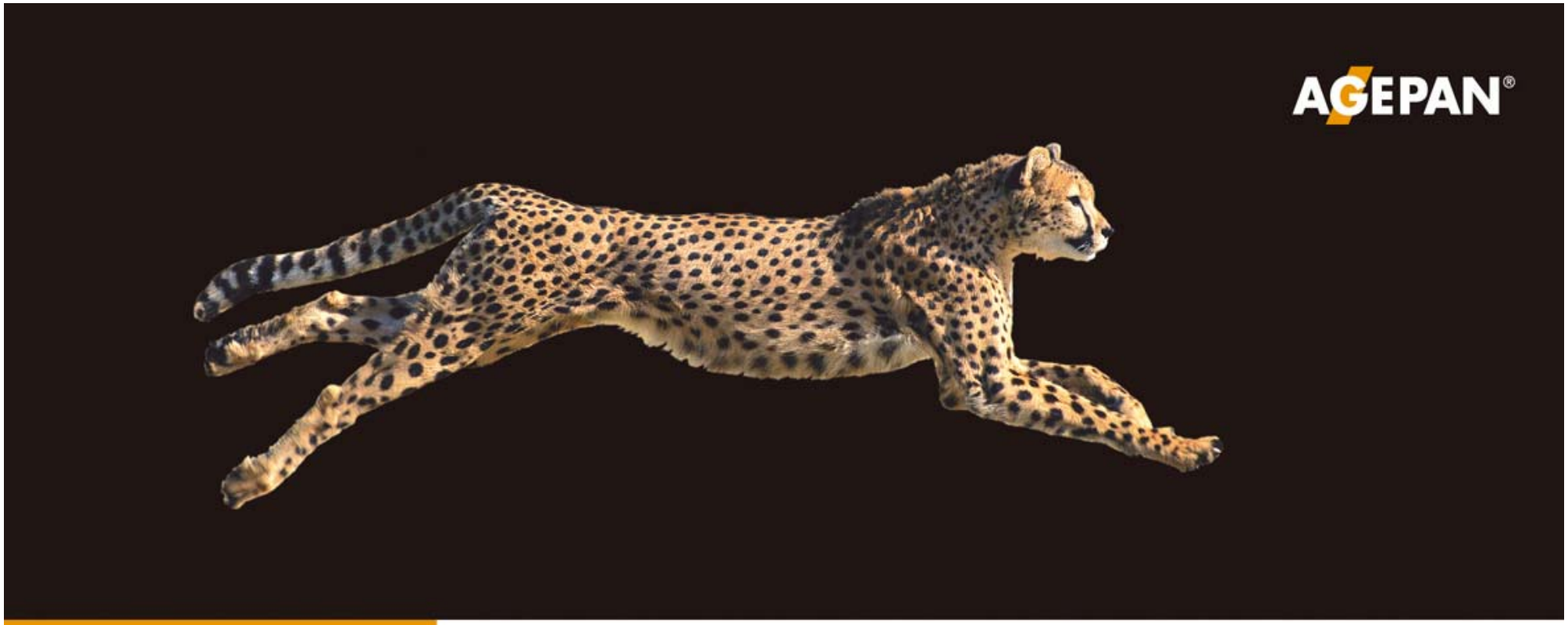


AGEPAN® products and building-system
03.01.2008

www.AGEPAN.de

SONAE INDÚSTRIA

AGEPAN® ® THD / TEP / UDP

summary

- products (the new generation of wood fibre boards)
  - AGEPAN® ® THD
  - AGEPAN® ® TEP
  - AGEPAN® ® UDP
  - AGEPAN® ® OSB

- theory + practice
  - building physics
  - instructions for using

- AGEPAN® ® building system
  - AGEPAN® ® building your dreams

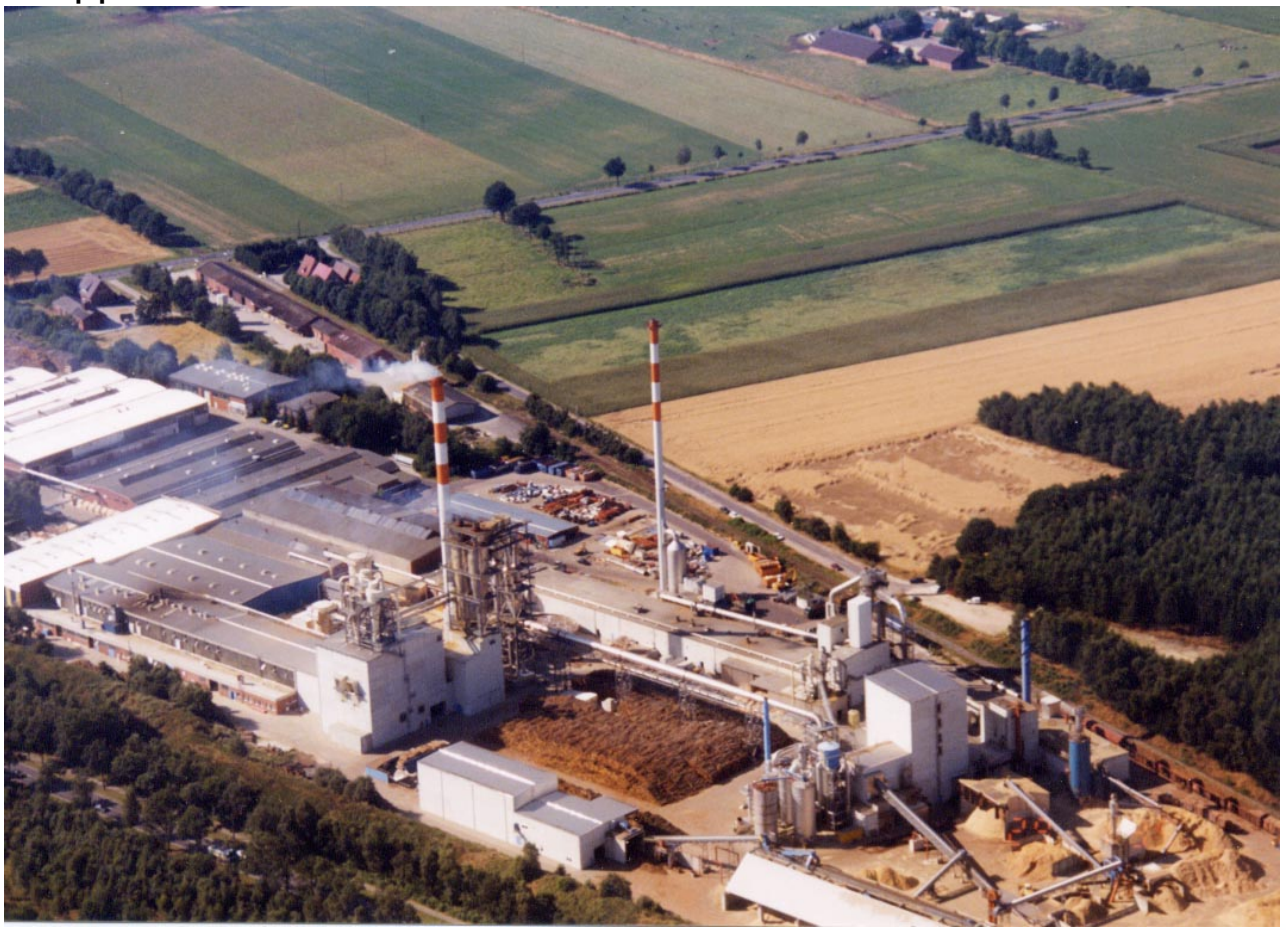
AGEPAN® THD

German: im Trockenverfahren hergestellte Holzfaser-Dämmplatte
dry proceeded wood fibre thermal insulation board

- processed technology comparable to MDF
- possible alternatives in production to variable specifications:
  - density
  - stiffness
  - hydrophobic characteristics

AGEPAN® THD

The plant in Meppen



AGEPAN® THD

The different kinds of AGEPAN® THD

- AGEPAN® THD STD 190
  - vapour permeable and with high compressive strength for use internally
  - density: 190 kg / m^3
  - thickness: 40, 60 and 80 mm
  - dimensions: 2650 x 600 mm and
    1320 x 600 mm, square edge

- AGEPAN® THD T+G 230
  - vapour permeable and with high compressive strength for use externally
  - density: 230 kg / m^3
  - thickness: 40, 60 and 80 mm
  - dimensions: 1875 x 625 mm, tongue and groove

AGEPAN® THD

Why did we develop AGEPAN® THD?

- improved mechanical strength properties compared to „Softboards“
  ➔ new areas of application for low density MDF

- solid construction
- optimises constructions
  - minimised thermal bridge
  - good summer heat insulation
  - stiff panelling
  - vapour permeable

- ecological product

AGEPAN® THD

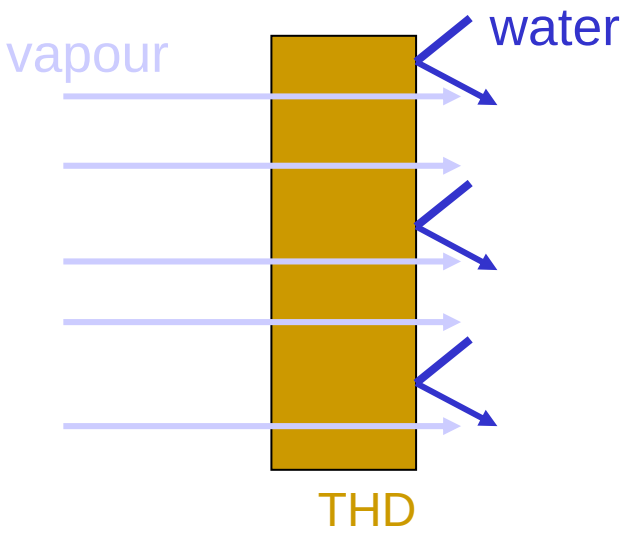
technical features

- dry processed wood fibre thermal insulation board with a low density
- MDF production in the plant in Meppen
- EN 13171 (DIN 68755-T1) certified
- density:
  - 190 und 230 kg/m³
- characteristics of thermal conductivity:
  - AGEPAN® THD 190 0,047 W/mK
  - AGEPAN® THD 230 0,050 W/mK
- PMDI-glued
  - formaldehyde-free
  - supports good hydrophobic features

AGEPAN® THD

technical features

- raw density profile differs to conventional „Softboards“
  - hard in the outer areas
  - soft inside
  - ➔ advantages when fixing
- high vapour permeability
  - vapour diffusion resistance factor μ=3
  - ➔ d=60mm s_d=0,18m < 0,20m
    high capillary activity
- high heat storage capacity
  - very solid constructions
  - high evaporation potential
  - ➔ excellent summer heat insulation



AGEPAN® THD

technical features

- warm surface immediately after installation
  - ➔ prevention of mold
- chemical wood preservation is not necessary within the exposure category 0, GK 0, according to DIN 68800-T3
- monolitically produced
  - ➔ no delamination
  - ➔ resistant to boiling water
- raw density profil offers acoustic advantages
  - impact sound absorbing
  - air sound absorbing
- no loss of stiffness when getting wet

AGEPAN® THD

technical features

- stable edges
- wind prove (tongue and groove)
- can be stepped on in dry condition (u<18%) up to a span width of l=1,0m (d=60/80mm)
- ideally suited for pre - fab components (load-carrying during the building process only)
- fibres are coated with paraffin wax
  - ➔good hydrophobic characteristics
  - ➔second water-repellent layer

AGEPAN® THD

technical features

- Why do we use fibres?

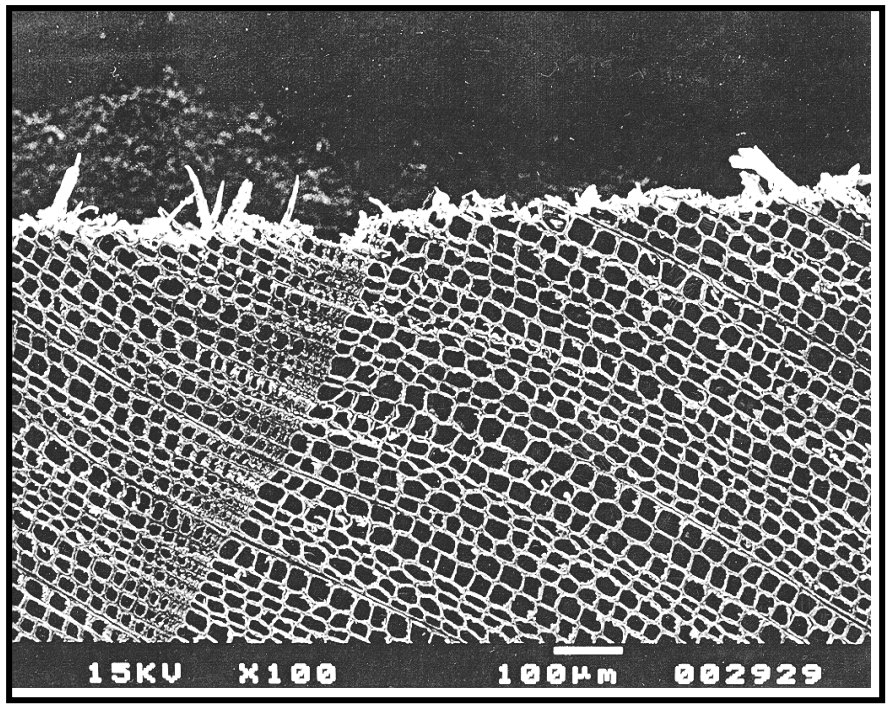


Fig:
solid wood

AGEPAN® THD

technical features

- ...Because they do have cavities!

