DASAR PERHITUNGAN KANDANG CLOSE HOUSE FLOOR SISTEM

Program Kredensial Mikro Mahasiswa
KMMI-UMM
2021

Mengapa kontrol Iklim begitu Penting

- Persaingan pasar
  - Menaikkan produksi dan menekan cost
- Memaksimalkan potensi genetik dan efisiensi penggunaan pakan dalam pertumbuhan dan produksi.
- Target
  - For broiler
    - FCR kurang dari 1.45 pada bobot 2kg?
    - Total kematian kurang dari 3% @ 32 hari

Dasar Penentuan Awal

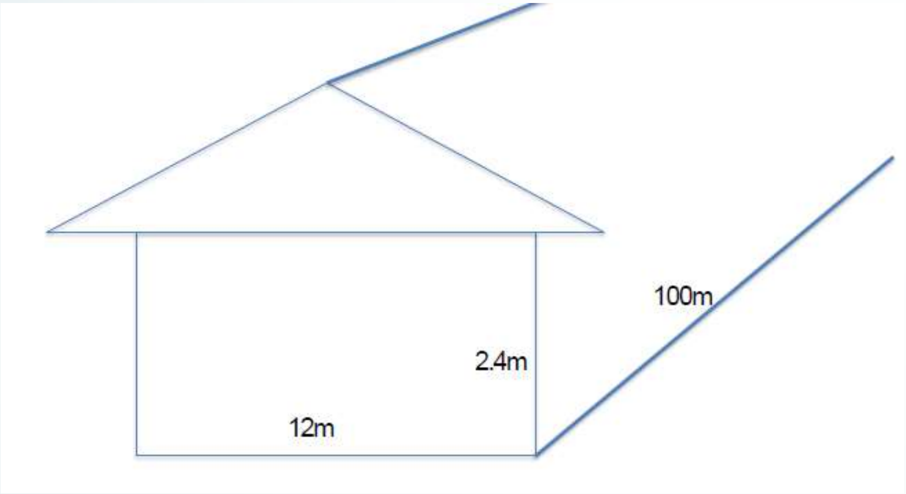
- 1. System Kandang
- 2. House Dimension dan Cross Section Area (CSA)
- 3. Sistem Ventilasi
- 4. kapasitas Kipas
- 5. Negative Pressure
- 6. Jumlah Kipas
- 7. Jumlah Cooling Pad
- 8. Luasan Inlet
- 9. Kebutuhan air sirkulasi cooling pad
- 10. Kebutuhan penerangan kandang

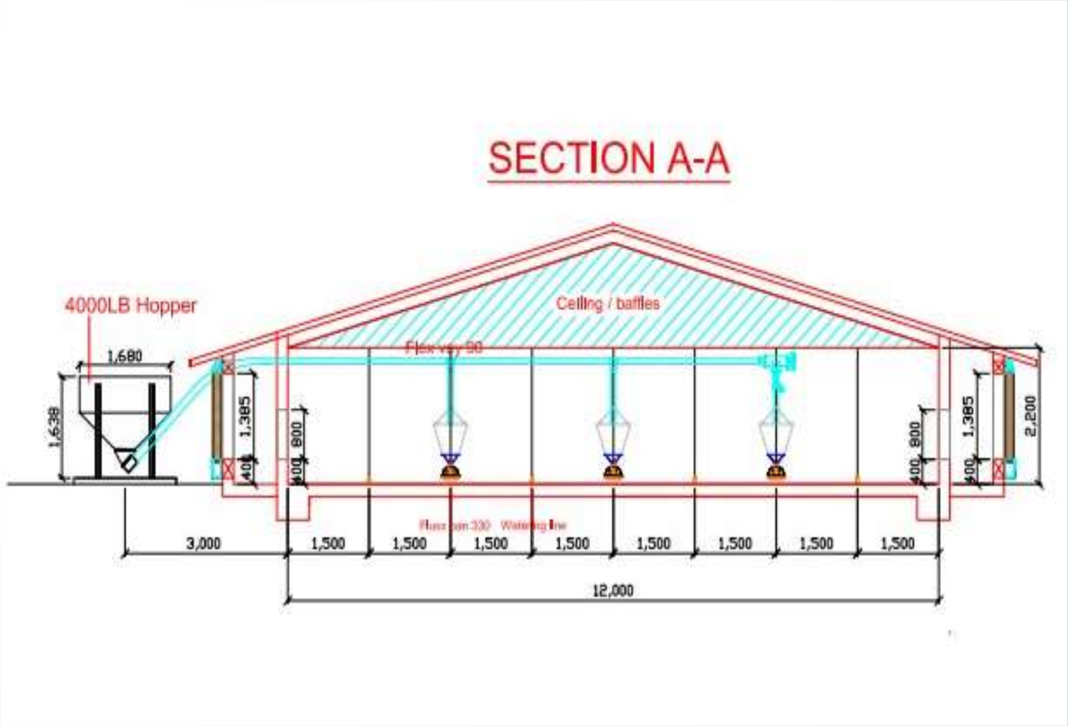
Sistem Kandang / Floor (Lantai) Sistem

Lantai dengan sekam

Lantai dengan plastic slat

House Dimension dan Cross Section Area (CSA)

