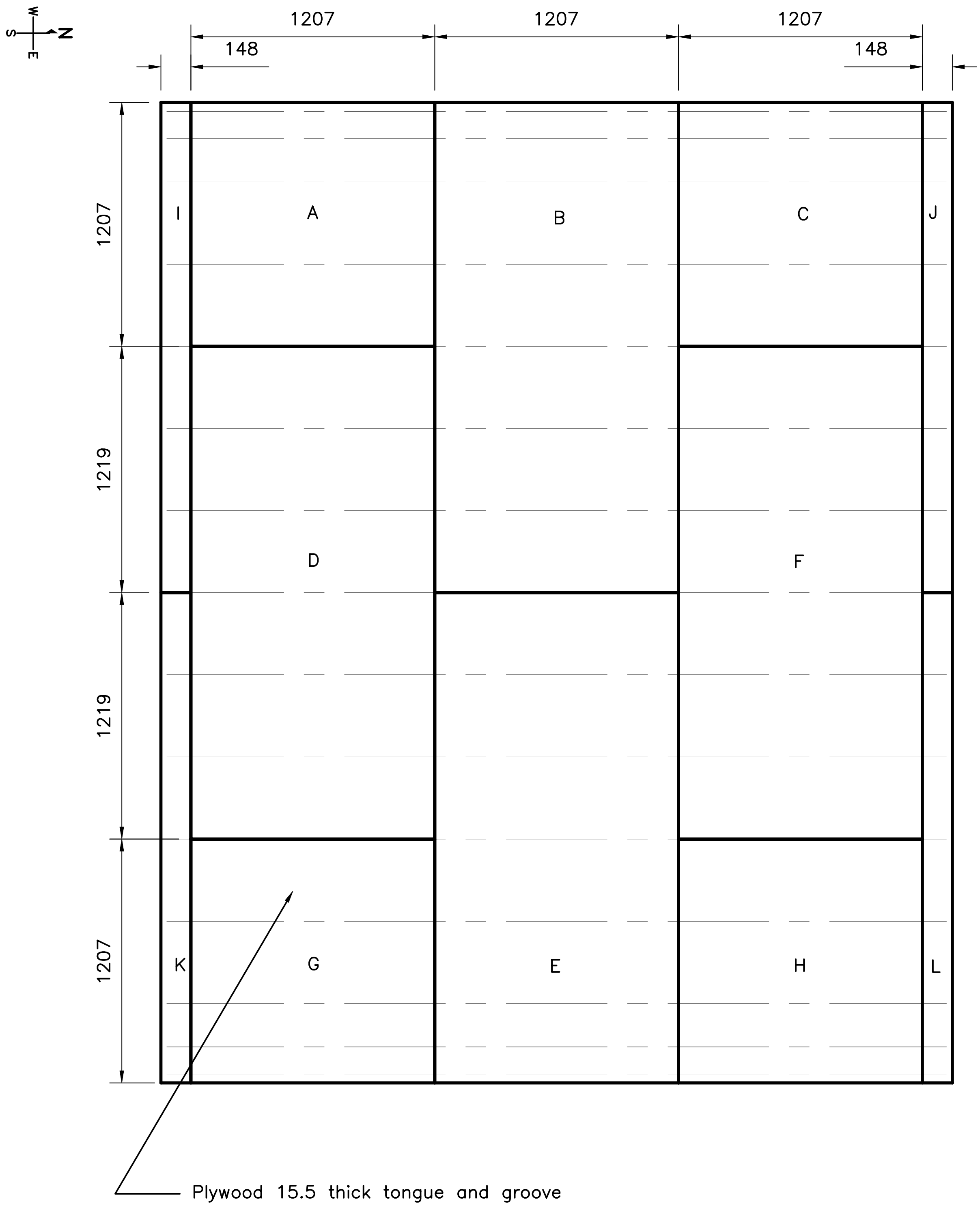
Plate size and location

A 152.4 x 76.2 both sides
B 50.8 x 101.6 both sides
C 254 x 76.2 both sides
D 228.6 x 101.6 both sides

(Dimensions are in millimetres)

(Assembly No. FF–56)

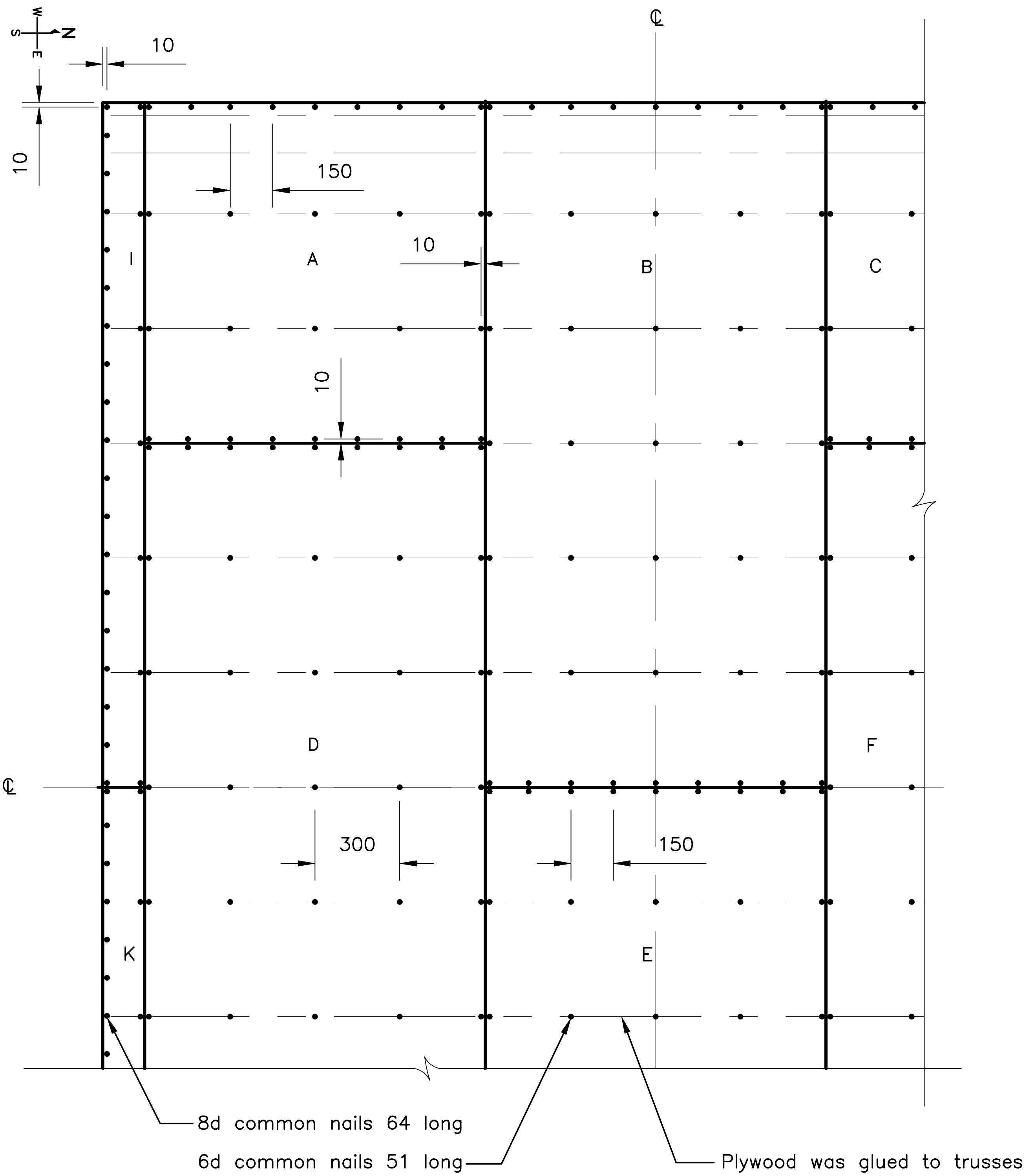
Figure C–51. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–56)

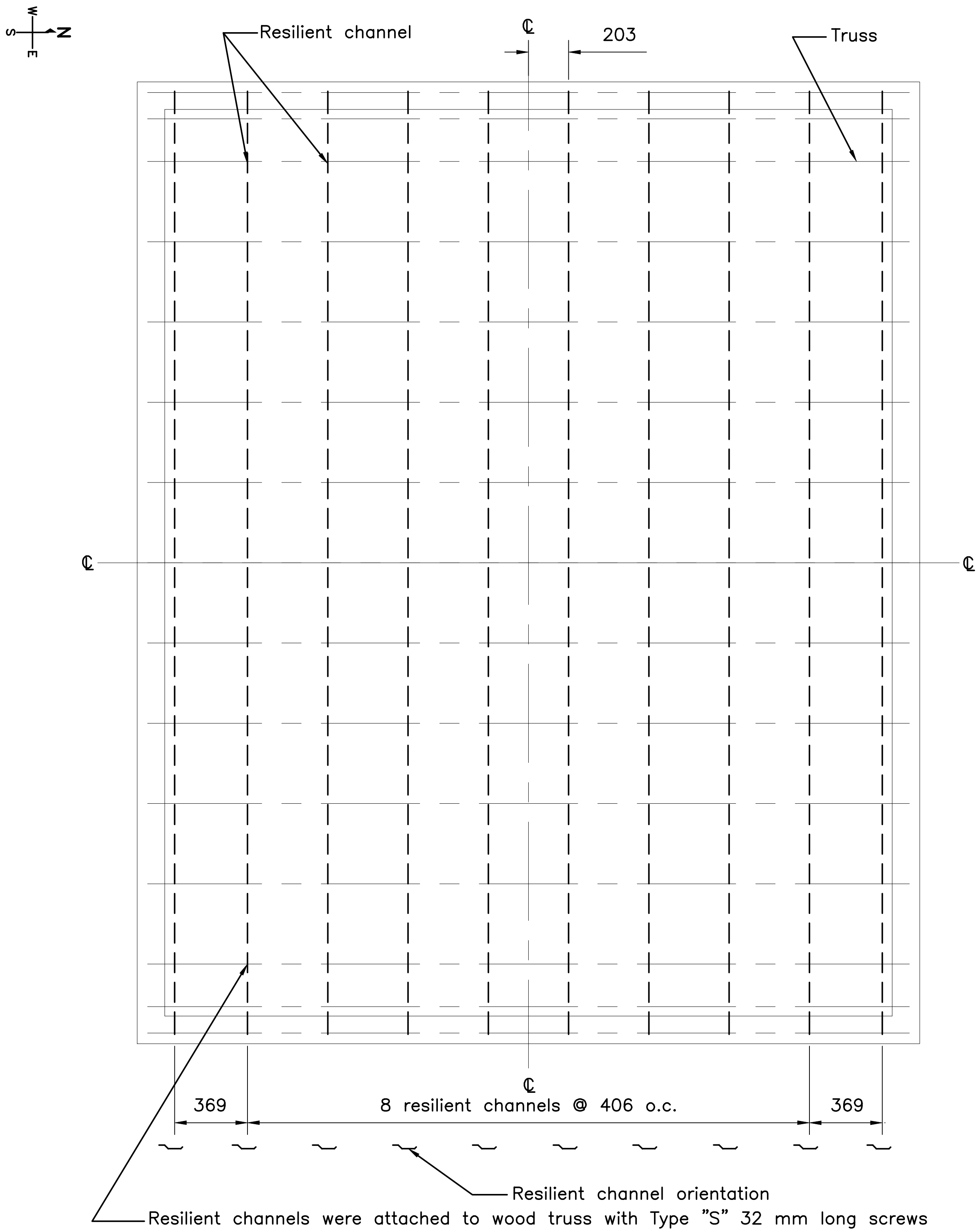
Figure C–52. Subfloor Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–56)

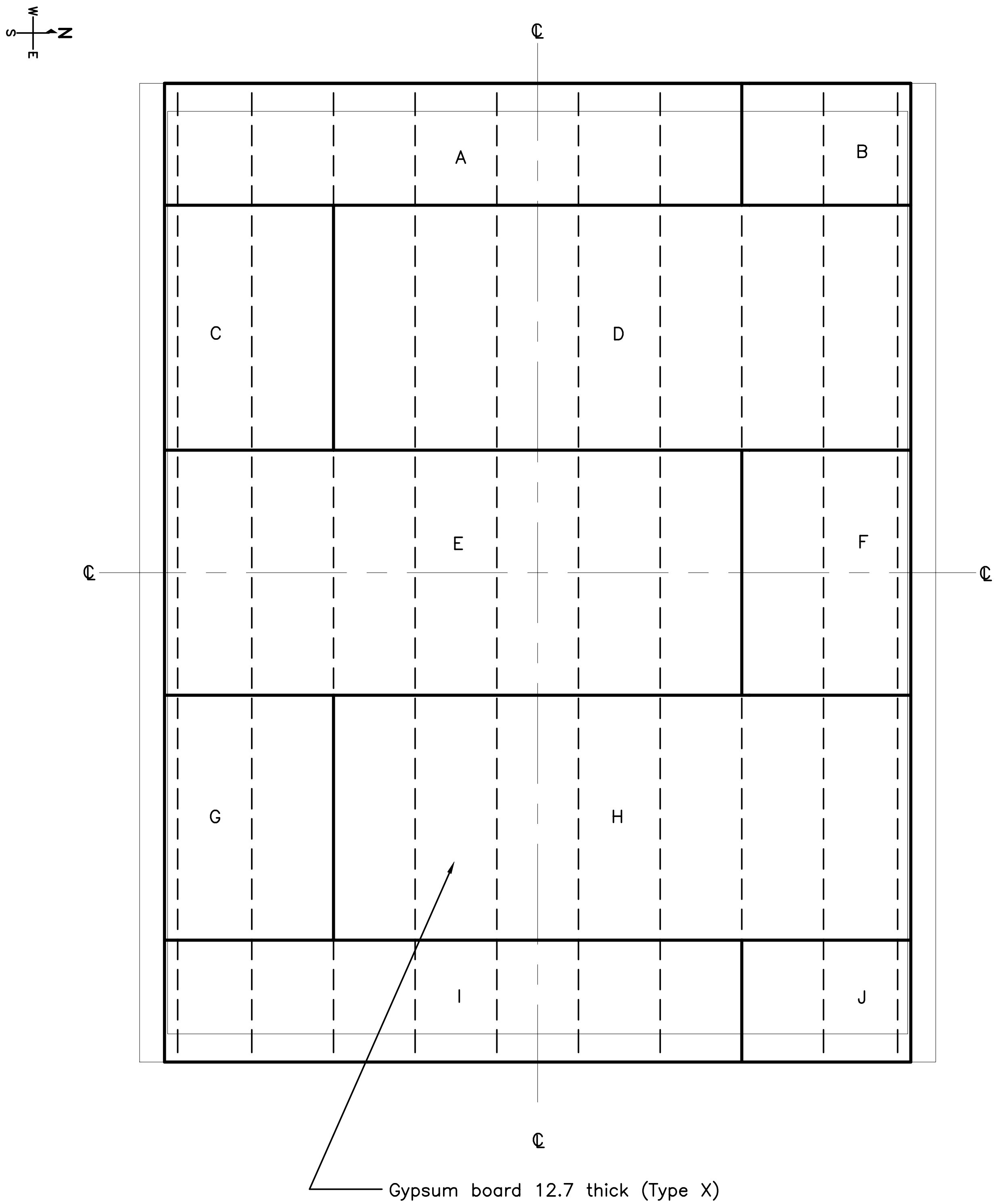
Figure C–53. Subfloor Nail Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–56)

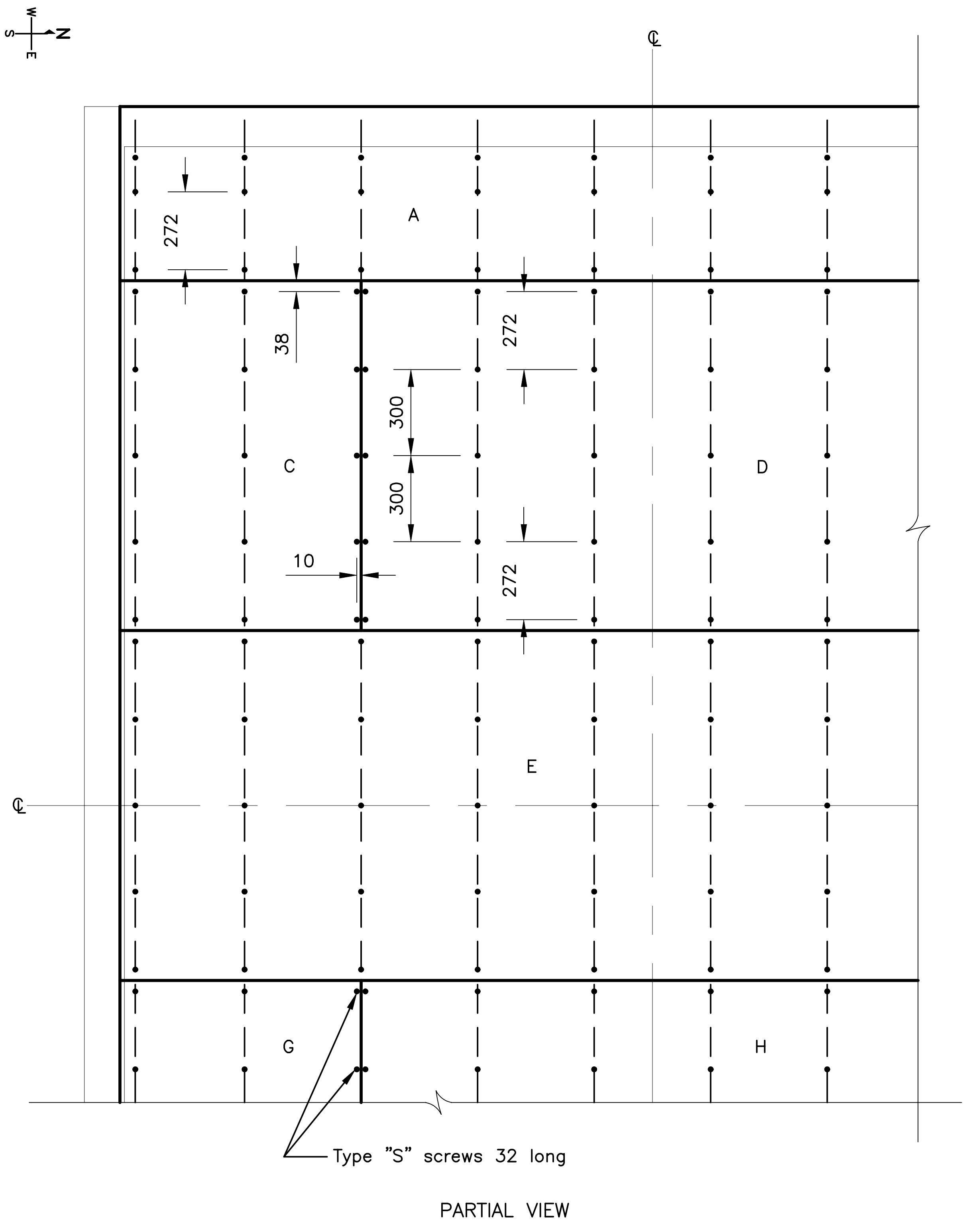
Figure C–54. Resilient Channel Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–56)

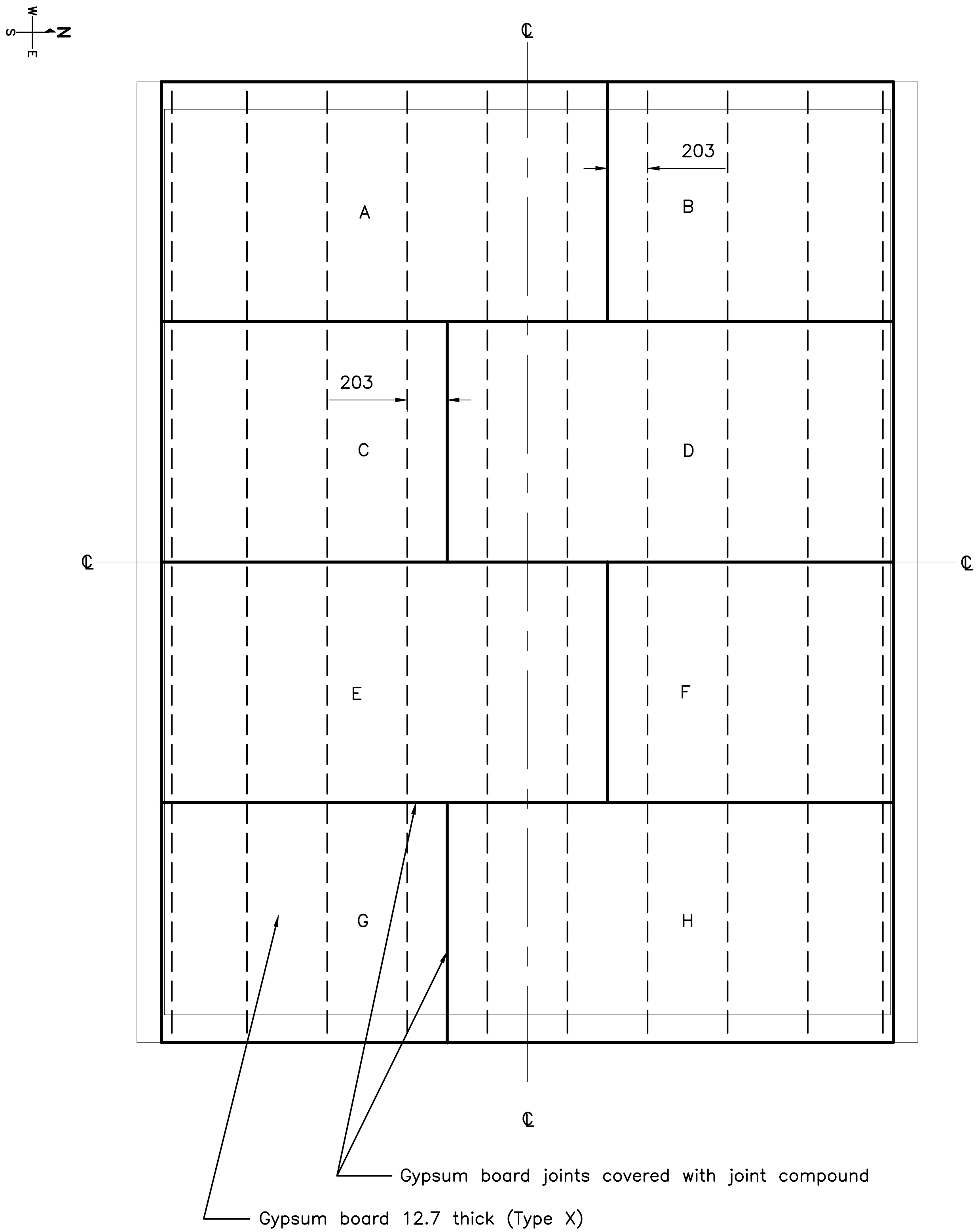
Figure C–55. Gypsum Board Base Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–56)

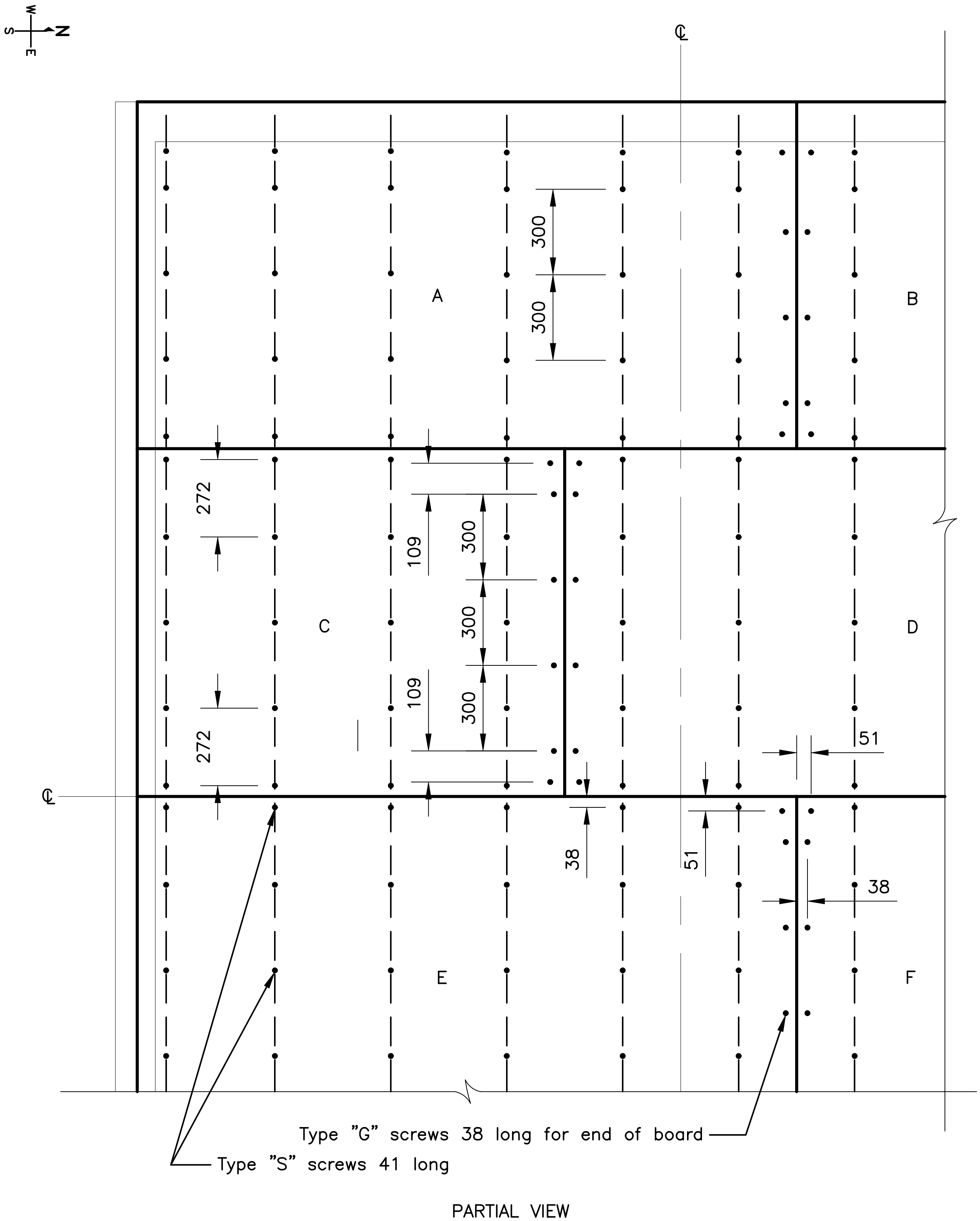
Figure C–56. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–56)

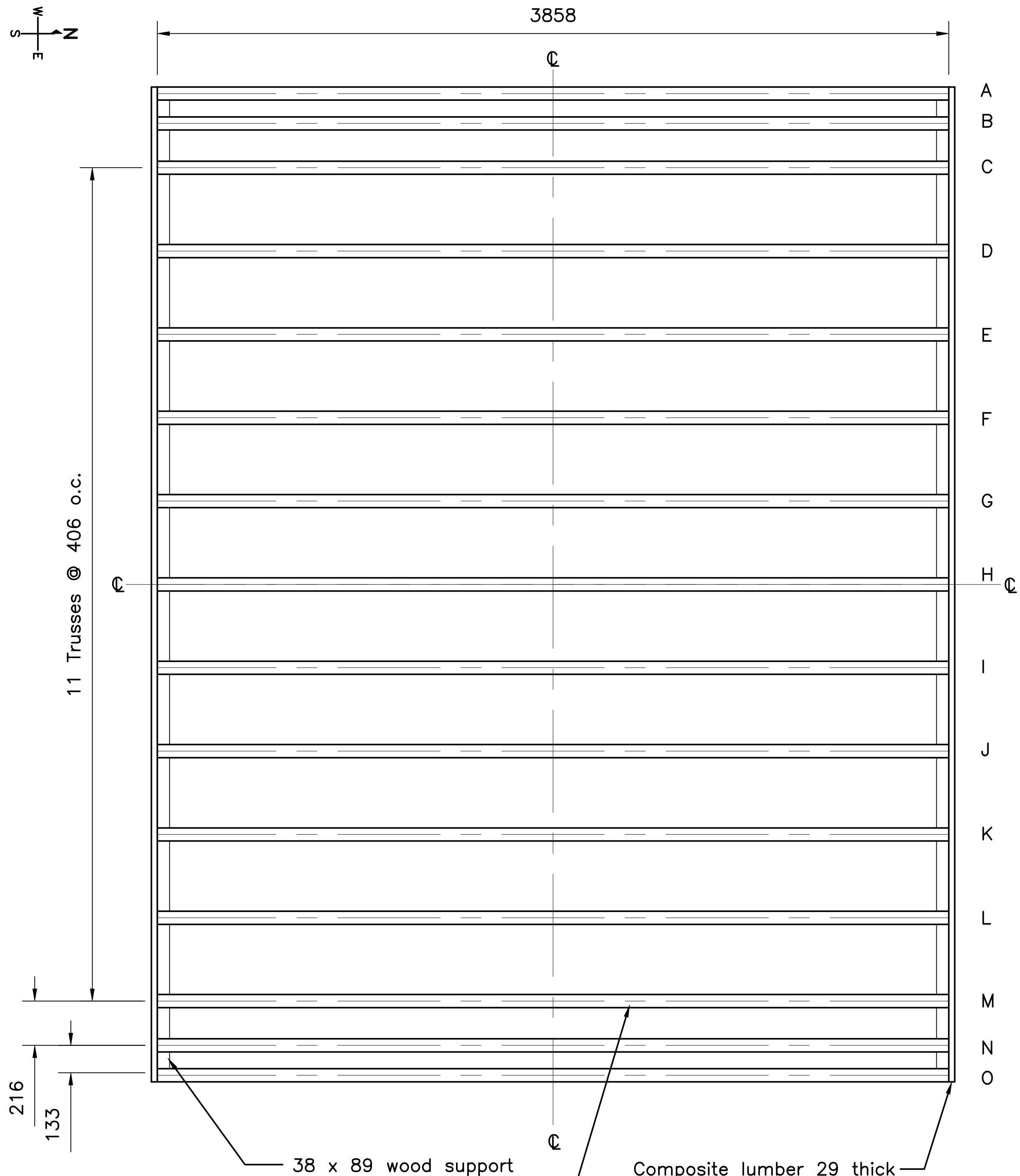
Figure C–57. Gypsum Board Face Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-56)

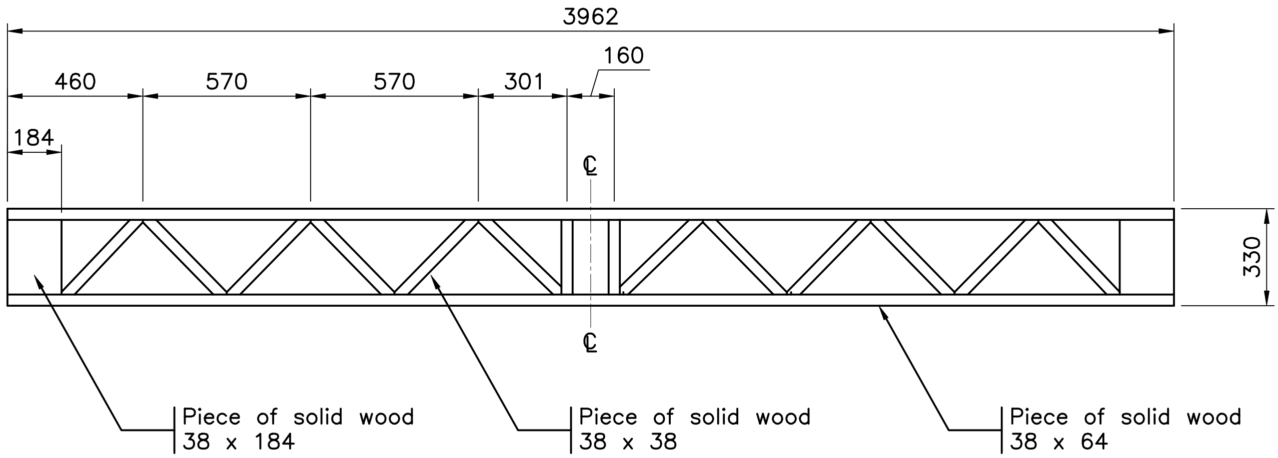
Figure C-58. Gypsum Board Face Layer Screw Pattern (Wood Truss)

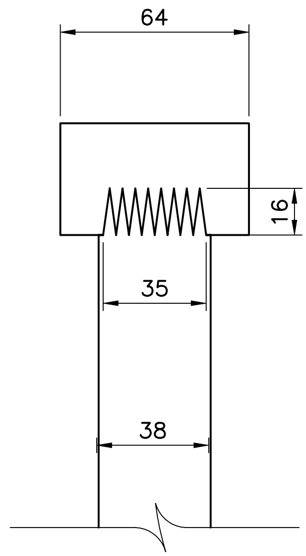


(Dimensions are in millimetres)

(Assembly No. FF–58)

Figure C–59. Truss Layout (Wood Truss)





Side view of joint detail

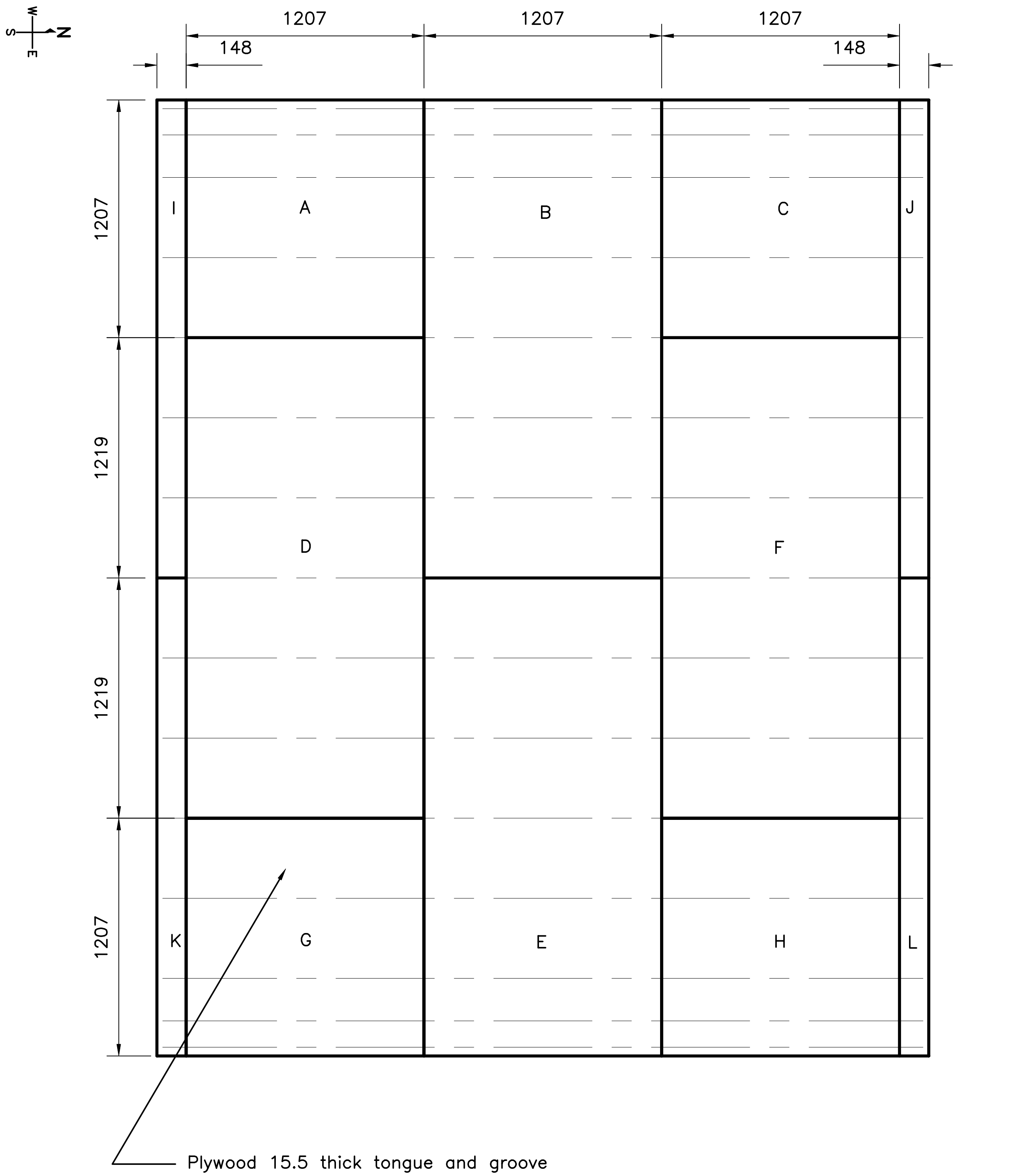
Truss:

The flanges of the truss are made of solid wood lumber 38 x 64 Spruce–Pine–Fir #2 S–DRY. The members between the flanges are made of solid wood lumber 38 x 38 Spruce–Pine–Fir #2 S–DRY. All members of the truss are assembled with a glued finger jointed connection. The large pieces of solid wood at both end of the truss allowed the truss to be trimmed to the required length.

(Dimensions are in millimetres)

(Assembly No. FF–58)

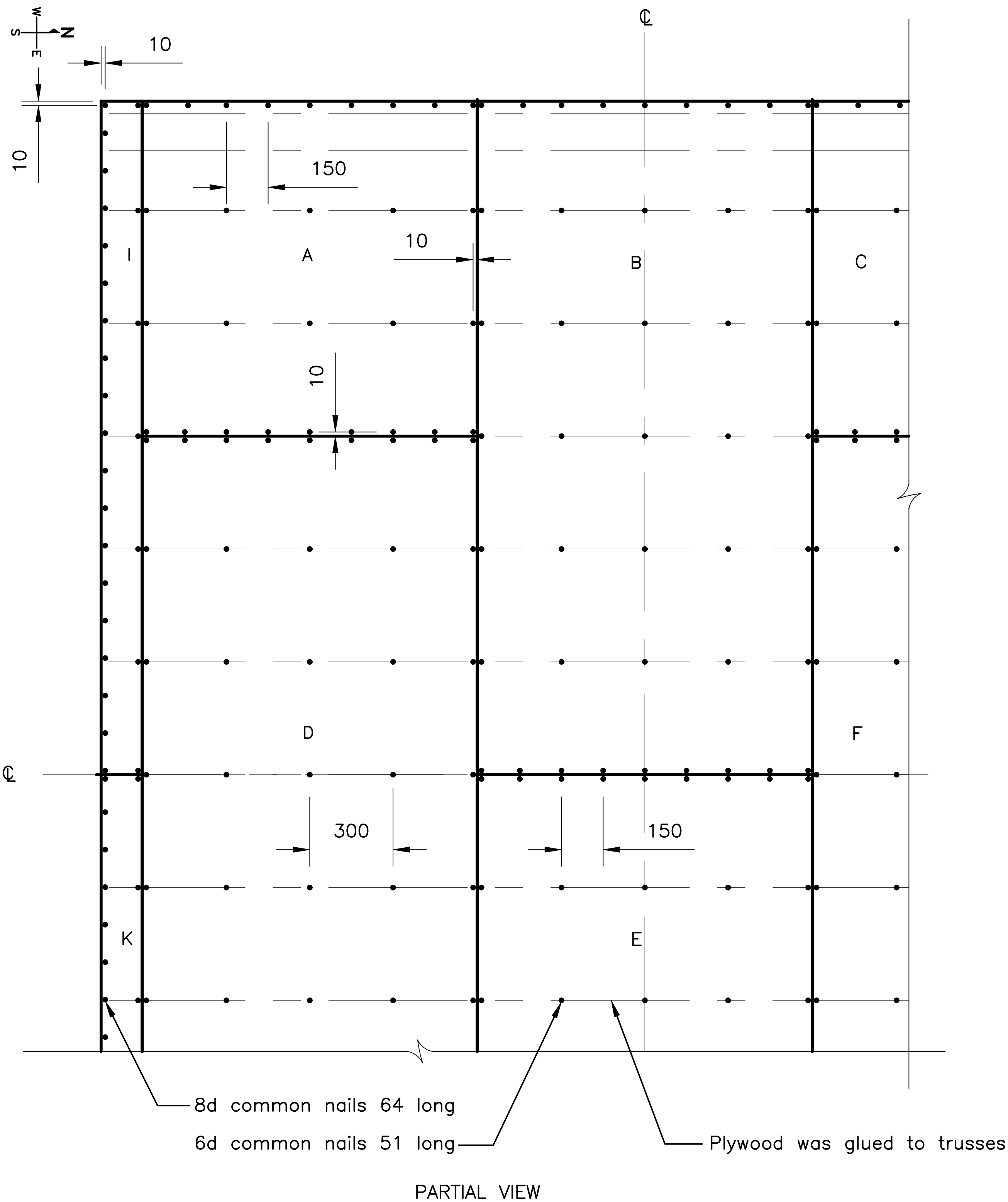
Figure C–60. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–58)

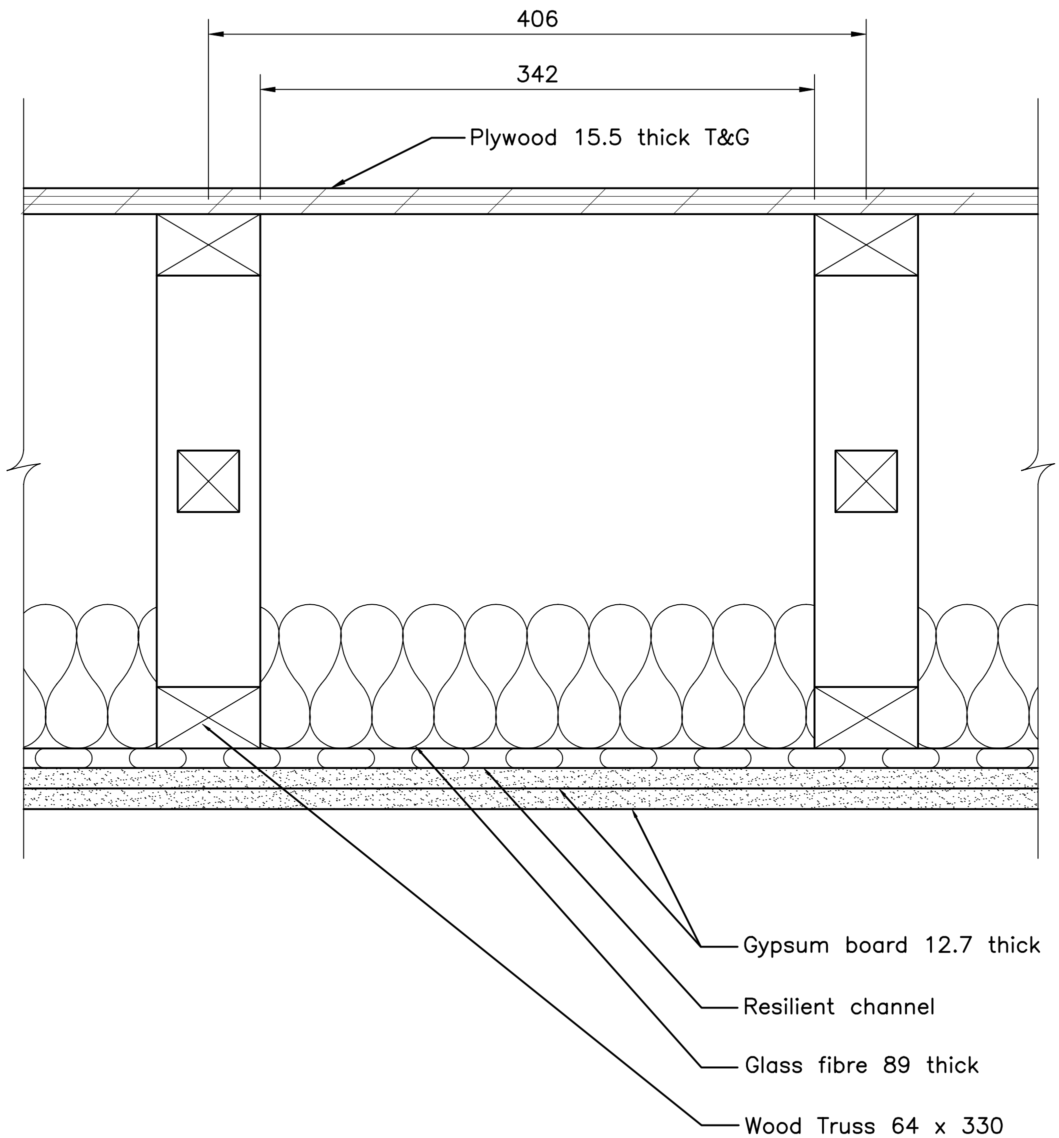
Figure C–61. Subfloor Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-58)

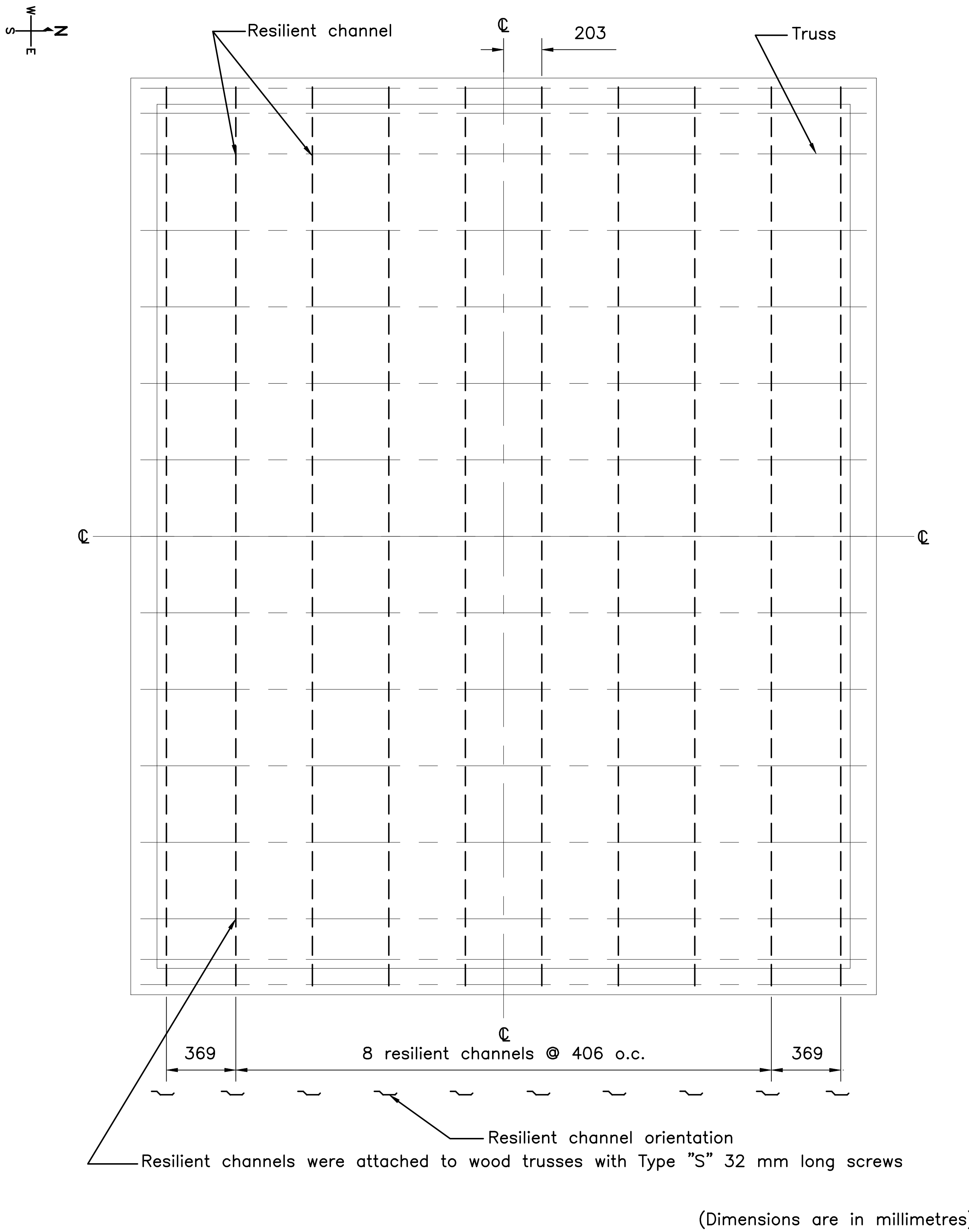
Figure C-62. Subfloor Nail Pattern (Wood Truss)



(Dimensions are in millimetres)

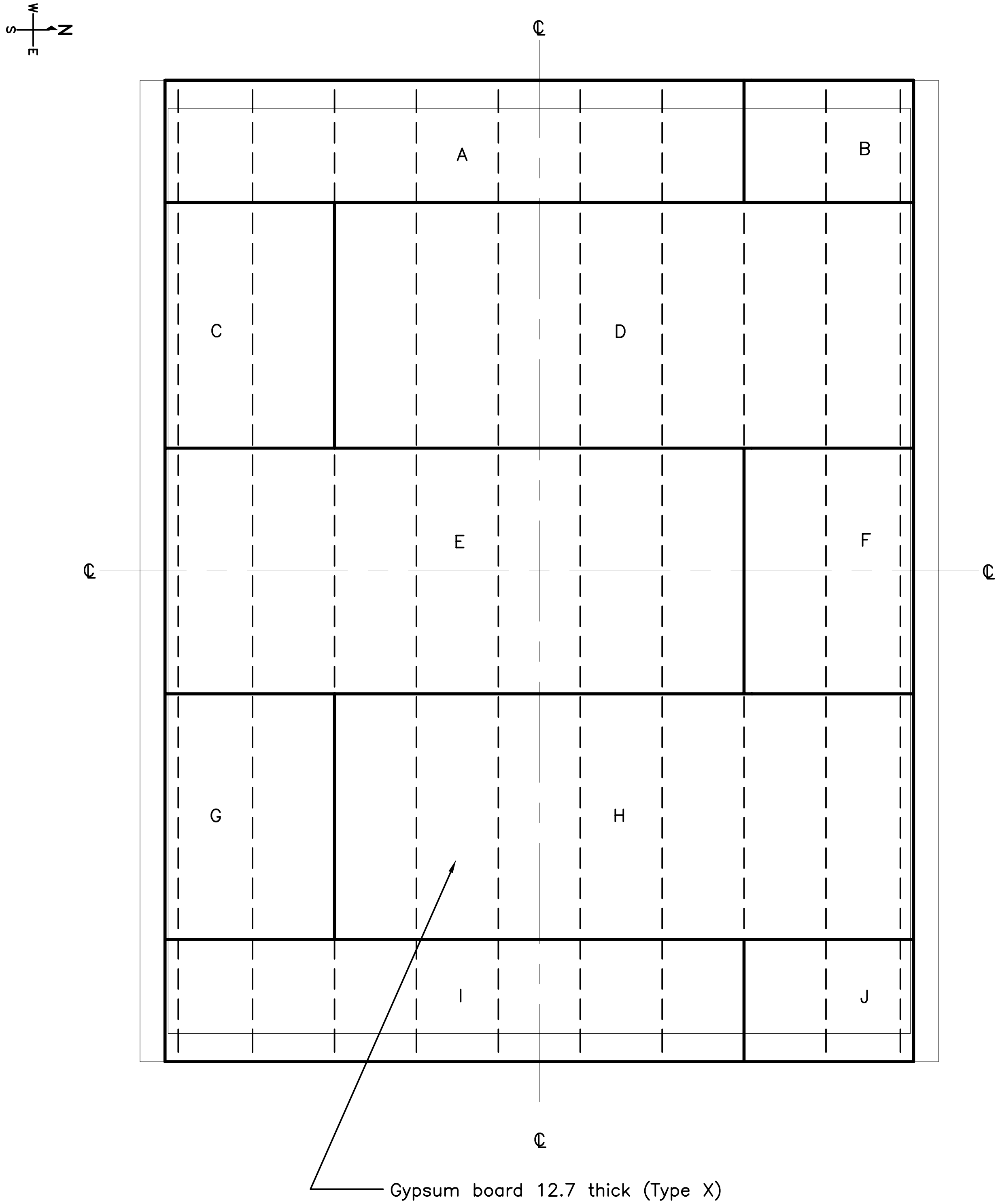
(Assembly No. FF–58)

Figure C–63. Insulation Location (Wood Truss)



(Assembly No. FF–58)

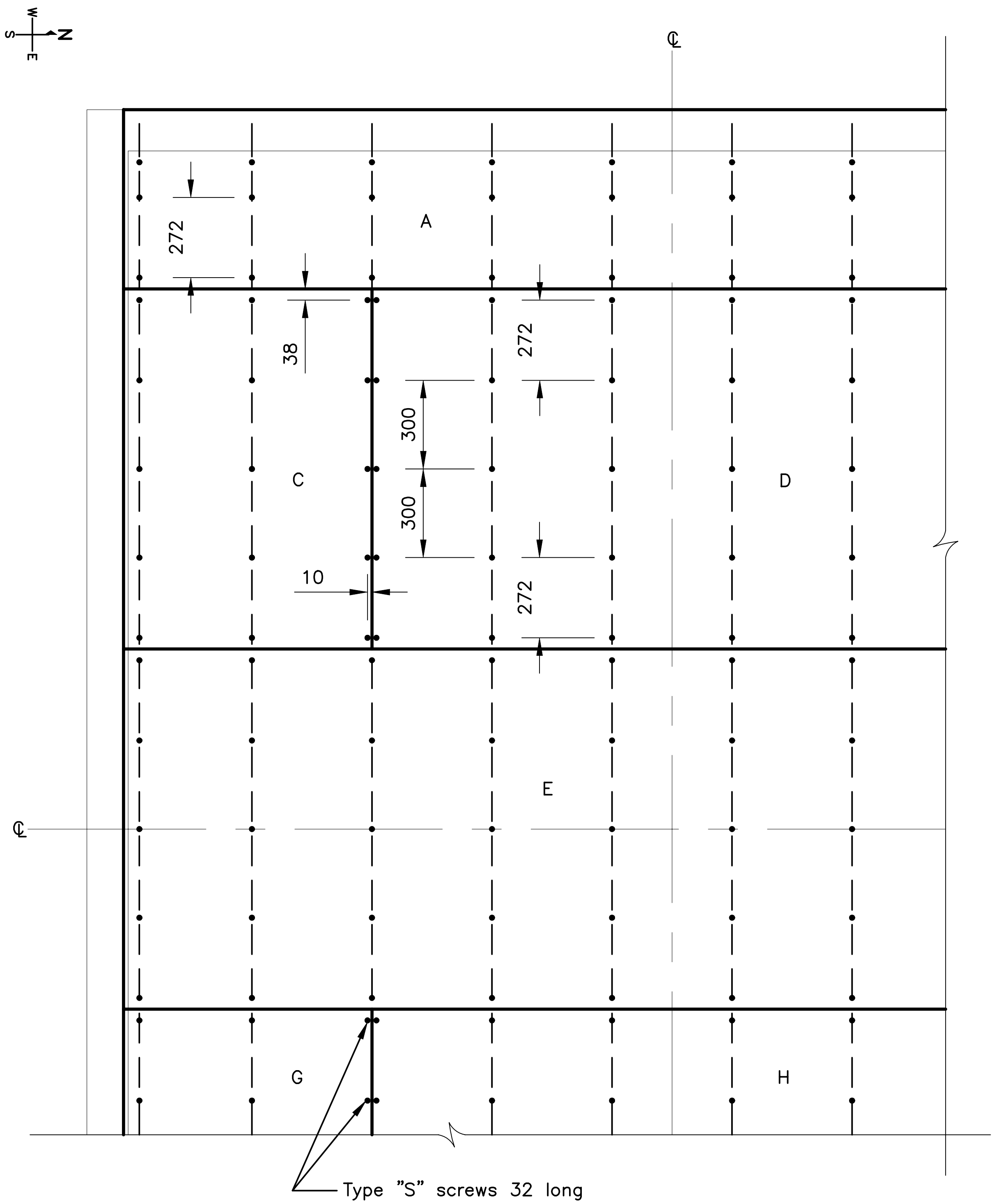
Figure C–64. Resilient Channel Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–58)

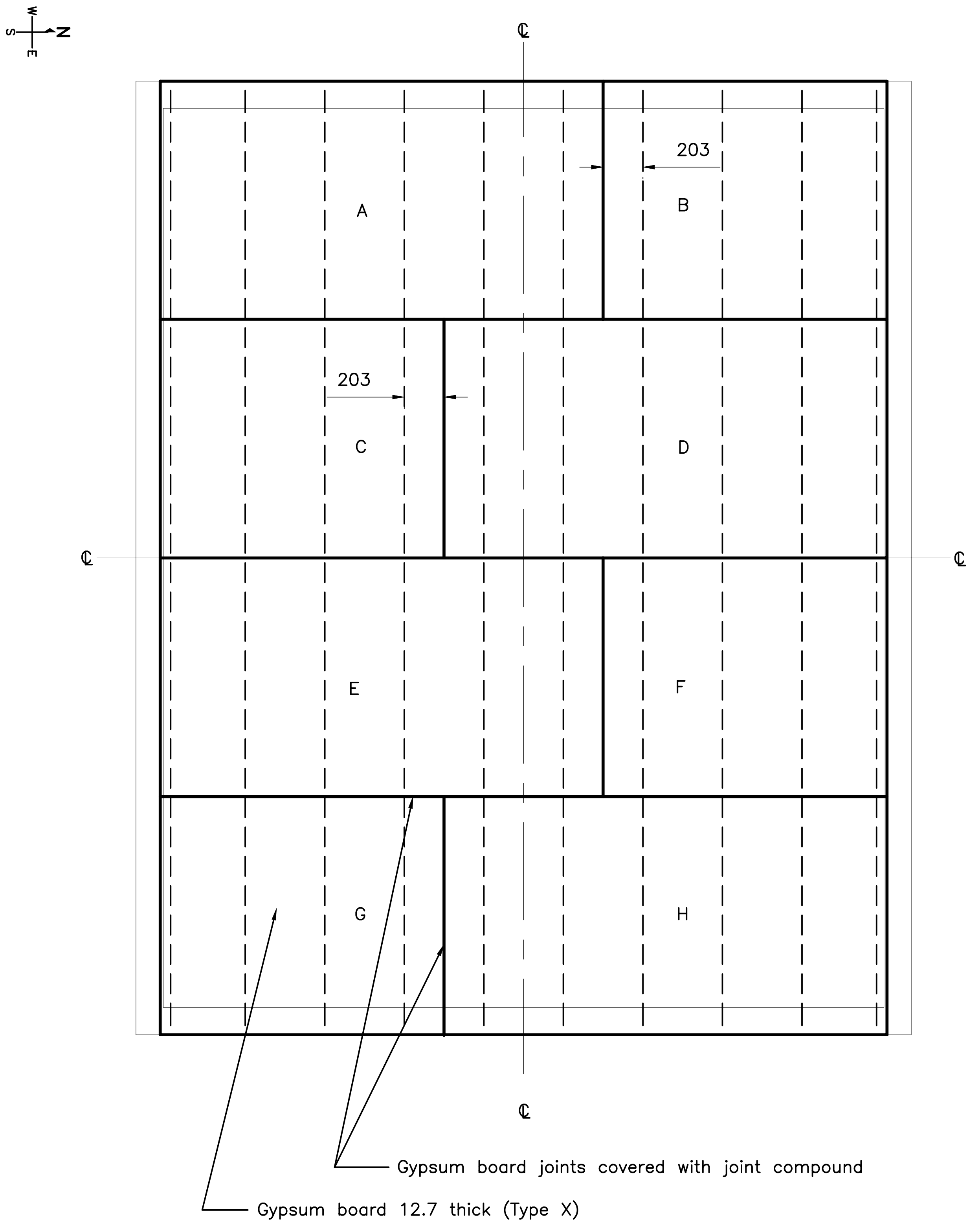
Figure C–65. Gypsum Board Base Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–58)

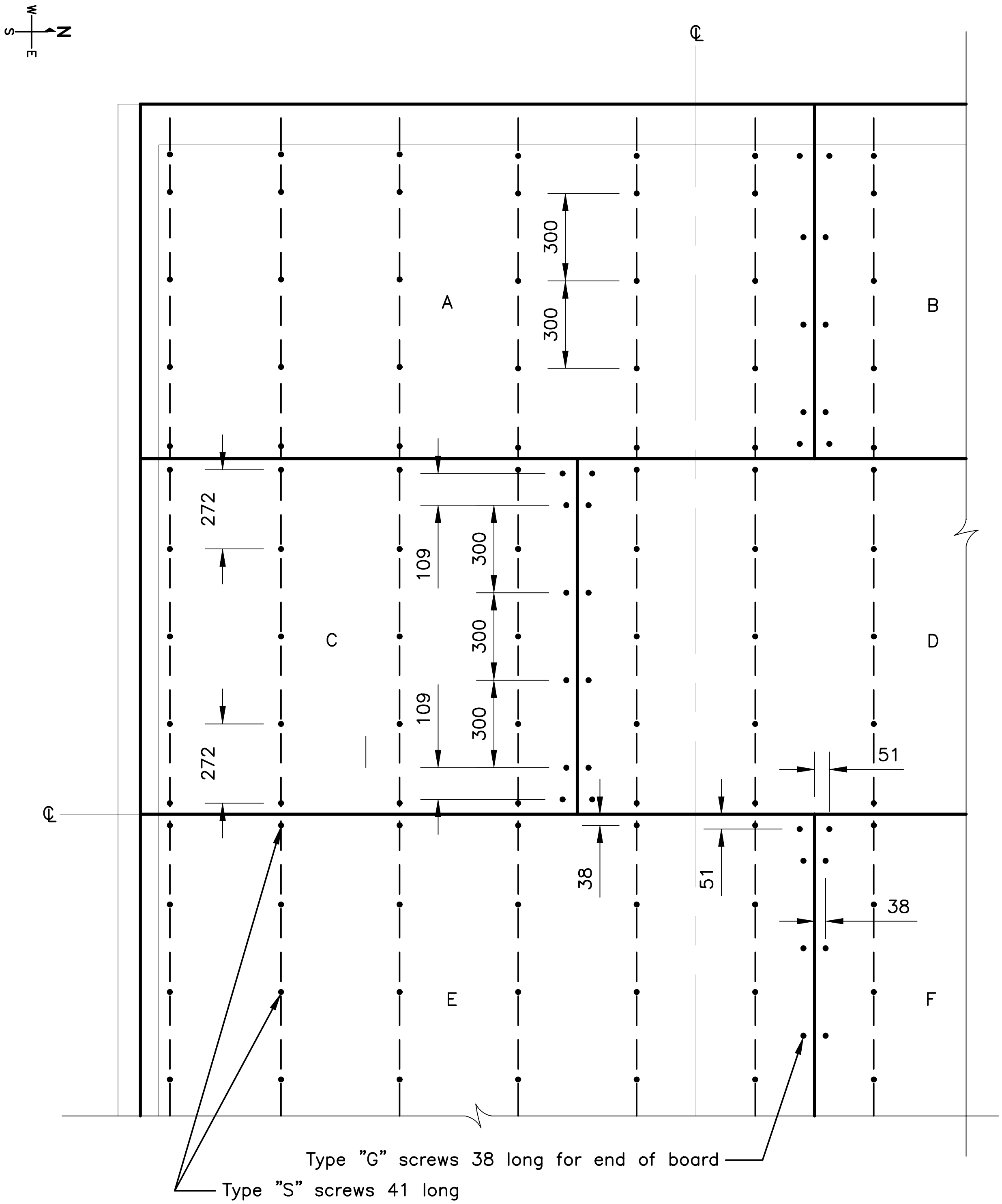
Figure C–66. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–58)

Figure C–67. Gypsum Board Face Layer Layout (Wood Truss)

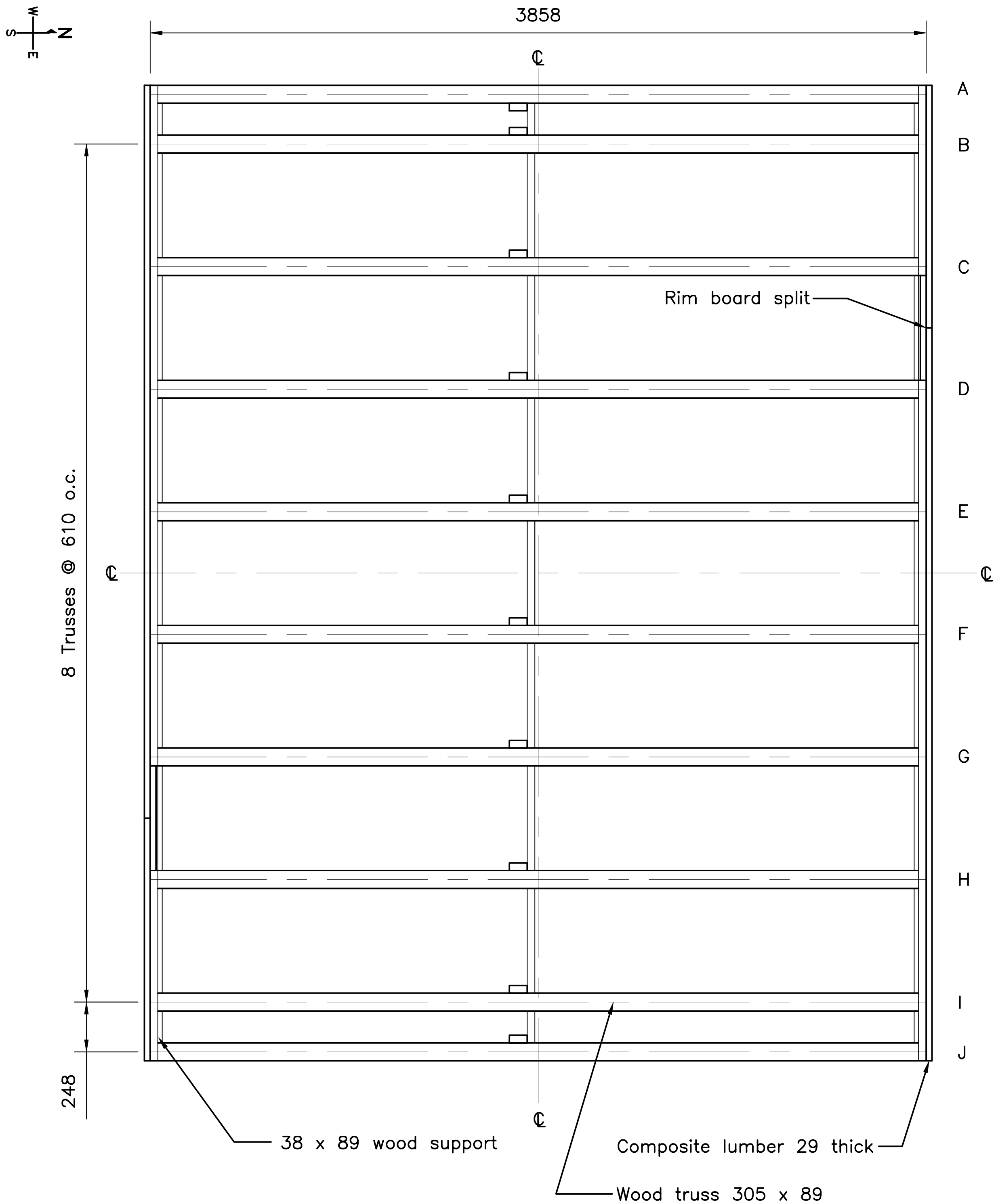


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF–58)

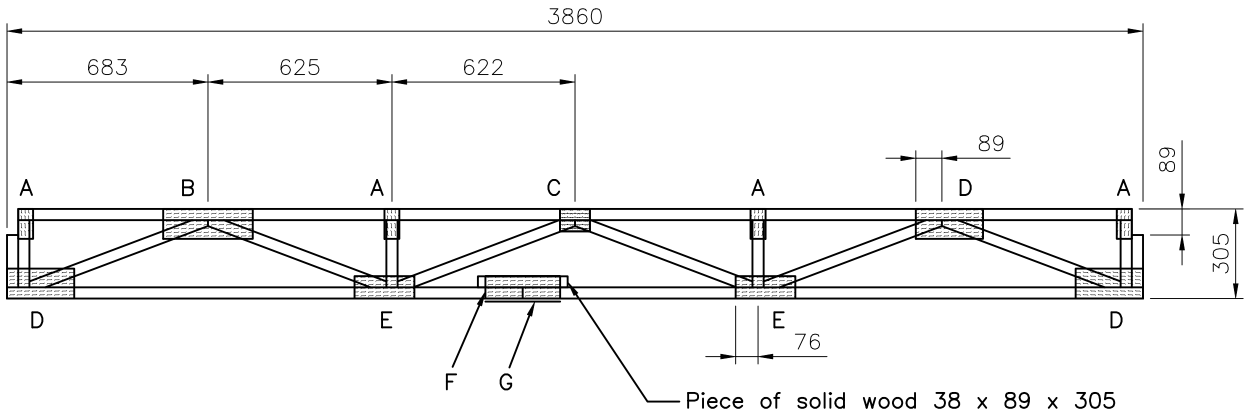
Figure C–68. Gypsum Board Face Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–59)

Figure C–69. Truss Layout (Wood Truss)



Truss members:
Truss members are made of solid wood lumber 38 x 89 Spruce–Pine–Fir #2 S–DRY O.L.M.A® 21 and NFP Mill #151 I.D. #2241

Plates:
TEE–LOK 20 plates 0.9 mm thick with 8 mm long teeth.
The number of teeth on the plate = plate area in mm² ÷ 80.645
All plates are centered in the middle of the joint except plates E and one of the plate D, see drawing for details.

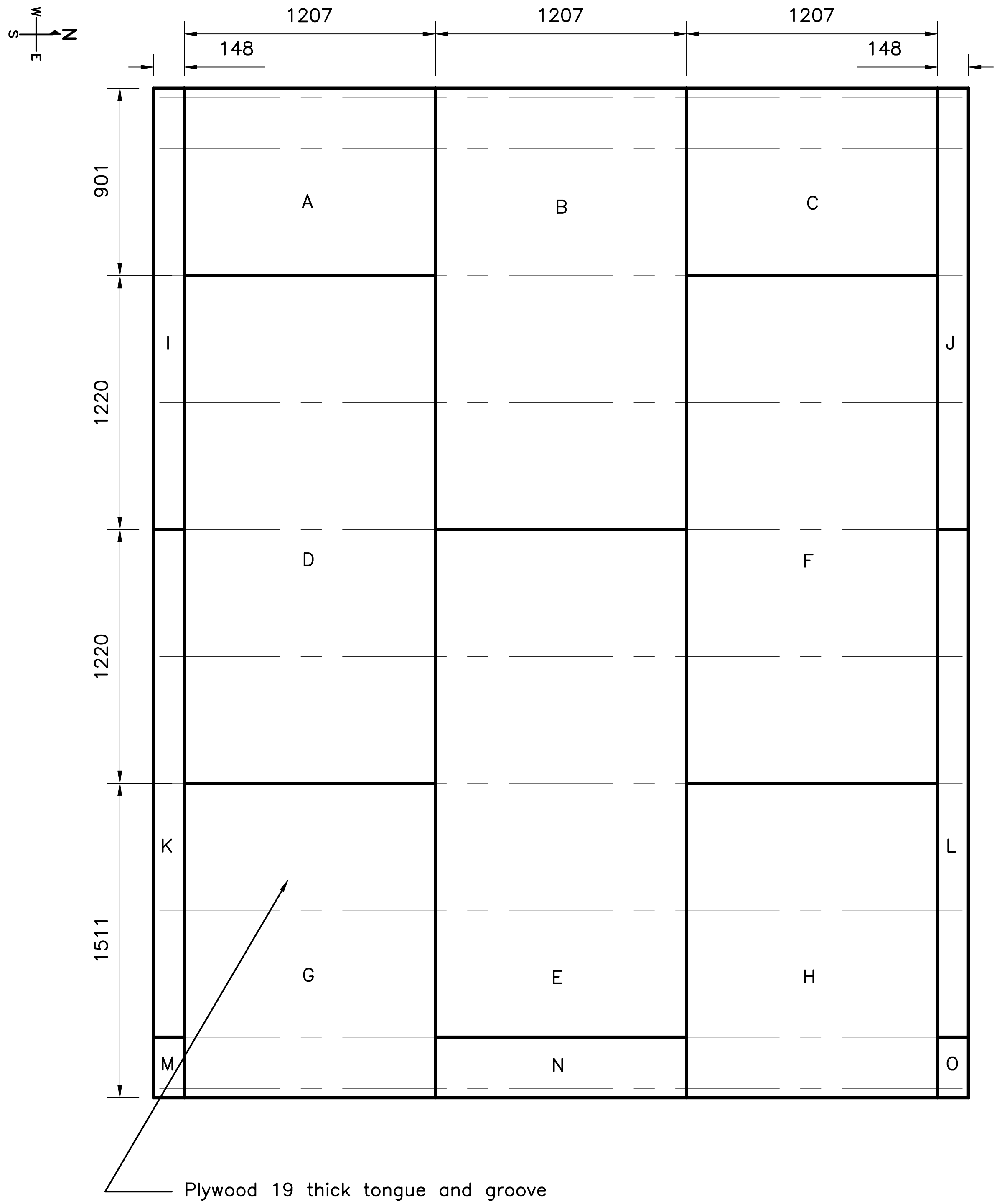
Plate size and location

A 50.8 x 101.6 both sides
B 304.8 x 101.6 both sides
C 101.6 x 76.2 both sides
D 228.6 x 101.6 both sides
E 203.2 x 76.2 both sides
F 254 x 76.2 both sides
G 254 x 76.2 both sides of bottom flange

(Dimensions are in millimetres)

(Assembly No. FF–59)

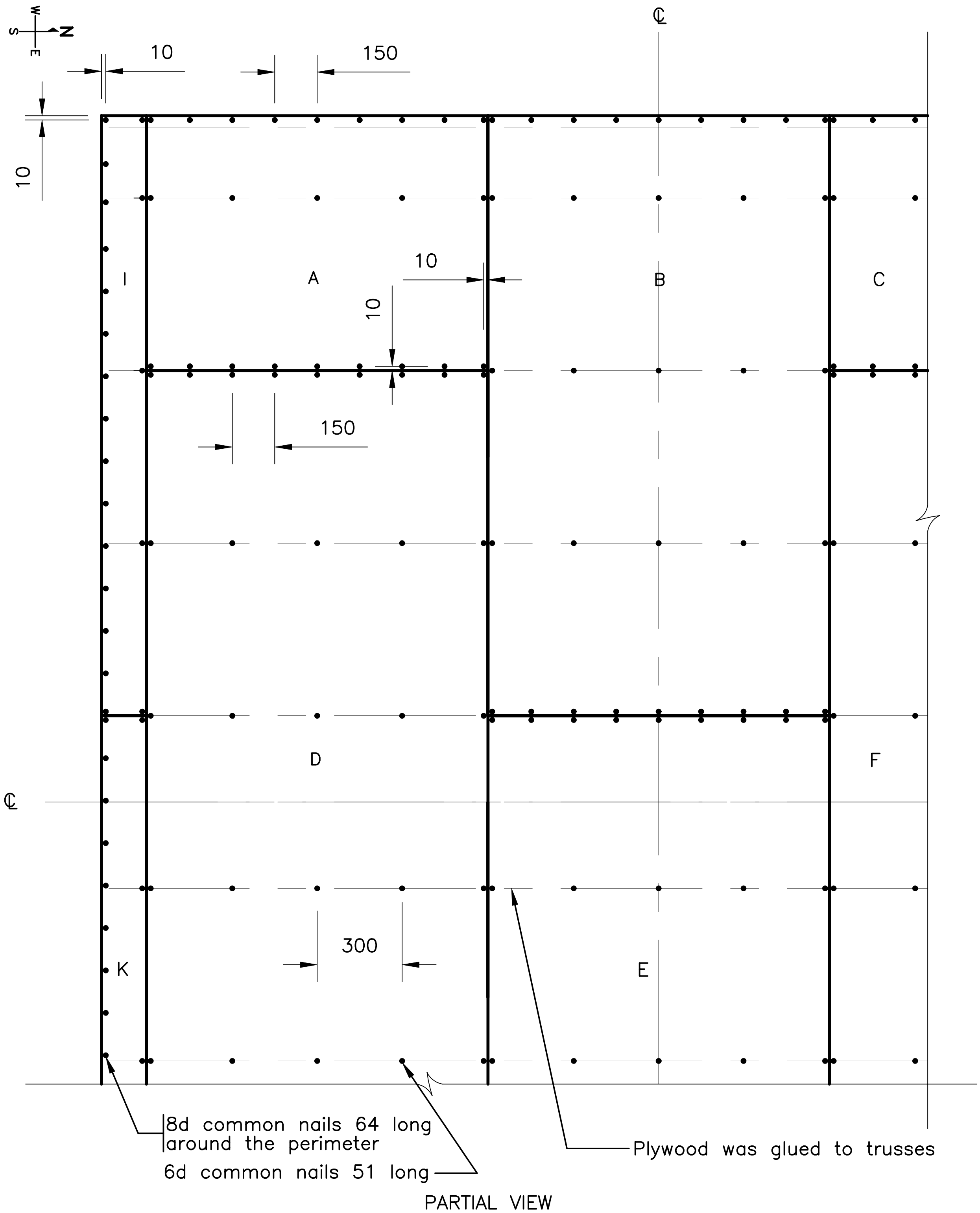
Figure C–70. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–59)

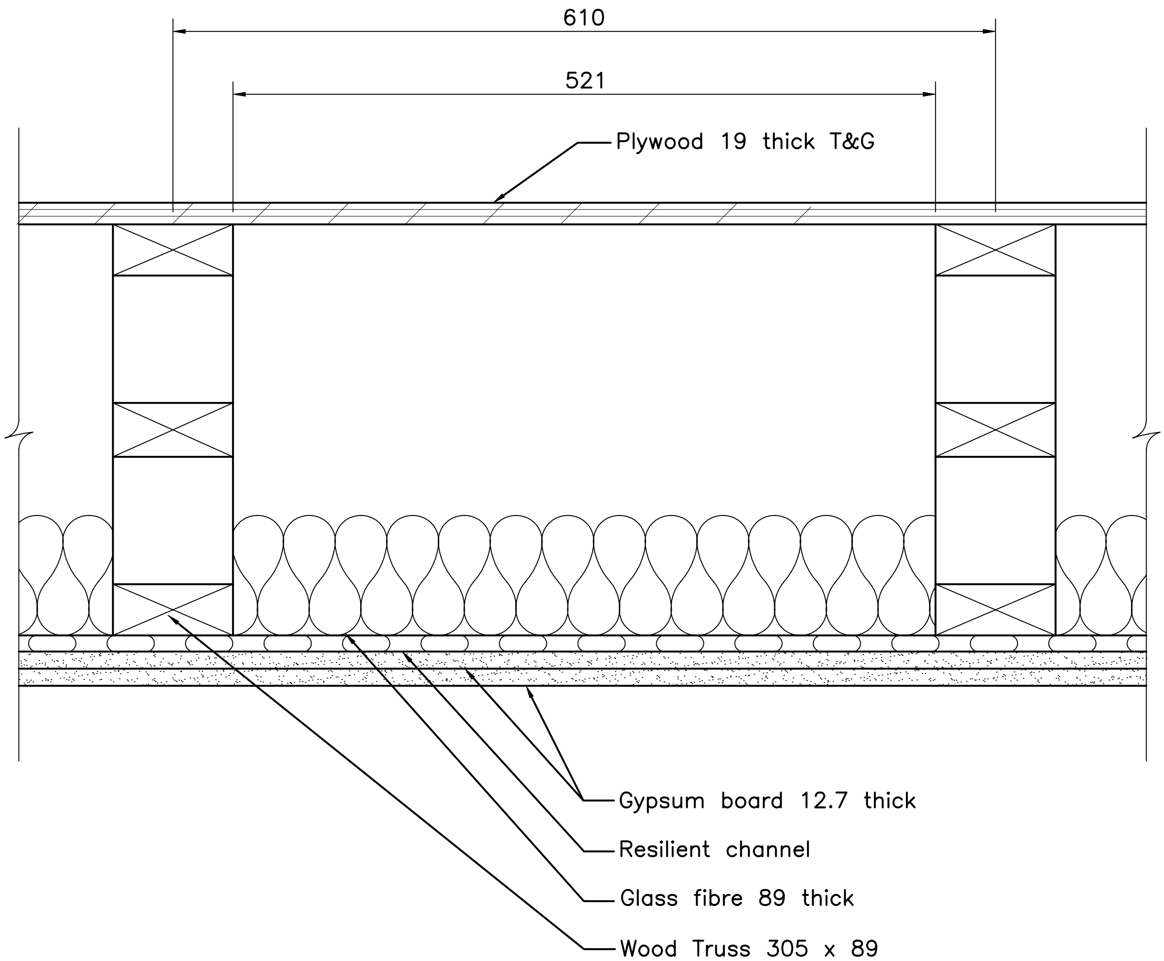
Figure C–71. Subfloor Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–59)

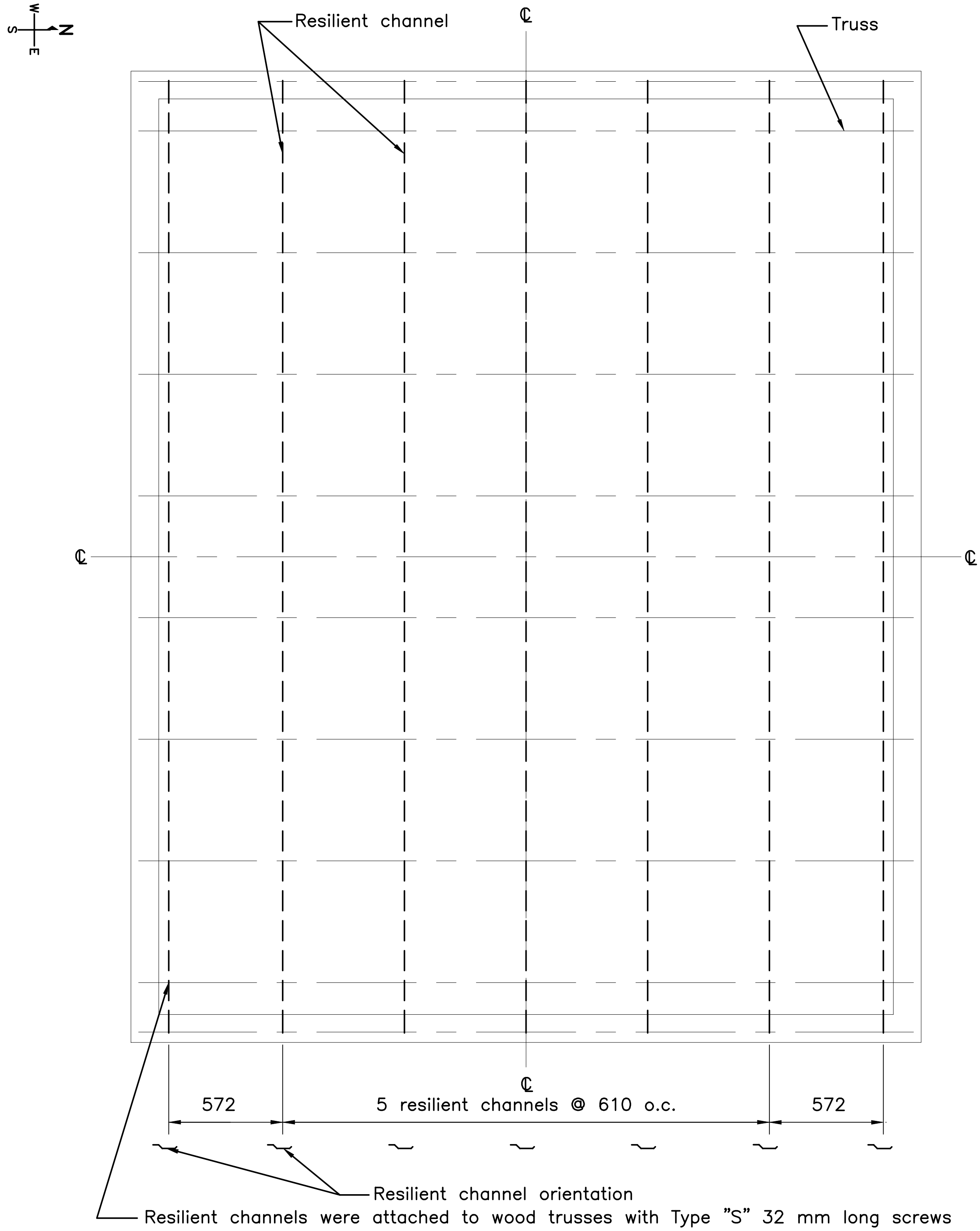
Figure C–72. Subfloor Nail Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–59)

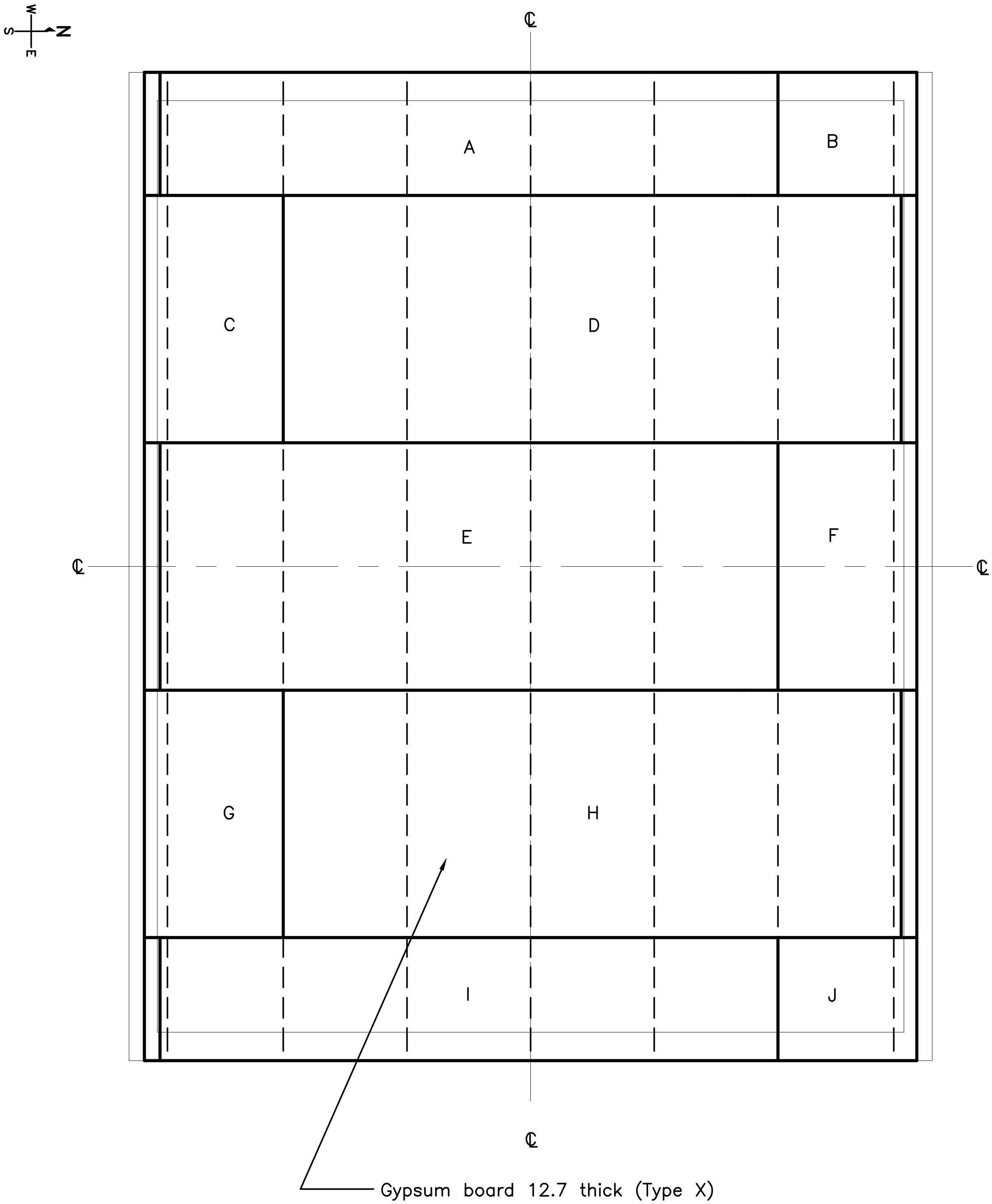
Figure C–73. Insulation Location (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–59)

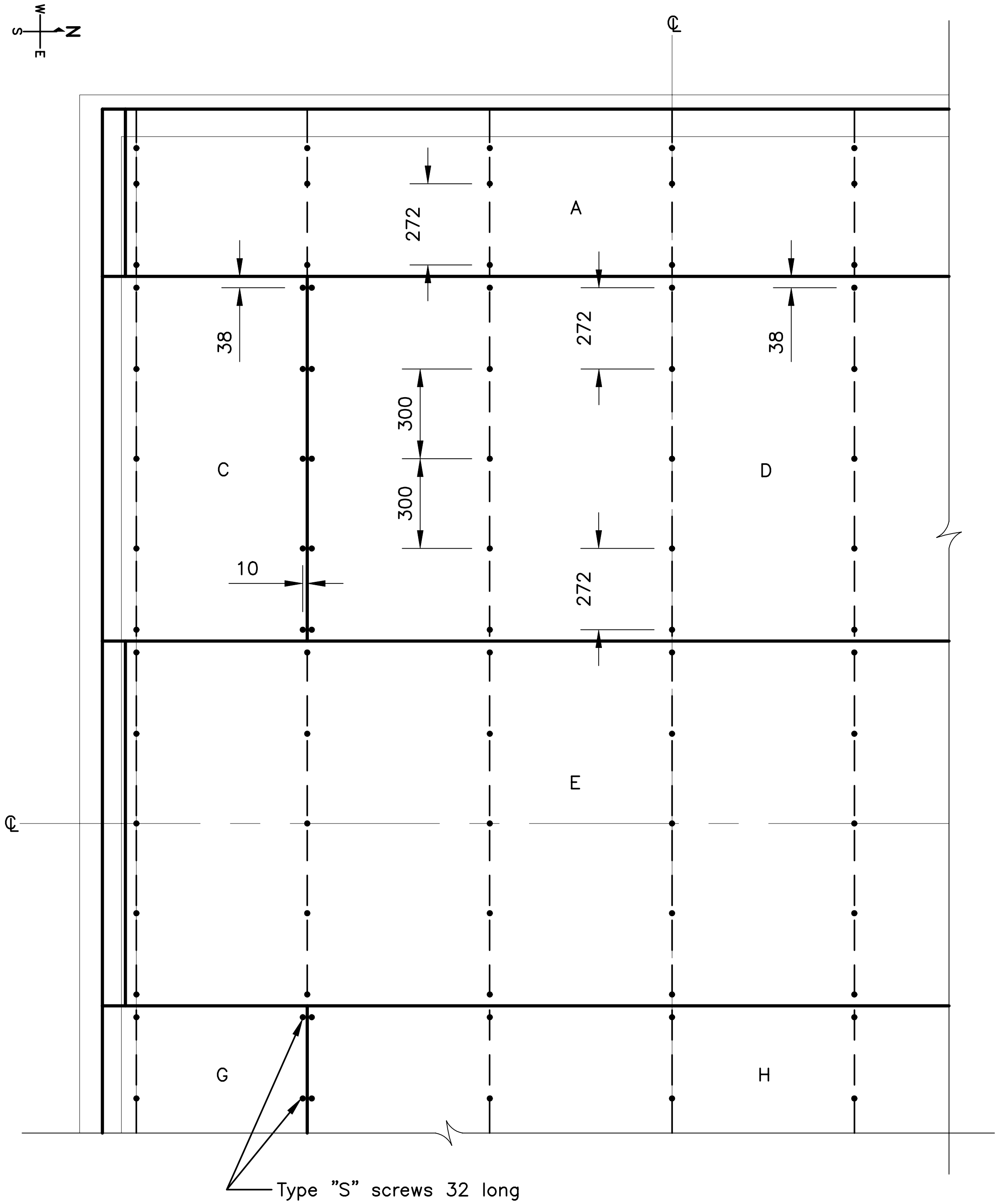
Figure C–74. Resilient Channel Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–59)

Figure C–75. Gypsum Board Base Layer Layout (Wood Truss)

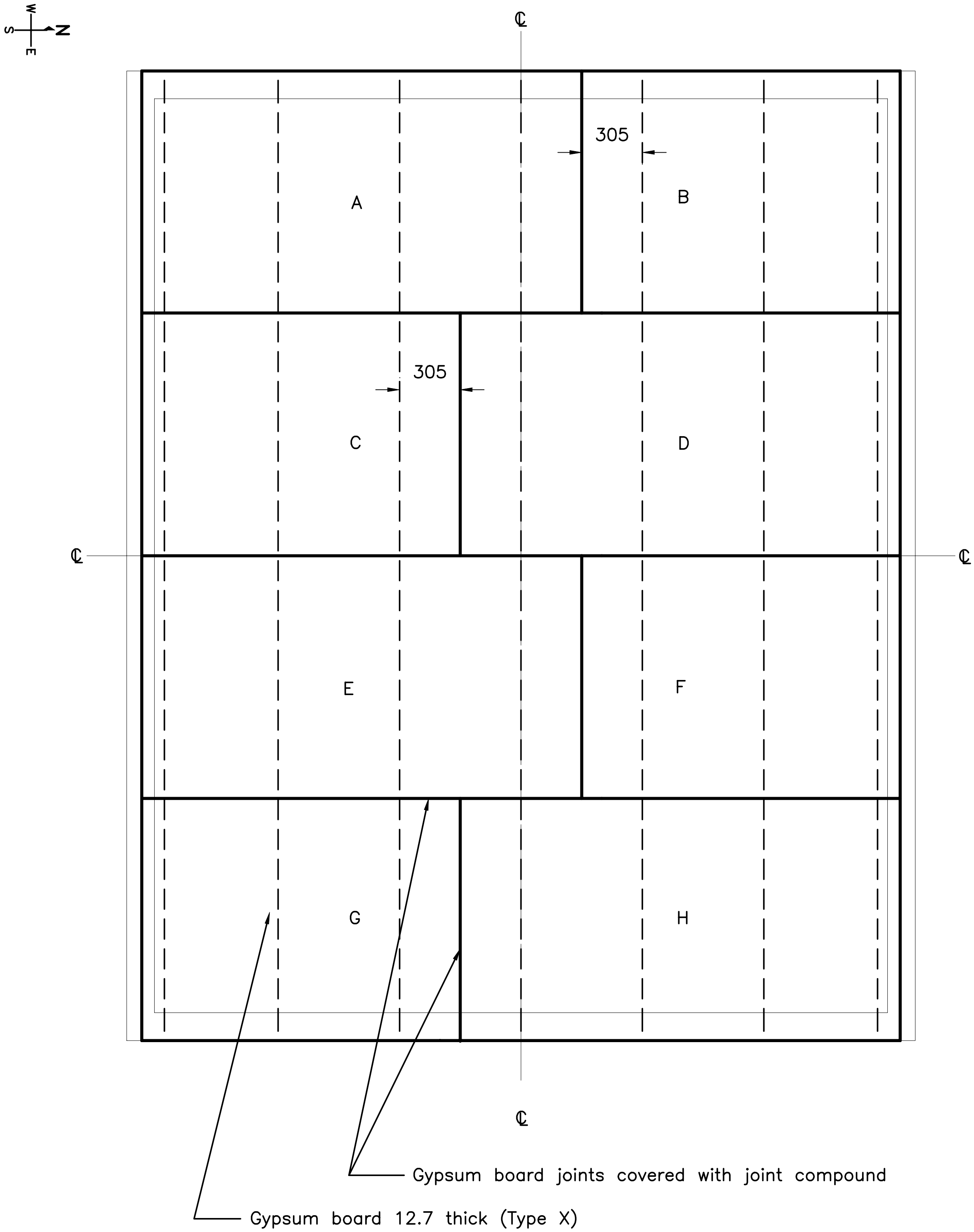


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF–59)

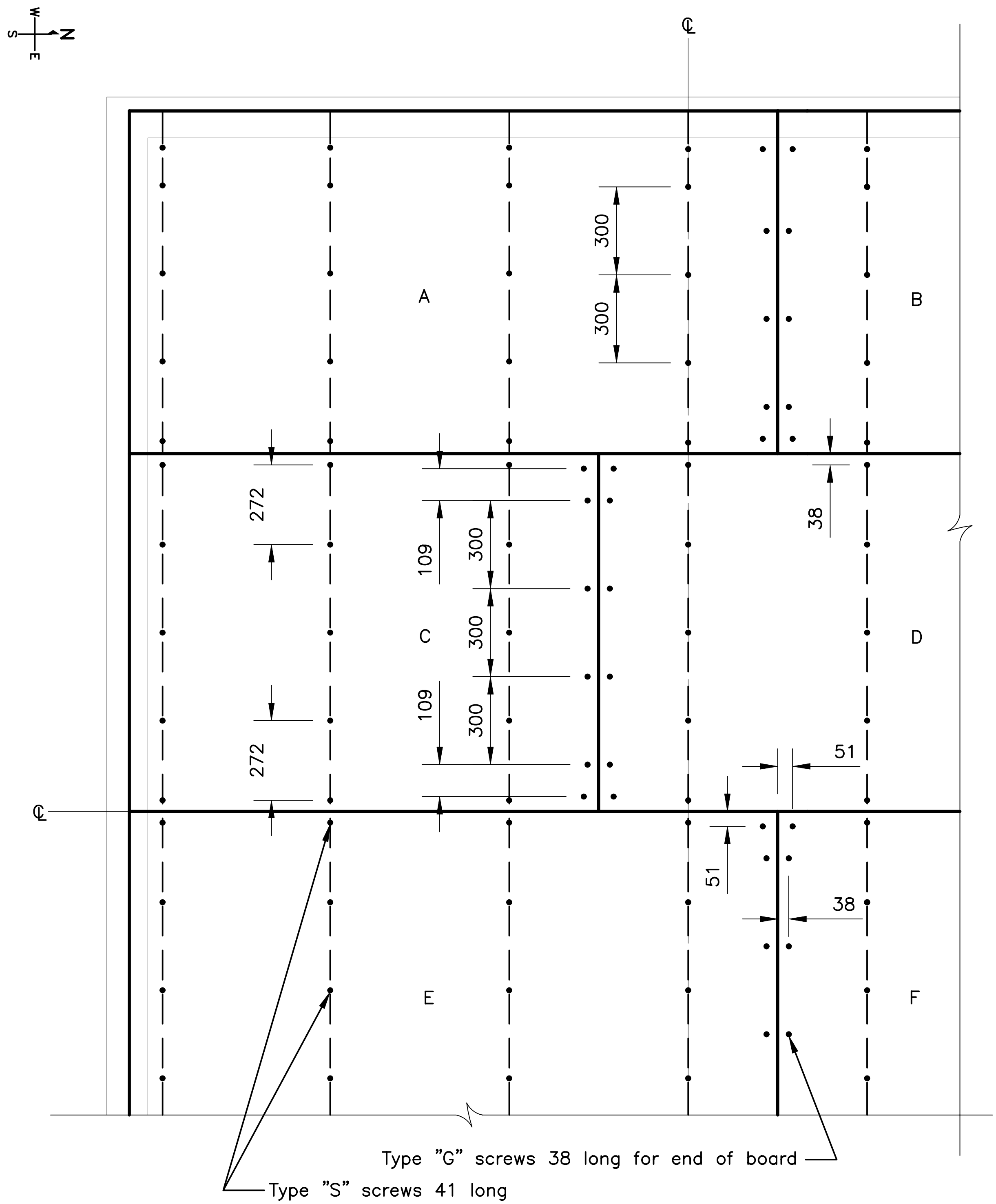
Figure C–76. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–59)

Figure C–77. Gypsum Board Face Layer Layout (Wood Truss)

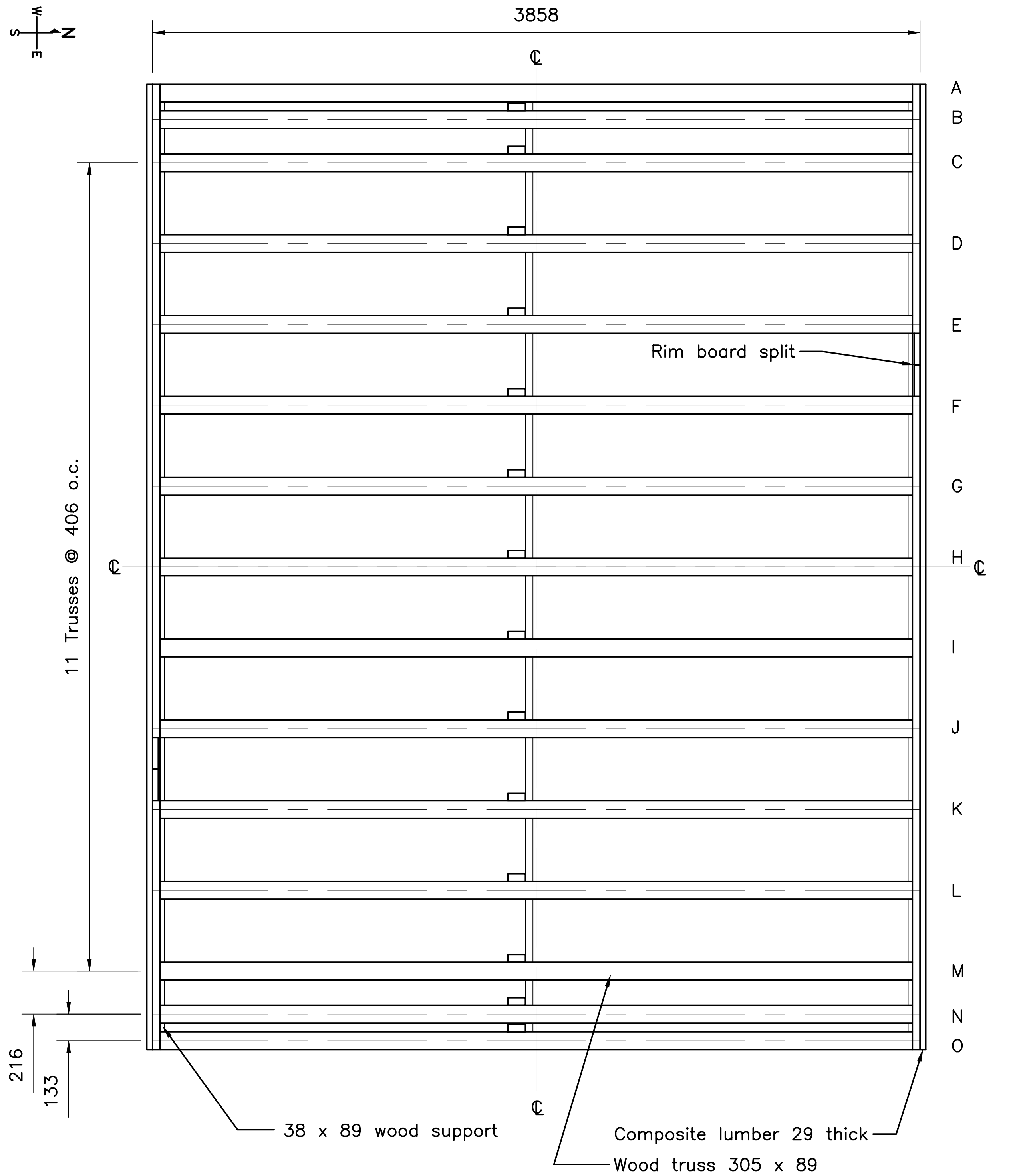


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF–59)

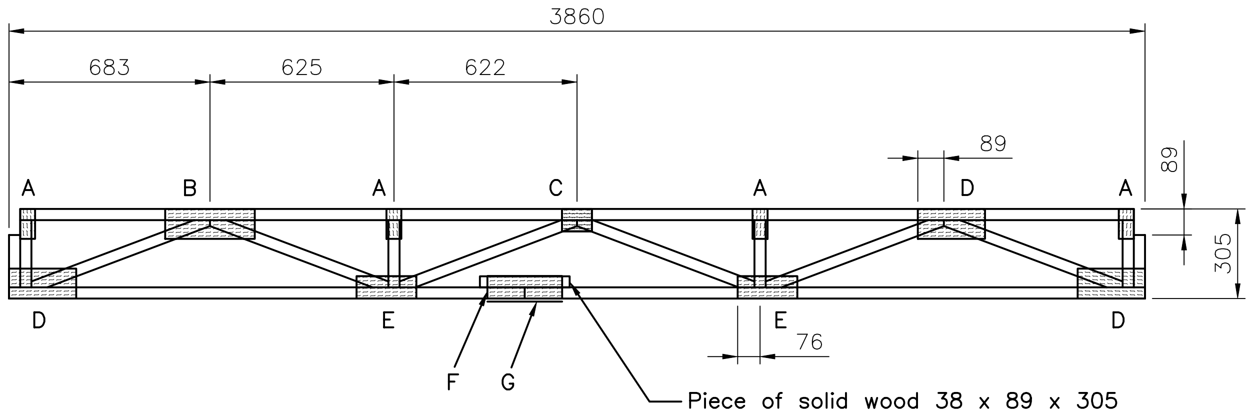
Figure C–78. Gypsum Board Face Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–60)

Figure C–79. Truss Layout (Wood Truss)



Truss members:
Truss members are made of solid wood lumber 38 x 89 Spruce–Pine–Fir #2 S–DRY O.L.M.A® 21 and NFP Mill #151 I.D. #2241

Plates:
TEE–LOK 20 plates 0.9 mm thick with 8 mm long teeth.
The number of teeth on the plate = plate area in mm² ÷ 80.645
All plates are centered in the middle of the joint except plates E and one of the plate D, see drawing for details.

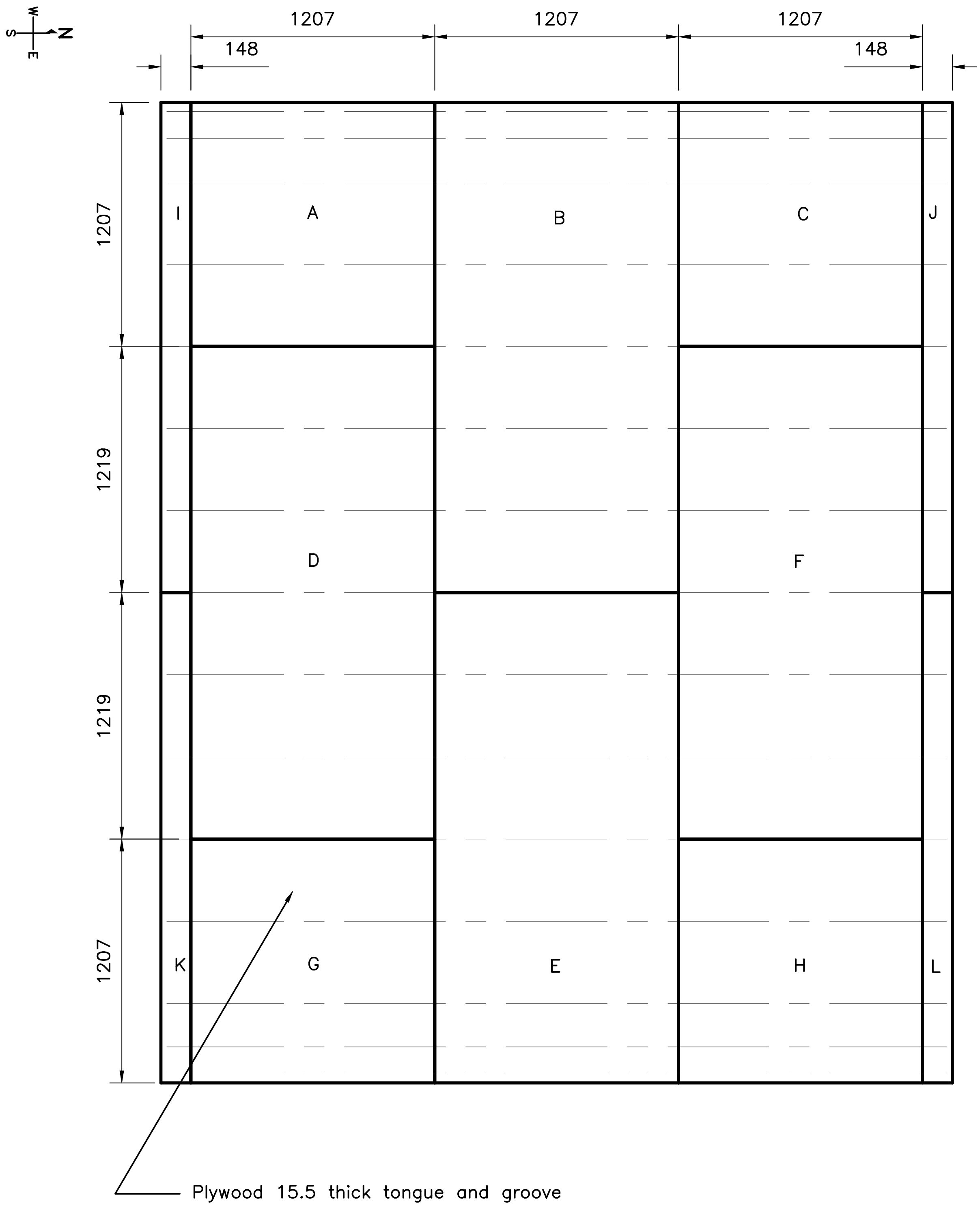
Plate size and location

A 50.8 x 101.6 both sides
B 304.8 x 101.6 both sides
C 101.6 x 76.2 both sides
D 228.6 x 101.6 both sides
E 203.2 x 76.2 both sides
F 254 x 76.2 both sides
G 254 x 76.2 both sides of bottom flange

(Dimensions are in millimetres)

(Assembly No. FF–60)

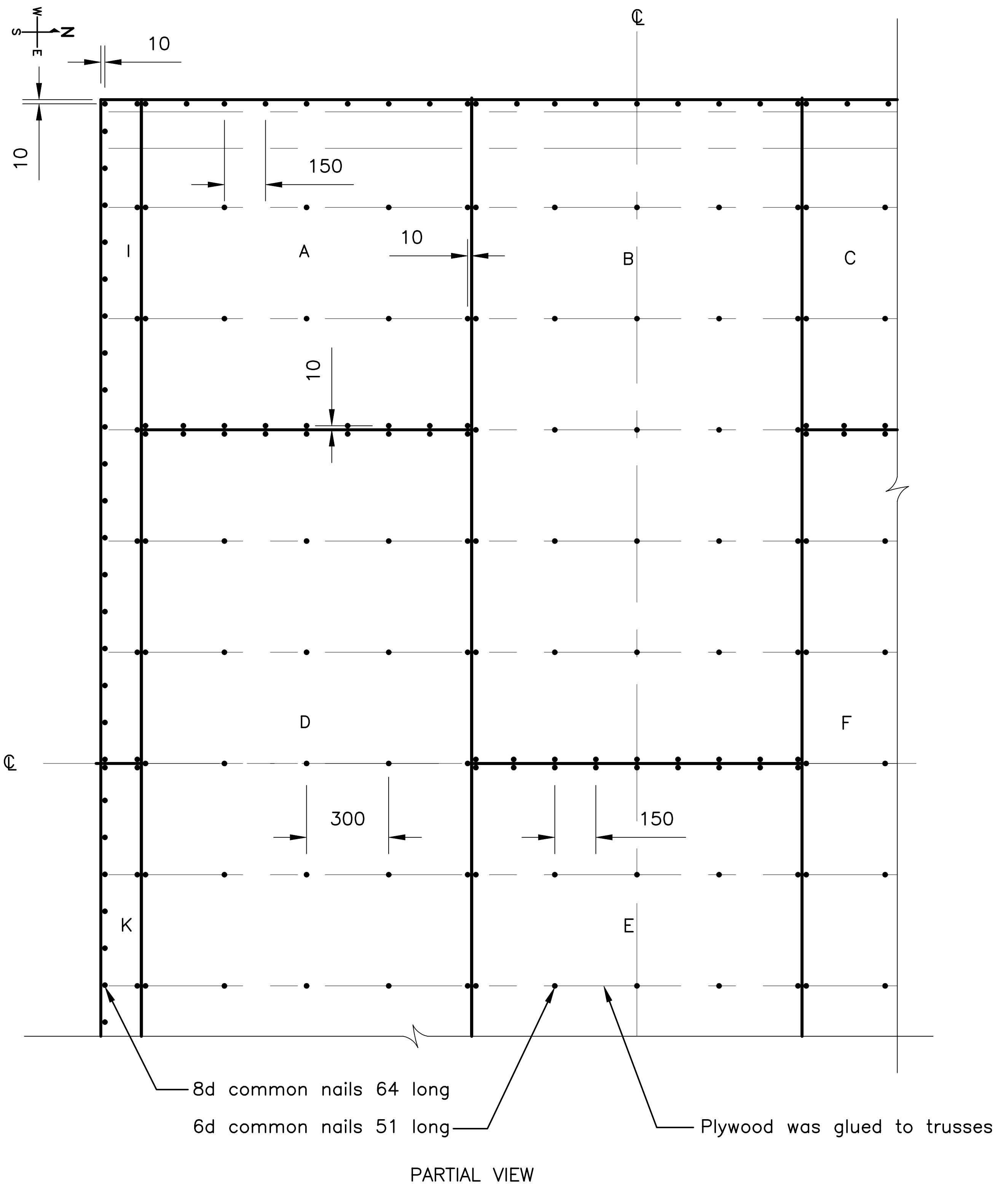
Figure C–80. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–60)

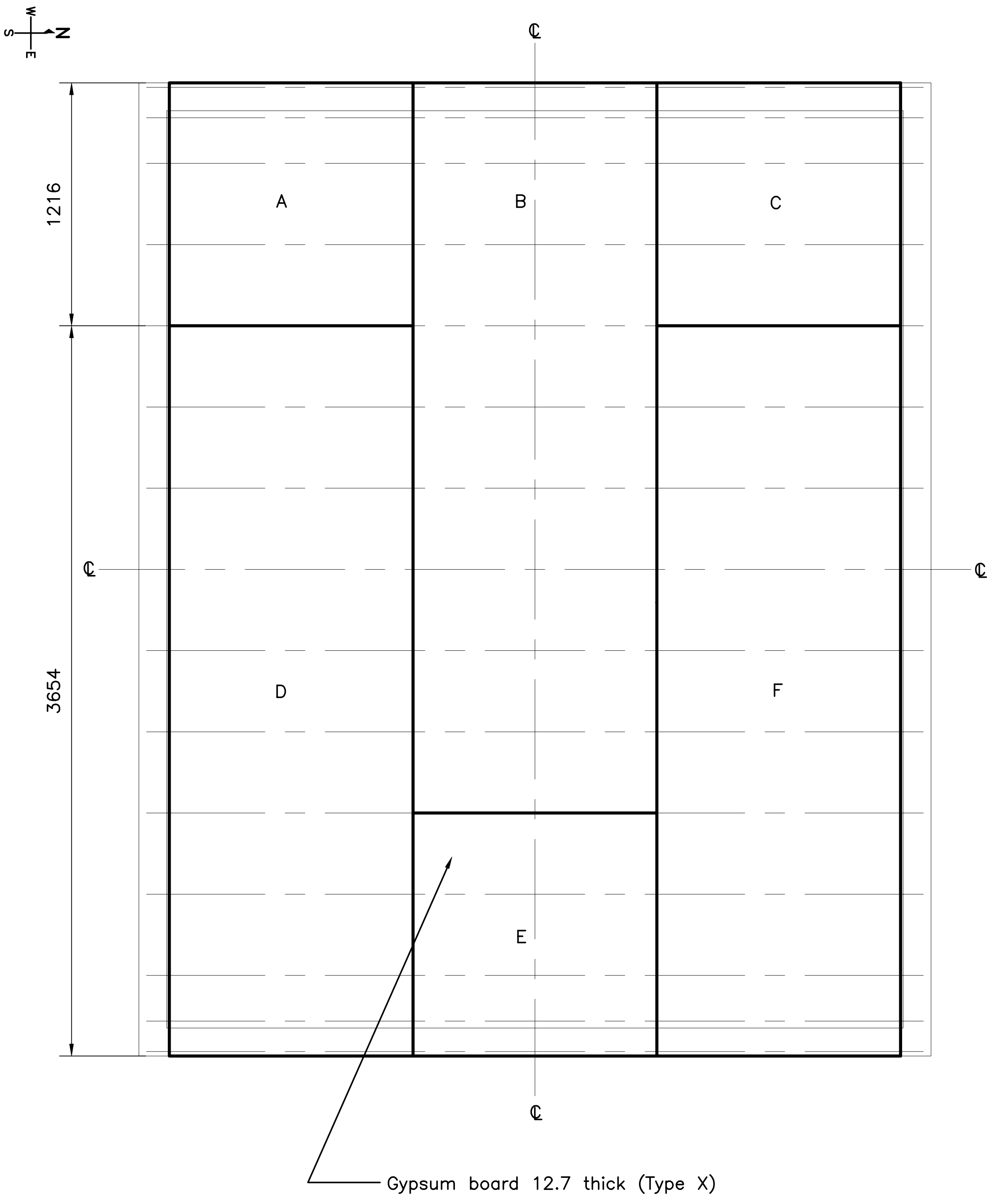
Figure C–81. Subfloor Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-60)

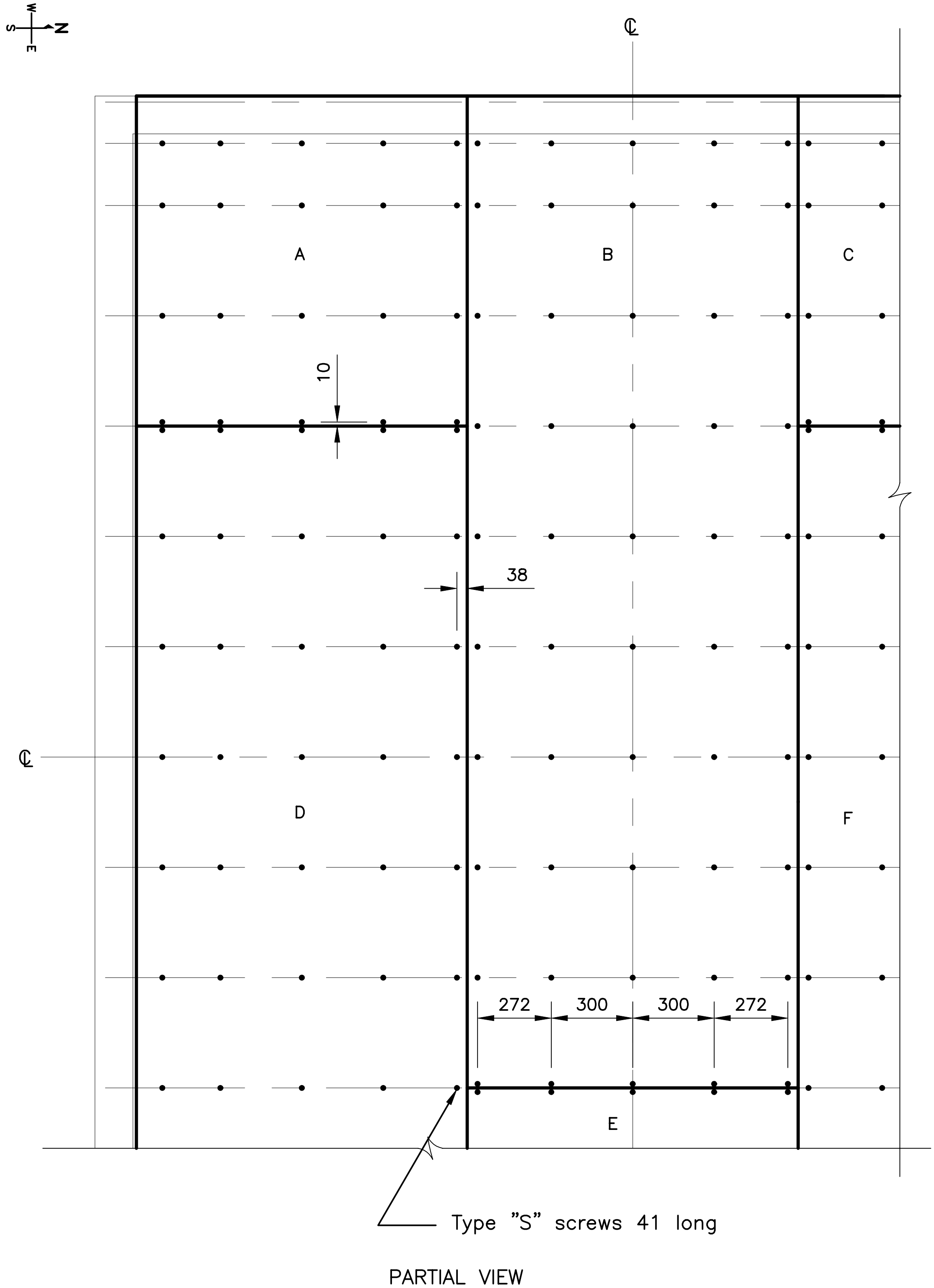
Figure C-82. Subfloor Nail Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–60)

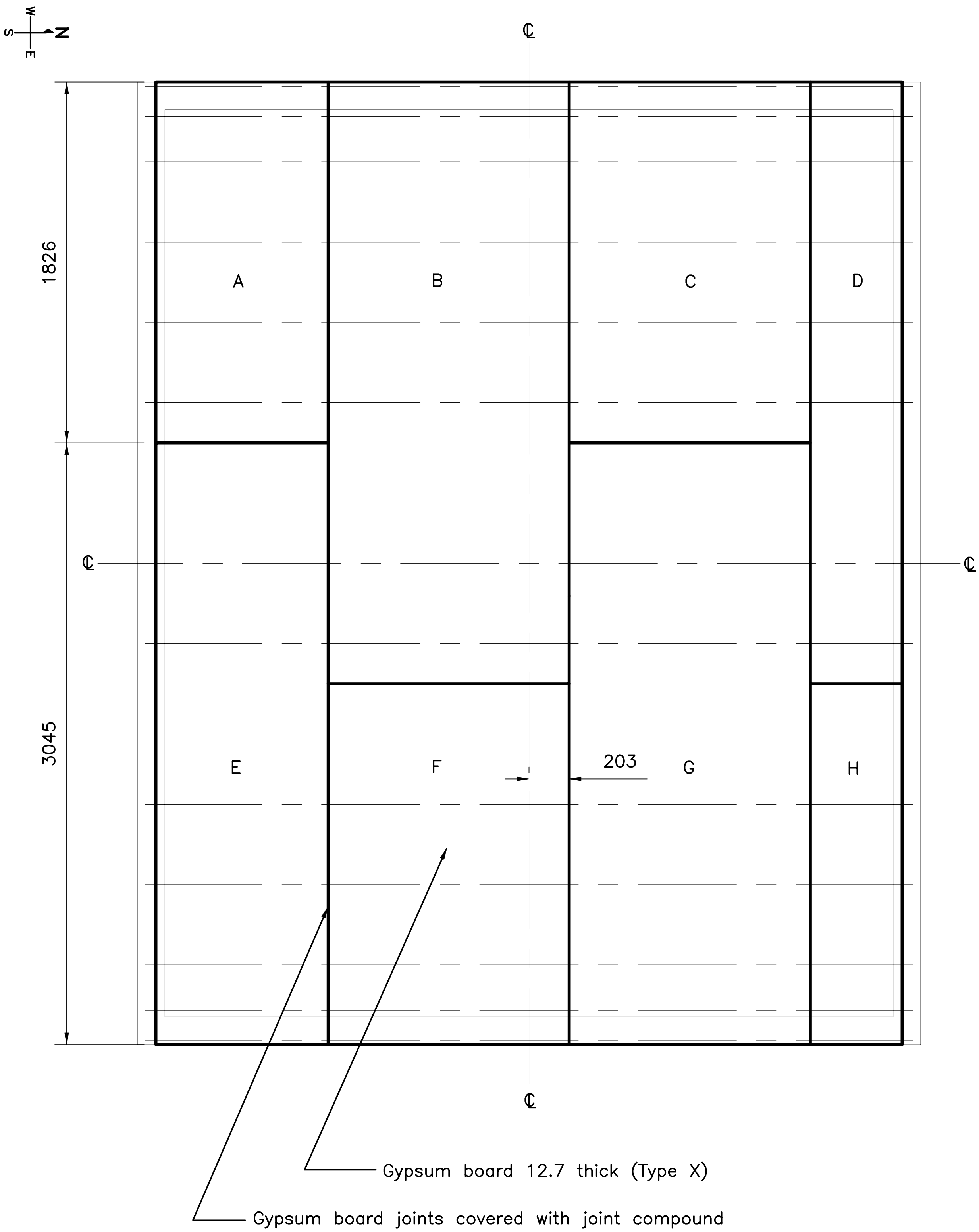
Figure C–83. Gypsum Board Base Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-60)

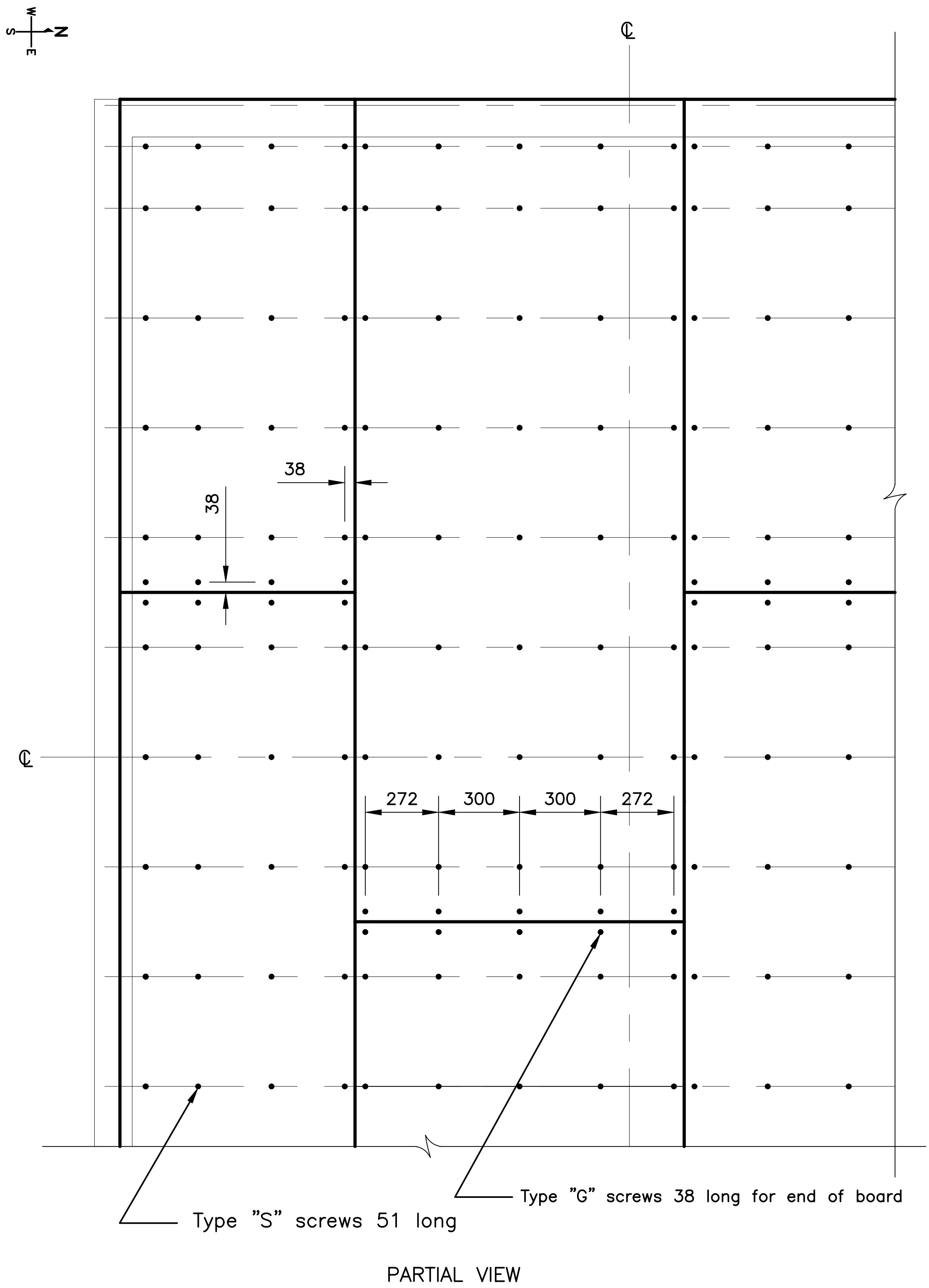
Figure C-84. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–60)

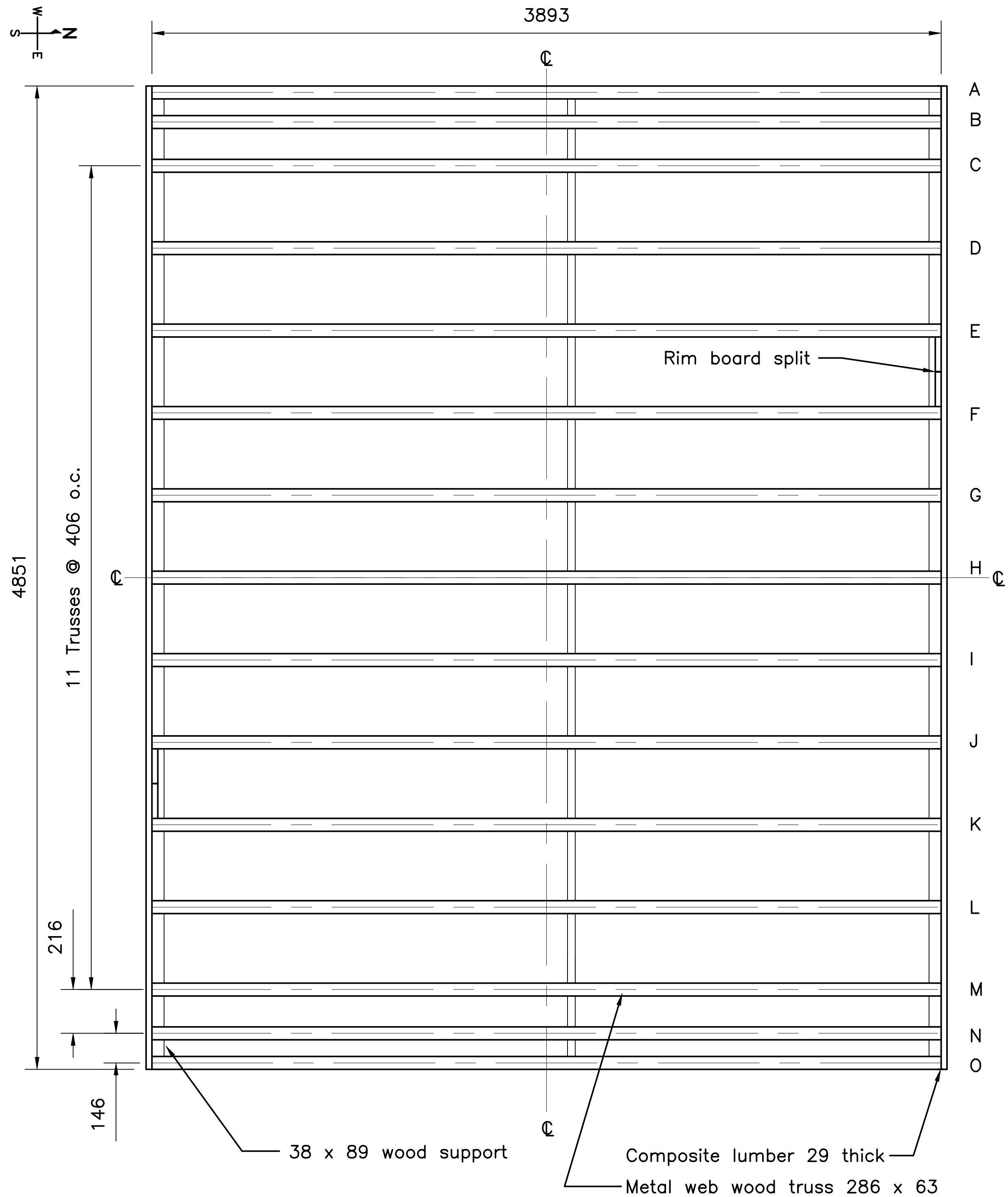
Figure C–85. Gypsum Board Face Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–60)

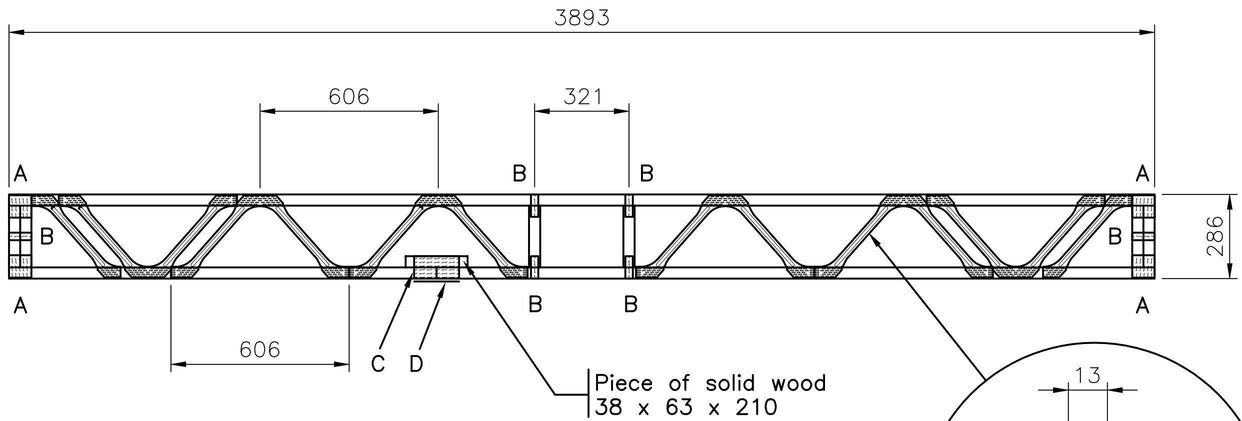
Figure C–86. Gypsum Board Face Layer Screw Pattern (Wood Truss)

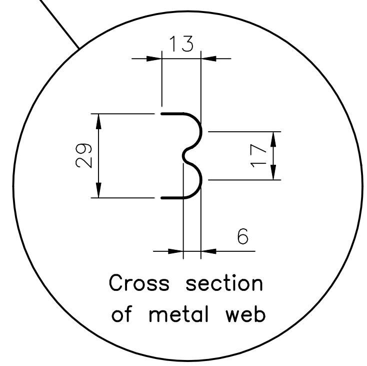


(Dimensions are in millimetres)

(Assembly No. FF–63)

Figure C–87. Truss Layout (Metal Web Wood Truss)





Truss flanges:
Truss flanges are made of solid wood lumber 38 x 63 Spruce–Pine–Fir #2 S–DRY 149–1 KD–HT

Truss metal web:
Truss metal webs are made of galvanised steel, 1 mm thick. The bottom of the web "V" shape has 34 teeth 8 mm long, and the top of the web "V" shape has 22 teeth, 8 mm long on each side. The web is shaped as shown on the cross section drawing

Gusset plates:
SK–20 634 and SK–20 4740 plates are 1 mm thick with 8 mm long teeth. The number of teeth on each plate = plate area in mm^2 ÷ 120.968. All plates are centered on the middle of the joint. See drawing for details.

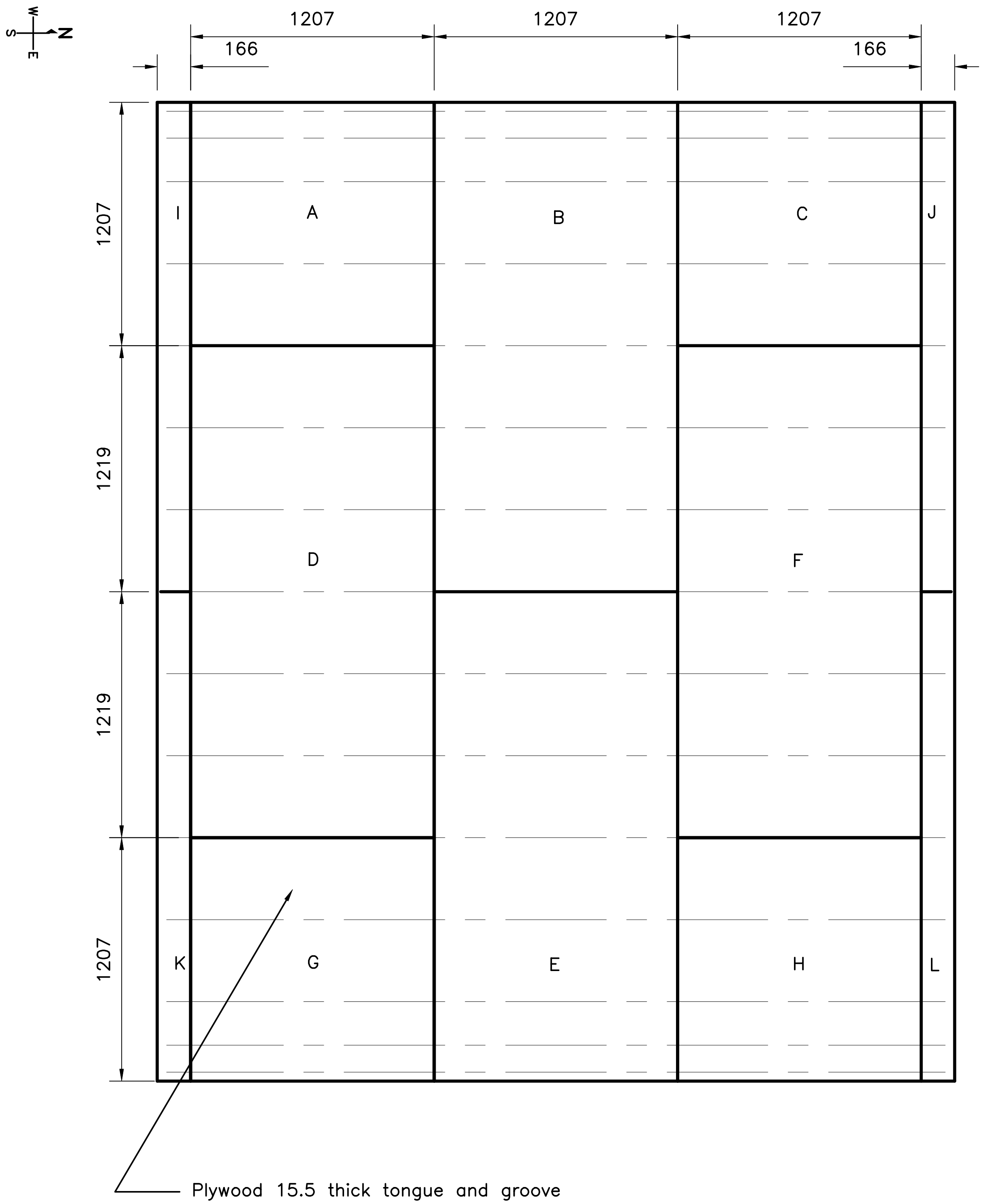
Plate size and location

A 76.2 x 76.2 both sides
B 76.2 x 25.4 both sides
C 152.4 x 152.4 both sides
D 152.4 x 50.8 top and bottom of joint in lower flange

(Dimensions are in millimetres)

(Assembly No. FF–63)

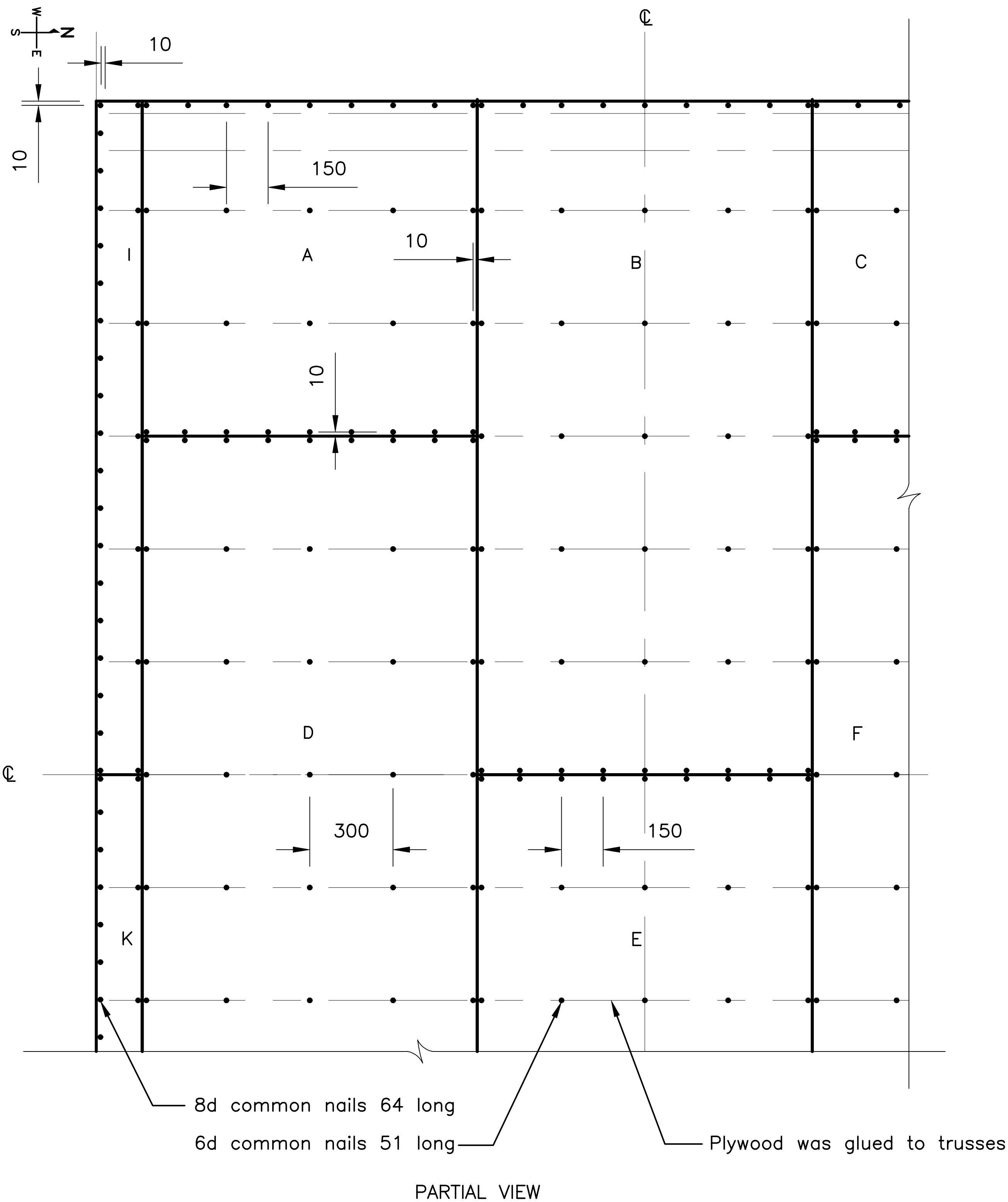
Figure C–88. Truss details (Metal Web Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–63)

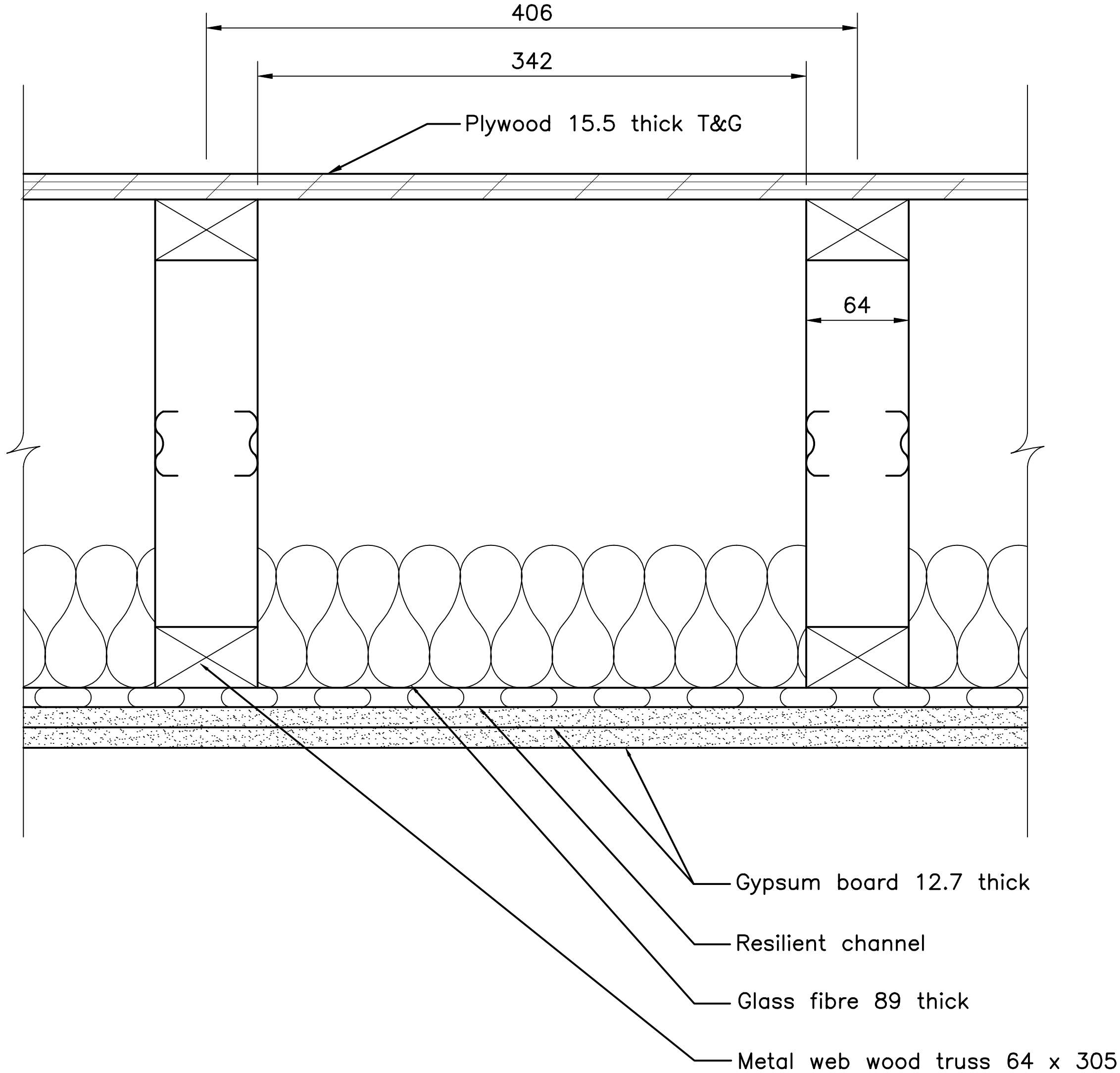
Figure C–89. Subfloor Layout (Metal Web Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–63)

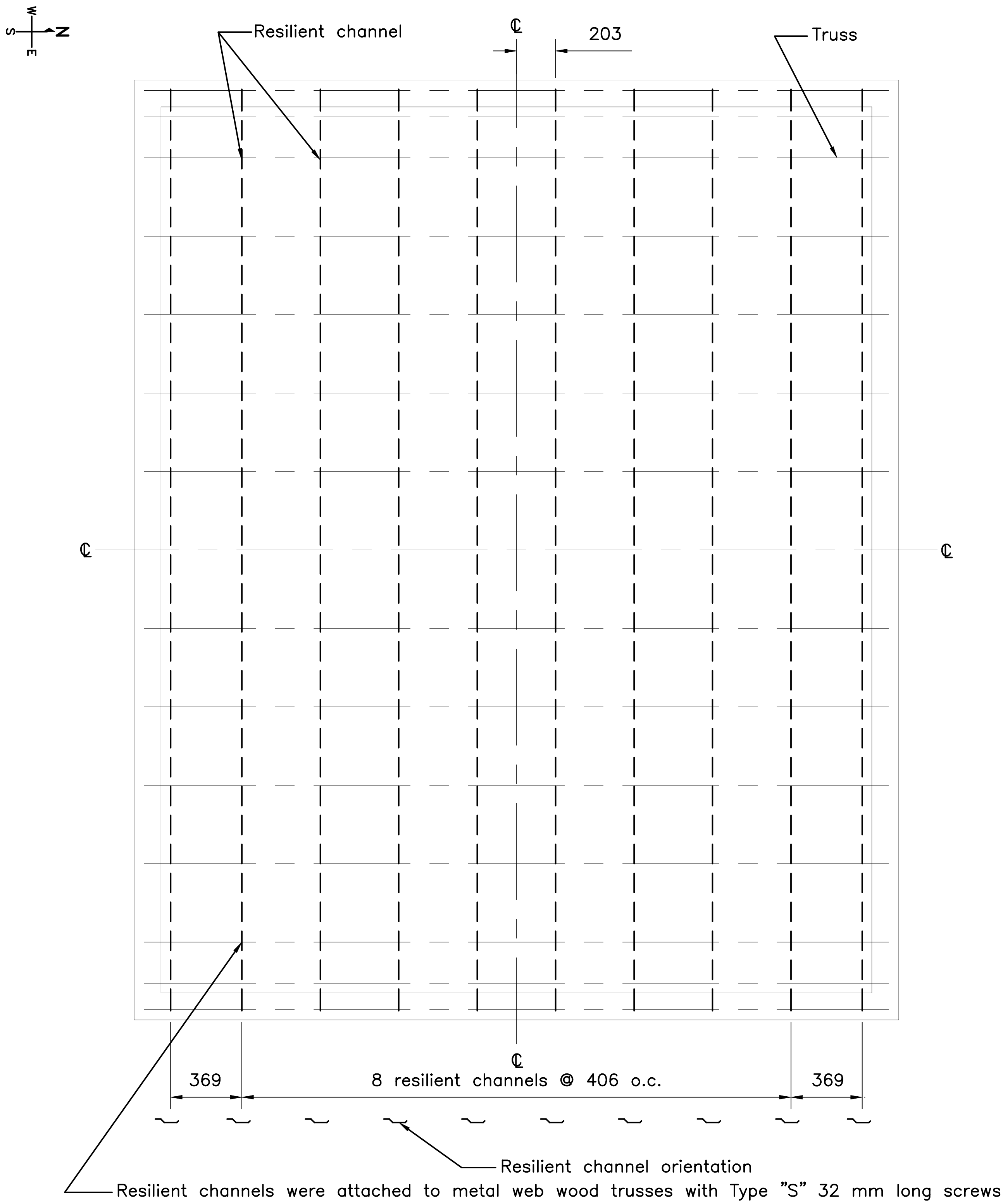
Figure C–90. Subfloor Nail Pattern (Metal Web Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-63)

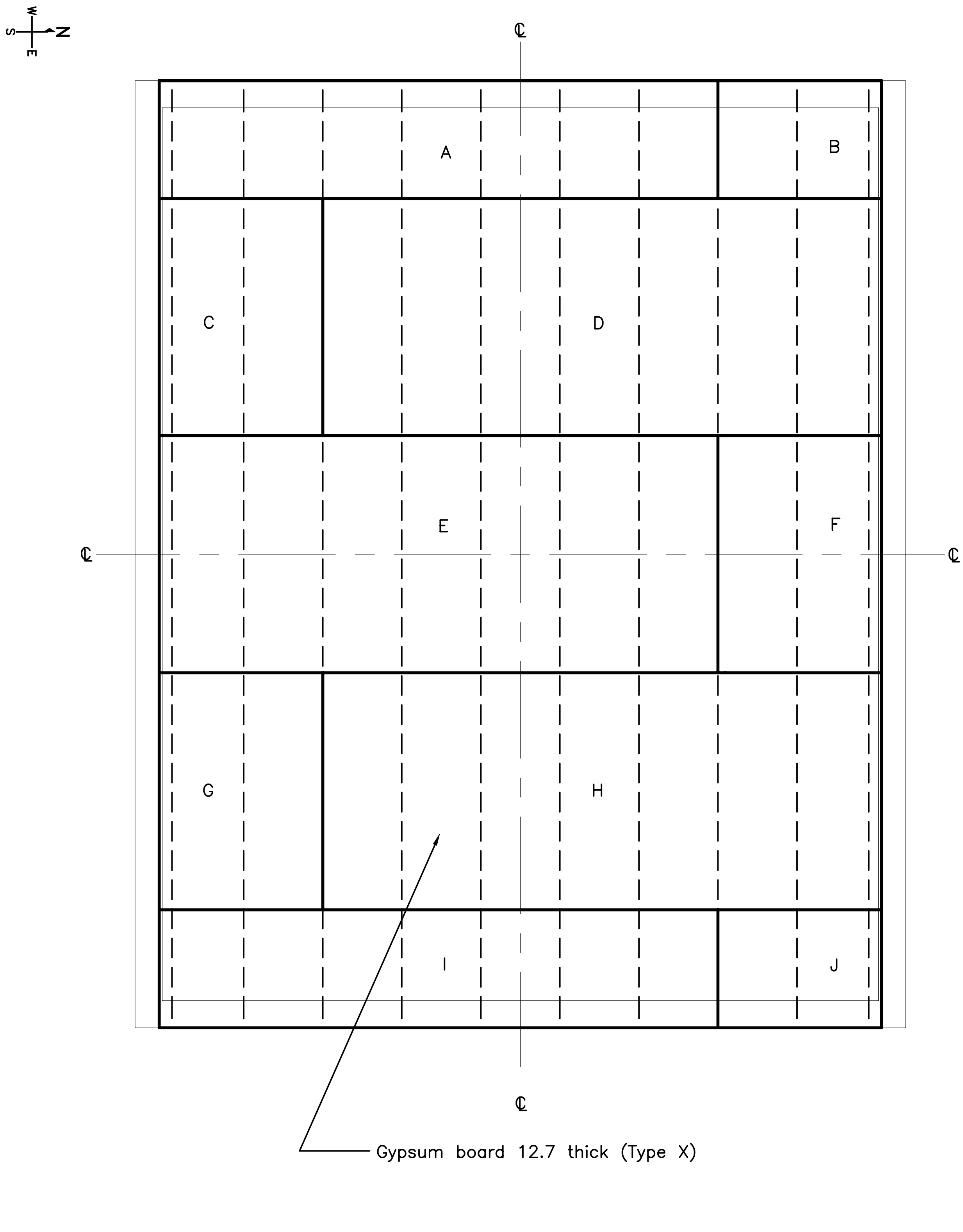
Figure C-91. Insulation Location (Metal Web Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–63)

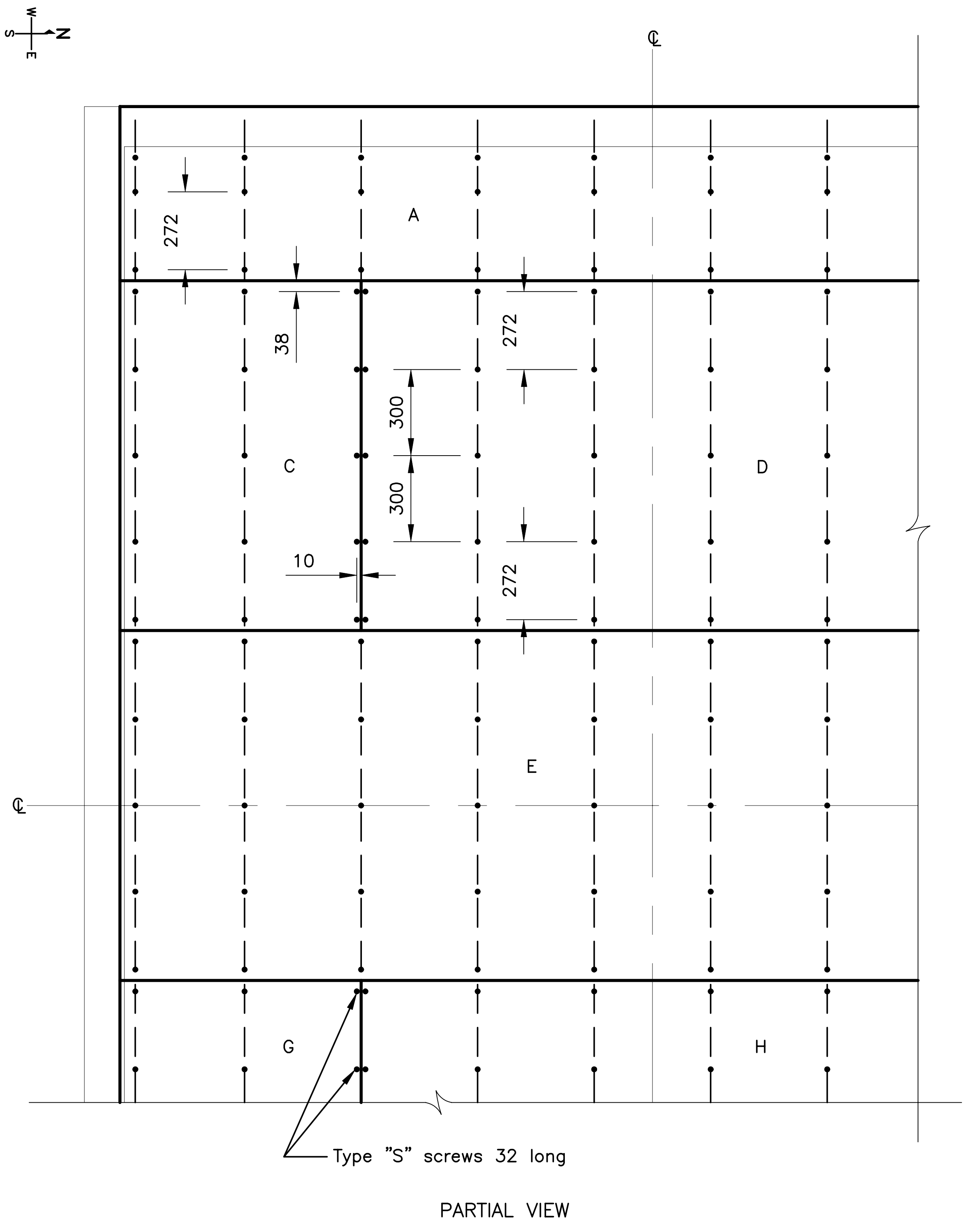
Figure C–92. Resilient Channel Layout (Metal Web Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–63)

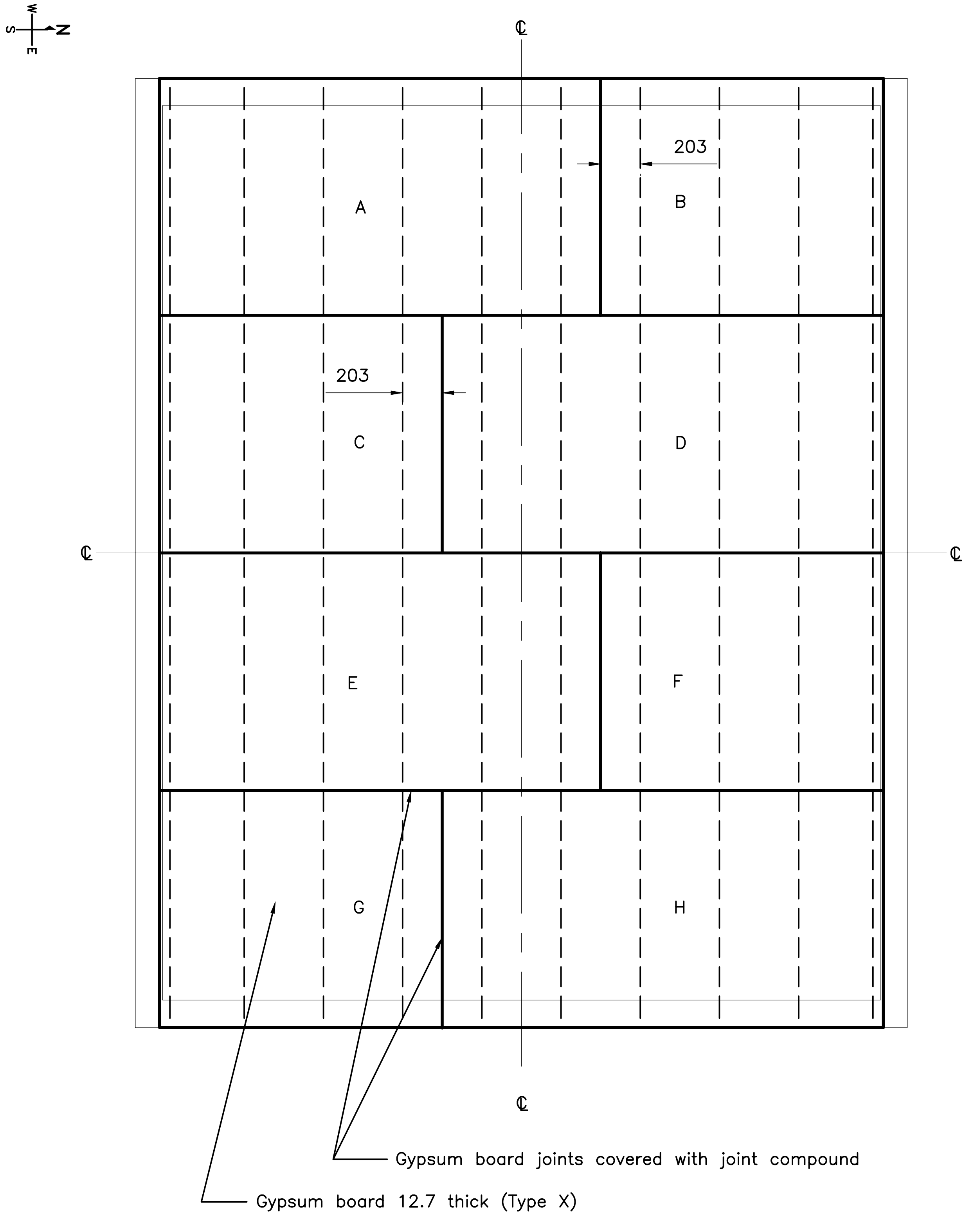
Figure C–93. Gypsum Board Base Layer Layout (Metal Web Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–63)

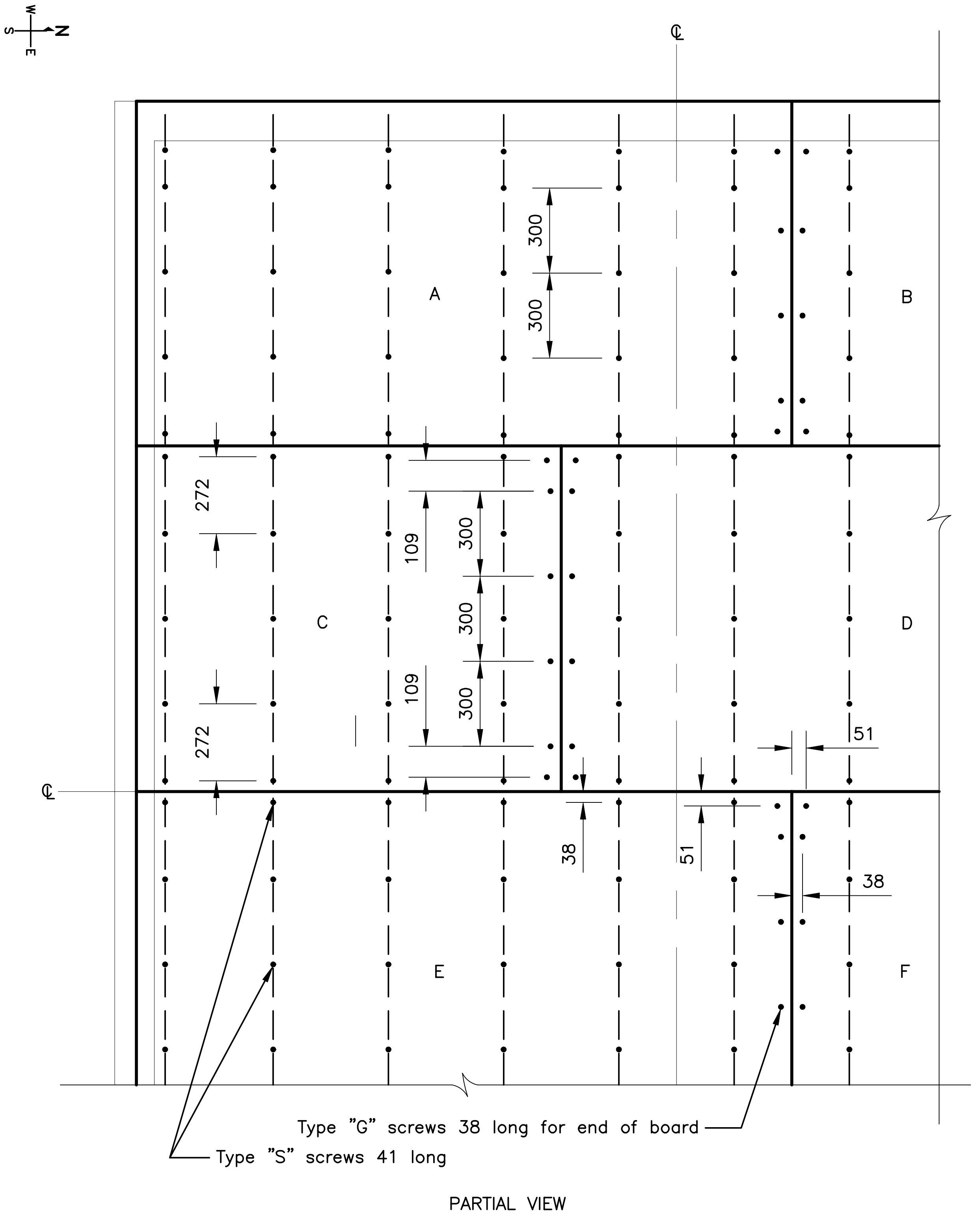
Figure C–94. Gypsum Board Base Layer Screw Pattern (Metal Web Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-63)

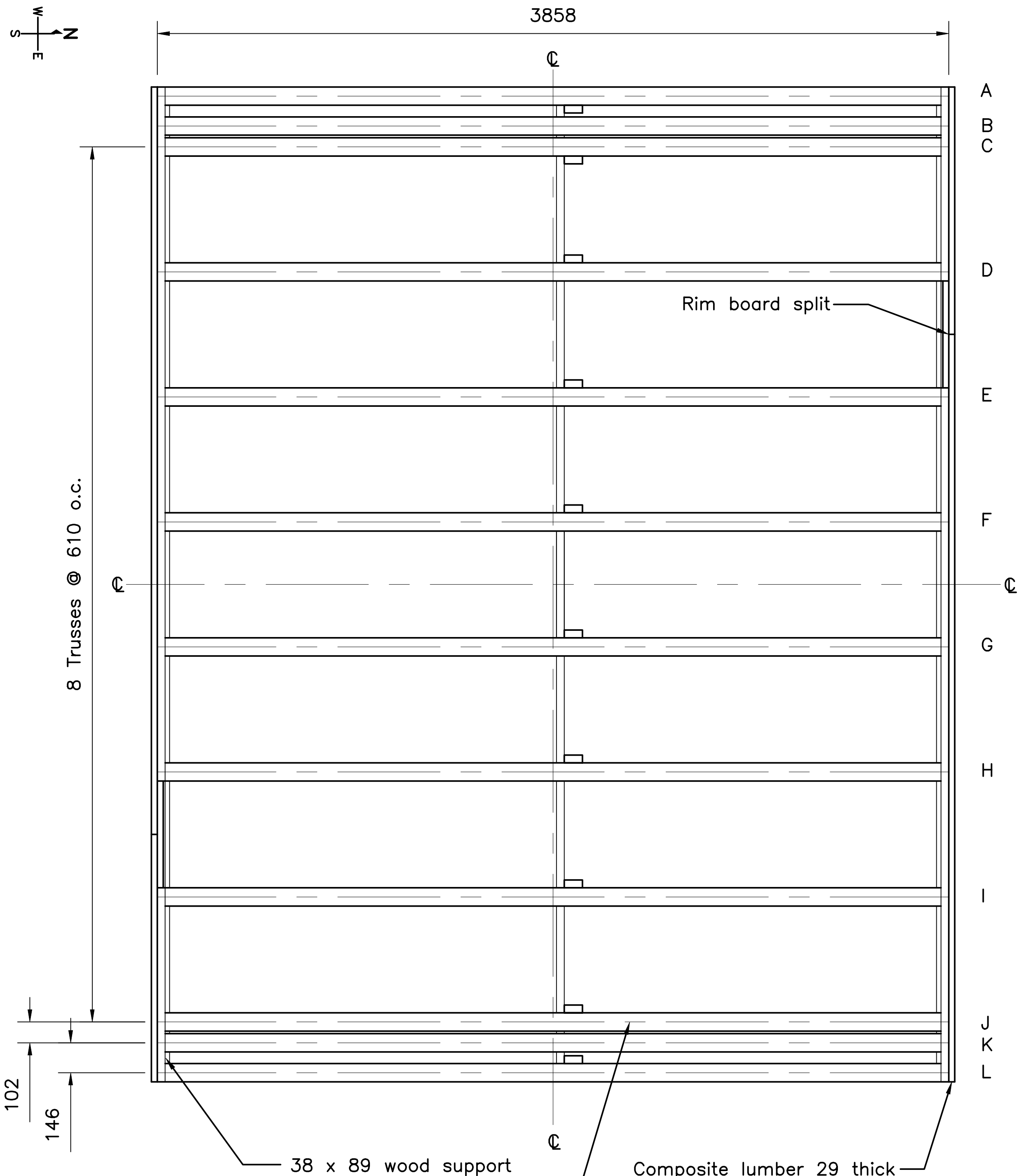
Figure C-95. Gypsum Board Face Layer Layout (Metal Web Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-63)

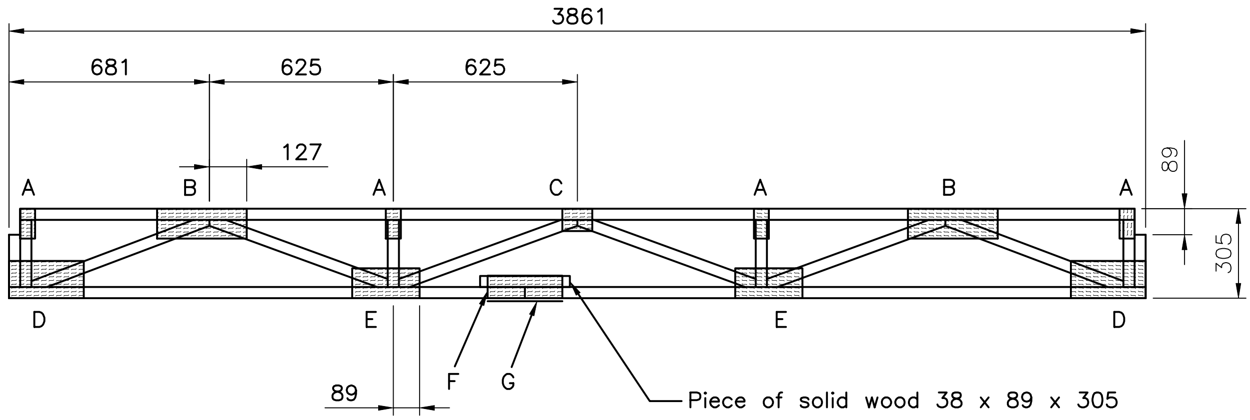
Figure C-96. Gypsum Board Face Layer Screw Pattern (Metal Web Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–71)

Figure C–97. Truss Layout (Wood Truss)



Truss members:
Truss members are made of solid wood lumber 38 x 89 Spruce–Pine–Fir #2 S–DRY and some members are stamped with O.L.M.A® 134

Plates:
TEE–LOK 20 plates 0.9 mm thick with 8 mm long teeth.
The number of teeth on the plate = plate area in mm² ÷ 80.645
All plates are centered in the middle of the joint except plates B and E, see drawing for details.

