LANDING DRIVE

2-Hour Exterior Wall Beam Rating

Prepared By:

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REPORT

Project Overview

The Landing Drive Project, in Portland, Oregon, is an apartment building of Type IIIB construction. The building is fully protected by automatic sprinklers, fire and smoke detection and a fire alarm system. A two-hour fire rated exterior wall beam assembly is required per Oregon Structural Specialty Code (OSSC) Table 601 and 704.

Code Unlimited has been asked to provide analysis of the rating of the 4th floor exterior wall beam to ensure it will provide at least two-hour fire rated protection as required by code.

Applicable Code

2010 Oregon Structural Specialty Code
2010 Oregon Fire Code

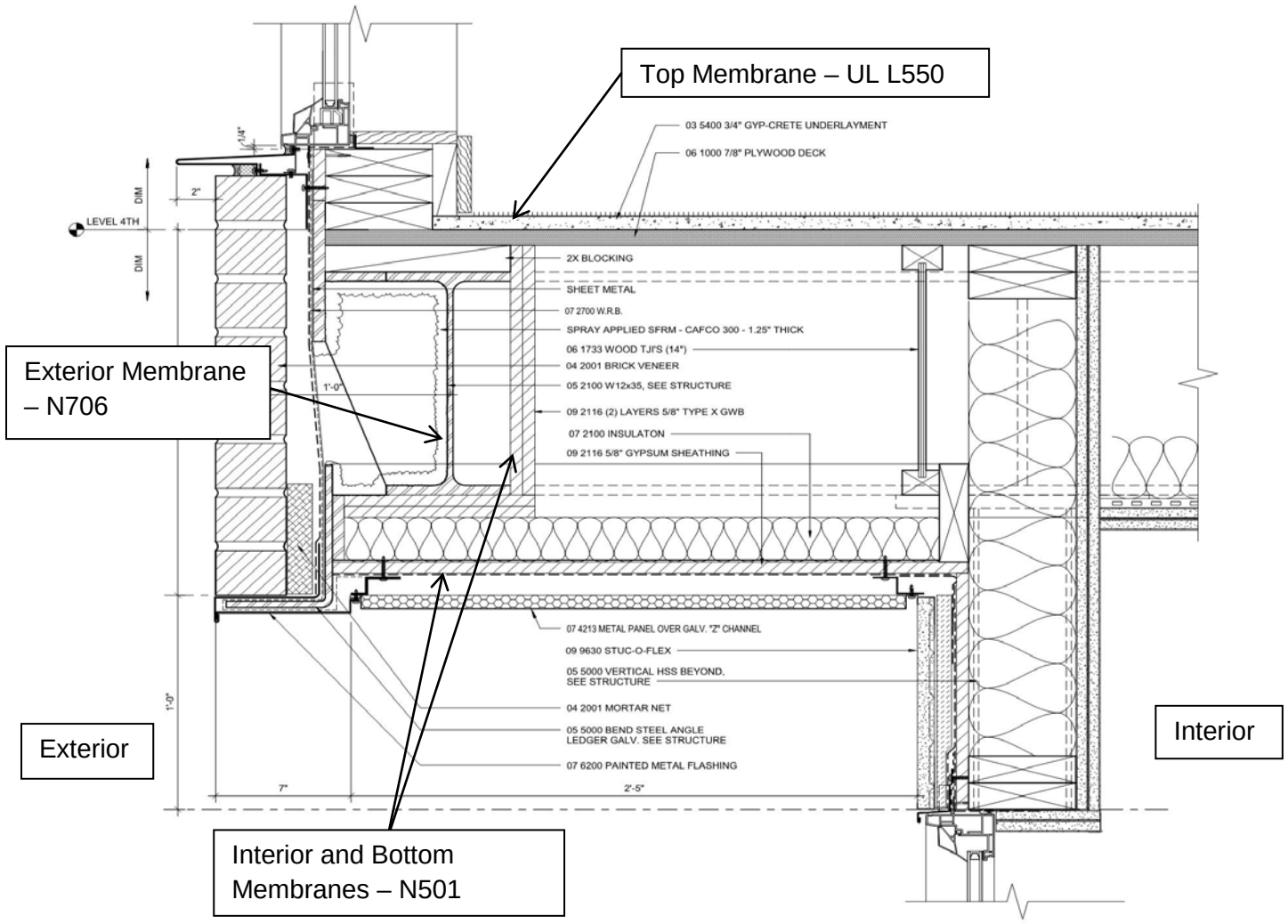
Approach

- The proposed wall beam protection assembly has been analyzed in accordance with 2010 OSSC §703.3.
- The exterior beam assembly is based on a two-hour fire rated assemblies tested by Underwriters Laboratories. (Details N706, N 501, and L550)
- Portions of the tested assemblies are modified to suit the unique design condition. The modification is analyzed for equivalency using published fire test data and acceptable fire science principles.
    - The analysis uses three (3) UL listed assemblies to provide the individual encasement protection of the beam.
        - UL N706 for the SFRM protection on the exterior side of the beam.
        - UL N501 for the gypsum board protection of the interior and bottom sides of the beam.
        - UL L550 for the floor membrane protection of the beam.
- A construction detail of the proposed joint system is provided for reference. Individual components of both are compared side by side in a table that follows.
- In the conclusion, section analysis and commentary are provided in support of the conclusion.

Proposed Design

The proposed restrained exterior beam assembly consists of W12x35 I-Beam with two layers of Type X Gypsum Board on the interior and bottom side, Concrete over plywood with 2x wood on the top and one layer Spray Applied Fire Resistive Materials (CAFCO 300-1.25") on the exterior with brick facing.

Figure 1: Proposed Assembly



Assembly Analysis

The Beam assembly was compared to UL N706 (Exterior Membrane), N501 (Interior and Bottom Membrane), L550 (Top Membrane), tested for 2 hour fire resistive construction.

