

# Inventory tools and strengthening measures for historical French metallic train sheds (1843-1931)

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# Research framework: PhD project “Study of the structural behaviour of riveted lattice beams in French train sheds of 1850-1930: between history and renovation”

PhD funded by AREP, subsidiary of French railway company SNCF, and the ANRT (Association Nationale de la Recherche et de la Technologie) through a Cifre contract (Industrial Agreements for Training through Research).



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Gare de Bayonne, built in 1868, refurbished in 2013.  
Photo: SNCF-AREP.

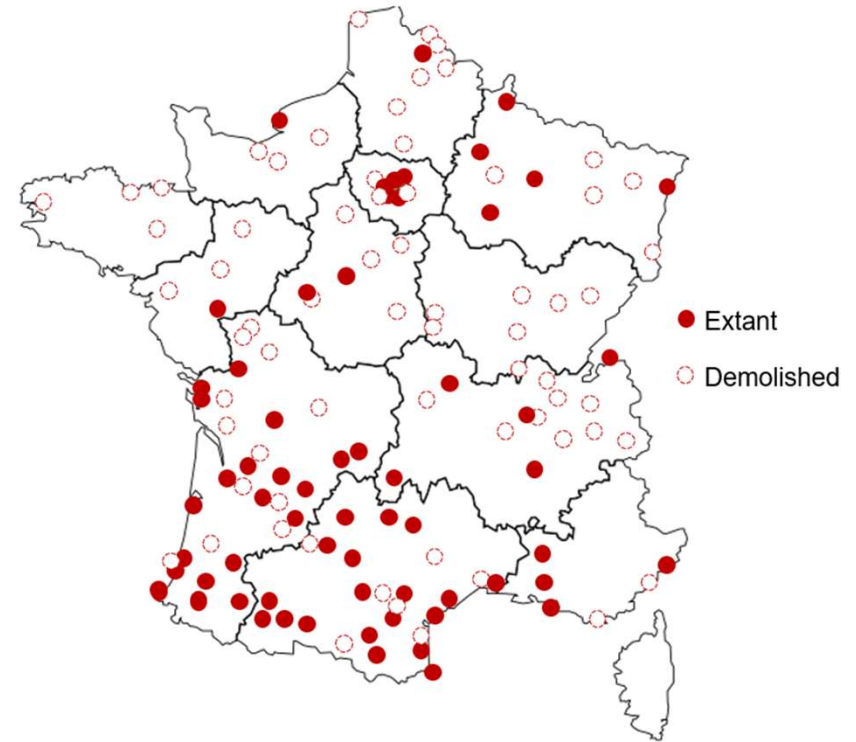


Gare de Perpignan, built in 1896, refurbished in 2013.  
Photo: SNCF-AREP.



## French metallic train sheds: a large heritage in need of refurbishment

- ~170 metallic train sheds were constructed in France in the period 1843 – 1931\*.
- ~70 extant historical train sheds are still in service\*.
- 50% of extant historical train sheds were refurbished more than 20 years ago. They need to be refurbished for basic repair purposes and to address climate issues\*.