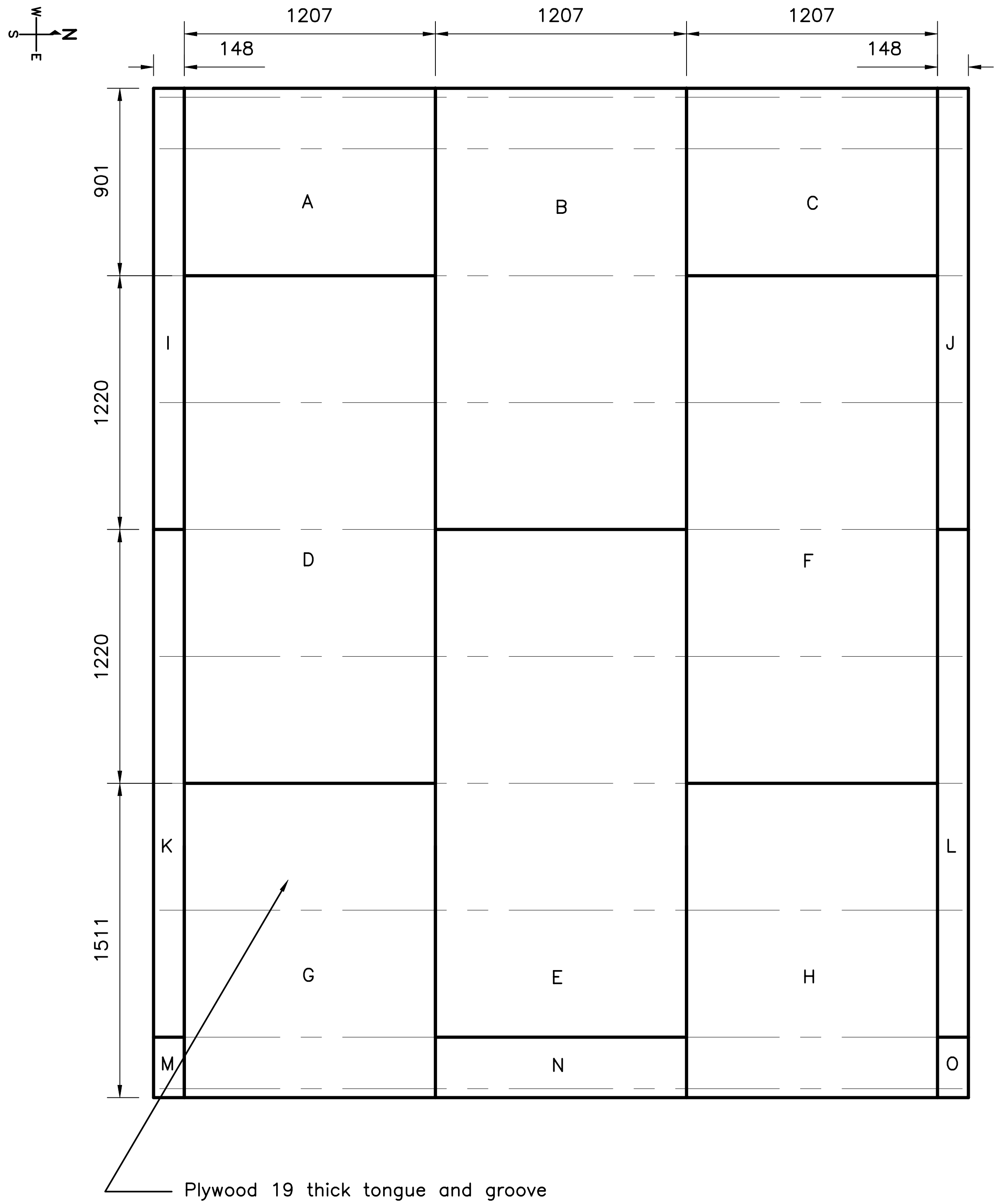
Plate size and location

A 50.8 x 101.6 both sides
B 304.8 x 101.6 both sides
C 101.6 x 76.2 both sides
D 254 x 127 both sides
E 228.6 x 101.6 both sides
F 254 x 76.2 both sides
G 254 x 76.2 both sides of bottom flange

(Dimensions are in millimetres)

(Assembly No. FF–71)

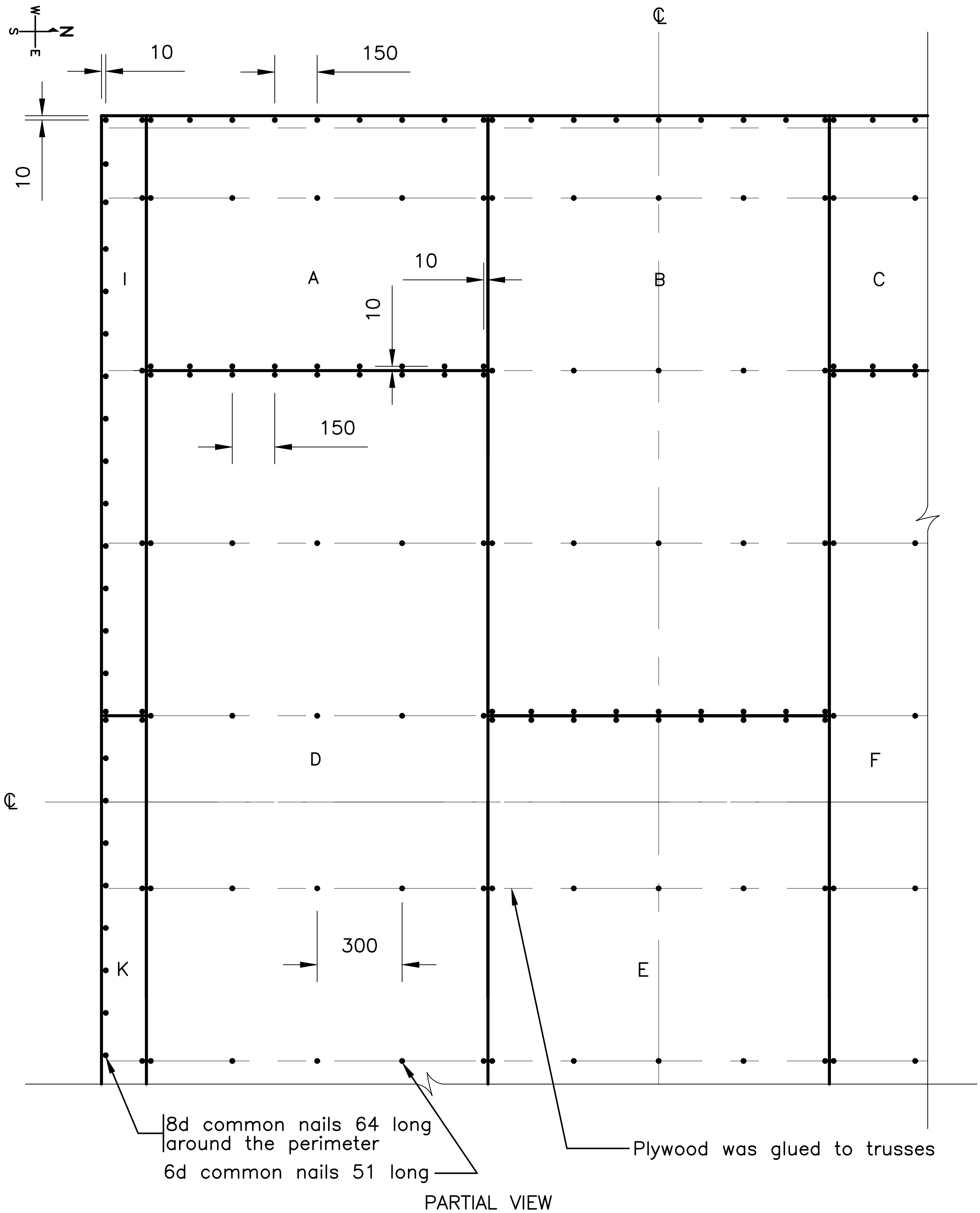
Figure C–98. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-71)

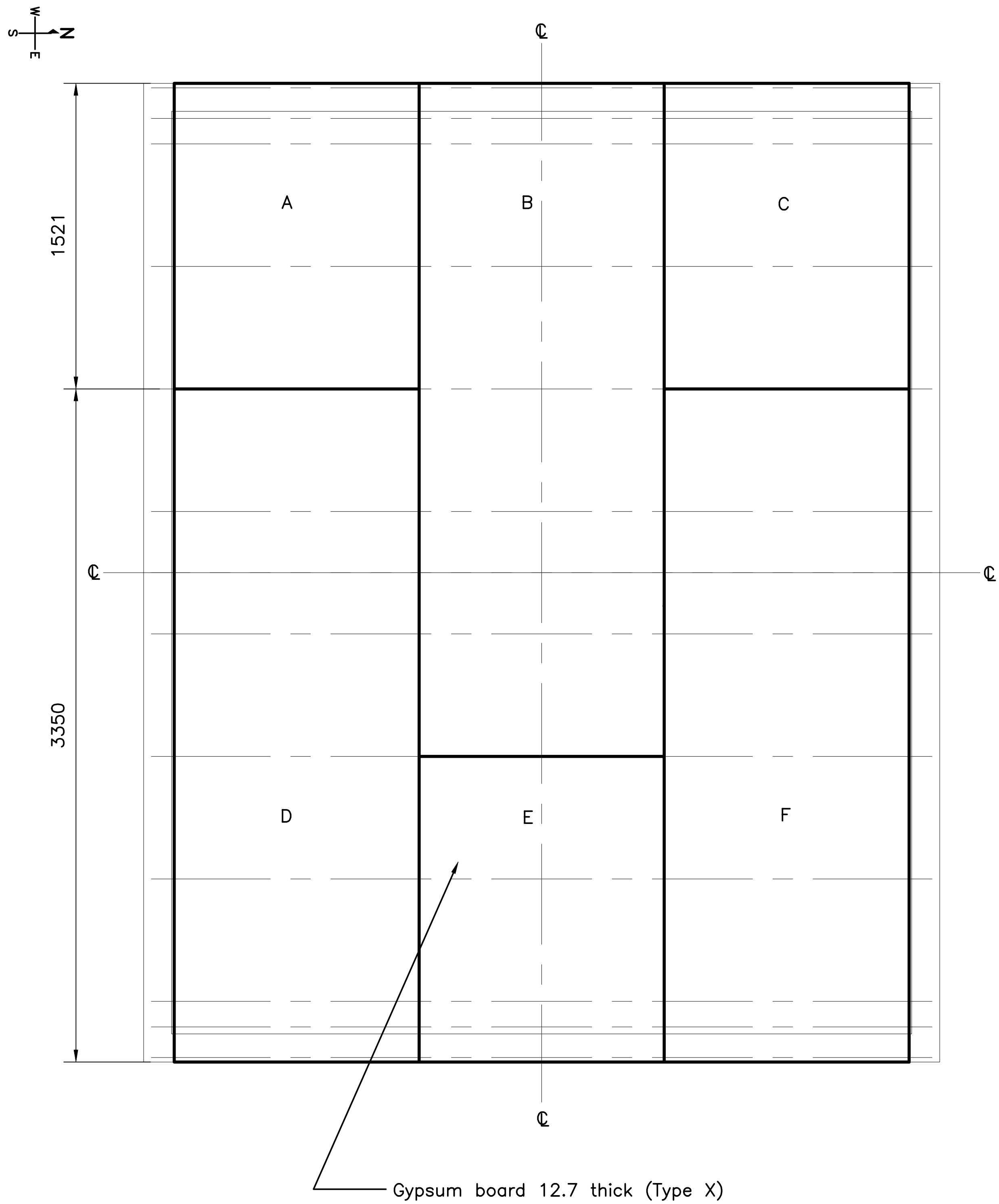
Figure C-99. Subfloor Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-71)

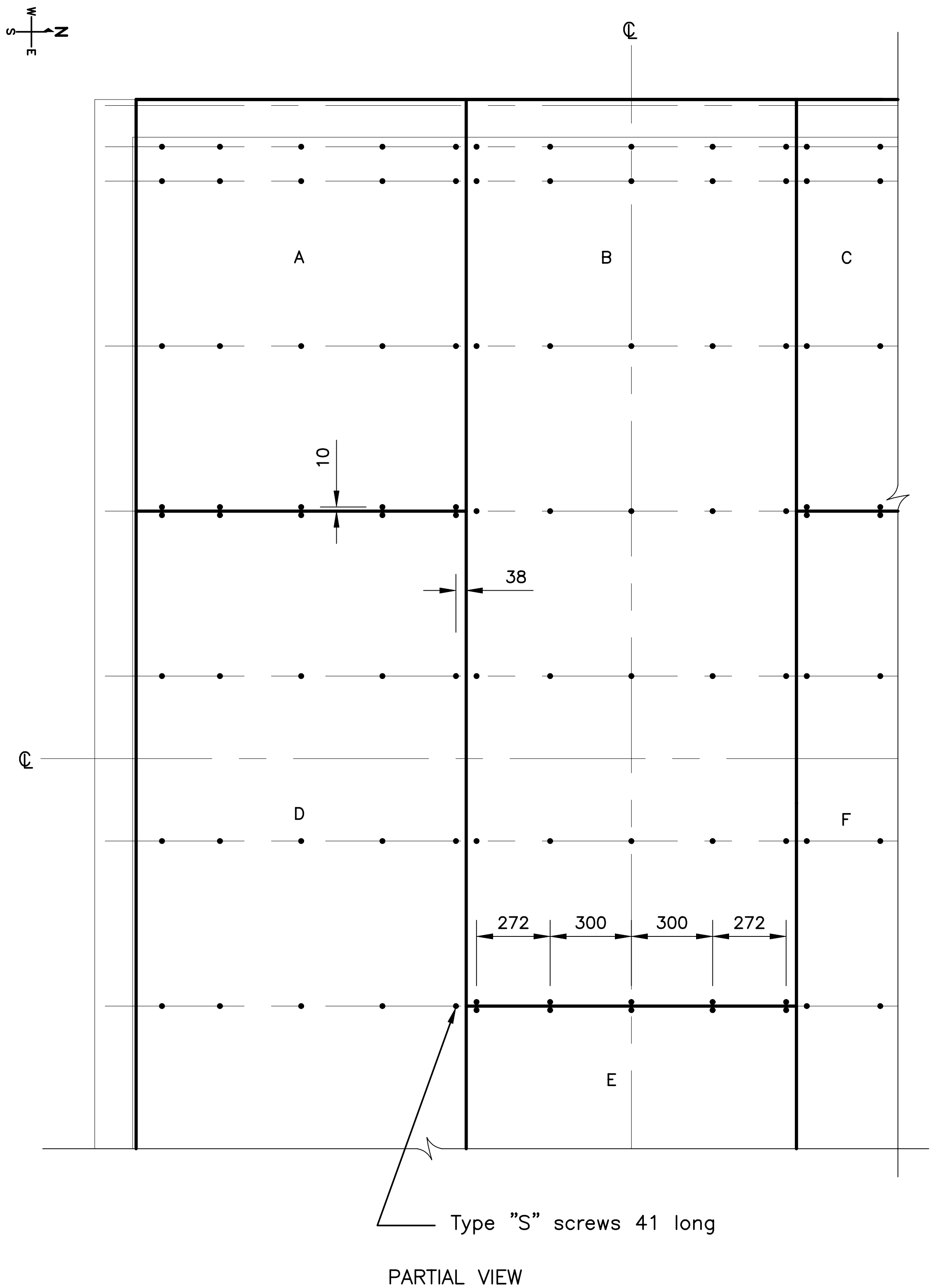
Figure C-100. Subfloor Nail Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–71)

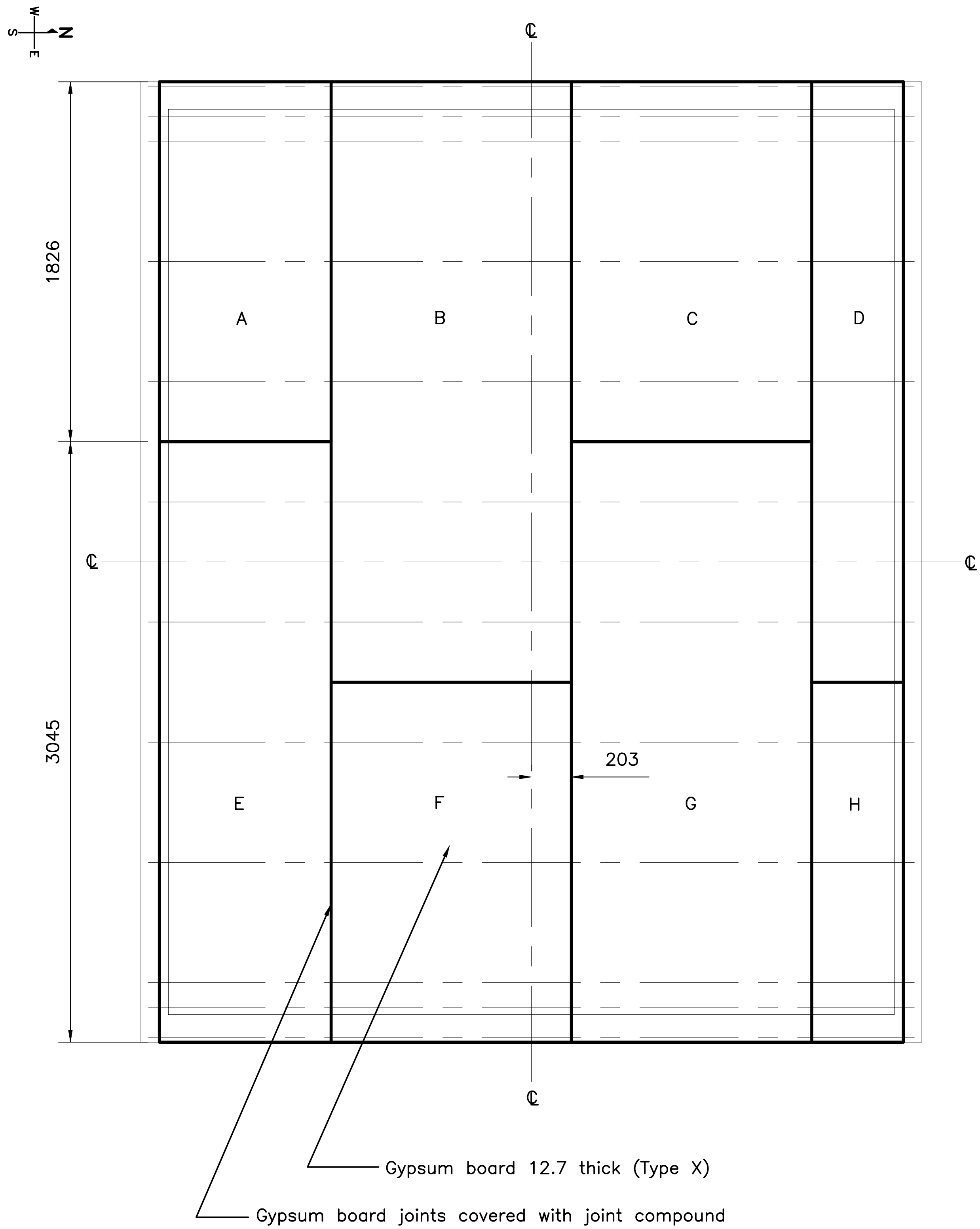
Figure C–101. Gypsum Board Base Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–71)

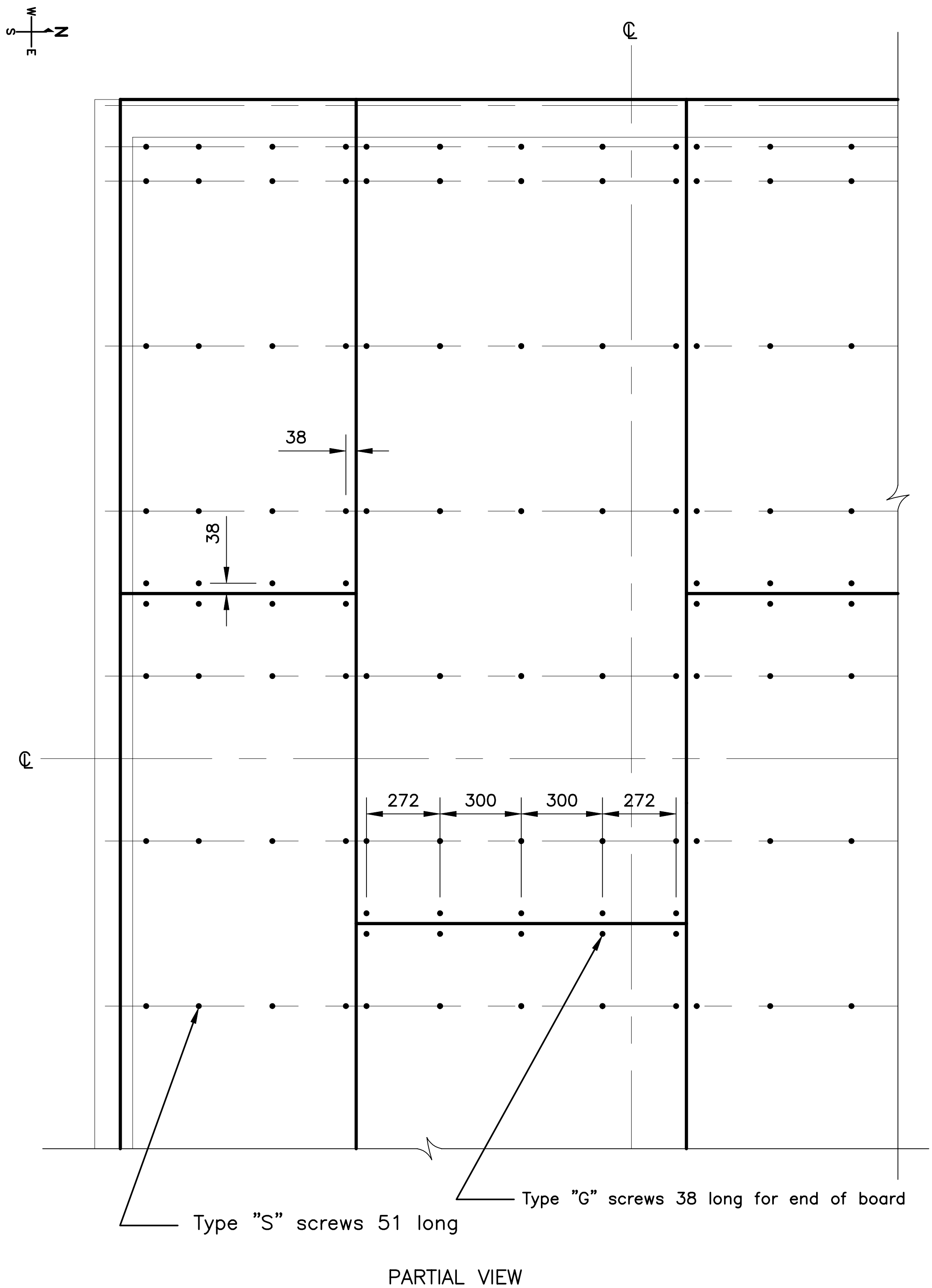
Figure C–102. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–71)

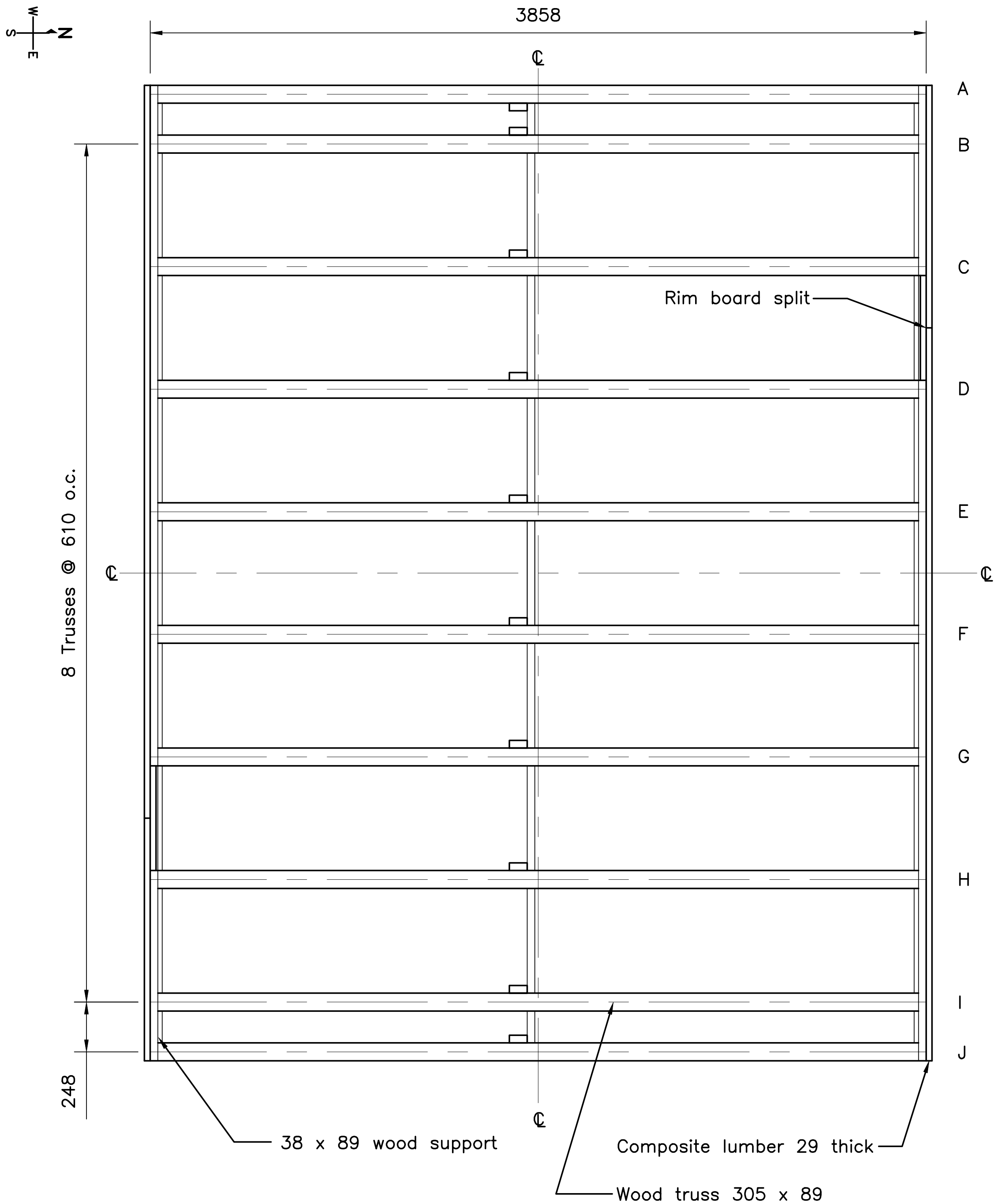
Figure C–103. Gypsum Board Face Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-71)

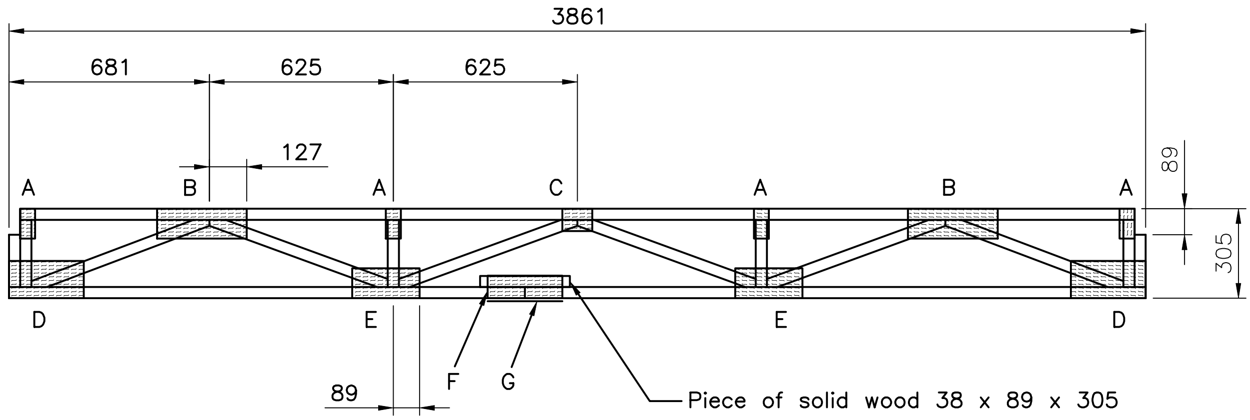
Figure C-104. Gypsum Board Face Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–72)

Figure C–105. Truss Layout (Wood Truss)



Truss members:
Truss members are made of solid wood lumber 38 x 89 Spruce–Pine–Fir #2 S–DRY O.L.M.A® 21 and NFP Mill #151 I.D. #2241

Plates:
TEE–LOK 20 plates 0.9 mm thick with 8 mm long teeth.
The number of teeth on the plate = plate area in mm² ÷ 80.645
All plates are centered in the middle of the joint except plates B and E, see drawing for details.

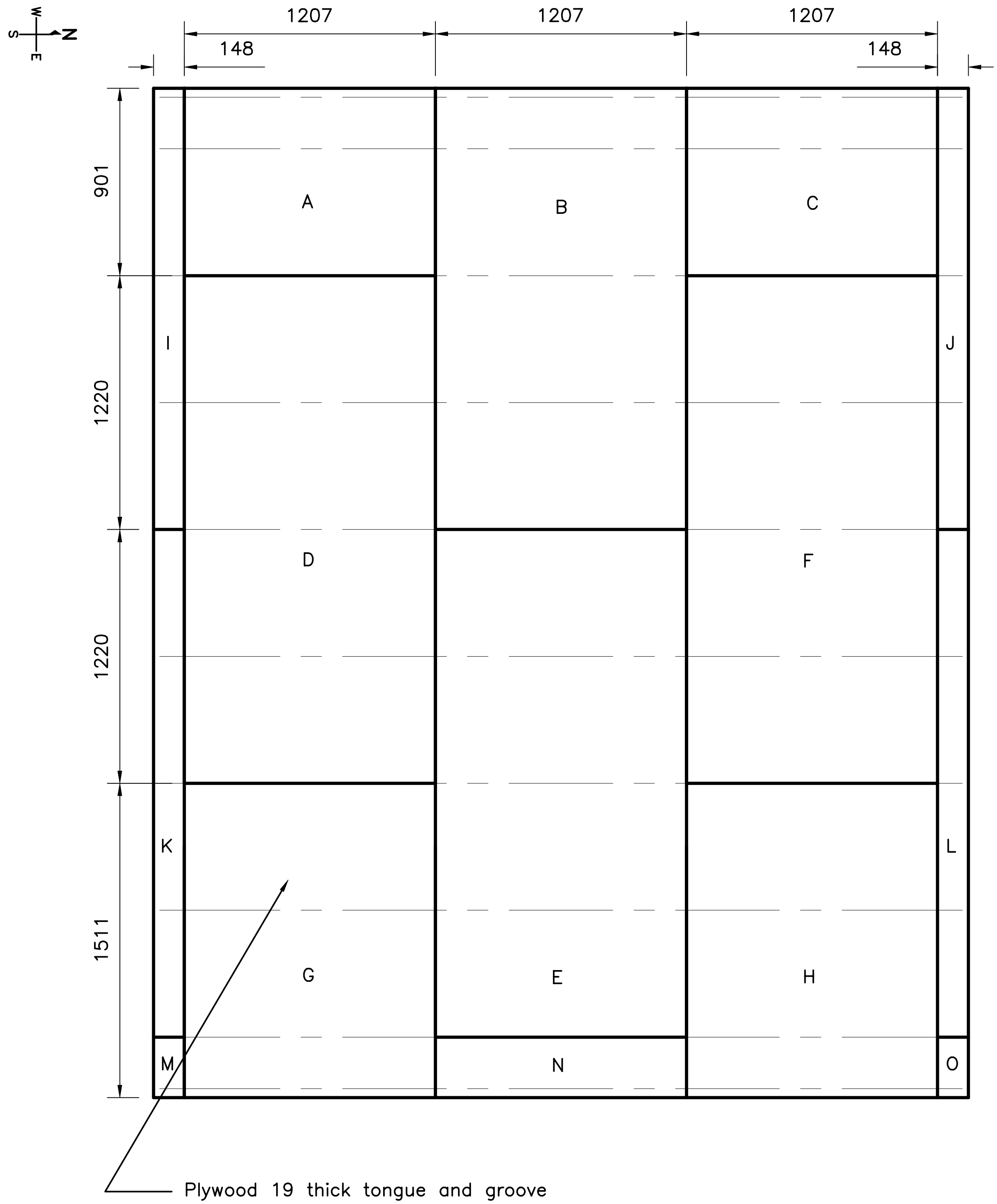
Plate size and location

A 50.8 x 101.6 both sides
B 304.8 x 101.6 both sides
C 101.6 x 76.2 both sides
D 254 x 127 both sides
E 228.6 x 101.6 both sides
F 254 x 76.2 both sides
G 254 x 76.2 both sides of bottom flange

(Dimensions are in millimetres)

(Assembly No. FF–72)

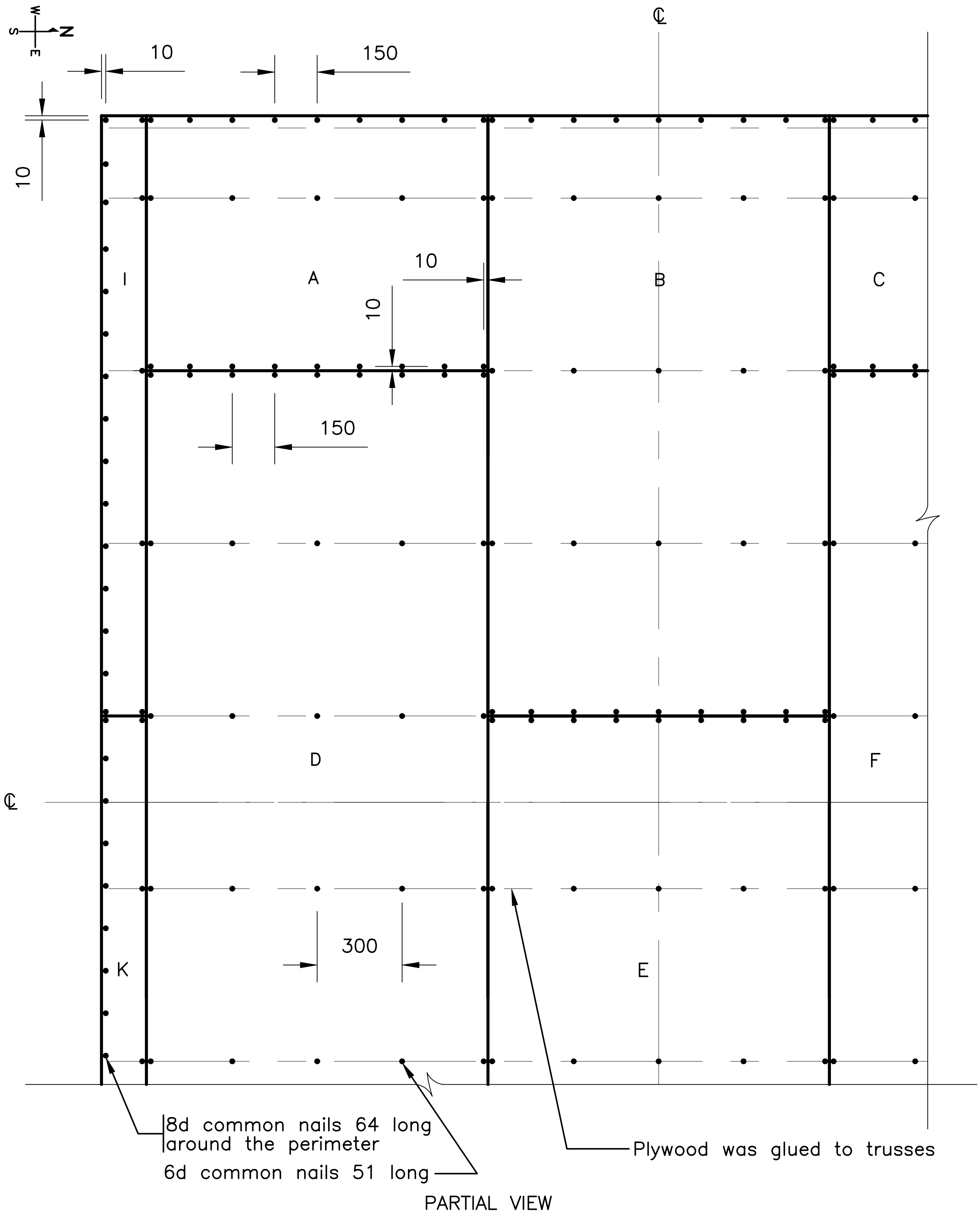
Figure C–106. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-72)

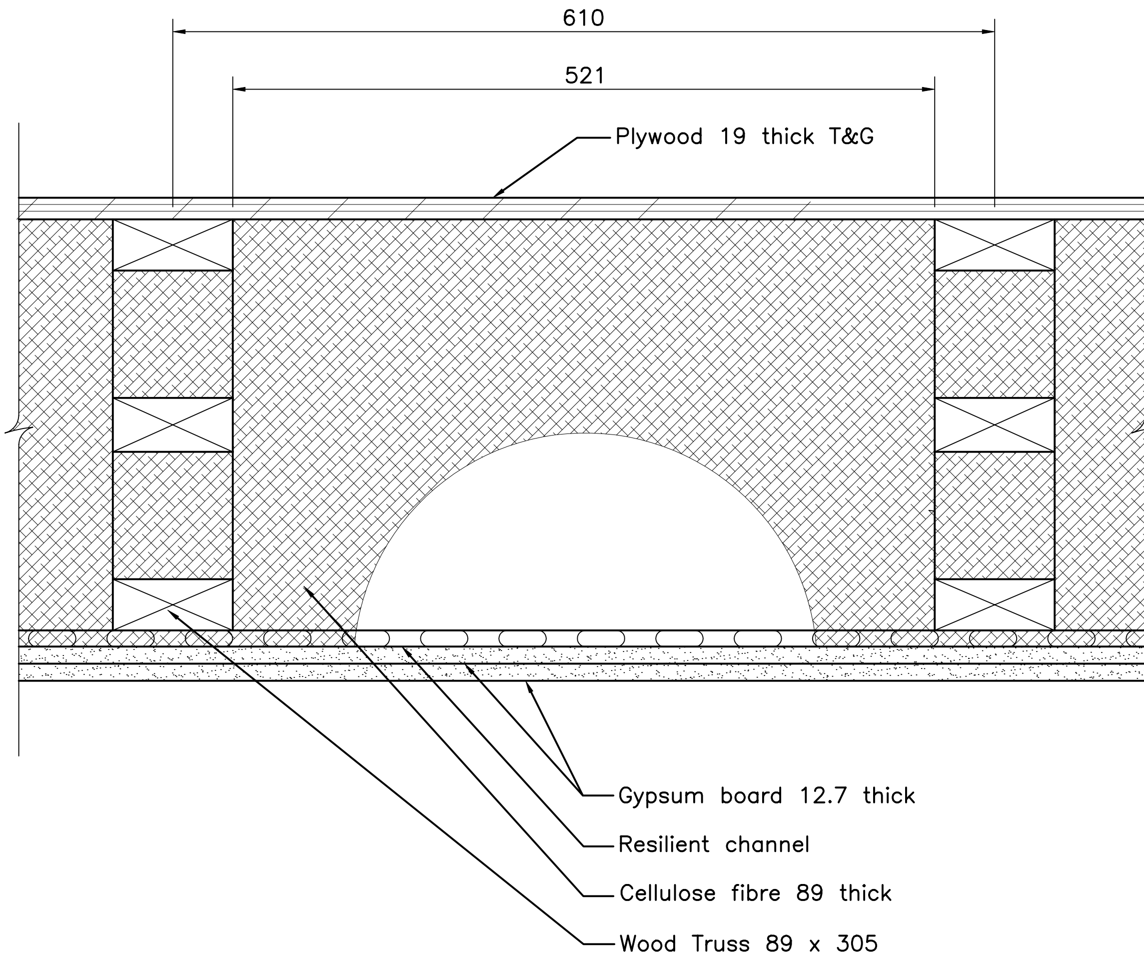
Figure C-107. Subfloor Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–72)

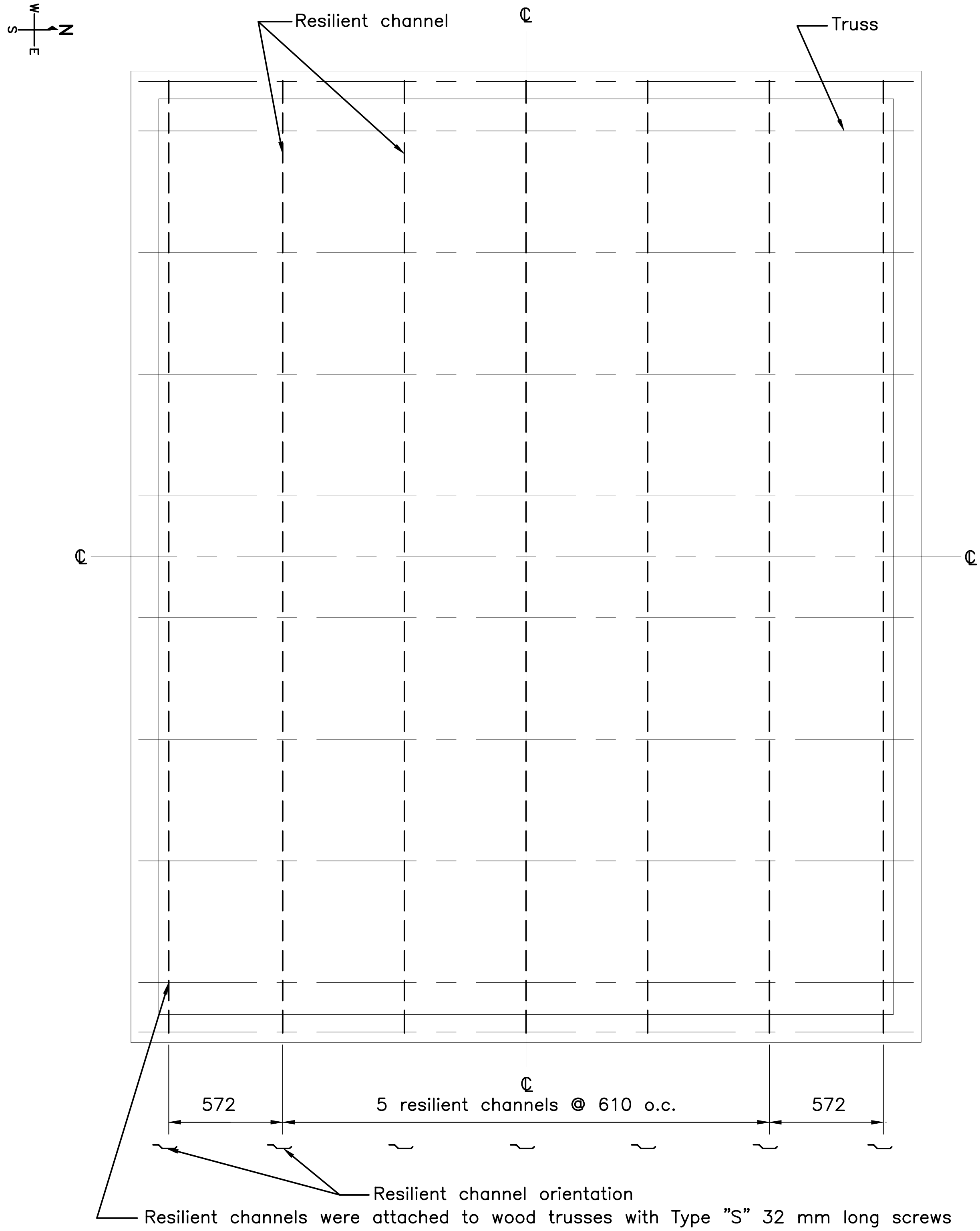
Figure C–108. Subfloor Nail Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–72)

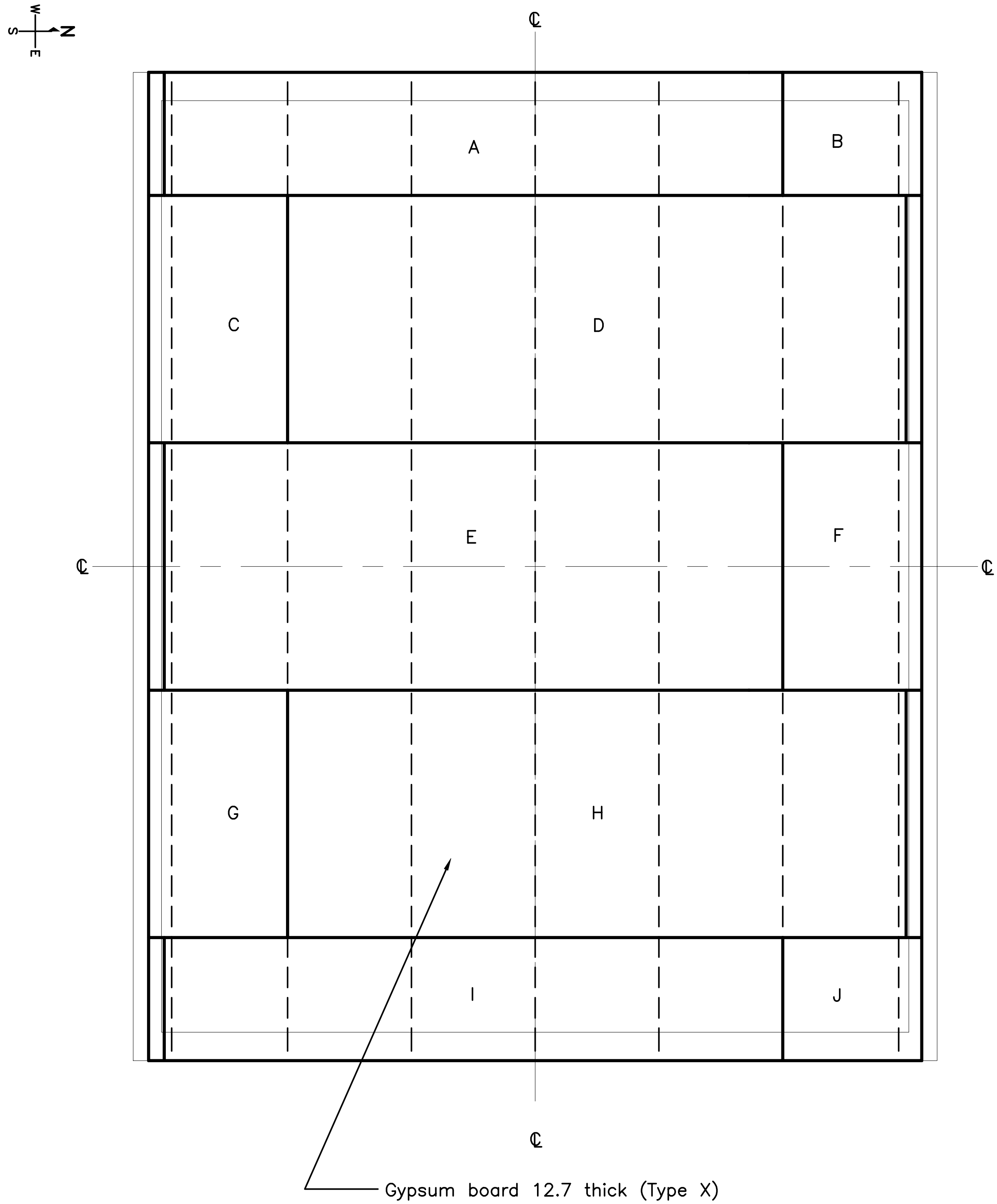
Figure C–109. Insulation Location (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-72)

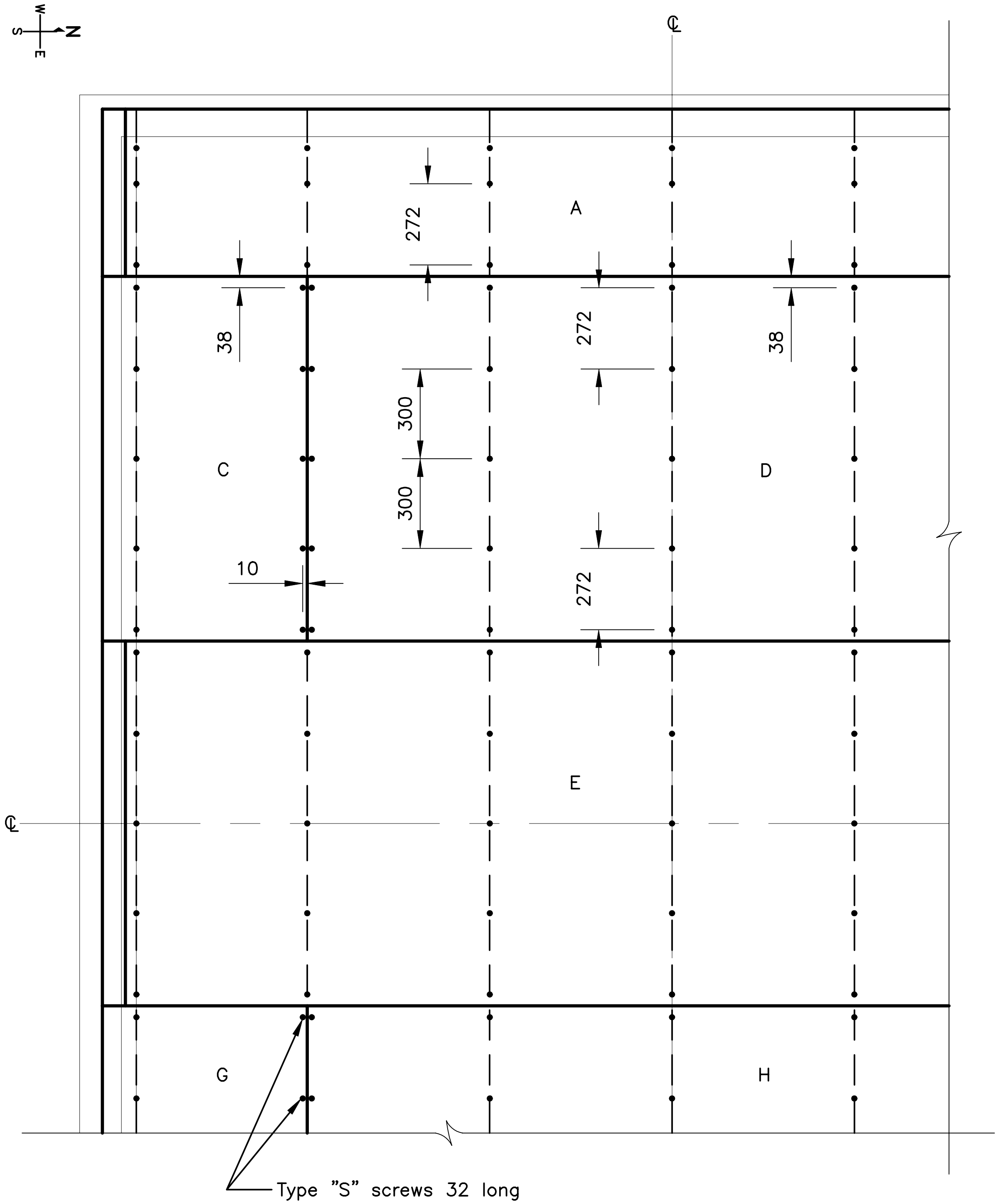
Figure C-110. Resilient Channel Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–72)

Figure C–111. Gypsum Board Base Layer Layout (Wood Truss)

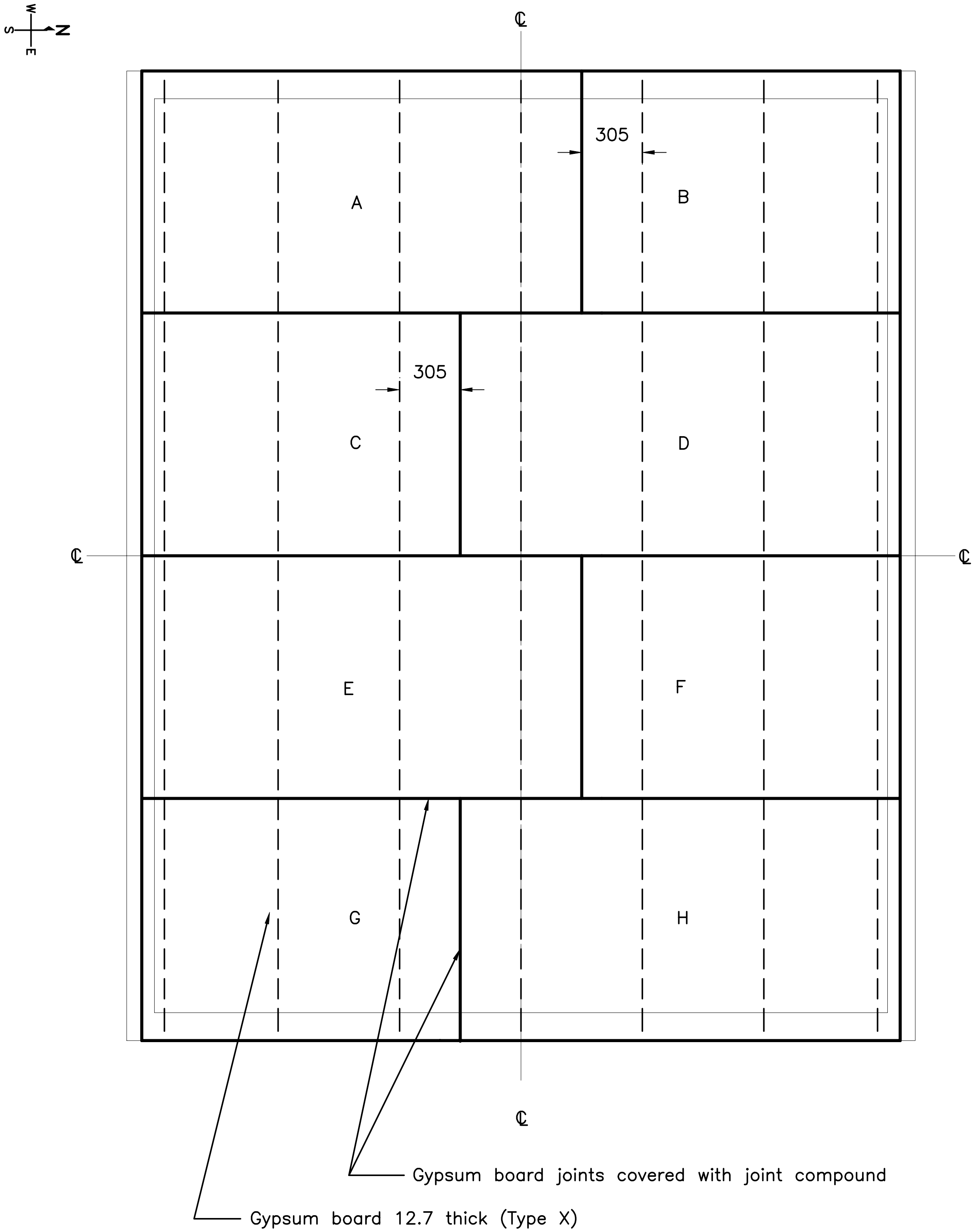


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF–72)

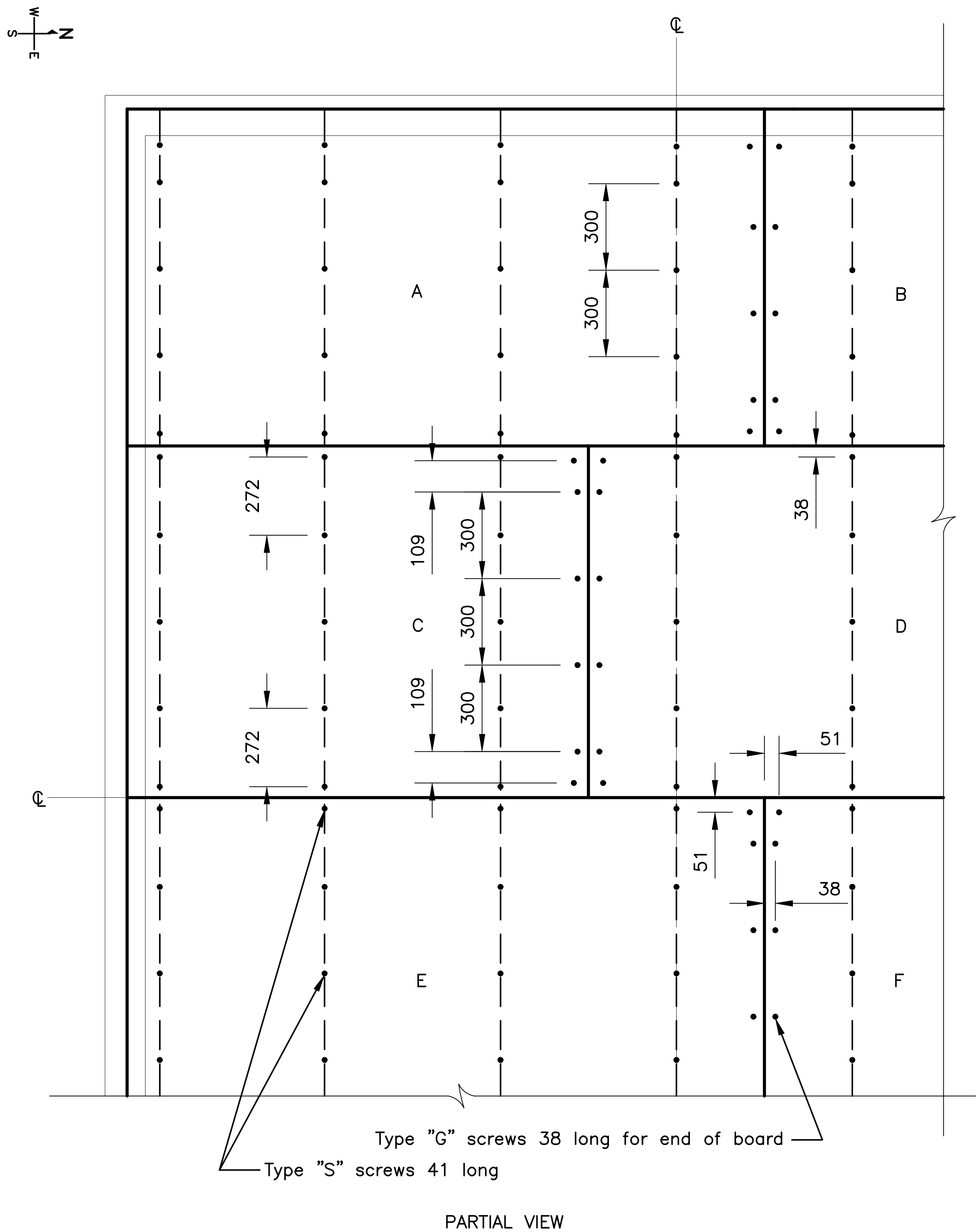
Figure C–112. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–72)

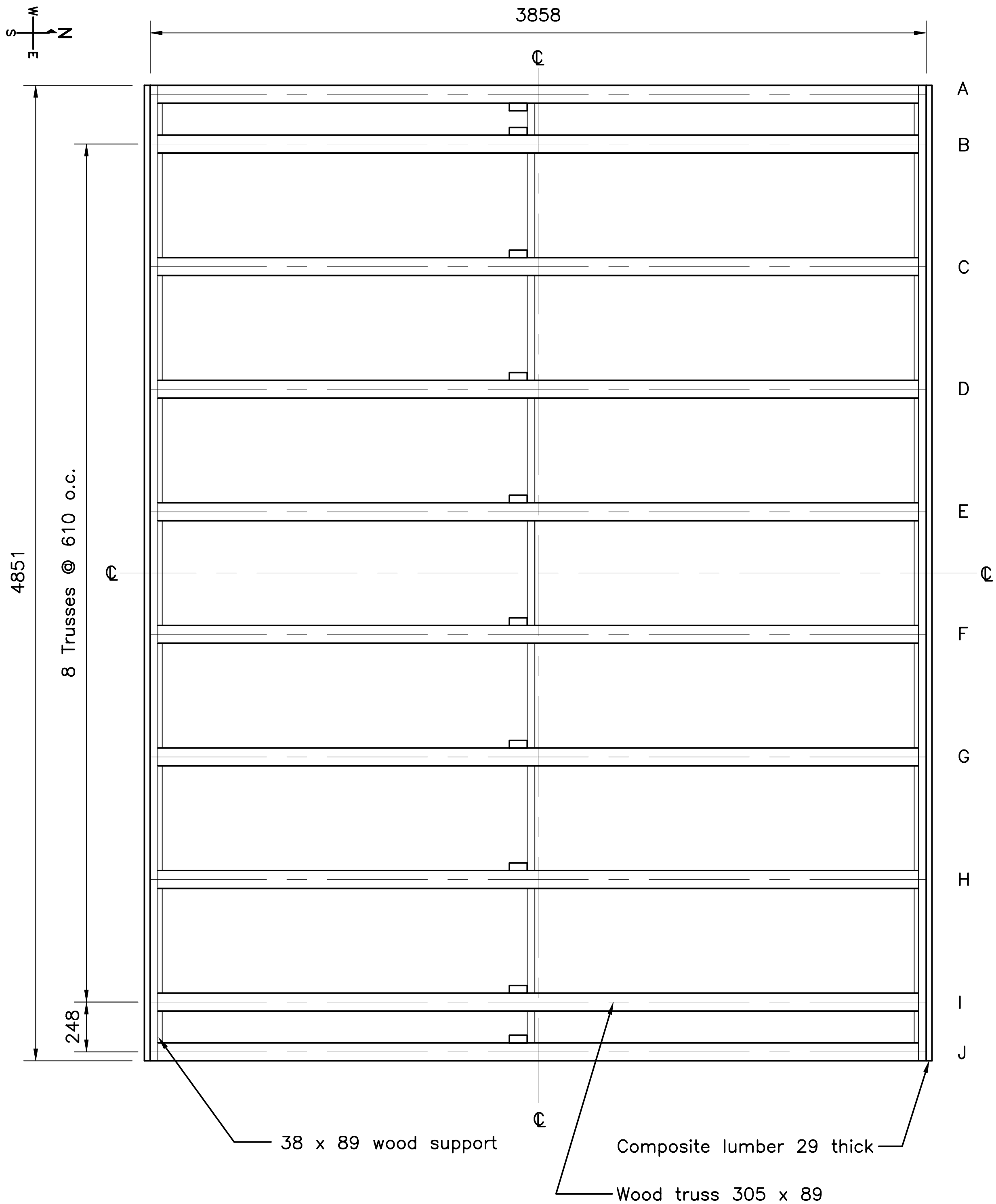
Figure C–113. Gypsum Board Face Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–72)

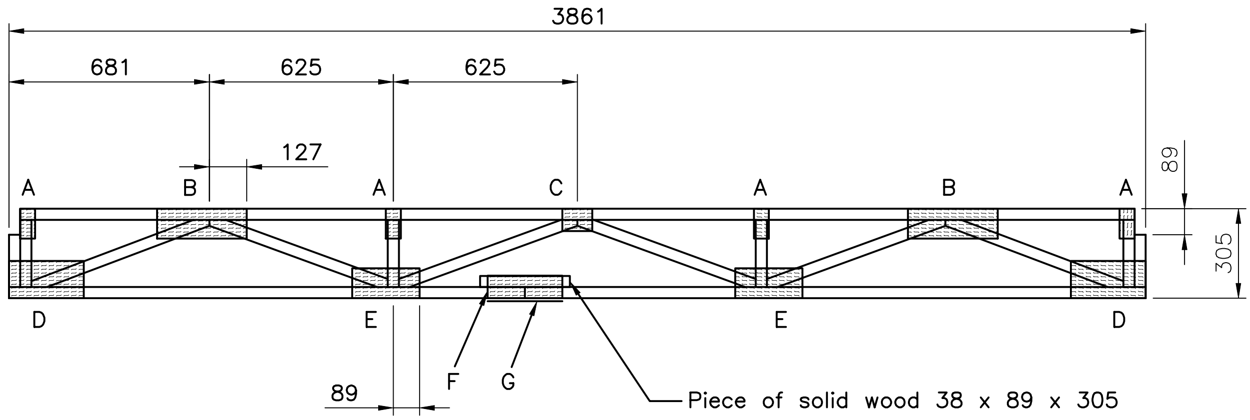
Figure C–114. Gypsum Board Face Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-75)

Figure C-115. Truss Layout (Wood Truss)



Truss members:
Truss members are made of solid wood lumber 38 x 89 Spruce–Pine–Fir #2 S–DRY CL®A 721, 363 NLGA

Plates:
TEE–LOK 20 plates 0.9 mm thick with 8 mm long teeth.
The number of teeth on the plate = plate area in mm² ÷ 80.645
All plates are centered in the middle of the joint except plates B and E, see drawing for details.

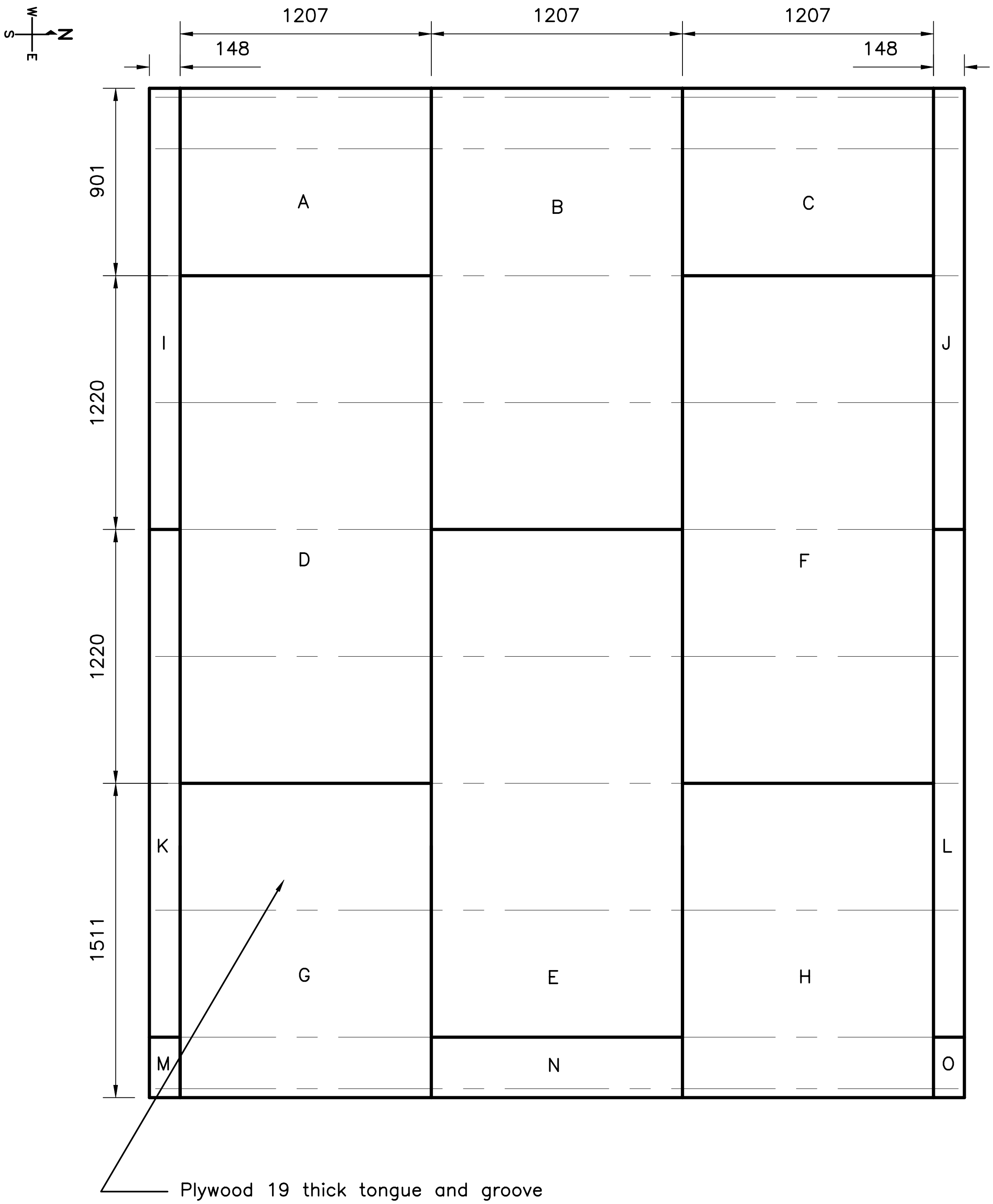
Plate size and location

A 50.8 x 101.6 both sides
B 304.8 x 101.6 both sides
C 101.6 x 76.2 both sides
D 254 x 127 both sides
E 228.6 x 101.6 both sides
F 254 x 76.2 both sides
G 254 x 76.2 both sides of bottom flange

(Dimensions are in millimetres)

(Assembly No. FF–75)

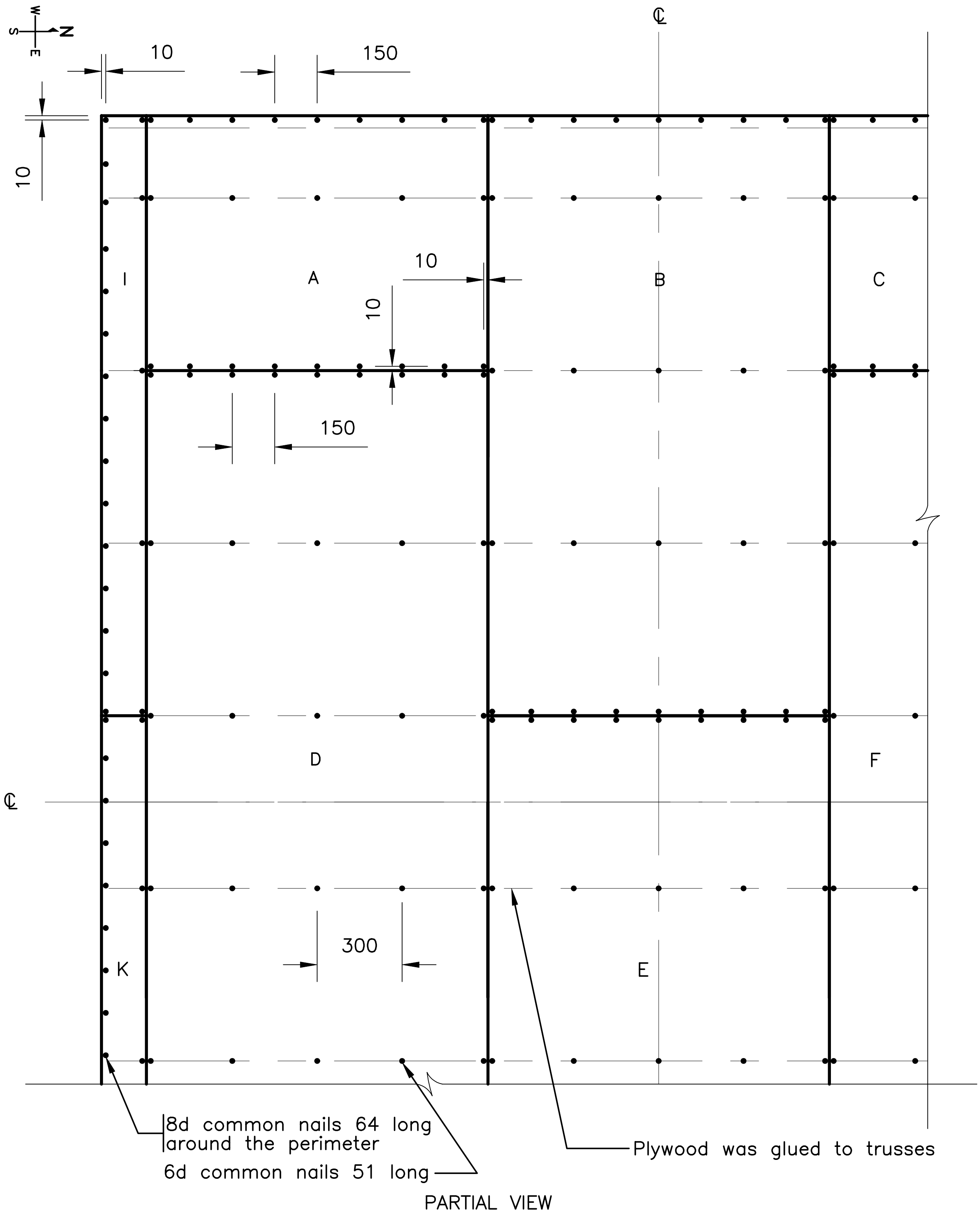
Figure C–116. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–75)

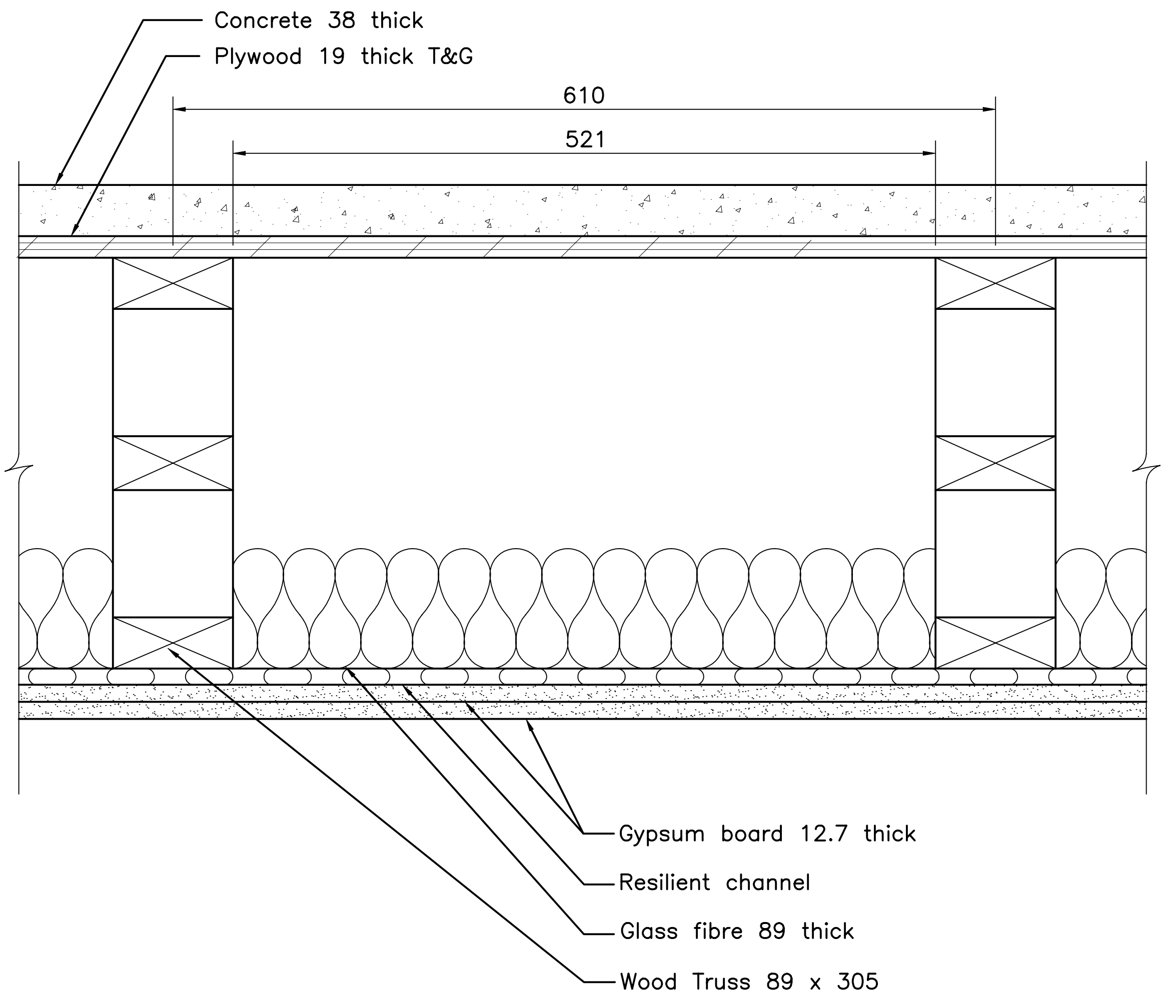
Figure C–117. Subfloor Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–75)

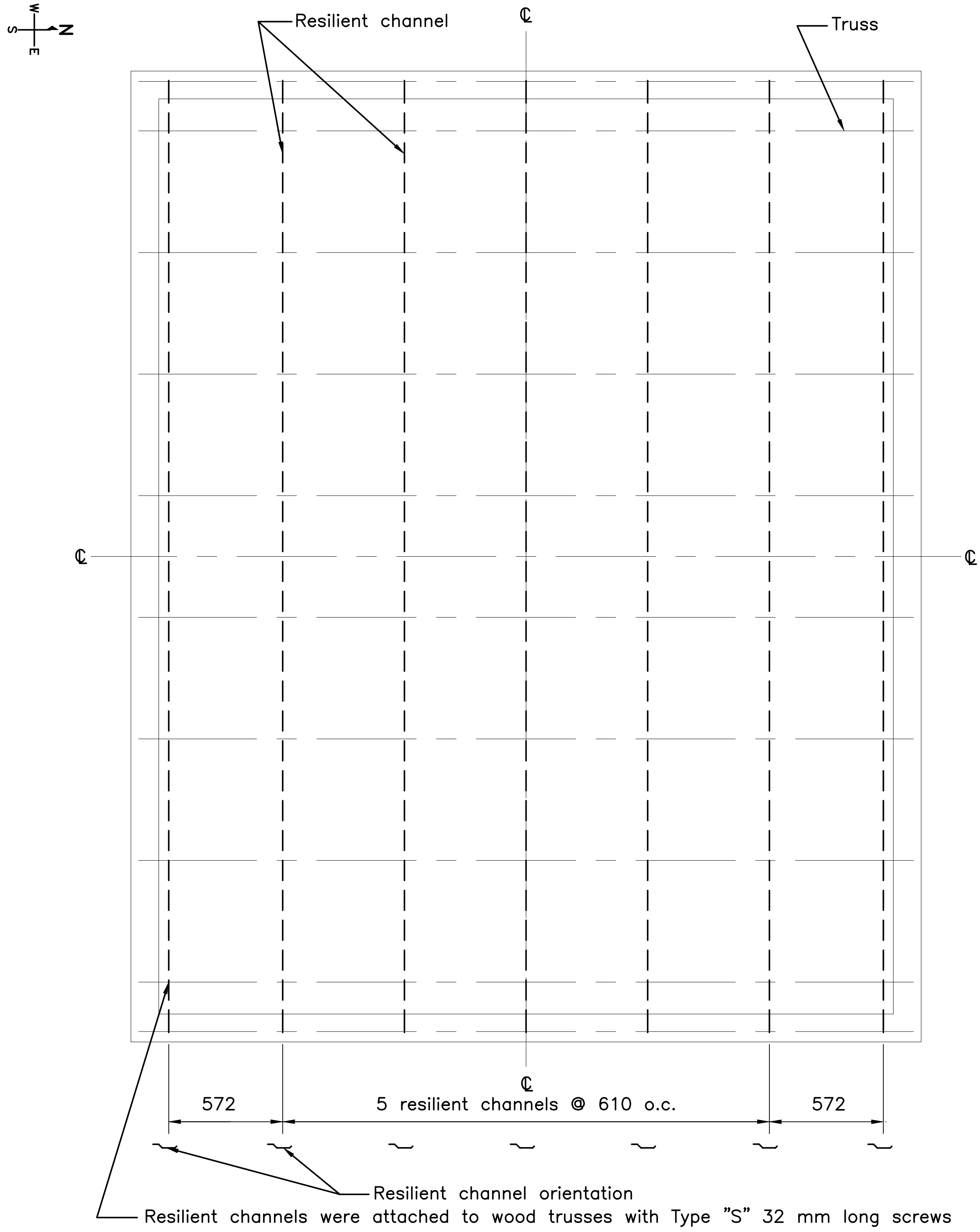
Figure C–118. Subfloor Nail Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–75)

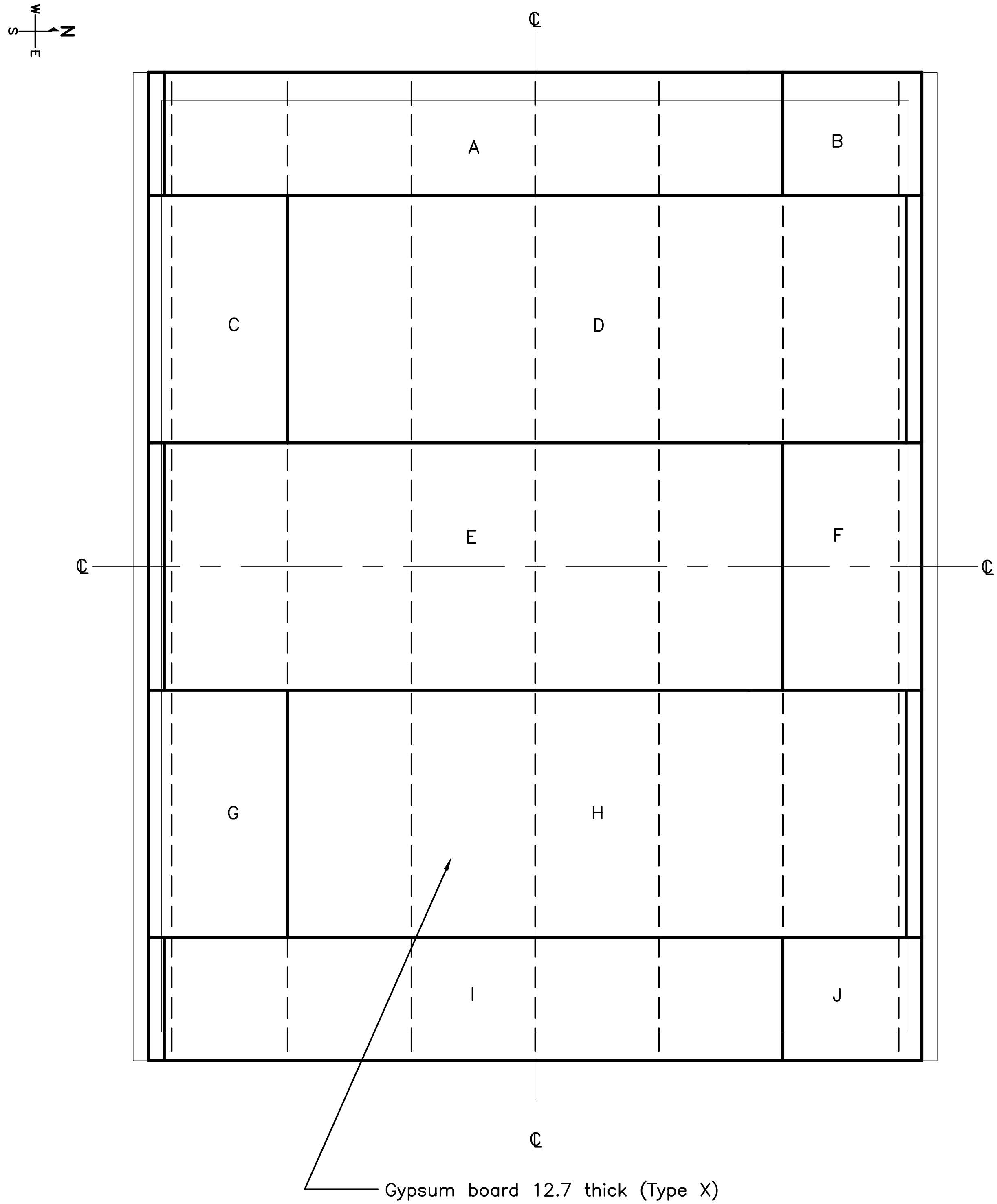
Figure C–119. Insulation Location (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–75)

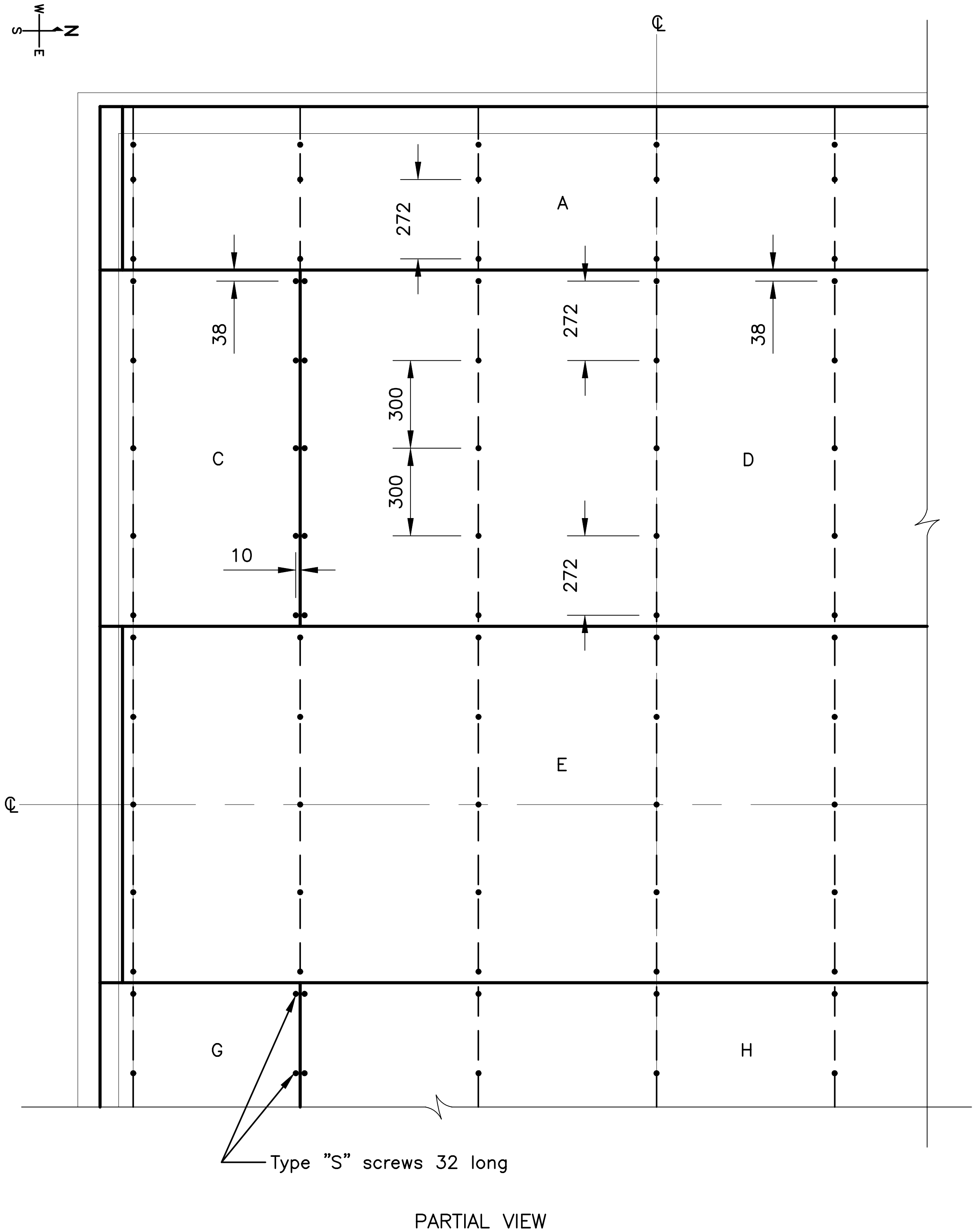
Figure C–120. Resilient Channel Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-75)

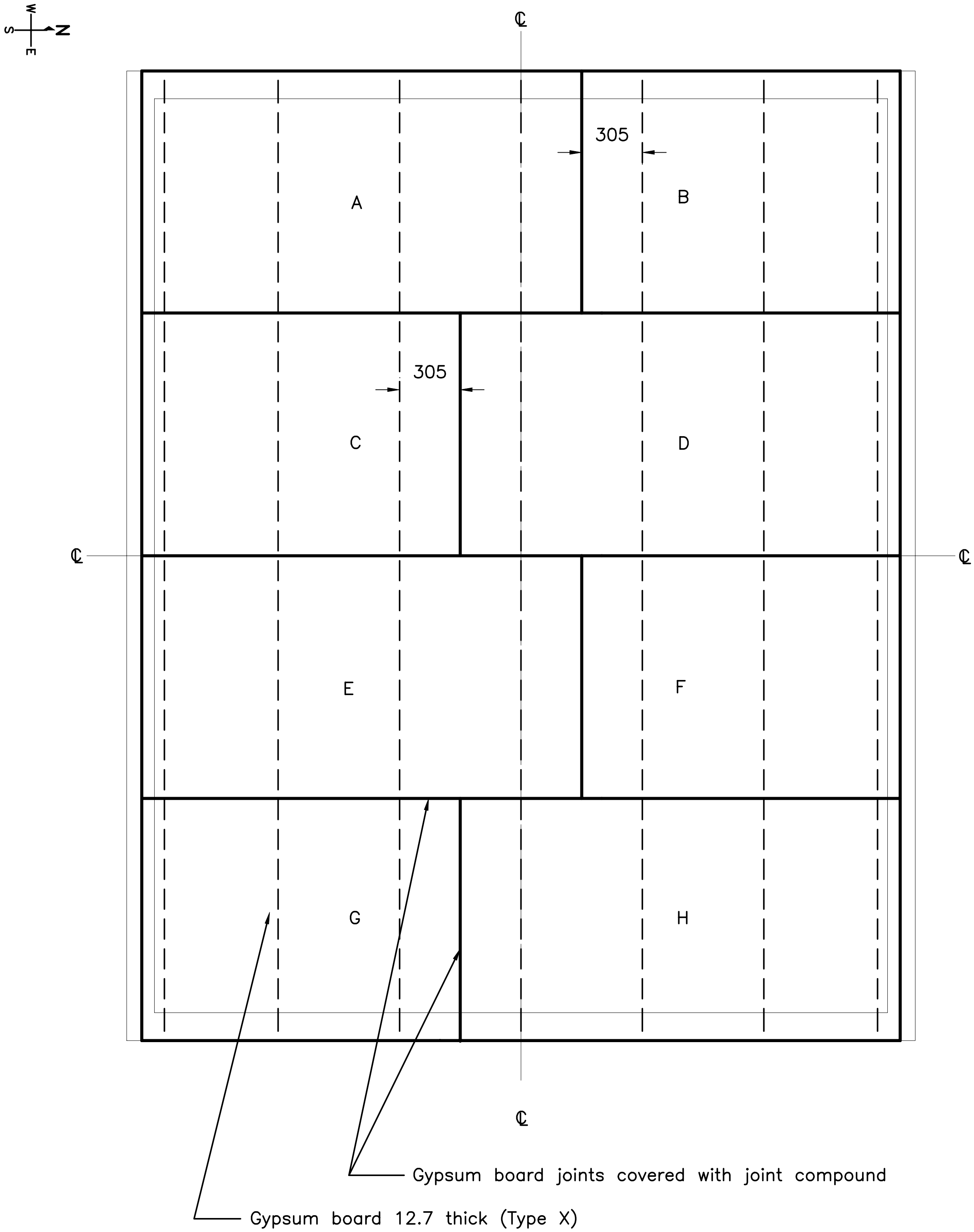
Figure C-121. Gypsum Board Base Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–75)

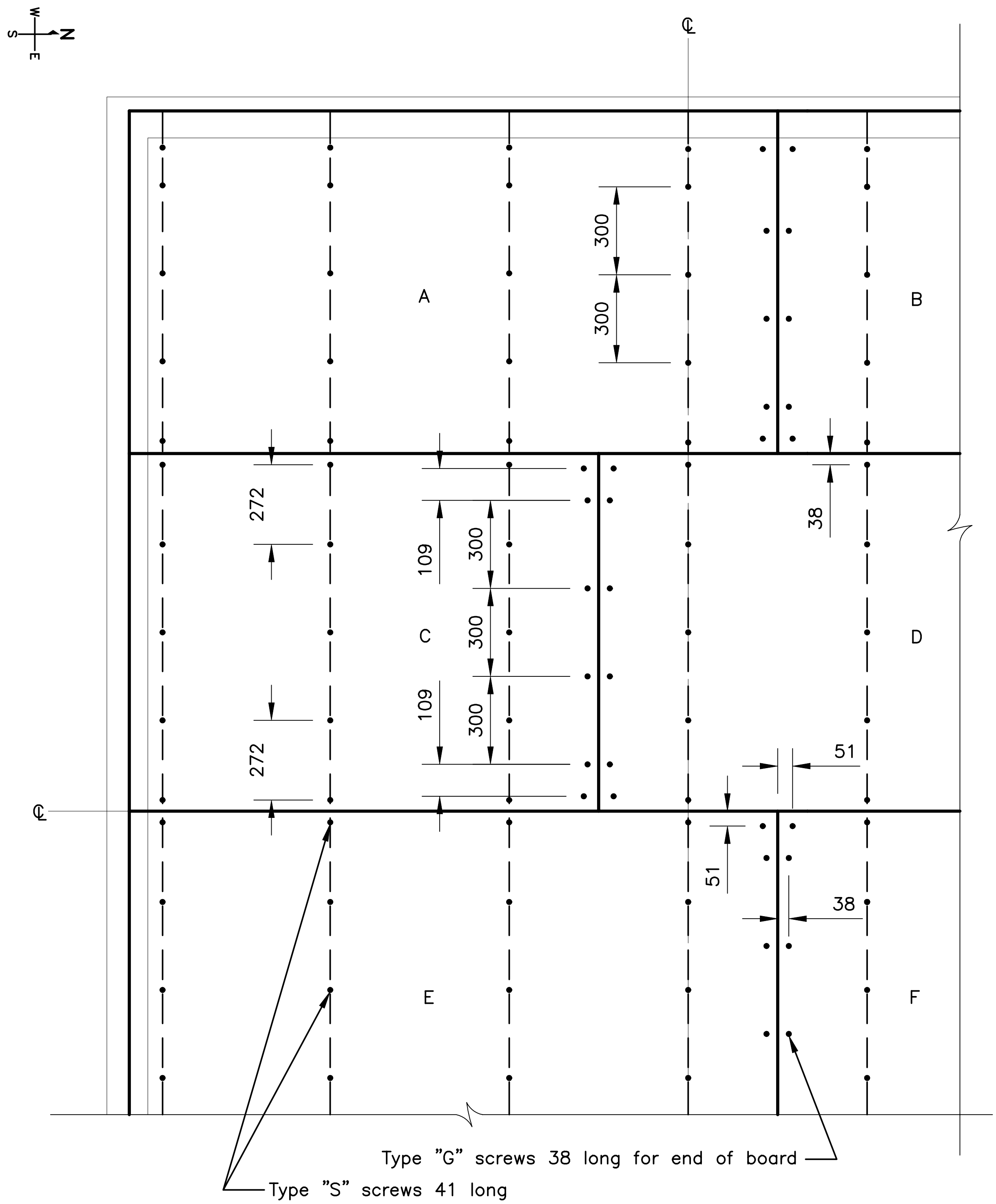
Figure C–122. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–75)

Figure C–123. Gypsum Board Face Layer Layout (Wood Truss)

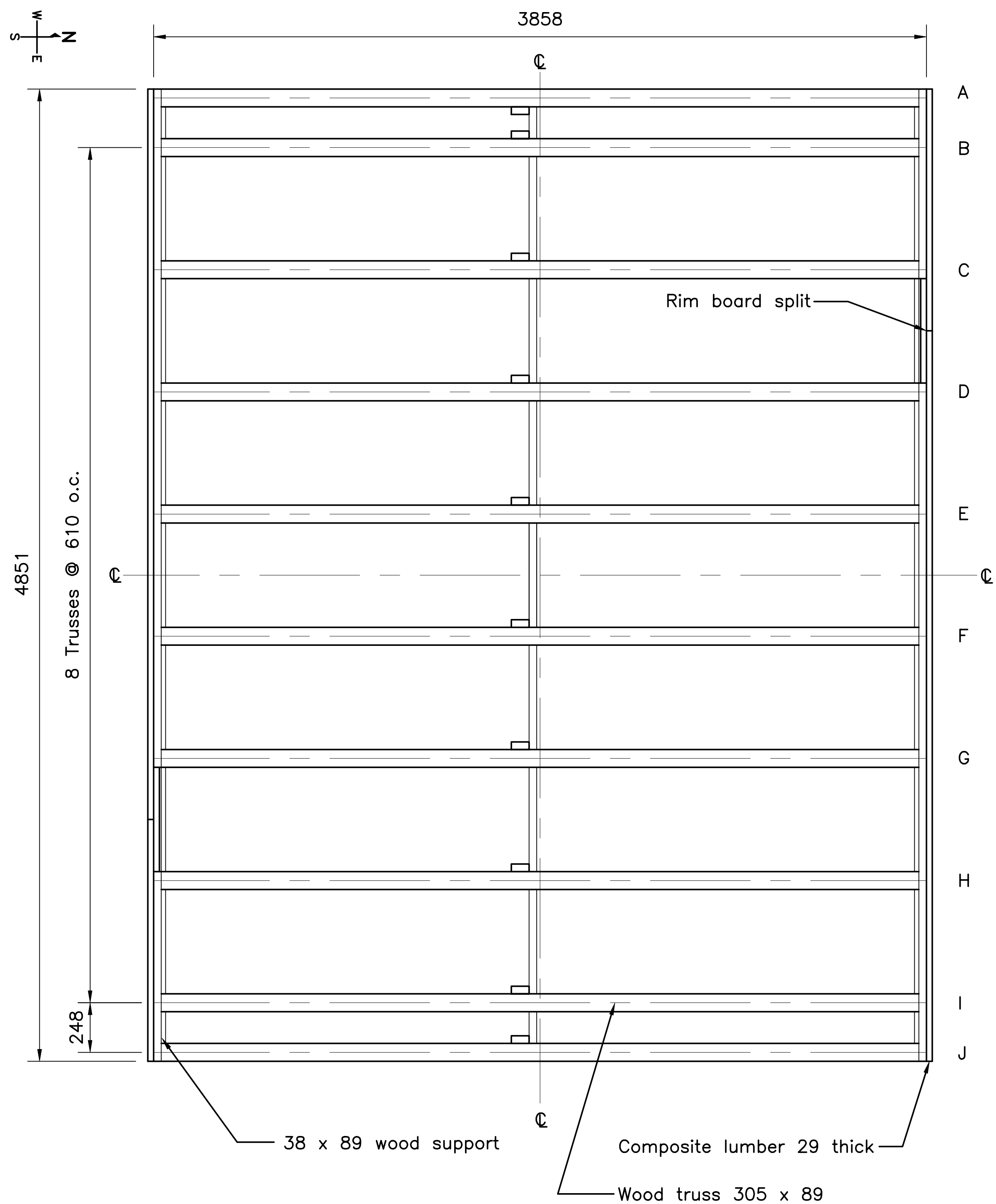


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF-75)

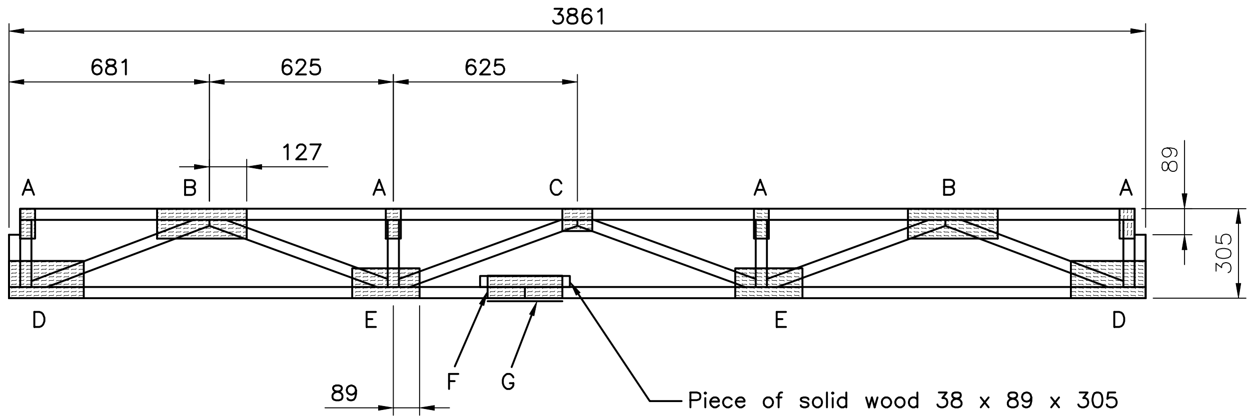
Figure C-124. Gypsum Board Face Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–79)

Figure C–125. Truss Layout (Wood Truss)



Truss members:
Truss members are made of solid wood lumber 38 x 89 Spruce–Pine–Fir #2 S–DRY CL®A 721, 363 NLGA

Plates:
TEE–LOK 20 plates 0.9 mm thick with 8 mm long teeth.
The number of teeth on the plate = plate area in mm² ÷ 80.645
All plates are centered in the middle of the joint except plates B and E, see drawing for details.

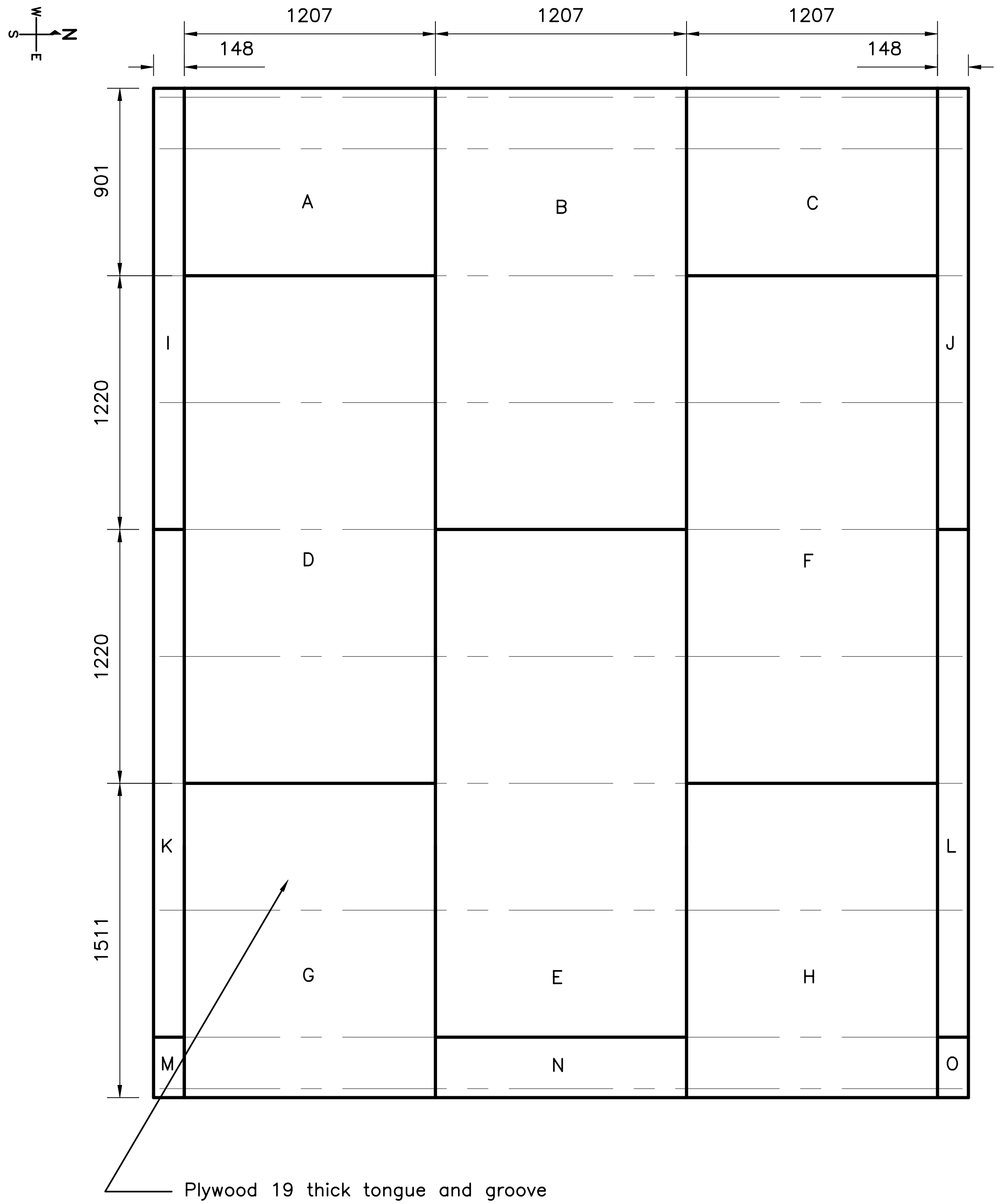
Plate size and location

A 50.8 x 101.6 both sides
B 304.8 x 101.6 both sides
C 101.6 x 76.2 both sides
D 254 x 127 both sides
E 228.6 x 101.6 both sides
F 254 x 76.2 both sides
G 254 x 76.2 both sides of bottom flange

(Dimensions are in millimetres)

(Assembly No. FF–79)

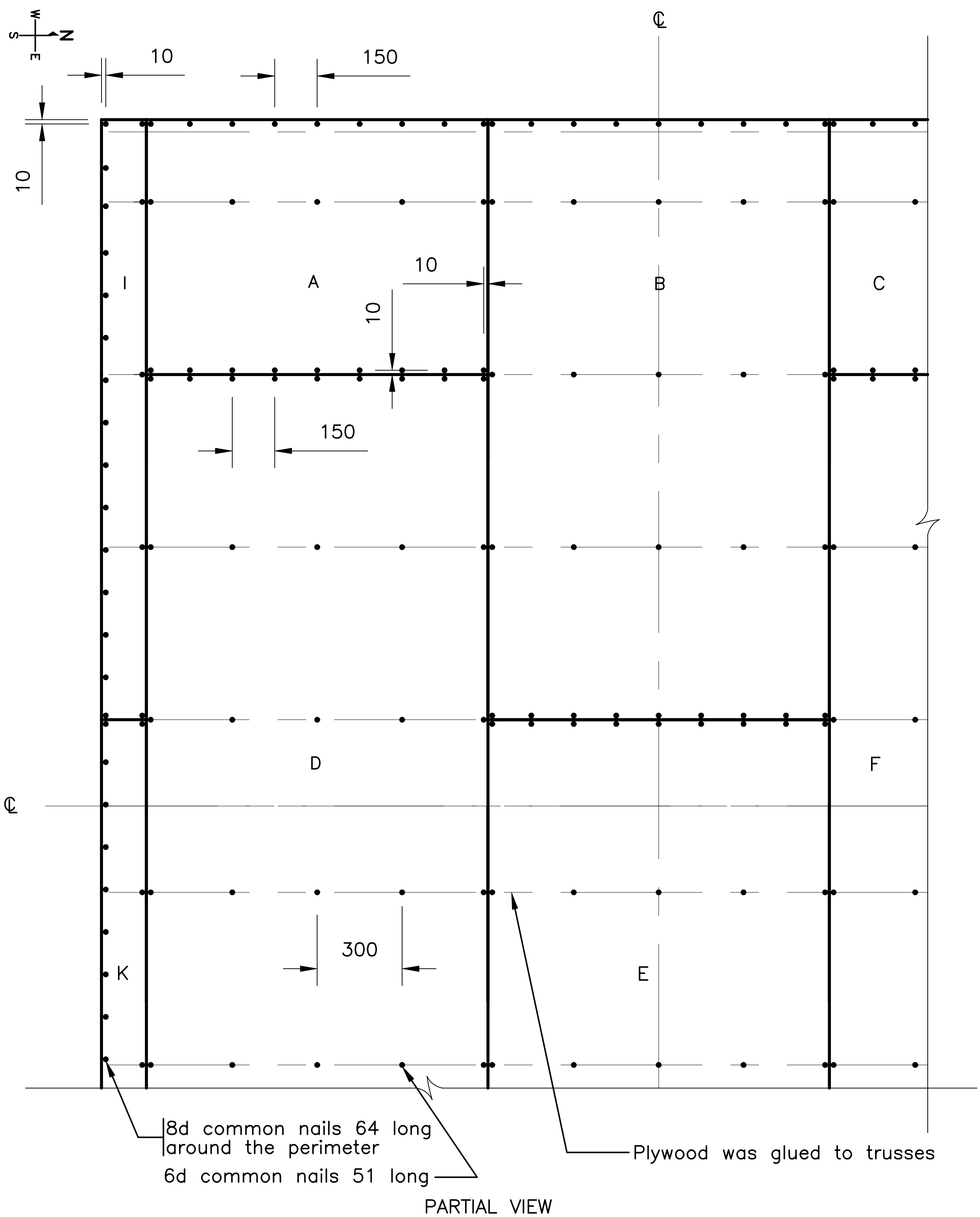
Figure C–126. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–79)

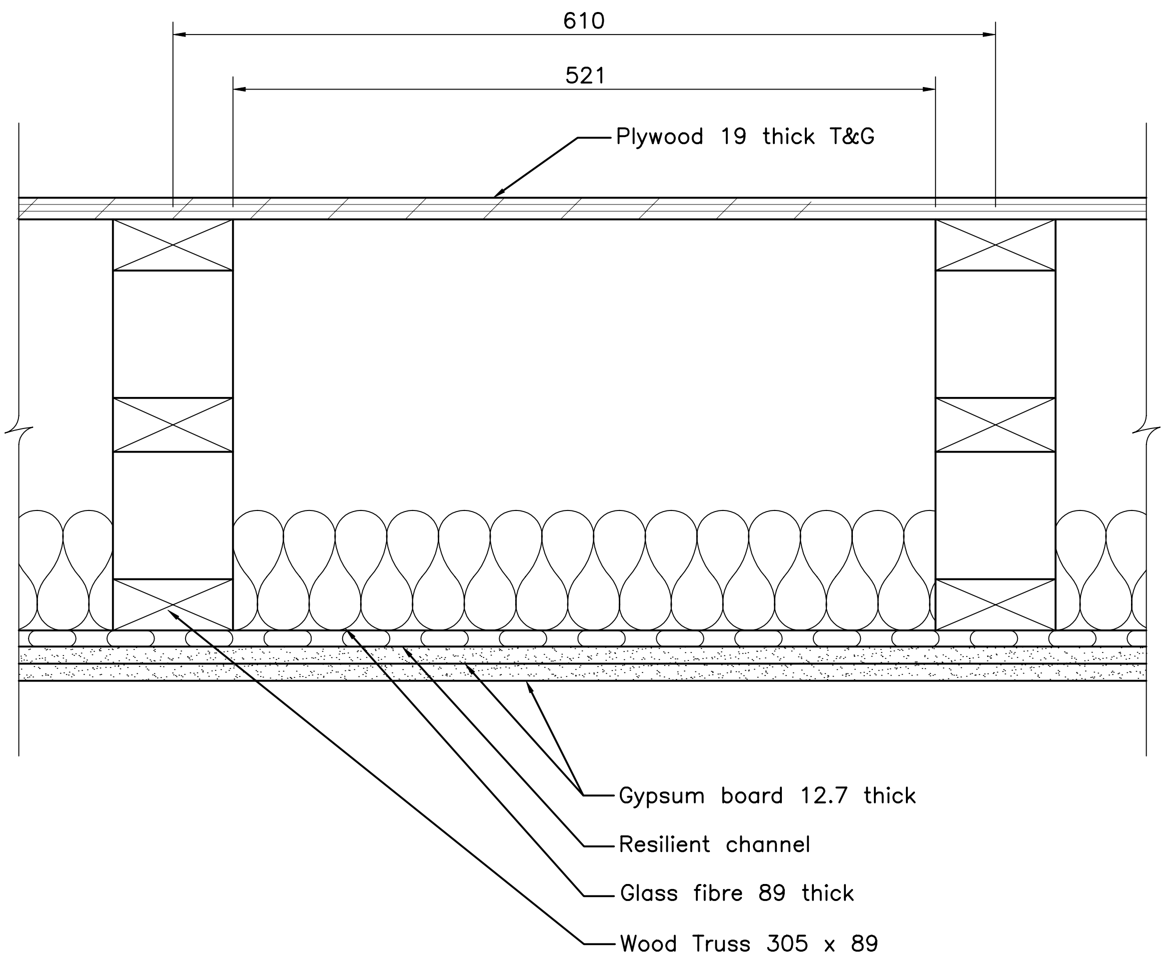
Figure C–127. Subfloor Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–79)

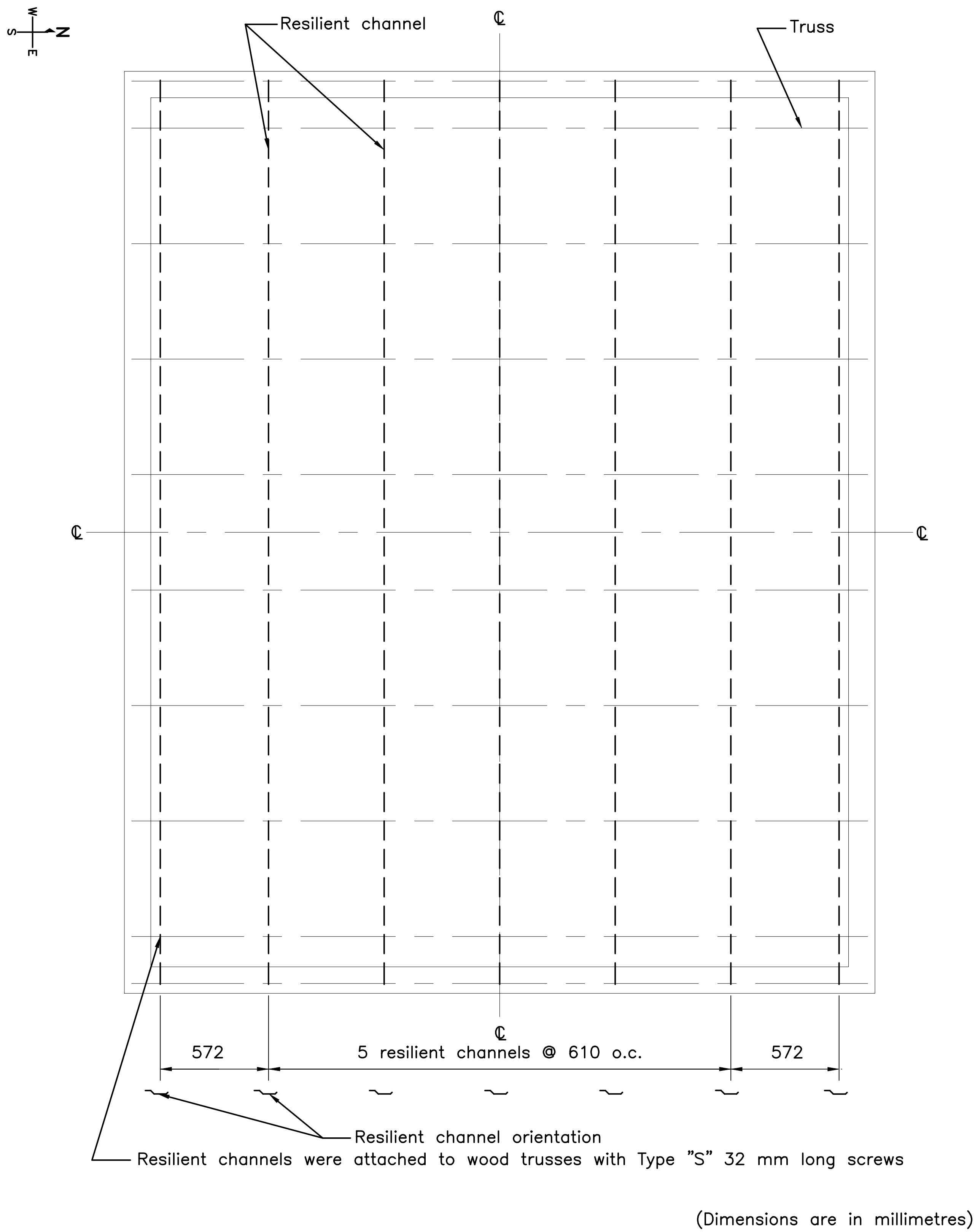
Figure C–128. Subfloor Nail Pattern (Wood Truss)



(Dimensions are in millimetres)

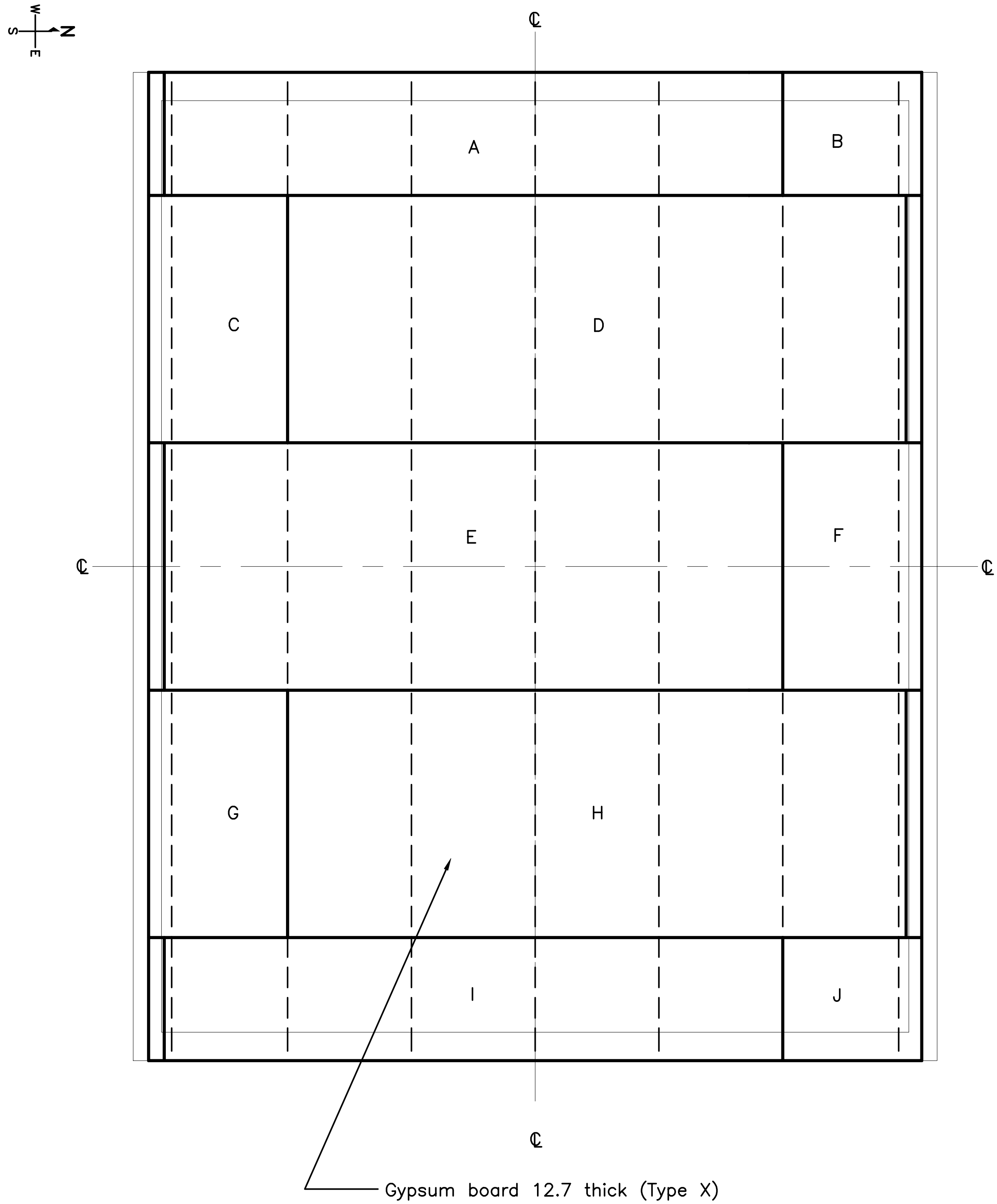
(Assembly No. FF–79)

Figure C–129. Insulation Location (Wood Truss)



(Assembly No. FF-79)

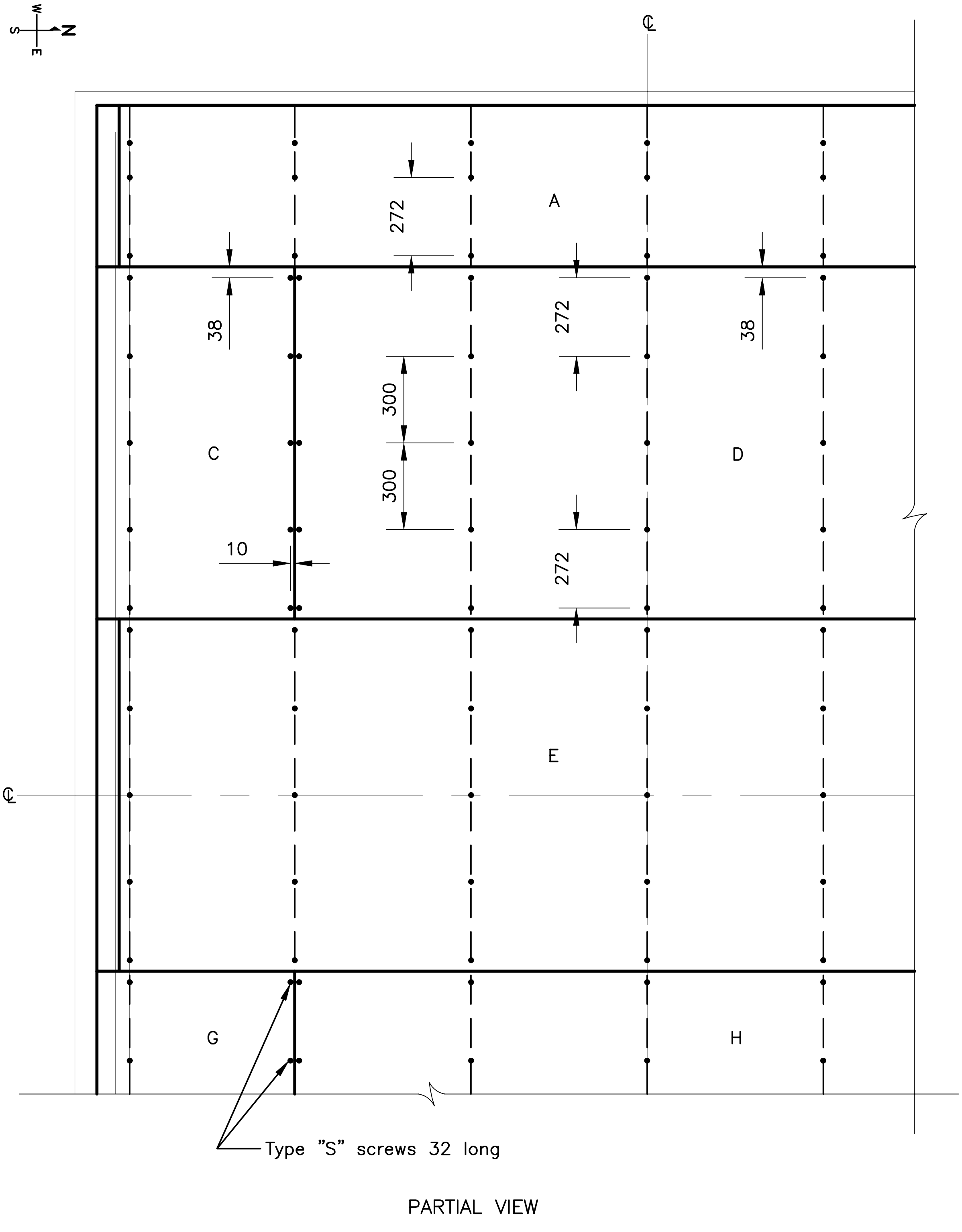
Figure C-130. Resilient Channel Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–79)

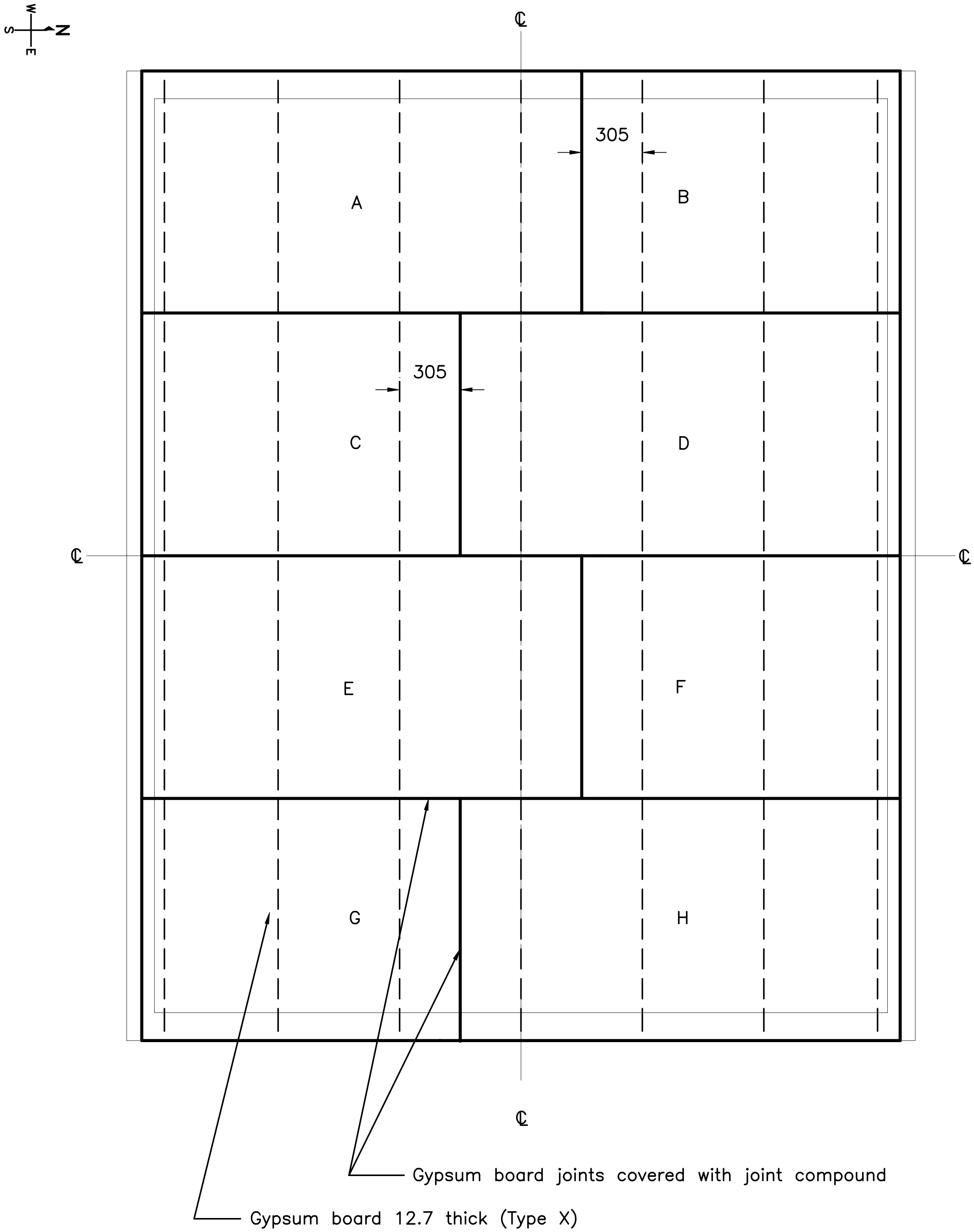
Figure C–131. Gypsum Board Base Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–79)

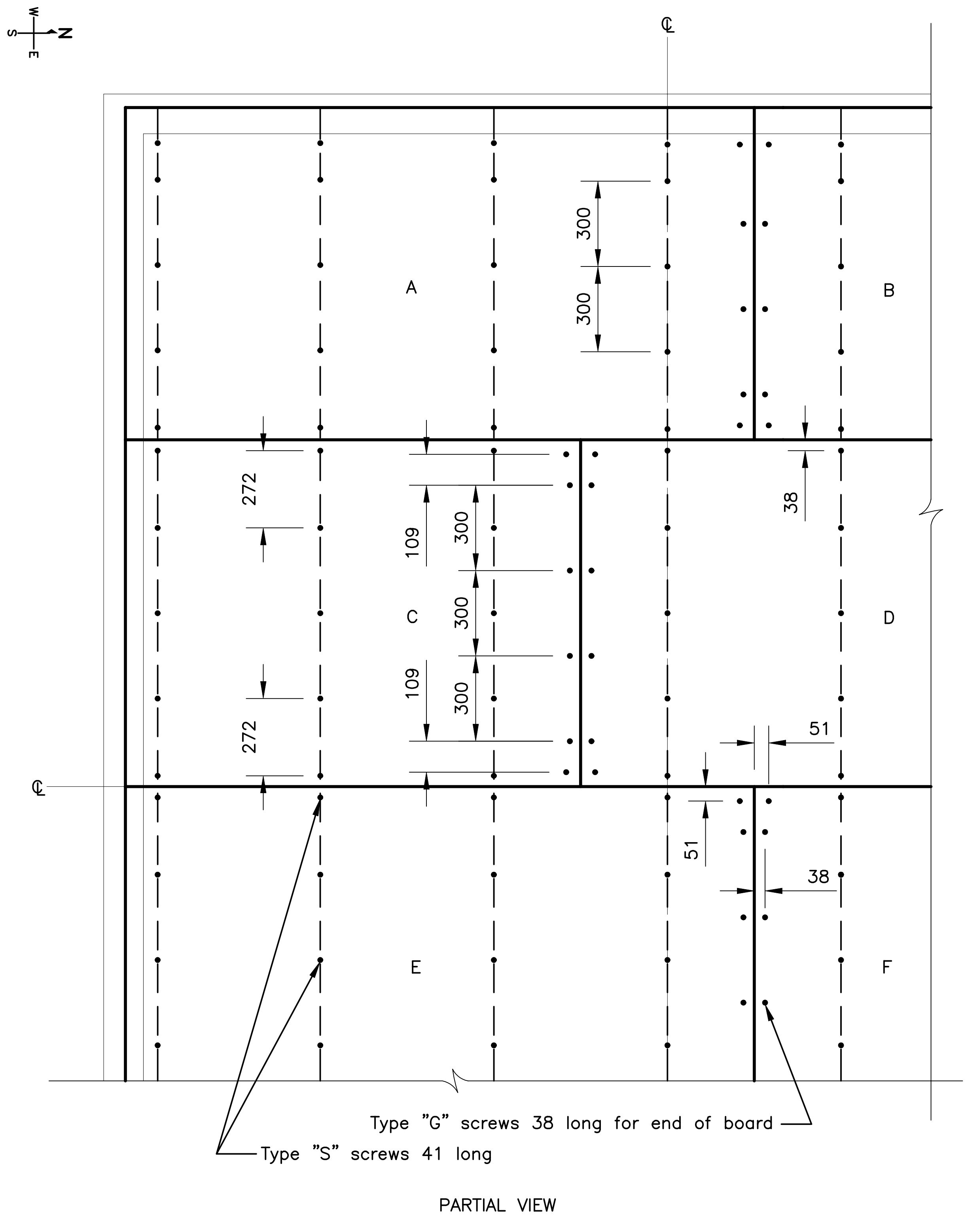
Figure C–132. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–79)

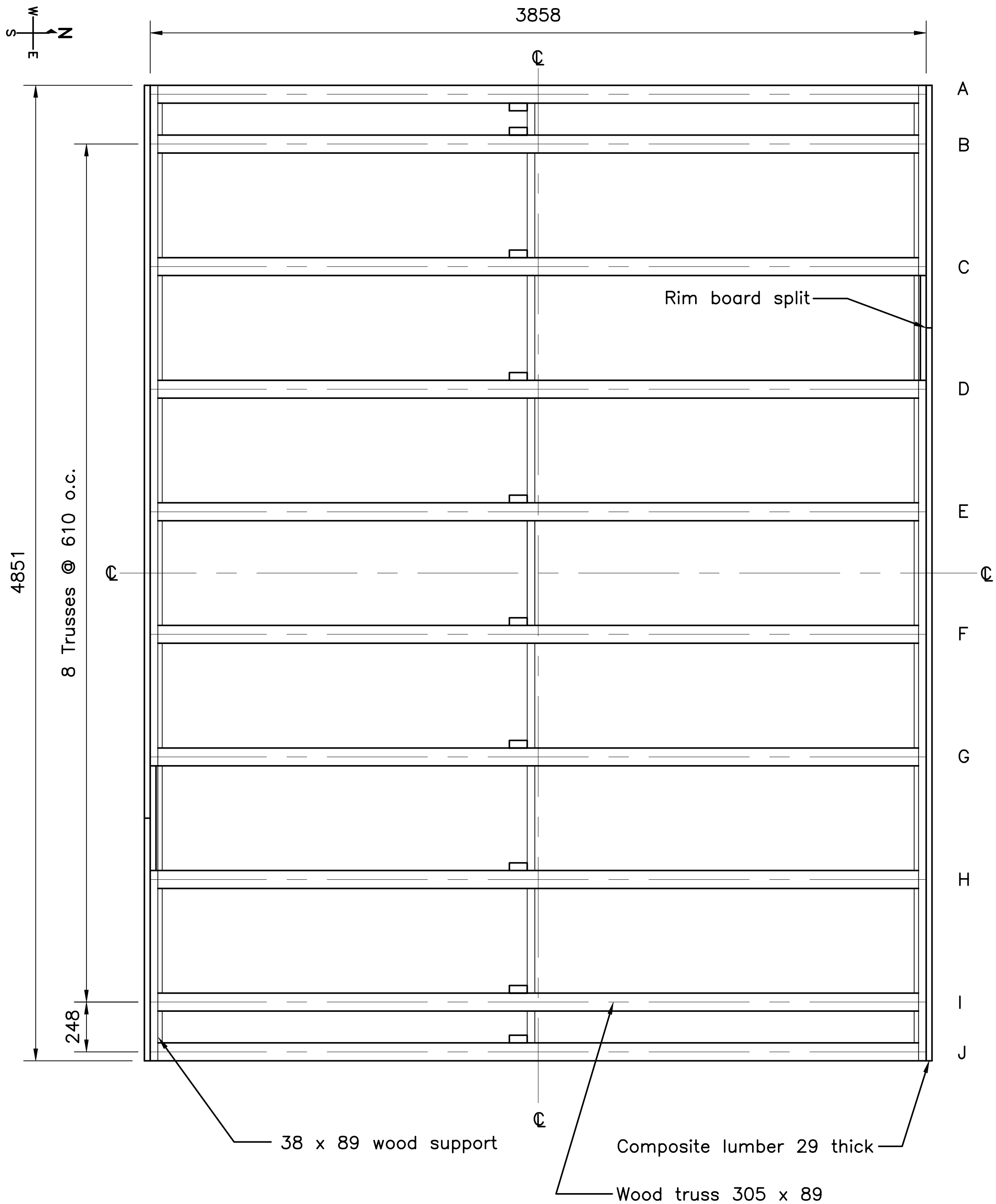
Figure C–133. Gypsum Board Face Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–79)

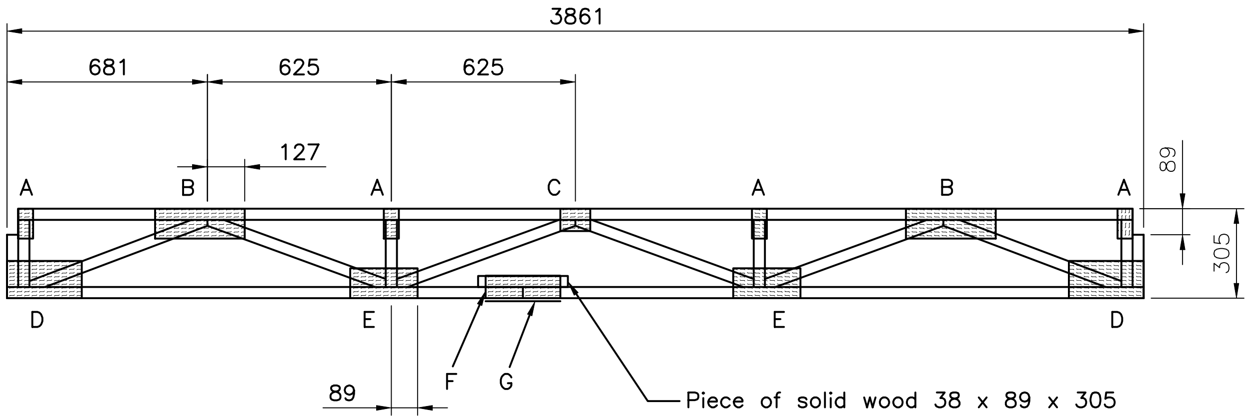
Figure C–134. Gypsum Board Face Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–80)

Figure C–135. Truss Layout (Wood Truss)



Truss members:
Truss members are made of solid wood lumber 38 x 89 Spruce–Pine–Fir #2 S–DRY CL®A 721, 363 NLGA

Plates:
TEE–LOK 20 plates 0.9 mm thick with 8 mm long teeth.
The number of teeth on the plate = plate area in mm^2 ÷ 80.645
All plates are centered in the middle of the joint except plates B and E, see drawing for details.

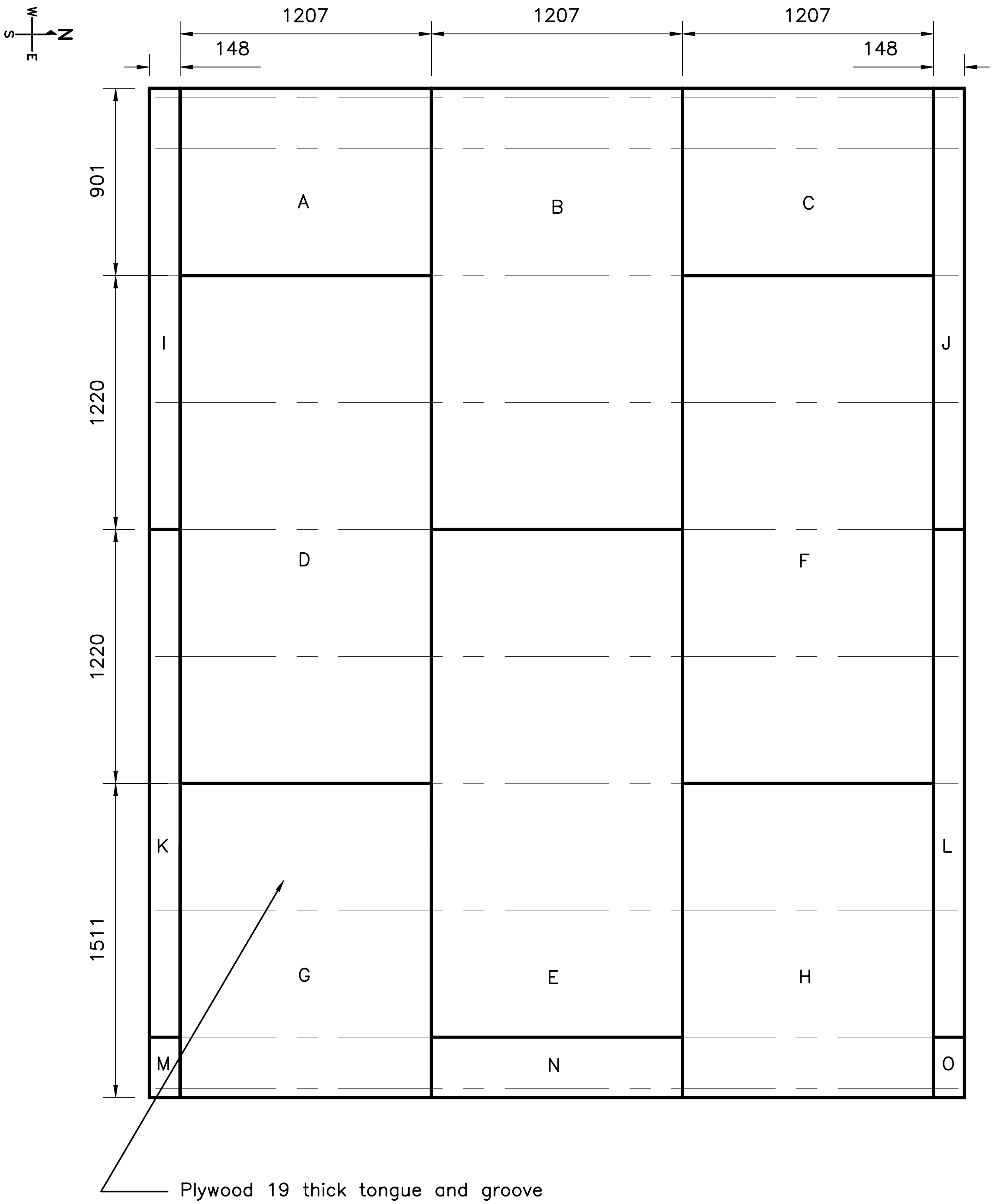
Plate size and location

A 50.8 x 101.6 both sides
B 304.8 x 101.6 both sides
C 101.6 x 76.2 both sides
D 254 x 127 both sides
E 228.6 x 101.6 both sides
F 254 x 76.2 both sides
G 254 x 76.2 both sides of bottom flange

(Dimensions are in millimetres)

(Assembly No. FF–80)

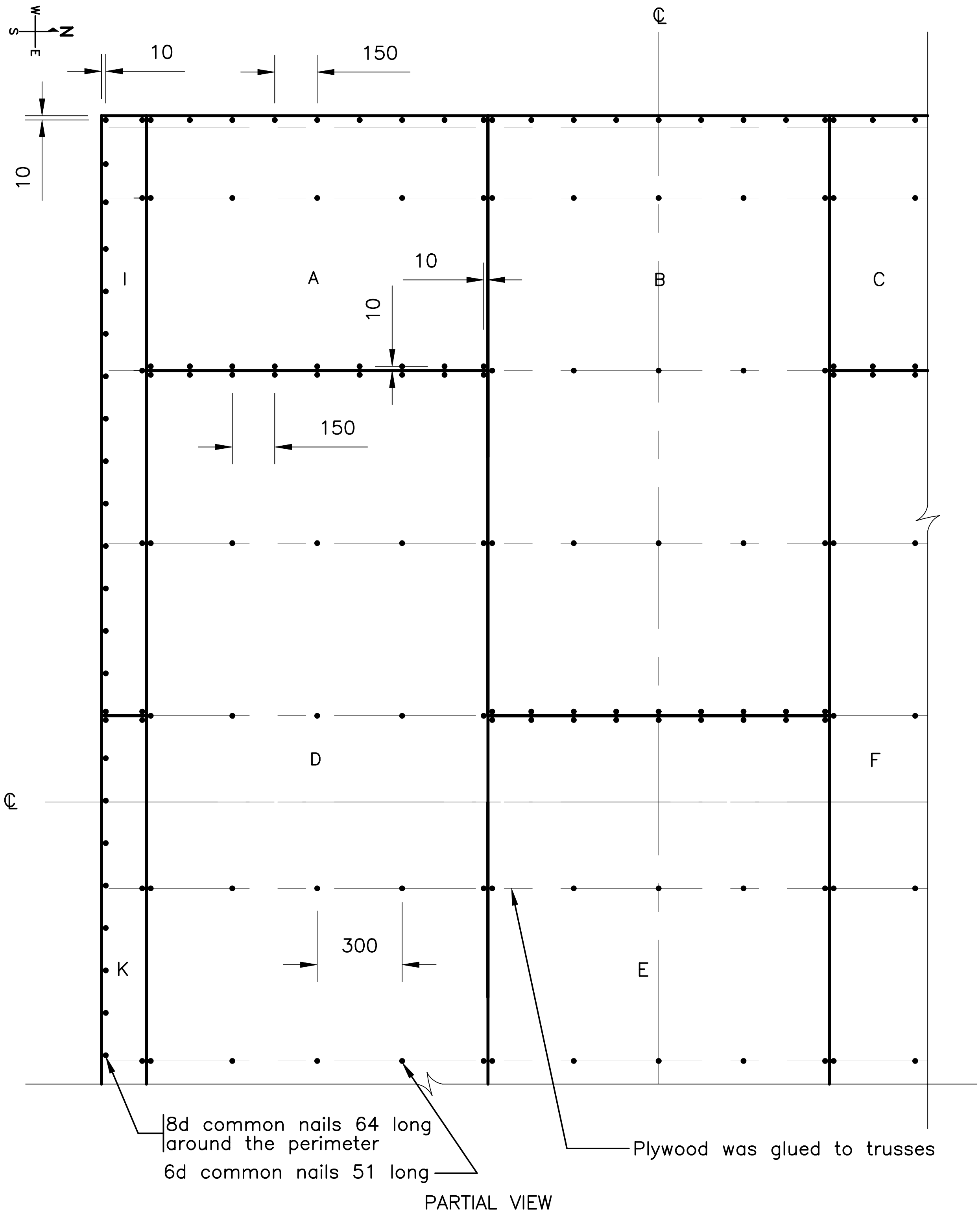
Figure C–136. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–80)

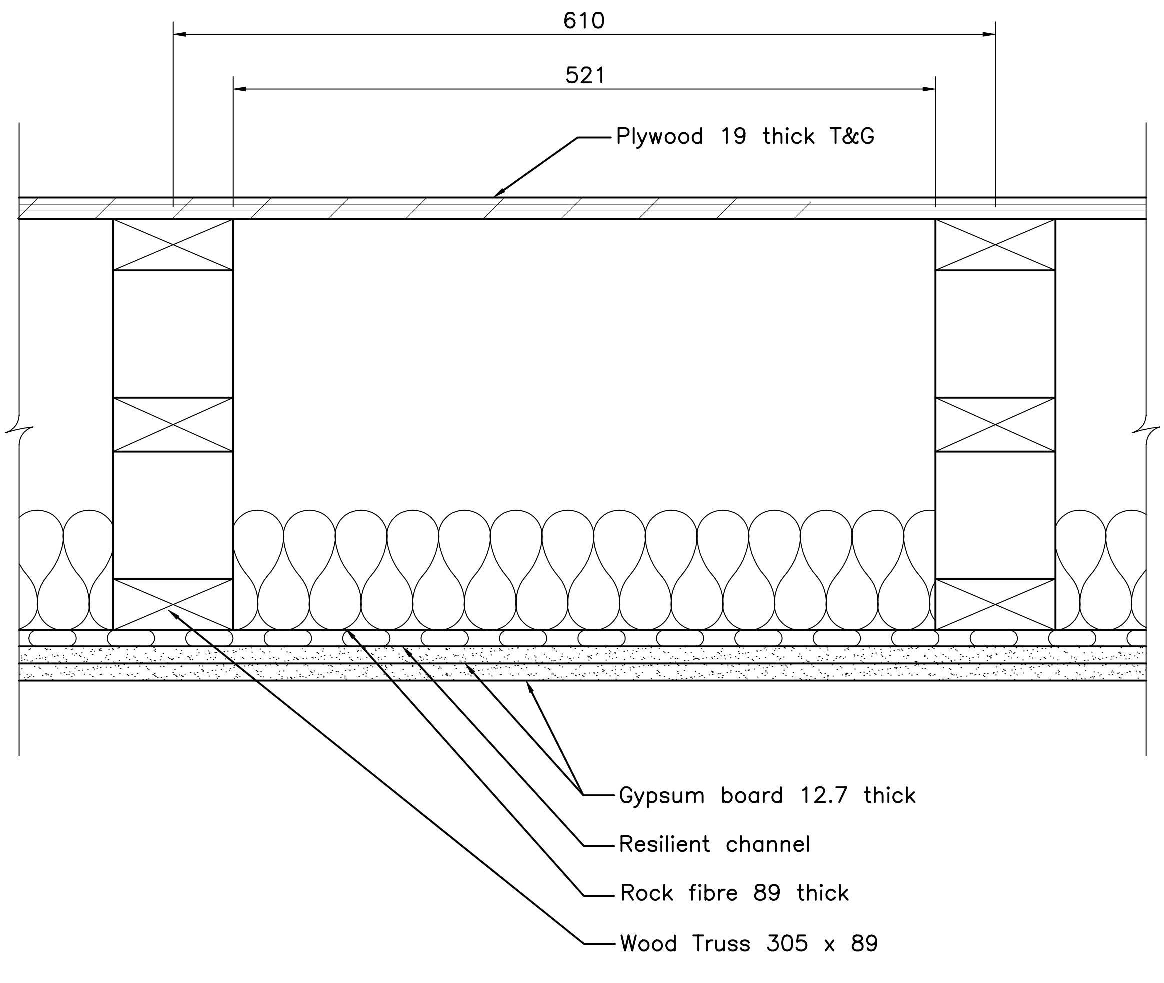
Figure C–137. Subfloor Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–80)

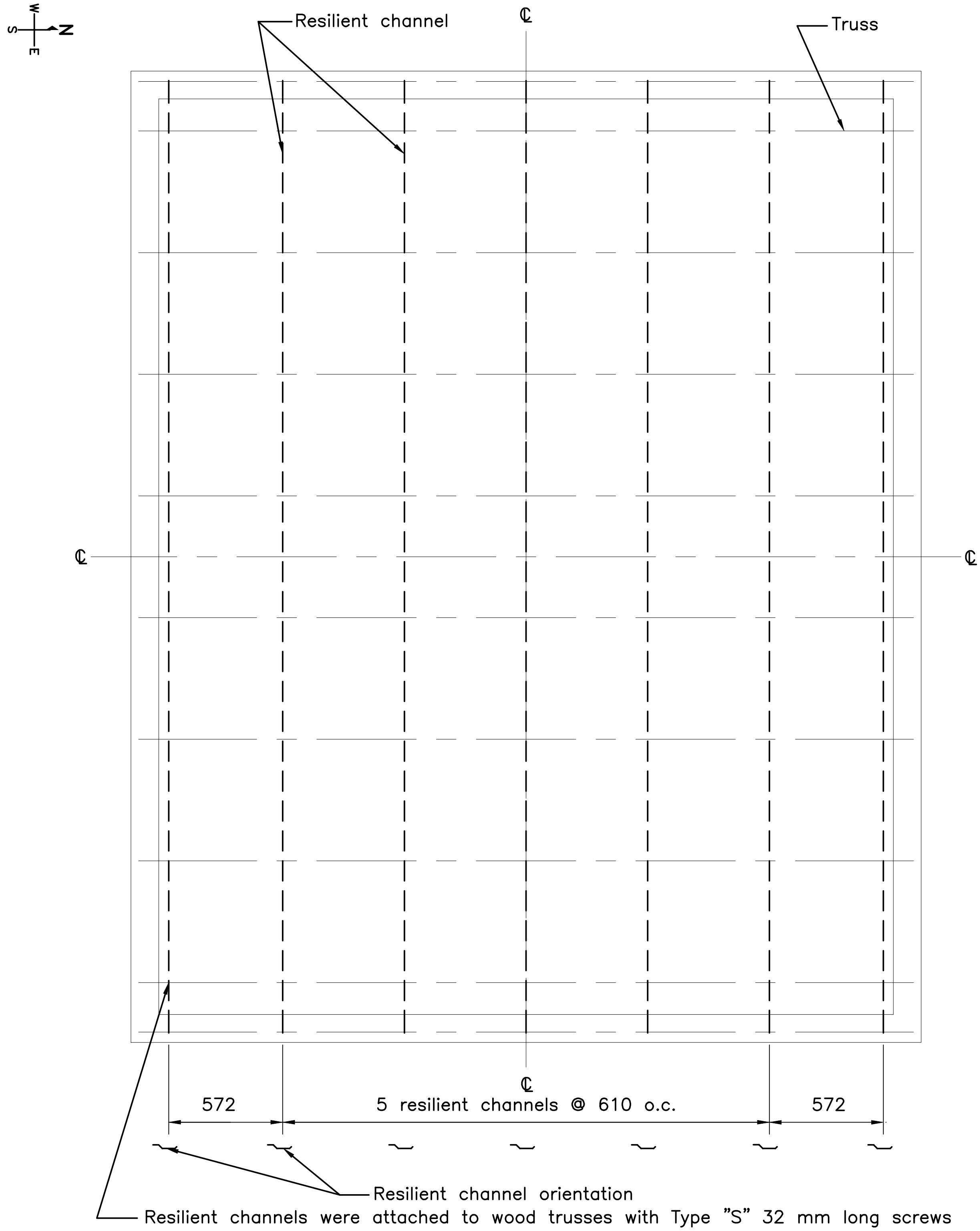
Figure C–138. Subfloor Nail Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–80)

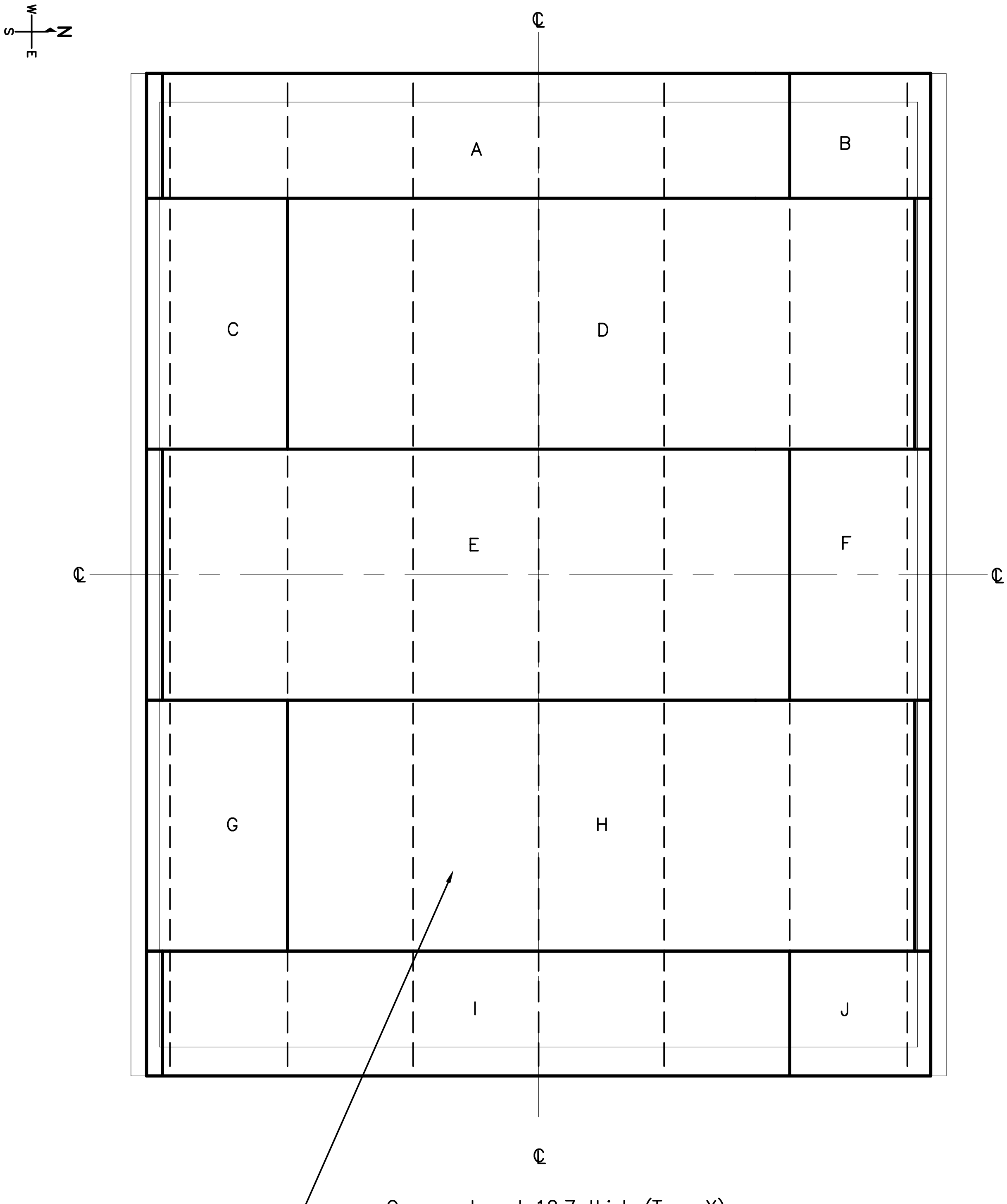
Figure C–139. Insulation Location (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–80)

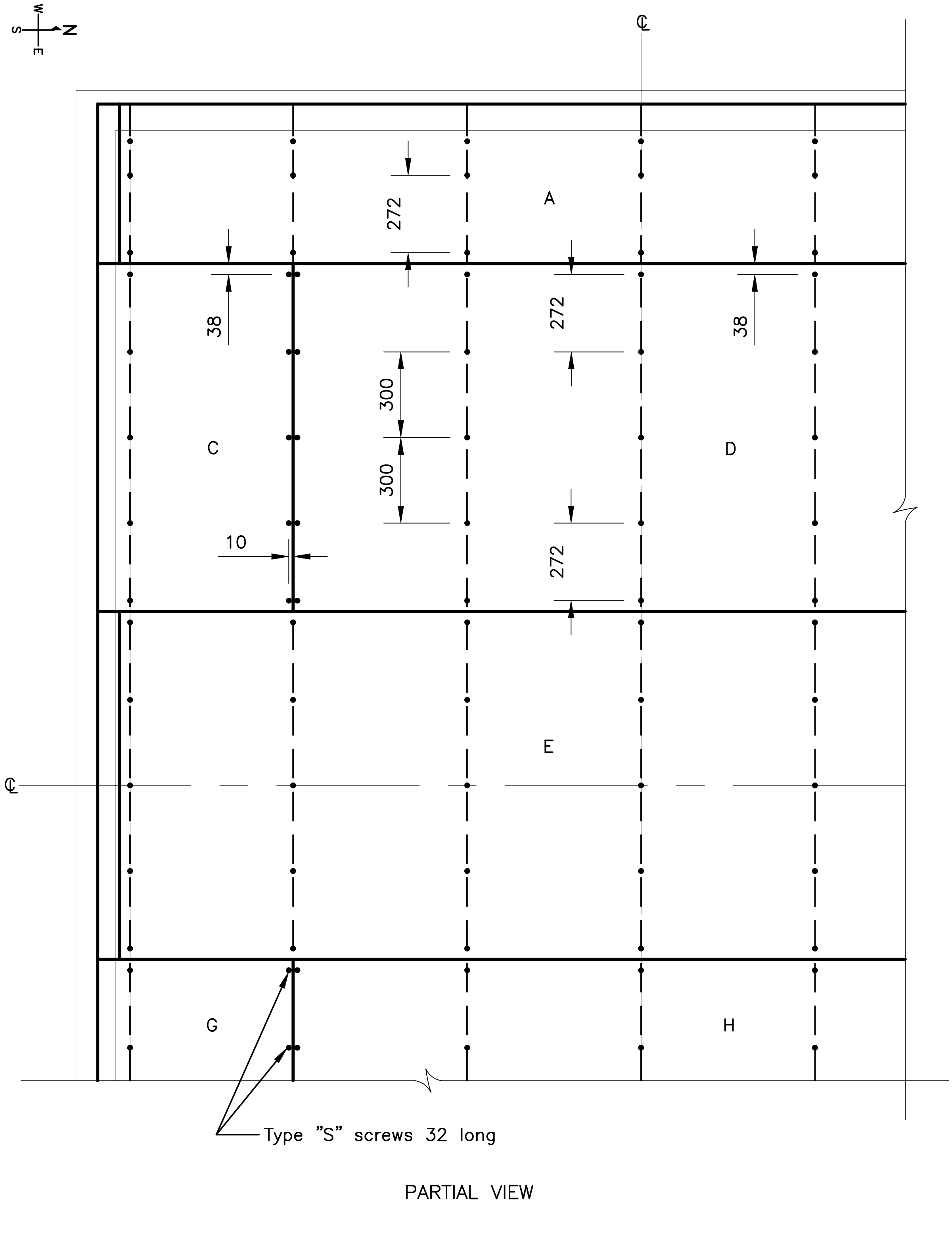
Figure C–140. Resilient Channel Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-80)

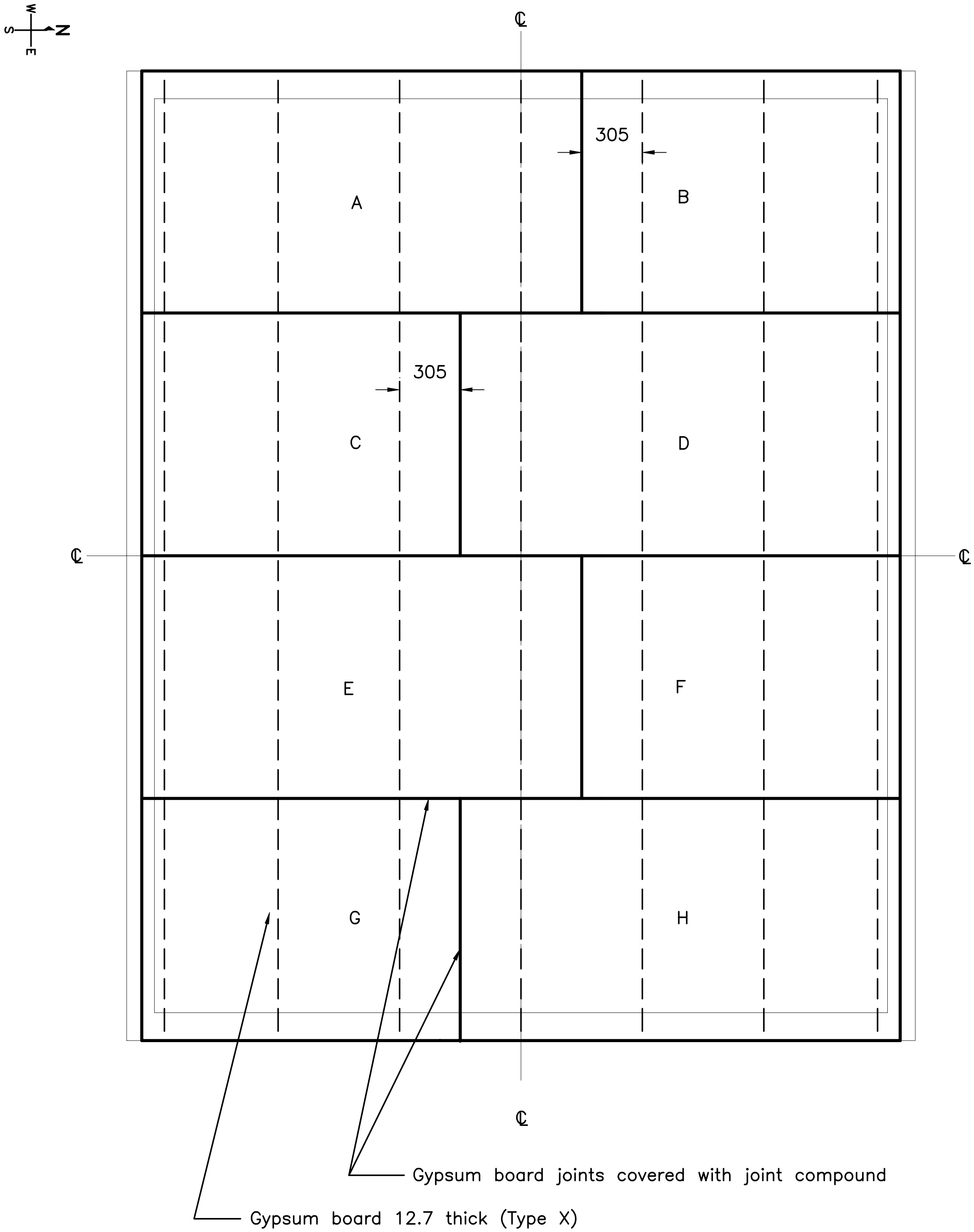
Figure C-141. Gypsum Board Base Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-80)

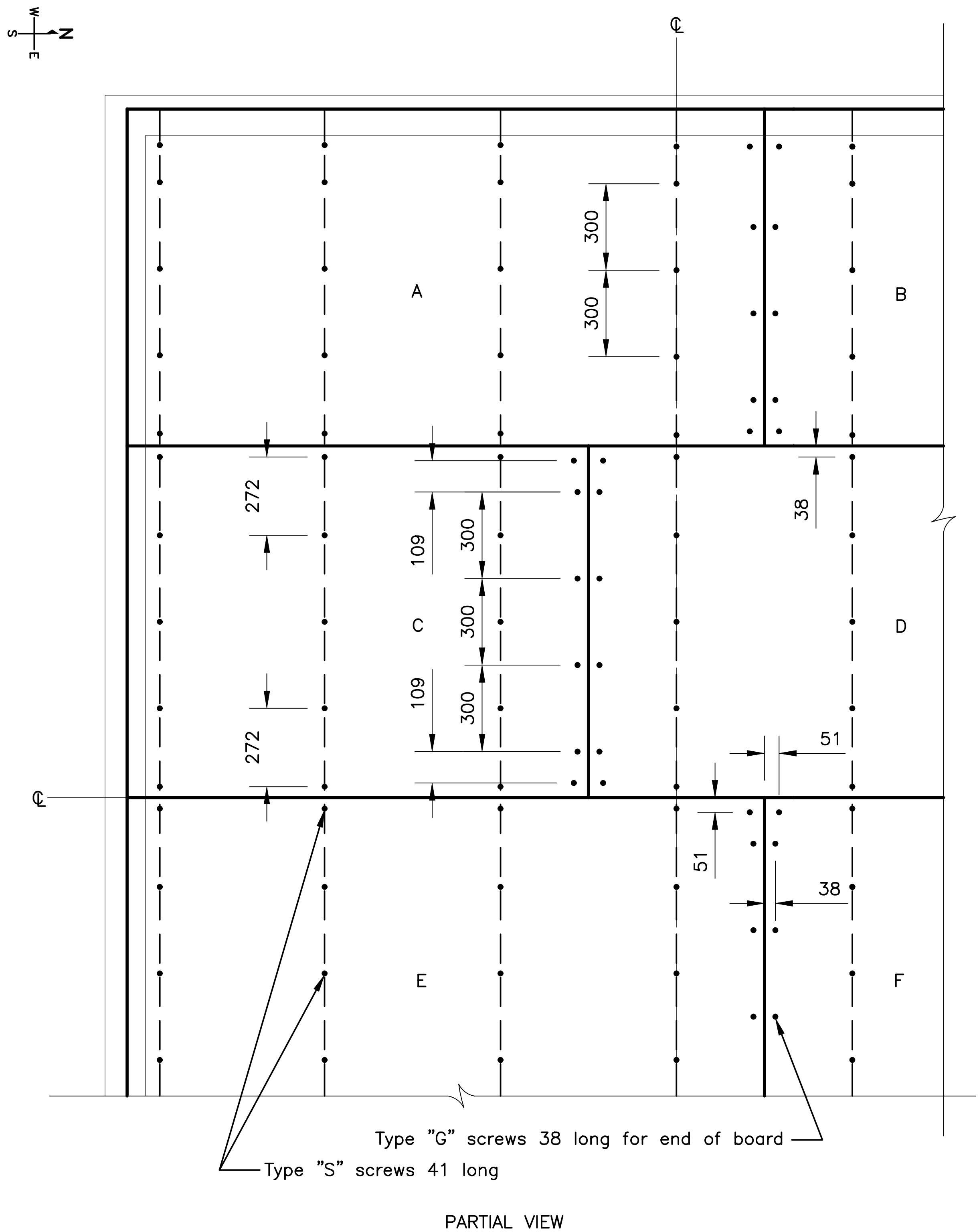
Figure C-142. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–80)

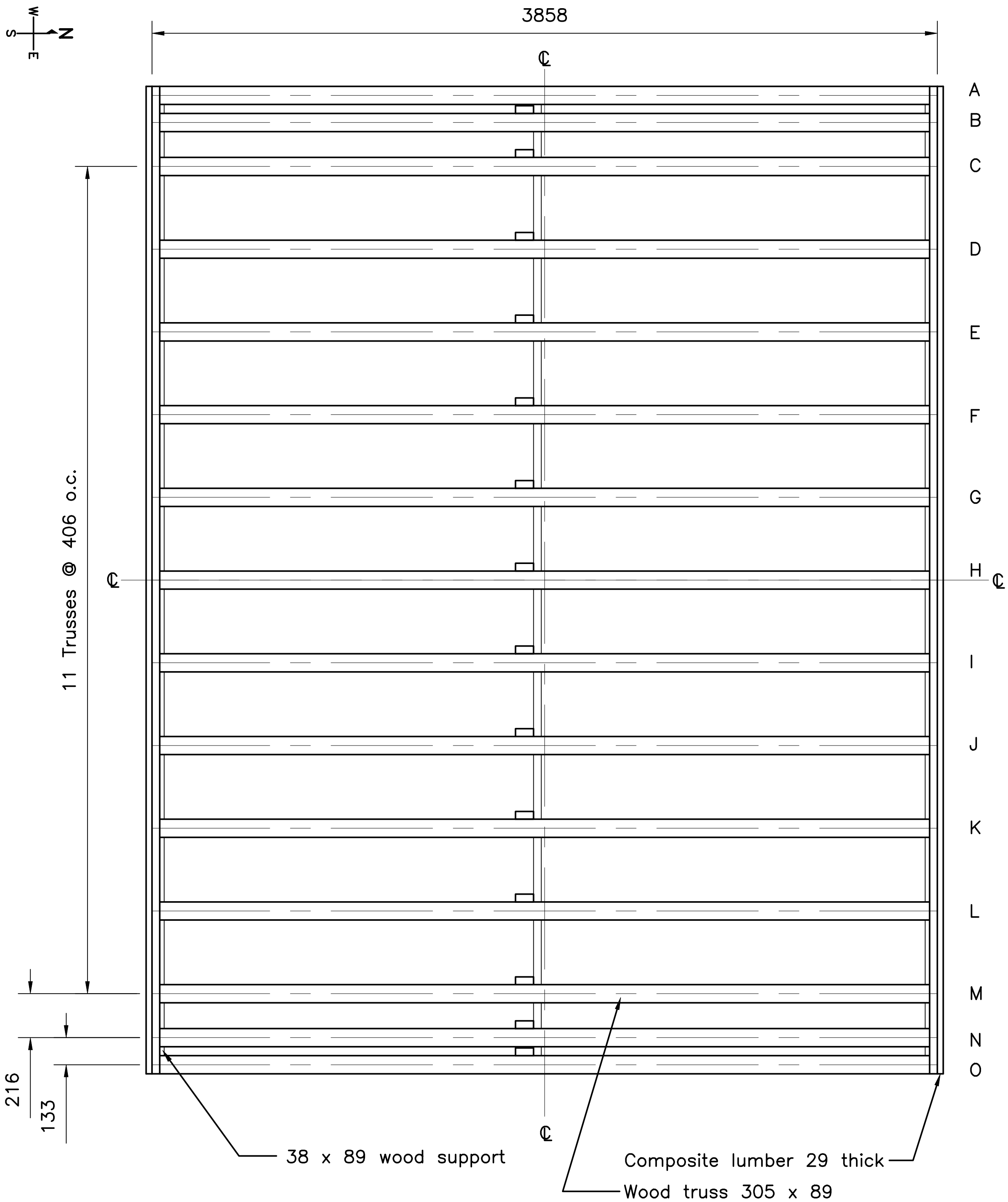
Figure C–143. Gypsum Board Face Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–80)

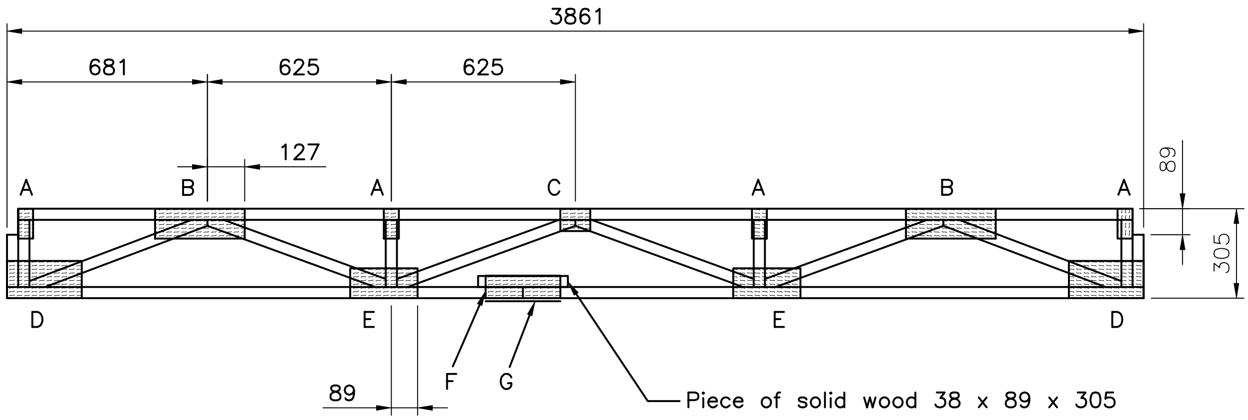
Figure C–144. Gypsum Board Face Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-82)

Figure C-145. Truss Layout (Wood Truss)



Truss members:
Truss members are made of solid wood lumber 38 x 89 Spruce–Pine–Fir #2 S–DRY CL®A 721, 363 NLGA

Plates:
TEE–LOK 20 plates 0.9 mm thick with 8 mm long teeth.
The number of teeth on the plate = plate area in mm² ÷ 80.645
All plates are centered in the middle of the joint except plates B and E, see drawing for details.

