THE MINERAL STOREYARD CONFINEMENT STRUCTURES: A CASE STUDY

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Summary

Large span steel coverings were introduced and extensively used since the beginning of the steel construction industry, for functional necessities related to the expansion of the railways and the realization of universal exhibitions, because of the excellent strength-weight ratio which enabled to carry develop daring, low weight structures.
Trussed arches, high tensile steels and modern technological processes allowed to substantially increase spans up to overcoming the concept of covering structures and reaching the idea of confinement structures-
The paper develops the concept design of the storeyard confinement structures of ILVA's plant in Taranto (Italy).
In the case study the results of a preliminary structural analysis are presented, in order to assess the feasibility of the project depending on the chosen structural typology.

Keywords: steel-structure, large span coverings, latticed arch, confinement structures.

1. Introduction

In recent decades it developed the concept of employing steel structures of great span to partially or completely isolate dangerous sites or plant polluting activities from their neighbourhood.
As an example we can recall the confinement of the Chernobyl nuclear power plant for human and environmental safety after the well known accident [1].

The present work aims to define a concept design to confine the mineral storeyard of the ILVA steel plant in Taranto [*Figg. 1,2*], that recently has been at the centre of a political case because of dust pollution generated by the plant.

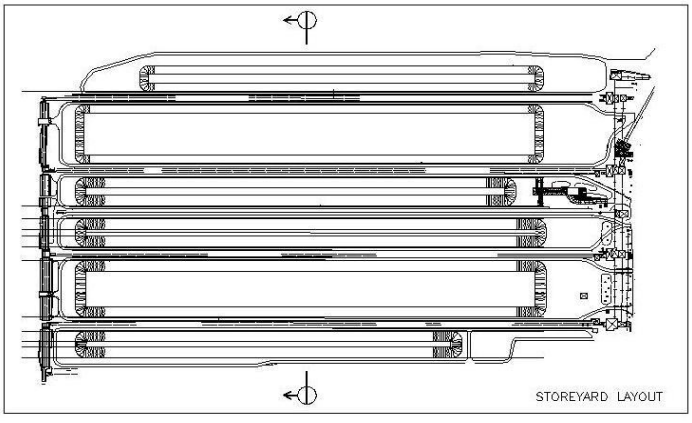

Fig. 1 – Storeyard layout

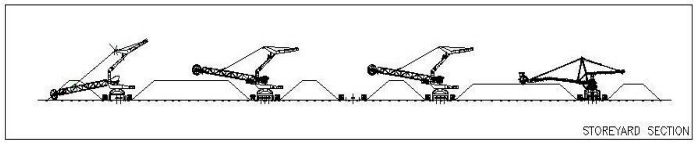

Fig. 2 – Storeyard section

2. Case study: shape, dimensions and structural design process

The area to cover [*Fig. 1*] is 840 m long and 530 m wide for a total of about 450,000 m^2.
Taking into account the layout of the heaps of raw material and the size constraints imposed by the operating machines a multiple covering with four aisles of span of about 140 m is considered.

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Two variants are evaluated [*Fig. 4*]: one with circular depressed arches with internal radius respectively of 73 m, for lateral arches, and 87 m, for interior ones, the other with parabolic arches of the same height.

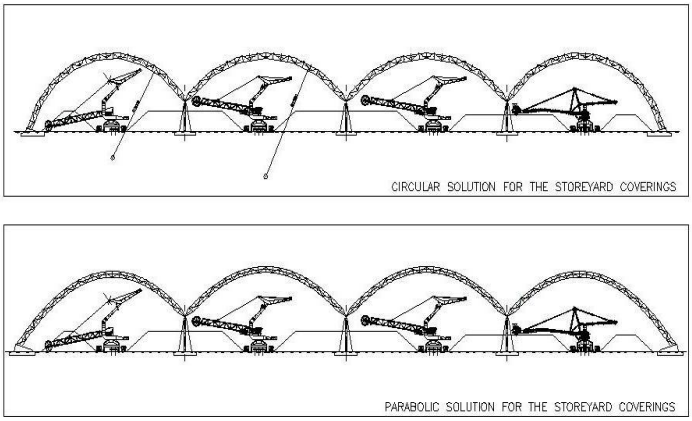

Fig. 3 – The two variants considered

In addition, with reference to the lateral arches only, two further variants are evaluated: arch double-hinged or alternatively fixed and hinged. The covering structures will be 840 m long, the arches are placed at 12 m on centre so to cover the all storeyard with 70 bays and 71 arch frames.
For these structures the analysis of the circular and parabolic arch solutions are developed both double-hinged and with fixed ends.
The structural typology is spatial latticed arch with distance between axes of the top and bottom chord 4.3 m, about 1/30 of the span.
In the two variants presented the covering structure has a span of 135 m, for the circular arch, and of 144 m, for the parabolic one, the internal height of about 54 m is the same for the two solutions.
The arch has been designed according to New Italian Standard [2] and analysed with the program SAP2000 [3]. The structure is sized with tubular steel elements, the lower chord consists of one tubular element, while the upper chord is realized by two tubular elements, with smaller dimensions and placed at 4 m from the centre. The arch structure is completed by posts and horizontal bracing.
The selection of the steel framings must be done by minimizing structural weight considering horizontal displacement of less than h/350, vertical displacement of less than l/400 and the bearing capacity of foundation soil.
The choice of the optimal solution has not resulted in a minimum weight design, but it has tried to standardize the selected members and to take into account not only the weight of the structure, but also the problems related to construction and assembly solutions.
Of the four variants analyzed the circular arch solutions are preferred as the bracing and the post elements are of equal length. Among the two variants of the circular arch the solution with the arch fixed to the ground and hinged on the intermediate support is liked best.

3. Conclusions

The conceptual design of the mineral storeyard of the ILVA steel plant in Taranto has demonstrated the technical feasibility of the work and how the arch structures make it easier.

4. References

[1] C.HOGG, M.WRONA, P.CONVERT and OTHERS - "Conceptual Design of the Chernobyl New Safe Confinement – An Overview" - *Pacific Basin Nuclear Conference*, 2004
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[3] SAP2000 – "Integrated Solution for Structural Analysis & Design" – CSI, Berkeley, 2012

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