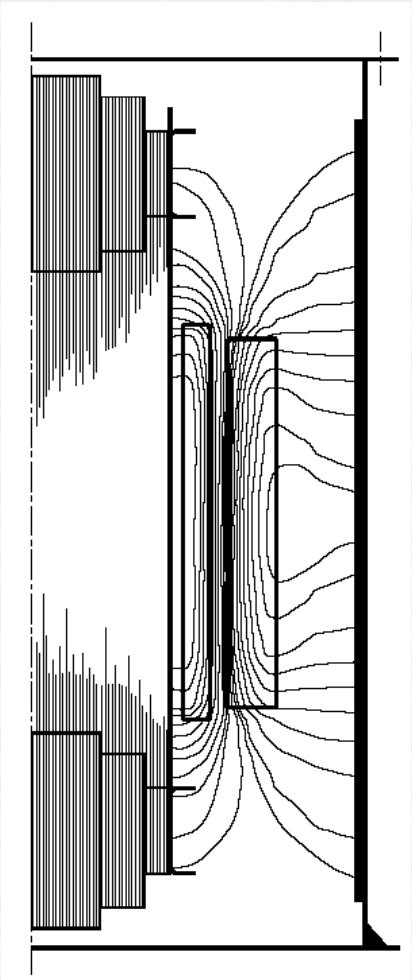
STATE-OF-THE-ART TANK SHIELDINGS (SHUNTS) FOR HV POWER TRANSFORMERS

For CIGRE A2-49 in Shanghai on 19th Sept., 2015

Selim Yürekten,
Enpay Transformer Components

Tank Shieldings (shunts) for Power Transformers



Introduction

The shielding effectiveness of power transformers is a very important target in transformer design.
The stray losses due to leakage field cause hot spots in structural components. Stray flux departing radially from outer windings gives rise to eddy current losses in the tank. Estimation methods of the tank loss have evolved from approximate analytical methods to more accurate 3-D FEM numerical methods.

Guidelines for state-of-the-art shielding with magnetic shunts :

- Length of shunts should be from top yoke centre to bottom yoke centre
- One piece without any gap
- Thickness of shunt elements depends on amount of flux collected
- Shunts should cover at least 70% of area in front of windings
- Gap placed on tank between 2 shunt elements wall should be as minimum as mechanically possible
- Types of shunts edgewise, PERPENDICULAR to tank wall, not parallel [1],[2].

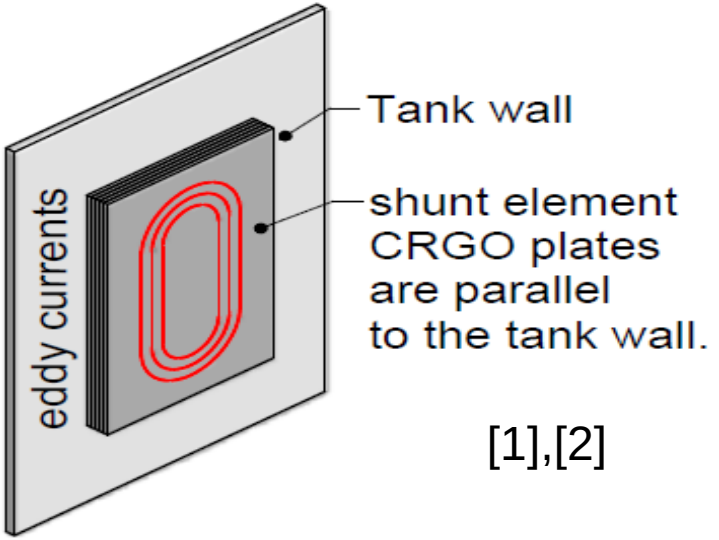
This paper presents the comparison of two types of tank shielding technology. The first one is old and expensive, the second is the state-of-the-art technology.