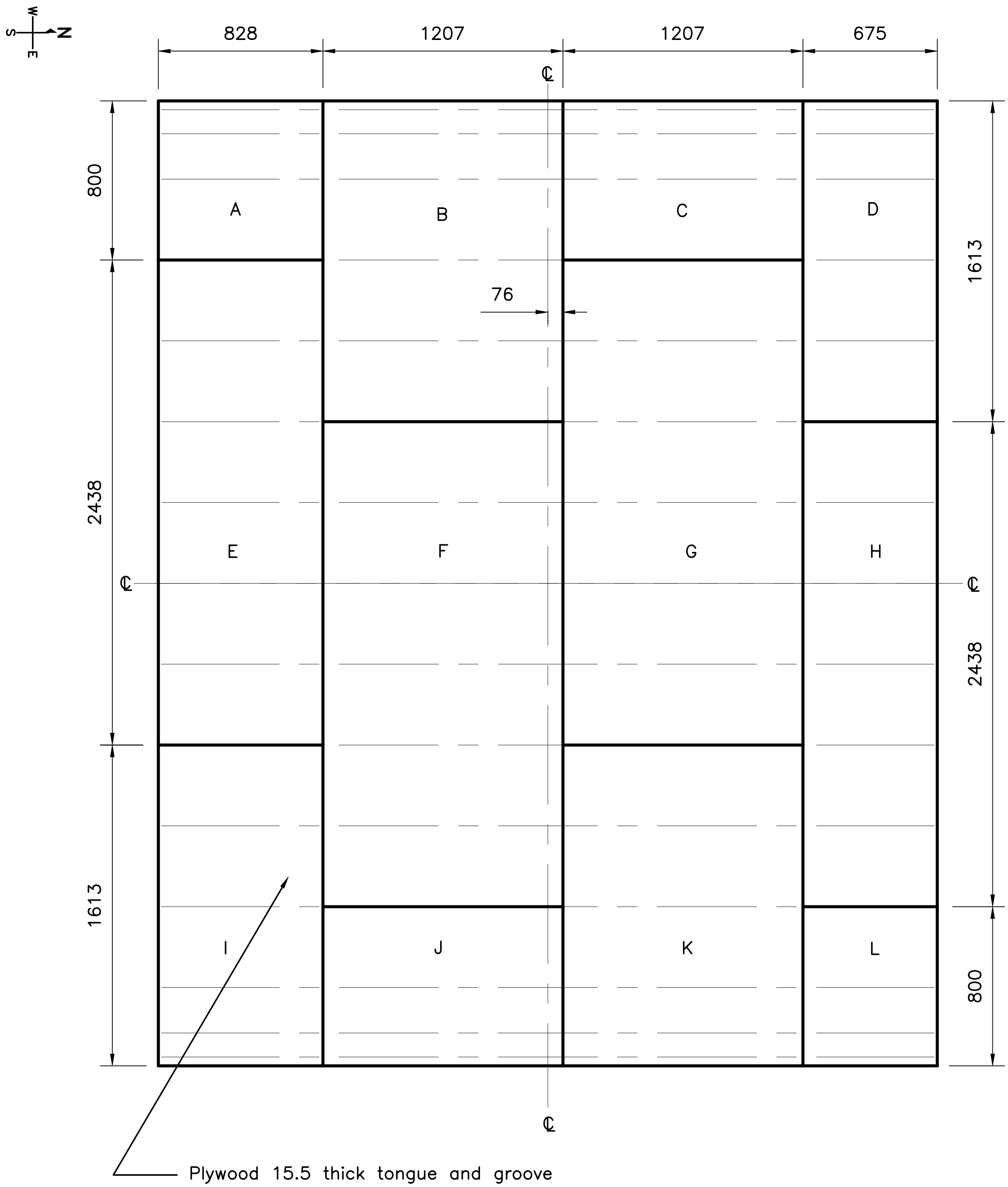
Plate size and location

A 50.8 x 101.6 both sides
B 304.8 x 101.6 both sides
C 101.6 x 76.2 both sides
D 254 x 127 both sides
E 228.6 x 101.6 both sides
F 254 x 76.2 both sides
G 254 x 76.2 both sides of bottom flange

(Dimensions are in millimetres)

(Assembly No. FF–82)

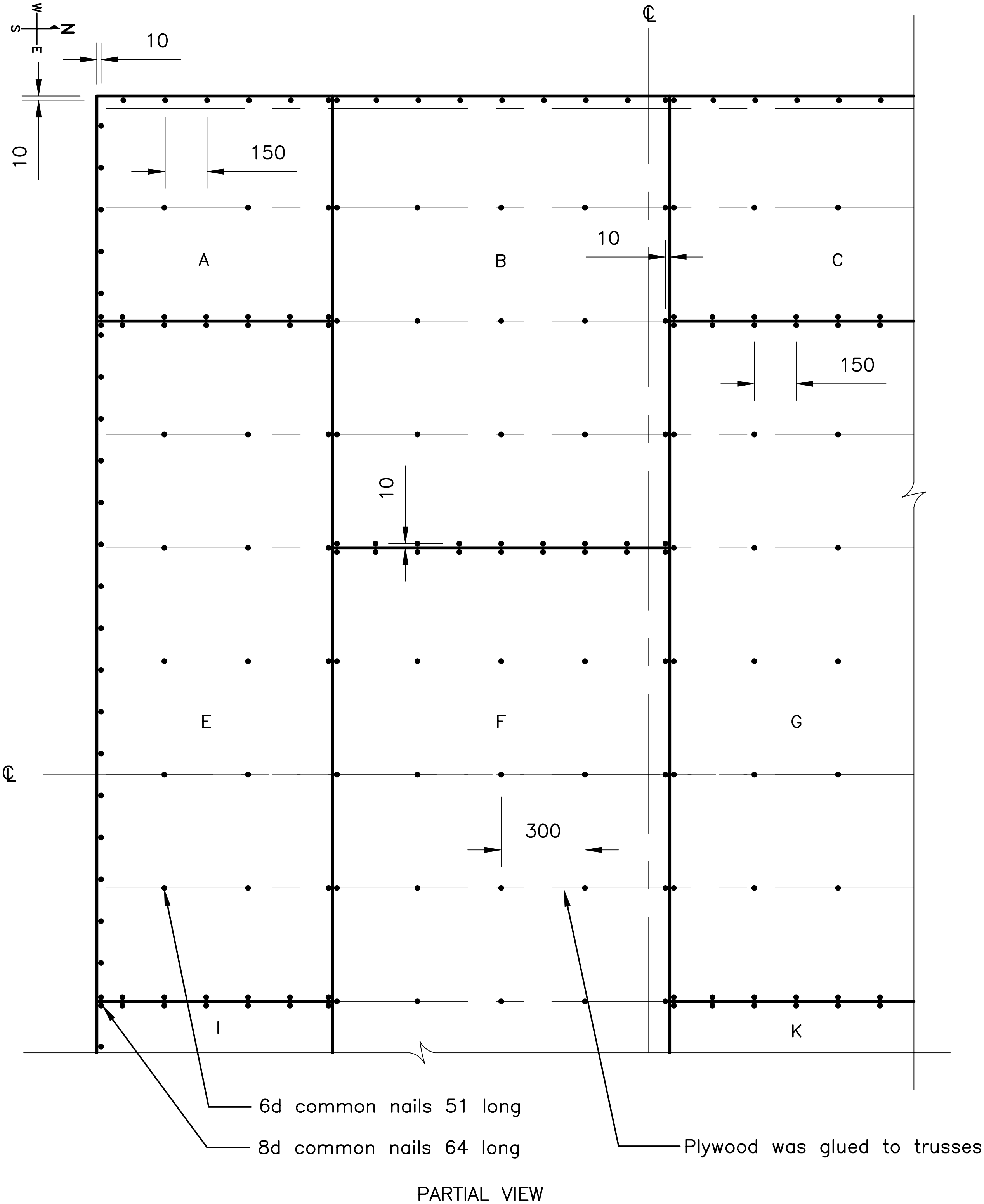
Figure C–146. Truss details (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–82)

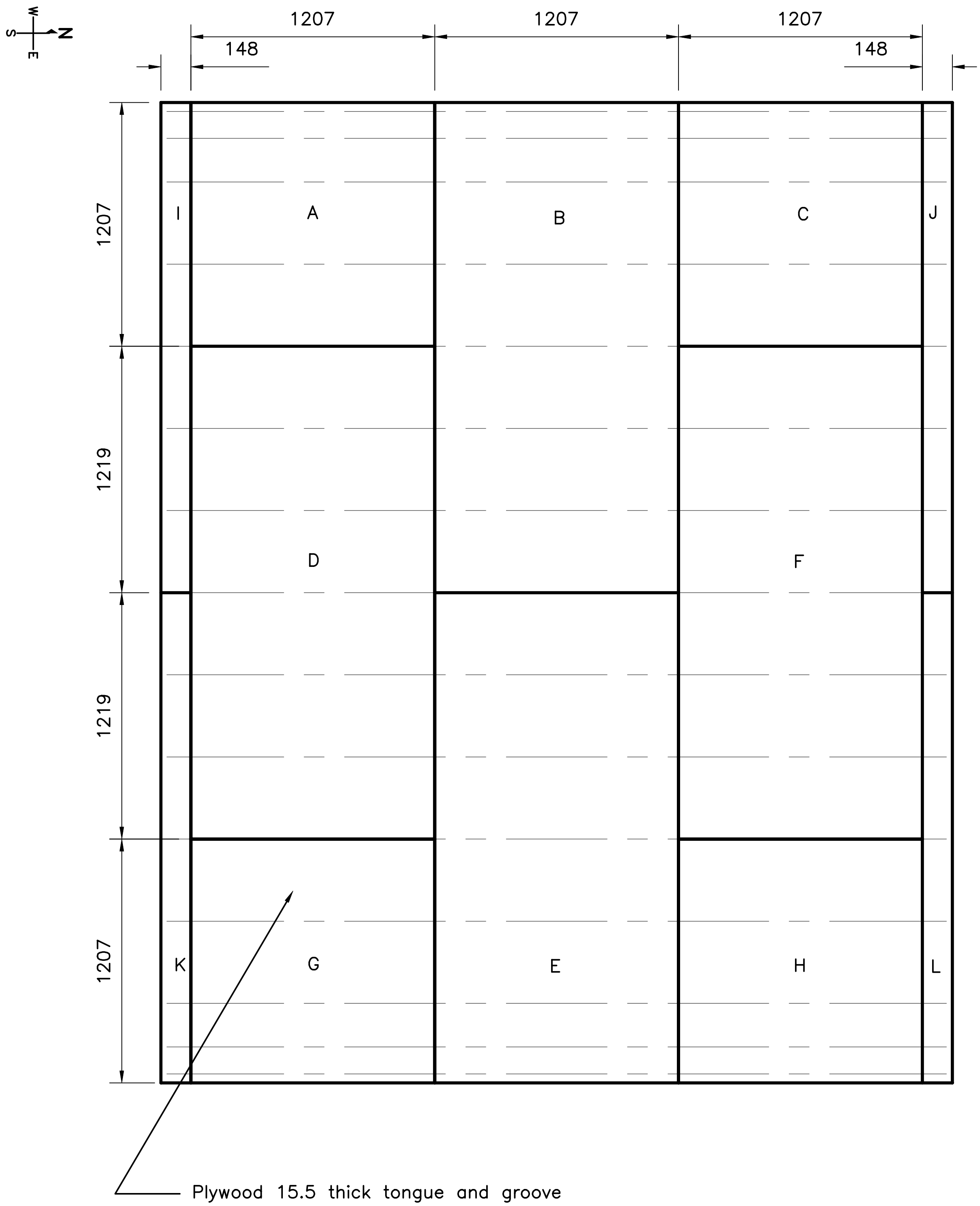
Figure C–147. Subfloor Layout Base Layer (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–82)

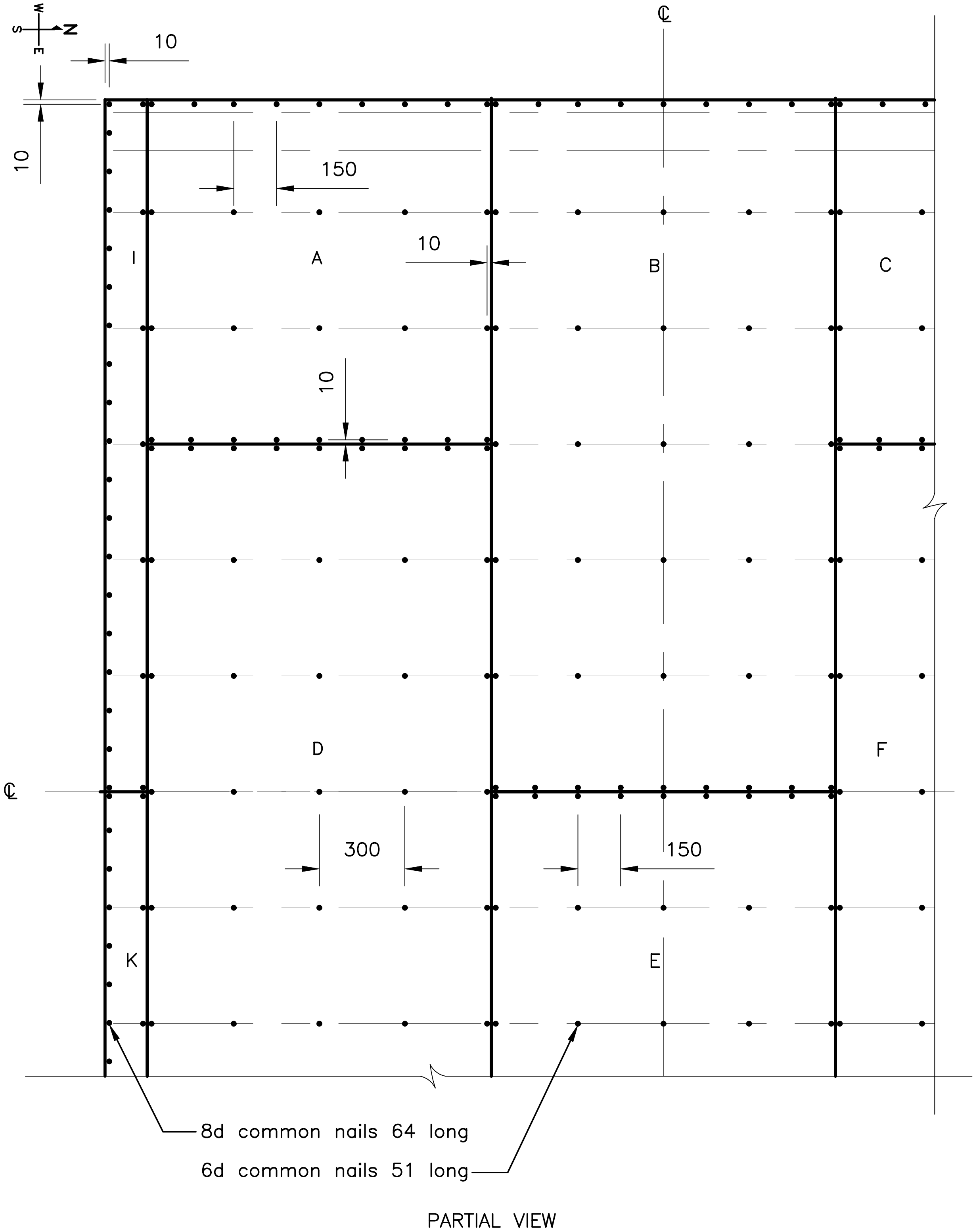
Figure C–148. Subfloor Nail Pattern Base Layer (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–82)

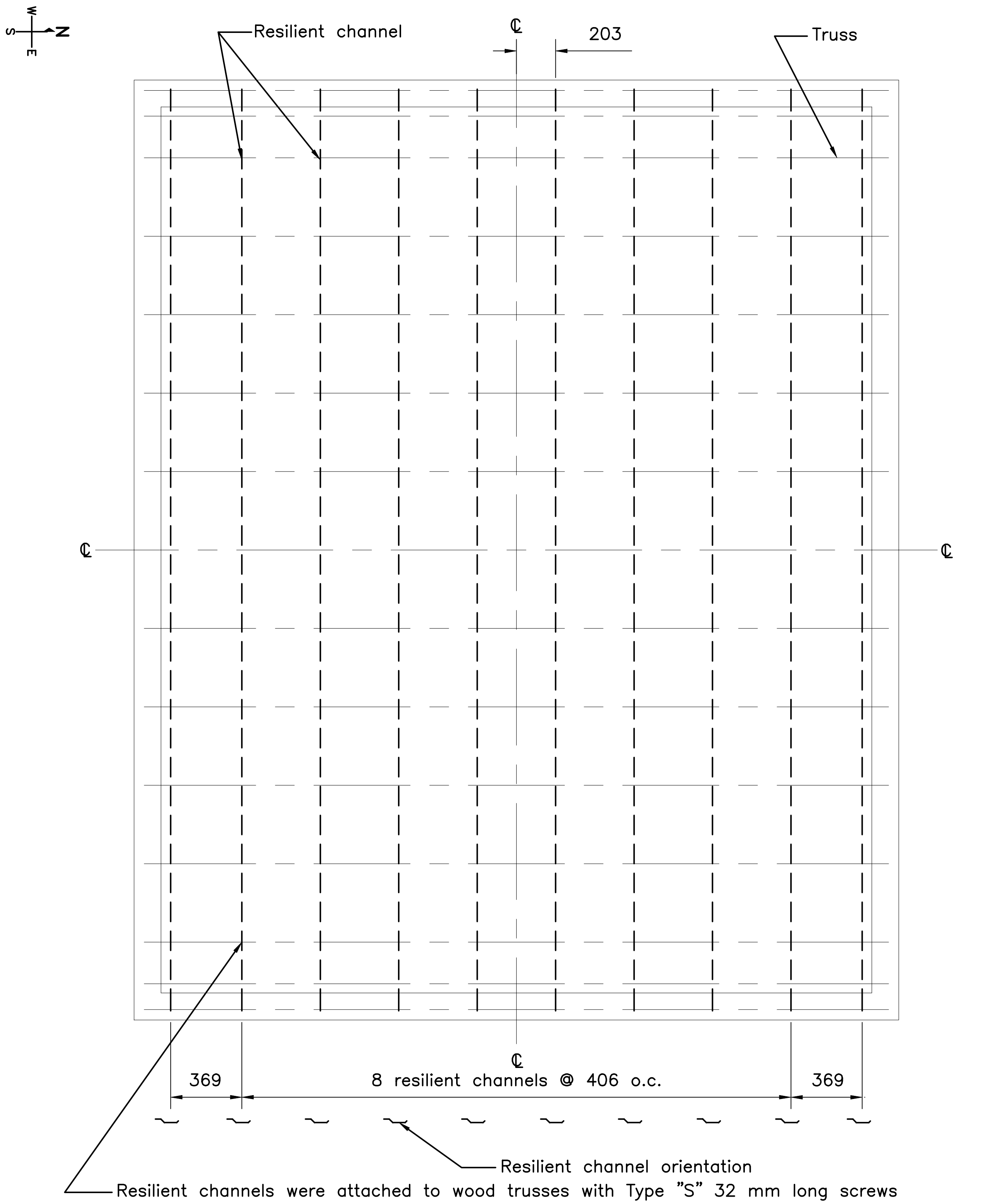
Figure C–149. Subfloor Layout Face Layer (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF–82)

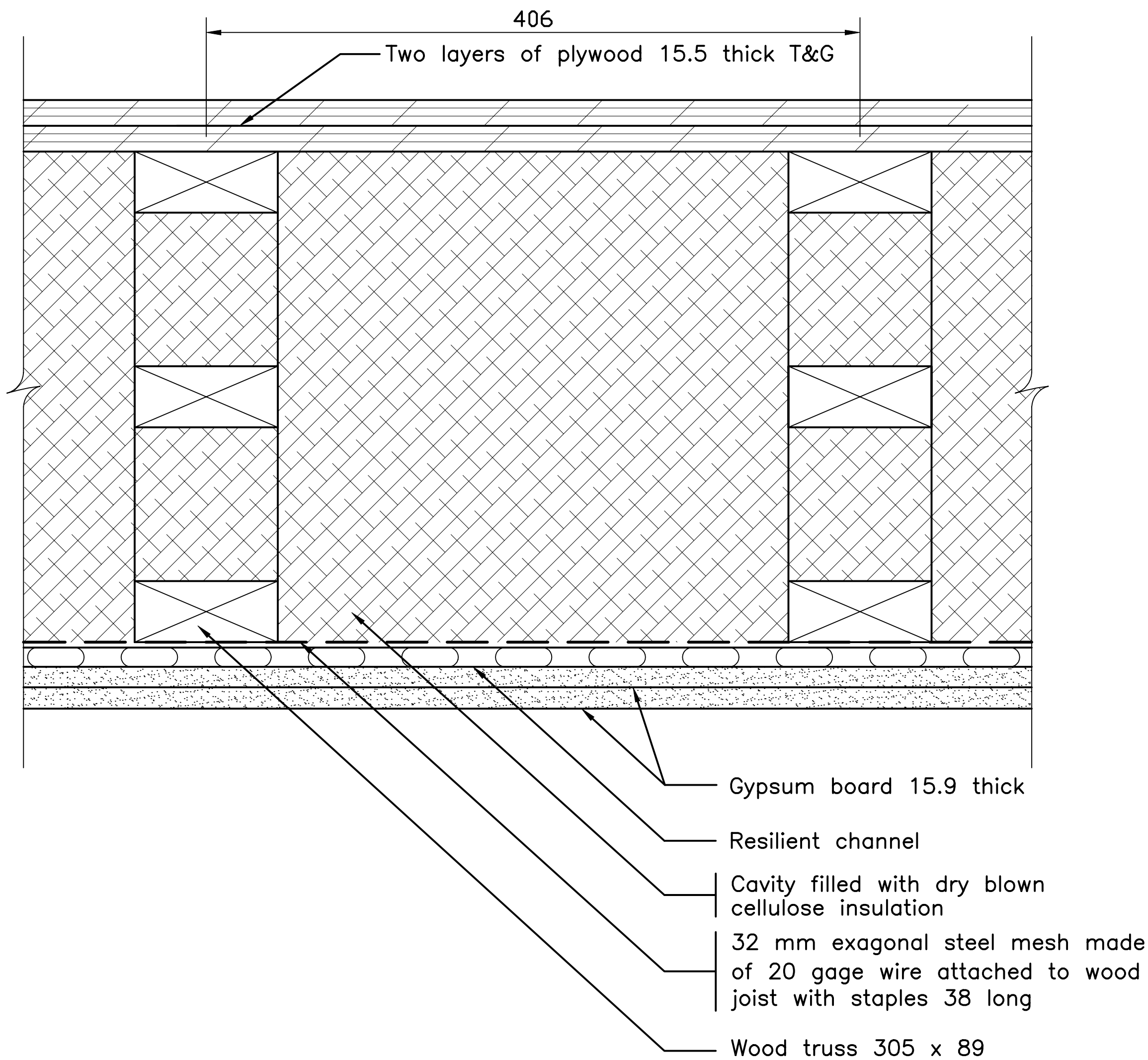
Figure C–150. Subfloor Nail Pattern Face Layer (Wood Truss)

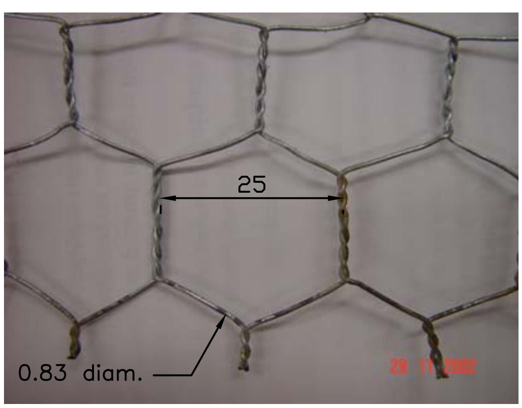


(Dimensions are in millimetres)

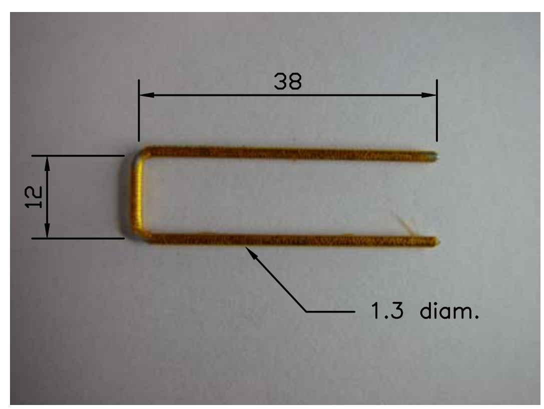
(Assembly No. FF–82)

Figure C–151. Resilient Channel Layout (Wood Truss)





Steel mesh

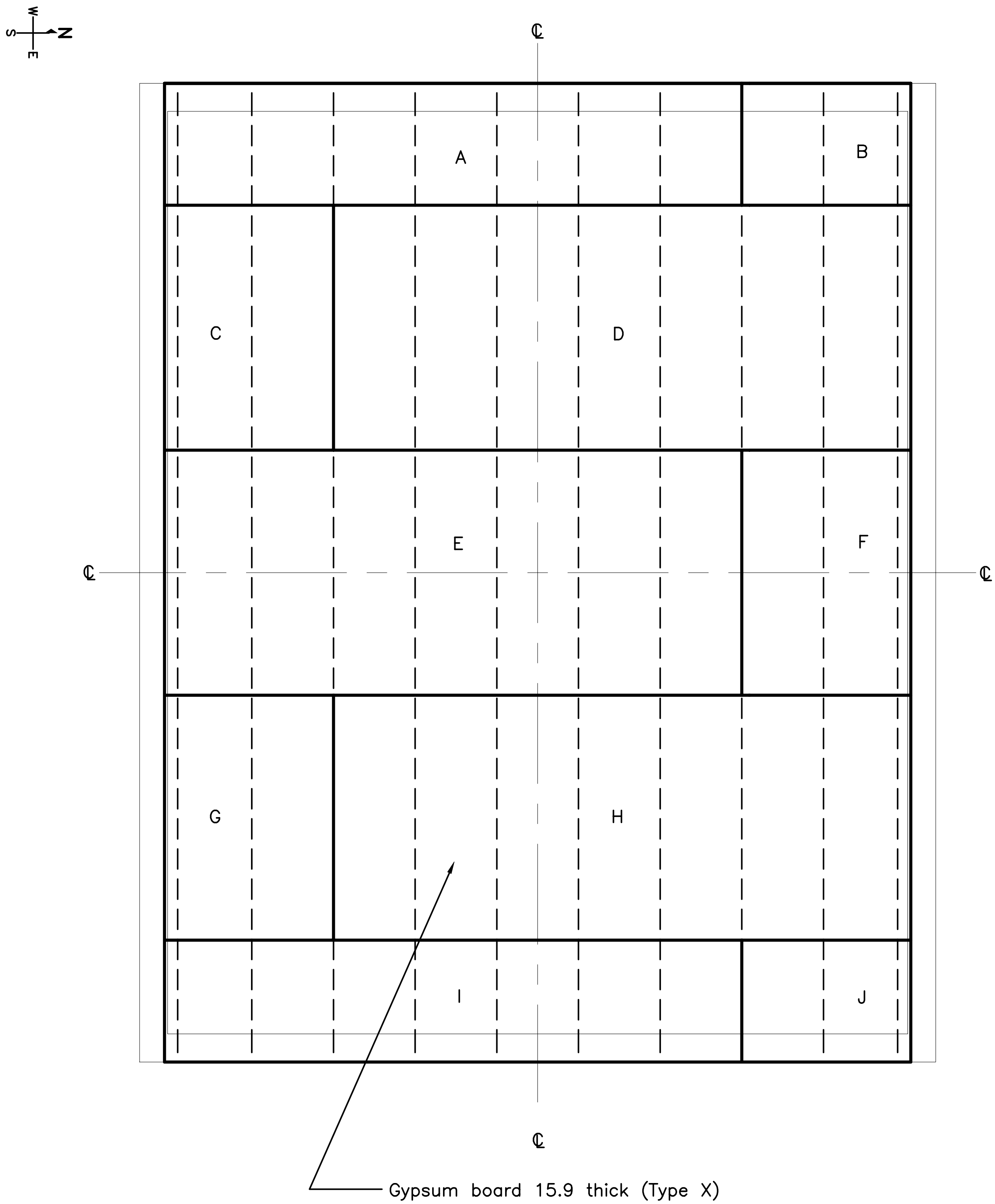


Staple used to secure the steel mesh to trusses

(Dimensions are in millimetres)

(Assembly No. FF-82)

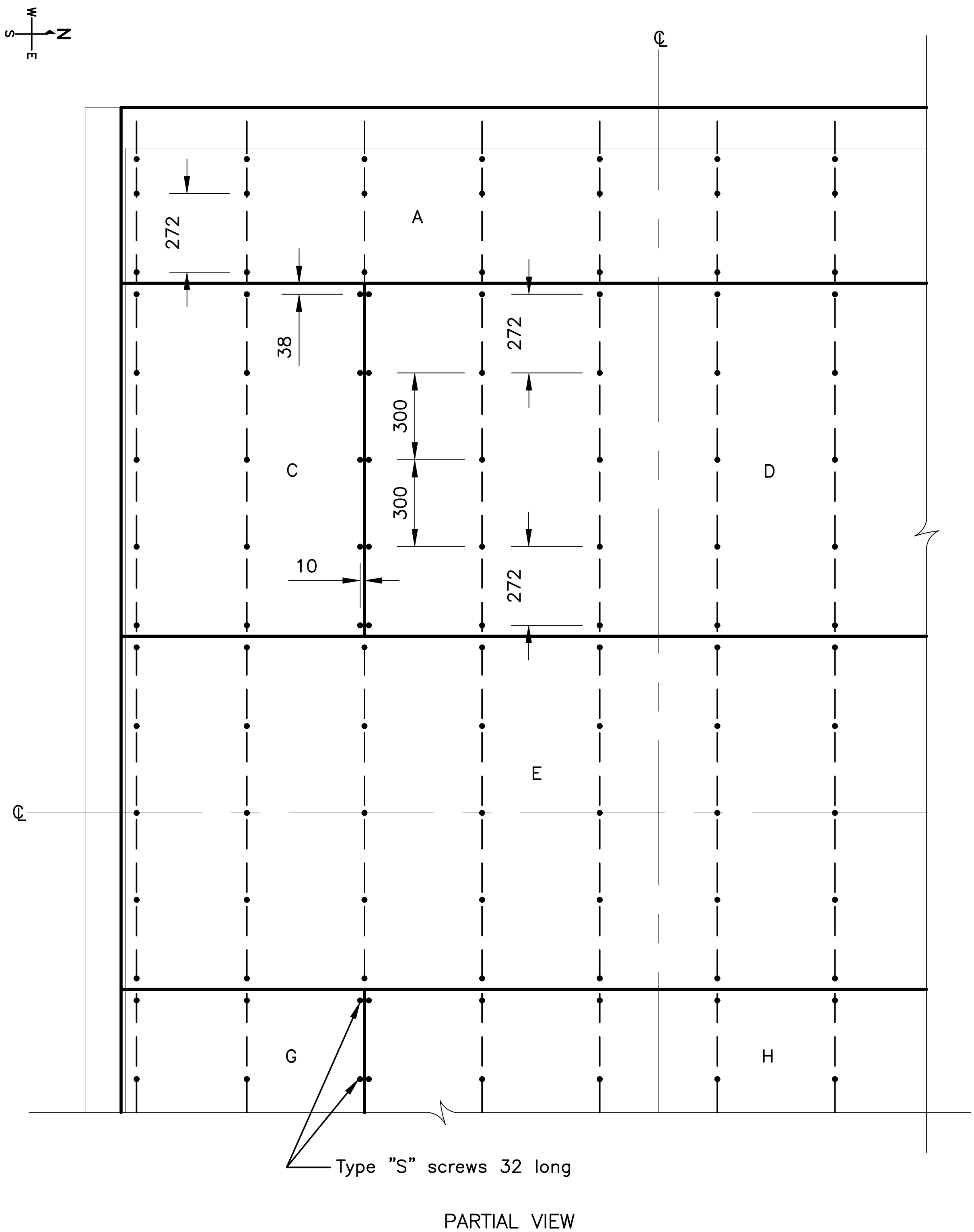
Figure C-152. Insulation Location (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-82)

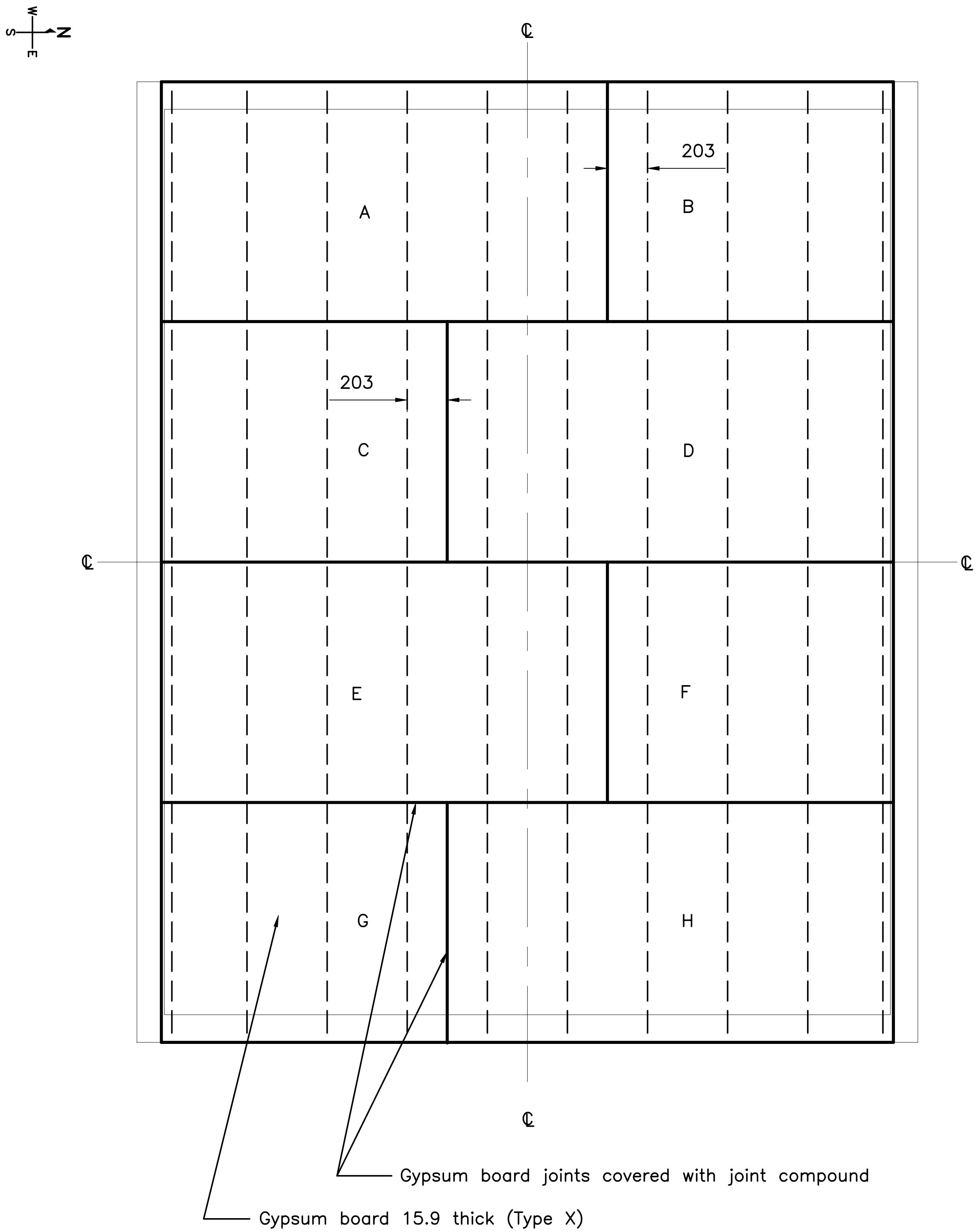
Figure C-153. Gypsum Board Base Layer Layout (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-82)

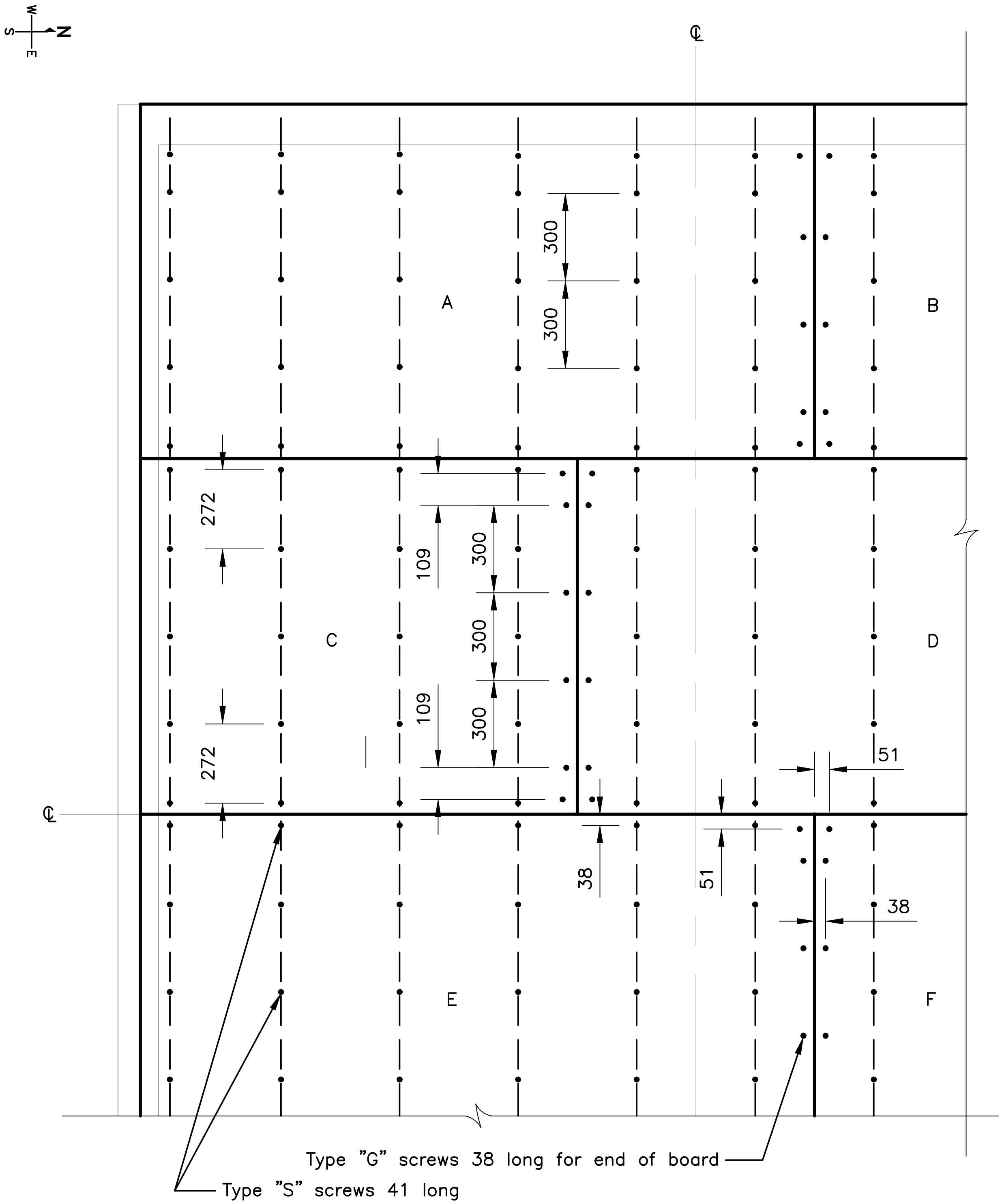
Figure C-154. Gypsum Board Base Layer Screw Pattern (Wood Truss)



(Dimensions are in millimetres)

(Assembly No. FF-82)

Figure C-155. Gypsum Board Face Layer Layout (Wood Truss)



PARTIAL VIEW

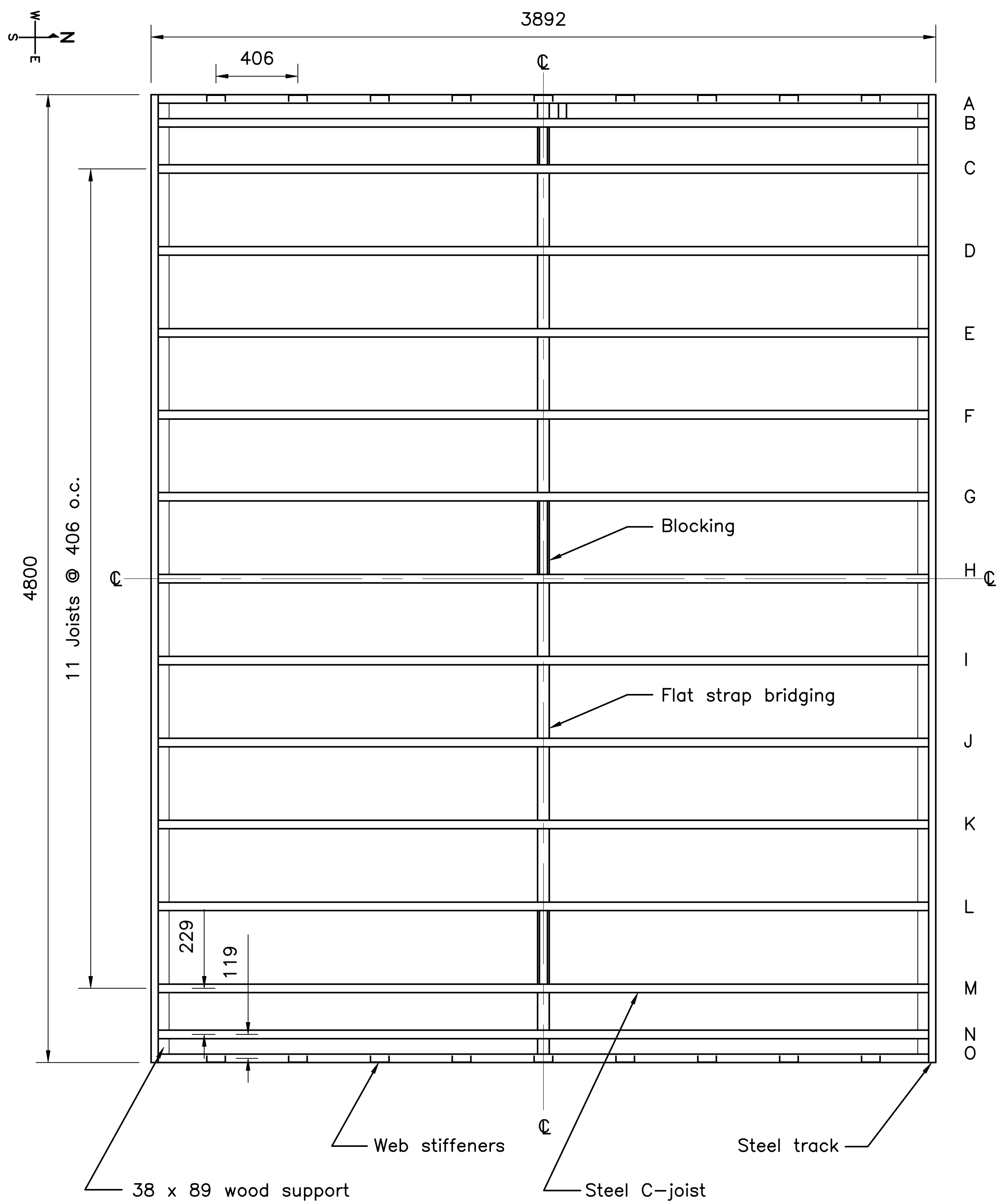
(Dimensions are in millimetres)

(Assembly No. FF-82)

Figure C-156. Gypsum Board Face Layer Screw Pattern (Wood Truss)

Appendix D

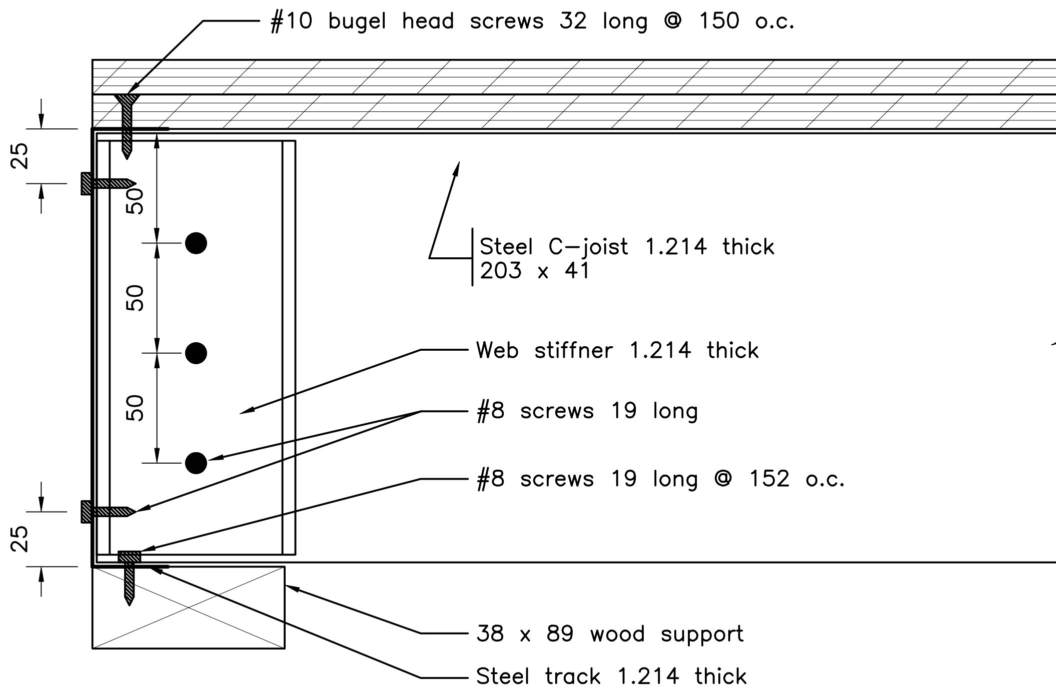
Design details for steel C-joist floor assemblies

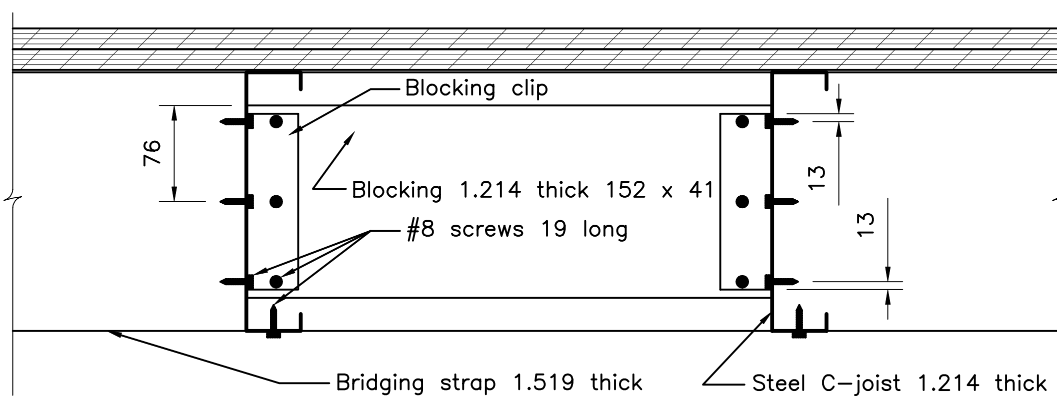


(Dimensions are in millimetres)

(Assembly No. FF-37)

Figure D-1. Joist Layout (Steel C-Joist)

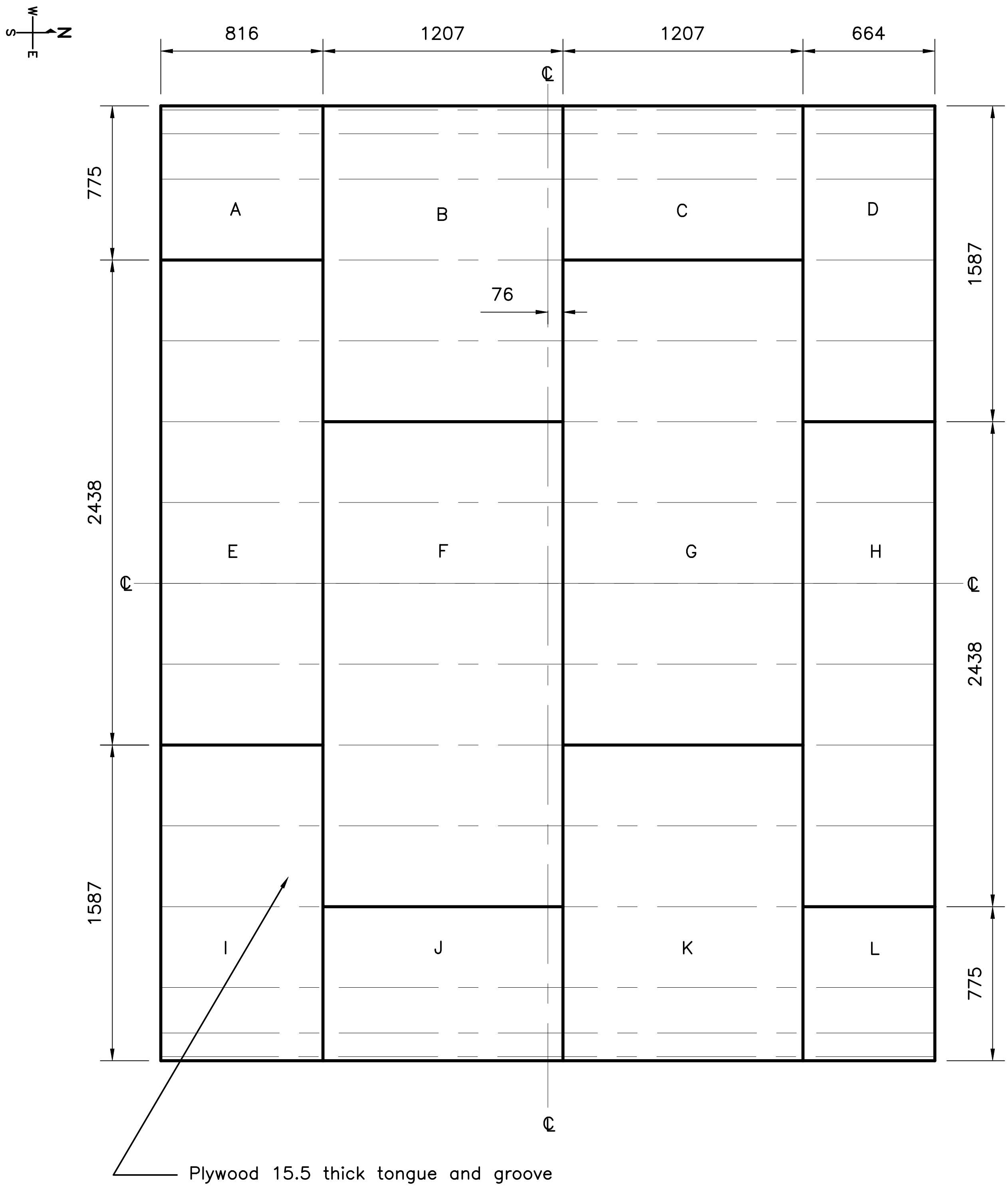




(Dimensions are in millimetres)

(Assembly No. FF–37)

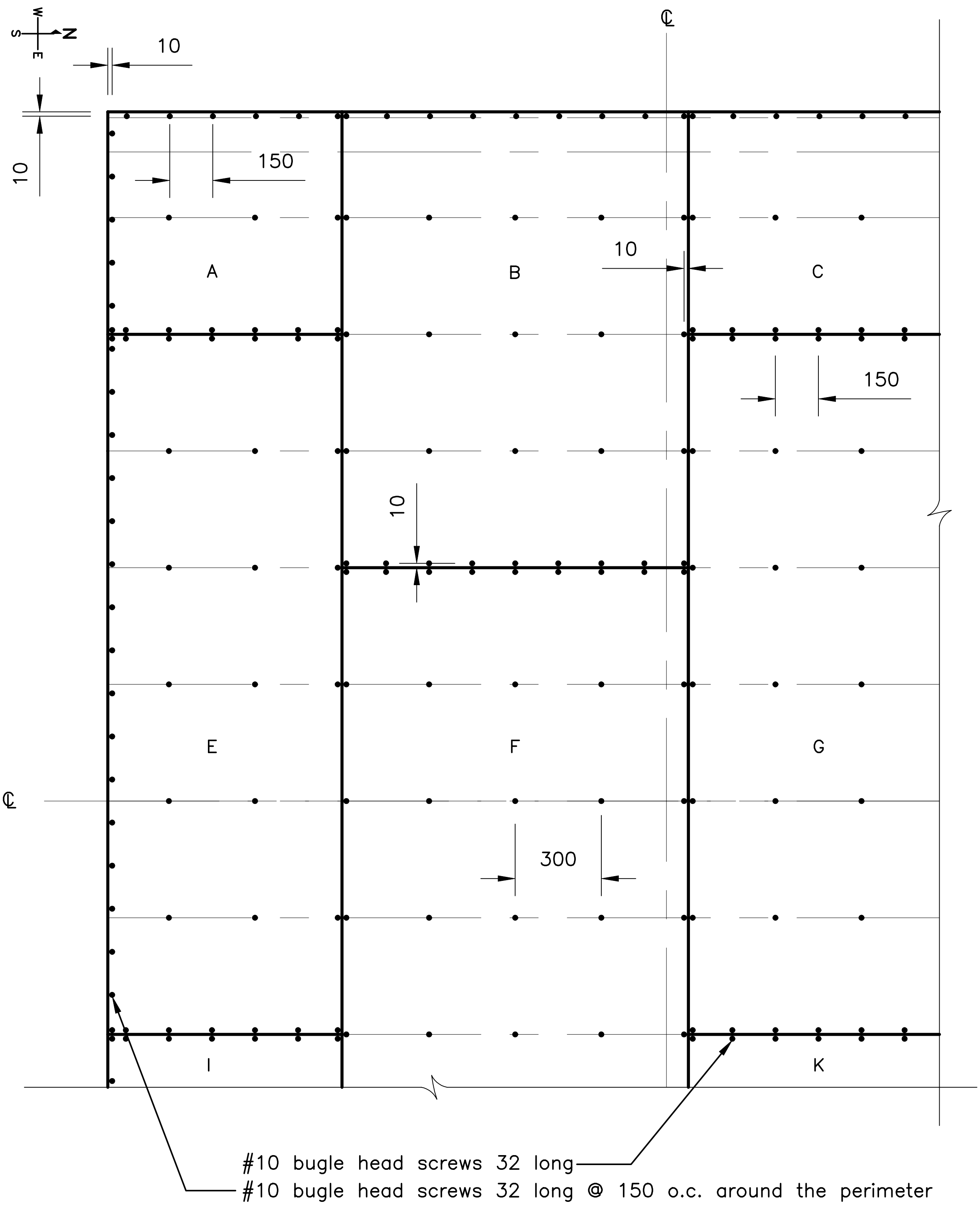
Figure D–2. Steel Joist End Connection and Blocking Detail (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–37)

Figure D–3. Subfloor Layout Base Layer (Steel C–Joist)

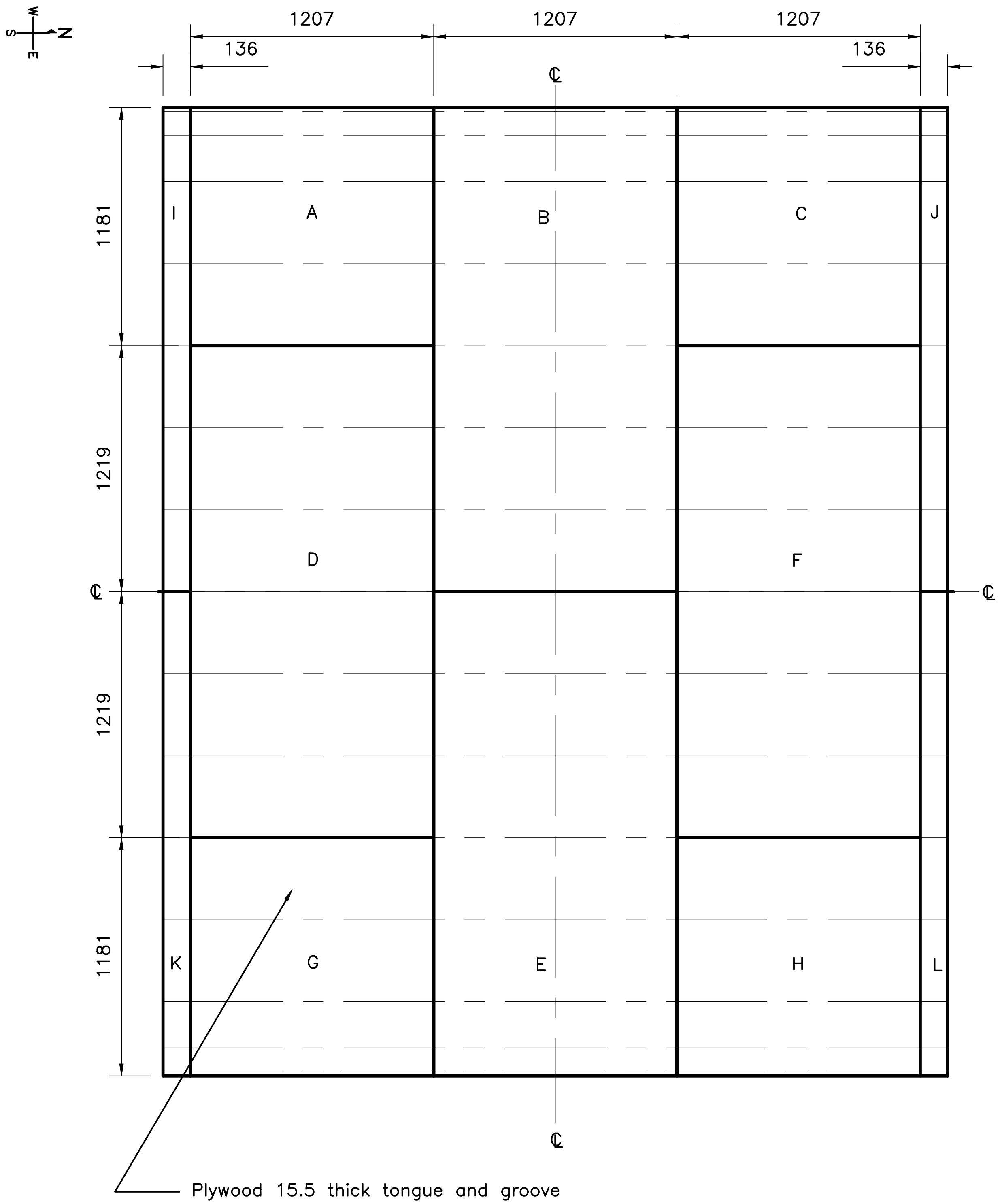


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF–37)

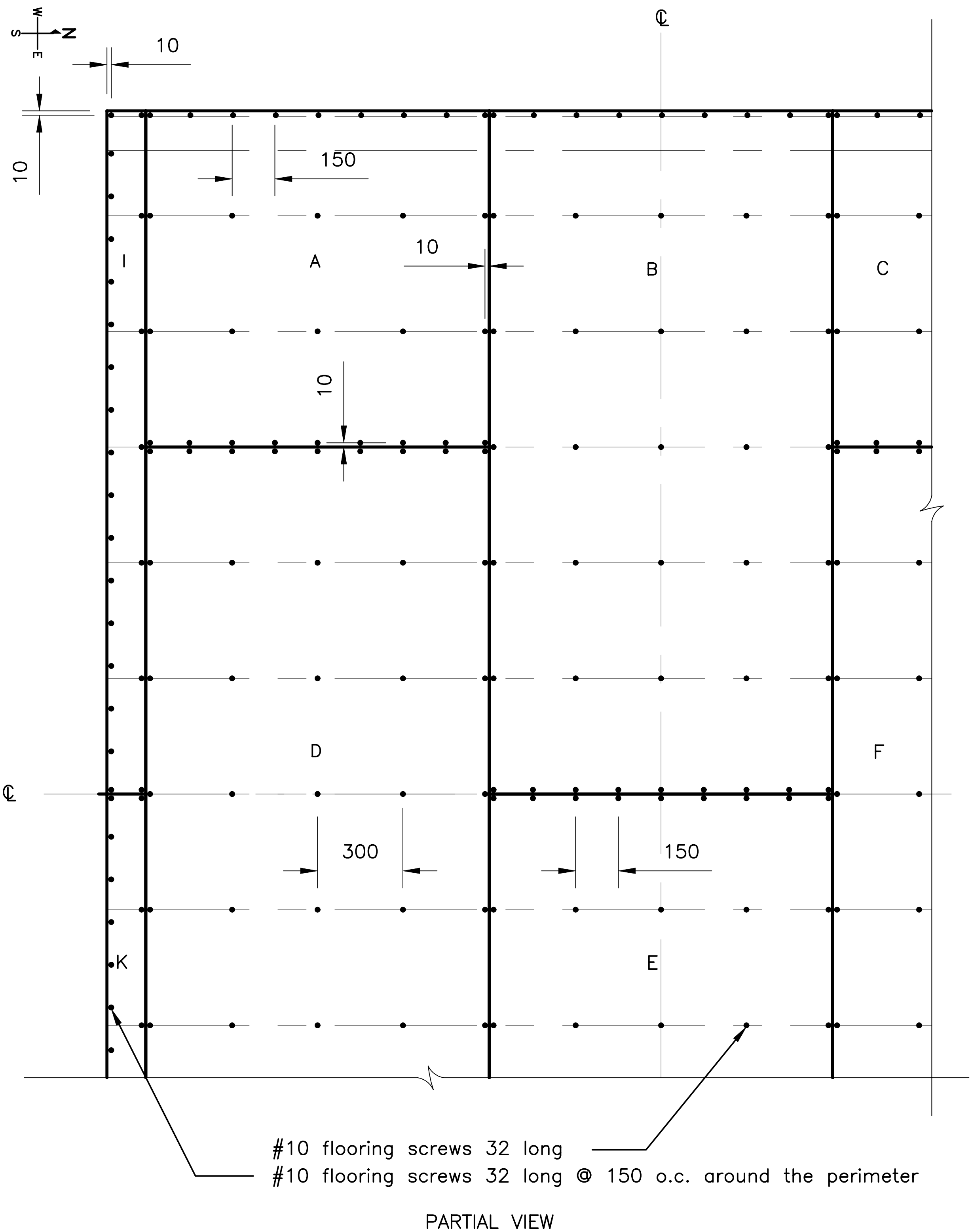
Figure D–4. Subfloor Screw Pattern Base Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-37)

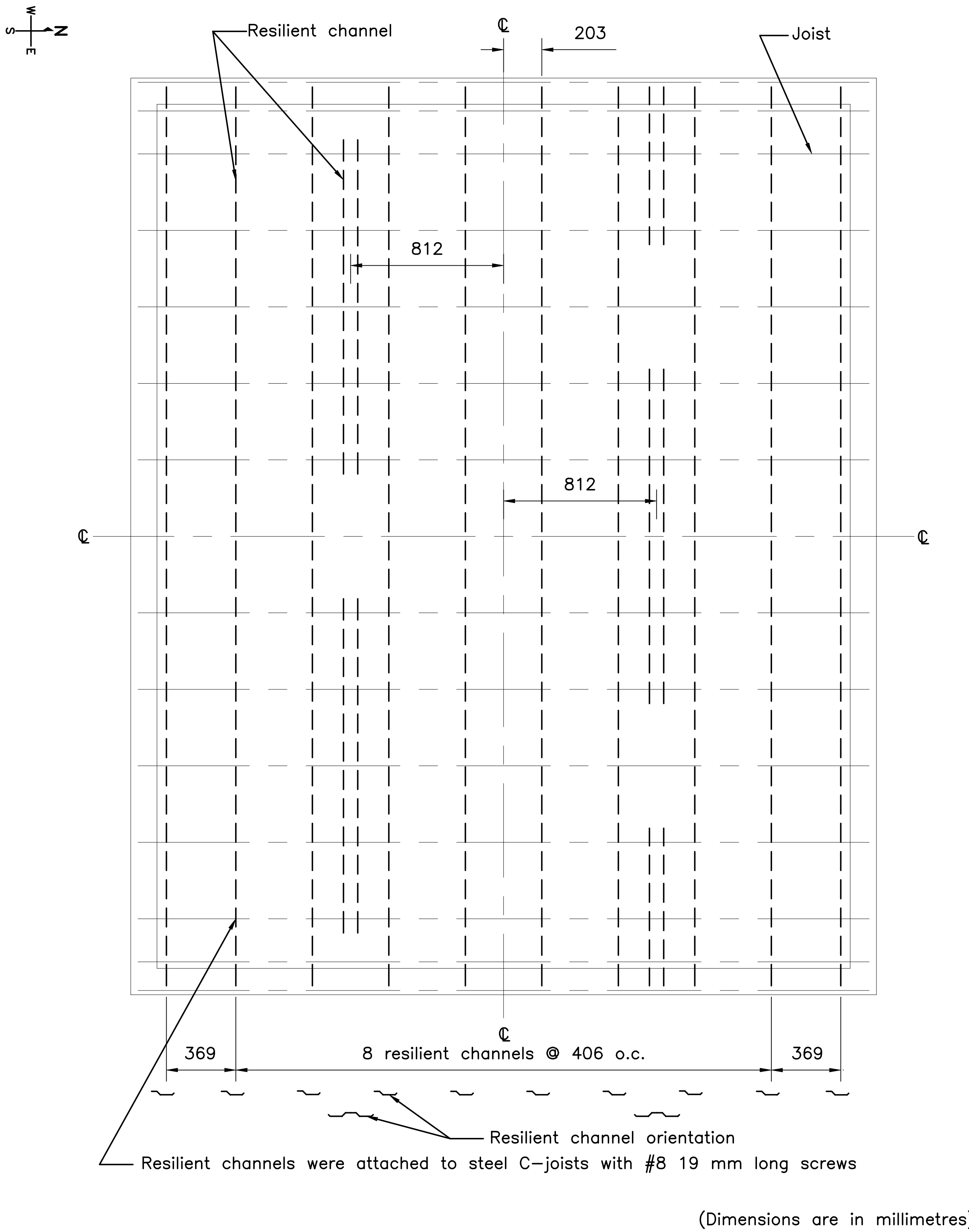
Figure D-5. Subfloor Layout Face Layer (Steel C-Joist)



(Dimensions are in millimetres)

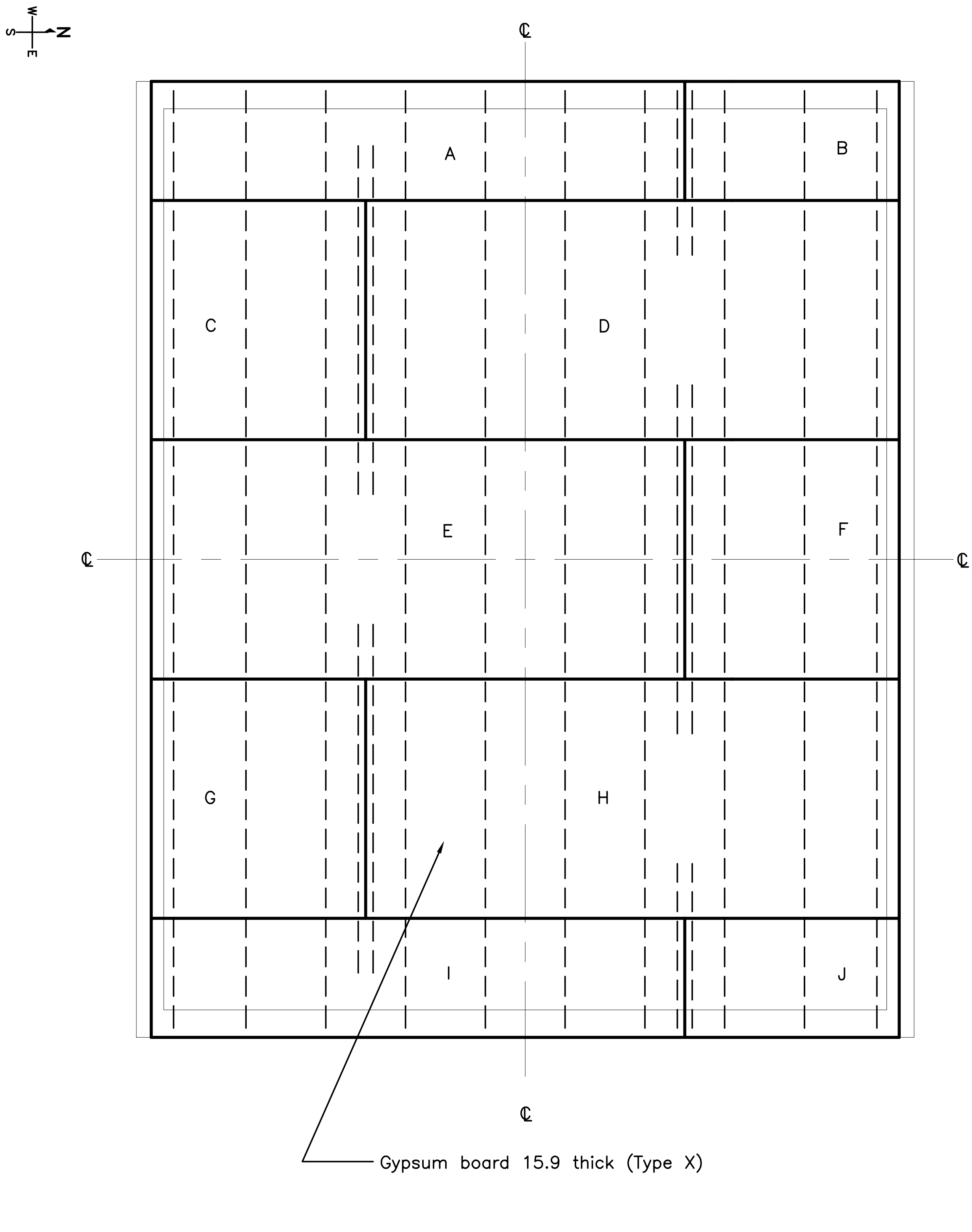
(Assembly No. FF–37)

Figure D–6. Subfloor Screw Pattern Face Layer (Steel C–Joist)



(Assembly No. FF–37)

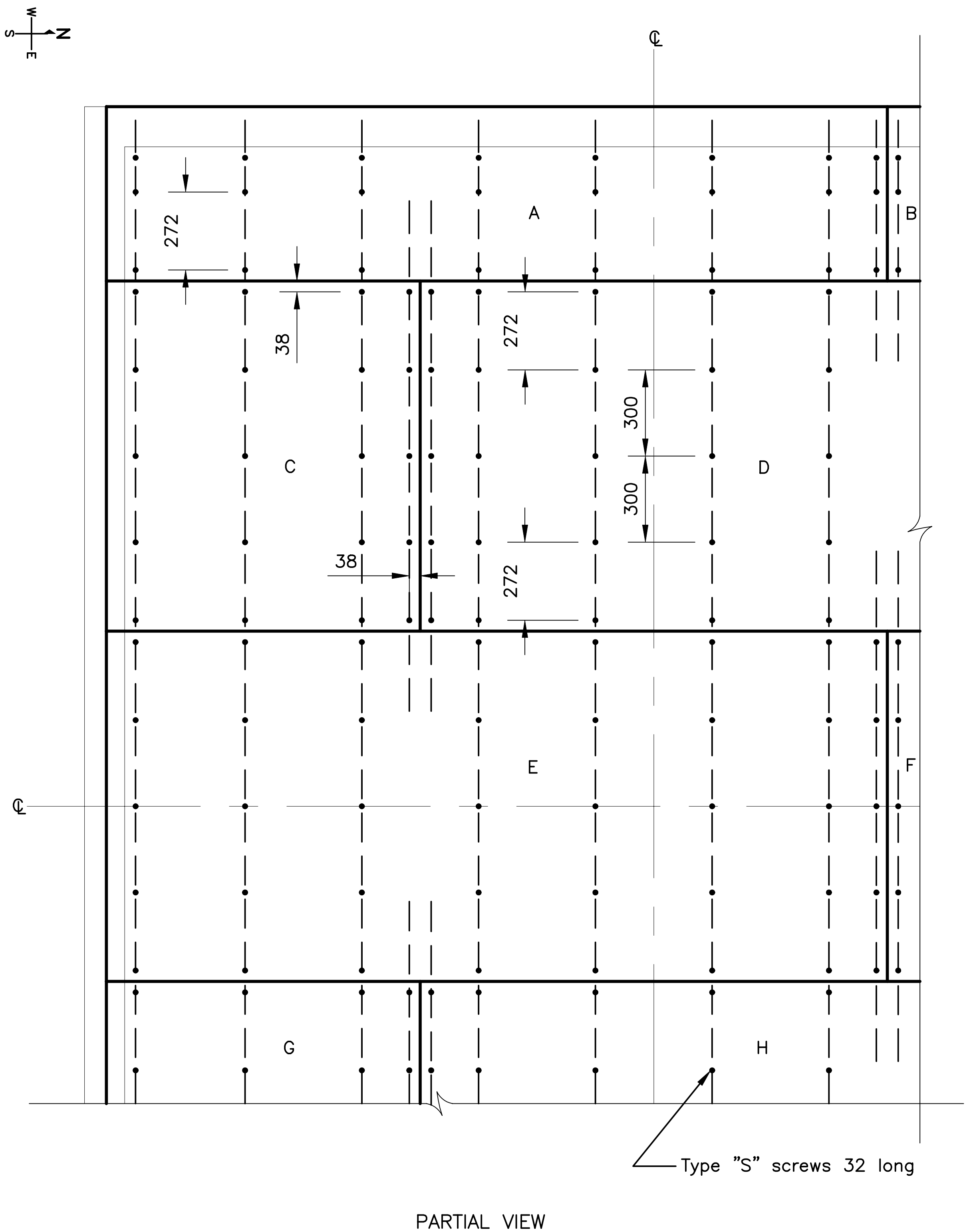
Figure D–7. Resilient Channel Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–37)

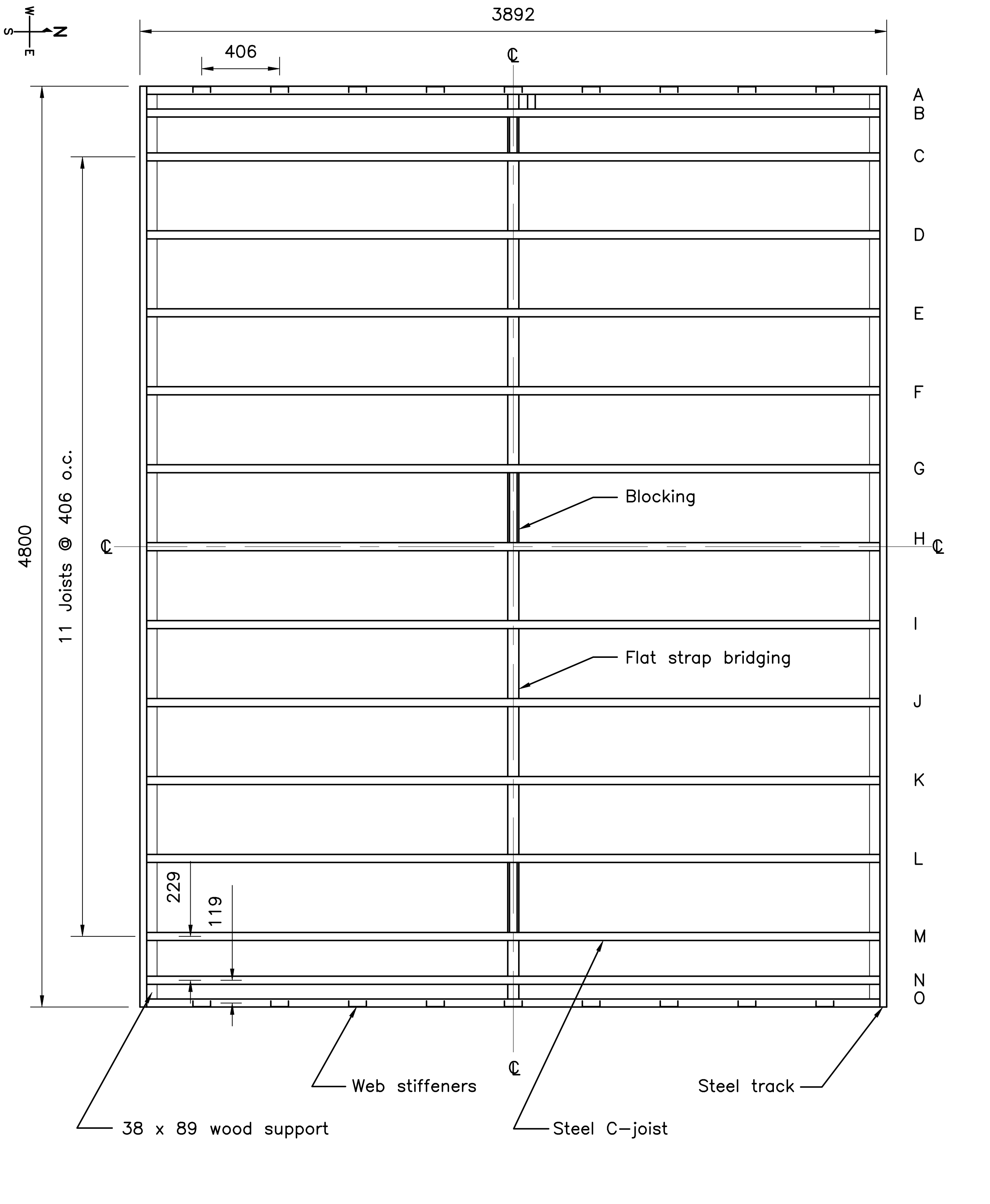
Figure D–8. Gypsum Board Single Layer Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–37)

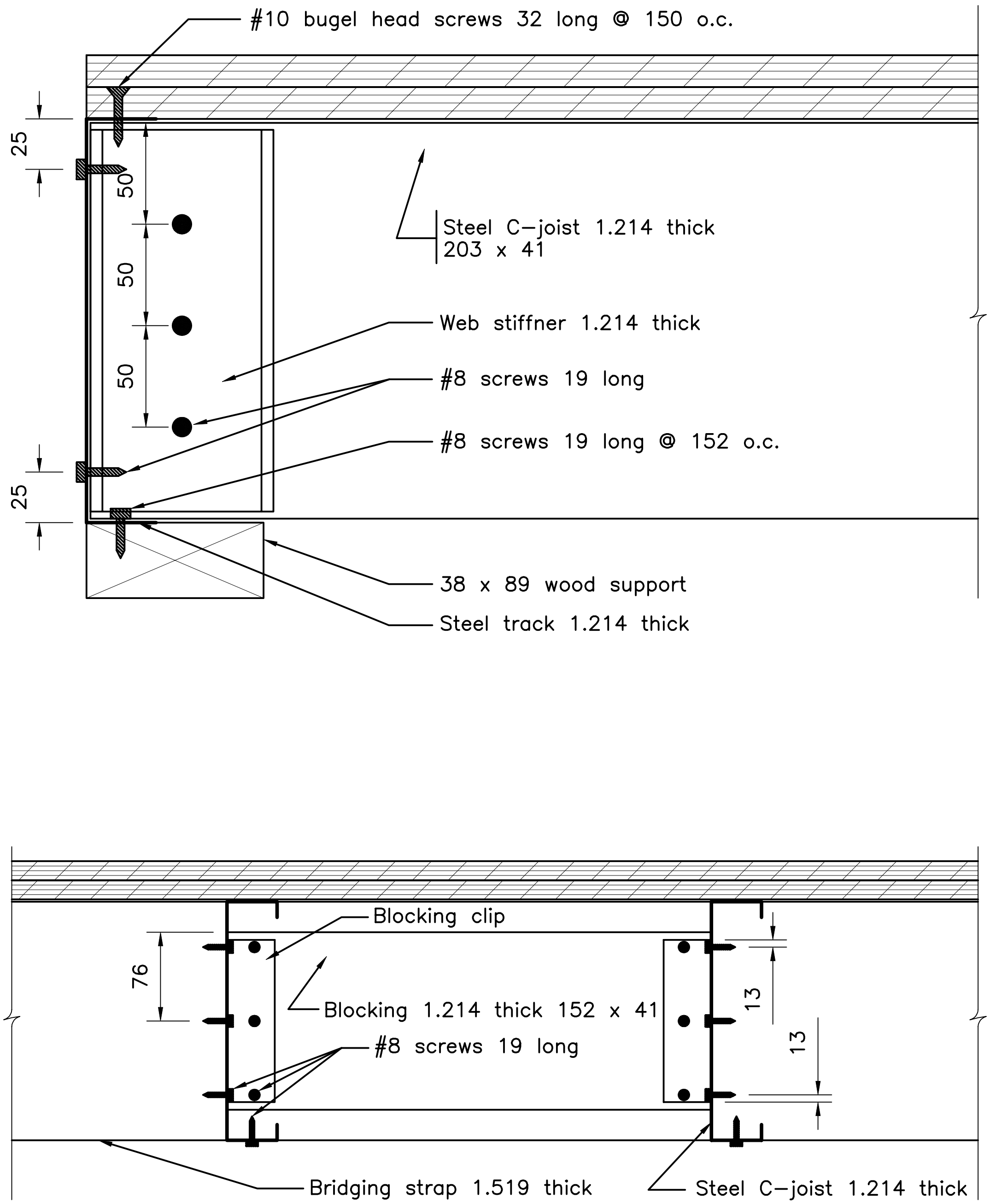
Figure D–9. Gypsum Board Single Layer Screw Pattern (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-38)

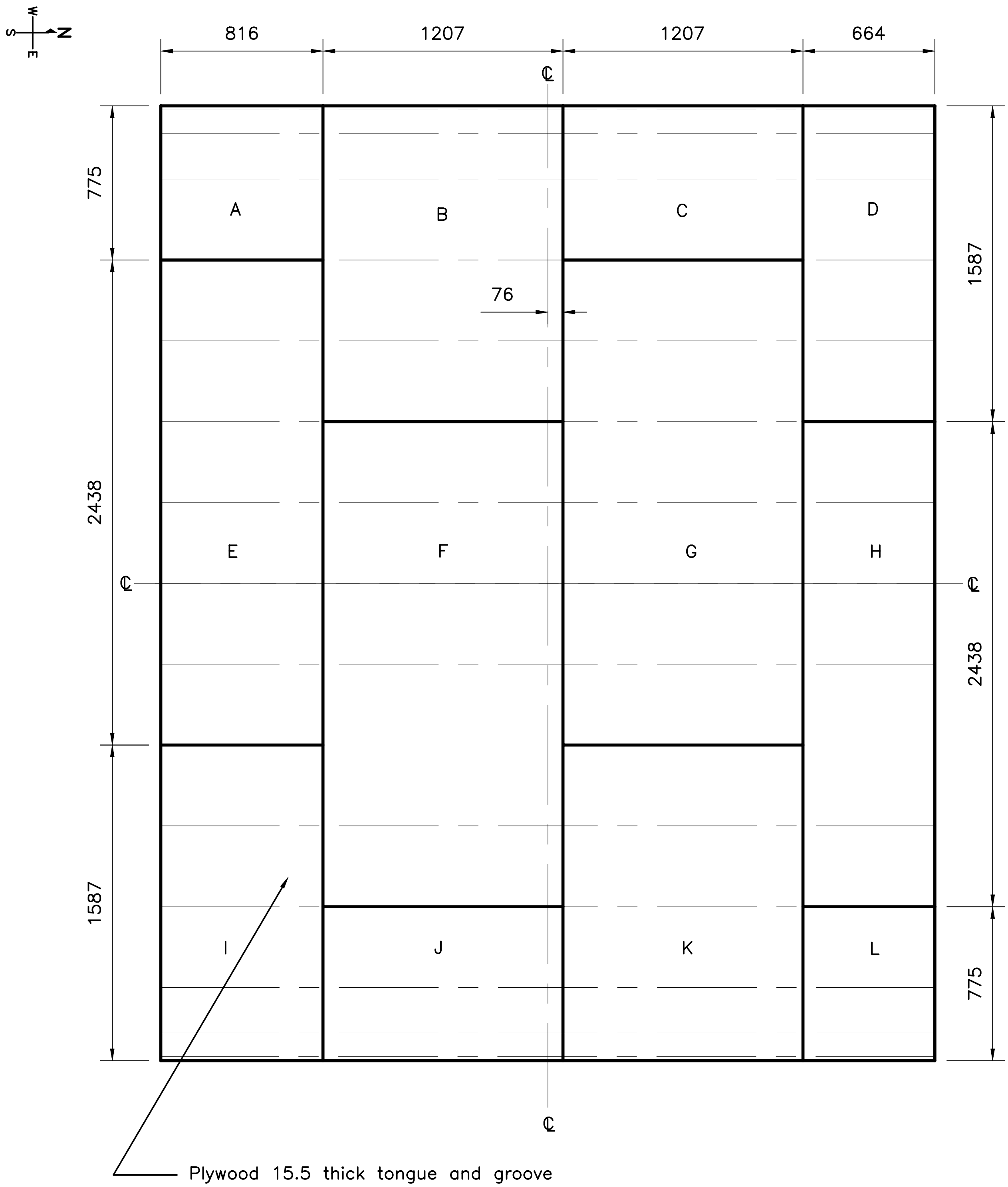
Figure D-10. Joist Layout (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF−38)

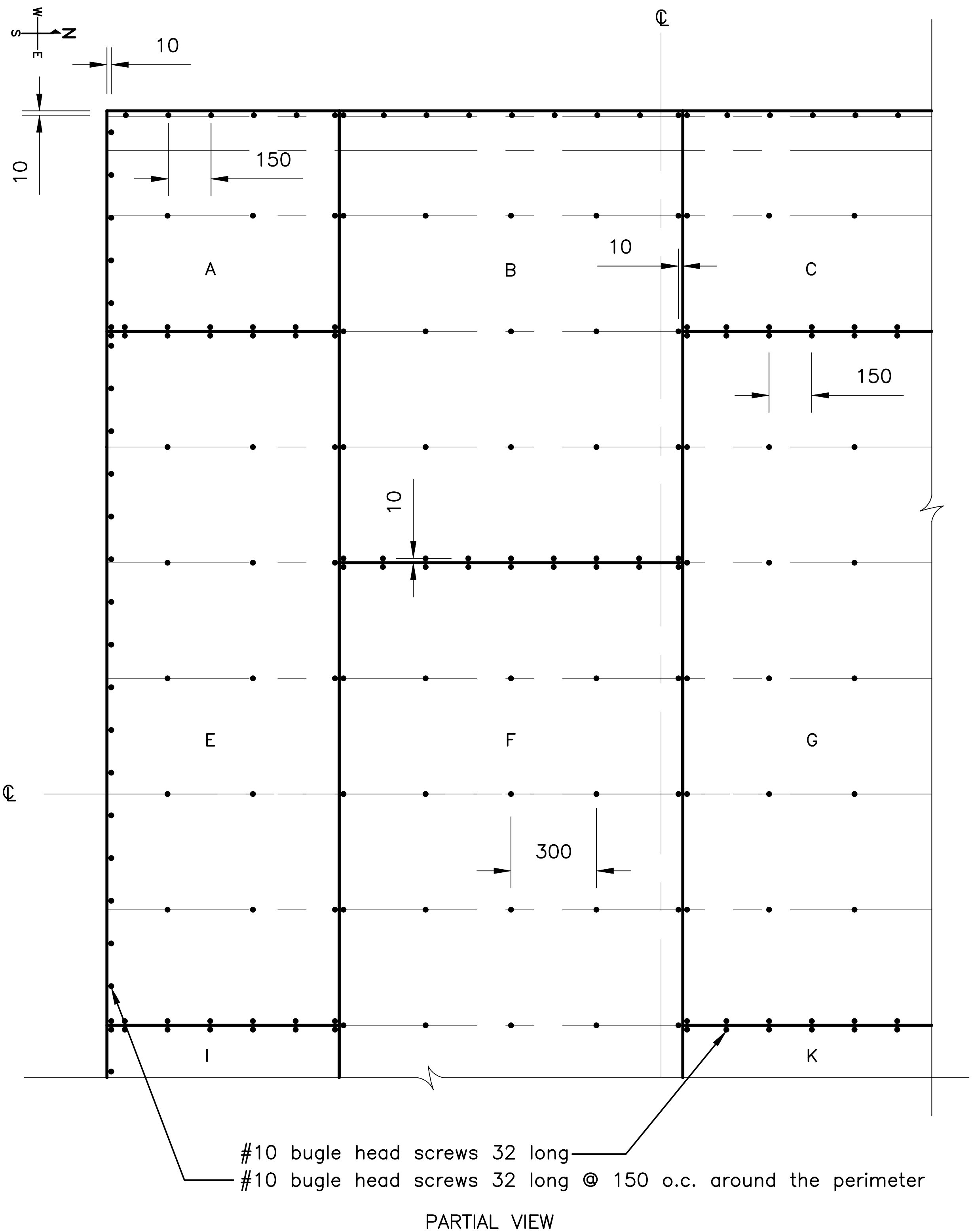
Figure D−11. Steel C−Joist End Connection and Blocking Detail (Steel C−Joist)



(Dimensions are in millimetres)

(Assembly No. FF–38)

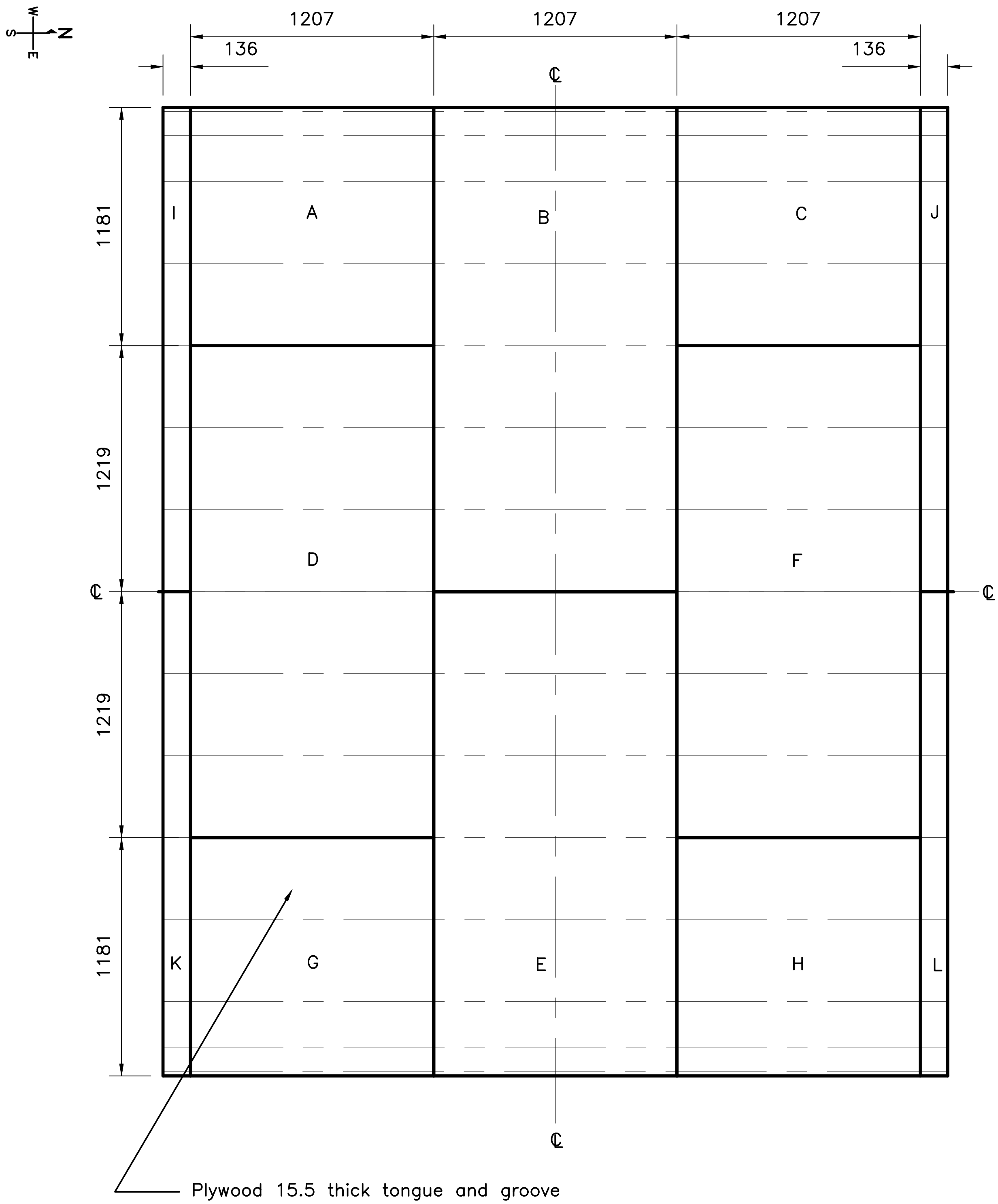
Figure D–12. Subfloor Layout Base Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-38)

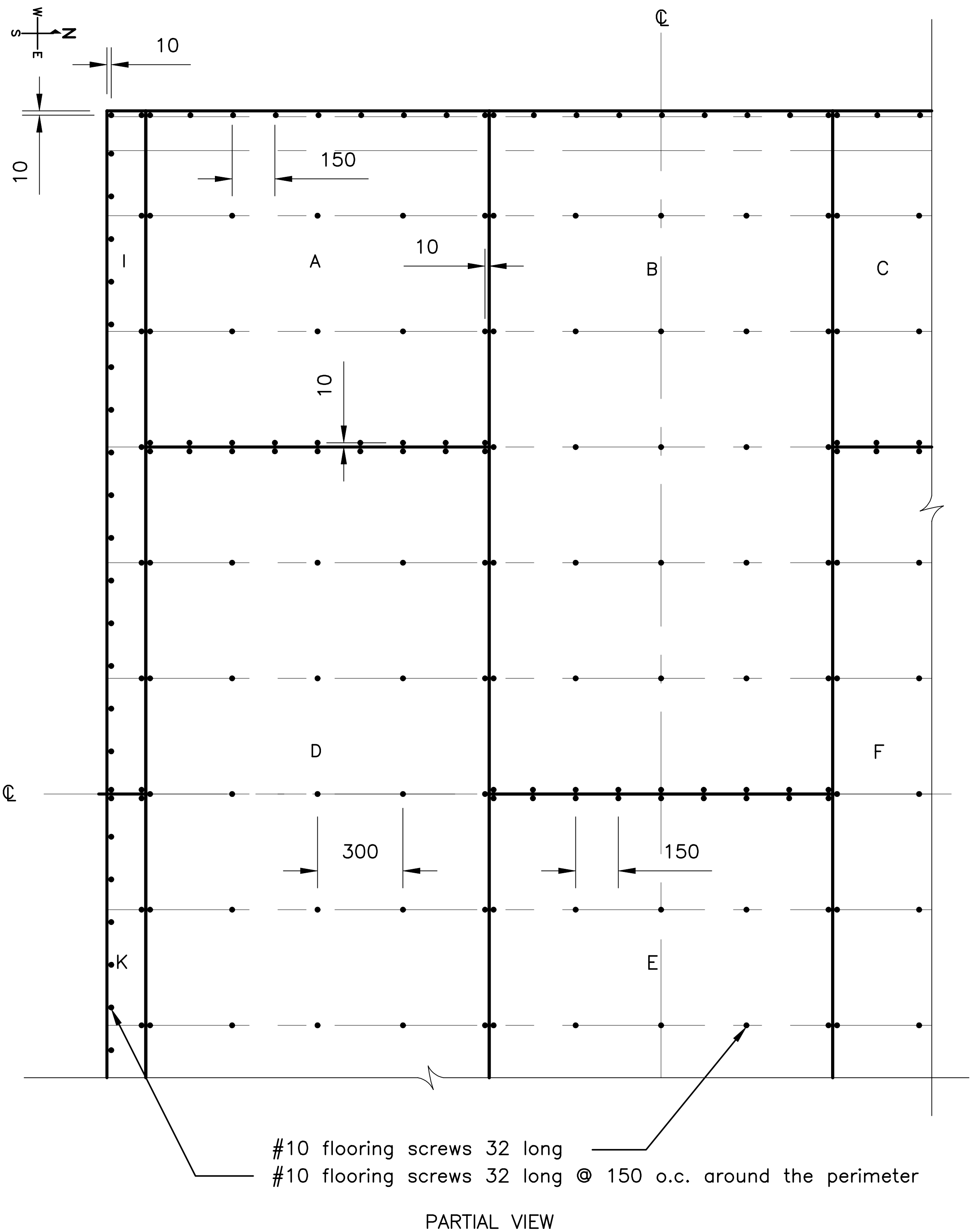
Figure D-13. Subfloor Screw Pattern Base Layer (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–38)

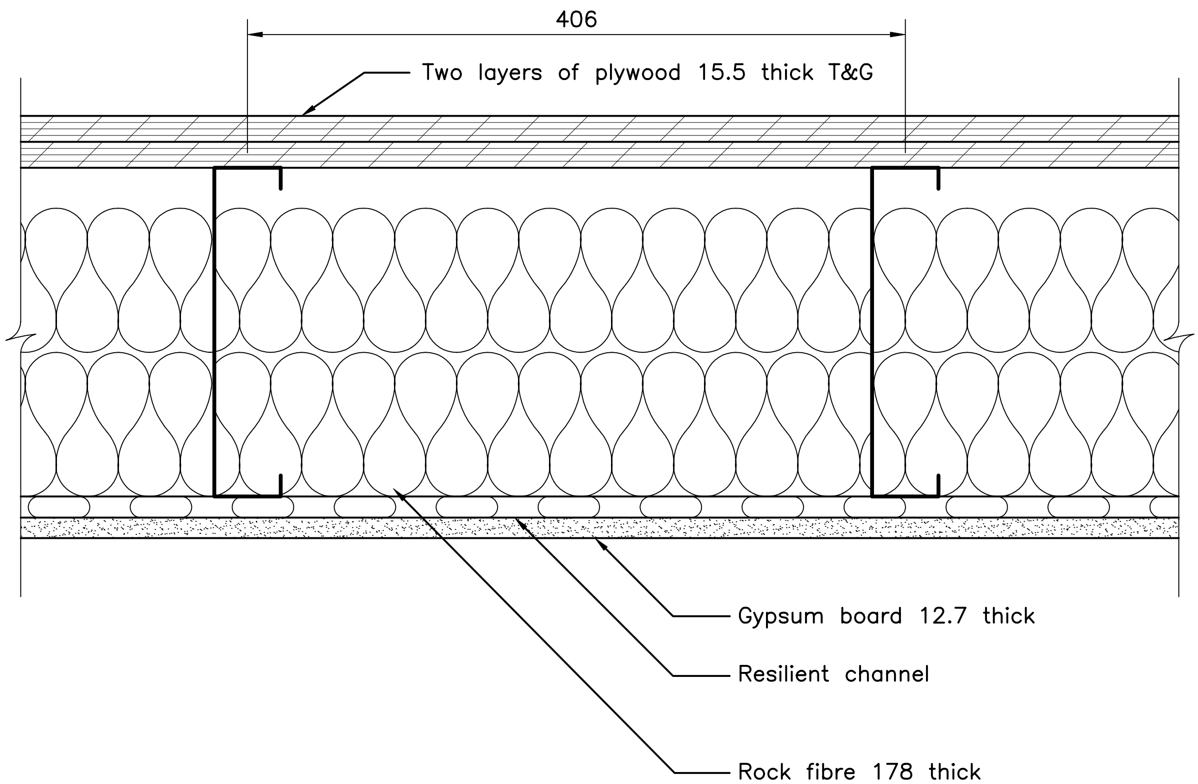
Figure D–14. Subfloor Layout Face Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-38)

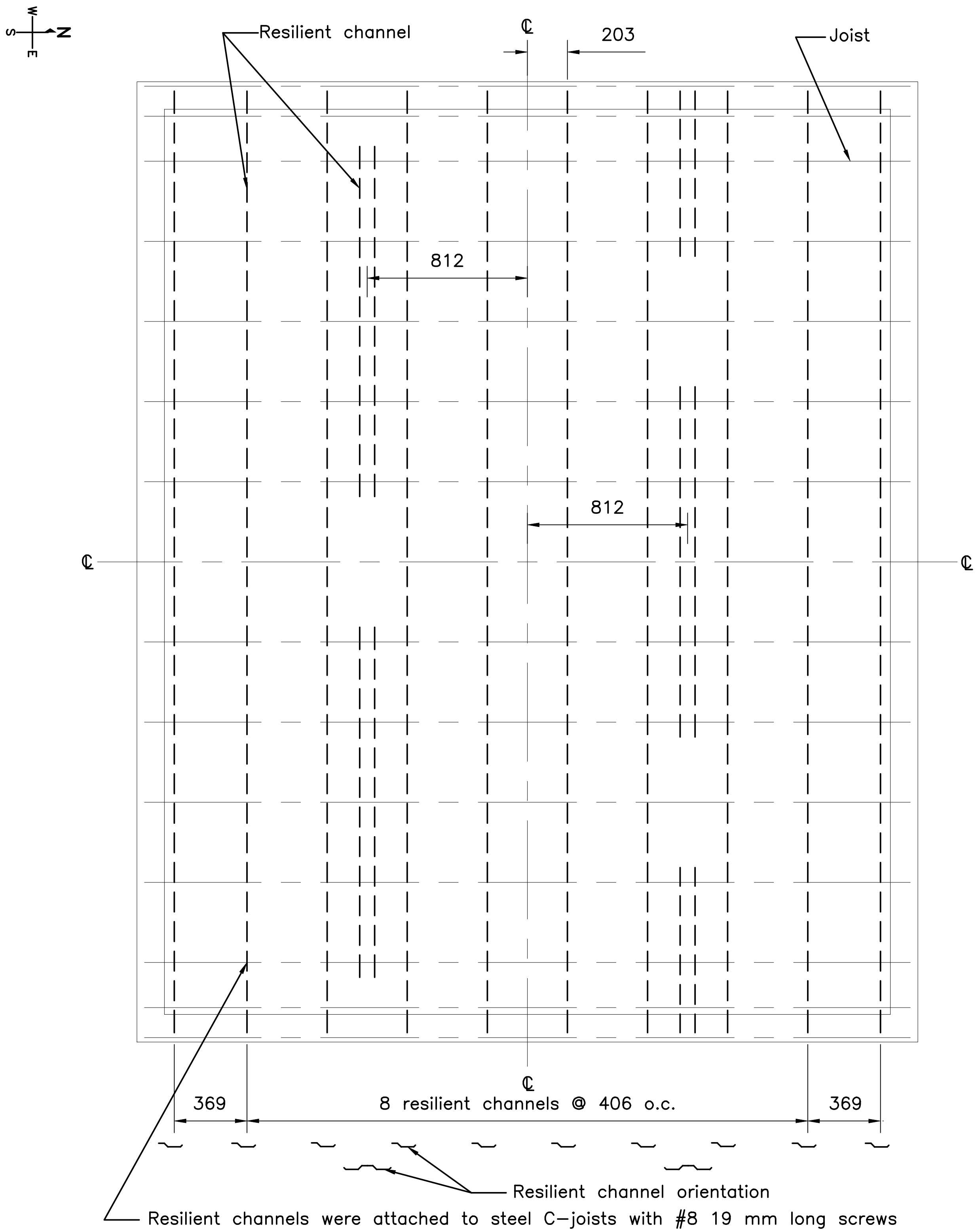
Figure D-15. Subfloor Screw Pattern Face Layer (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–38)

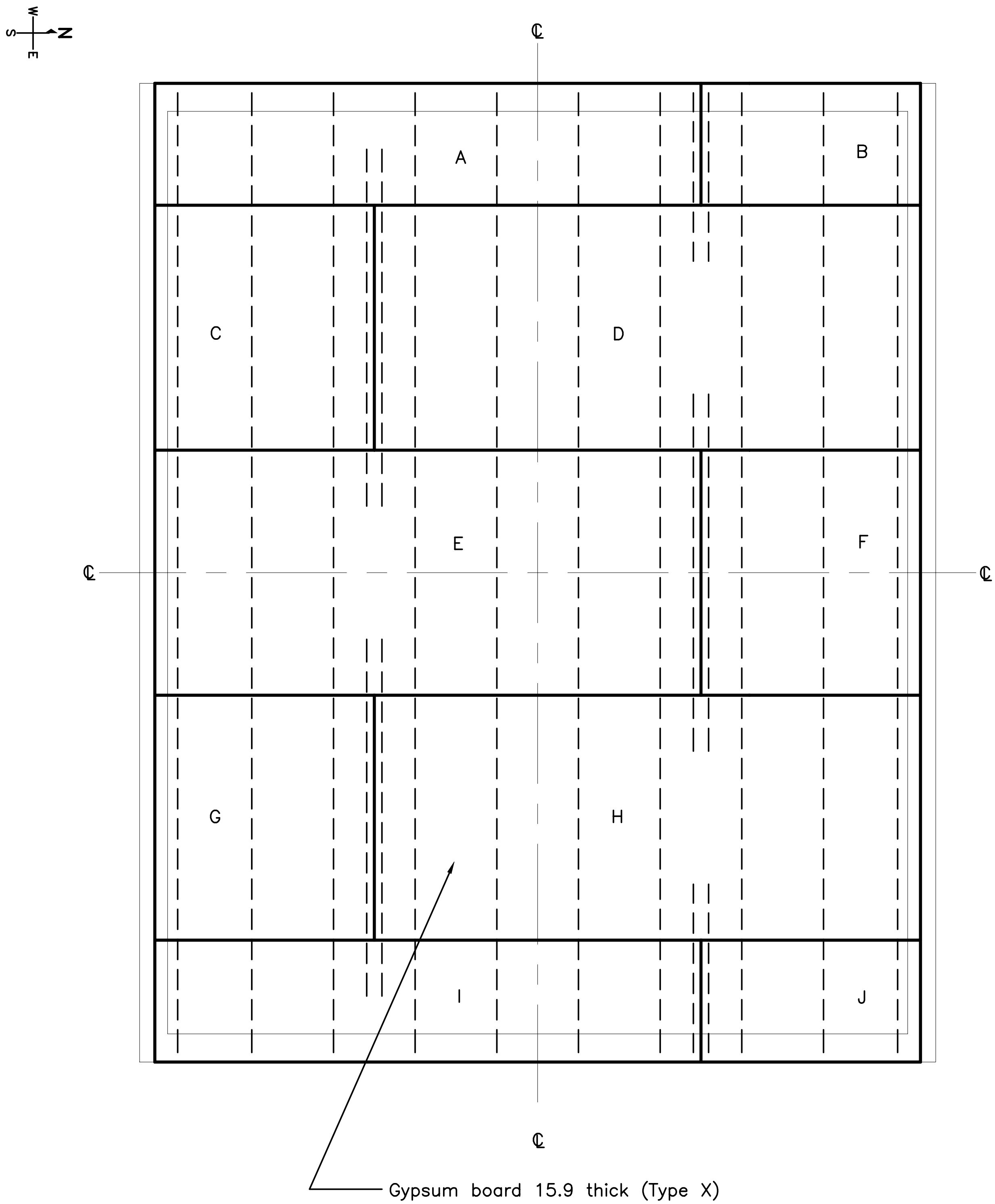
Figure D–16. Insulation Location (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–38)

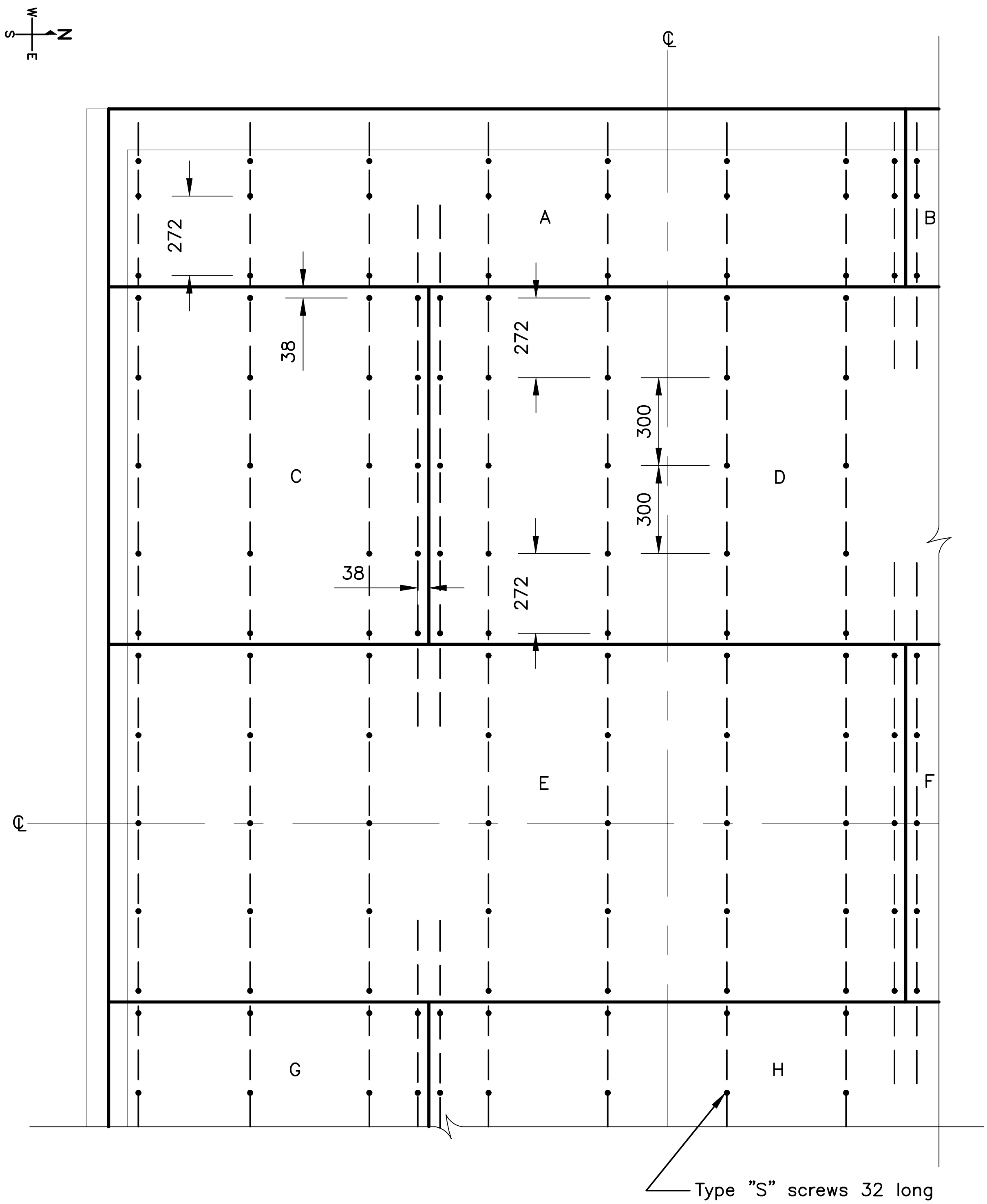
Figure D–17. Resilient Channel Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-38)

Figure D-18. Gypsum Board Single Layer Layout (Steel C-Joist)

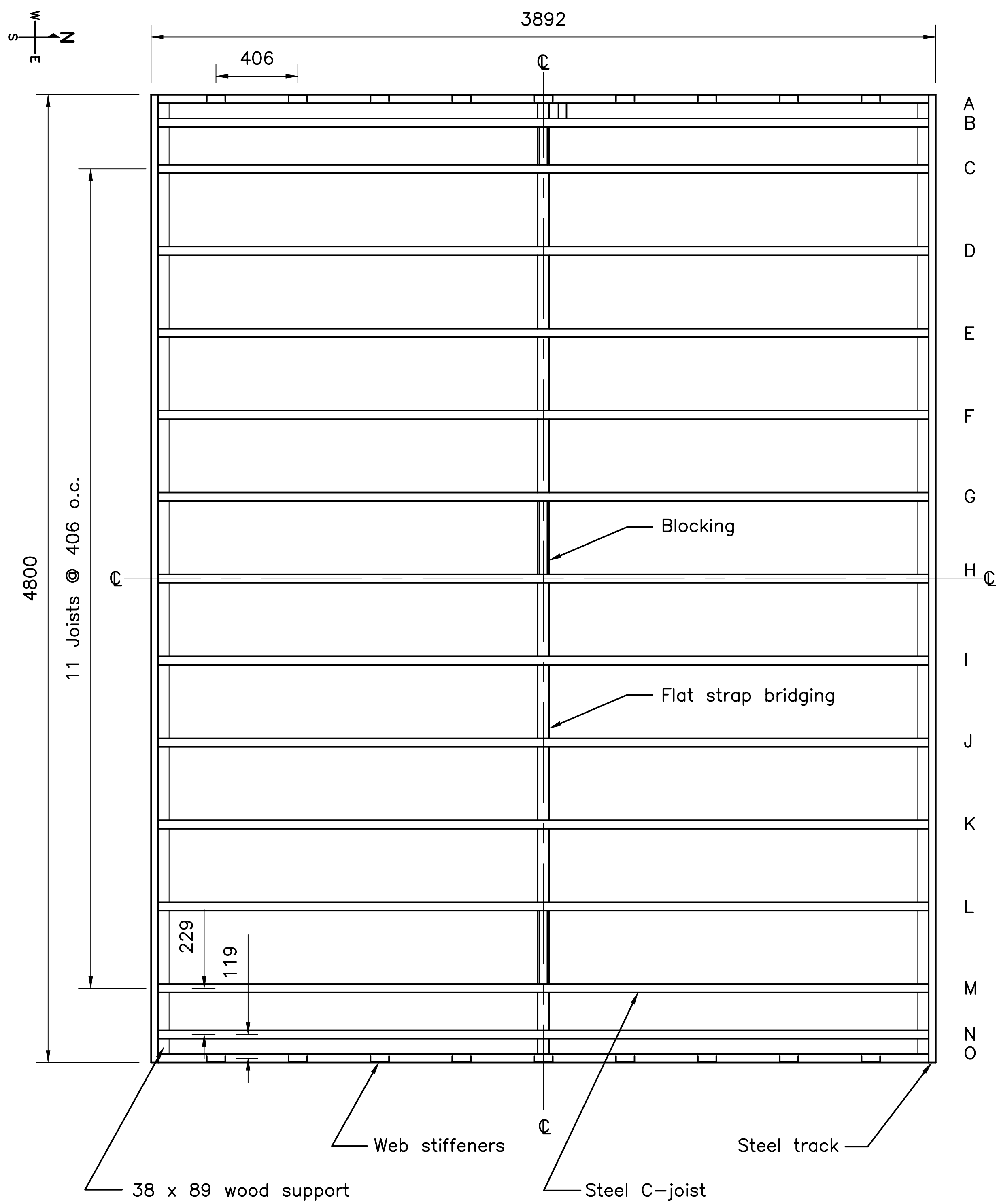


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF−38)

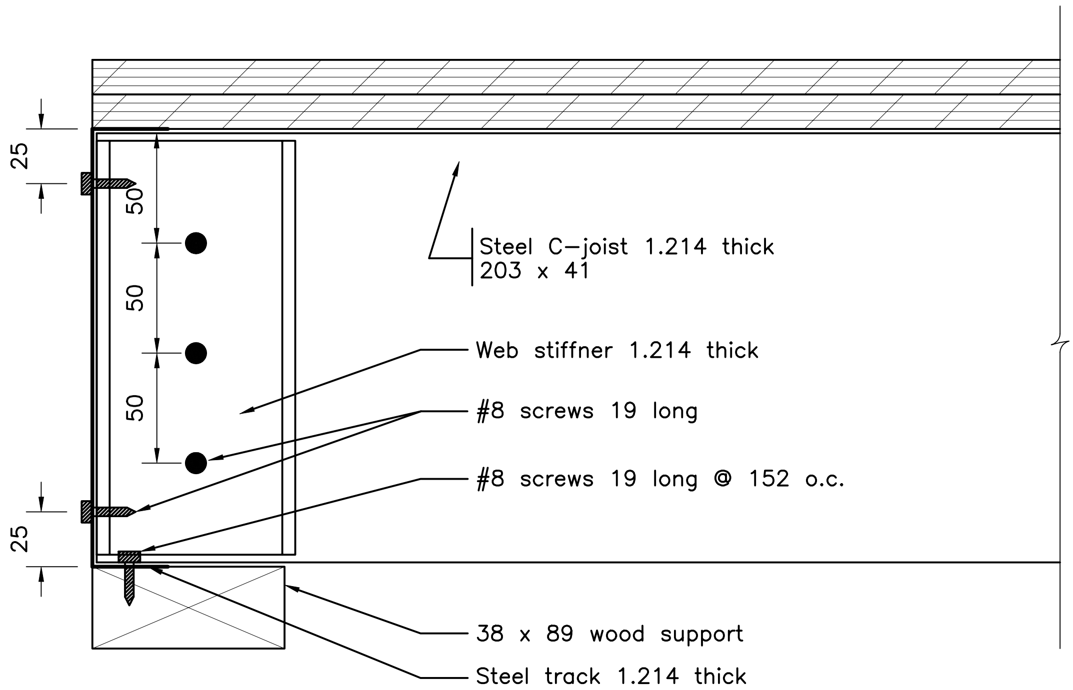
Figure D−19. Gypsum Board Single Layer Screw Pattern (Steel C−Joist)

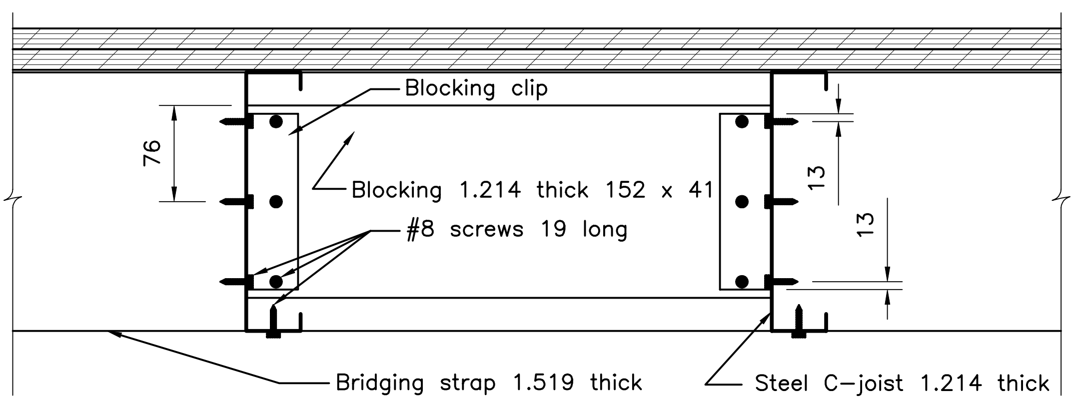


(Dimensions are in millimetres)

(Assembly No. FF–39)

Figure D–20. Joist Layout (Steel C–Joist)

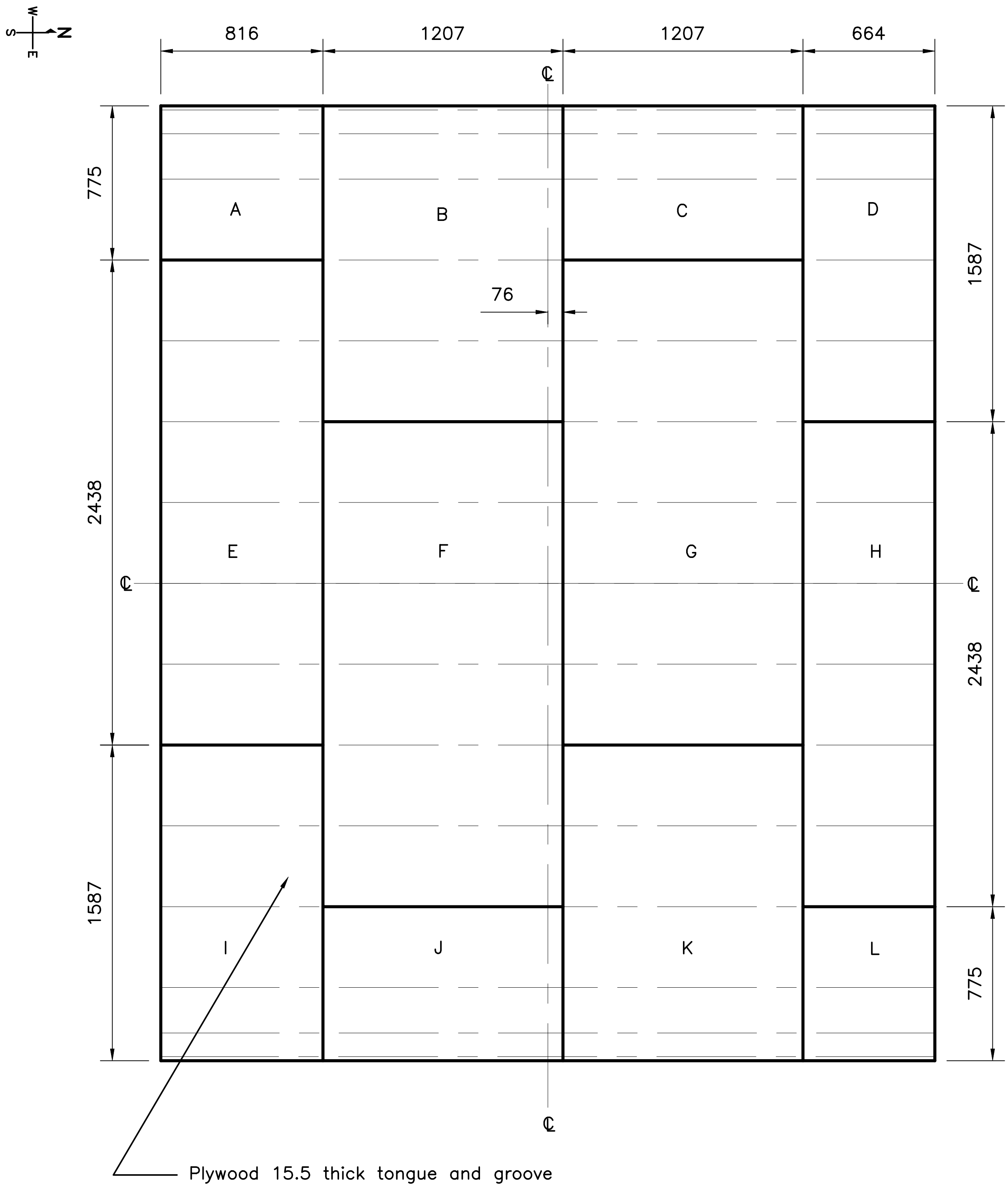




(Dimensions are in millimetres)

(Assembly No. FF–39)

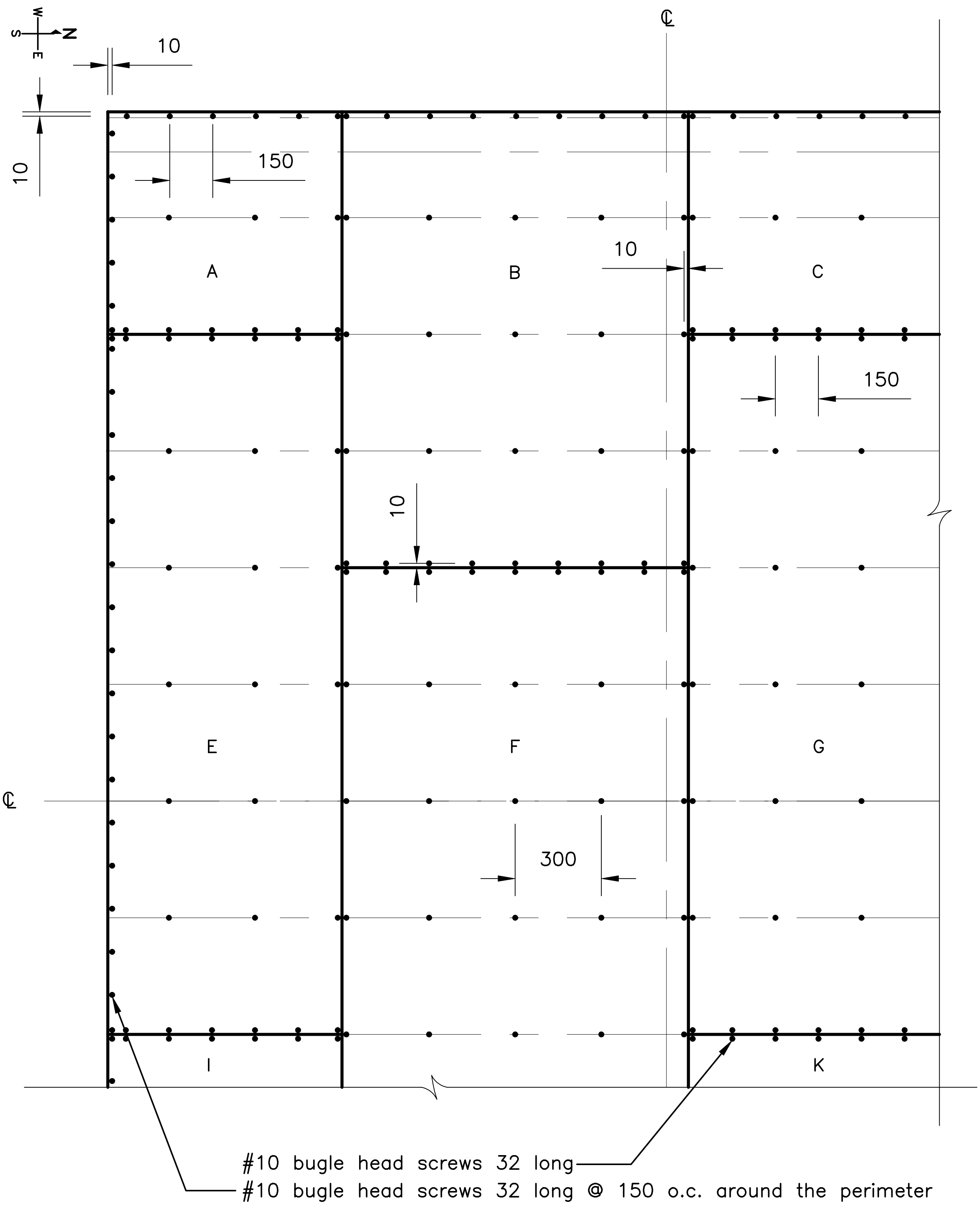
Figure D–21. Steel C–Joist End Connection and Blocking Detail (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–39)

Figure D–22. Subfloor Layout Base Layer (Steel C–Joist)

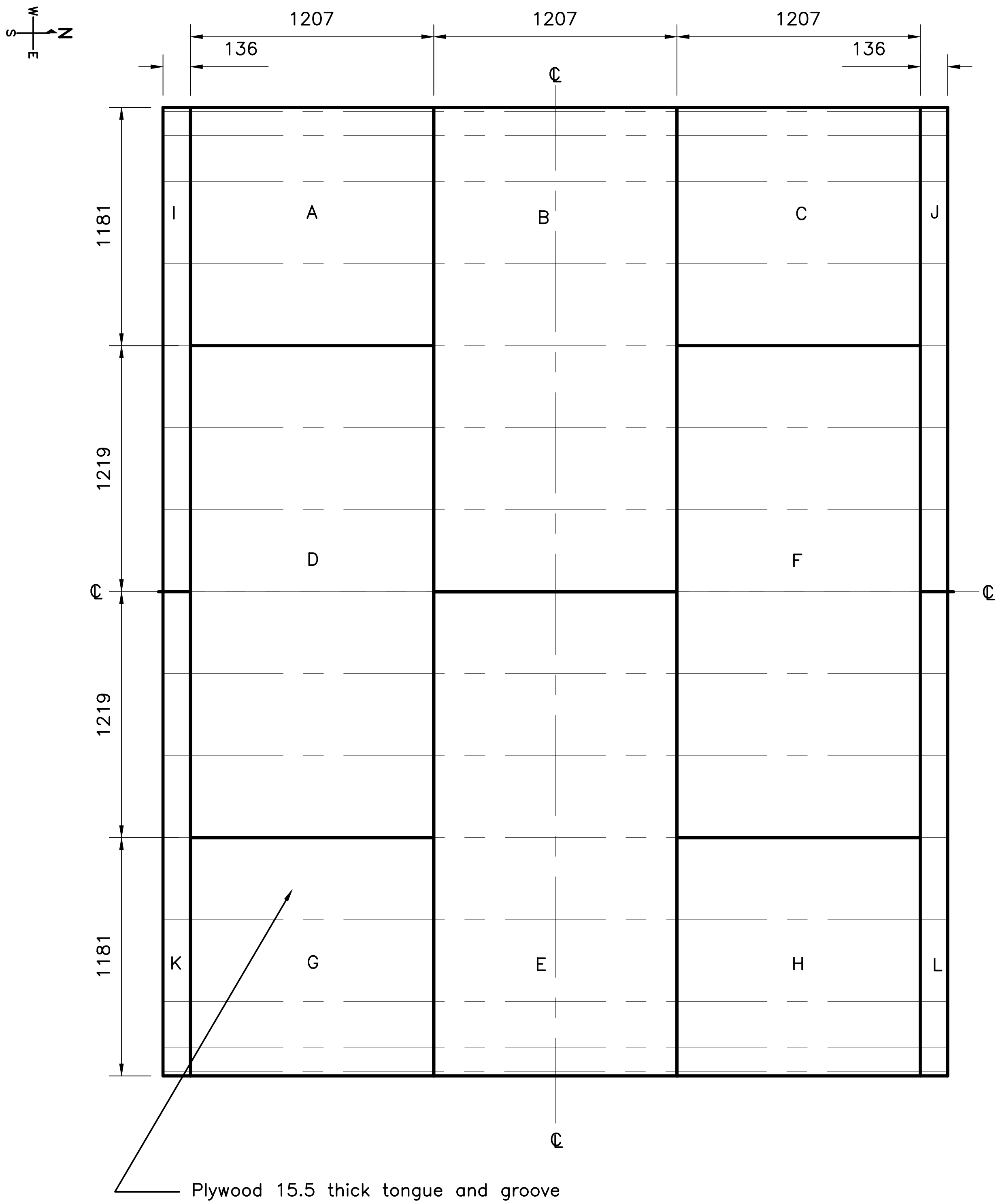


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF–39)

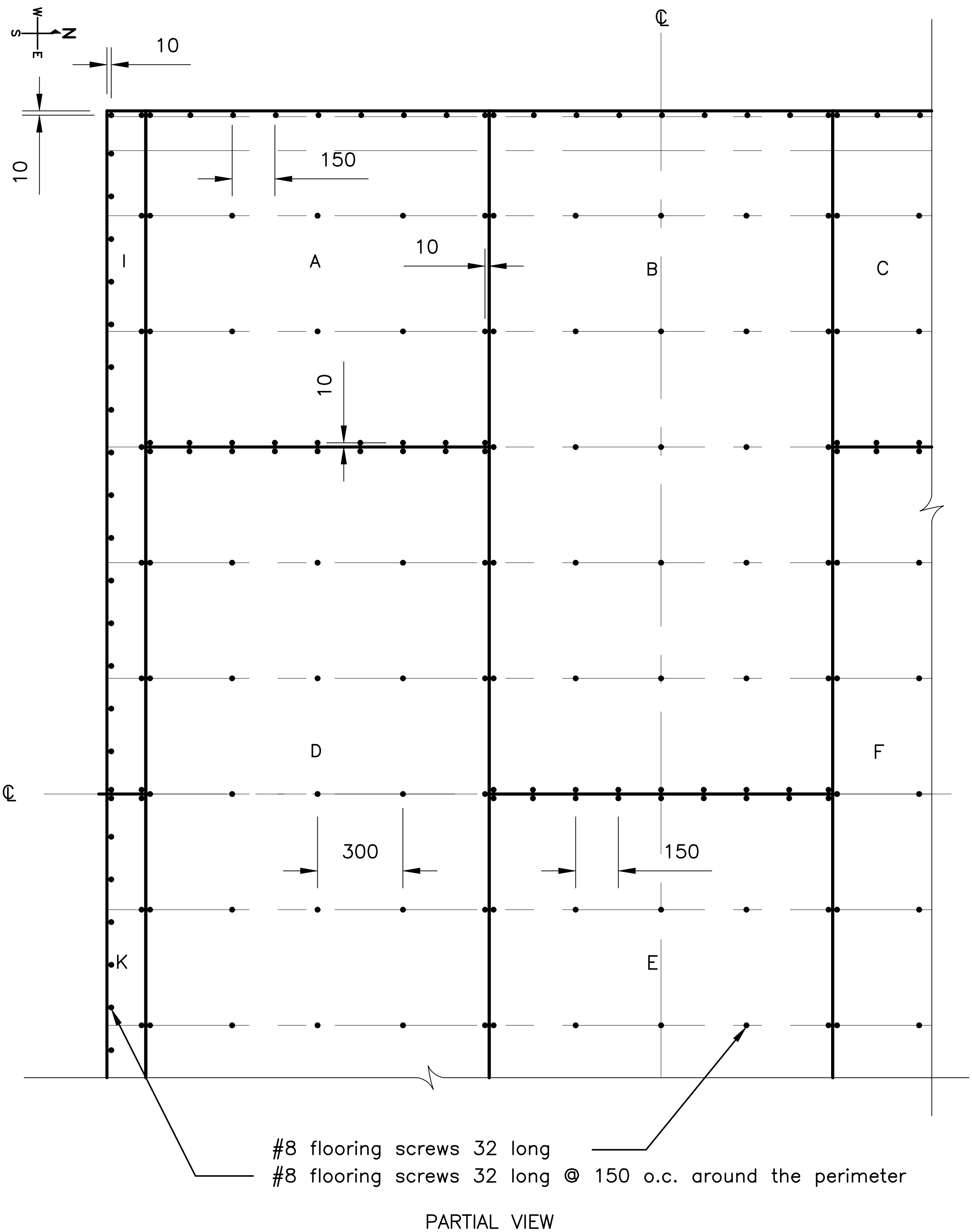
Figure D–23. Subfloor Screw Pattern Base Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–39)

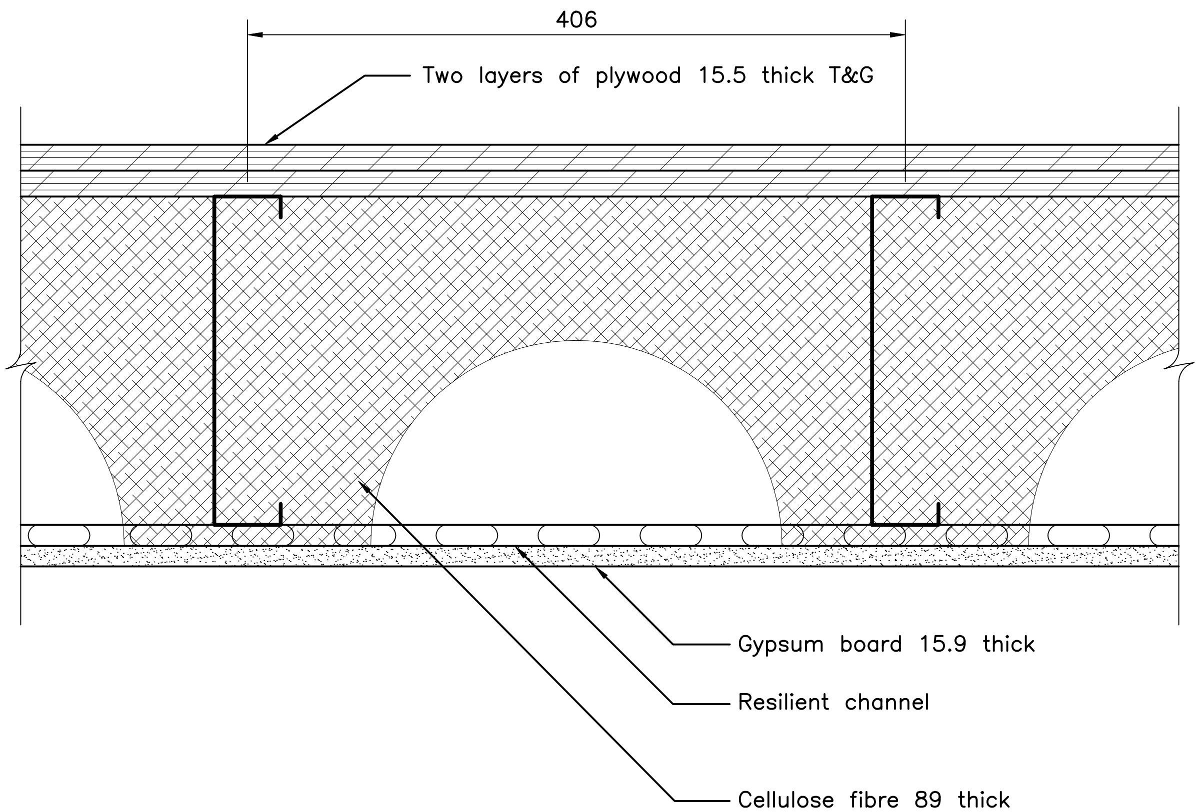
Figure D–24. Subfloor Layout Face Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-39)

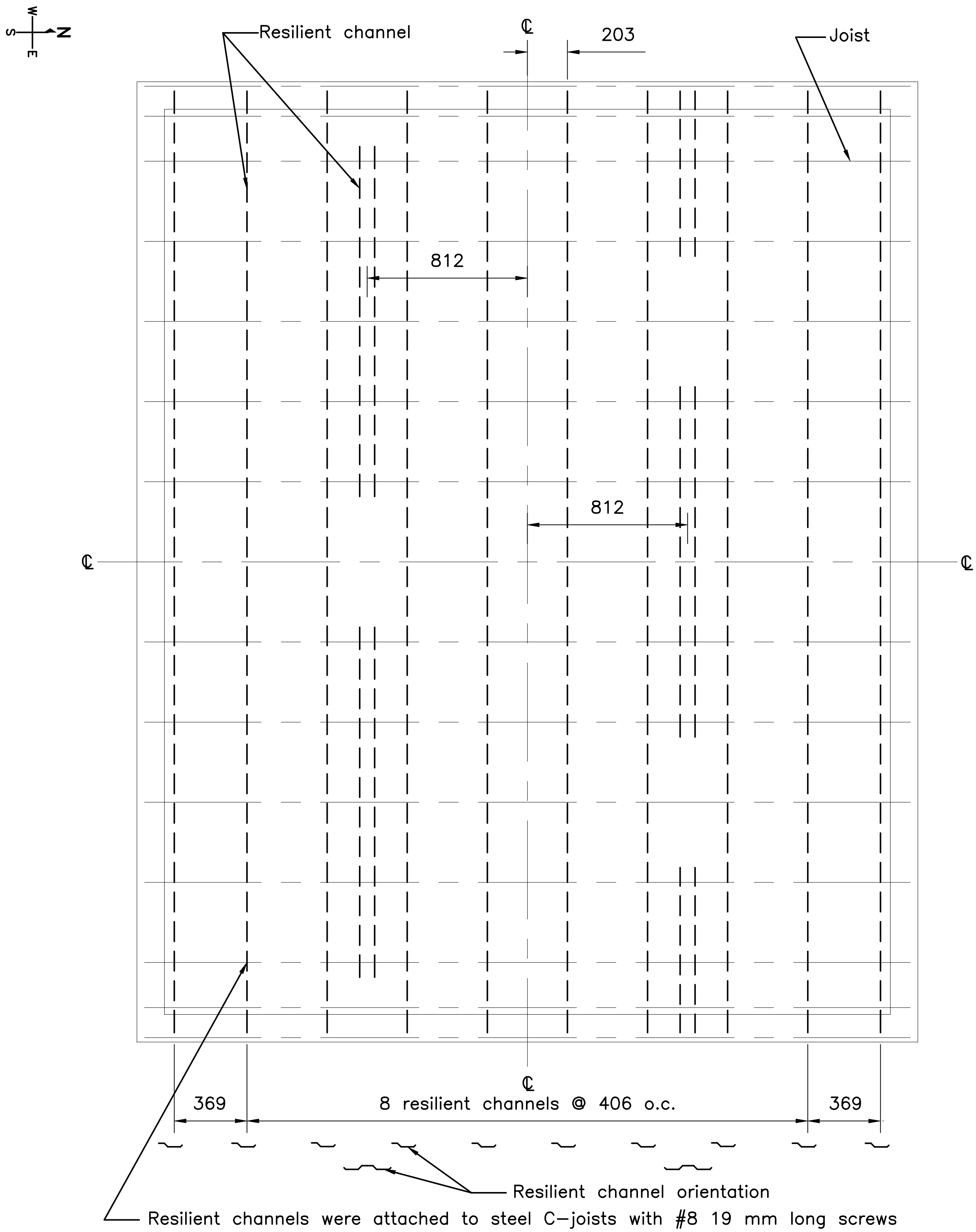
Figure D-25. Subfloor Screw Pattern Face Layer (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–39)

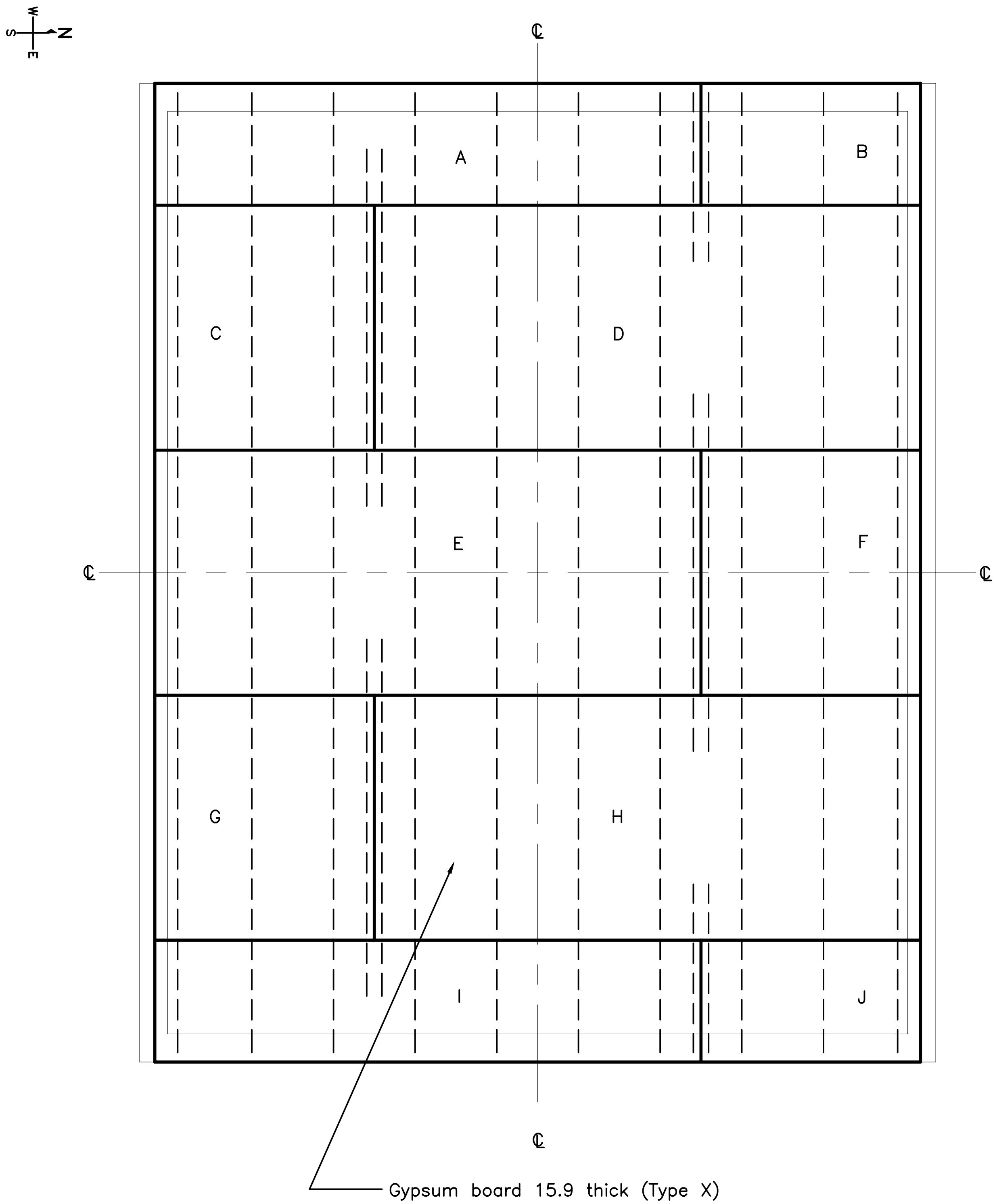
Figure D–26. Insulation Location (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–39)

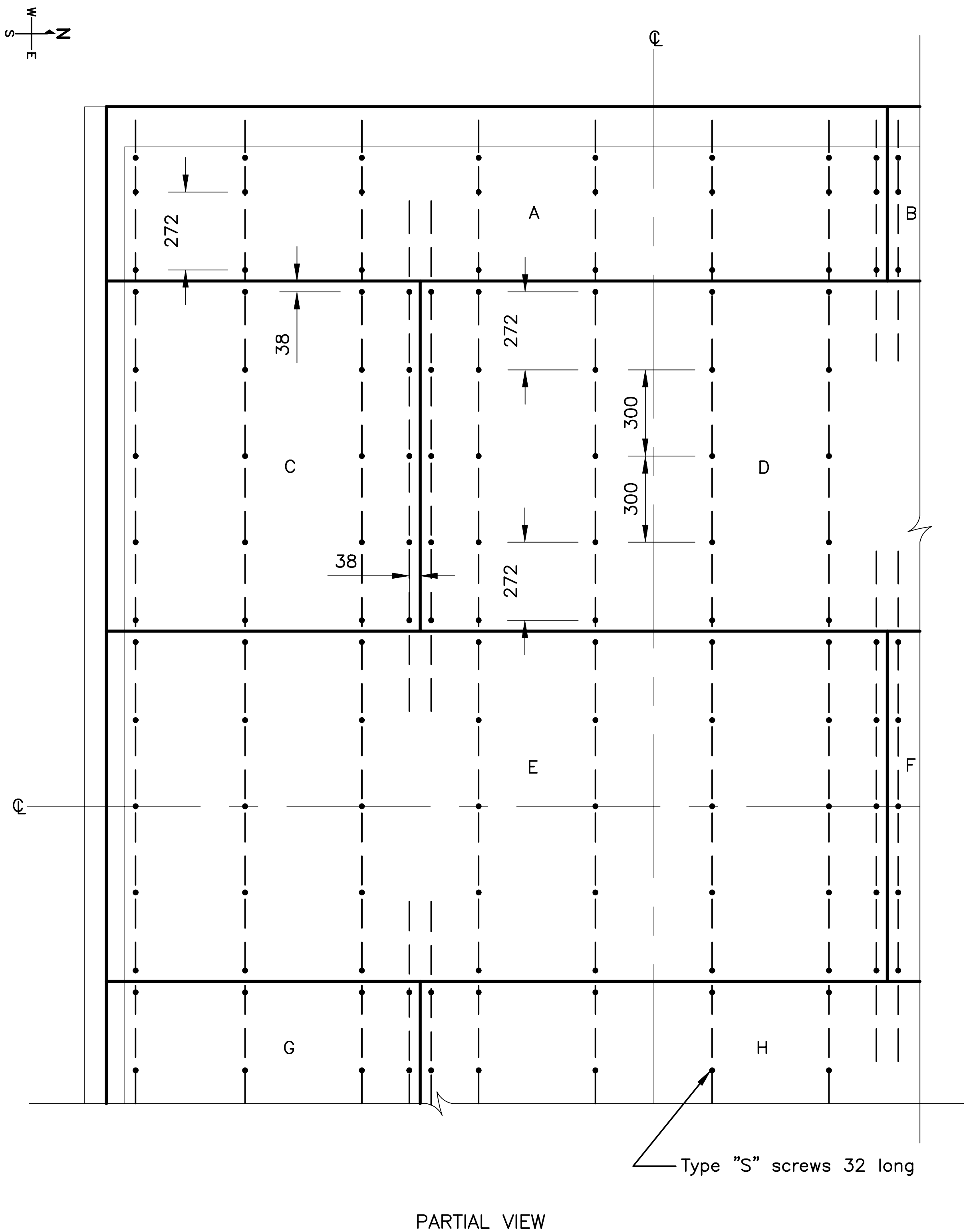
Figure D–27. Resilient Channel Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF−39)

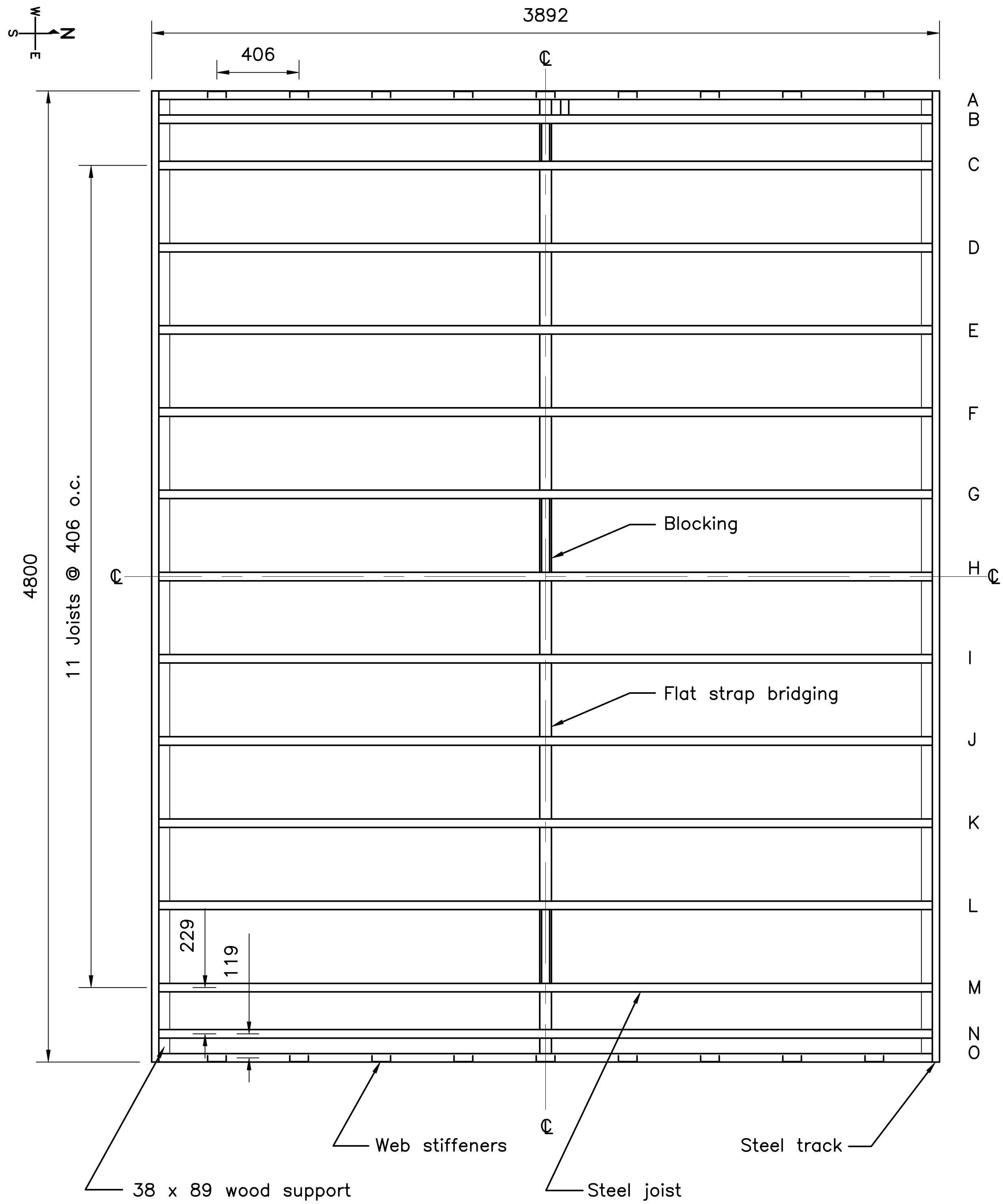
Figure D−28. Gypsum Board Single Layer Layout (Steel C−Joist)



(Dimensions are in millimetres)

(Assembly No. FF–39)

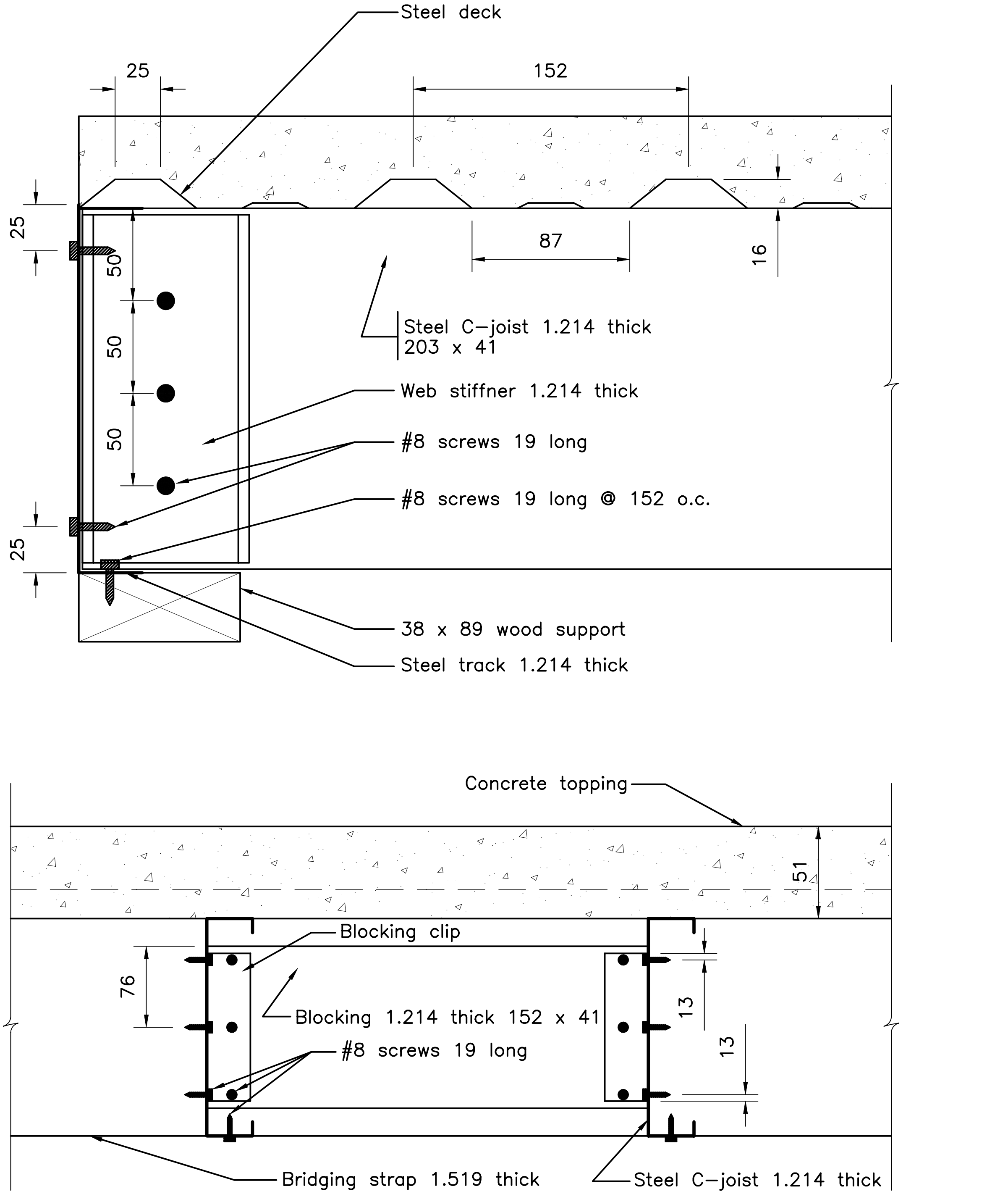
Figure D–29. Gypsum Board Single Layer Screw Pattern (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-40)

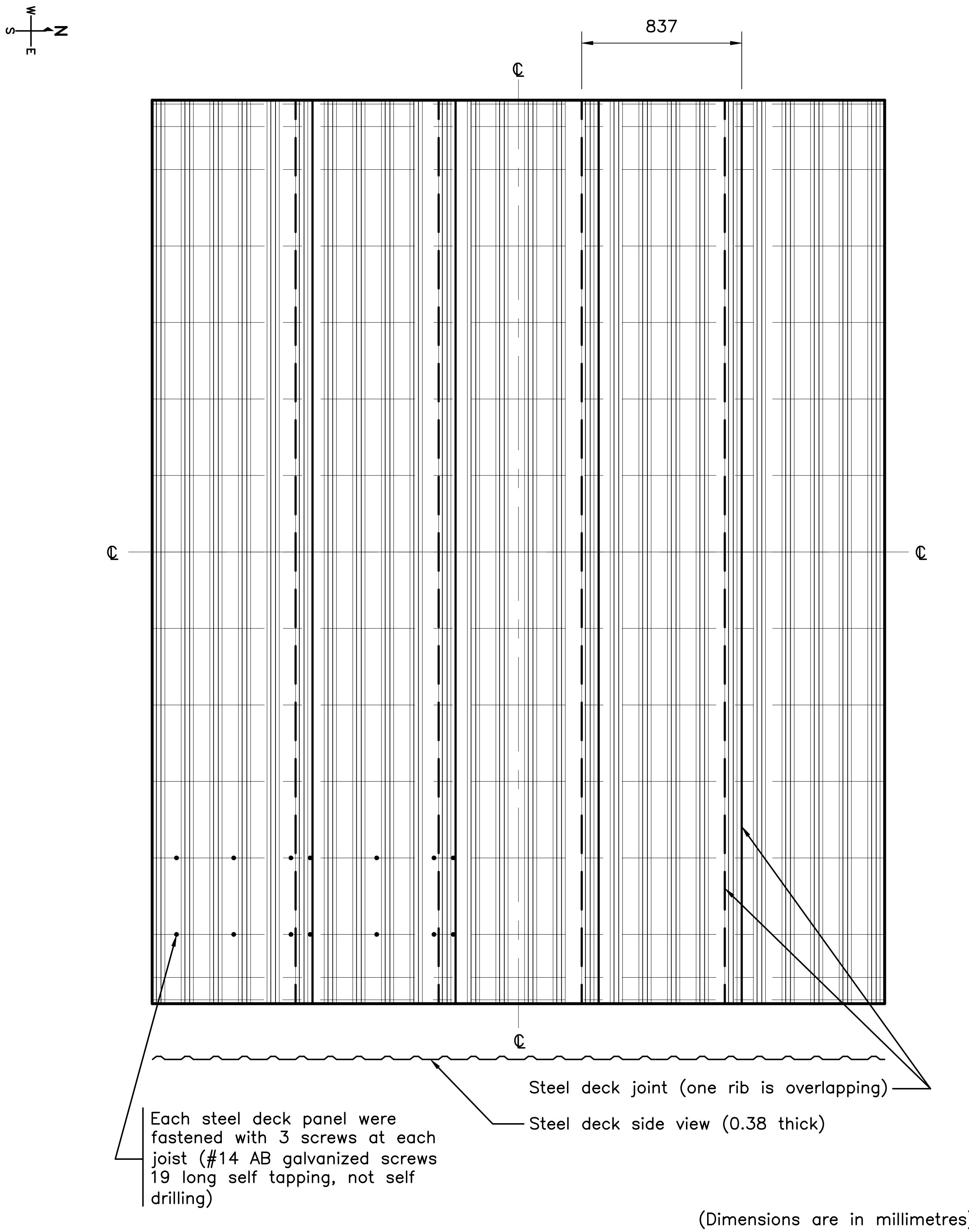
Figure D-30. Joist Layout (Steel C-Joist)



(Dimensions are in millimetres)

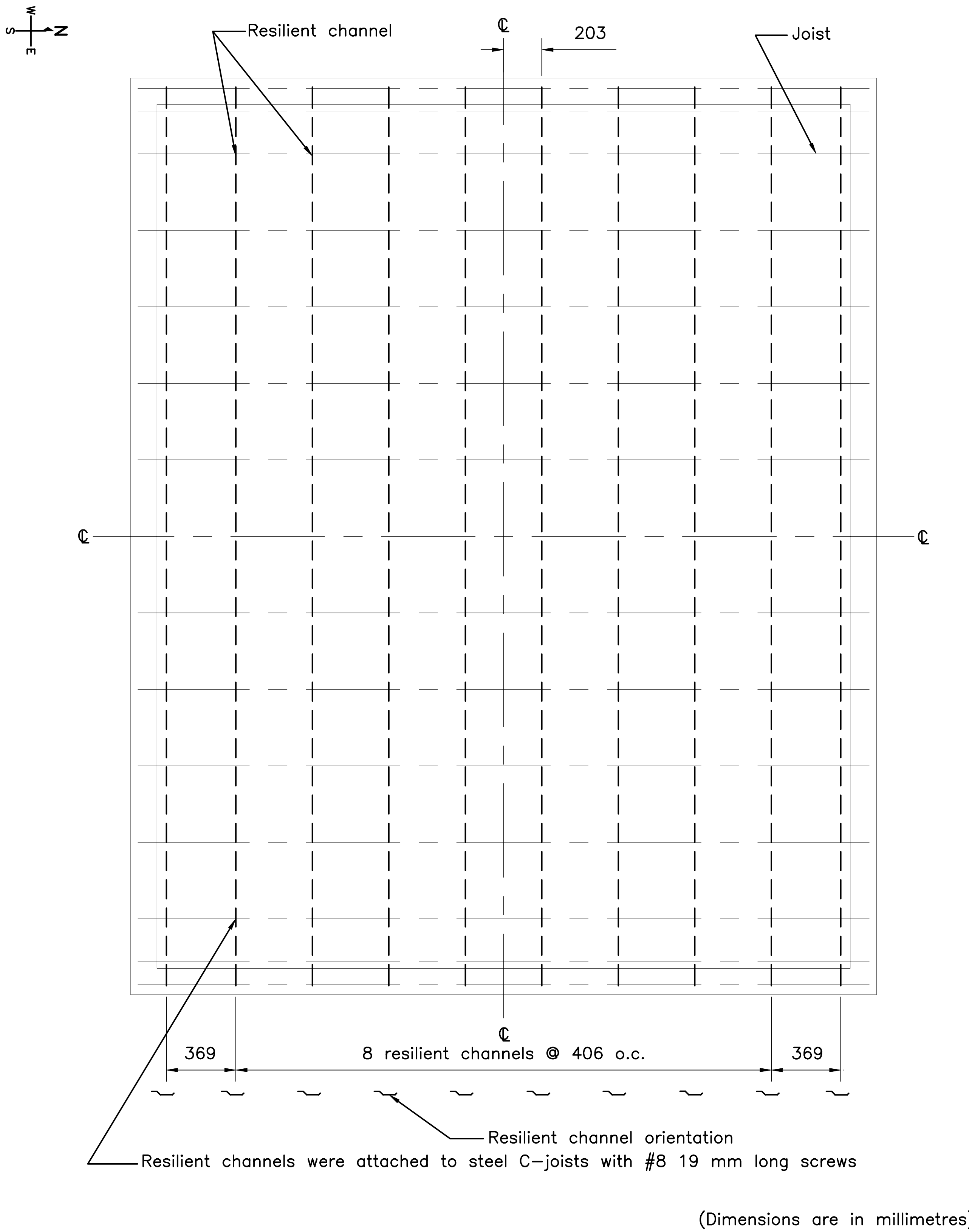
(Assembly No. FF–40)

Figure D–31. Steel C–Joist End Connection, Concrete slab and Blocking Details (Steel C–Joist)



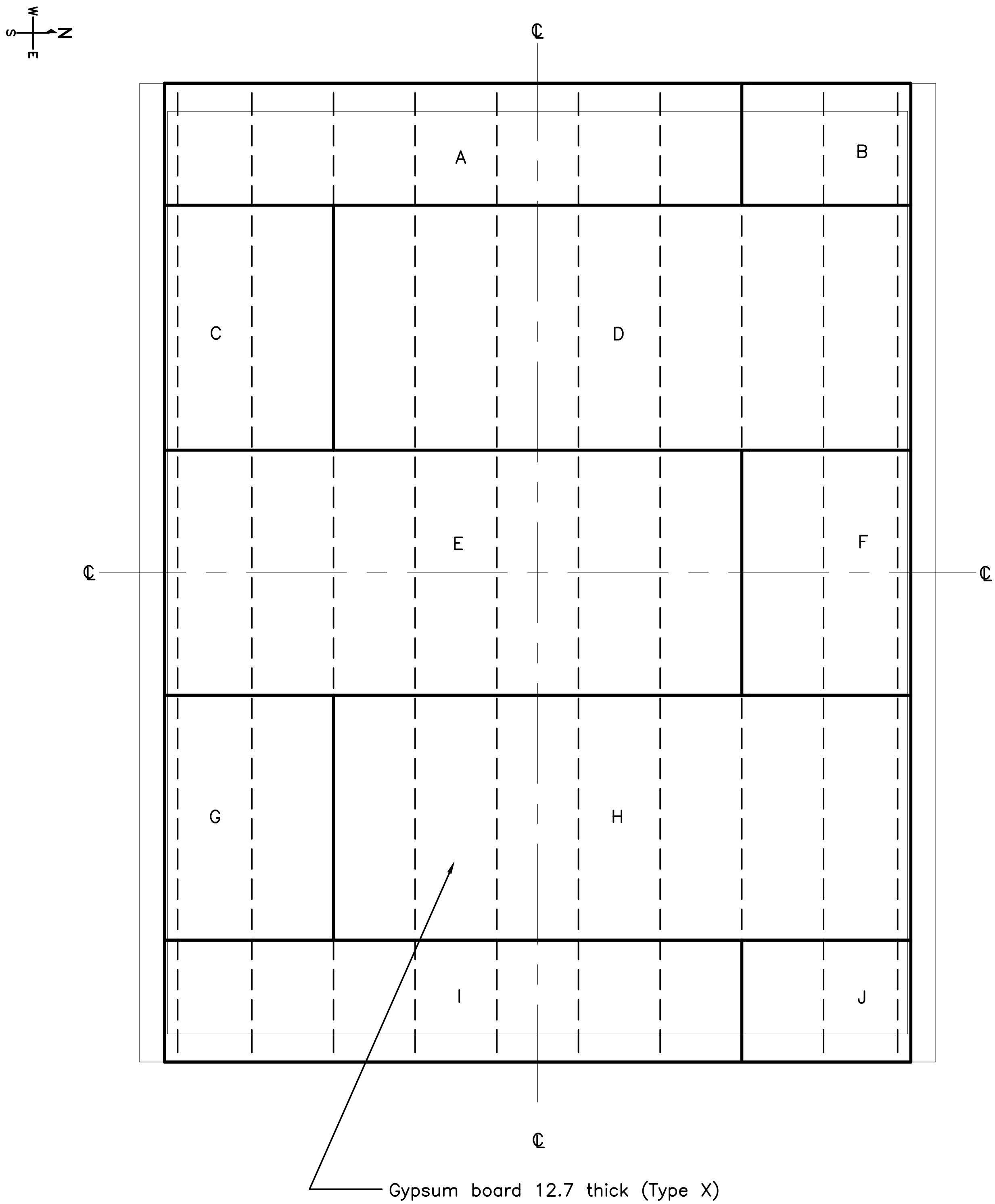
(Assembly No. FF-40)

Figure D-32. Steel Deck Layout (Steel C-Joist)



(Assembly No. FF–40)

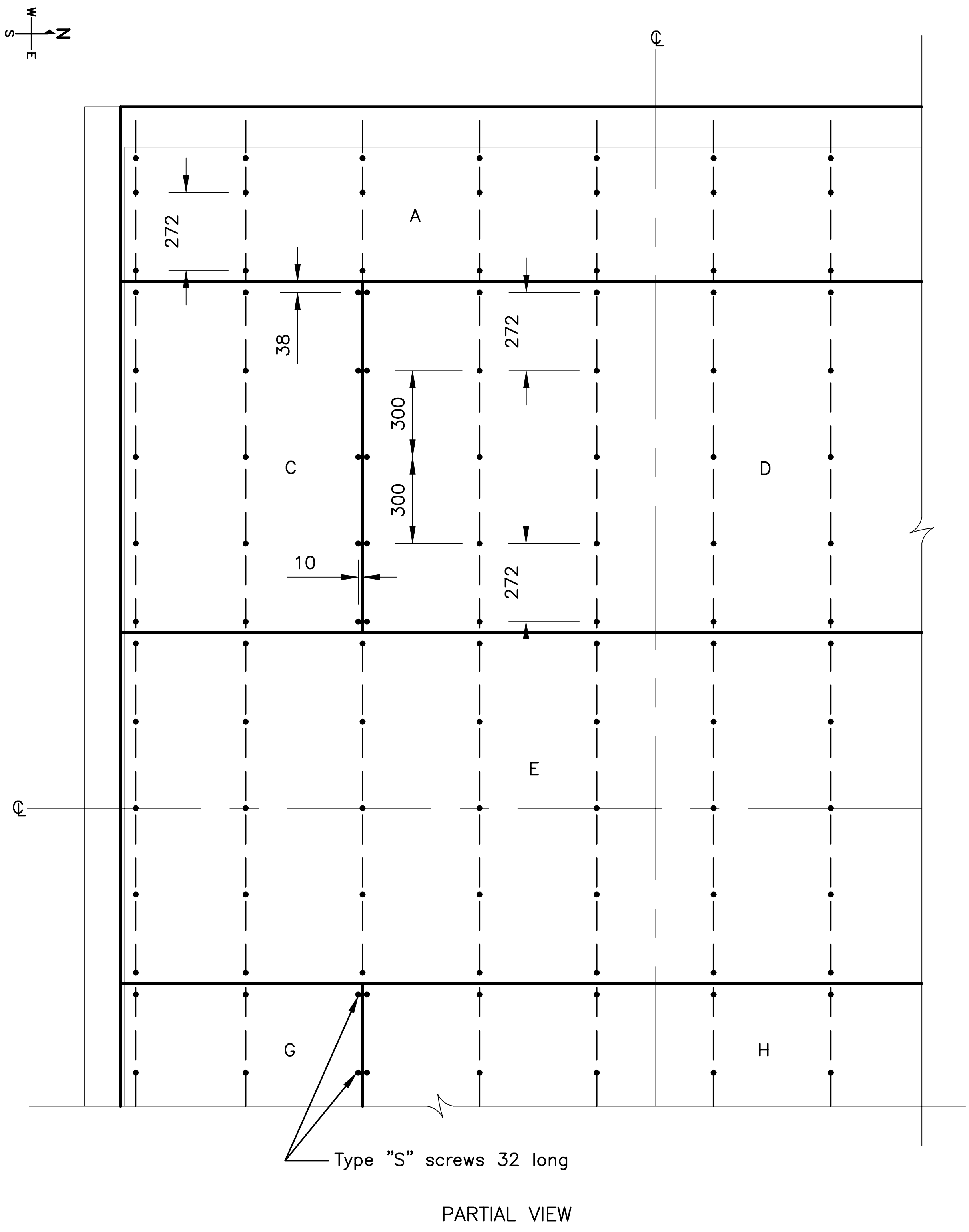
Figure D–33. Resilient Channel Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–40)

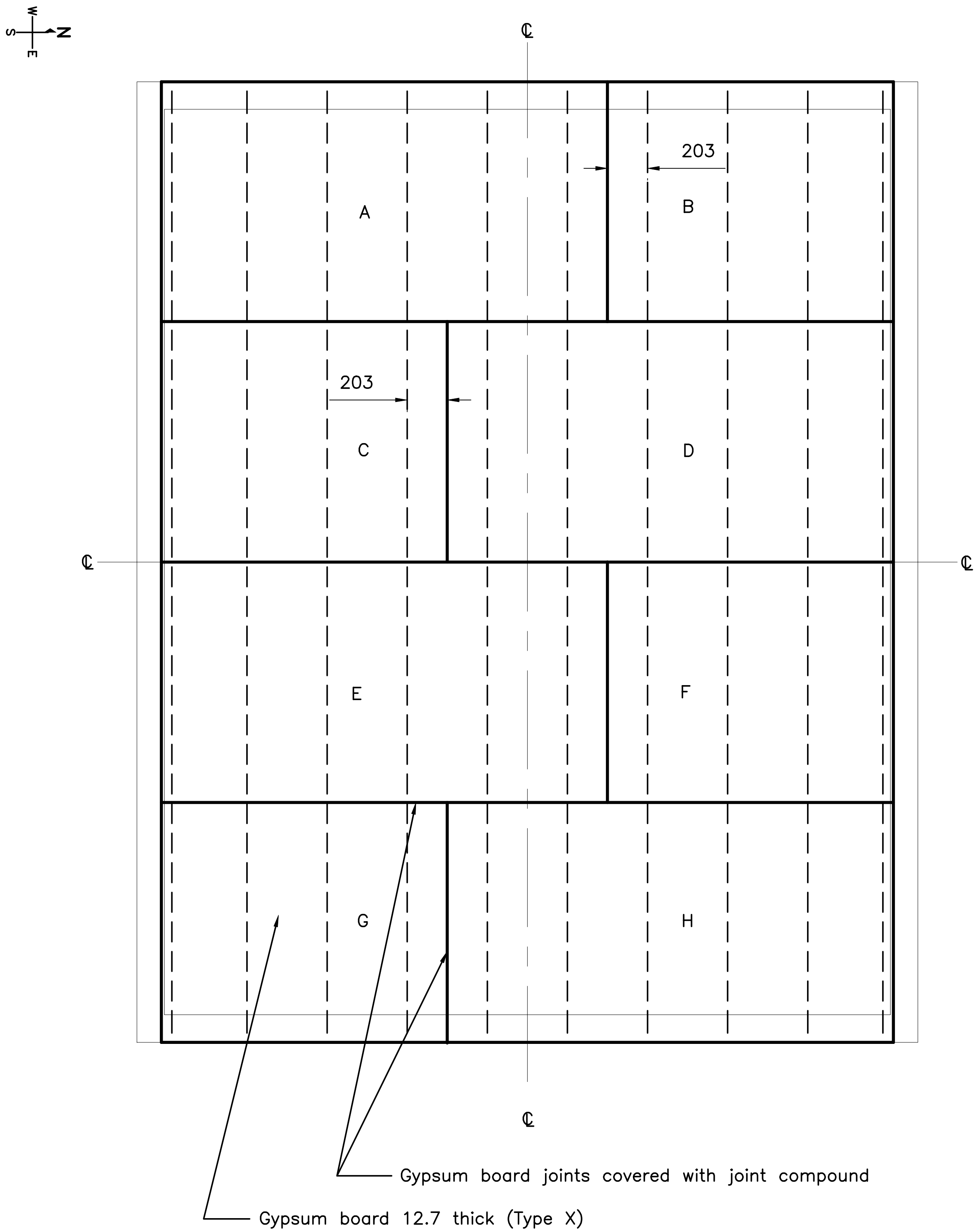
Figure D–34. Gypsum Board Base Layer Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF—40)

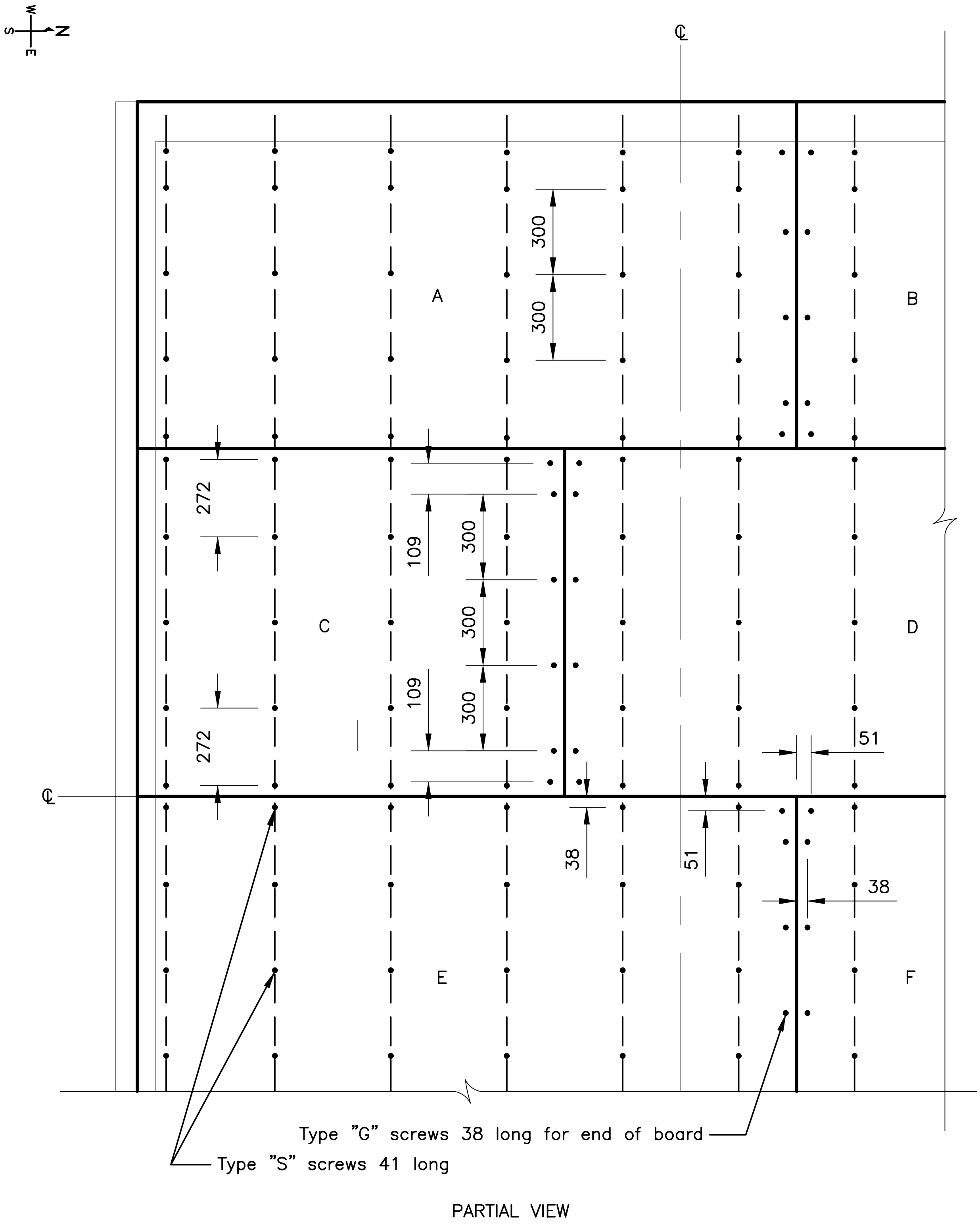
Figure D—35. Gypsum Board Base Layer Screw Pattern (Steel C—Joist)



(Dimensions are in millimetres)

(Assembly No. FF–40)

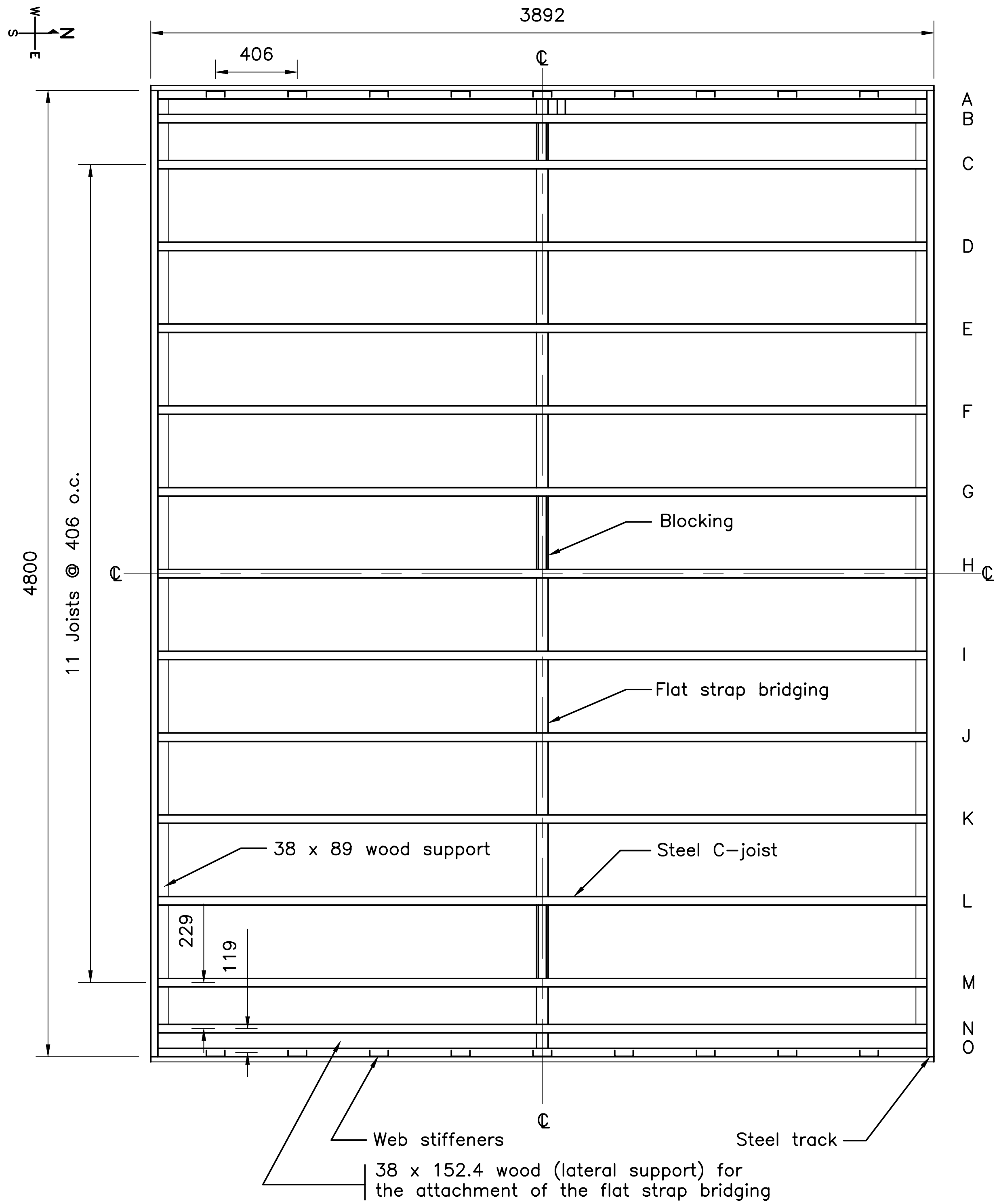
Figure D–36. Gypsum Board Face Layer Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–40)

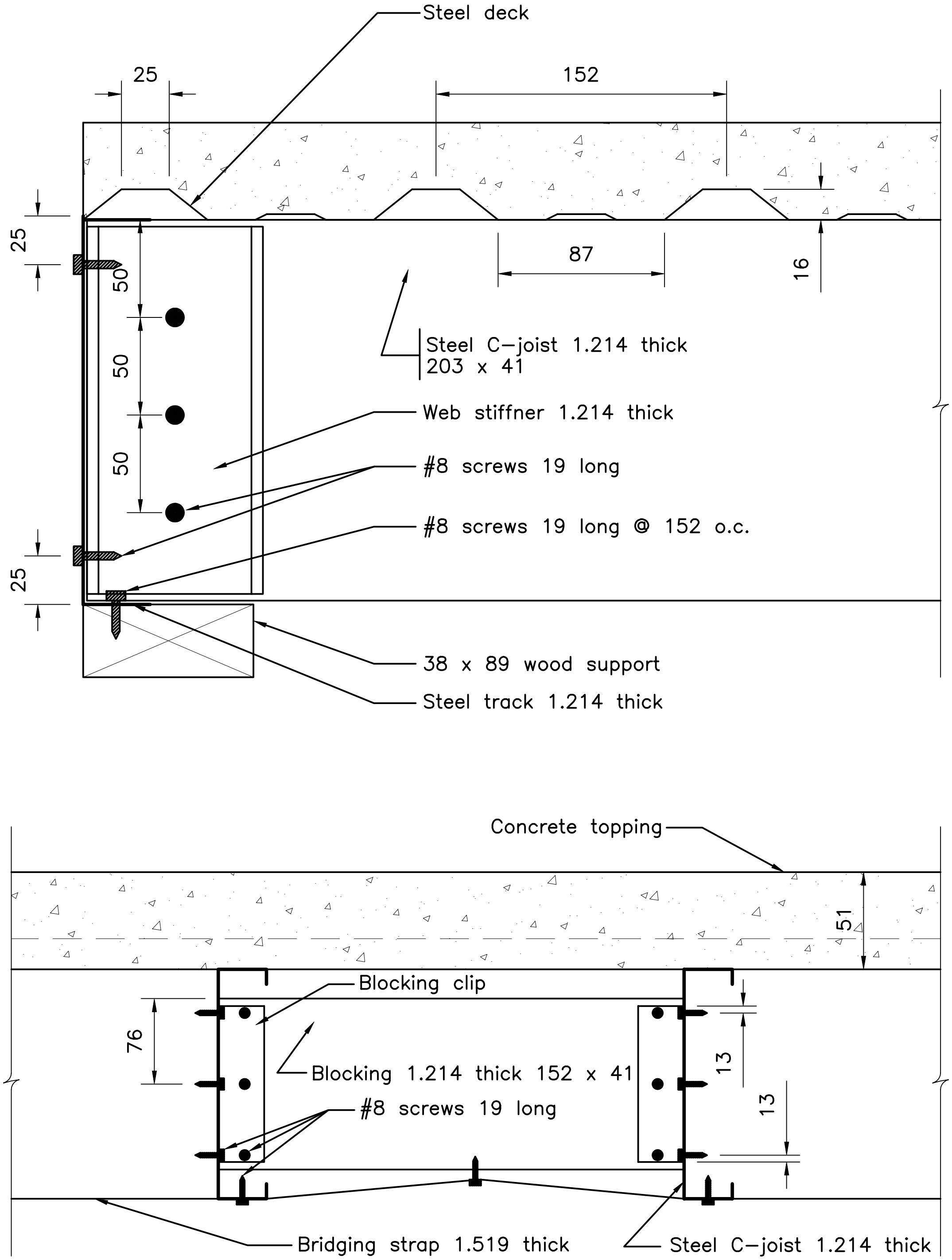
Figure D–37. Gypsum Board Face Layer Screw Pattern (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–43)

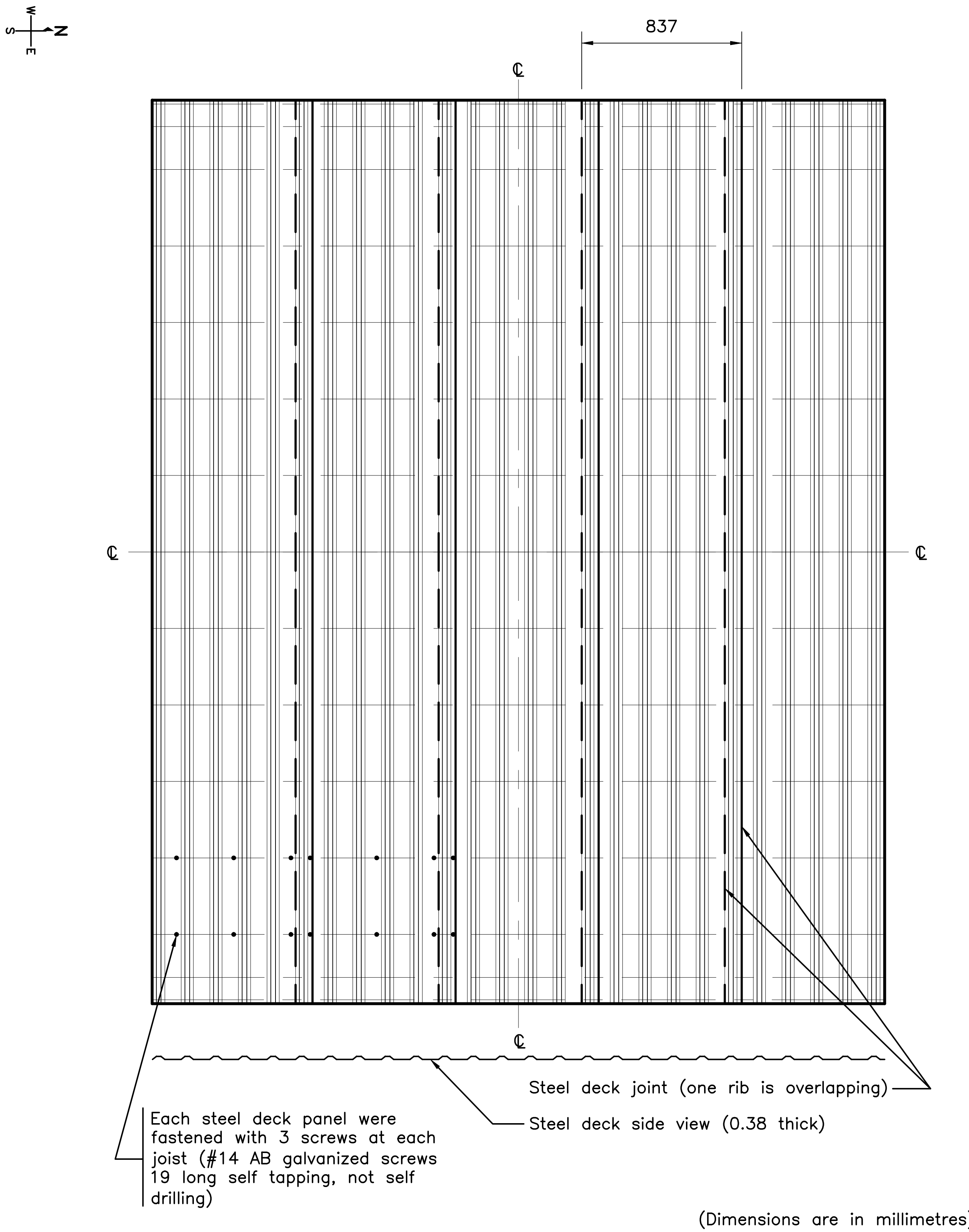
Figure D–38. Joist Layout (Steel C–Joist)