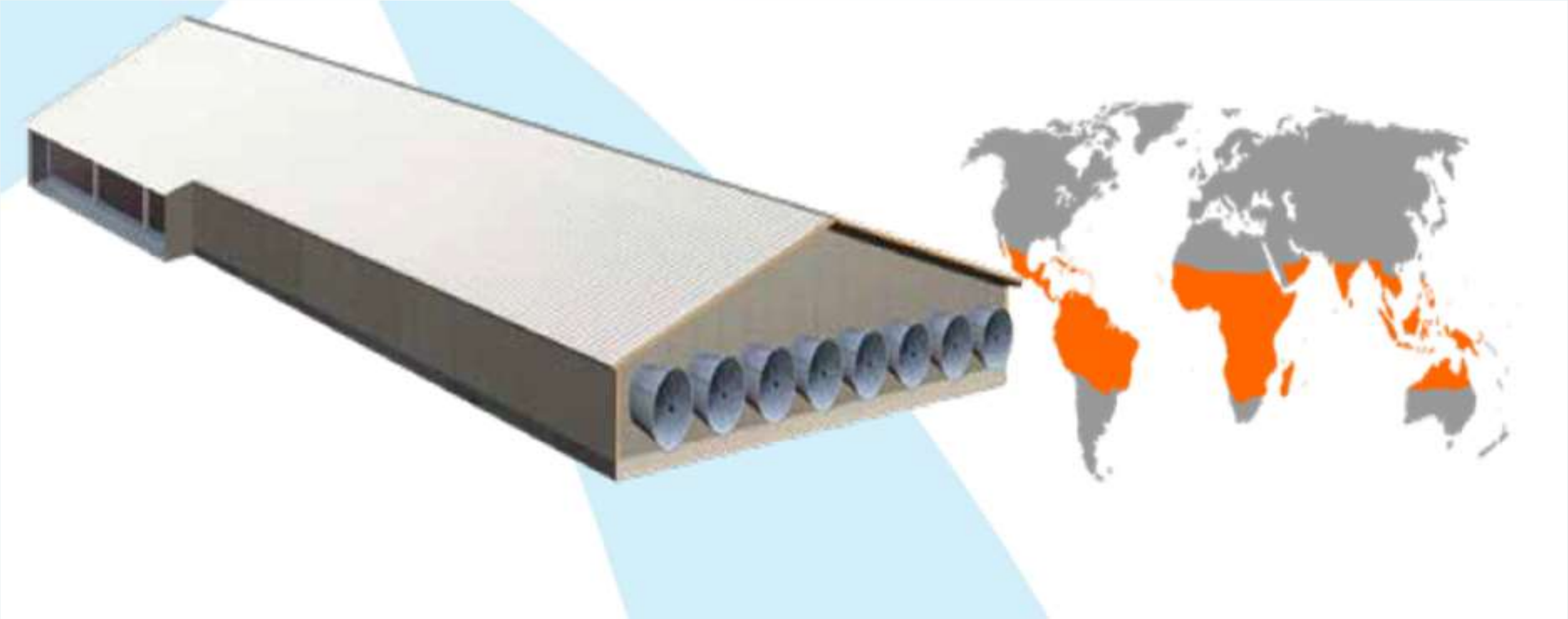




Sistem Ventilasi

- 1. Cross Ventilasi
- 2. Side Ventilasi / Minimum Ventilasi
- 3. Combi tunnel Ventilasi
- 4. Tunnel Ventilasi / Maksimum Ventilasi
- 5. Double tunnel Ventilasi

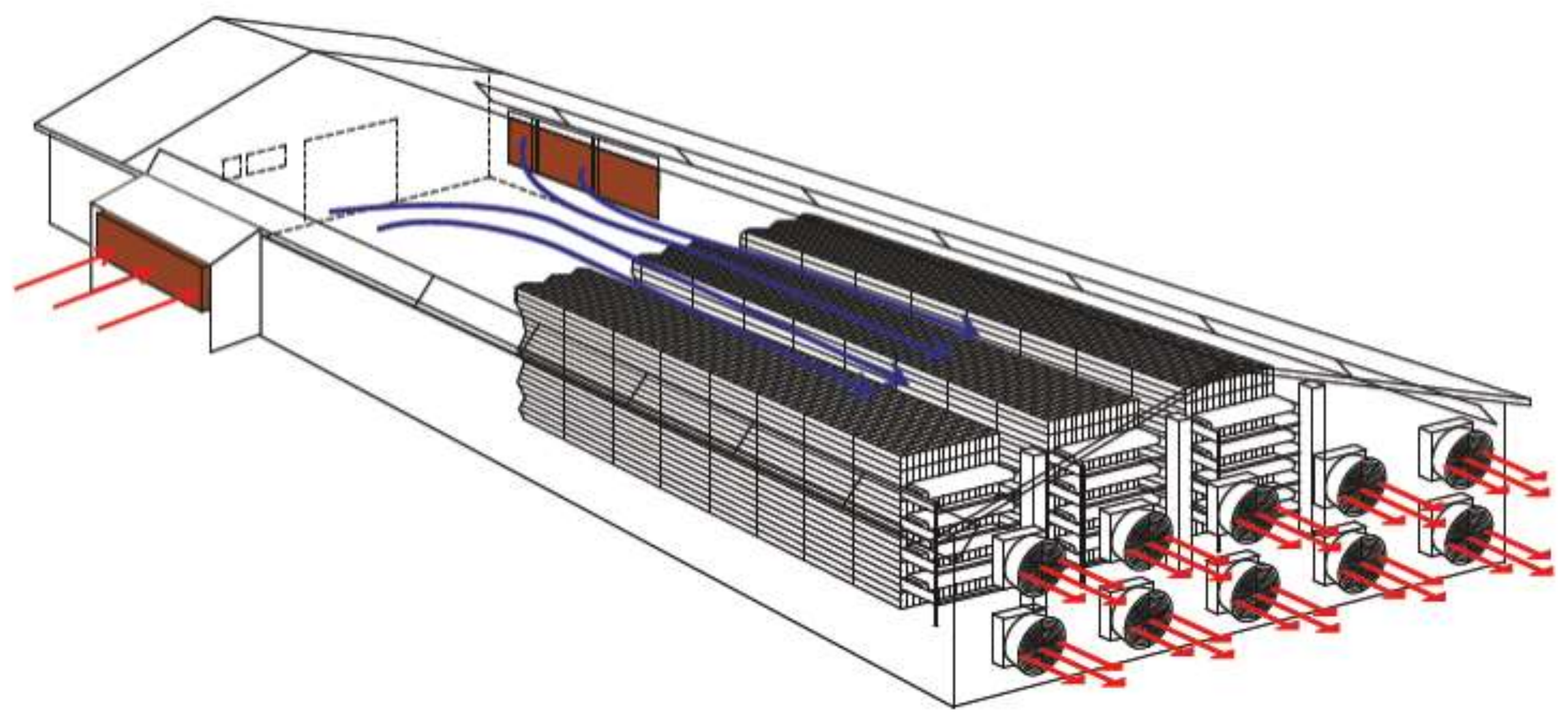
Sistem Tunnel Ventilasi ideal pada suhu tropis