Tank Shieldings (shunts) for Power Transformers

1.TANK SHIELDING IN OLD AND EXPENSIVE DESIGN

Parallel installation of shunts

In the parallel installation of steel plates, we can see the appearance of the eddy currents, which leads to losses and heating. Today it is an outdated design, less effective compared with shunts of perpendicular installation, where eddy currents are reduced to naught.

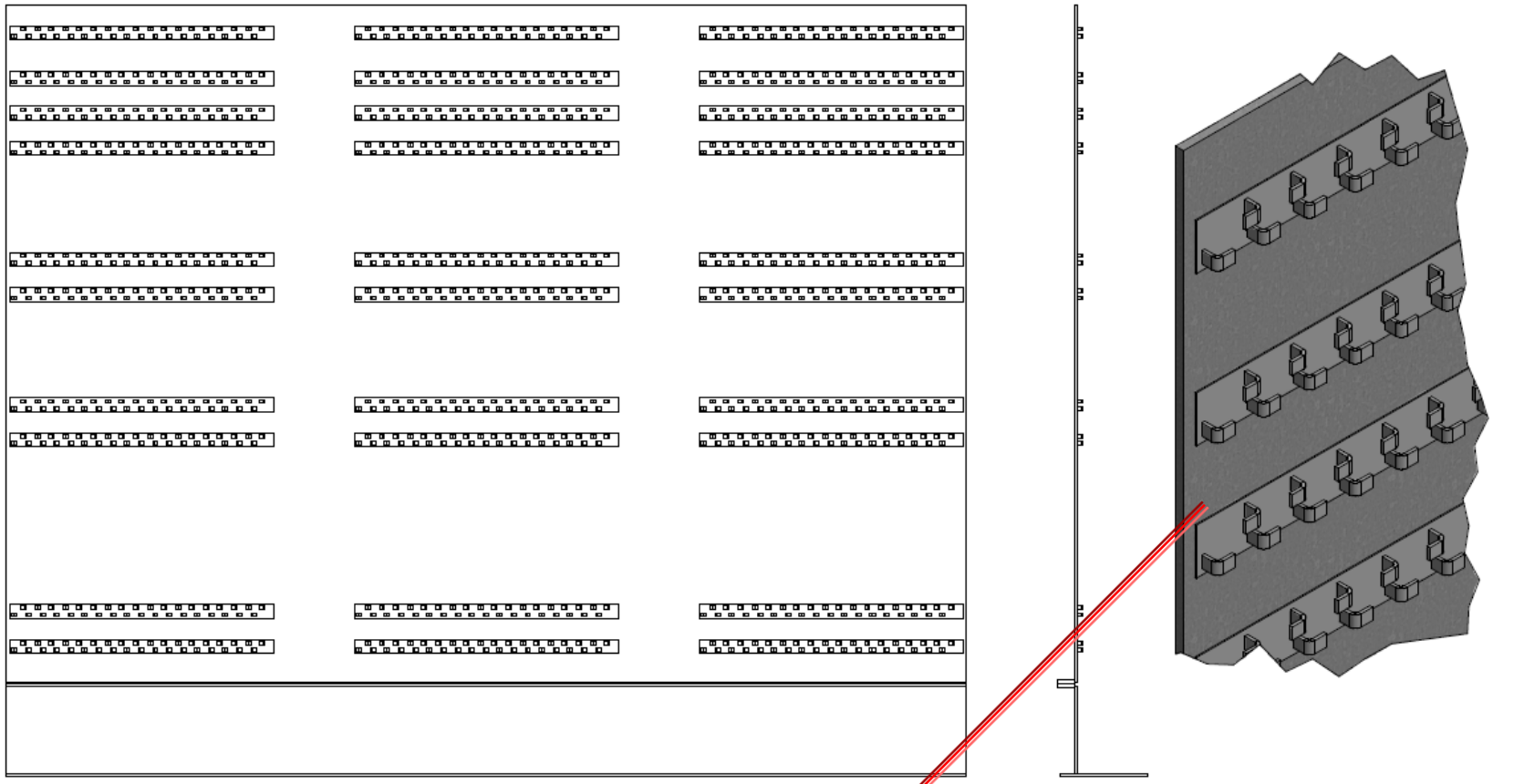


[1],[2]

