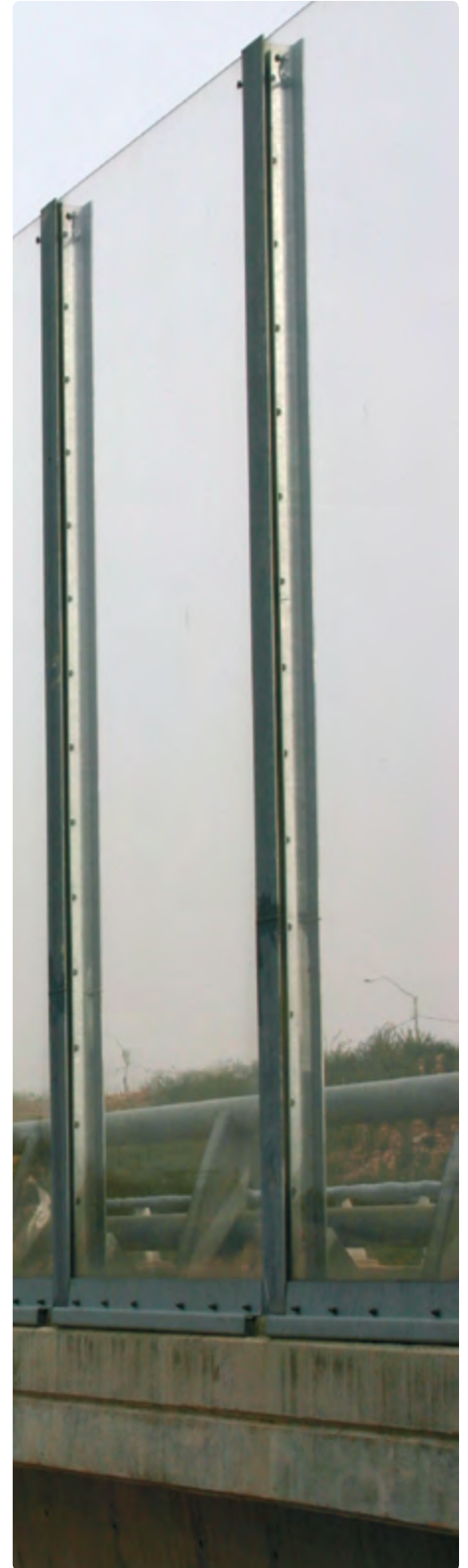




Transparent Acoustic Barriers



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About Palram

A Global Leader in Thermoplastic Sheets and Panels

Palram Industries Ltd. is a leading multinational manufacturer of thermoplastic panels, mainly from polycarbonate, PVC and acrylic. The products are used in a wide variety of applications and projects around the world, including the following market sectors: building and construction, architectural projects, advertising and printing, agriculture, fabrication and DIY. Palram's global presence and advanced technological abilities allow us to provide our customers with competitive products, while maintaining a high level of service. Palram delivers excellence to a global marketplace, backed by professional support and service on both local and regional levels. Palram is proud of its unique corporate culture that makes us agile, creative and committed to all our customers.

Architectural Project Support

In the last two decades, the Palram Project Support Center has helped specify, adapt, support and facilitate architectural challenges around the globe. Among the Center's team members are civil engineers, designers, technical supporters, plastics engineers and others. The team offers a bundle of professional services based on accumulated experience in medium and large scale projects, a part of which are displayed here.

Services for Architects

Planning Stage

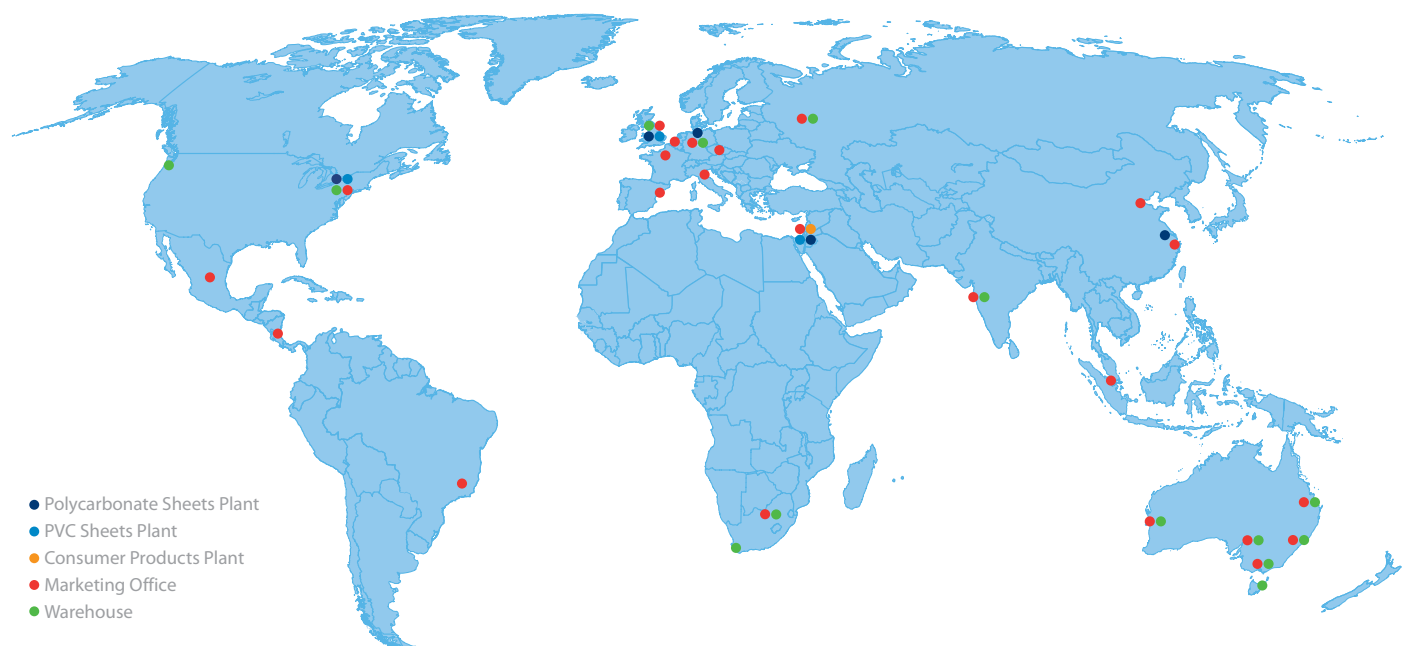
- Quick matching of product specification per project
- Adapting plans while preserving the architect's vision
- Creating specific planning details for architects
- Professional consultation on planning meetings
- Expert advisory on materials and engineering
- Creating conceptual designs for given structures