(Dimensions are in millimetres)

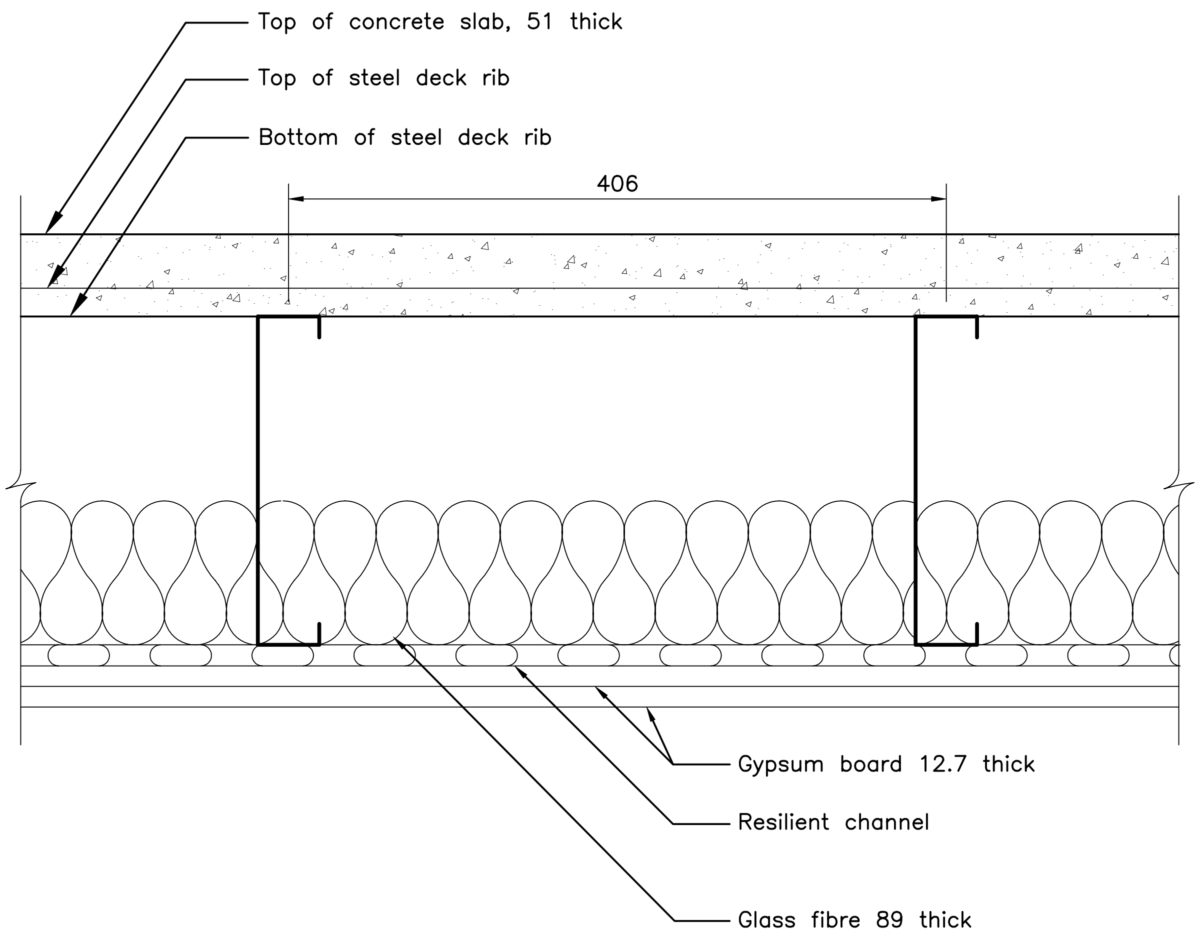
(Assembly No. FF–43)

Figure D–39. Steel C–Joist End Connection, Concrete Slab and Blocking Details (Steel C–Joist)



(Assembly No. FF-43)

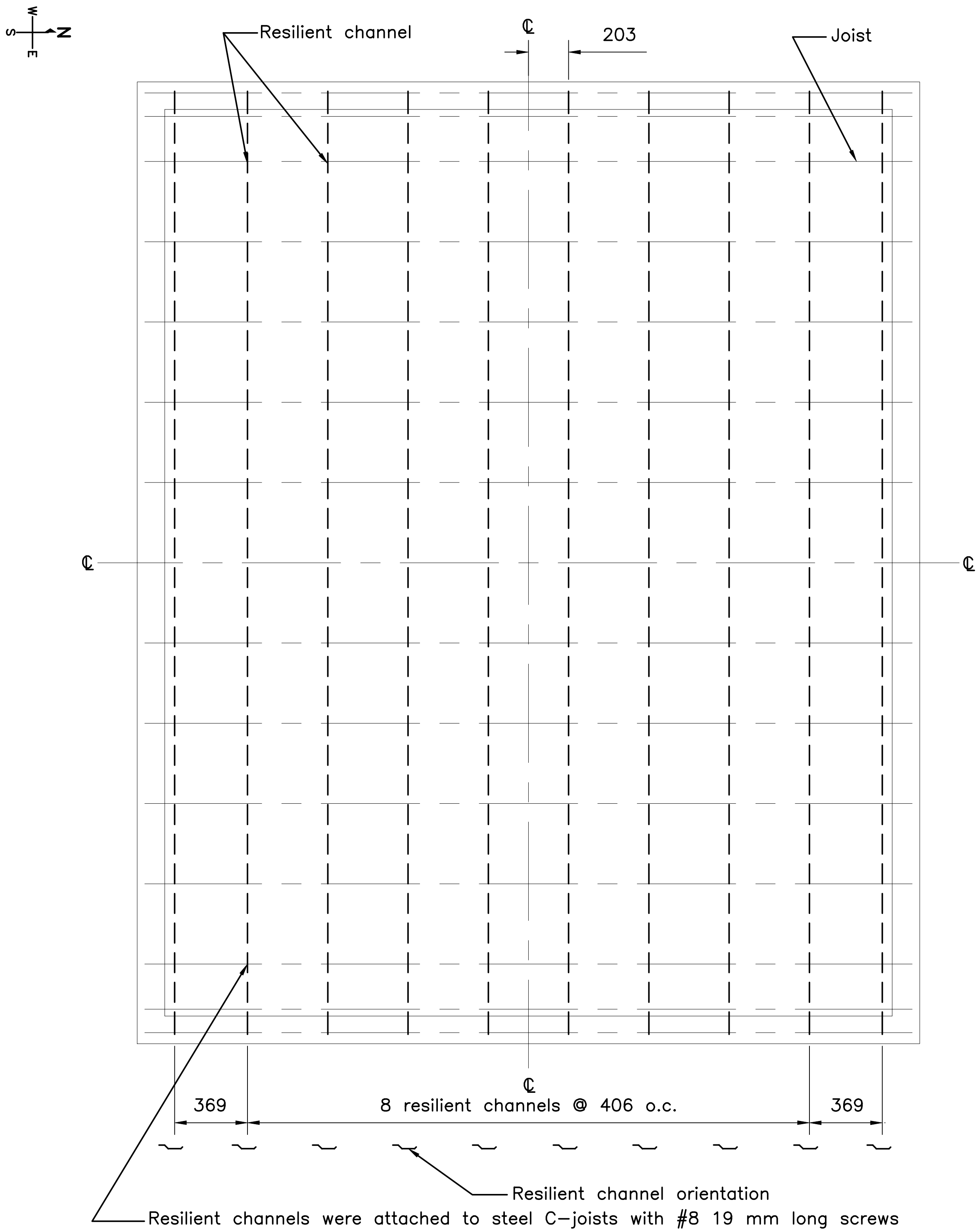
Figure D-40. Steel Deck Layout (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF-43)

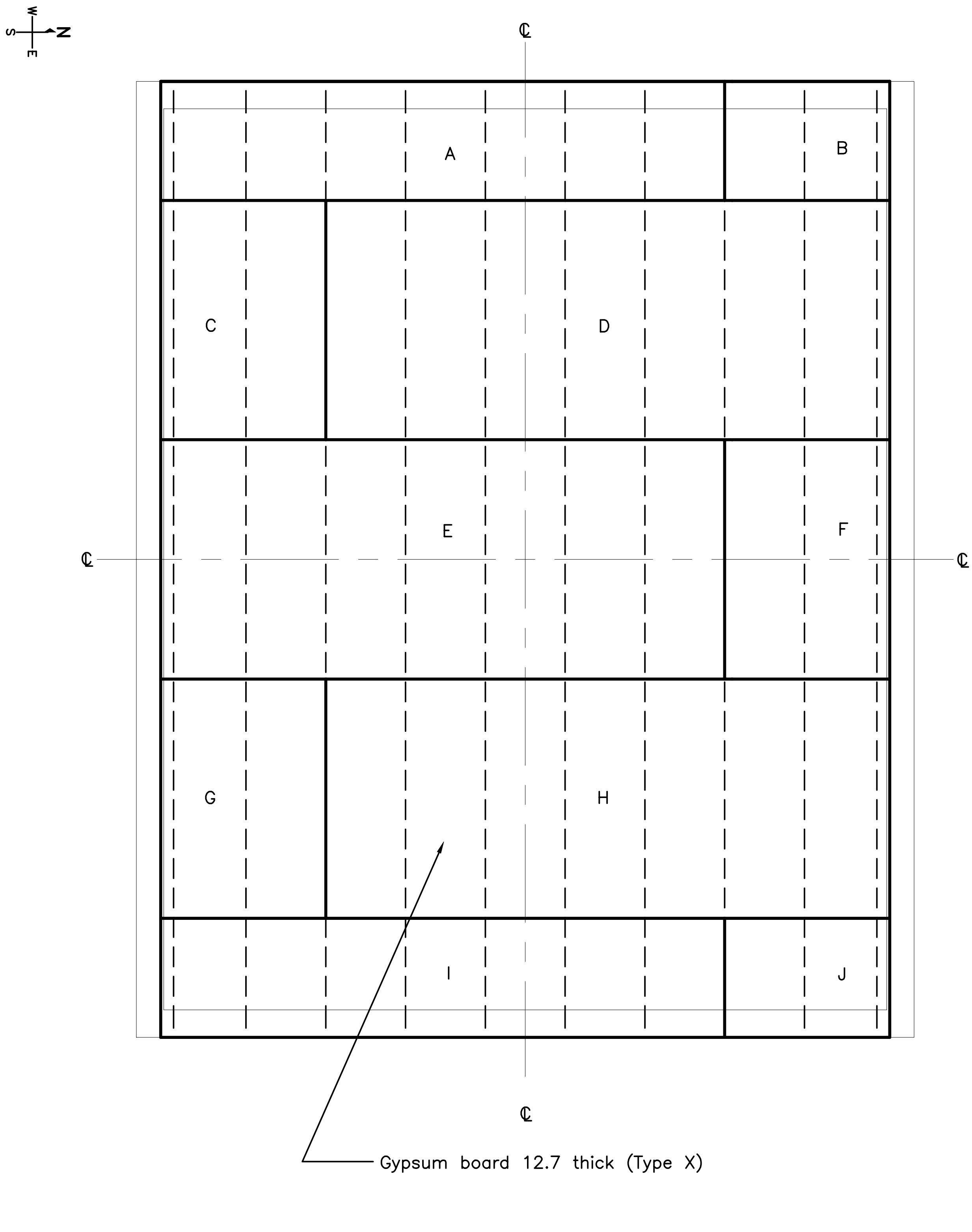
Figure D-41. Insulation Location (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–43)

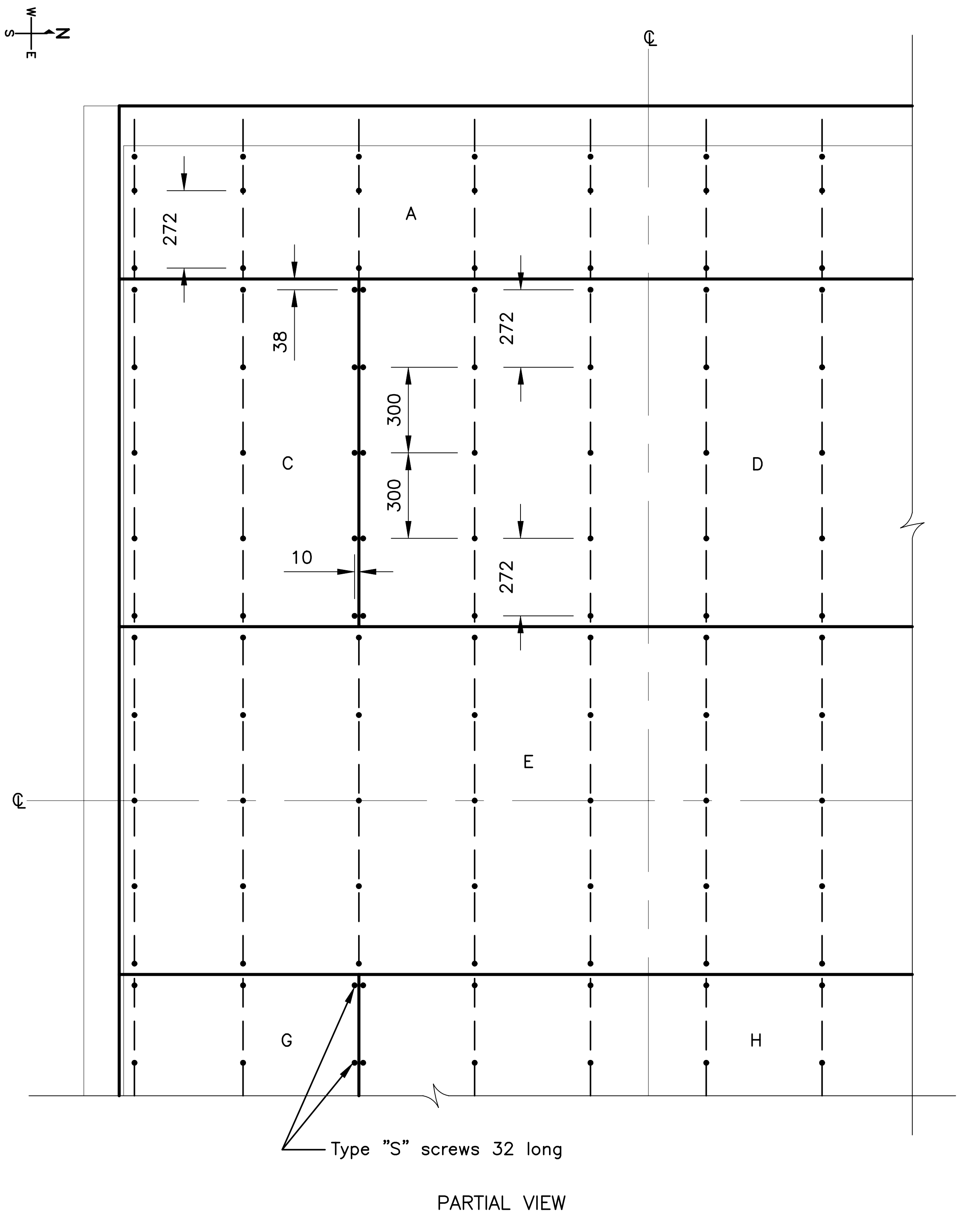
Figure D–42. Resilient Channel Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–43)

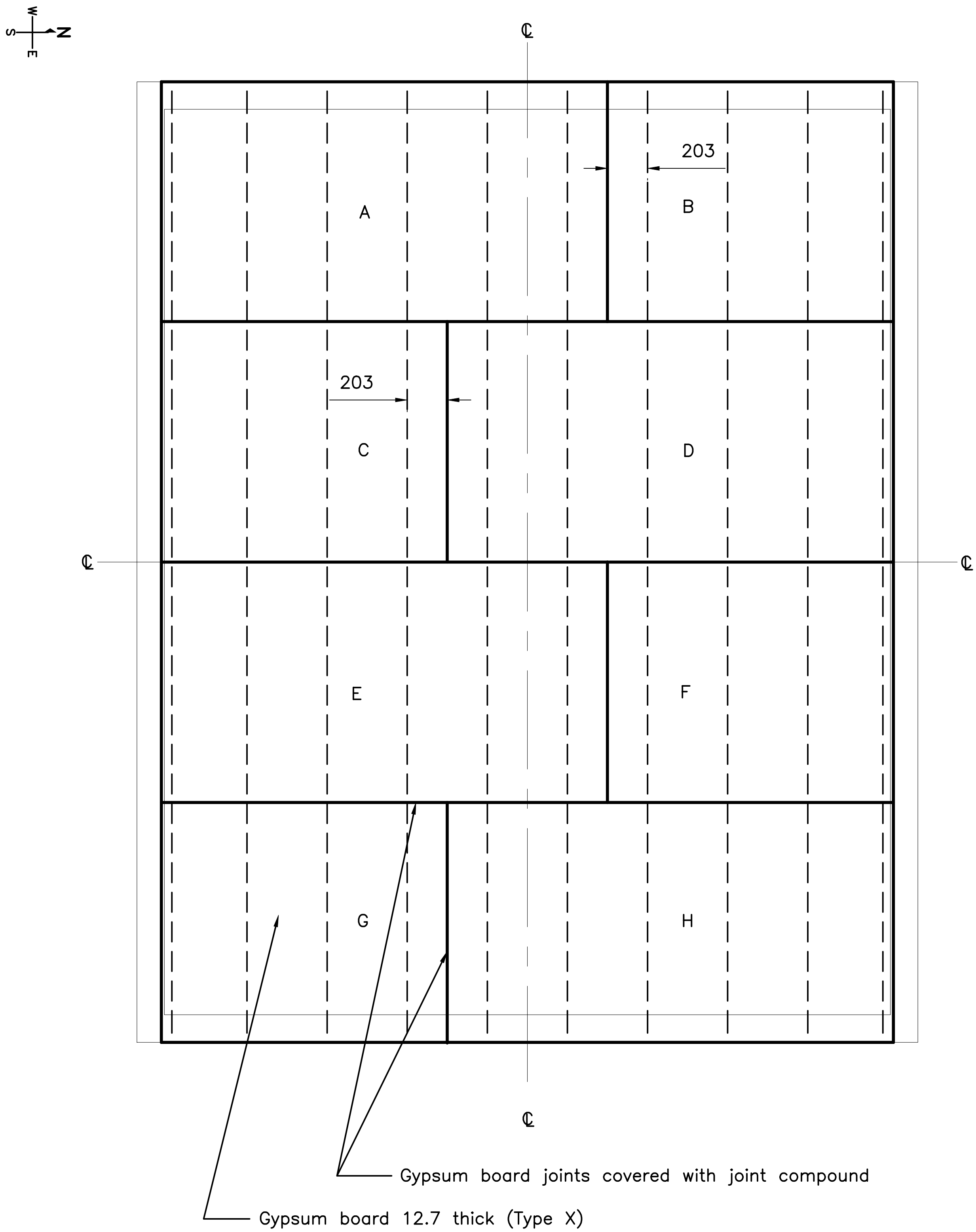
Figure D–43. Gypsum Board Base Layer Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-43)

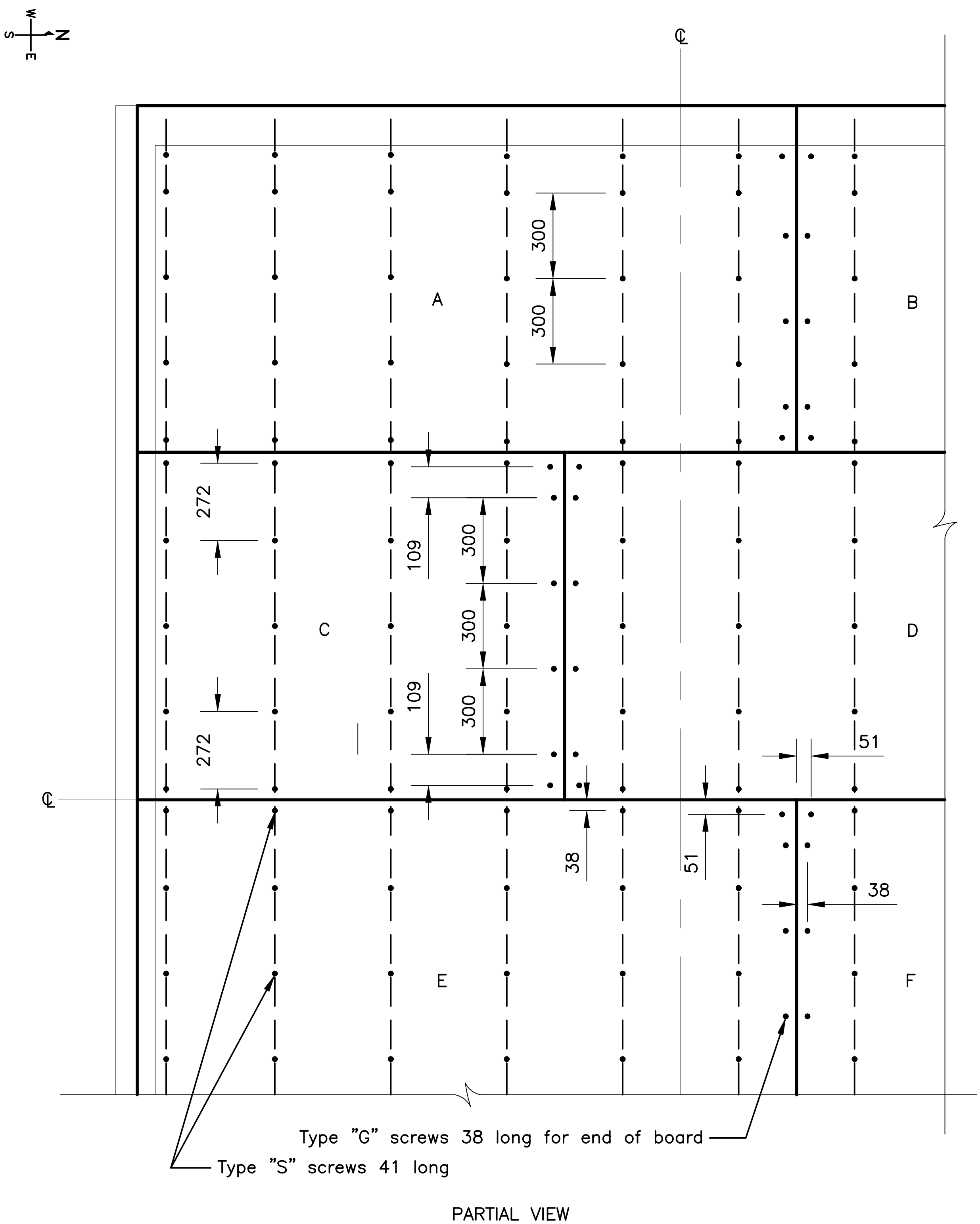
Figure D-44. Gypsum Board Base Layer Screw Pattern (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–43)

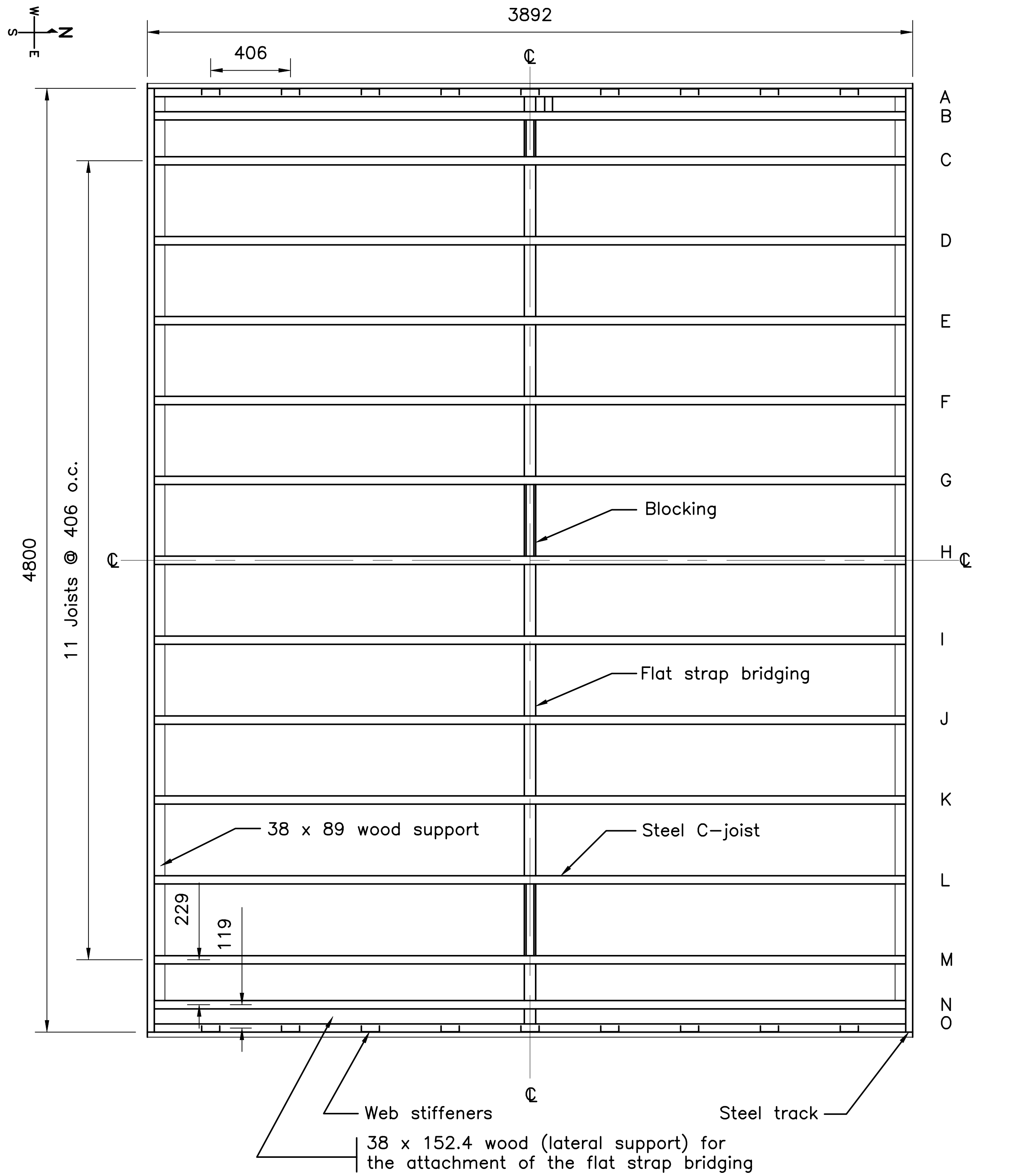
Figure D–45. Gypsum Board Face Layer Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–43)

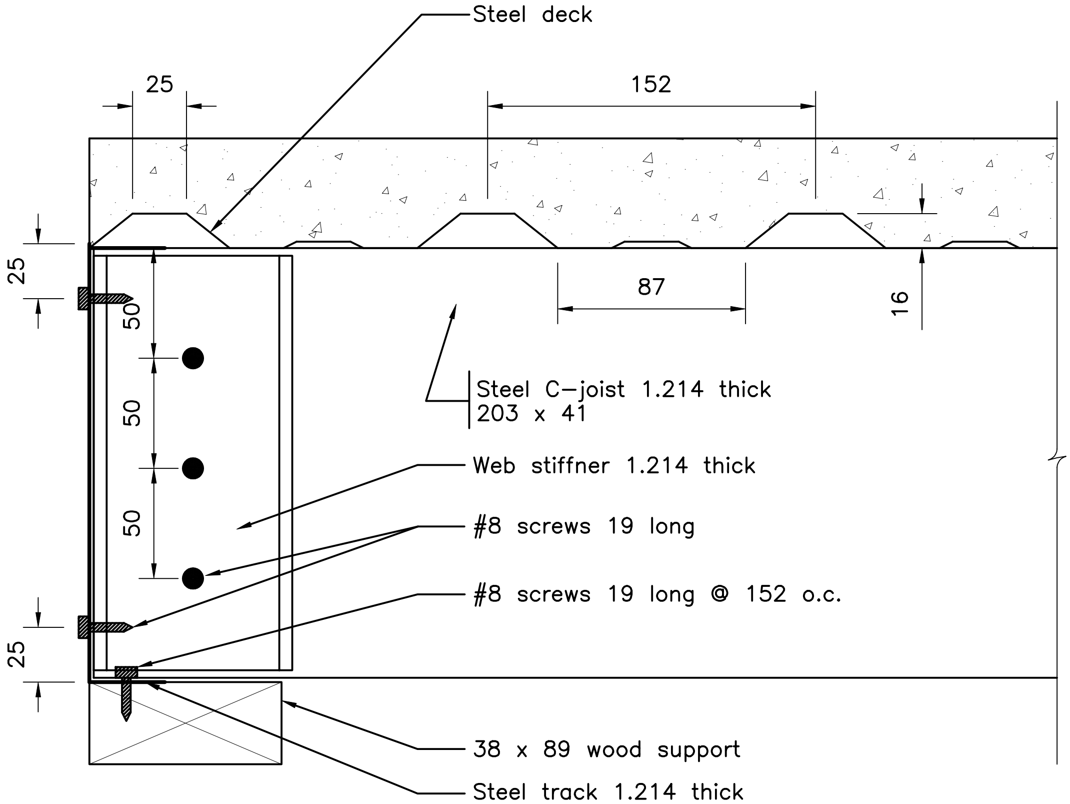
Figure D–46. Gypsum Board Face Layer Screw Pattern (Steel C–Joist)

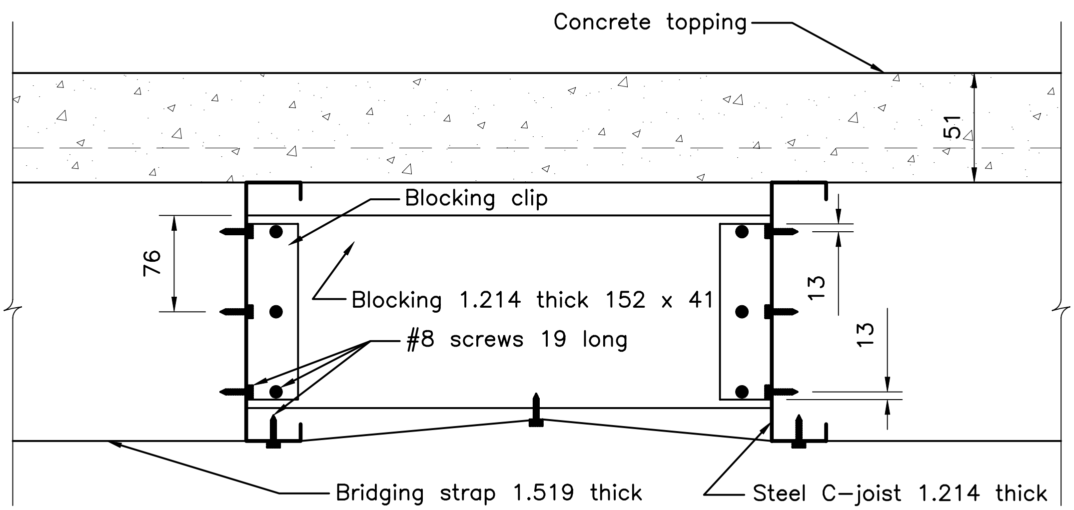


(Dimensions are in millimetres)

(Assembly No. FF–44)

Figure D–47. Joist Layout (Steel C–Joist)

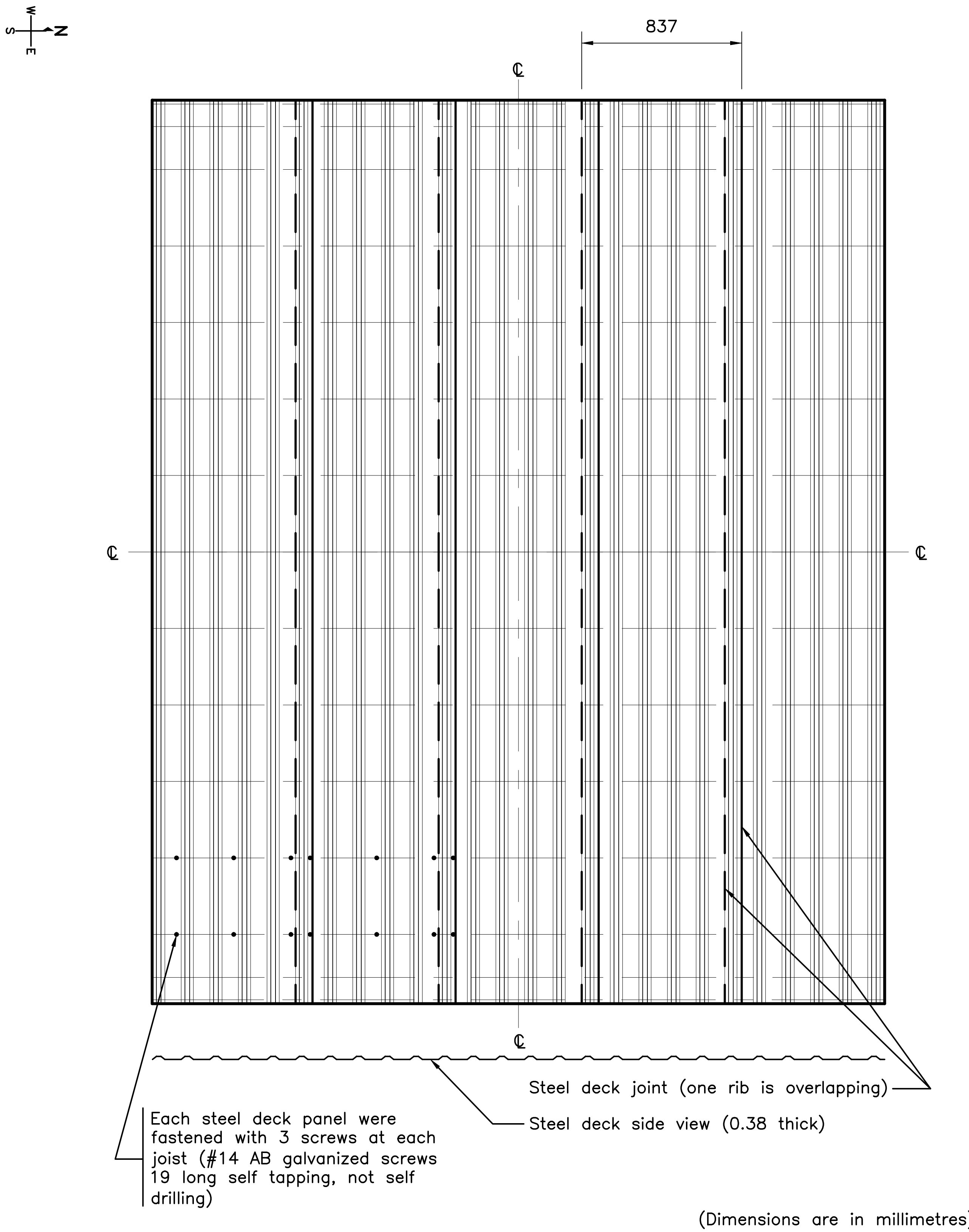




(Dimensions are in millimetres)

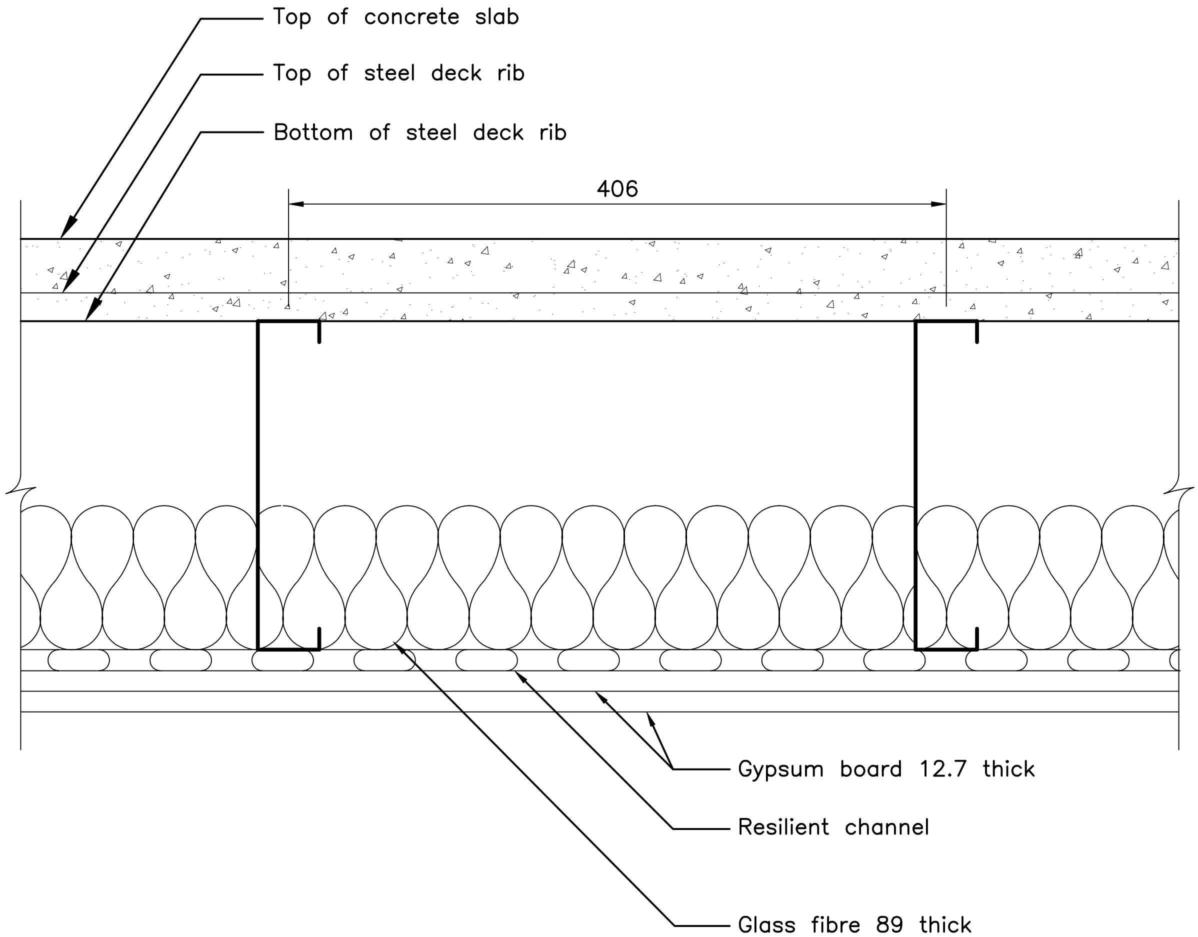
(Assembly No. FF–44)

Figure D–48. Steel C–Joist End Connection, Concrete slab and Blocking Details (Steel C–Joist)



(Assembly No. FF-44)

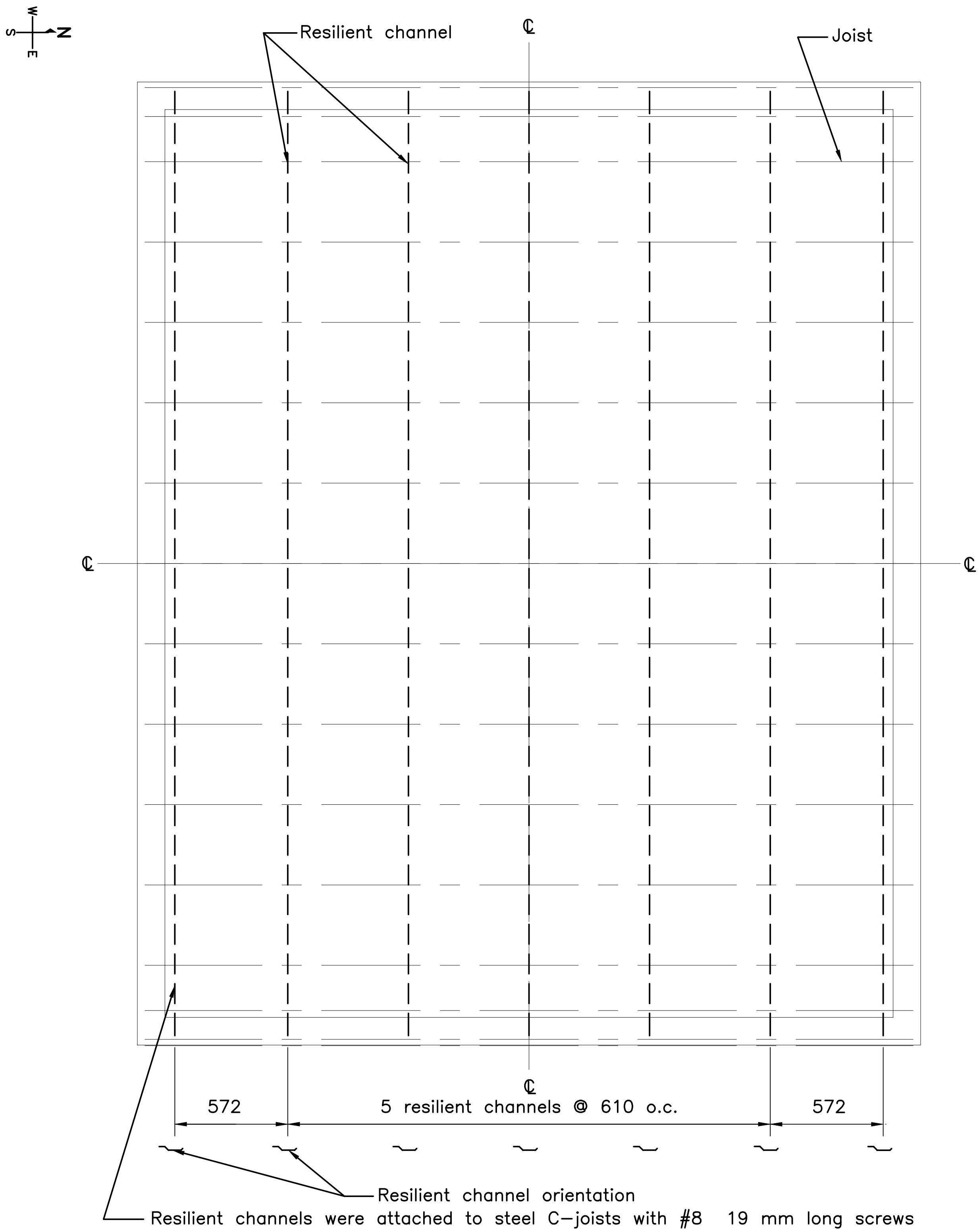
Figure D-49. Steel Deck Layout (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–44)

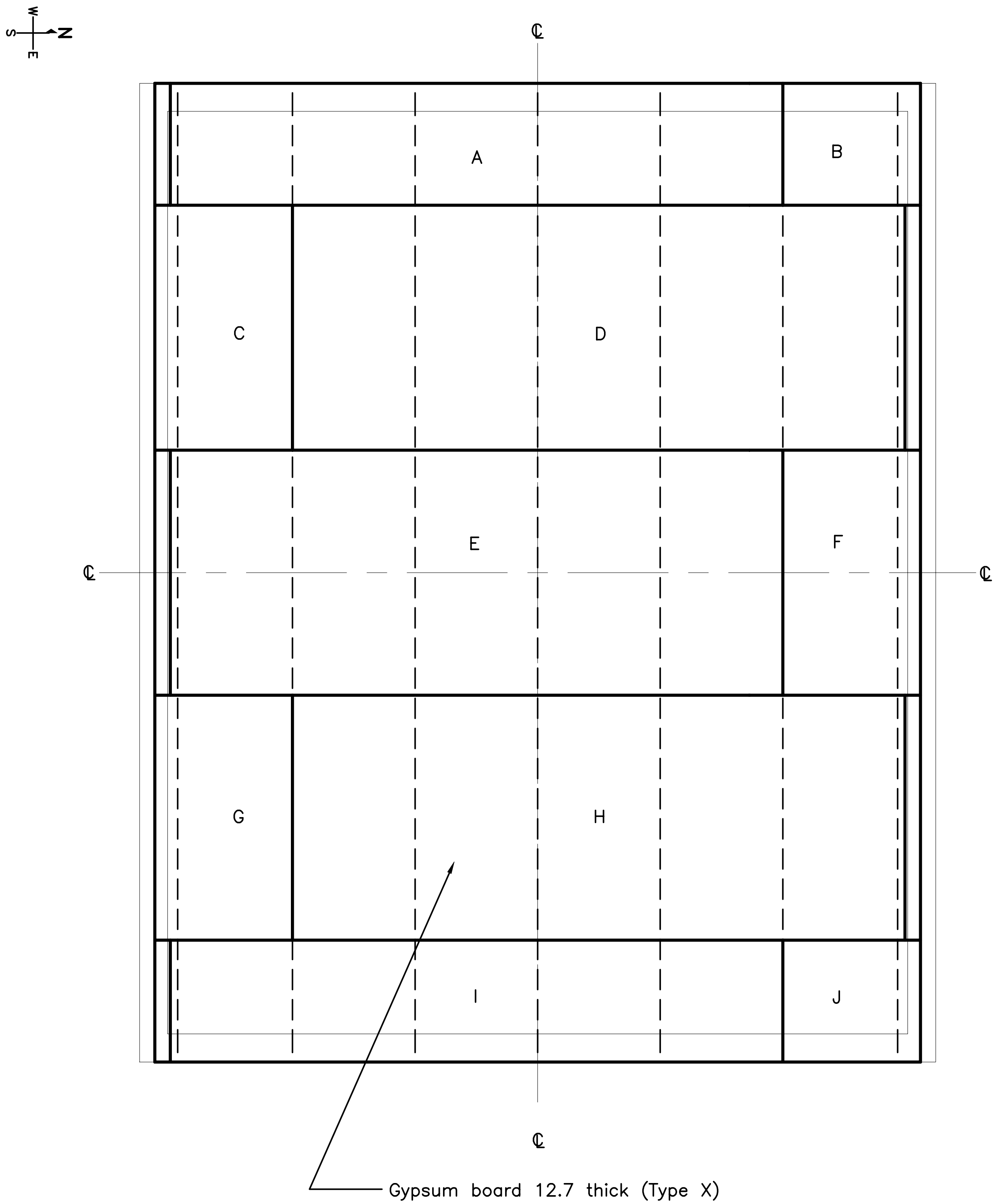
Figure D–50. Insulation Location (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–44)

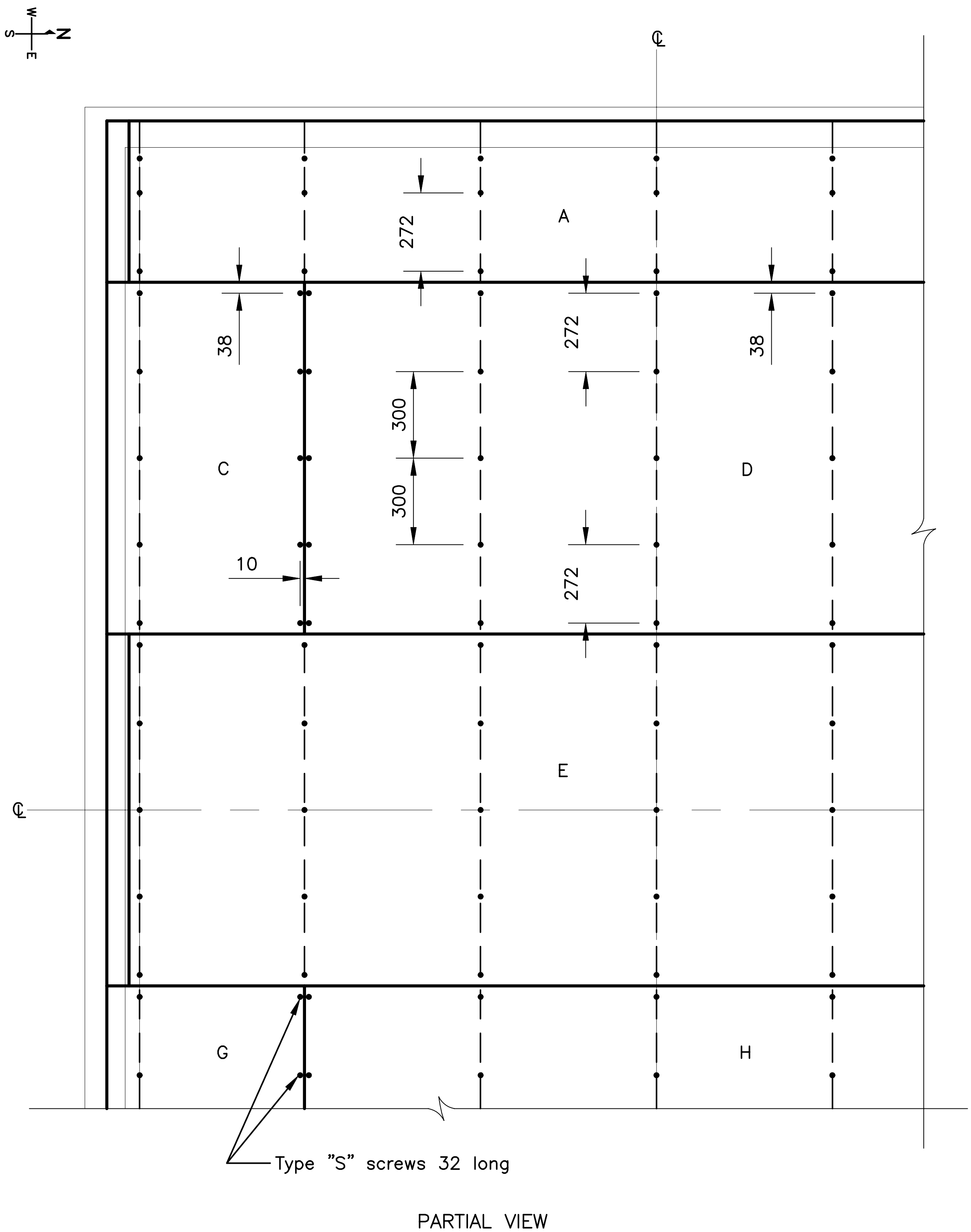
Figure D–51. Resilient Channel Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-44)

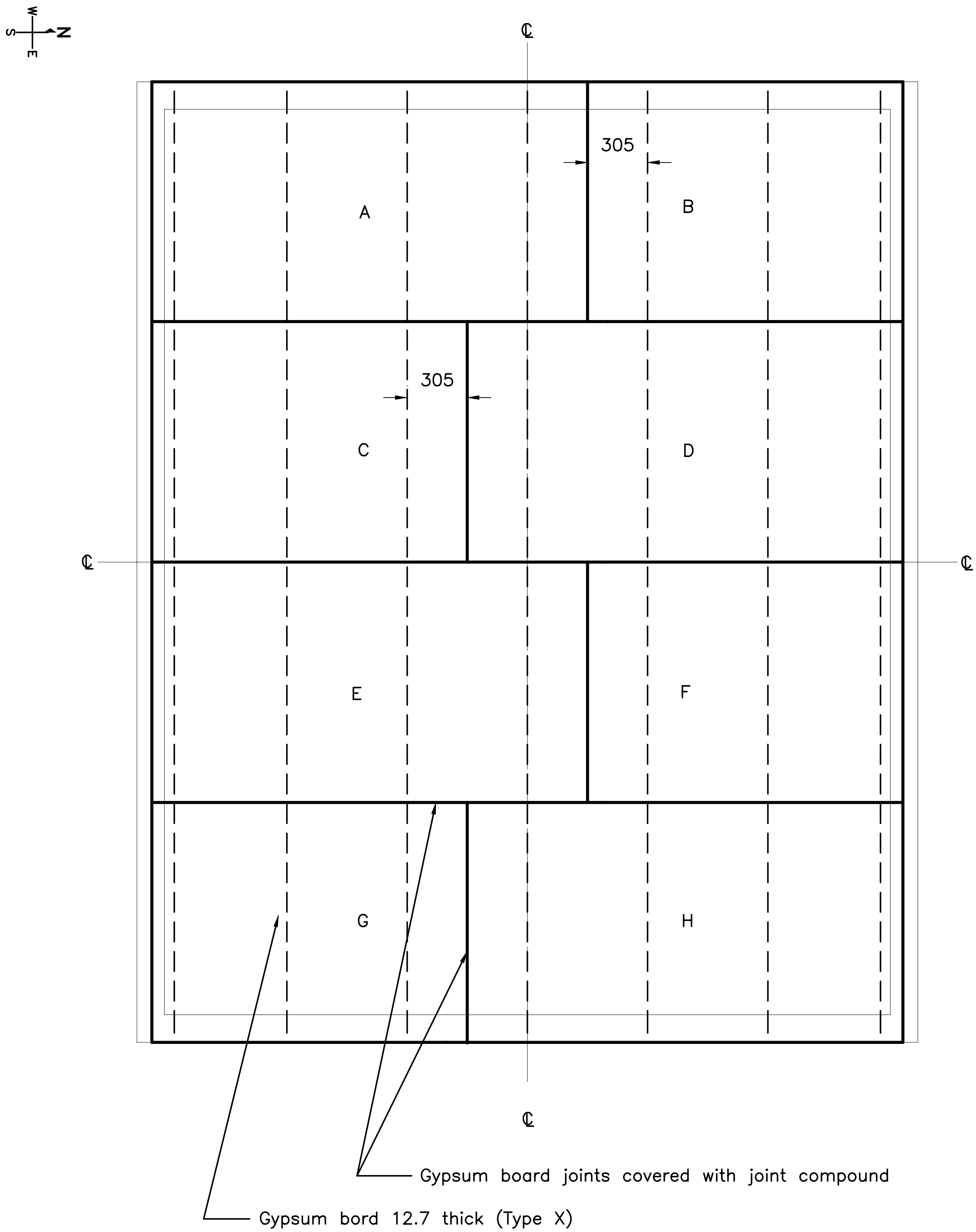
Figure D-52. Gypsum Board Base Layer Layout (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF-44)

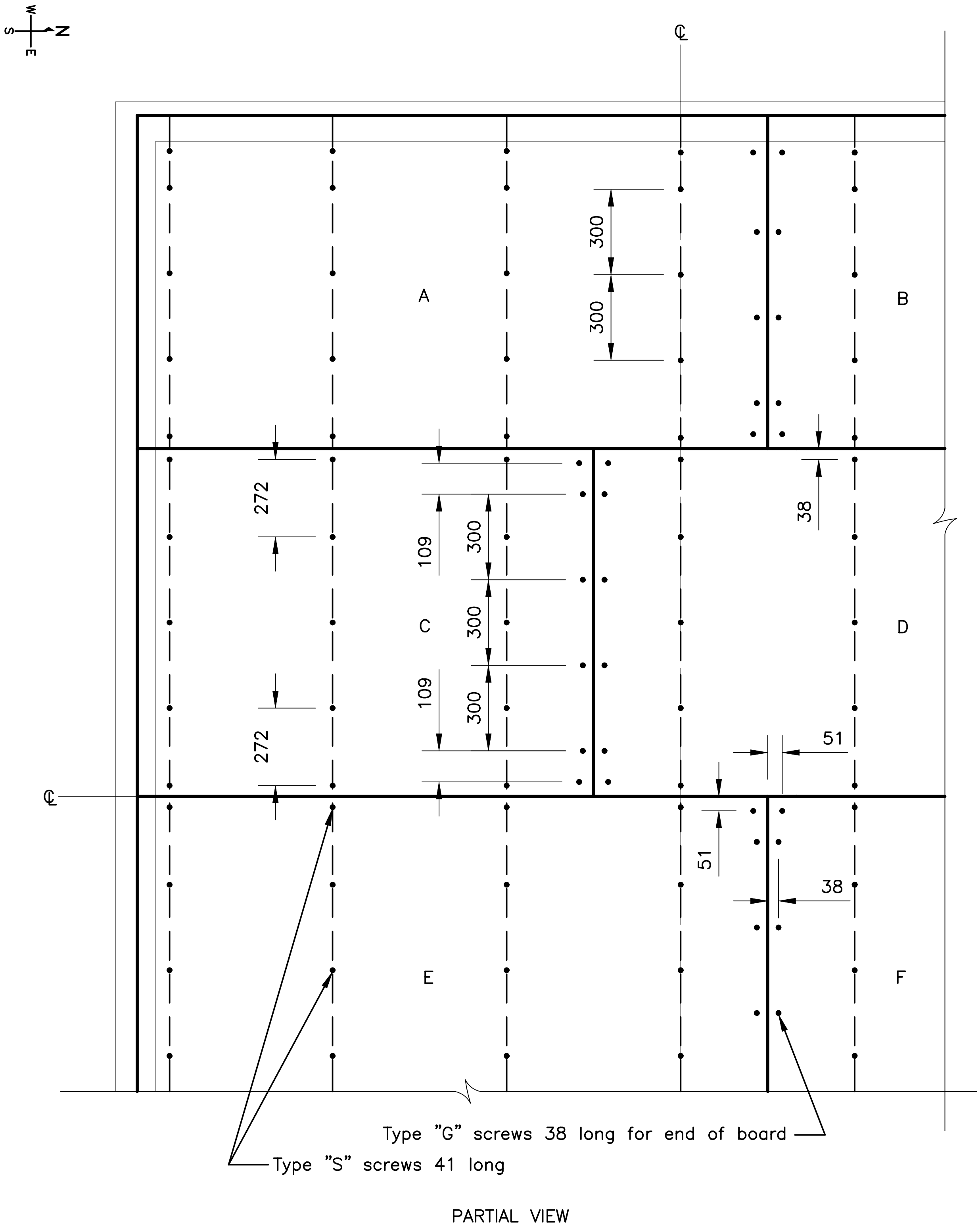
Figure D-53. Gypsum Board Base Layer Screw Pattern (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF-44)

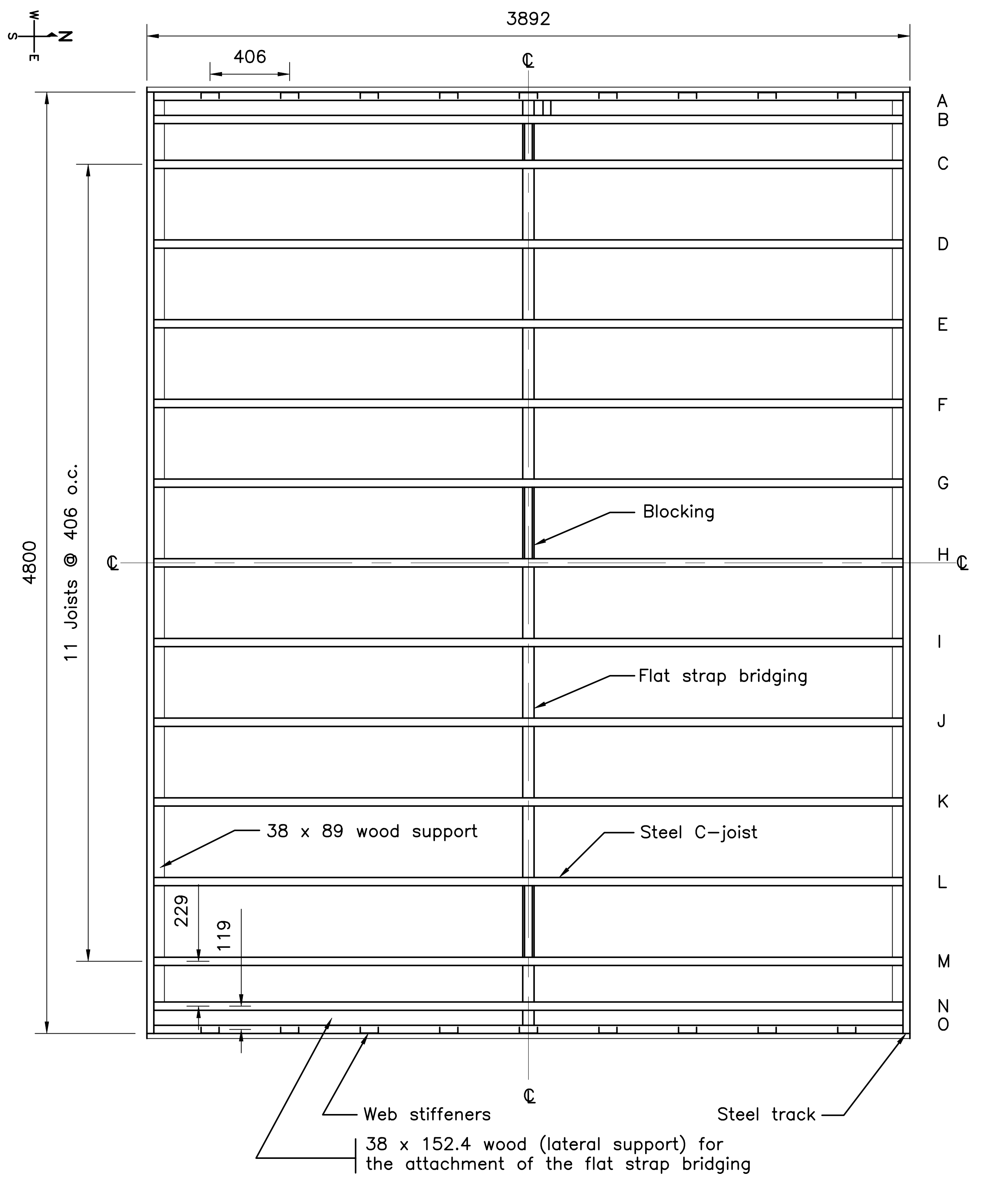
Figure D-54. Gypsum Board Face Layer Layout (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF-44)

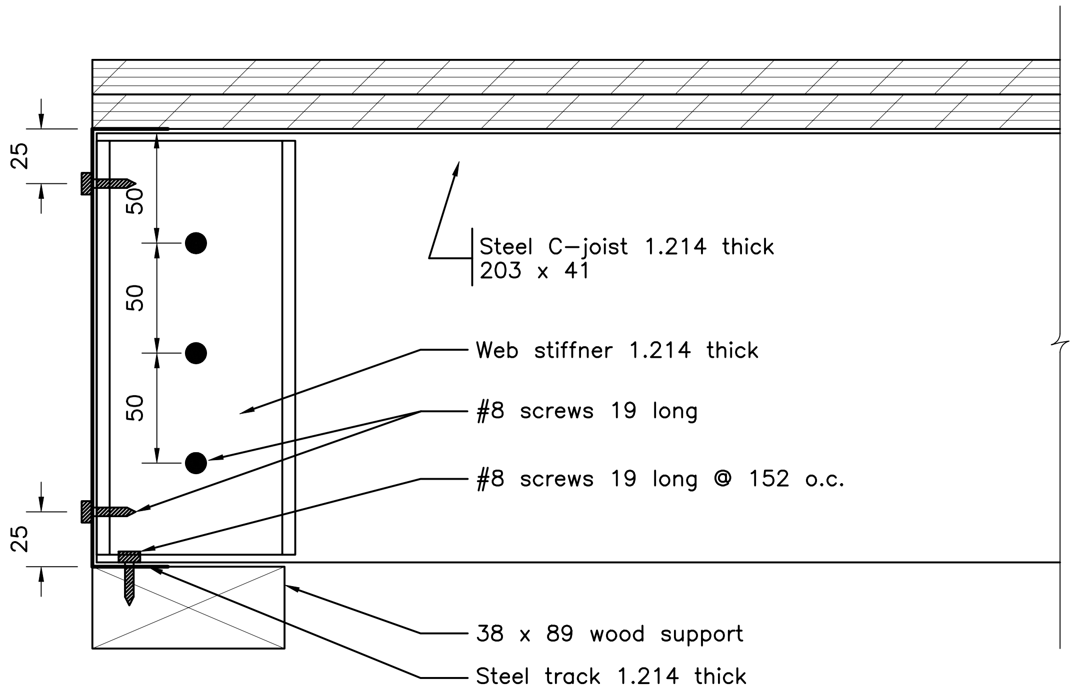
Figure D-55. Gypsum Board Face Layer Screw Pattern (Steel C-Joist)

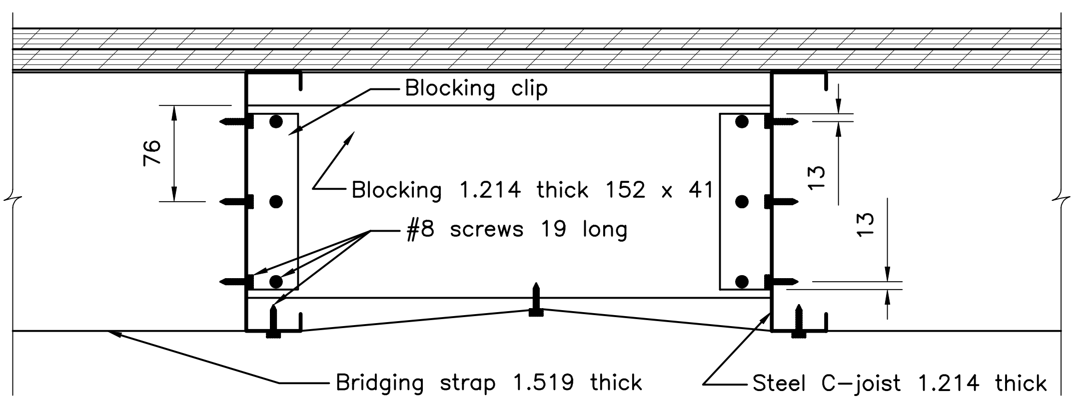


(Dimensions are in millimetres)

(Assembly No. FF–50)

Figure D–56. Joist Layout (Steel C–Joist)

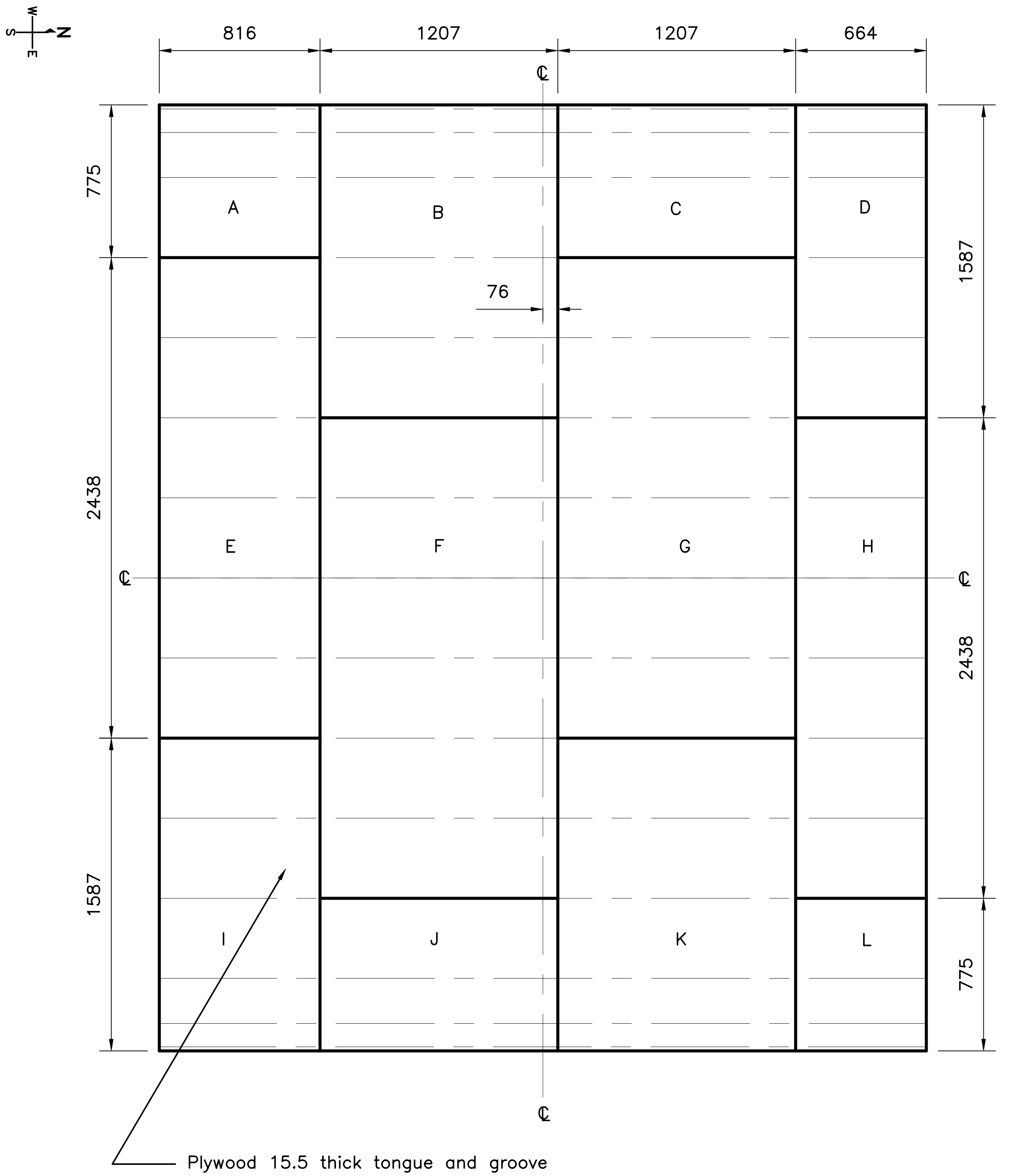




(Dimensions are in millimetres)

(Assembly No. FF–50)

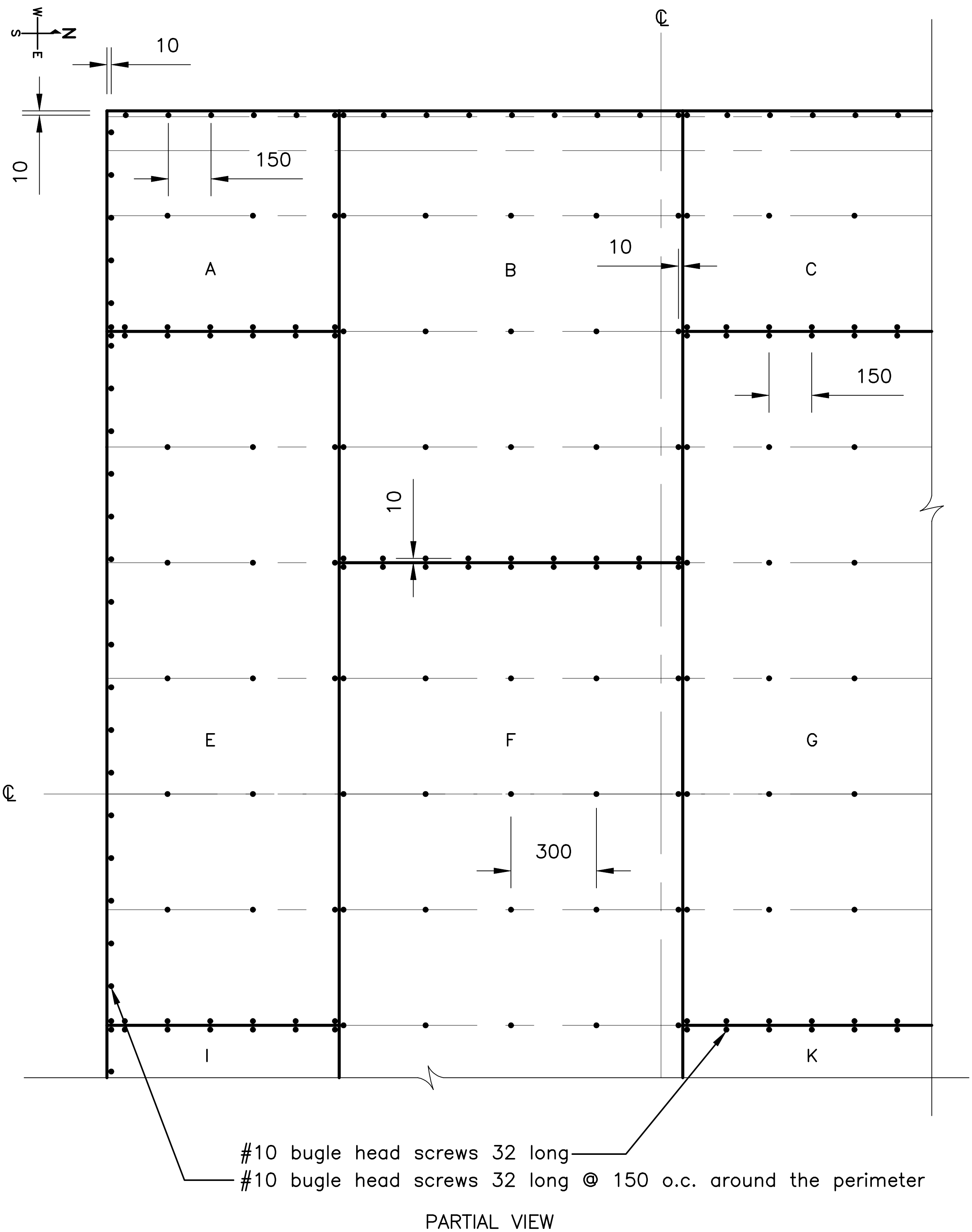
Figure D–57. Steel C–Joist End Connection and Blocking Detail (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–50)

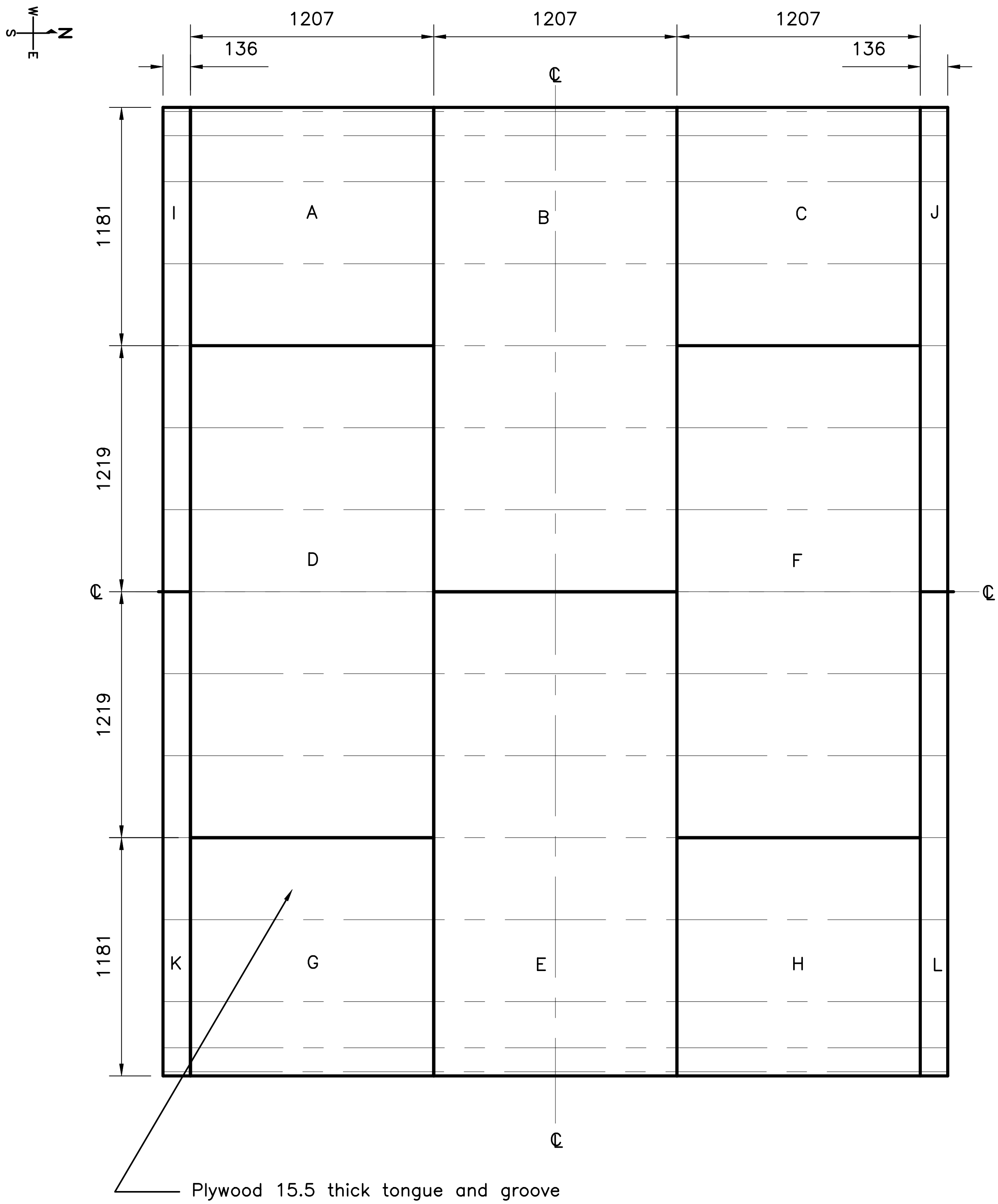
Figure D–58. Subfloor Layout Base Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–50)

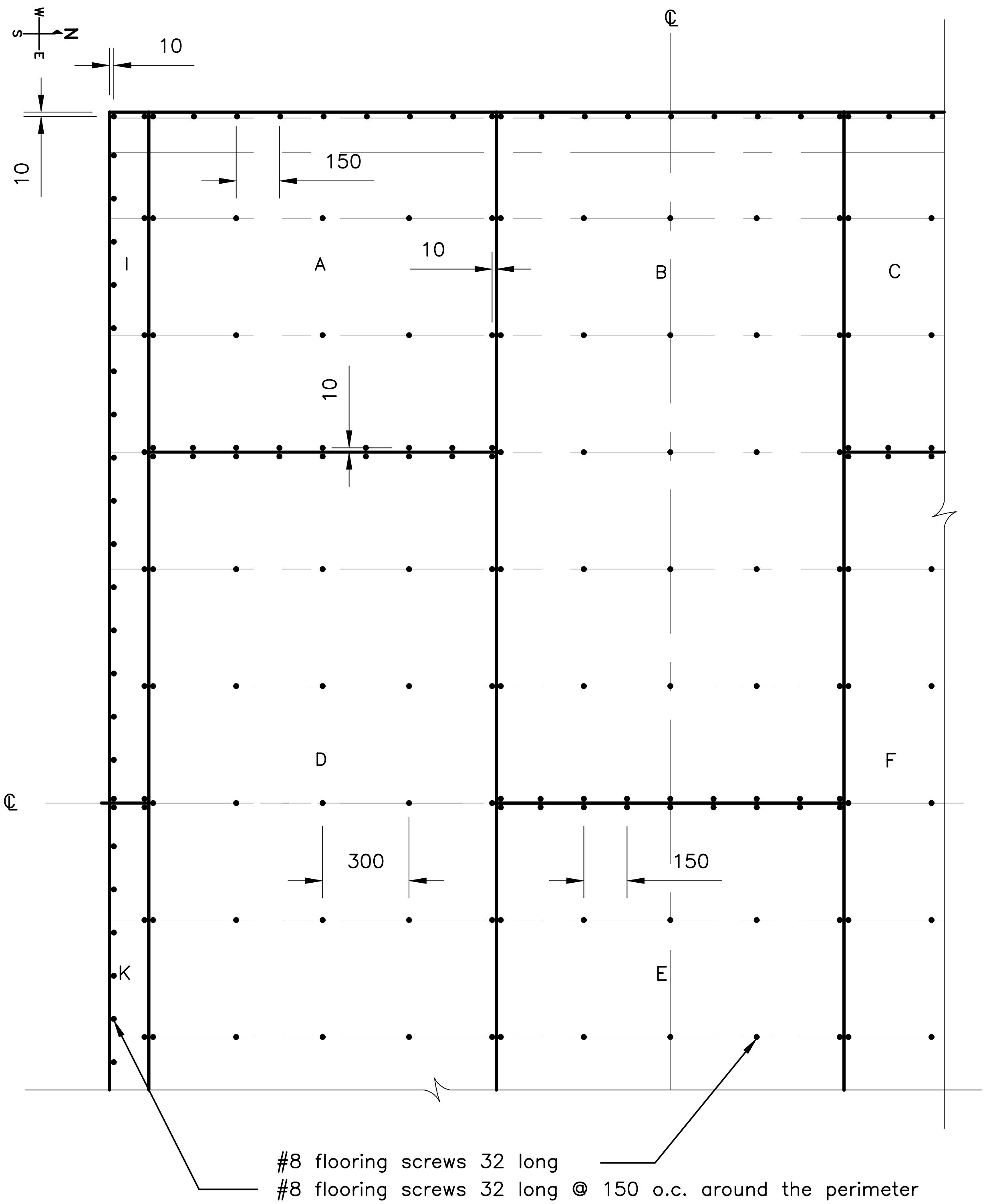
Figure D–59. Subfloor Screw Pattern Base Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–50)

Figure D–60. Subfloor Layout Face Layer (Steel C–Joist)

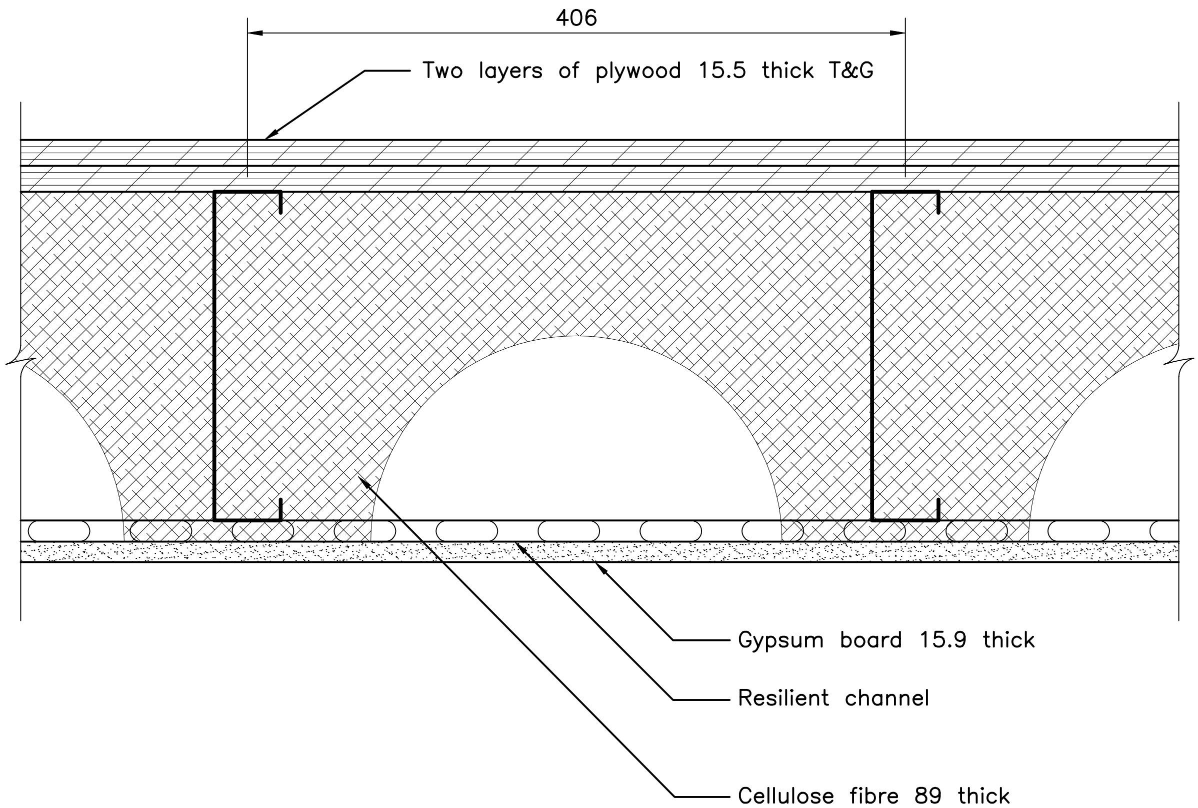


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF–50)

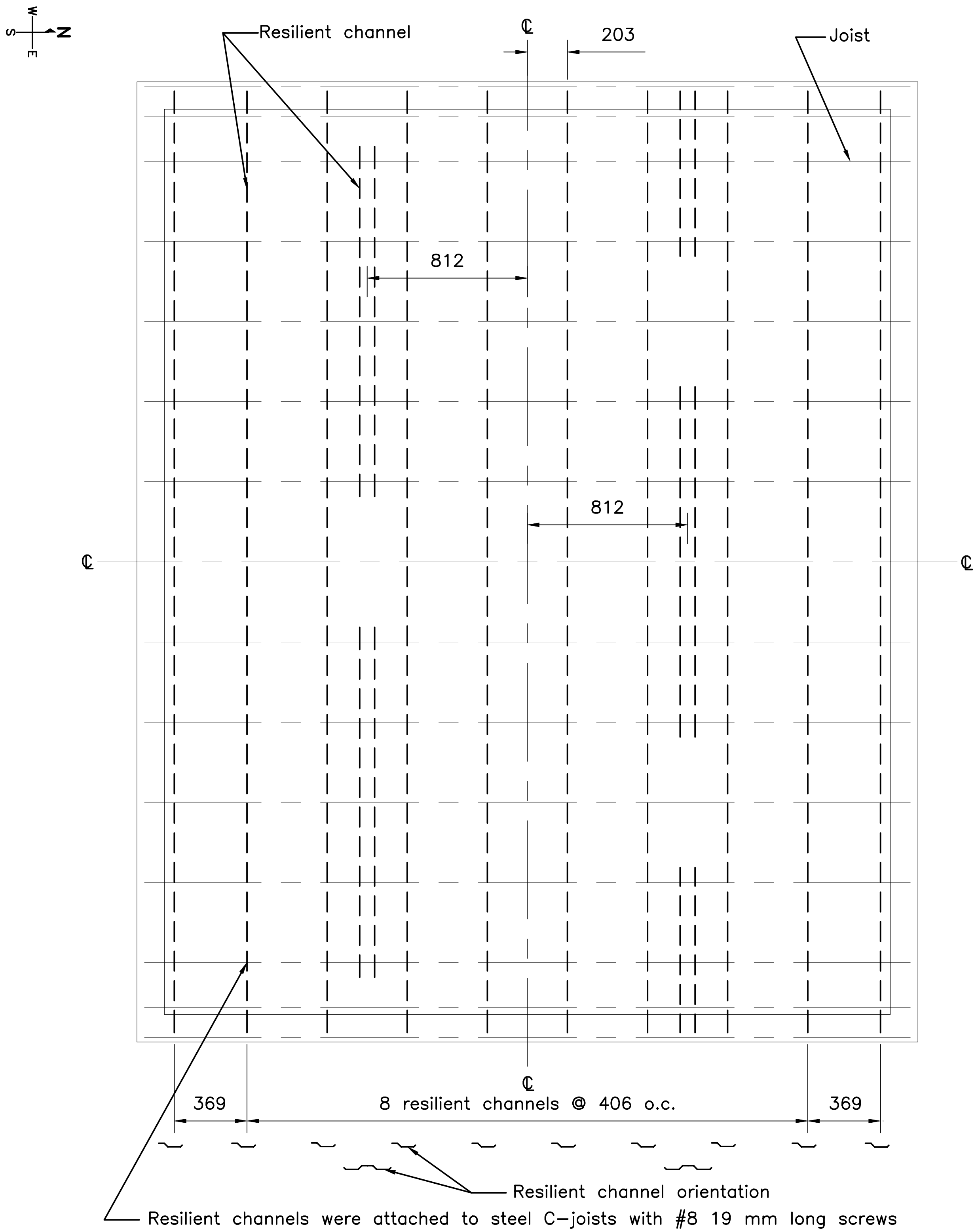
Figure D–61. Subfloor Screw Pattern Face Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–50)

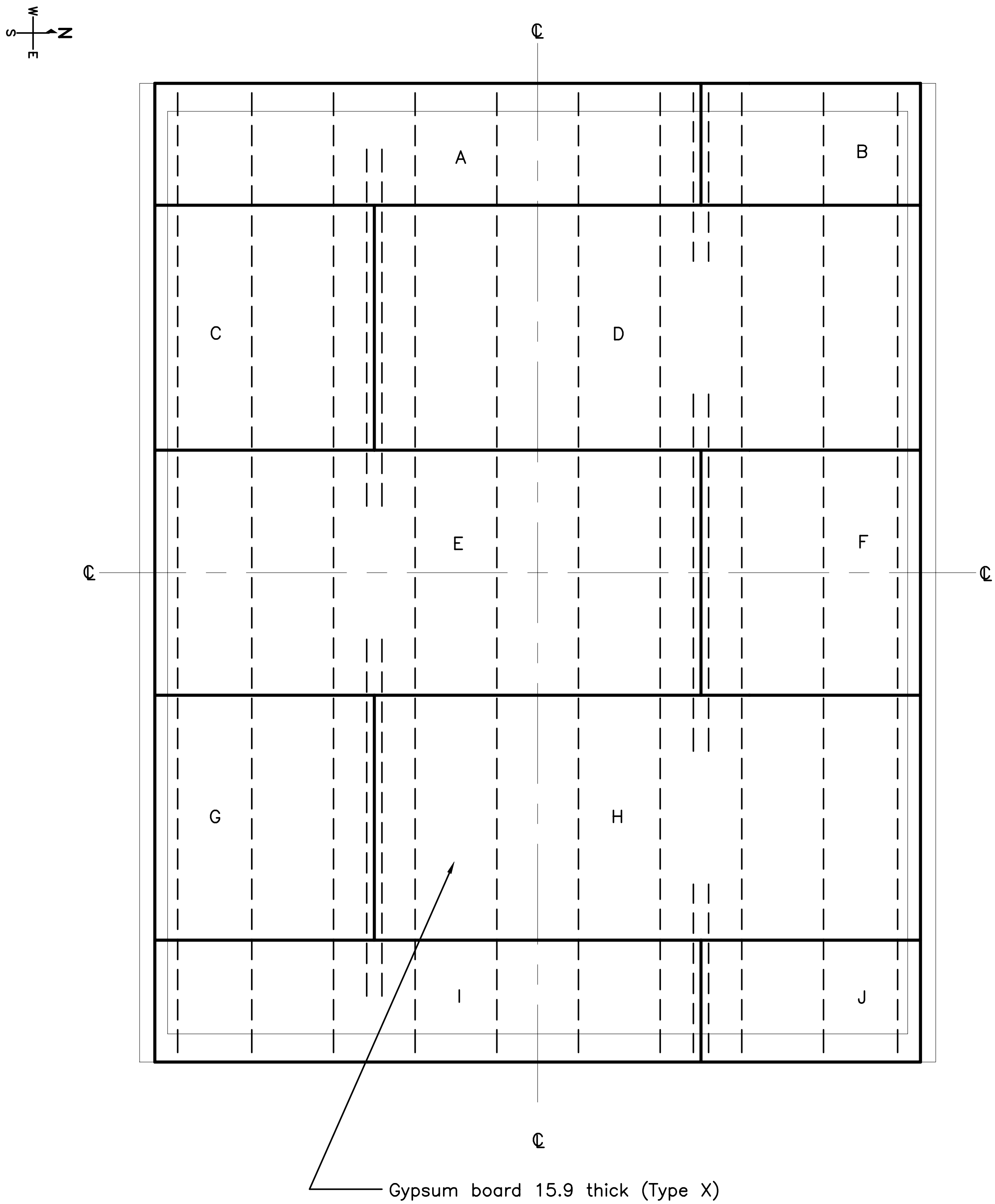
Figure D–62. Insulation Location (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–50)

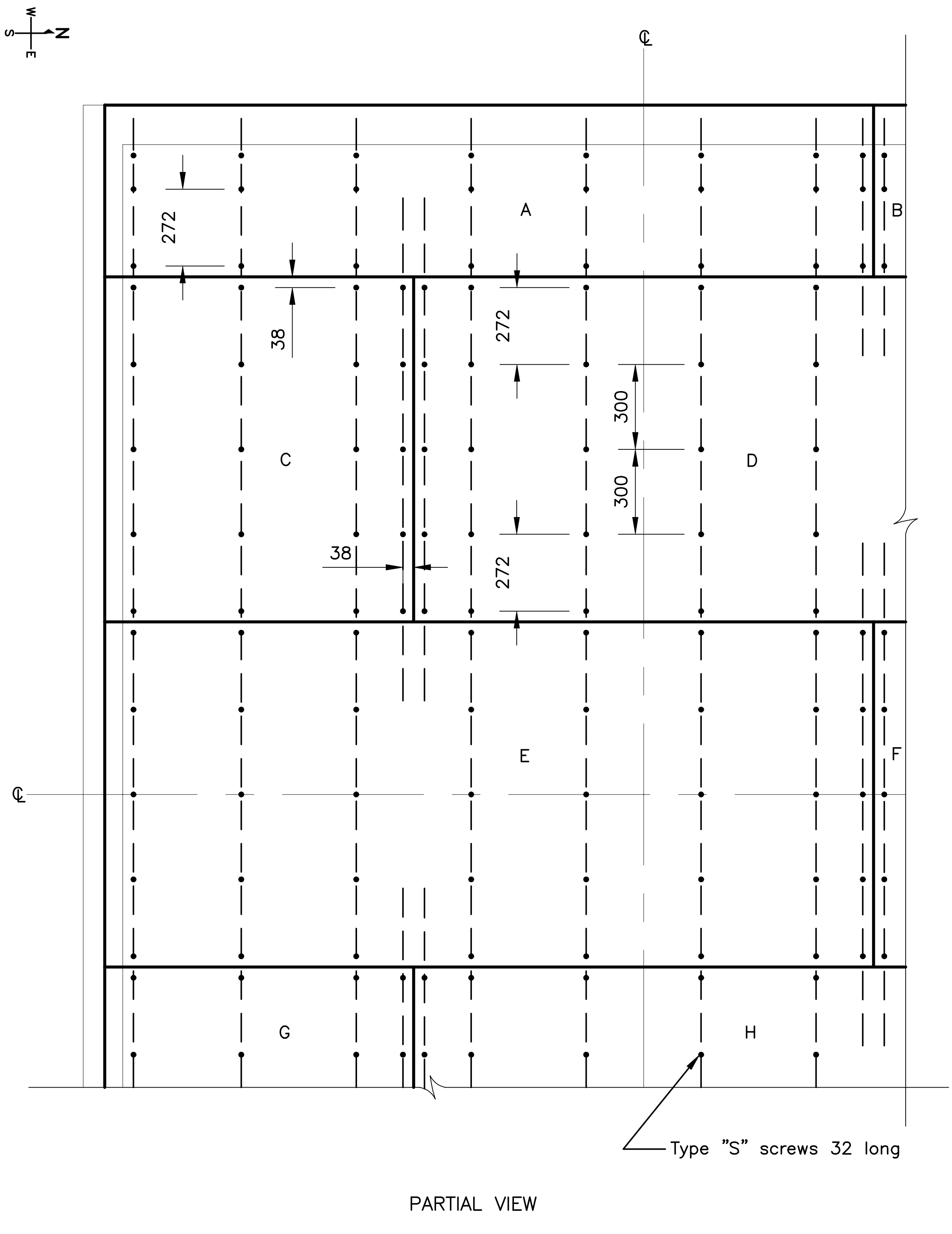
Figure D–63. Resilient Channel Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–50)

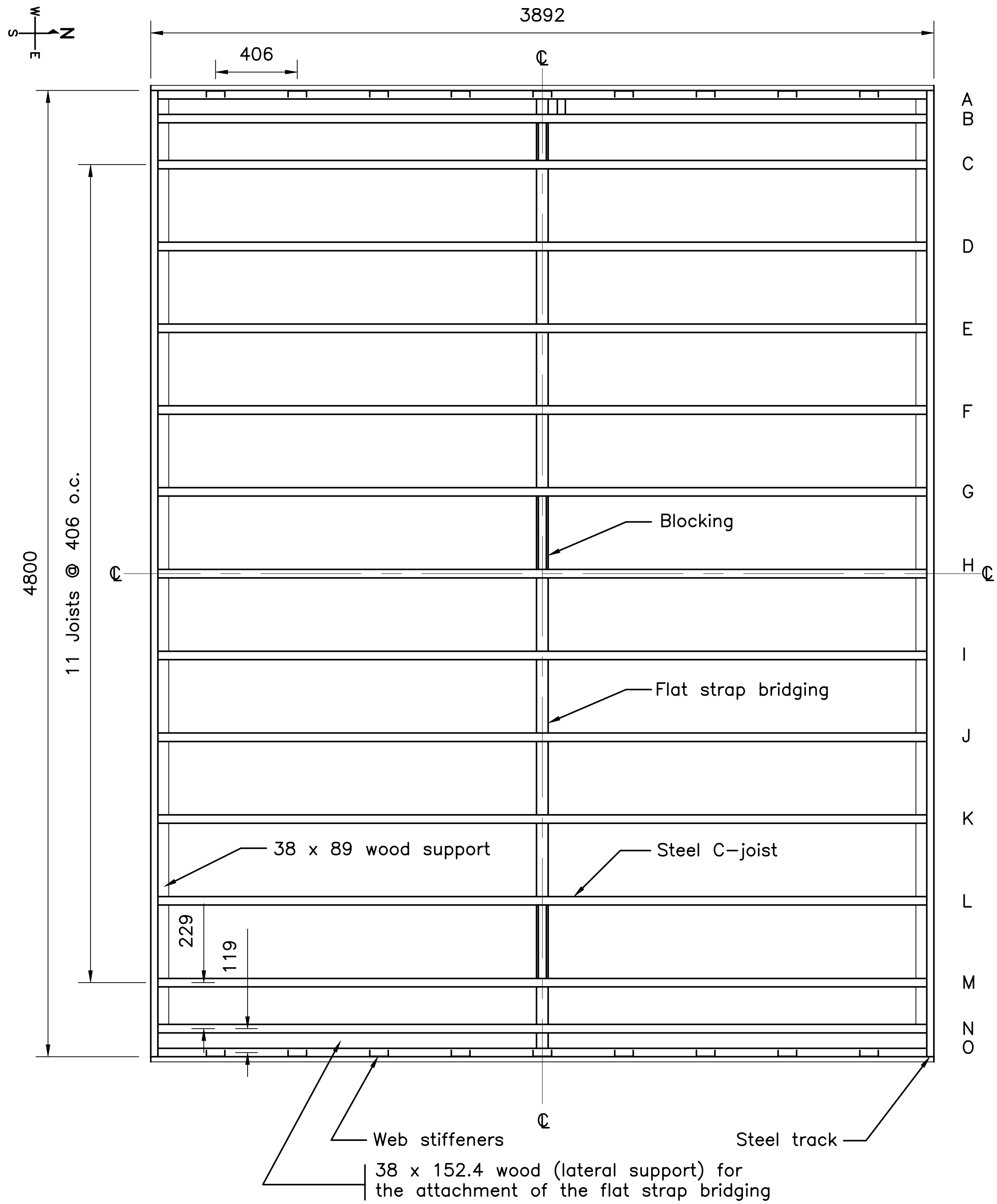
Figure D–64. Gypsum Board Single Layer Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-50)

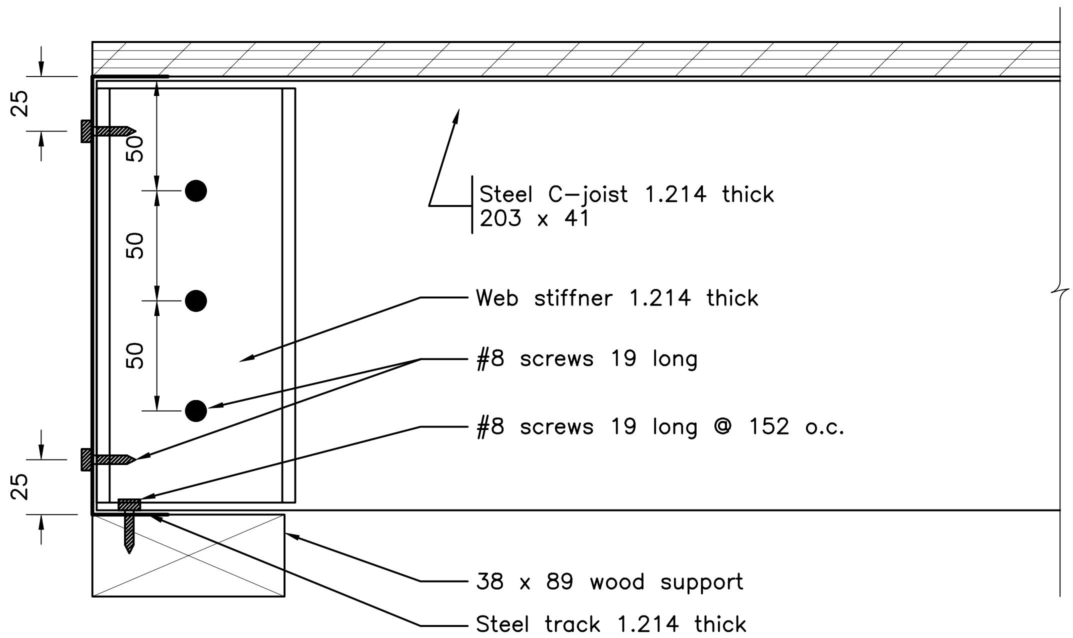
Figure D-65. Gypsum Board Single Layer Screw Pattern (Steel C-Joist)

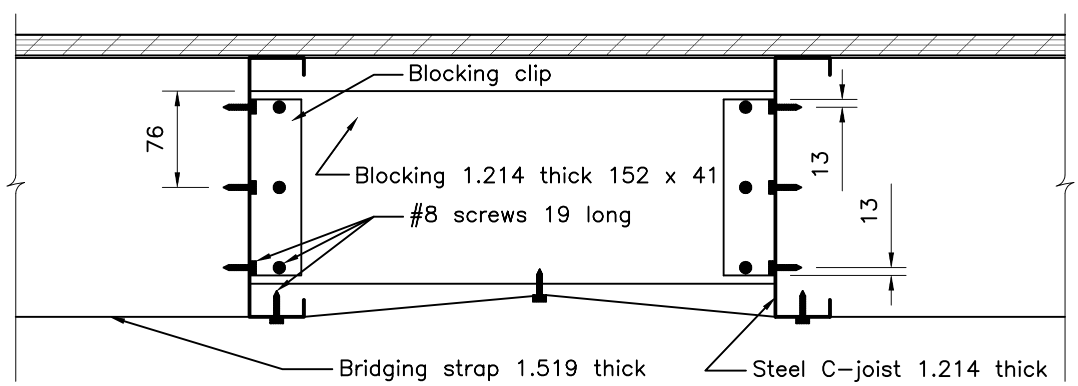


(Dimensions are in millimetres)

(Assembly No. FF–51)

Figure D–66. Joist Layout (Steel C–Joist)

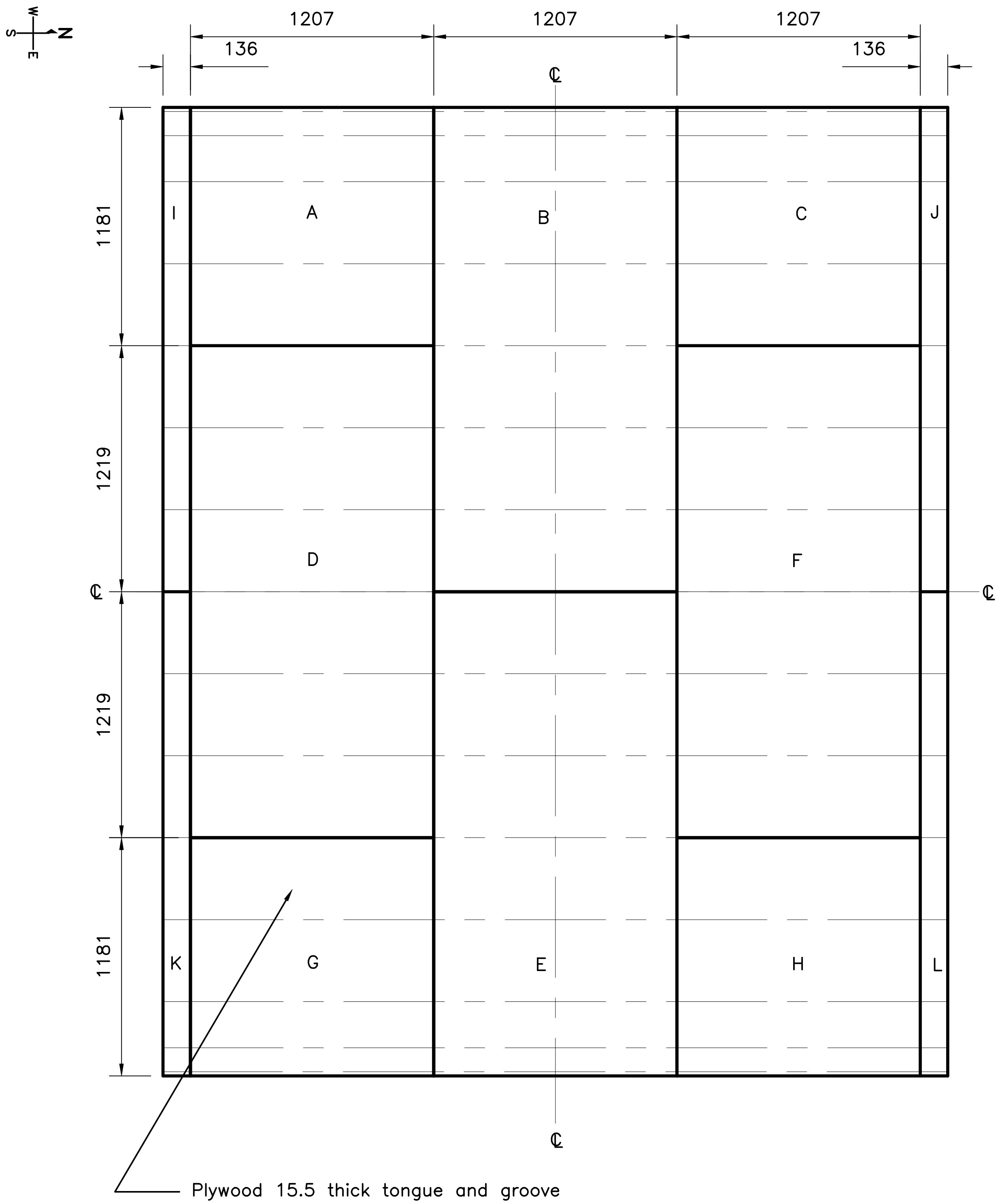




(Dimensions are in millimetres)

(Assembly No. FF–51)

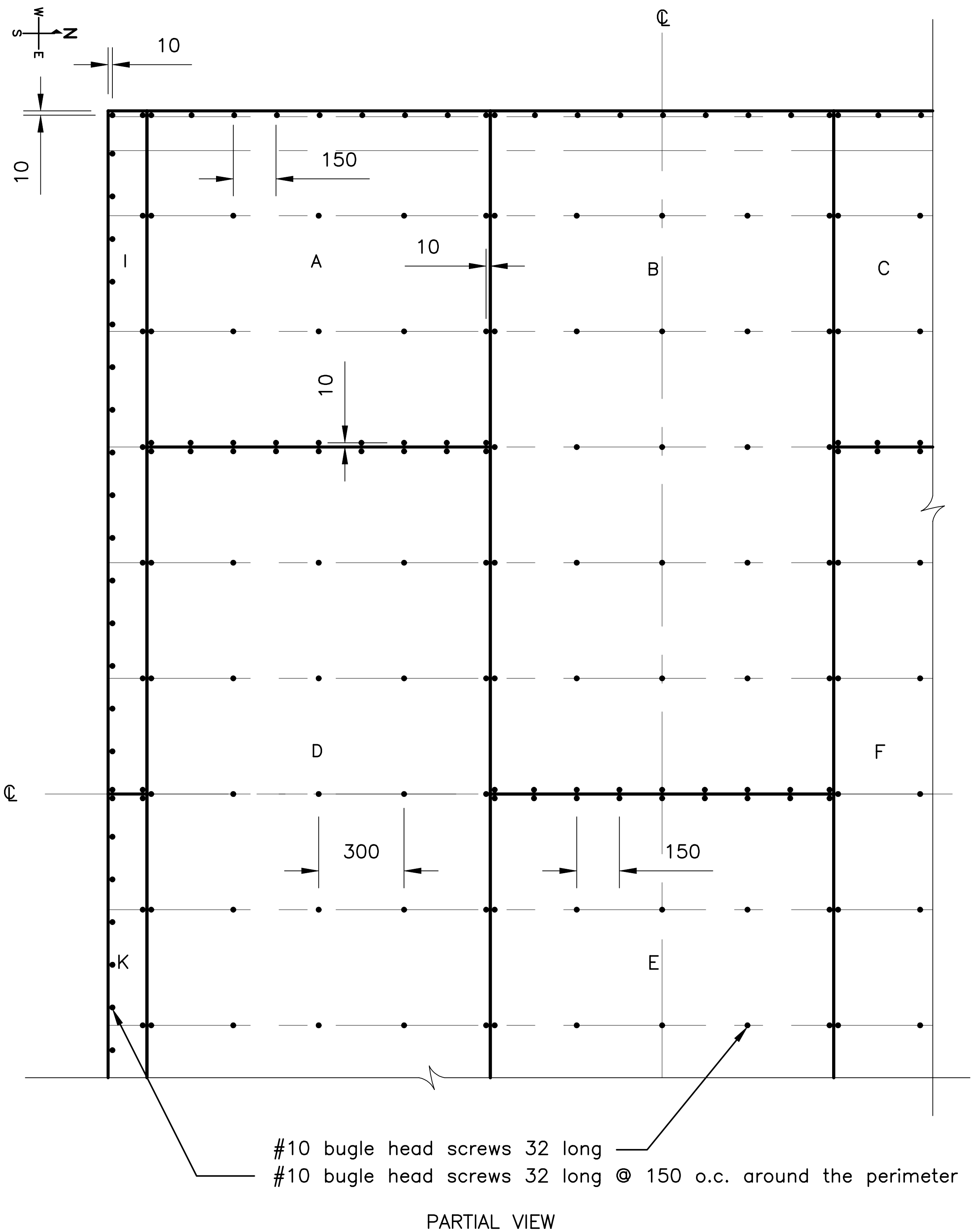
Figure D–67. Steel C.–Joist End Connection and Blocking Detail
(Steel C–joist)



(Dimensions are in millimetres)

(Assembly No. FF–51)

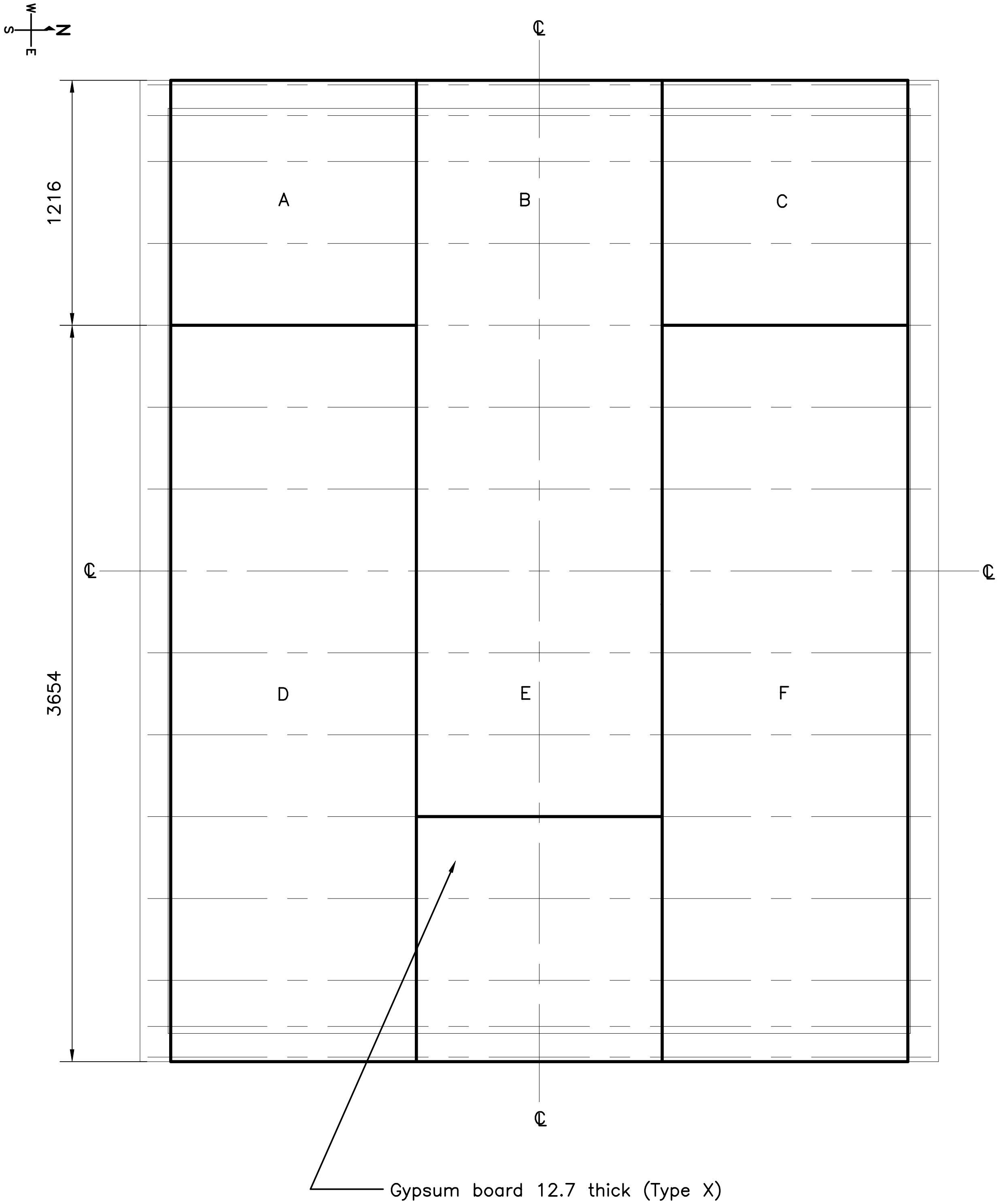
Figure D–68. Subfloor Layout Single Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–51)

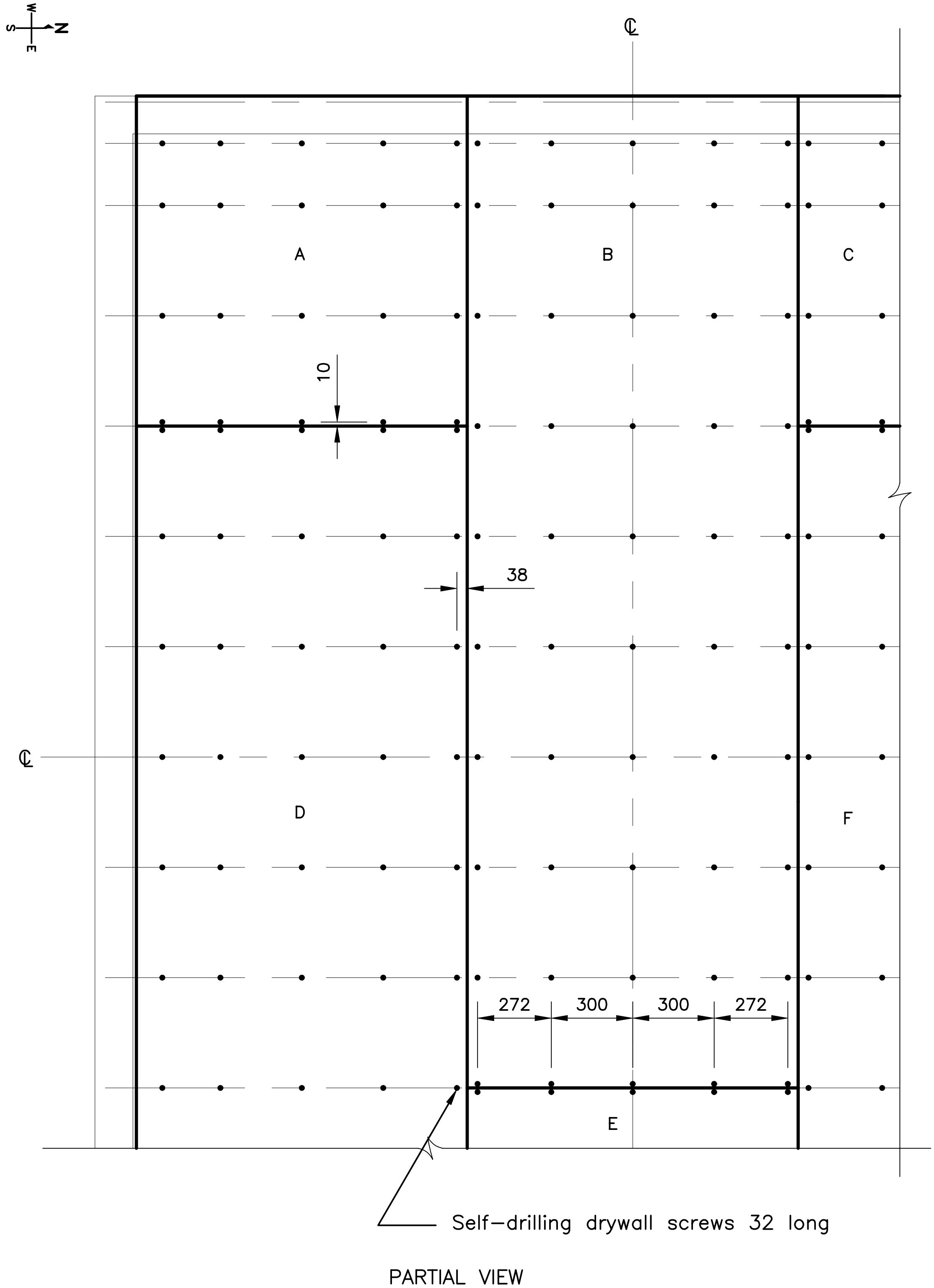
Figure D–69. Subfloor Screw Pattern Single Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–51)

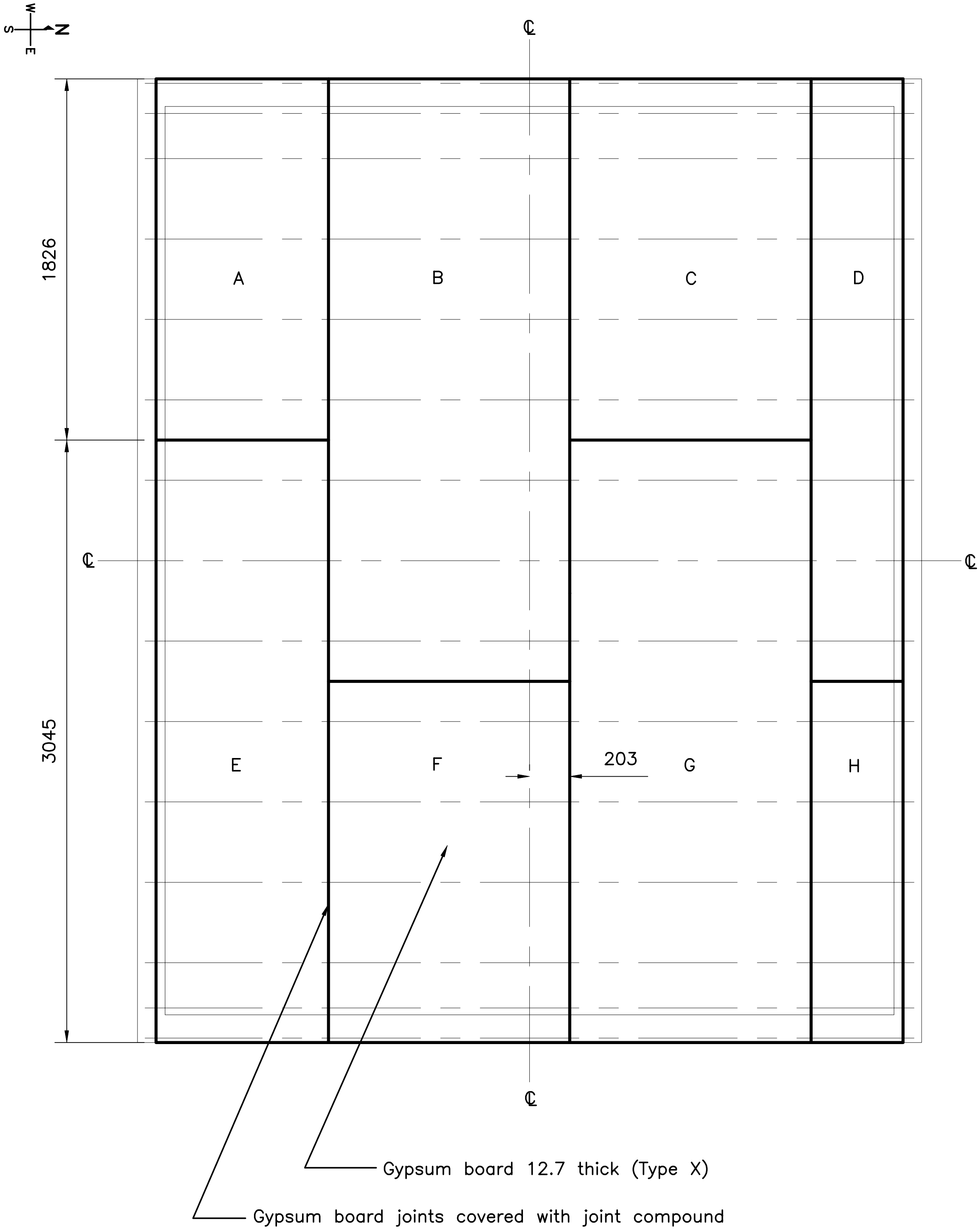
Figure D–70. Gypsum Board Base Layer Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-51)

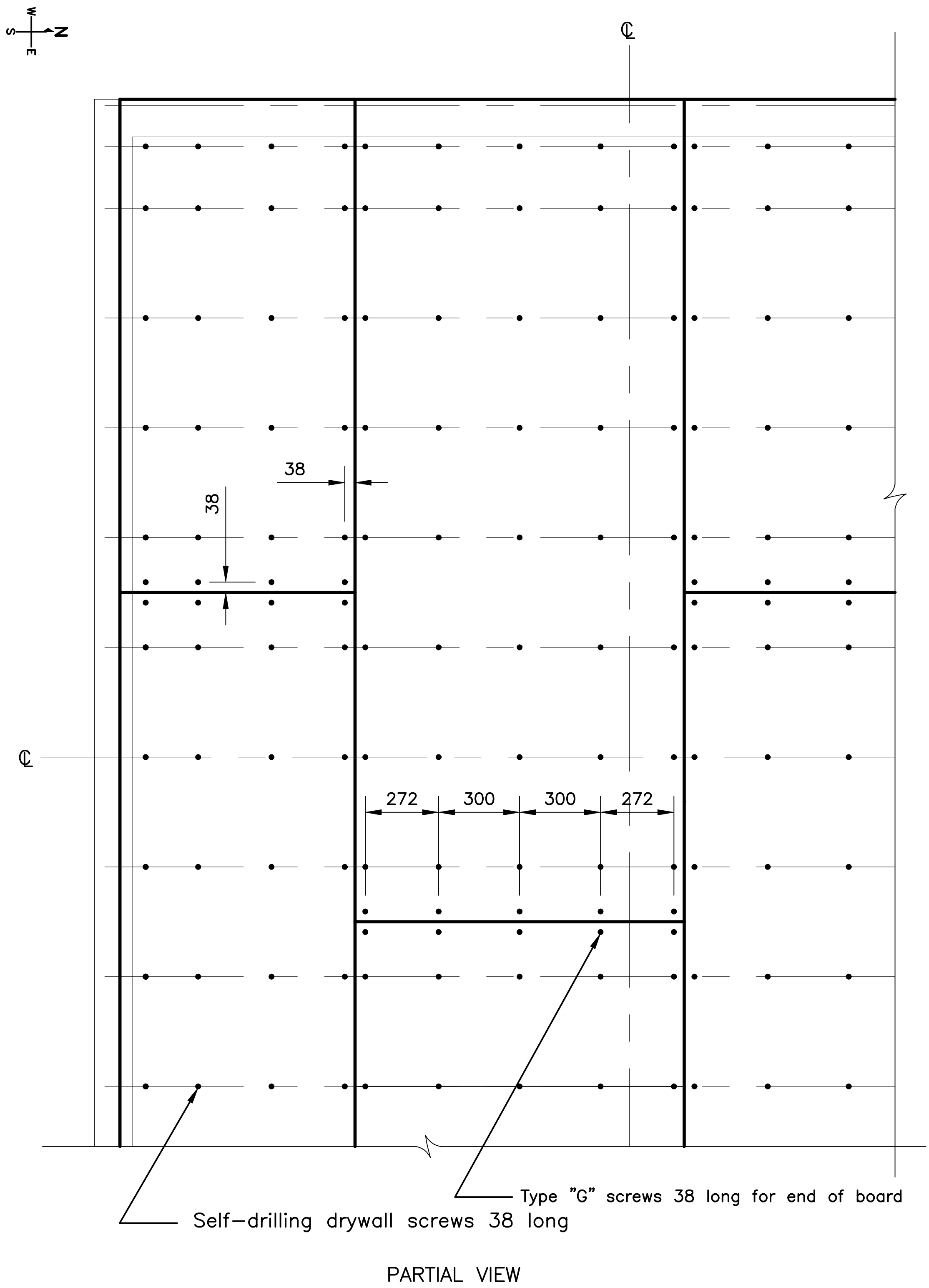
Figure D-71. Gypsum Board Base Layer Screw Pattern (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–51)

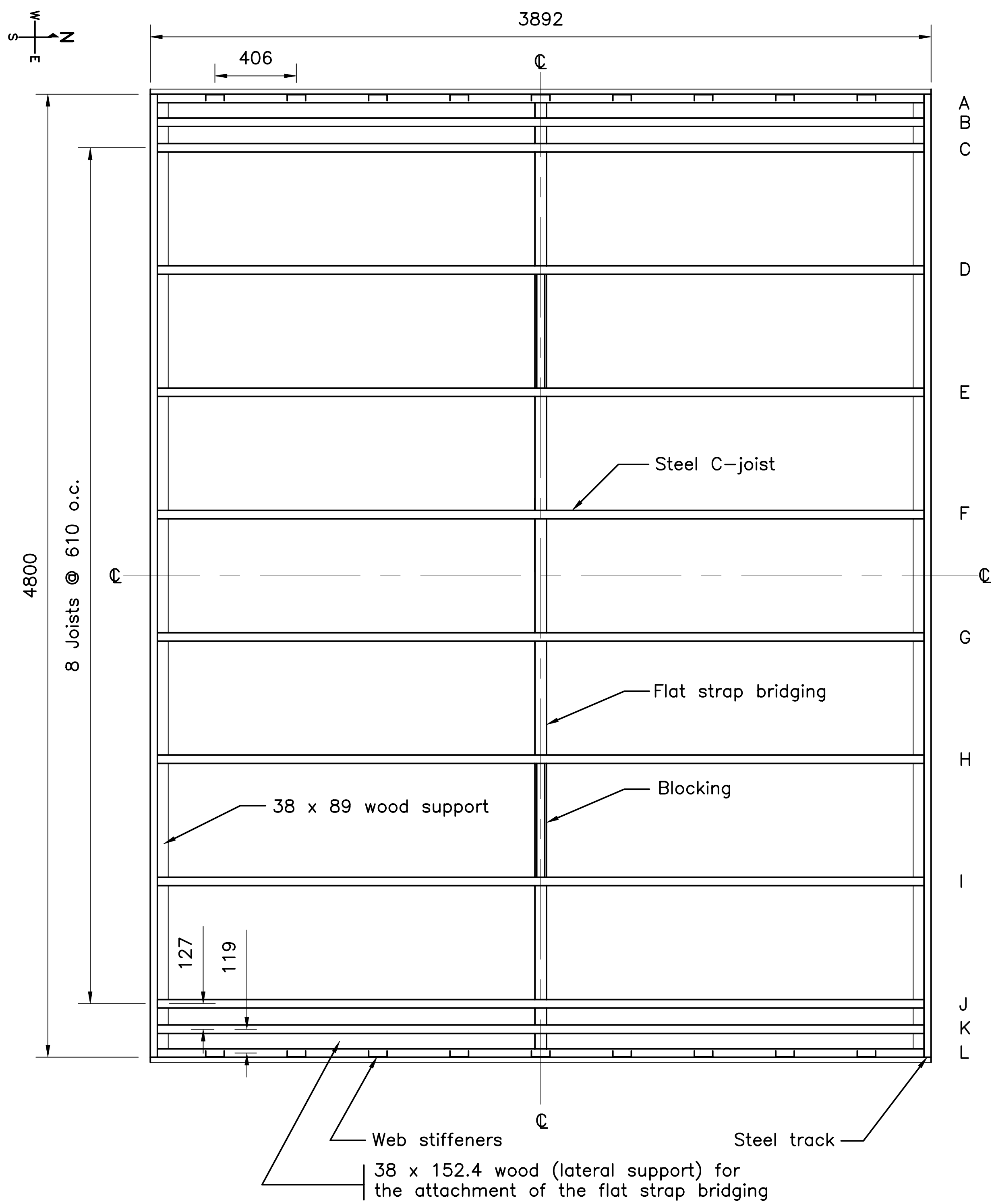
Figure D–72. Gypsum Board Face Layer Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–51)

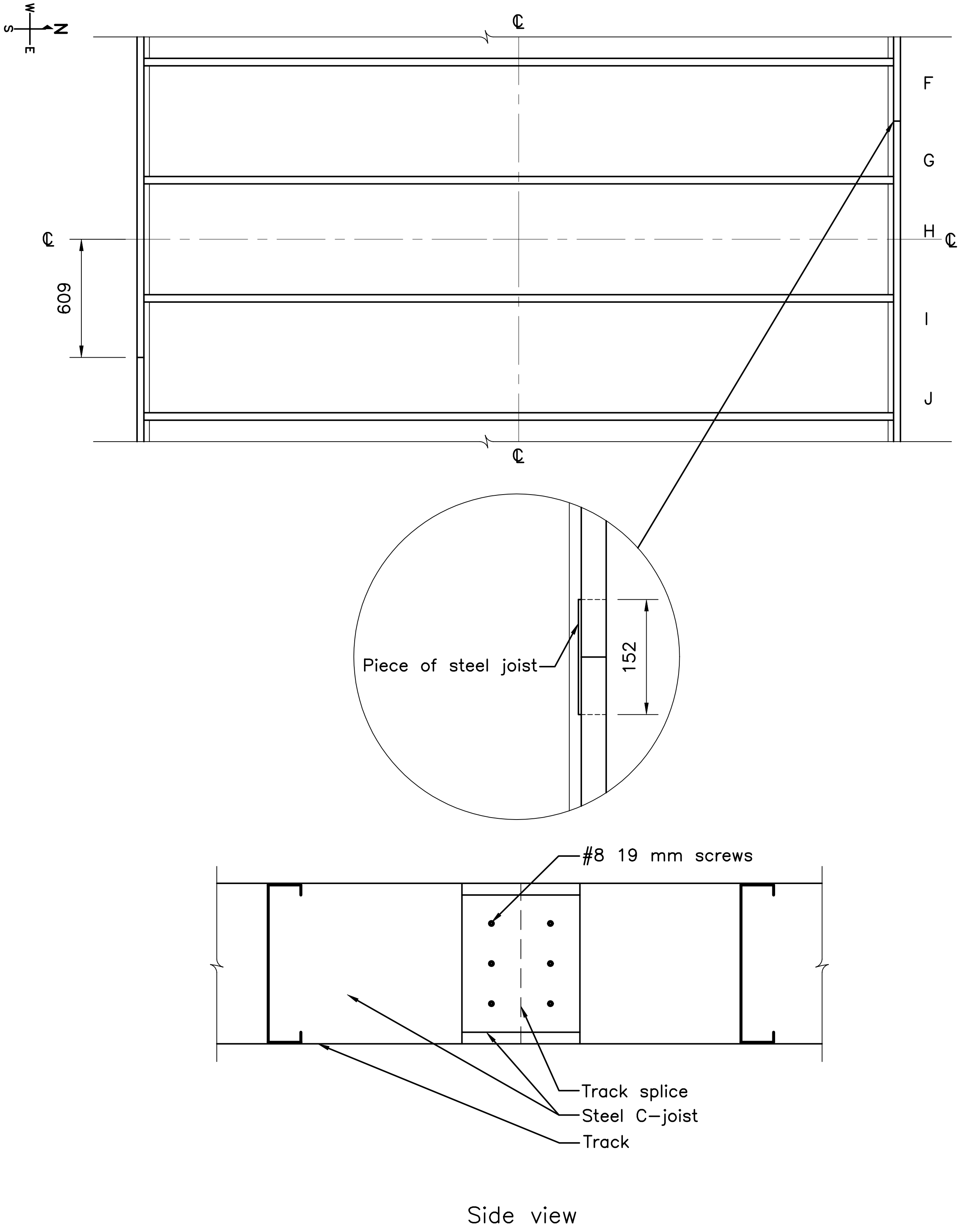
Figure D–73. Gypsum Board Face Layer Screw Pattern (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–52)

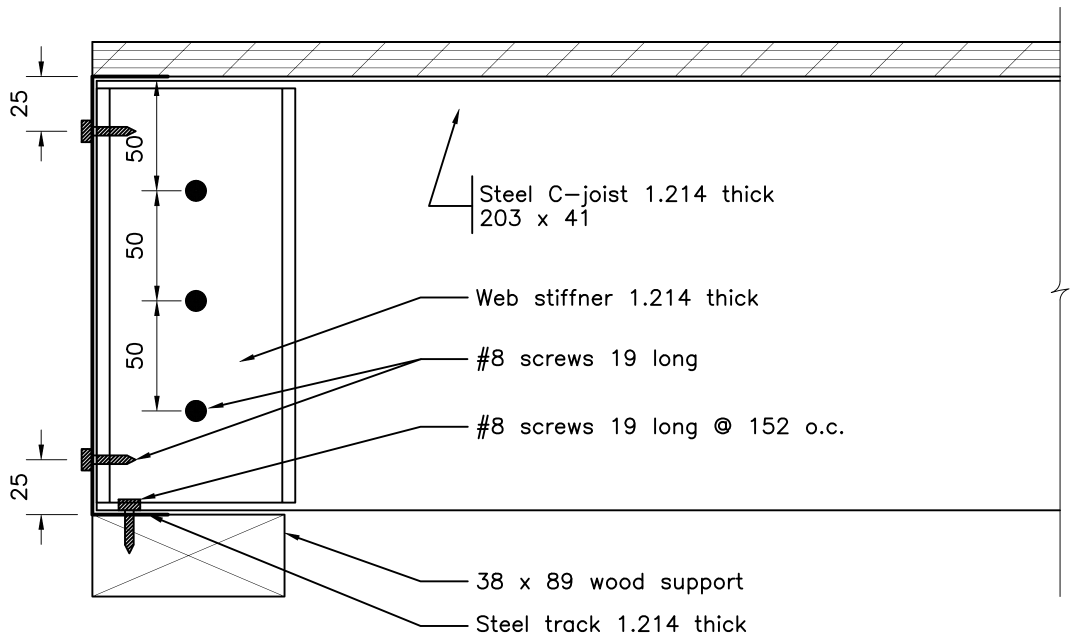
Figure D–74. Joist Layout (Steel C–Joist)

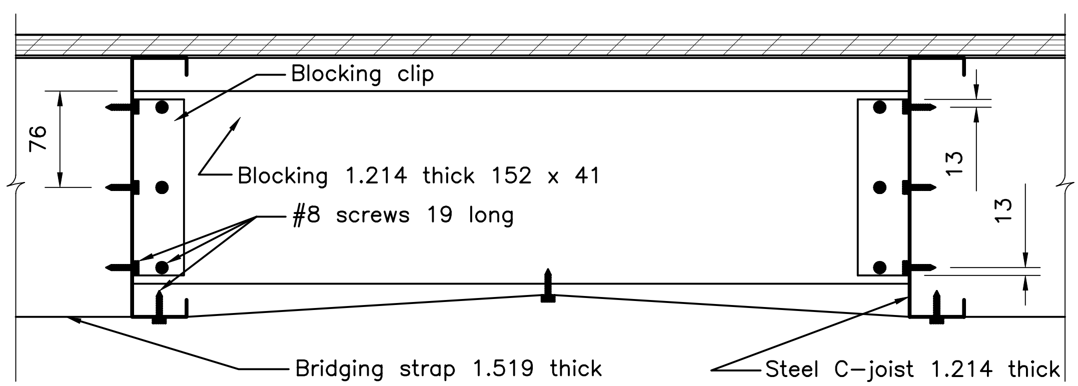


(Dimensions are in millimetres)

(Assembly No. FF–52)

Figure D–75. Track Joint Detail (Steel C–Joist)

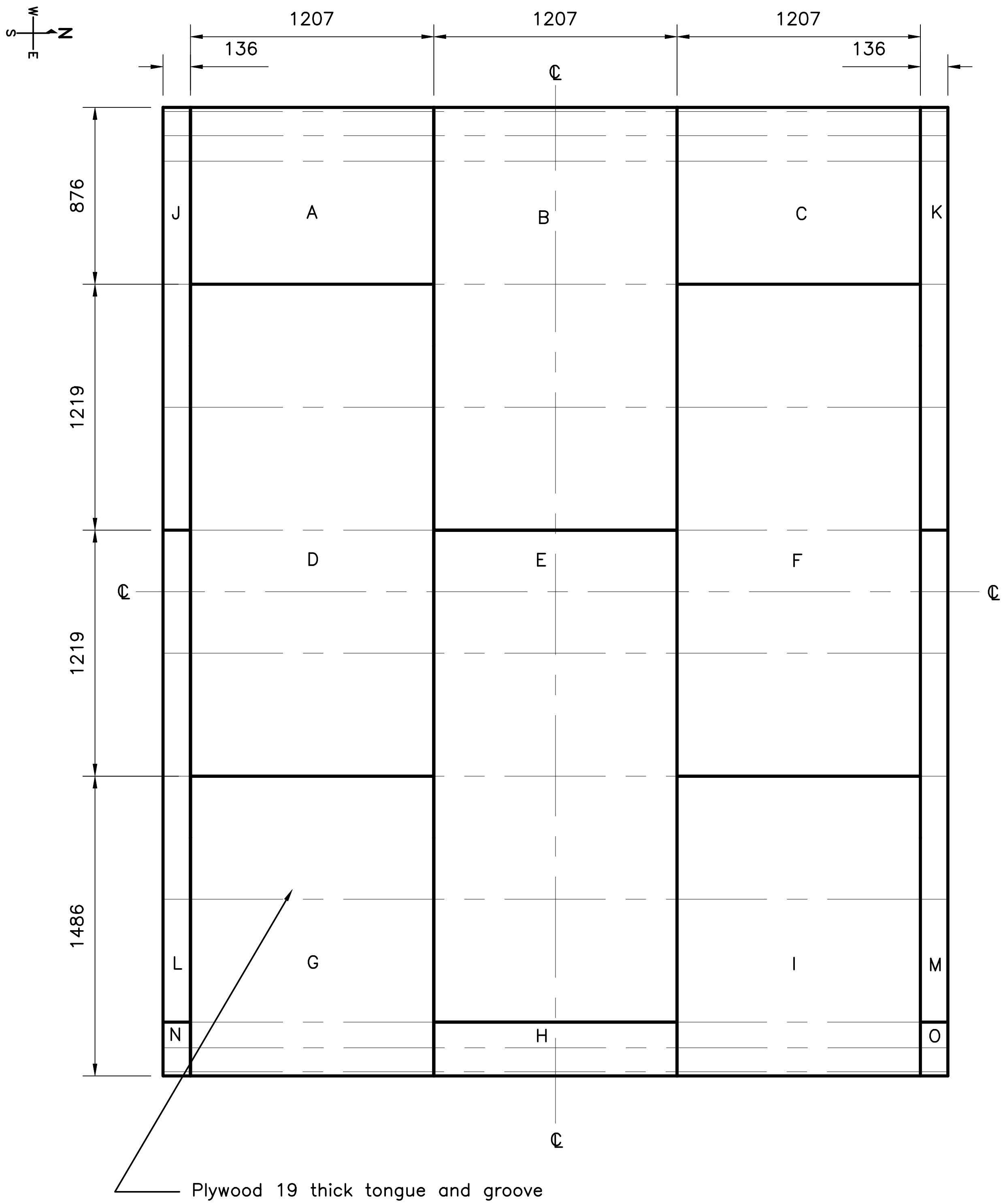




(Dimensions are in millimetres)

(Assembly No. FF–52)

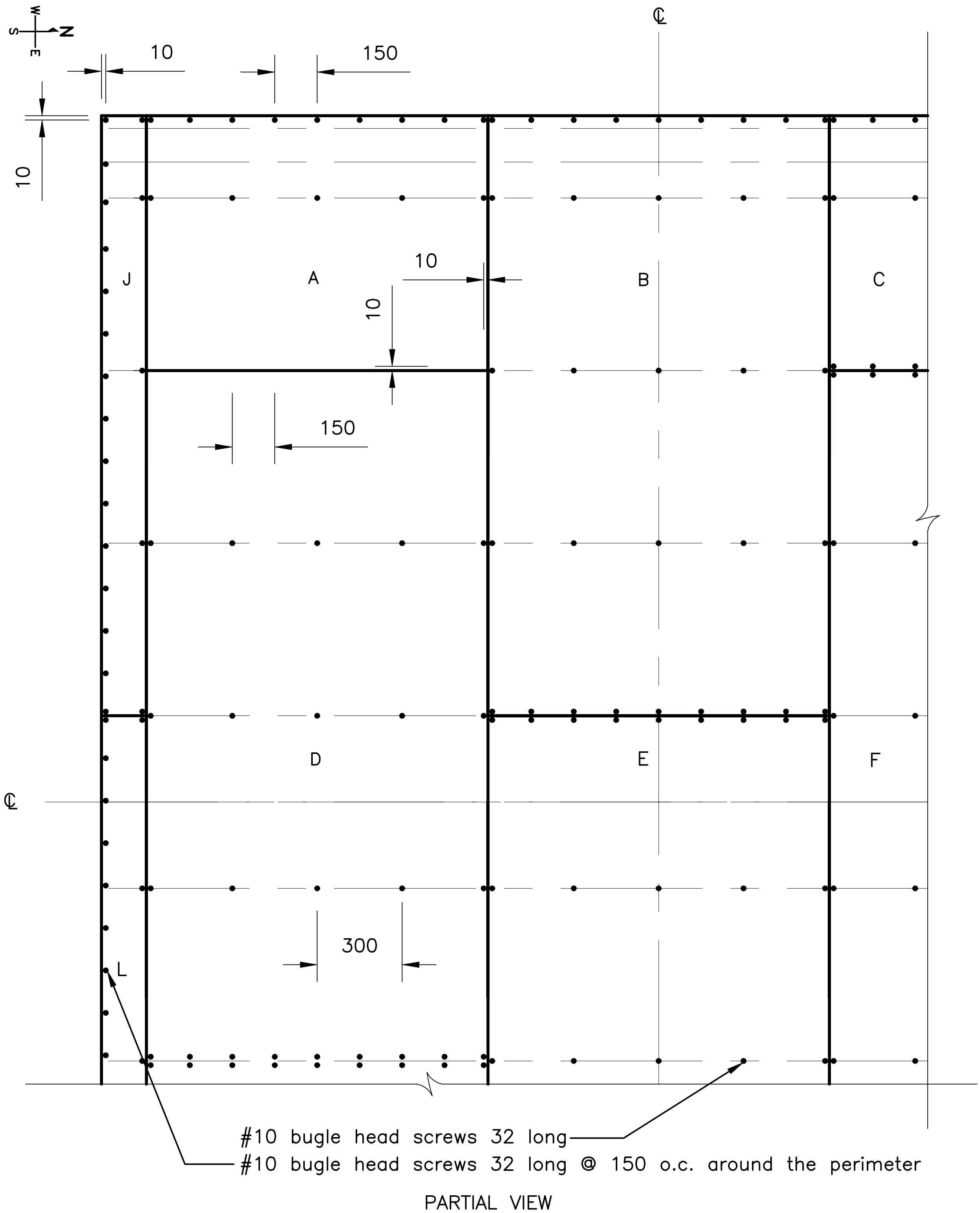
Figure D–76. Steel C–Joist End Connection and Blocking Detail (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-52)

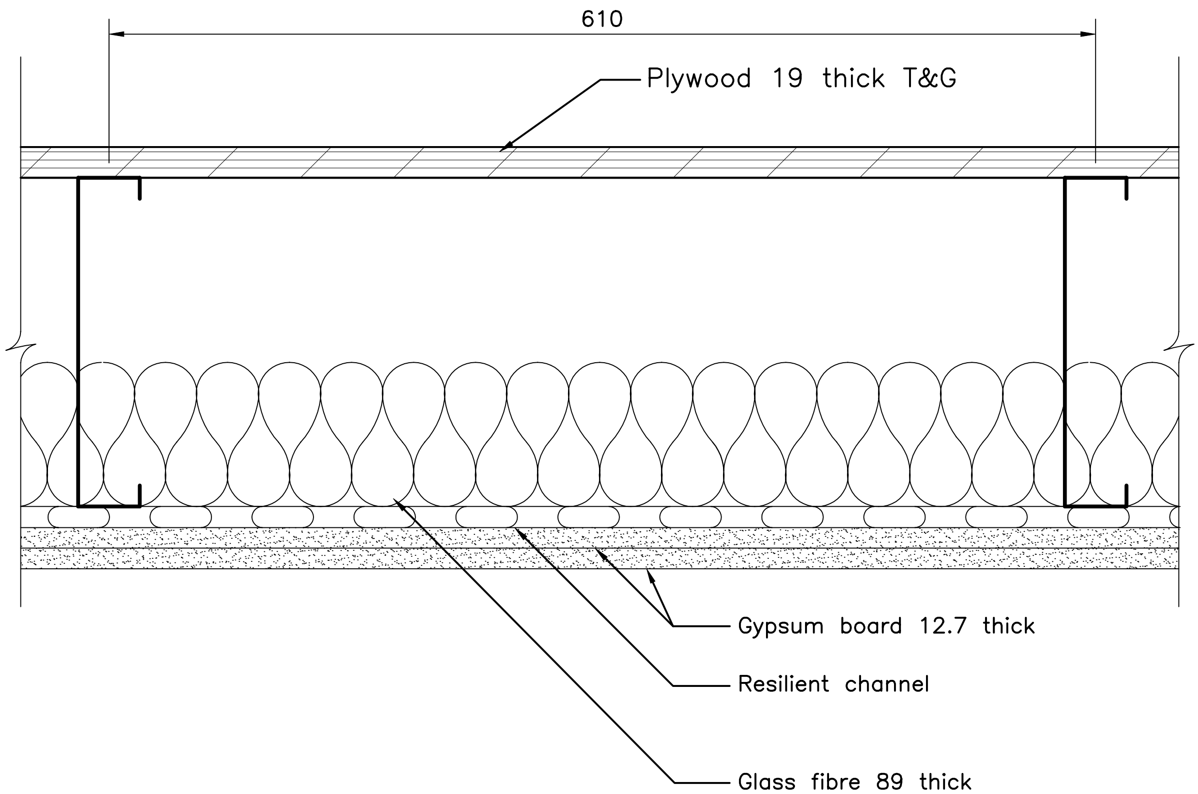
Figure D-77. Subfloor Layout Single Layer (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–52)

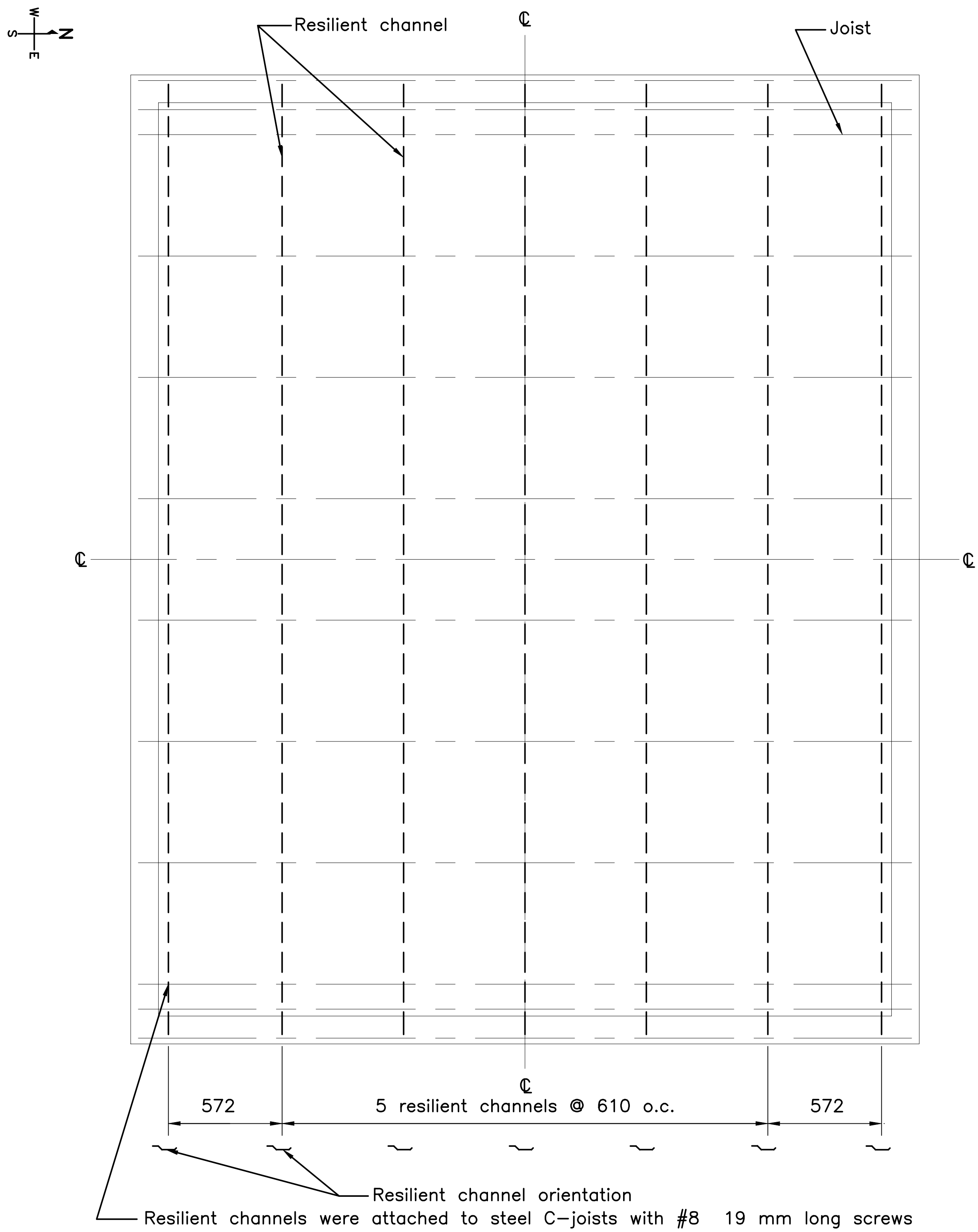
Figure D–78. Subfloor Screw Pattern Single Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–52)

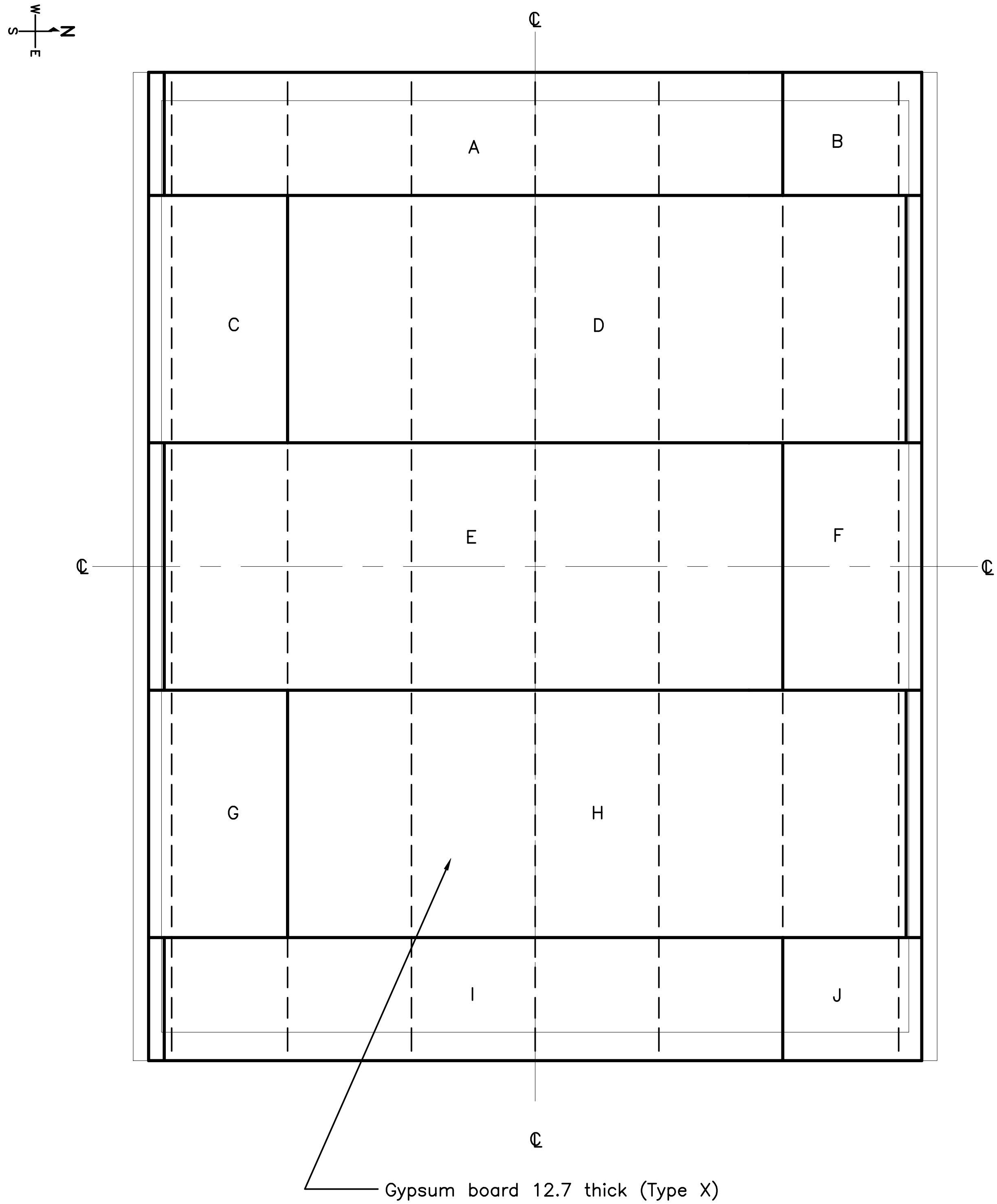
Figure D–79. Insulation Location (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–52)

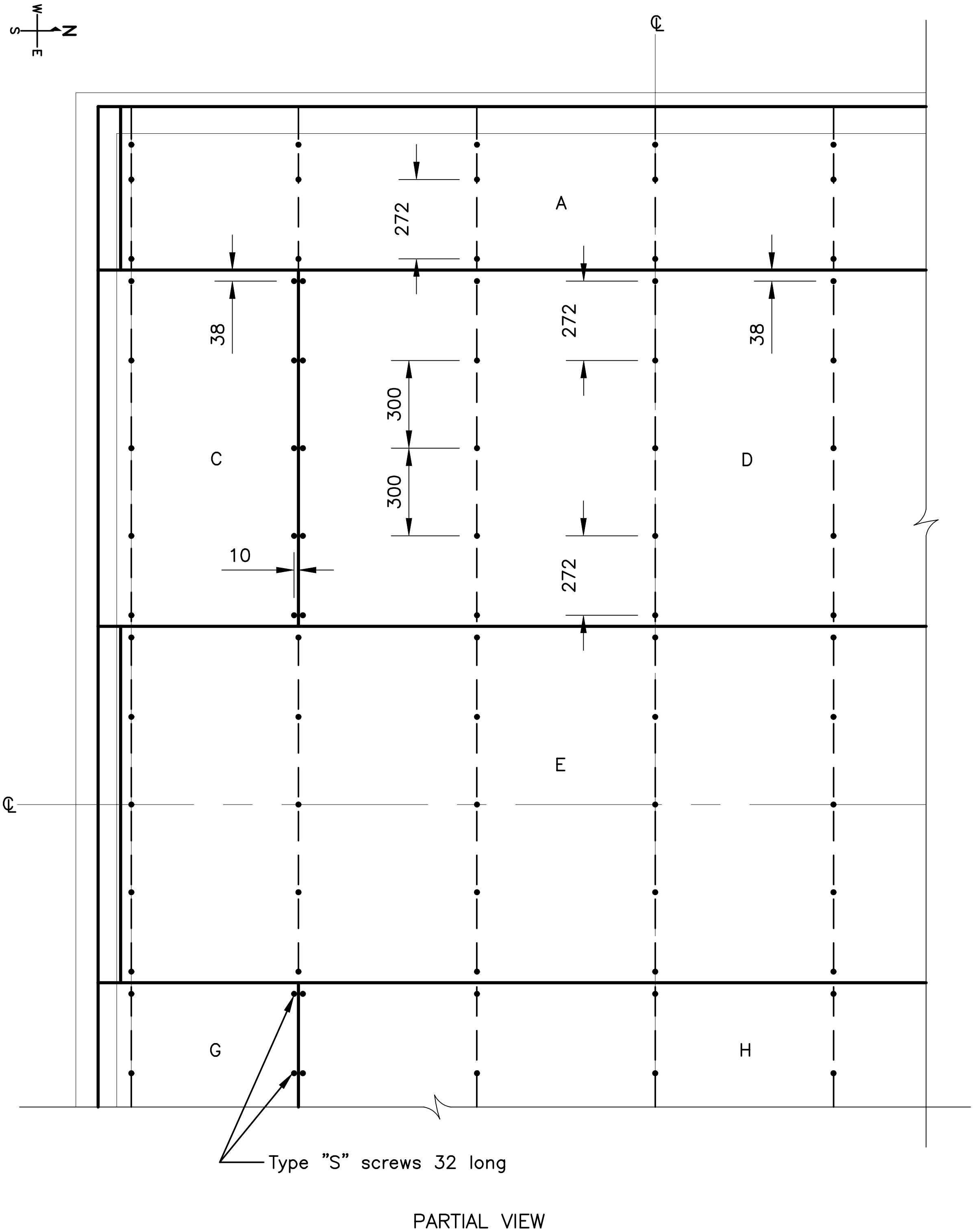
Figure D–80. Resilient Channel Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–52)

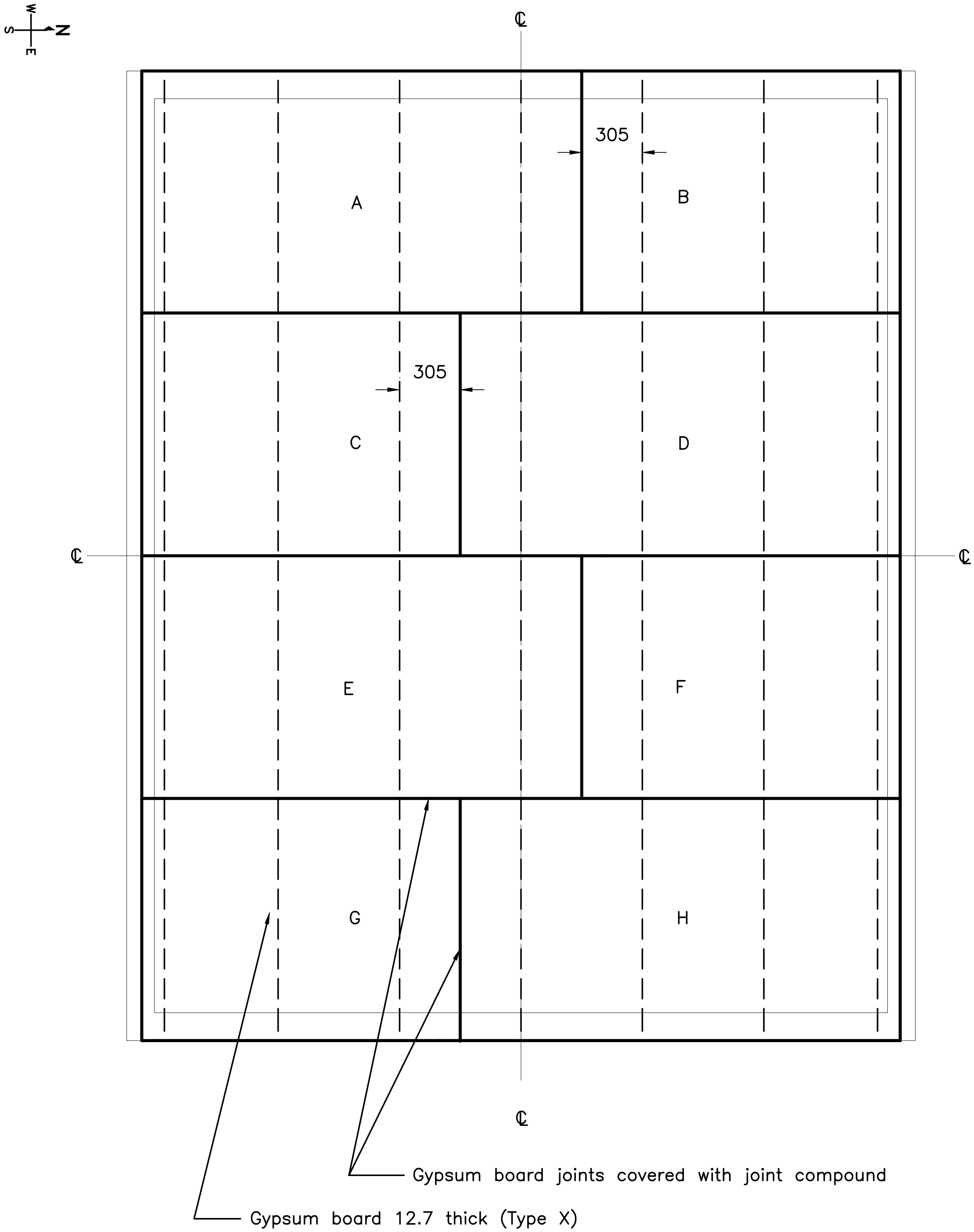
Figure D–81. Gypsum Board Base Layer Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–52)

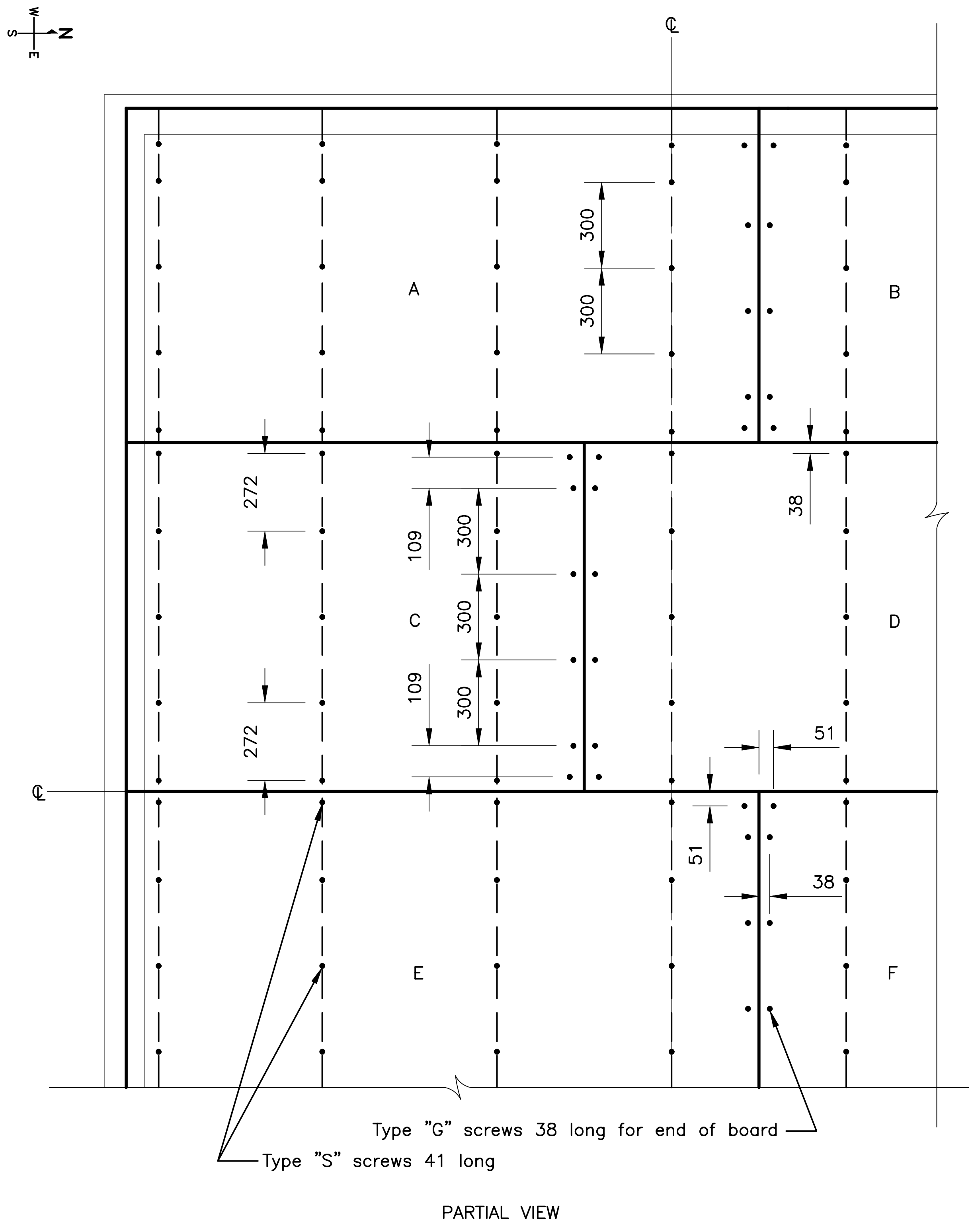
Figure D–82. Gypsum Board Base Layer Screw Pattern (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–52)

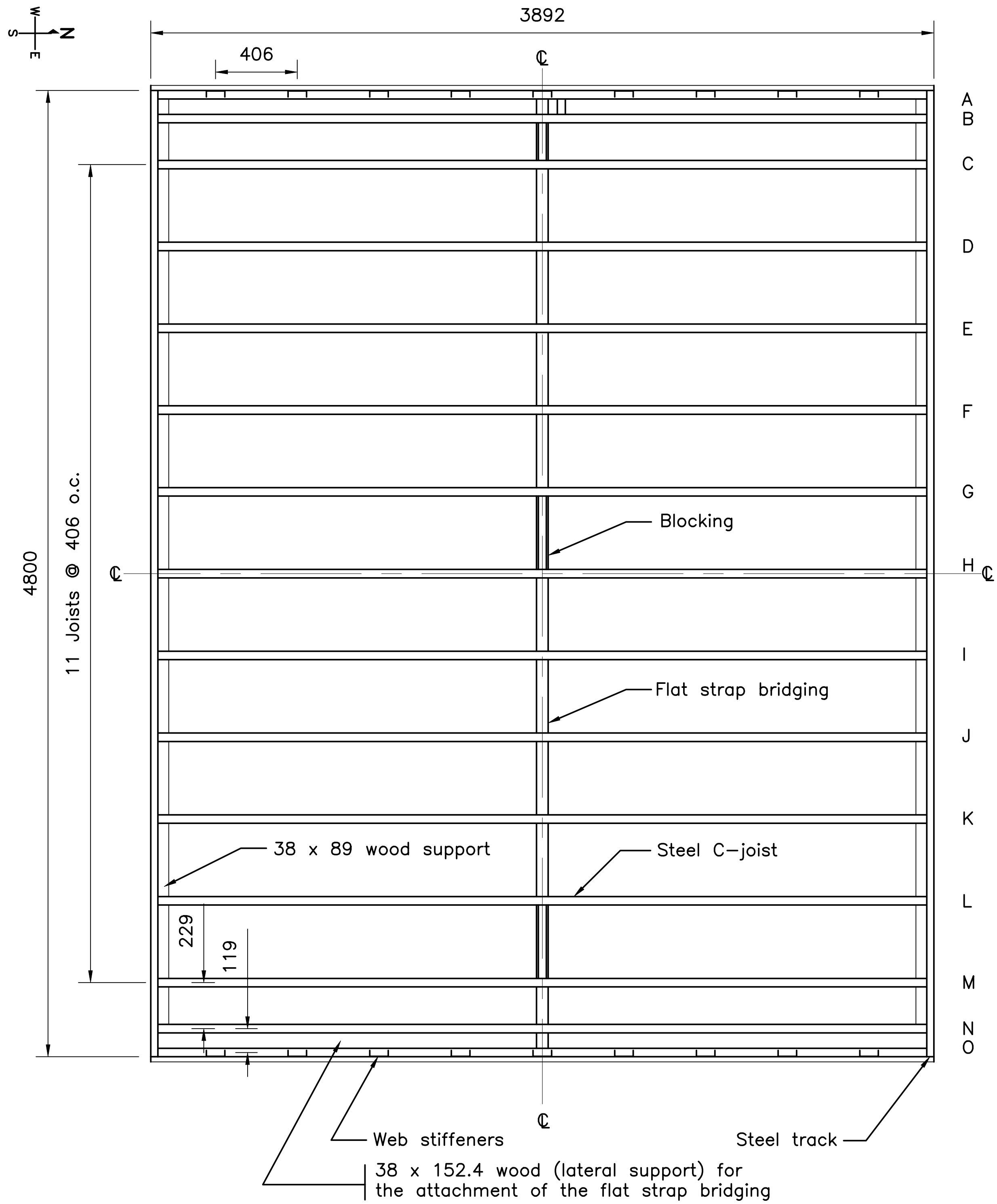
Figure D–83. Gypsum Board Face Layer Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-52)

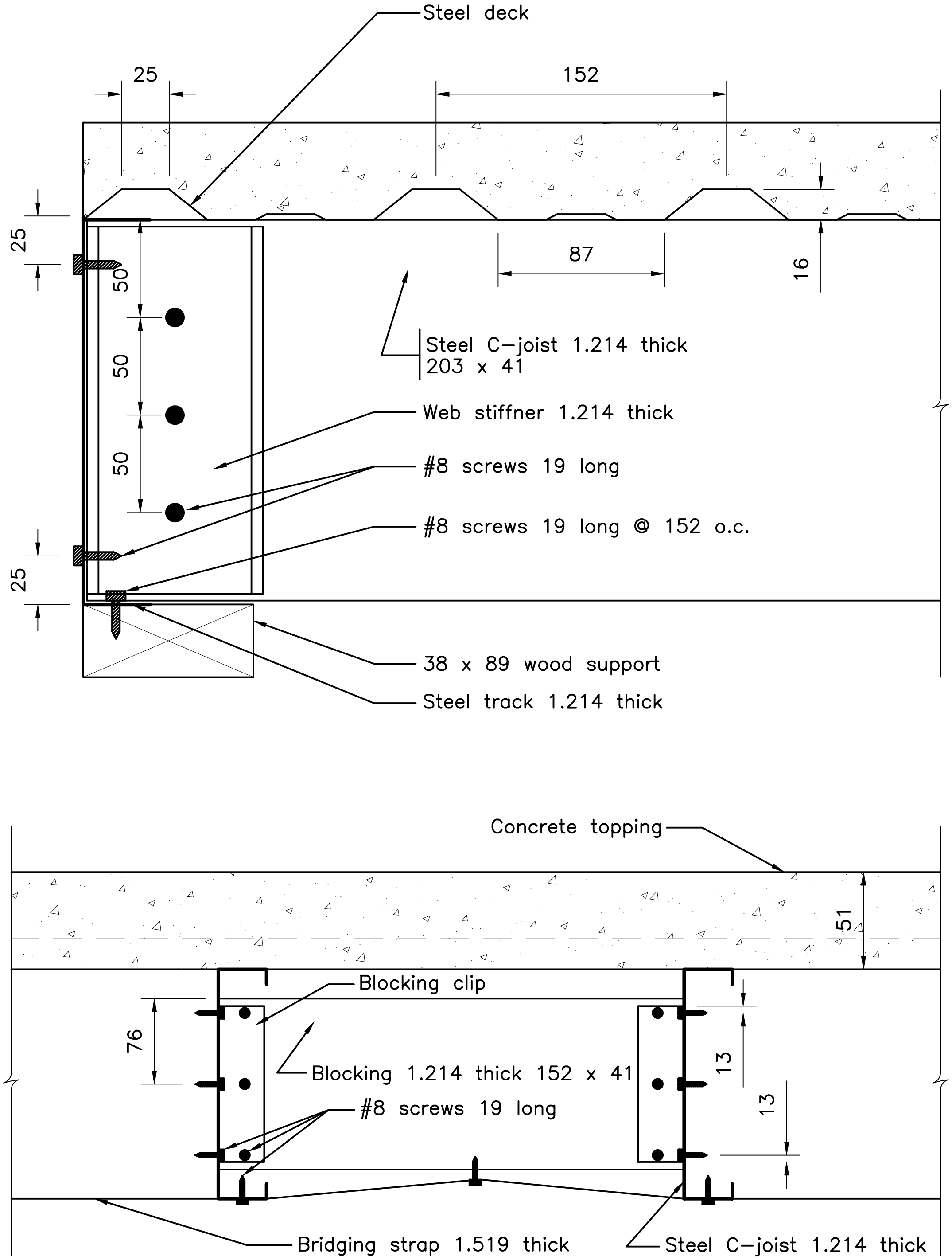
Figure D-84. Gypsum Board Face Layer Screw Pattern (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–53)

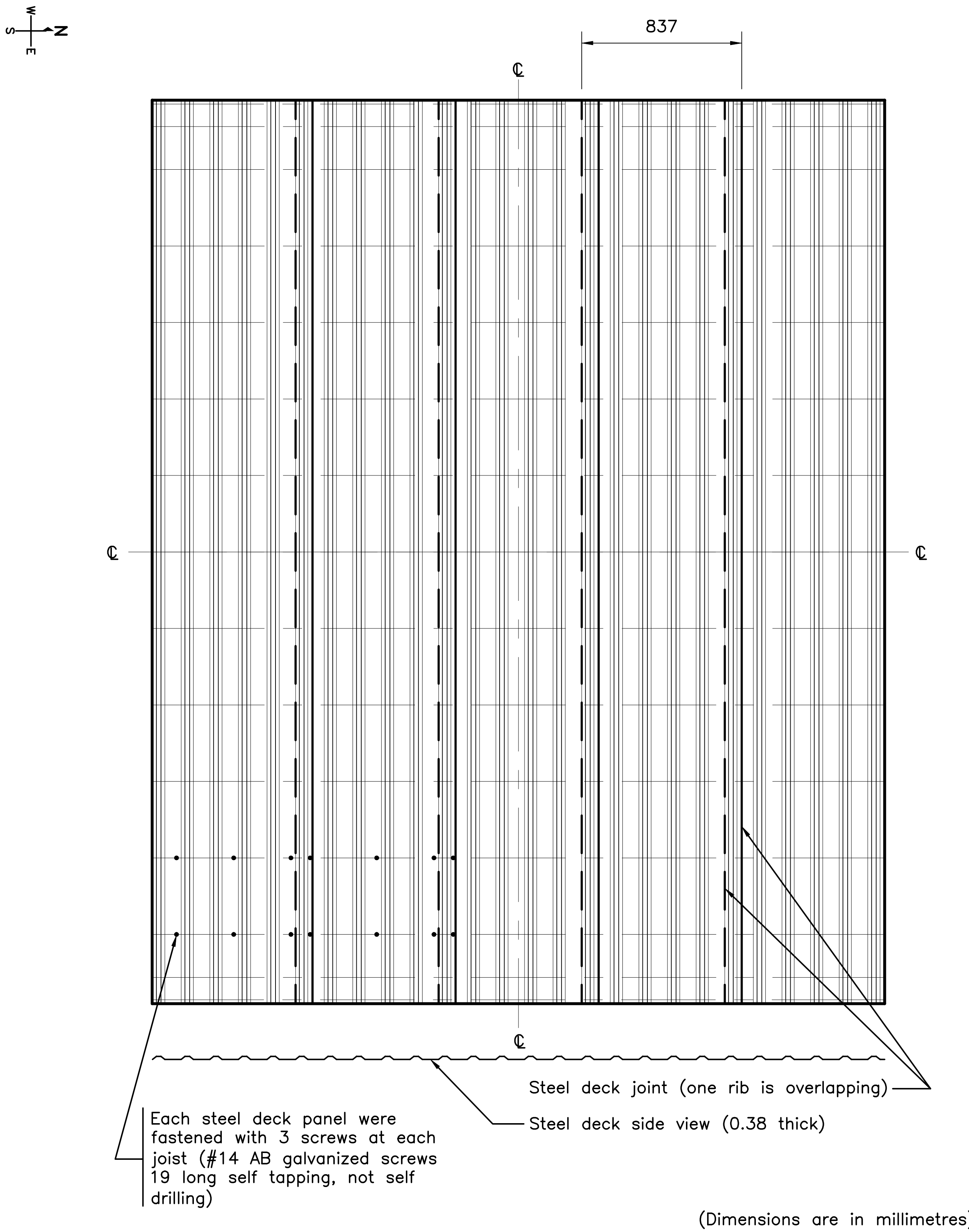
Figure D–85. Joist Layout (Steel C–Joist)



