FAST. EXACT. SCALABLE OPTIMIZATION IN ACTION FOR SOLAR RACKING

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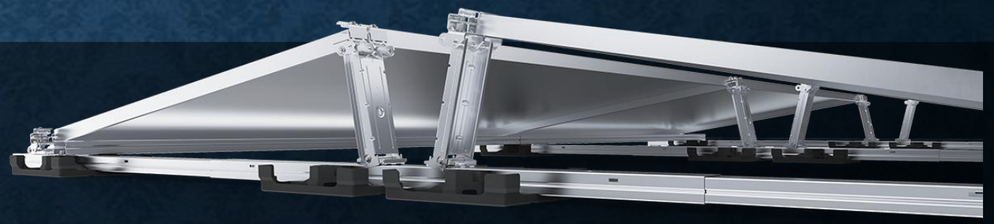
OVERVIEW

- Who are we what problem we solve and what do we do?
- Why we use a solver and what we use it for?
- How we use it?
- Why enabling Real – Time decisions are a game changer?
- Pitfalls and opportunities
- What have we Achieved?
- Key Takeaways

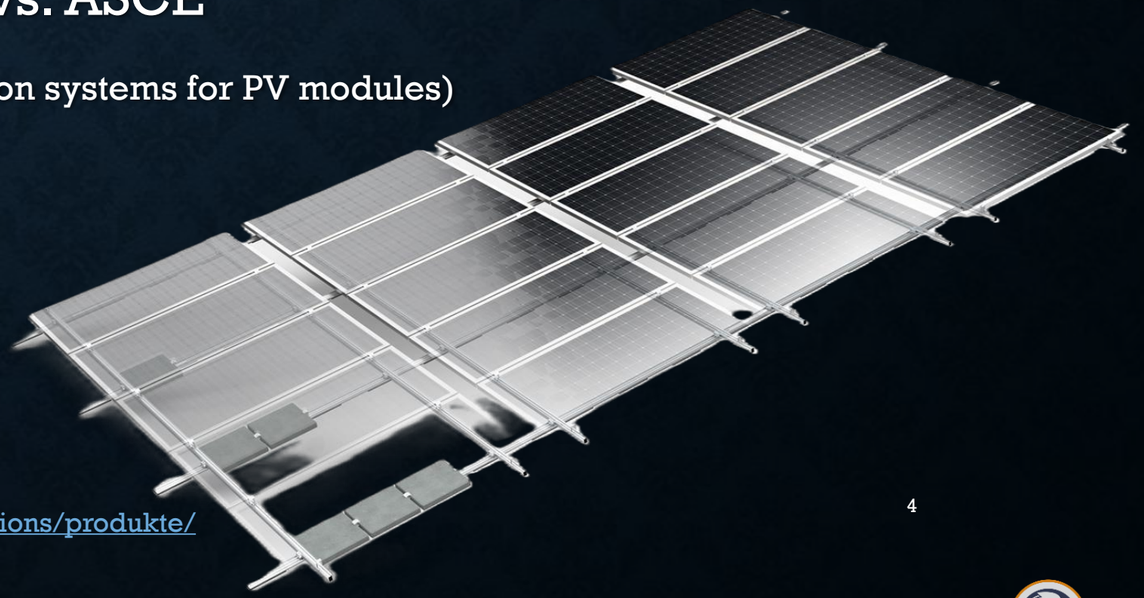
WHO WE ARE: LEVASOFT GMBH

- Core Business – Solar Pro Tool
  - Software Platform for racking systems manufacturers
  - Simulation and planning of PV with statics, Bom, construction drawings, …
- Headquartered in Klagenfurt, Austria
- 80+ customers across Europe and beyond
- ~60 Employees (75%+ developers)