Tank Shieldings (shunts) for Power Transformers

Parallel installation of shunts

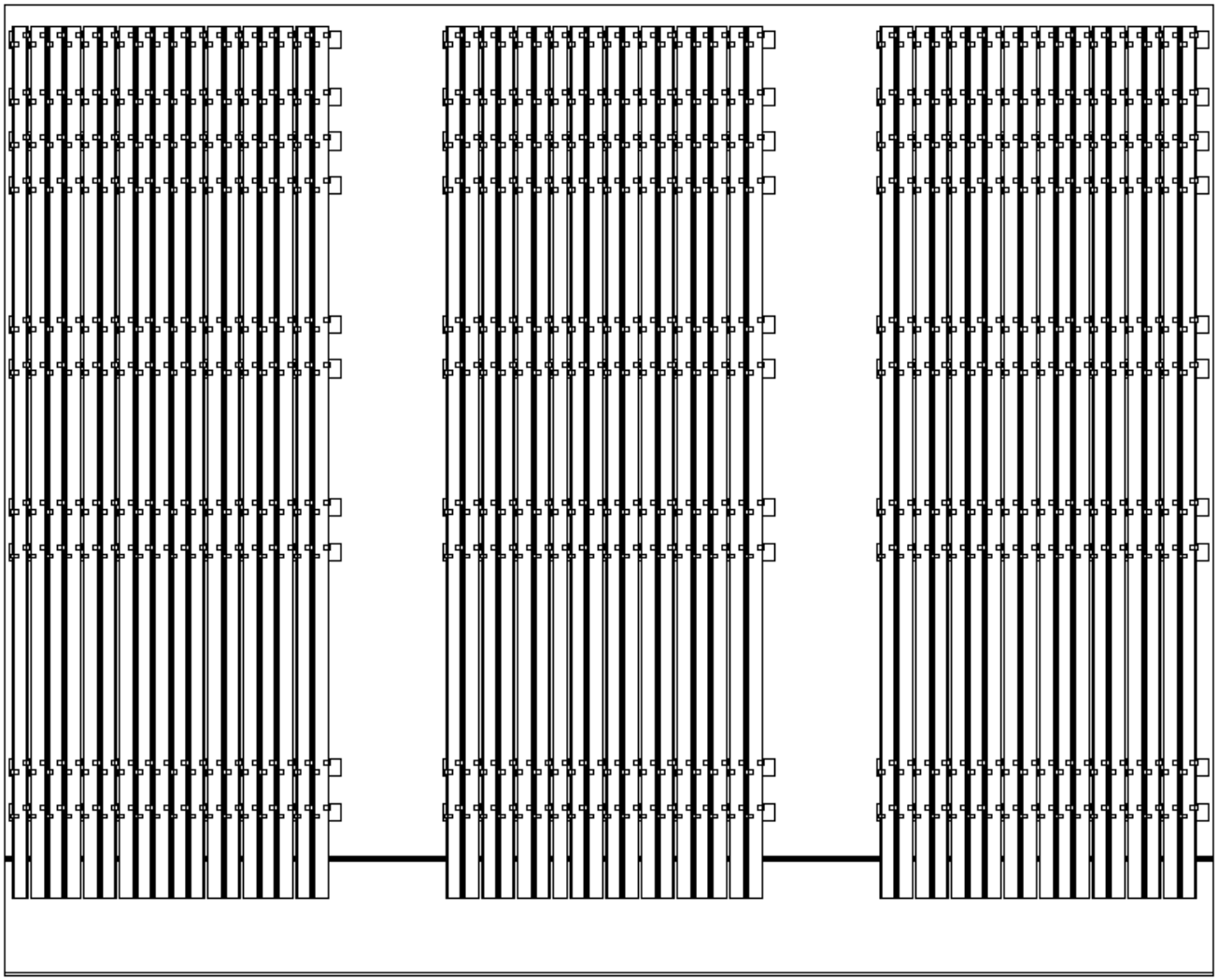
This is an unnecessary material that increases costs only