Implementation Stage

- Creating specific installation guidelines per project
- On-site support at important execution stages
- Background construction engineering supervision
- Conducting special seminars upon request

Global Presence

Palram operates production plants in Europe, America and Asia, allowing close logistic support and supply of panels.



Introduction

Acoustic barriers, or noise walls, are exterior structures designed to protect sensitive land areas from noise pollution. They are the most effective method of reducing roadway, railway, and industrial noise sources without effectively changing the noise source itself. Transparent acoustic barriers neutralize the shortcomings of opaque barriers by allowing a clear view of the countryside or urban landscapes and admittance of sunlight, thus preventing a sense of closure or disconnection while providing a significant reduction of both acoustic and environmental pollution.

Main Purposes of Transparent Acoustic Barriers

- Create noise barriers between high traffic and populated areas
- Maintain visibility and landscape sequence
- Provide lightweight and efficient solution for bridges, in comparison with complete concrete designs
- Provide lightweight extensions for concrete walls

Palram Transparent Flat Sheets for Acoustic Barriers

PALGLAS® flat extruded acrylic and PALSUN® solid polycarbonate sheets are installed in dozens of acoustic barriers around the globe. The sheets offer:

- **Low weight:** Less than half the weight of glass with similar thickness
- **High transparency:** Matching that of the clearest glass.
- **Durability:** High resistance to impact and vandalism (PALSUN).
- **Weatherability:** Excellent resistance to UV radiation and extreme outdoor conditions.
- **Flexibility** that allows curving, bending and shaping without any special treatment.
- **Compliance** with international standards.



Considerations for Transparent Acoustic Barriers

Acoustic Barriers Standardization

Standards EN-1793 and EN-1794 are designed to test all characteristics required for acoustic barriers; the first relates to acoustic properties and the second to other requirements such as wind load, flammability, impact resistance and light transmission. Palram's PALGLAS and PALSUN were tested and approved in accordance with the aforementioned standards.

Reducing Noise Pollution

Noise levels beyond 80 dB (Decibels) causes high levels stress, loss of attention, physiological changes and other effects. While Normal pleasing sound level is around 30 dB and normal environmental noise is between 40-60 dB, the noise generated by a busy 6 lane highway can reach up to 115 dB, which is unbearable for humans on long term exposure. Transparent acoustic barriers can reduce noise levels by over 30 dB, which can make the difference between a bearable and unbearable environment. Sheet thickness directly effects the level of noise it will reduce. For acoustic test results of Palram sheets please refer to pages 6-7.

Transparency of the Barrier Glazing

Virgin (unused) sheets have low haze level (~1%). Haze level of all transparent sheets, including acrylic and glass, is highly effected by smog, dust and chemicals that are present in the environment. In order to maintain low haze (high clarity) certain guidelines have to be maintained in the installation. Following these guidelines will allow the transparent wall to maintain its optical properties for many years.

Impact resistance

Maximum impact parameters should be taken into consideration when designing an Acoustic Transparent Barrier. Anticipated scenarios should include automotive accidents and various collisions, as well as vandalism (Break from stone impact, hammers, etc.).

Life expectancy

Weatherability & UV Resistance

Harmful UV rays and other weathering effects may cause deterioration in the performance and appearance of the sheet over very long periods. Please consult with your PALRAM representative to ensure selection of a most suitable product for your requirements.

Chemical resistance in a highway environment

The main chemicals present in the highway environment are Sulfuric compounds: NO_x, CO, and H₂O. Trace quantities of O₃ (Ozone) from ignition systems are also found. In addition to these chemicals there are continuous clouds of particulate matter such as dust (usually silicates), soot (partly oxidized hydrocarbons) and salt from anti freeze powders. Fortunately, PALGLAS is not particularly sensitive to these. The main damage to the sheet is surface coating by particulate matter and acidic etching that might make the sheet hazy. The main goal of maintaining the glazing clear is protecting it from a "Highway soup" of dust, smoke and water.

Warranty

PALGLAS and PALSUN sheets for acoustic barriers are warranted against breakage and light transmission loss for 10 years.

Installation considerations

Frame size

It is recommended to limit the width of a single glazing panel to 2 meters due to several reasons:

- Strength requirement of the metal frame: In lengths over 2m, the forces induced by the sheet on each post is so high that a very thick, unattractive and heavy metal frame is required.
- Rabbet depth must be increased in order to prevent sheets from displacement during high wind loads.

Framing Method

Sheets must be installed floating in a frame, as glass. It is not allowed to fix the sheet with screws or rivets due to the stresses that such methods induce. Standard glazing frames and profiles for PALGLAS & PALSUN can be suitable, using adequate EPDM profiles. For safety reasons one screw can be attached to every sheet to secure it in cases of extreme impact. The screw should be 10-12 mm diameter and the hole should be well oversized. ***The safety screw should not touch the sheet or limit its thermal expansion.***

Architectural Considerations

To reduce light transmission a tinted sheet can be used. This will also help to hide the dust and smoke contaminating the sheet. PALRAM recommends 50%-60% LT at any standard color supplied (many other colors can be supplied upon request). Install the sheets as far away from pollution sources as possible. The heavy smog on jammed intersections and bridges or in polluted industrial areas will cause any transparent sheet to lose its transparency very rapidly.