(Dimensions are in millimetres)

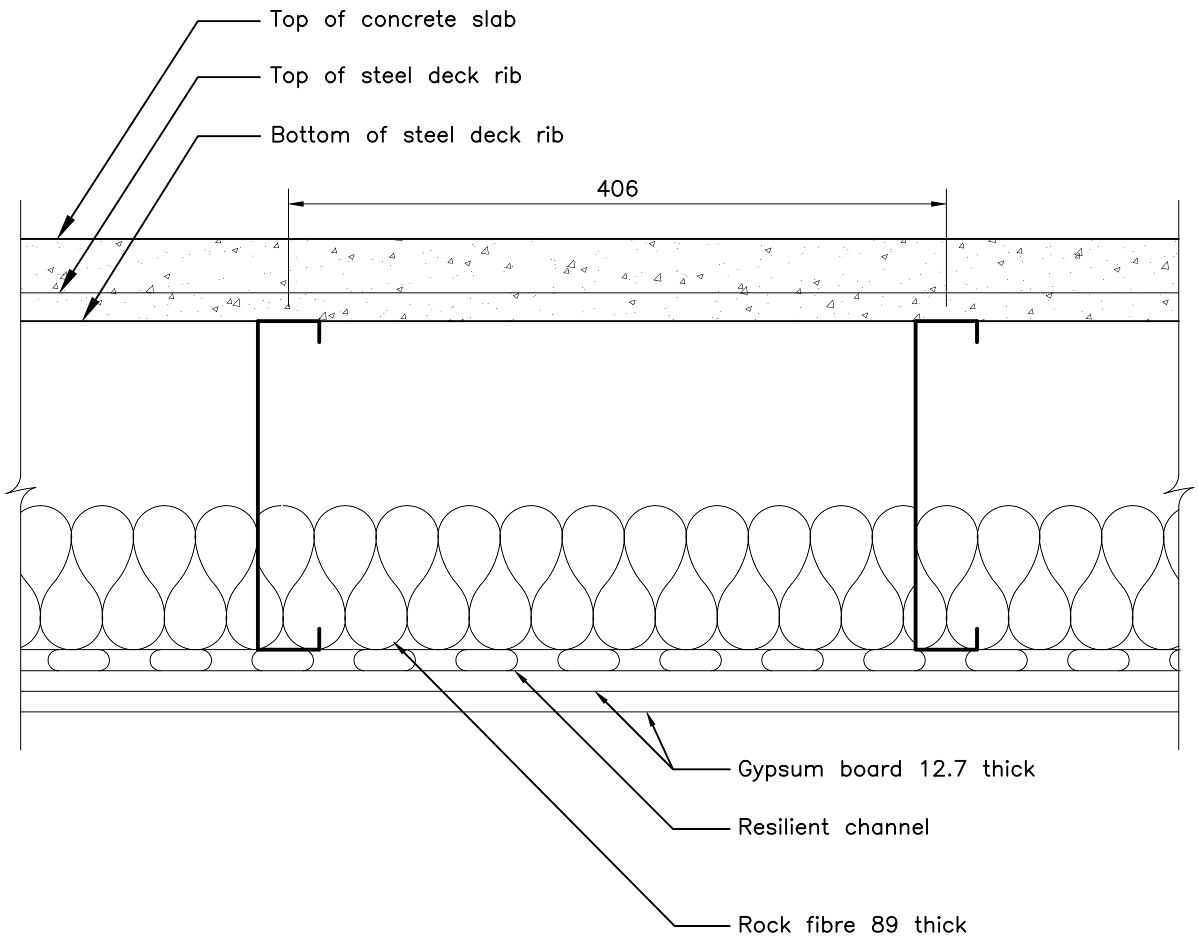
(Assembly No. FF–53)

Figure D–86. Steel C–Joist End Connection, Concrete Slab and Blocking Details (Steel C–Joist)



(Assembly No. FF–53)

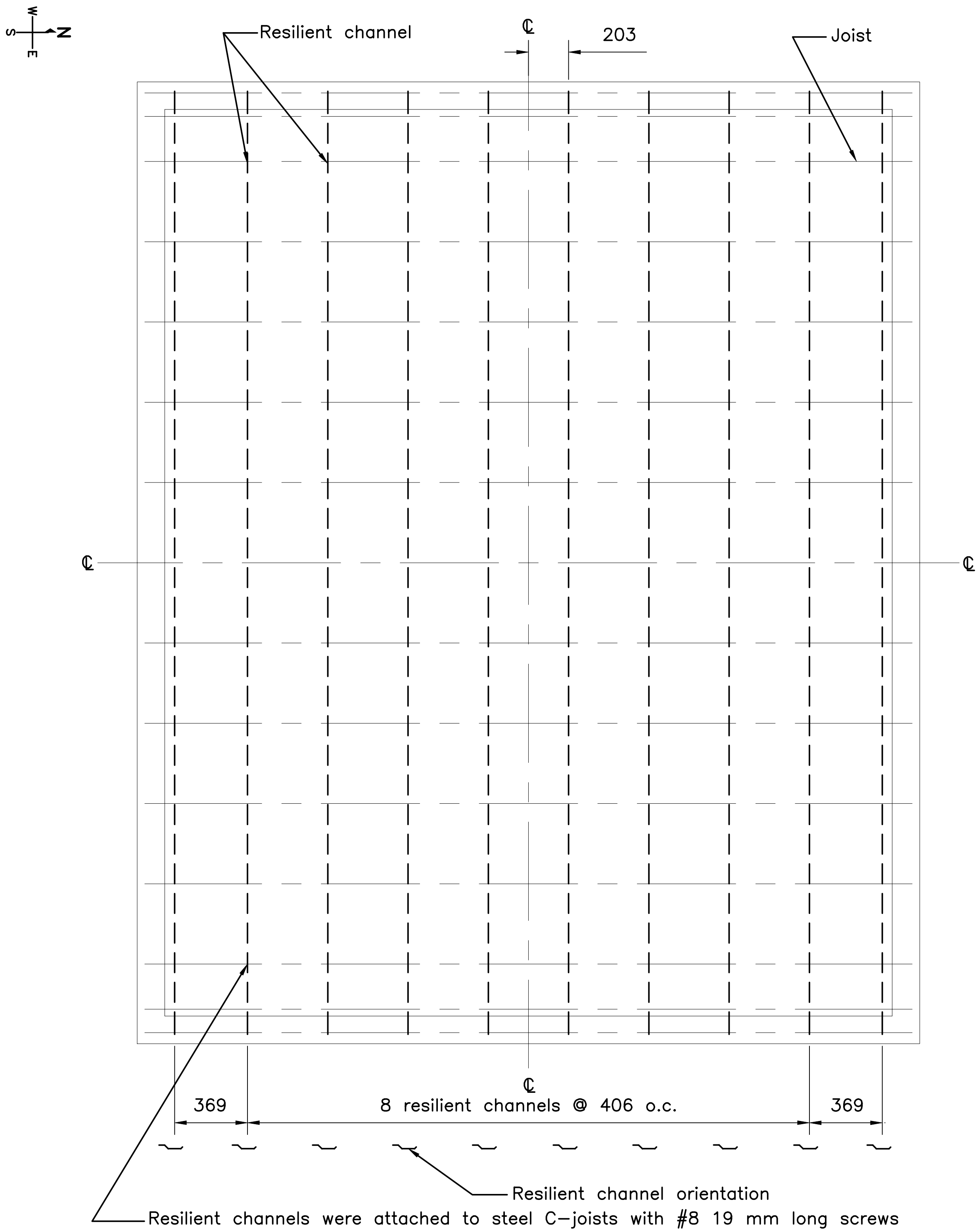
Figure D–87. Steel Deck Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–53)

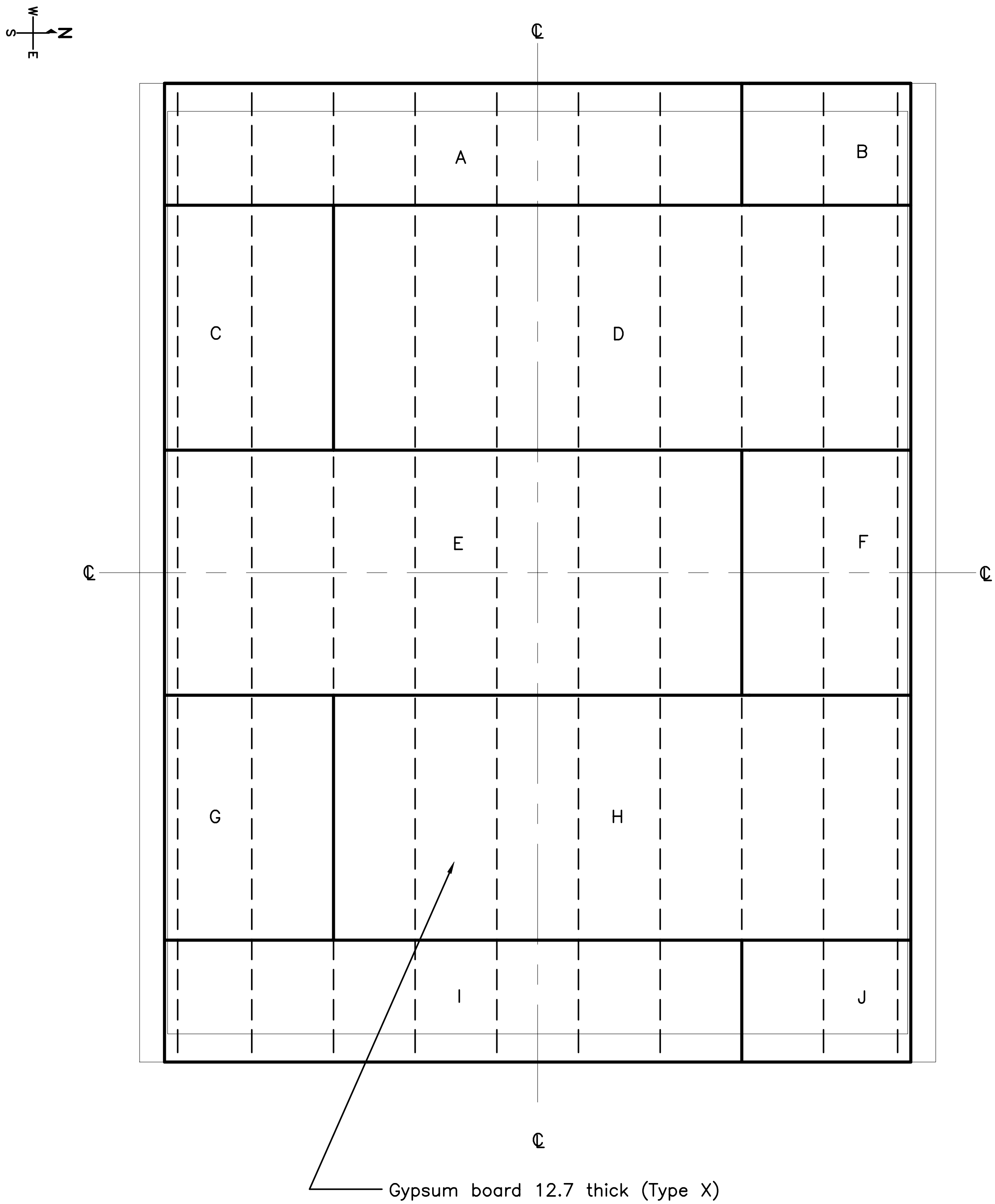
Figure D–88. Insulation Location (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–53)

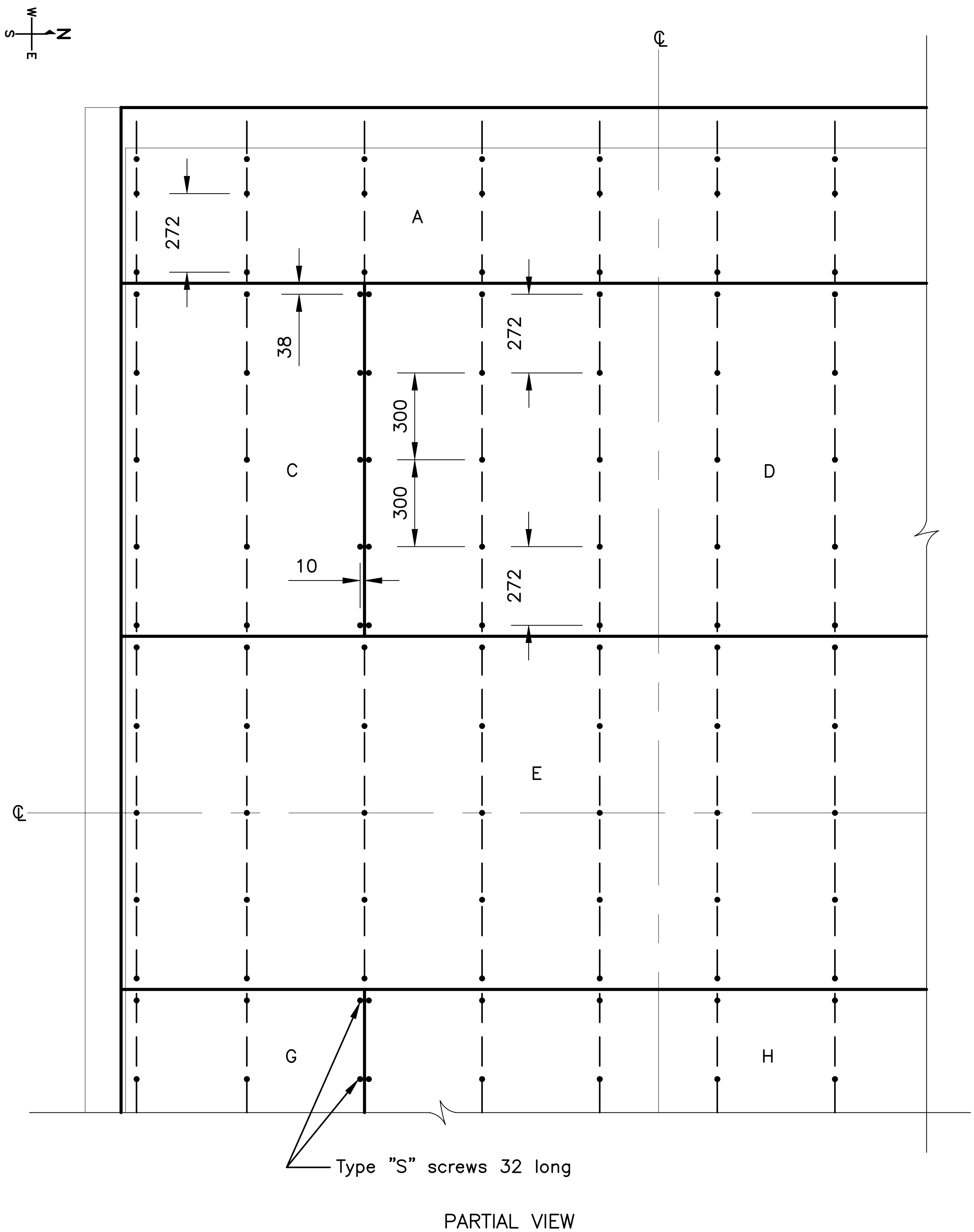
Figure D–89. Resilient Channel Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–53)

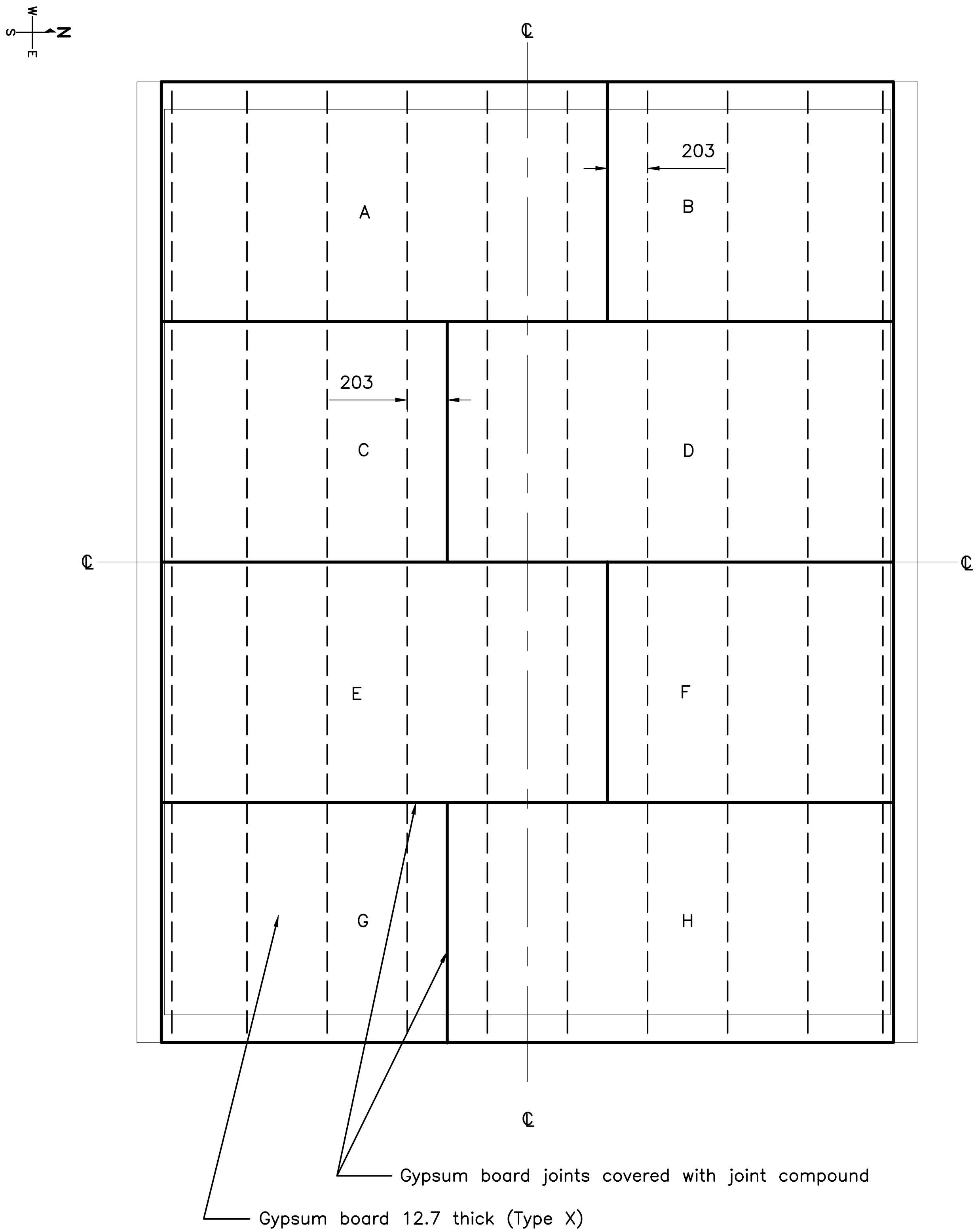
Figure D–90. Gypsum Board Base Layer Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–53)

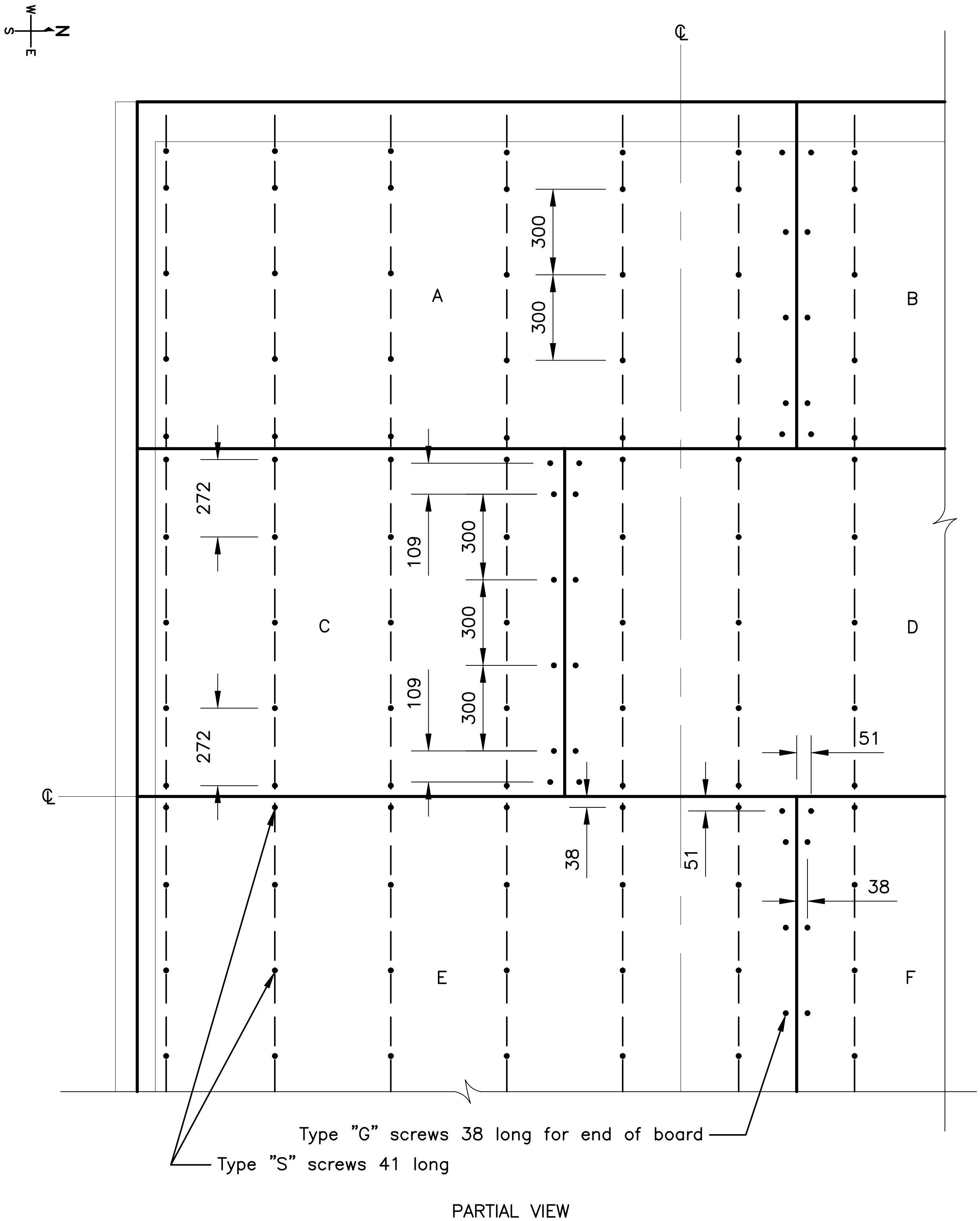
Figure D–91. Gypsum Board Base Layer Screw Pattern (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–53)

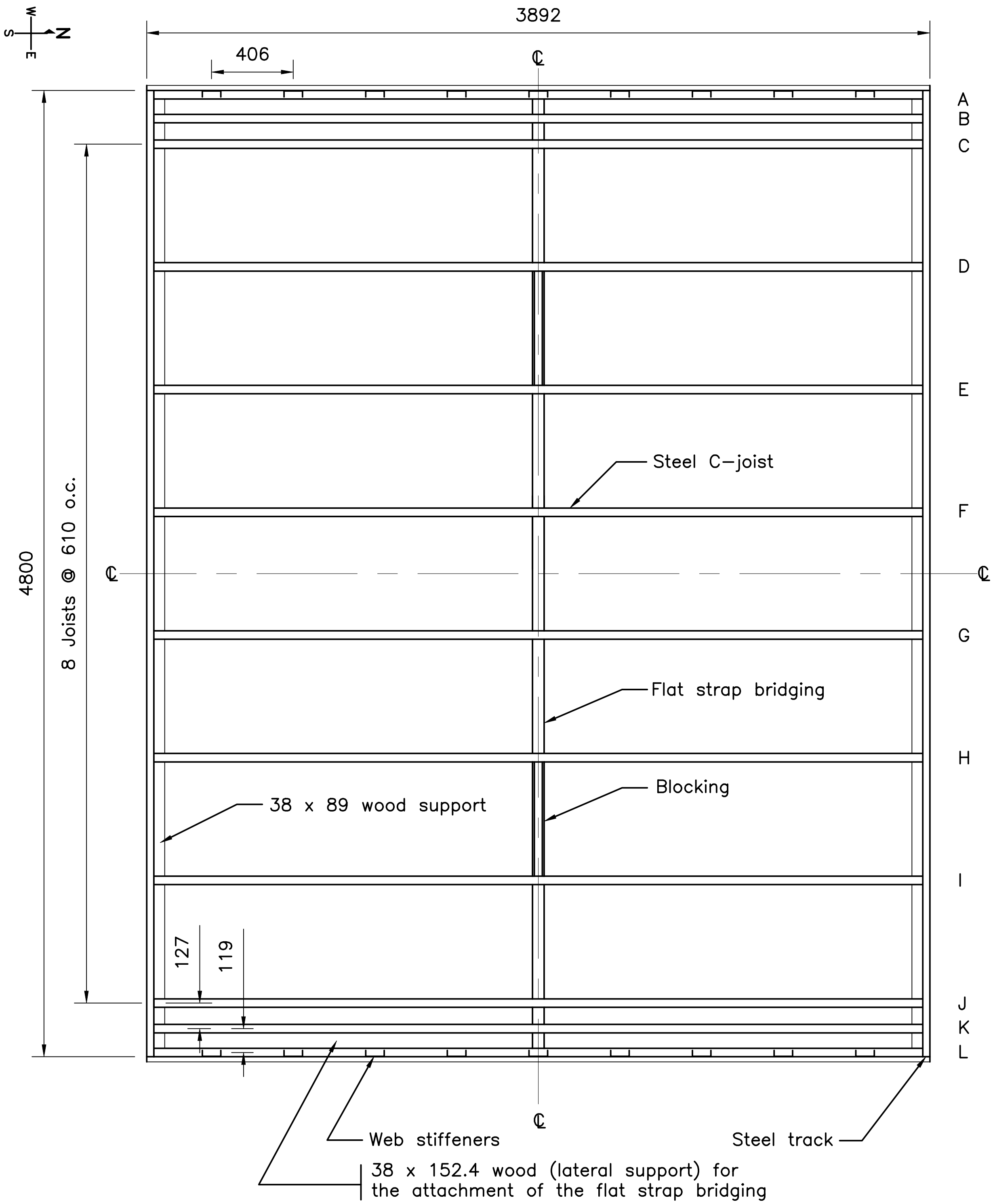
Figure D–92. Gypsum Board Face Layer Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–53)

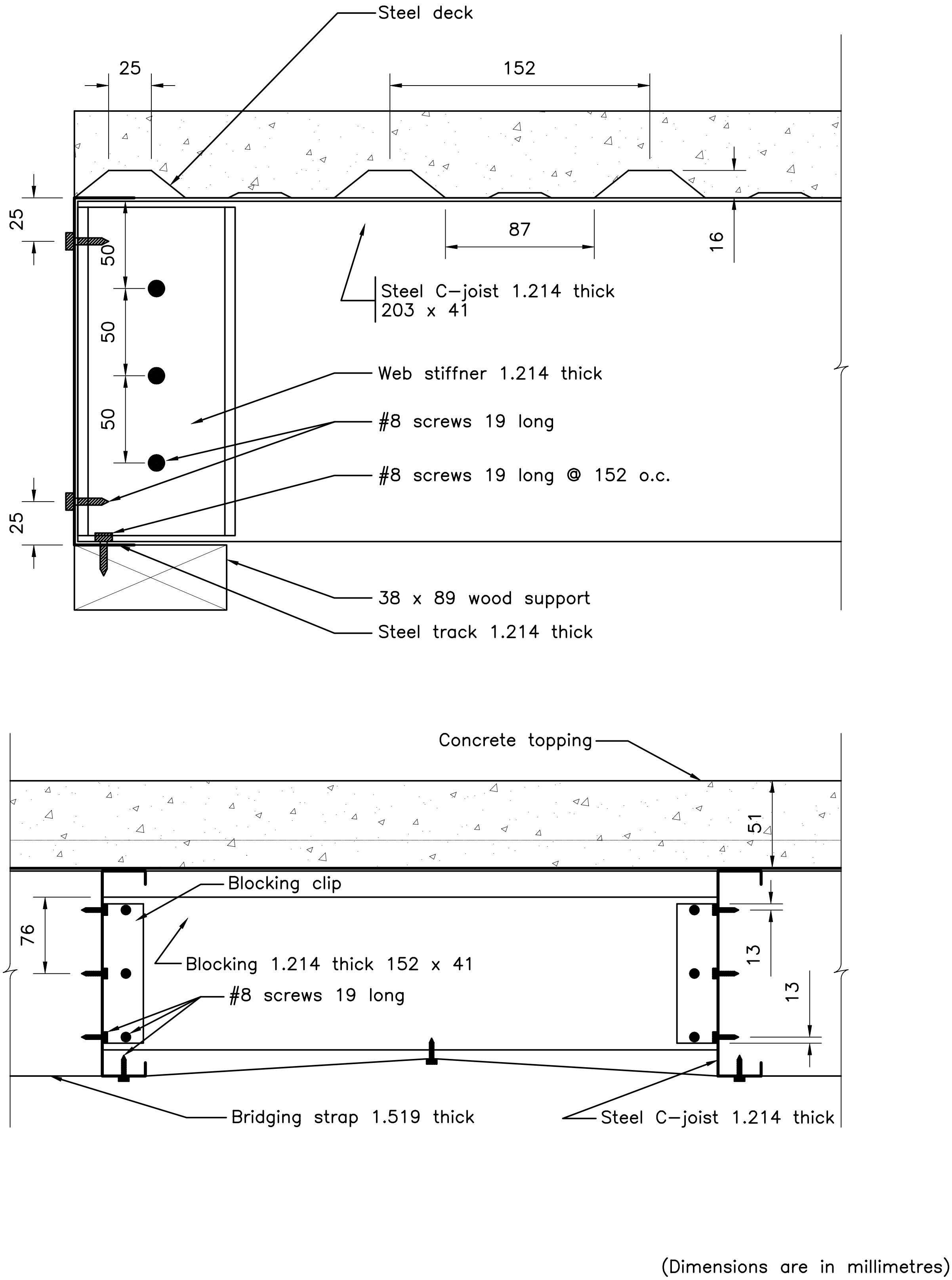
Figure D–93. Gypsum Board Face Layer Screw Pattern (Steel C–Joist)



(Dimensions are in millimetres)

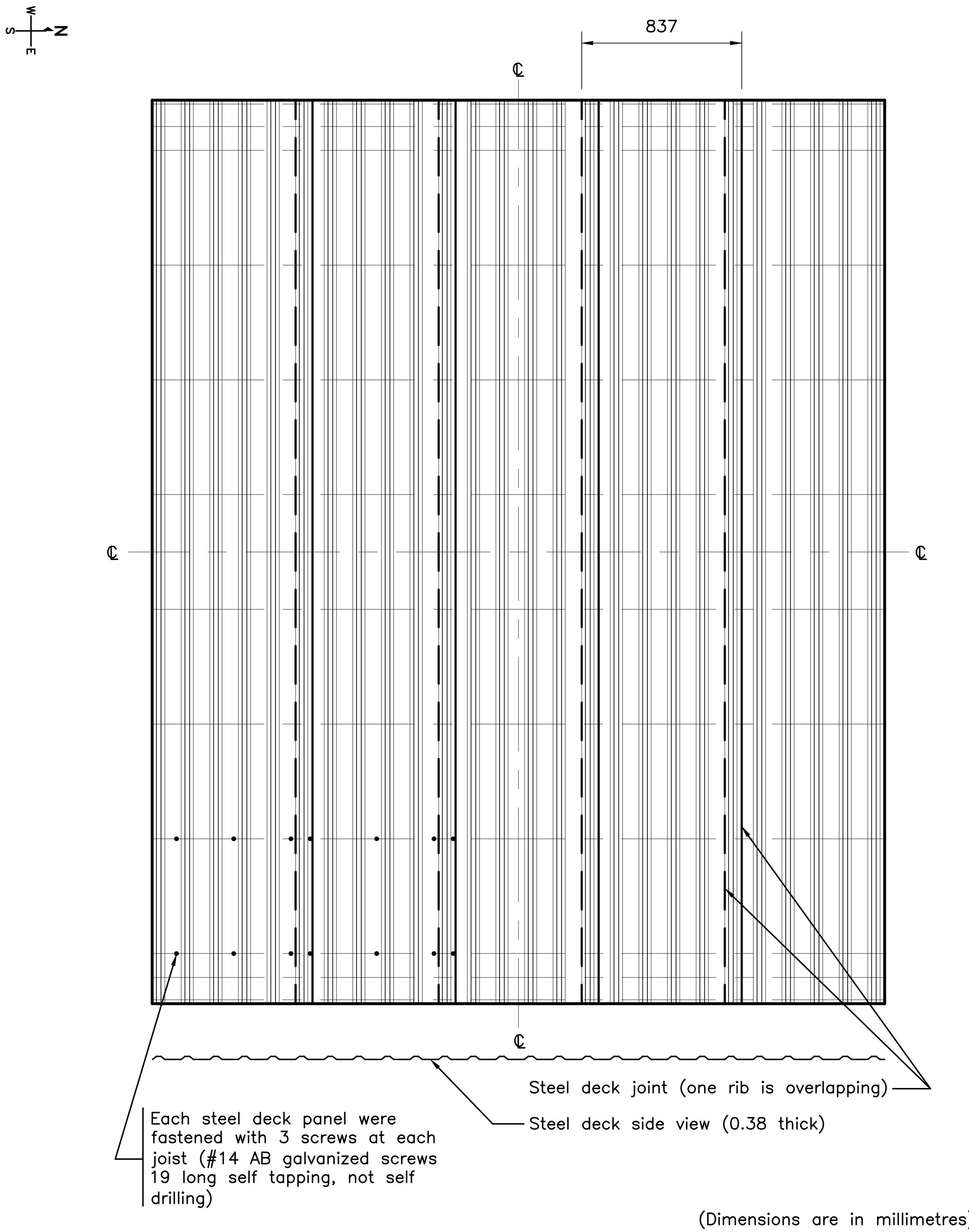
(Assembly No. FF–54)

Figure D–94. Joist Layout (Steel C–Joist)



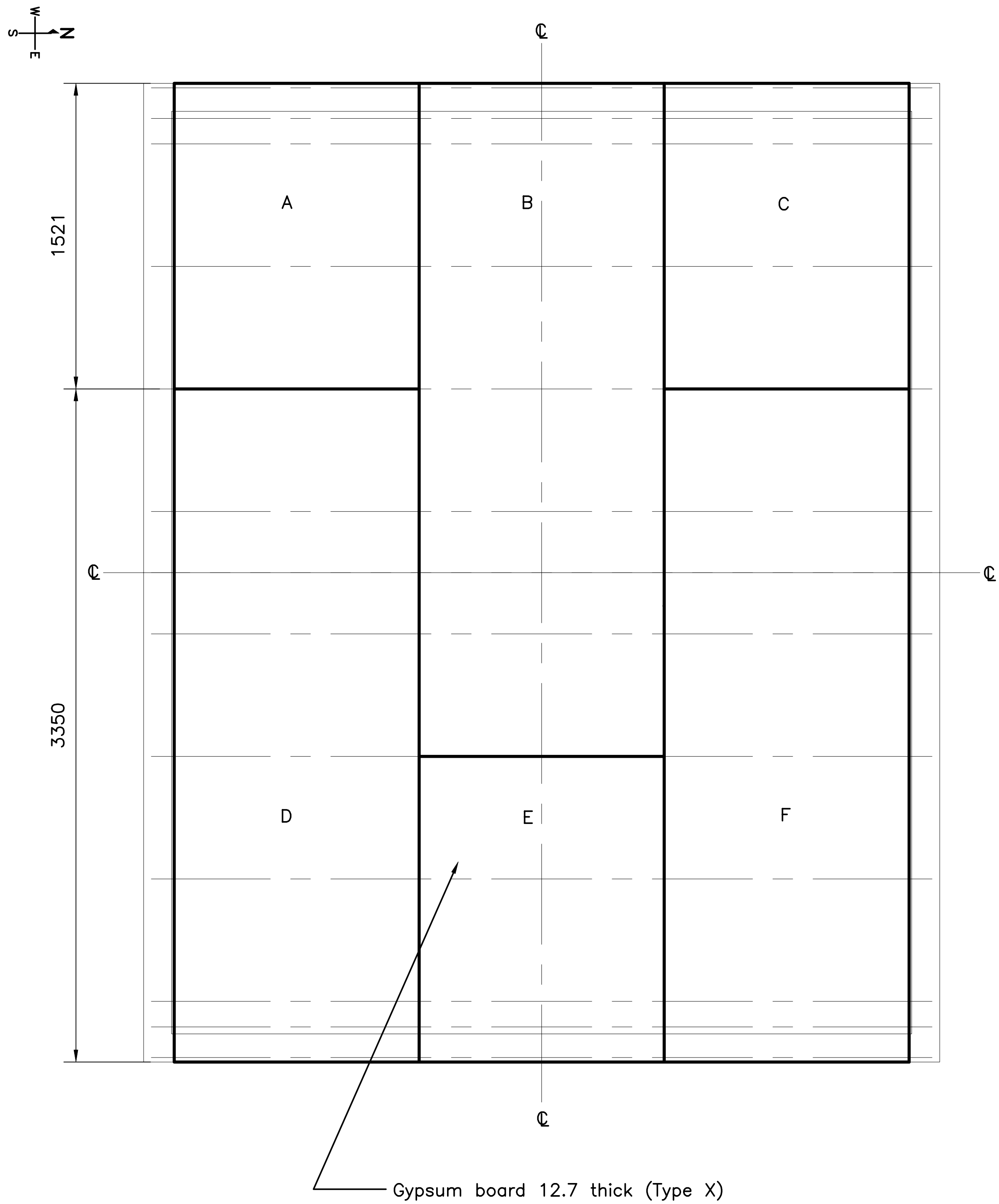
(Assembly No. FF–54)

Figure D–95. Steel C–Joist End Connection and Blocking Detail
(Steel C–joist)



(Assembly No. FF-54)

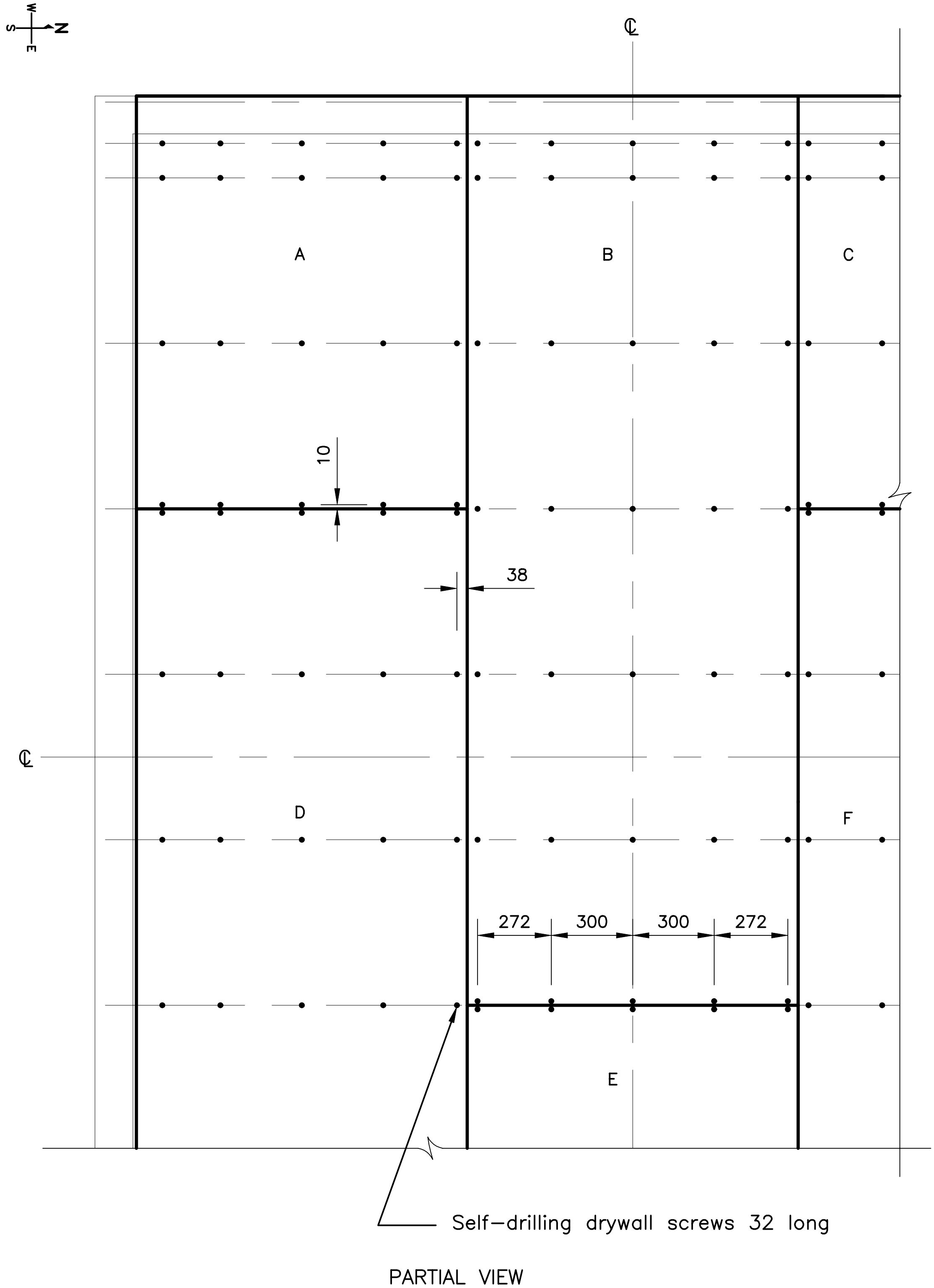
Figure D-96. Steel Deck Layout (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF-54)

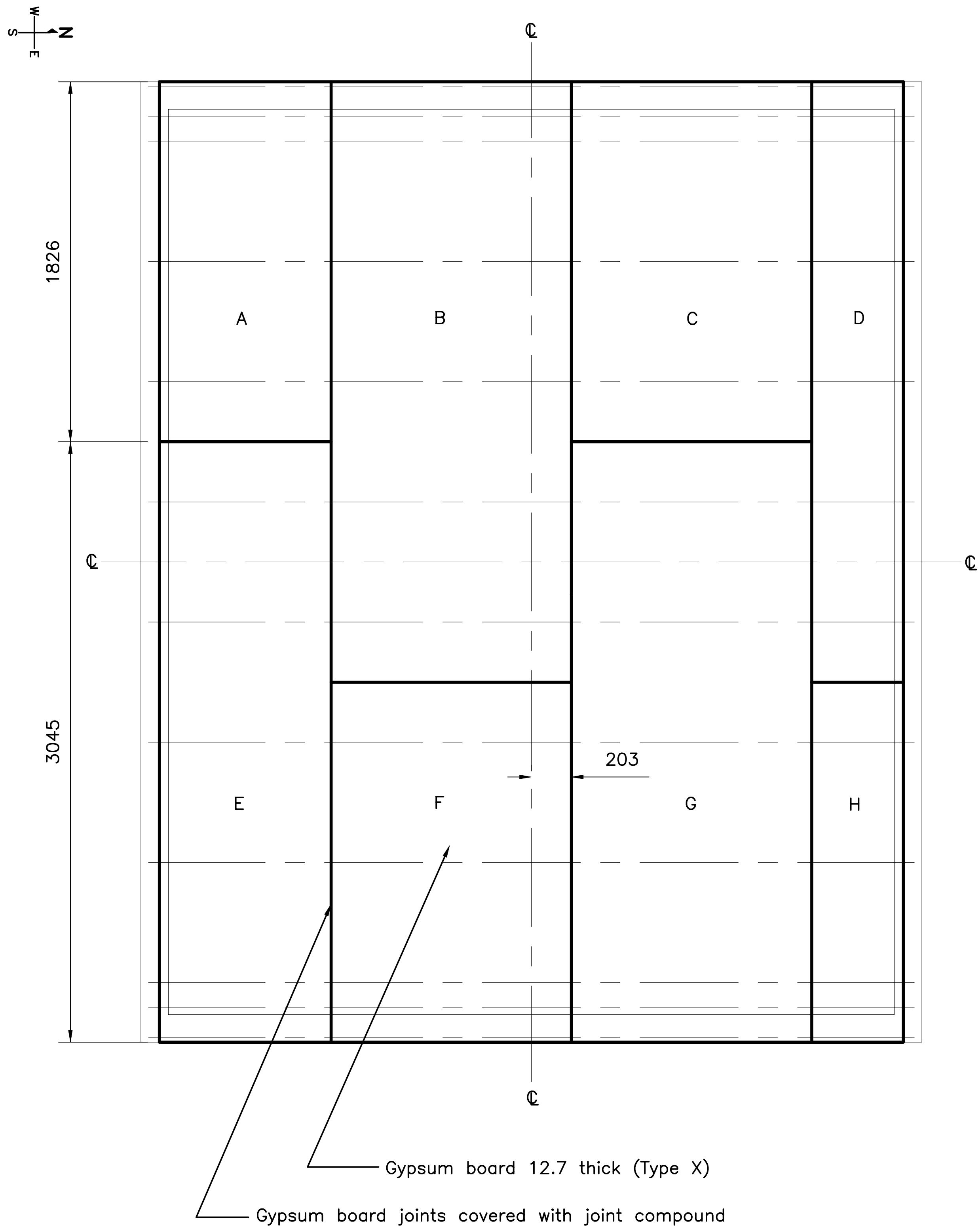
Figure D-97. Gypsum Board Base Layer Layout (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF-54)

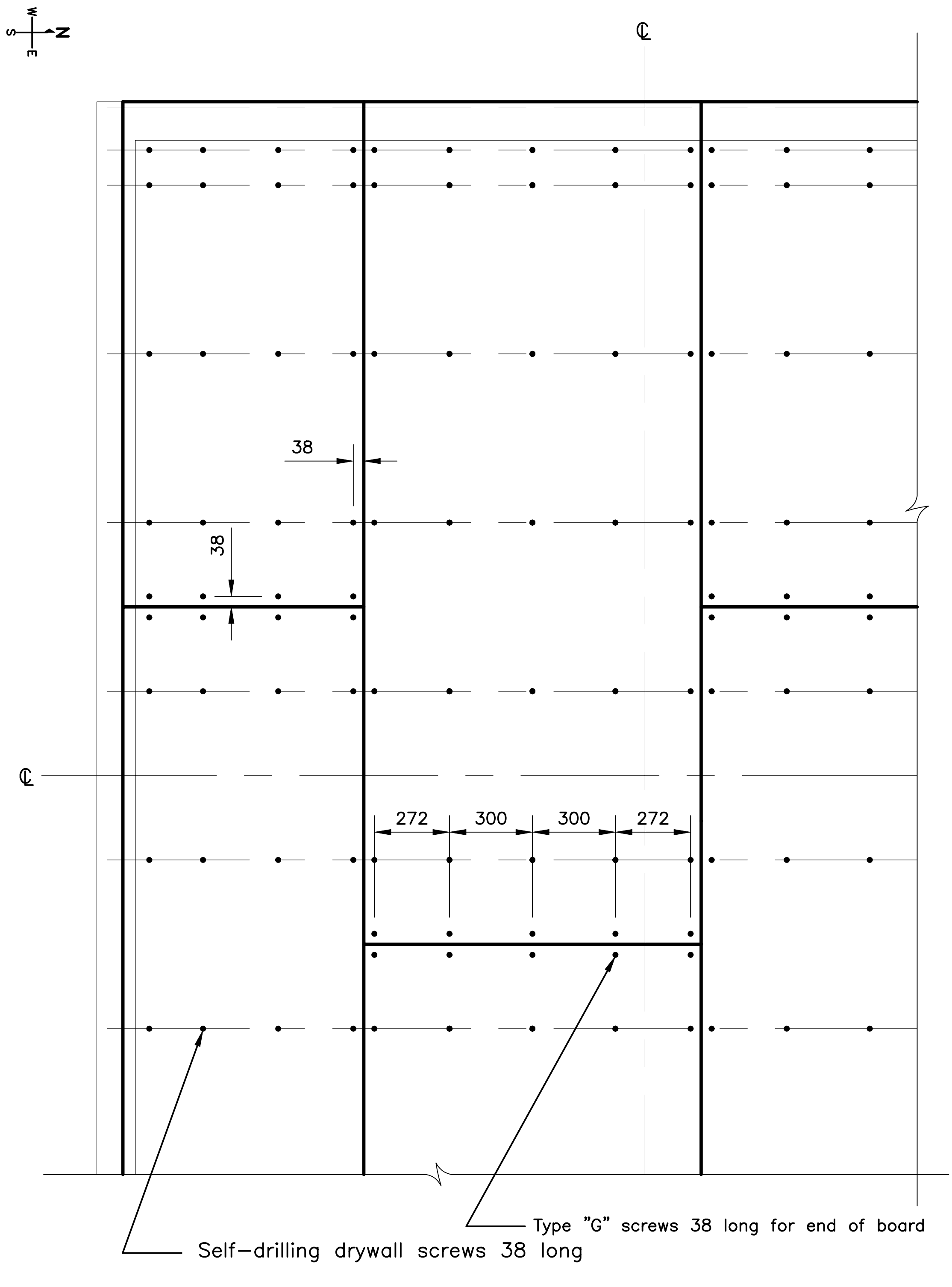
Figure D-98. Gypsum Board Base Layer Screw Pattern (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–54)

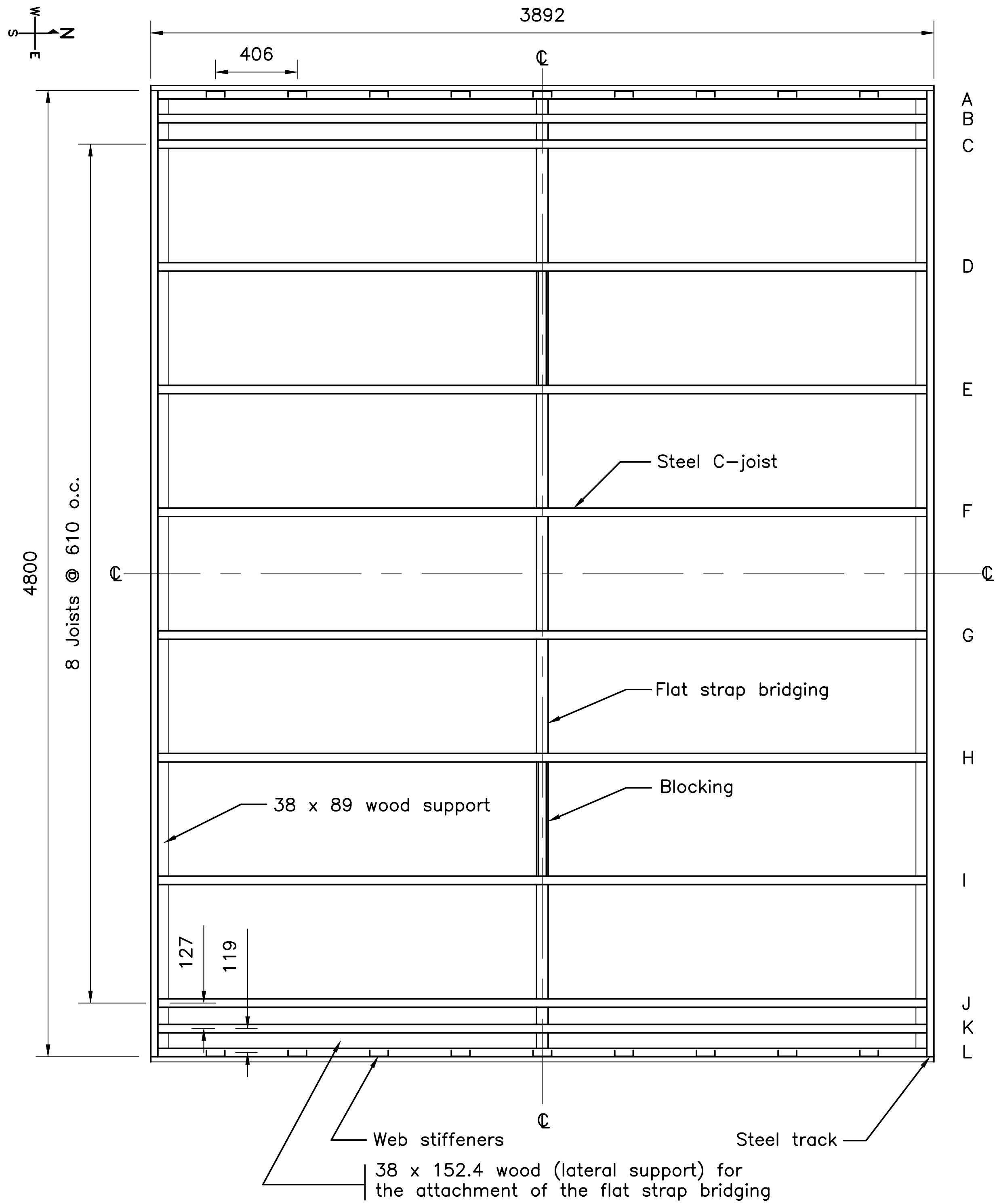
Figure D–99. Gypsum Board Face Layer Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-54)

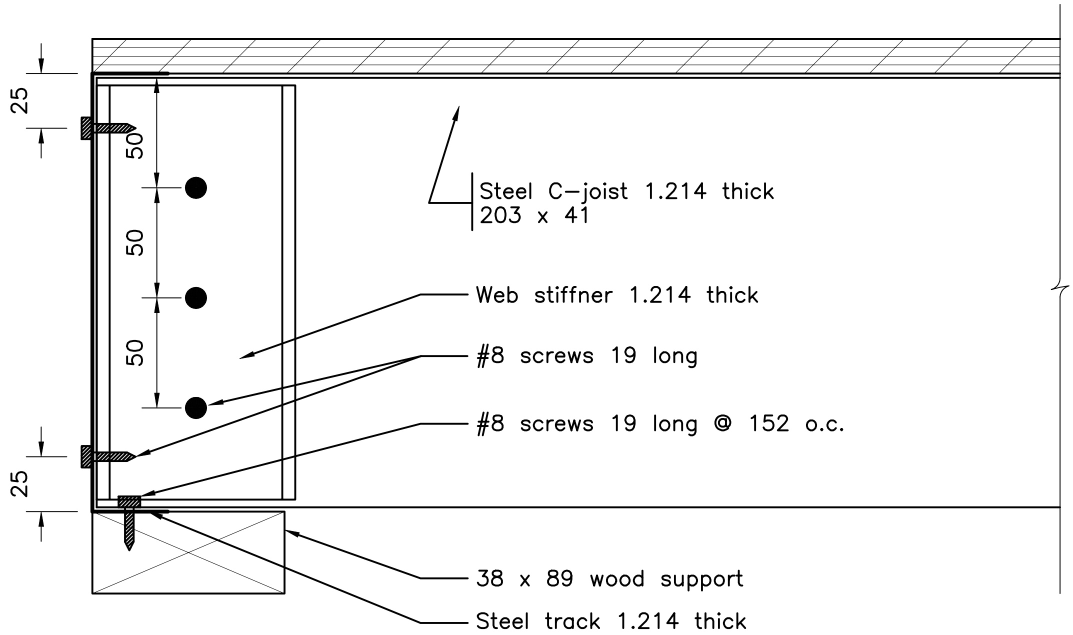
Figure D-100. Gypsum Board Face Layer Screw Pattern (Steel C-Joist)

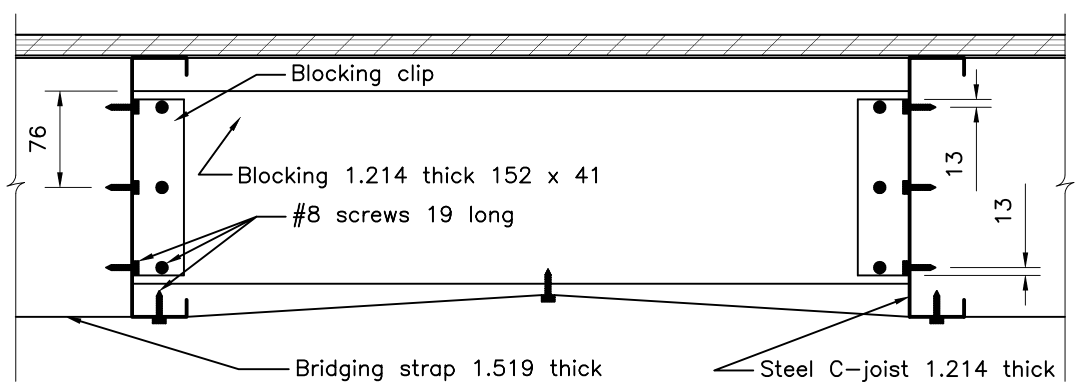


(Dimensions are in millimetres)

(Assembly No. FF–62)

Figure D–101. Joist Layout (Steel C–Joist)

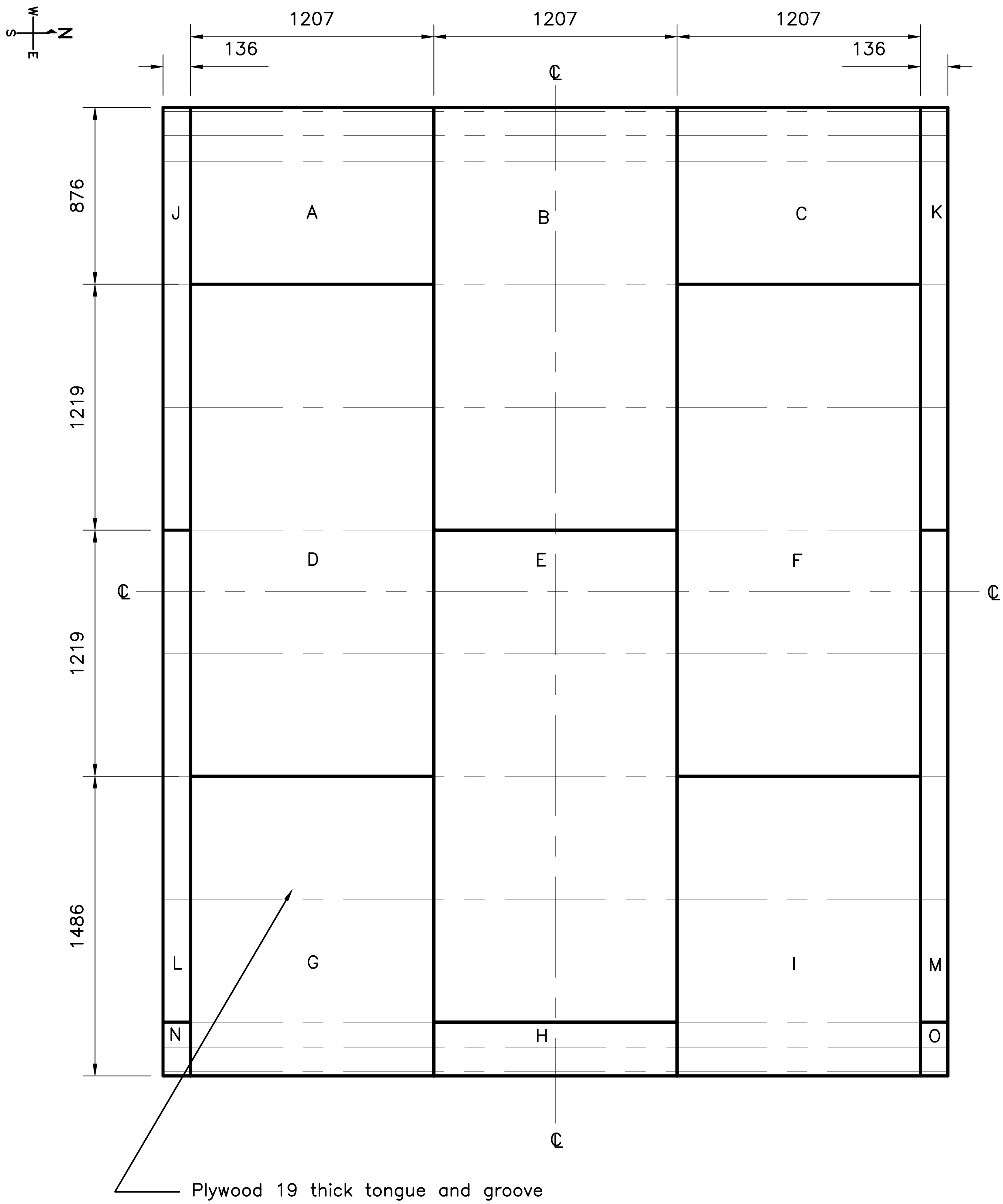




(Dimensions are in millimetres)

(Assembly No. FF-62)

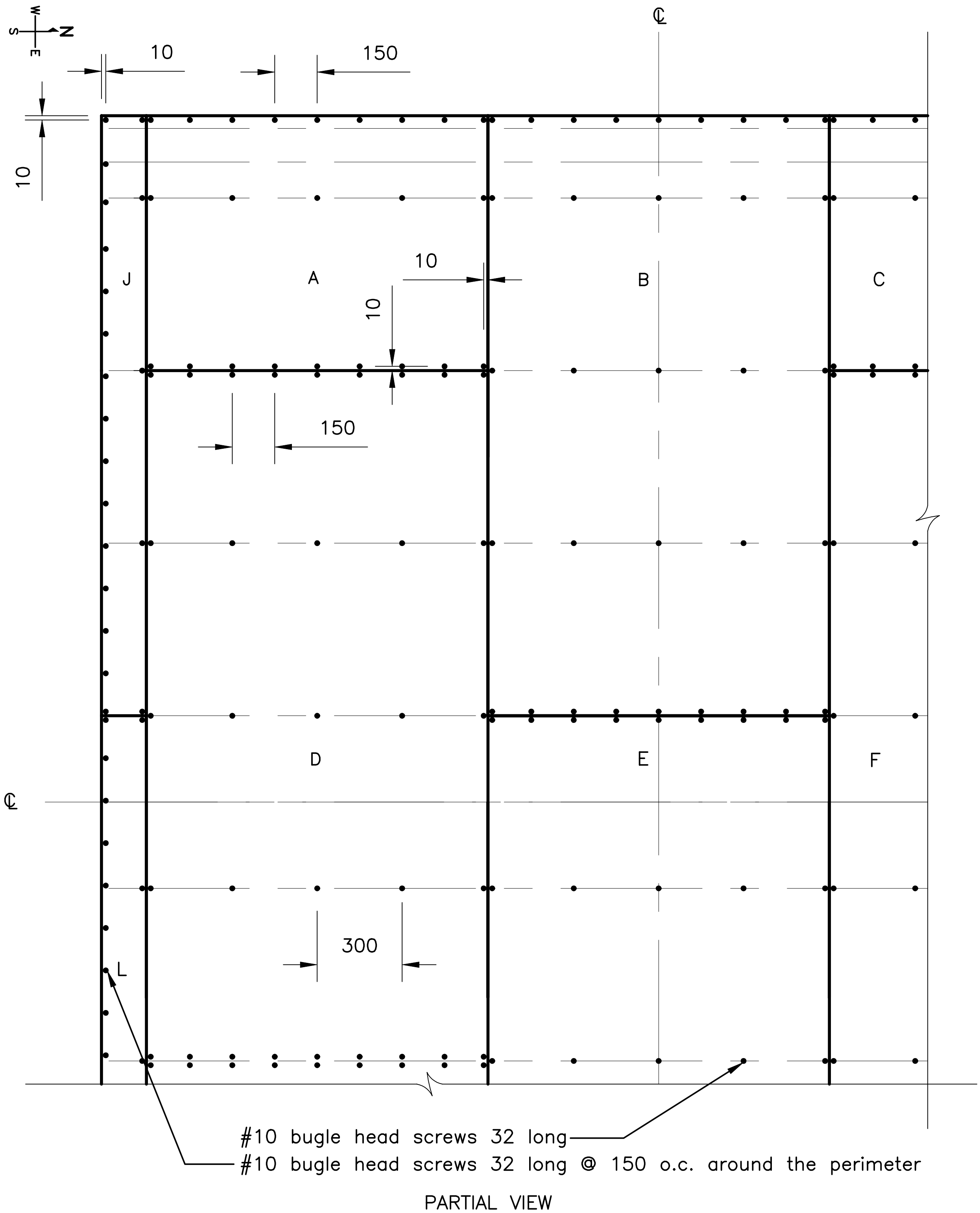
Figure D-102. Steel C-Joist End Connection and Blocking Detail
(Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–62)

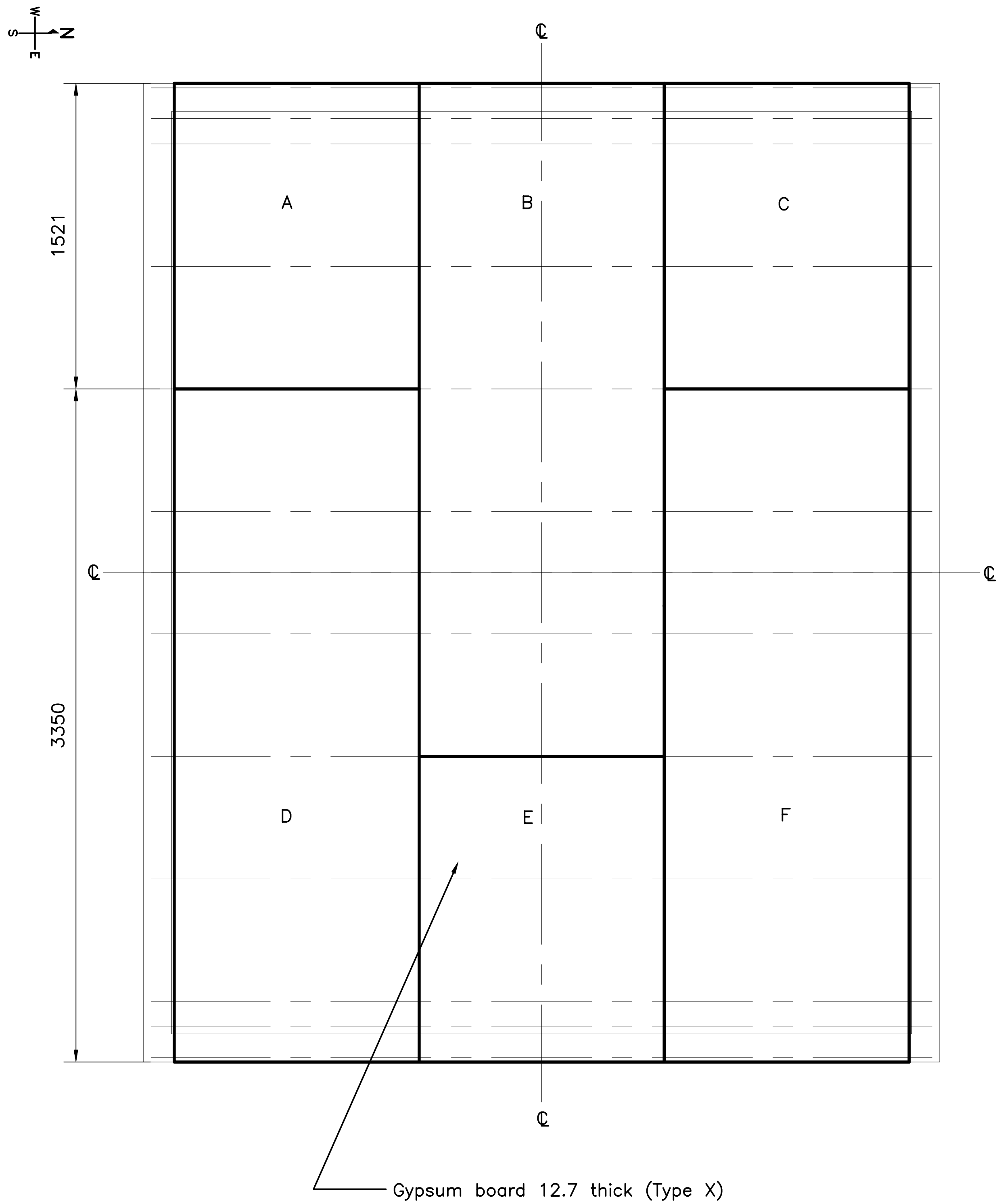
Figure D–103. Subfloor Layout Single Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–62)

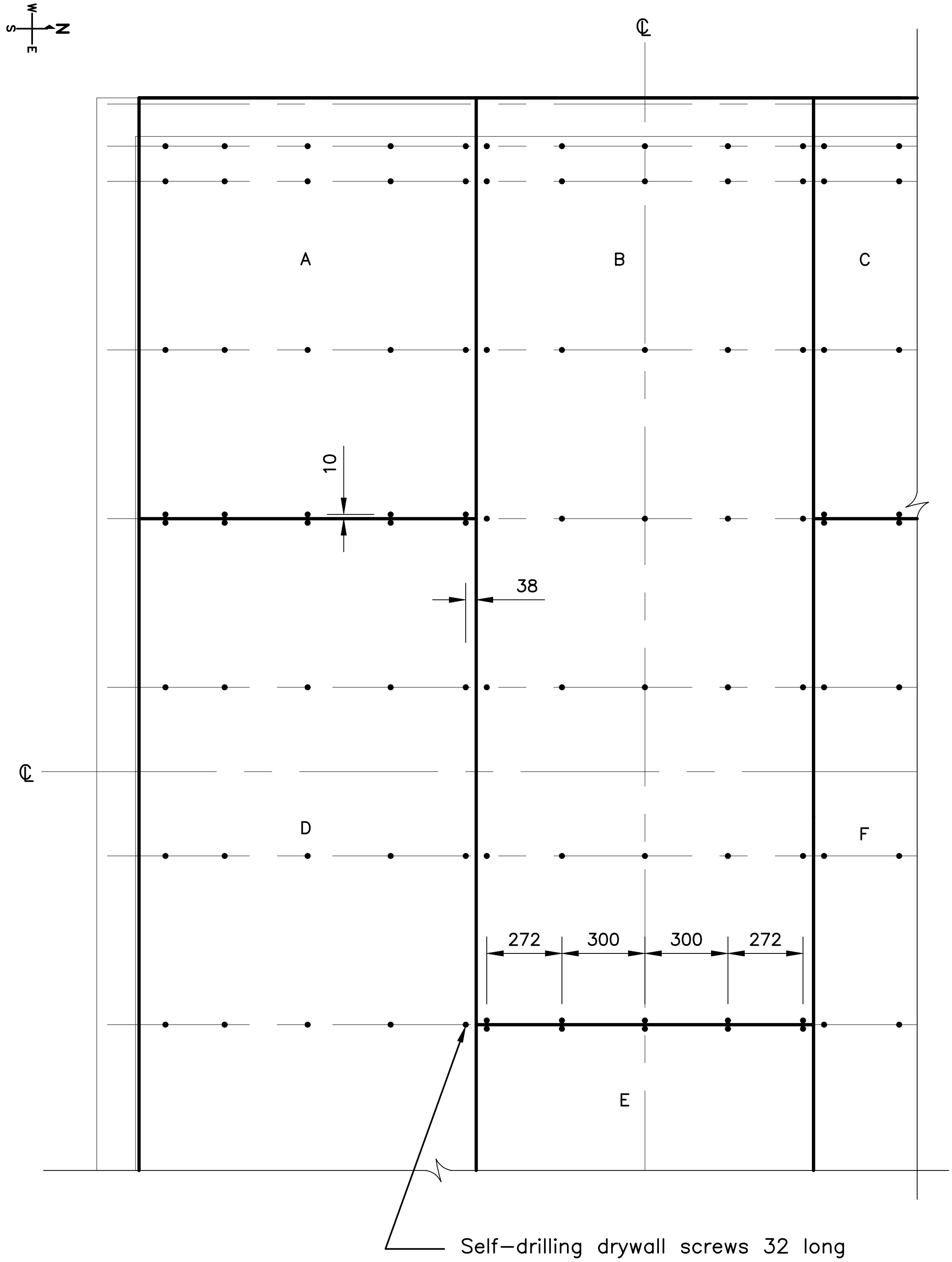
Figure D–104. Subfloor Screw Pattern Single Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–62)

Figure D–105. Gypsum Board Base Layer Layout (Steel C–Joist)

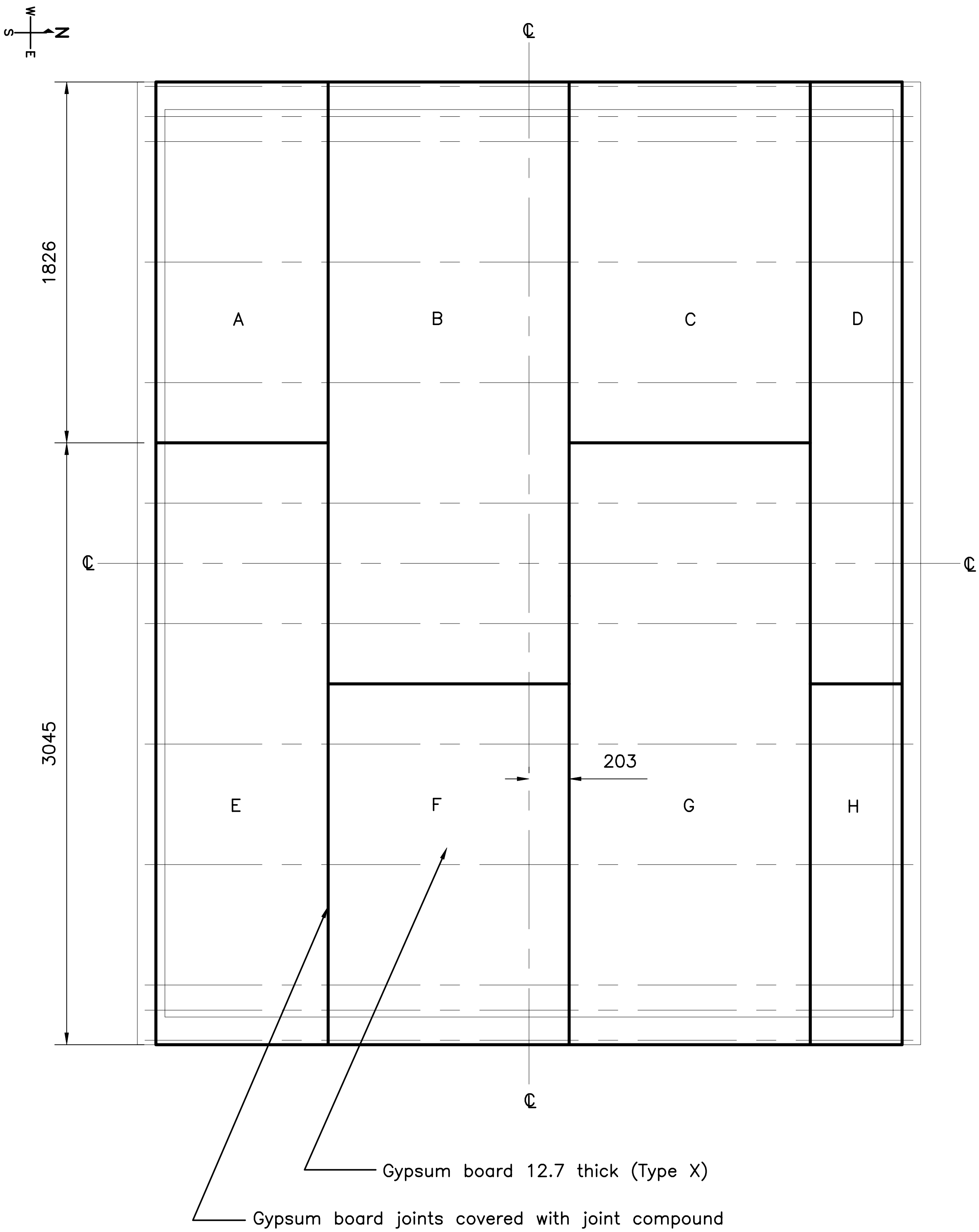


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF–62)

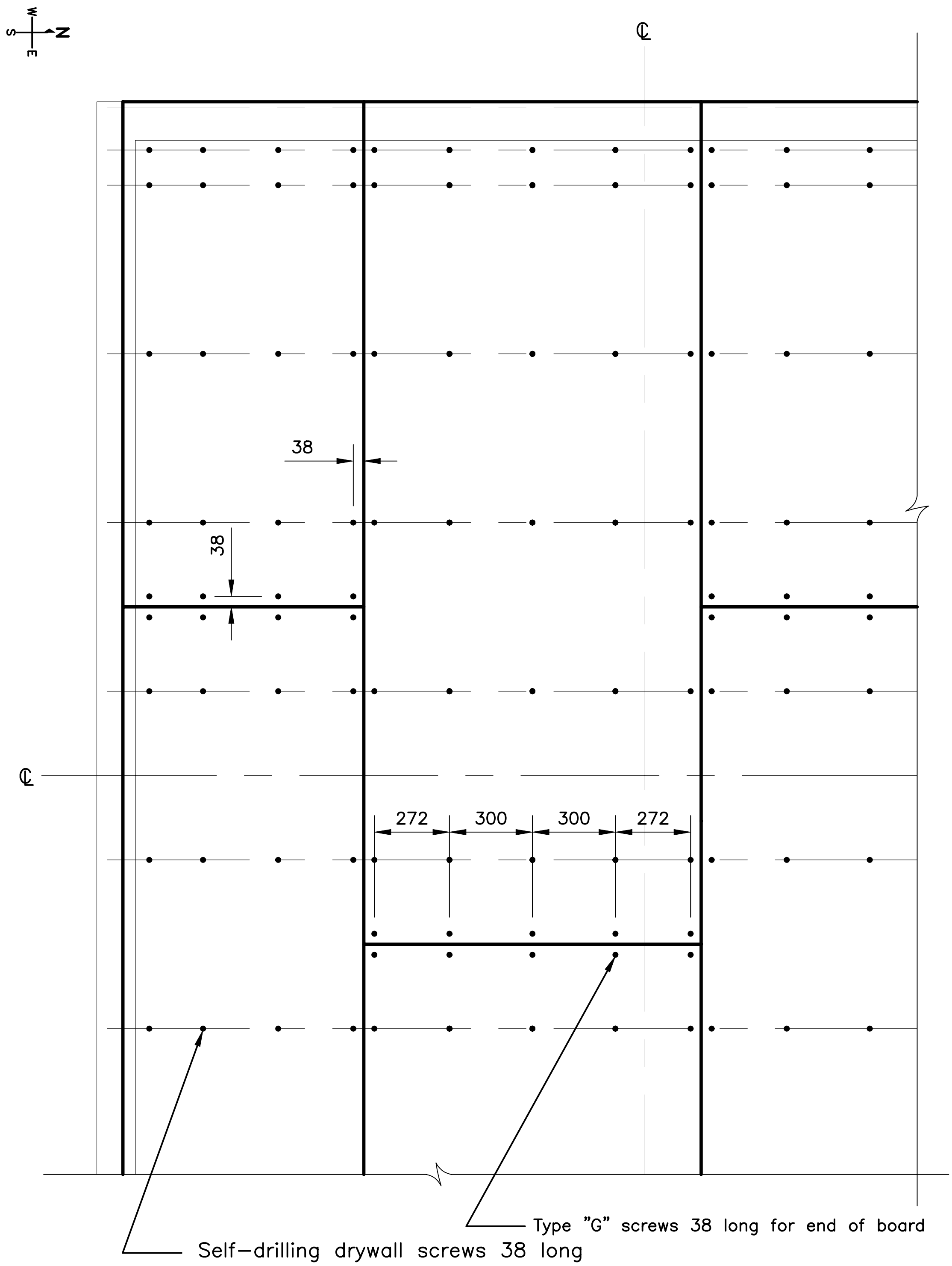
Figure D–106. Gypsum Board Base Layer Screw Pattern (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-62)

Figure D-107. Gypsum Board Face Layer Layout (Steel C-Joist)

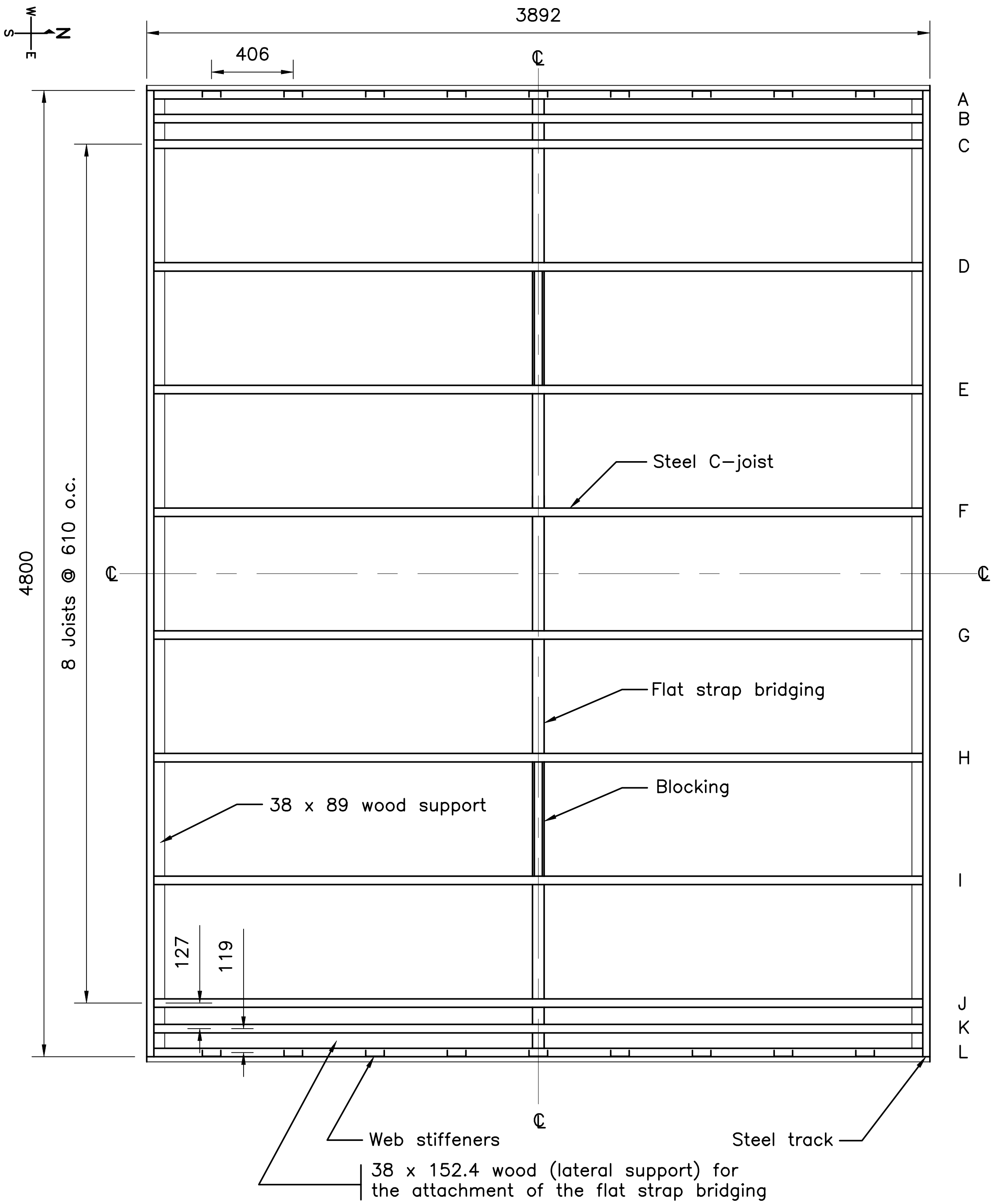


PARTIAL VIEW

(Dimensions are in millimetres)

(Assembly No. FF-62)

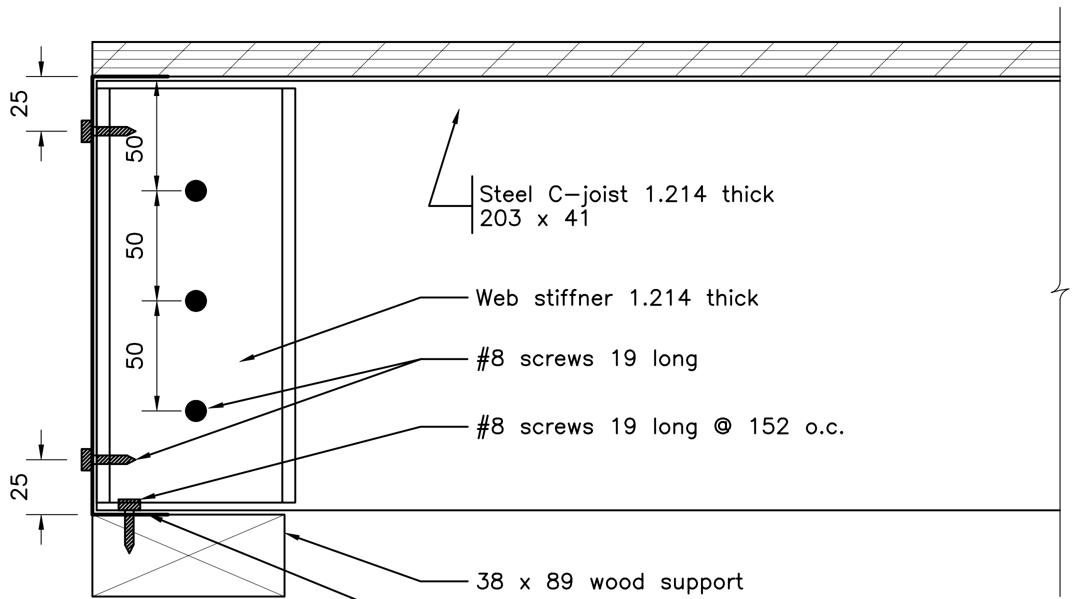
Figure D-108. Gypsum Board Face Layer Screw Pattern (Steel C-Joist)

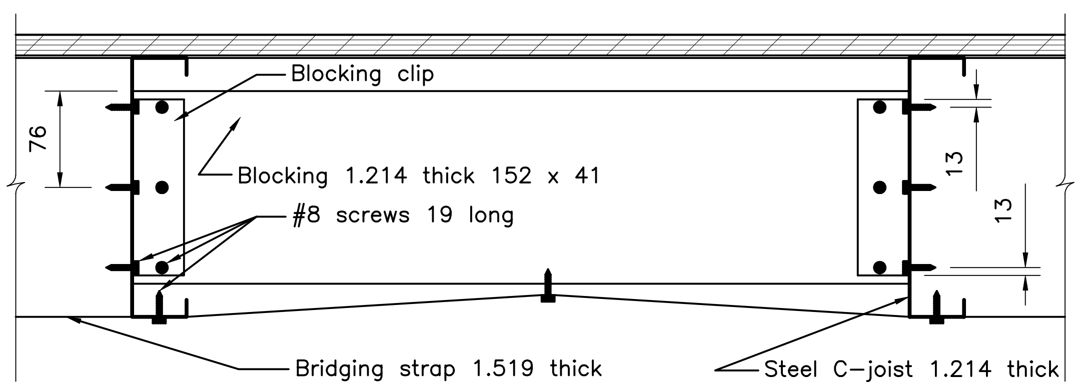


(Dimensions are in millimetres)

(Assembly No. FF–65)

Figure D–109. Joist Layout (Steel C–Joist)

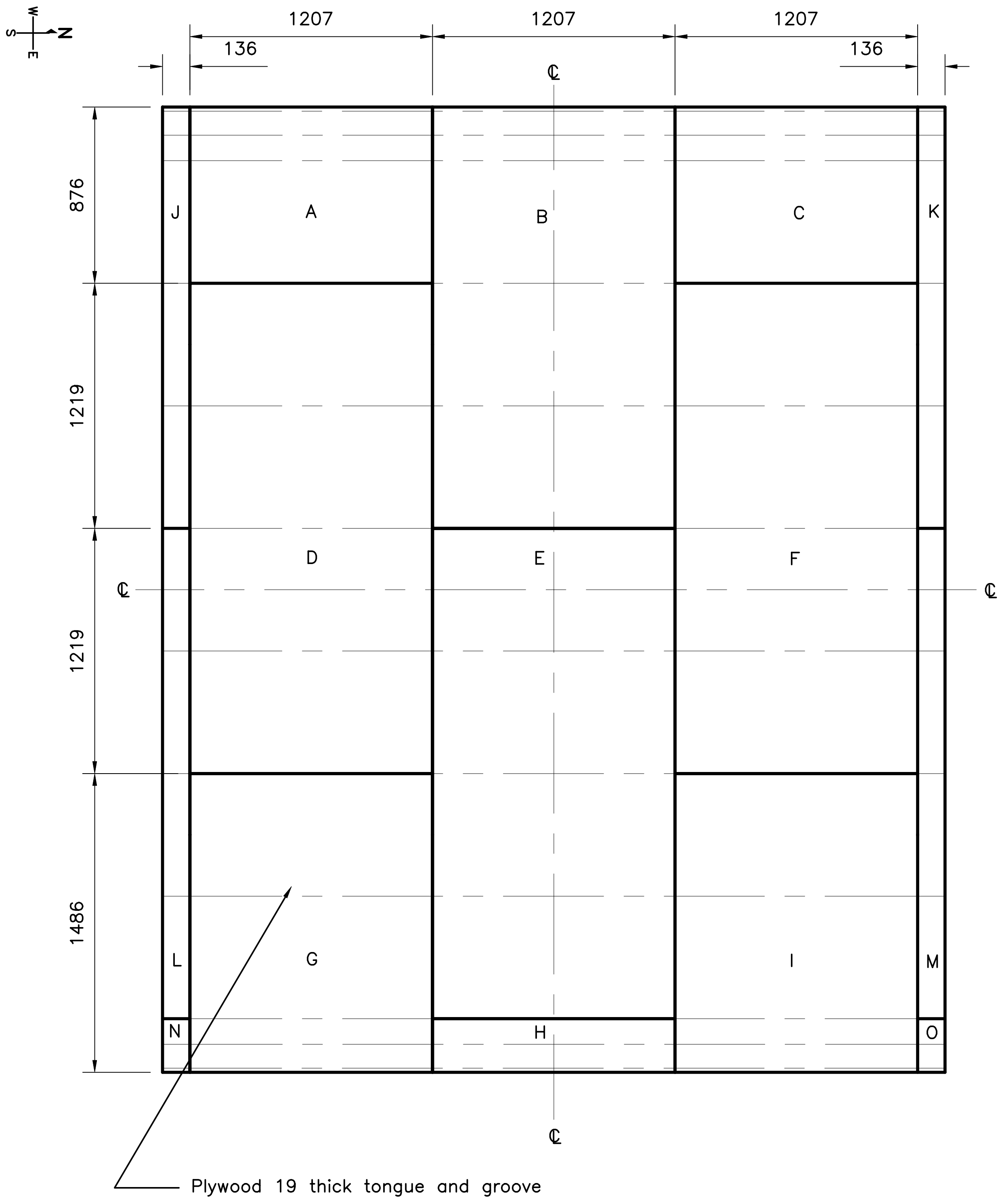




(Dimensions are in millimetres)

(Assembly No. FF–65)

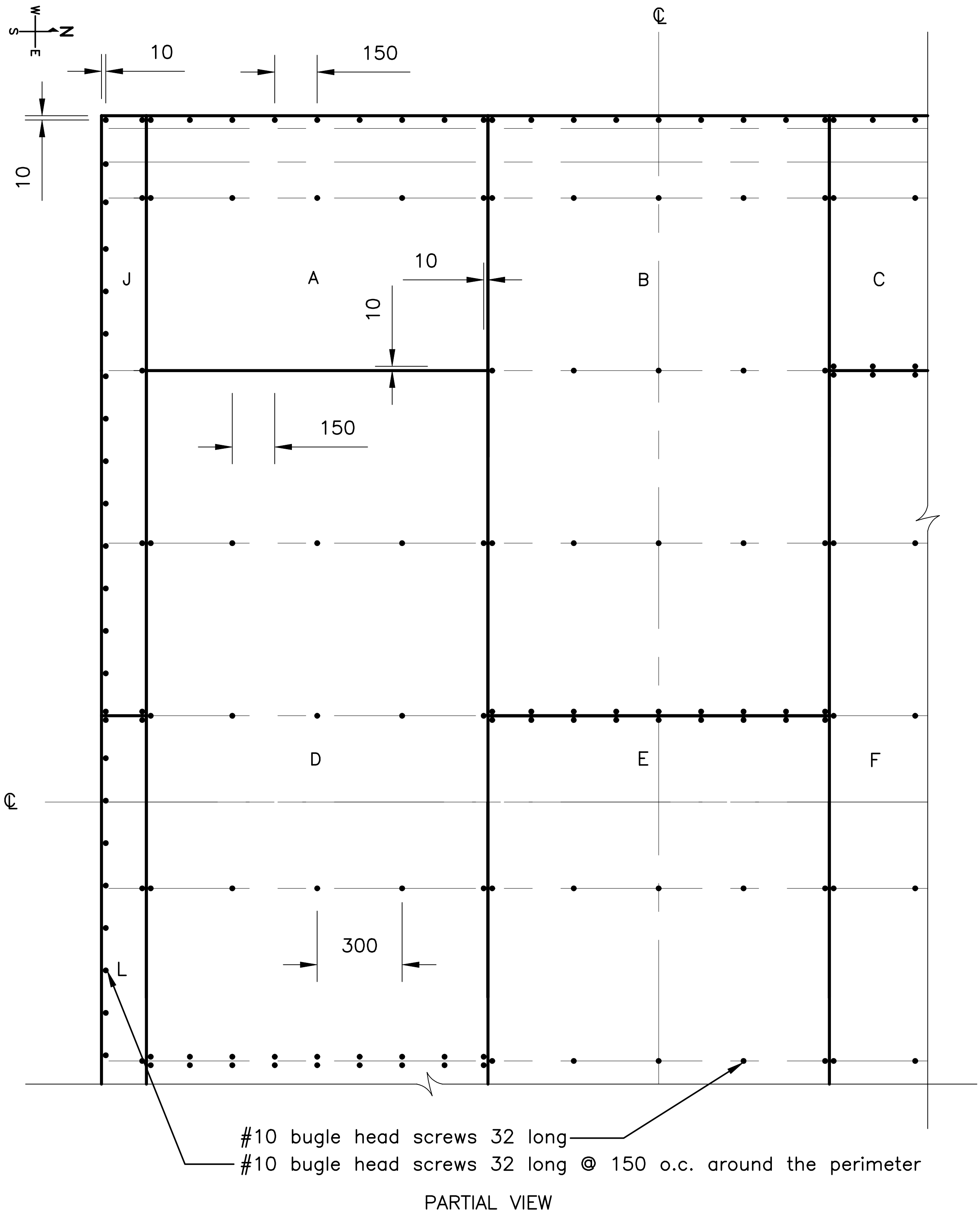
Figure D–110. Steel C–Joist End Connection and Blocking Detail
(Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–65)

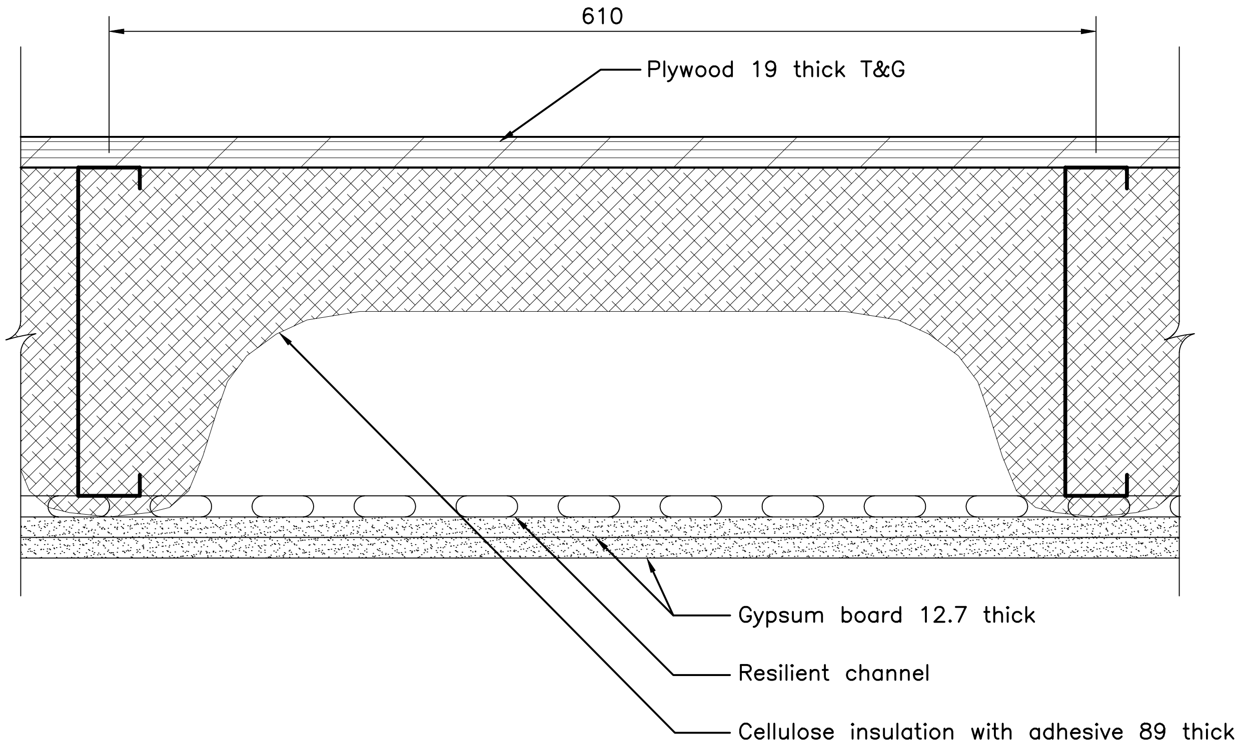
Figure D–111. Subfloor Layout Single Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–65)

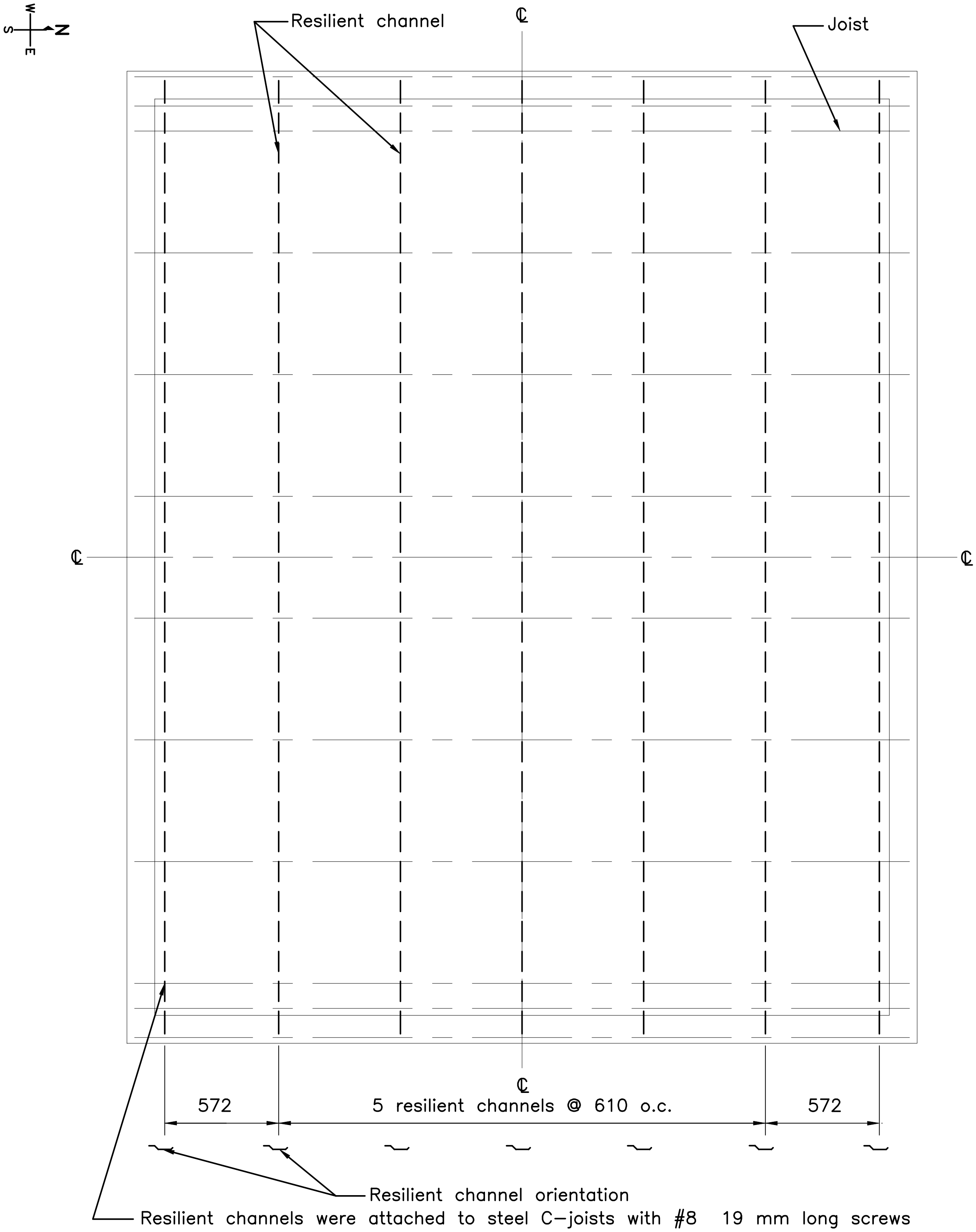
Figure D–112. Subfloor Screw Pattern Single Layer (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–65)

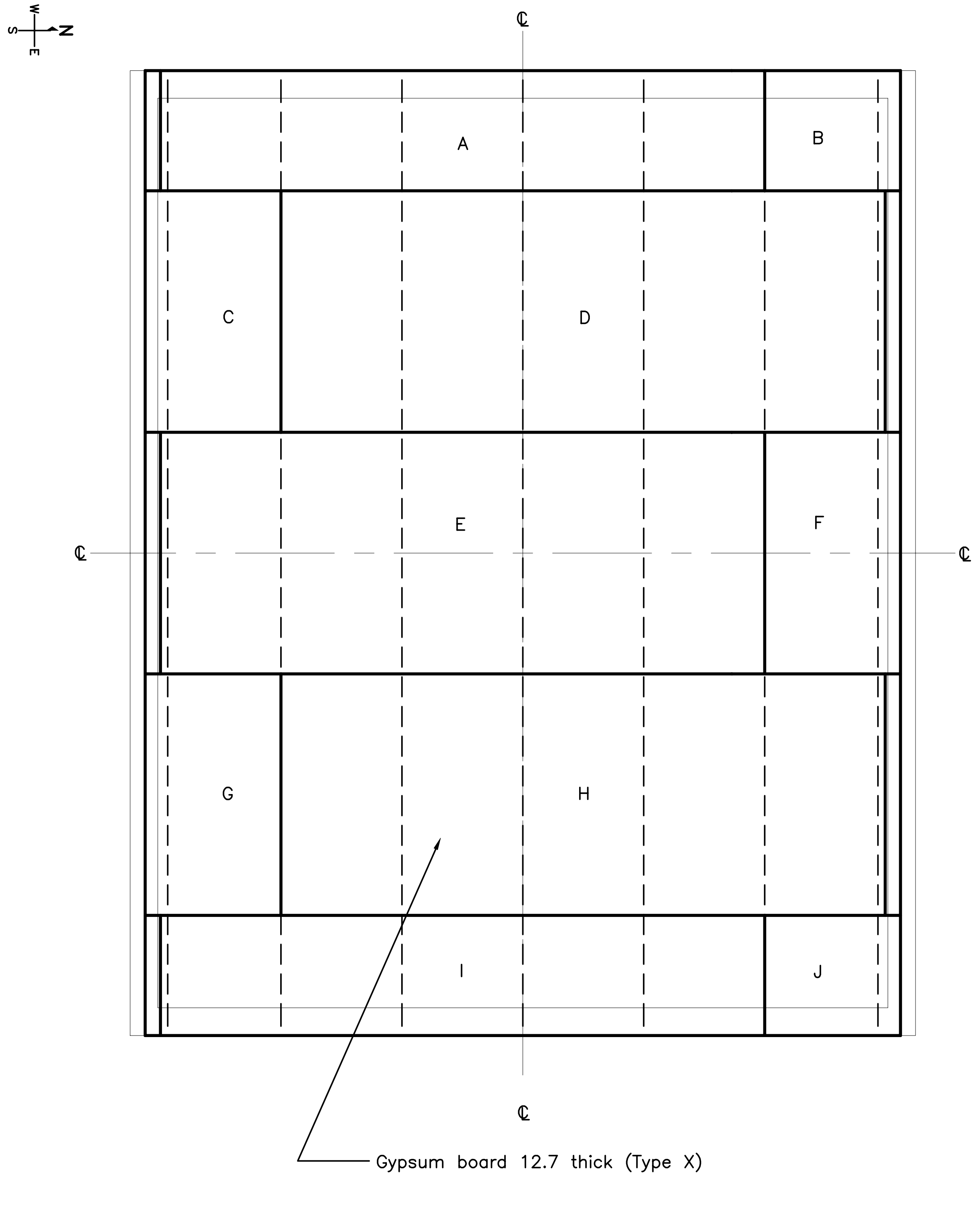
Figure D–113. Insulation Location (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–65)

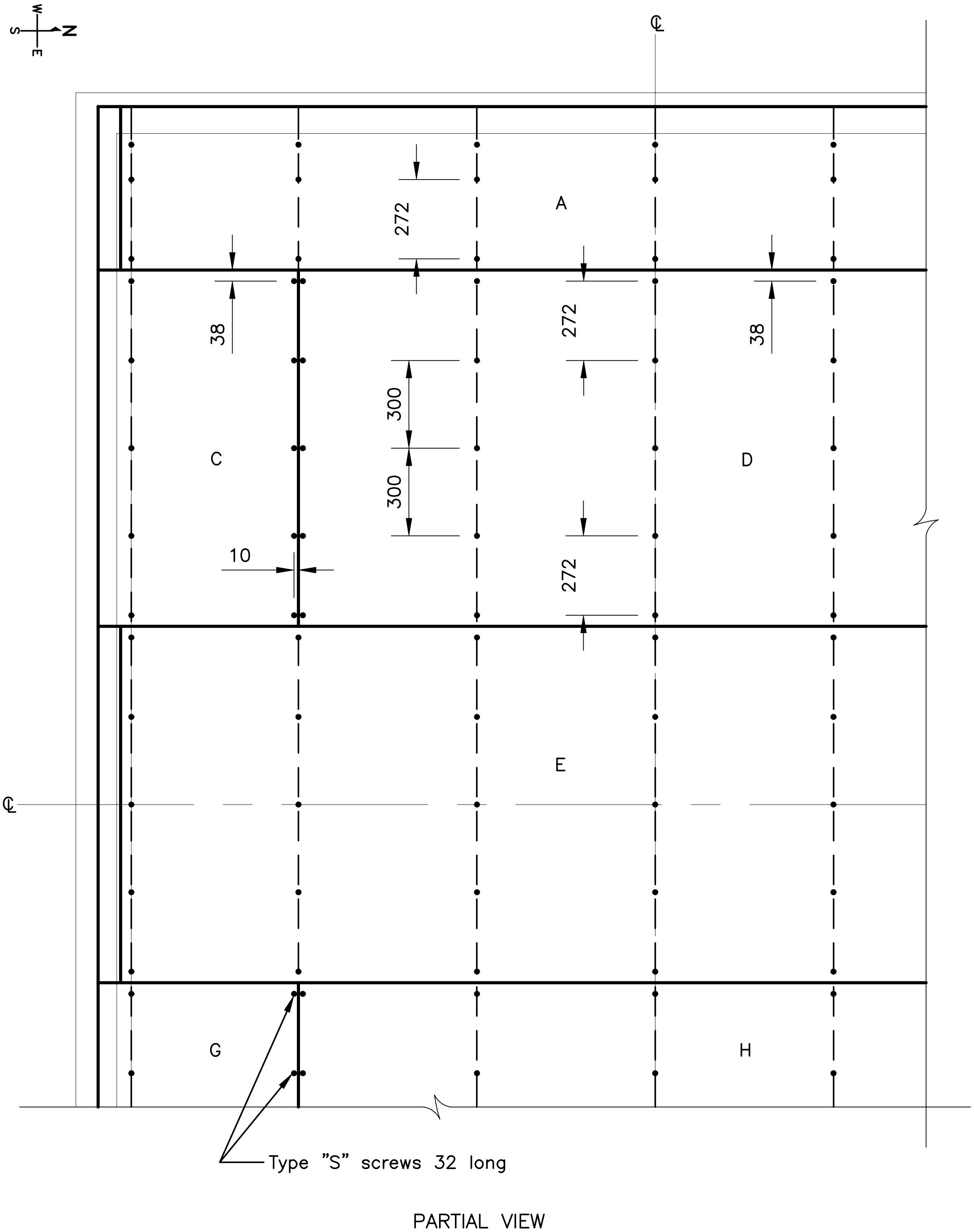
Figure D–114. Resilient Channel Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF-65)

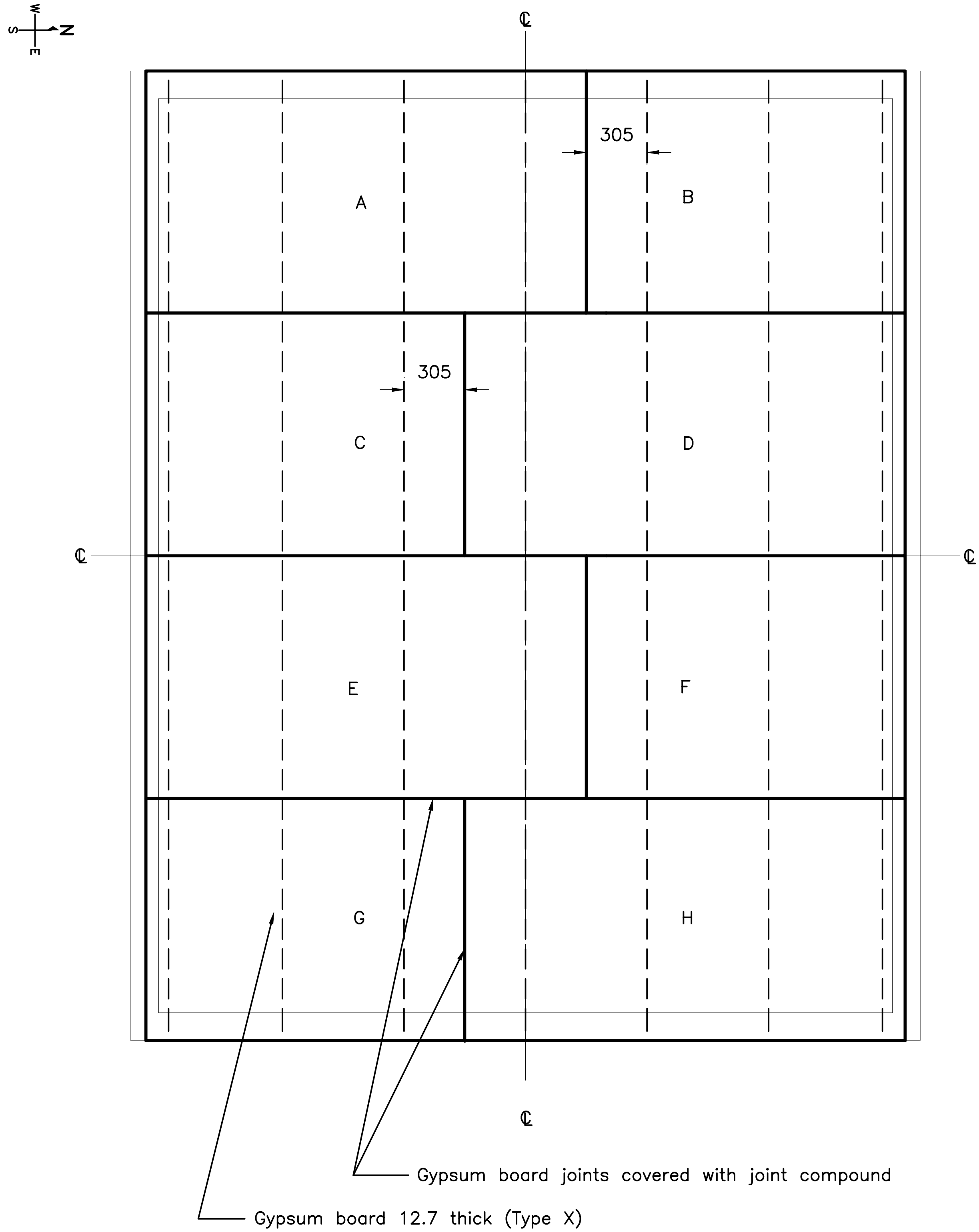
Figure D-115. Gypsum Board Base Layer Layout (Steel C-Joist)



(Dimensions are in millimetres)

(Assembly No. FF–65)

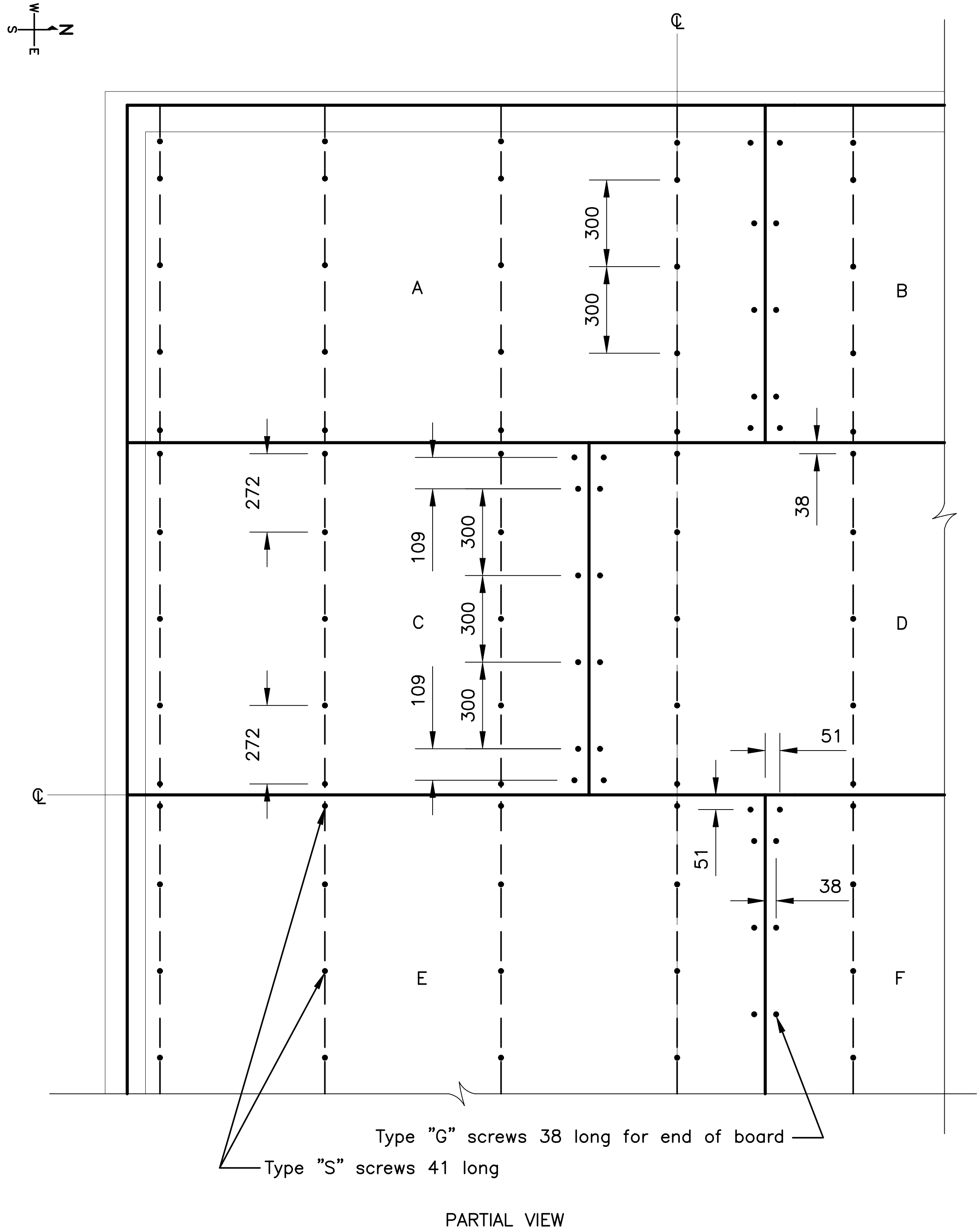
Figure D–116. Gypsum Board Base Layer Screw Pattern (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–65)

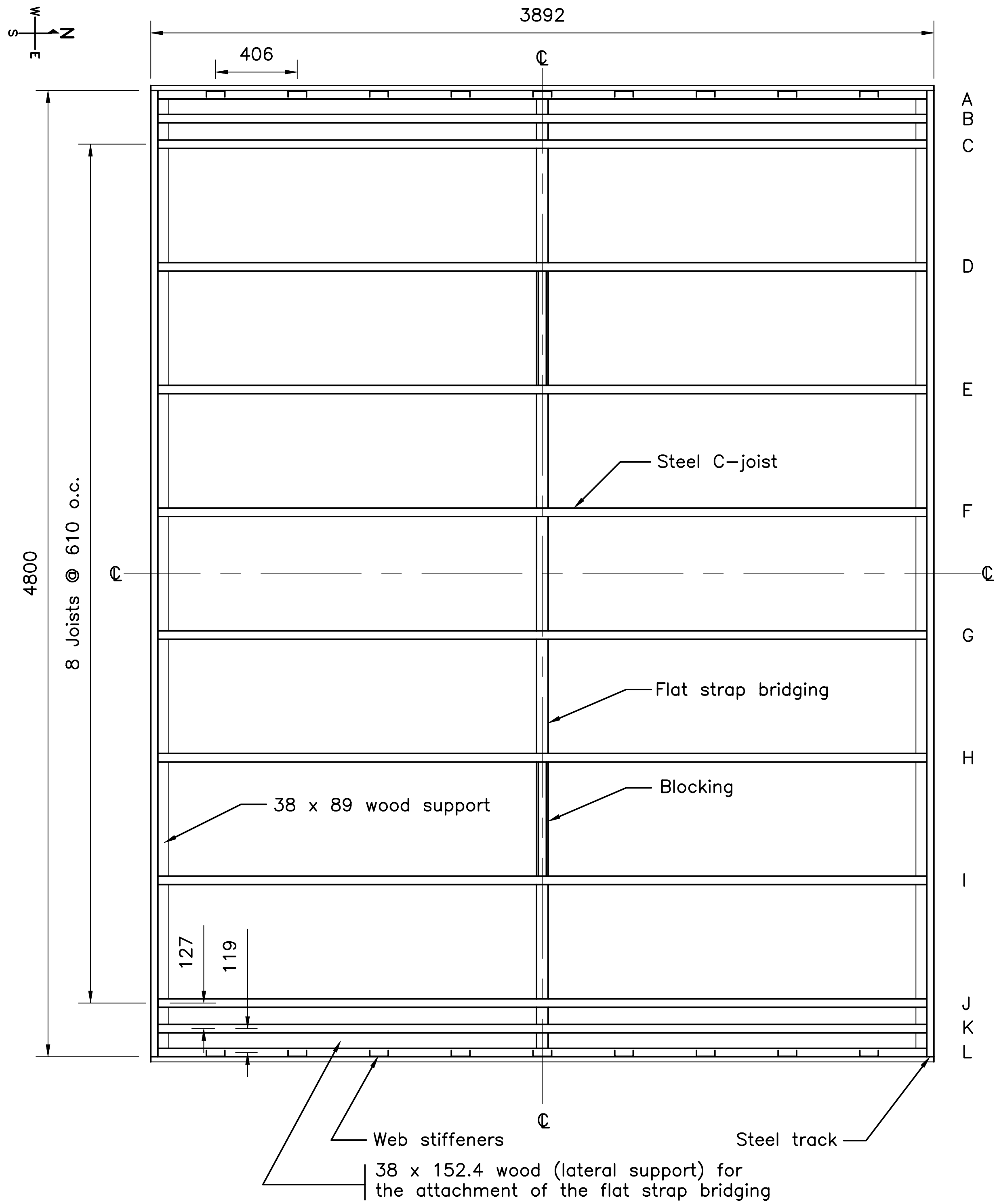
Figure D–117. Gypsum Board Face Layer Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–65)

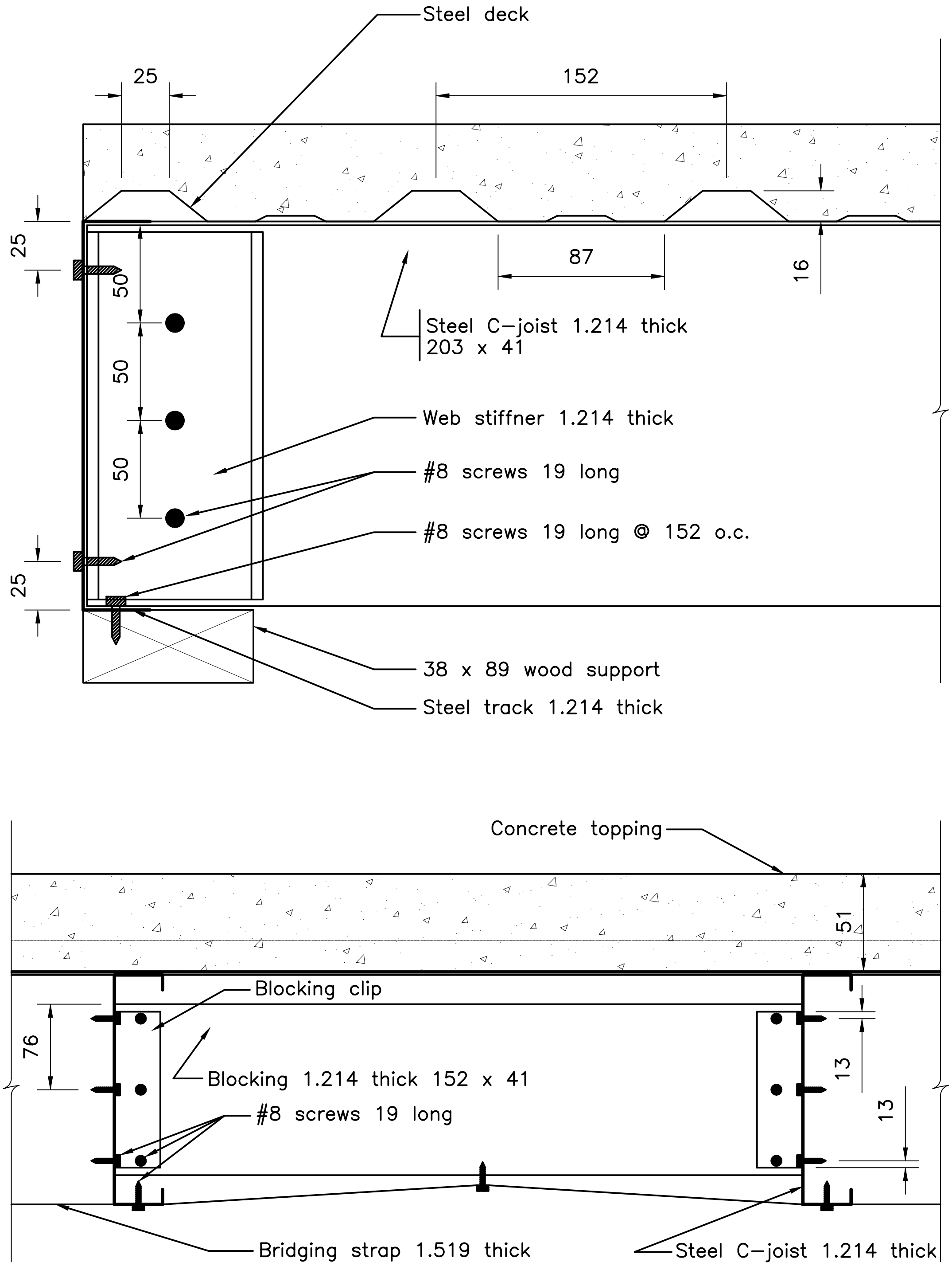
Figure D–118. Gypsum Board Face Layer Screw Pattern (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–74)

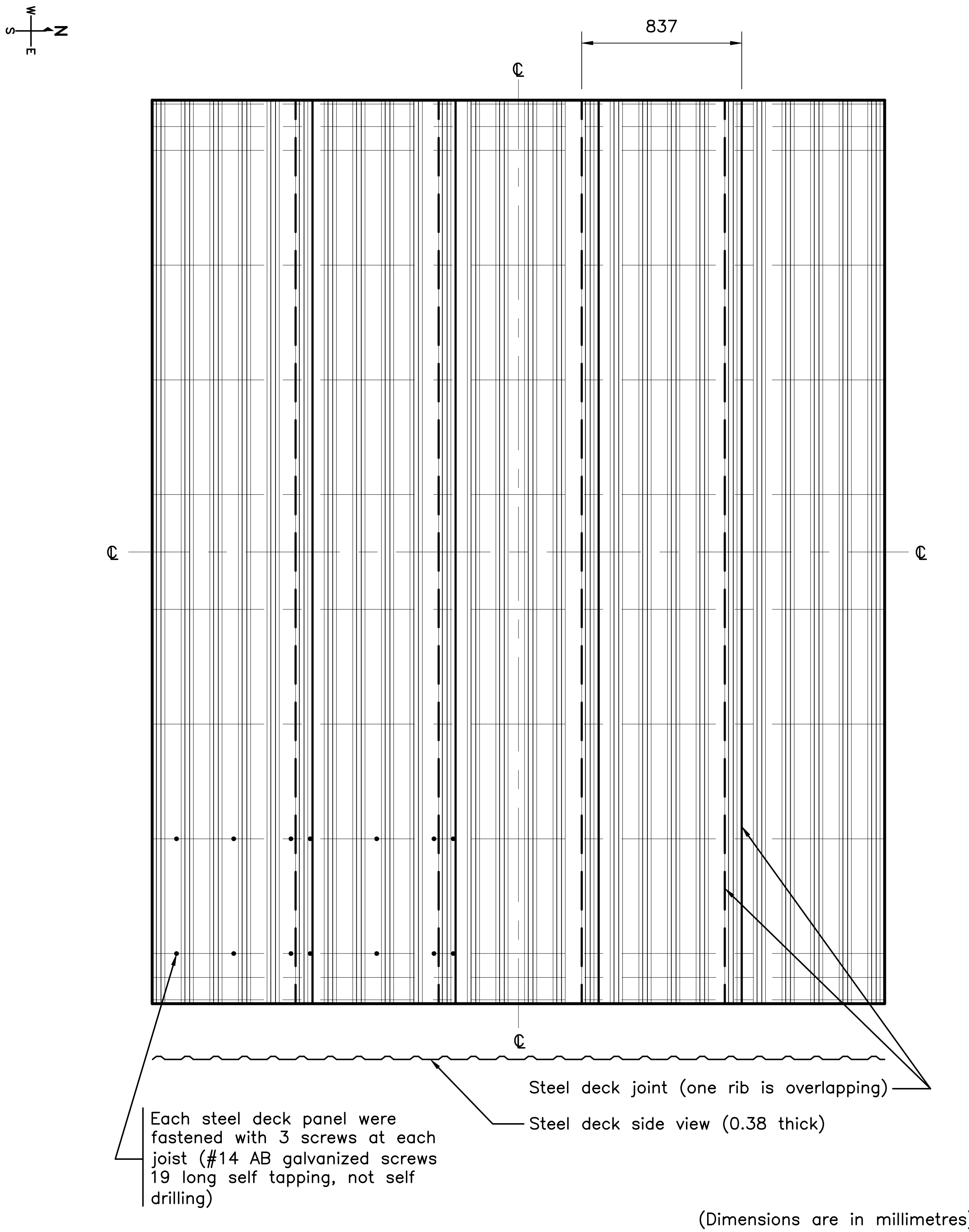
Figure D–119. Joist Layout (Steel C–Joist)



(Dimensions are in millimetres)

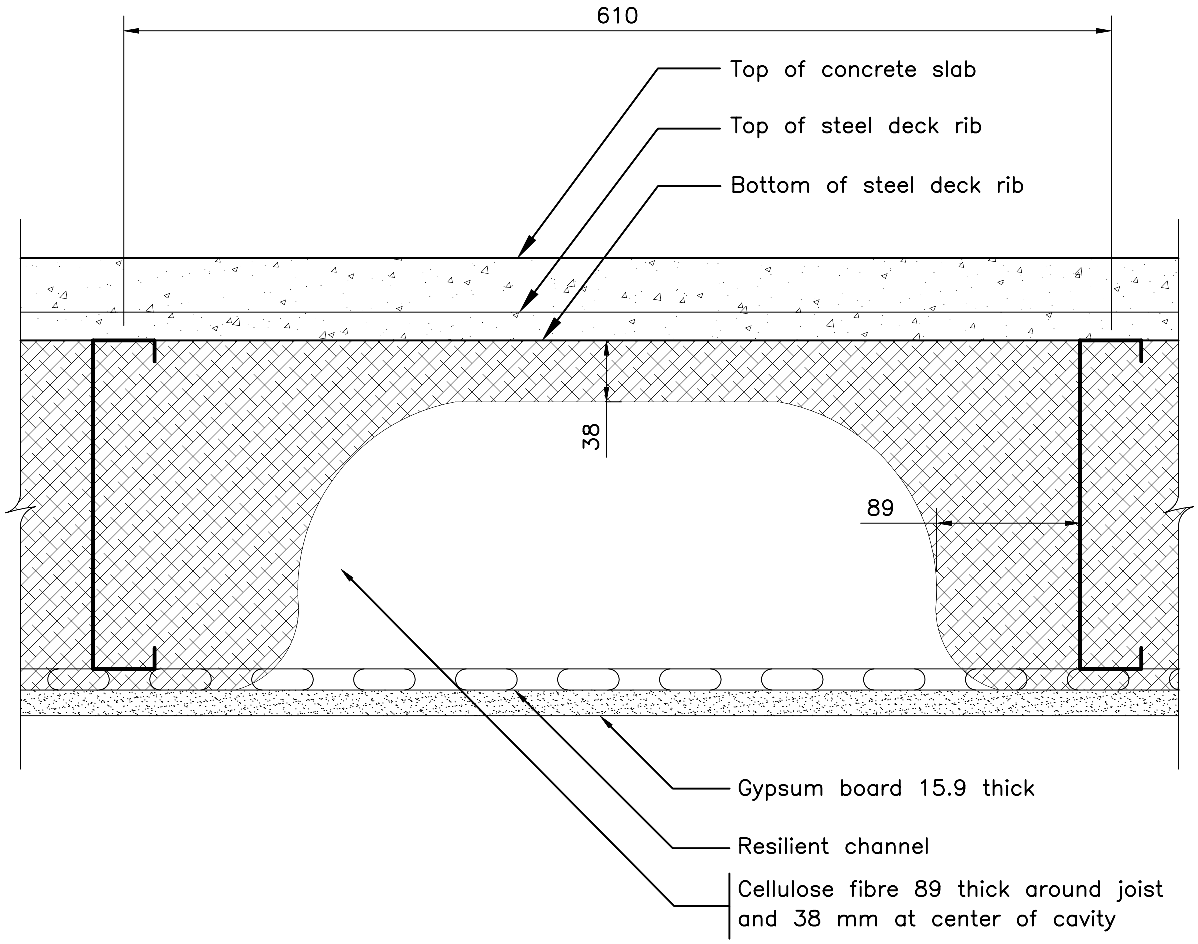
(Assembly No. FF–74)

Figure D–120. Steel C–Joist End Connection and Blocking Detail
(Steel C–joist)



(Assembly No. FF-74)

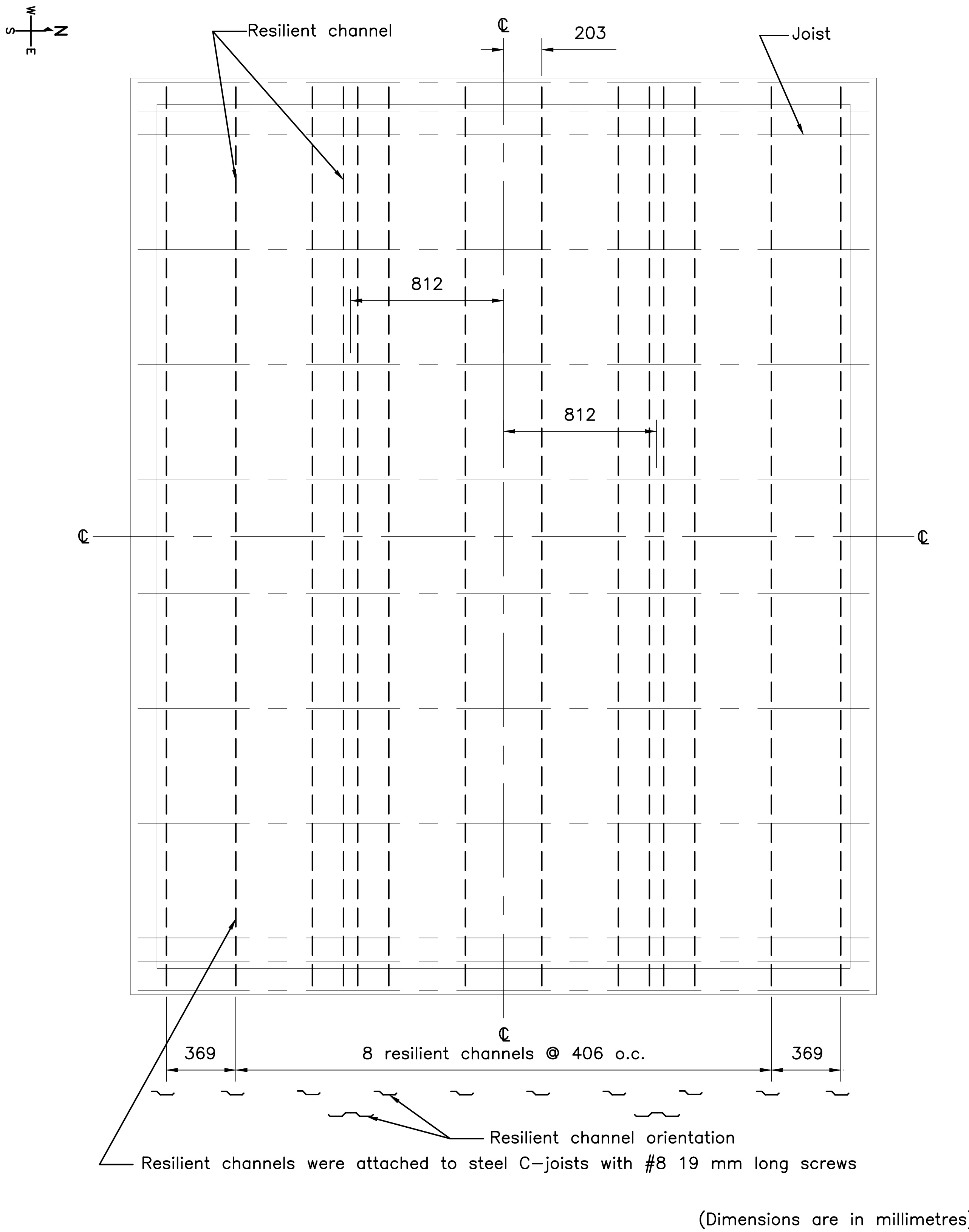
Figure D-121. Steel Deck Layout (Steel C-Joist)



(Dimensions are in millimetres)

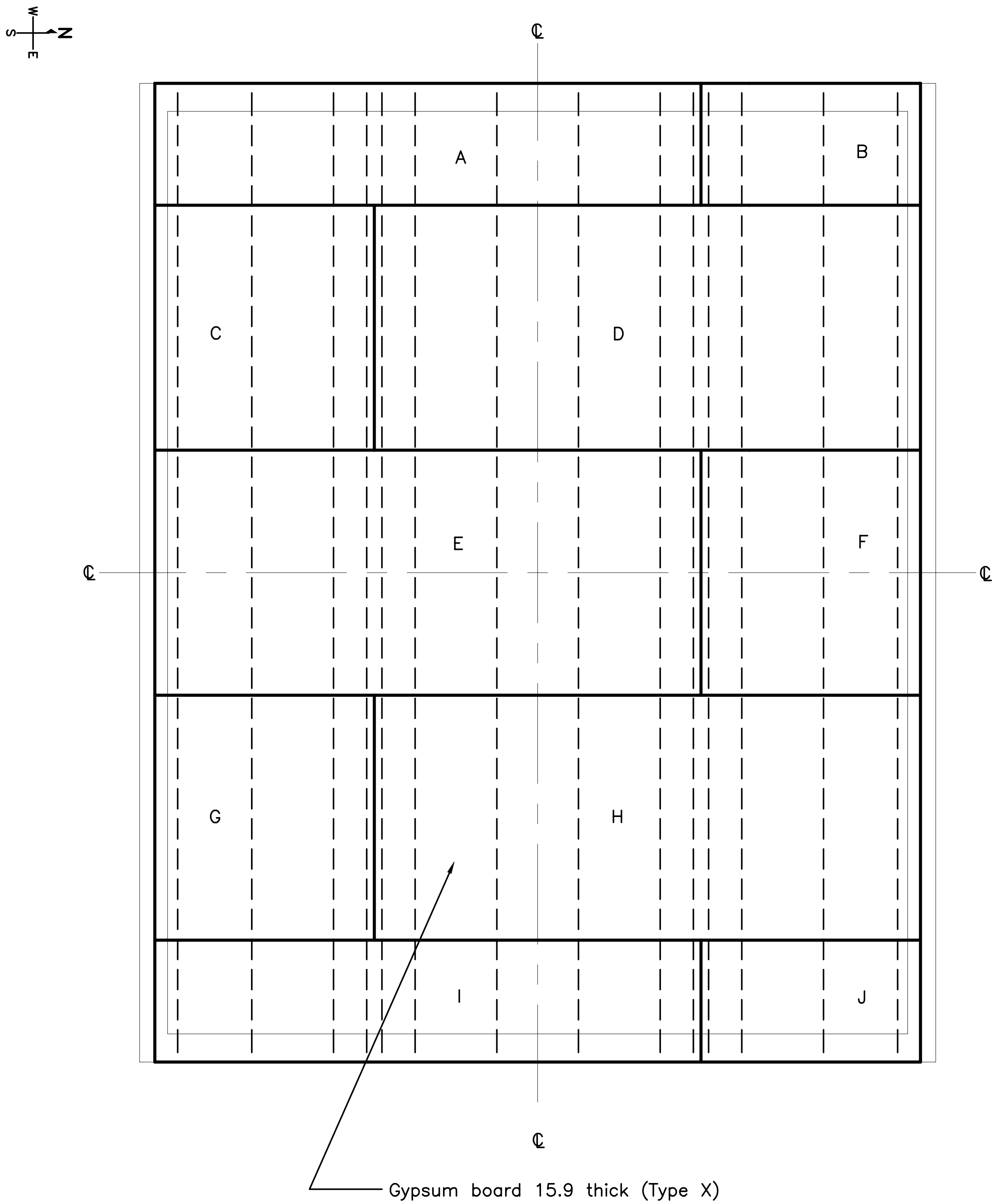
(Assembly No. FF–74)

Figure D–122. Insulation Location (Steel C–Joist)



(Assembly No. FF–74)

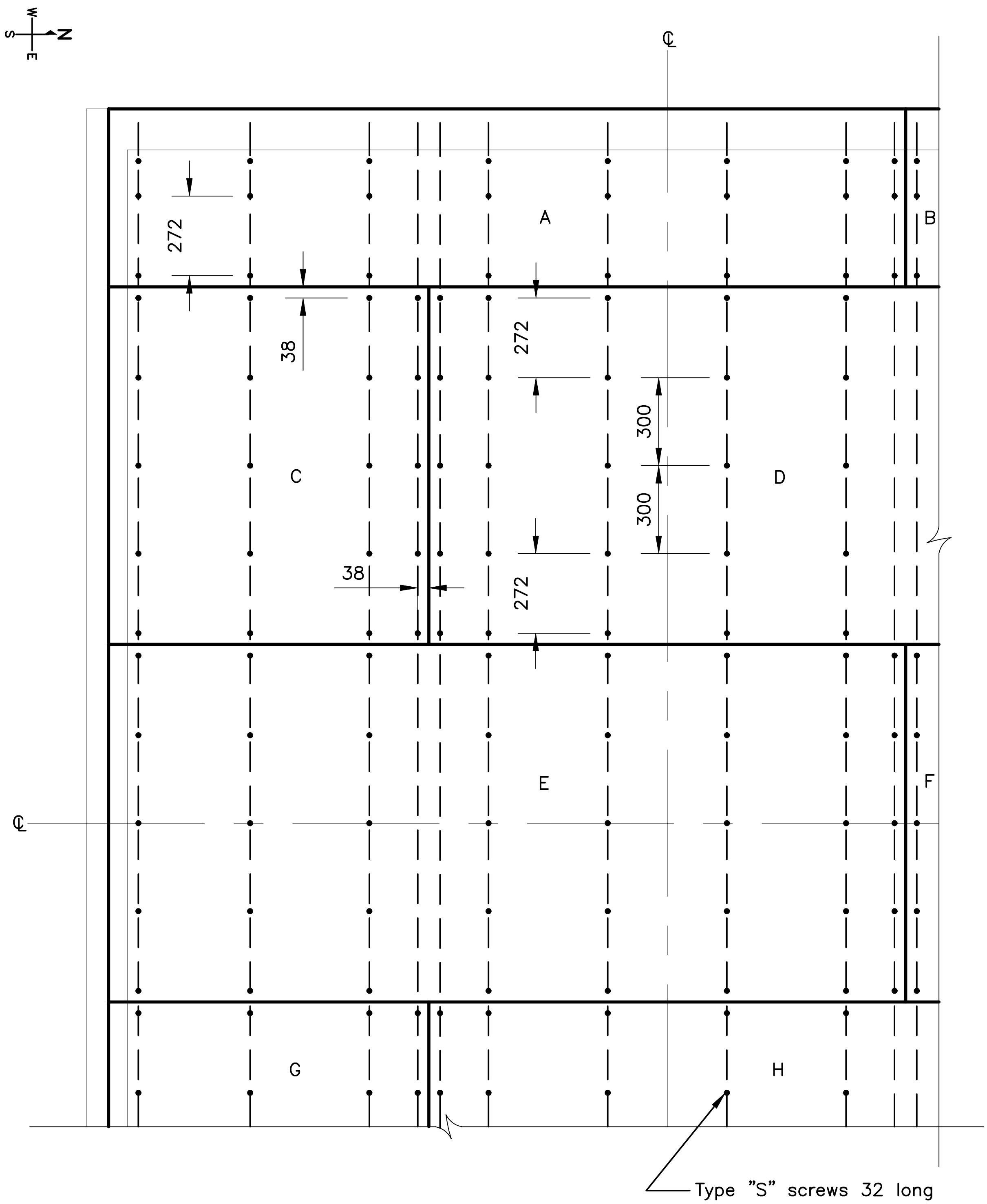
Figure D–123. Resilient Channel Layout (Steel C–Joist)



(Dimensions are in millimetres)

(Assembly No. FF–74)

Figure D–124. Gypsum Board Single Layer Layout (Steel C–Joist)



PARTIAL VIEW

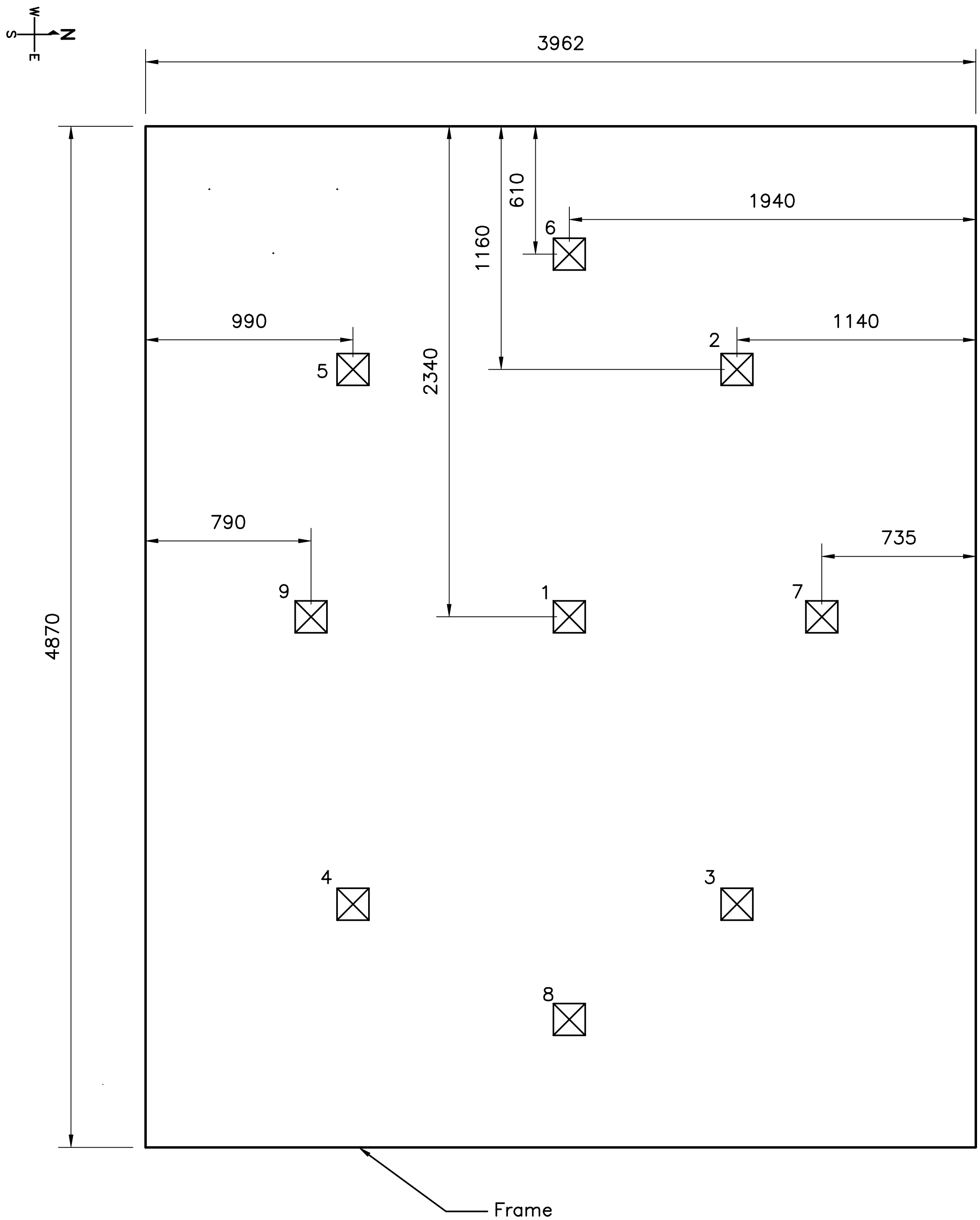
(Dimensions are in millimetres)

(Assembly No. FF–74)

Figure D–125. Gypsum Board Single Layer Screw Pattern (Steel C–Joist)

Appendix E

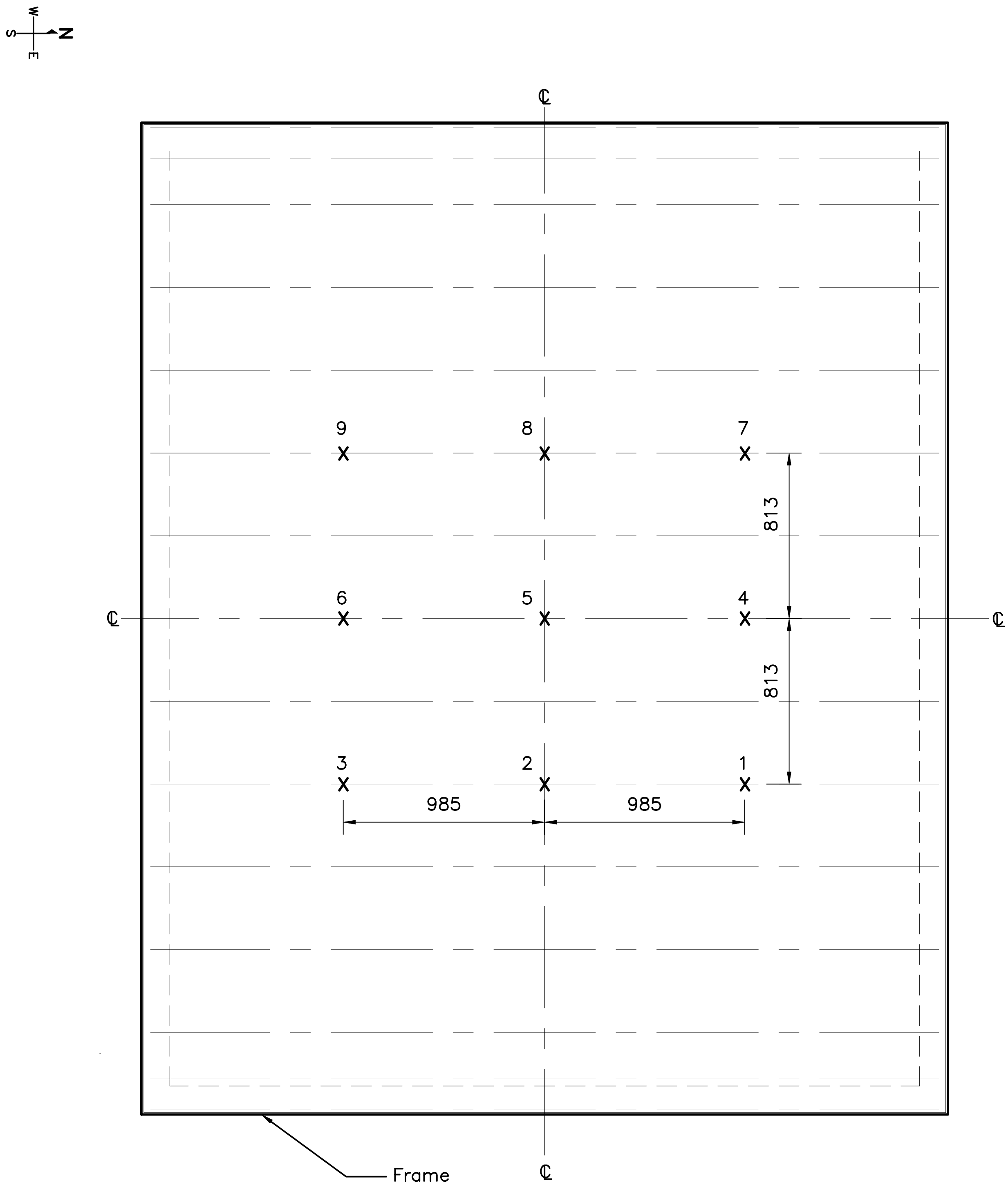
Full-scale floor furnace details



(Dimensions are in millimetres)

(All assemblies)

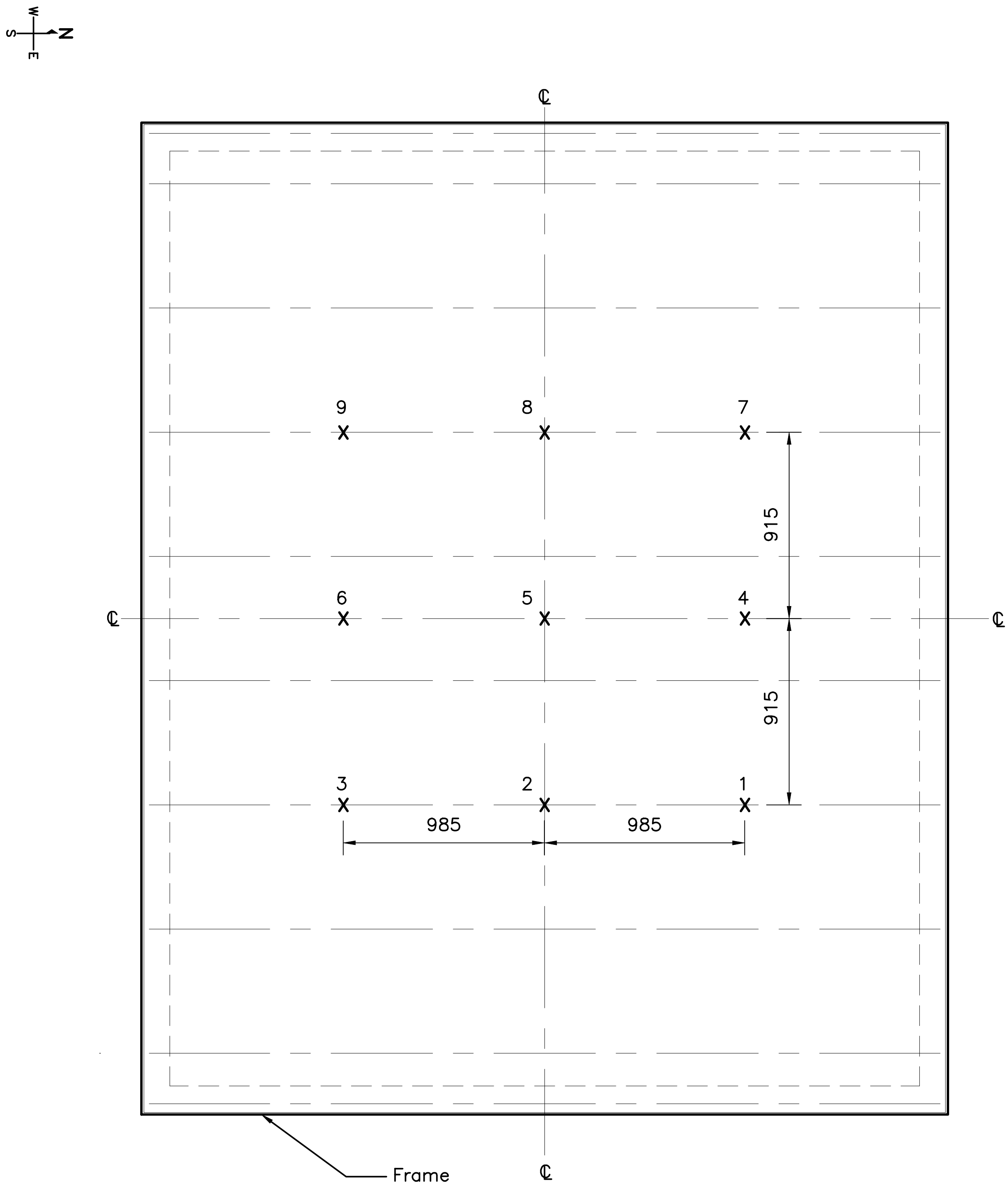
Figure E–1. Floor Assembly Top Thermocouple Layout



(Dimensions are in millimetres)

(All assemblies with framing @ 406 o.c.)

Figure E–2. Floor Assembly Deflection Measurement Locations



(Dimensions are in millimetres)

(All assemblies with framing @ 610 o.c.)

Figure E–3. Floor Assembly Deflection Measurement Locations

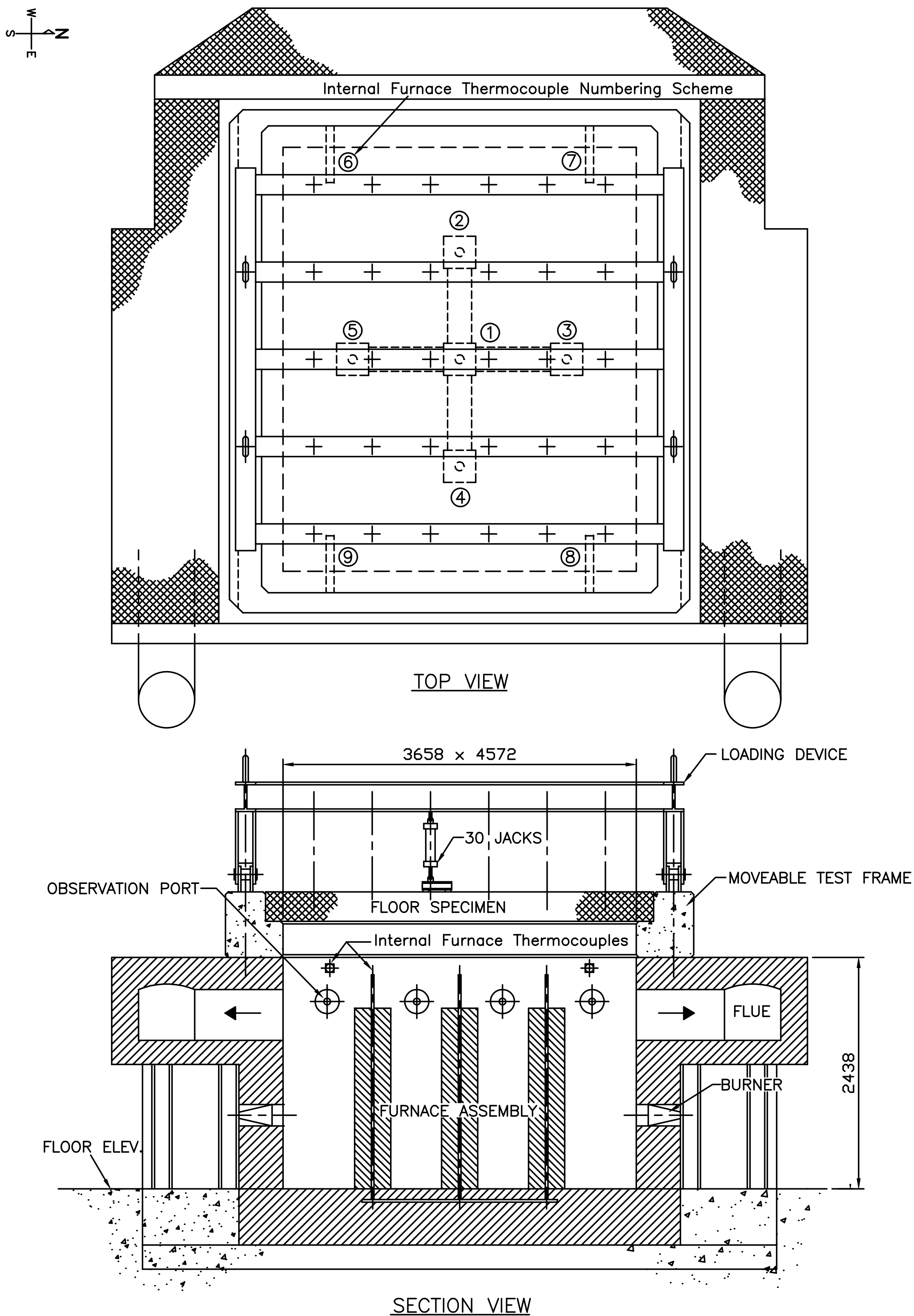


Figure E–4. Full–Scale Floor Furnace (Dimensions are in millimetres)

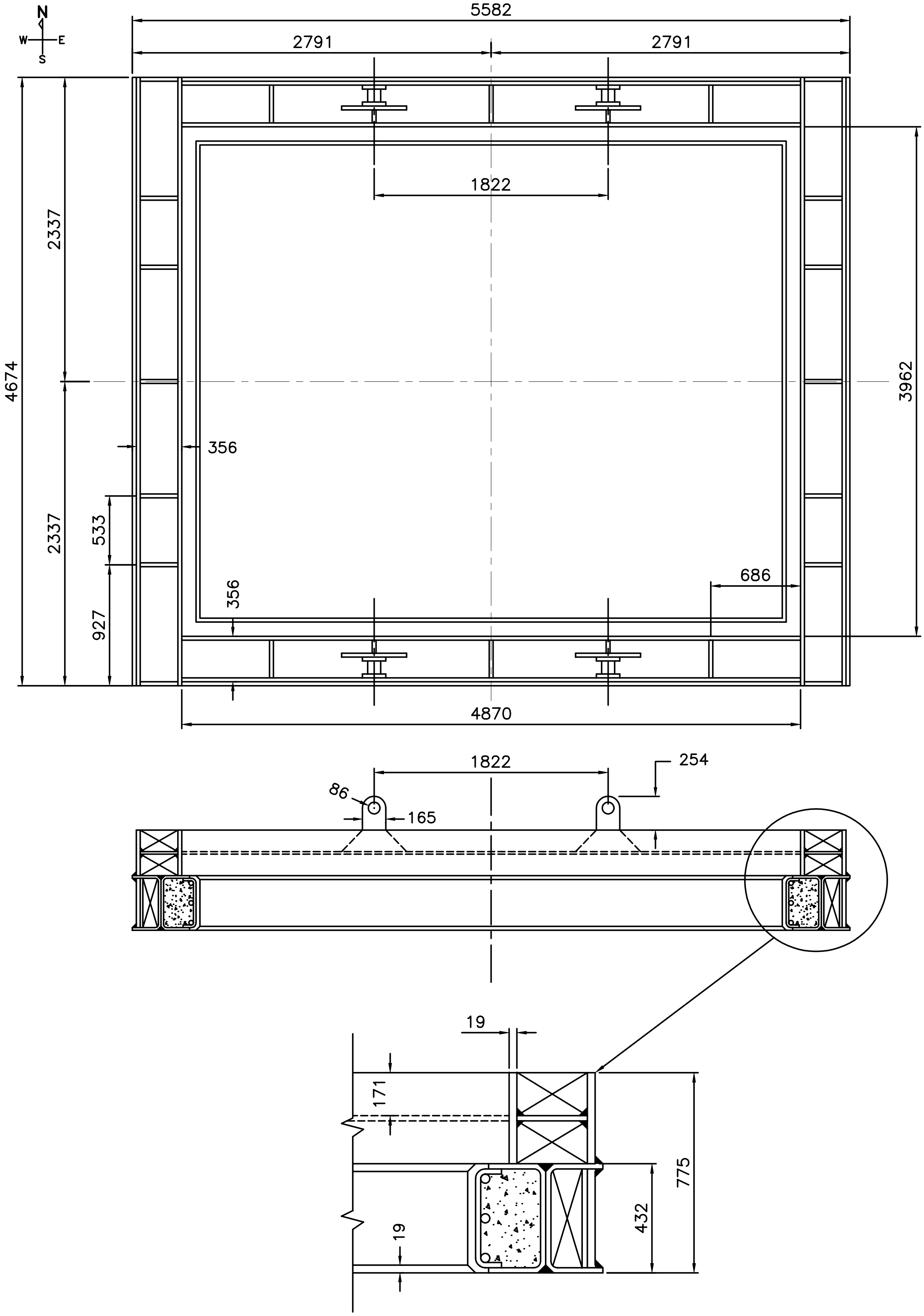
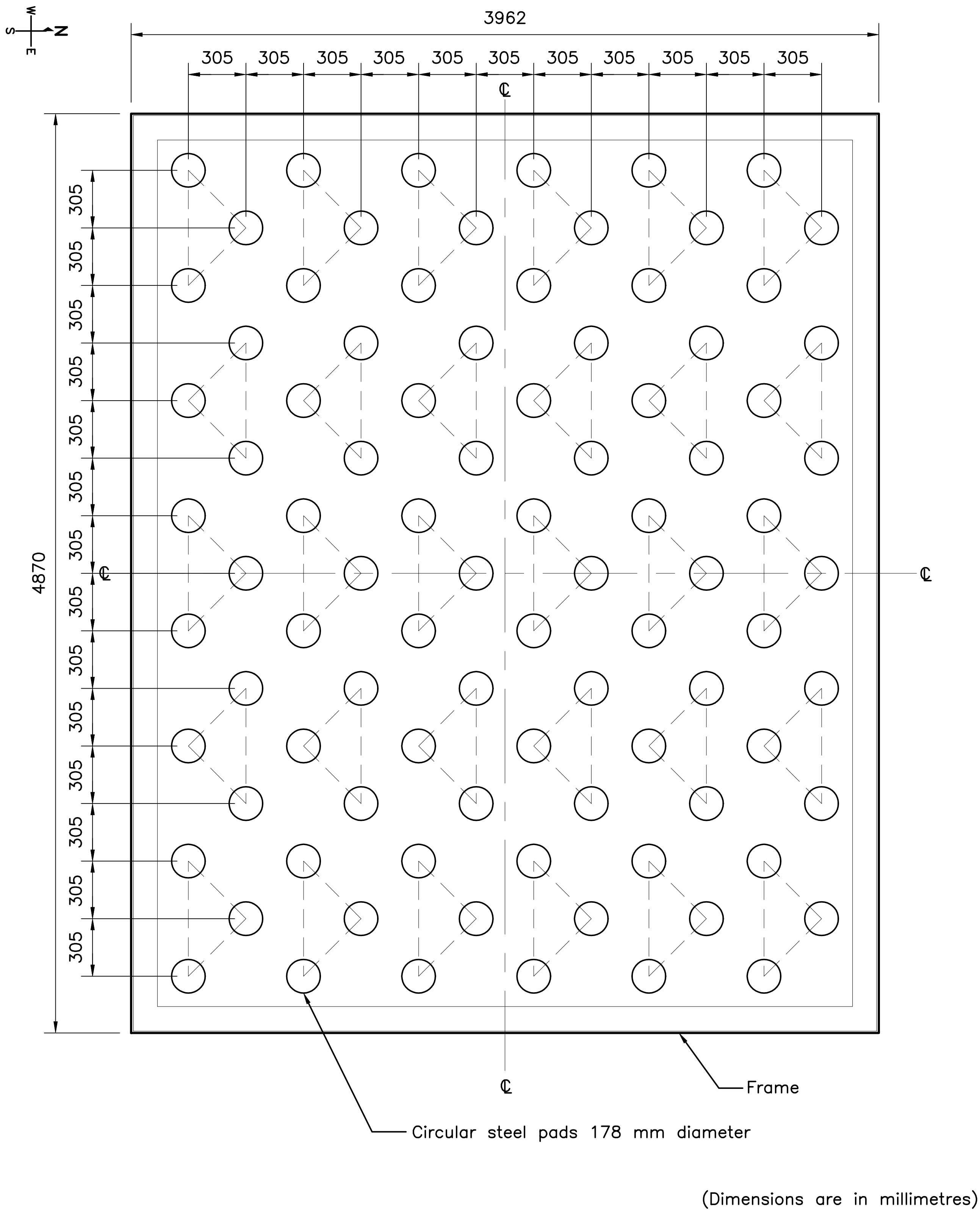
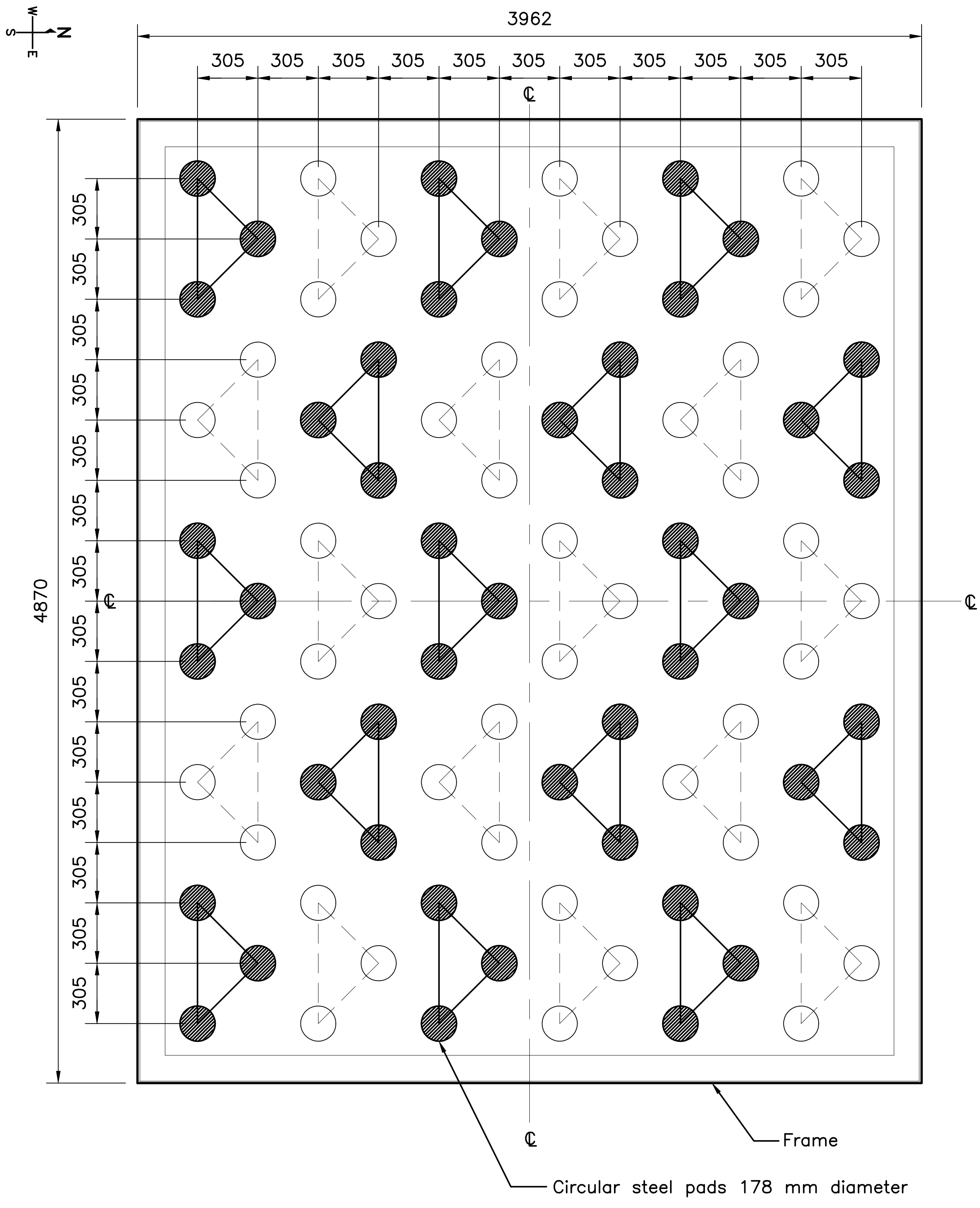


Figure E–5. Full–Scale Floor Assembly Test Frame (Dimensions are in millimetres)



(Assembly Nos. FF-30 to 53, FF-55 to 73 and FF-75 to 82)

Figure E-6. Load Distribution on Test Assemblies



Note: Assemblies were loaded by the shaded circular steel pads.