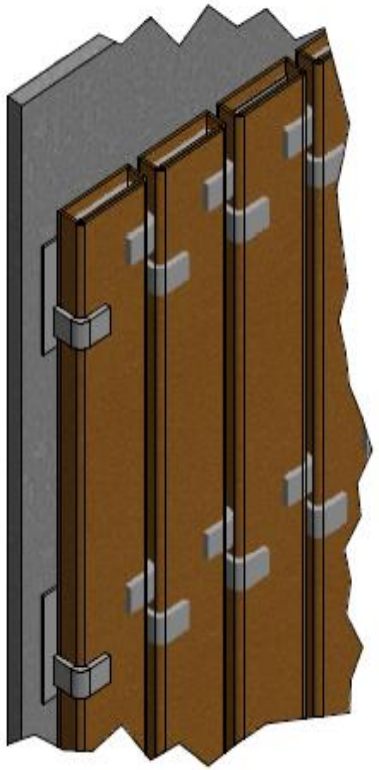


EXPENSIVE DESIGN

The thickness of iron plates= 2 мм

Tank Shieldings (shunts) for Power Transformers





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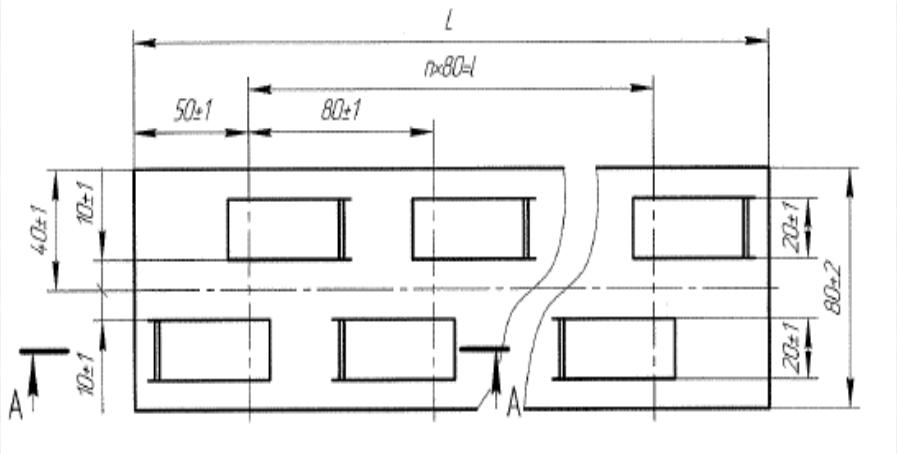
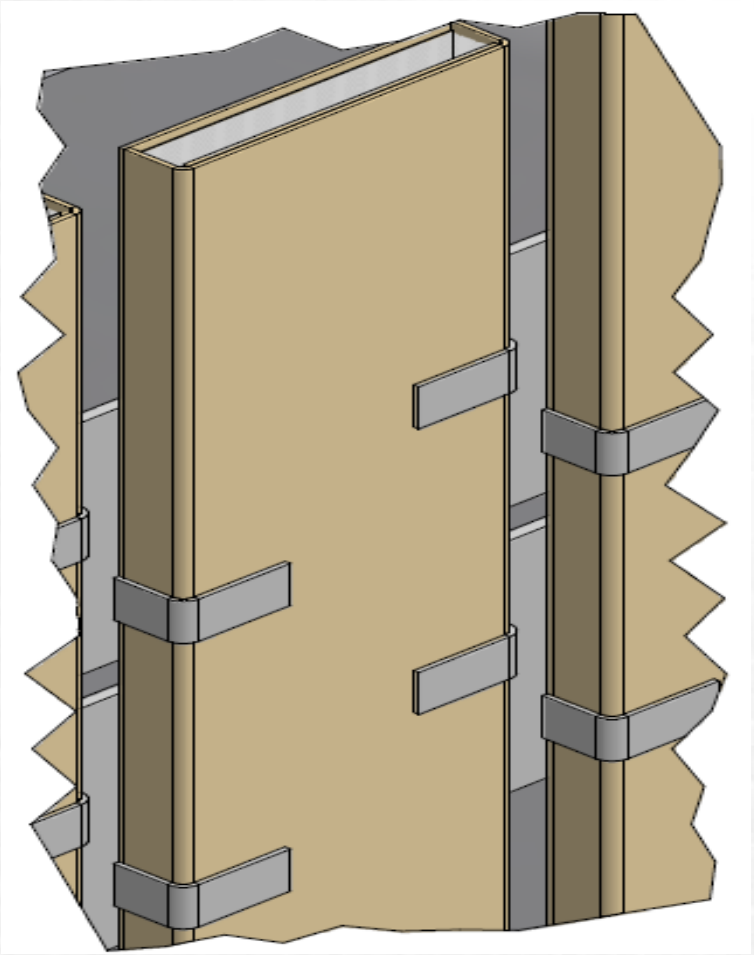