Cleaning

As for today we do not know of any successful method to clean plastic Acoustic Barriers from pollution and graffiti. So for the time being the best method is preventive care as explained above.

Summary

The following guidelines should be considered when planning a transparent acoustic barrier:

- The Sheets width should not be more than 2 meters.
- Install the sheets at least 5, preferably 10 meters away from traffic, the further the better.
- Provide physical barriers of green fences, protection walls or trenches between the sheet and the road.
- Where severe graffiti and vandalism is expected, lift transparent parts of the wall 2-3 meters above ground.

Installation of PALGLAS Clear 20mm in Road 6 highway project- Israel



PALGLAS® Flat Extruded Acrylic Sheet

Main Features

- Thickness suitable for acoustic barriers: 15-25mm
- Inherently resistant to the effects of UV radiation
- Transparent- Above 90% light transmission in clear sheet
- Can be formed and fabricated
- Good chemical resistance: Withstands vehicle gas emissions and graffiti
- Available with matte surface for anti-glare effect

Sound Insulation

PALGLAS sheets achieved the following results in tests under EN-1793 standard:

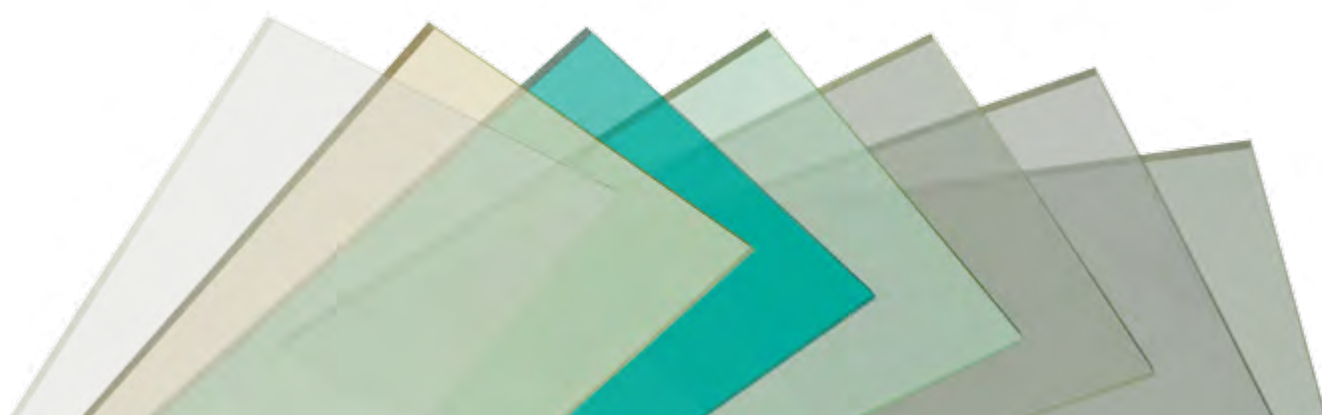
Sheet Type	Noise Reduction
PALGLAS 15mm	32
PALGLAS 20mm	34

Transparency

Light transmission of clear PALGLAS ranges from 90-93%, depending on thickness. Tinted sheet offer limited light transmission when it is preferred. Typical PALGLAS tints are Bronze and Solar Grey (each of them specified with 50% light transmission).

Weatherability

PALGLAS is inherently resistant to UV radiation and is completely immune to its harmful effects. This property is a natural part of the acrylic sheet, with no requirement to any UV protective layer.



PALSUN® Flat Solid Polycarbonate Sheet

Main Features

- High impact resistance - Virtually unbreakable
- Weather and UV resistant
- Wide service temperature range
- Blocks harmful UV radiation
- Versatile, formable, and machinable
- Available with matte surface for anti-glare effect

Sound Insulation

PALSUN sheets achieved the following results in tests under EN-1793 standard:

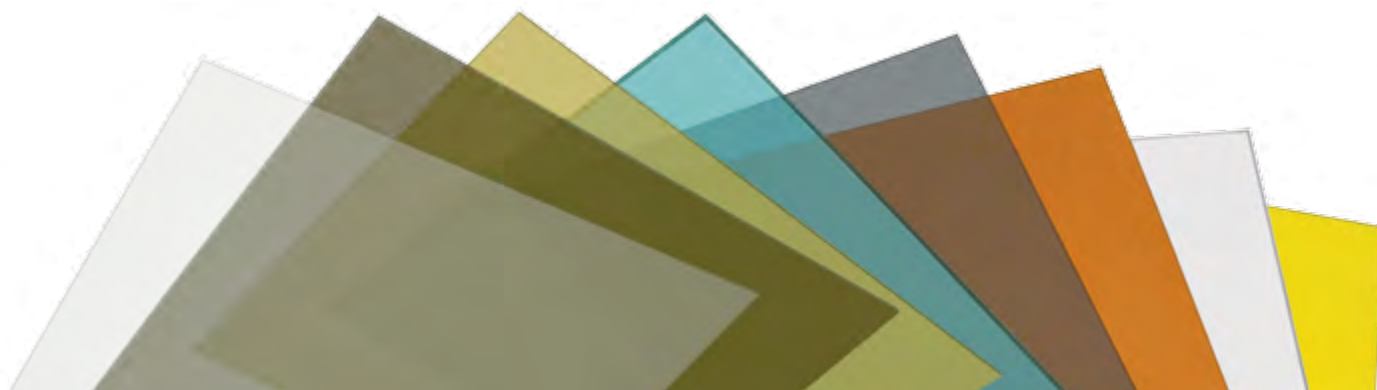
Sheet Type	Noise Reduction
PALSUN / PALGARD 12mm	31
PALSUN / PALGARD 15mm	33

Transparency

Light transmission of clear PALSUN ranges from 89-90%, depending on thickness. Tinted sheet offer limited light transmission when it is preferred. PALSUN is offered in numerous colors as standard (see product brochure for more information).