THE COMPLEXITY OF THE RACKING SYSTEM WORLD



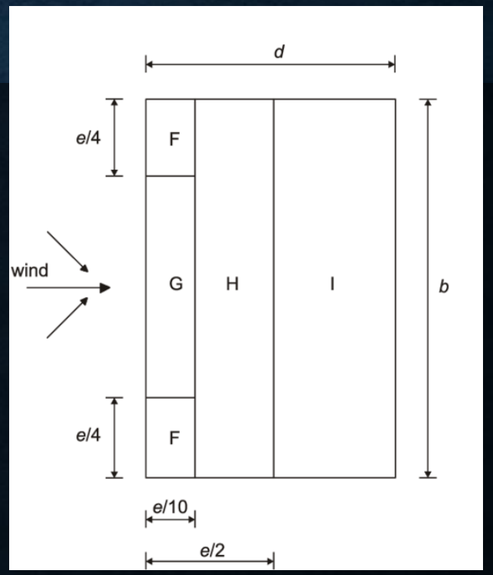
- Difficult Roofs
- Different Norms
  - Wind and Snow-loads: Euro Code vs. ASCE
  - UL 2703 (Safety for mounting, clamping, retention systems for PV modules)
  - UL 3703 (Standard for solar trackers)
- Specialized reports
  - Wind tunnel reports

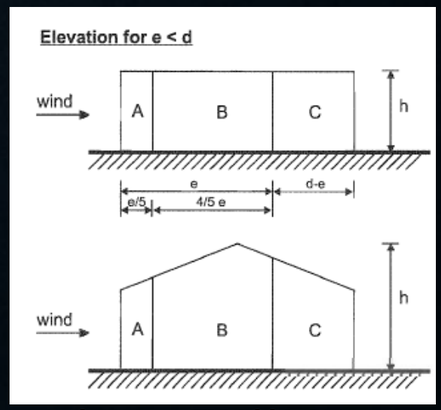


Both Products depicted are sourced from https://pmt.solutions/produkte/
PMT X118 and PMT Flat Direct

THE COMPLEXITY OF THE RACKING SYSTEM WORLD CONT.

- Different countries – different Snow and Wind zones
  - Different Norms for correction factors
- Different roof shapes – Wind turbulences
  - Lead to Roof - zones
  - Depending on Roof - zones different correction factors
  - Also dependent on:
    - Roof Pitch
    - Roof height
    - Roof shape
- Wind tunnel reports are a lot more complex





Sources: EN 1991-1-4.

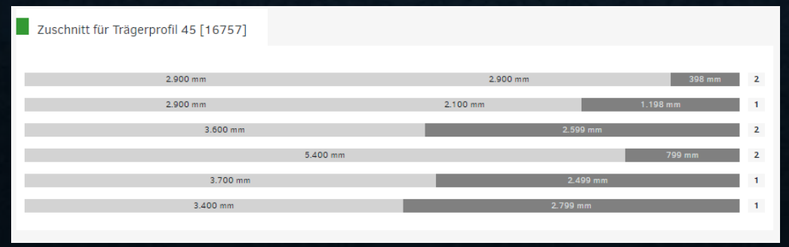
WHO ARE OUR CUSTOMERS AND WHAT DO THEY EXPECT?

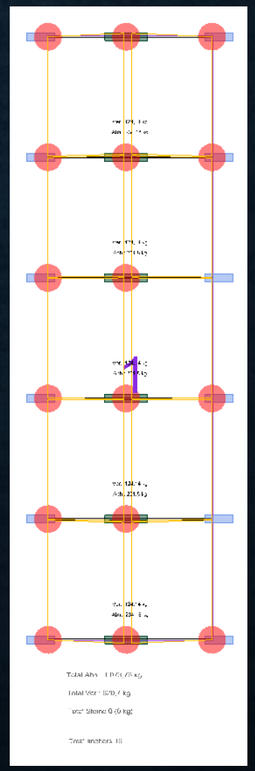
- Racking systems manufacturer & Distributors
- Heavy competition meets liability
  - Need to have simple solutions for their customers
  - Need to have correct planning methods for projects
  - Need for their own solutions
- Mechanical and/or Electrical Engineering business

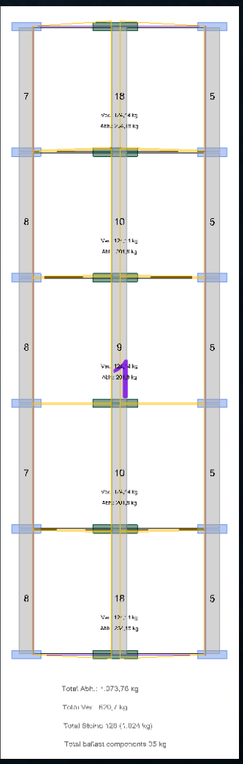
They expect a partner who helps them build software for their needs

WHAT WE USE GUROBI FOR IN SOLAR PRO TOOL

- Stone calculation
- Anchor placement and utilization
- Seismic with ballast planning
- Material optimization
- Inverter calculation
- Rail cutting







BUT WHY USE A SOLVER AT ALL?

