

The research leading to these results has received funding from the European Union  
CIP Entrepreneurship and Innovation Programme under grant agreement n° SI2.662792.

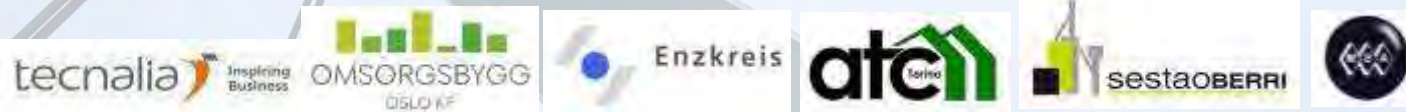


**PAPIRUS**

Public Administration Procurement Innovation  
to Reach Ultimate Sustainability

# Public Procurement ENZKREIS

19/11/2014



# Mühlacker Vocational School

## Building Owner:

Landratsamt Enzkreis

## City/Country:

Enzkreis (Germany)

## Location: Mühlacker



- Mühlacker is a town in the eastern part of the district “Enzkreis” in Baden-Württemberg in southern Germany
- The school complex consists of several buildings, among them the workshop building – hosting 16 workshops for apprenticeships in metal technology, electrical engineering, automotive technology and woodworking.



# Mühlacker Vocational School

## Functionality:

- The construction is a workshop building: the 16 workshops are provided with heavy machinery and tools for practical lessons and with furniture and teaching aids for theory lessons.
- Additionally there are materials stores, sanitary rooms, washing and changing rooms. In the southern basement there's an underground car park.
- Schedule during school period is Mondays to Fridays from 7:30 to 15:00
- During holidays the building remains closed.



# Mühlacker Vocational School

## Architectural Characteristics:

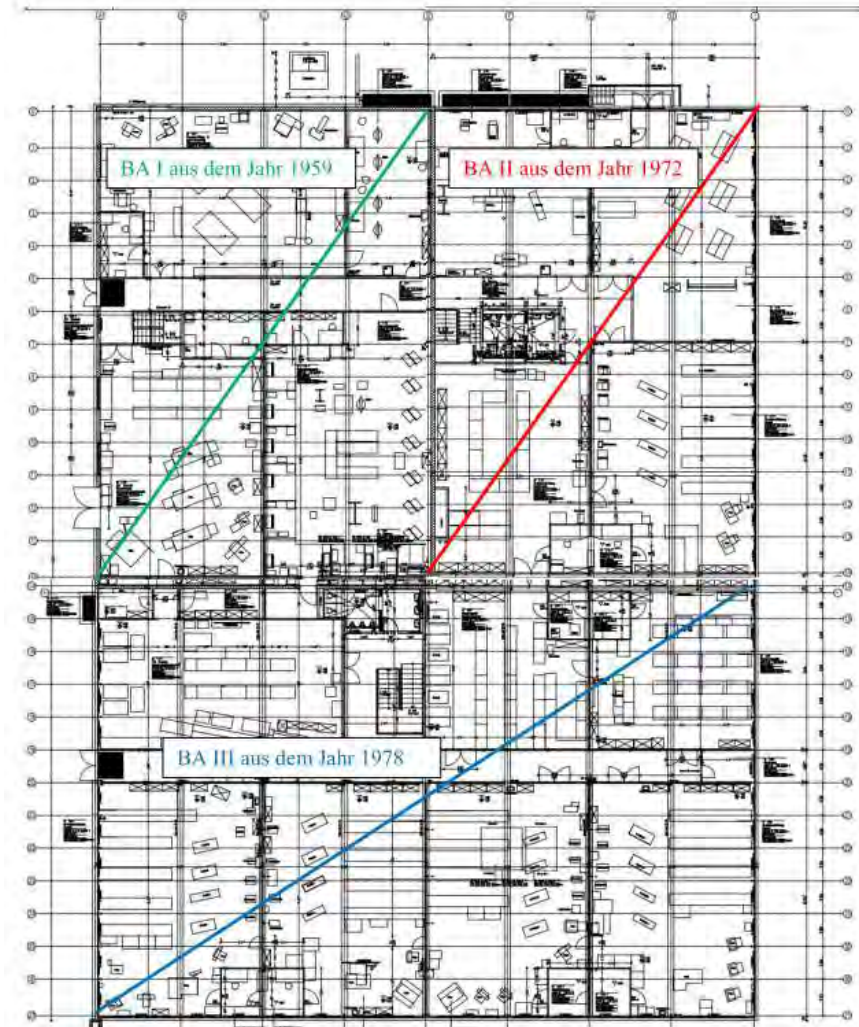
Rectangular plant (55 m x 40 m)  
distributed into two floors:

1<sup>st</sup>. 950 m<sup>2</sup>

2<sup>nd</sup>. 2038 m<sup>2</sup>

Ridge height: 6,20 – 9,50 m

The building was constructed in  
three phases (1959, 1972 and 1978).