Weatherability

PALSUN is produced with UV protective layer on one or both sides. Additionally, PALSUN blocks 99.9% of harmful UV radiation.



Acoustic Barrier Projects

Project: Eastlink Road - Melbourne, Australia (2007) | Barrier Glazing: PALGLAS® 20mm Custom Green & Orange



Project: Geelong Ring Road - Victoria, Australia (2008) | Barrier Glazing: PALGLAS® 20mm Custom Orange & Purple



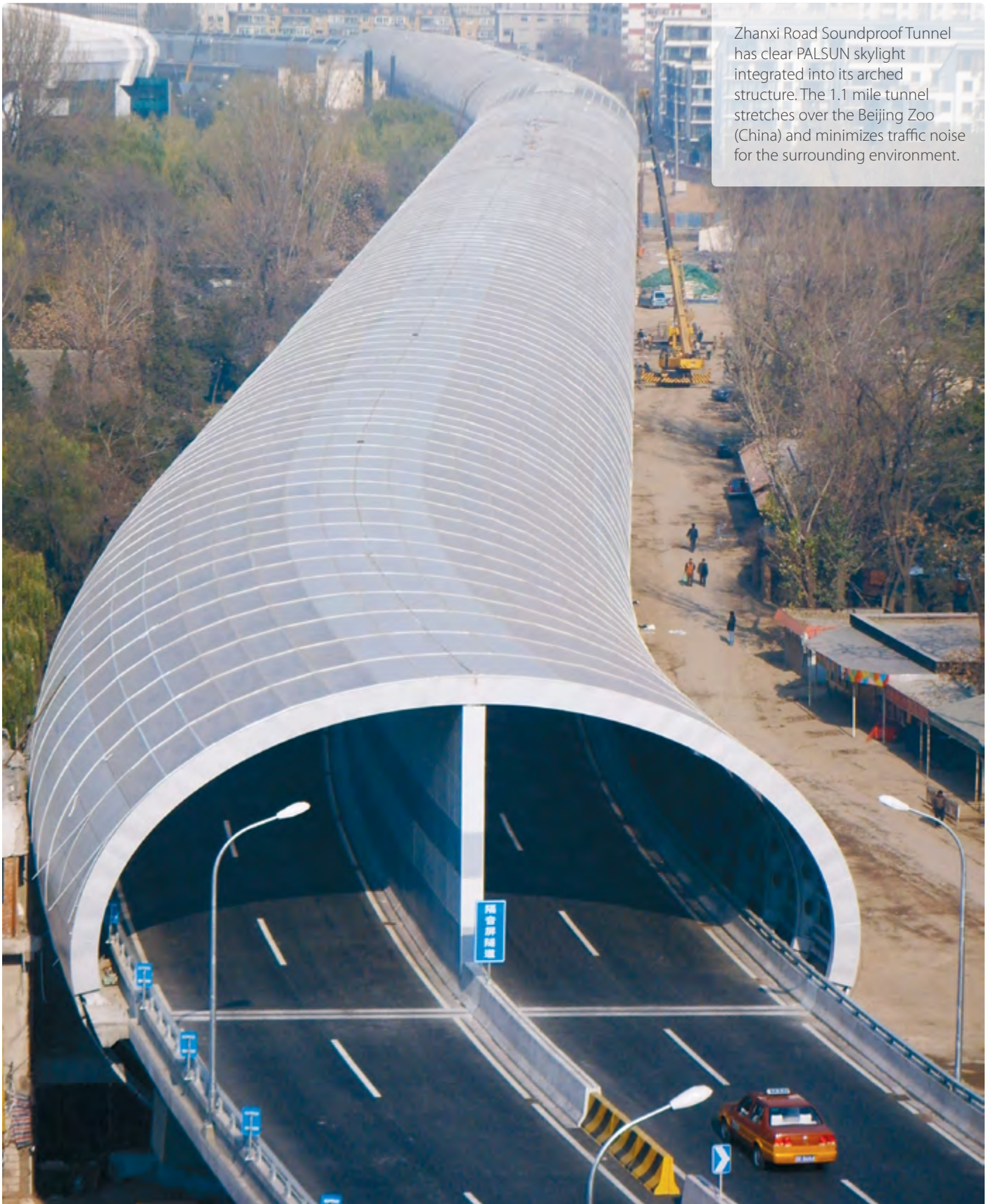
Project: Beijing Ring Road 6 - China (2006) | Barrier Glazing: PALSUN® 6mm Clear



Project: Lai Chi Kok Viaduct - Hong Kong, China (2006) | Barrier Glazing: PALGLAS® 15mm & 18mm Clear & Light Blue



Project: Zhanxi Road Soundproof Tunnel - Hong Kong, China (2005) | **Barrier Glazing:** PALSUN® 10mm Clear