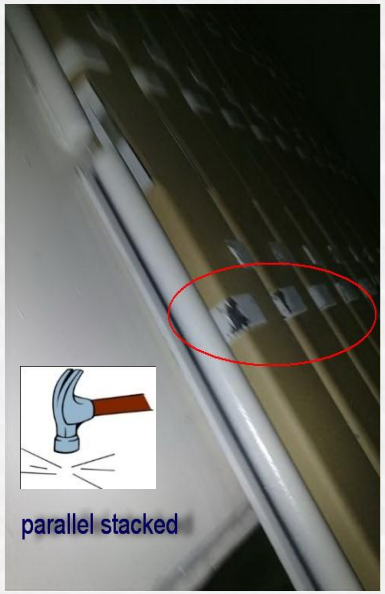
Shunts of parallel installation

To fix the shunts to the wall of the tank metal plates along the wall are used

Tank Shieldings (shunts) for Power Transformers

Shunts with a parallel to the tank stacking of the plates

- Damage of the clamping
- The use of cardboard
- The presence of vibration and noise
- Fixed set of assembly parts
- Requires a significant investment of time
- High cost



Tank Shieldings (shunts) for Power Transformers

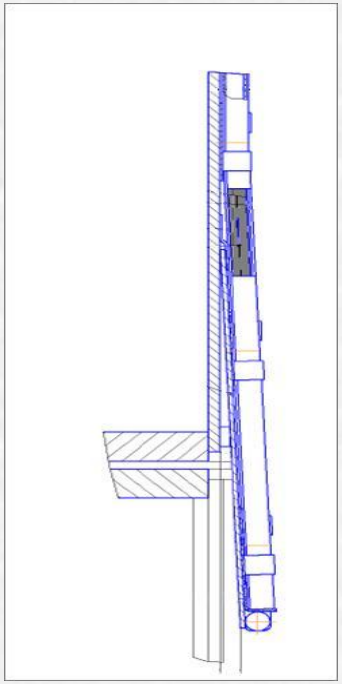
The use of shunts in the bottom of the tank