# Mühlacker Vocational School

## Building design:

**1st floor.** steel structure

- inner walls: brick walls;
- external walls (depending on the phase of construction): aerated concrete (1972, 1978) or brick walls (1959)

**2nd floor.** massive construction

## Refurbishments already implemented

in 2011 (façade and interior):

- façade (thermal insulation composite system)
- vertical windows (triple glazing,  $U_g = 0,7 \text{ W/m}^2\text{K}$ )
- internal partitions formed by brick fabric
- building services and sanitary rooms

## Planned refurbishments:

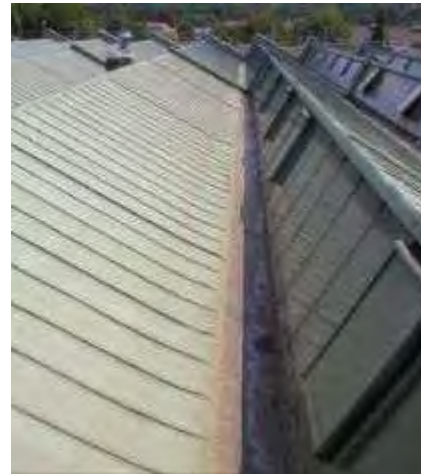
The roof is going to be refurbished in the frame of the PAPIRUS project (roof structure and glazing).



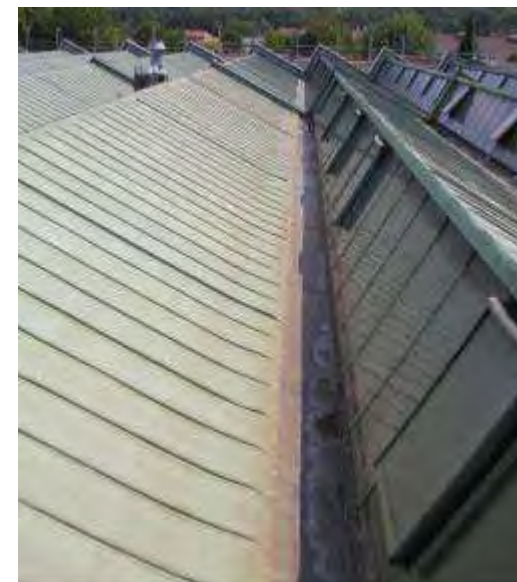
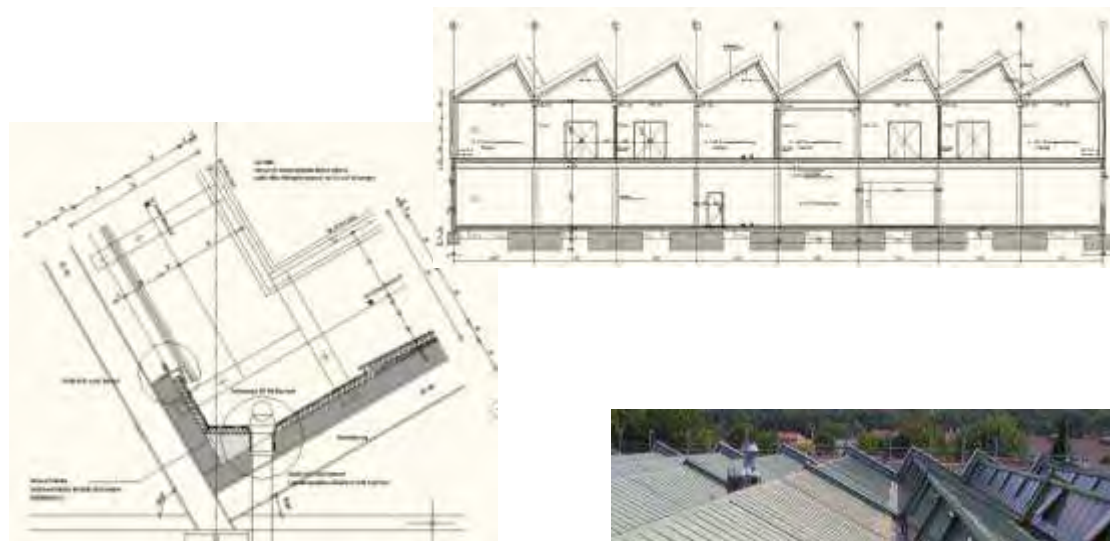
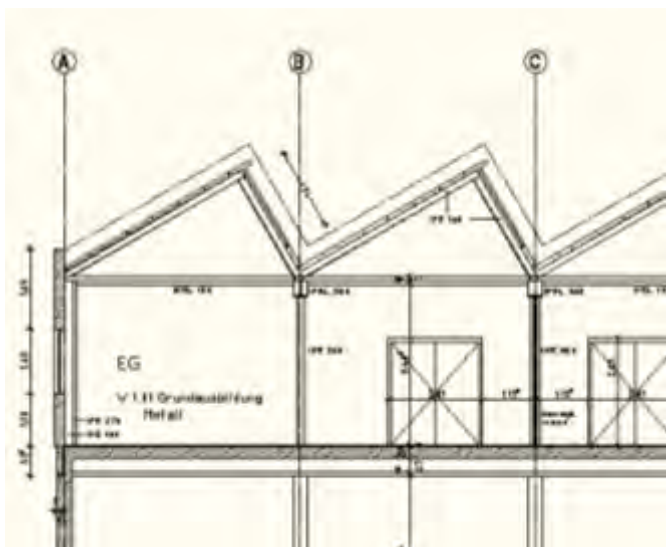
# Mühlacker Vocational School