Tunnel Ventilasi

- Sistem tekanan negative dengan kipas di salah satu ujung dan inlet di ujung lain.
- Kandang harus kedap
- Hanya untuk cuaca panas , menciptakan aliran udara dengan kecepatan 3-4 m/s dan mendinginkan melalu cooling pad

Tunnel ventilasi yang baik kombinasi antara Kipas Tunnel + Cooling Pad



Kapasitas Kipas

Technical specifications of the AIR MASTER type V130

Type	Code no.	Speed-control	Air rate in m³/h 0 Pa	20 Pa	30 Pa	40 Pa	60 Pa	80 Pa	Current consumption (ampere)	spec. output (watt/1000m³/h)
V130-3 1,5 PS-R	60-25-4000	FC	43,700	39,700	37,500	34,800	28,600	19.200	3.1	36.7
V130-3 1,5 PS	60-25-4005	T	43,200	39,000	36,600	34,000	27,900	19.600	3.1	35.9
V130-3 1,0 PS	60-25-4004	T	39,700	35,600	32,300	29,300	21,600		2.6	30.5
VC130-3 1,5 PS-R	60-25-4020	FC	47,700	43,800	41,600	39,200	34,300	21.800	3.2	34.3
VC130-3 1,5 PS	60-25-4025	T	47,300	43,300	41,000	38,700	33,500	21.200	3.2	33.1
VC130-3 1,0 PS	60-25-4024	T	42,800	38,500	35,900	33,400	23,600		2.7	27.3
V130-5 1,5 PS-R	60-25-4040	FC	38,700	35,600	34,100	32,500	28,800	24,500	3.0	36.8
V130-5 1,5 PS	60-25-4045	T	37,900	35,300	33,800	32,200	28,300	23,900	3.0	35.5
VC130-5 1,5 PS-R	60-25-4060	FC	41,800	38,800	37,200	35,600	32,300	27,100	3.1	33.4
VC130-5 1,5 PS	60-25-4065	T	41,400	38,400	36,800	35,100	31,700	26,200	3.1	32.1

V = fan without cone; VC = fan with cone; 130 = vane diameter; 3 = 3-blade; 5 = 5-blade; R = regular motor
FC - frequency controlled drive T - transformer controlled
Connexion values: 400 V, 50 Hz; also available with one or three phase and with 60 Hz
Weight: AIR MASTER without cone: 80 kg; AIR MASTER with cone: 99 kg
All types are also available unmounted

Kapasitas Kipas

KEBUTUHAN JUMLAH EXHAUST FAN PERICOLLI EOS

Static Pressure (in.H2O)	Airflow (cfm)	rpm	Volts	Amps	Watts	cfm/Watt	Static Pressure (Pa)	Airflow m^3/hr	W/1000m^3/hr
0.00	**26200**	516	229.6	5.59	1914	**13.7**	0	44500	43
0.05	**25300**	513	229.6	5.72	1972	**12.8**	12	42900	46
0.10	**24200**	510	230.5	5.81	2019	**12.0**	25	41100	49
0.15	**23000**	507	229.7	5.94	2062	**11.1**	37	39000	53
0.20	**21700**	503	228.5	6.09	2119	**10.2**	50	36800	58
0.25	**20200**	499	231.5	6.08	2130	**9.5**	62	34300	62
0.30	**18300**	495	230.0	6.19	2164	**8.5**	75	31100	70
0.40	**14600**	487	230.4	6.24	2188	**6.7**	100	24800	88

PERICOLLI 50/1.5Hp -> 39.000 M3/H = 9,8 M3/sec

Kapasitas Kipas

University of Illinois Department of Agricultural and Biological Engineering
Bioenvironmental and Structural Systems Lab
Final Report

Project Number: 12359
Test Date: May 22, 2012

Fan:
Make- *Termotecnica Pericol*
Model- *EOC53/1.5*
Blade dia.- *52" (1320mm)*
Orifice dia.- *52.5" (1334mm)*

Blade:
Number- *6*
Shape- *propeller*
Material- *aluminum*
Pitch- *-*
Clearance- *0.3" (7mm)*

Drive Sheaves:
Drive dia.- *4.0" o.d. (100 p.d.)*
Axle dia.- *12" o.d.(305mm o.d.)*

Motor:
Make- *ABB*
Model- *M2VA90S-4*
Hp- *1.5 (1.1 kW)*
RPM- *1660*
Volts- *380-480/220-280*
Amps- *2.85/4.9*
Hz- *60/50*
Phase- *3*
S. F.- *-*

Housing:
Material- *galvanized steel*
Intake area- *51.9"x51.9" (1318x13*
Discharge- *52.5" dia.(1334mm)*
Depth- *18.8" (478 mm)*
0

Shutter:
Material- *aluminum*
Doors- *11*
Columns- *1*
Door length *51.3" (1303mm)*
Location- *intake*

Guards:
Description- *wire*
Spacing- *1.8" (45mm) concentric*
Location- *exhaust*