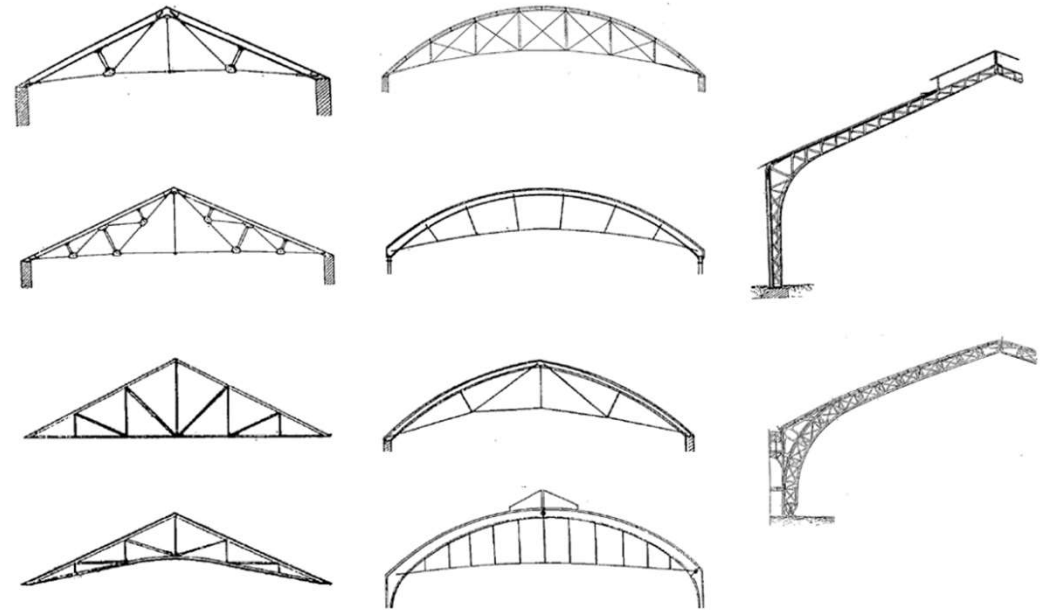


\*Emile, A. & Veston, V., Les "Grandes Halles Voyageurs" : une architecture durable, *Patrimoine industriel*, 75–83 (Dec. 2020).

Map of extant and demolished historical metallic train sheds (© AREP)

# How to make an inventory of train sheds? Using the typology of the roof trusses.

- The roof trusses are the main load-bearing elements covering the span.
- The typology of the roof trusses is the classic tool used to itemize train sheds.
- Many different approaches exist in the literature to classify roof truss typologies:
  - Trusses inspired by wooden trusses or stone arches\*
  - Trusses with straight or bent components\*\*
  - Trusses with or without tension ties\*\*\*



\*Schädlich C., *Das Eisen in der Architektur des 19. Jahrhunderts*, 2015, Geymüller.

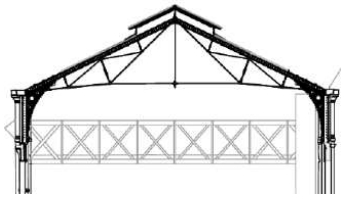
\*\*de Bouw M., *Brussels Model Schools (1860-1920) - Structural Analysis of the Metal Roof Trusses*, PhD thesis, 2010.

\*\*\*Cordeau A. L., *Charpente en fer et serrurerie. Guide des Constructeurs : traité complet des connaissances relatives aux constructions* (7e édition), 1901, E. Lévy.

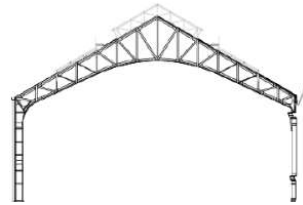
Examples of typologies presented by Cordeau, 1901\*\*\*

# How to make an inventory of train sheds? Using the typology of the roof trusses.

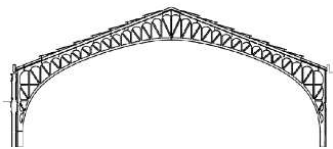
→ 4 main types of roof trusses prevail in France: a more specific classification can be used for the inventory of French train sheds\*.