## Roof:

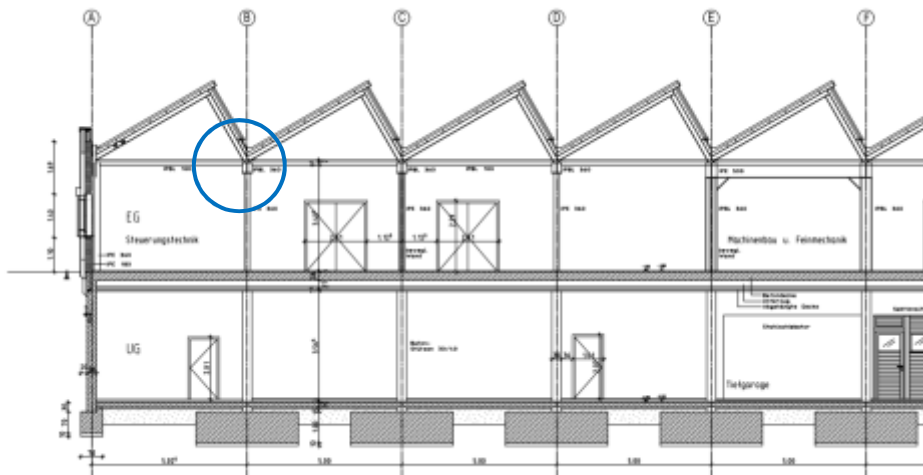
- The roof has shed shape, where glazed areas are combined with opaque surfaces
- 8 sheds, roof inclination  $62^{\circ}/28^{\circ}$
- Axial dimension 5,0 m
- Length 55 m (subdivided at approx. 22,5 m)
- Roof area 2915 m<sup>2</sup>
- Glazing area 701 m<sup>2</sup>