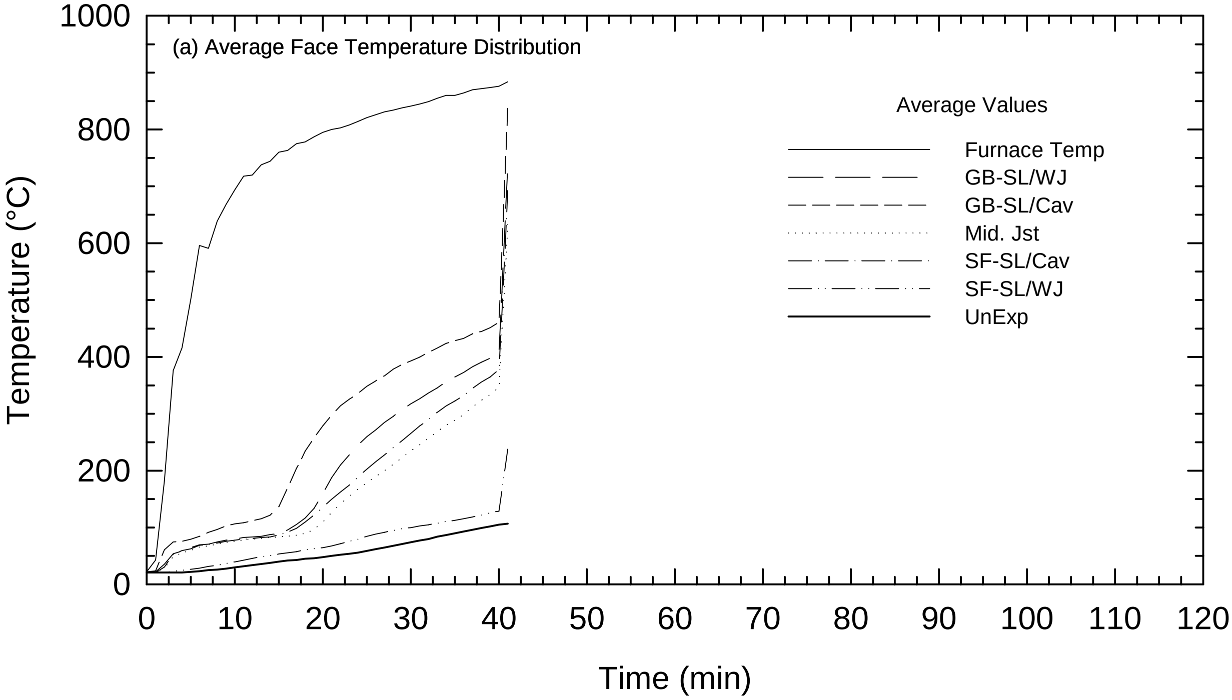
(Dimensions are in millimetres)

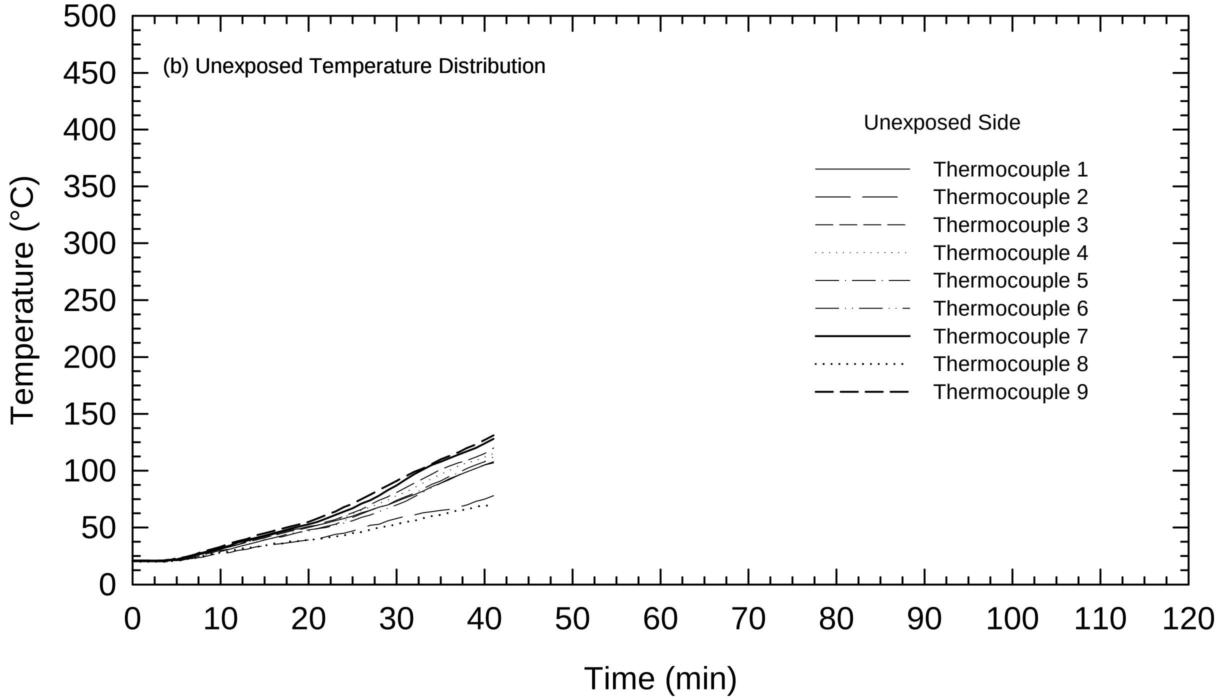
(Assembly Nos. FF–54 and FF–74)

Figure E–7. Load Distribution on Test Assemblies with half of the hydraulic Cylinders

Appendix F

Temperature measurements

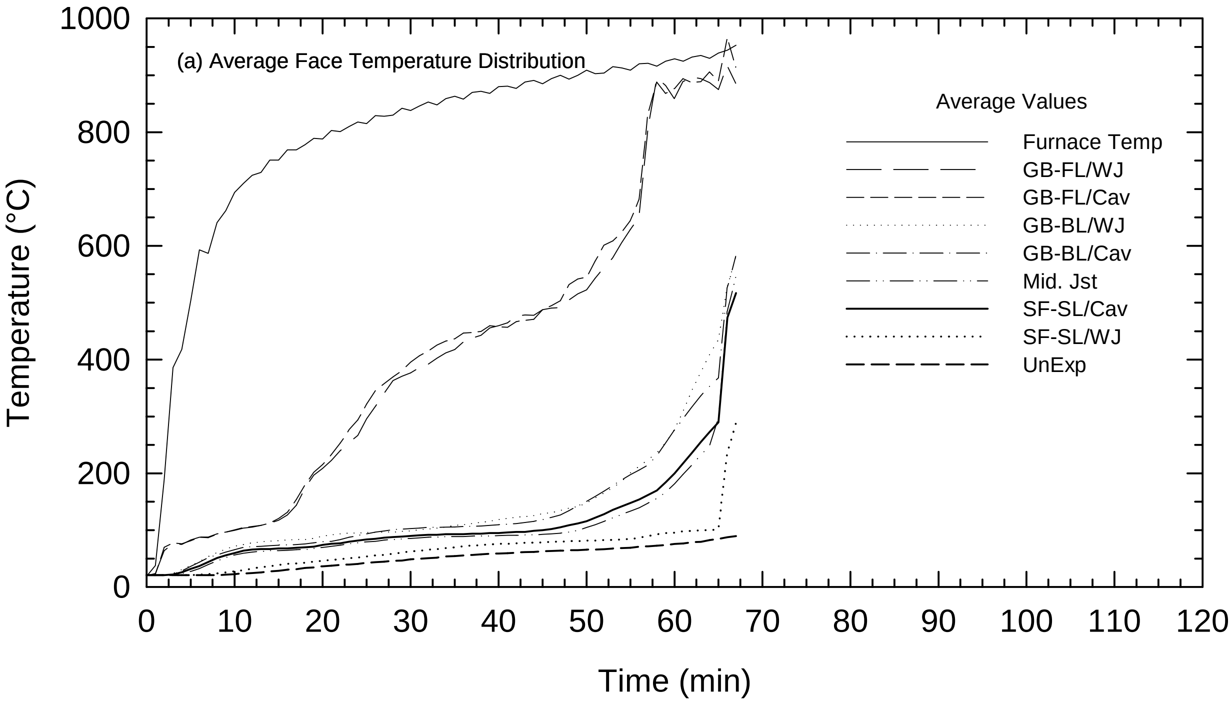


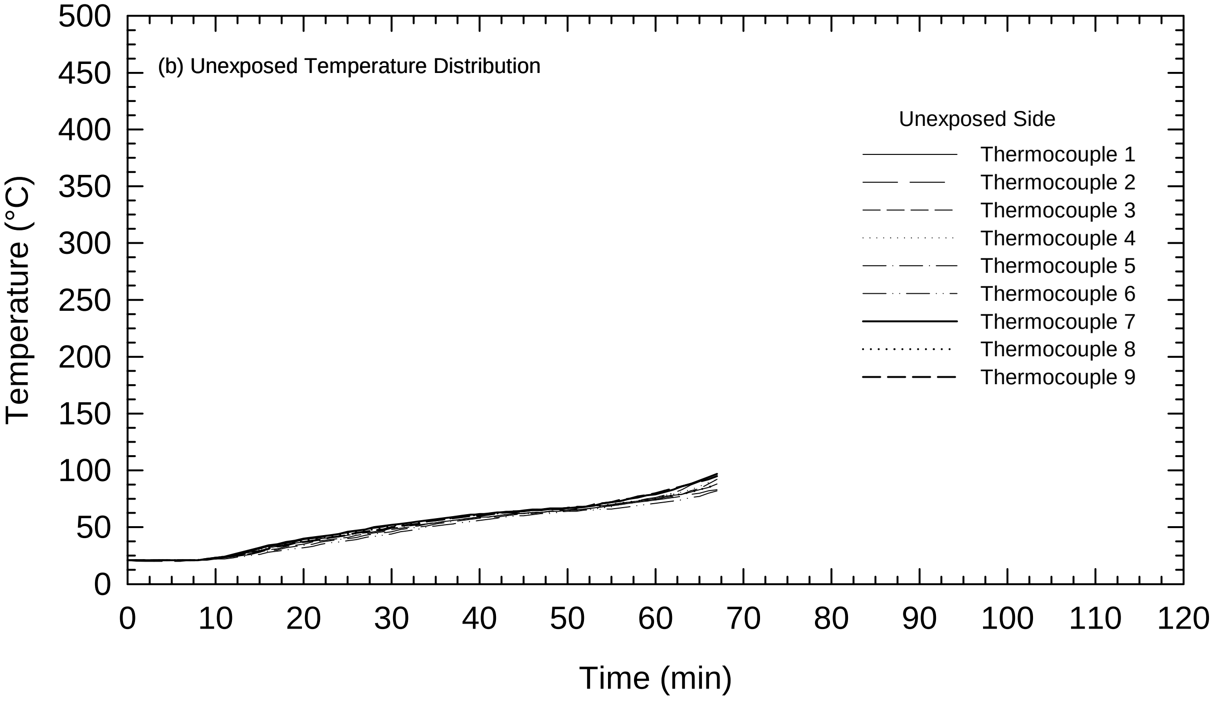


Legend

SL - Single Layer GB - Gypsum Board WJ - Solid Wood Joist Cav - Cavity Mid.Jst - Middle Joist
UnExp - Unexposed Side SF - Subfloor

Figure F-1. Temperature Distributions for Floor Fire Test, FF-30

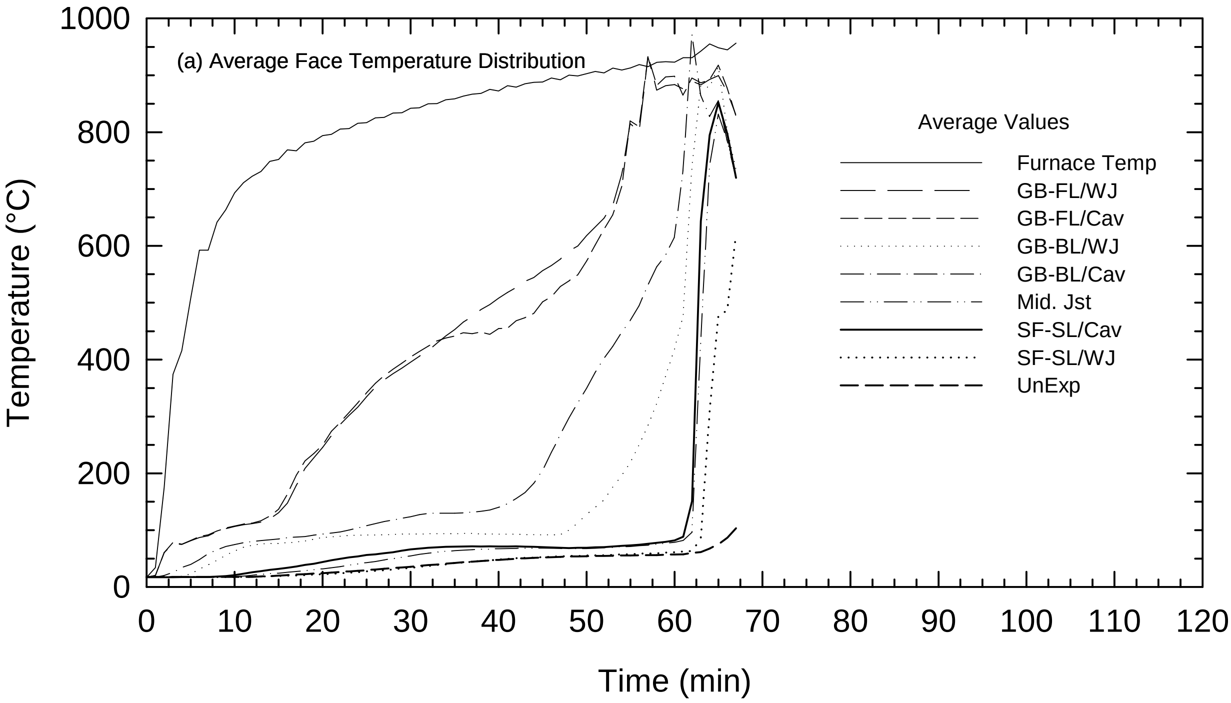


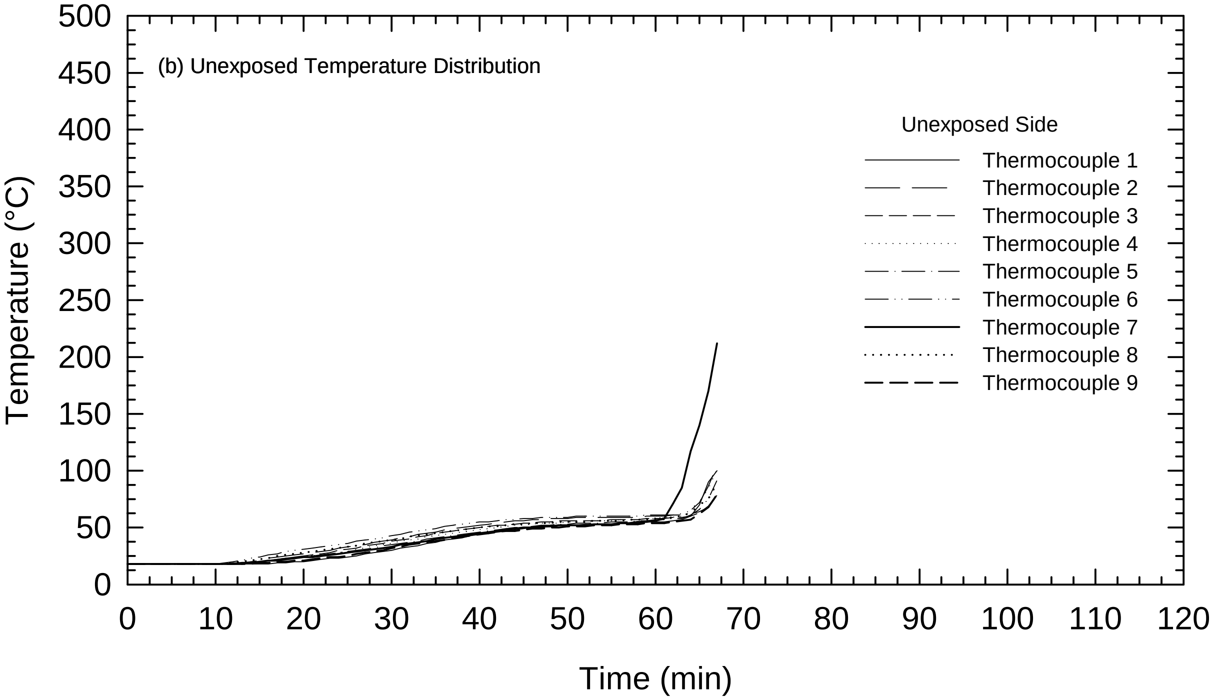


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
WJ - Solid Wood Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-2. Temperature Distributions for Floor Fire Test, FF-31

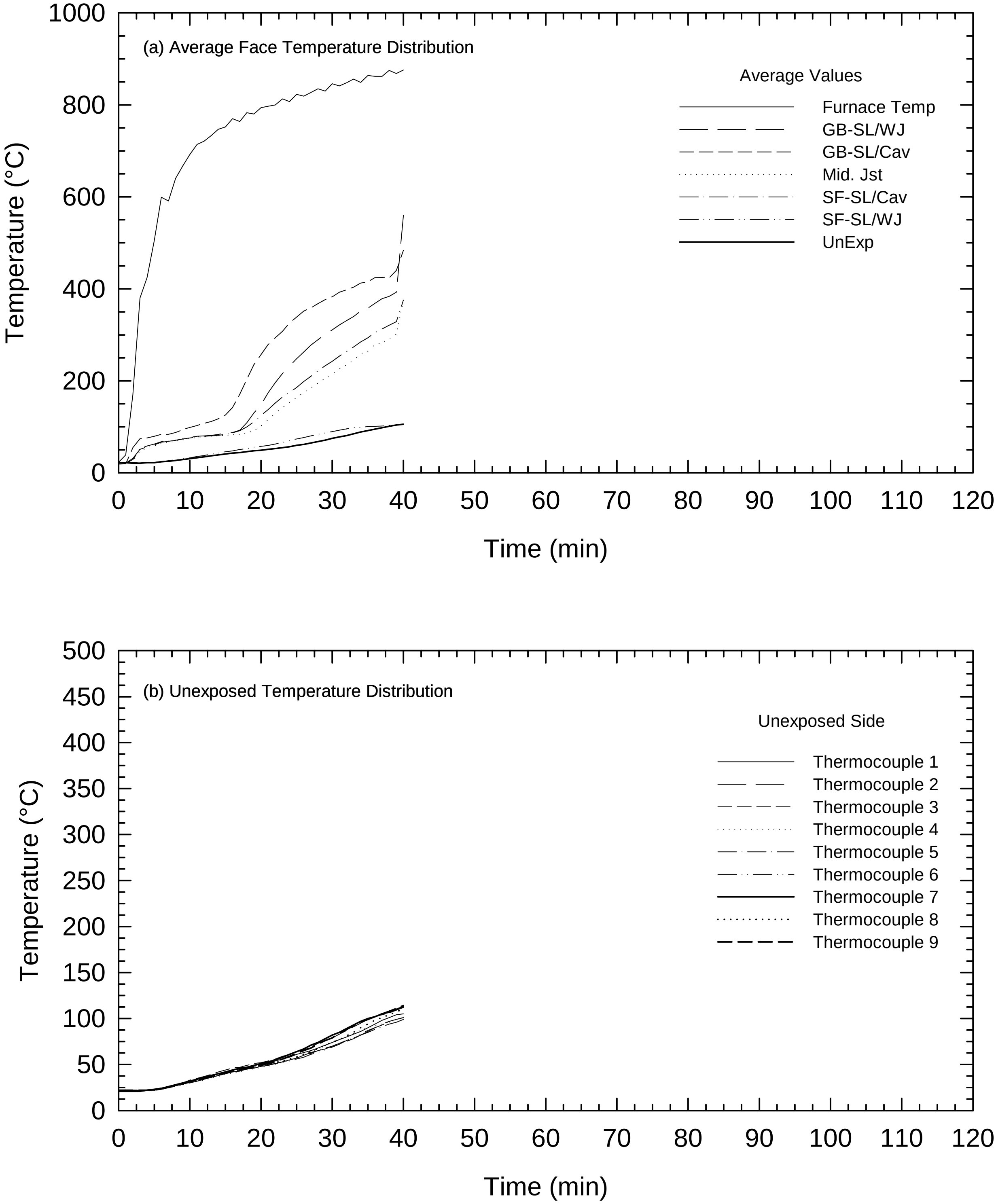




Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
WJ - Solid Wood Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

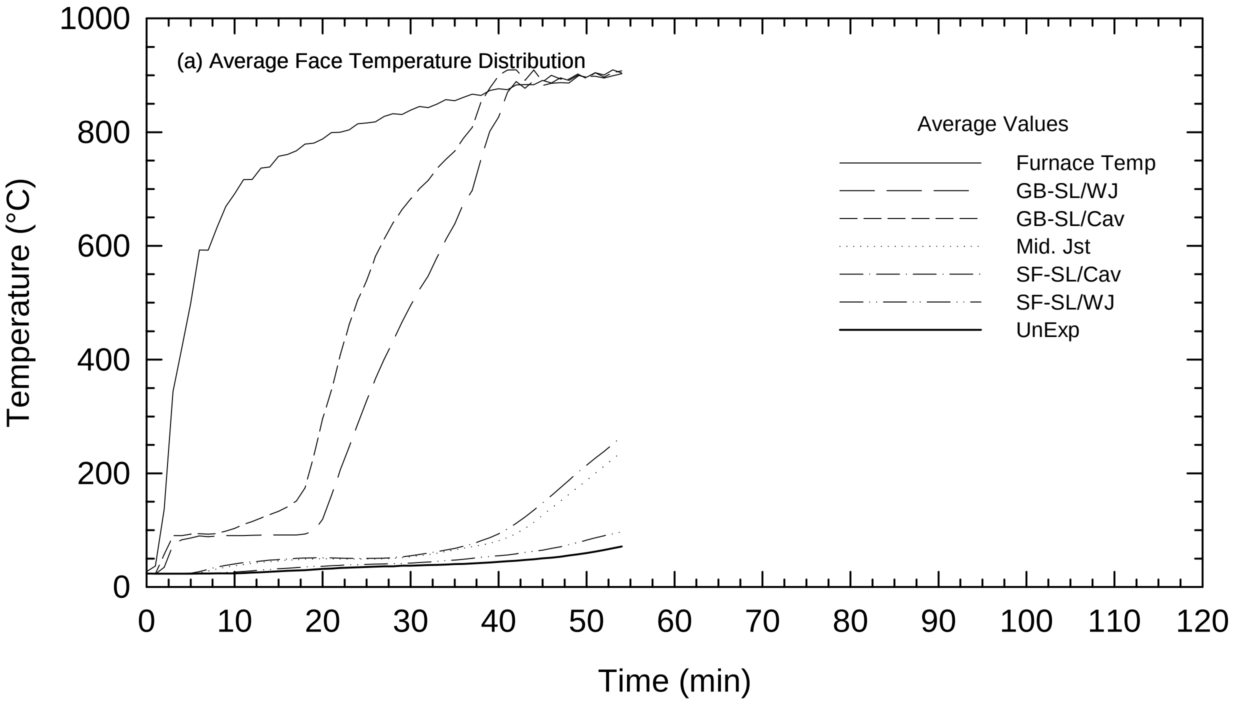
Figure F-3. Temperature Distributions for Floor Fire Test, FF-32

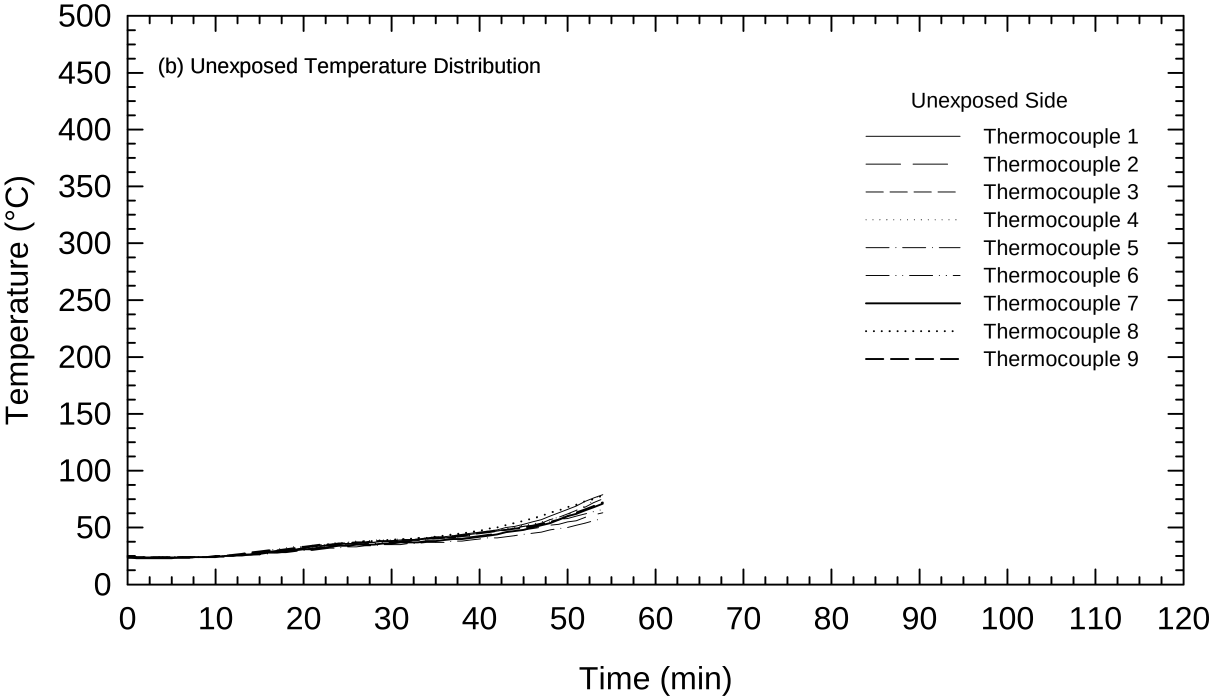


Legend

SL - Single Layer   GB - Gypsum Board   WJ - Solid Wood Joist   Cav - Cavity   Mid.Jst - Middle Joist
UnExp - Unexposed Side   SF - Subfloor

Figure F-4. Temperature Distributions for Floor Fire Test, FF-33

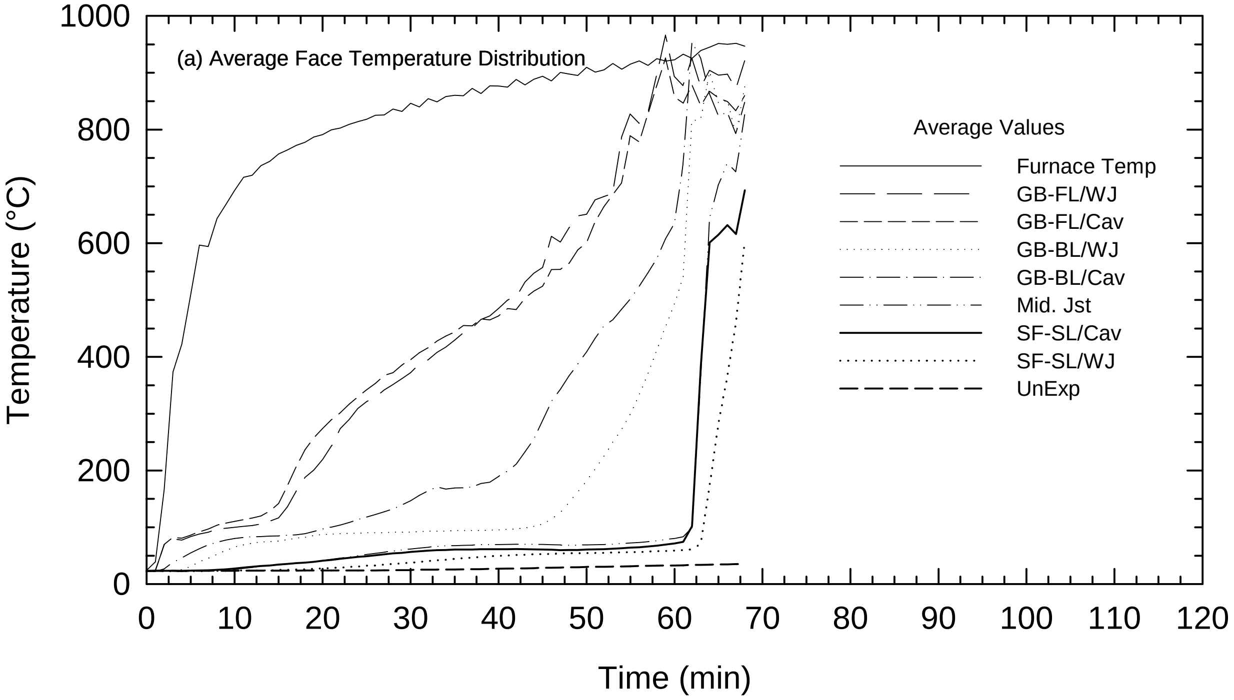


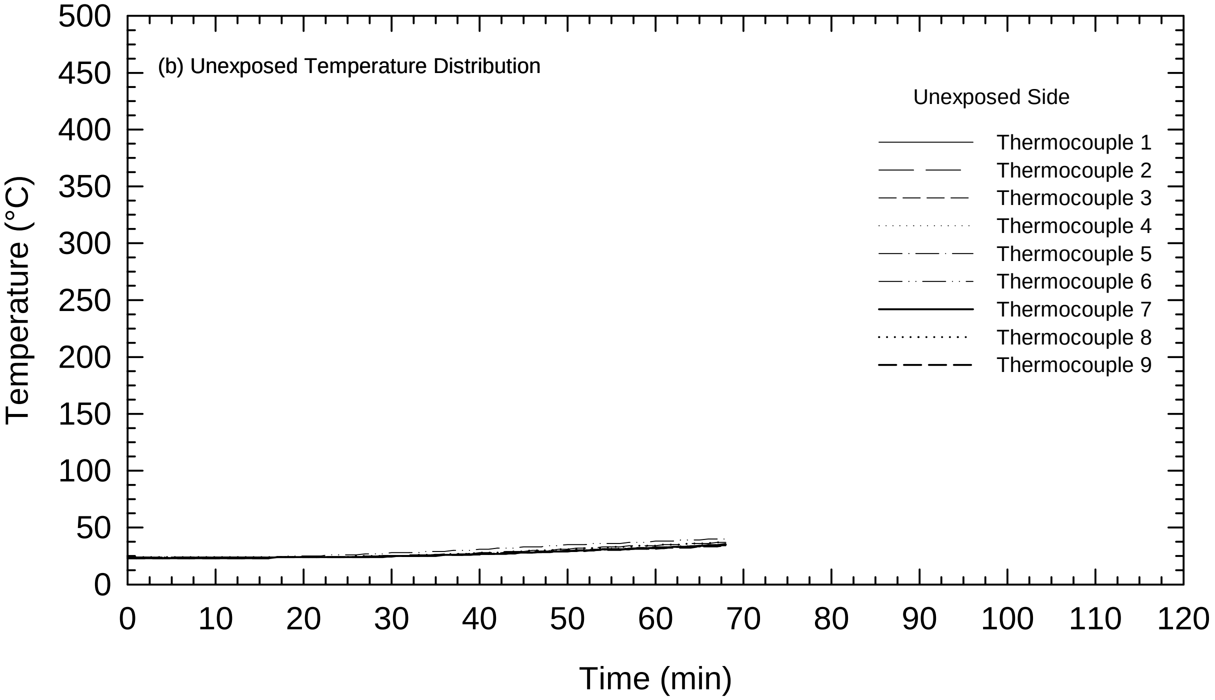


Legend

SL - Single Layer GB - Gypsum Board WJ - Solid Wood Joist Cav - Cavity Mid.Jst - Middle Joist
UnExp - Unexposed Side SF - Subfloor

Figure F-5. Temperature Distributions for Floor Fire Test, FF-34

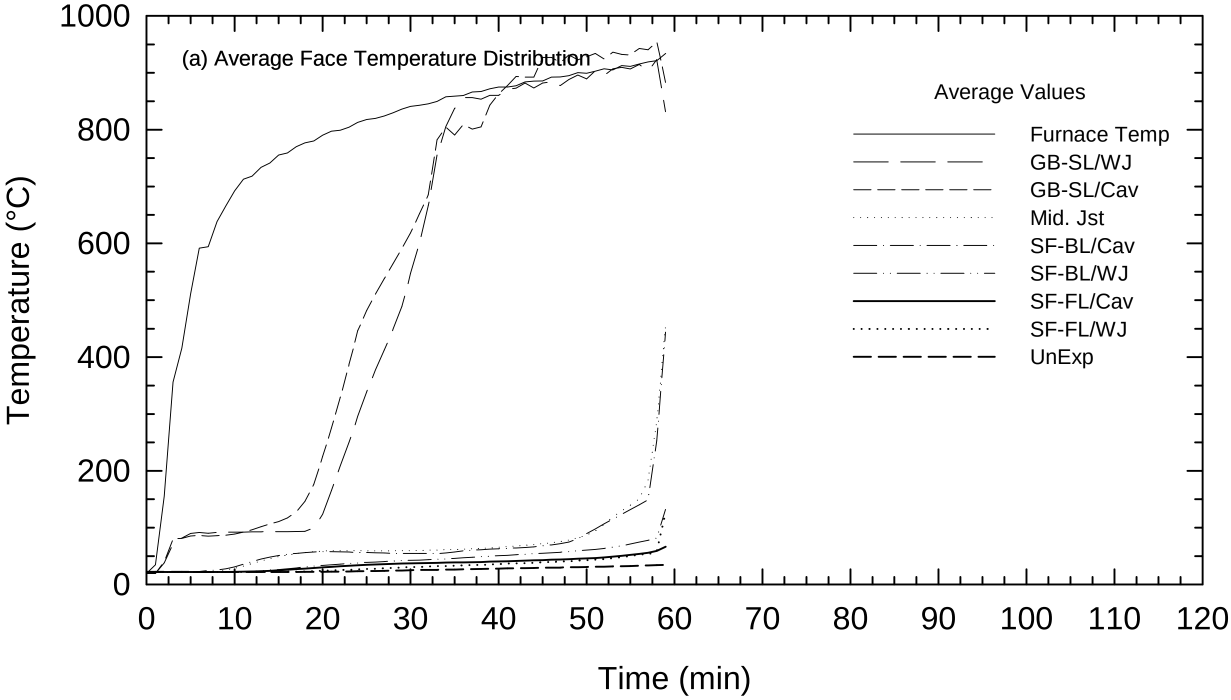


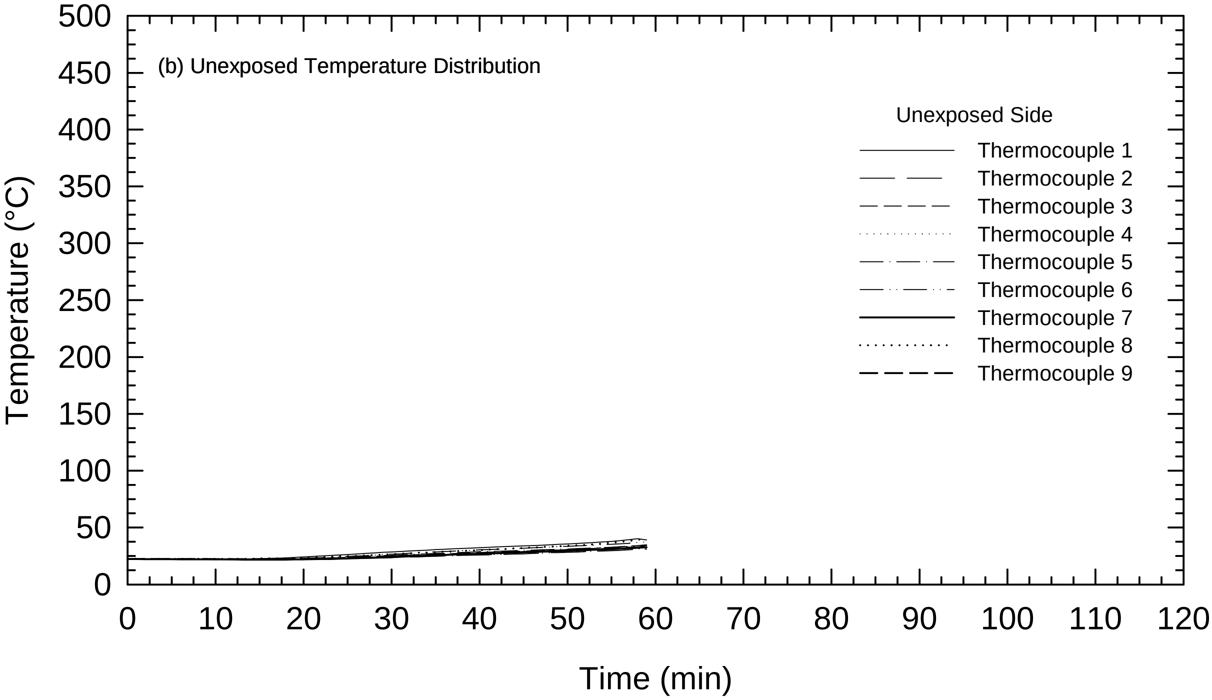


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
WJ - Solid wood Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-6. Temperature Distributions for Floor Fire Test, FF-35

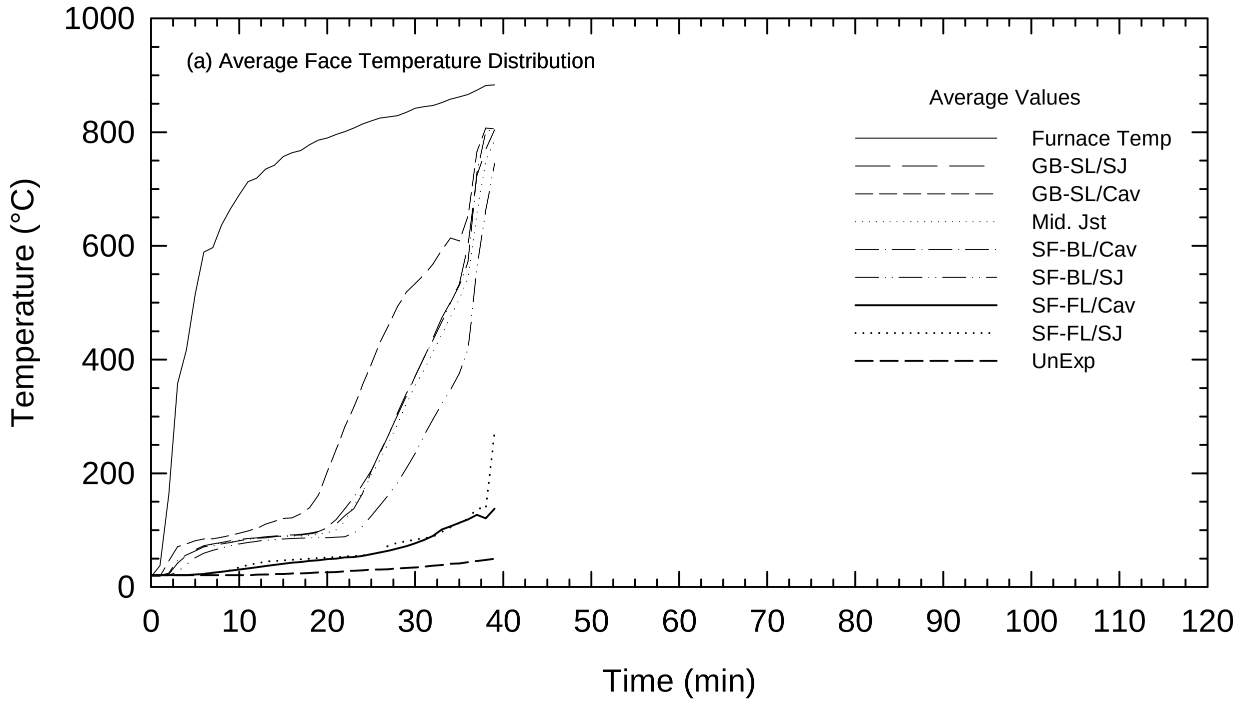


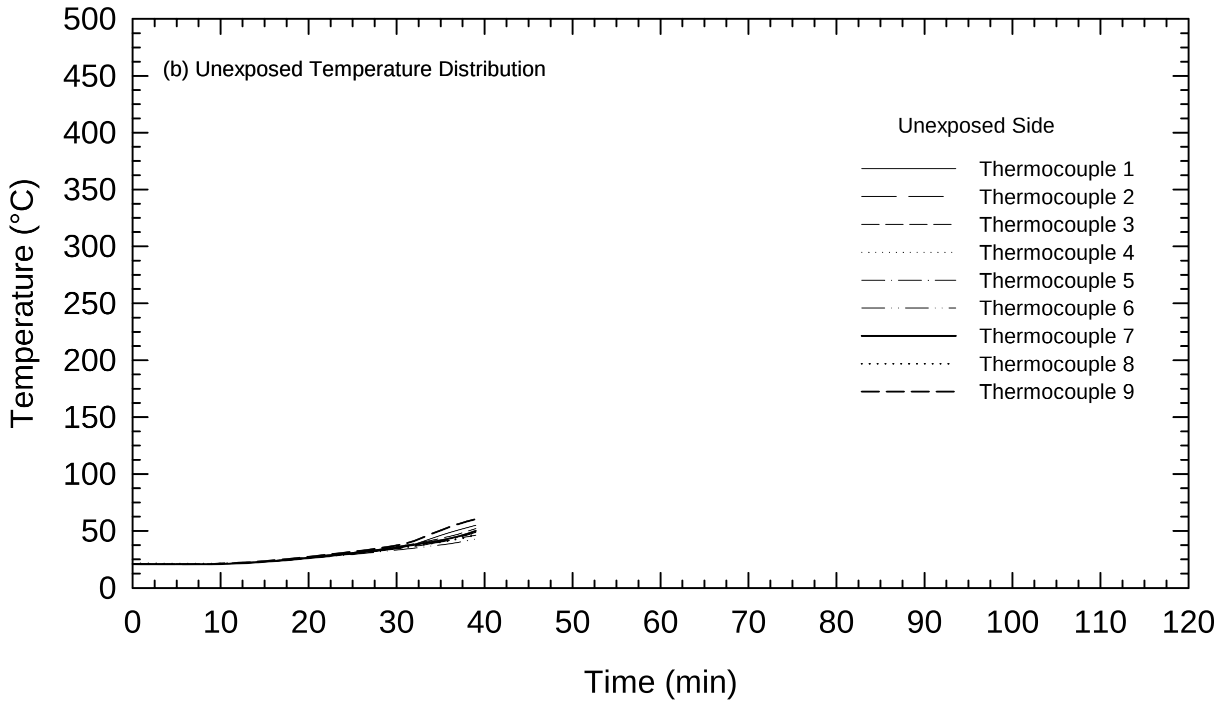


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
WJ - Solid Wood Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-7. Temperature Distributions for Floor Fire Test, FF-36

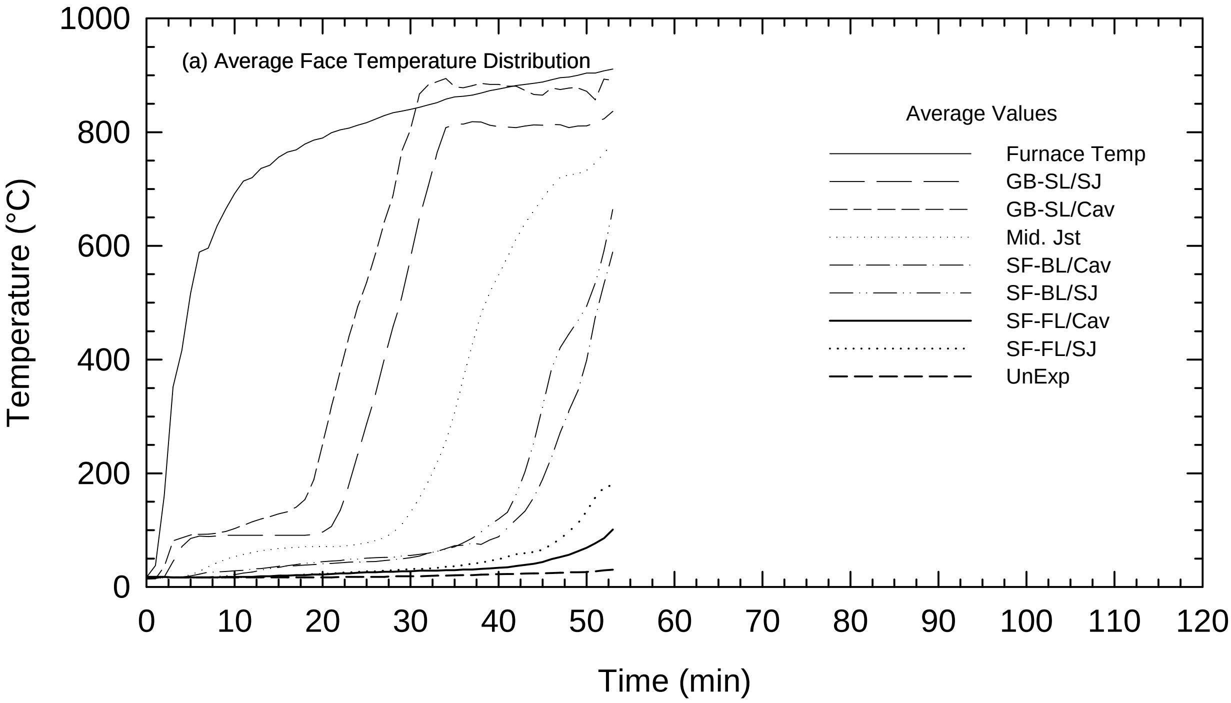


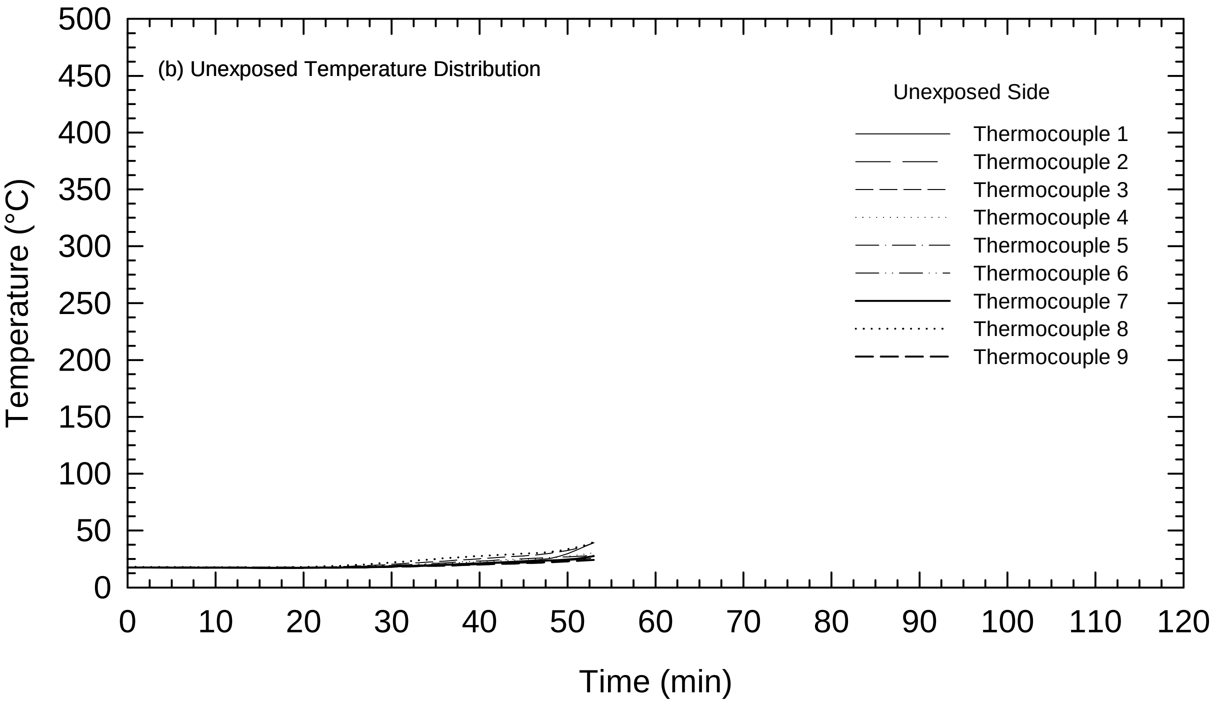


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
SJ - Steel C-Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-8. Temperature Distributions for Floor Fire Test, FF-37

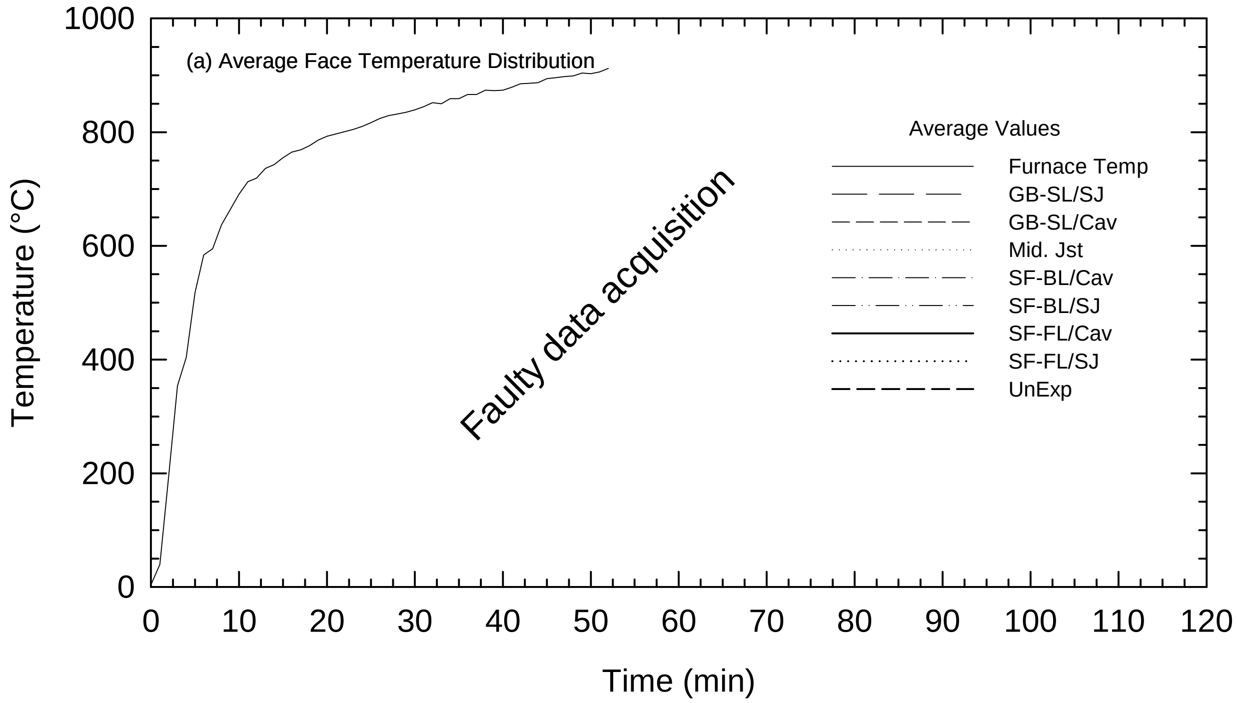


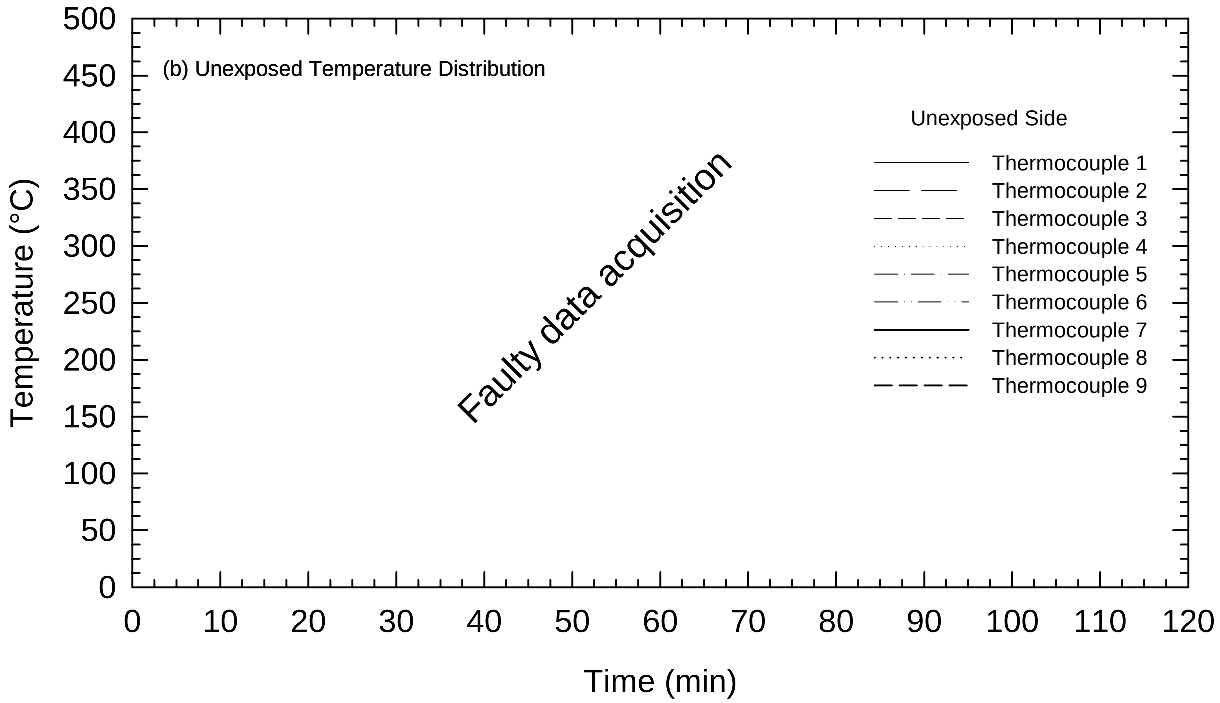


Legend

FL - Face Layer BL - Base Layer SL - Single Layer Cav - Cavity GB - Gypsum Board
SJ - Steel C-Joist Mid.Jst - Middle Joist UnExp - Unexposed Side SF - Subfloor

Figure F-9. Temperature Distributions for Floor Fire Test, FF-38

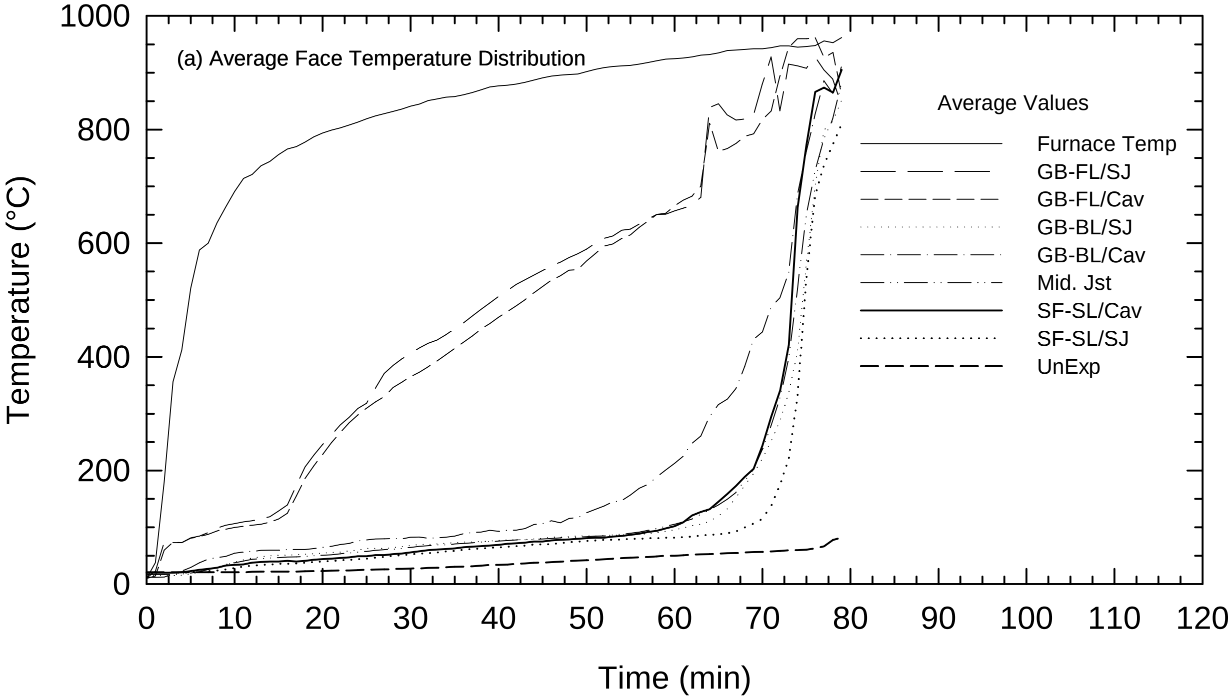


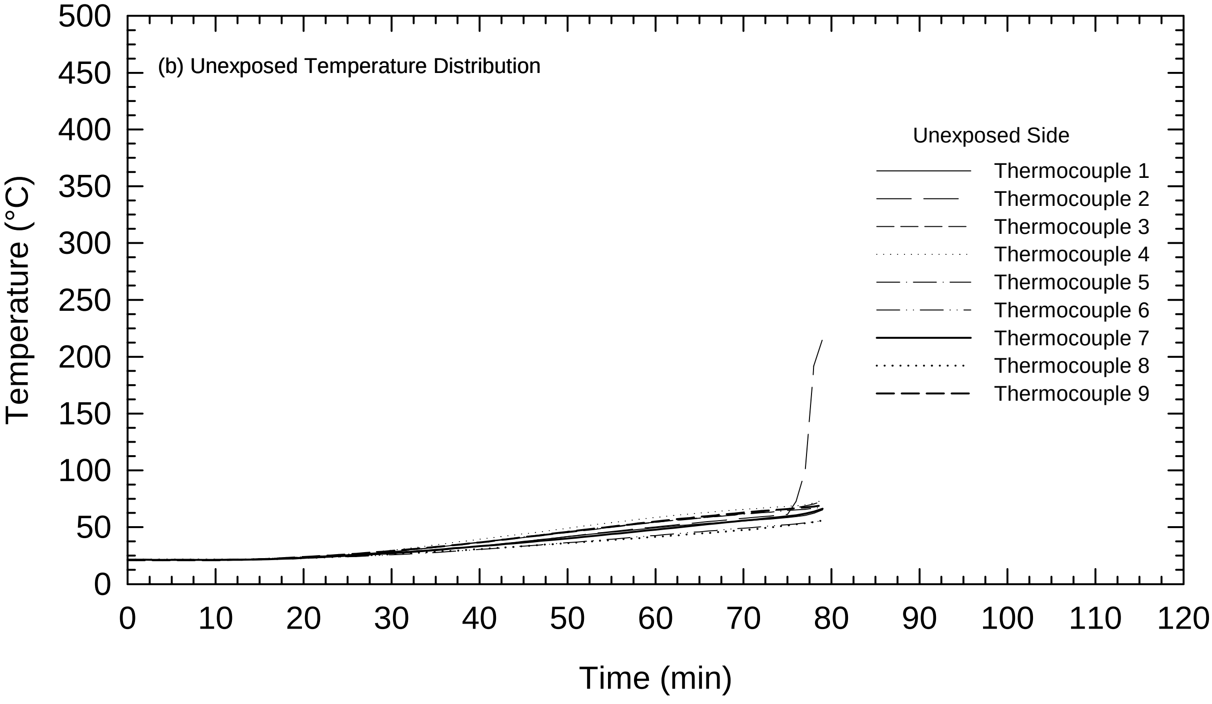


Legend

FL - Face Layer BL - Base Layer SL - Single Layer Cav - Cavity GB - Gypsum Board
SJ - Steel C-Joist Mid.Jst - Middle Joist UnExp - Unexposed Side SF - Subfloor

Figure F-10. Temperature Distributions for Floor Fire Test, FF-39

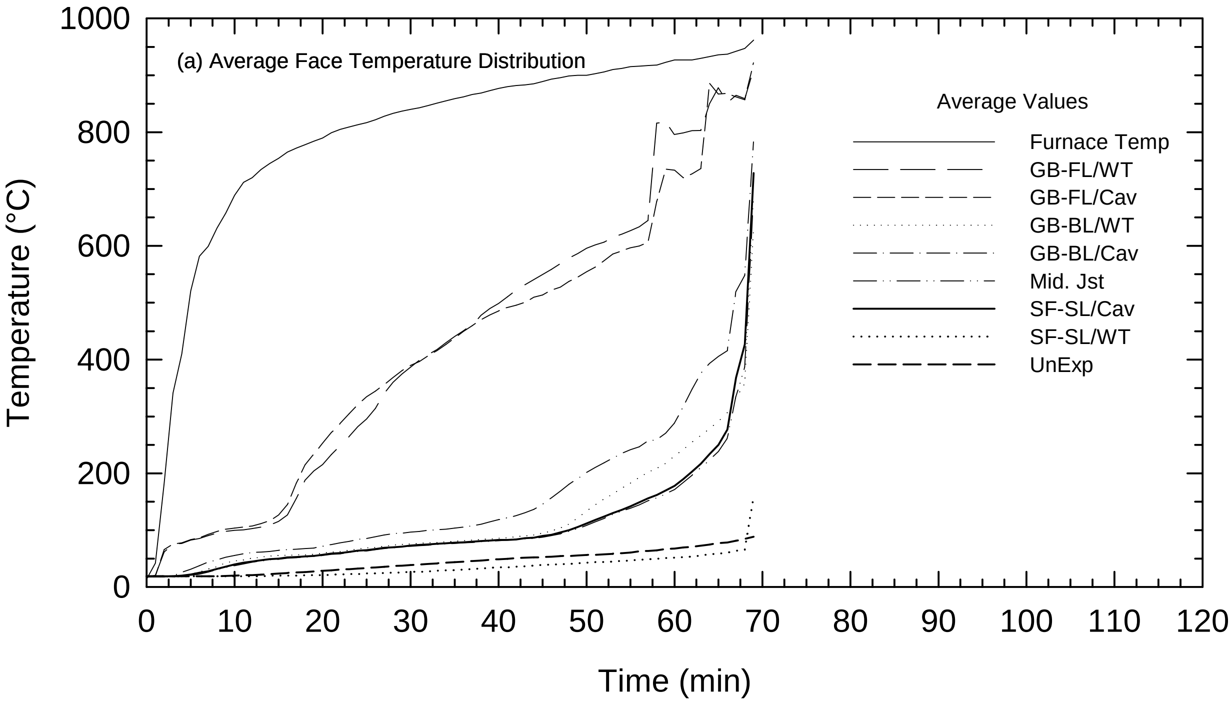


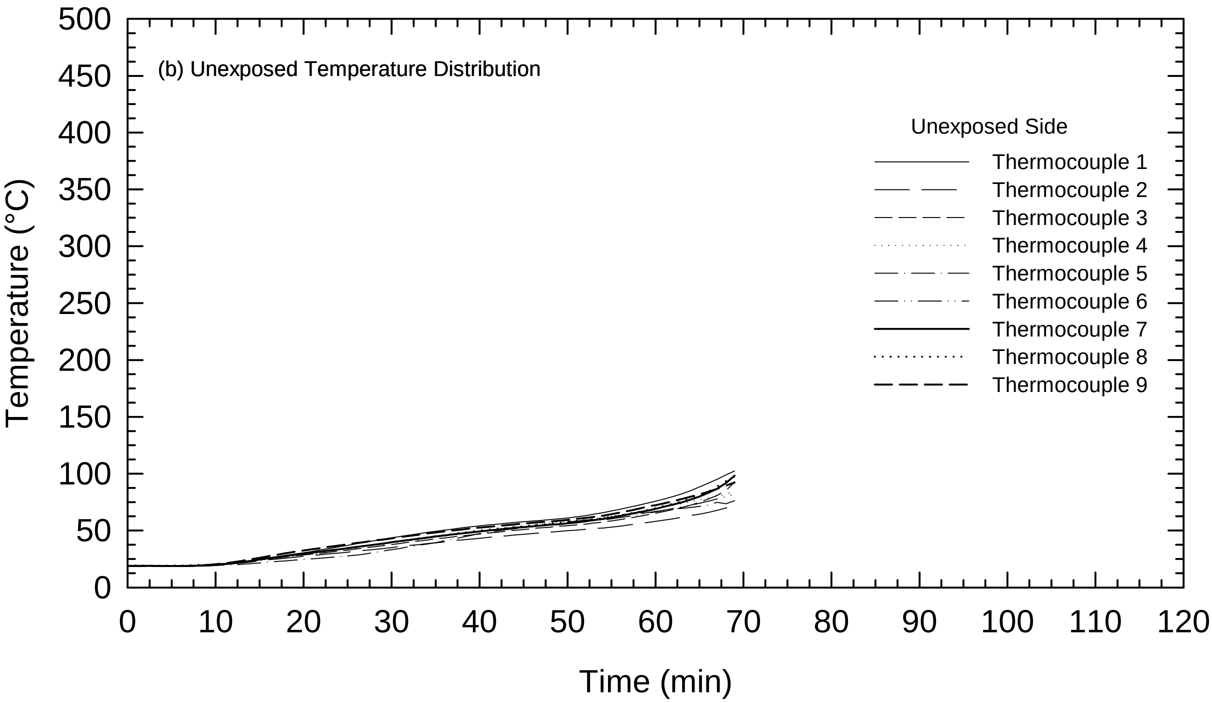


Legend

FL - Face Layer BL - Base Layer SL - Single Layer Cav - Cavity GB - Gypsum Board
SJ - Steel C-Joist Mid.Jst - Middle Joist UnExp - Unexposed Side SF - Subfloor

Figure F-11. Temperature Distributions for Floor Fire Test, FF-40

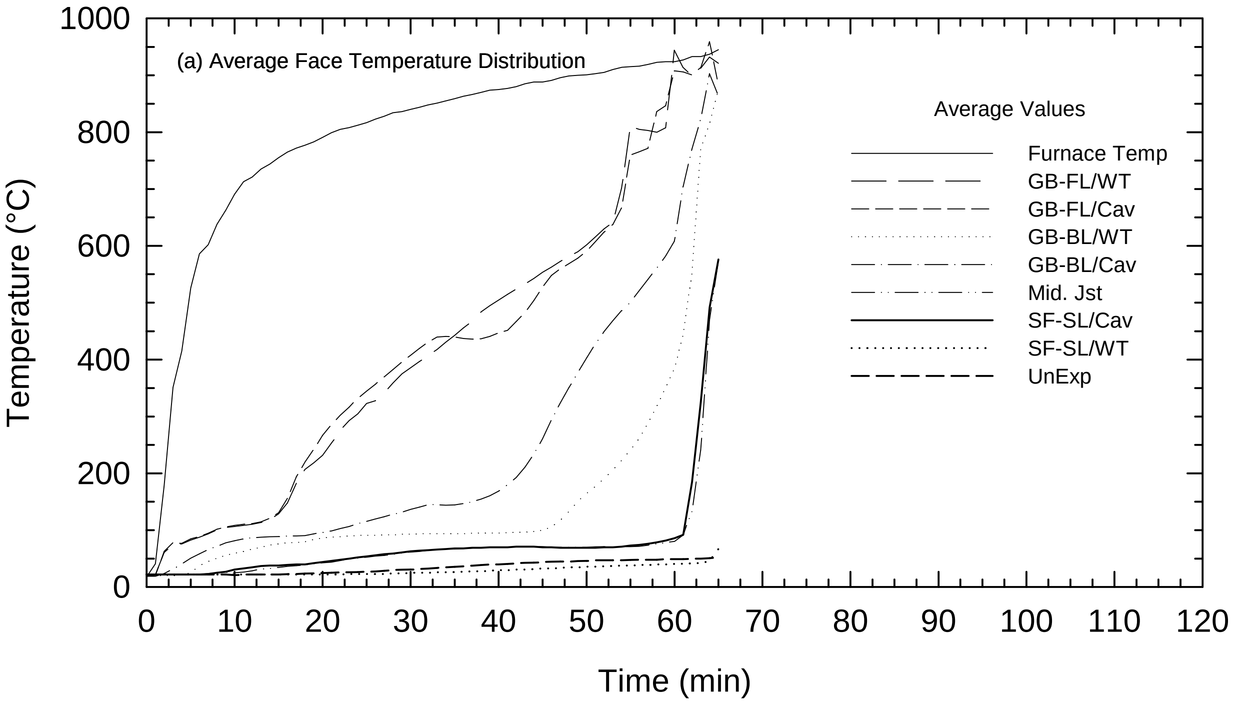


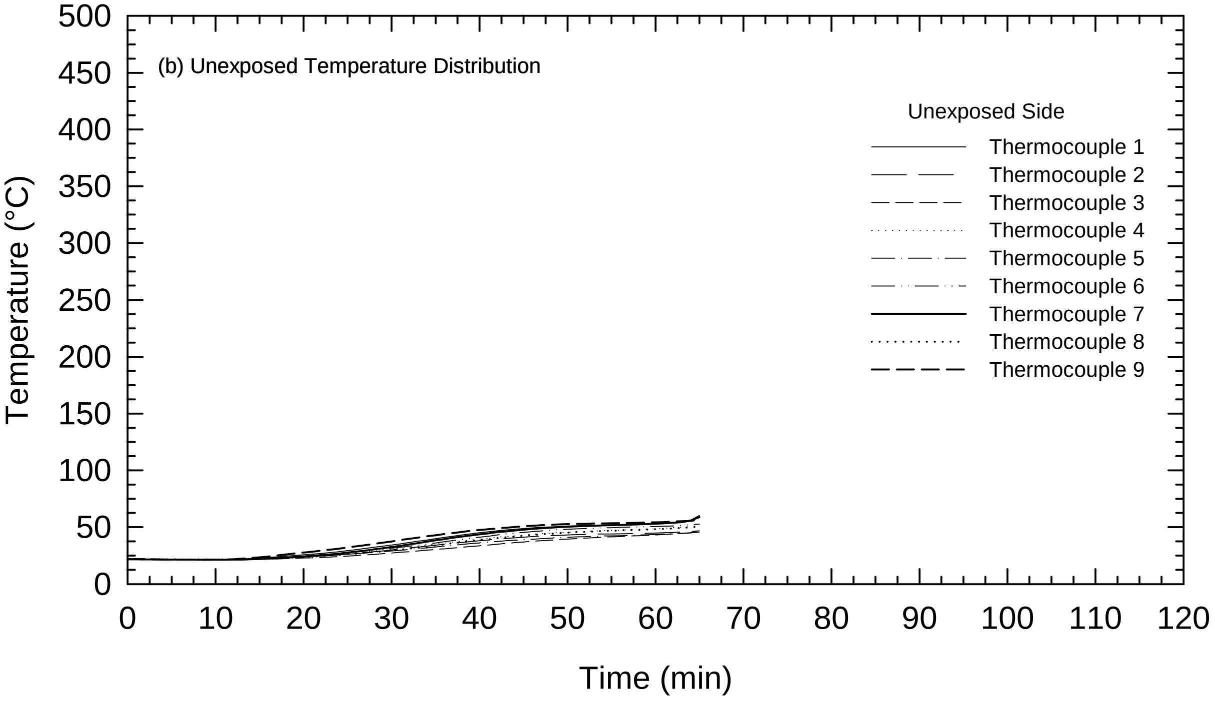


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   GB - Gypsum Board   WT - Wood Truss   Cav - Cavity
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-12. Temperature Distributions for Floor Fire Test, FF-41

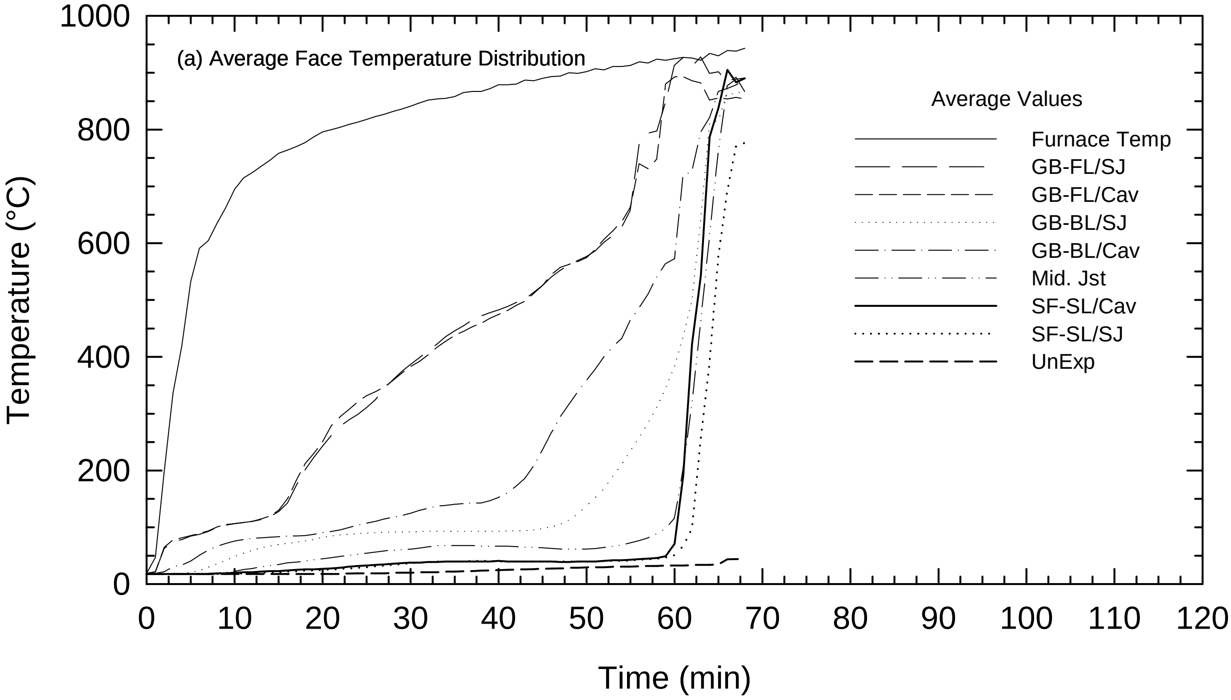


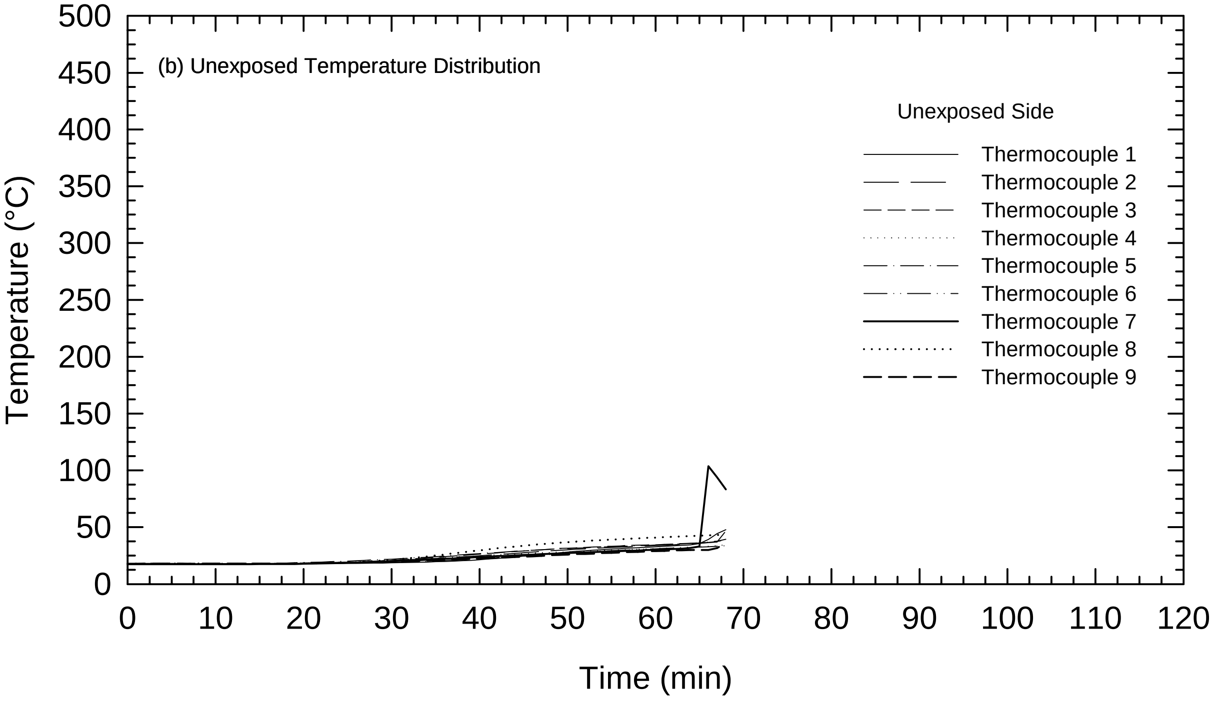


Legend

FL - Face Layer   BL - Base Layer   SL Single Layer   GB - Gypsum Board   WT - Wood Truss   Cav - Cavity
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-13. Temperature Distributions for Floor Fire Test, FF-42

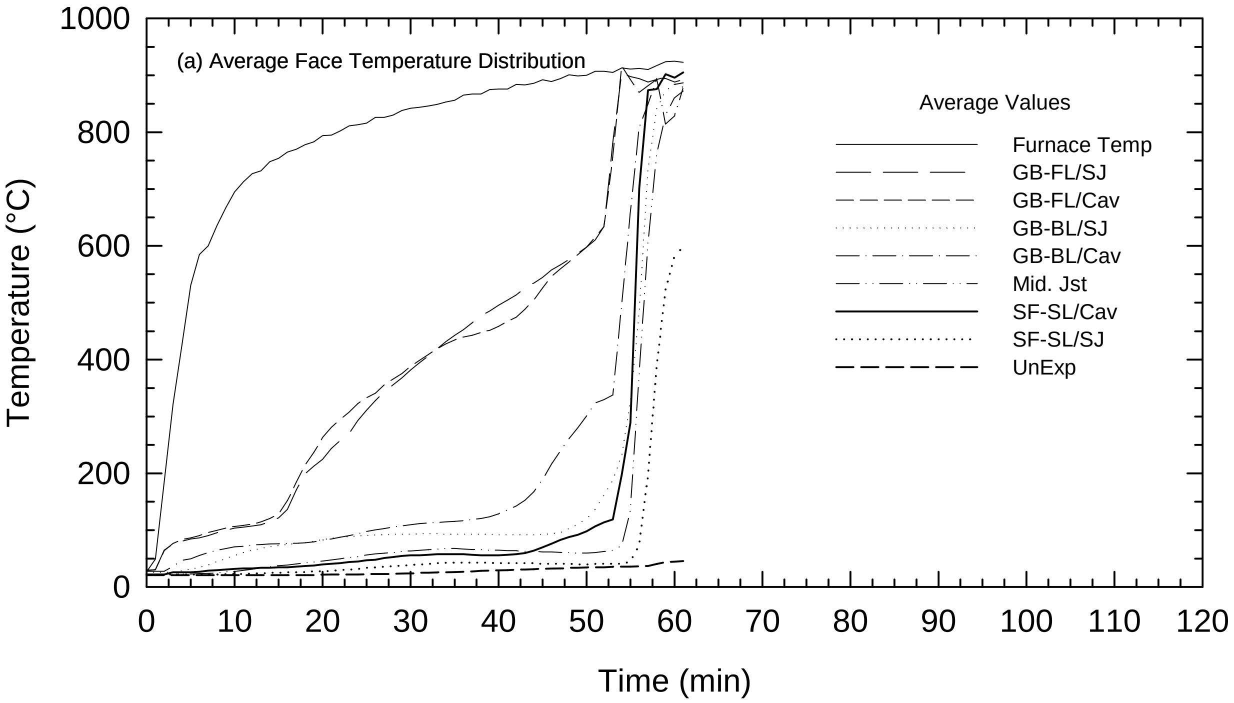


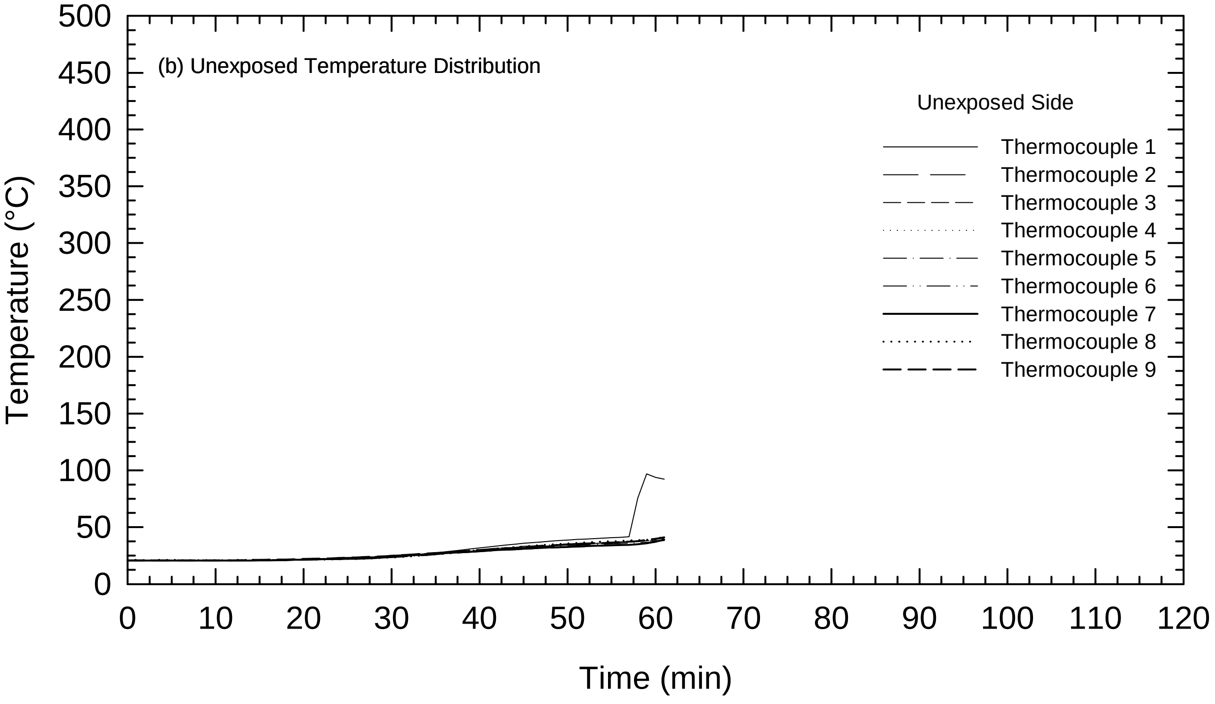


<u>Legend</u>

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
SJ - Steel C-Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-14. Temperature Distributions for Floor Fire Test, FF-43

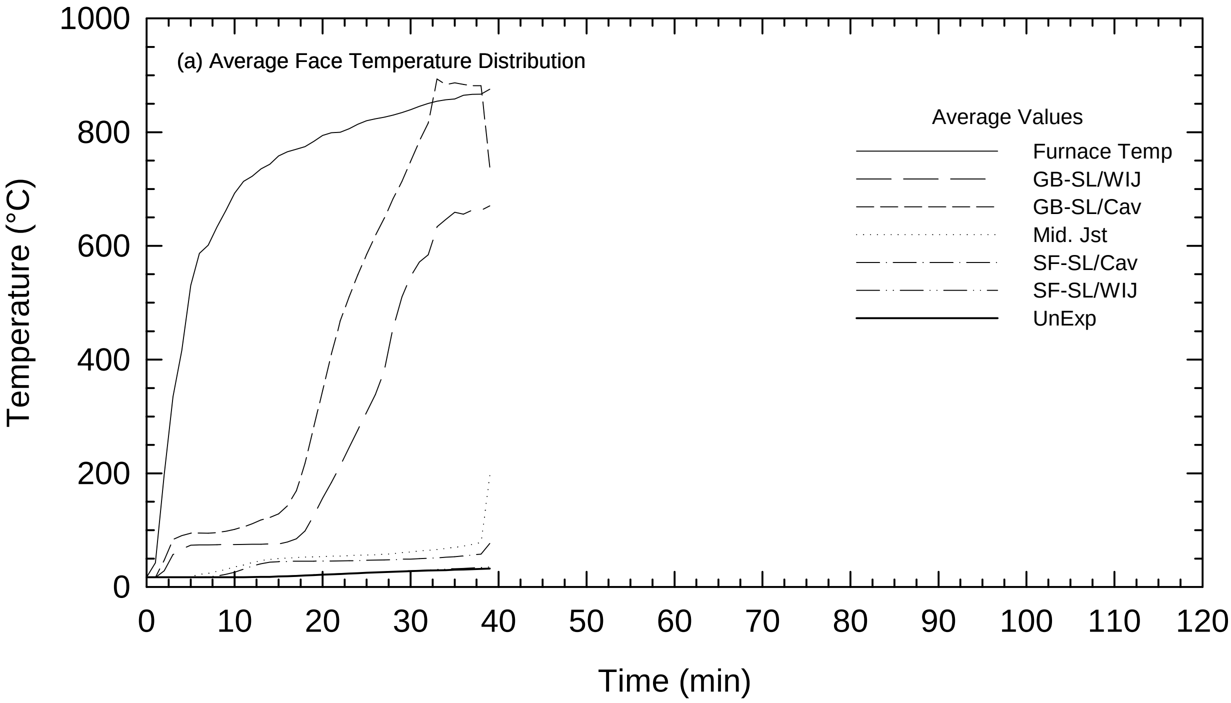


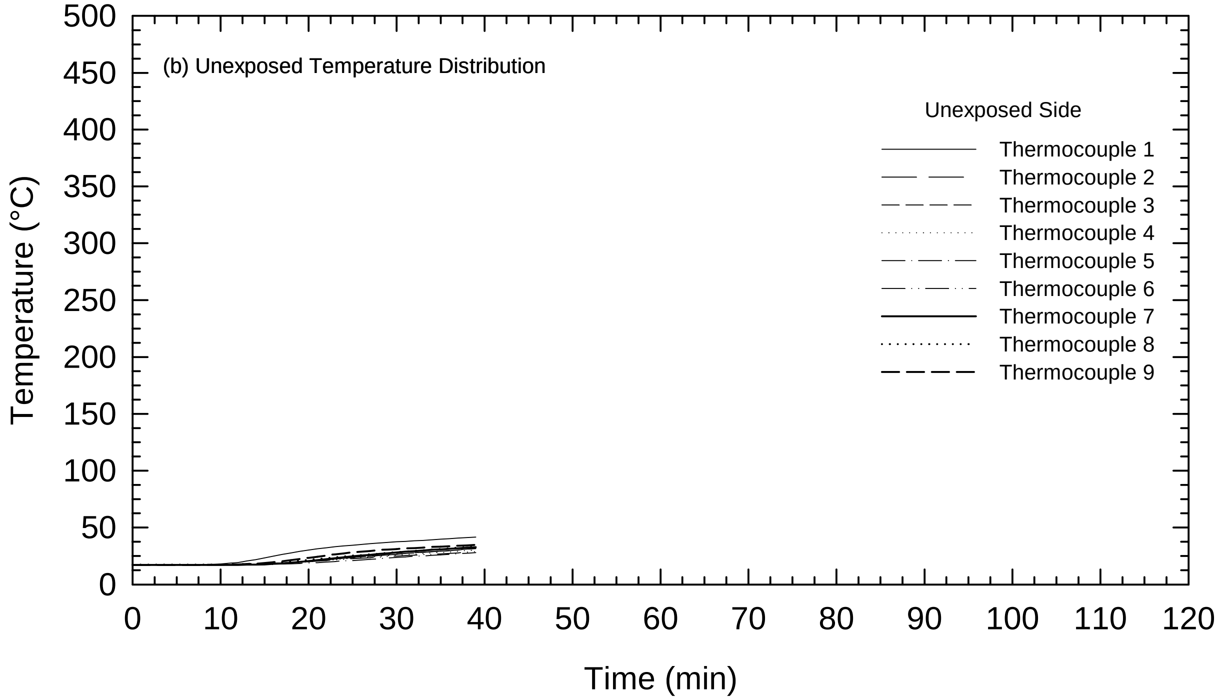


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
SJ - Steel C-Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-15. Temperature Distributions for Floor Fire Test, FF-44

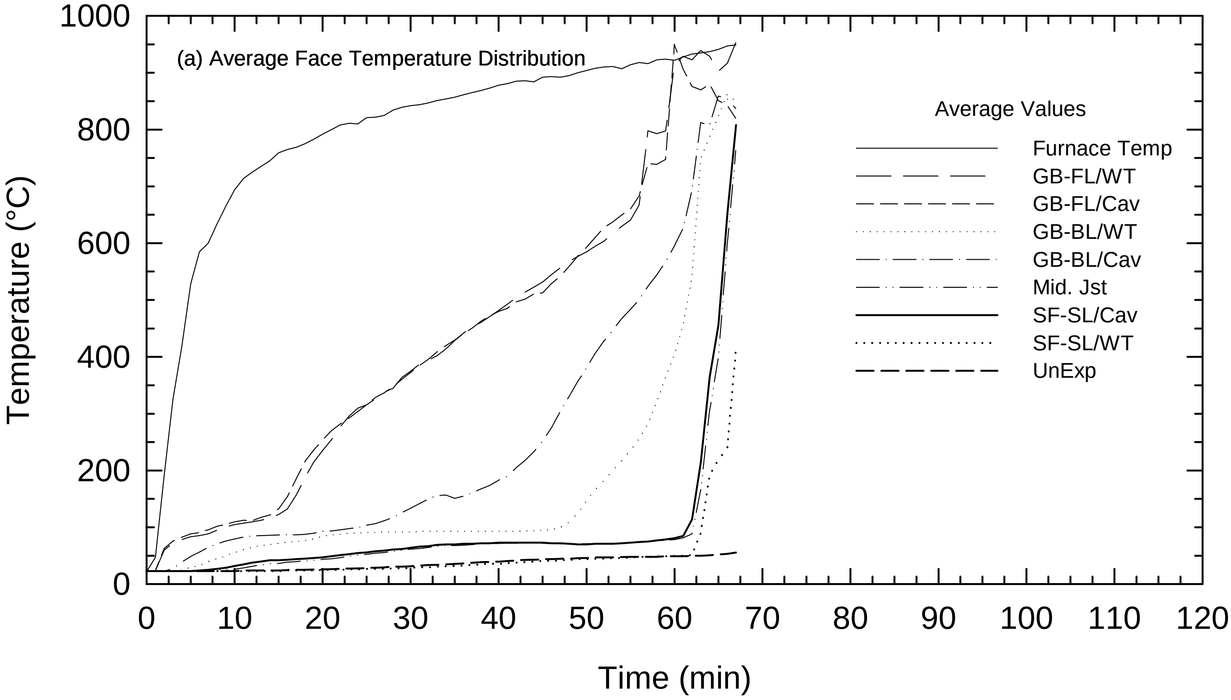


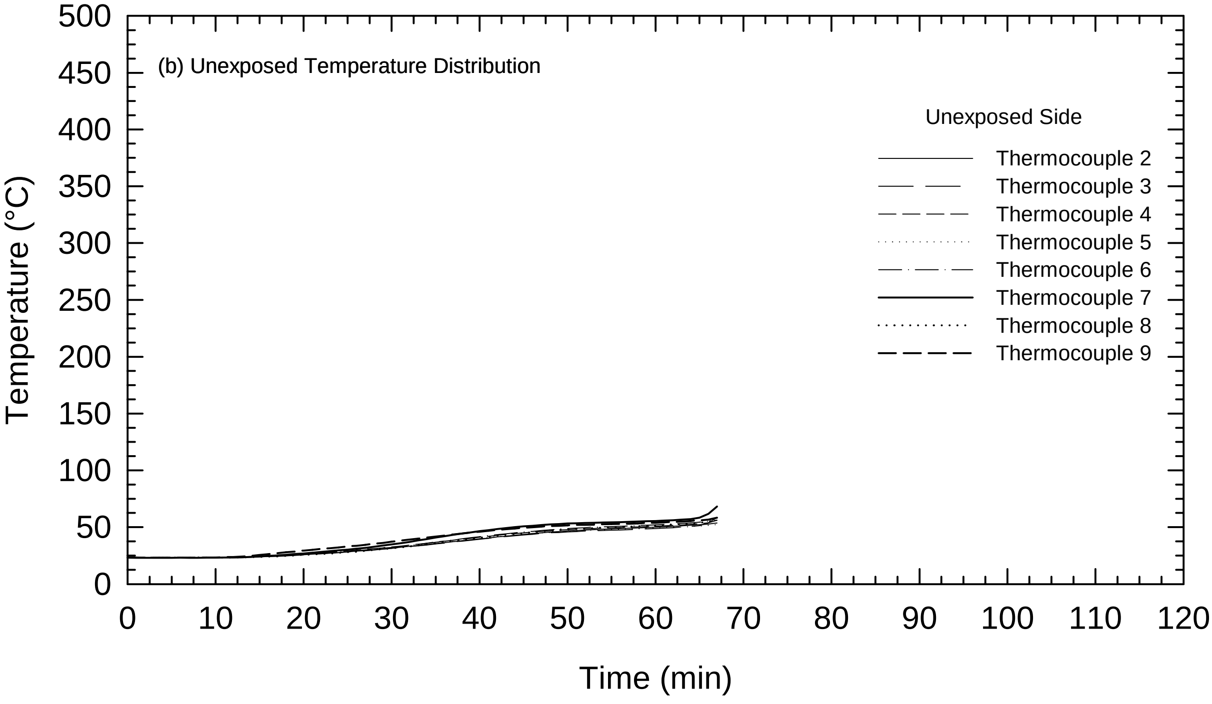


Legend

SL - Single Layer GB - Gypsum Board WIJ - Wood I-Joist Cav - Cavity Mid.Jst - Middle Joist
UnExp - Unexposed Side SF - Subfloor

Figure F-16. Temperature Distributions for Floor Fire Test, FF-45

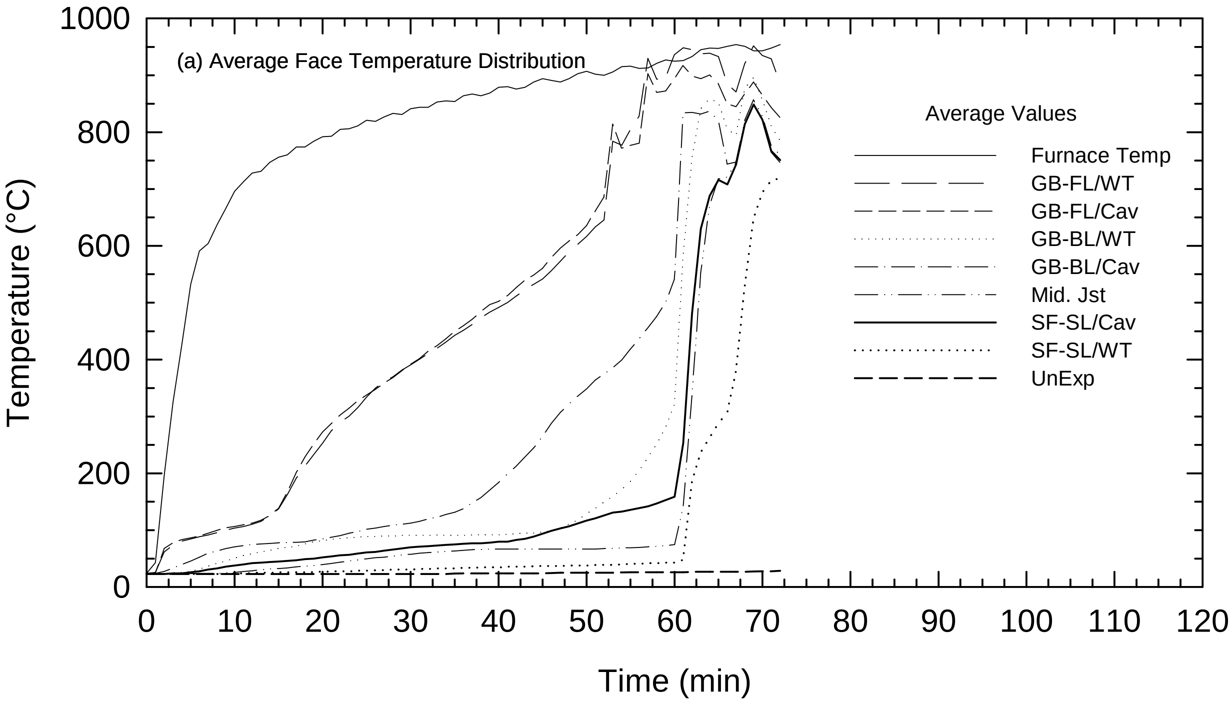


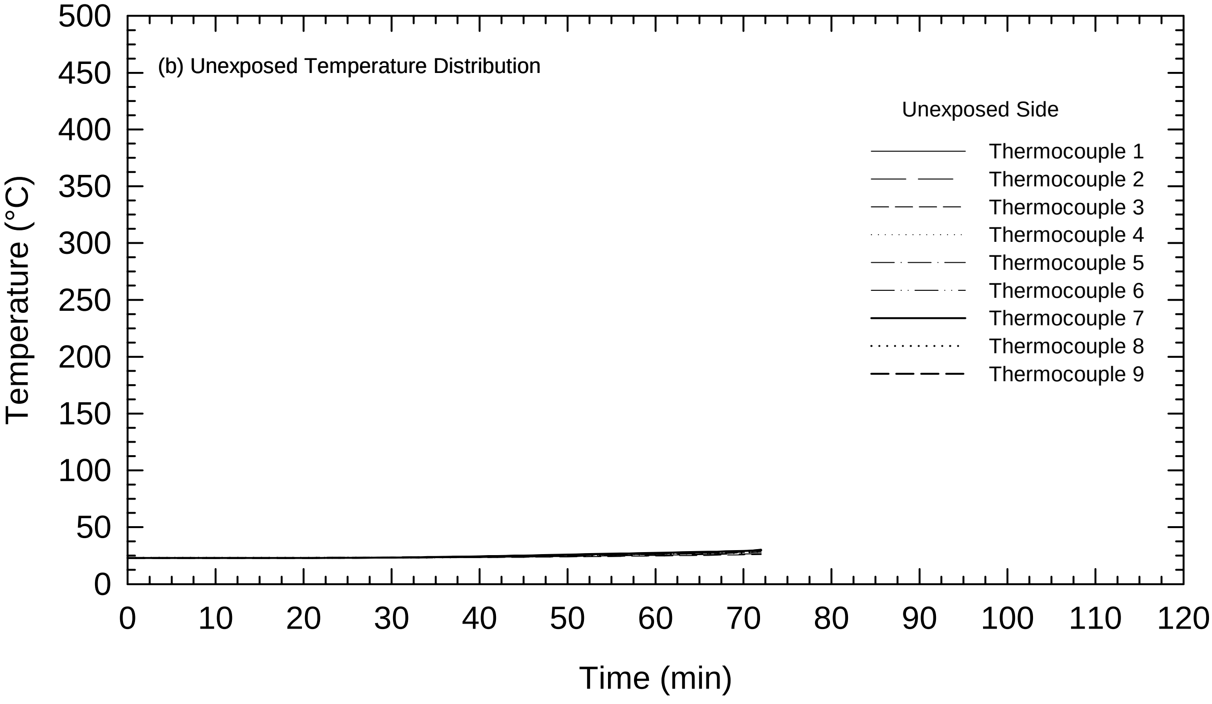


Legend

FL - Face Layer   BL - Base Layer   SL Single Layer   GB - Gypsum Board   WT - Wood Truss   Cav - Cavity
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-17. Temperature Distributions for Floor Fire Test, FF-46

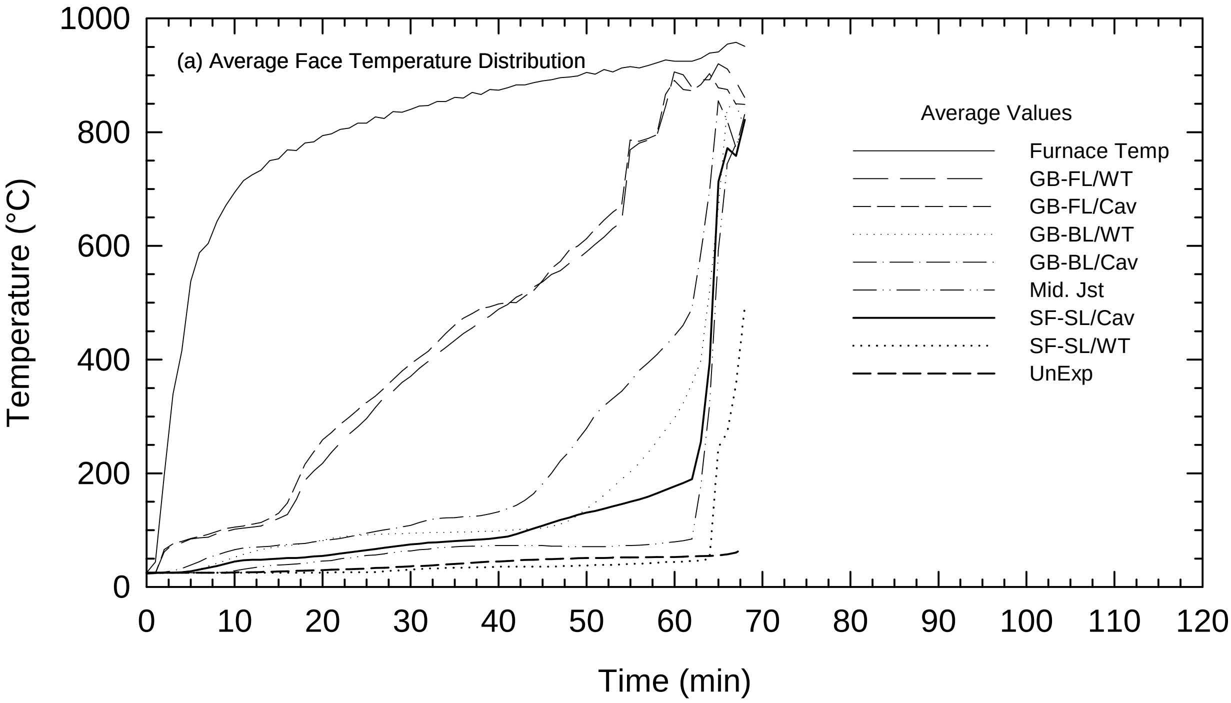


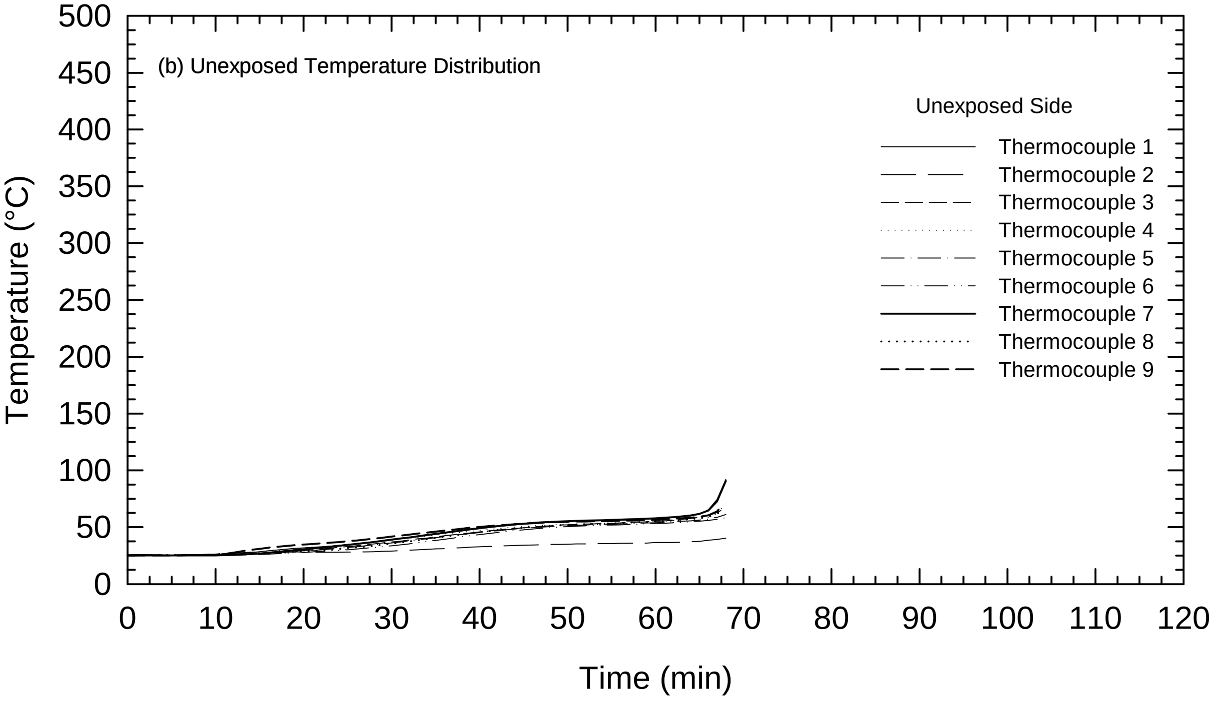


Legend

FL - Face Layer   BL - Base Layer   SL Single Layer   GB - Gypsum Board   WT - Wood Truss   Cav - Cavity
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-18. Temperature Distributions for Floor Fire Test, FF-47

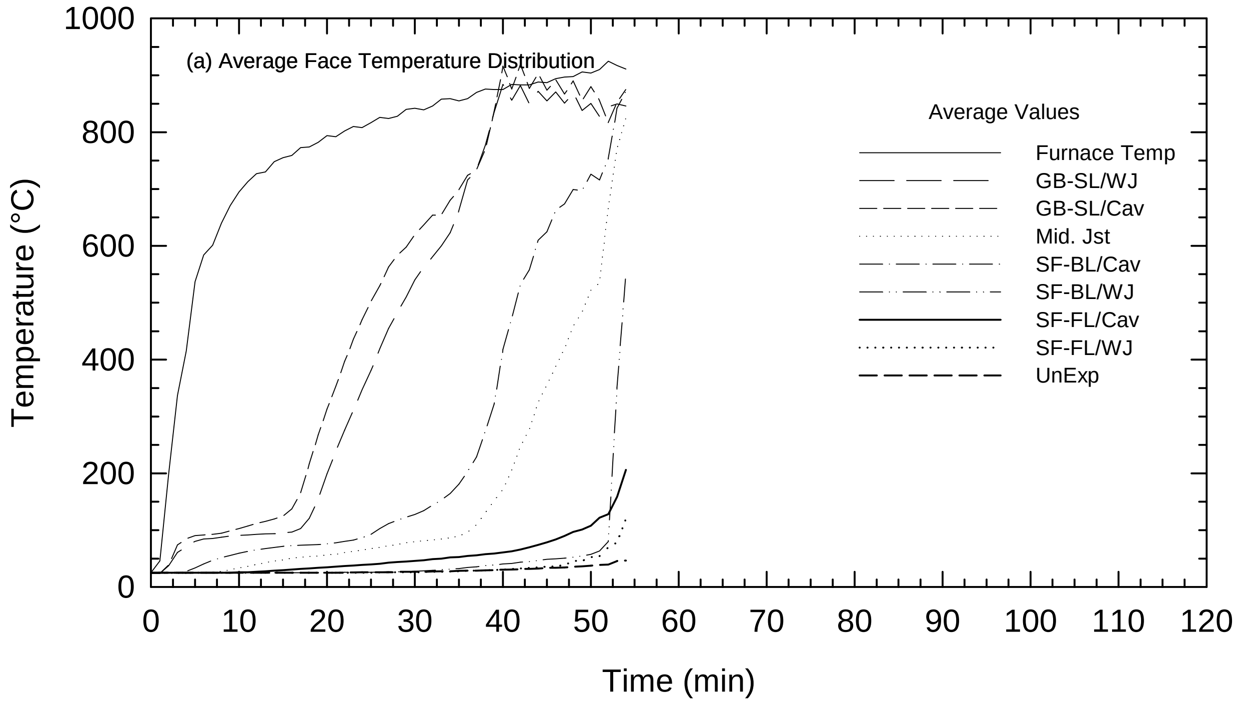


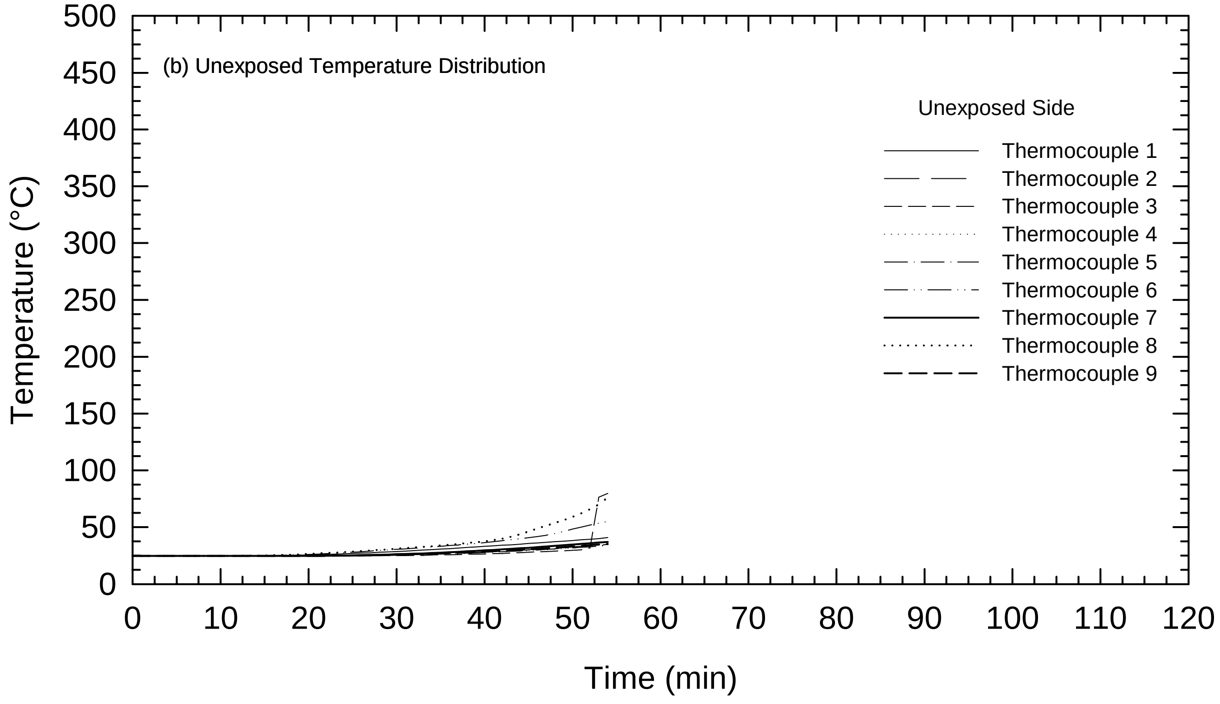


Legend

FL - Face Layer BL - Base Layer SL Single Layer GB - Gypsum Board WT - Wood Truss Cav - Cavity
Mid.Jst - Middle Joist UnExp - Unexposed Side SF - Subfloor

Figure F-19. Temperature Distributions for Floor Fire Test, FF-48

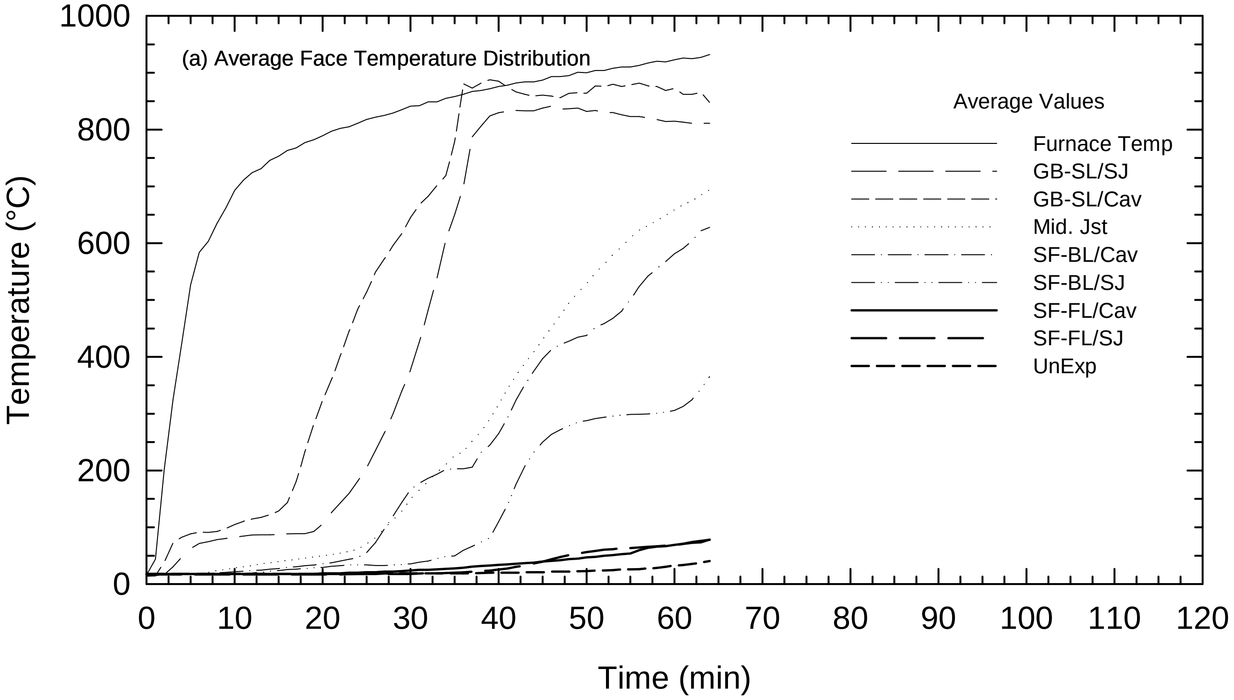


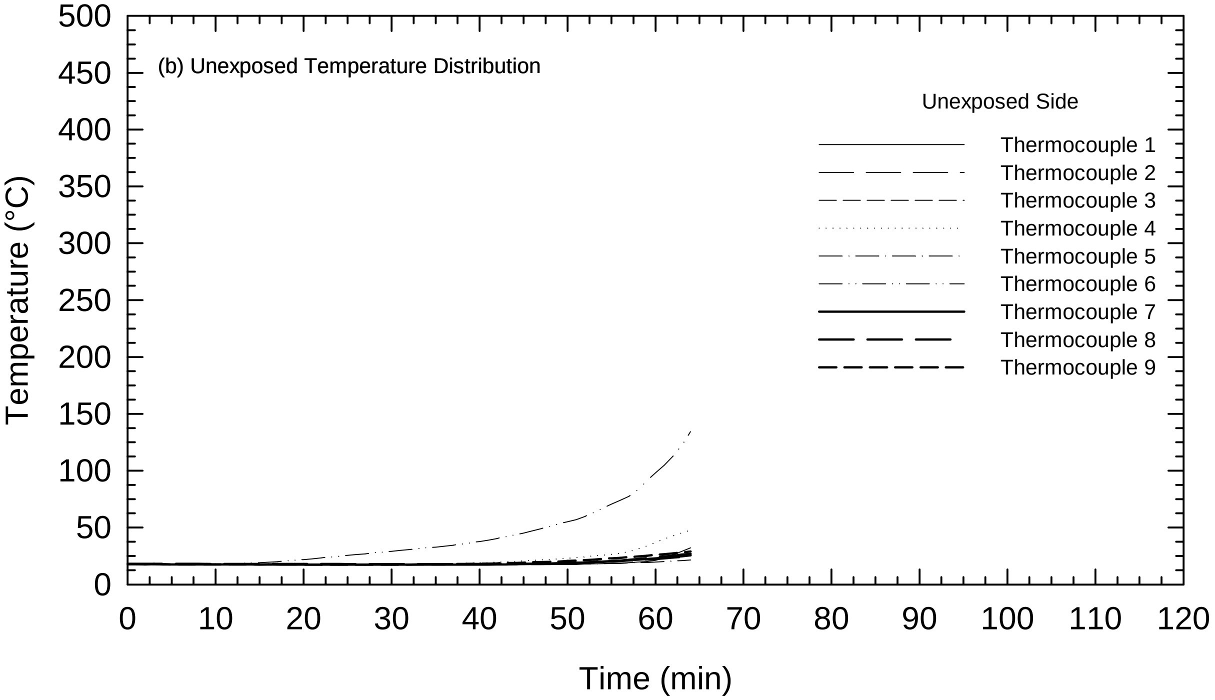


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
WJ - Solid Wood Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-20. Temperature Distributions for Floor Fire Test, FF-49

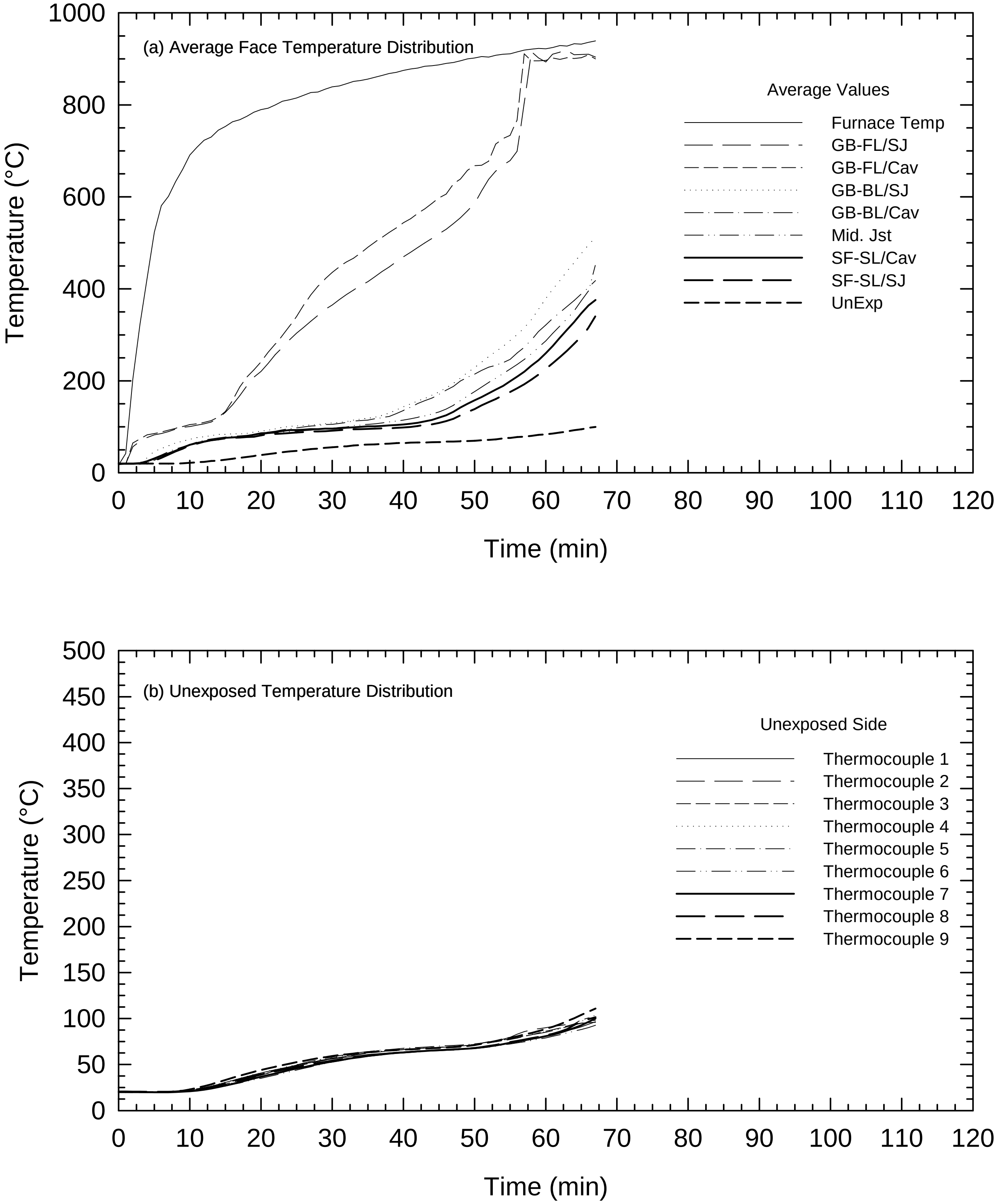




Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
SJ - Steel C-Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

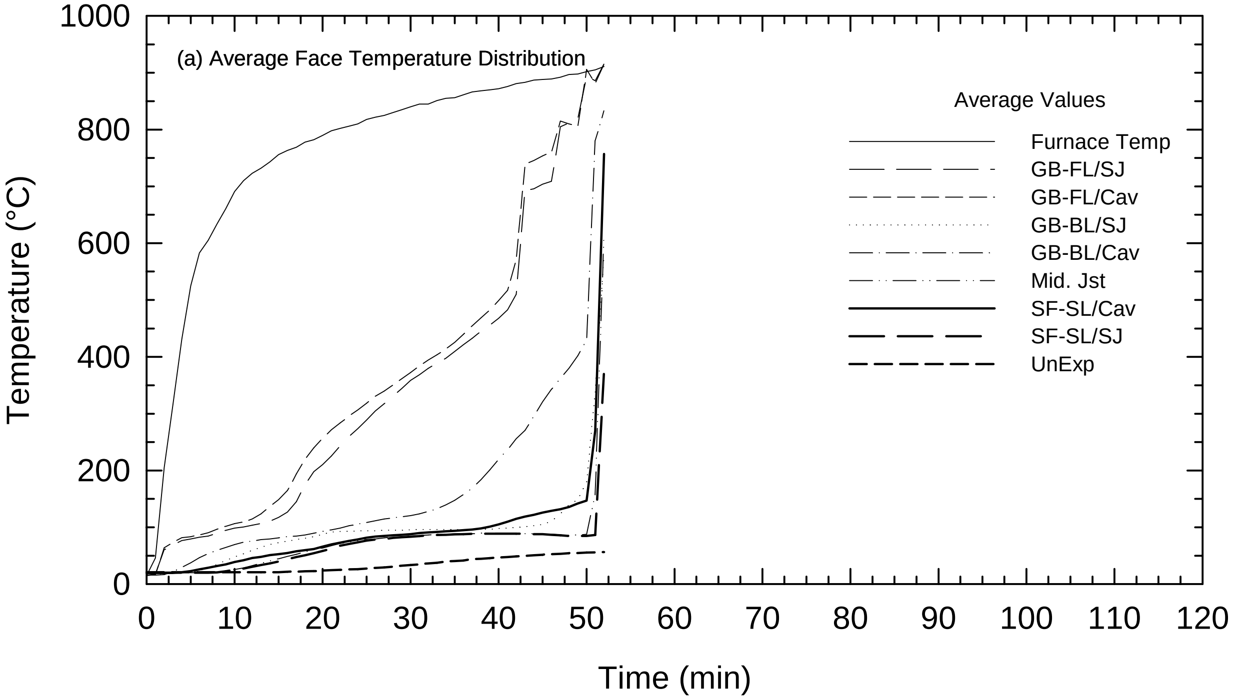
Figure F-21. Temperature Distributions for Floor Fire Test, FF-50

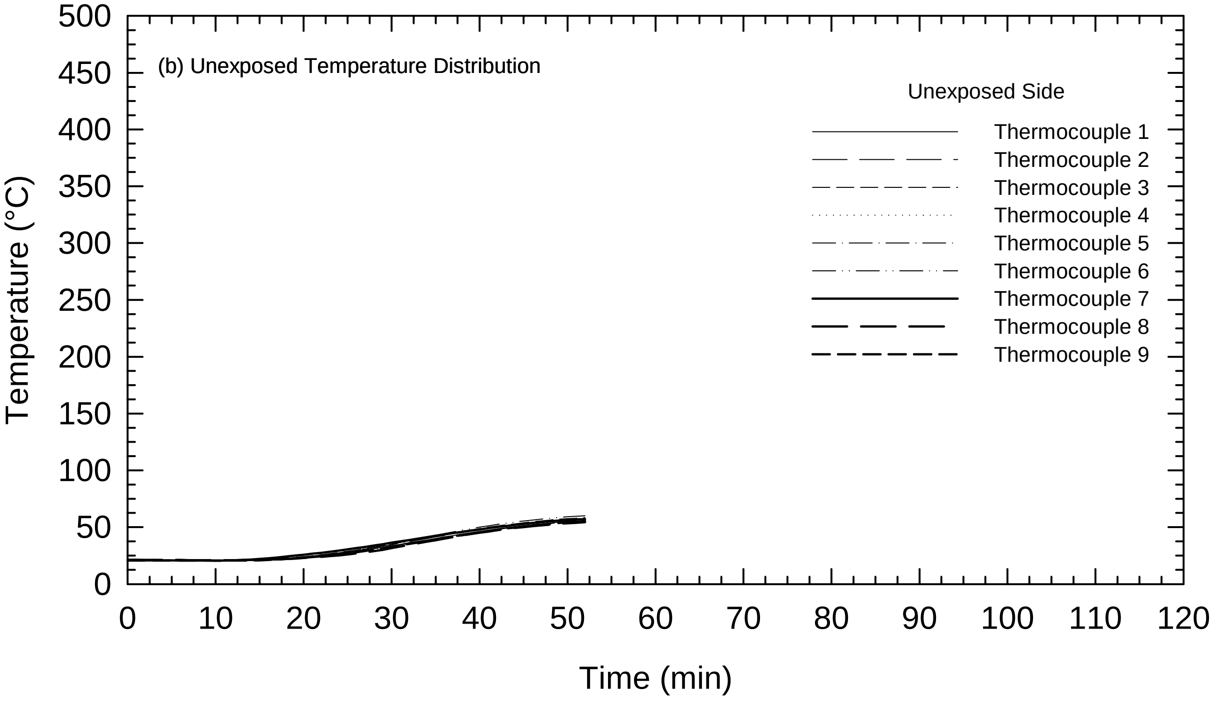


Legend

FL - Face Layer BL - Base Layer SL - Single Layer Cav - Cavity GB - Gypsum Board
SJ - Steel C-Joist Mid.Jst - Middle Joist UnExp - Unexposed Side SF - Subfloor

Figure F-22. Temperature Distributions for Floor Fire Test, FF-51

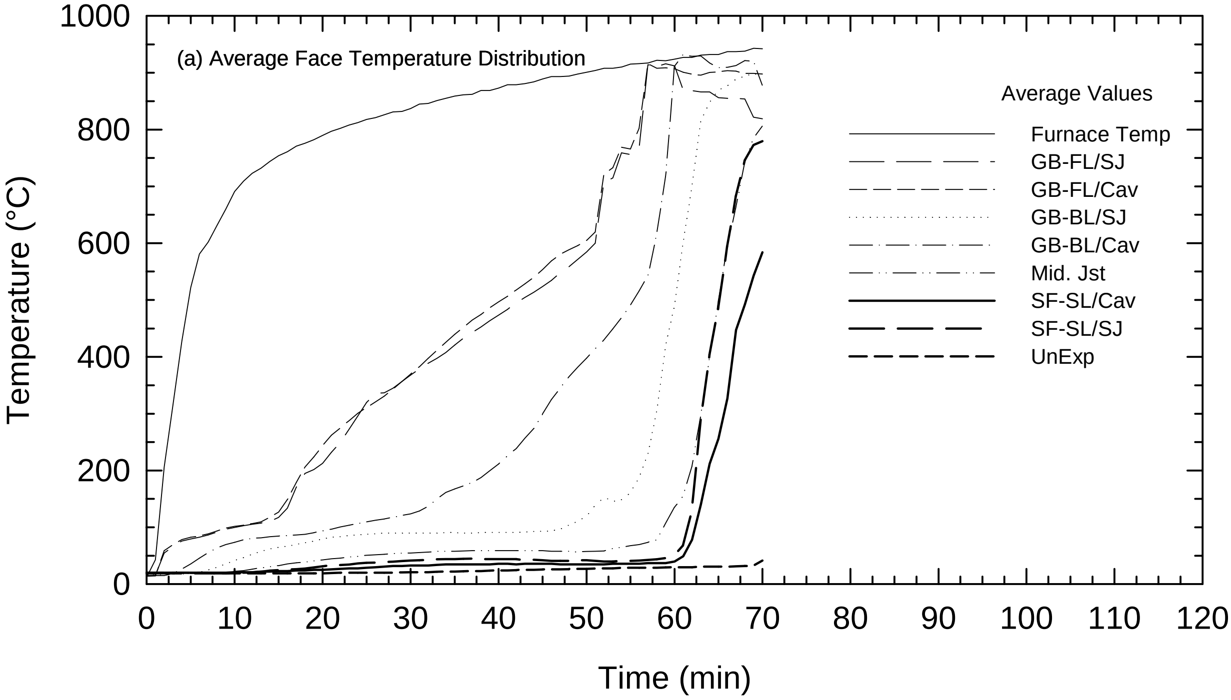


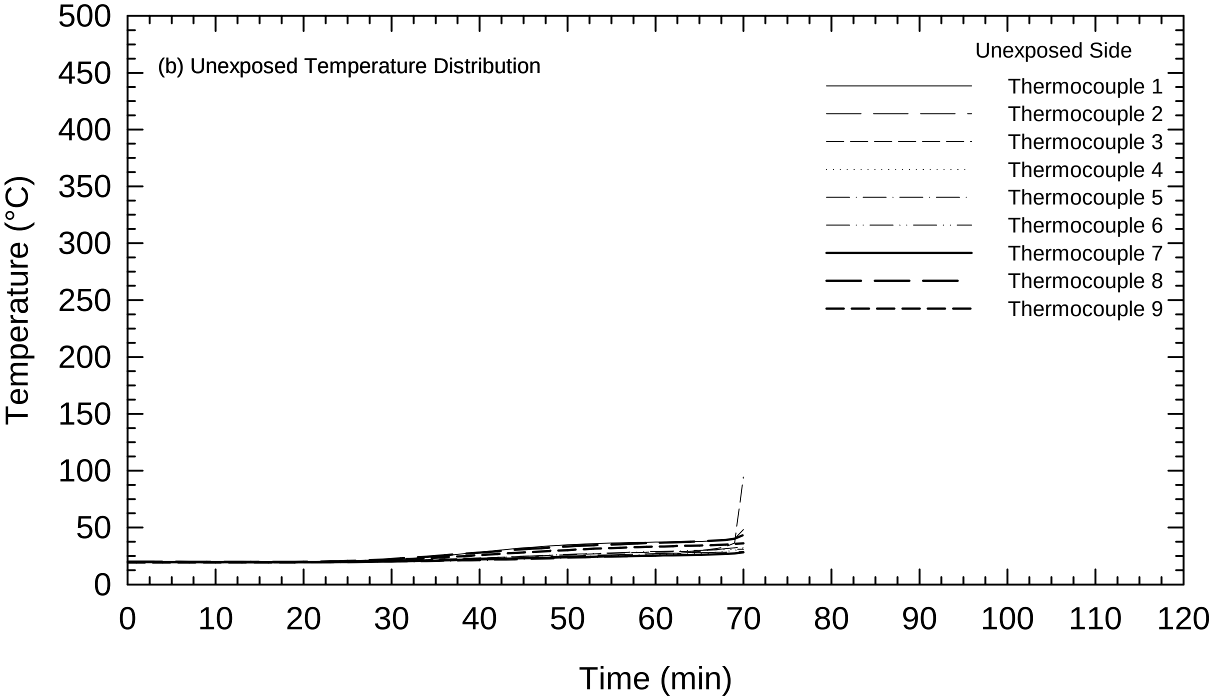


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
SJ - Steel C-Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-23. Temperature Distributions for Floor Fire Test, FF-52

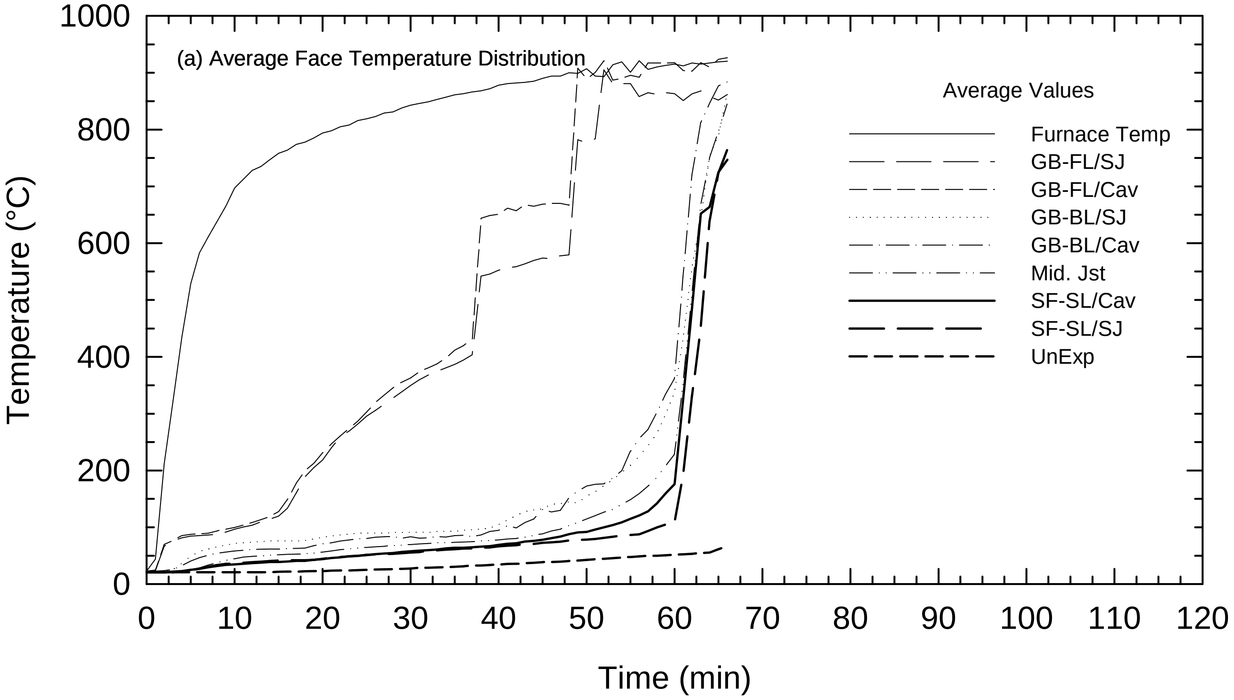


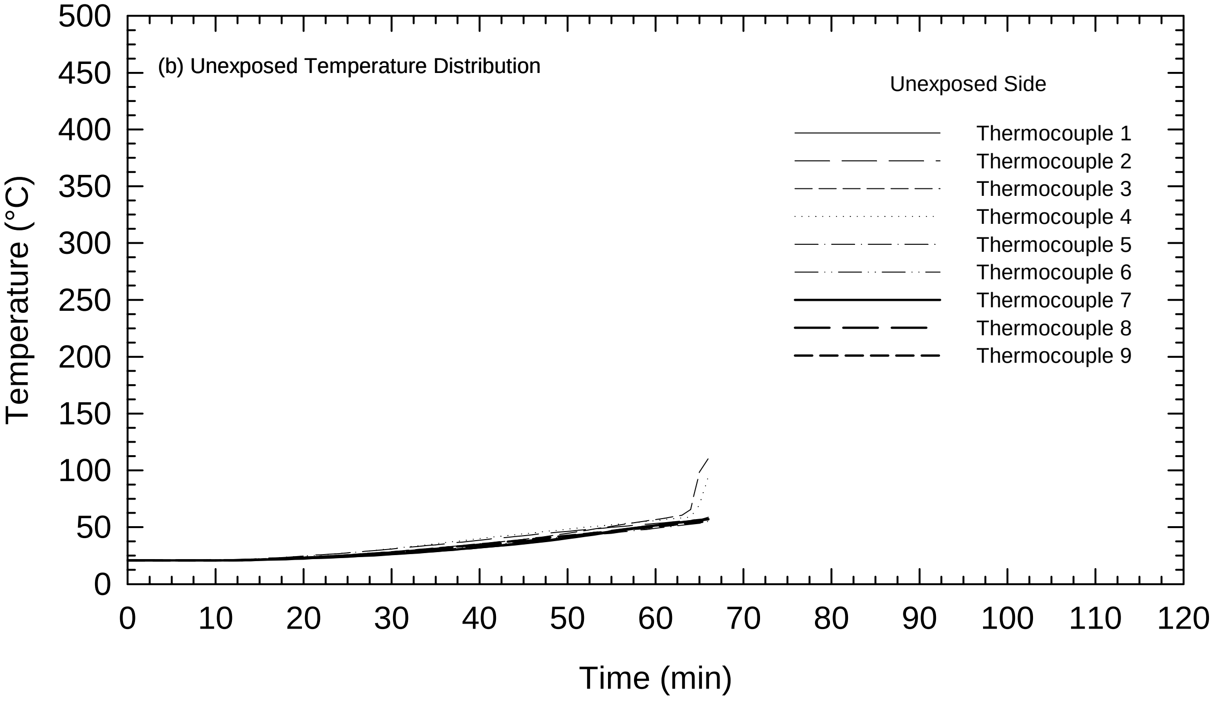


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
SJ - Steel C-Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-24. Temperature Distributions for Floor Fire Test, FF-53

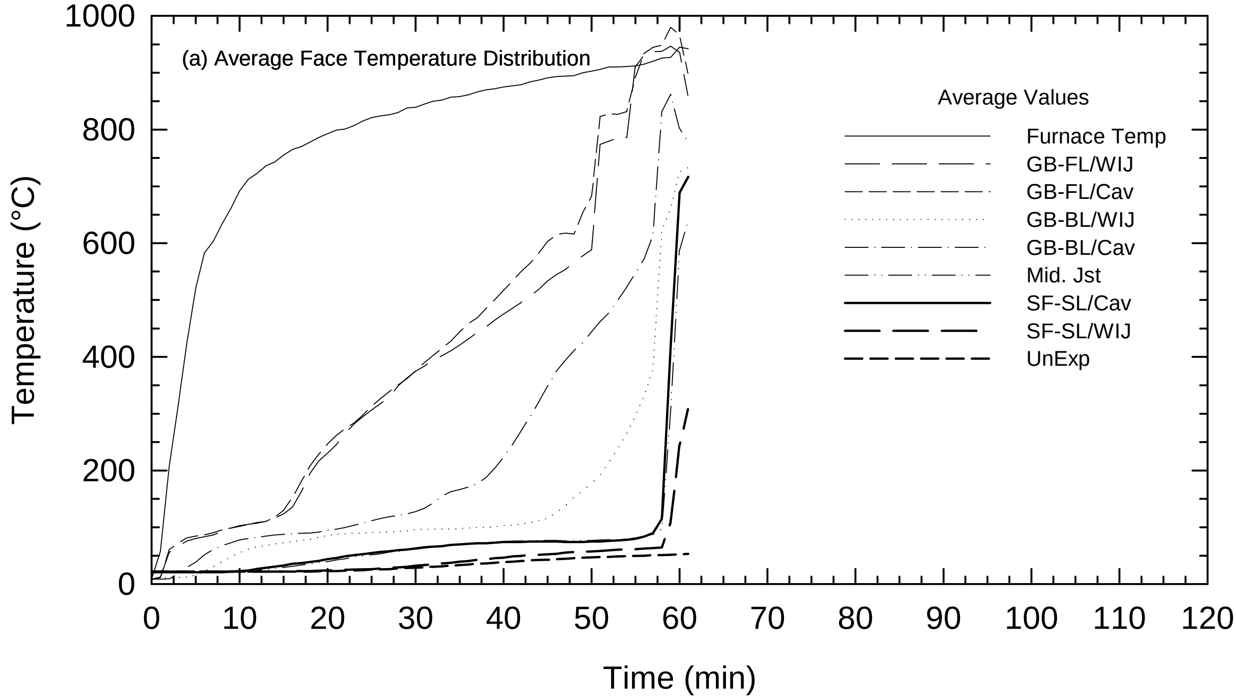


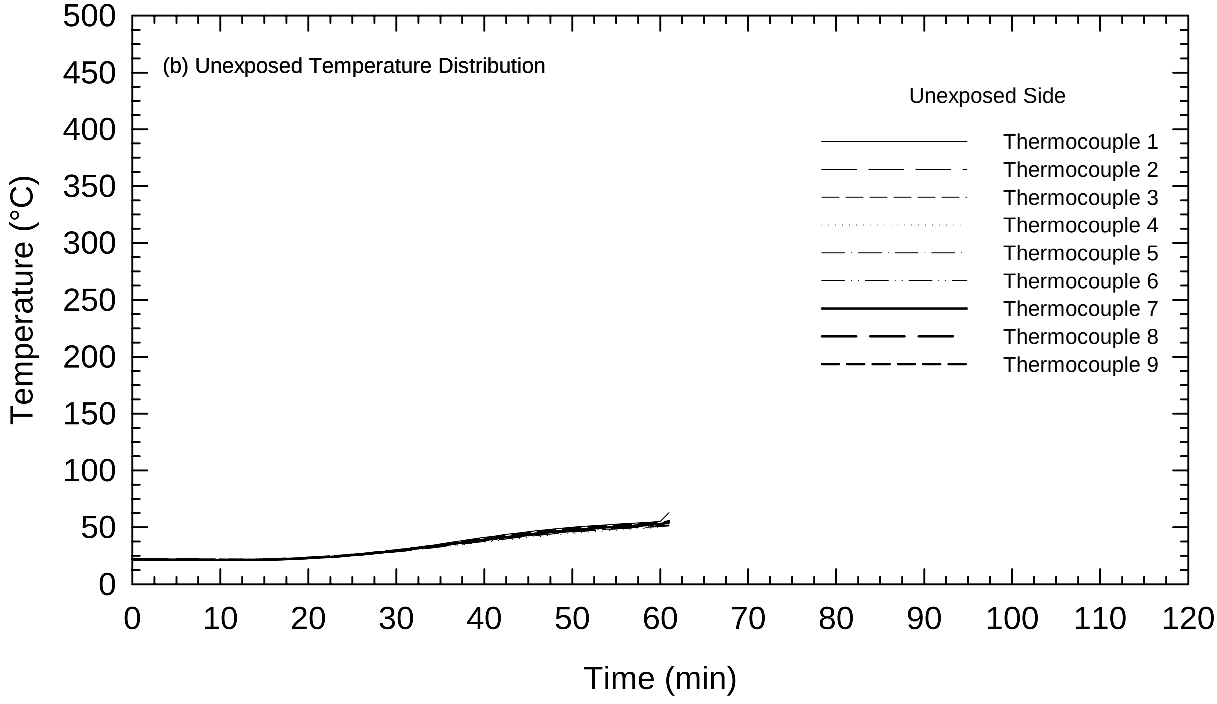


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
SJ - Steel C-Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-25. Temperature Distributions for Floor Fire Test, FF-54

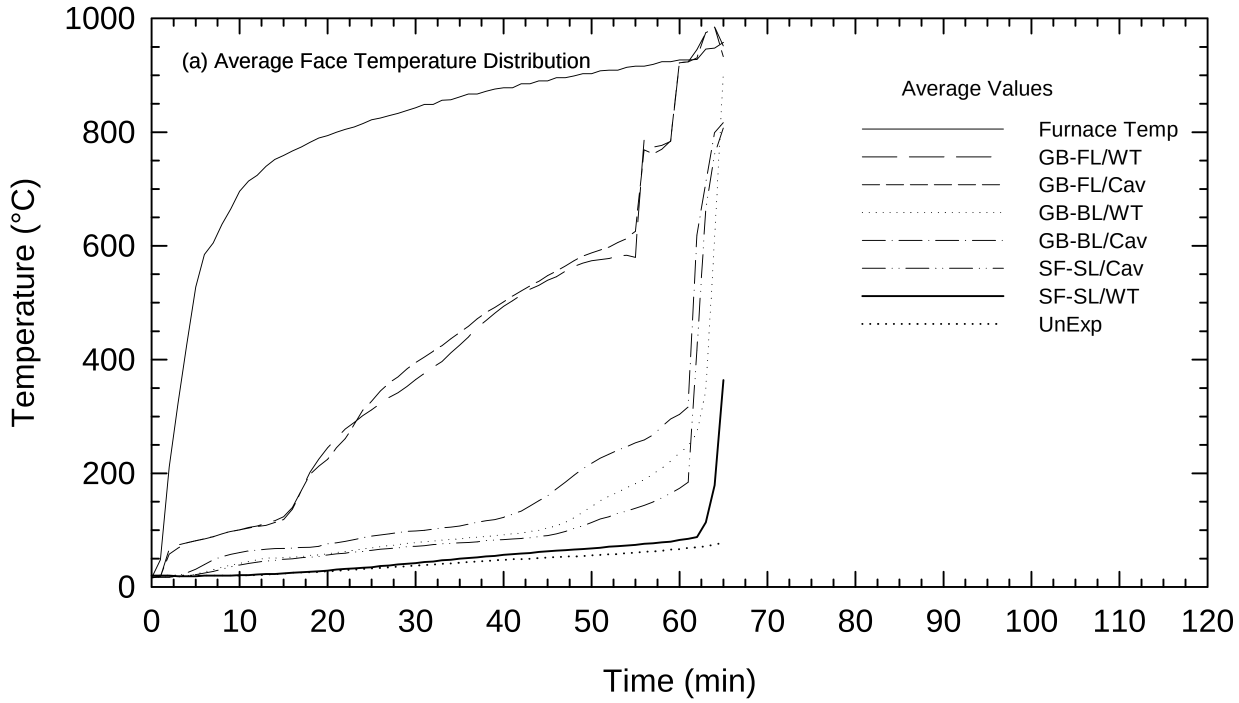


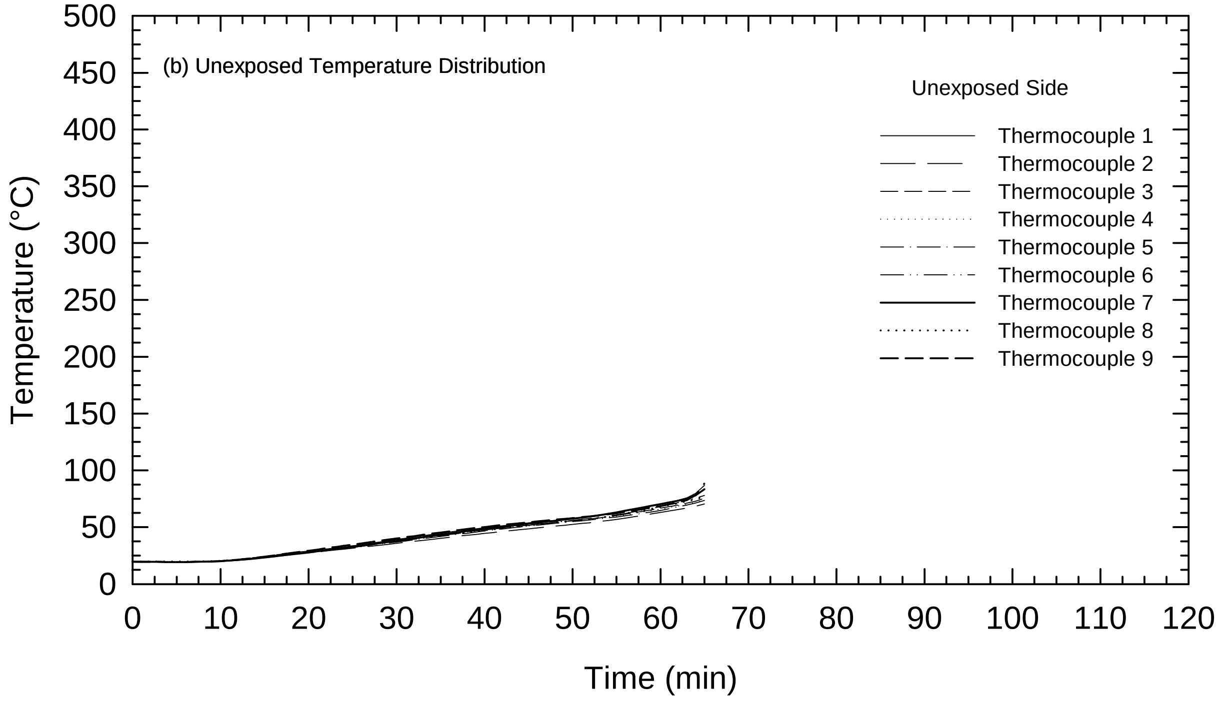


Legend

FL - Face Layer   BL - Base Layer   SL Single Layer   GB - Gypsum Board   WIJ - Wood I-Joist   Cav - Cavity
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-26. Temperature Distributions for Floor Fire Test, FF-55

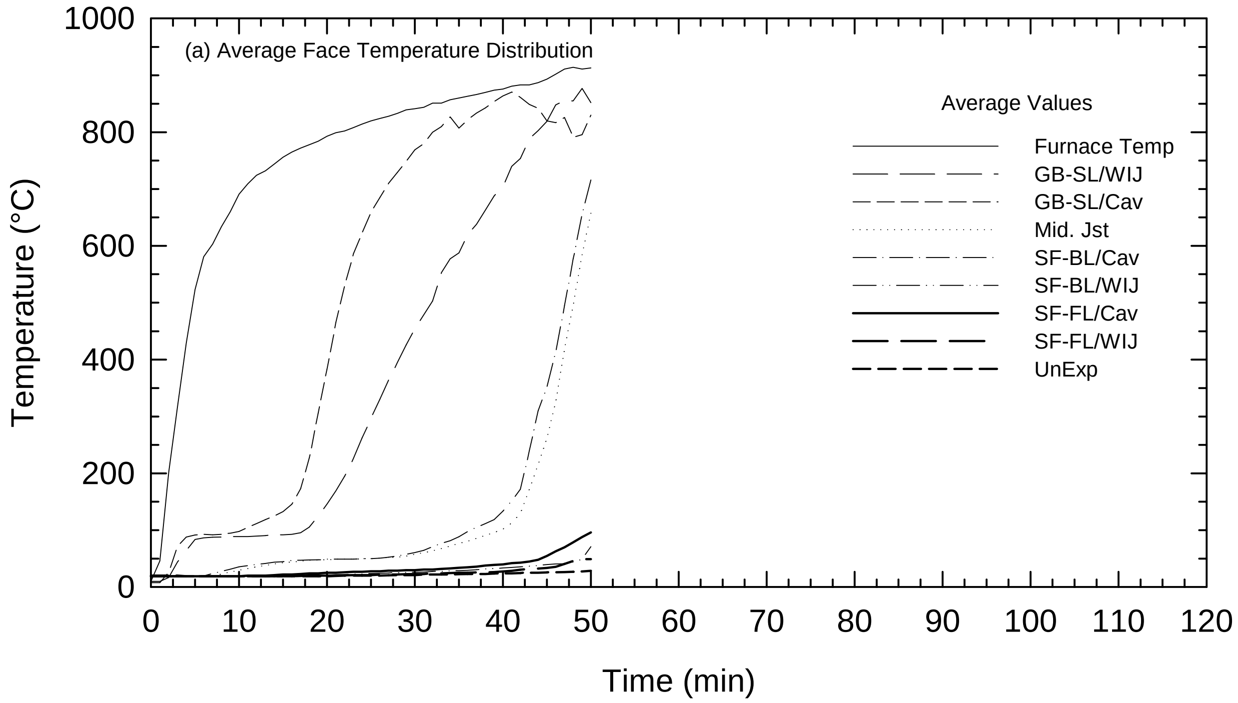


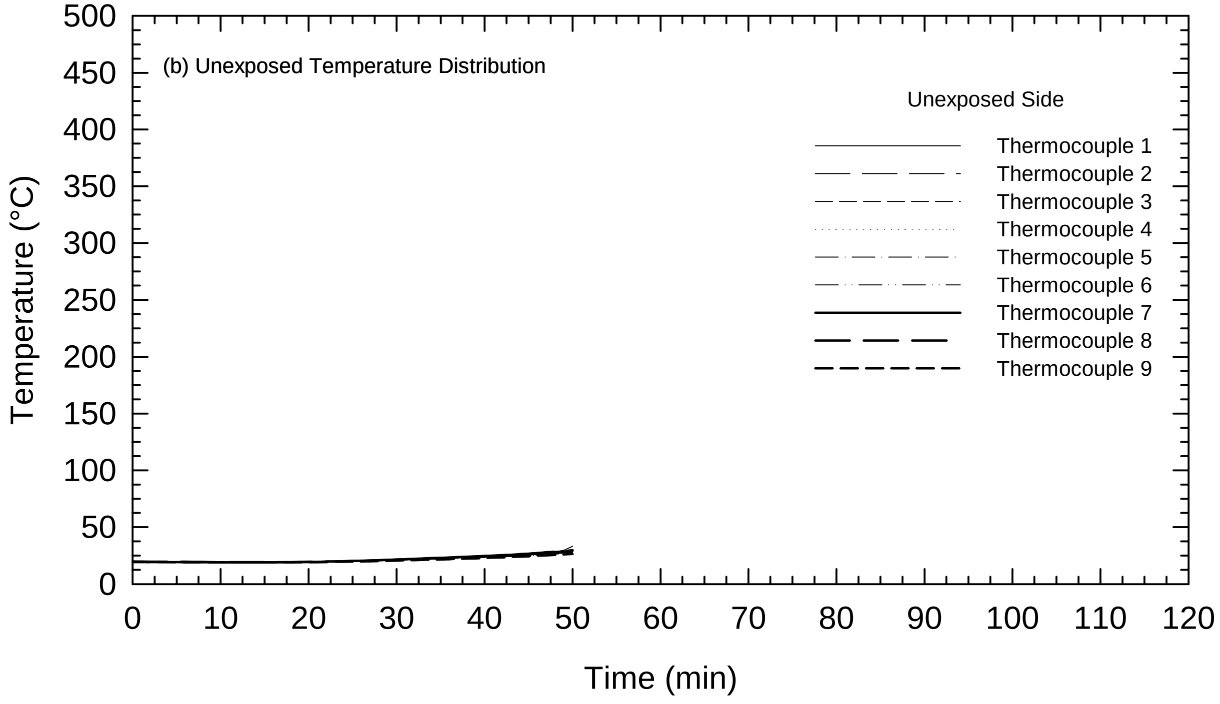


Legend

FL - Face Layer BL - Base Layer SL Single Layer GB - Gypsum Board WT - Wood Truss Cav - Cavity
UnExp - Unexposed Side SF - Subfloor

Figure F-27. Temperature Distributions for Floor Fire Test, FF-56

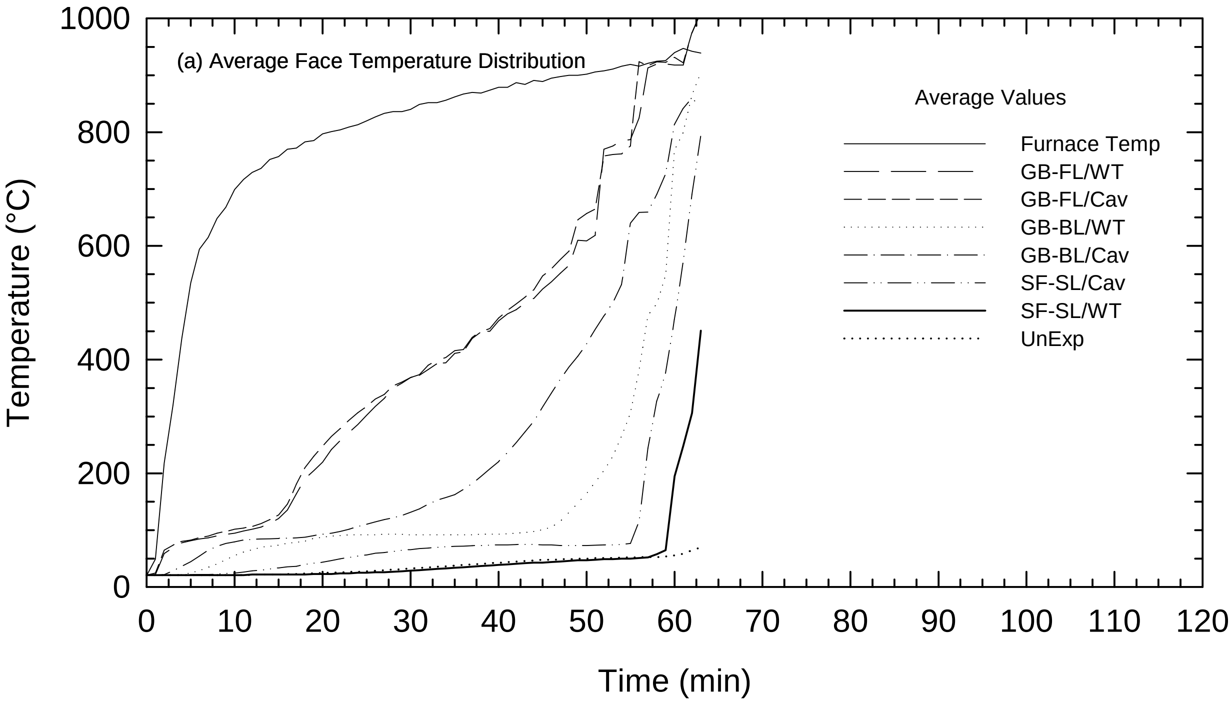


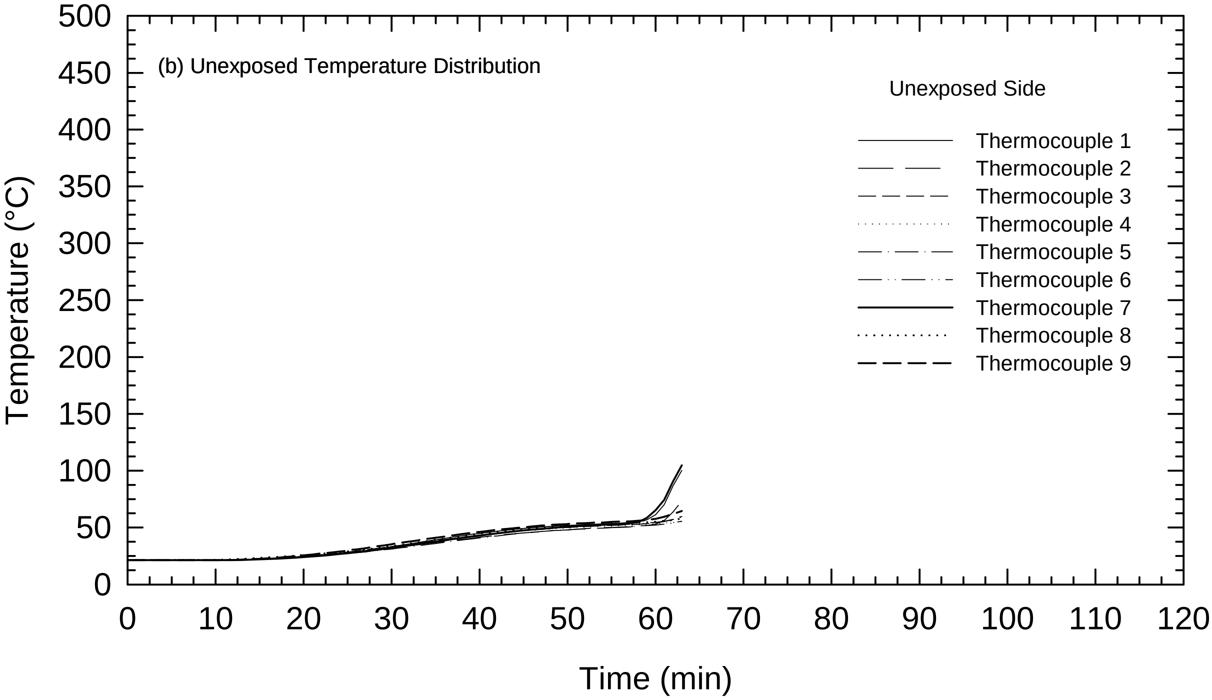


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
WIJ - Wood I-Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-28. Temperature Distributions for Floor Fire Test, FF-57

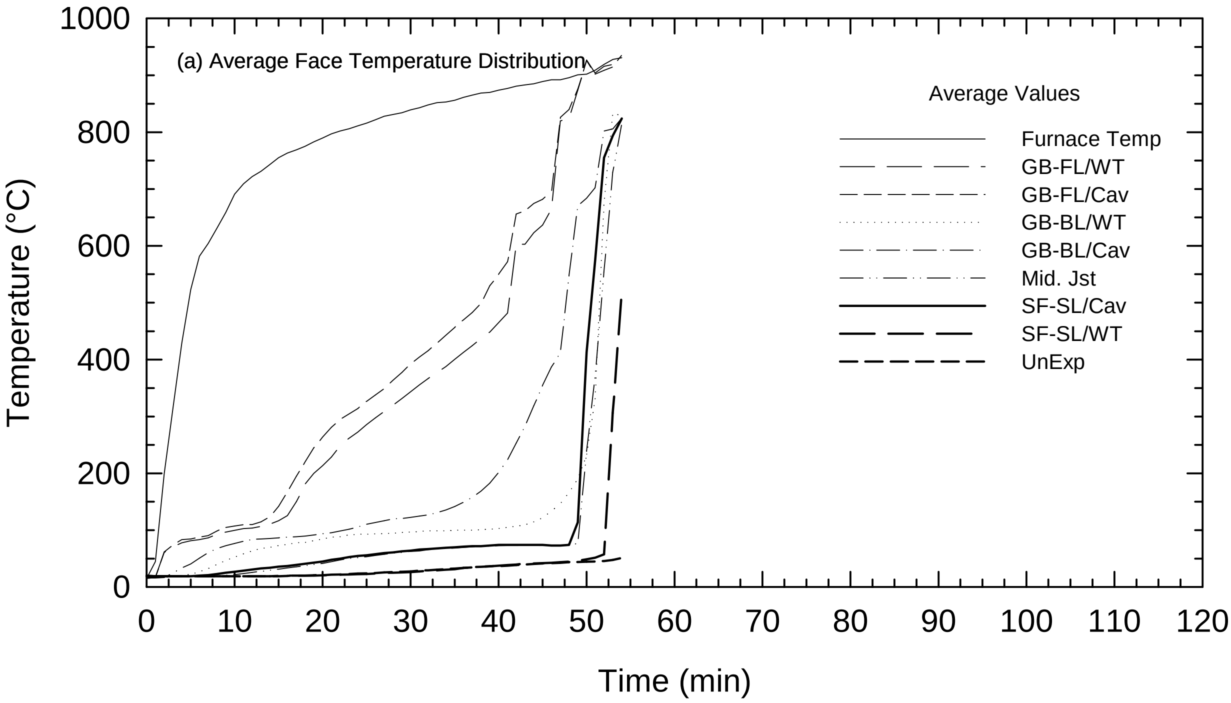


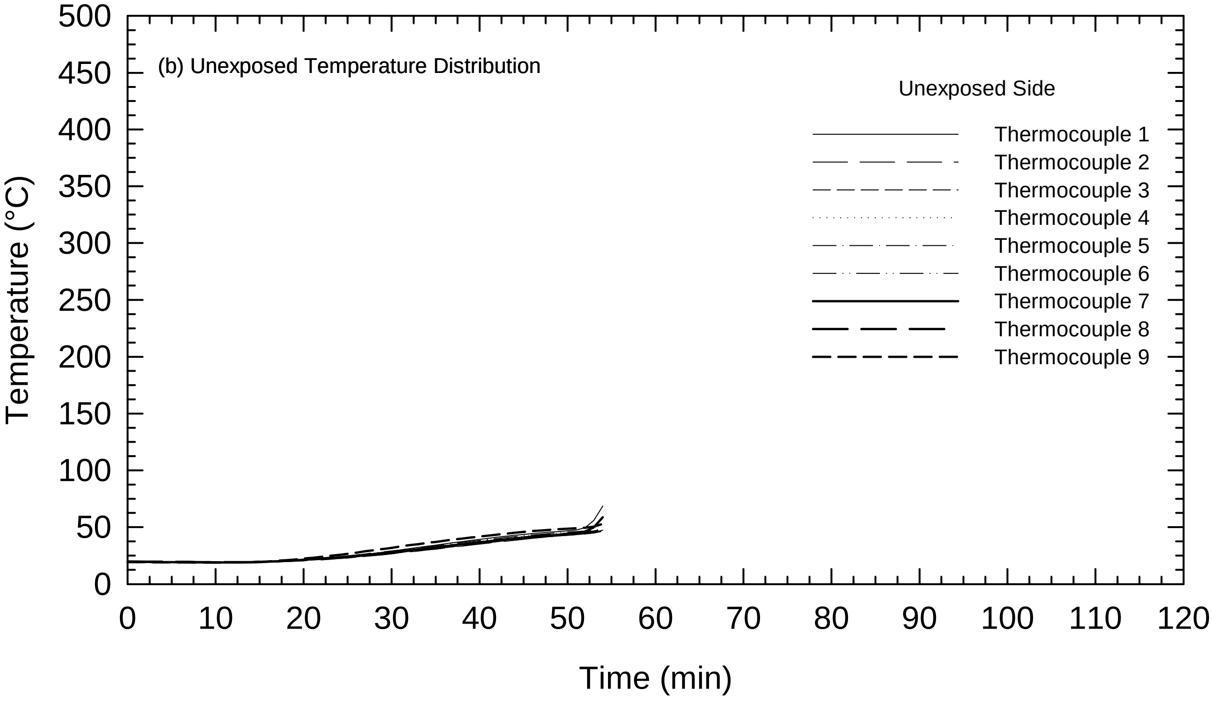


<u>Legend</u>

FL - Face Layer BL - Base Layer SL Single Layer GB - Gypsum Board WT - Wood Truss Cav - Cavity
UnExp - Unexposed Side SF - Subfloor

Figure F-29. Temperature Distributions for Floor Fire Test, FF-58

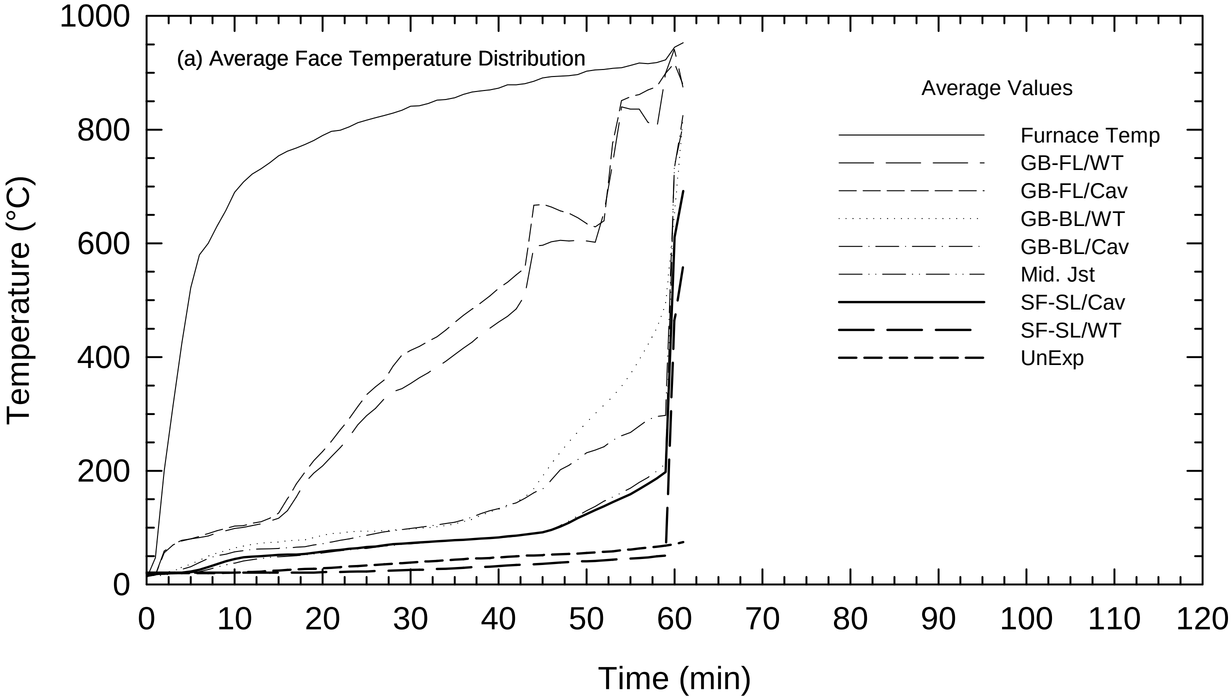


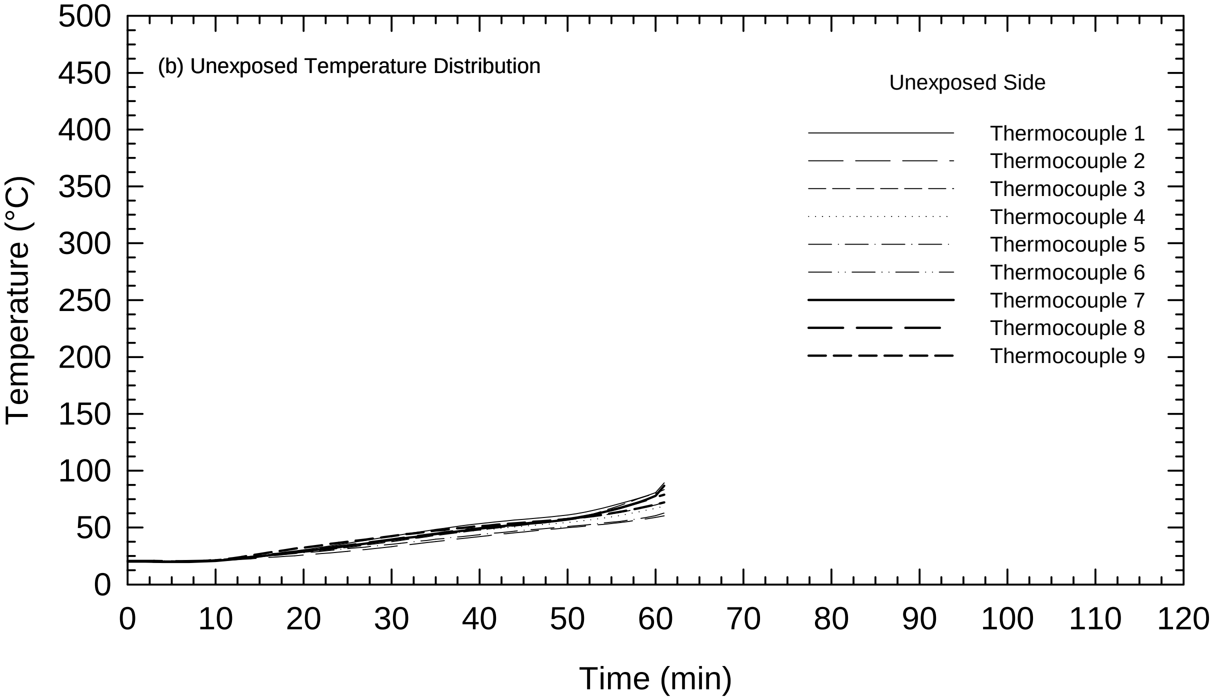


<u>Legend</u>

FL - Face Layer   BL - Base Layer   SL Single Layer   GB - Gypsum Board   WT - Wood Truss   Cav - Cavity
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-30. Temperature Distributions for Floor Fire Test, FF-59

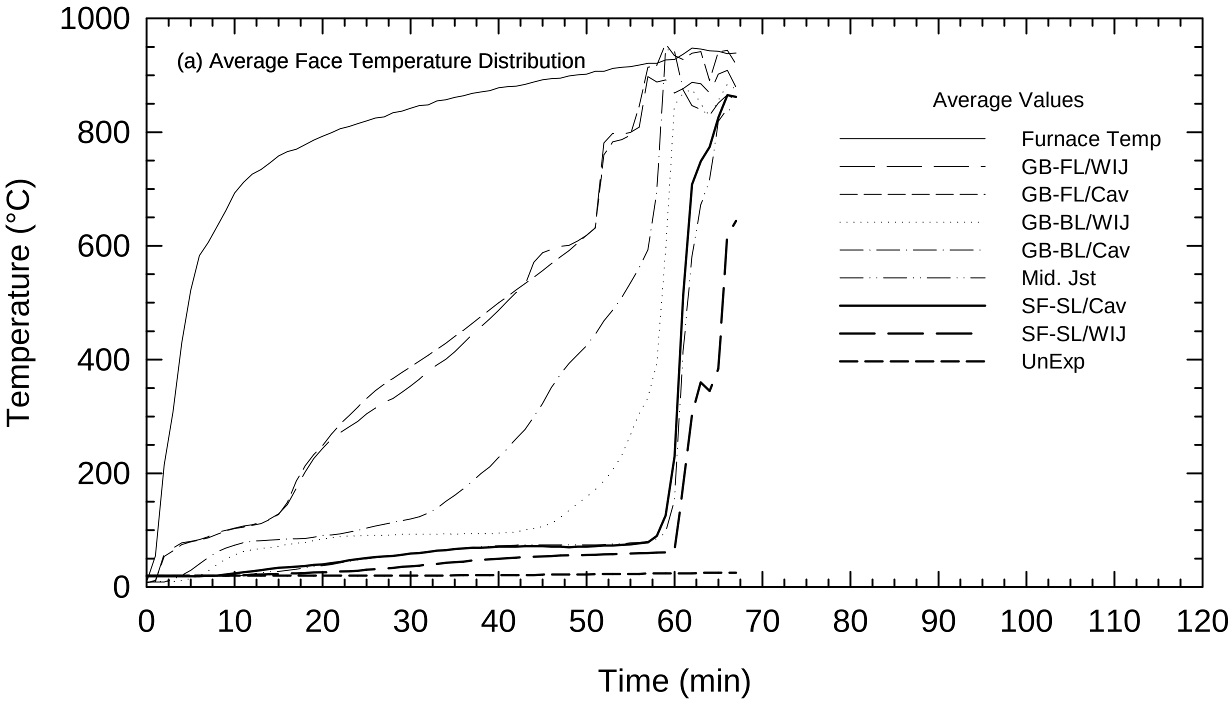


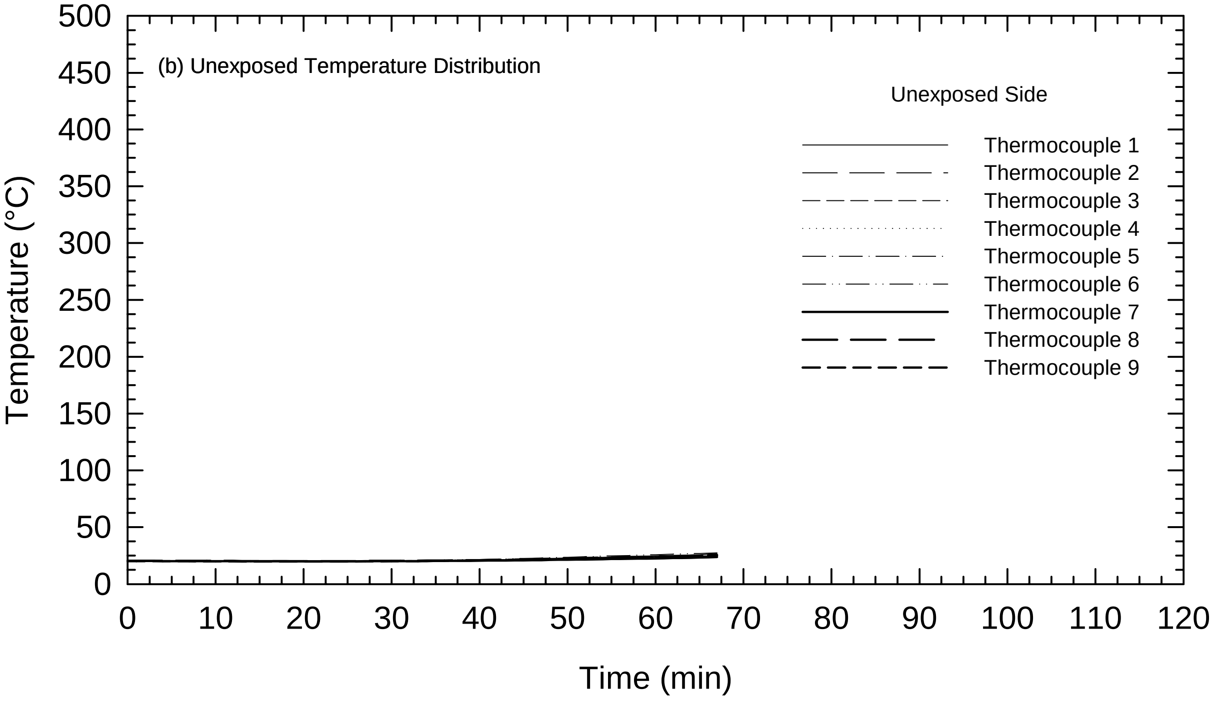


Legend

FL - Face Layer BL - Base Layer SL - Single Layer GB - Gypsum Board WT - Wood Truss Cav - Cavity
Mid.Jst - Middle Joist UnExp - Unexposed Side SF - Subfloor

Figure F-31. Temperature Distributions for Floor Fire Test, FF-60

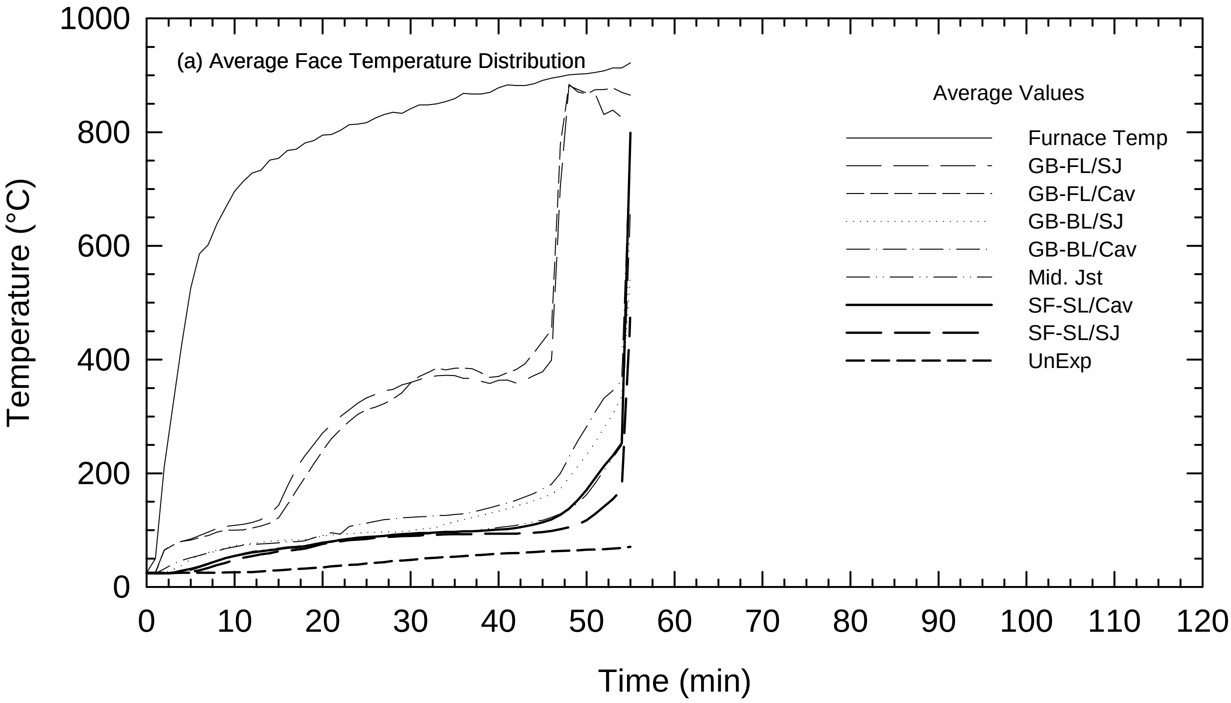


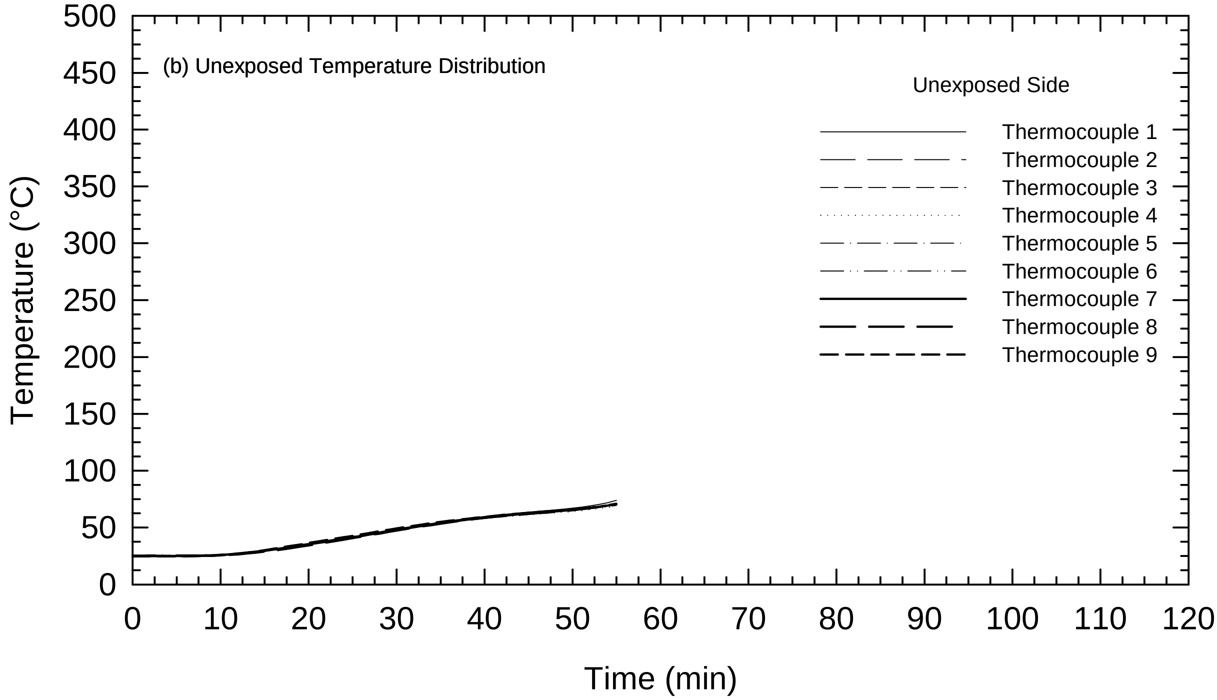


Legend

FL - Face Layer   BL - Base Layer   SL Single Layer   GB - Gypsum Board   WIJ - Wood I-Joist   Cav - Cavity
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-32. Temperature Distributions for Floor Fire Test, FF-61

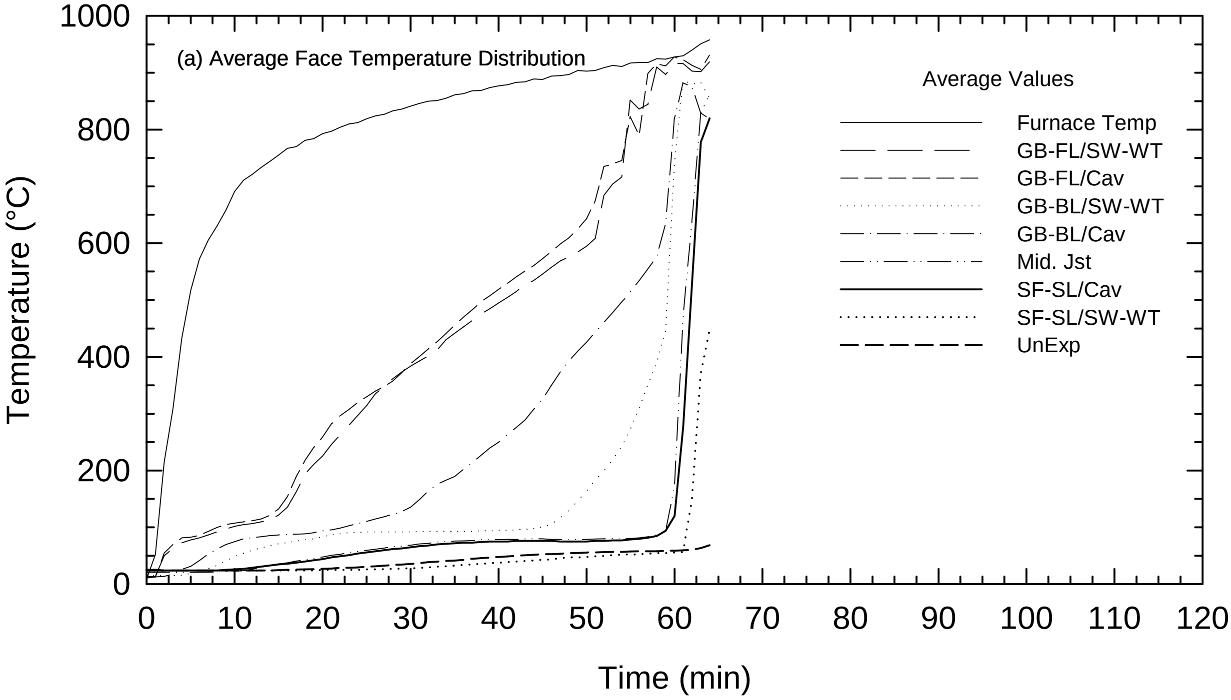


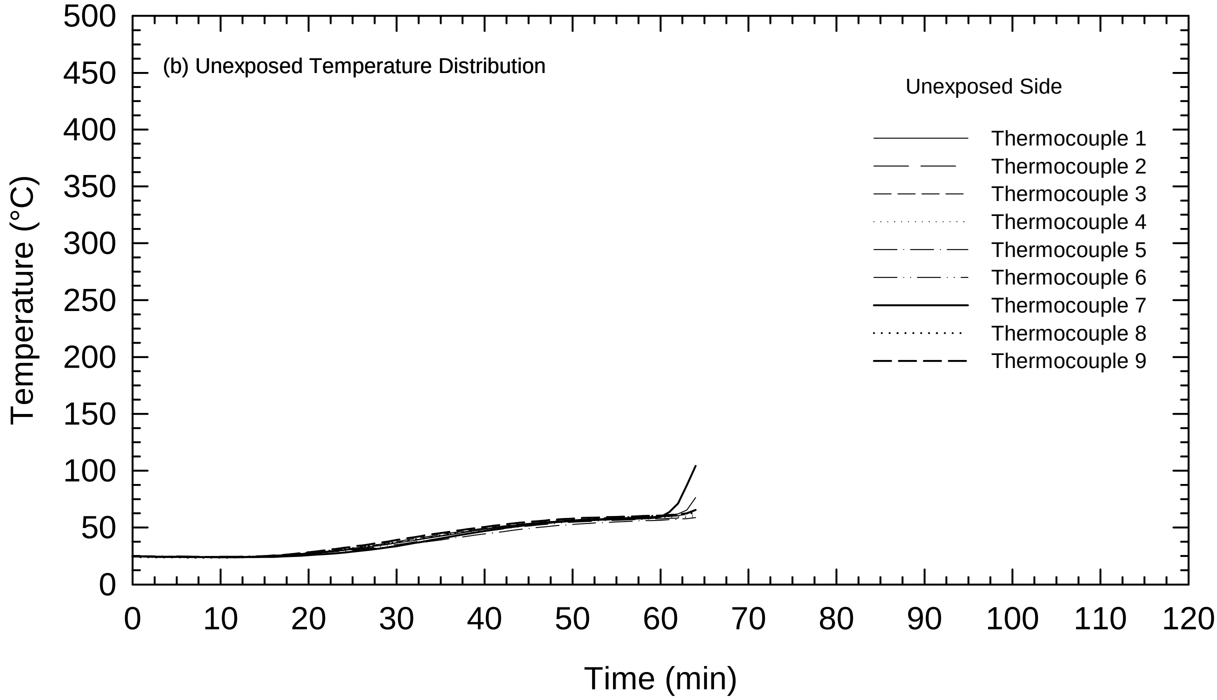


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
SJ - Steel C-Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-33. Temperature Distributions for Floor Fire Test, FF-62

