

## Airfield Pavement Analysis Practice Problems

### Air Force

At the request of the Air Force HQ Air Mobility Command a pavement evaluation team conducted the field portion of an airfield pavement evaluation at Your Air Force Base (YAFB) and produced Table 1, Summary of Physical Property Data. Using the physical property data calculate the Allowable Gross Loads (AGLs) for each feature and Pass Intensity Level and report results in the table below.

*Notes:*

- *Air Force uses the Shattered Slab failure criteria for rigid pavement. Be sure to set failure criteria appropriately.*
- *Use “Reports” for reporting the AGLs for the 14 groups. Reports provide AGLs for all features, pass intensity levels, and groups simultaneously.*
- *Use the following notation where needed. Description of Aircraft Group Indices and Pass Intensity Levels are provided in Table 2.*  
*A - if the pavement cannot support the minimum weight of any aircraft in that aircraft group*  
*+ - if the pavement can support more than the maximum weight of any aircraft in that group*

<b>Summary of Allowable Gross Loads</b>															
		<b>Pavement Capacity in Kips for Aircraft Group Index Numbers</b>													
<b>Feature Name</b>	<b>Pass Intensity Level</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>
A15B	I														
	II														
	III														
	IV														
R12A	I														
	II														
	III														
	IV														
R13C	I														
	II														
	III														
	IV														
R14A	I														
	II														
	III														
	IV														
T24C	I														
	II														
	III														
	IV														

The International Civil Aviation Organization (ICAO) has adopted the standard Aircraft Classification Number/Pavement Classification Number (ACN/PCN) method for reporting pavement strength. The ACN is a number that expresses the demand an aircraft places on a pavement. The PCN is a number that expresses the capability of a pavement to support aircraft. The Air Force standard model for reporting is based on 50,000 passes of a 580,000-pound C-17 aircraft. Calculate the PCNs for each feature and report values in the table below. Also give the ACN for each feature. *Note: Refer to Table 3 for help in Understanding the PCN Code.*

<b>Aircraft Classification Numbers (ACN) &amp; Pavement Classification Numbers (PCN)*</b>		
<b>Feature</b>	<b>ACN</b>	<b>PCN</b>
A15B		
R12A		
R13C		
R14A		
T24C		
*Based on C-17 aircraft at 50,000 passes		

Occasionally, it may be necessary to operate an aircraft on a given pavement feature at a weight that exceeds the AGL. Overloading the pavement in an isolated instance will not necessarily cause a catastrophic failure, but the pavement engineer must be aware that there will be some reduction in pavement life. Another option is to restrict the weight of the aircraft to allow additional aircraft. At YAFB report to the Commander the number of passes a C-17 operating at a reduced weight of 500 kips can support. Also determine the maximum load for 100,000 passes of an F-15E for the features identified below.

<b>Facility</b>	<b>Feature</b>	<b>Allowable Passes of C-17 @ 500 Kips</b>	<b>Allowable Load for 100,000 passes of F-15E</b>
Runway	R14C		
Taxiway	T24C		
Apron	A15B		

**TABLE 1 - SUMMARY OF PHYSICAL PROPERTY DATA**

FACILITY					OVERLAY PAVEMENT			PAVEMENT			BASE			SUBBASE			SUBGRADE	
FEAT	IDENT	LGTH (ft)	WIDTH (ft)	COND	THICK (in)	DESCRP	FLEX (psi)	THICK (in)	DESCRP	FLEX (psi)	THICK (in)	DESCRP	K/CBR	THICK (in)	DESCRP	K/CBR	DESCRP	K/CBR
A15B	CONTINGENCY APRON	560	175	POOR				10	PCC	700							*(SP-SM) F-2	75
R12A	RUNWAY TOUCHDOWN AREA, 17 END	1000	150	FAIR				*12	*PCC	660	*12	*SILTY SAND (SM) F-3					*POORLY GRADED SILTY SAND (SP-SM) F-2	75
R13C	RUNWAY 17/35 CENTER SECTION	7000	150	VERY GOOD				*8	*AC		*4	*SILTY SAND (SM) F-3	70	10	*(SW-SM) F-2	20	*(SP-SM) F-2	8
R14A	RUNWAY TOUCHDOWN AREA, 35 END	1000	150	GOOD	6	UNBONDED PCC	690	8	*PCC	690	*20	*SILTY SAND (SM) F-3					*(SP-SM) F-2	70
T24C	CONTINGENCY APRON TAXIWAY	5000	25	FAIR				4	AC		*11	(GP-GM) F-2	60	18	PCC Stab (SC) (SC) F-3	40 20	*(SM) F-3	6

**NOTES:**

1. All length and width dimensions are approximate.
2. Condition codes were determined using modified PCI methods.
3. Flexural strengths for PCC pavements were determined using tensile split methods on core samples taken from in-situ concrete.
4. All soil classifications conform to ASTM standards.
5. The asterisk (\*) symbol denotes information used from previous airfield pavement evaluation reports.
6. PCC denotes Portland Cement Concrete.
7. AC denotes Asphaltic Concrete.