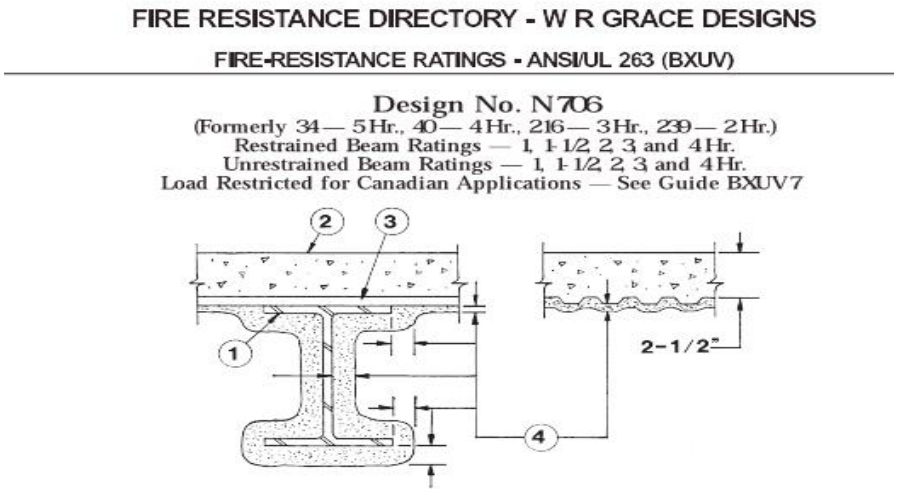


Figure 2: UL Assembly Design Number N706

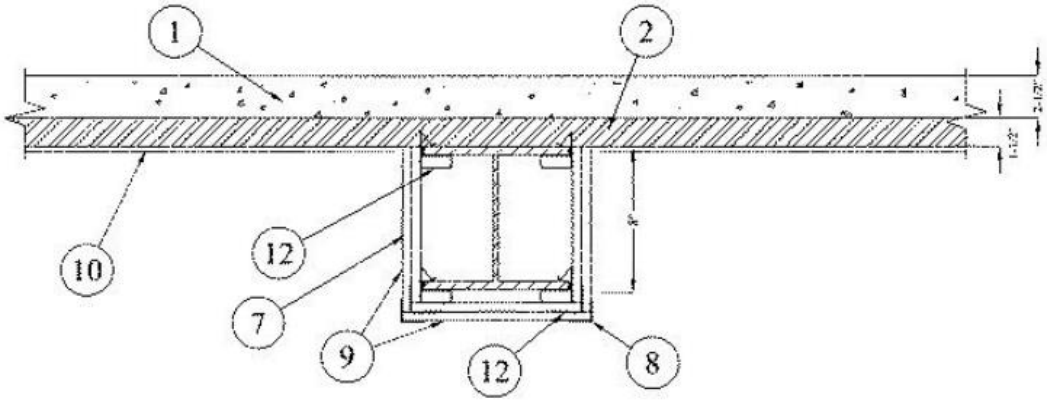


Figure 3: UL Assembly Design Number N501

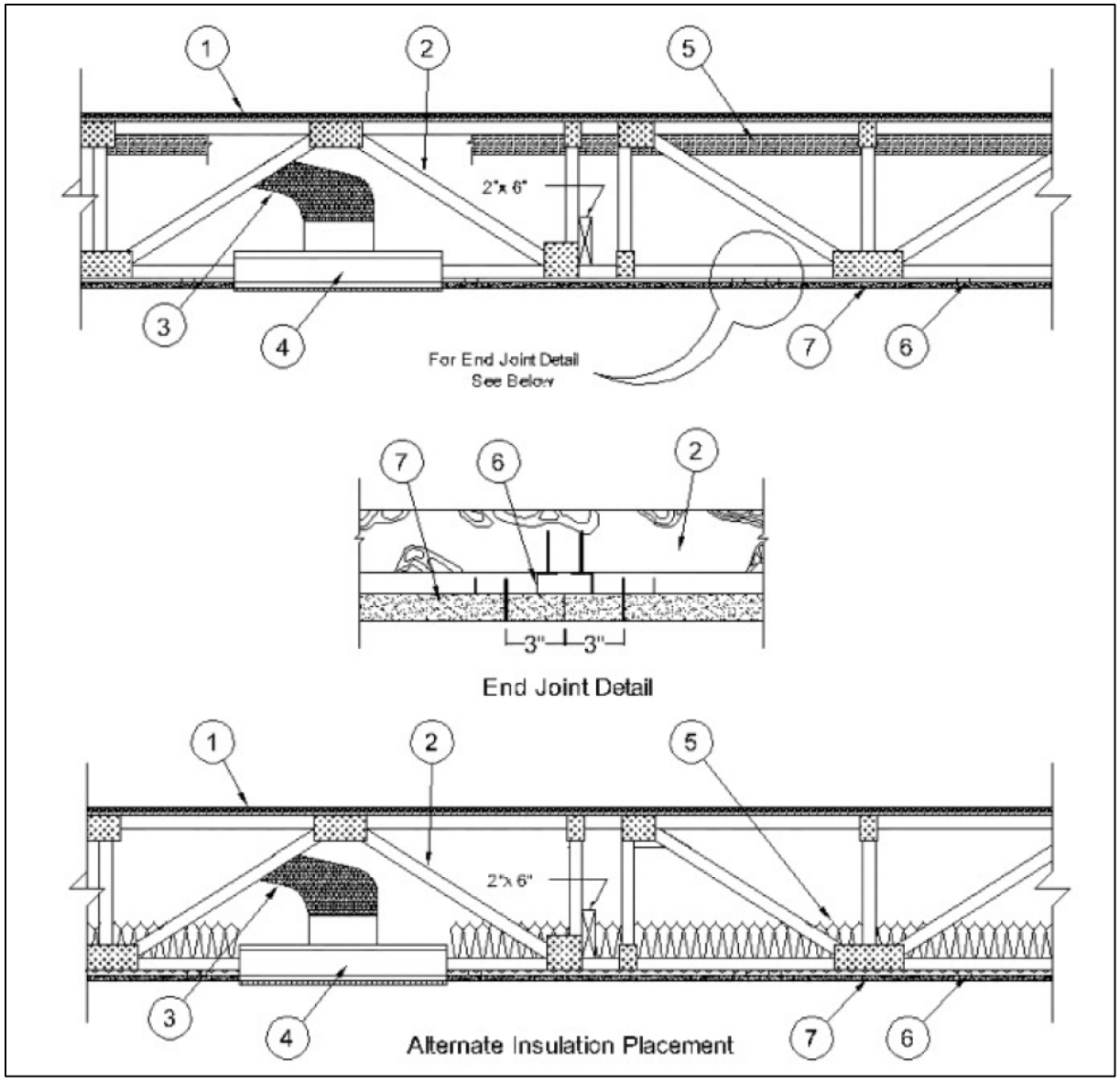


Figure 4: UL Assembly Design Number L550

Table 1: Comparison to exterior membrane construction and UL Design Number N706

Element	UL N706	Proposed Design for Landing Drive
1.Steel Beam	Min Sizing shall be W8x28 (Restrained or Unrestrained)	• W12x35 • **Meets requirements.**
2. Flooring System	• Normal or Lightweight Concrete. Unit weight 148 pcf. For lightweight concrete, unit weight 110 pcf.	**Top membrane – see analysis, Table 3, for UL L550.** • Finish Flooring – Floor Topping Mixture: 1-1/4" thickness of UL certified Gypsum Concrete. • **Not used for analysis.**
3.Steel Form and Form Units	• Min 1.5 to 3" deep cellular or fluted type, welded to beam.	**Top membrane – see analysis, Table 3, for UL L550.** • 7/8" plywood • **Not used for analysis.**
4.Spray-Applied Fire Resistant Materials	• The minimum required thickness spray-applied on all exposed surfaces of the beam	• 1.25" thickness applied on exposed surfaces of the steel beam. • **Meets requirements, max. 1.125" required.**
Fire Resistance	**1, 1-½, 2,3, or 4 Hour**	**2-Hour (Minimum)**

Table 2: Comparison to interior and bottom membrane construction and UL Design Number N501