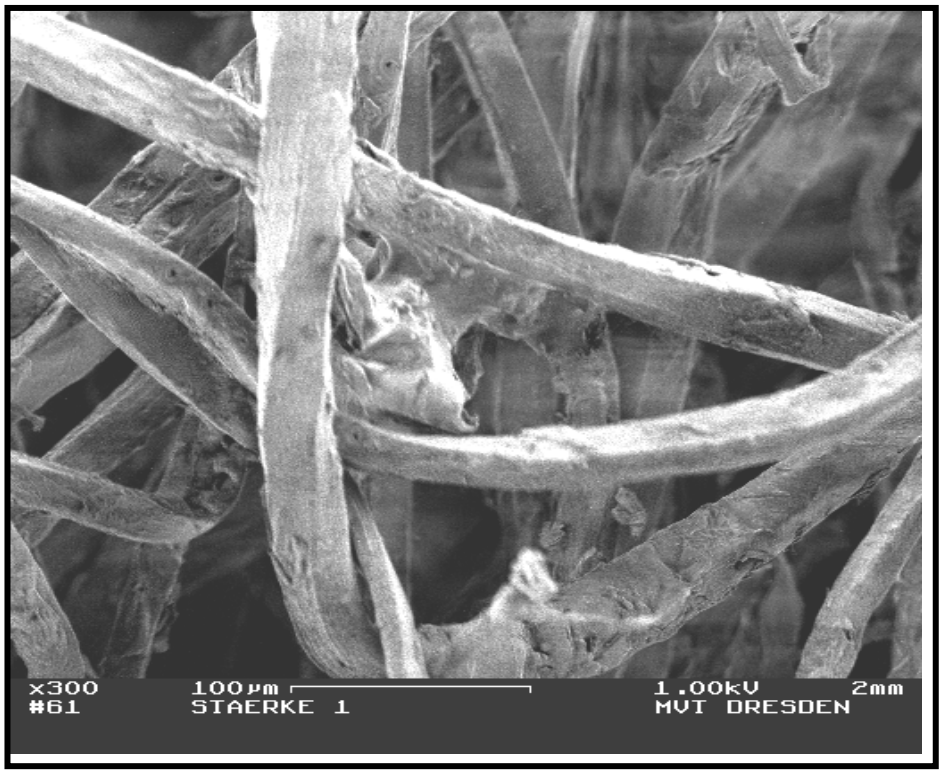


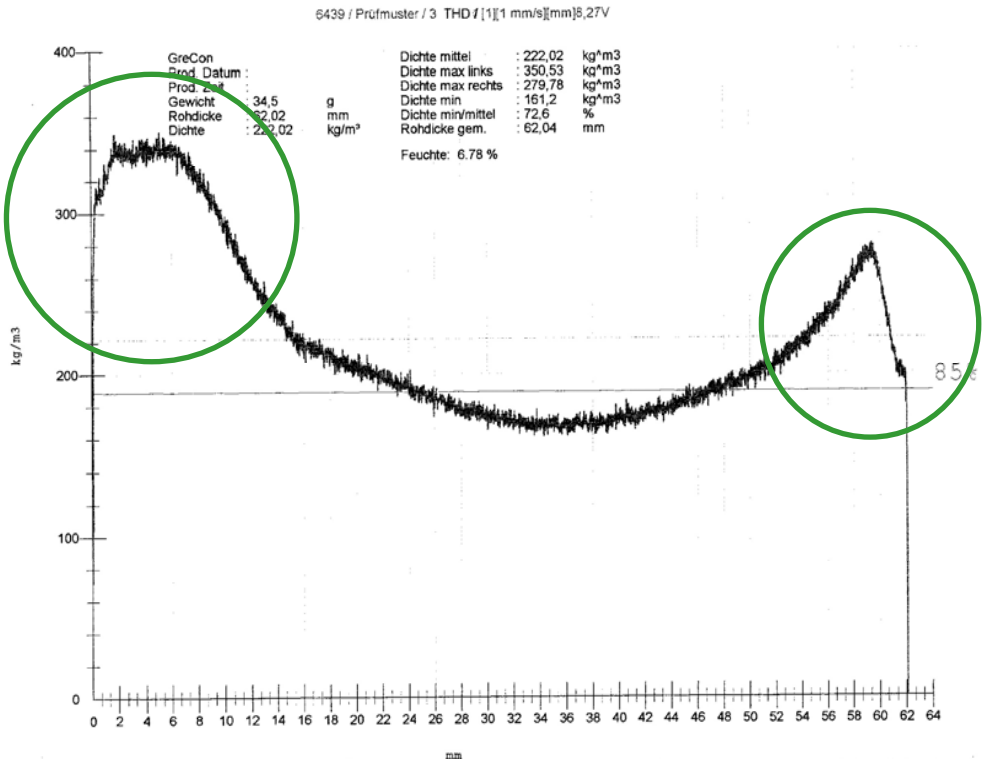
Fig: wood fibres

∅≈20µm
l≈3000µm

AGEPAN® THD

technical features

- raw density profile



AGEPAN® THD

certification

- EN 13171 „thermal insulation regulation for buildings with wood fibre products“
- DIBt: „Allgemeine bauaufsichtliche Zulassung“ Z-23.15-1508
  (German regulation)
- external control certificates the product to be in accordance with this regulation
  ➔German „accordance-certificate“: “Ü-Zeichen“

AGEPAN® THD

natureplus®

- quality mark of ecological, nonhazardous and functional building products
- decision support for planning and processing of sustained materials
- quality, ecology and economy are consistent with each other
- application both as vapour permeable, wind proof and thermal insulating outer panelling and as compressing proof flooring boards
- excellent material for new buildings and renovation !

AGEPAN® THD

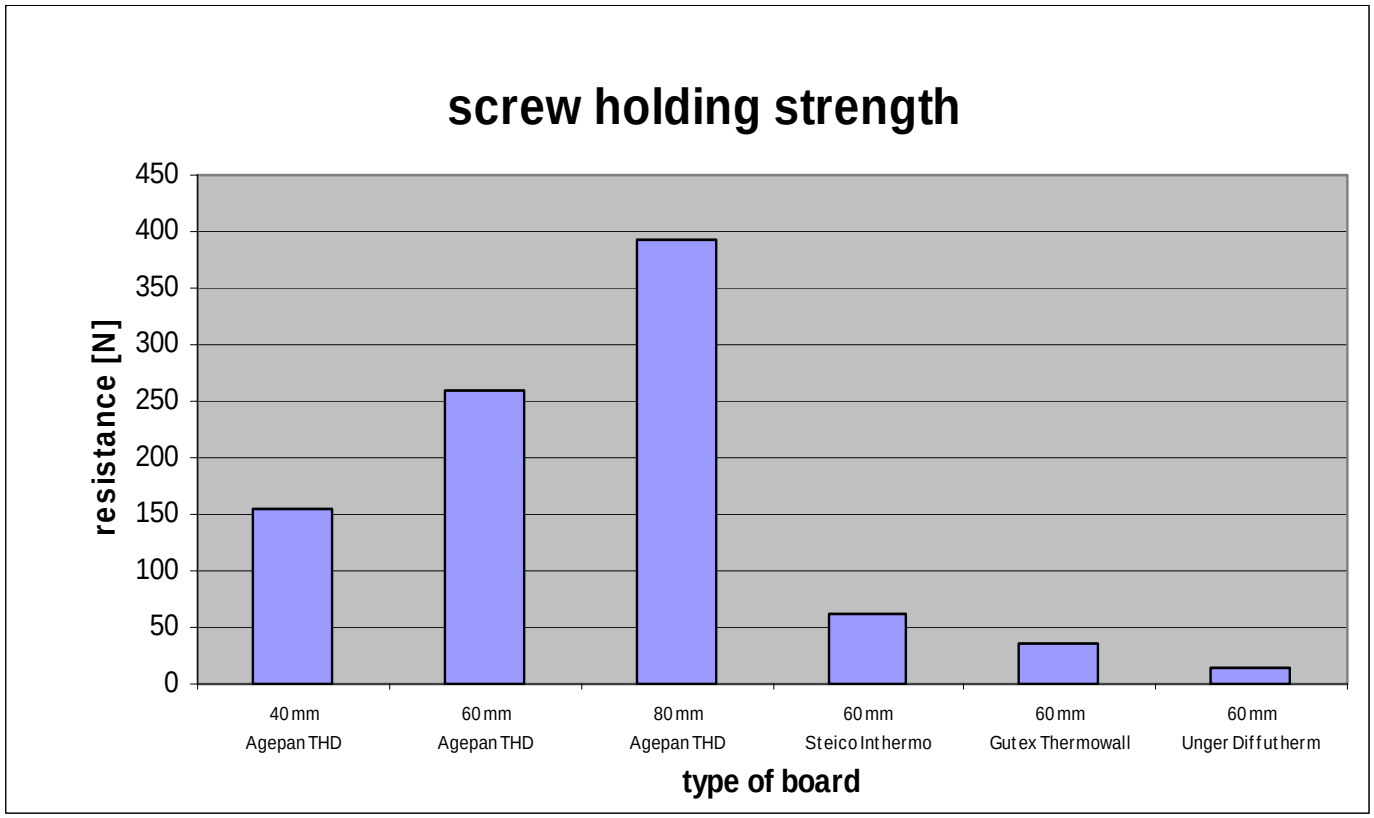
packaging

- 6-8 pallets stackable
  - without bowing

- in a shrink wrapped
- 3 bearers are enough
- Total traceability

AGEPAN® THD

assembling instructions: screw retention



AGEPAN® THD

practice

simple and good
to profile

screwed with a
component

AGEPAN® THD

practice

after 7 weeks of outdoor exposure

AGEPAN® THD

project in Tettnang: roof reconstruction

AGEPAN® THD

project in Tettnang: THD as upper panelling /
mineral fibres as filling components

AGEPAN® THD

project in Tettnang: THD- version as an edge of the roof

German: “Schubknagge“

AGEPAN® THD

project in Tettnang: AGEPAN® THD during the assembling

AGEPAN® THD

project in Tettnang: ready assembled roof surface

AGEPAN® THD

practice: Render on AGEPAN® THD T+G 230

AGEPAN® TEP

technical features

- a wood fibre thermal insulation board as dry floor panel
  German: „Trockenestrichplatte“
- according to EN 13171
- thickness: 40 / 60 / 80 mm
- format: 1320 x 600 mm
- edge: square edge
- weight: 190 kg / m³

AGEPAN® TEP

technical features

- typical characteristics of a compression strained and sound absorbing dry flooring construction
  - no long drying period
  - immediately ready to be stepped on
  - minimal dimensional changes
- thermal conductivity: 0,047 W/(m·K)
  - warm surface feel (haptic)
- joint protecting - comfortable walking

AGEPAN® TEP

technical features

- category of compression strength: P150
  - ↳ therefore qualified for home buildings
- no additional stiff board for load distribution required
  - ↳ less work required when installing
  - ↳ no additional board
- simple to handle and to profile

AGEPAN® TEP

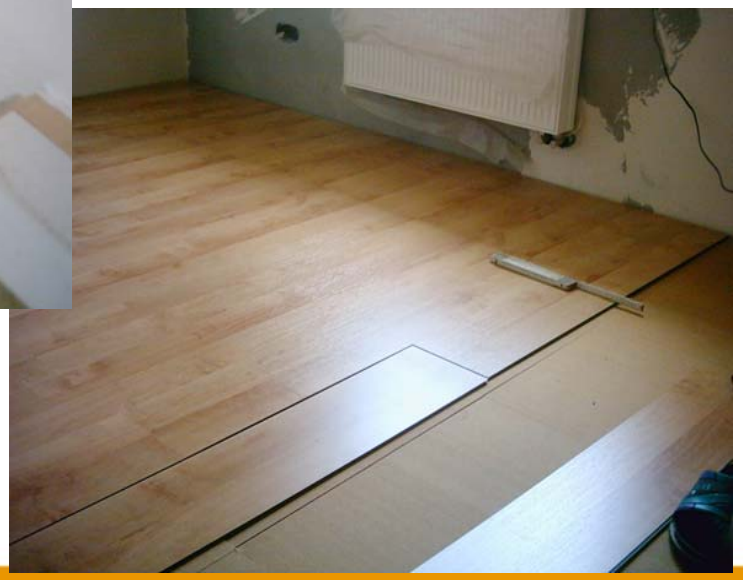
practice

- plate formation using a 1-component-glue

AGEPAN® TEP

practice

- floating or glued installation of parquet and laminat flooring



AGEPAN® UDP

the strong roof panel tx (German: Unterdeckplatte)

- according to EN 13171

- weight: 270 kg/m³
- thickness: 22 / 25 / 32 mm
- size: 2510 x 600 mm
  effective: 2500 x 590 mm

- characteristic thermal conductivity: 0,051 W/(m·K)

AGEPAN® UDP

technical features

- complete with paraffin wax coated fibres for good hydrophobic characteristics
  - hydrophobic category H10
  - minimal water absorbtion
- no bad smell (no bitumen)
- AGEPAN® UDP is stronger as you might expect
- simple handling due to tongue and groove profile

AGEPAN® UDP

technical features

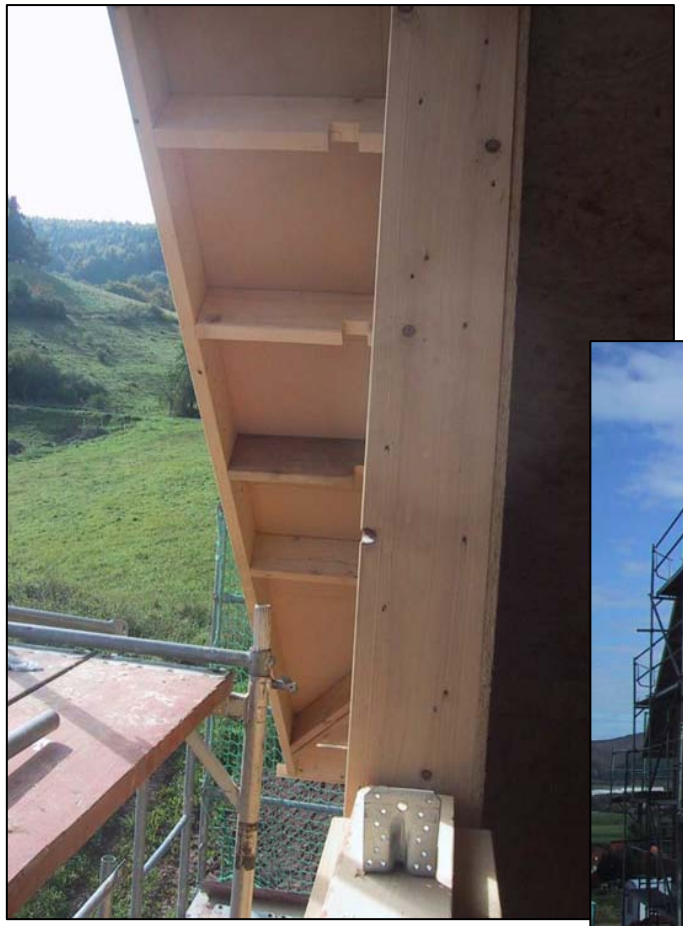
- application
  - outer thermal insulation of roof or ceiling, protection against weathering, insulation below backing, very high compression resistance
    - second water-repellent layer

AGEPAN® UDP

pratice

AGEPAN® UDP

practice



AGEPAN® DWD

the strong roof panel tx (German: Diffusionsoffene Wand- und Dachplatte)

- with certification (german regulation: Z-9.1-381)

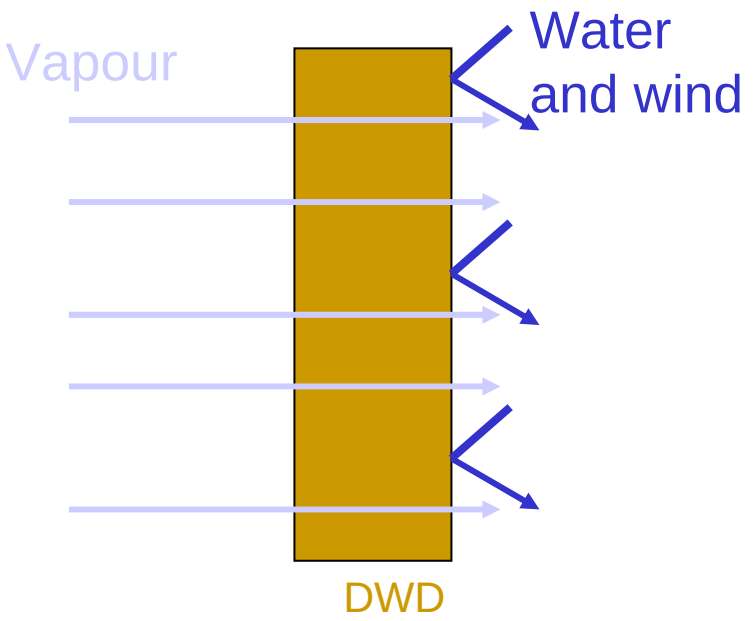
- weight: 540 - 590 kg/m³
- thickness: 16 mm
- available with and without tongue and groove
- format: 2500 x 1000 mm (t+g)
  2500 x 625 mm (t+g)
  2800 x 1247