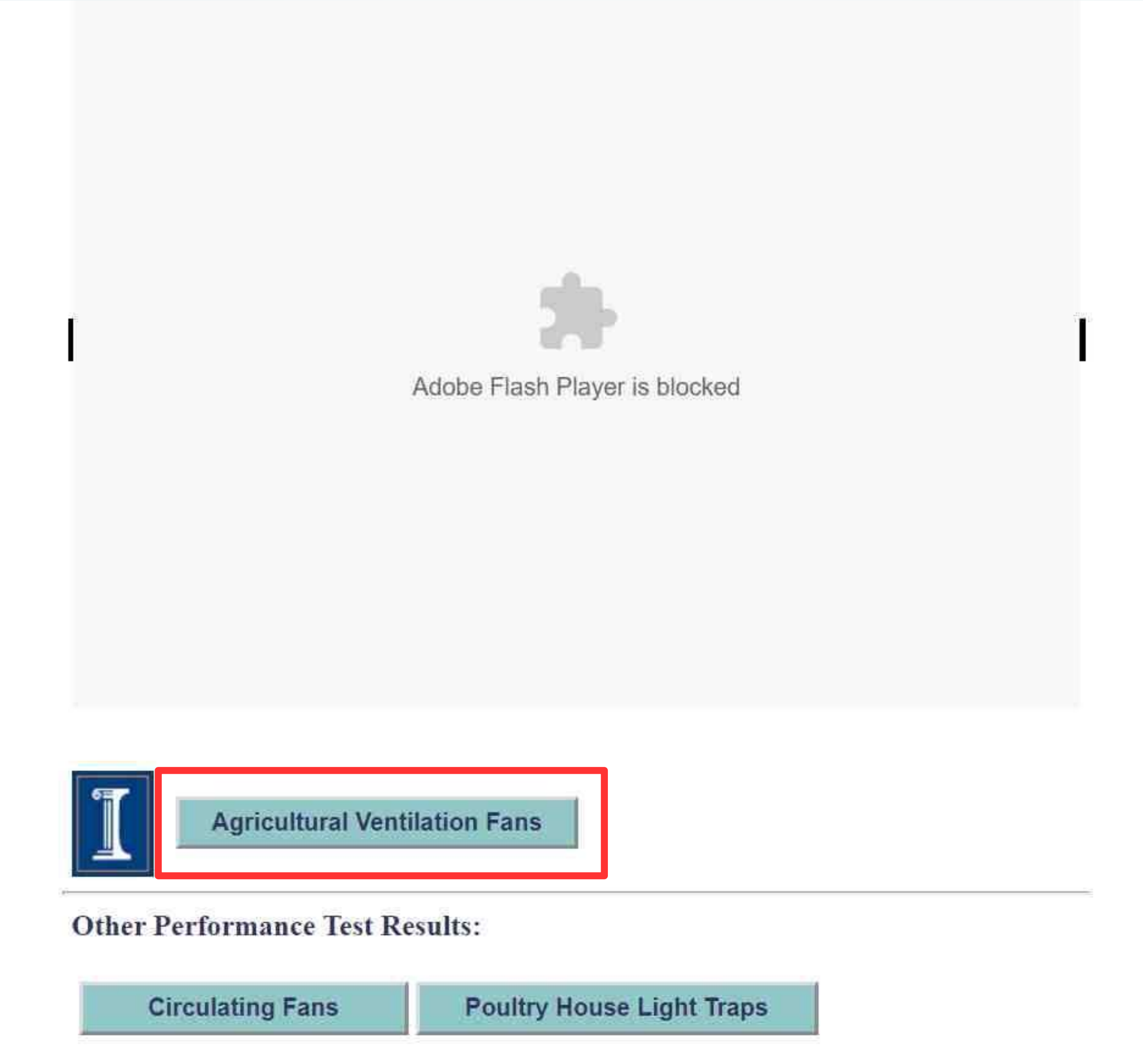
Discharge Cone:
Depth- *23.6" (600mm)*
Minor dia.- *52.5" (1334mm)*
Major dia.- *61.5" (1562mm)*

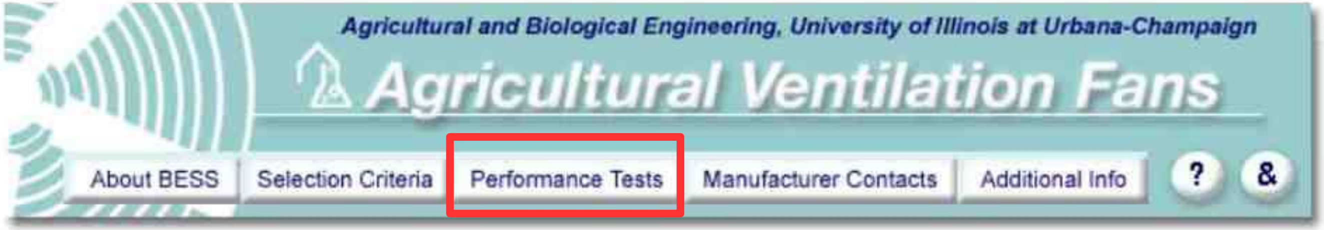
Notes: ** 50 Hz test*
0

Test Conditions:
T(wb): 57.5 Barometric pressure, recorded 29.40
T(db): 76 Barometric Pressure, corrected 29.27