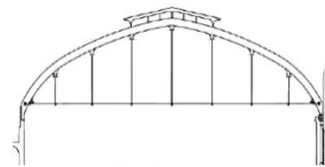
■ Polonceau



■ Triangulated truss

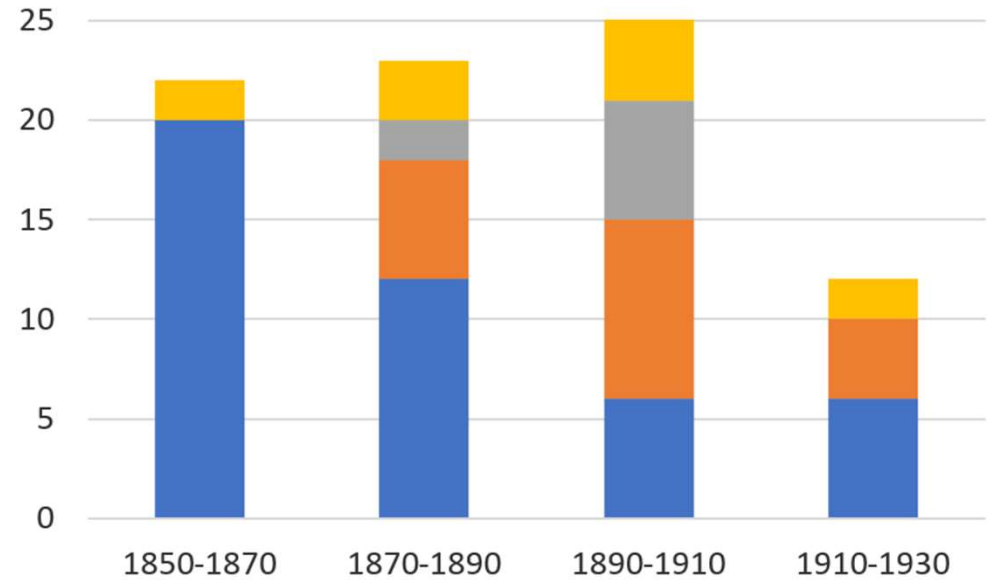


■ de Dion



■ Arch

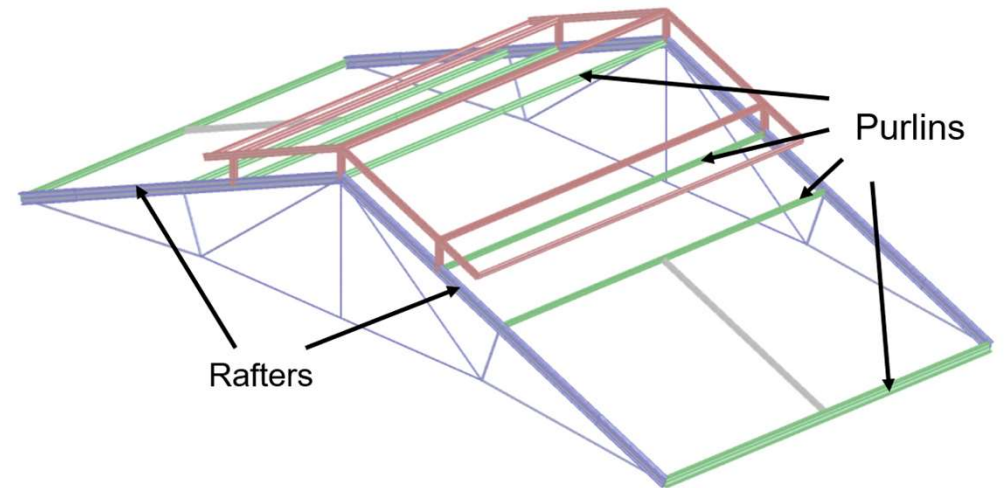
\*Emile, A. & Veston, V., Les "Grandes Halles Voyageurs" : une architecture durable, *Patrimoine industriel*, 75–83 (Dec. 2020).



Number of individual train sheds built with each roof truss typology according to the construction period.

## How to make an inventory of train sheds? Using the typology of lattice beams.

- The lattice beams used both as **purlins** and **rafters** are also distinctive structural elements.
- Purlins and rafters are “secondary” structural elements compared to the main roof trusses.
- The purlins are the longitudinal beams of the roof structure.
- The rafters are the elements within the main roof trusses that follow the shape of the roof.



## How to make an inventory of train sheds? Using the typology of lattice beams.

→ Examples of lattice purlins



Gares de Montauban et Tours. Photos: SNCF-AREP.

→ Examples of lattice rafters



Gares d'Evian et Dax. Photos: SNCF-AREP.



## How to make an inventory of train sheds? Using the typology of lattice beams.

→ Resulting from varied design approaches, lattice beams testify to an original construction practice and architectural style inclined towards delicacy and ornamentation, characteristic of the French heritage.

X

Crossed



Gare de Cerbère. Photo: SNCF-AREP.

IXI

Crossed  
with  
vertical  
members



Gare de Paris Austerlitz . Photo: SNCF-AREP.

N

Pratt /  
Howe



Gare d'Etampes . Photo: SNCF-AREP.

W

Warren



Gare d'Agen . Photo: SNCF-AREP.