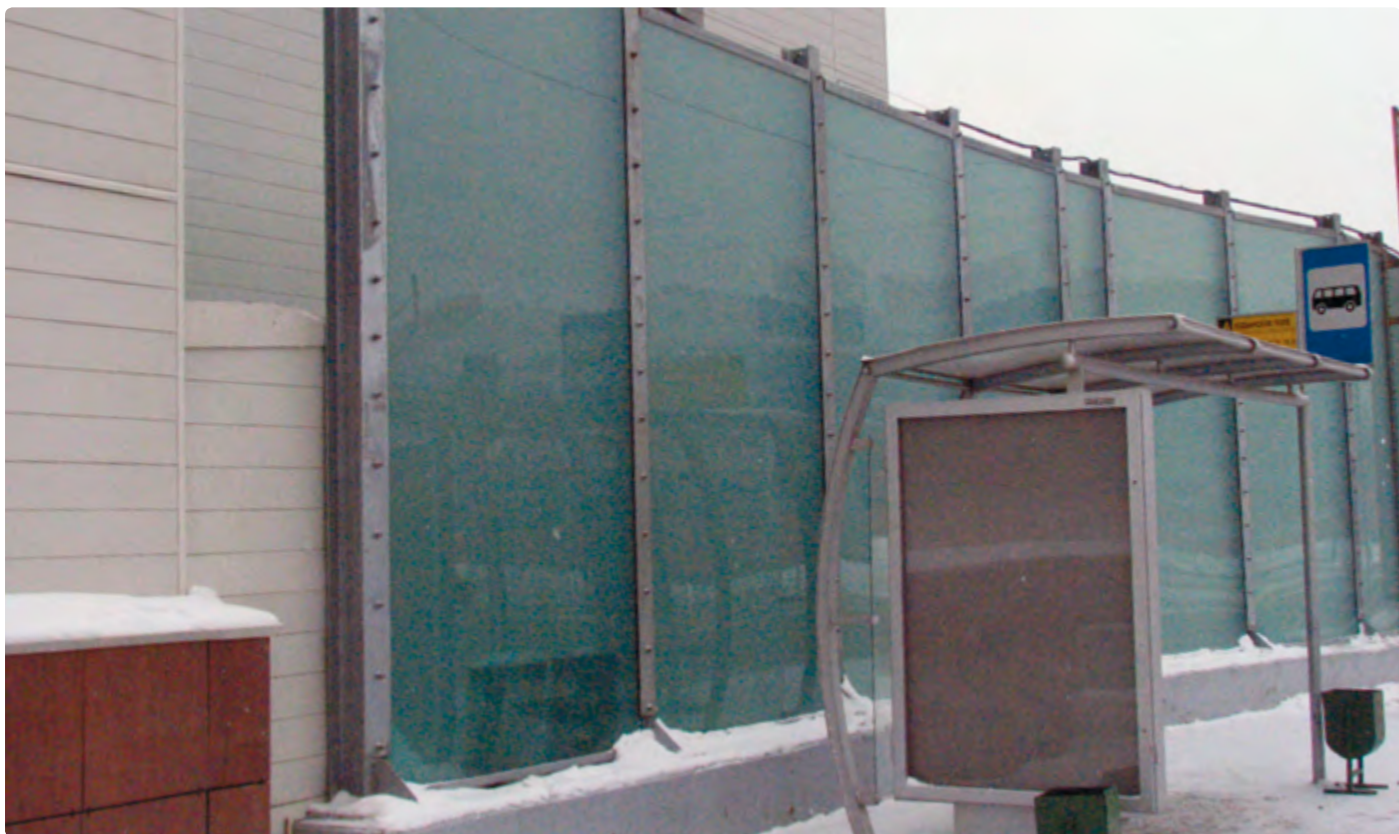


Zhanxi Road Soundproof Tunnel has clear PALSUN skylight integrated into its arched structure. The 1.1 mile tunnel stretches over the Beijing Zoo (China) and minimizes traffic noise for the surrounding environment.

Project: Police Dog Pound - Hong Kong, China (2005) | Barrier Glazing: PALSUN® 12mm Clear



Project: Urban Acoustic Barrier - Moscow, Russia (2007) | **Barrier Glazing:** PALGARD™ 12mm Translucent Green



Project: Road 6 Cross-Country Highway - Israel (2004) | **Barrier Glazing:** PALGLAS® 20mm Clear



Project: Netania Interchange - Israel (2002) | Barrier Glazing: PALGLAS® 15mm Clear



Project: Kfar Saba Interchange (Road 531) Israel (2002) | **Barrier Glazing:** PALGLAS® 20mm Clear



Project: Ayalon/Holon Interchange - Israel (2003) | Barrier Glazing: PALGLAS® 20mm Clear



Project: Ayalon Road System - Tel Aviv, Israel (2000) | Barrier Glazing: PALGLAS® 20mm Clear



Project: Tai Po Project - Hong Kong, China (2009) | **Barrier Glazing:** PALGLAS® 15mm Green Matte