Static Pressure (in.H2O)	Airflow (cfm)	rpm	Volts	Amps	Watts	cfm/Watt	SI Units Static Pressure (Pa)	Airflow (m^3/hr.)	(m^3/hr)/W	W/1000m^3/hr
0.00	**25900**	481	229.3	4.51	1431	**18.1**	0	44100	30.8	32
0.05	**24900**	478	230.1	4.67	1505	**16.6**	12	42400	28.2	36
0.10	**24000**	477	229.4	4.81	1559	**15.4**	25	40700	26.1	38
0.15	**22700**	475	230.3	4.95	1623	**14.0**	37	38600	23.8	42
0.20	**21400**	473	229.4	5.12	1689	**12.7**	50	36300	21.5	46
0.25	**19800**	471	230.3	5.25	1748	**11.3**	62	33600	19.2	52
0.30	**17900**	469	229.6	5.40	1806	**9.9**	75	30400	16.8	59

Check kapasitas exhaust fan: www.bess.uiuc.edu





The BESS Lab online version of **Agricultural Ventilation Fans, Performance and Efficiencies** can be accessed by clicking on the *"Performance Tests"* button above

This online publication provides the livestock/poultry housing designer and greenhouse designer an unbiased source of performance data for over 800 commercially available ventilation fans ranging in size from 8” to 54” in diameter. The fans are searchable according to size, airflow, ventilating efficiency rating and manufacturers, so comparisons can easily be made between manufacturers and models.

Additional links related to ventilating agricultural building are listed under the *"Additional info"*button above.

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Agricultural Ventilation Fans
About BESS
Selection Criteria
Performance Tests
Manufacturer Contacts
Additional Info
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Performance Tests Archive
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Select Fan Frequency
60 hz (North America)
50 hz
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3 phase 380V, 50 Hz

Agricultural and Biological Engineering, University of Illinois at Urbana-Champaign

Agricultural Ventilation Fans

About BESS | Selection Criteria | Performance Tests | Manufacturer Contacts | Additional Info | ? | &

Search Results

Power supply: 3 phase 380V, 50 Hz

Convert Table to SI Units | Unit Conversion Calculator

Test #	Model	Size	Cone	Shutter	Air Flow (cfm) 0.05" SP	VER (cfm/W) 0.05" SP	Air Flow (cfm) 0.10" SP	VER (cfm/W) 0.10" SP	Air Flow Ratio*
Agrifan Shandong Zhongrun Mach.									
18364	24" cone fan	24"	Y	P	6700	11.2	6510	10.6	0.90
18400	36" cone fan	36"	Y	P	13350	15.6	12830	14.4	0.88
18403	50" cone fan	50"	Y	P	25900	19	24400	17.3	0.80
18404	54" cone fan	54"	Y	P	31300	18.8	29900	17.3	0.86
18491	54" cone fan (1.5 hp)	54"	Y	P	27700	20.9	26500	19.4	0.75
Canarm									
03046	FG36BD350	36"	N	P	9790	20.5	8610	17.2	0.38
03047	FG36BD350 w/cone	36"	Y	P	10250	22.2	8990	18.3	0.38
03055	SW36BD350	36"	N	P	9530	20.4	8260	17	0.44
02206	SWC48350	48"	Y	P	23700	20.2	22100	18.1	0.76
04178	FC50A350	50"	Y	P	24100	21.6	22600	19.6	0.77

University of Illinois Department of Agricultural and Biological Engineering
Bioenvironmental and Structural Systems Lab
Final Report

Project Number: 18404
Test Date: August 17, 2018

Fan:
Make- *Agrifan*
Model- *54" cone fan*
Blade dia.- *54"*
Orifice dia.- *54.8"*

Blade:
Number- *3*
Shape- *propeller*
Material- *plastic*
Pitch- *-*
Clearance- *0.4"*

Drive Sheaves:
Drive dia.- *5.1" o.d.*
Axle dia.- *12" o.d.*

Motor:
Make- *none listed*
Model- *MSE3-90L-4*
Hp- *2 hp (1.5 kW)*
RPM- *1440*
Volts- *230 / 380*
Amps- *5.99 / 3.47*
Hz- *50*
Phase- *3*
S. F.- *-*

Housing:
Material- *fiberglass*
Intake area- *60.5" x 60.5"*
Discharge- *54.8" dia.*
Depth- *28.5"*

Shutter:
Material- *plastic*
Doors- *19 per column*
Columns- *3*
Door length *19.8"*
Location- *intake*

Guards:
Description- *wire*
Spacing- *2.4" concentric*
Location- *exhaust*

Discharge Cone:
Depth- *41"*
Minor dia.- *54.8"*
Major dia.- *73.8"*

Notes: *"50 Hz test*

Test Conditions:
T(wb) F: 67 Barometric pressure, recorded 29.26
T(db) F: 78 Barometric Pressure, corrected 29.13 (In. Hg)

Static Pressure (in.H2O)	Airflow (cfm)	rpm	Volts	Amps	Watts	cfm/Watt	SI Units Static Pressure (Pa)	Airflow (m^3/hr.)	(m^3/hr)/W	W/1000m^3/hr
0.00	**32600**	631	380.5	3.56	1592	**20.5**	0	55500	34.8	29
0.05	**31300**	630	380.5	3.64	1661	**18.8**	12	53100	32	31
0.10	**29900**	629	380.6	3.72	1729	**17.3**	25	50800	29.4	34
0.15	**28500**	628	380.6	3.81	1798	**15.8**	37	48400	26.9	37
0.20	**26800**	627	380.5	3.89	1858	**14.4**	50	45600	24.5	41
0.25	**24500**	626	380.6	3.97	1920	**12.7**	62	41600	21.7	46
0.30	**16300**	627	380.6	3.90	1862	**8.7**	75	27700	14.9	67

Rumus rumus :

- Chill Effect = Chill Factor x Air Speed (m/s)
- Effective Temperature = Ambient Temp. – Chill Effect
- CFM = m^3/h x 0.5886
- CFM = m^3/h : 1,7
- Ft/min = m/s x 197
- Inch of Water = Pa/249

Rumus Wind speed

- Rumus perhitungan wind speed berdasarkan kapasitas kipas
- Wind speed m/s = Kapasitas kipas m3/h : (3600 x cross section m2)