## How to make an inventory of train sheds? Using the typology of lattice beams.

→ In Germany, lattice beams were much less prevalent. German engineers favoured more rational structures.

FRANCE



Gare de Foix, built in 1902.  
Photo : <https://fr.wikipedia.org>

versus

GERMANY

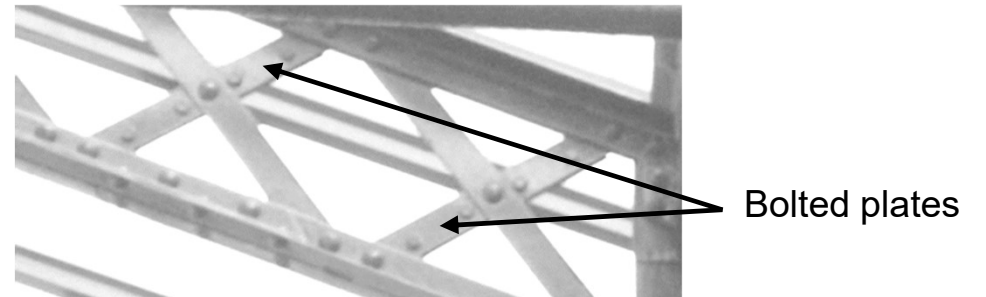
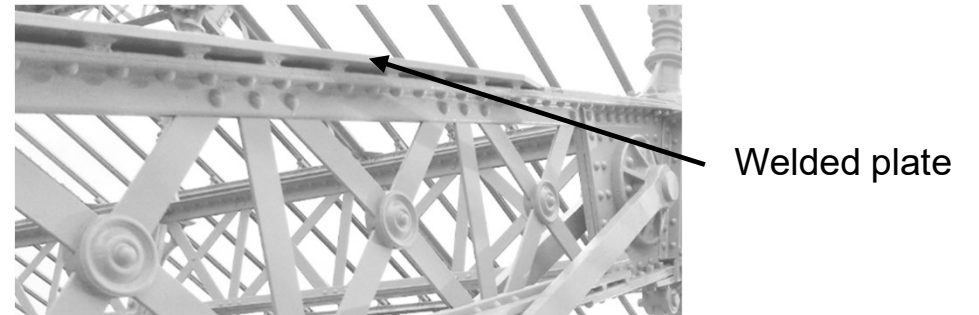


Halle Hauptbahnhof (Germany), built in 1880.  
Photo : <https://dubisthalle.de>

## Refurbishment and strengthening measures

- Refurbishment of train sheds mainly consist of:
  - Repairing and/or replacing the roofing.
  - Stripping and repainting the metallic structure.
  - Implementing strengthening measures if needed.
- In train shed renovations of the last 20 years, strengthening measures of the metallic structure mostly addressed stability problems (buckling) of the lattice beams.
- Two main strategies prevail:
  - 1) locally increasing cross-sections
  - 2) adding structural elements.

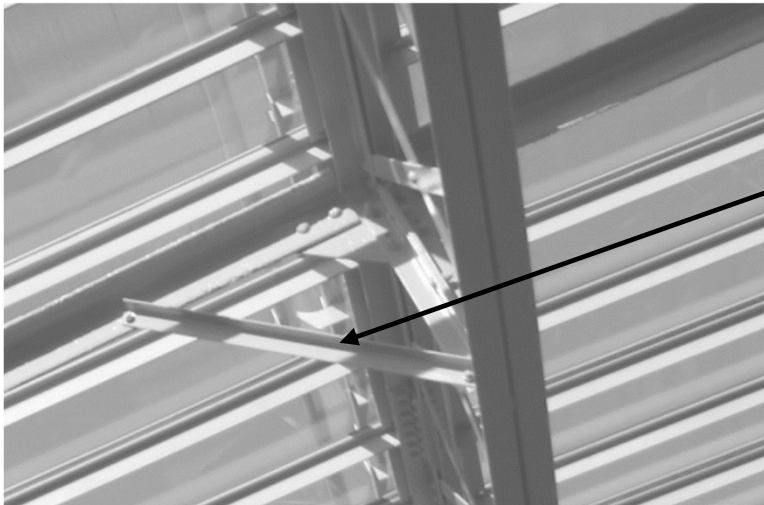
→ Strategy 1: locally increasing cross-sections



Gare d'Austerlitz (refurbished in 2015) and Gare d'Hendaye (refurbished in 2013). Photos: SNCF-AREP.