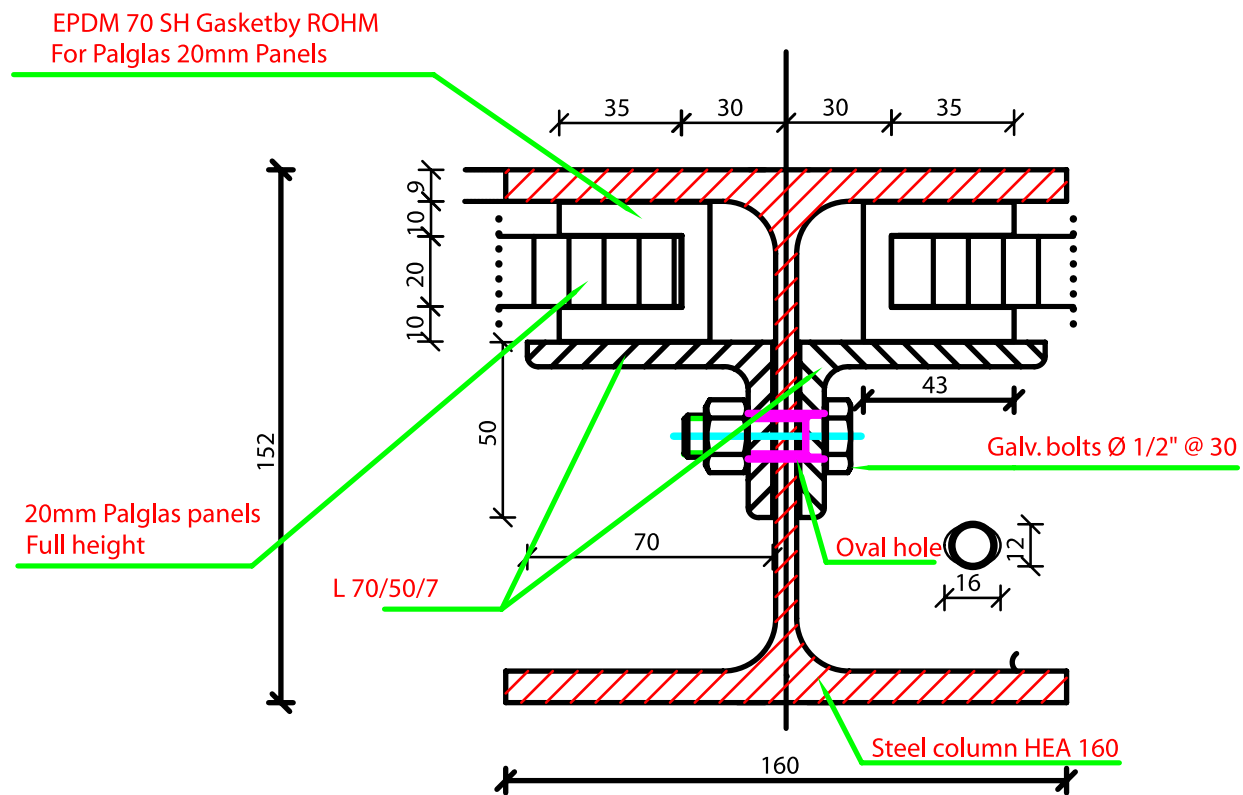


Project: Kowloon Bay MTR (Metro Station) - Hong Kong, China (2008) | Barrier Glazing: PALGLAS® 20mm Grey