- characteristic thermal conductivity: 0,090 W/(m·K)

AGEPAN® DWD

Technical features

- vapour open, protection against wind
- second water-repellent layer
- passable (e smaller than 1 meter)
- 4 weeks weather proof



AGEPAN® OSB

Oriented **S**trand **B**oard

- **O**riented: Exact adjustment of the Strands
- **S**trand = Long, thin scale of wood
- **B**oard = Delivery form

Application area

- For decorative and constructive applications
- Load bearing wall and floor covering
- Fire safety constructions
- Vapour barrier
- Airtight layer
- Perfect surface for AGEPAN® THD STD 190 as installation level

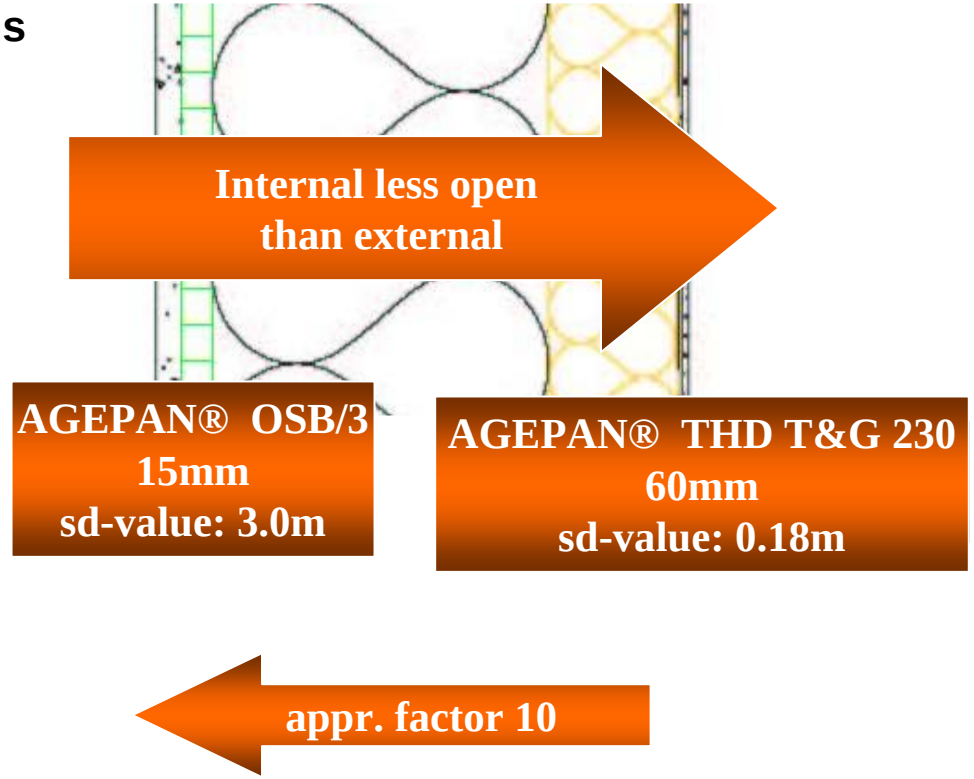
combination of products

AGEPAN® Building System

- External
  - AGEPAN® DWD
  - AGEPAN® UDP
  - AGEPAN® THD T+G 230
- Internal
  - OSB (structural)
  - AGEPAN® THD STD 190
- The AGEPAN® Building Systems may be modified for each country requirements

AGEPAN® ® Building System

Vapour open for breathing wall systems



Record Ozone Layer

The NASA and the American Weather Service measured between the 21st and the 30th September 2006 that the Ozone Layer over the South Pole reached a new record high:

27,450,000 km².

Global warming

The world temperature will increase by the year 2050 by 1.0 to 1.5°C - and in the year 2100 by 2.0 to 4.5°C.

August 2004

Flooding of Boscastle

A high tide with severe storms flooded Boscastle in Cornwall.

June 2005

Flooding of Carlisle

A high tide with severe storms floods in Carlisle. Houses still being rebuilt.

Sea Level

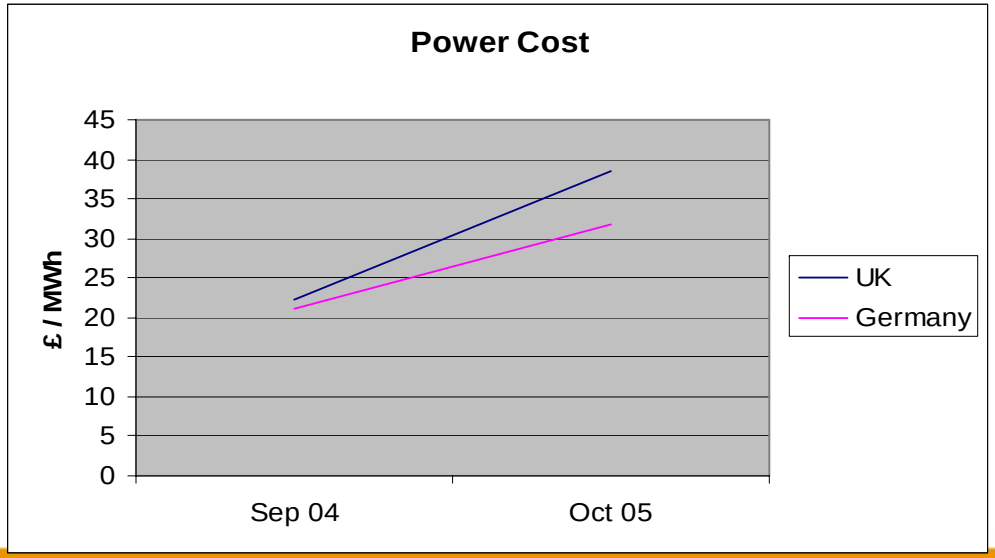
The Sea Level will increase by the year 2050 by 50 cm (20”) - and in the year 2080 by 86 cm(34”).

The number of people living in UK flood regions will be doubled very soon up to

3,500,000!

Energy Costs

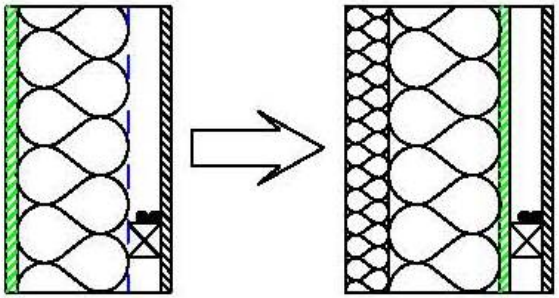
The British people spent in the period 2004/2005 £ 5,2 Bn. more for gas and electricity than in the previous year. Only a couple of years before we had the cheapest power in the EU - now we are the most expensive.



Increases 2005

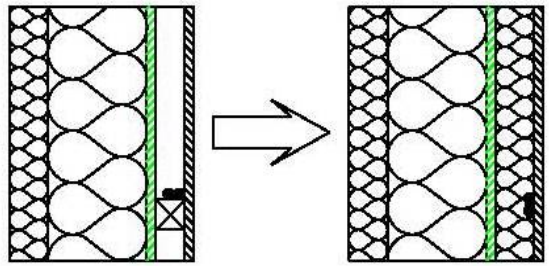
Gas:	47%
Electricity:	34%

Change the system and save money



“Oil Skin”		Vapour open	
9mm	OSB	40mm	AGEPAN® THD T+G 230
89mm	Mineral Fibre	89mm	Mineral Fibre
	Foil	9mm	OSB
	Service Layer Gypsum		Service Layer Gypsum
U-Value	0.39		0.29
Time Shift	4.6 h		7.7 h
TAV	47 %		17 %

Change a bit more and save even more money



“Oil Skin”		Vapour open	
9mm	OSB	40mm	AGEPAN® THD T+G 230
89mm	Mineral Fibre	89mm	Mineral Fibre
	Foil	9mm	OSB
	Service Layer	40mm	AGEPAN® THD STD 190
	Gypsum		Gypsum
U-Value	0.39		0.24
Time Shift	4.6 h		9.7 h
TAV	47 %		9 %

How much would be saved

Houses with 3 bedrooms spend on average
£ 1,500 per annum.

Using one AGEPAN® board save 26%:
i.e. £ 390 per annum at today´s levels.

Using two AGEPAN® boards save 38%:
i.e. £ 570 per annum at today´s levels.

If costs continues to rise in the same rate this will be
£ 4,300 per annum by 2012!

AGEPAN® THD

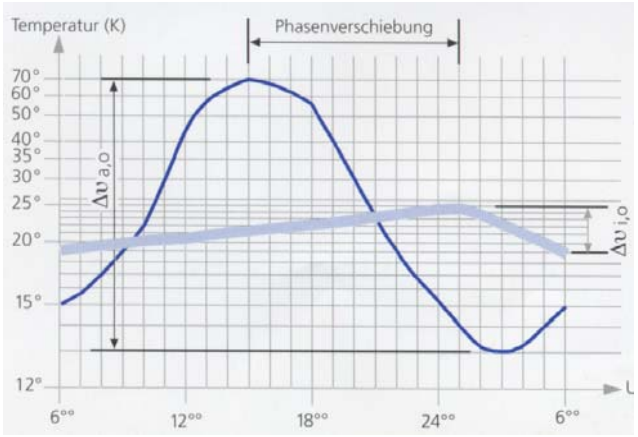
summary

- products
  - AGEPAN® THD
  - AGEPAN® TEP
  - AGEPAN® UDP
  - AGEPAN® OSB
- theory & practice
  - building physics
- AGEPAN® building system

The AGEPAN® Building System

No high temperatures underneath the roof

Summer heat protection



Ratio of temperature amplitudes

Phase shift

Very good heat storage capacity

Unit: [J/kg*K]

Mineral fiber	830	55	45,7 T	0,035
PS / PU	1480	35	5[illegible] T	[illegible]5
Cellulose	1900	55	10[illegible] T	[illegible]0
AGEPAN® THD 230	2100	230	483,0 T	0,050

Factor 10,6

Factor 1,4

AGEPAN®

building physics

- phase shift
  - time gap between the maximum inside- and outside-temperature amplitudes
  - optimum: 10 -15 h

- ratio of temperature amplitudes („TAV“)
  - maximum difference between board inside temperature and outside temperature