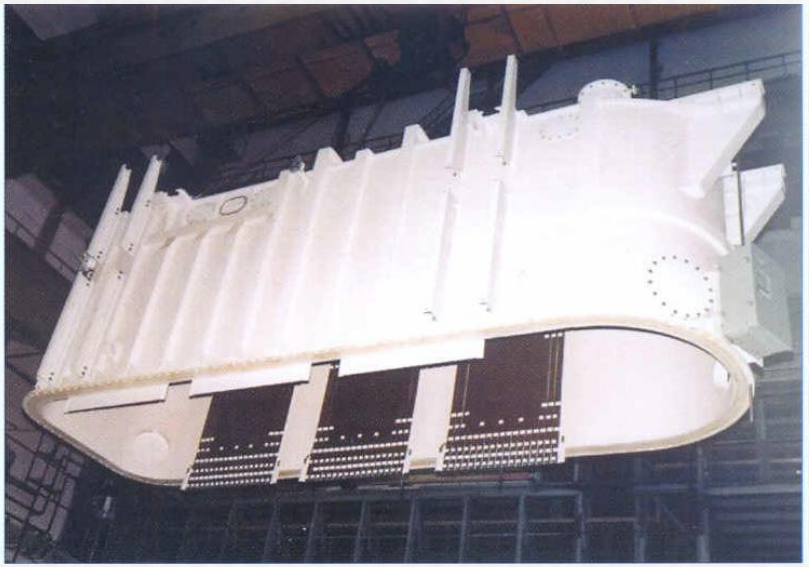
The use of an additional metal plate

The use of props under the metal plate

One-sided welding of metal plate

As shunts are not welded to the bottom of the tank, additional vibration and noise appear





EXPENSIVE AND NOT EFFECTIVE TECHNOLOGY

Tank Shieldings (shunts) for Power Transformers

2.STATE –OF-THE-ART PRODUCTION FOR TANK SHIELDINGS

State – of – the - art design, which is used by world transformer companies

[4],[6],[7]

Tank Shieldings (shunts) for Power Transformers

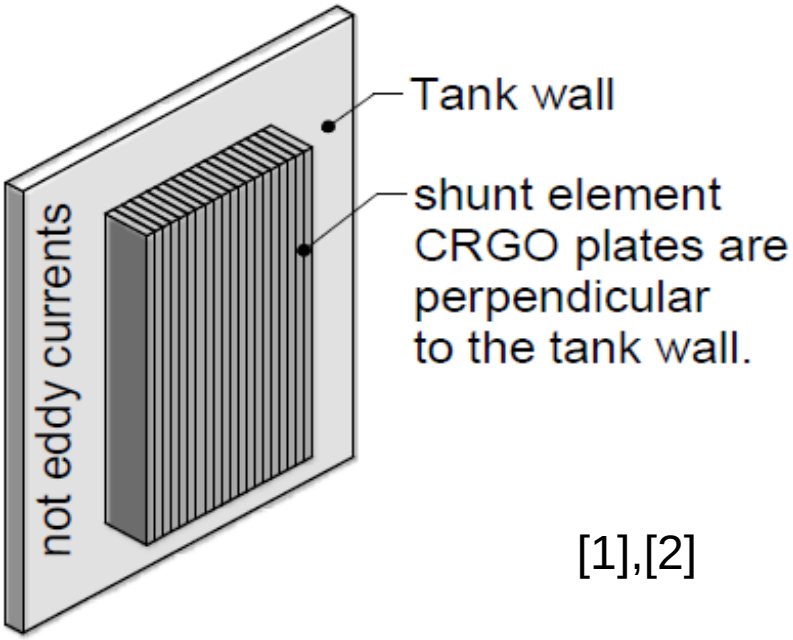
Tank shunts ready to dispatch

Yoke Shunts

Tank Shieldings (shunts) for Power Transformers

Shunts of perpendicular stacking

Stacked steel plates produced by ENPAY, are perpendicular to the wall of the tank. With this design, there is a reduction of eddy currents. This type of shunts is supplied to world manufacturers of transformers except Russia.