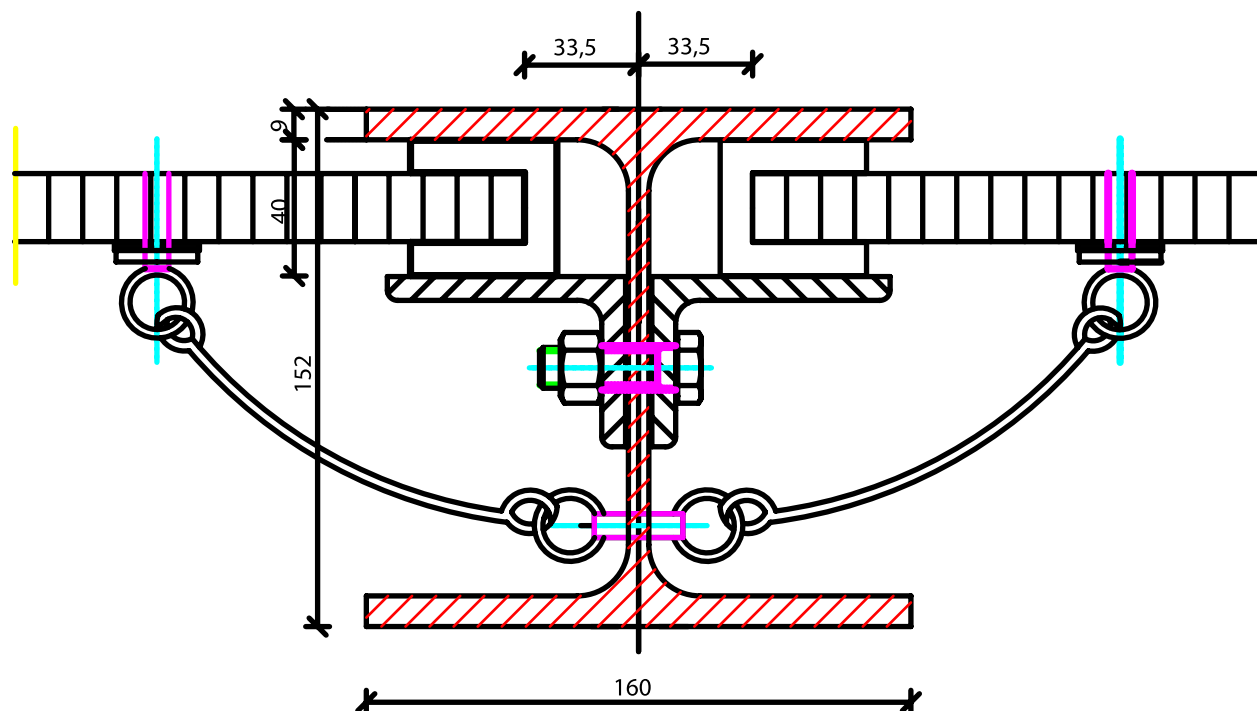


Typical Installation Details

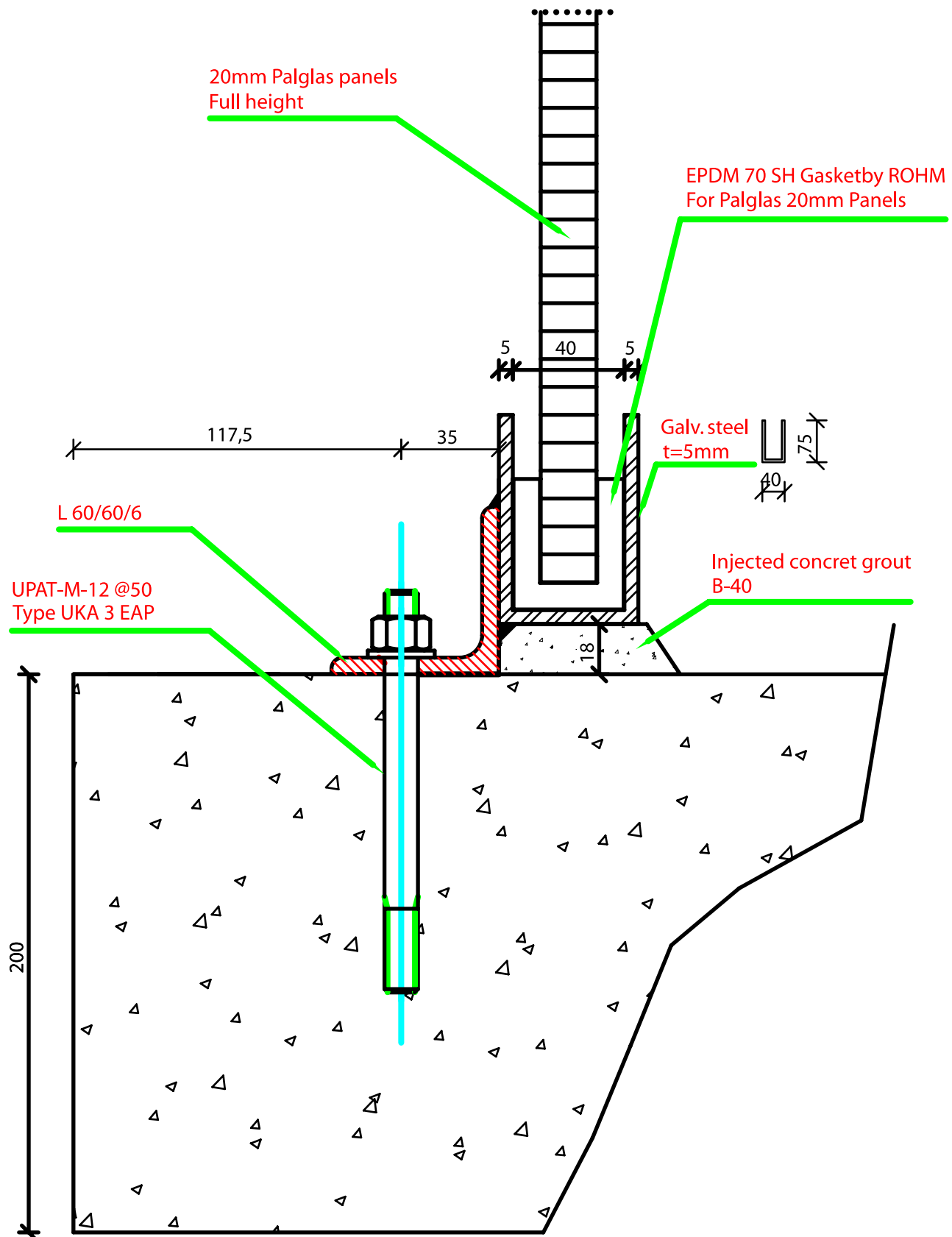
Typical PALGLAS® Connection Detail



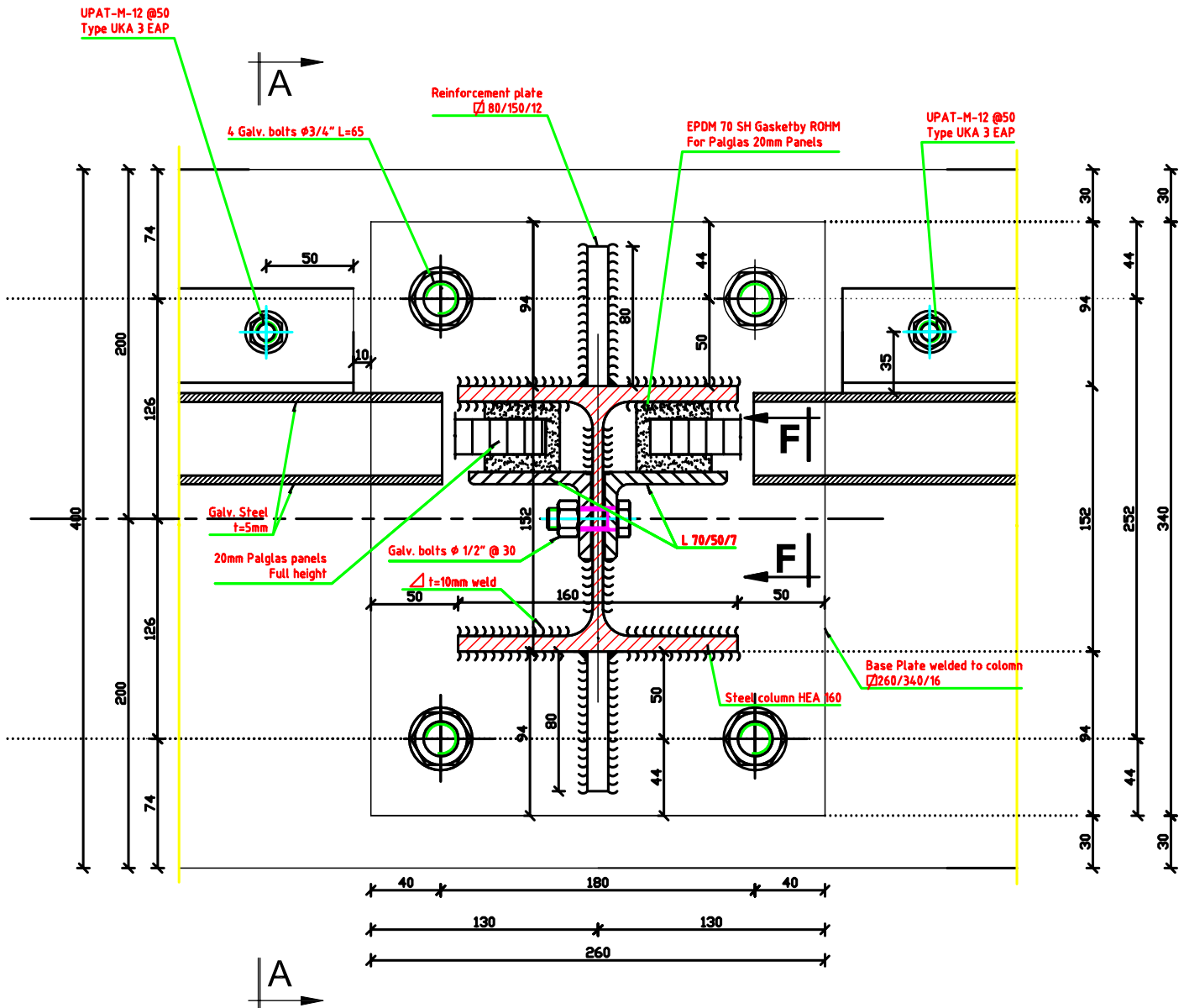
Acoustic Wall Safety Wire



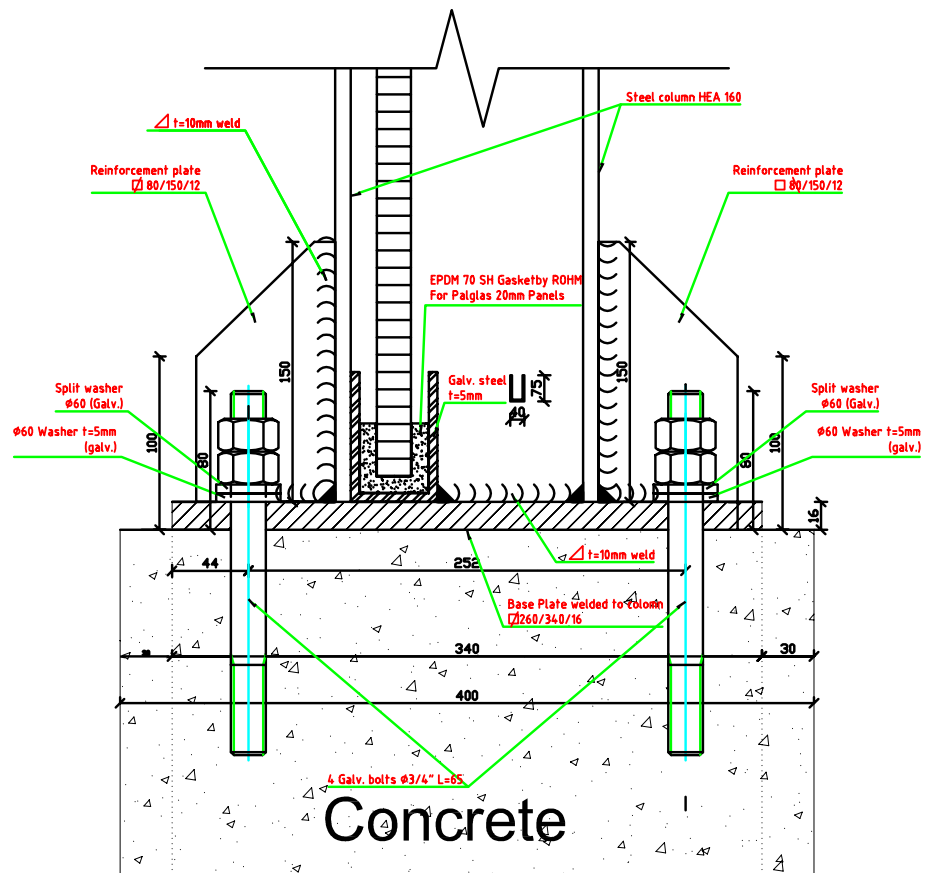
PALGLAS® Lower Fixing to Concrete Detail



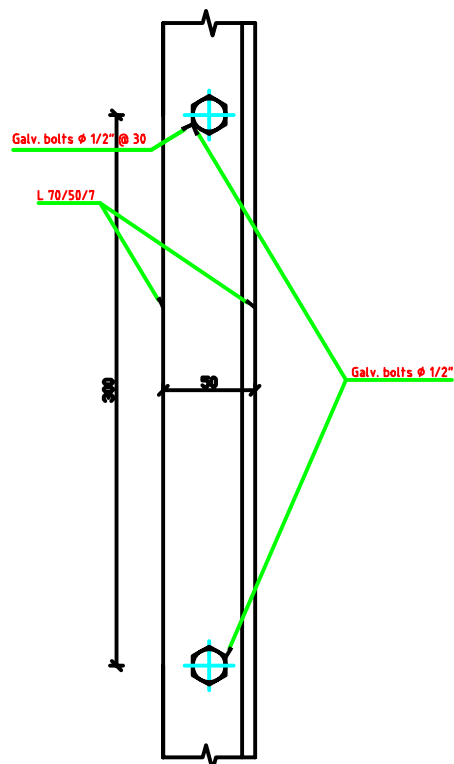
Steel Column Detail



Steel Column Detail - Cross Section AA



Steel Column Detail - Cross Section FF





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**PALRAM H.Q.**

Tel: +972 4 8459900
Fax: +972 4 8444980
palram@palram.com
www.palram.com

PALRAM EUROPE LTD.

Tel: +44 1302 380777
Fax: +44 1302 380778
sales.europe@palram.com
www.palram.com

PALRAM AMERICAS

Tel: 610 2859918
Fax: 610 2859928
palramamericas@palram.com
www.palramamericas.com



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