➔leading to an optimum summer heat protection

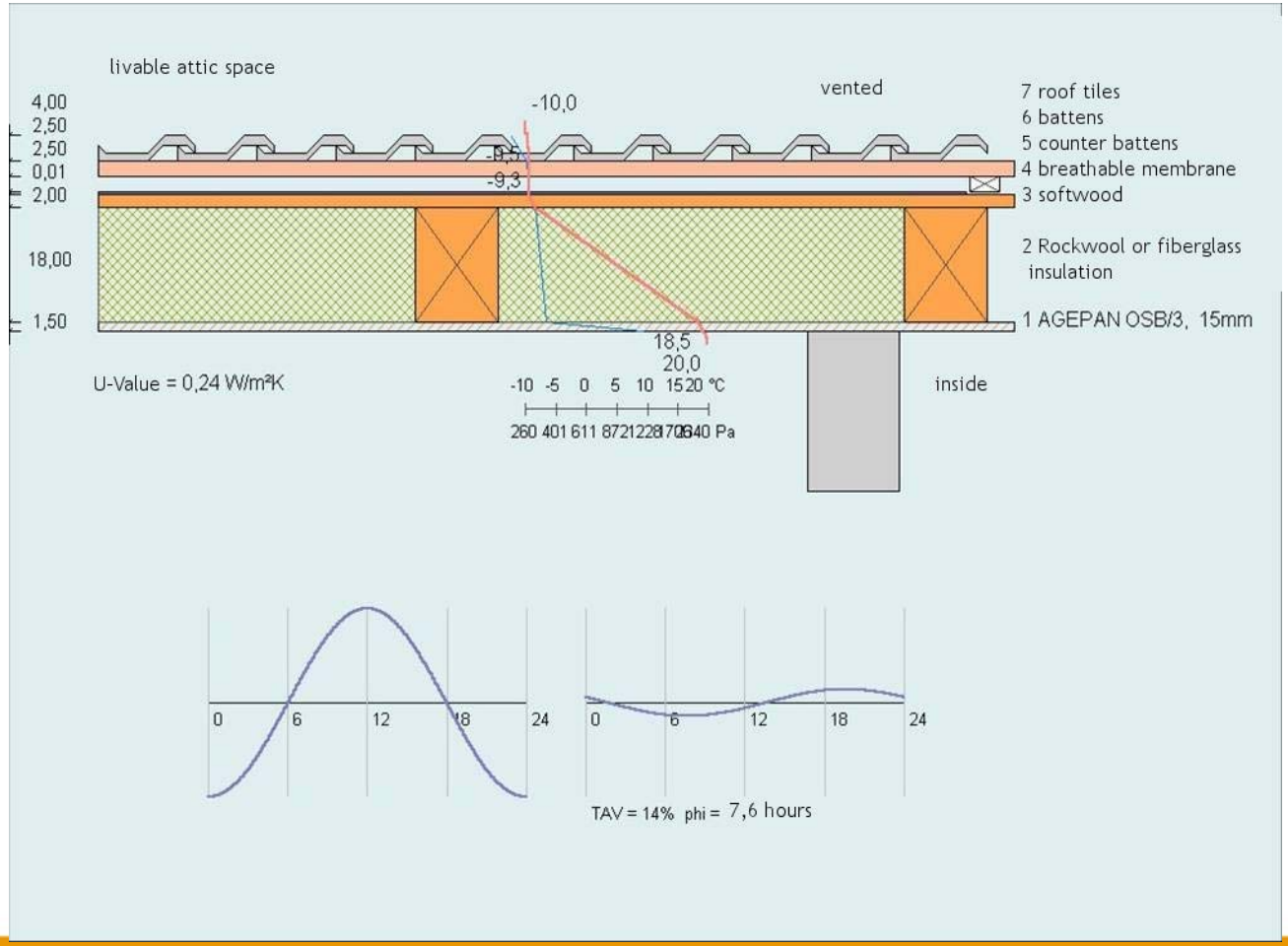
AGEPAN® THD

theory & practice

- rafter roof

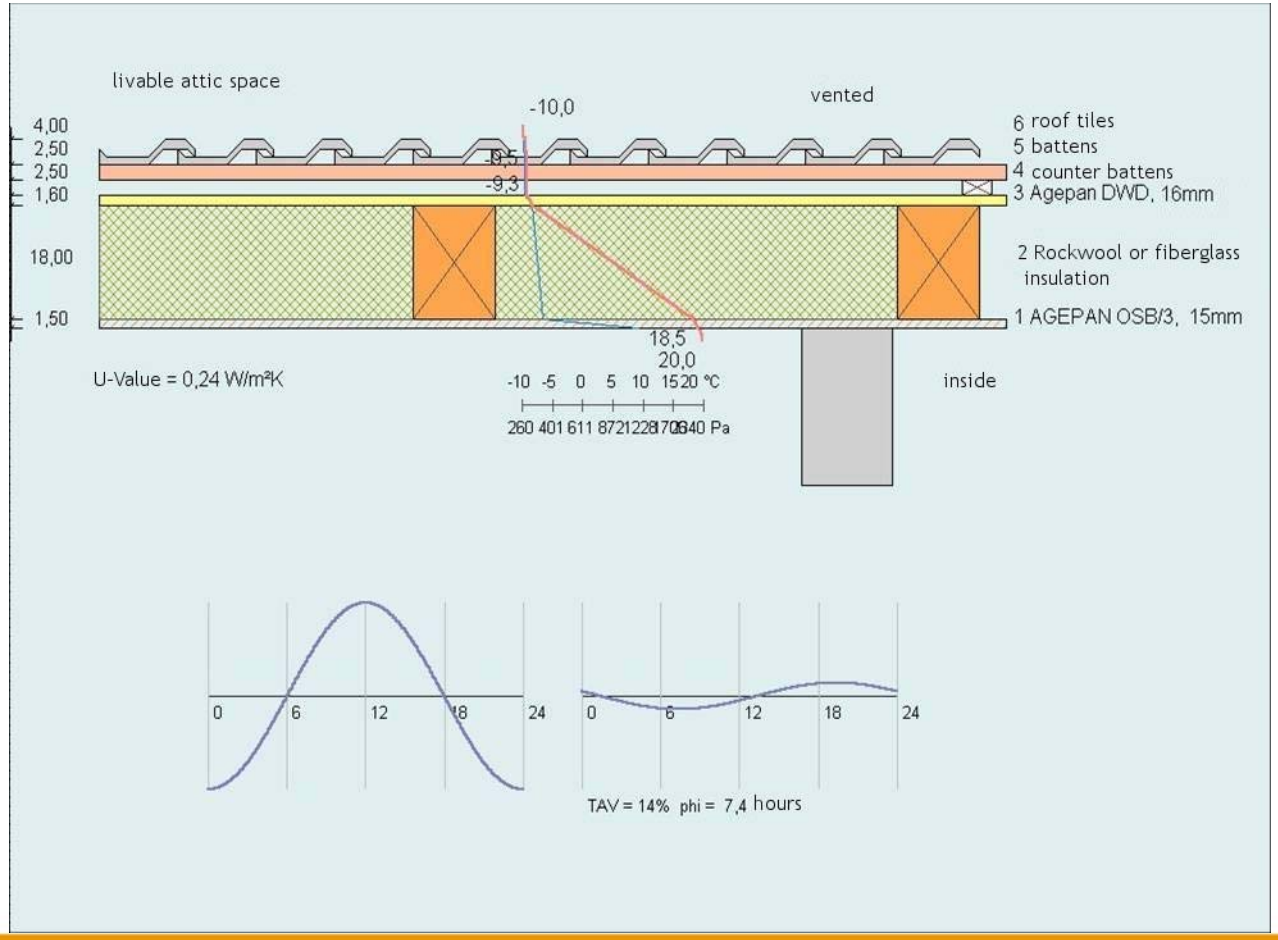
AGEPAN® THD

building physics: without AGEPAN® THD



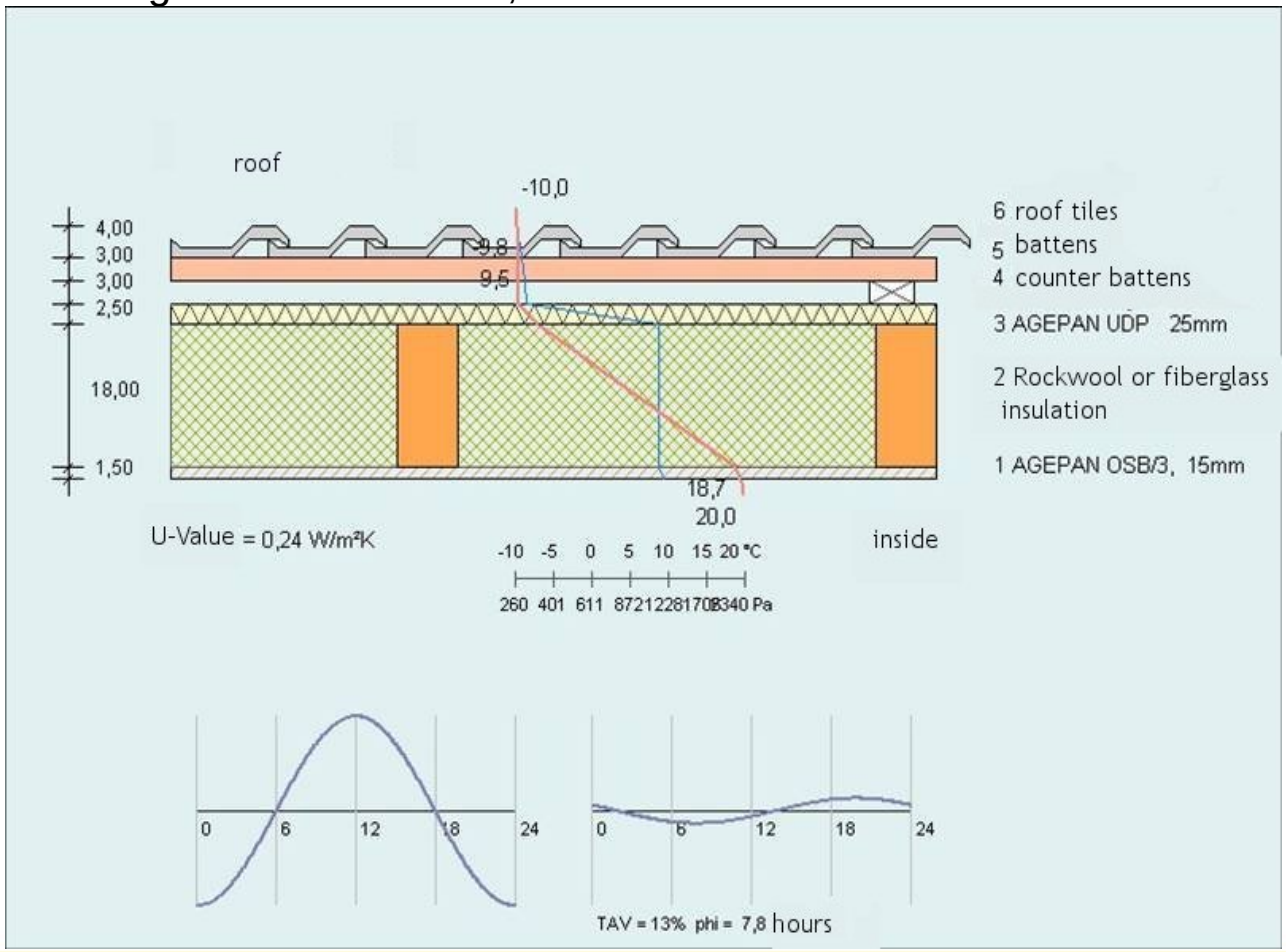
AGEPAN® THD

building physics: using AGEPAN® DWD, without AGEPAN® THD



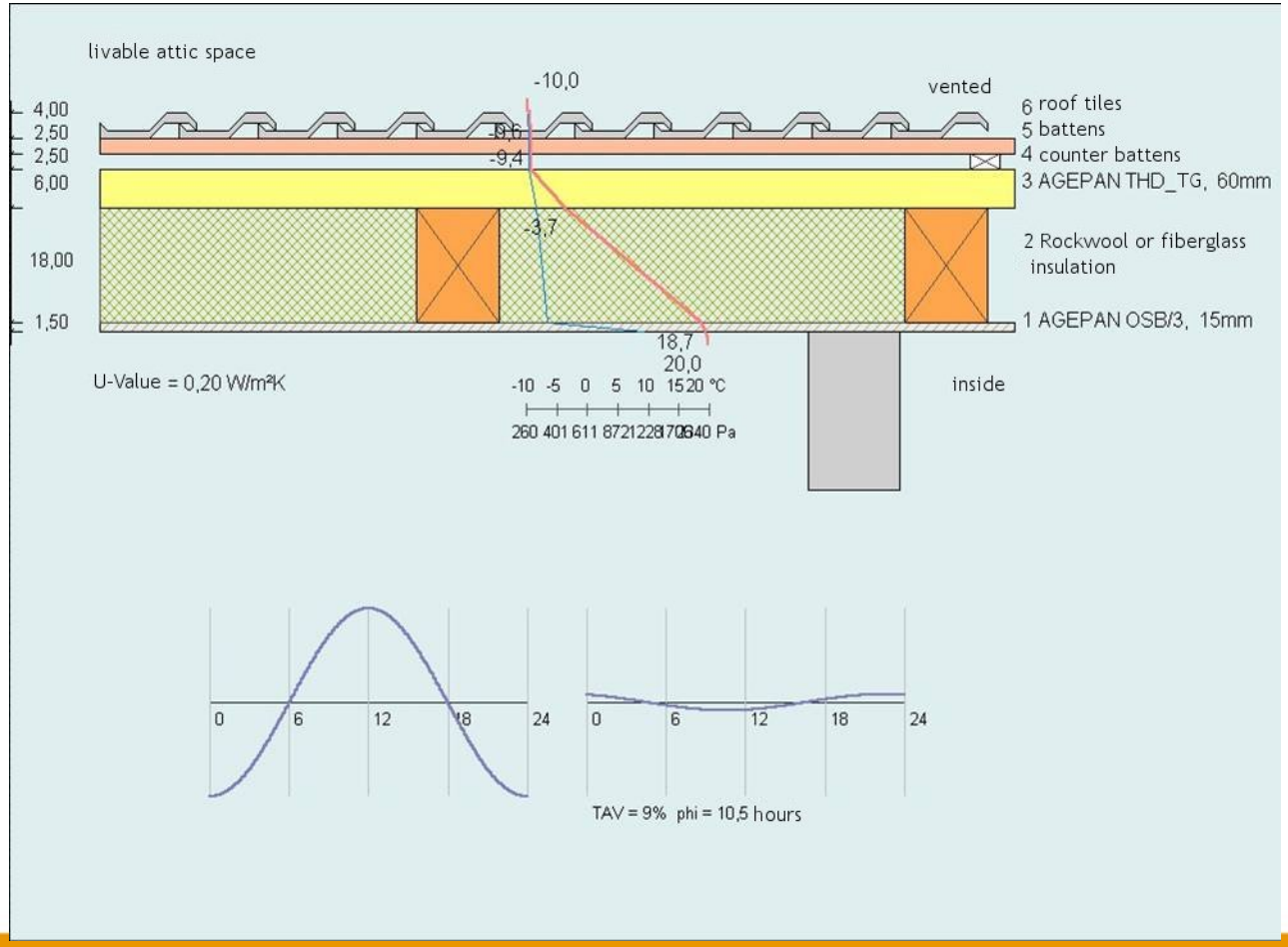
AGEPAN® THD

building physics: using AGEPAN® UDP, without AGEPAN® THD



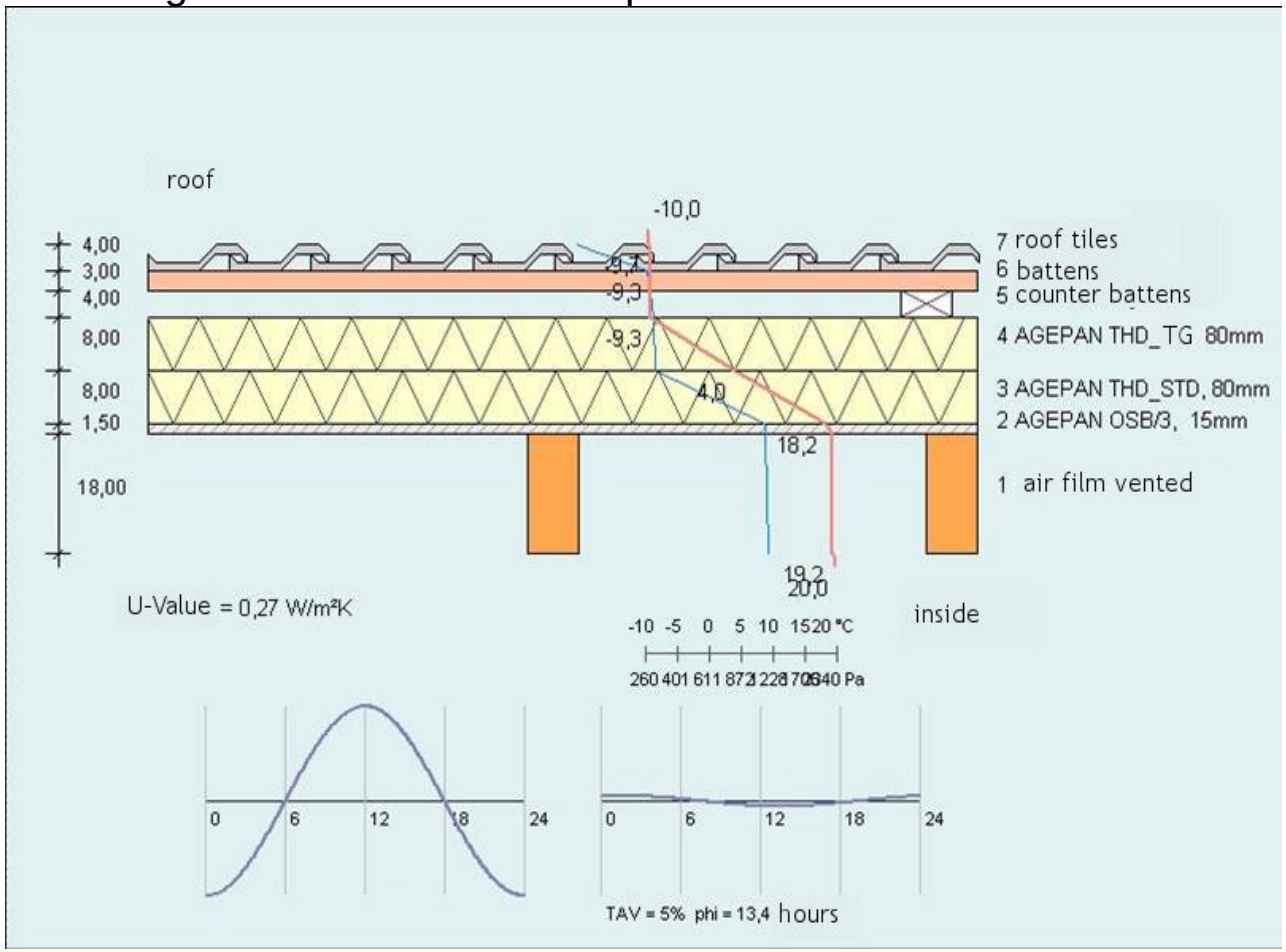
AGEPAN® THD

building physics: using AGEPAN® THD



AGEPAN® THD

building physics: using AGEPAN® THD as top-rafter insulation



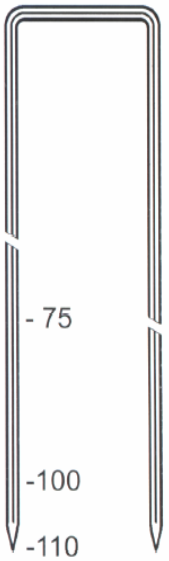
AGEPAN® THD

building physics: comparison

	ratio [%]	phase shift [h]
totaly without using AGEPAN products	14	7,6
without AGEPAN THD using AGEPAN DWD	14	7,4
without AGEPAN THD using AGEPAN UDP 25	13	7,8
using AGEPAN THD T+G 230 60 mm	9	10,5
using 2 x 80 mm AGEPAN THD only	6	13,0