[1],[2]

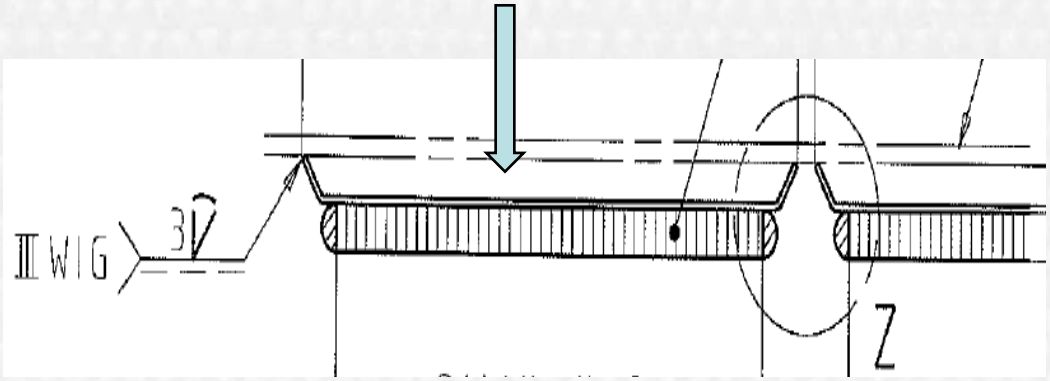
State – of – the- art design

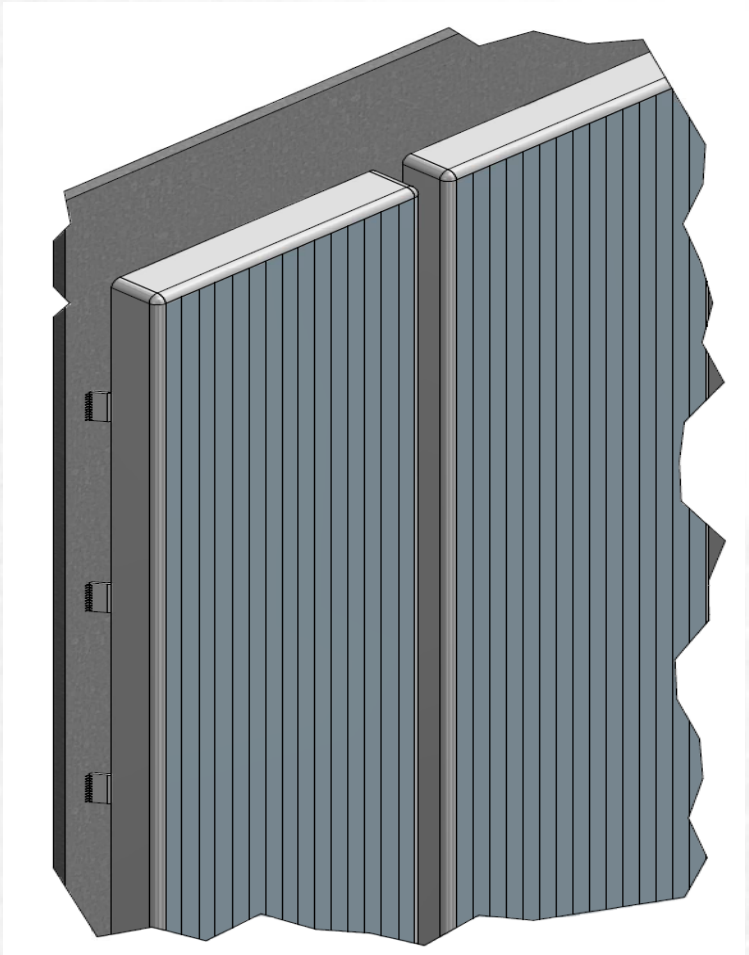
Tank Shieldings (shunts) for Power Transformers

Shunts of perpendicular stacking

Shunts are fixed to the wall of the tank at the corners

The place of oil circulation,if necessery





[4],[6],[7]