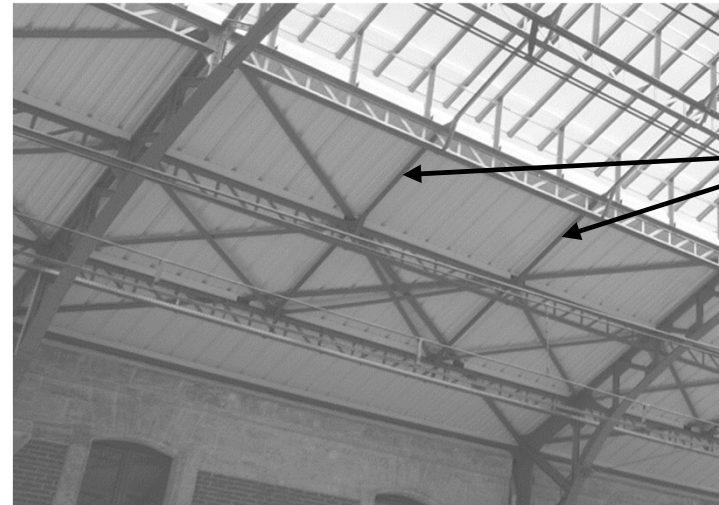
## Refurbishment and strengthening measures

→ Strategy 2: adding structural elements.



Bracket

Gare de Montauban (refurbished in 2012).  
Photo: SNCF-AREP.



Struts

Gare de Perpignan (refurbished in 2013).  
Photo: SNCF-AREP.



## Degree of heritage preservation?

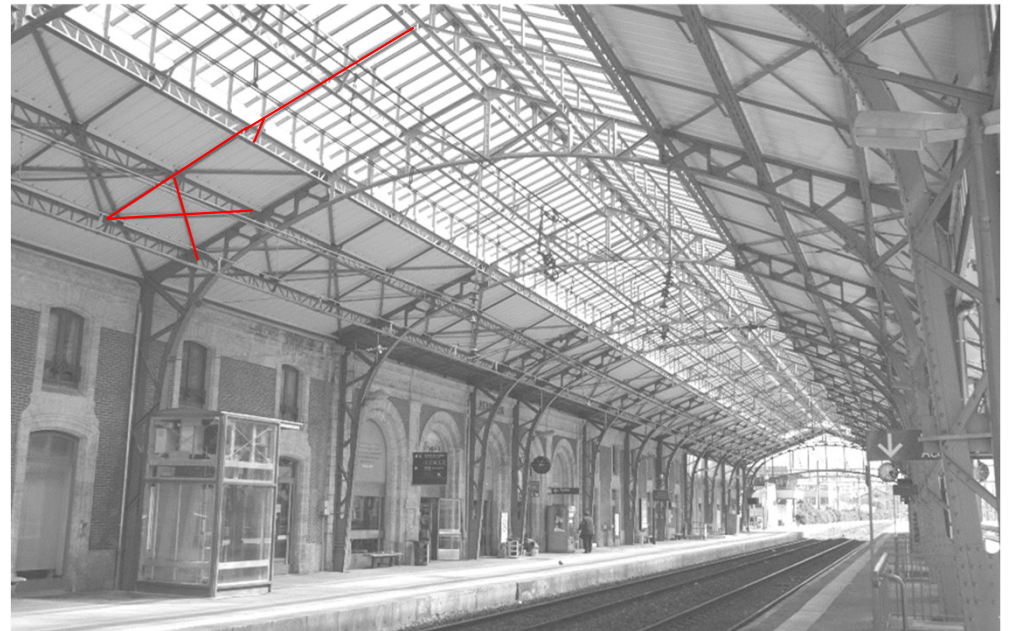
→ Lack of understanding of the original design concept and of the actual capacity today.

BEFORE



Gare de Perpignan (refurbished in 2013).  
Photos: SNCF-AREP.

AFTER



Added elements: braces, struts and brackets.



**THANK YOU!**