# Mühlacker Vocational School

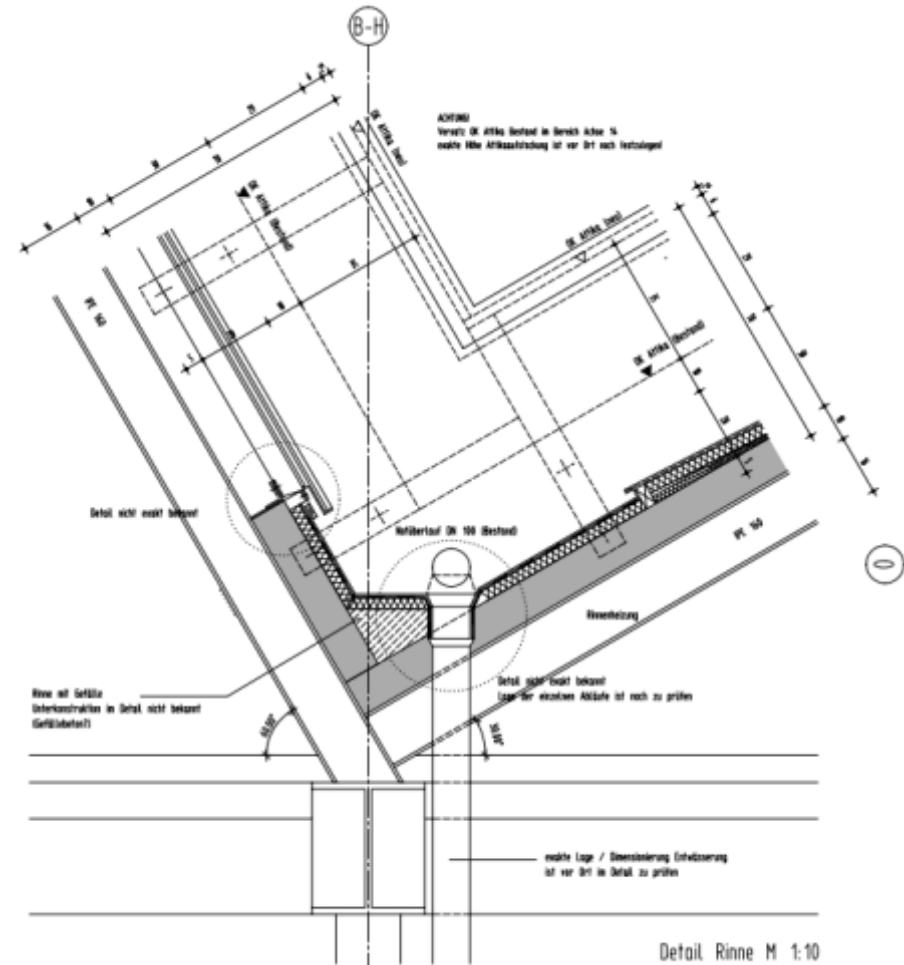


# Mühlacker Vocational School



## Existing roof structure:

- Standing seam roof cover copper
  - Insulation approx. 0-3 cm
  - Aerated concrete 10 cm
  - Steel girders
  - Wired glass
- 99-110 kg
- 40-45 kg





# Mühlacker Vocational School

## Requirements glazing

- Light-weight material (current weight approx. 40-45 kg/m<sup>2</sup>)
- Roof inclination 62°, position north-east
- Inclined and overhead glazing
- Puncture-resistant glazing
- Construction free of thermal bridges
- Heat protection, integrated sun protection
- Desired U-value < 0,7 W/(m<sup>2</sup>K)
- Desired g-value < 0,2-0,3 W/(m<sup>2</sup>K)
- Heat and smoke extraction systems, ventilation flaps
- Night cooling
- Recyclability of the material
- Self-cleaning glazing (optional)

# Mühlacker Vocational School

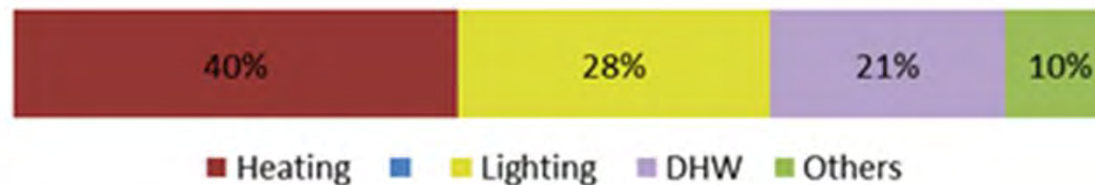
## Requirements insulation

- Light-weight material
- Roof inclination  $28^\circ$ , position south-west
- Installation height incl. sealing  $\leq 18\text{cm}$
- Desired U-value  $< 0,15 \text{ W}/(\text{m}^2\text{K})$
- Construction free of thermal bridges
- Recyclability of the material
- Sealing has to fit to the existing roof design as well as to the connections to the shed glazing, the roof edges and the drainage channels

# Mühlacker Vocational School

## Critical points to consider:

- Appreciable roof area in contact with external conditions compared to occupied floor area
- Existing building design and statics
- High exposure to solar gains through roof glazing
- Limited access to natural lighting in lower floor
- Building must continue in operation during retrofitting process (heavy machinery and equipment cannot be moved):
  - Intervention has to be carried out mainly during educational holidays
  - Construction period in two phases: 2016 and 2017 (always May to September); 4 workshops at one time



# Mühlacker Vocational School

| Technologies   | Units       |
|--|-------------|
| Reduce the energy losses through buildings opaque envelope   | 2.239,64 m2 |
| Reduce energy losses in winter and solar gains through window in summer  | 820 m2      |
| Technologies that provide good quality natural day-lighting  | -           |
| Solutions that store thermal energy increasing the thermal comfort and shifting heating and cooling peak loads | -           |
| Technologies for light weight prefabricated panels with low specific CO2 emissions.                            | -           |

**TOTAL AMOUNT: 912.360 €**

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