Tank Shieldings (shunts) for Power Transformers

Shunts of perpendicular stacking

- No clamping damage
- No cardboard insulation
- No vibration, no noise
- The lack of a fixed set of components
- Easy assembly
- Significant reduction in costs

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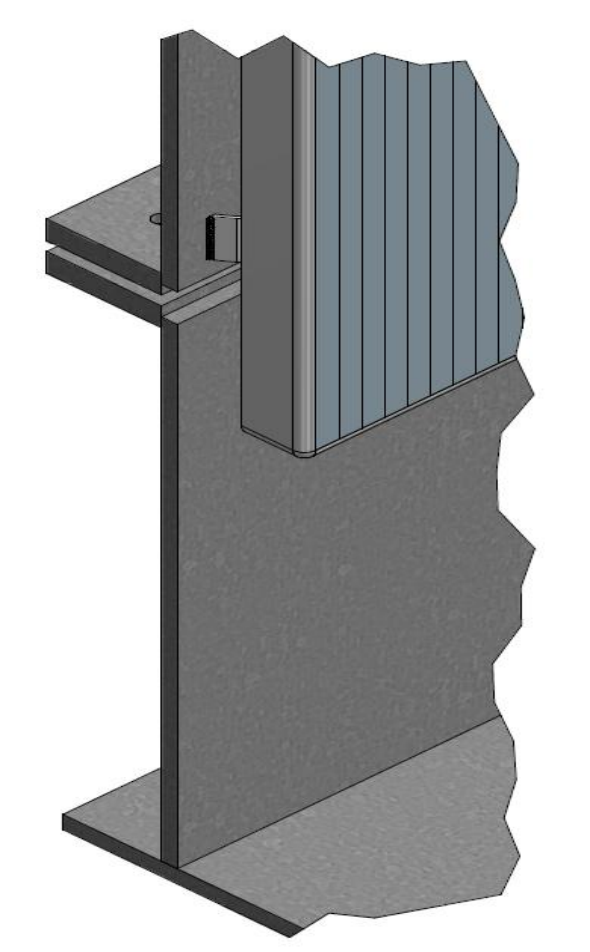
State-of-the art Technology

Tank Shieldings (shunts) for Power Transformers



The use of Enpay shunts in the bottom of the tank

Welding directly to the wall of the tank

Lack of support materials

Fixed distance between the tank and the shunt

As a consequence the lack of noise and vibration due to the strength of the structure.

Tank Shieldings (shunts) for Power Transformers

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CASE STUDY

Auto Transformer with data's : 125 MVA 230/121/10,5 kV.

Comparison of the calculated Losses in the Tank

Without Shunts (accord.Tr..Producers)	with Shunts (apprx)	A d v a n t a g e
51,8 kW (70 kW)	6,9 kW	44,9 kW (63,1 kW)

Comparison of classic design and improved design (worldwide most used design), it is 2 type of Advantages LESS WEIHGT & LESS LOSSES

W e i h g t s

With Shunts in classic Design	with Shunts in improved Design	A d v a n t a g e
v Kg.	Kg.	Kg.
1600 (2000)	980	620 (1020)

Loss Penalty evaluation of Transformer in International Tenders shows Price Differences.

RESULT
The Shunts with improved Design have BIG ADVANTAGE,COST SAVING
LIFETIME OF THE TRANSFORMERS SMALLER EDDY CURRENT LOSSES

Tank Shieldings (shunts) for Power Transformers

Conclusion

- The modern shielding are one of the important issue in transformer design.
- By shielding the tank they reduce the amount of flux that goes in the tank, so that reduce of tank losses.
- For the calculation of the loss reduction and the dimensions of shunts can use a 3D FEM model with greater accuracy. [3],[5].
- We compared two type of tank shielding technology. The state-of-the-art type is more effective technically and cost effective price wise. The traditional shunts which are used in such countries generally more expensive and technically not good solution for large power transformers.

References

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