AGEPAN® THD

assembling instructions



Bühnen staples:

- wide-back-clamp type SP 30 (l = 100 mm, Ø = 2,03 mm)
- type S (zinc coated), (l = 90 mm, Ø = 2,03 mm)
- for top-rafter insulation: TOPIX-screw (Z-9.1-471)

Haubold staples:

- wide-back-clamp type BS 29000
- edge >30 mm, clamp distance approx. 65 mm, penetration >30 mm

AGEPAN® THD

assembling instructions:

Bierbach DaBAU-screw:

- by building authorities accredited (Z-9.1-337)
- without predrilling, drilling aid available,
  structural analysis as a special Bierbach – service

ABC Spax-S scew:

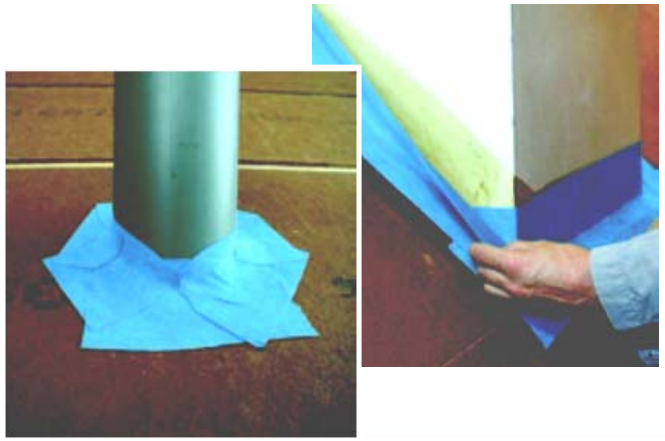
- by building authorities accredited (Z-9.1-449)
- without predrilling,
  structural analysis as a special ABC – service

AGEPAN® THD

assembling instructions for splice sealing with „BUDAX Top“

- splice sealing of THD N+F 230 is required for:
  - sliced boards
  - connections to other components
  - component penetrations

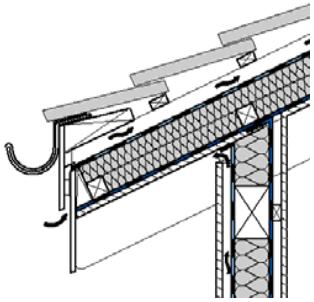
➔BUDAX TOP (pro clima®) was successfully tested and has proved to be excellent



AGEPAN® THD

assembling instructions for splice sealing with „A

- Ampacoll BK 535 was successfully proved for splice sealing of the AGEPAN® THD N+F 230 and is accredited
- The dry boards need to be amply coated with the primer Ampacoll® Primer 531.
- Follow the producer instructions of AMPACK.
- For connection-splices and free splices a strip width of 80mm is recomended.



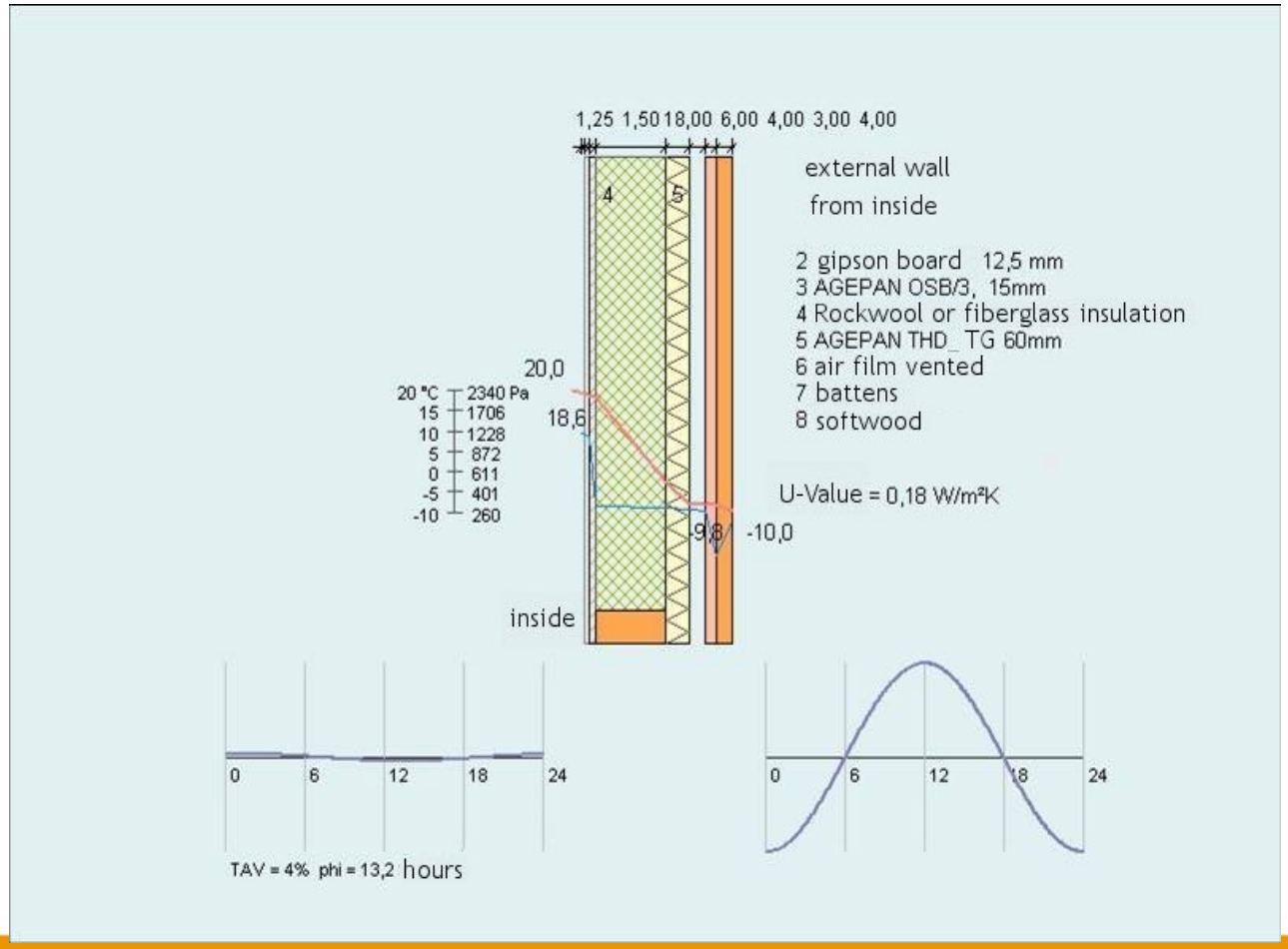
AGEPAN® THD

theory & practice

- outer wall

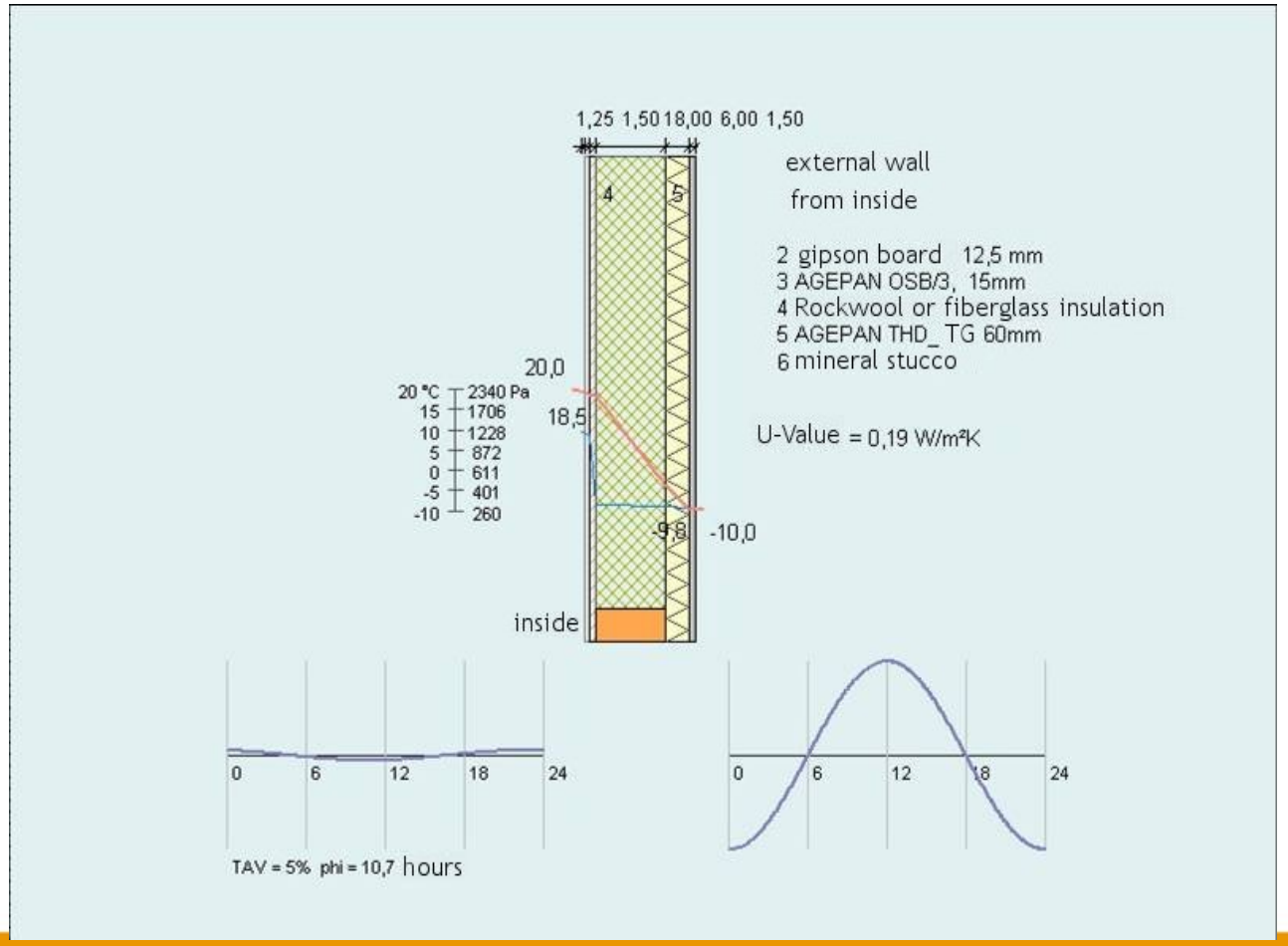
AGEPAN® THD

building physics: backside ventilated facade with AGEPAN® THD



AGEPAN® THD

building physics: plasted facade with AGEPAN® THD



AGEPAN® THD

practice: WDVS – System - accreditation with Knauf - Marmorit

AGEPAN® THD

summary

- products
  - AGEPAN® THD
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  - AGEPAN® UDP
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  - assembling instructions
- AGEPAN® building system

AGEPAN® building system

building system: AGEPAN® `s philosophy

The AGEPAN® Business Unit does not only provide panels and boards,

but complete system solutions and services.

AGEPAN® building system

building system

- A building system consists of various matched single solutions.
  - roof
  - walls
  - flooring

- The single components fit together in many variations.

  ↬ building

AGEPAN® building system

advantages of the AGEPAN® building system

- Prefabrication is possible because of the well planned range of products.
  - Structural analysis planned by one hand (possible)
  - clean and dry assembling
  - short construction periods
  - as higher component of internal activities as possible
  - ground plans are easy to correct after assembling
    ↳ taking out non-load-bearing walls
- assembling:
  - wall-slots for installation is not necessary

AGEPAN® building system

advantages of the AGEPAN® building system

- Assembling a complete timber frame construction house is possible without using foil.
  - no special refuse for recycling
- ecological in production and using
  - good ecological balance
- pleasant sense of well-living (e.g. visible rafters)
  - convenient ambience

AGEPAN® building system

advantages of the AGEPAN® building system

- sensible building is possible (in terms of building physics)
  - sealed on the inside (sd ≤ 0,2 meter)
  - open on the outside

↳ exposure category 0, (regulation: „GK 0“) for solid structural timber

  - absorption-characteristics

↳ good internal climate

AGEPAN® building system

advantages of the AGEPAN® building system

- short construction period
  - less rental fees
  - less costs of capital
- a high contingent of internal activities is possible
  - step by step completion of the interior
- assembled almost without using water containing materials
  - ecological and healthy building
  - no „ dry heating „ of the building
- earthquake safe building because of light - weigth construction

AGEPAN® building system

advantages of the AGEPAN® building system

- fire prevention
  - according to statements of insurances and firefighters:
    - wood builded houses do not have an increased fire danger
- less maintenance costs per year

AGEPAN® building system

advantages of the AGEPAN® building system

- likewise thin and light wall constructions with excellent U-value (regulation:EnEV)
  - e.g. 24 cm wall
    - U ≈ 1,00 W/m•K
  - 15 mm OSB, 180 mm wood fibre soft board (WLG 045), 40 mm THD (together 235 mm)
    - U ≈ 0,20 W/m•K
- promised values and quality are guaranteed

AGEPAN® building system

advantages of the AGEPAN® building system

- because of thin walls:
  - good area utilisation relatively to the floor plan

- easy building on to existing houses

  - increase
  - extension
  - reconstruction
  - quick and quiet

AGEPAN® building system

advantages of the AGEPAN® building system

- because of the excellent thermal insulating
  - low energy costs
  - support by KFW (germany)
  - financial support for energy saving program in your country?