- Neural Networks too unreliable
- Heuristics might not grant correctness
- “Dumb” Algorithms not competitive

Structural safety requires exact solutions, not approximations

- Optimization allows flexibility
- Enables customers to push product boundaries

BUT WHY USE A SOLVER AT ALL? CONT.

- Optimizing cost, weight and pressure
- Optimizing Rail – waste
- Optimizing for inventory
- Component attributes can be manipulated
- Possibility of n parameters for optimization
- **In (acceptable) Real Time!**

WHY REAL – TIME IS A GAME CHANGER

- Customers need instant, precise answers
  - Manual calculations are not feasible
  - Approximating leads to waste
- Delays in computation directly affect competitiveness
- Incorrect results can lead to safety/structural failures

Trust and speed are core differentiators

Real Time planning is not a luxury – it‘s a necessity

HOW DO WE ACHIEVE REAL – TIME PERFORMANCE?

- Solver engine for our NP Hard problems
- Using the best solver on the market
- On good multi-core servers
- Making good models
- **But also**
  - By working hand in hand with the customer
  - Hiring and retaining amazing talent
  - Removing blocking points where we can

HOW DO WE USE GUROBI?

- Only very few employees have access
- Instead, use of Wrapper (a library of rules)
  - Different objects (stands, components, elements)
  - Have different understandable rules available
    - Anchored in real world engineering needs
  - Rules are postprocessed into constraints
  - What to optimize done through settings
- Constant optimization of Wrapper
- Internal trainings for optimizing rules

PITFALLS (CONSTRAINTS AND CANCELLATIONS)

- Time increased for extremely complex problems
- Time expired, suboptimal solution is given
  - Best one found, but not the best one
- Constraints that are contradicting
- Too many rules
  - Varying complexities

GETTING IT RIGHT – VALIDATION & QUALITY

- Full optimality targeted
  - Preferably gap = 0
- Fail – safe mechanisms
  - Always "possible to build"
- Automatic validations
  - Total needs < provided
- Validation by developers, staticians and customers
- Internal trainings and knowledge handovers

QUALITY CONTROL PIPELINE

- Requirements pre-calculated before optimization
- Smart Rules ensured through Agile Development process
  - Risks clearly communicated
  - Errors isolated at rule level – not solver level
- Solver meets or exceeds requirements
- Automatic and manual validation
  - Rigorous validation required due to high stakes

OPPORTUNITIES & RISKS AHEAD

- Less rigid assisted Module Placement for early-stage design
- Dynamic model adaptation based on customer input
- Expanding to even more racking systems and use cases
- Further cutting down time

- Rapid customer base growth adds constraint variability
- Keeping wrapper and top layer clean requires discipline

Scaling safely is as important as scaling fast

OPPORTUNITY – COMBIMING OPTIMIZATION WITH AI AND USER IMPUT

- AI best suited for quick early-stage placement
  - Adapt costs
- Further adapt placement manually
- Hybrid methods promise new efficiency gains
- Risk management remains crucial
- Long-term vision:
  - Instant – intelligent planning
  - Reduction of needed rules

WHAT WE ACHIEVED

- Traditional planning was slow
- A lot of over - ballasting
  - Optimization proved that speed and accuracy can coexist
- Changed how the industry approaches roof design
- Lowered the price for end customer
- Impact on Green Transformation

EMBRACING COMPLEXITY VS. SIMPLIFICATION

- Complexity enabled us to
  - Lower Costs
  - Add precision
  - Transform the industry
- Solvers allowed us to manage complexity smartly
- Rules helped us to structure complexity efficiently

Simplification would have meant loss of competitiveness

KEY TAKEAWAYS

- Complexity embraced correctly = advantage
- Trust is built on precise, validated solver outputs
- Hybrid approaches can open new opportunities

Empowering bold decisions doesn’t have to be a compromise but instead can be optimized

CLOSING REMARKS
QUESTIONS OR COMMENTS?