Element	N501	Proposed Design for Landing Drive
Steel Beam	• Minimum size, a W8X24 with outside dimensions of 7-7/8x6-1/2 in. with a flange thickness of 3/8 in., a web thickness of 1/4 in., and a cross-sectional area of 7.06 sq in.	• W12x35 • **Meets requirements.**
1. Normal Weight Concrete	• 148 pcf.	**Top membrane – see analysis, Table 3, for UL L550.** • Floor Topping Mixture: 1-1/4" thickness of UL certified Gypsum Concrete • **Not used for analysis.**
2. Steel Floor and Form Units	• 1-1/2 in. fluted type, welded to beam.	**Top membrane – see analysis, Table 3, for UL L550.** • 2 x Member • **Not used for analysis.**
3. Drill Screw	• No. 8-18 by ½" long Phillips panhead drill screws, self-drilling and self-tapping, made of case-hardened steel.	• Separation of steel beam from gypsum board provided by the following protection layers. o 3 ½" fiberglass batt insulation o 5/8" gypsum sheathing o Metal panel over galv. 'Z' channel. • **Provides equivalent protection of beam from fire source by thermal transmission. Meets requirements.**
4. Runner Angle	• 24 MSG galv. Steel with 1 and 2-in. legs. Fastened to steel deck 12 in. O.C. with Item 3.	
5. Channel Bracket	• Fabricated from 25 MSG galv. Steel, 1-11/16 in. deep with 1-in. legs and spaced 24 in. O.C. Fastened to runner angles with Item 3.	
6. Corner Angle	• Same material as Item 4, fastened to channel brackets with Item 3.	