↬ quick payoff

AGEPAN® building system

advantages of the AGEPAN® building system

- summer heat protection: phase shift
  - 24 cm thick walls:
    - approx. 8 h
  - wood-supported wall with cellulose or wood fibre insulating (20 cm)
    - up to 15 h

AGEPAN® building system

advantages of the AGEPAN® building system

- summer heat protection: „TAV“
  - 24 cm thick walls
    - approx. 30 %
  - wood-supported wall with cellulose or wood fibre insulating (20 cm)
    - up to 6 %

AGEPAN® building system

AGEPAN® support

- hotline- personal service - trained technicians
- training program
- show house and video
- detailed brochures with instructions for assembling and special solutions
- create a network via sonae academy

AGEPAN® building system

AGEPAN® support to international markets

- remodel datas of AGEPAN® building system into national demands
- hotline- personal service - trained technicians
- video of building the show house
- detailed brochures with instructions for assembling and special solutions

AGEPAN® building system

AGEPAN® support to international markets

- Internet
- technical support building your AGEPAN® show houses
- help by analyse the market
- develop a marketing strategy fitted to country needs
- help by selling on stock - finding preferend traders

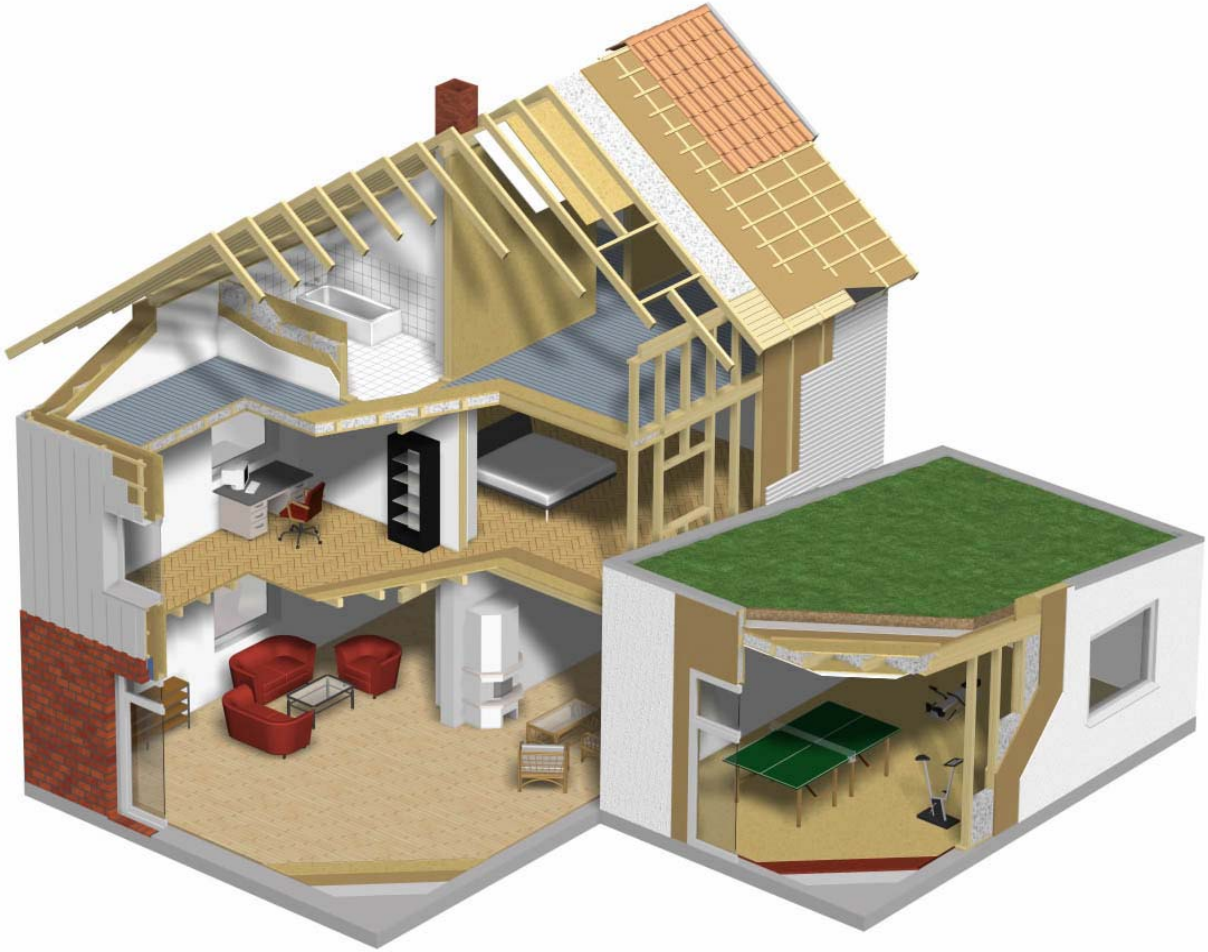
AGEPAN® building system

AGEPAN® support to international markets

- presenting the AGEPAN® products and AGEPAN® building system
  - pull strategy for the good range of market penetration
- help by calculate a comparison the AGEPAN® building system with typical national systems
- finding cooperative partners (screws, adhesive tapes a. s. o.)
- help by remodel the prefabrication line (having a specialist)
- big dimensions of the AGEPAN® THD are possible
  - get the prefabrication easier

AGEPAN® building system

details



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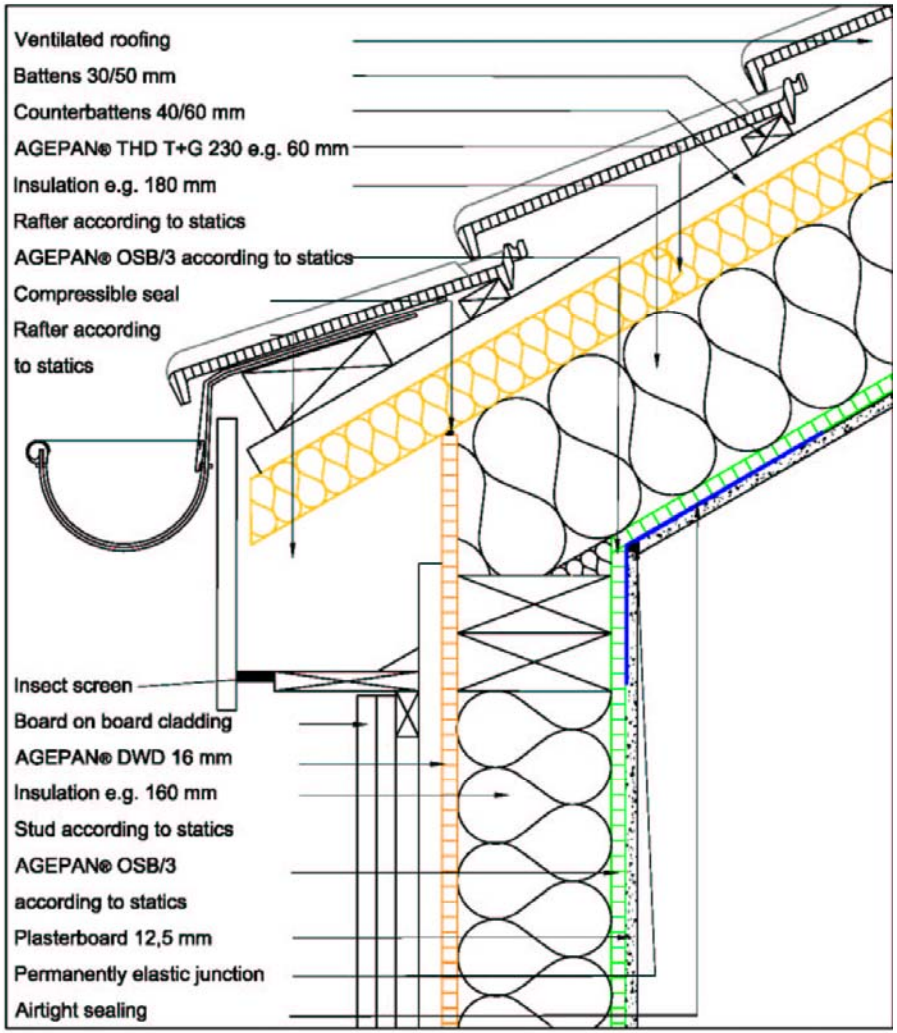
detail drawings



Detail drawing			1.1.1
Insulated roof AGEPAN® THD eaves			Roof
Scale: 1:5	Building physics calculate: 1.1.1.1 - 1.1.1.3	AGEPAN	Sonae Akademie
Date: 15.08.2006	Invitation to tender: 1.1.1		

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tenders

1.1.1 Dach mit AGEPAN DWD

Pos.	Menge	Einheit	Leistungsbeschreibung	Einheits-preis	Gesamt-Preis
1		m²	Dachsparren aus ..... Dicke.....x ..... cm Abstand..... m Abmessungen, Befestigungsmittel und Abstand der Sparren nach Vorgaben des Tragwerkplaners anbringen und einbauen.		
2		m²	Anbringen der AGEPAN OSB /3 Dicke.....mm unter die Dachsparren (mit aufsteigender Feder), beginnend am Kniestock. Platten sind im Verbund dicht zu verlegen, Kreuzfugen sind zu vermeiden, im Firstbereich passgenau zuschneiden. Befestigung mit geeigneten Klammern oder Schrauben nach Angaben des Tragwerkplaners. Inkl. luftdichtem Verkleben der Plattenstöße und Anschlüsse nach DIN 4108-7 mit dem Klebeband Ampacoll AT 950 der Firma Ampack Bautechnik GmbH oder gleichwertig. Die Verarbeitunghinweise des Herstellers sind zu berücksichtigen. (siehe *Verarbeitungshinweise AGEPAN OSB und Ampacoll BK 535*).		
3		m²	Innenbeplankung aus Gipskartonplatte nach DIN 18180 Dicke .....mm mit geeigneten Befestigungsmittel fixieren. Anschließend sach- und fachgerechtes verspachteln der Fugen mit Fugenmörtel. Die Verarbeitunghinweise des Herstellers sind zu berücksichtigen.		
4a		m²	Fugenversetztes Verlegen von ISOROY Thermisorel, Baustoffklasse B2 nach 4102 Materialdicke .....mm. Wärmeleitfähigkeit ..... W/(m K) Sämtliche Anschlüsse sind passgenau und fugendicht herzustellen. (siehe *Verarbeitungshinweise ISOROY Thermisorel*)		

1.1.1	Ausschreibungstext		
Dach	**Unterdach AGEPAN DWD**		
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4b		m²	Einbringen von Mineralfaserdämmung zwischen die Sparren. Materialdicke.....mm. Wärmeleitfähigkeit .....W/(mK) Sämtliche Anschlüsse sind passgenau und fugendicht herzustellen. Die Verarbeitunghinweise des Herstellers sind zu berücksichtigen.		
4c		m²	Zellulosedämmstoff, Wärmeleitfähigkeit ..... W/(mK) Brandklasse B2, mit reduziertem Boratgehalt (max. 10 M%), Dämmdicke.....cm, liefern und mit Verdichtungsmaßen gemäß Verarbeitungsrichtlinien des Herstellers im Dachbereich zwischen die Sparren fugenfrei, hohlraumfüllend und setzungssicher einbringen – inkl. Öffnen und luftdichtes Verschließen der Einblasöffnungen. Die Verarbeitunghinweise des Herstellers sind zu berücksichtigen.		
5		m²	Verlegen von AGEPAN DWD nach Z-9.1-382 auf die Dachsparren (mit aufsteigender Feder), beginnend an der Traufschalung. Platten sind im Verbund dicht zu verlegen, Kreuzfugen sind zu vermeiden, im Firstbereich passgenau zuschneiden. Als zweite wasserableitende Schicht empfohlen. Die Befestigung ist mit geeigneten Schrauben nach Vorgabe des Tragwerkplaner auszuführen. Bei einer Mindestdachneigung von 15° kann nach ZVDH-Regelwerk eine verfalzte Unterdeckung ausgeführt werden. Bei Unterschreitung der Dachneigung von 15° ist eine verklebte Unterdeckung auszuführen in jedem Fall ist eine Mindestdachneigung von 10° einzuhalten. Beide Ausführungen anwendbar bei max. 6° Unterschreitung der Regeldachneigung. Inkl. Wind- und wasserdichtem Anschluss bei zurückgeschnittenen Platten mit Klebeband Ampacoll BK 535 der Firma Ampack Bautechnik GmbH oder gleichwertig (siehe *Verarbeitungshinweise AGEPAN DWD und Ampacoll BK 535*).		
6		m	Ausklinken der Sparren im Bereich der Sichtschalung, um Niveauausgleich zur DWD-Plattenebene zu schaffen.		

7		m²	Sichtschalung im Bereich der Dachtraufe aus ..... Dicke .....mm Auf die Sparren sach- und fachgerecht mit geeigneten Befestigungsmitteln mechanisch fixieren.		
8		m	Abdeckung der Sichtschalung im Bereich der Dachtraufe mit .... Unterspannbahn $s_d \leq 0{,}1$ m, firstseitig ca. 20 cm über die Schalung auf die AGEPAN DWD verlegen, Gesamtbreite.....cm. Wind- und wasserdichtem Anschluss der Folie mit dem Ampacoll BK 535 der Firma Ampack Bautechnik GmbH oder gleichwertig zu verkleben. Gesamtbreite.....cm (*siehe Verarbeitungshinweise AGEPAN DWD und Ampacoll BK 535)*.		
9		m²	Anschluss an Ortgang: Abdecken des Ortgangsschalung mit.....Schalungsbahn. Diese sollte ca. 25 cm auf die AGEPAN DWD aufliegen als Schutz gegen eindringendes Wasser, verkleben mit dem Ampacoll BK 535 der Firma Ampack Bautechnik GmbH oder gleichwertig. (siehe *Verarbeitungshinweise AGEPAN DWD und Ampacoll BK 535)*		
10		-	Durchdringungen passgenau einarbeiten und mit abgewinkeltem Blech in.....mm Stärke und Länge.....m abdichten. Sach- und fachgerechtes Verkleben mit Klebeband Ampacoll BK 535 der Firma Ampack Bautechnik GmbH oder gleichwertig. (siehe *Verarbeitungshinweise AGEPAN DWD und Ampacoll BK 535*)		
11		Stk.	Dachflächenfenster entsprechend der Herstellerrichtlinien anschließen und abdichten, Abmessung: ..... x ..... m²		

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Bauteilquerschnitt

Querschnitt

von innen	s [cm]	ρ [kg/m³]	[kg/m²]	λ_R [W/mK]	R [m²K/W]
Rsi					0,10
01 Gipskartonplatten 12,5 mm	1,250	900	11,3	0,250	0,05
02 Luftschicht ruhend	2,500	1	0,0	-	0,18
03 AGEPAN OSB/3, 15mm	1,500	600	9,0	0,130	0,12
04 Mineralfaser 040	18,000	20	3,6	0,040	4,50
05 Agepan DWD, 16mm	1,600	560	9,0	0,090	0,18
06 Grundlattung	2,500	-	-	-	-
07 Traglattung	2,500	-	2,0	-	-
08 Tondachziegel	4,000	2000	80,0	1,000	0,04
Rse					0,04
	d = 33,850		G = 114,8		R_T = 5,20

U_{Gefach} = 0,192 W/m²K

Zusammengesetztes Bauteil

Rahmenbreite	Achsabstand		zusammengesetztes Bauteil
8,0 cm	80,0 cm	10,0 %	125,3 kg/m³