Negative Pressure

- Perhitungan Negative Pressure di tentukan Oleh :
  1. Sistem kandang
  2. Jenis cooling pad
  3. Panjang kandang

Negative Pressure

Indikator / Manometer

Sensor

Negative Pressure

Table # 1: Pressure coefficients

Cage type / Air speed	1,0 m/s	1,5 m/s	2,0 m/s	2,5 m/s	3,0 m/s
Broiler house	0,03 Pa/m	0,08 Pa/m	0,1 Pa/m	0,1 Pa/m	0,2 Pa/m
Breeder house	0,05 Pa/m	0,11 Pa/m	0,15 Pa/m	0,2 Pa/m	0,3 Pa/m
A-Frame	0,08 Pa/m	0,12 Pa/m	0,16 Pa/m	0,2 Pa/m	0,25 Pa/m
Compact cage with wire partition	0,08 Pa/m	0,16 Pa/m	0,2 Pa/m	0,3 Pa/m	0,3 Pa/m
Compact cage with solid partition	0,11 Pa/m	0,22 Pa/m	0,3 Pa/m	0,5 Pa/m	0,7 Pa/m

Negative Pressure

Air speed (m/s) in tunnel								
m/s	1	1.5	2	2.5	3	3.5	4	4.5
Type					pa/m			
Broiler Hou	0.03	0.08	0.11	0.17	0.25	0.33	0.41	0.49
Breeder Ho	0.05	0.11	0.15	0.23	0.34	0.45	0.56	0.67
A- Frame	0.08	0.12	0.16	0.20	0.25	0.3	0.35	0.4
Compact cage with wire partitions	0.08	0.16	0.23	0.31	0.38	0.45	0.52	0.59
Compact cage with solid partitions	0.11	0.22	0.32	0.50	0.72	0.94	1.16	1.38

Negative Pressure

- Contoh perhitungan negative pressure floor/lantai dengan panjang
  Kandang 120 m dan kecepatan angina yang di inginkan 3,0 m/detik
- = Pa CP + (0,2 x 120)
- = 17 + 24
- = 41 Pa

Jumlah Kipas

1. Penentuan jumlah kipas pada dasarnya adalah total Air Capacity di bagi Fan Capacity
2. Ada 2 pendekatan untuk menentukan jumlah kipas :

   - Populasi

   - Cross section Area (CSA)

E.F. CONE 54” VS CONE 50”

E.F. CONE 54”/1.5HP

E.F. CONE 50”/1.5HP

POTENSI E.F.CONE54” > ±15%

E.F. BOX 50" VS CONE 50"

EXHAUST FAN 50" BOX / 1,5HP

EXHAUST FAN 50" CONE / 1,5HP

POTENSI E.F.CONE50" > ±20%

Berdasarkan Populasi

Penentuan Air Ventilation adalan berdasarkan kebutuhan ventilasi berdasarkan breed dikalikan dengan jumlah populasi dikalikan dengan faktor kenyamanan berdasarkan letak geografis daan iklimnya
Untuk iklim seperti Indonesia, untuk mencapai kenyamanan ayam dibutuhkan 200-250% kebutuhan air ventilation

Penghitungan Jumlah Kipas berdasar Populasi

- Jumlah Kipas = Populasi x kebutuhan udara segar (sesuai iklim / Indonesia 10-11m3/jam)
- Contoh : kandang ukuran 12x120 dengan density 15/m2

  total kapasitas 12x120x15 = 21600 ekor
- Jumlah kipas = 21600 x 11m3/jam

  = 237.600 : 36.011

  = 6,59 kipas

  = 7 Kipas

Penghitungan Jumlah Kipas berdasarkan CSA

Contoh

Ch Broiler dengan lebar 12m, tinggi 2m panjang 120m dengan target kecepatan angin 3,0 m/s dengan perhitungan negatif pressure adalah 57 Pa maka:

Total air cap = 12 X 2 X 3,0 X 3.600

= 259.200 m3/h

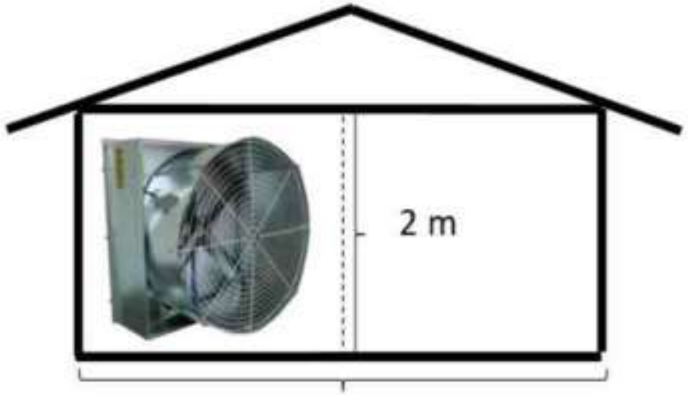
Apabila menggunakan Fan Pericoli eoc 50 dengan kapasitas fan 36.011 m3/h, maka kipas yang digunakan adalah:

= 259.200/36.011

= 7,19 kipas

= 7 kipas

Penghitungan Jumlah Kipas berdasar CSA



Panjang kandang: 120 meter

AIR FLOW CAPACITY (M^3/H)

TYPE	0 Pa	20 Pa	30 Pa	50 Pa
KH3605	35300	30600	28300	23600
KH3610	38900	33800	31100	25900
KH5010	53400	46900	43500	34100
KH5015	58700	51600	47800	37600