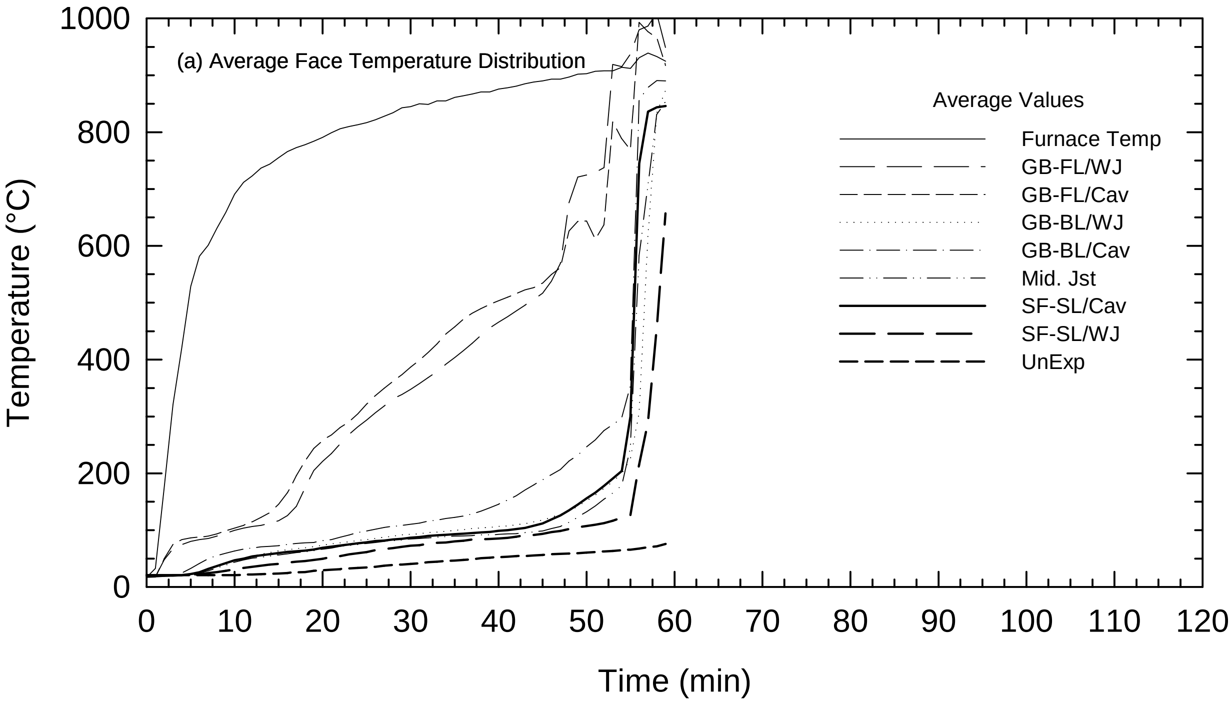


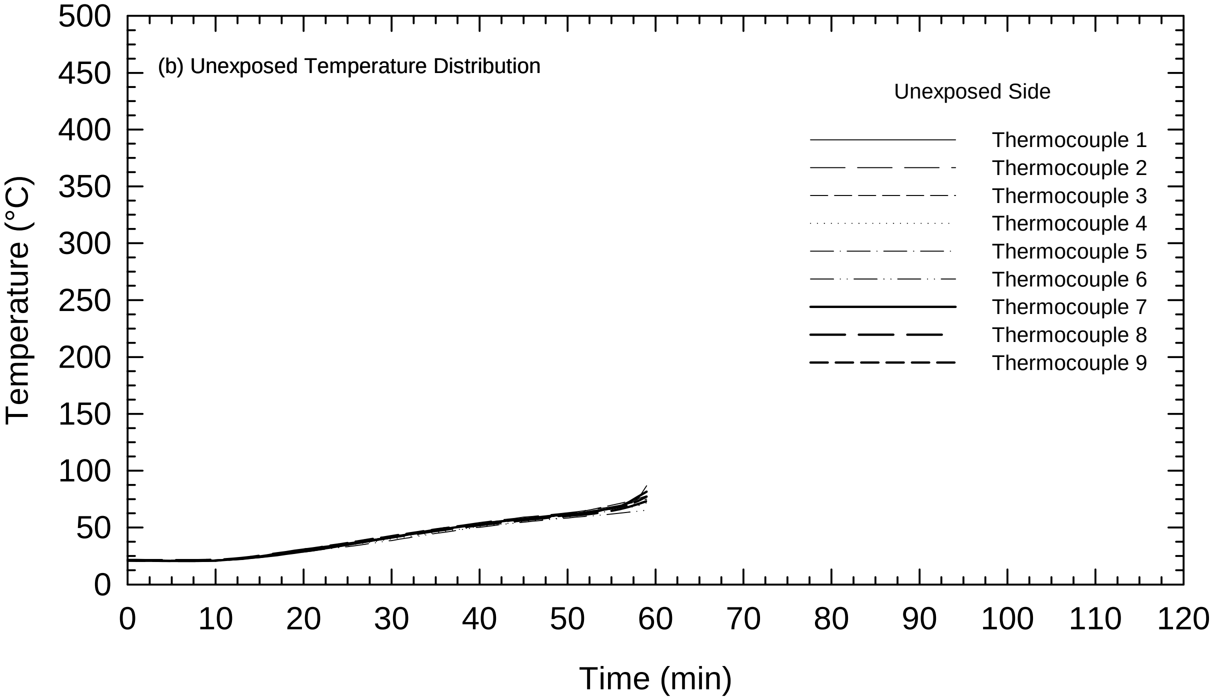


<u>Legend</u>

FL - Face Layer   BL - Base Layer   SL - Single Layer   GB - Gypsum Board   SW-WT - Steel Web Wood Truss   Cav - Cavity
Mid. Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-34. Temperature Distributions for Floor Fire Test, FF-63

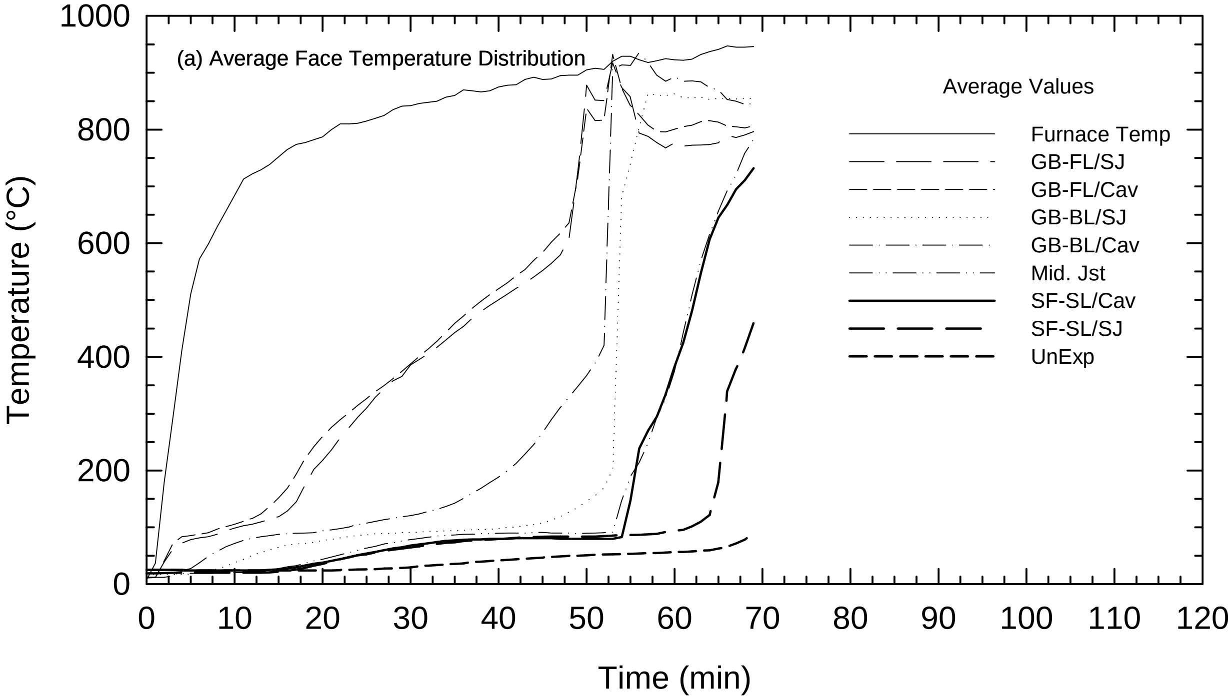


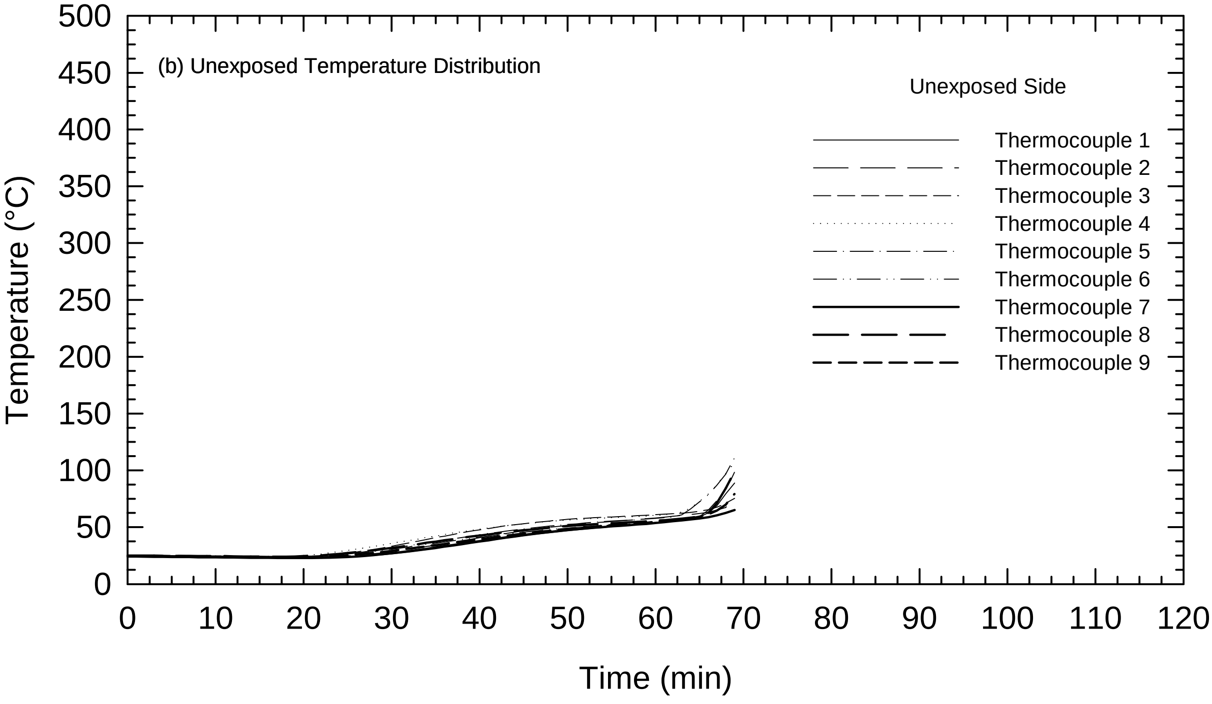


Legend

FL - Face Layer   BL - Base Layer   SL Single Layer   GB - Gypsum Board   WJ - Solid Wood Joist   Cav - Cavity
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-35. Temperature Distributions for Floor Fire Test, FF-64

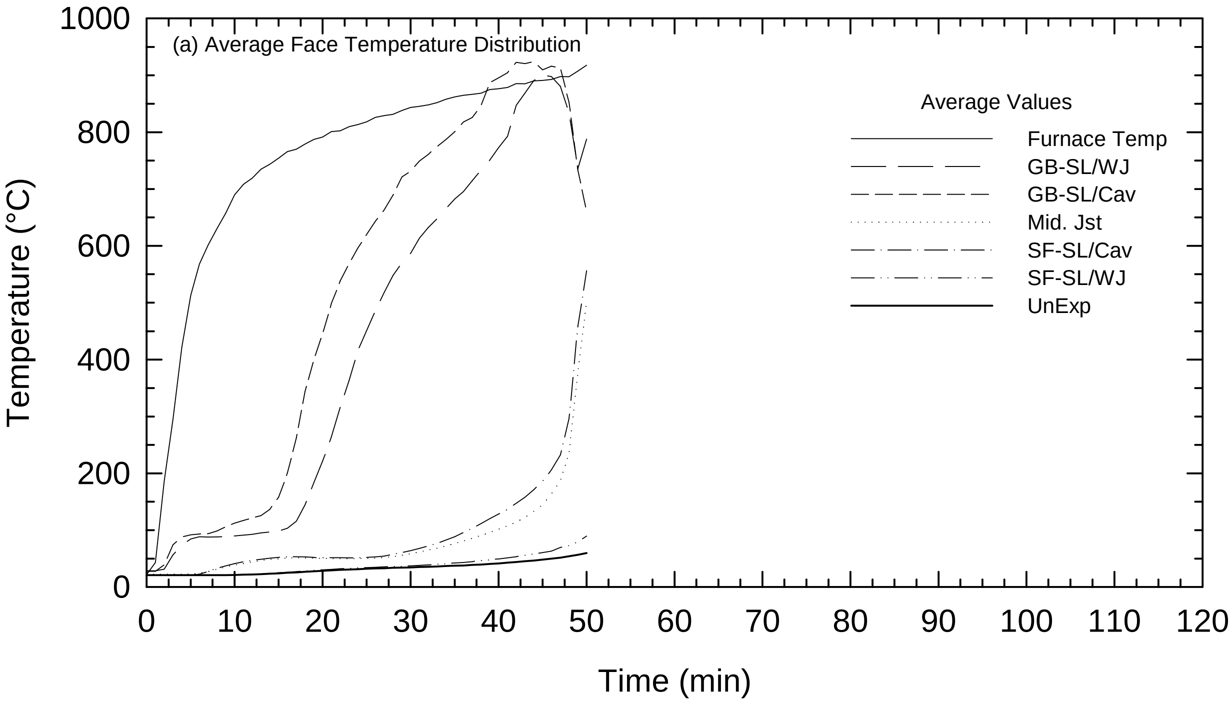


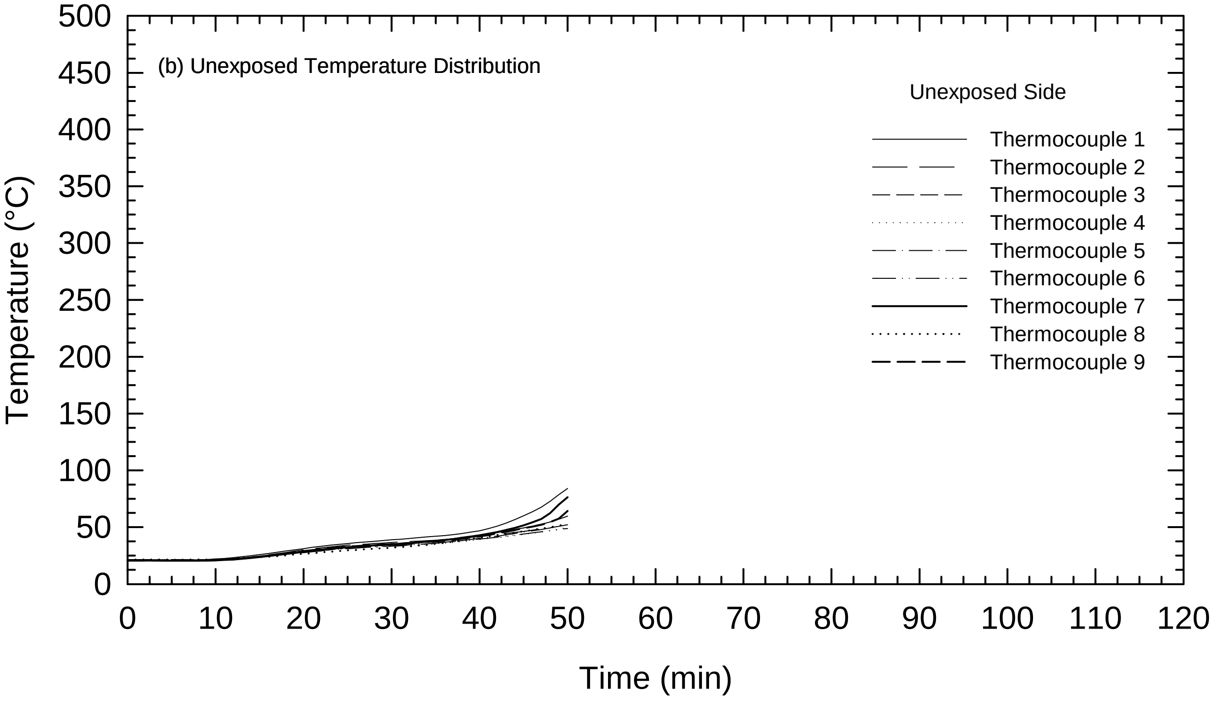


Legend

FL - Face Layer BL - Base Layer SL - Single Layer Cav - Cavity GB - Gypsum Board
SJ - Steel C-Joist Mid.Jst - Middle Joist UnExp - Unexposed Side SF - Subfloor

Figure F-36. Temperature Distributions for Floor Fire Test, FF-65

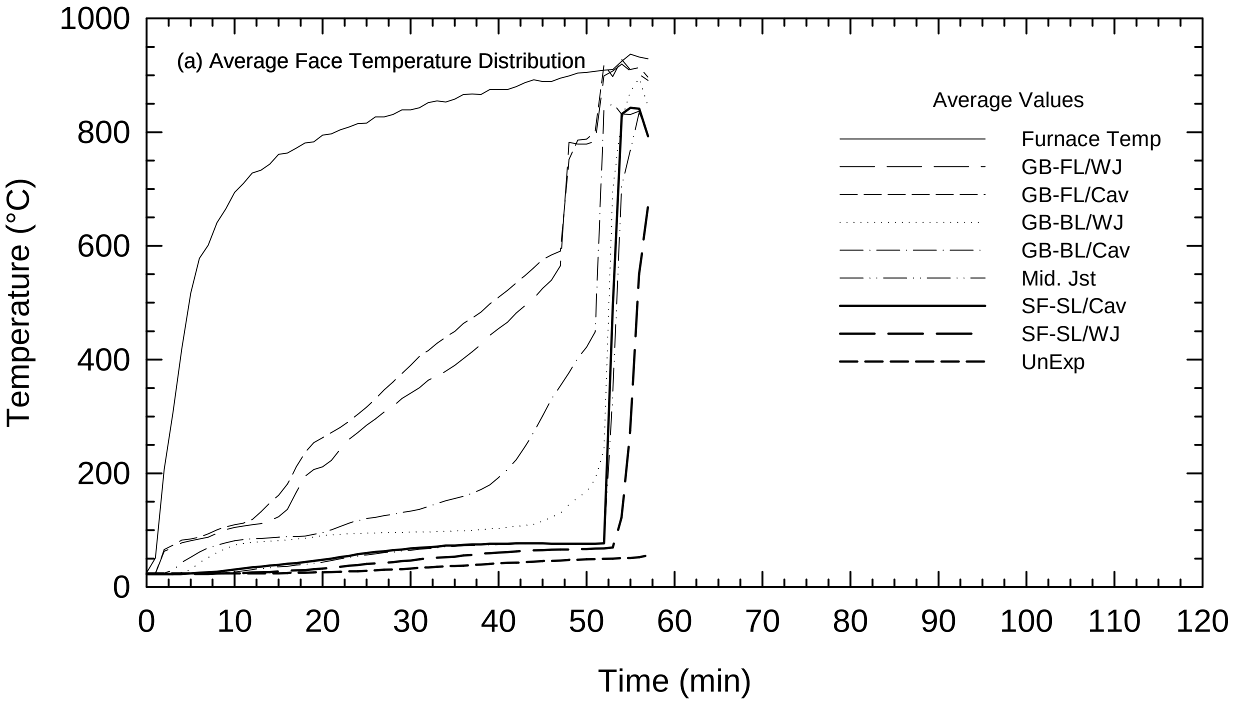


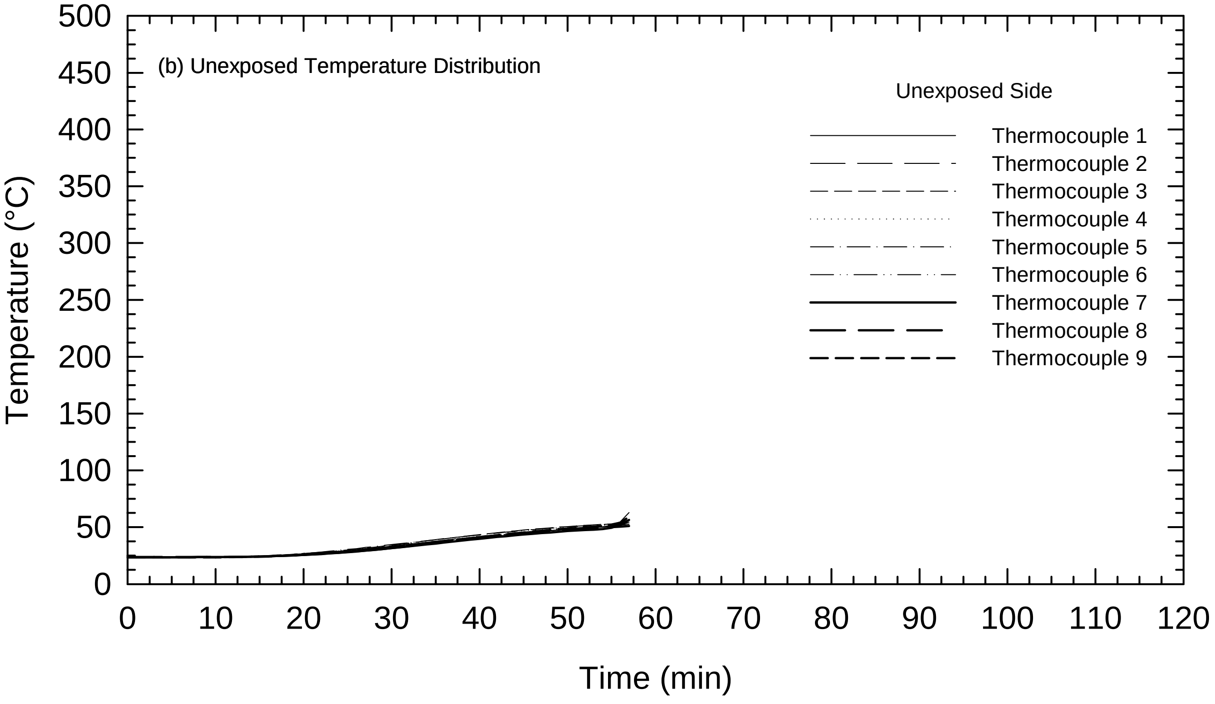


Legend

SL - Single Layer   GB - Gypsum Board   WJ - Solid Wood Joist   Cav - Cavity   Mid.Jst - Middle Joist
UnExp - Unexposed Side   SF - Subfloor

Figure F-37. Temperature Distributions for Floor Fire Test, FF-66

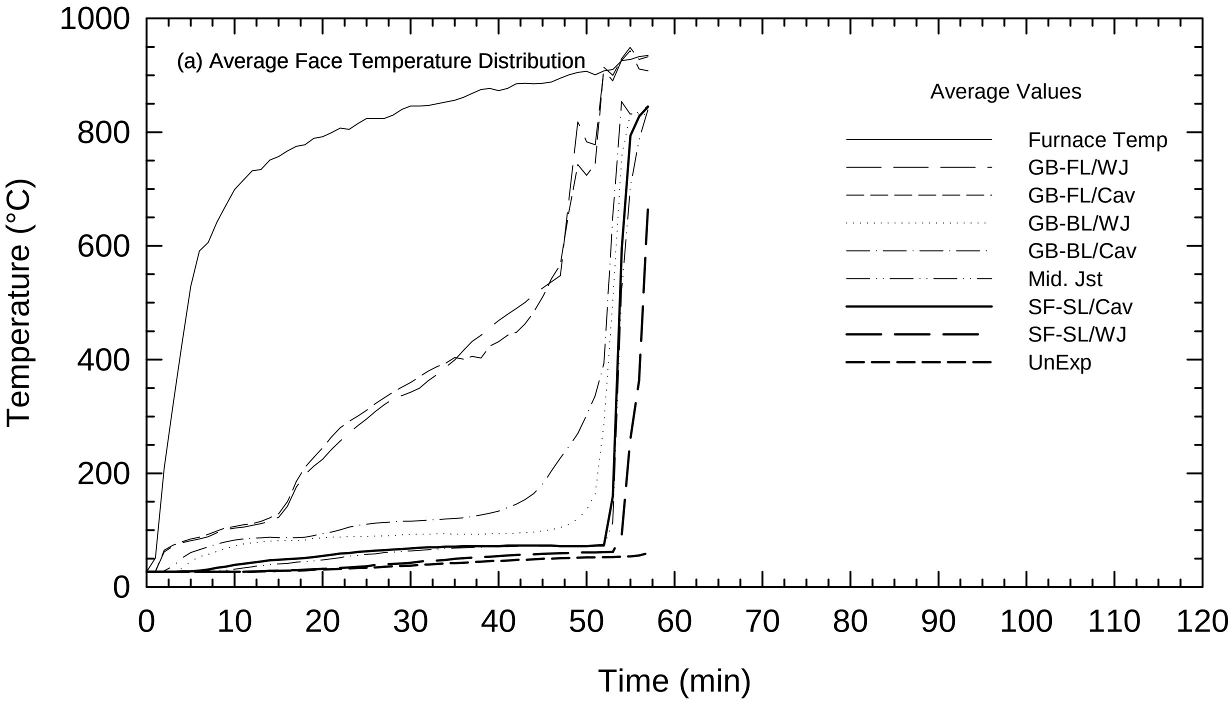


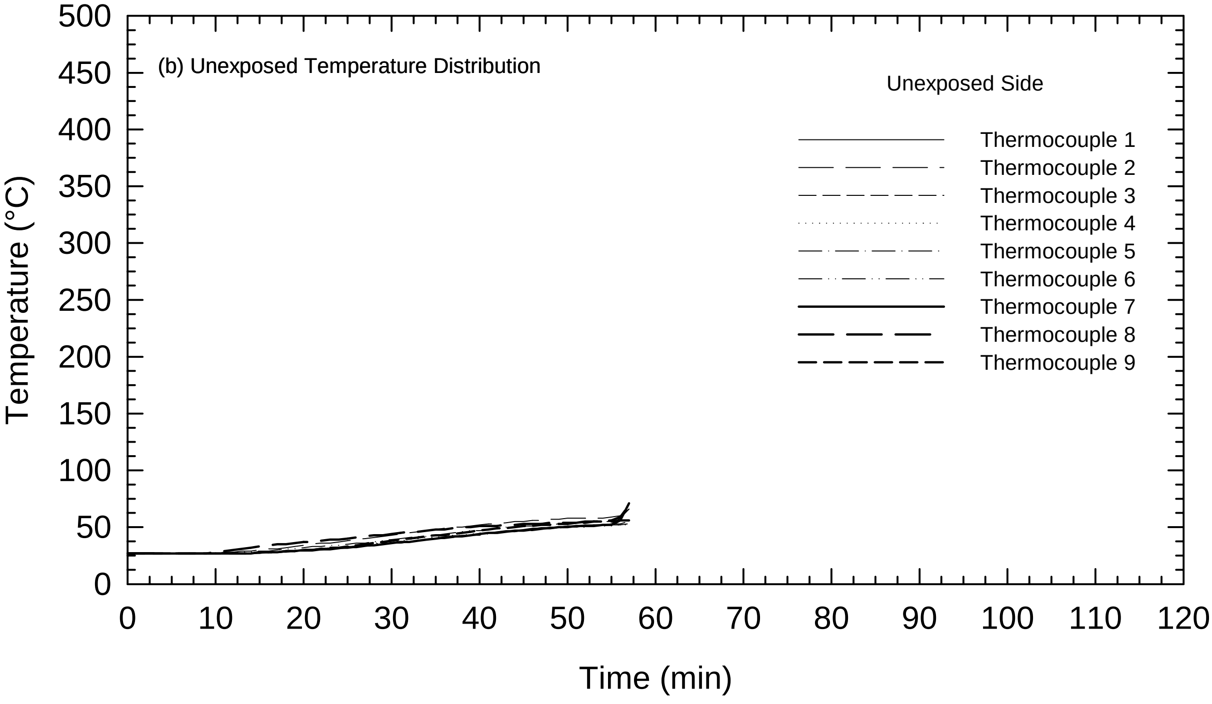


Legend

FL - Face Layer   BL - Base Layer   SL Single Layer   GB - Gypsum Board   WJ - Solid Wood Joist   Cav - Cavity
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-38. Temperature Distributions for Floor Fire Test, FF-67

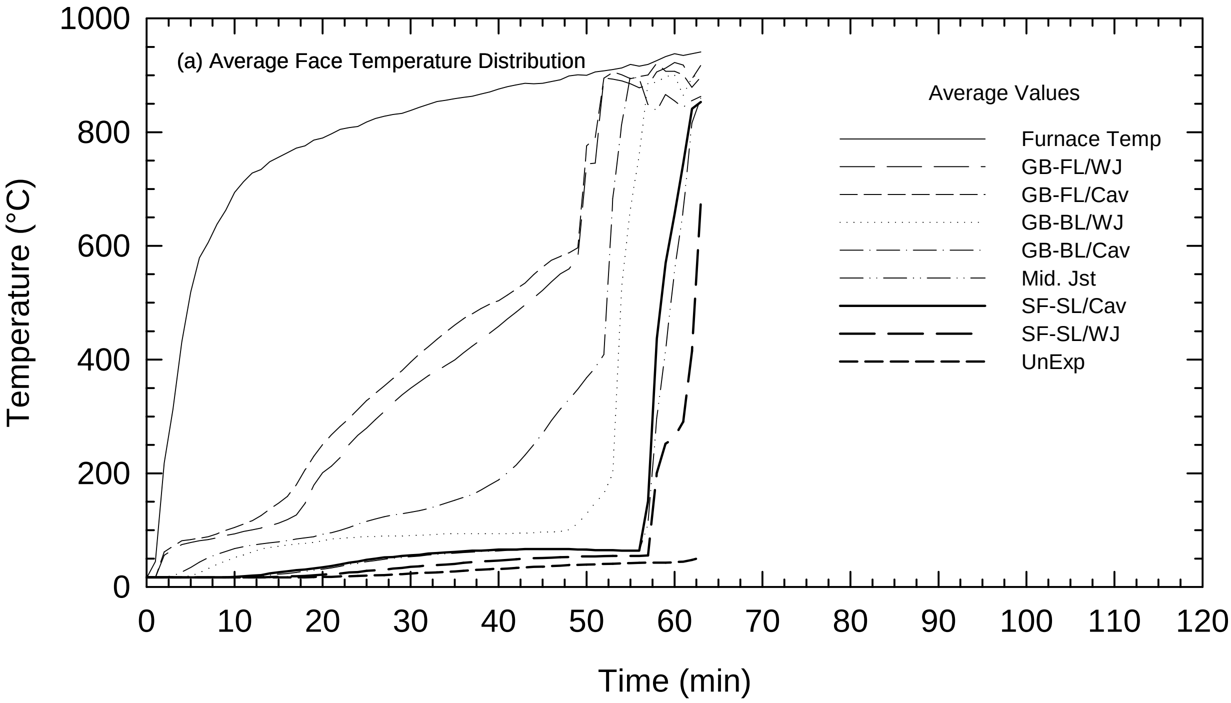


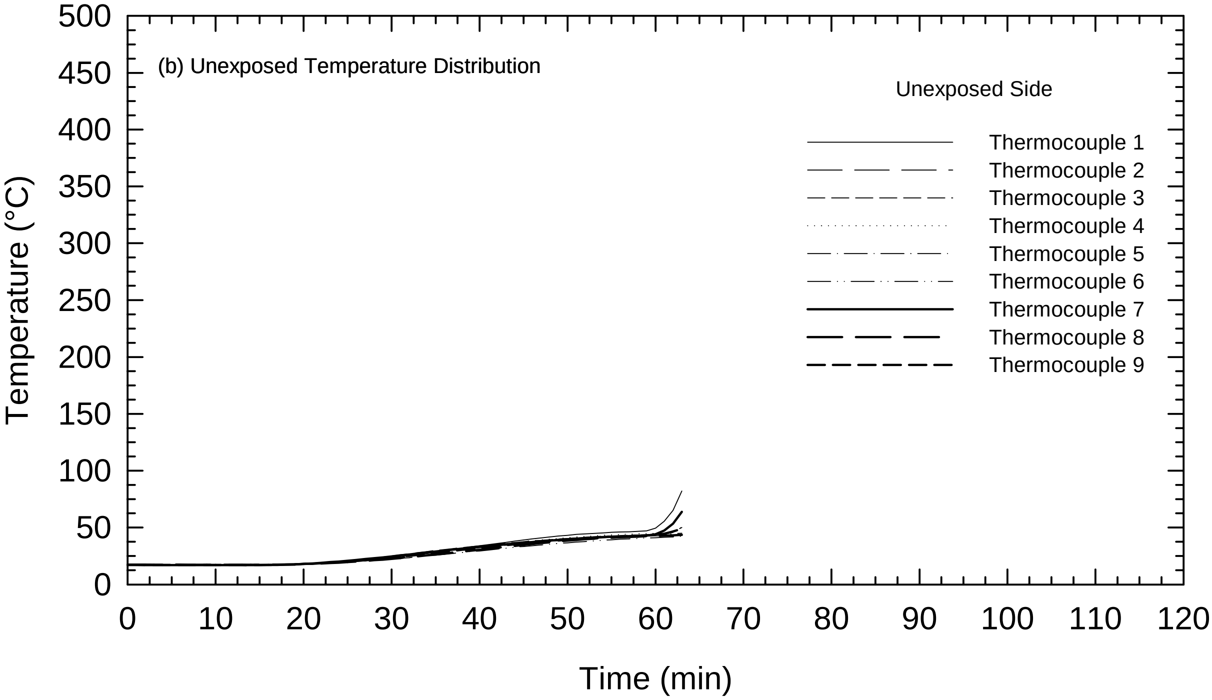


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   GB - Gypsum Board   WJ - Solid Wood Joist   Cav - Cavity
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-39. Temperature Distributions for Floor Fire Test, FF-68

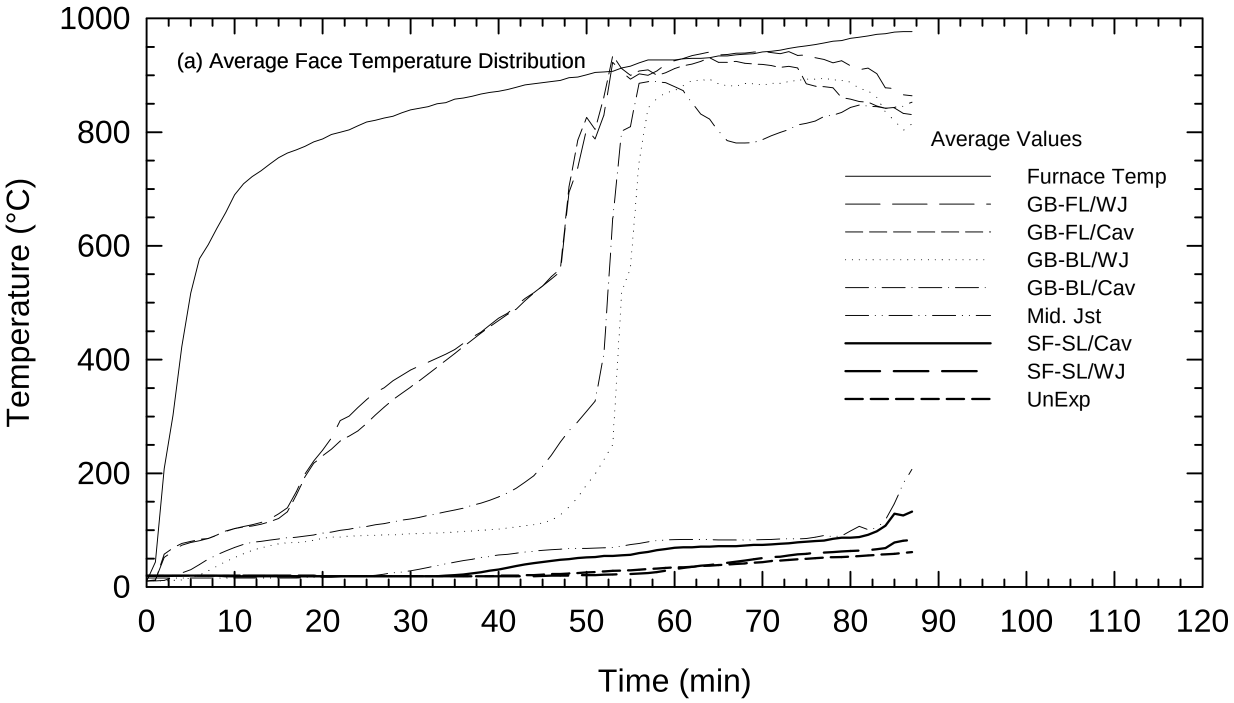


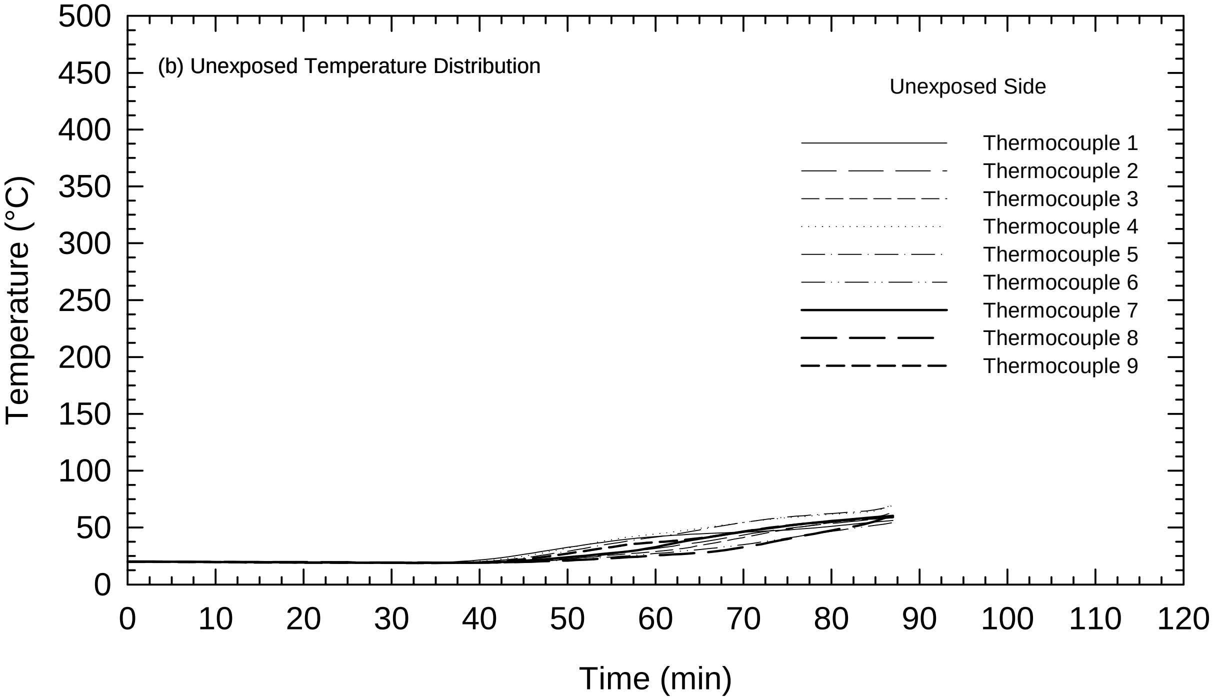


Legend

FL - Face Layer   BL - Base Layer   SL Single Layer   GB - Gypsum Board   WJ - Solid Wood Joist   Cav - Cavity
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-40. Temperature Distributions for Floor Fire Test, FF-69

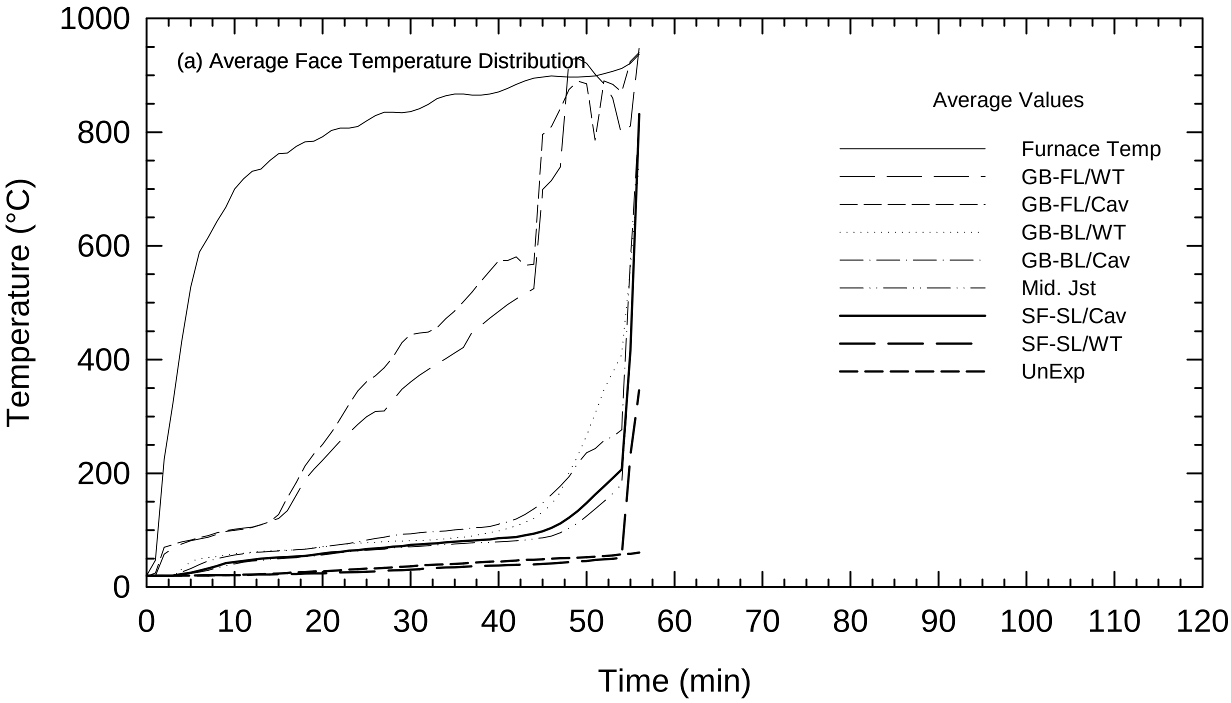


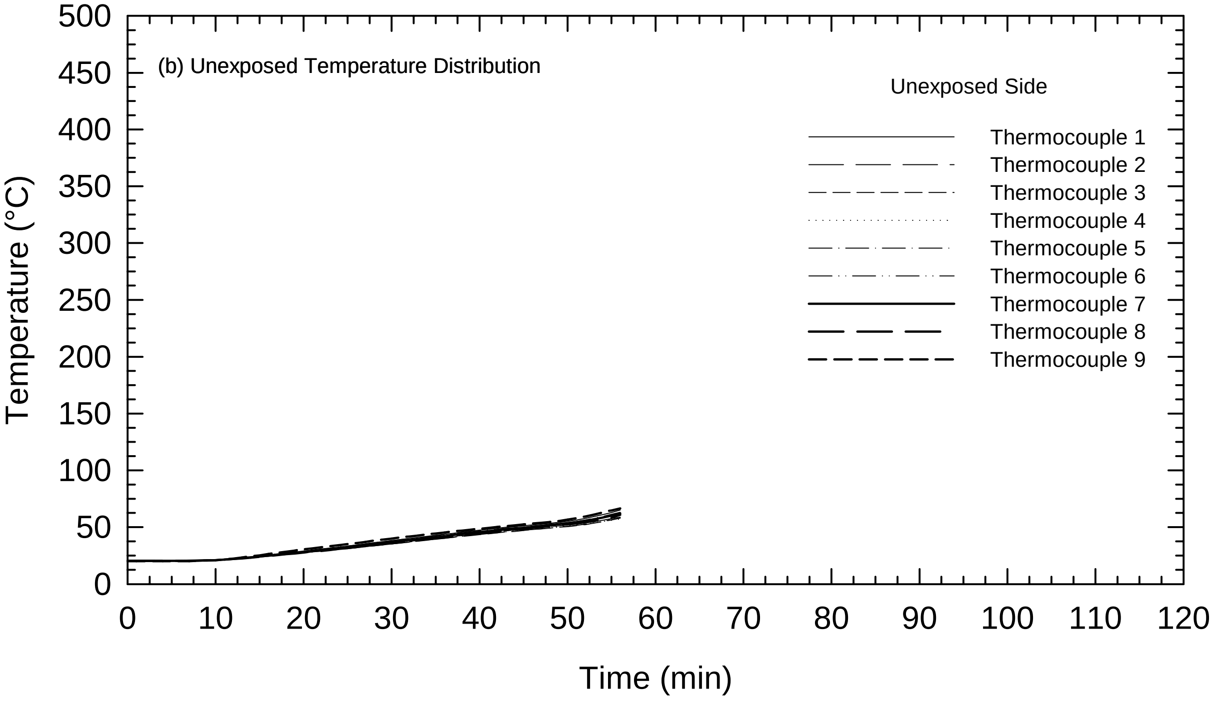


Legend

FL - Face Layer BL - Base Layer SL - Single Layer GB - Gypsum Board WJ - Solid Wood Joist Cav - Cavity
Mid.Jst - Middle Joist UnExp - Unexposed Side SF - Subfloor

Figure F-41. Temperature Distributions for Floor Fire Test, FF-70

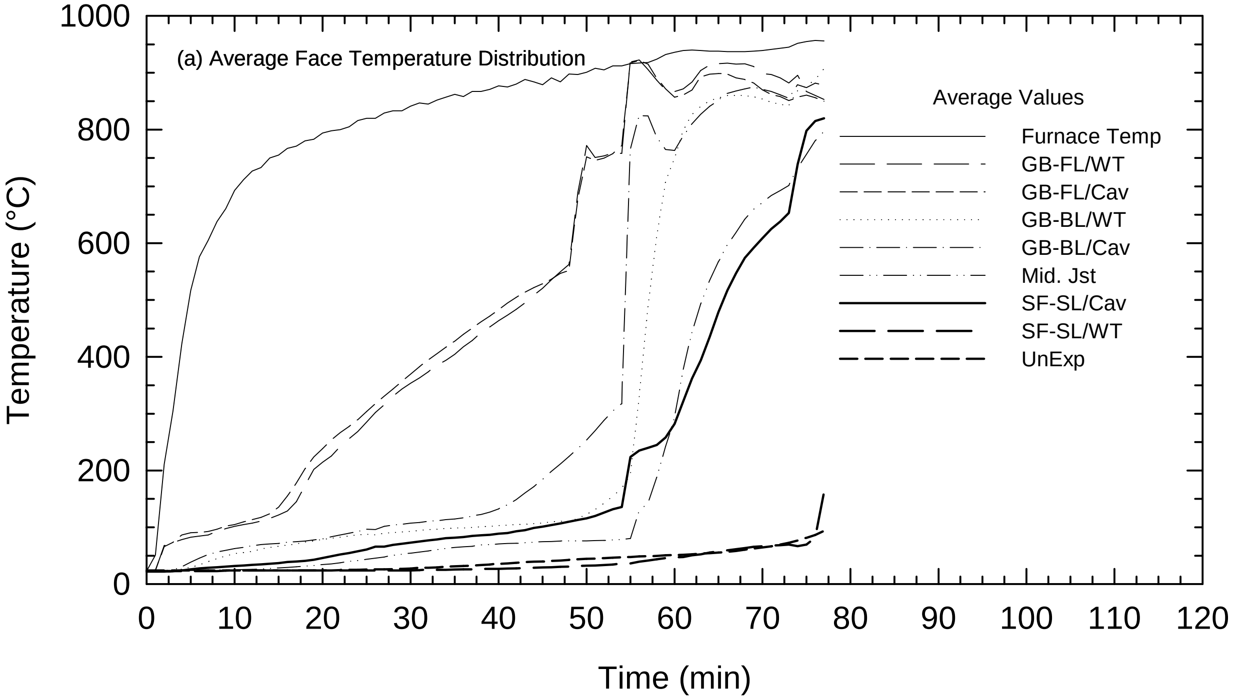


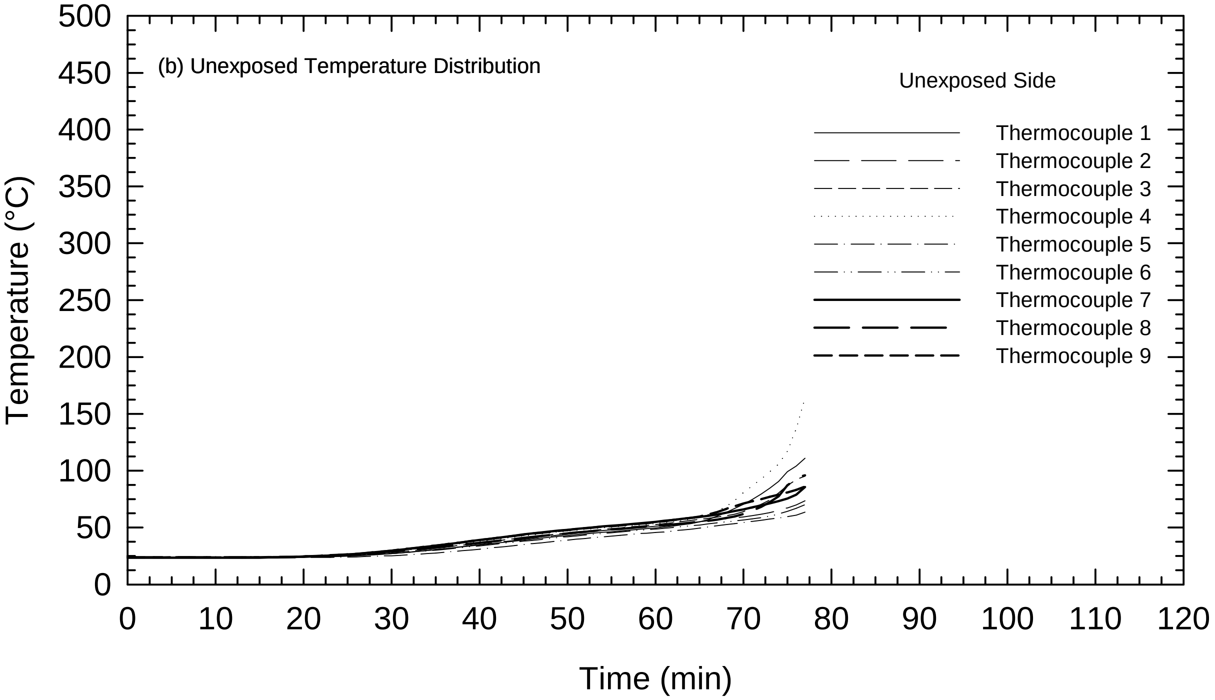


Legend

FL - Face Layer   BL - Base Layer   SL Single Layer   GB - Gypsum Board   WT - Wood Truss   Cav - Cavity
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-42. Temperature Distributions for Floor Fire Test, FF-71

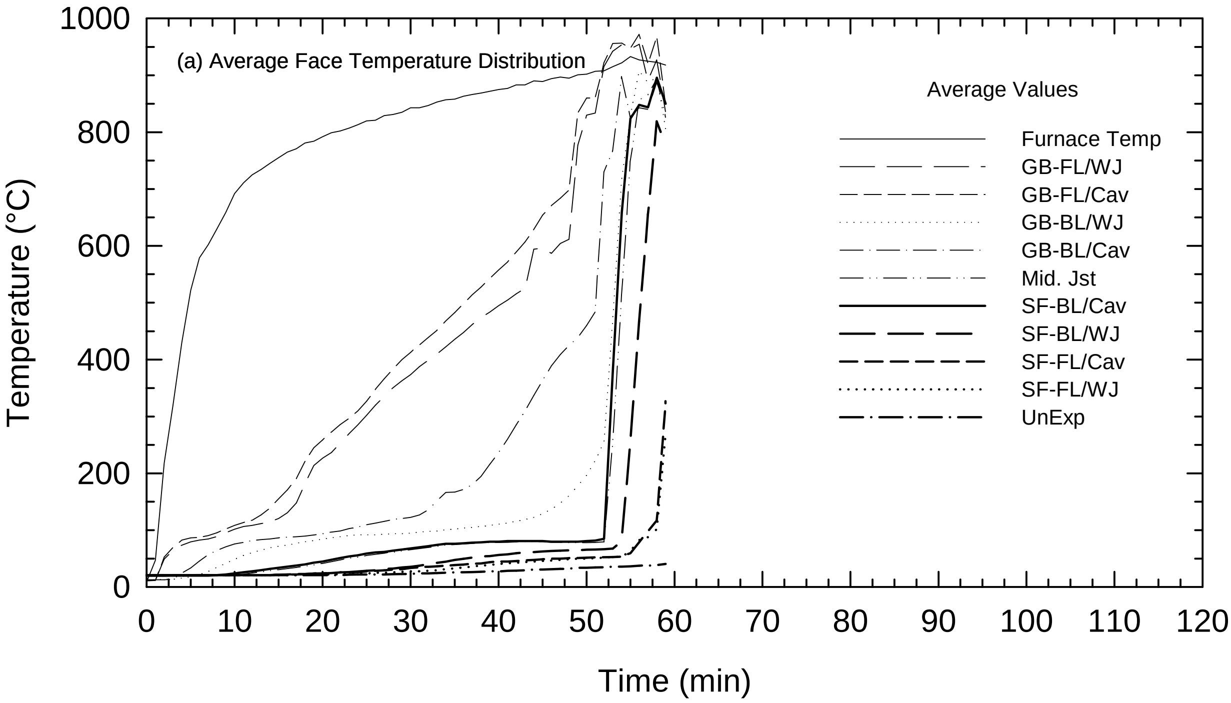


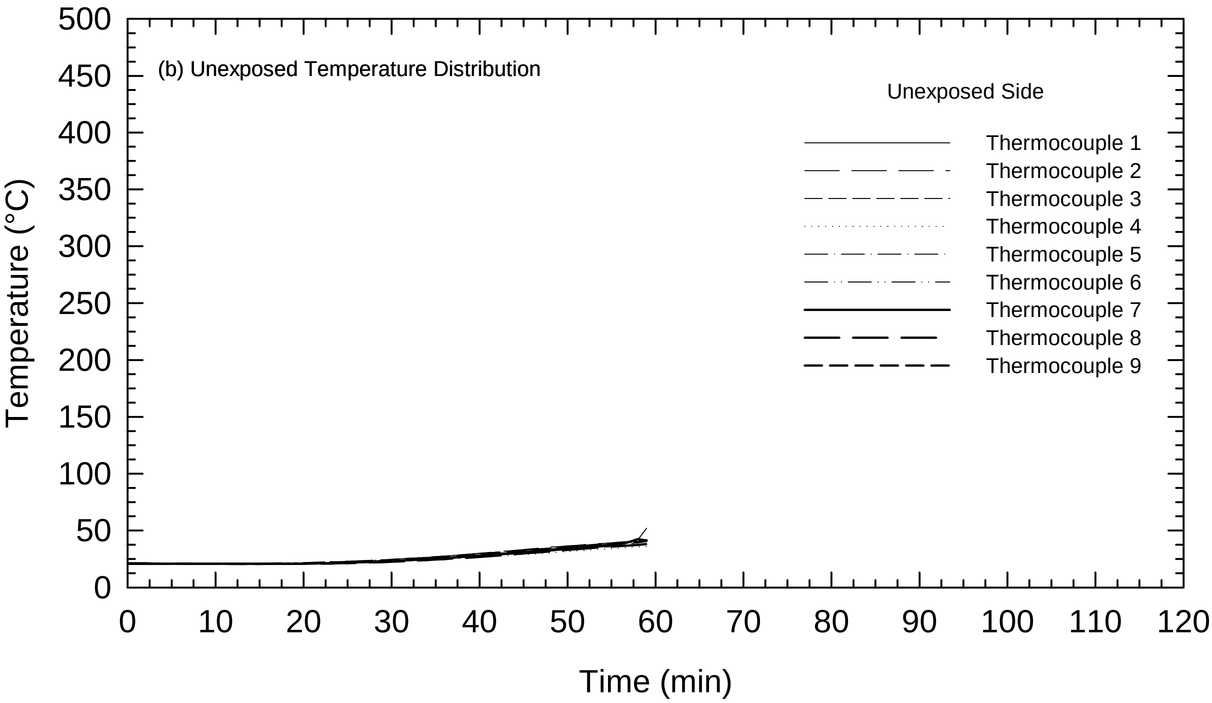


Legend

FL - Face Layer BL - Base Layer SL Single Layer GB - Gypsum Board WT - Wood Truss Cav - Cavity
Mid.Jst - Middle Joist UnExp - Unexposed Side SF - Subfloor

Figure F-43. Temperature Distributions for Floor Fire Test, FF-72

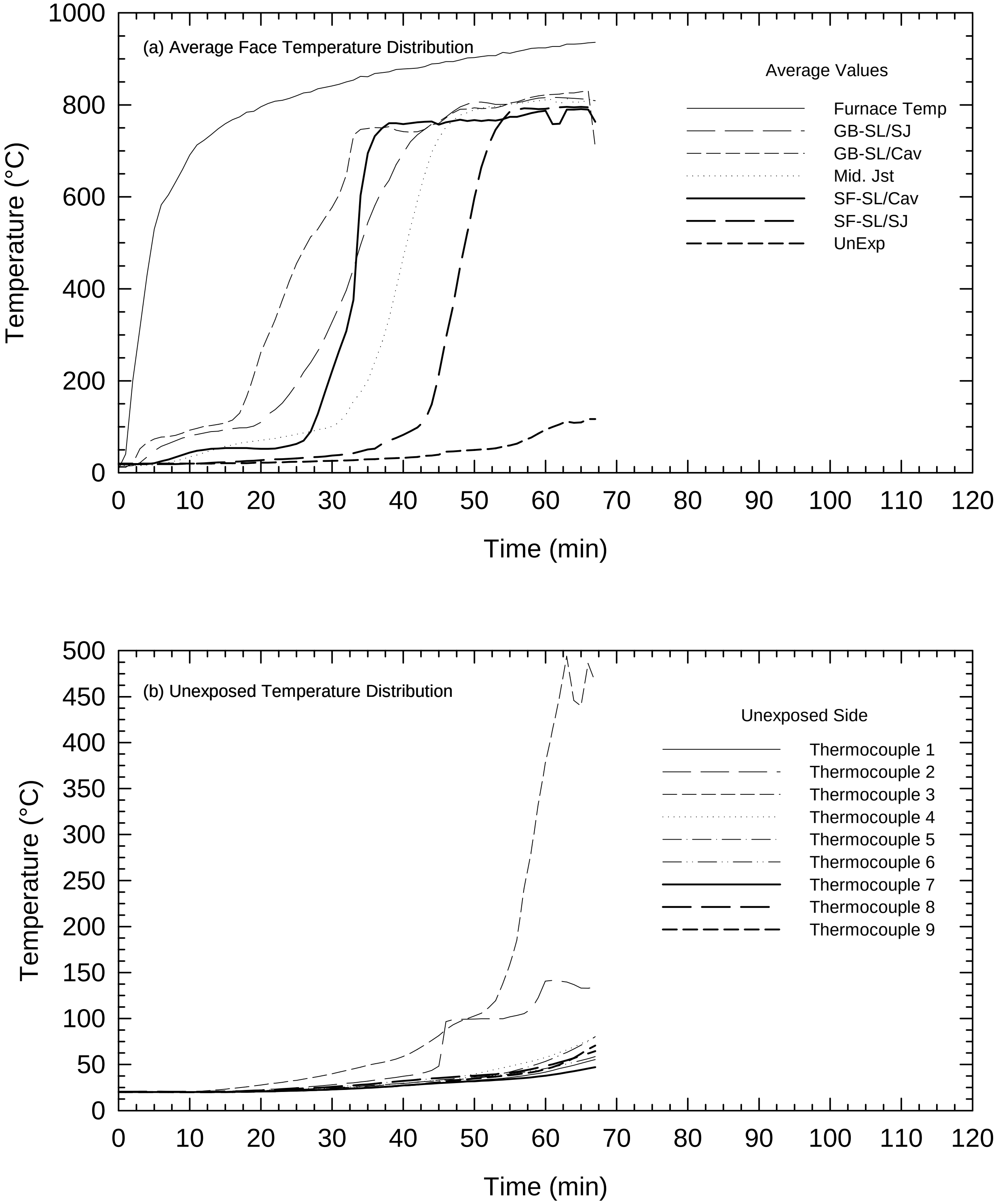




Legend

FL - Face Layer BL - Base Layer SL Single Layer GB - Gypsum Board WJ - Solid Wood Joist Cav - Cavity
Mid.Jst - Middle Joist UnExp - Unexposed Side SF - Subfloor

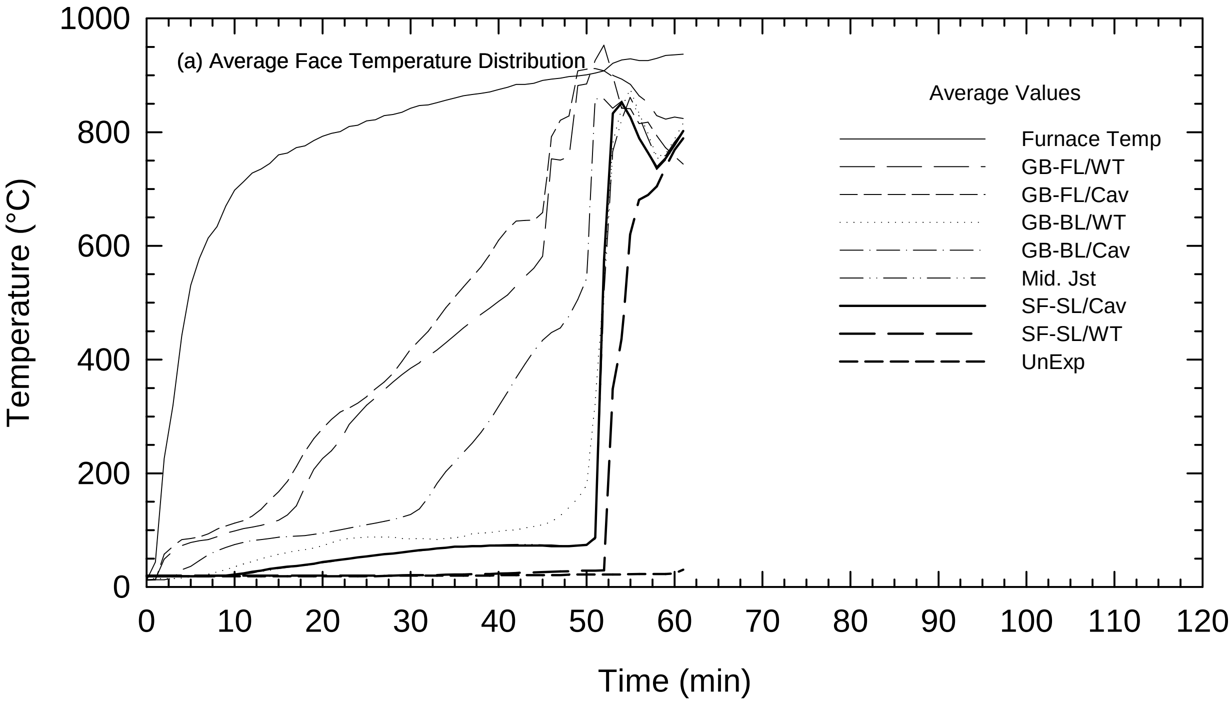
Figure F-44. Temperature Distributions for Floor Fire Test, FF-73

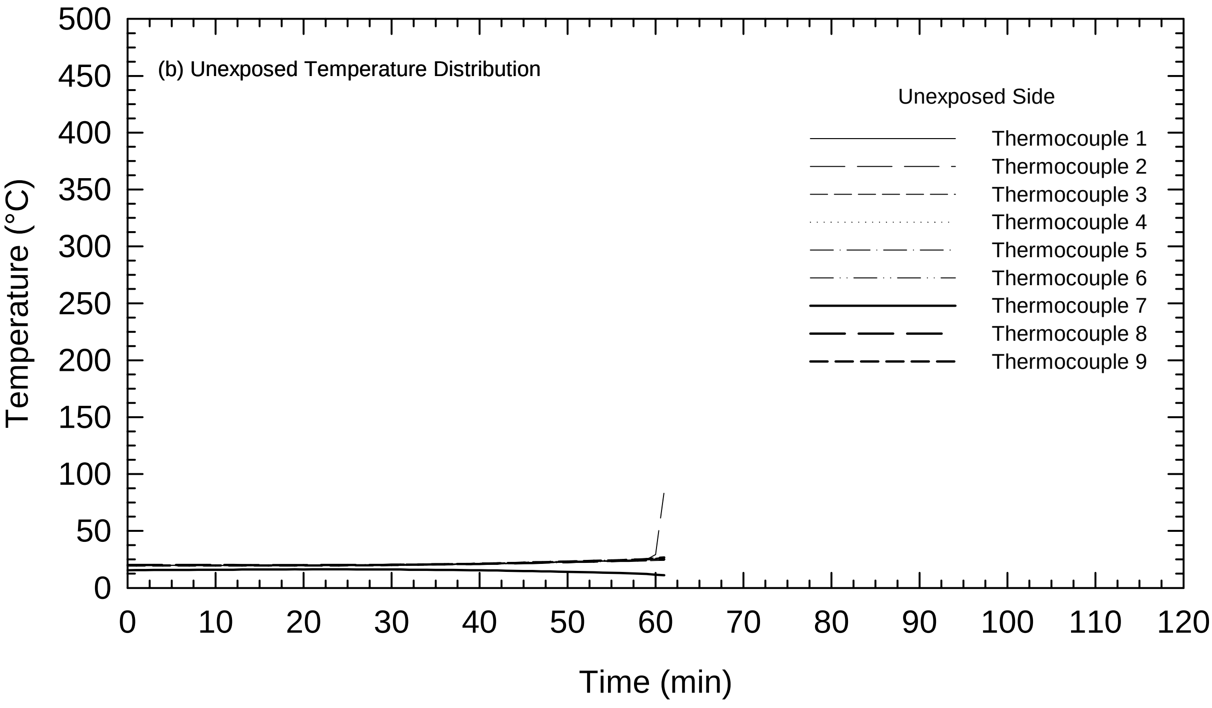


Legend

SL - Single Layer   Cav - Cavity   GB - Gypsum Board   SJ - Steel C-Joist
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-45. Temperature Distributions for Floor Fire Test, FF-74

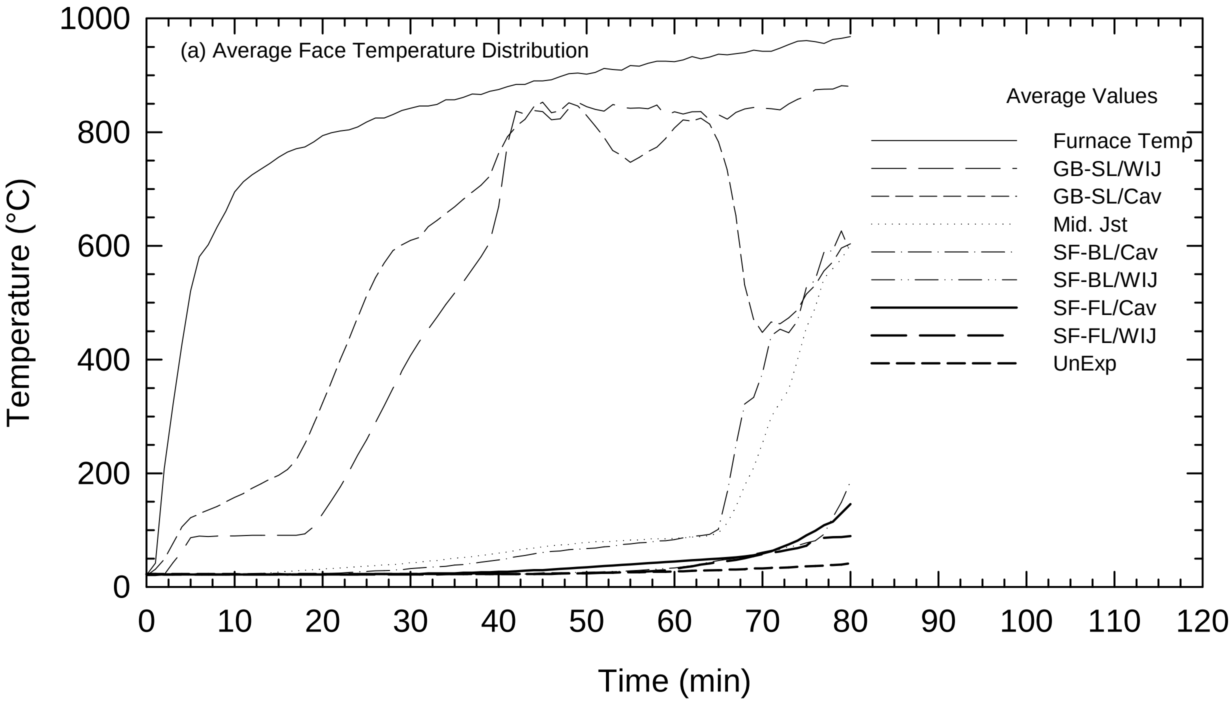


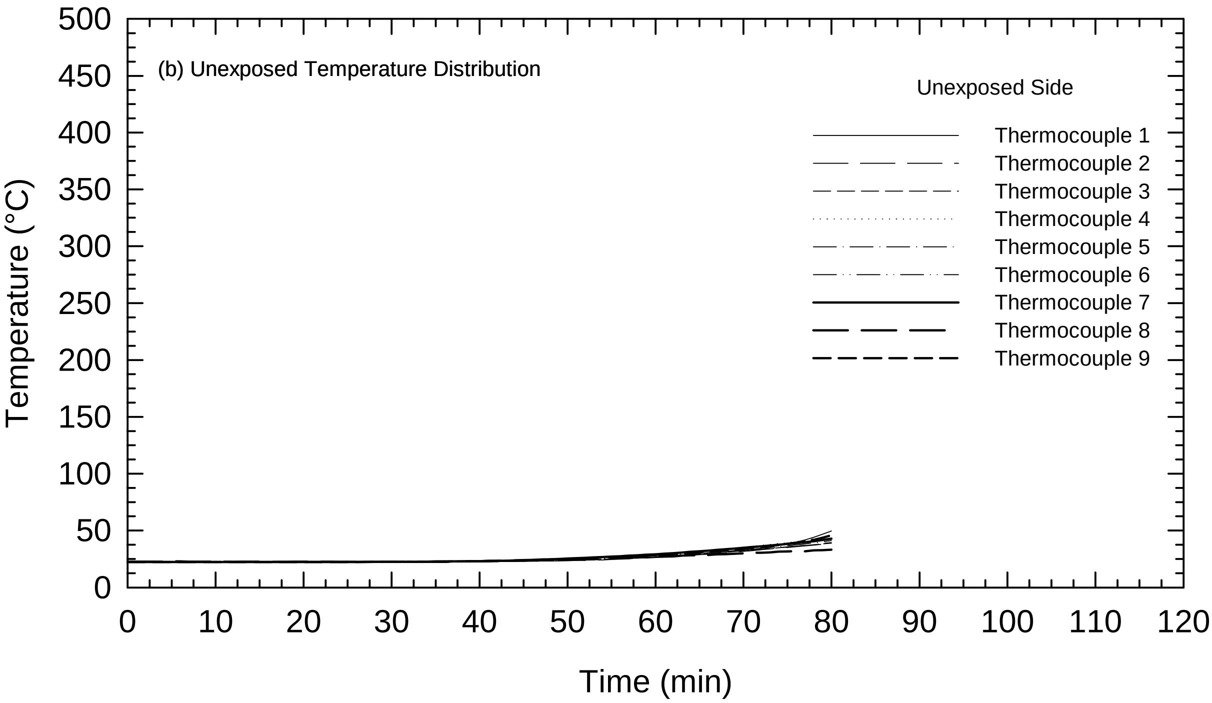


Legend

FL - Face Layer   BL - Base Layer   SL Single Layer   GB - Gypsum Board   WT - Wood Truss   Cav - Cavity
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-46. Temperature Distributions for Floor Fire Test, FF-75

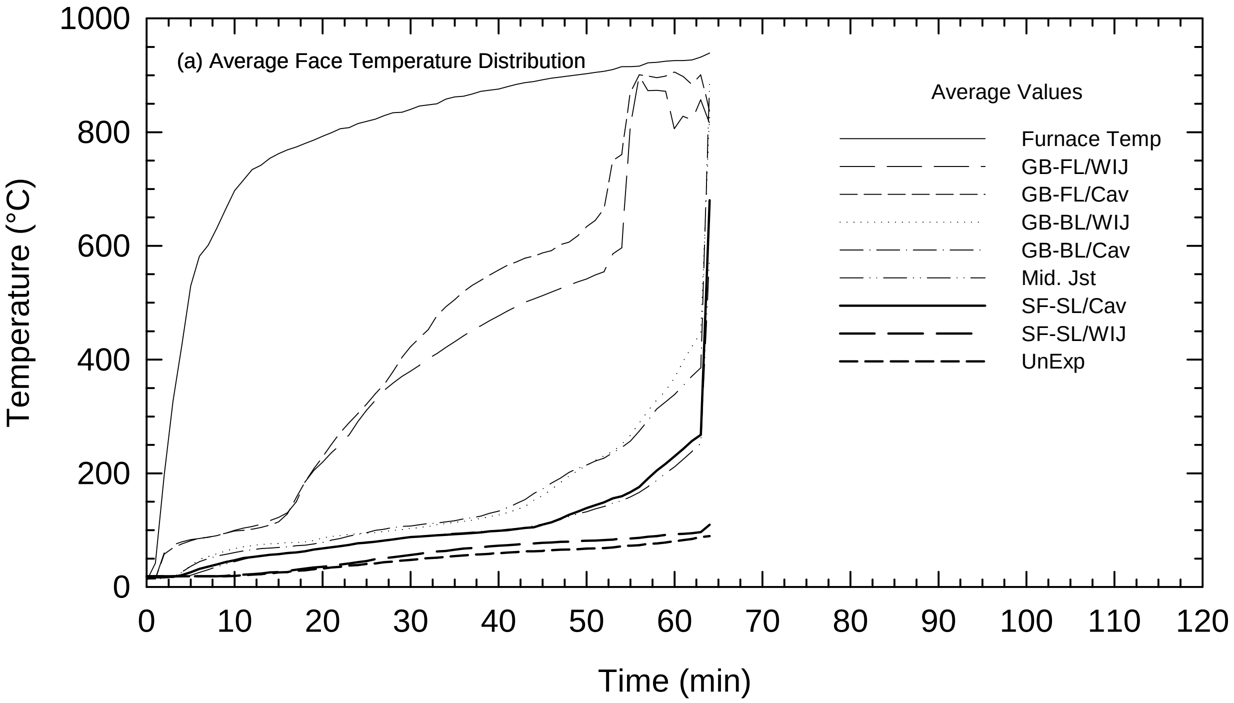


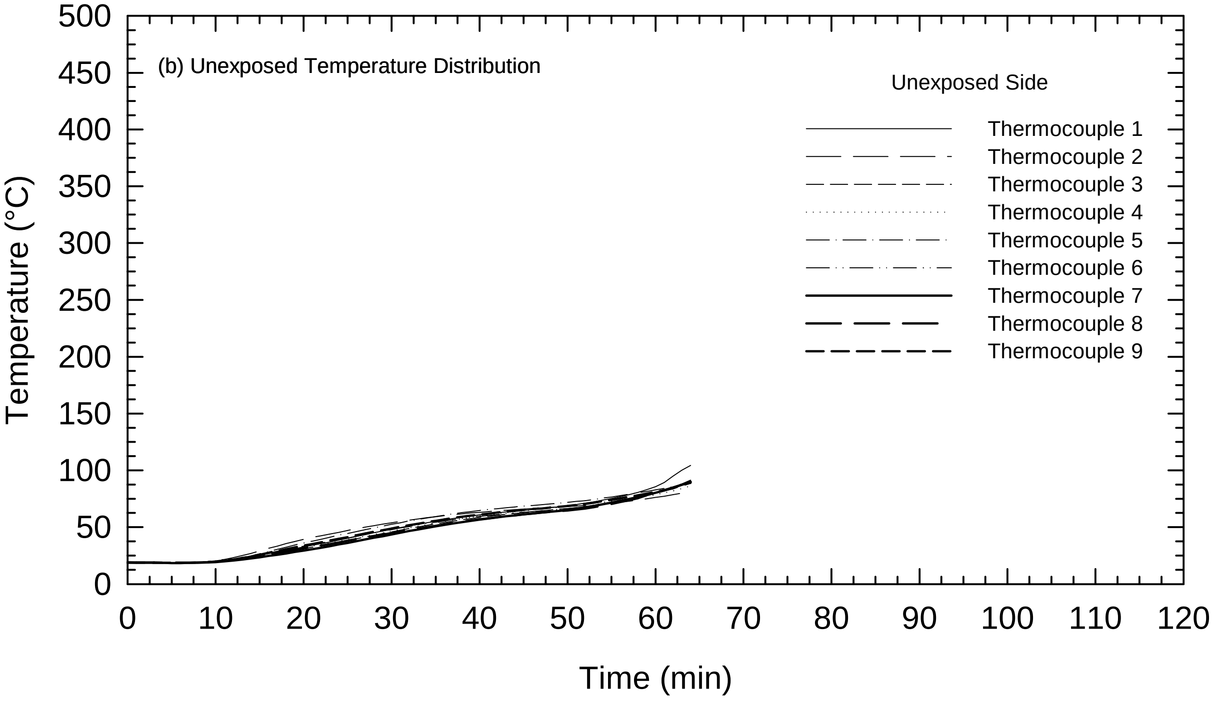


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
WIJ - Wood I-Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-47. Temperature Distributions for Floor Fire Test, FF-76

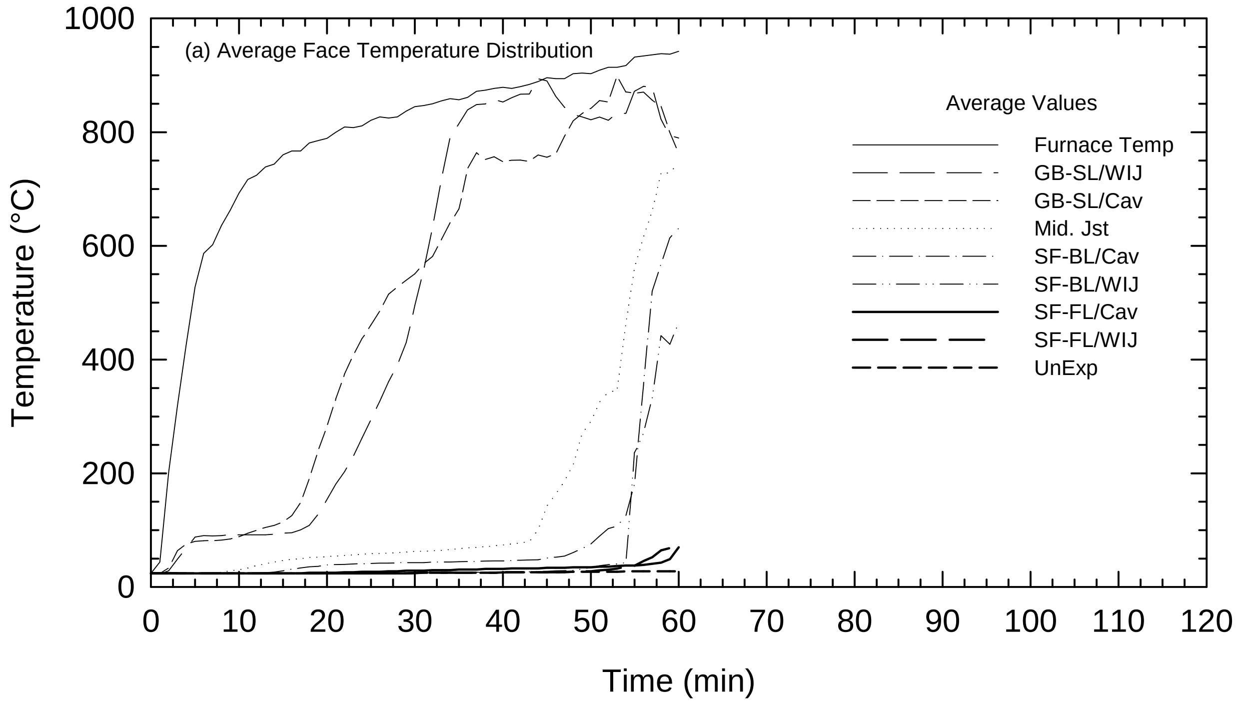


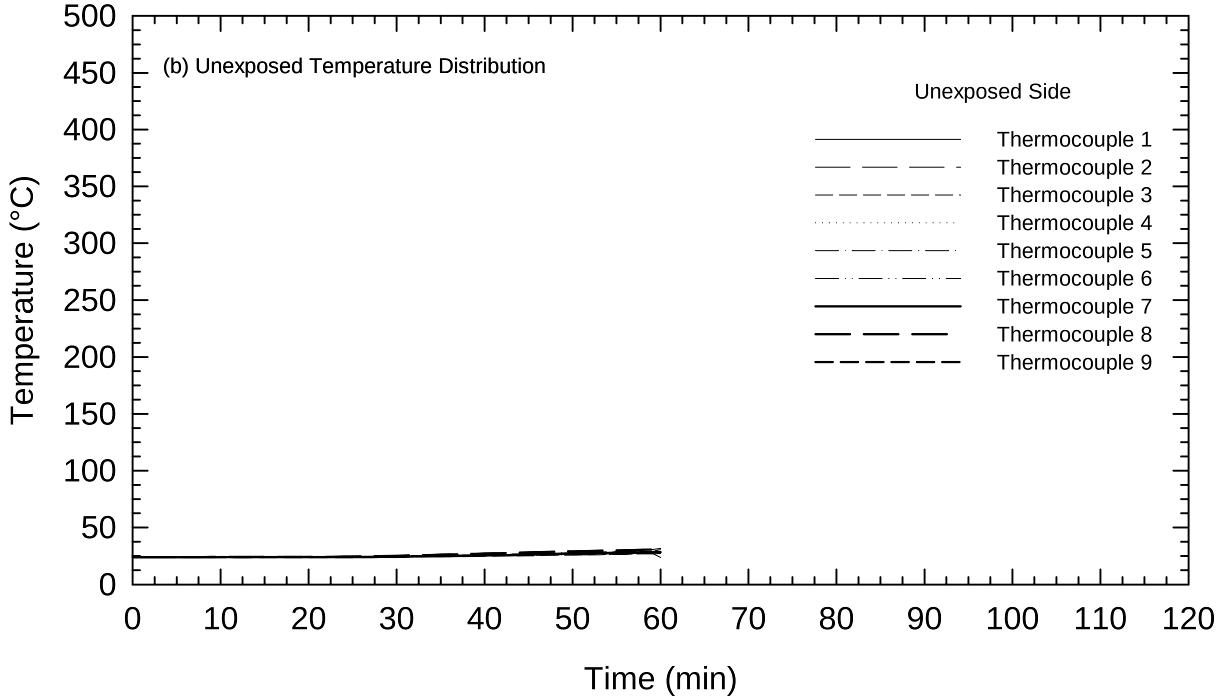


Legend

FL - Face Layer   BL - Base Layer   SL Single Layer   GB - Gypsum Board   WIJ - Wood I-Joist   Cav - Cavity
Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-48. Temperature Distributions for Floor Fire Test, FF-77

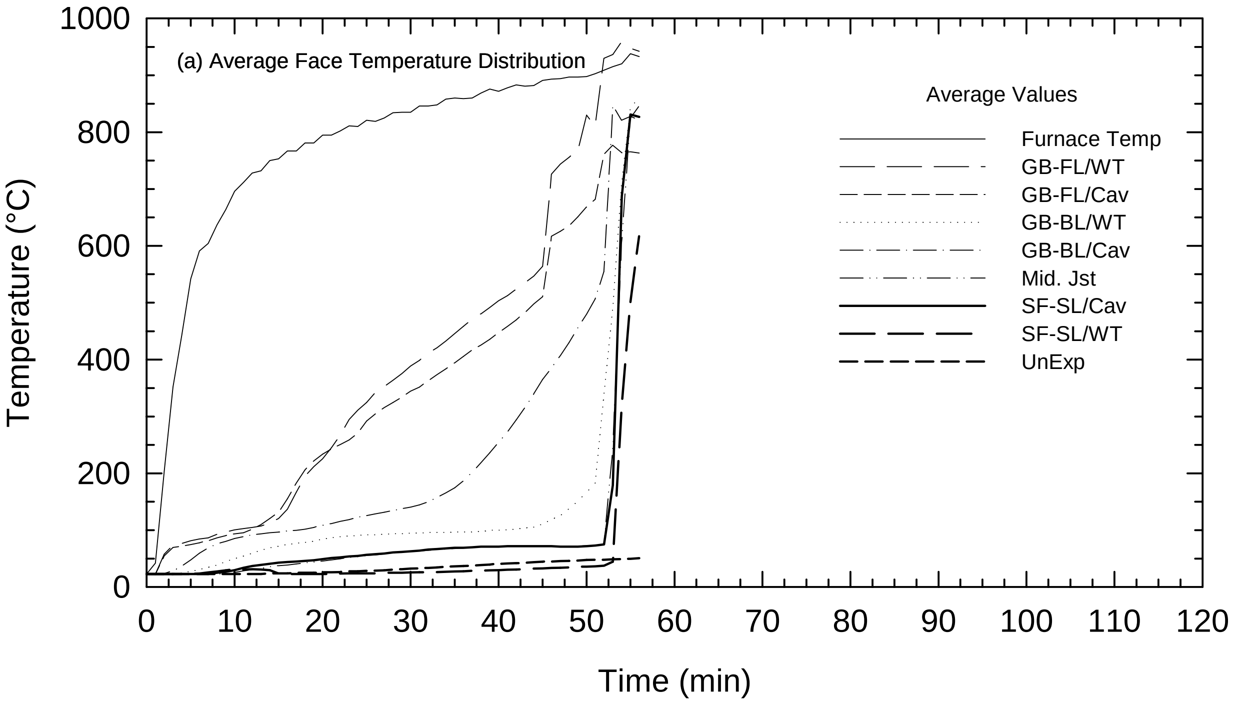


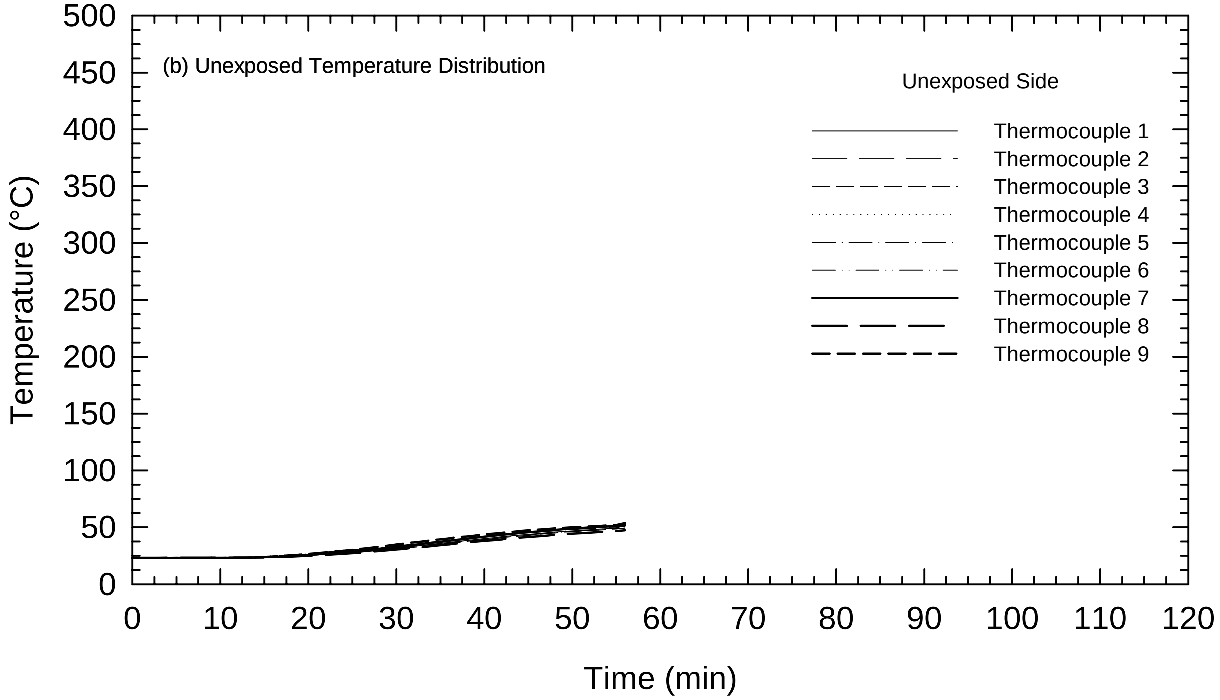


Legend

FL - Face Layer   BL - Base Layer   SL - Single Layer   Cav - Cavity   GB - Gypsum Board
WIJ - Wood I-Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-49. Temperature Distributions for Floor Fire Test, FF-78

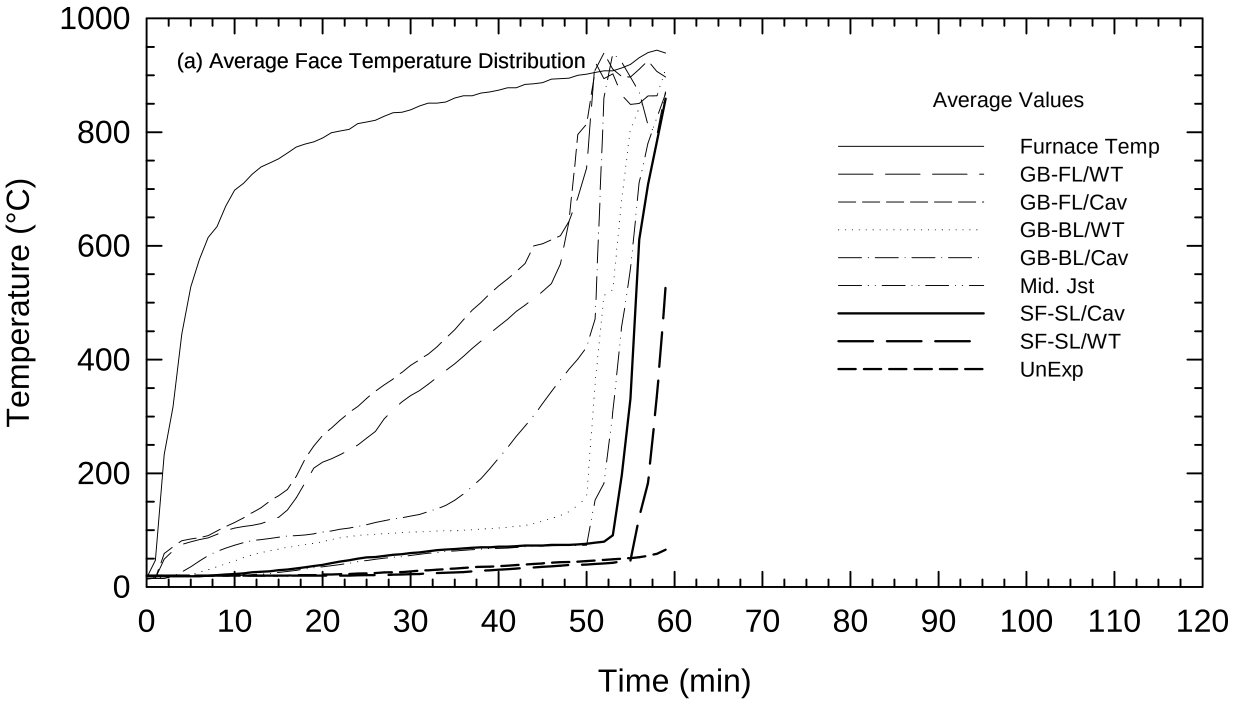


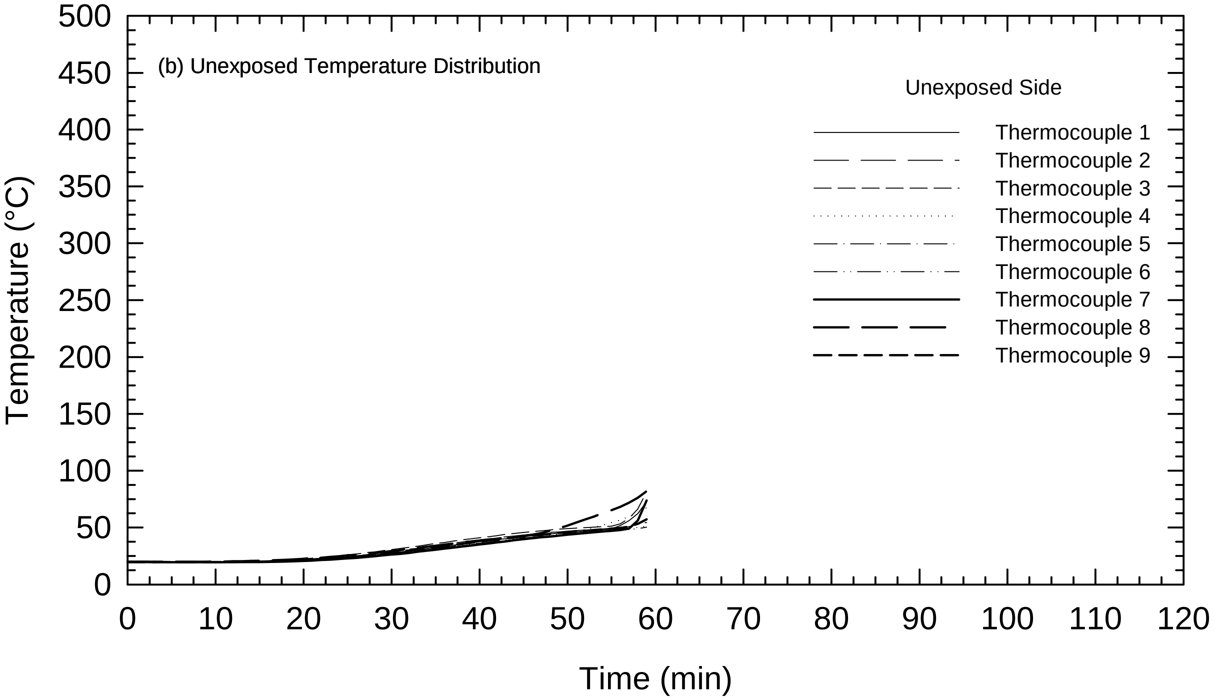


Legend

FL - Face Layer BL - Base Layer SL Single Layer GB - Gypsum Board WT - Wood Truss Cav - Cavity
Mid.Jst - Middle Joist UnExp - Unexposed Side SF - Subfloor

Figure F-50. Temperature Distributions for Floor Fire Test, FF-79

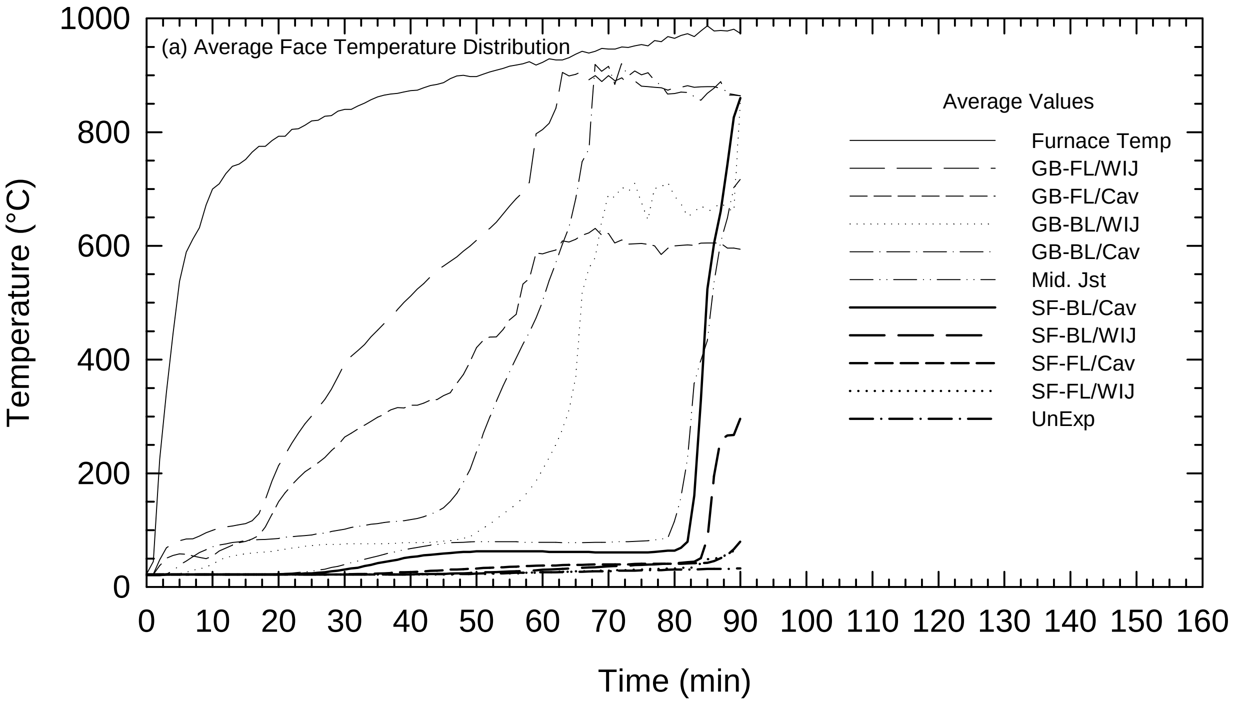


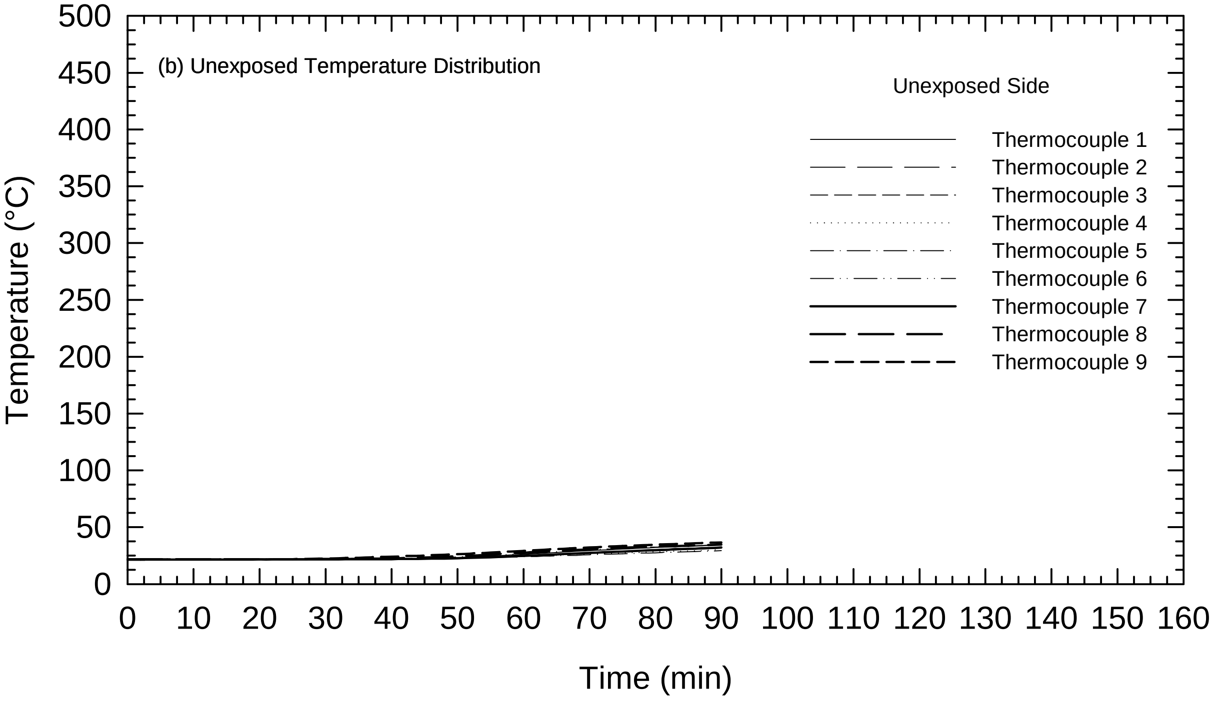


Legend

FL - Face Layer BL - Base Layer SL Single Layer GB - Gypsum Board WT - Wood Truss Cav - Cavity
Mid.Jst - Middle Joist UnExp - Unexposed Side SF - Subfloor

Figure F-51. Temperature Distributions for Floor Fire Test, FF-80

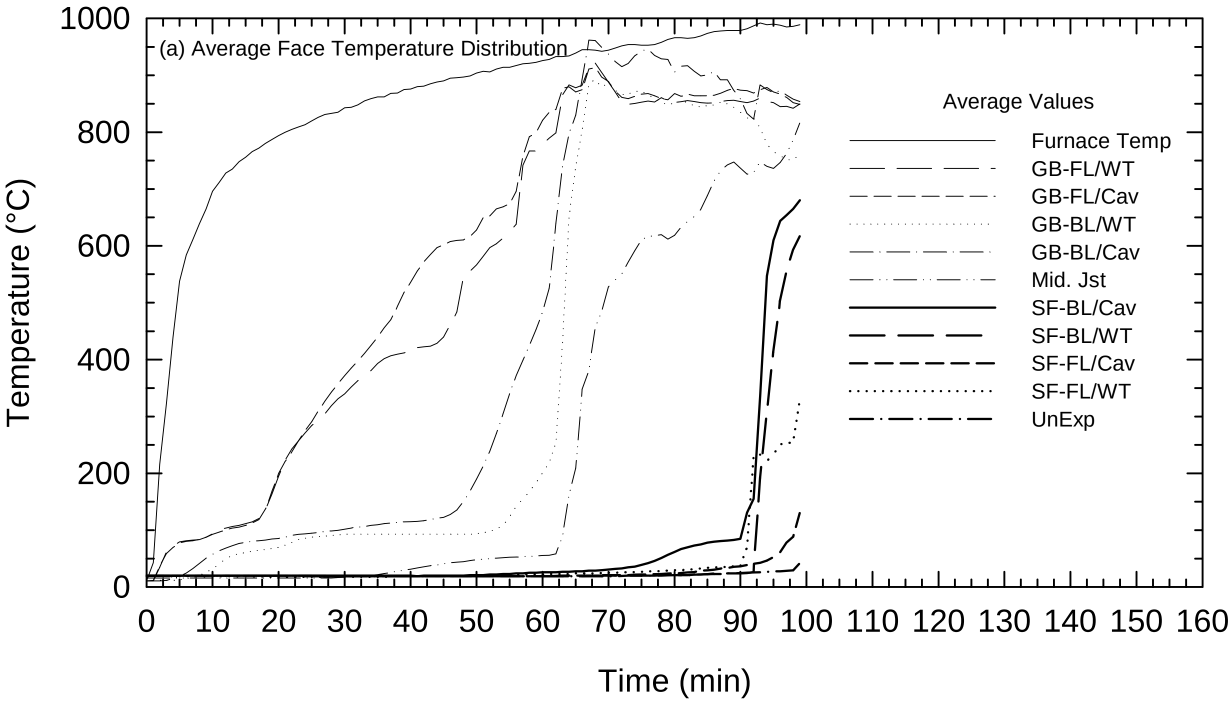


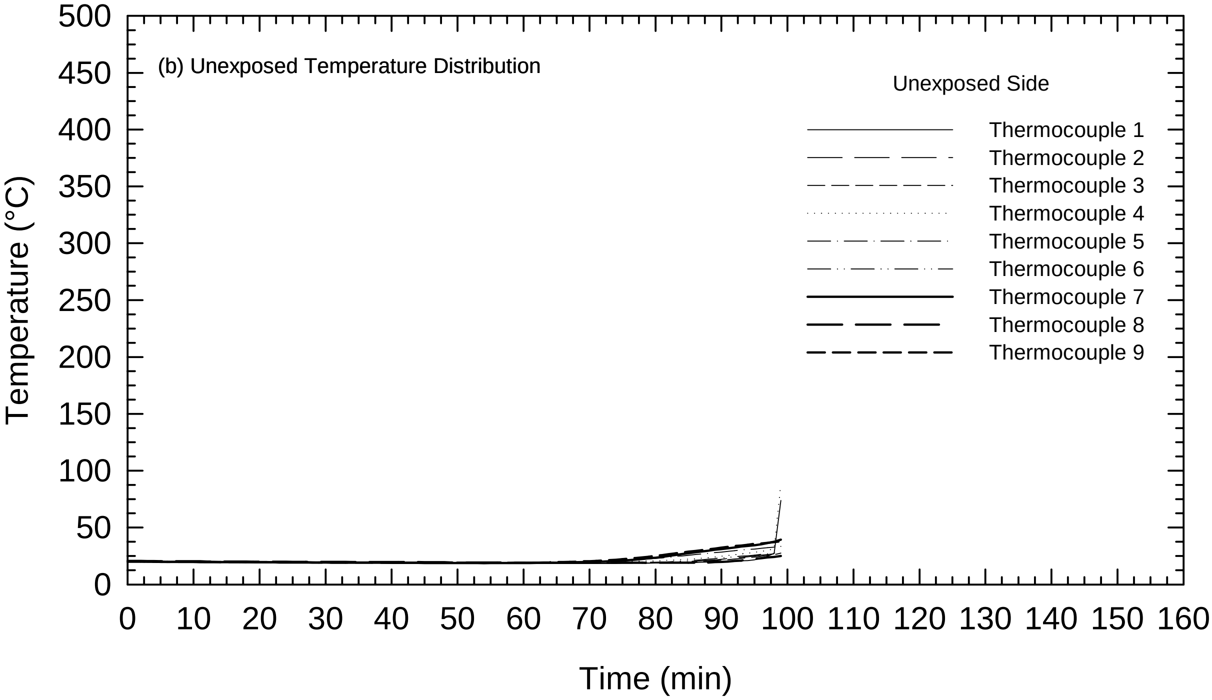


<u>Legend</u>

FL - Face Layer   BL - Base Layer   SL Single Layer   GB - Gypsum Board   Cav - Cavity
WIJ - Wood I-Joist   Mid.Jst - Middle Joist   UnExp - Unexposed Side   SF - Subfloor

Figure F-52. Temperature Distributions for Floor Fire Test, FF-81





Legend

FL - Face Layer BL - Base Layer SL Single Layer GB - Gypsum Board Cav - Cavity
WT - Wood Truss Mid.Jst - Middle Joist UnExp - Unexposed Side SF - Subfloor

Figure F-53. Temperature Distributions for Floor Fire Test, FF-82

Appendix G

Deflection measurements

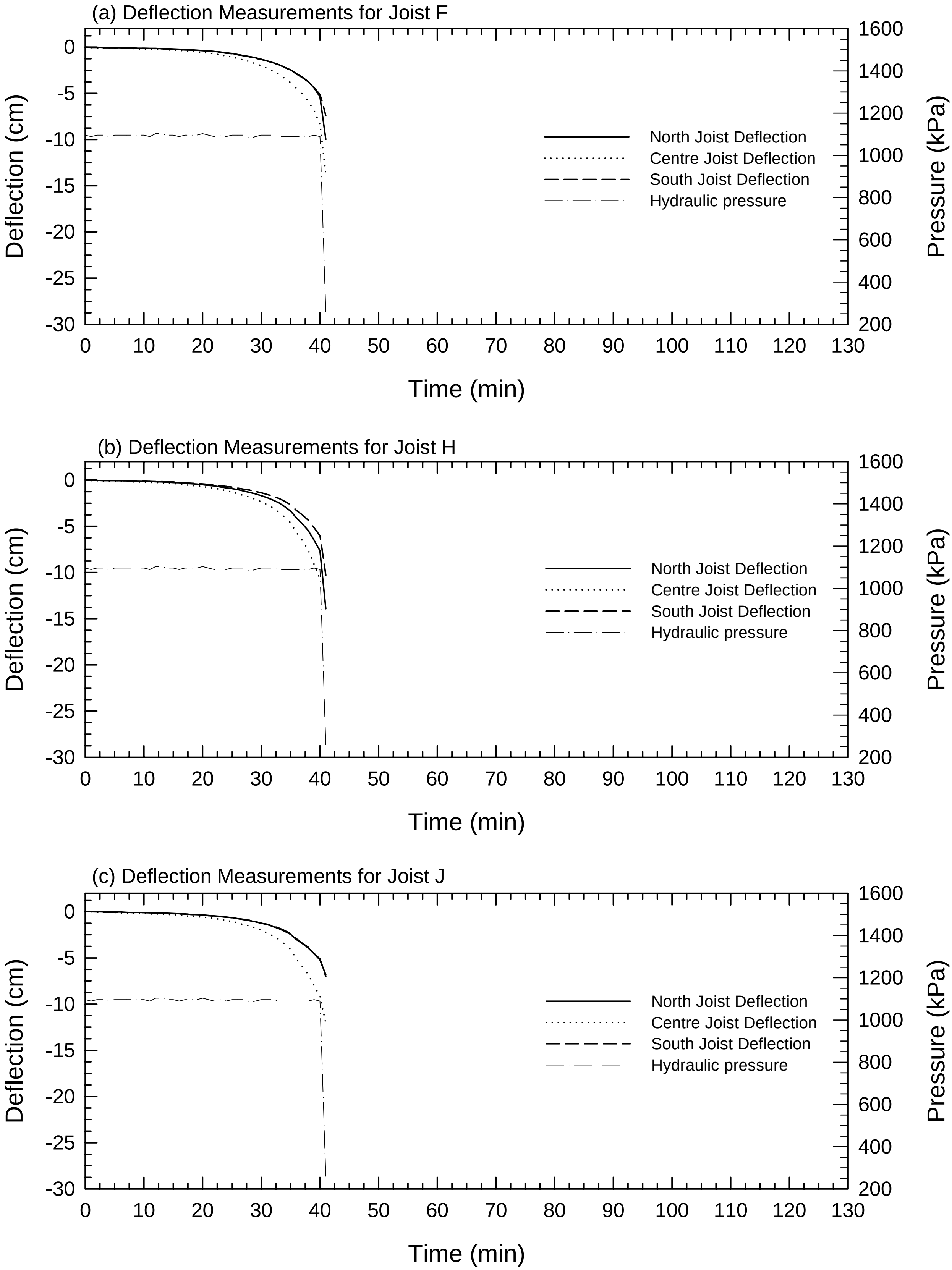


Figure G-1. Deflection Measurements for Floor Fire Test, FF-30

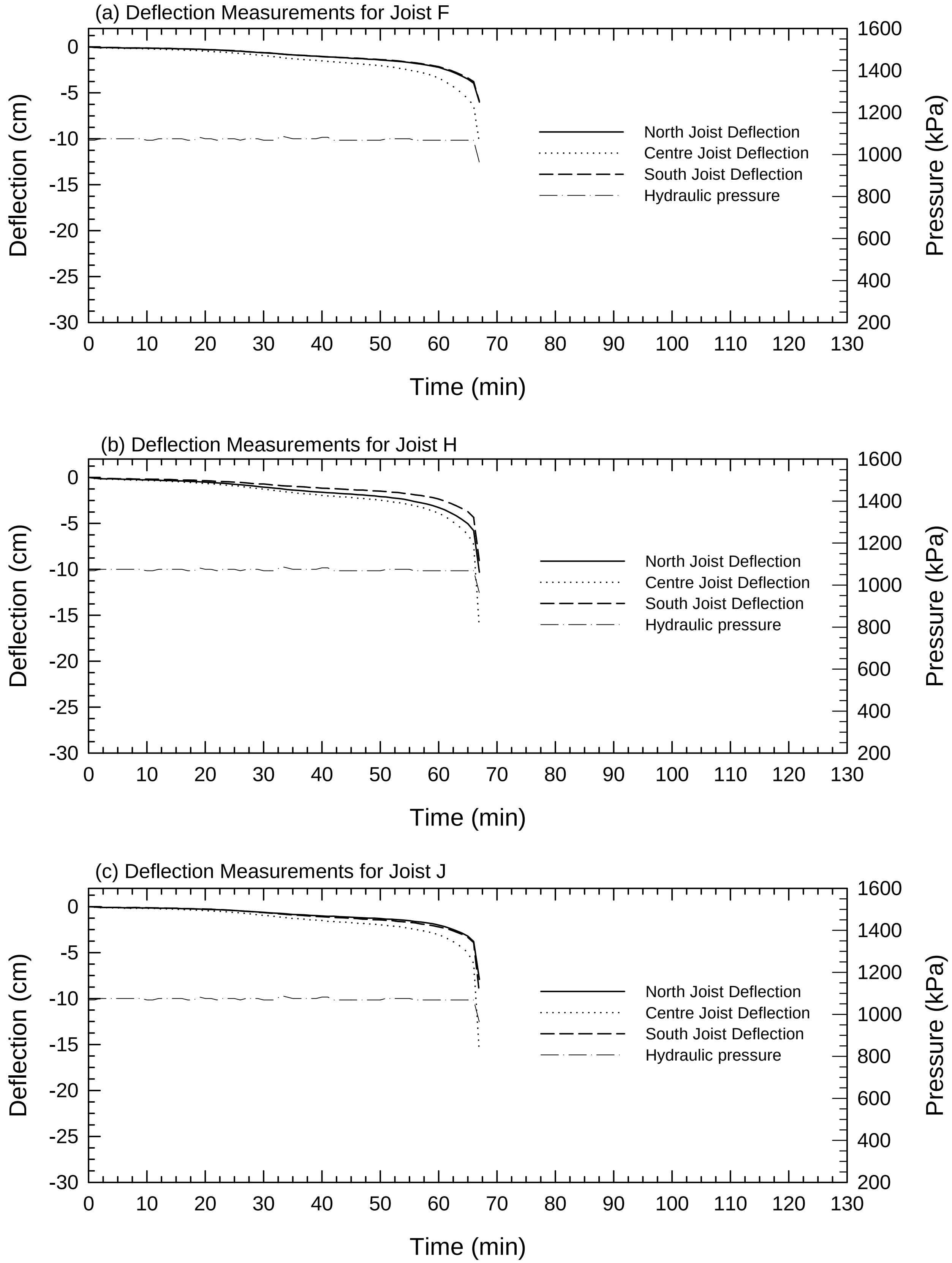
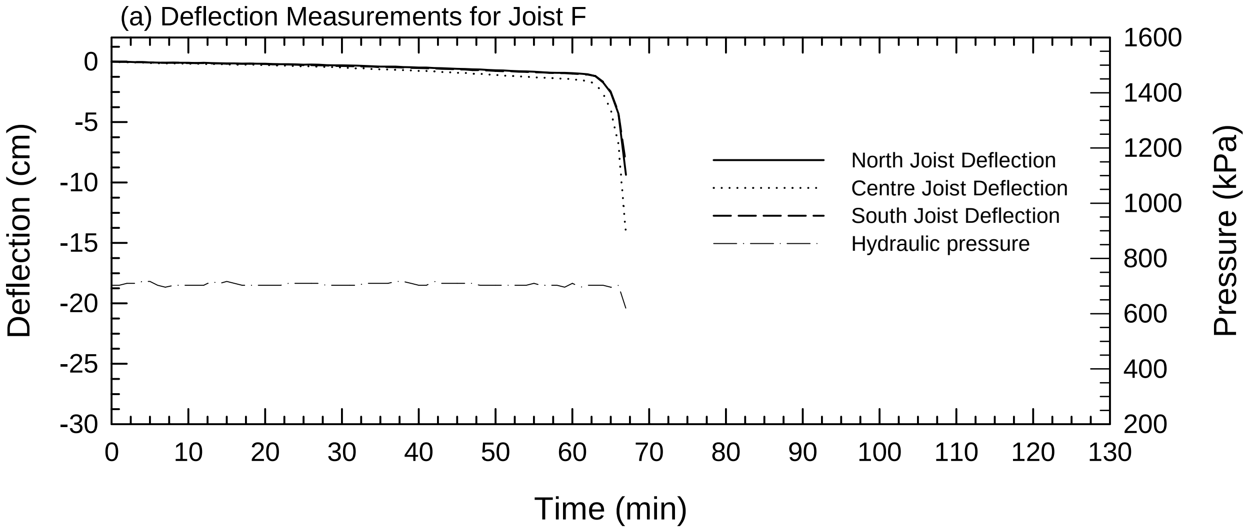
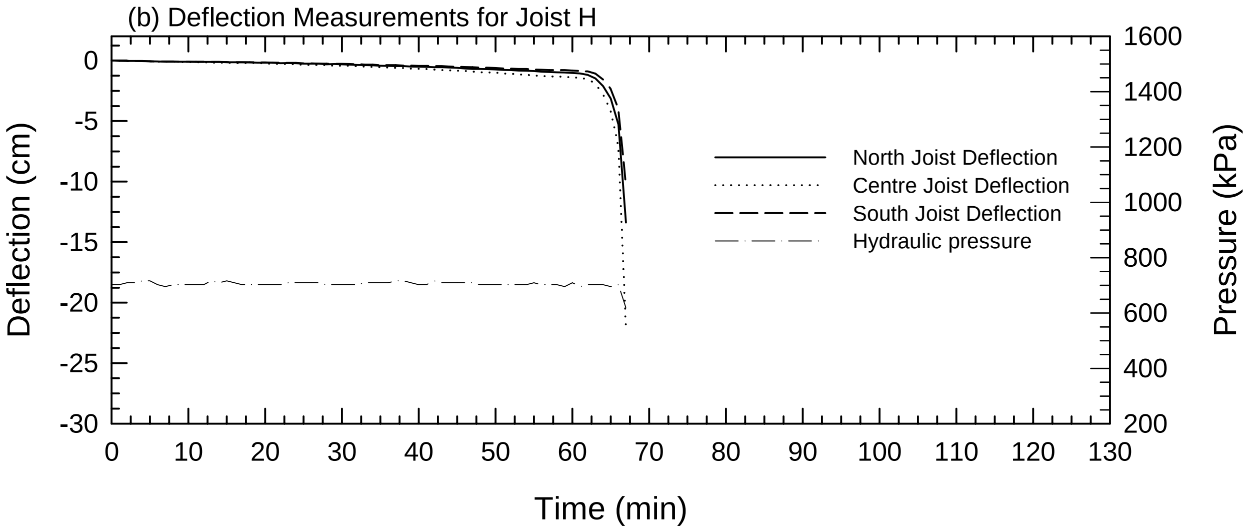


Figure G-2. Deflection Measurements for Floor Fire Test, FF-31





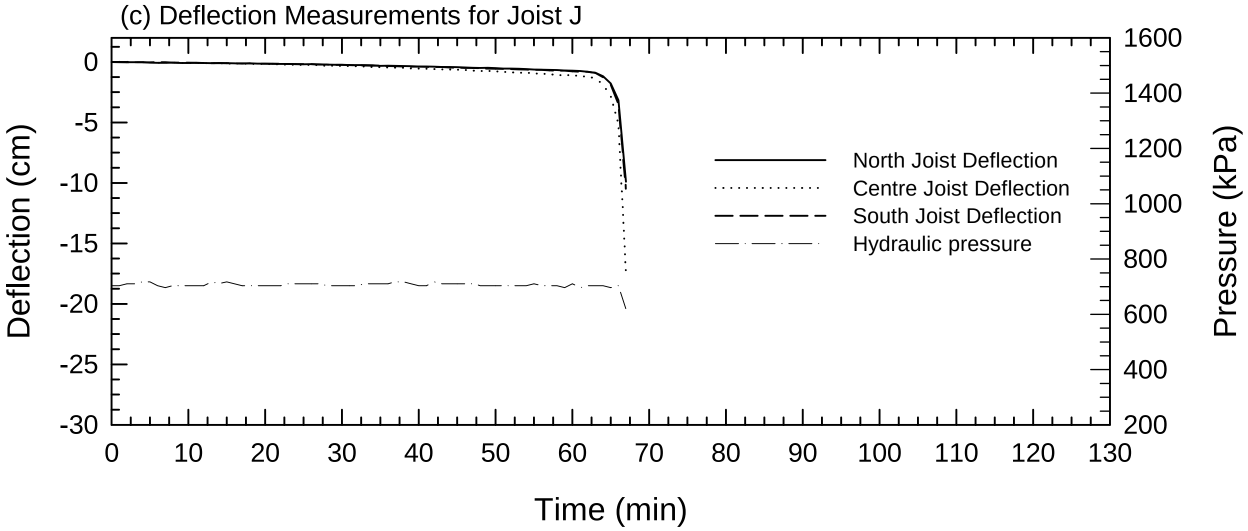


Figure G-3. Deflection Measurements for Floor Fire Test, FF-32

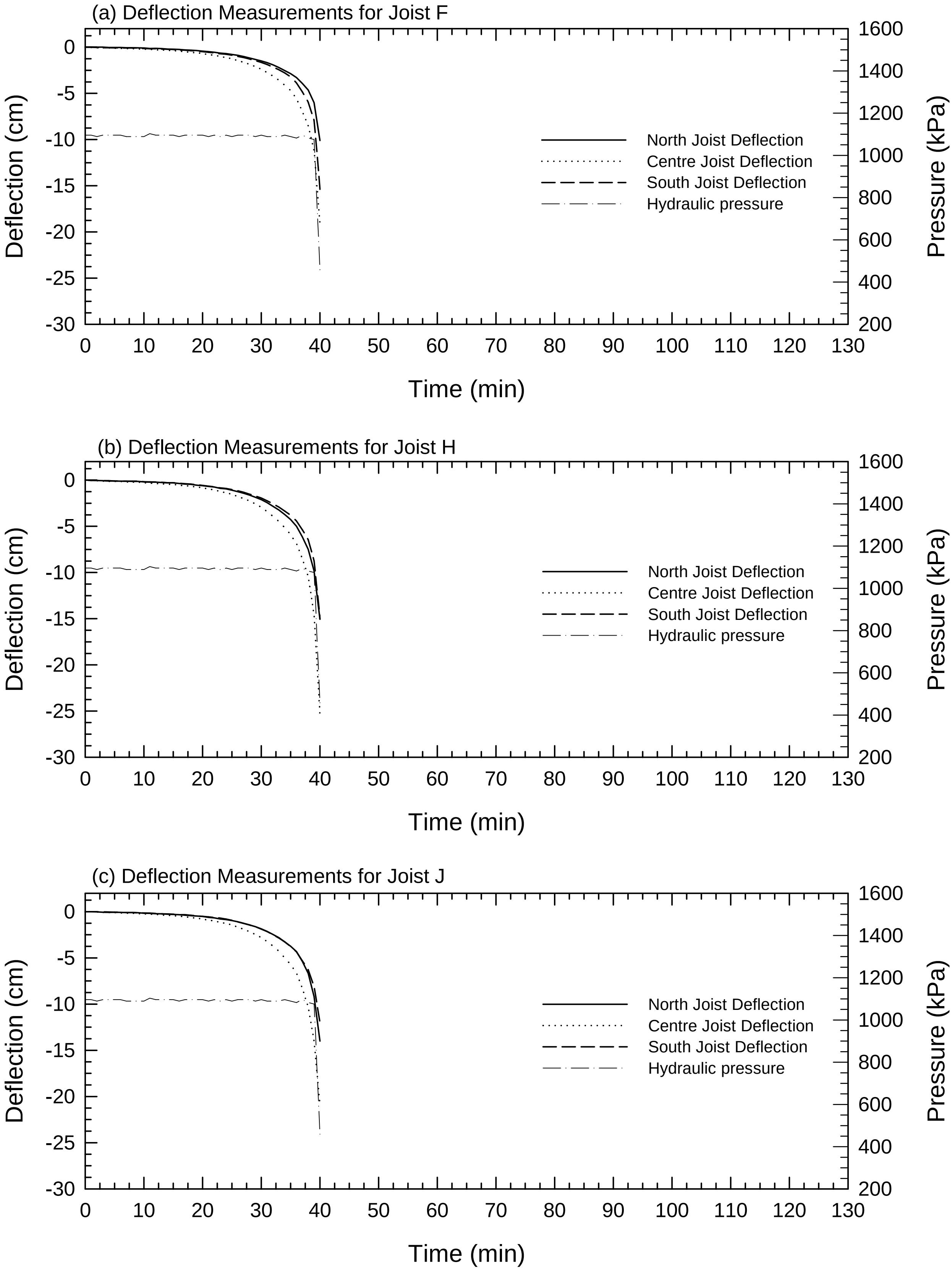
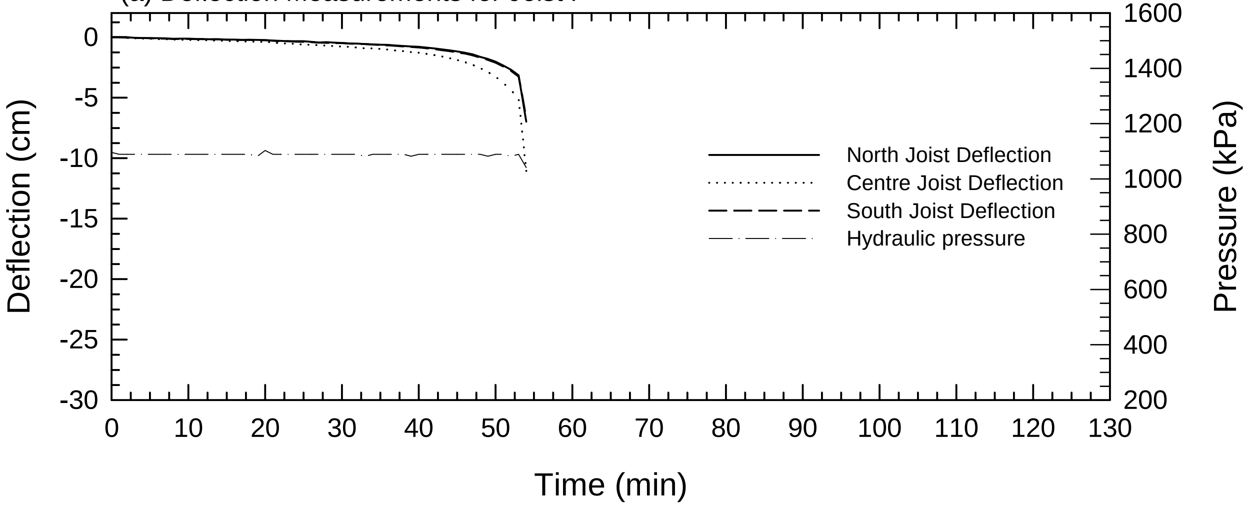
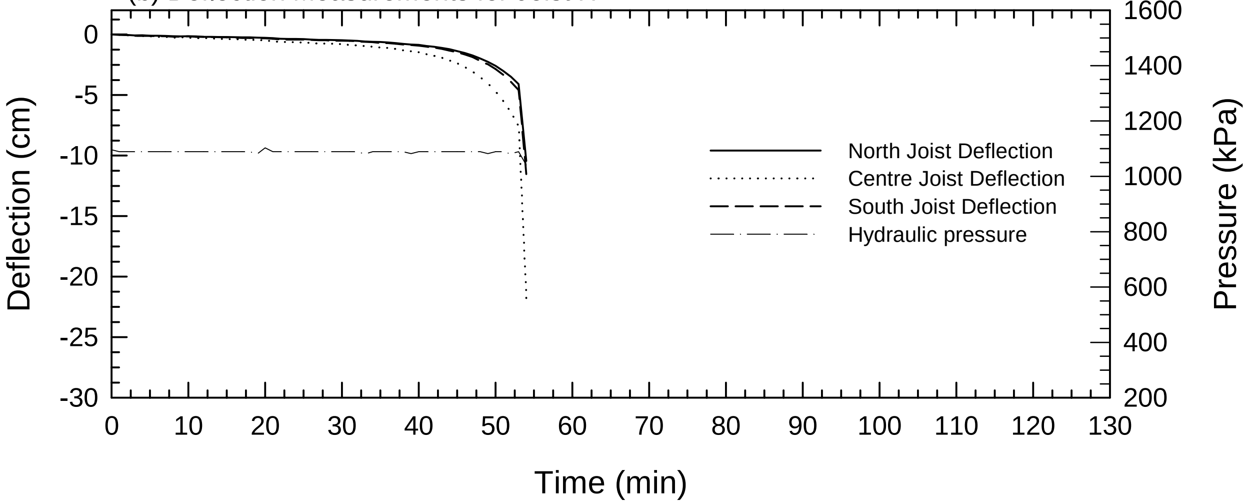


Figure G-4. Deflection Measurements for Floor Fire Test, FF-33

(a) Deflection Measurements for Joist F



(b) Deflection Measurements for Joist H



(c) Deflection Measurements for Joist J

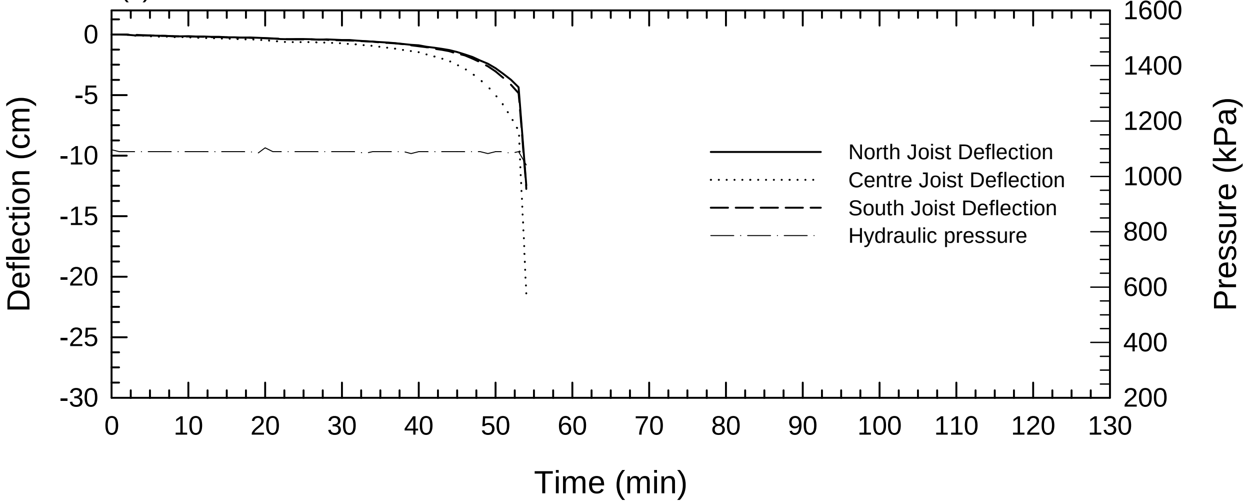


Figure G-5. Deflection Measurements for Floor Fire Test, FF-34

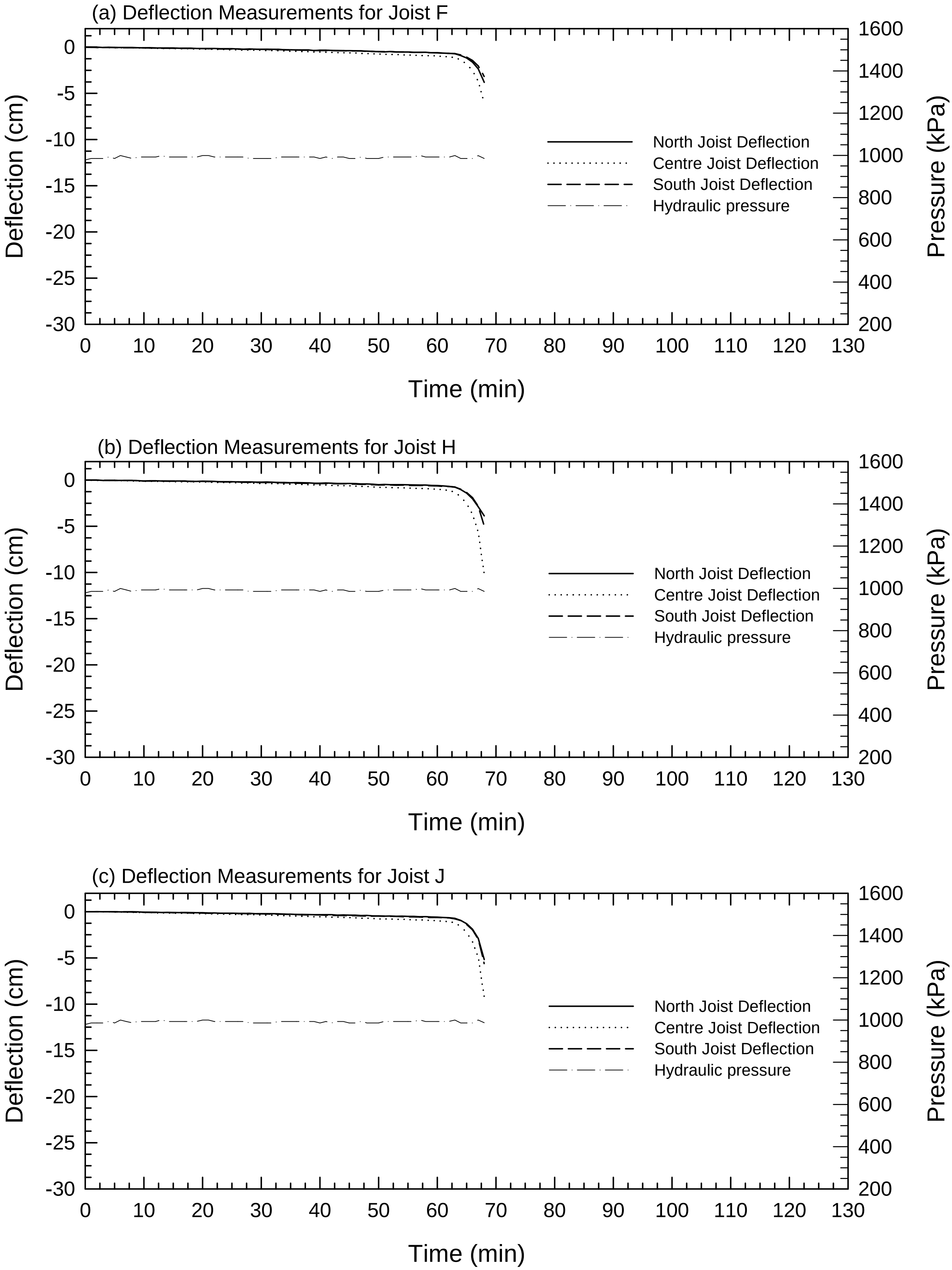


Figure G-6. Deflection Measurements for Floor Fire Test, FF-35

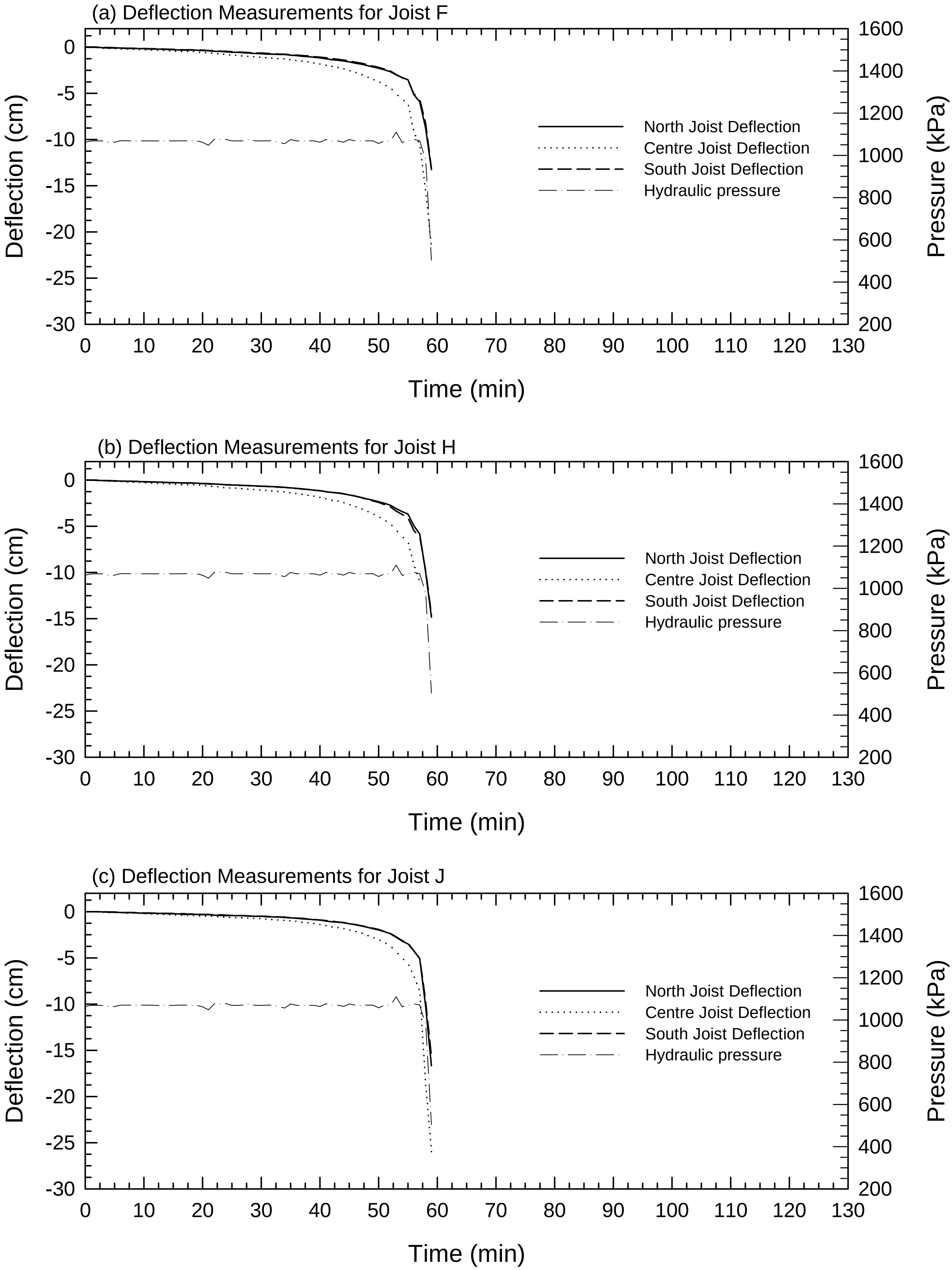


Figure G-7. Deflection Measurements for Floor Fire Test, FF-36

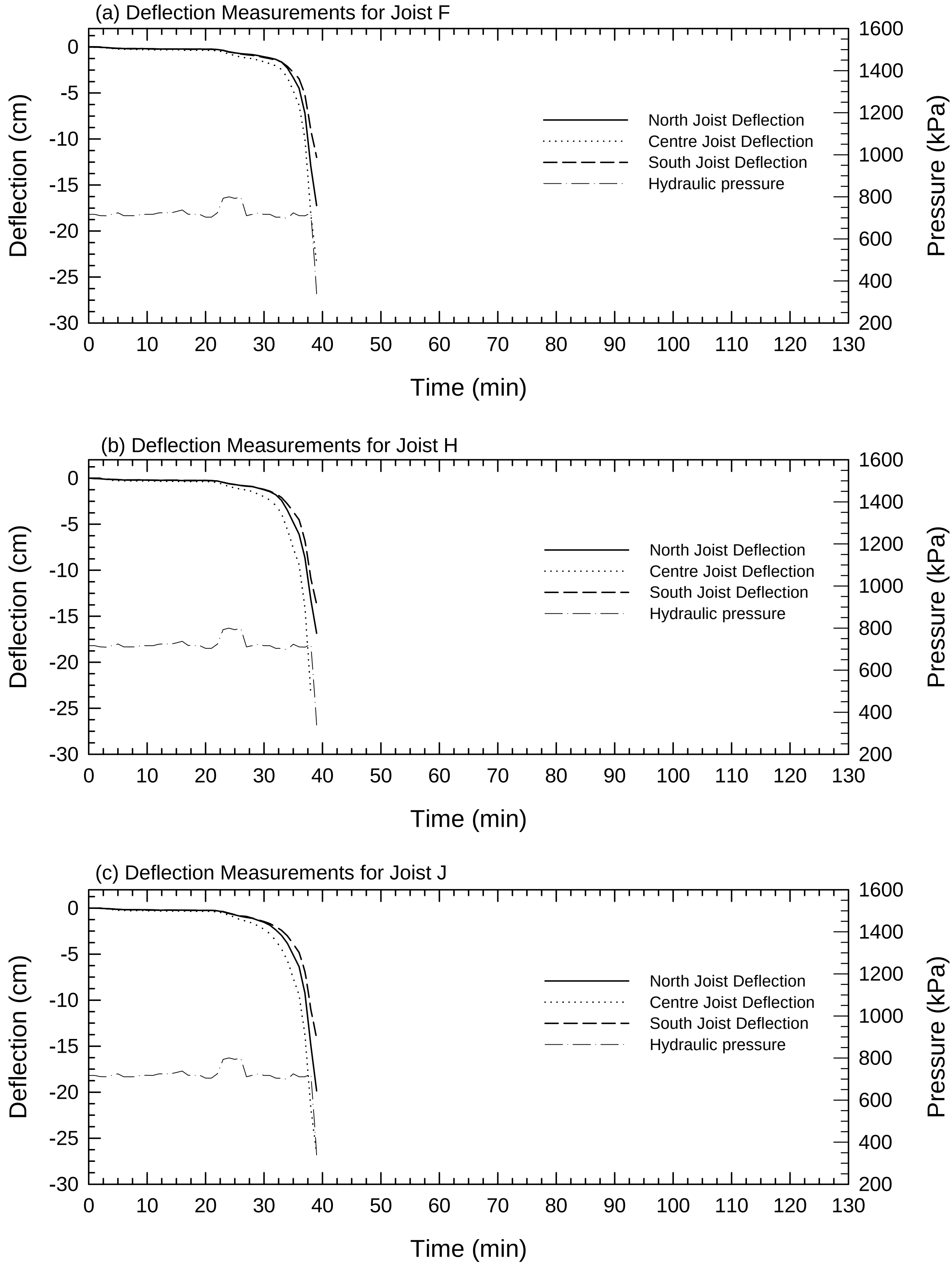


Figure G-8. Deflection Measurements for Floor Fire Test, FF-37

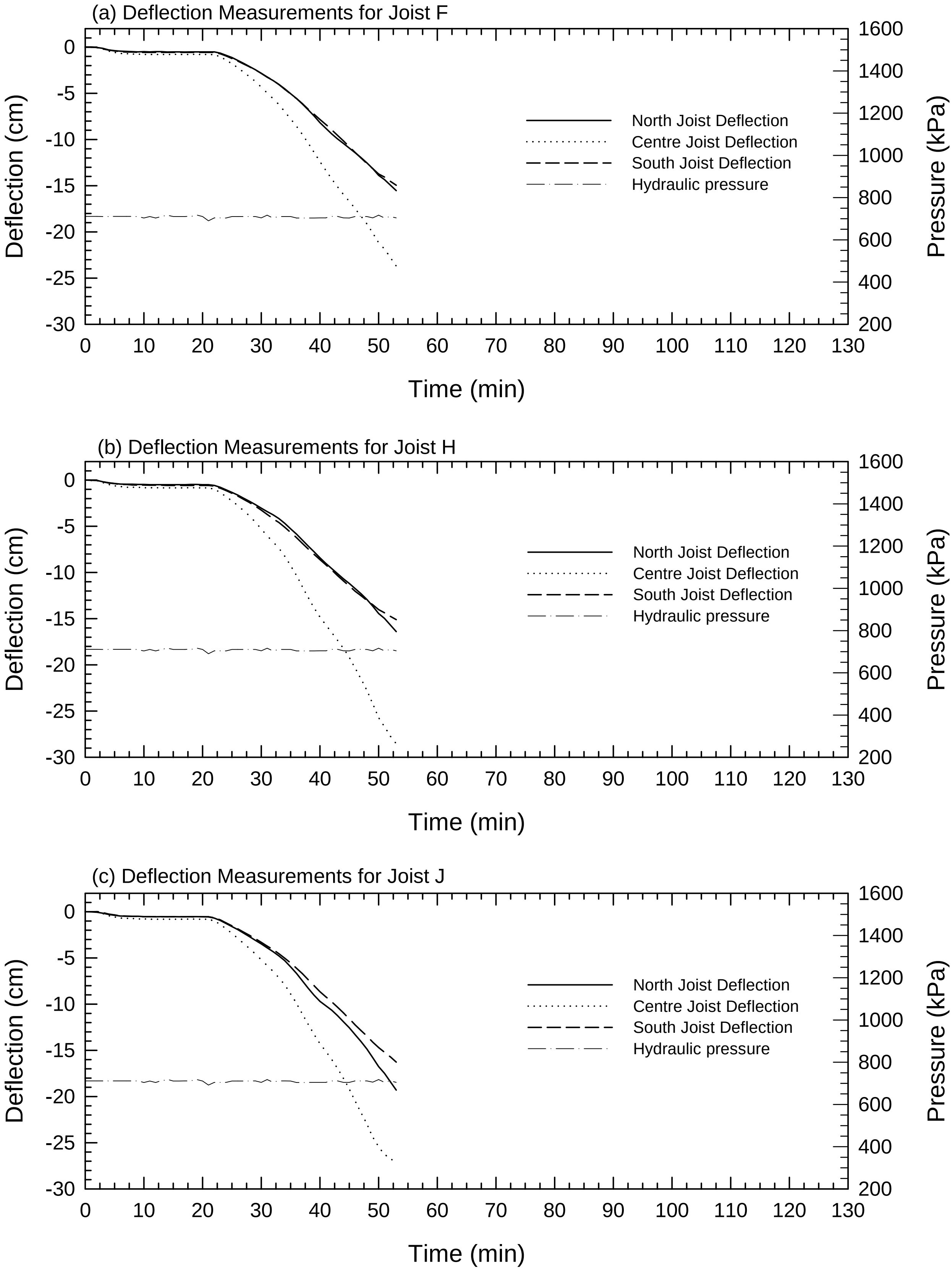


Figure G-9. Deflection Measurements for Floor Fire Test, FF-38

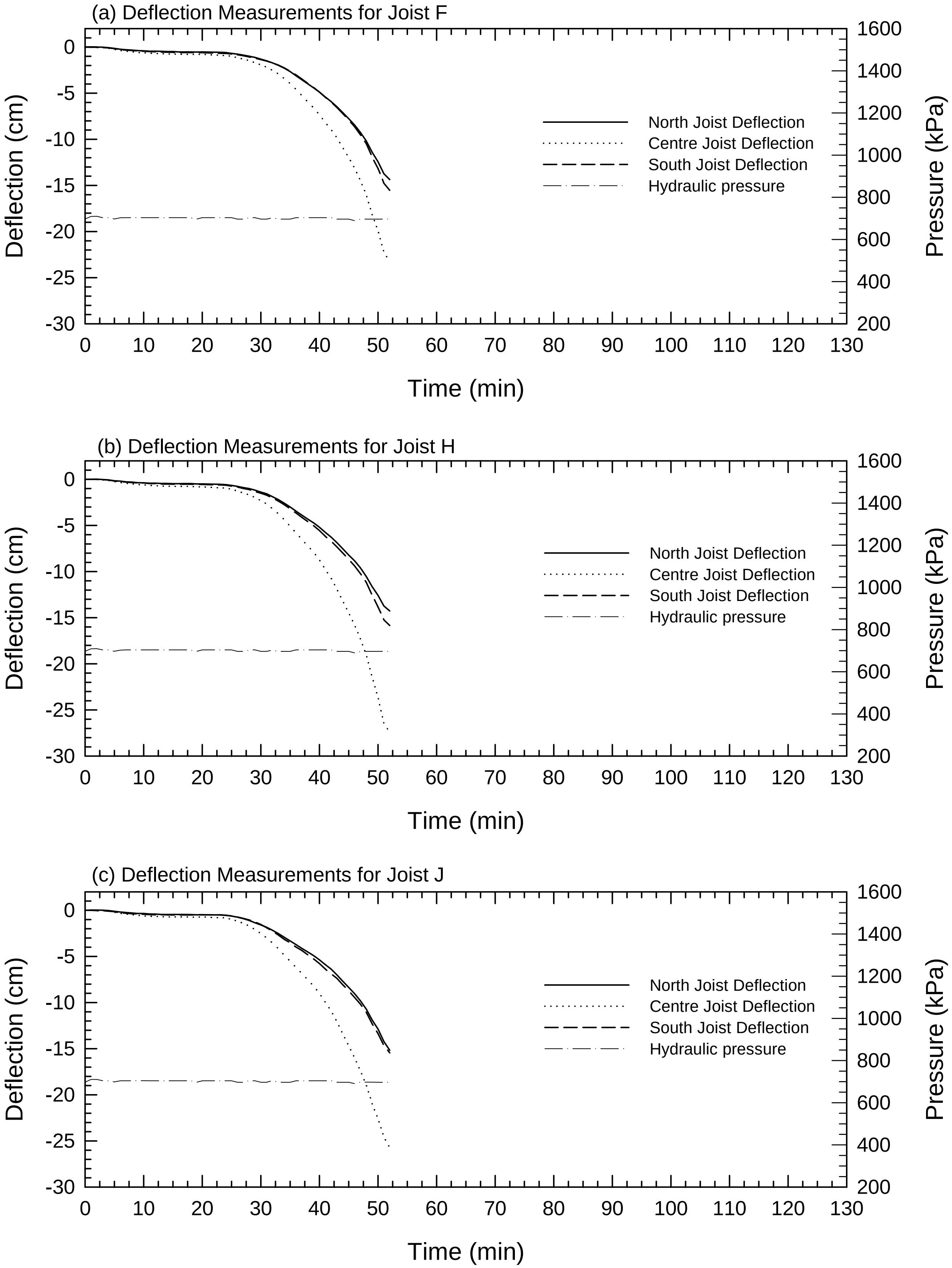


Figure G-10. Deflection Measurements for Floor Fire Test, FF-39

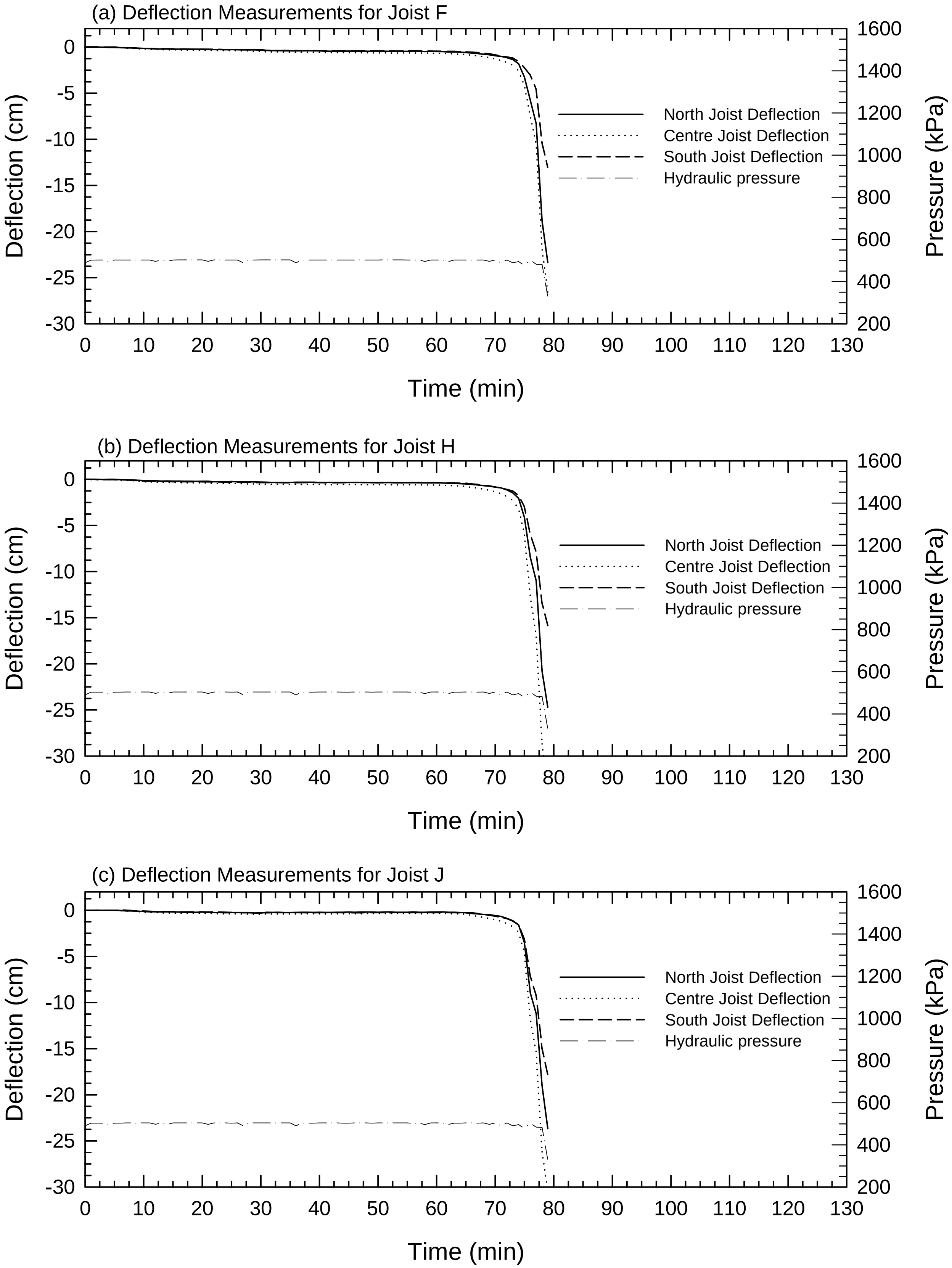
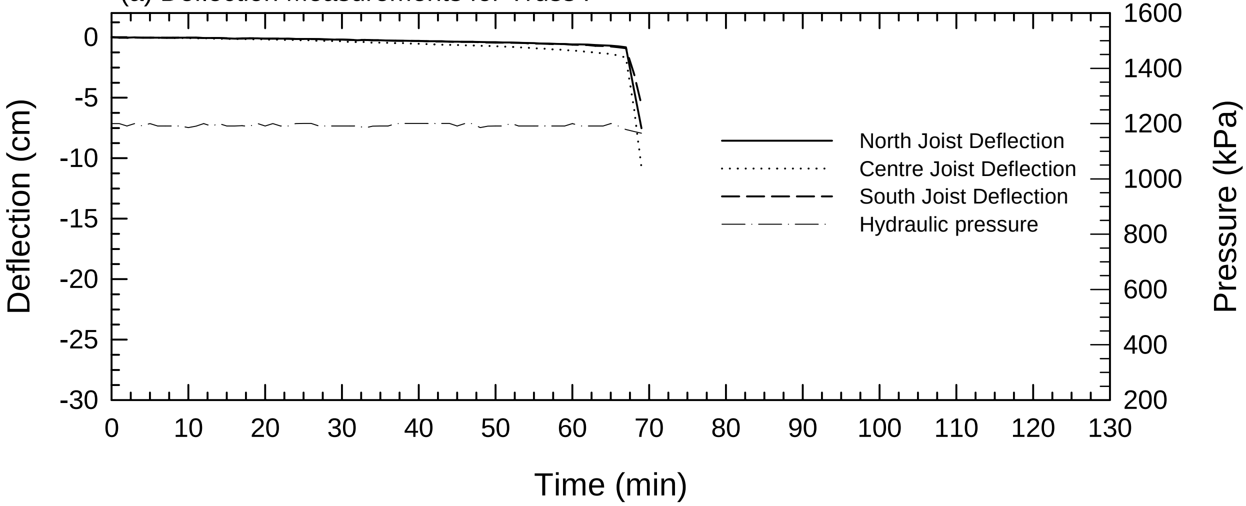
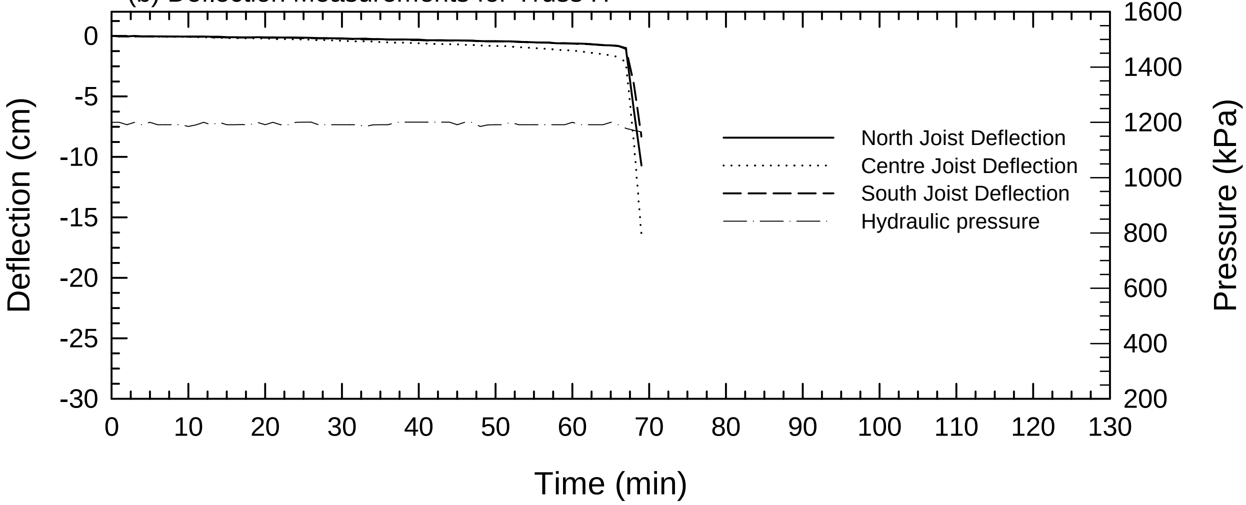


Figure G-11. Deflection Measurements for Floor Fire Test, FF-40

(a) Deflection Measurements for Truss F



(b) Deflection Measurements for Truss H



(c) Deflection Measurements for Truss J

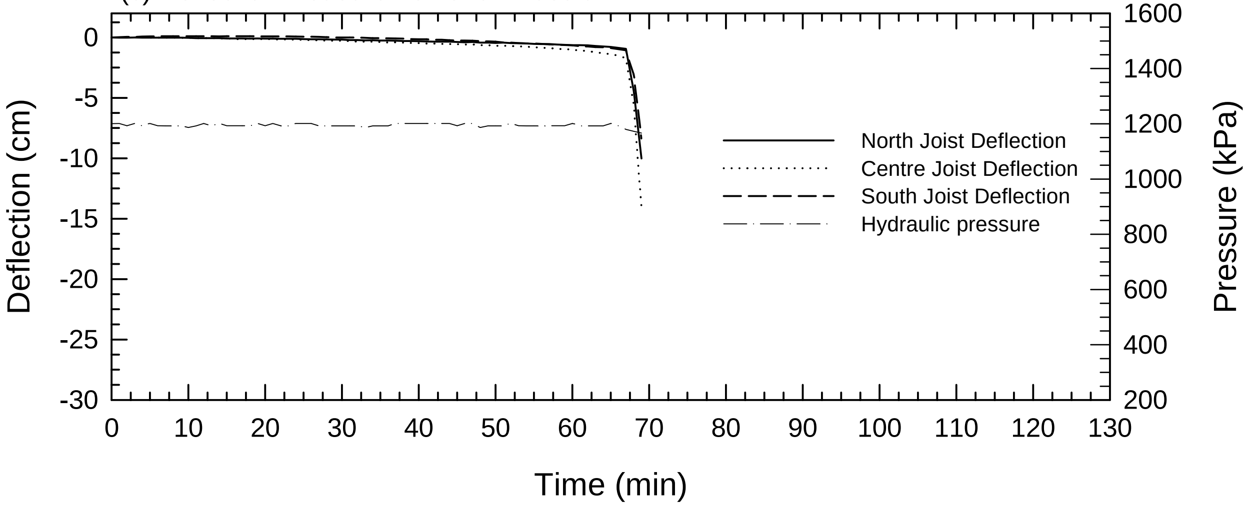
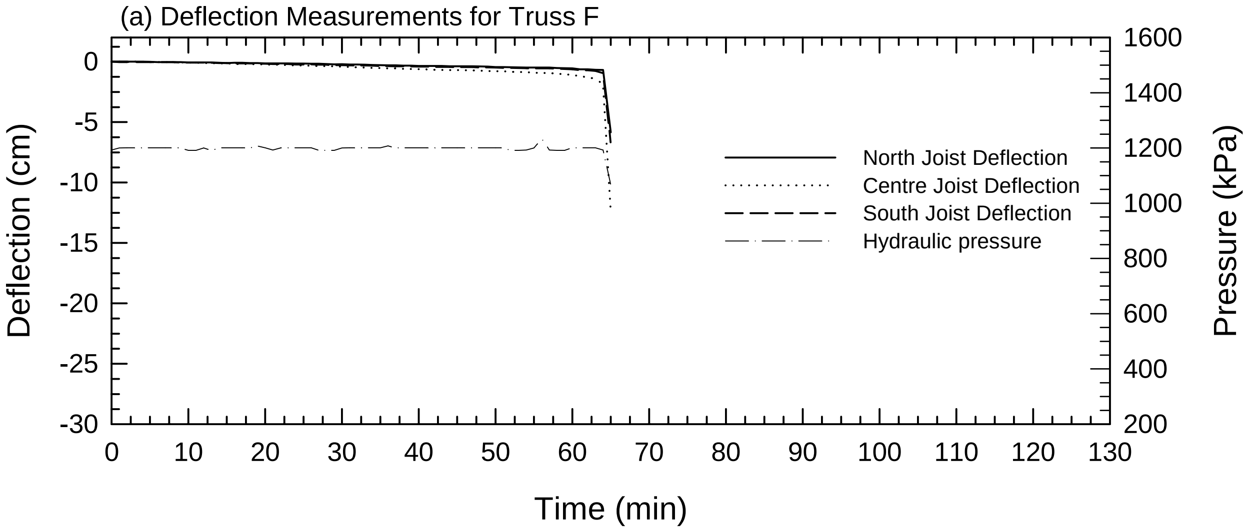
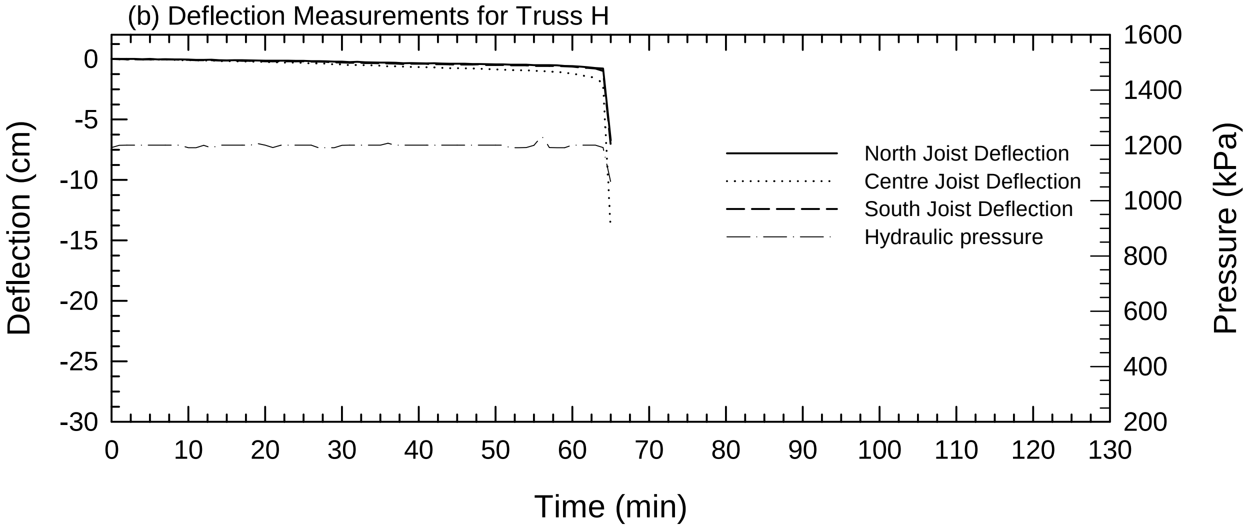


Figure G-12. Deflection Measurements for Floor Fire Test, FF-41





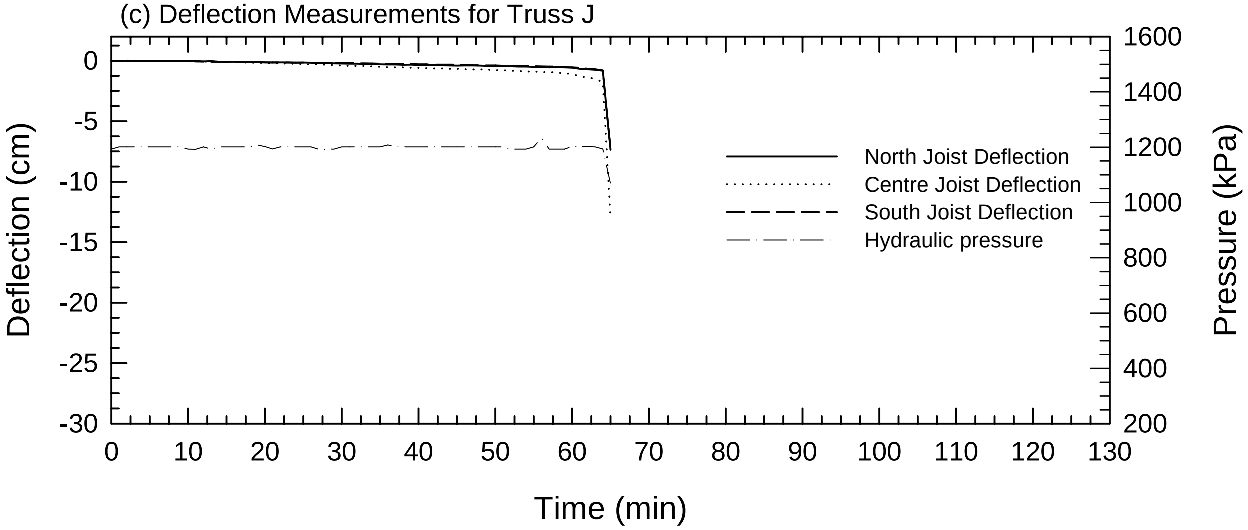


Figure G-13. Deflection Measurements for Floor Fire Test, FF-42

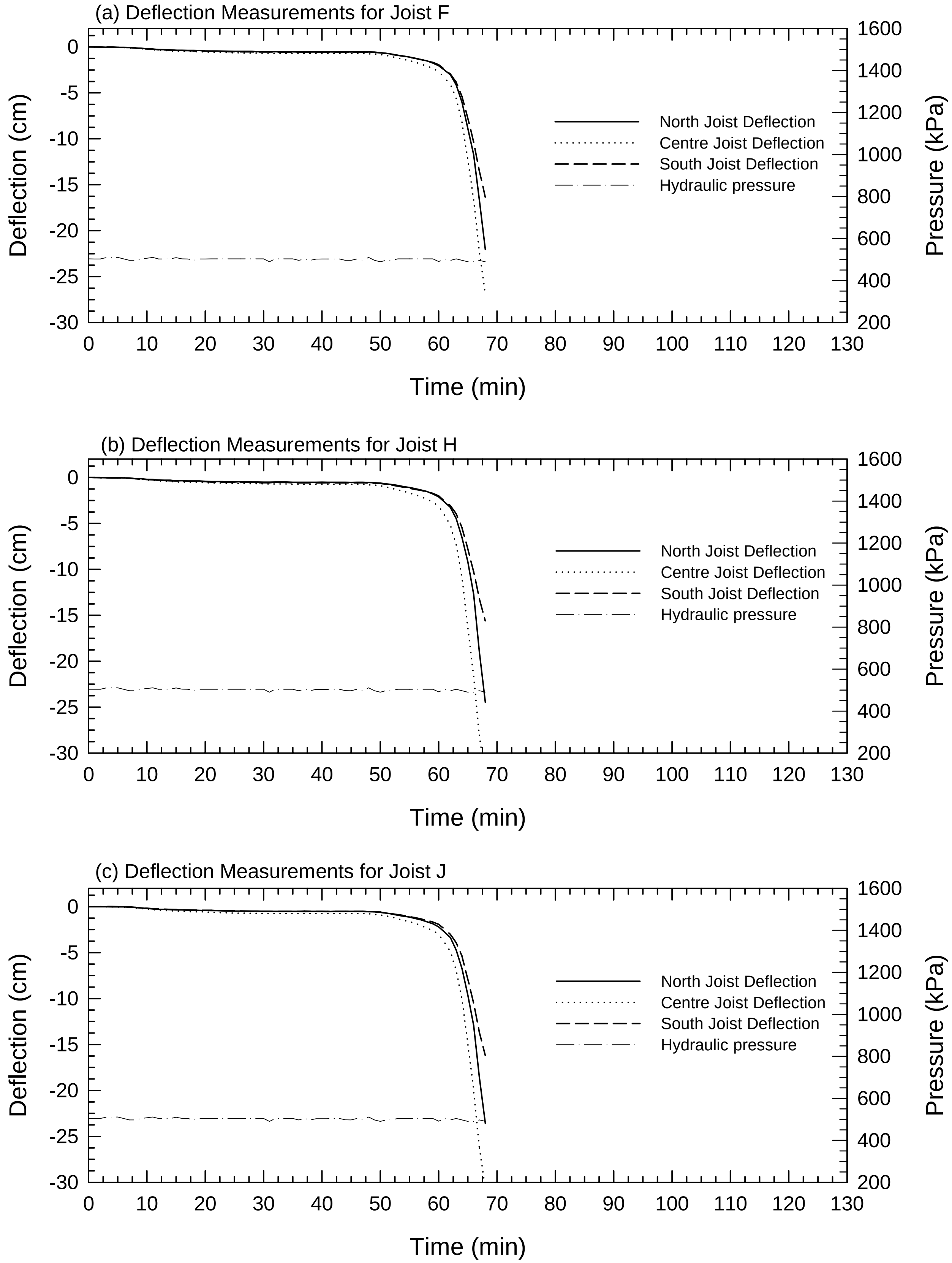


Figure G-14. Deflection Measurements for Floor Fire Test, FF-43

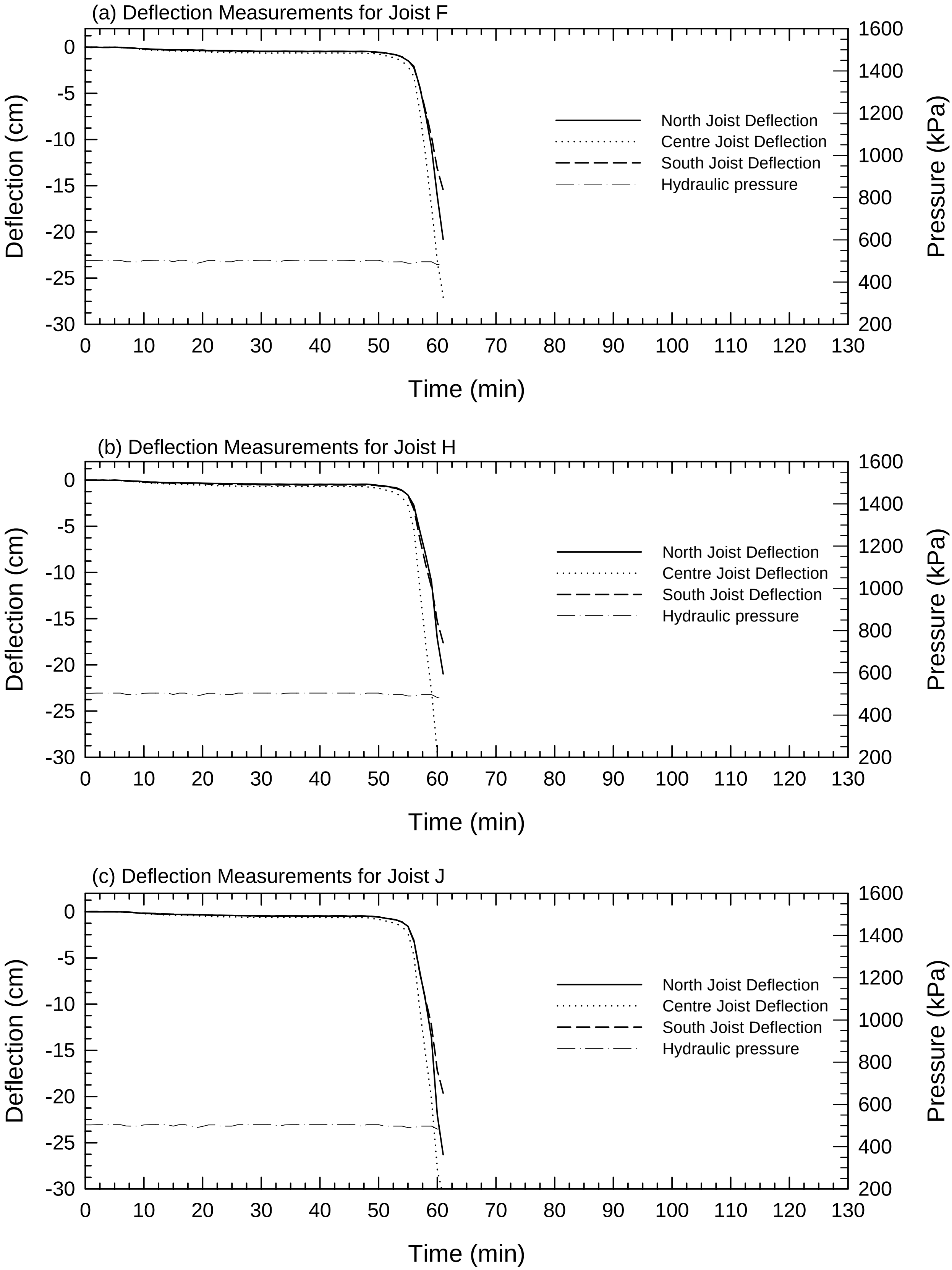
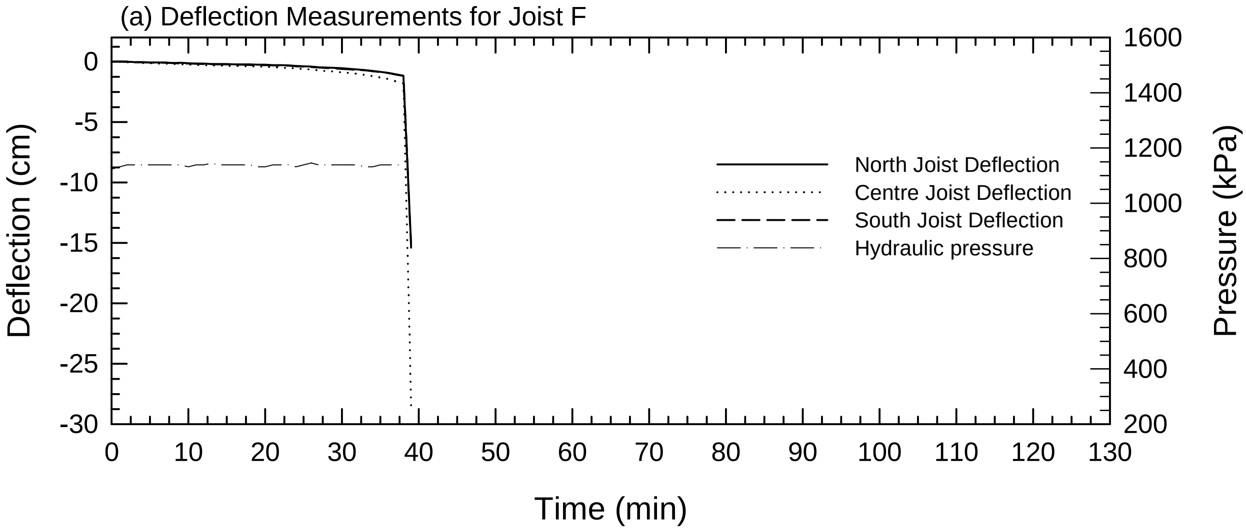
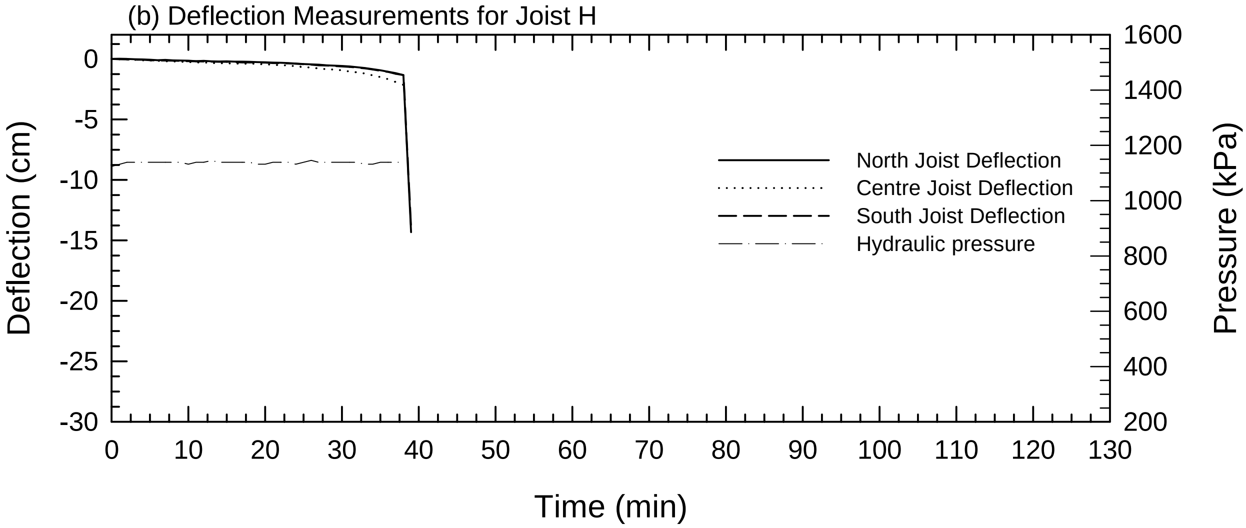