Rahmenanteil von innen	s [cm]	ρ [kg/m³]	[kg/m²]	λ_R [W/mK]	R [m²K/W]
Rsi					0,10
01 Gipskartonplatten 12,5 mm	1,250	900	11,3	0,250	0,05
02 Grundlattung	2,500	-	-	-	-
03 AGEPAN OSB/3, 15mm	1,500	600	9,0	0,130	0,12
04 Nadelholz	18,000	600	108,0	0,130	1,38
05 Agepan DWD, 16mm	1,600	560	9,0	0,090	0,18
06 Grundlattung	2,500	-	-	-	-
07 Traglattung	2,500	-	2,0	-	-
08 Tondachziegel	4,000	2000	80,0	1,000	0,04
Rse					0,04
	33,850		219,2		R_T = 1,91

$U_{(R)}$ = 0,524 W/m²K

1.1.1	Bauphysikalische Berechnungen		
Dach	**Unterdach AGEPAN DWD**		
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R'_T = 1 / (90,00% * 1/5,203 + 10,00% * 1/1,908) = 4,44 m²K/W
R''_T = 0,10+0,05+0,01+0,12+3,67+0,18+0,00+0,00+0,04+0,04 = 4,21 m²K/W

R_{min} = 0.001 m²K/W angenommen: Rahmen-2 Gefach-6 Rahmen-6 Gefach-7 Rahmen-7

R_T = (R'_T + R''_T)/2 = 4,32 m²K/W

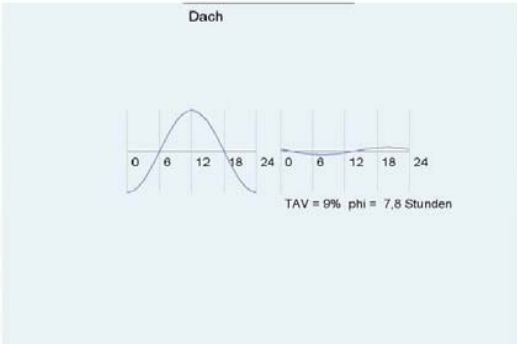
Wärmedurchgangskoeffizient U = **0,231 W/m²K**

Temperaturamplitudenverhältnis und Phasenverschiebung

für das Gefach

von innen	ρ [kg/m³]	λ_R [W/mK]	R [m²K/W]	c [Wh/kgK]	f_0
1 Gipskartonplatten 12,5 mm	900	0,250	0,05	0,28	0,14
2 Luftschicht ruhend	1	0,139	0,18	0,30	0,01
3 AGEPAN OSB/3, 15mm	600	0,130	0,12	0,58	0,28
4 Mineralfaser 040	20	0,040	4,50	0,23	0,70
5 Agepan DWD, 16mm	560	0,090	0,18	0,47	0,31
6 Grundlattung	-	-	-	0,58	-
7 Traglattung	80	-	-	0,58	-
8 Tondachziegel	2000	1,000	0,04	0,22	0,31

TAV = 0,0888 (9%), Temperaturamplitudendämpfung 1/TAV = 11
Phasenverschiebung φ = 2,042 rad (7,8 Stunden)



1.1.1	Bauphysikalische Berechnungen		
Dach	**Unterdach AGEPAN DWD**		
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Temperaturverlauf und Diffusionsberechnung

Bauteil Dach

Klimabedingungen Normklimadaten DIN 4108

Tauperiode	Außenklima	-10,0 °C	φ =	80 %
1440 Stunden	Innenklima	20,0 °C	φ =	50 %
Verdunstungsperiode	Außenklima	12,0 °C	φ =	70 %
2160 Stunden	Innenklima	12,0 °C	φ =	70 %

Temperatur der Dachoberfläche 20,0 °C

Grenzschichttemperaturen und Sättigungsdampfdrücke

von innen vor der Schichtgrenze	Tauperiode T_{gr} [°C]	Tauperiode p_s [Pa]	Verdunstungsperiode T_{gr} [°C]	Verdunstungsperiode p_s [Pa]
Raumluft	20,0	2340	12,0	1403
1 Gipskartonplatten 12,5 mm	19,4	2254	12,2	1422
2 Luftschicht ruhend	19,1	2212	12,2	1422
3 AGEPAN OSB/3, 15mm	18,1	2079	12,5	1451
4 Mineralfaser 040	17,4	1988	12,7	1470
5 Agepan DWD, 16mm	-8,5	296	19,7	2297
6 Grundlattung	-9,5	272	19,9	2324
7 Traglattung	-9,5	272	19,9	2324
8 Tondachziegel	-9,5	272	19,9	2324
	-9,8	264	20,0	2340
Außenluft	-10,0	260	12,0	1403

Diffusionswiderstände

Schicht	μmin [-]	μmax [-]	μmin*s [m]	μmax*s [m]		Sd [m]
1 Gipskartonplatten 12.5 mm	8	8	0,10	0,10		0,10
2 Luftschicht ruhend	1	1	0,03	0,03		0,03
3 AGEPAN OSB/3, 15mm	200	250	3,00	3,75	->	3,00
4 Mineralfaser 040	1	1	0,18	0,18		0,18
5 Agepan DWD, 16mm	11	11	0,18	0,18		0,18
6 Grundlattung	1	1	0,03	0,03		0,03
7 Traglattung	1	1	0,03	0,03		0,03
8 Tondachziegel	30	40	1,20	1,60	<-	1,60
					Σ μ*s =	5,13

1.1.1	Bauphysikalische Berechnungen		
Dach	**Unterdach AGEPAN DWD**		
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Klimabedingter Feuchteschutz nach DIN 4108-3:2001

Vermeidung kritischer Feuchte auf Innenoberflächen (A.5)

Die Taupunkttemperatur der Raumluft beträgt θ_s = 9,3 °C (DIN 4108-3, Tab A.4)
Randbedingungen: θ_i = 20,0 °C ϕ = 50 % R_{si} = 0,10 m²K/W θ_e = -10,0 °C R_{se} = 0,04 m²K/W
80% relative Luftfeuchte werden bei einer Abkühlung der Raumluft auf 12,6 °C erreicht

R_{min} = 0,14 < 5,06 m²K/W = R_{vorh}, in Ordnung nach DIN 4108-3, A.12
Mindest-Wärmedurchlasswiderstand $R_{min} = R_{si} * ((\theta_i - \theta_e) / (\theta_i - \theta_s)) - (R_{si} + R_{se})$ (Gl. A.12)

Tauwasserbildung im Inneren von Bauteilen (A.2)

Taubereich "Agepan DWD, 16mm - Grundlattung"

$$m_{w,T} = 1440 * \left(\frac{1170 - 296}{3,31} - \frac{272 - 208}{1,65} \right) / 1500 = 216,6 \text{ g/m}^2 \text{ Tauwasser}$$

$$m_{w,V} = 2160 * \left(\frac{2310 - 982}{3,39} + \frac{2310 - 982}{1,74} \right) / 1500 = 1663,9 \text{ g/m}^2 \text{ Verdunstung}$$

"Agepan DWD, 16mm" in der Tauzone. Die Feuchtezunahme beträgt 2,4 Masse %.
Erfüllt die Anforderungen nach DIN 4108-3, 4.2.1.

Die Tauwasserbildung im Bauteil ist im Sinne von DIN 4108-3 unschädlich, da
$m_{W,T}$ < zul $m_{W,T}$ und $m_{W,V} > m_{W,T}$

1.1.1	Bauphysikalische Berechnungen		
Dach	**Unterdach AGEPAN DWD**		
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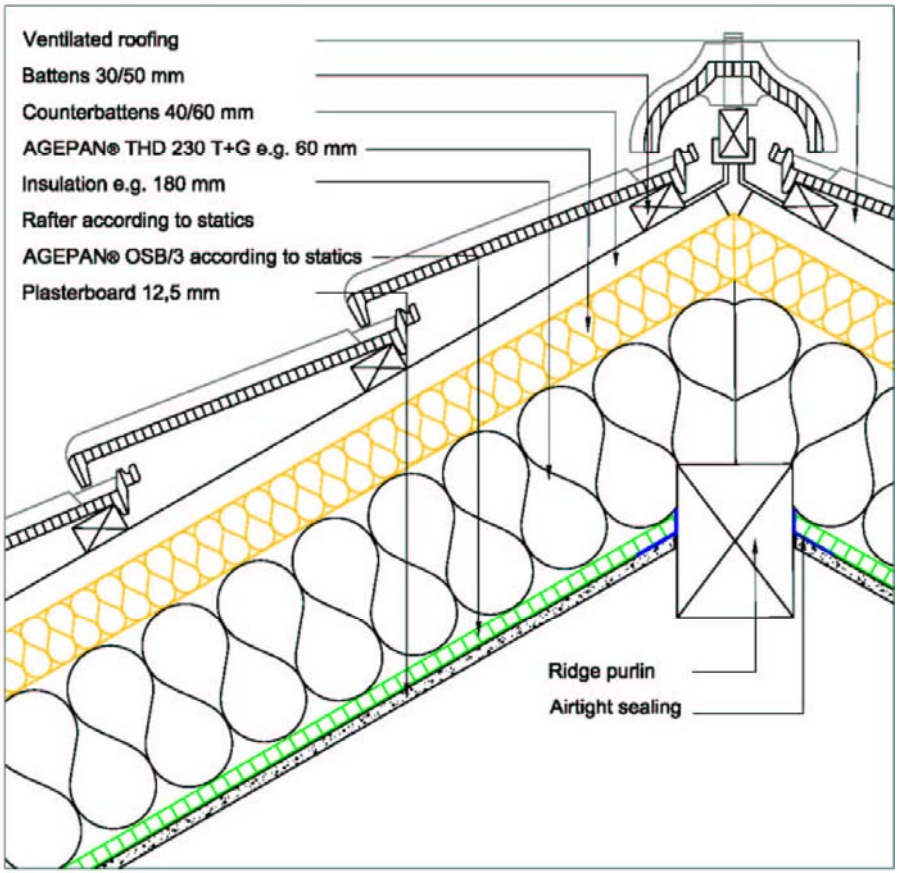
detail drawings



Detail drawing			1.1.2
Insulated roof AGEPAN® THD ridge			Roof
Scale: 1:5	Building physics calculate: 1.1.1.1 - 1.1.1.3	AGEPAN® Sonae Indústria	Sonae Akademie
Date: 15.08.2006	Invitation to tender: 1.1.1		

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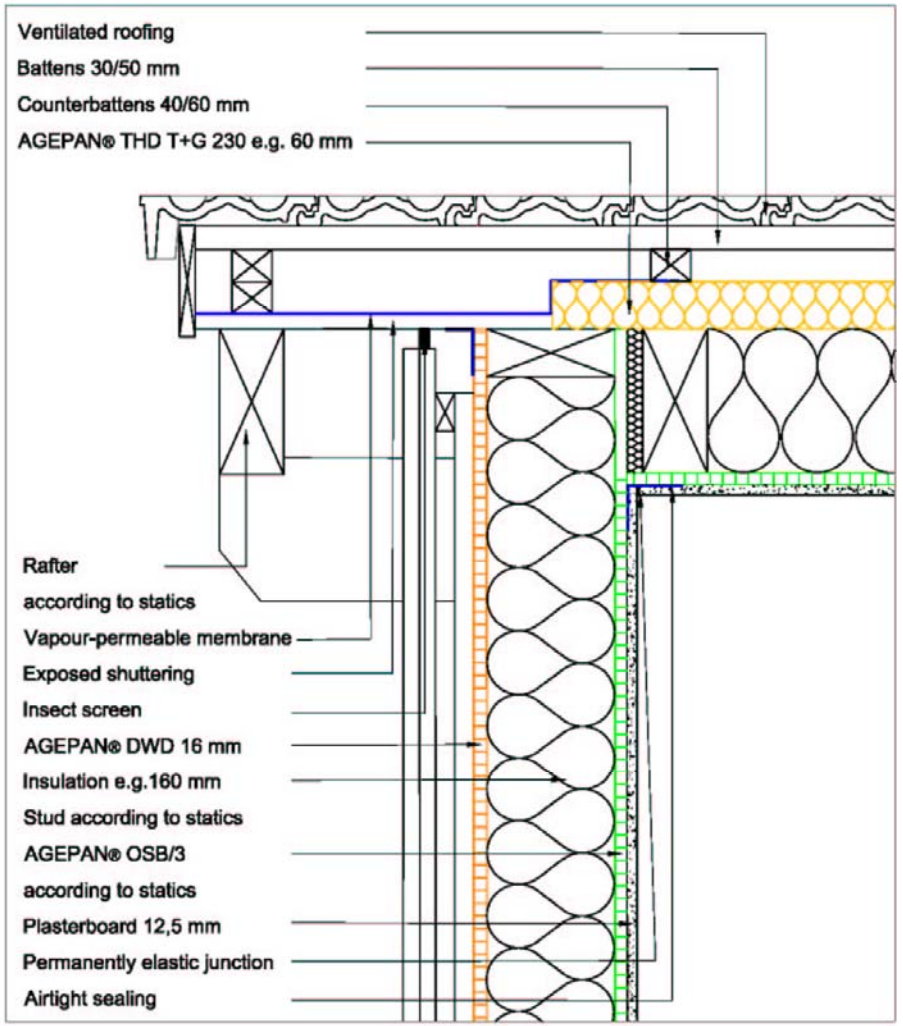
detail drawings



Detail drawing			1.1.3
Insulated roof AGEPAN® THD verge			Roof
Scale: 1:6	Building physics caculate: 1.1.1.1 - 1.1.1.3	AGEPAN	Sonae Akademie
Date: 15.08.2006	Invitation to tender: 1.1.1		