KHI50/1.5Hp -> 47.800 M3/H = 13.3 M3/sec

Contoh: Kandang L= 12 m, T= 2 m, Keb. Kecepatan Angin= 3,2 m/s

Perhitungan = (Cross section x Keb. Kec. Angin)/Kapasitas kipas yang digunakan
= ((Lebar Kdg x Tinggi Kdg) x Keb. Kec. Angin)/Kapasitas Kipas
= ((12 m x 2 m) x 3,2 m/s)/**13,3** m^3/s
= 76,8/13,3
= 5,7 (6 buah kipas)

Karena ada dua pertimbangan yang sangat berbeda, dasar penentuan kebutuhan ventilasi adalah berdasarkan yang nilainya tertinggi, yaitu berdasarkan **CSA:**

7,19 kipas

Kebutuhan Jumlah Exhaust Fan dengan panjang Kandang <120 meter

Rumus pendekatan:

Panjang kandang = 60 m

Kec. Maks (m/s)
= {Panjang kandang : (120 : **Kec. Angin Std**)} + {(120 – Panjang Kandang) : 100}
= {60 : (120 : **3,2**)} + {(120 – 60)} : 100
= {(60 : 37,5)} + {(60 : 100)}
= 1,6 + 0,6
= 2,2 m/s

Kebutuhan Jumlah Exhaust Fan dengan Panjang Kandang <120 meter

Panjang kandang = 60 m Kec.
Angin Maks = 2,2 m/s

Keb. Jml. Kipas (bh)
= (Cross Section x Keb. Kec. Angin Maks) : Kapasitas Kipas
= {(2 m x 12 m) x 2,2 m/s} : 13,3 m3/s
= 52,8 m3/s : 13,3 m3/s
= 3,9 (atau 4 bh)

Kebutuhan Jumlah Exhaust Fan dengan Panjang Kandang >120 meter

Rumus pendekatan:

Panjang kandang = 140 m

Kec. Maks (m/s)
= {Panjang kandang : (120 : **Kec. Angin Std**)} – {(Panjang Kandang – 120) : 100}
= {140 : (120 : **3,2**)} – {(140 – 120) : 100}
= {(140 : 37,5)} - {(20 : 100)}
= 3,7 - 0,2
= 3,5 m/s

Kebutuhan Jumlah Exhaust Fan dengan Panjang Kandang >120 meter

Panjang kandang = 140 m Kec. Angin Maks = 3,5 m/s

Keb. Jml. Kipas (bh)
= (Cross Section x Keb. Kec. Angin Maks) : Kapasitas Kipas
= {(2 m x 12 m) x 3,5 m/s} : 13,3 m3/s
= 84 m3/s : 13,3 m3/s
= 6,3 (atau 7 bh)

Penentuan Luasan Inlet

Inlet sangat menentukan faktor pendinginan dan beban kerja fan. Semakin kecil luasan inlet, semakin tinggi kecepatan angin di inlet, akibatnya pendinginan tidak maksimal. Selain itu apabila inlet terlalu kecil akan meningkatkan negatif pressure, akibatnya kerja fan semakin berat dan kapasitas kipas menjadi menurun

Penghitungan luasan inlet

Kebutuhan luasan inlet dengan target kecepatan 1,5 m/s adalah :

=(total air capacity/3600)/ wind speed

= (259.200/3600)/1,5

= 48,0 m2 / 1,5

= 32 m

Ukuran Cooling pad

P X L X T

Misal: 150 X 60 X 15 cm

1. Inlet depan 15 lembar (luas= 15X0.6X1.5 =13,5m2)
2. Inlet samping 19 lembar (luas= 19X0,6X1,5=17,1m2)

Total luasan inlet = (17,1X2)+13.5

= 47,7m2

Kecepatan di inlet setelah penyesuaian inlet:

= (259.200/3600)/47.7

=1,509 m/s

Luasan Cooling Pad

Perhitungan = (Kapasitas kipas x jumlah kipas : kec angin di celldek) : jumlah kipas

= (13,3 m3/s x 7 kipas : 2m/s) : 7 kipas

= 6,65 m2 / kipas

Note : Fokus pada kecepatan angin di celdek, angka kapasitas kipas mengikuti jenis dan ukuran kipas

Luasan Area Inlet

Contoh: Kandang L= 12 m, T= 2 m, Jumlah Exhaust Fan= 7 buah
Konstanta keb. luasan inlet/kipas= 4 m^2

Panjang pad (7 x 6,65 x 0,6) / (0.9 x 2) = 15,51 m

Kebutuhan tinggi inlet kandang
= (Jumlah kipas yang digunakan x konstanta keb. luasan inlet) : (panjang inlet x 2 sisi)
= (7 EF x 4 m^2) : (15,51 m x 2 sisi)
= 0,9 m

Note: Konstanta kebutuhan luasan inlet/kipas adalah 3,5 – 4,5 m^2. Angka ini merupakan angka pendekatan agar nilai pressure inlet sebesar 0,02 – 0,03 iwc (5 - 7,5pa)

(Penentuan bukaan inlet digunakan untuk memastikan bahwa pressure inlet sebesar 0,02 – 0,03 iwc.)

Contoh:

Kebutuhan luasan bukaan inlet

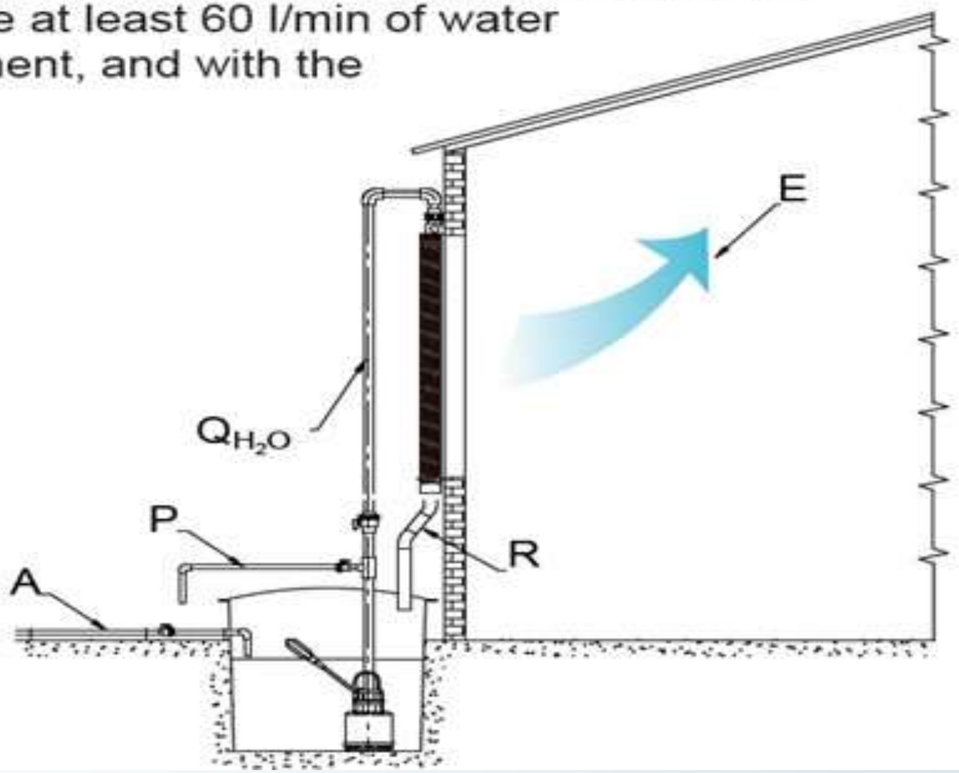
= (Jumlah kipas yang digunakan x konstanta keb. bukaan/EF) : panjang cell pad

= (1 EF x 4 m²) : 31,02 m

= 0,1289 m (13 cm)

Kebutuhan Air Sirkulasi Cell Pad

To ensure that the panel is adequately wetted, in order to achieve maximum efficiency, one must assure a minimum water flowrate calculated on the basis of the upper surface area of the distribution panel. For every ***m²*** of distributor surface at least 60 l/min of water supply must be ensured. In function of this requirement, and with the following data known:



L = Pericool® length ***[m]***

T = Pericool® thickness ***[m]***

The required water flow (Q_{H_2O}) is derived

$$Q_{H_2O} = 60 \cdot L \cdot T \quad [l/min]$$

- Panjang instalasi pad 13,3 m/sisi, tebal pad 15 cm
- Debit air/menit
- QH2O = panjang x tebal x 60 liter/menit

  =13,3 m x 0,15 m x 60 liter/menit

  =119,7 liter/menit
- Pertimbangan hambatan dan kinerja pompa yang semakin menurun, maka hitungan awal kebutuhan 130% dari kebutuhan minimum
- QH2O X (130%)= 119,7 x 1,3 = 155,61 liter/ menit

Kebutuhan Penerangan Kandang

KALKULASI RUMUS :

$$N = \frac{\text{Kuat Penerangan (E) x Luas Bidang kerja (A)}}{\text{Lumen Lampu x LLF x CU}}$$

N = JUMLAH TITIK LAMPU
E = INTENSITAS PENERANGAN (LUX)
A = LUAS BIDANG KERJA (M2)
Ø = LUMEN (LM)
LLF = LOSS LIGHT FACTOR (0.7 – 0.8)
CU = COEFFICIENT of UTILIZATION (50%-65%)

Specification

Product Description	Power (W)	Power Factor	Lumen (lm)	Efficacy (lm/W)	Input current (mA)	CRI	CCT (K)	Average Lifetime(hrs)	Energy Level
LED E1 P45 E14 WV 3W	3	0.5	300	100	25	80	3000K/6500K	25000	A+
LED E1 P45 E27 WV 3W	3	0,5	300	100	25	80	3000K/6500K	25000	A+
LED E1 P45 B22 WV 3W	3	0,5	300	100	25	80	3000K/6500K	25000	A+
LED E1 P45 E14 WV 4,5W	4,5	0,5	400	89	38	80	3000K/6500K	25000	A+
LED E1 P45 E27 WV 4,5W	4,5	0,5	400	89	38	80	3000K/6500K	25000	A+
LED E1 P45 B22 WV 4,5W	4,5	0,5	400	89	38	80	3000K/6500K	25000	A+
LED E1 A60 E27 WV 7W	7	0,9	660	94	51	80	3000K/6500K	25000	A+
LED E1 A60 B22 WV 7W	7	0,9	660	94	51	80	3000K/6500K	25000	A+
LED E1 A60 E27 WV 9W	9	0,9	900	100	65	80	3000K/6500K	25000	A+
LED E1 A60 B22 WV 9W	9	0,9	900	100	65	80	3000K/6500K	25000	A+
LED E1 A70 E27 WV 12W	12	0,9	1200	100	103	80	3000K/6500K	25000	A+
LED E1 A70 B22 WV 12W	12	0,9	1200	100	103	80	3000K/6500K	25000	A+
LED E1 A70 E27 WV 14W	14	0,9	1400	100	103	80	3000K/6500K	25000	A+
LED E1 A70 B22 WV 14W	14	0,9	1400	100	103	80	3000K/6500K	25000	A+

KANDANG BROILER 12M X 120M
KEBUTUHAN INTENSITAS CAHAYA 23 LUX ,
MENGGUNAKAN LAMPU LED 9W (900 lumen)

$$75.5 = \frac{23 \times 1440}{900 \times 0.65 \times 0.75}$$

TOTAL KEBUTUHAN LAMPU LED 9W DALAM 1 KANDANG 76 TITIK LAMPU
MISAL INSTALASI 3 LINE -> MASING-MASING LINE 26 TITIK

Sekian & Terimakasih