Figure G-15. Deflection Measurements for Floor Fire Test, FF-44





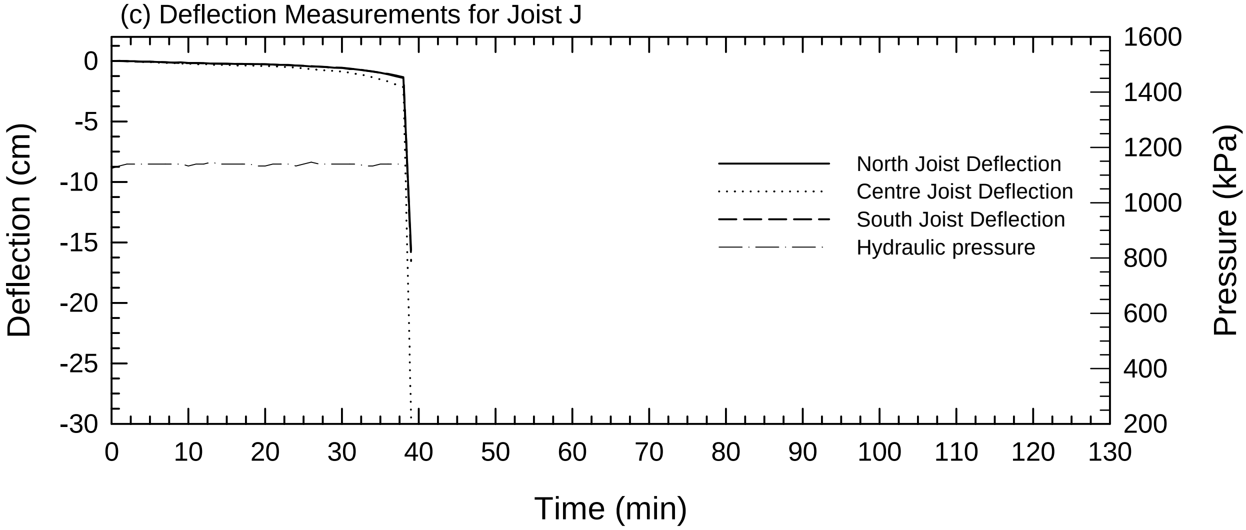
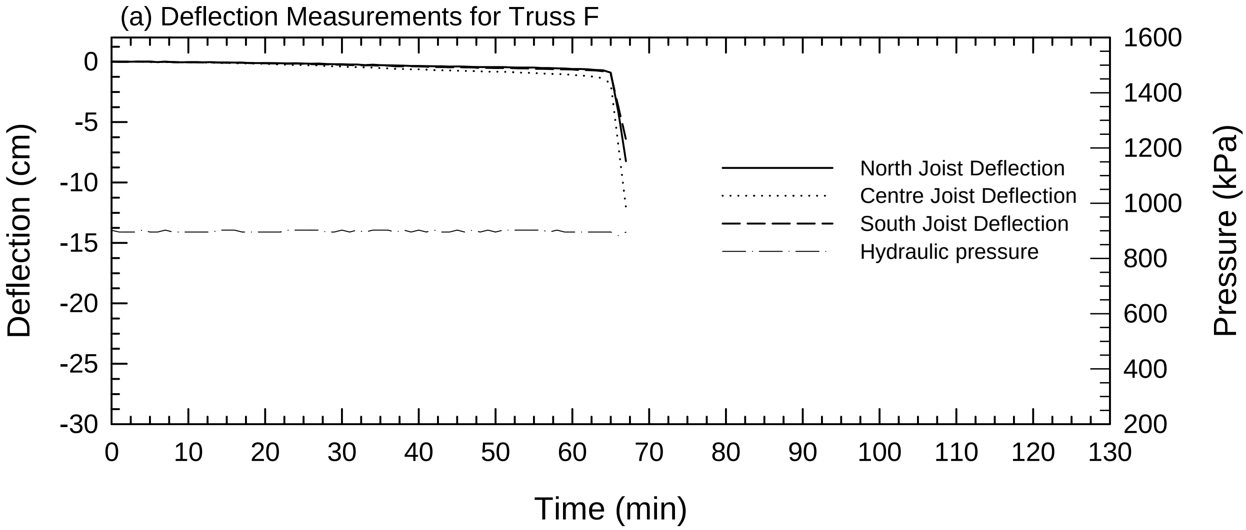
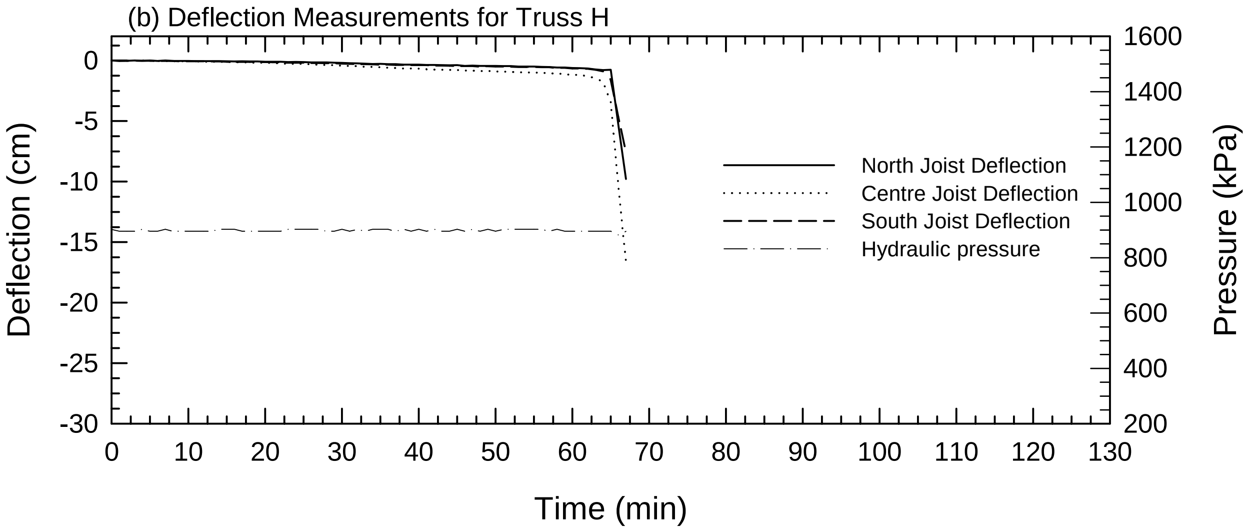


Figure G-16. Deflection Measurements for Floor Fire Test, FF-45





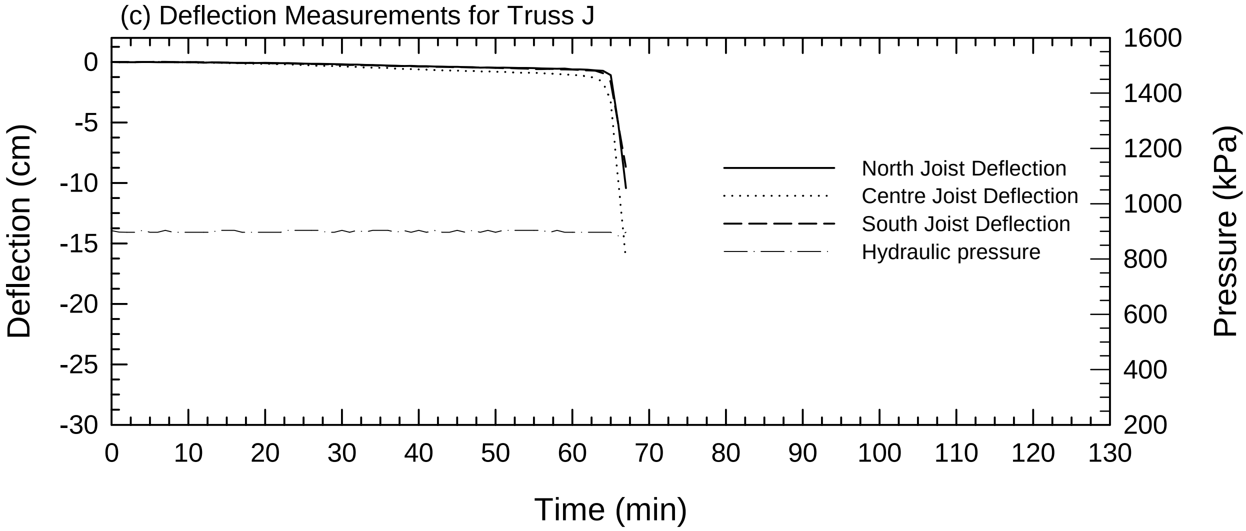


Figure G-17. Deflection Measurements for Floor Fire Test, FF-46

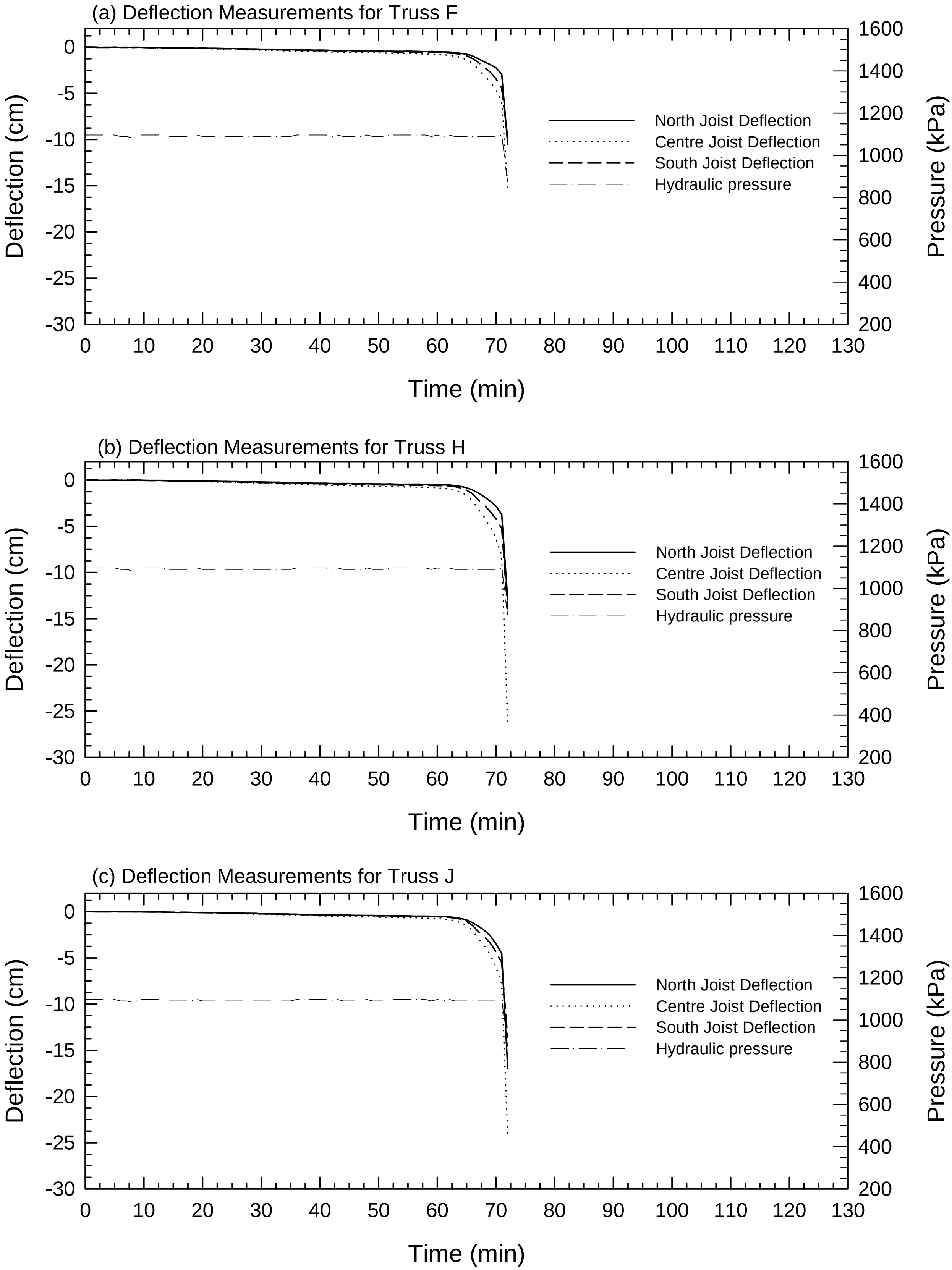
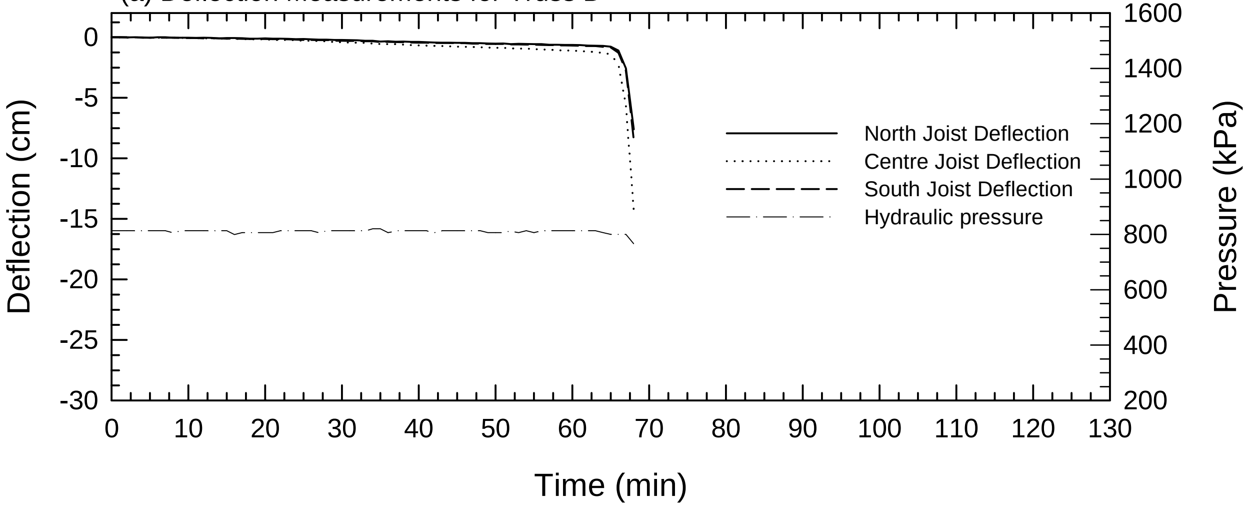
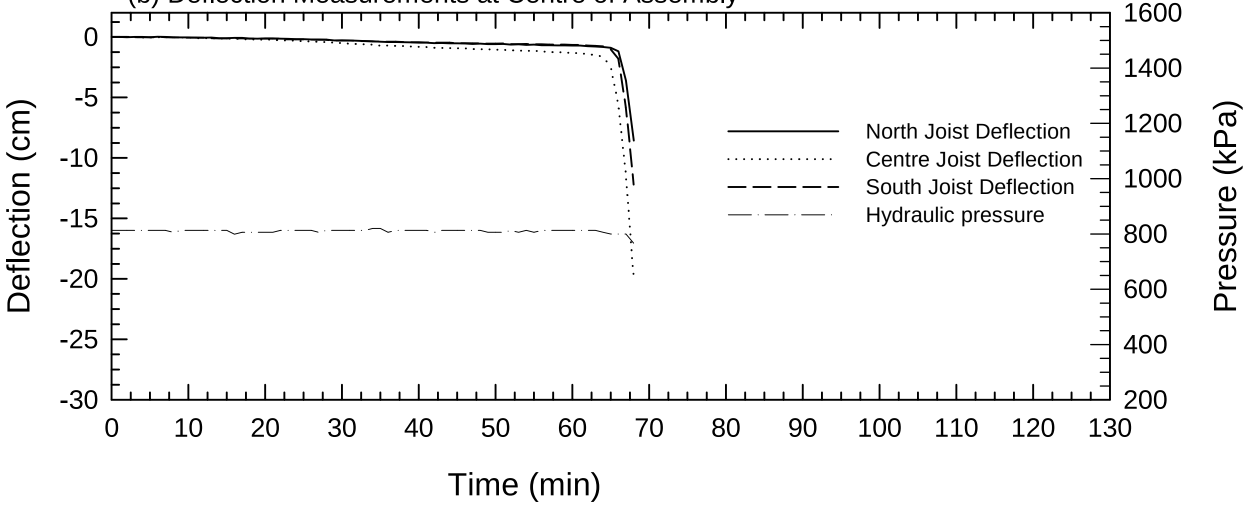


Figure G-18. Deflection Measurements for Floor Fire Test, FF-47

(a) Deflection Measurements for Truss D



(b) Deflection Measurements at Centre of Assembly



(c) Deflection Measurements for Truss G

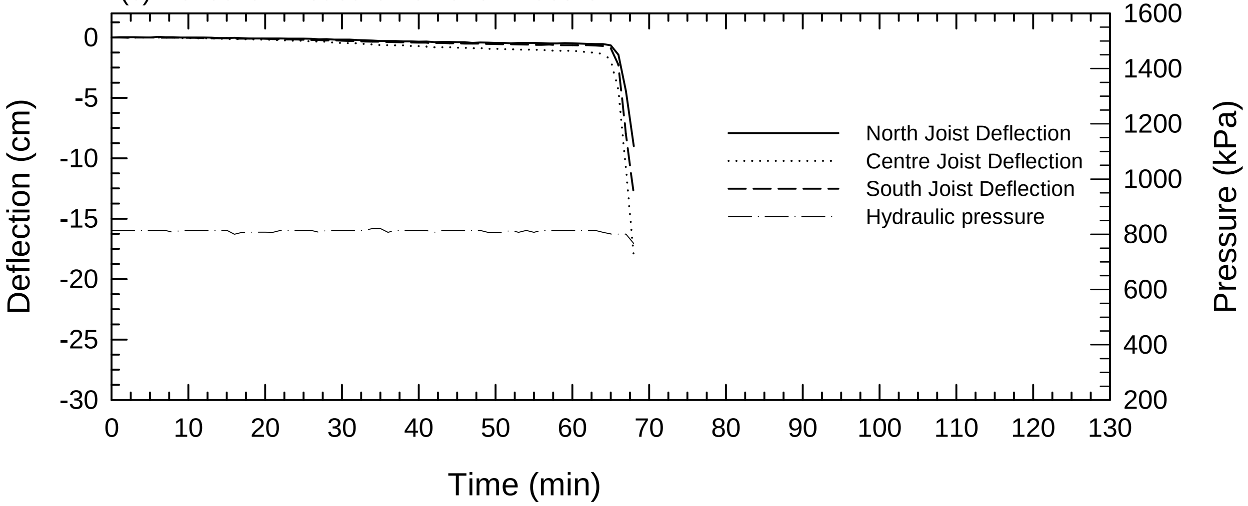


Figure G-19. Deflection Measurements for Floor Fire Test, FF-48

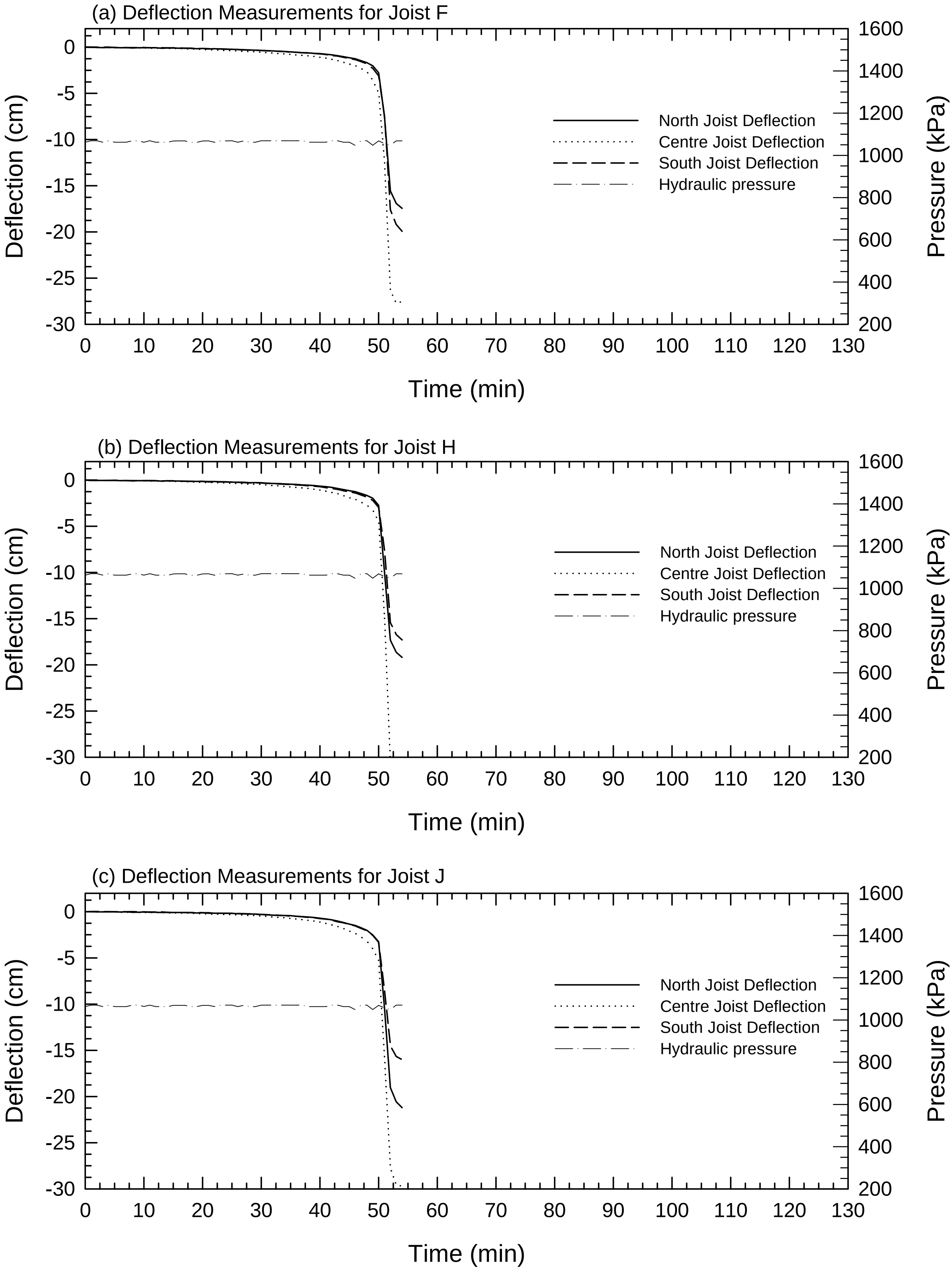


Figure G-20. Deflection Measurements for Floor Fire Test, FF-49

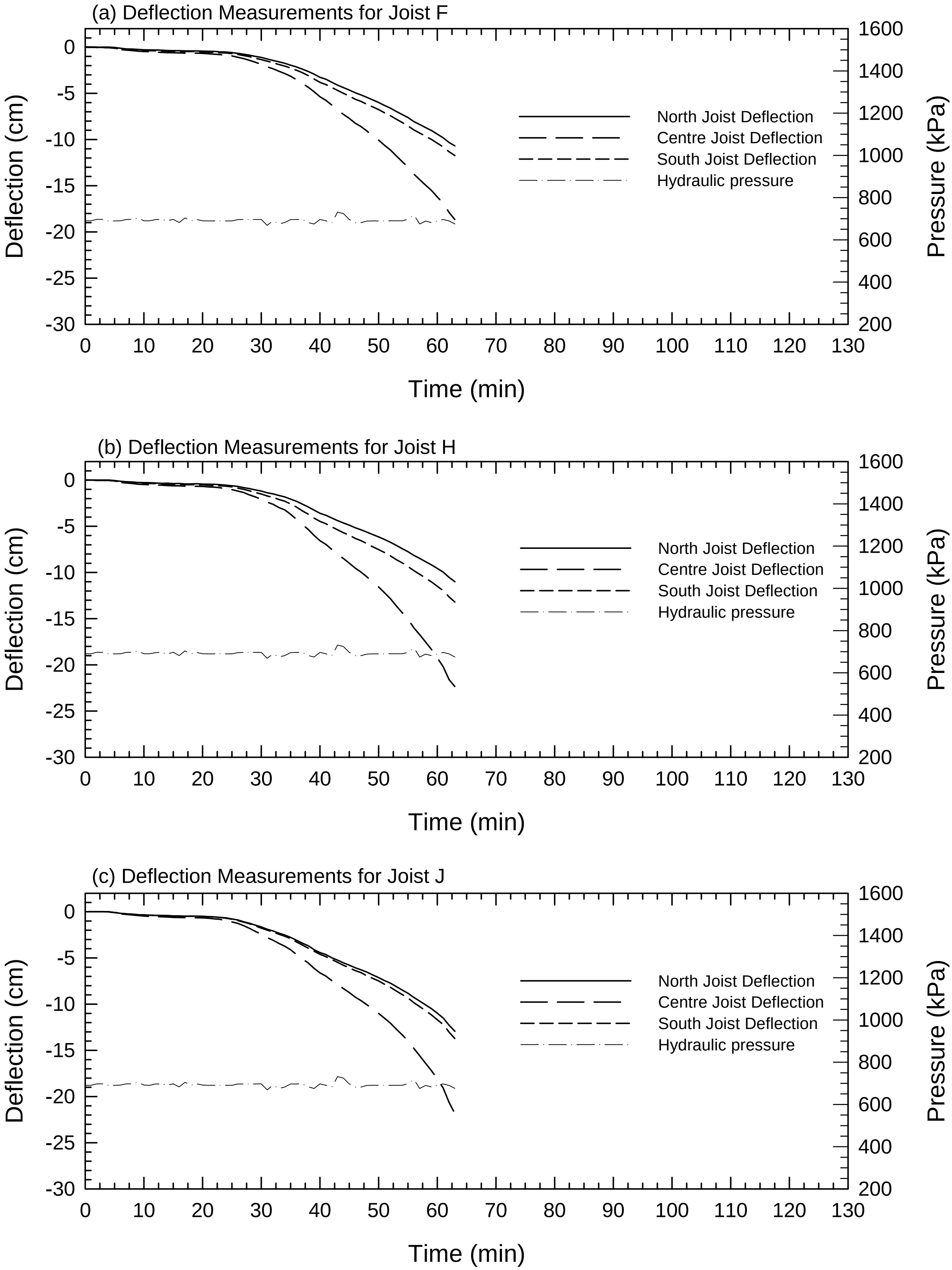


Figure G-21. Deflection Measurements for Floor Fire Test, FF-50

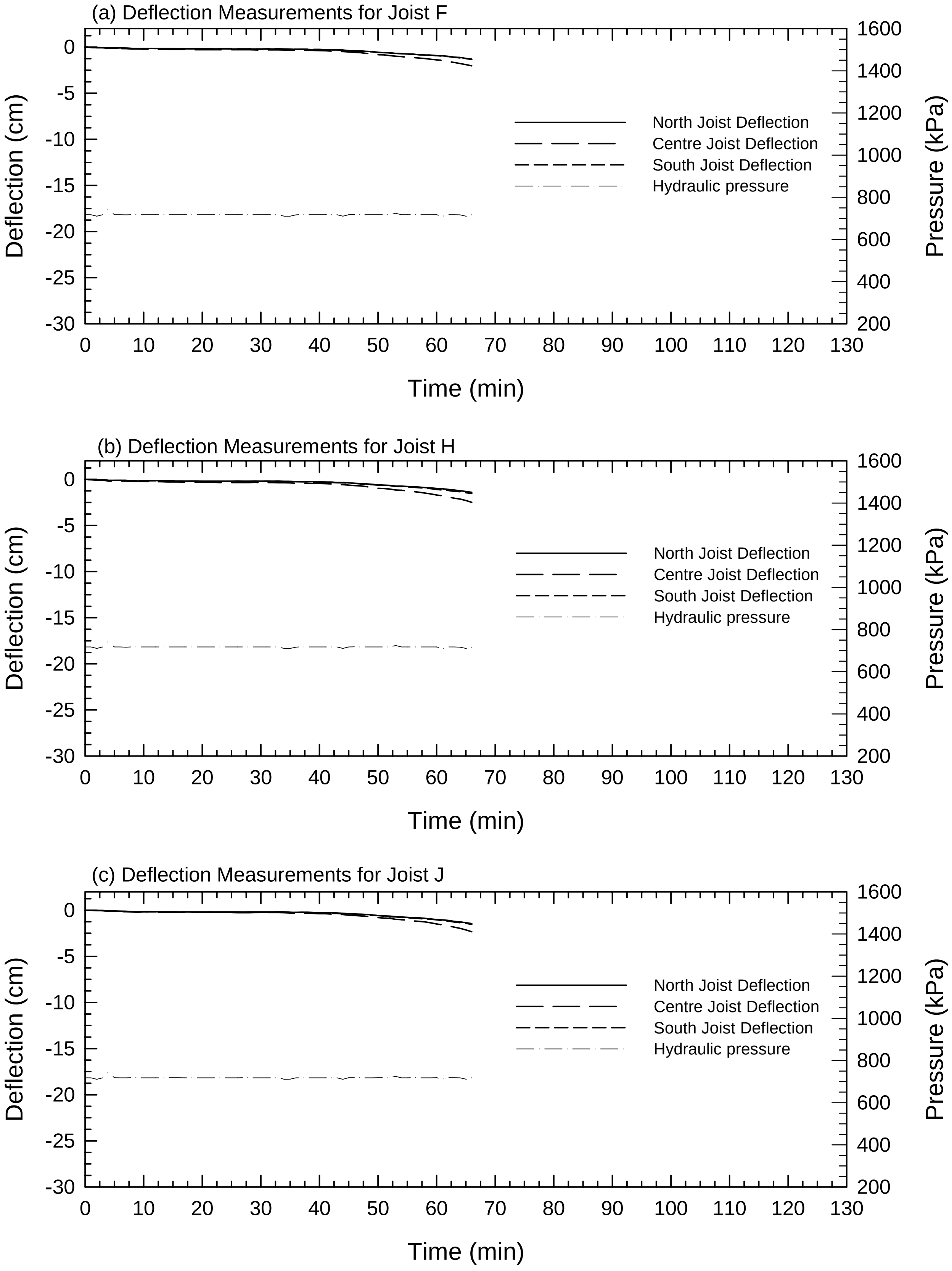


Figure G-22. Deflection Measurements for Floor Fire Test, FF-51

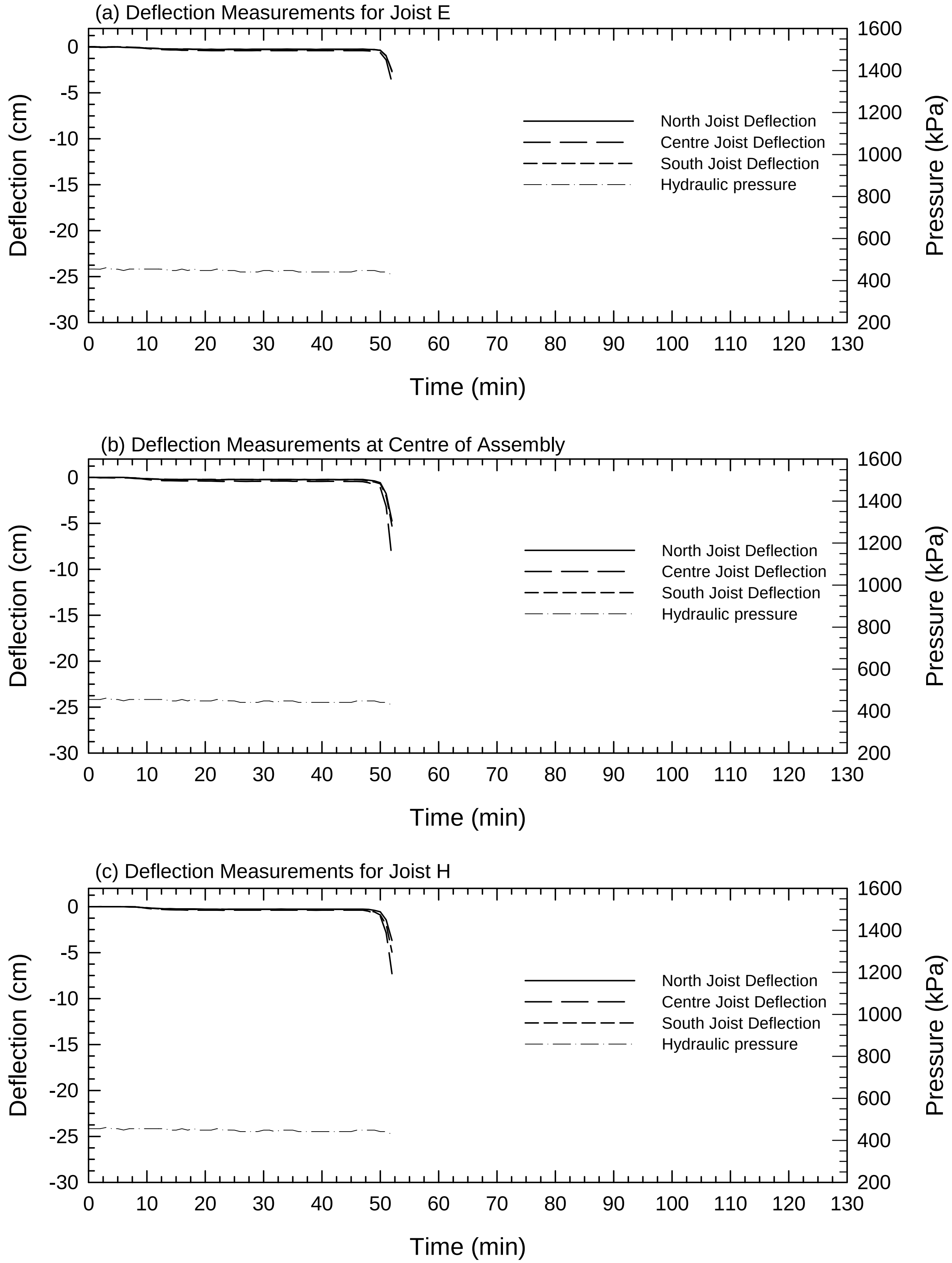


Figure G-23. Deflection Measurements for Floor Fire Test, FF-52

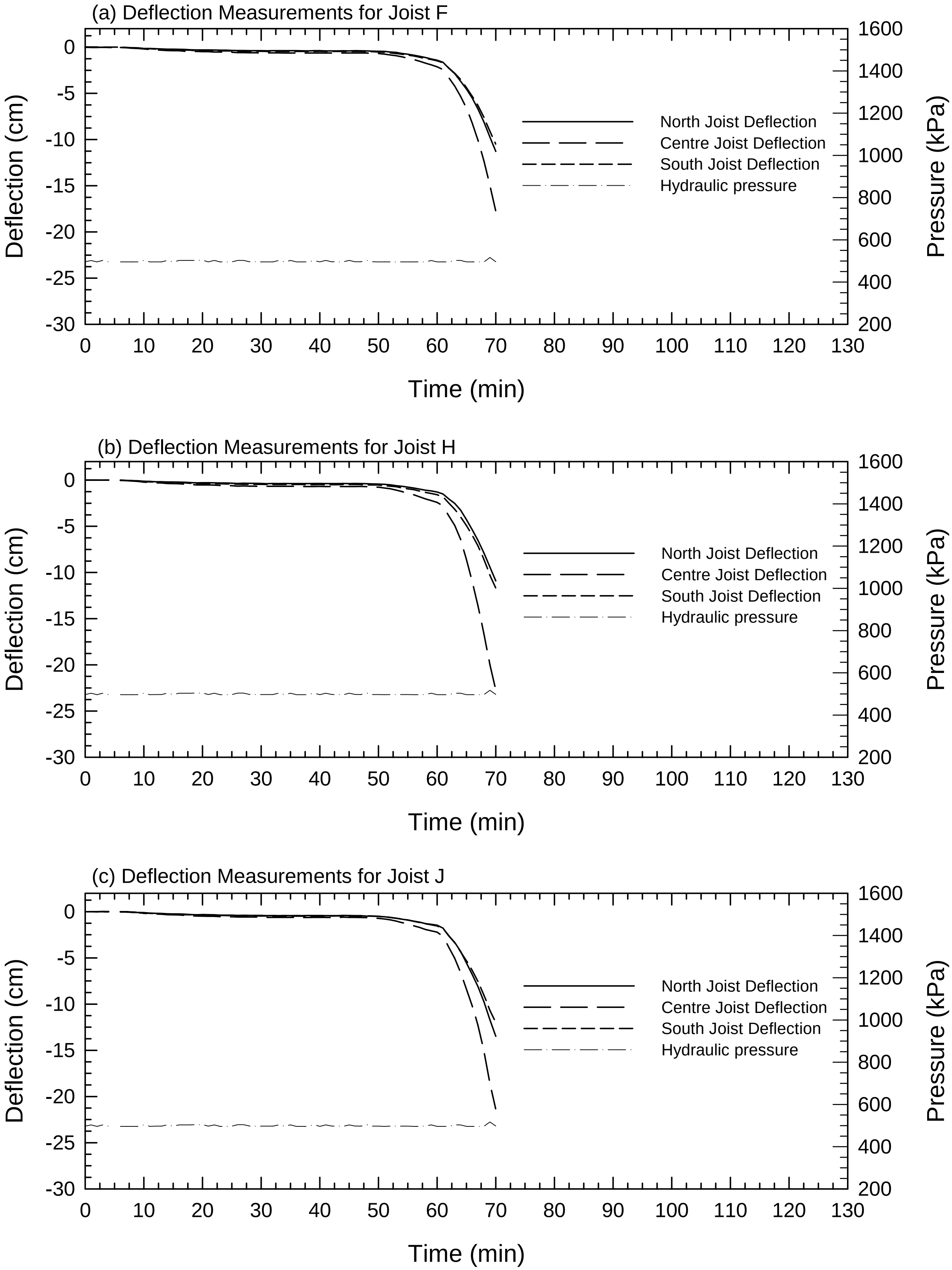


Figure G-24. Deflection Measurements for Floor Fire Test, FF-53

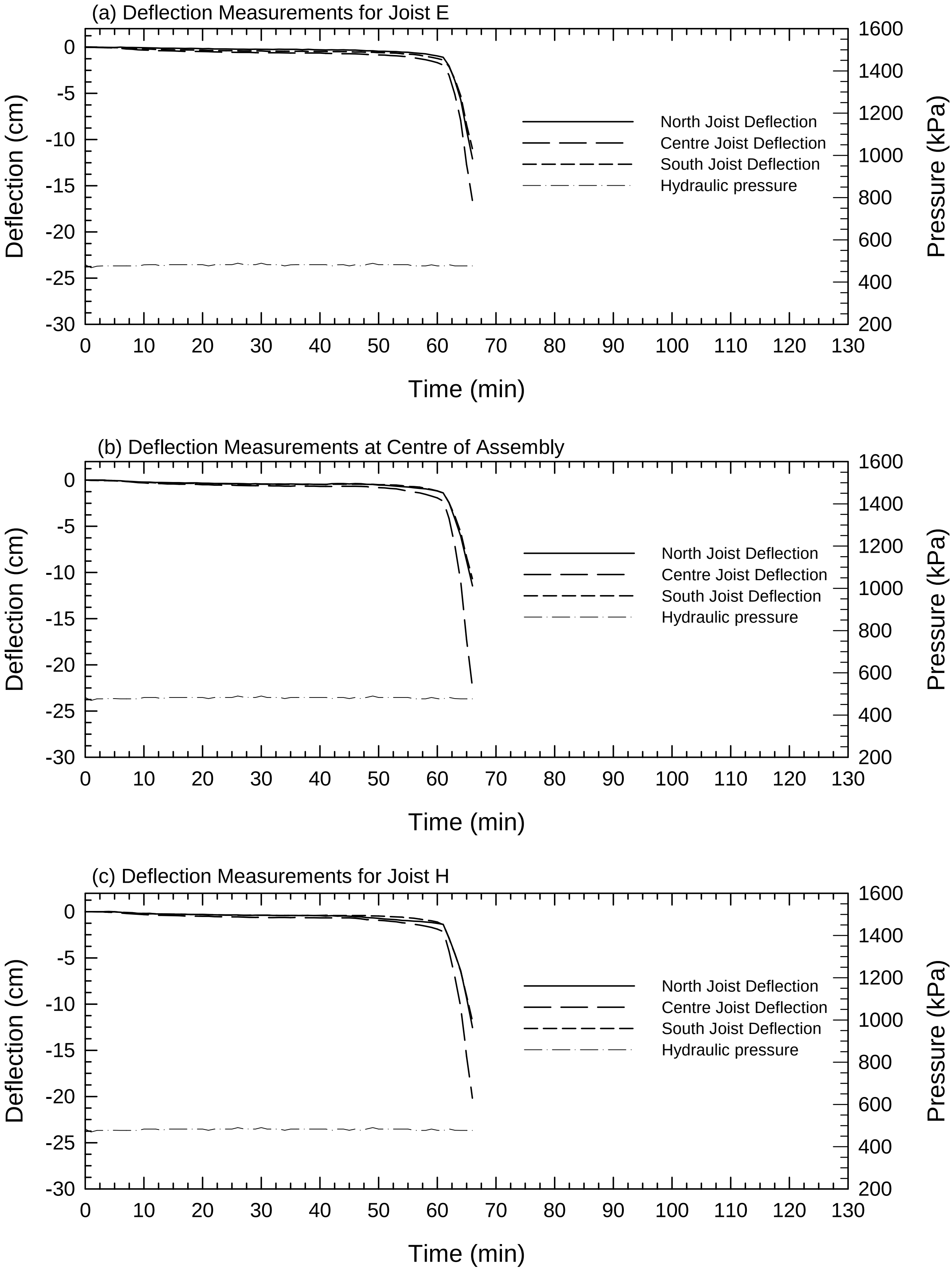


Figure G-25. Deflection Measurements for Floor Fire Test, FF-54

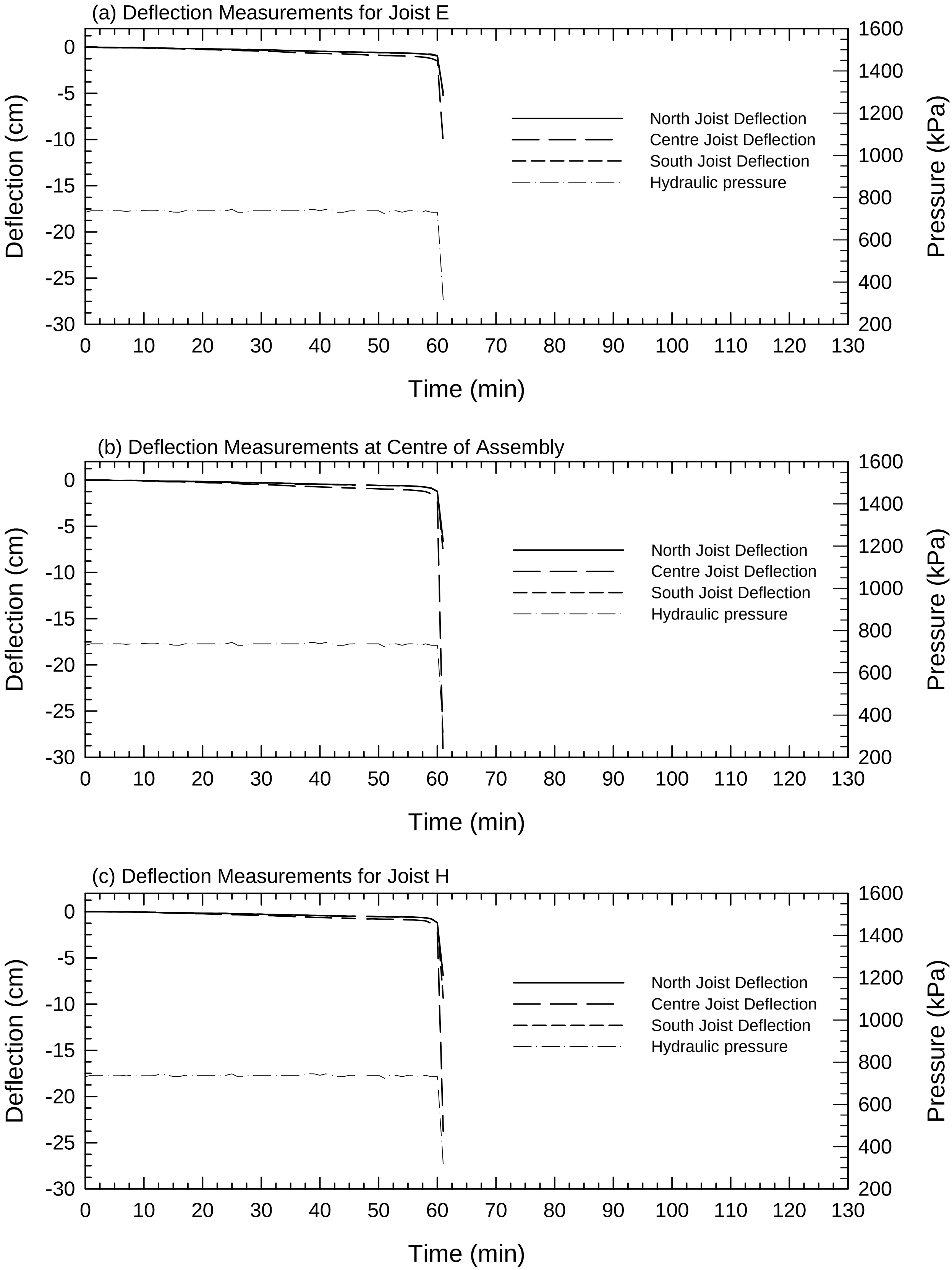
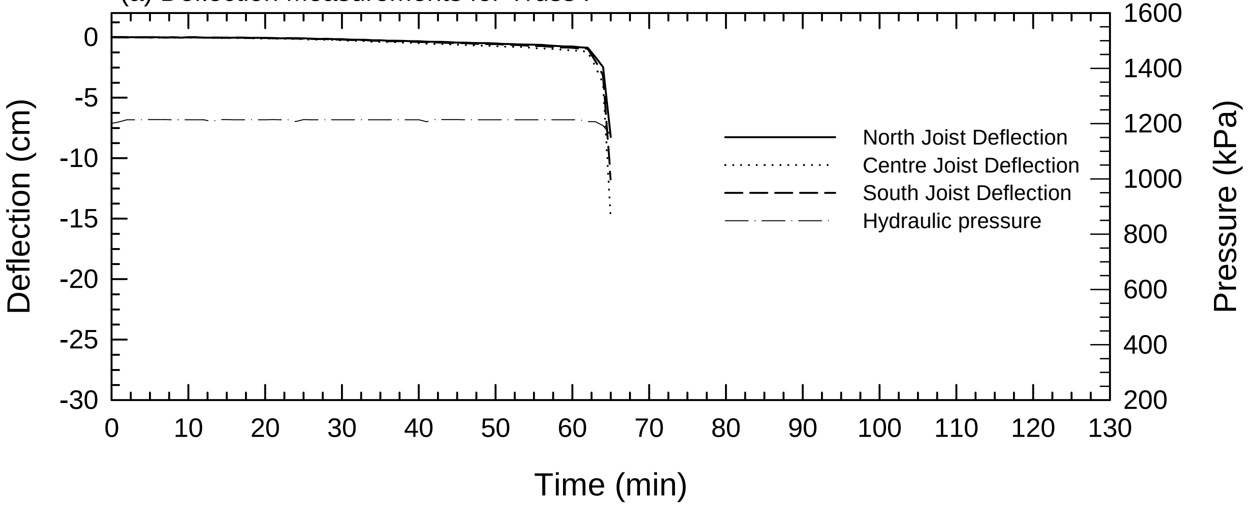
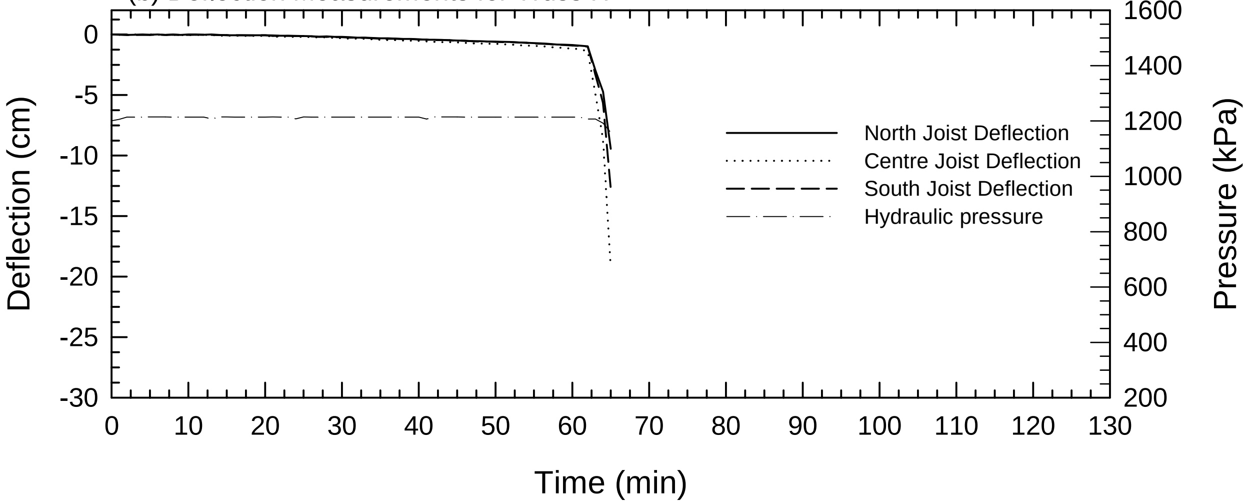


Figure G-26. Deflection Measurements for Floor Fire Test, FF-55

(a) Deflection Measurements for Truss F



(b) Deflection Measurements for Truss H



(c) Deflection Measurements for Truss J

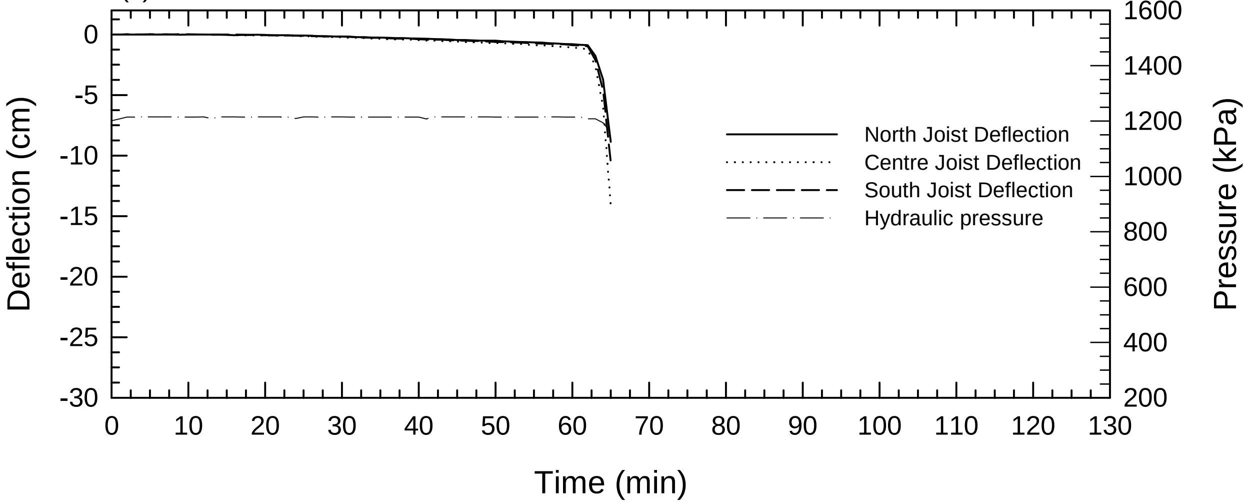


Figure G-27. Deflection Measurements for Floor Fire Test, FF-56

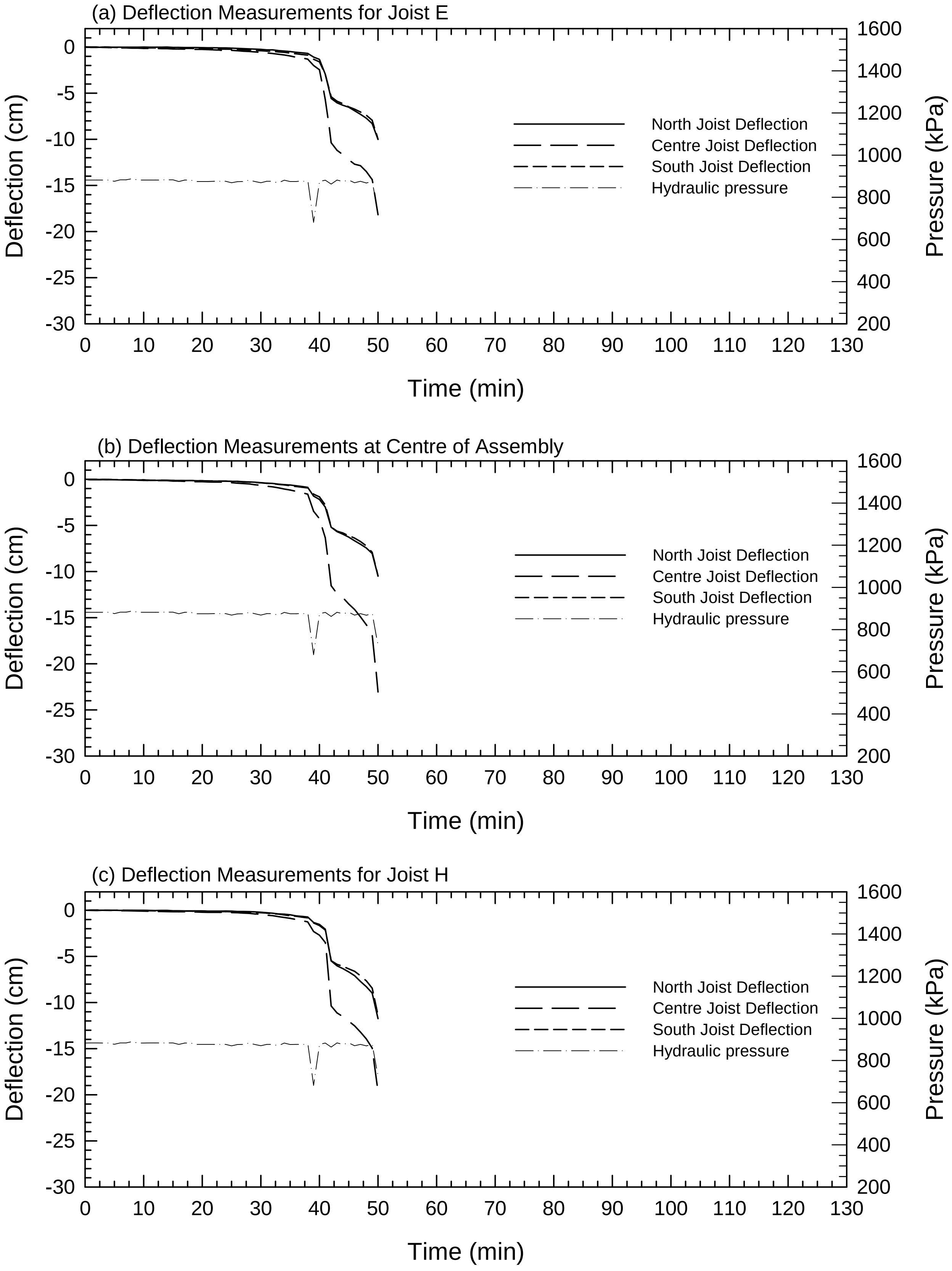
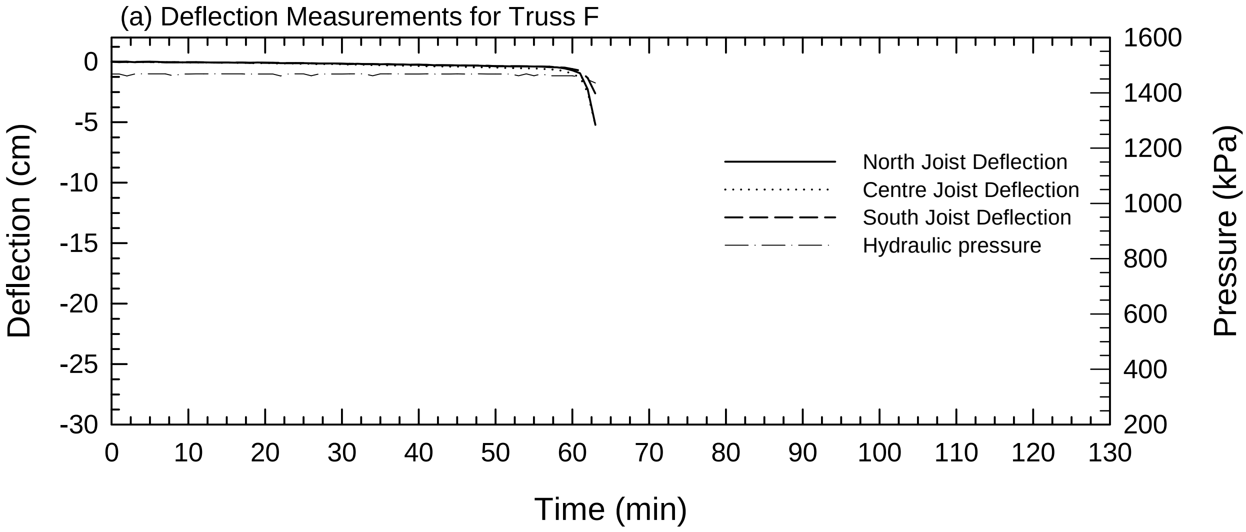
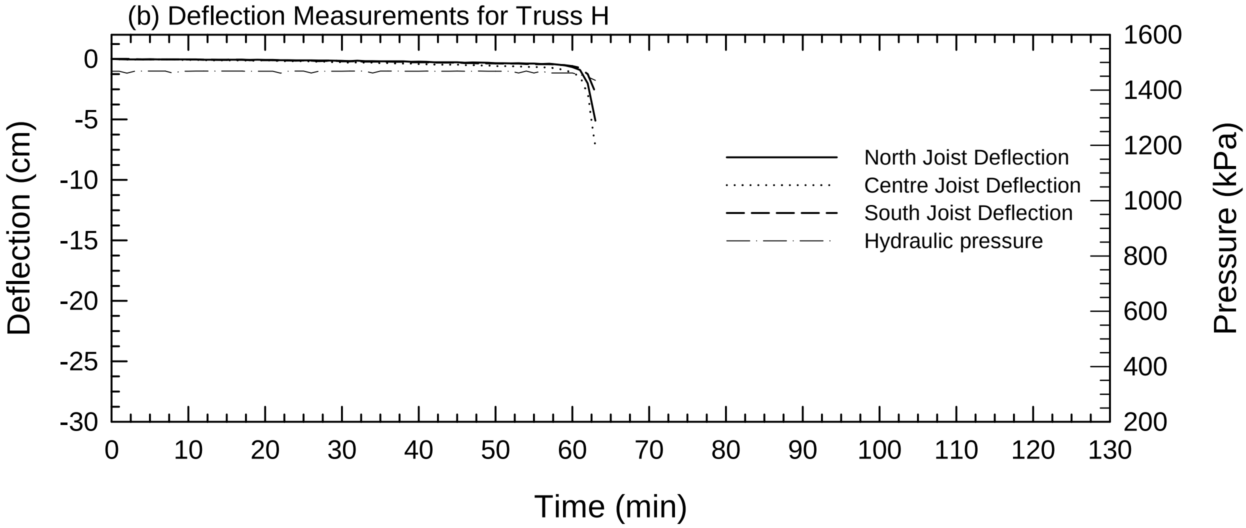


Figure G-28. Deflection Measurements for Floor Fire Test, FF-57





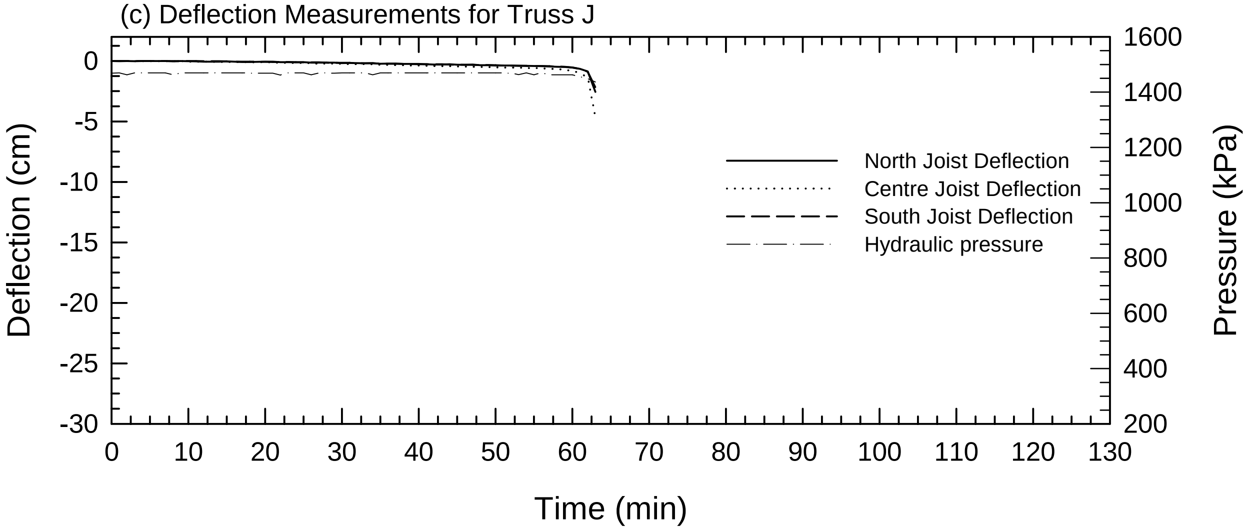
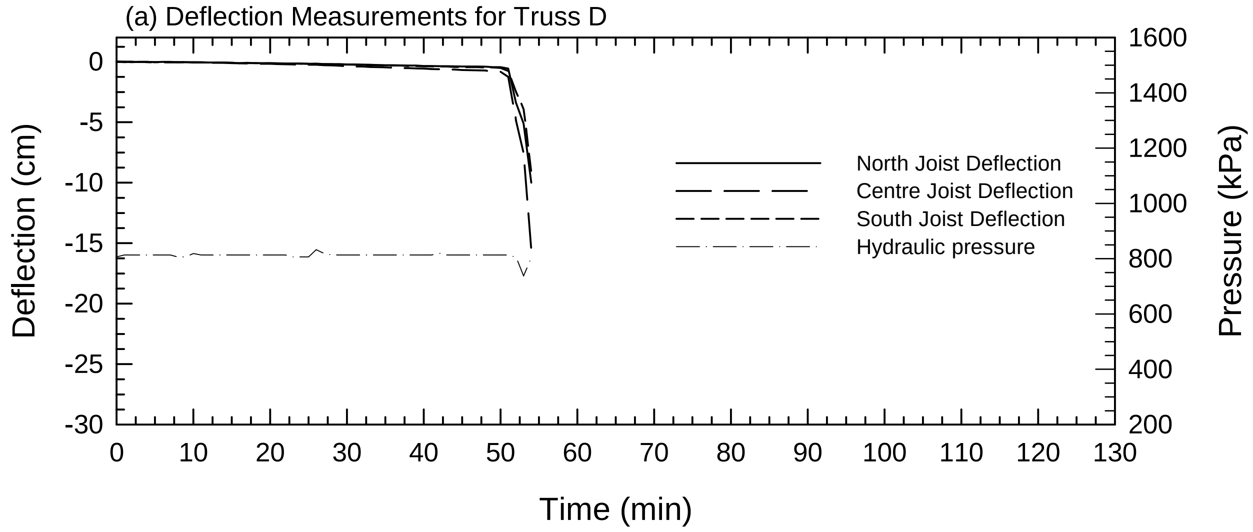
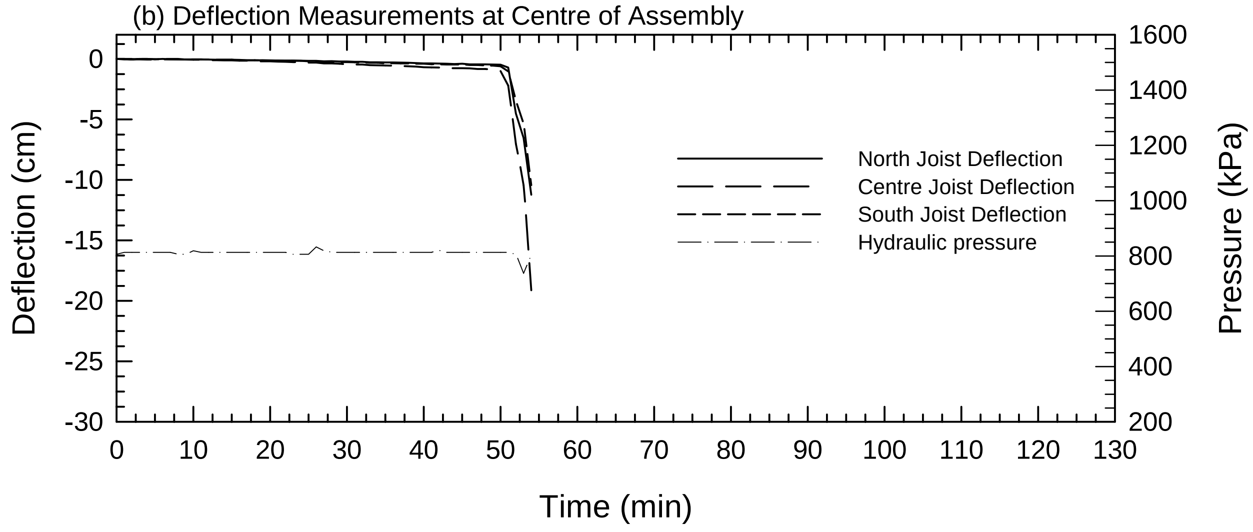


Figure G-29. Deflection Measurements for Floor Fire Test, FF-58





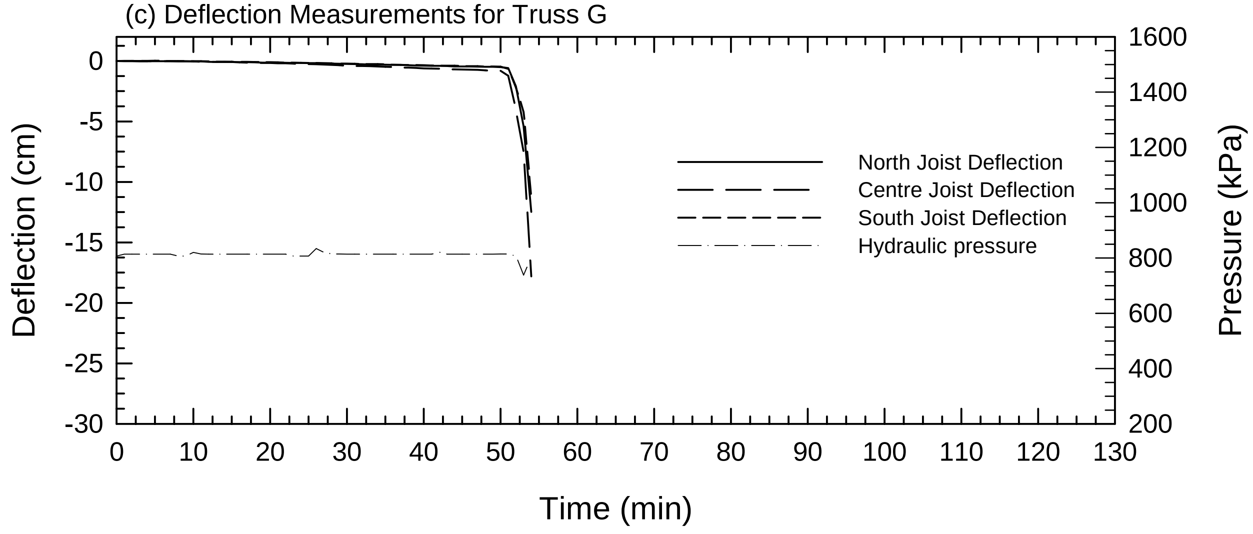


Figure G-30. Deflection Measurements for Floor Fire Test, FF-59

(a) Deflection Measurements for Truss F
(b) Deflection Measurements for Truss H
(c) Deflection Measurements for Truss J

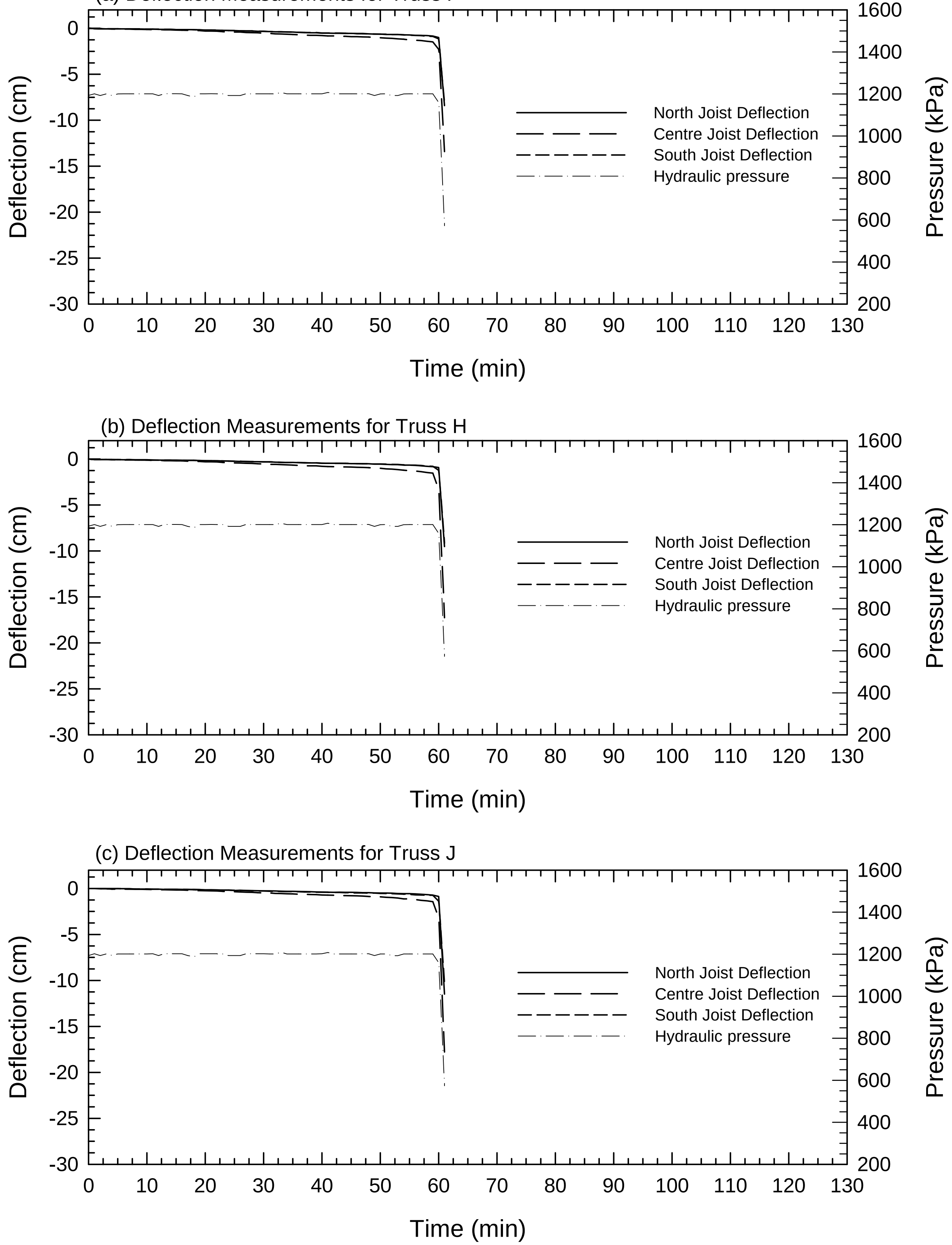


Figure G-31. Deflection Measurements for Floor Fire Test, FF-60

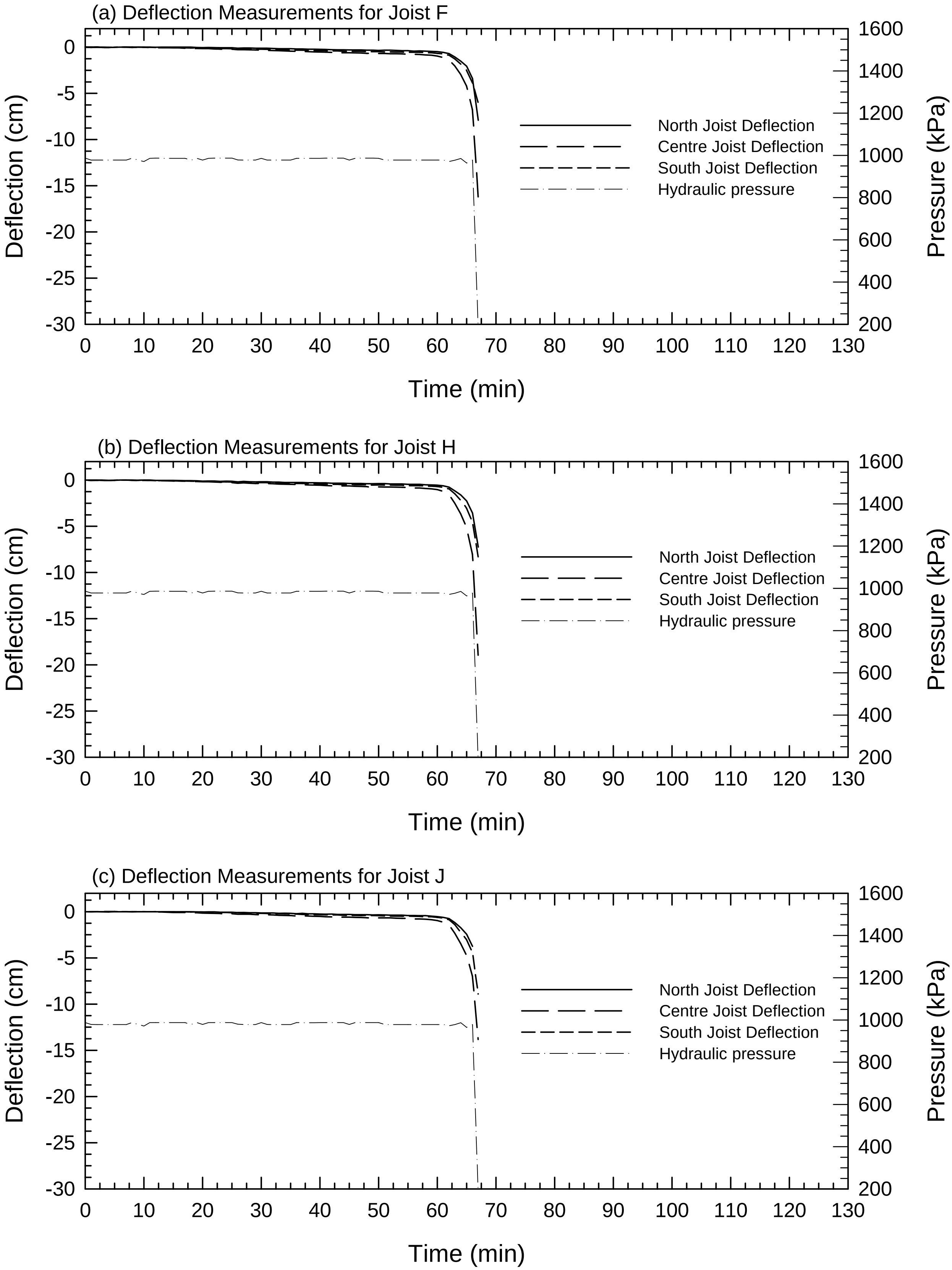


Figure G-32. Deflection Measurements for Floor Fire Test, FF-61

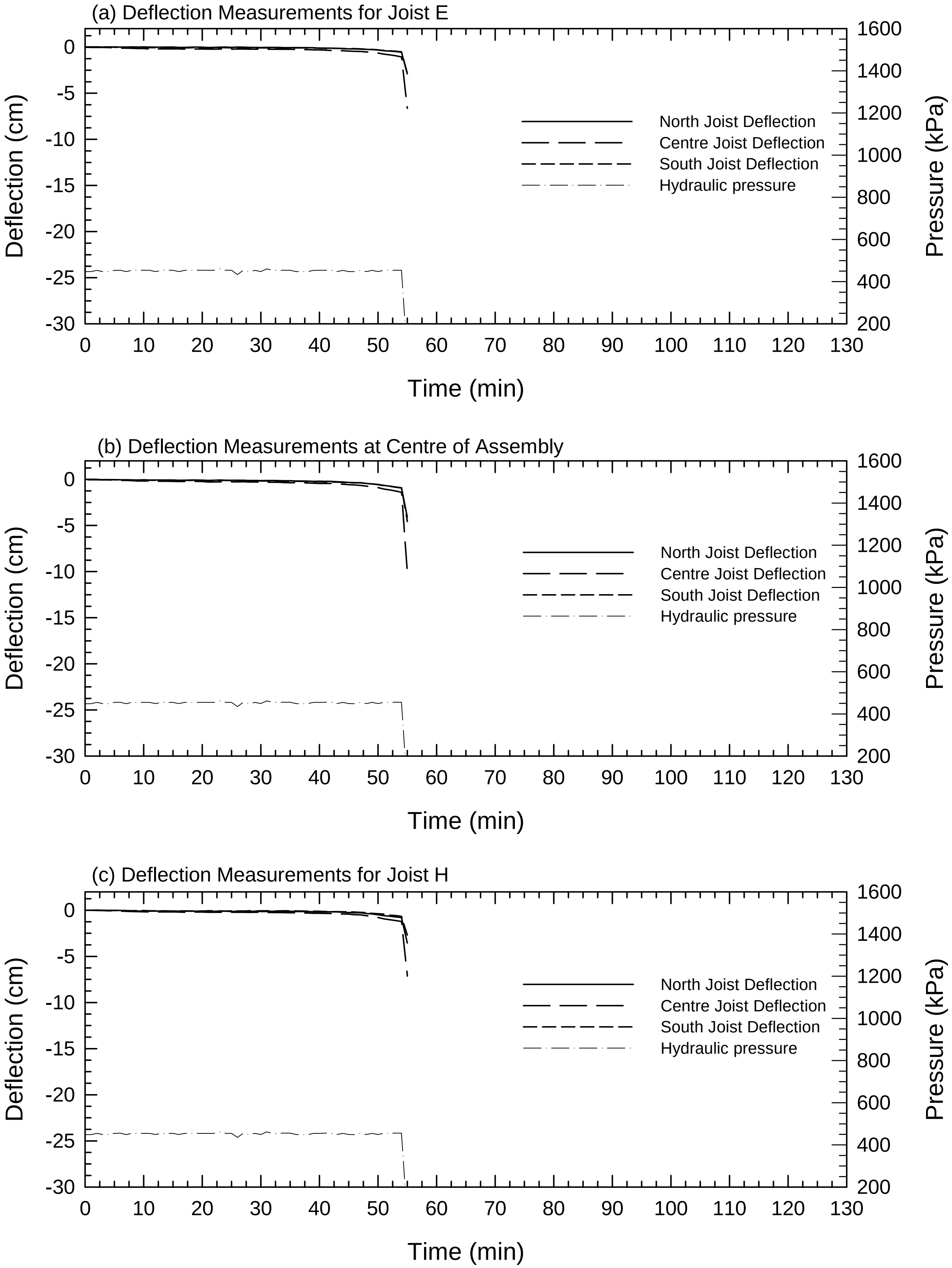
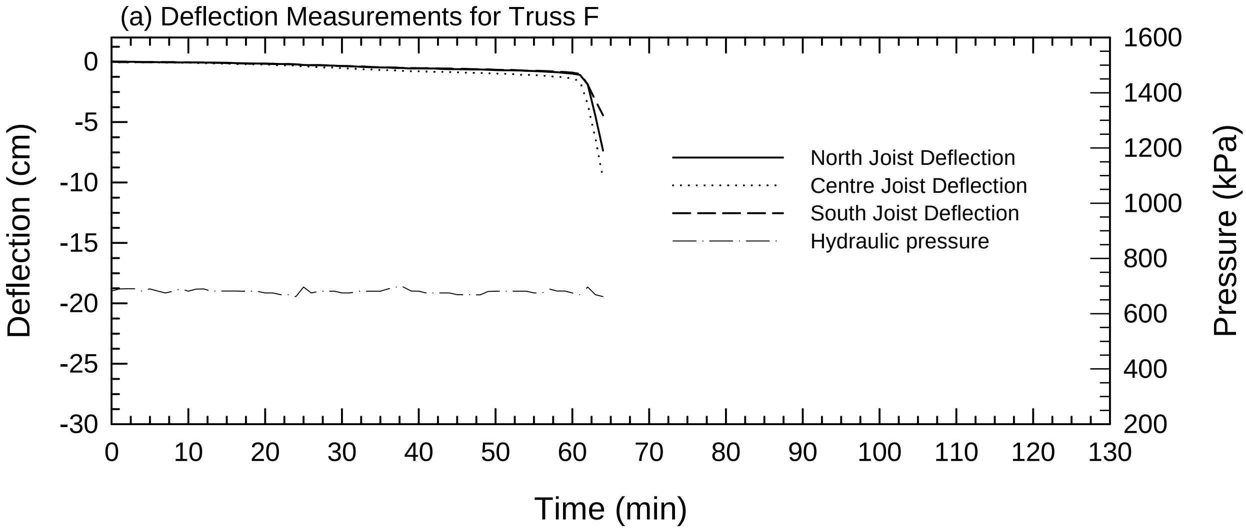
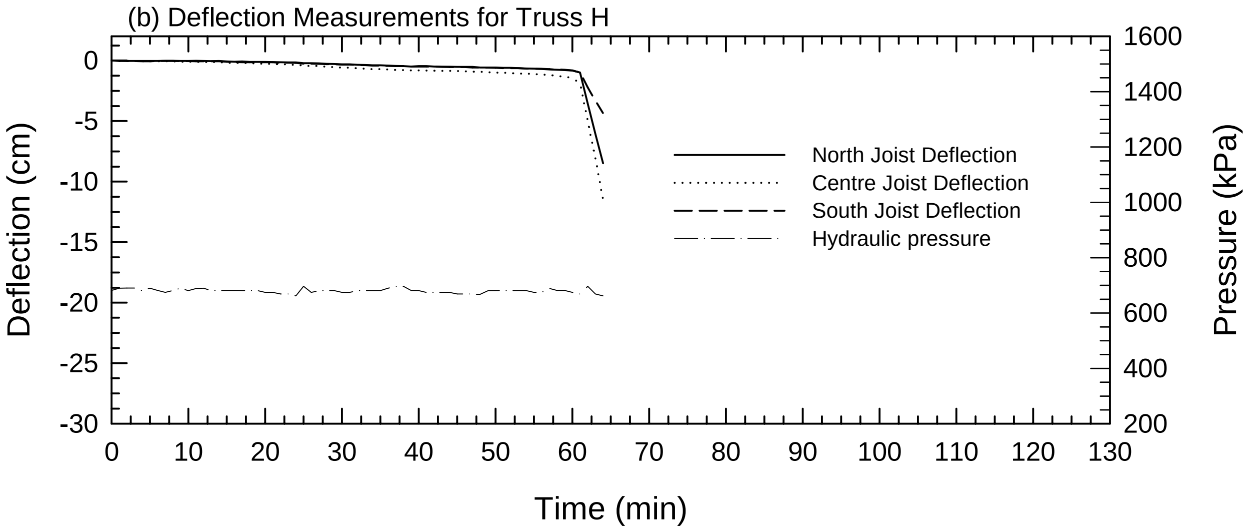


Figure G-33. Deflection Measurements for Floor Fire Test, FF-62





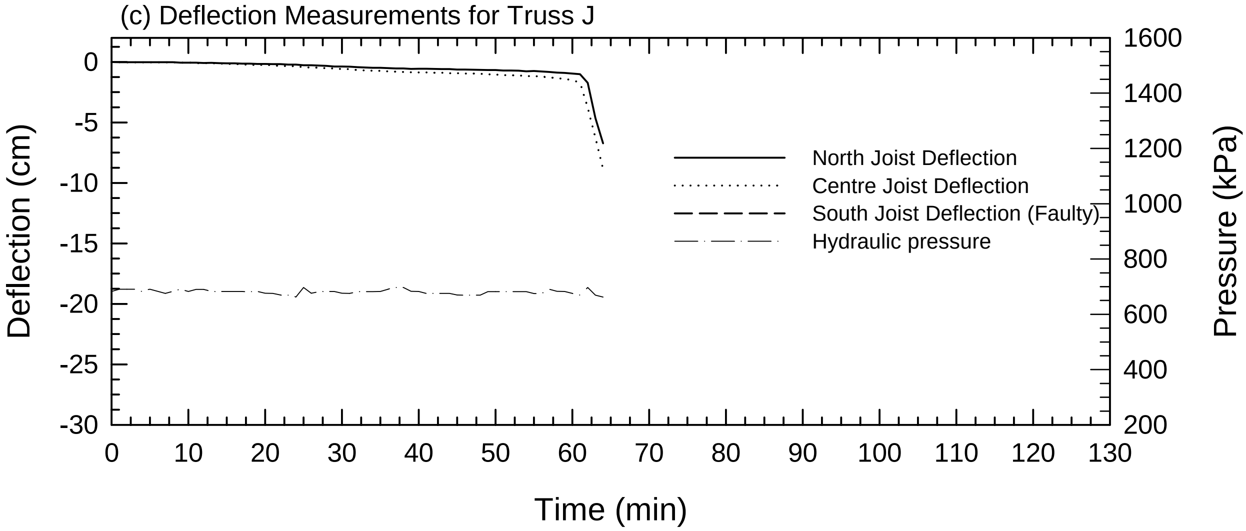


Figure G-34. Deflection Measurements for Floor Fire Test, FF-63

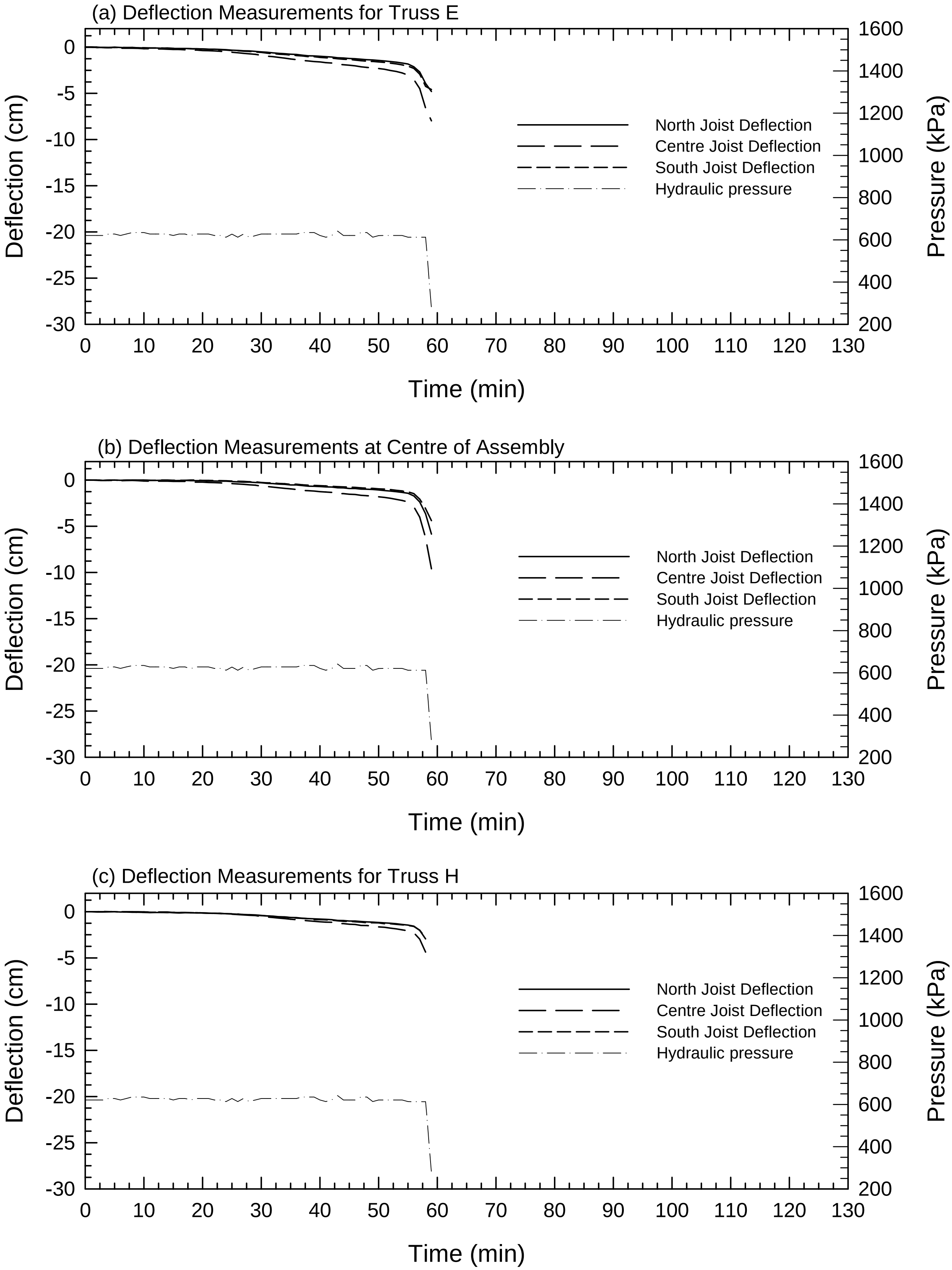
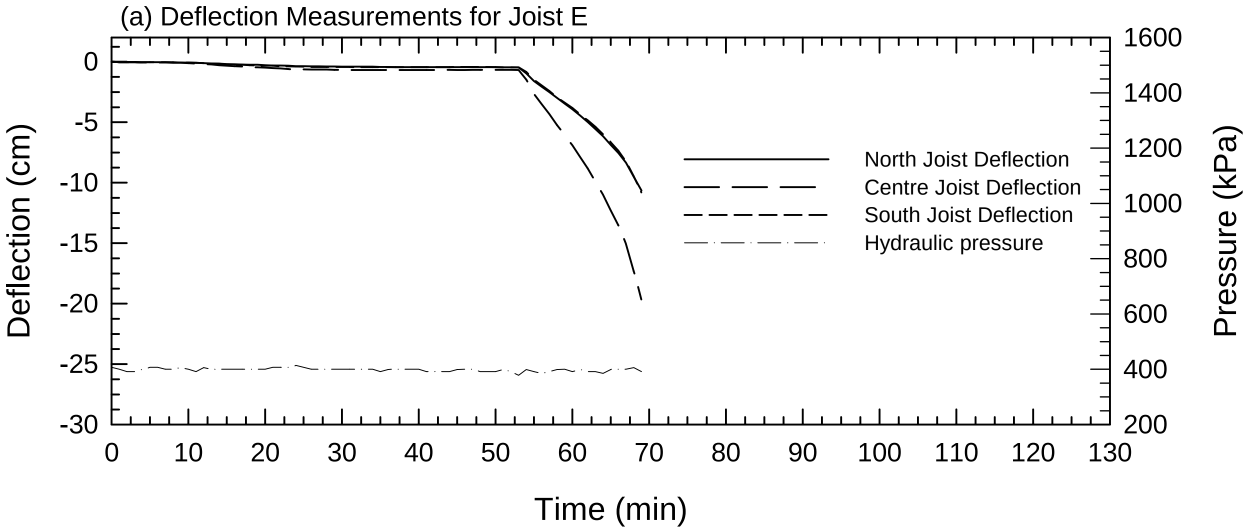
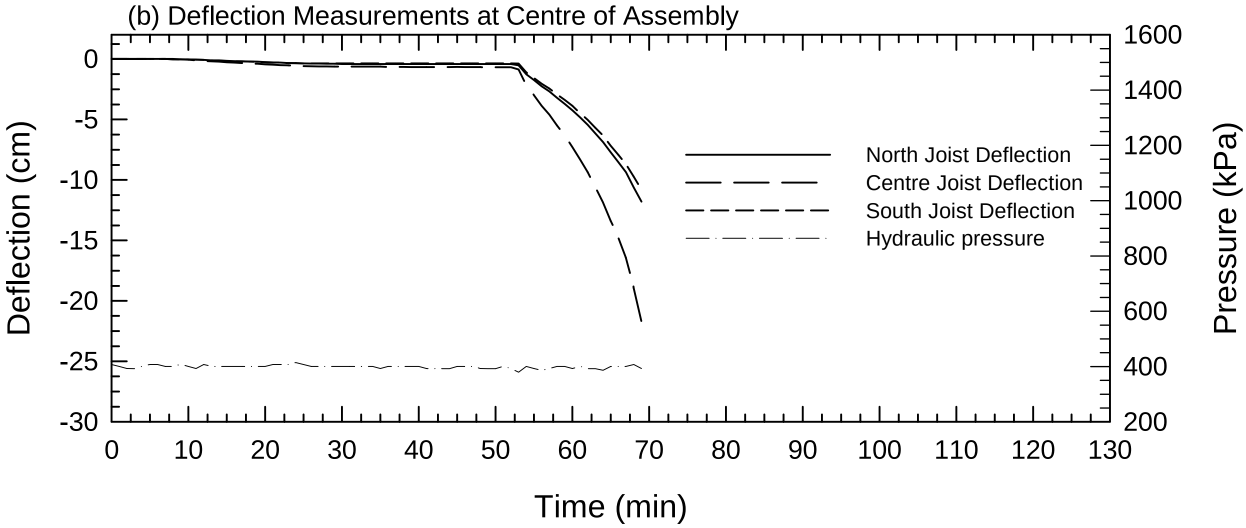


Figure G-35. Deflection Measurements for Floor Fire Test, FF-64





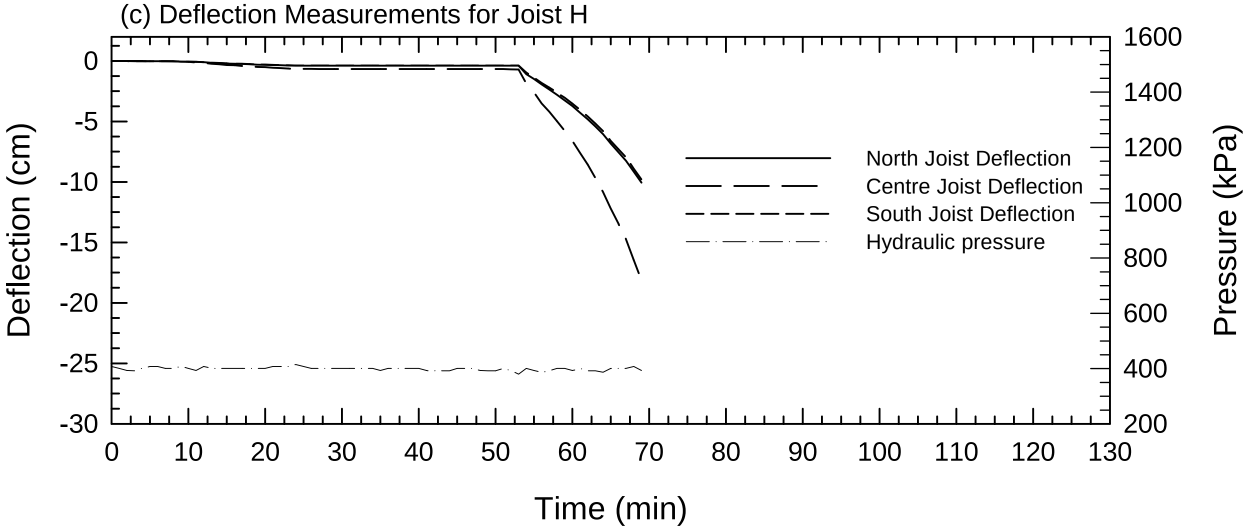


Figure G-36. Deflection Measurements for Floor Fire Test, FF-65

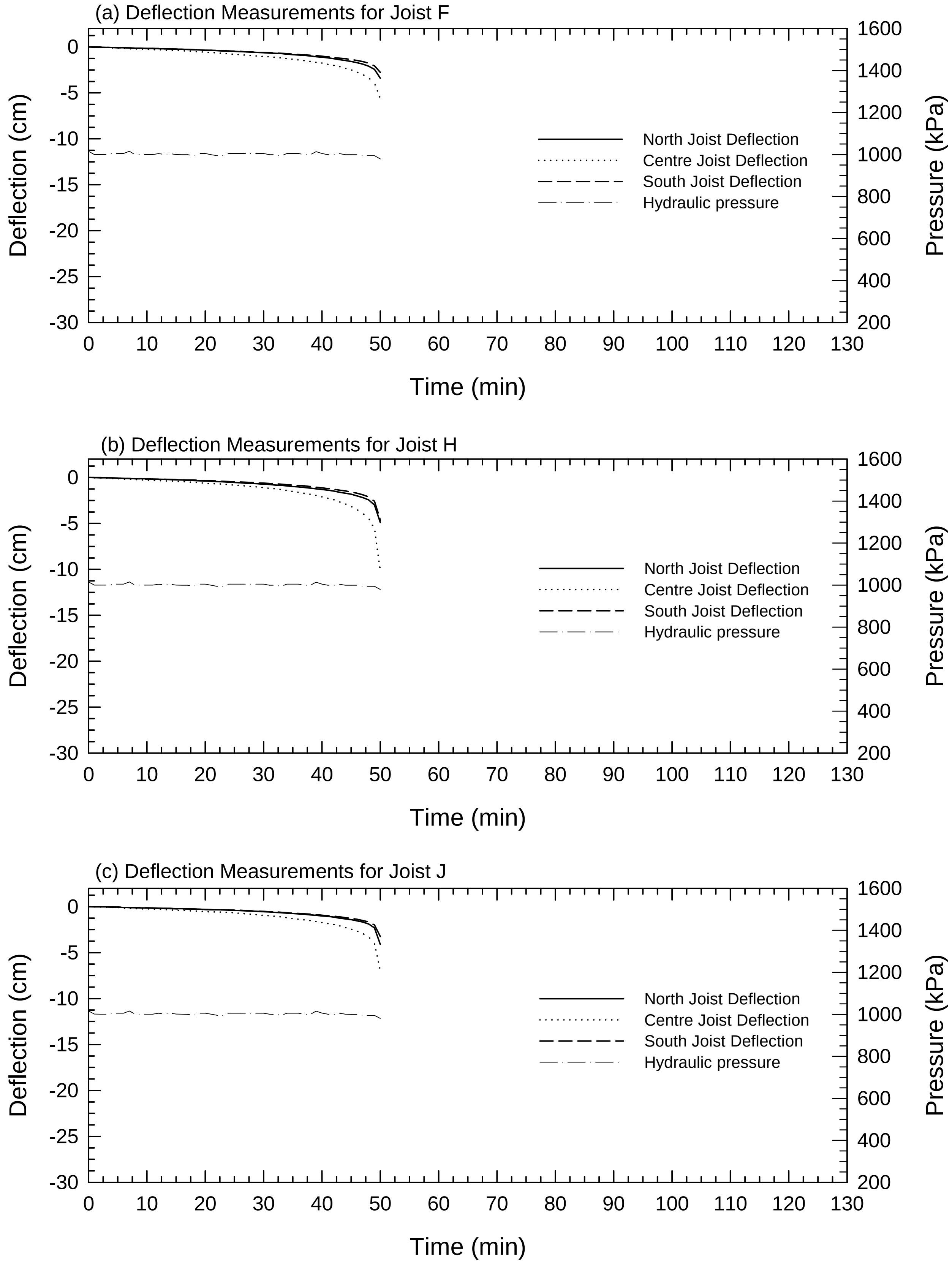


Figure G-37. Deflection Measurements for Floor Fire Test, FF-66

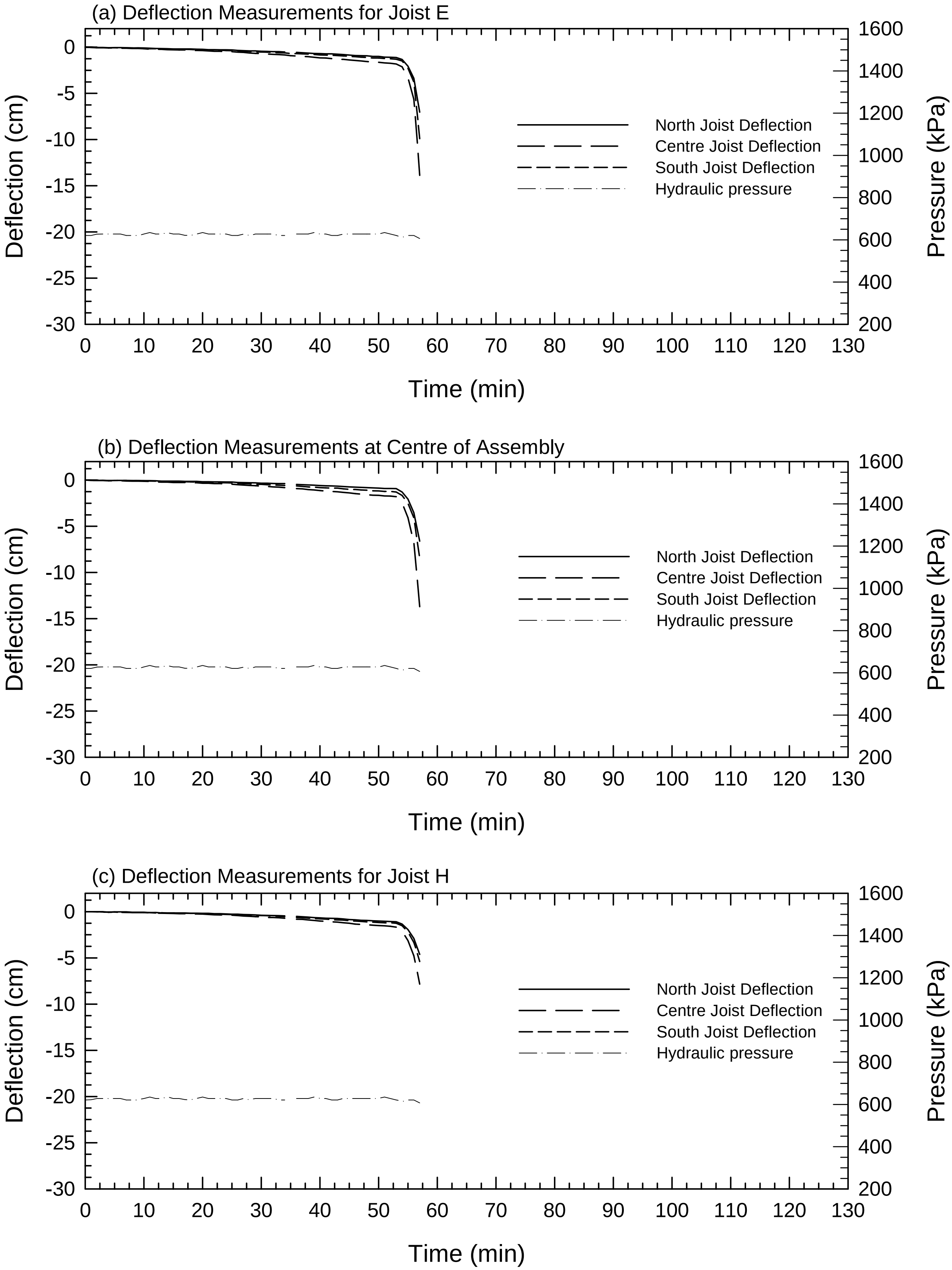
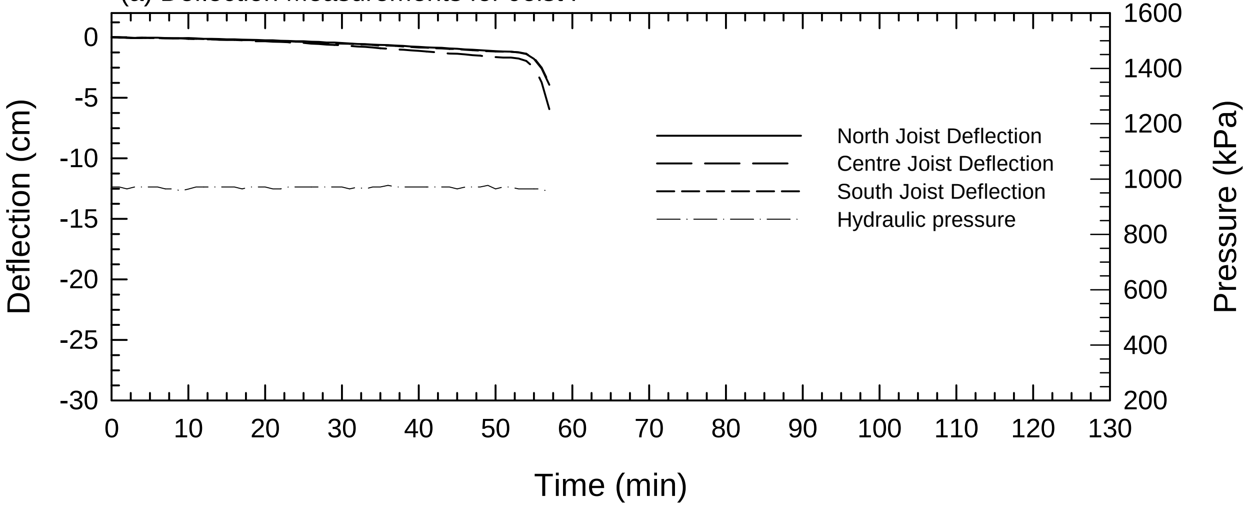
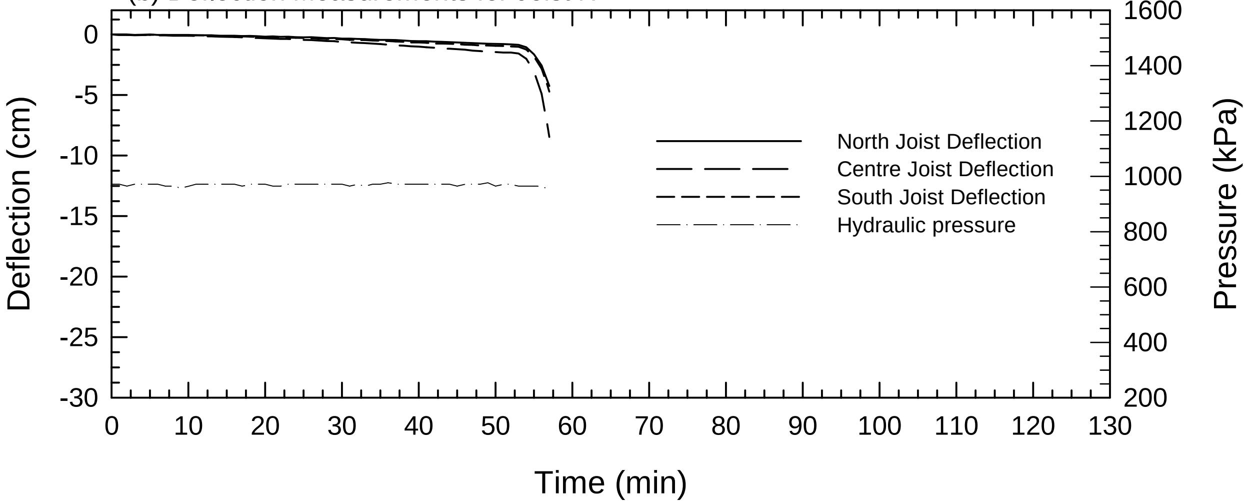


Figure G-38. Deflection Measurements for Floor Fire Test, FF-67

(a) Deflection Measurements for Joist F



(b) Deflection Measurements for Joist H



(c) Deflection Measurements for Joist J

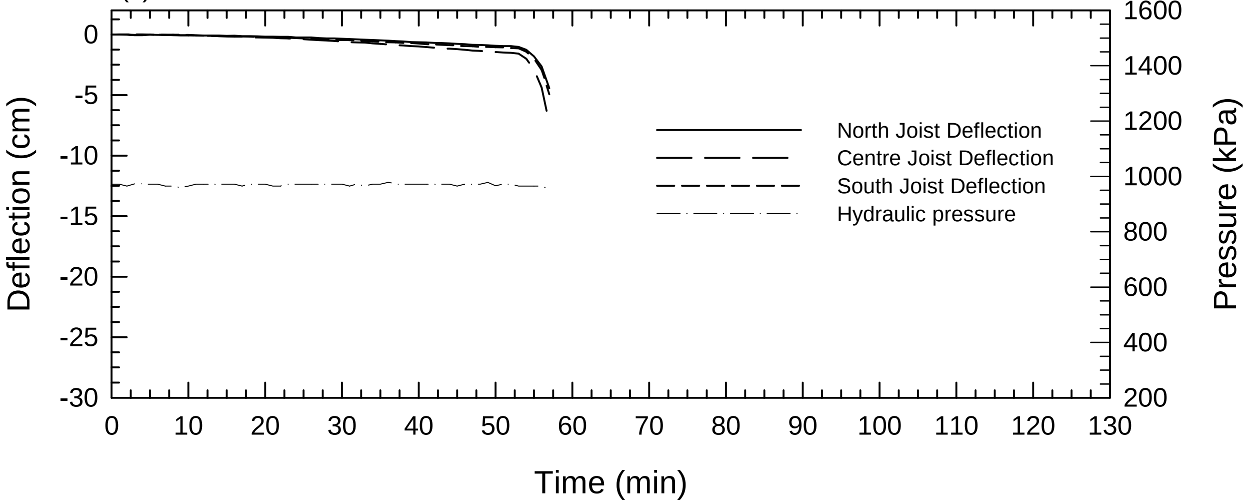


Figure G-39. Deflection Measurements for Floor Fire Test, FF-68

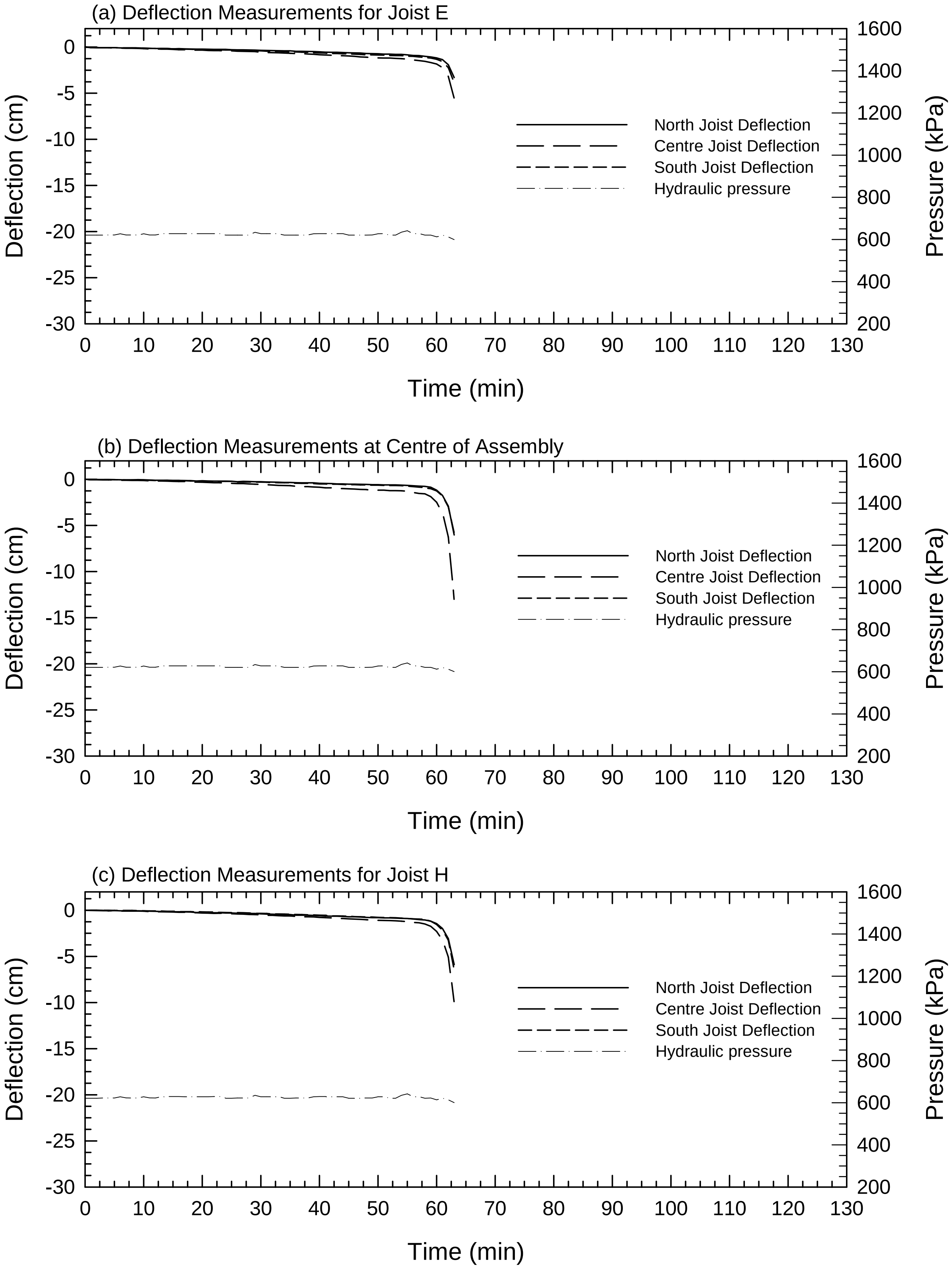


Figure G-40. Deflection Measurements for Floor Fire Test, FF-69

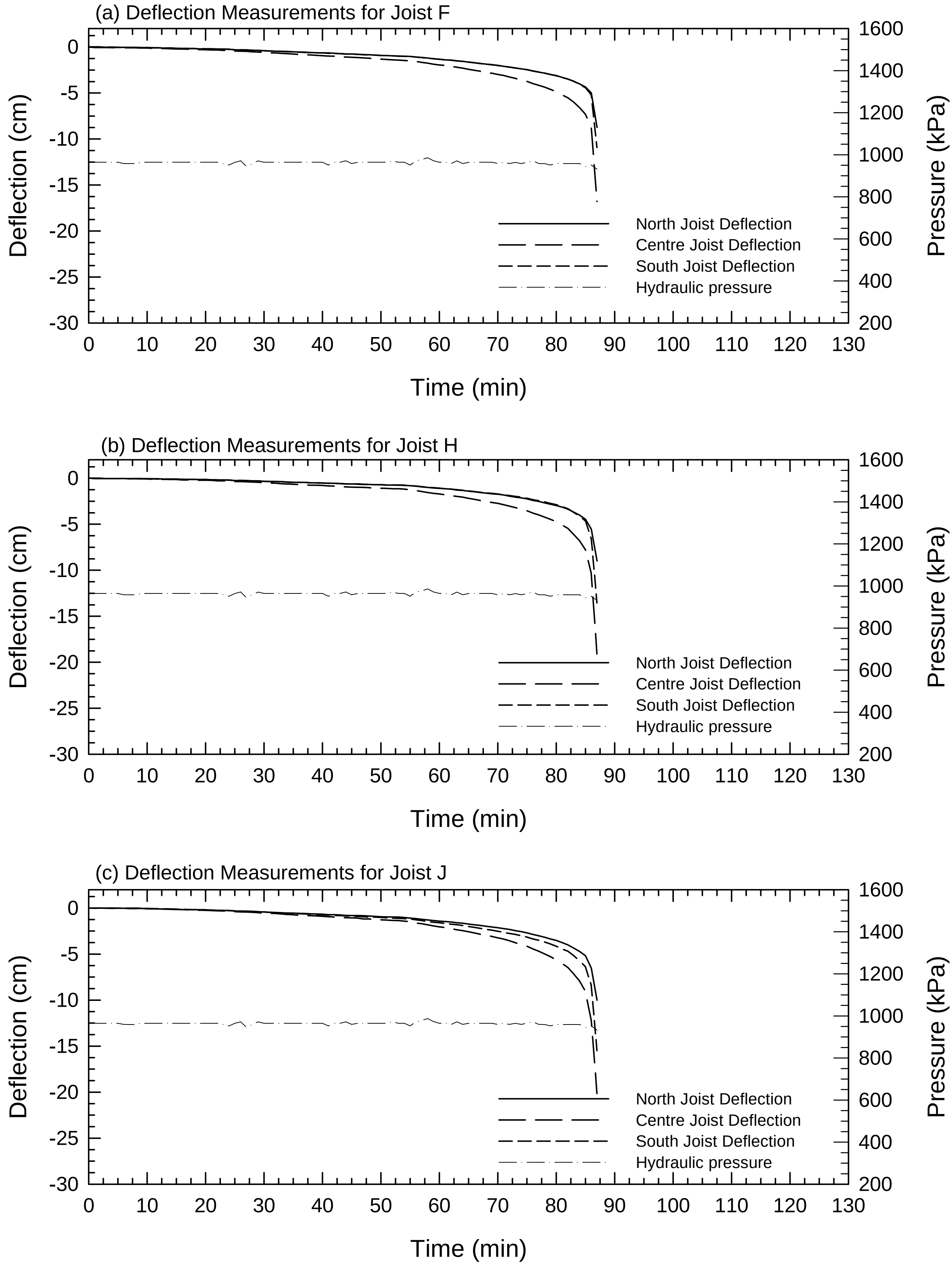
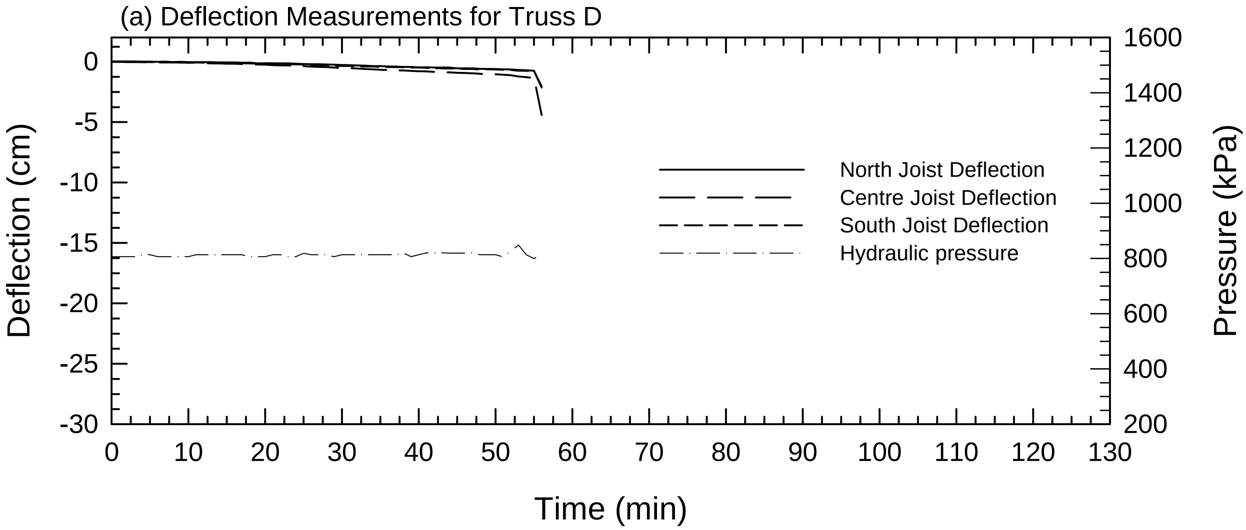
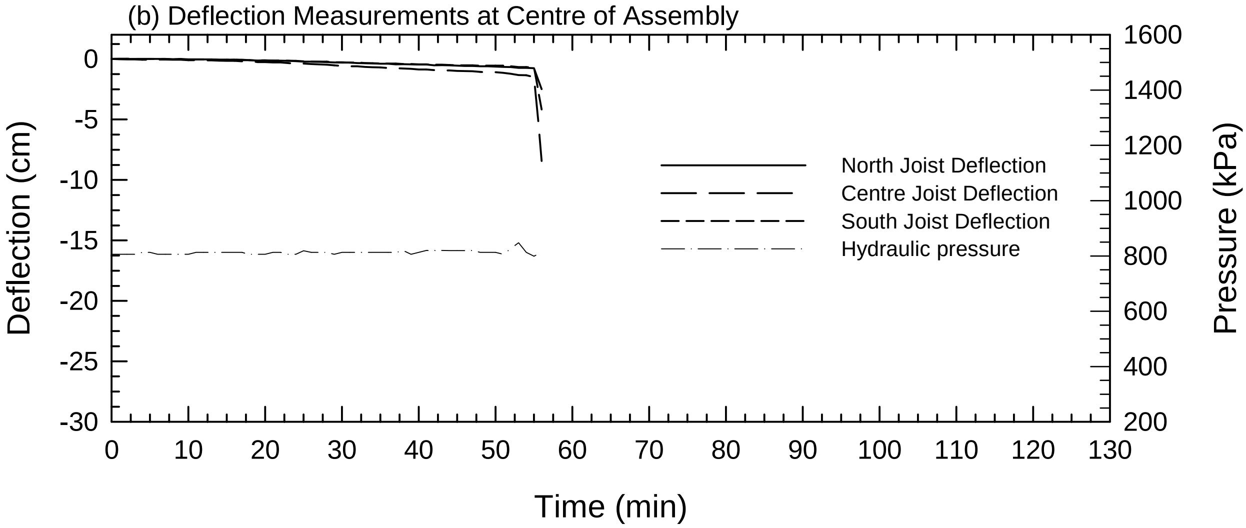


Figure G-41. Deflection Measurements for Floor Fire Test, FF-70





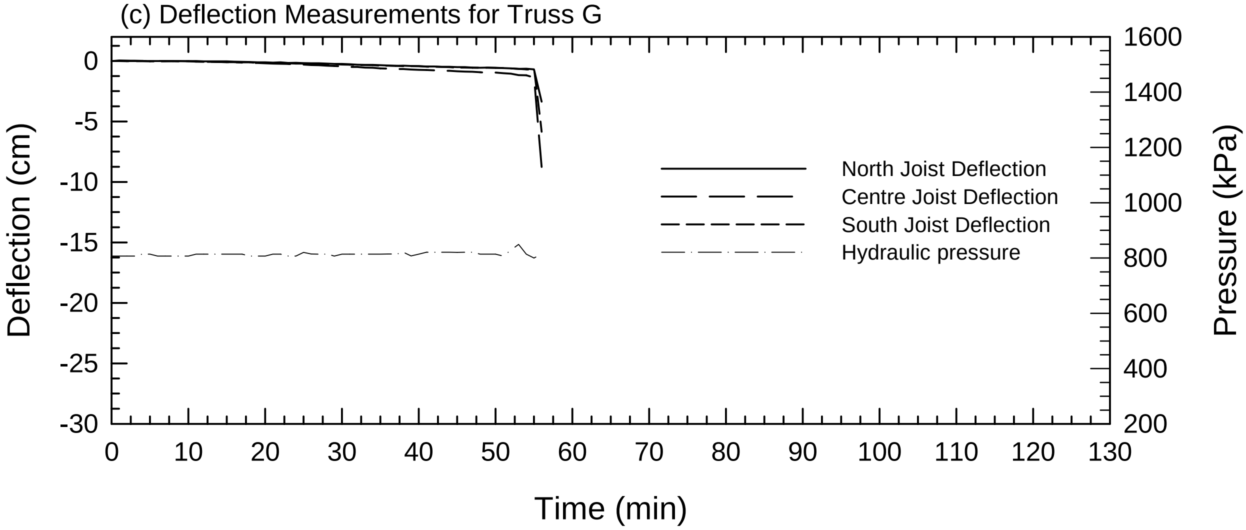


Figure G-42. Deflection Measurements for Floor Fire Test, FF-71

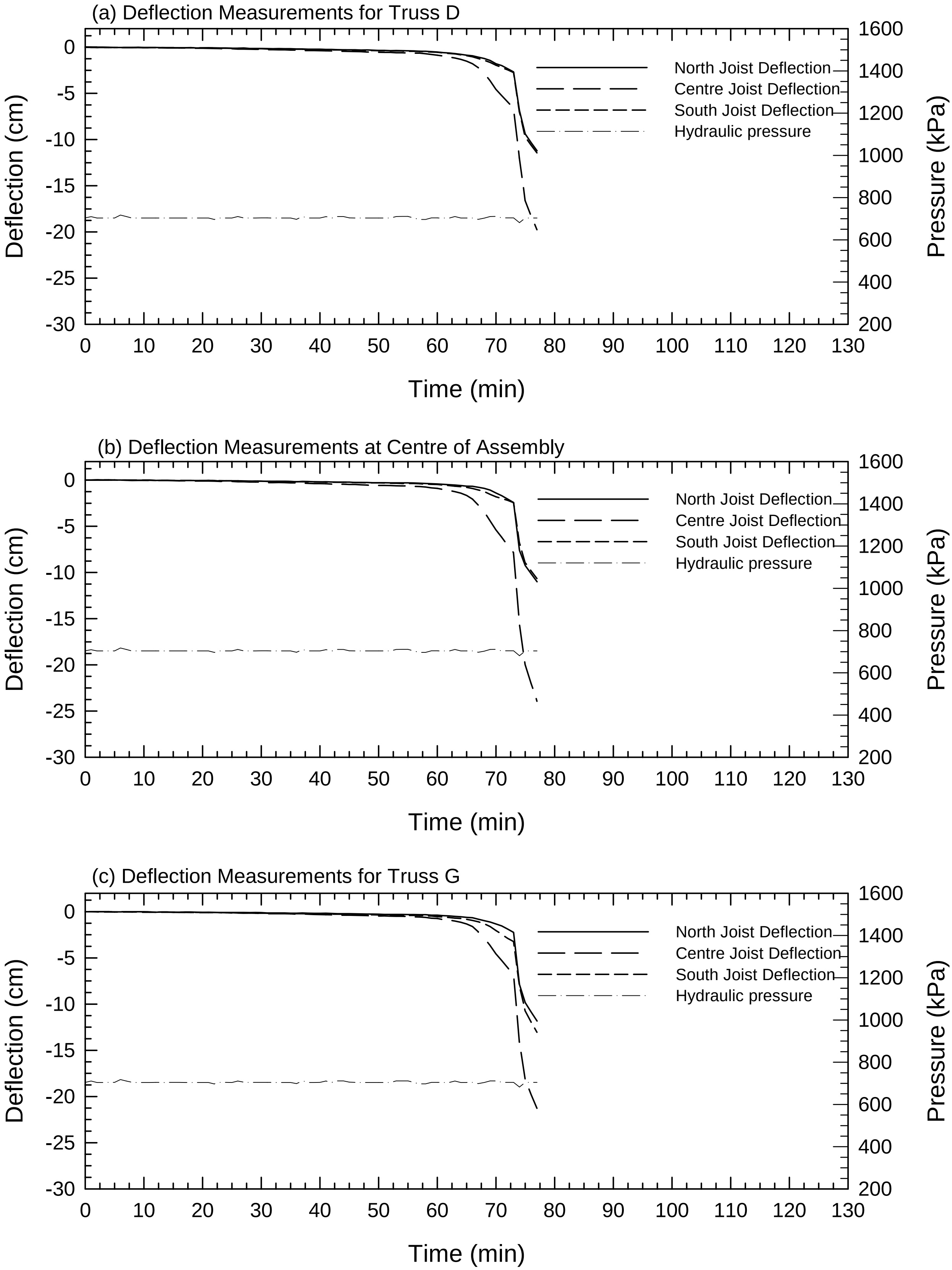


Figure G-43. Deflection Measurements for Floor Fire Test, FF-72

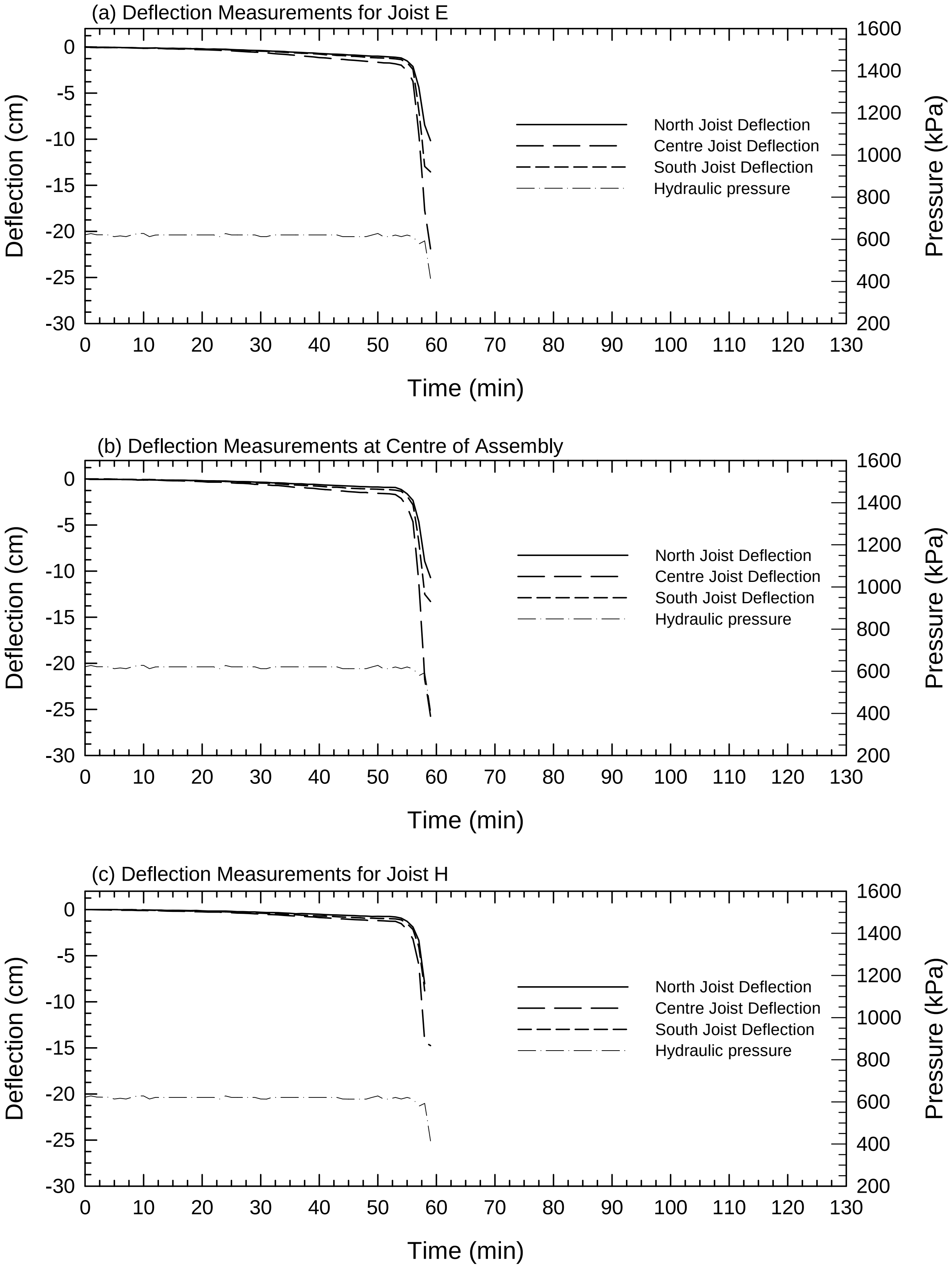
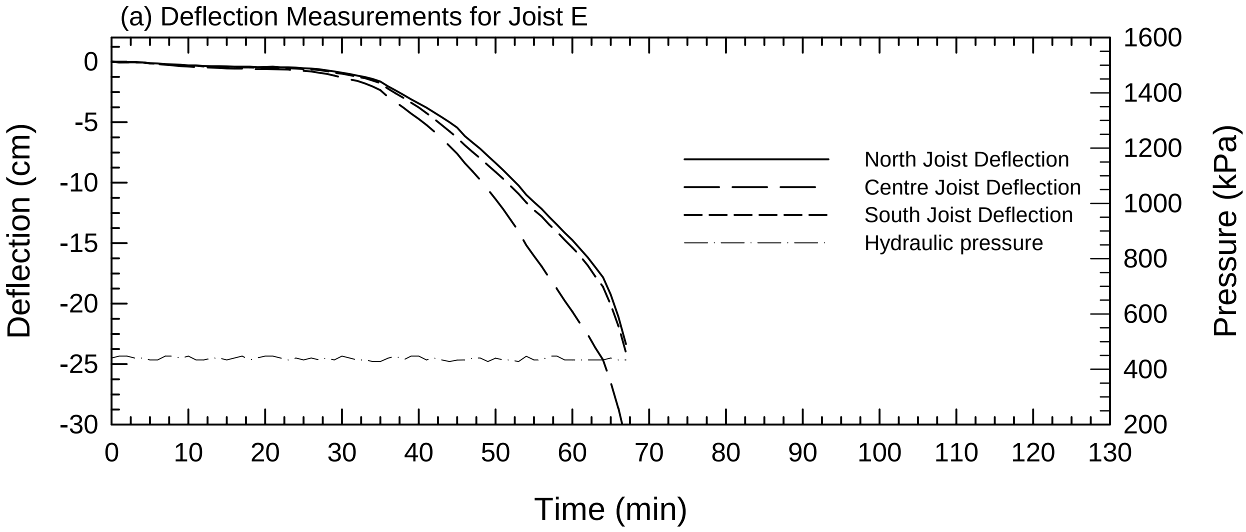
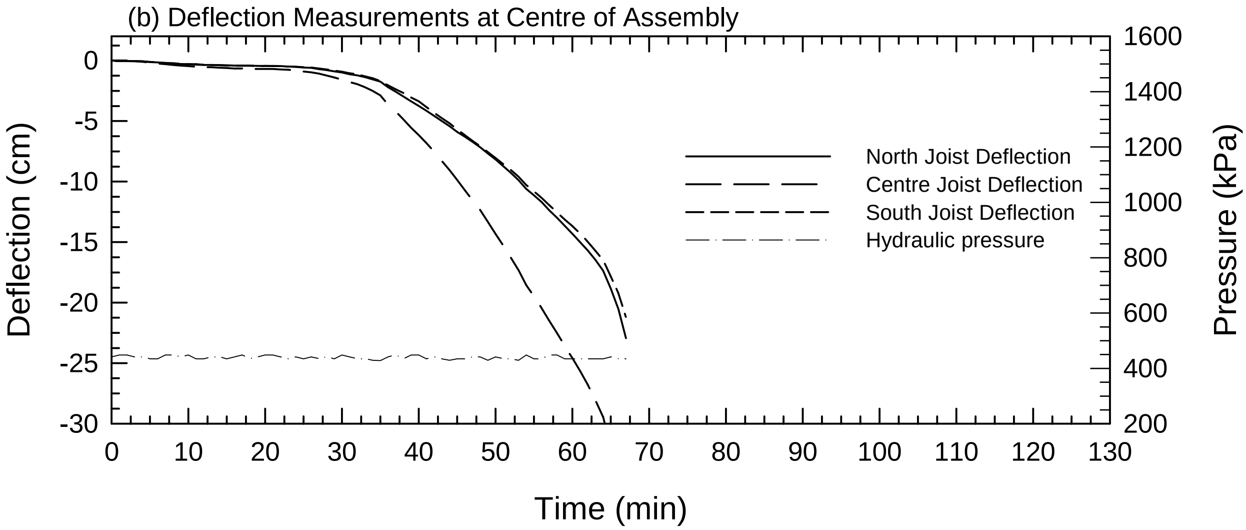


Figure G-44. Deflection Measurements for Floor Fire Test, FF-73





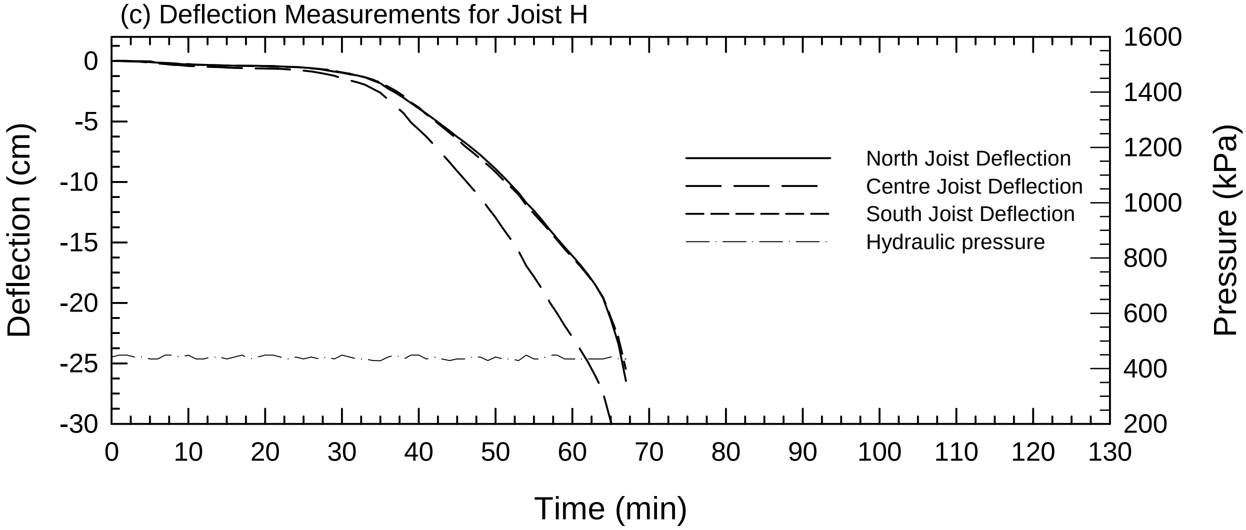


Figure G-45. Deflection Measurements for Floor Fire Test, FF-74

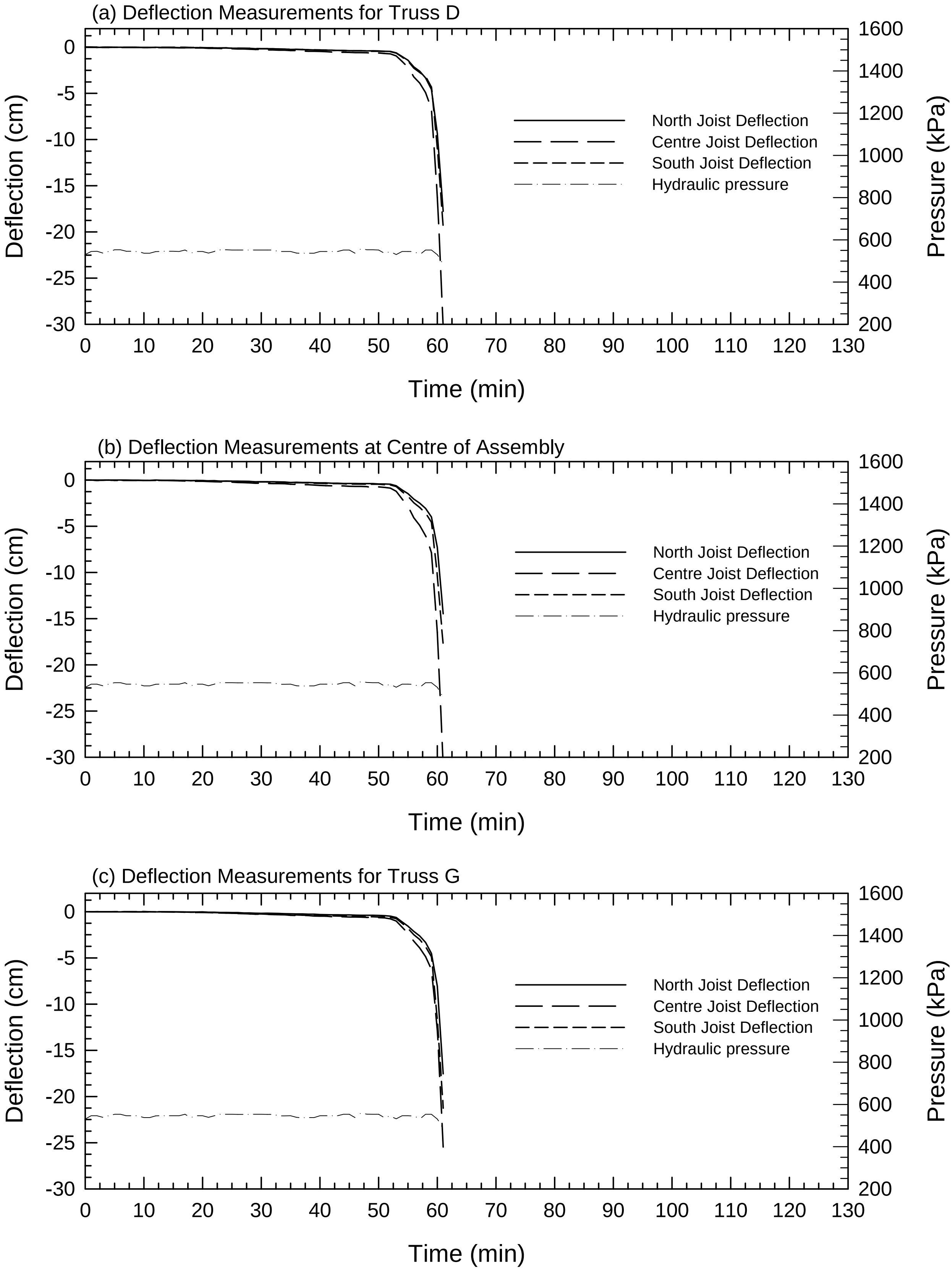
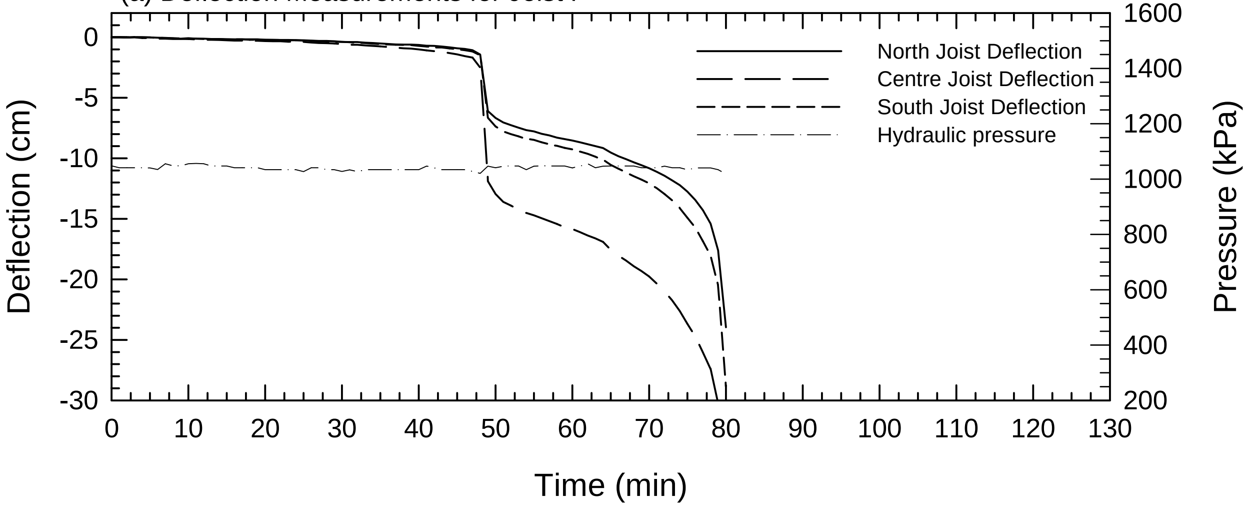
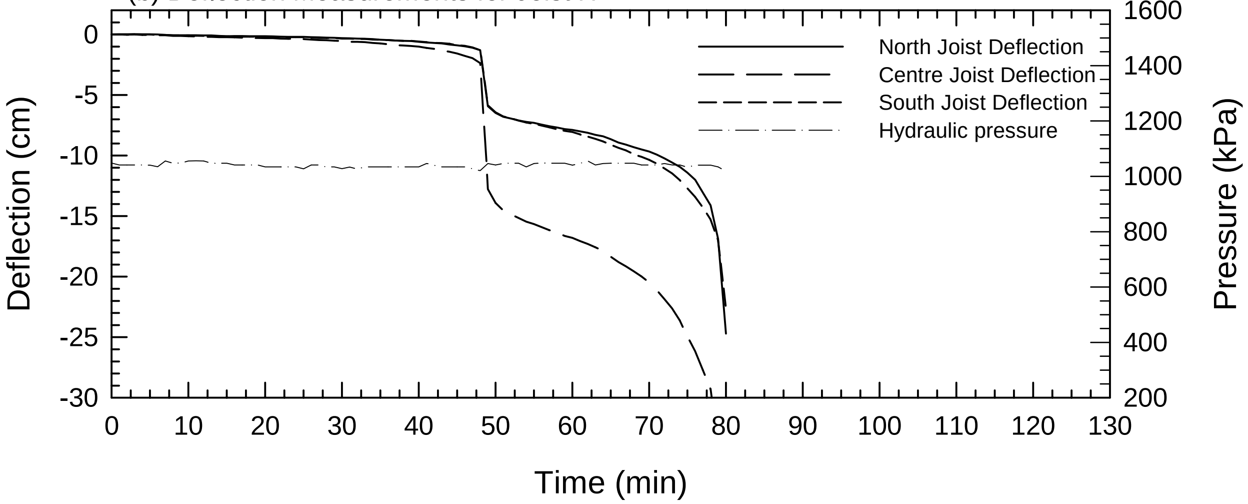


Figure G-46. Deflection Measurements for Floor Fire Test, FF-75

(a) Deflection Measurements for Joist F



(b) Deflection Measurements for Joist H



(c) Deflection Measurements for Joist J

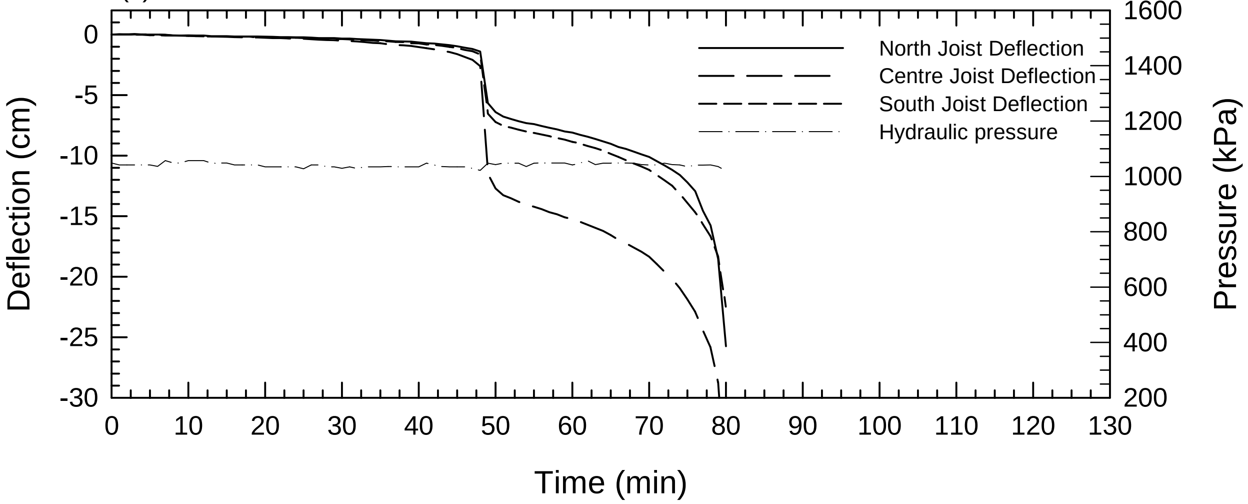


Figure G-47. Deflection Measurements for Floor Fire Test, FF-76

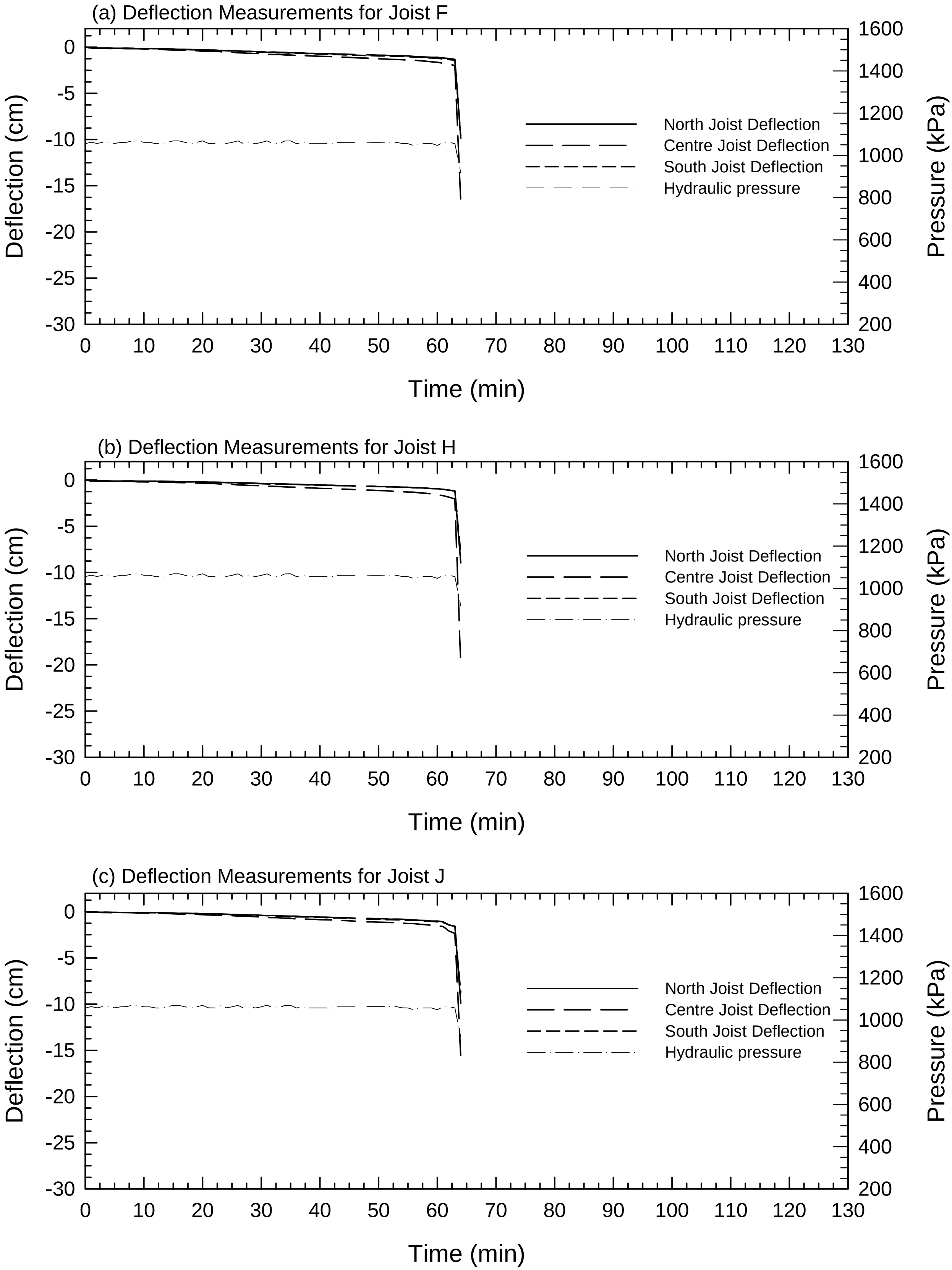


Figure G-48. Deflection Measurements for Floor Fire Test, FF-77

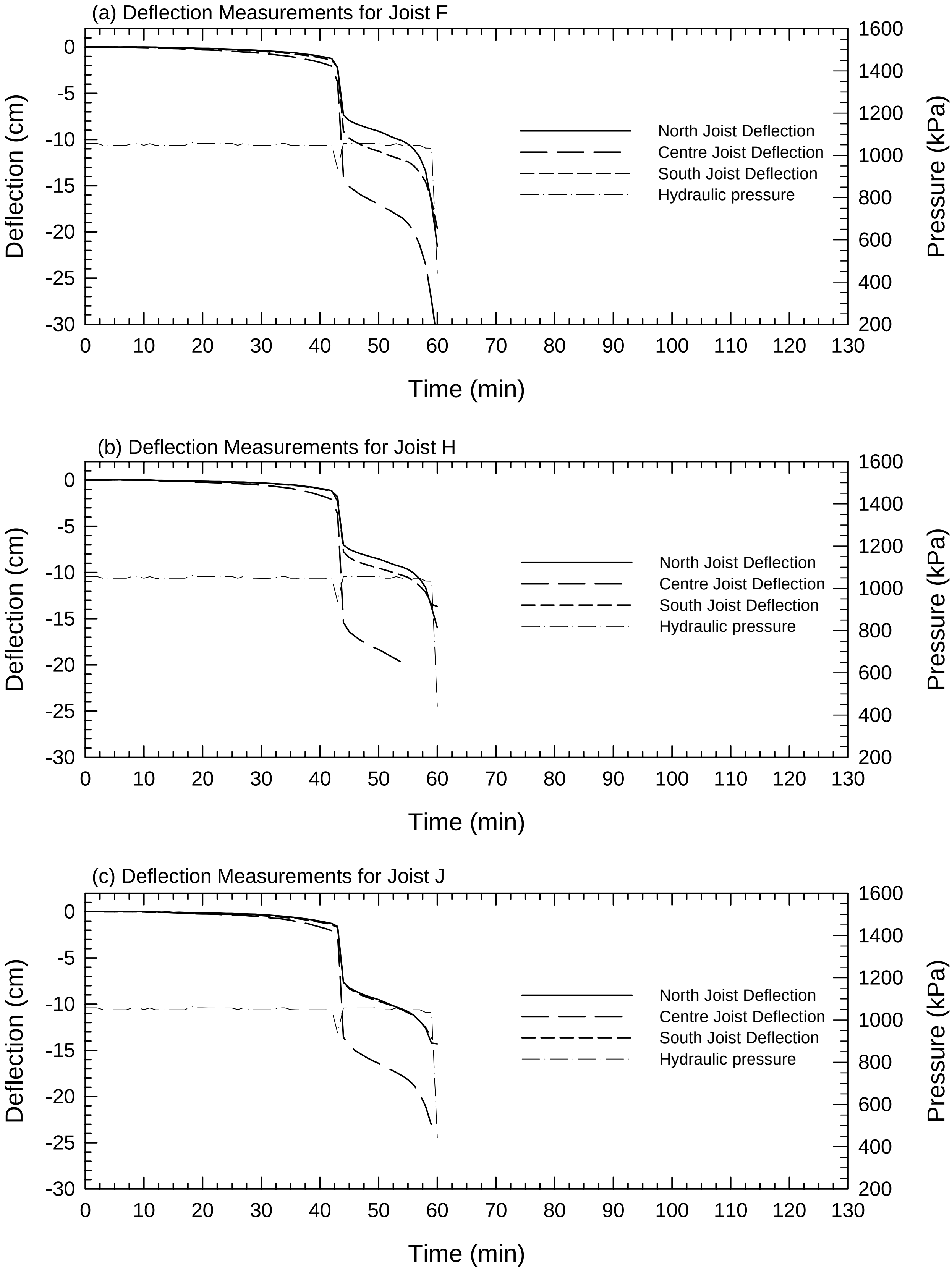
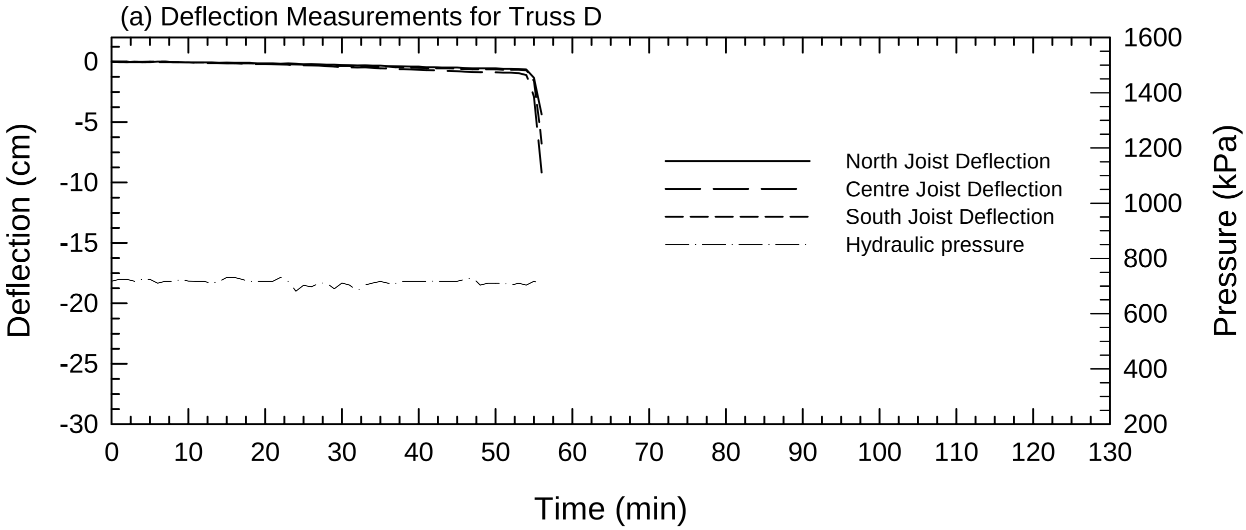
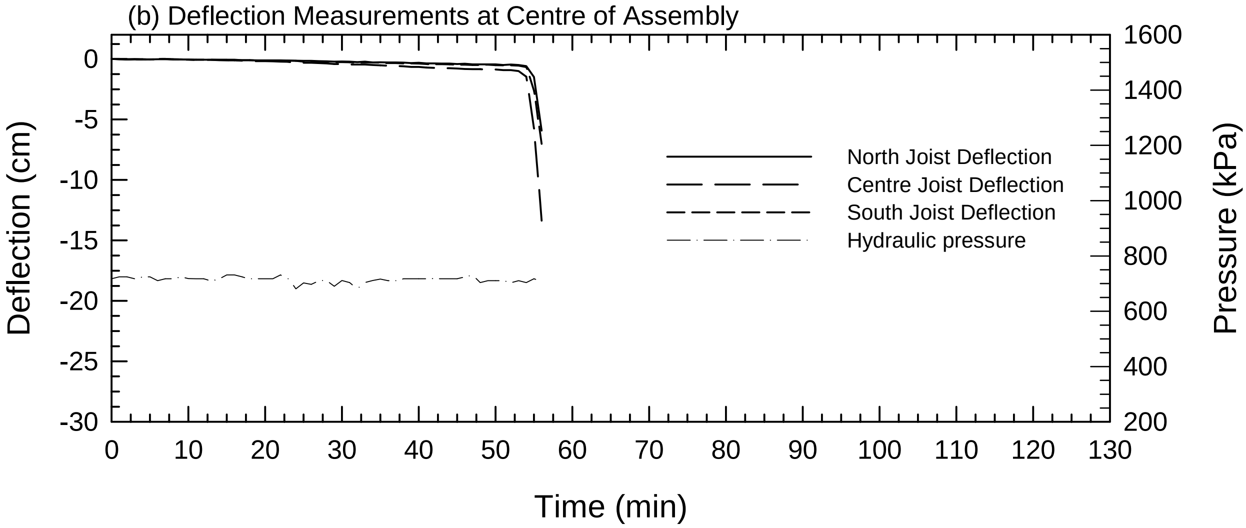


Figure G-49. Deflection Measurements for Floor Fire Test, FF-78





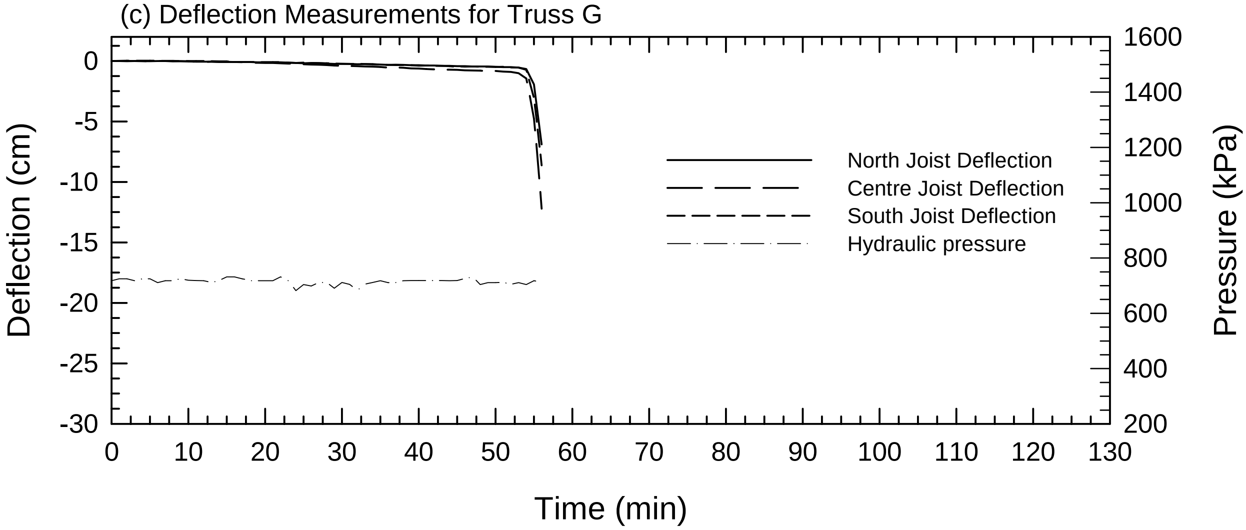
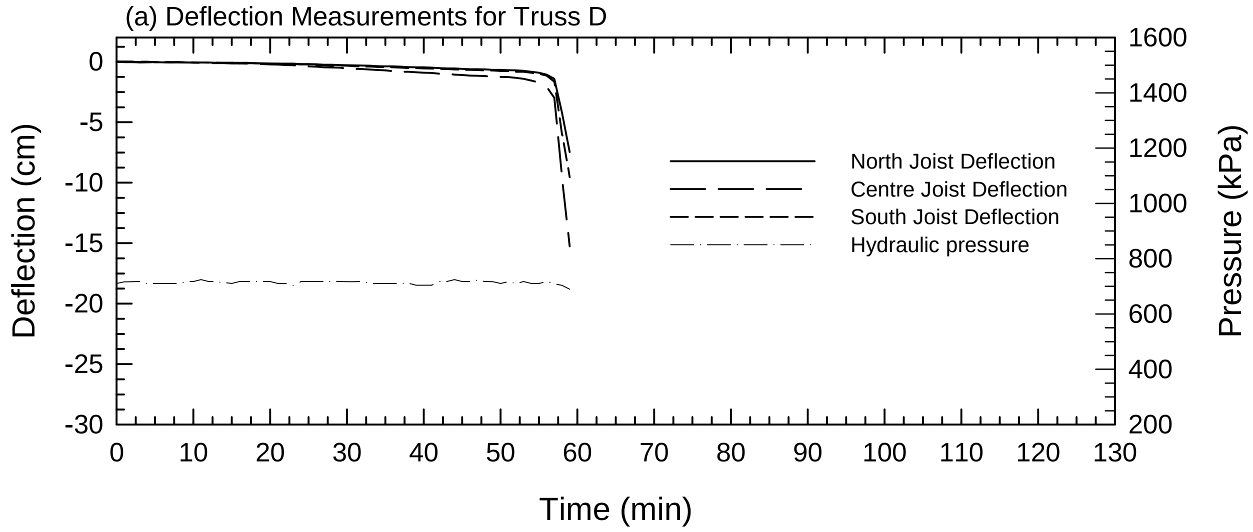
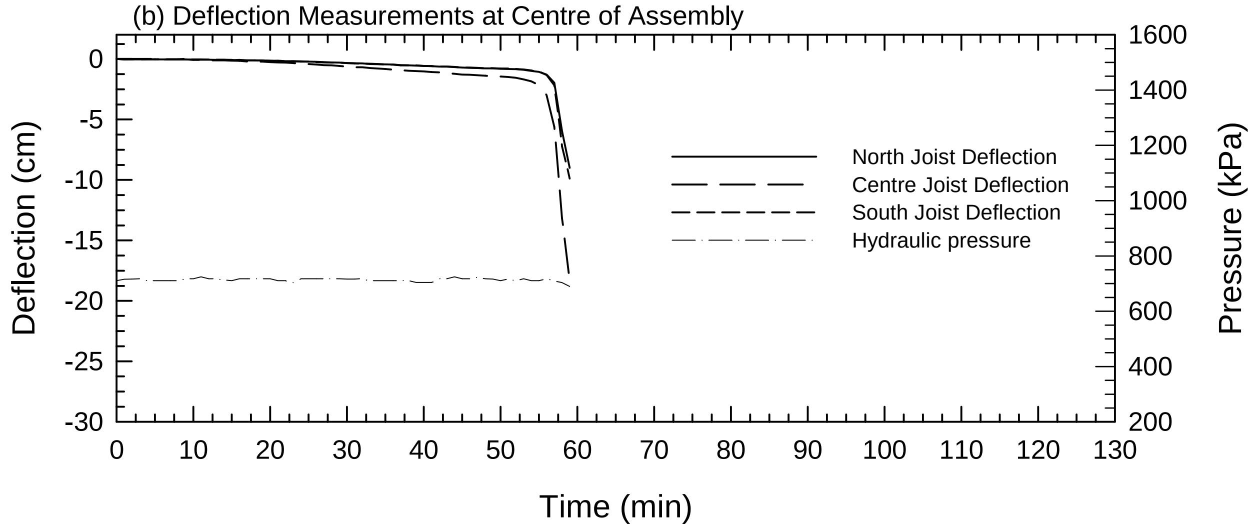


Figure G-50. Deflection Measurements for Floor Fire Test, FF-79





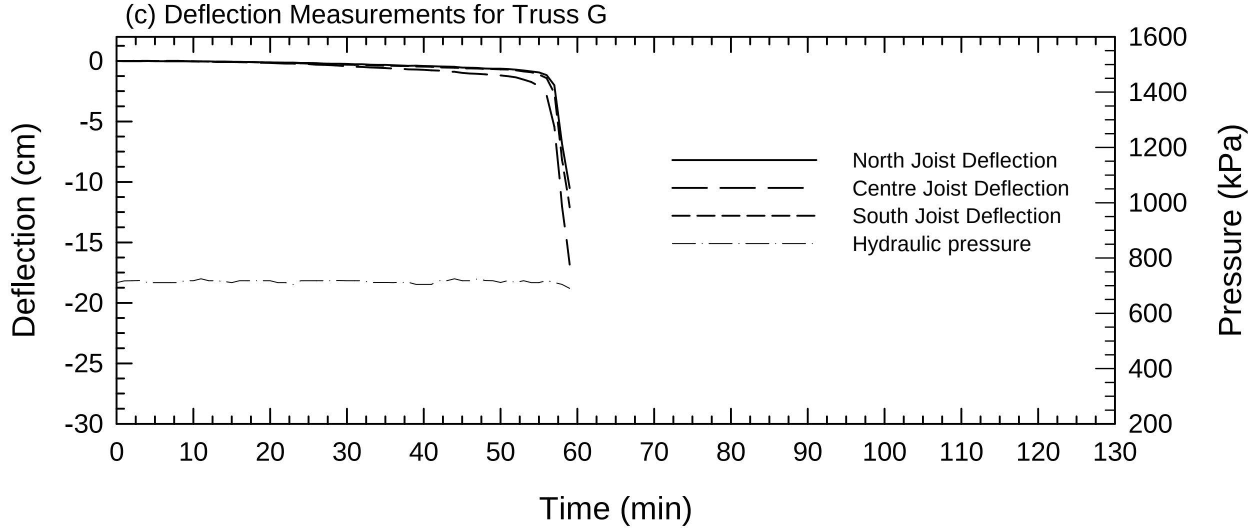


Figure G-51. Deflection Measurements for Floor Fire Test, FF-80

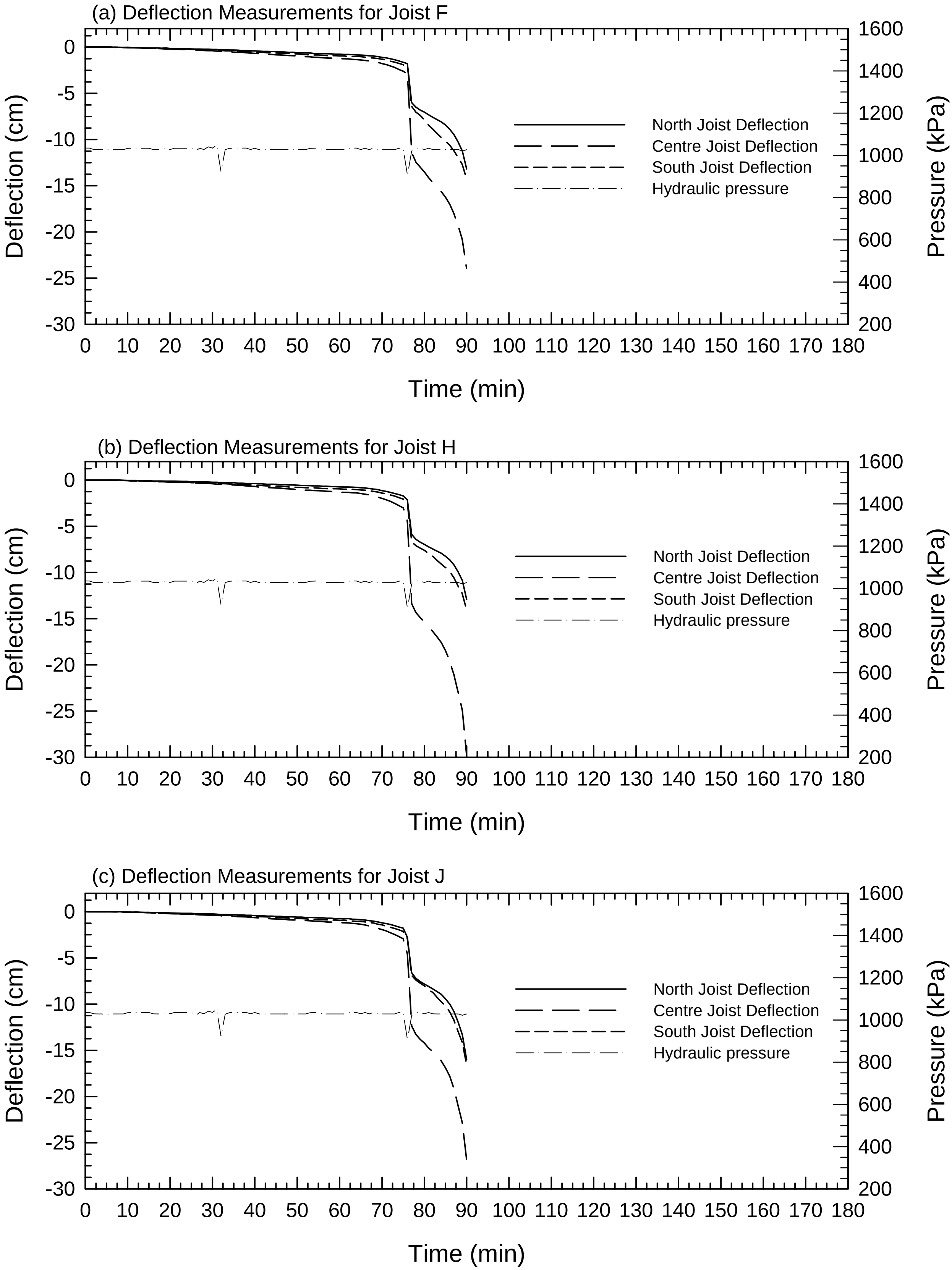


Figure G-52. Deflection Measurements for Floor Fire Test, FF-81

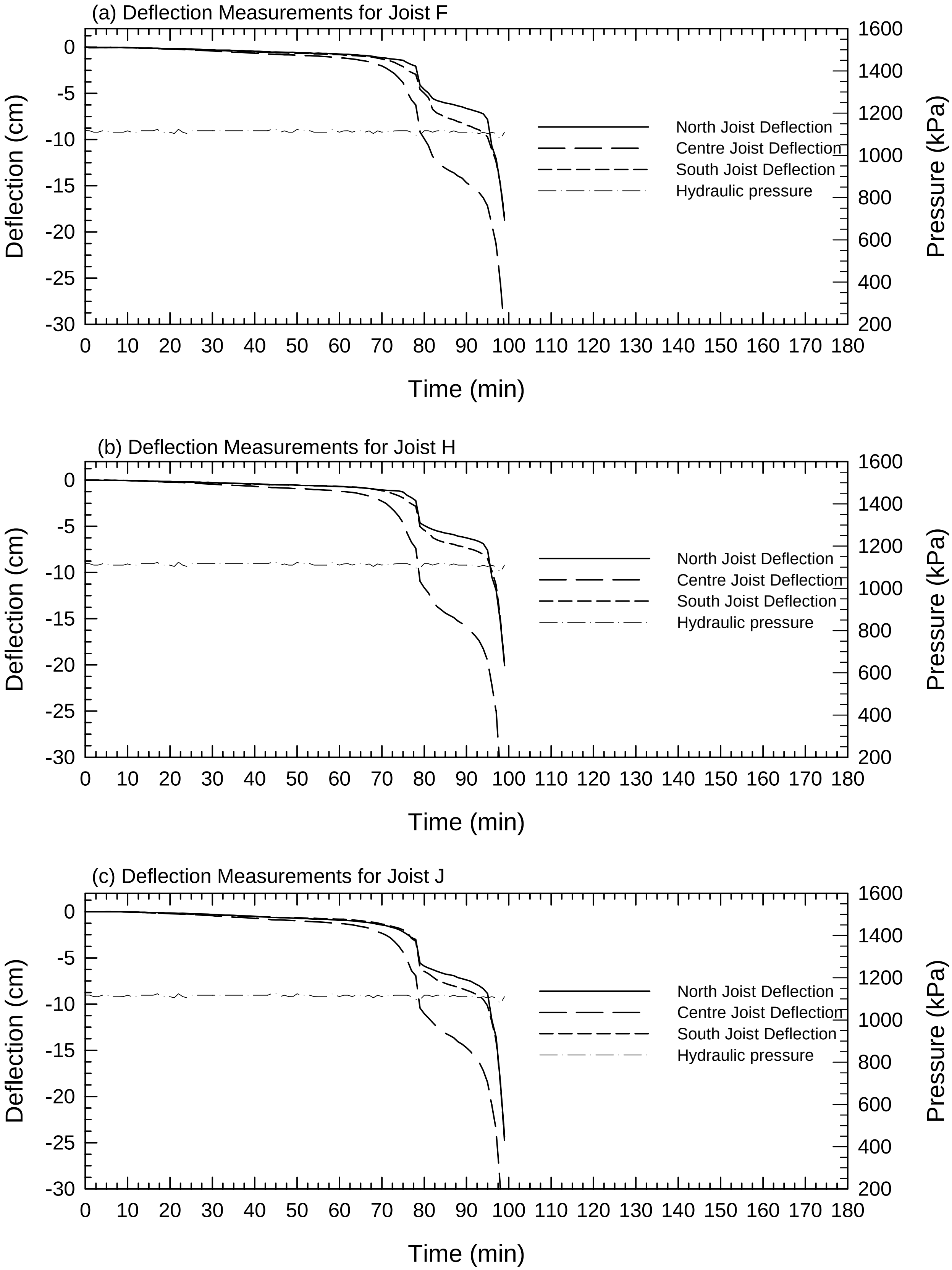


Figure G-53. Deflection Measurements for Floor Fire Test, FF-82