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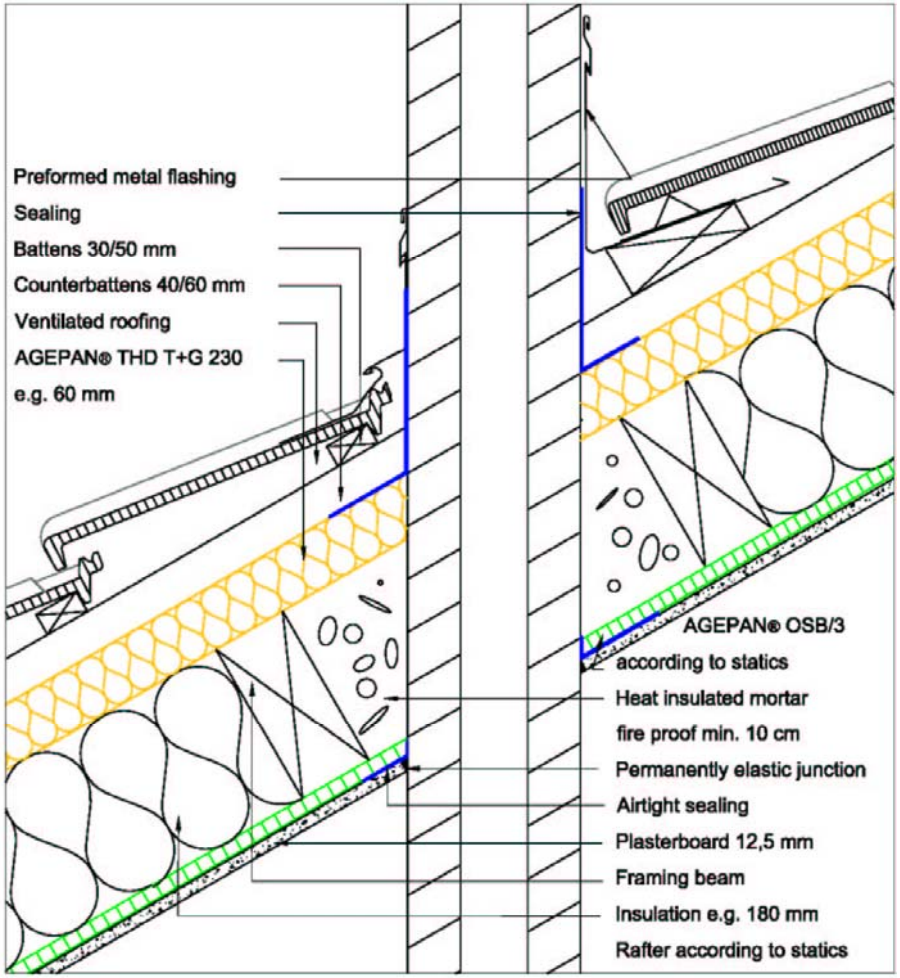

Detail drawing			1.1.5
Insulated roofing AGEPAN® THD chimney penetration			Roof
Scale: 1:5	Building physics calculate: 1.1.1.1 - 1.1.1.3	AGEPAN	Sonae Akademie
Date: 15.08.2006	Invitation to tender: 1.1.1		

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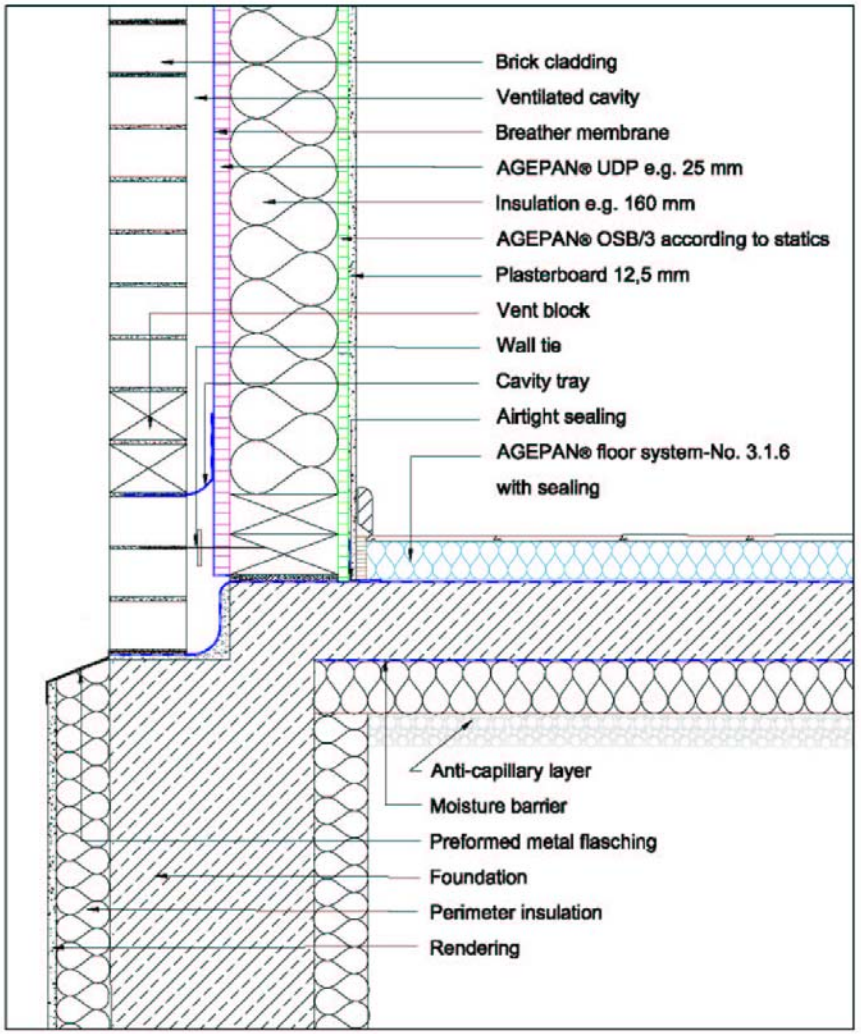

Detail drawing			2.2.7
AGEPAN UDP plinth connection with brick cladding (vertical cut)			External wall
Scale: 1:7	Building physics calculate: 2.2.4.1 - 2.2.4.3	AGEPAN®	Sonae Akademie
Date: 15.08.2006	Invitation to tender: 2.2.1		

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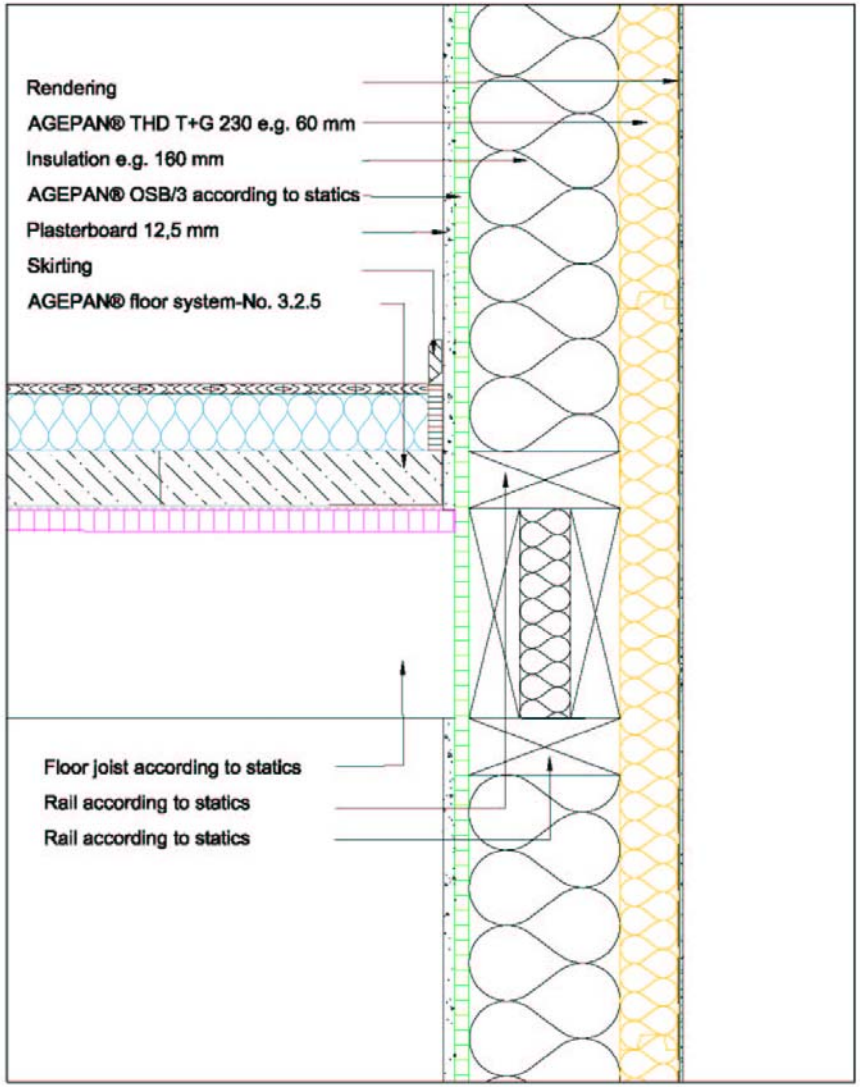

Detail drawing			2.1.3
External wall with AGEPAN THD on exposed joists system (vertical cut)			External wall
Scale: 1:5	Building physics calculation: 2.1.2.1 - 2.1.2.3	AGEPAN®	Sonae Akademie
Date: 15.08.2006	Invitation to tender: 2.1.1		

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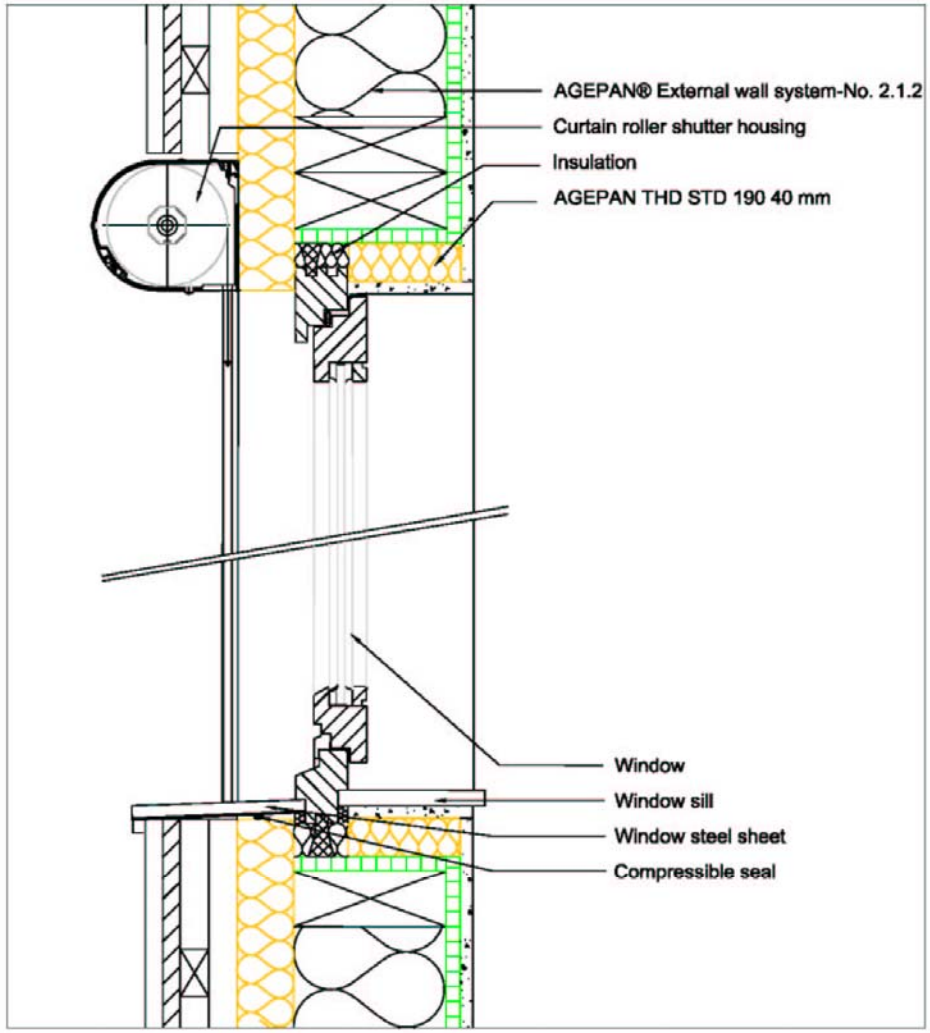

Detail drawing			2.1.2.1
AGEPAN THD window junction with board-on-board cladding			Window
Scale: 1:5	Building physics calculate: 2.1.1.1 - 2.1.1.3	AGEPAN	Sonae Akademie
Date: 02.11.2006	Invitation to tender: 2.1.1		

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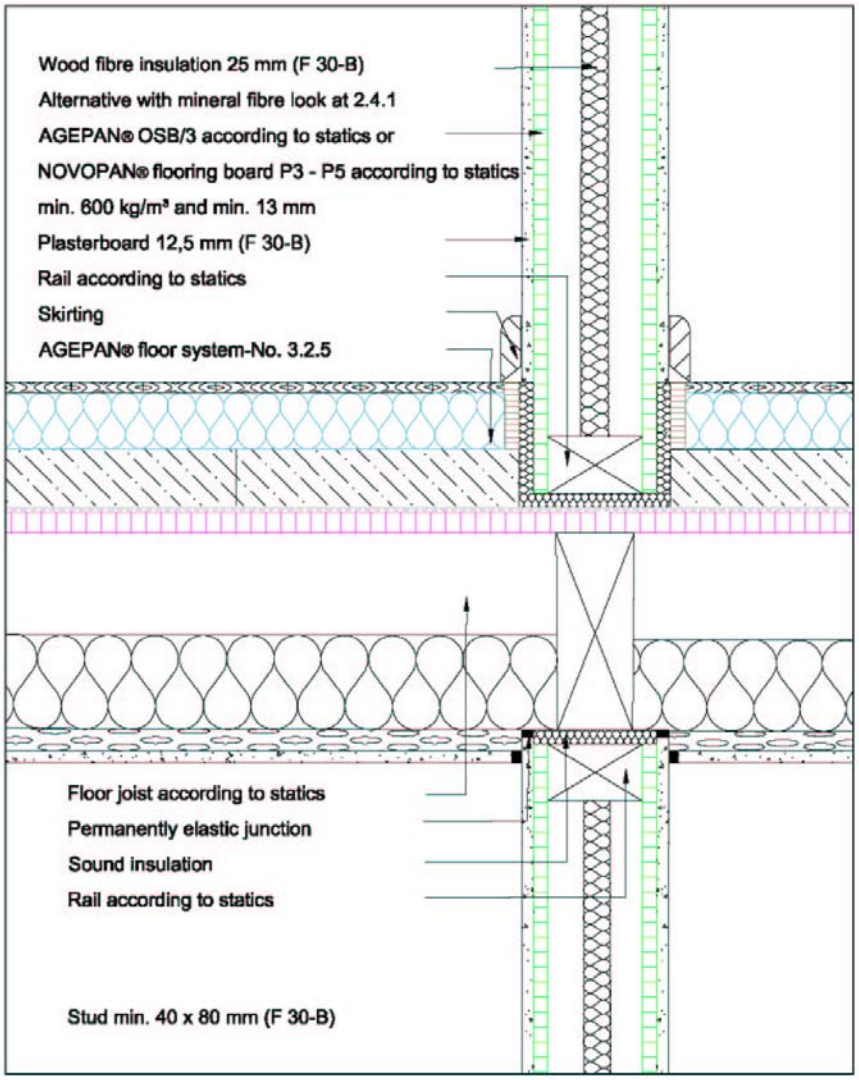

Detail drawing			2.4.2
Internal wall AGEPAN OSB / NOVOPAN (F 30-B)			Internal wall
Scale: 1:5	Building physics calculate:	AGEPAN	Sonae Akademie
Date: 15.08.2006	Invitation to tender: 2.4.1		

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- **Contact:**

- **Hans Robert Holzer**
- **Manager AGEPAN Business Unit**
- **Industriegebiet**
- **56759 Kaisersesch**
- **Germany**
- **Cell Phone: + 49 (0) 151 1270 39 40**
- **haro.holzer@agepan.de**

Thank you

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