7. Gypsum Board*	• 5/8 in. thick. First layer fastened with 1-1/4 in. long, 0.150 in. diam screws spaced 16 in. O.C. Second layer attached with 1-3/4 in. long, 0.150 in. diam. screws spaced 8 in. O.C.	• Two layers of 5/8" Type X Gypsum Board. First layer fastened with 1-1/4 in. long, 0.150 in. diam. screws spaced 16 in. O.C. Second layer attached with 1-3/4 in. long, 0.150 in. diam. screws spaced 8 in. O.C. • **Meets requirements.**
8. Corner Bead	Fabricated from 20 MSG galv steel to form an angle with 1-1/4 in. legs. Legs perforated with 1/4 in. diam holes approx 1 in. OC. Attached to wallboard with special crimping tool approx 6 in. OC. As an alternate, the bead may be nailed to the wallboard.	• Fabricated from 20 MSG galv. steel to form an angle with 1-1/4 in. legs. Legs perforated with 1/4 in. diam. holes approx 1 in. OC. Attached to wallboard with special crimping tool approx 6 in. OC. As an alternate, the bead may be nailed to the wallboard. • **Meets requirements.**
9. Joint Compound	• 1/32 in. thick on bottom and sides of wallboard from corner beads and feathered out. Paper tape embedded in joint compound over joints with edges of compound feathered out.	• 1/32 in. thick on bottom and sides of wallboard from corner beads and feathered out. Paper tape embedded in joint compound over joints with edges of compound feathered out. • **Meets requirements.**
10. Protective Material — Spray-Applied Fire Resistive Materials*	• Spray applied to the underside of the steel floor units, filling the flutes of the units and providing a smooth ceiling which was 1/4 in. thick as measured from the bottom plane of the floor units.	**Top membrane – see analysis, Table 3, for UL L550.** • 7/8” plywood subfloor in lieu of steel floor units. • **Not used for analysis.**

12. **Alternate Construction - Steel Framing Members —**	• Steel clips attached to both sides of beam flanges 2 ft OC and at ends of beam. First layer of gypsum board fastened to steel clips with 1-1/4 in. long Type S drywall screws. 2 in. by 2 in. 25 MSG angle fastened to clips on bottom portion of assembly with 2 in. long Type S drywall screws. Second layer of gypsum board fastened to angle and steel clips with 2 in. long Type S drywall screws, spaced 2 ft OC. Screws are self-drilling and self-tapping Phillips head made of casehardened steel.	• **Not used for analysis.**
Fire Resistance	**2-Hour**	**2-Hour (Minimum)**

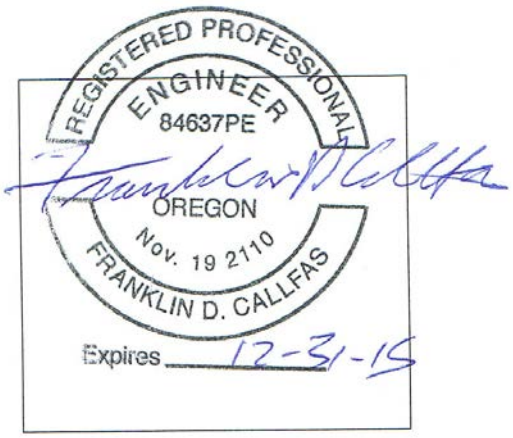
Table 3: Comparison of Top Membrane and UL Design Number L550

Element	UL L550	Proposed Design for Landing Drive
1. Flooring System	Flooring system option No. 2 (out of 11 options) • Subflooring: Min 23/32 in. thick plywood with T & G edges. • Finish Flooring – Floor Topping mixture: Min 3/4 in. thickness of floor topping mixture having a min compressive strength of 1100 psi. Proprietary UL certified Gypsum Concrete.	• Subflooring: 7/8” thick plywood. • Finish Flooring – Floor Topping Mixture: 3/4” thickness of UL certified Gypsum Concrete. • **Provides 1 hour membrane protection, meets requirements.**
2. through 8.	2. Trusses 3. Air Duct 4. Damper 5. Batts and Blankets 6. Resilient Channels 7. Gypsum Board 8. Finishing system	• Not provided in assembly. • **Not used for analysis.**
Additional protection	• Not provided	• 2x blocking. • **Provides 1 hour protection.**
Fire Resistance	**1-Hour**	**2-Hour (Minimum)**

Conclusion

The assembly, evaluated through conservative evaluation methods, will provide minimum 2-hour fire resistive protection for individual encasement of the beam. The proposed assembly meets the requirements of the 2010 OSSC.

Therefore it is our opinion that the proposed design for the exterior assembly at Landing Drive will provide 2-hour fire rated protection.



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