**Table 2 - Aircraft Group Indices and Pass Intensity Levels**

<b>AIRCRAFT GROUP INDEX</b>														
LIGHT LOAD			MEDIUM LOAD								HEAVY LOAD			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
A-37	A-7	*F-111	C-130	C-7	B-737	*B-727	B-707	*C-141	*C-17	*C-5	*KC-10	B-747	*B-52	
C-12	A-10	FB-111		*C-9	*T-43	C-22	*E-3	*B-1			DC-10	*E-4		
C-21	F-4			DC-9		P-3	C-135	B-757			L-1011	VC-25		
*C-23	F-5			C-140			*KC-135	B-2						
T-37	*F-15						VC-137							
	F-16						DC-8							
	F-10X						EC-18							
	T-33						A-300							
	T-38						B-767							
	T-39													
	OV-10													
	C-20													
* CONTROLLING AIRCRAFT														
<b>GROSS WEIGHT LIMITS FOR AIRCRAFT GROUPS</b>														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
PAVEMENT CAPACITY IN KIPS														
LOWEST POSSIBLE GROSS WEIGHT	5	7	53	69	19	60	96	135	144	279	375	270	414	230
HIGHEST POSSIBLE GROSS WEIGHT	26	81	100	175	122	150	210	380	477	580	837	590	870	480
<b>PASS INTENSITY LEVEL</b>														
LEVEL	1	2	3	4	5	6	7	8	9	10	11	12	13	14
I	300,000 PASSES			50,000 PASSES								15,000 PASSES		
II	50,000 PASSES			15,000 PASSES								3,000 PASSES		
III	15,000 PASSES			3,000 PASSES								500 PASSES		
IV	3,000 PASSES			500 PASSES								100 PASSES		
<b>NOTES</b>							UNITED STATES AIR FORCE CIVIL ENGINEER SUPPORT AGENCY TYNDALL AIR FORCE BASE, FLORIDA							
IN REFERENCE TO THE AGL TABLE:							RELATED DATA							
A Denotes lowest possible empty gross weight of any aircraft within the group exceeds the AGL of the pavement. Pavement cannot support aircraft for respective pass intensity level.														
+ Denotes no weight restrictions. AGL of the pavement exceeds the greatest possible gross weight of any aircraft in the group.														
Pass intensity levels V and VI are used with reduced subgrade strengths to determine the maximum allowable loads during the frost-melt period.														

**Table 3 - PCN Codes**

<b>UNDERSTANDING THE PCN CODE</b>				
<b>EXAMPLE: 31/F/C/W/T</b>				
PCN NUMERIC VALUE	PAVEMENT TYPE	SUBGRADE STRENGTH	ALLOWABLE TIRE PRESSURE	METHOD OF PCN DETERMINATION
<b>31</b>	<b>F - FLEXIBLE</b>	A	<b>W</b>	<b>T - TECHNICAL EVALUATION</b>
	R - RIGID	B	X	U - USING AIRCRAFT
		<b>C</b>	Y	
		D	Z	
<b>SUBGRADE STRENGTH CODES</b>				
CODE	CATEGORY	FLEXIBLE PAVEMENT CBR (%)	RIGID PAVEMENT k (pci)	
A	HIGH	OVER 13	OVER 400	
B	MEDIUM	9-13	201 - 400	
C	LOW	4-8	100 - 200	
D	ULTRA LOW	< 4	< 100	
<b>TIRE PRESSURE CODES</b>				
CODE	CATEGORY	ALLOWABLE TIRE PRESSURE, psi		
W	HIGH	NO LIMIT		
X	MEDIUM	146 - 217		
Y	LOW	74 - 145		
Z	ULTRA LOW	0 - 73		

<b>Table 4 – Air Force Recommendations for ACN/PCN Ratios</b>	
<b>ACN/PCN Ratio</b>	<b>Recommendation</b>
< 1.0	Unlimited Passes
1.0 – 1.10	Continued Operations, but watch for distresses
1.10 – 1.40	Limited to 10 Passes
>1.40	Emergencies Only

## Airfield Pavement Analysis Practice Problems - Solutions Air Force

SUMMARY OF ALLOWABLE GROSS LOADS															
Non-Frost Period															
		PAVEMENT CAPACITY IN KIPS FOR AIRCRAFT GROUP INDEX NUMBERS													
FEATURE NAME	PASS INTENSITY LEVEL	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A15B	I	+	34	A	100	61	62	A	140	A	A	A	A	A	A
	II	+	39	A	111	67	68	A	154	A	A	390	283	A	A
	III	+	44	A	130	78	80	A	179	166	293	446	344	472	A
	IV	+	51	61	160	95	97	107	219	203	349	530	426	585	A
R12A	I	+	67	80	+	118	121	135	282	262	489	738	499	693	247
	II	+	77	92	+	+	134	150	313	290	538	812	582	812	286
	III	+	+	+	+	+	+	175	366	340	+	+	+	+	347
	IV	+	+	+	+	+	+	+	+	419	+	+	+	+	430
R13C	I	+	+	+	+	+	+	+	+	474	+	+	+	+	+
	II	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	III	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	IV	+	+	+	+	+	+	+	+	+	+	+	+	+	+
R14A	I	+	48	60	162	93	96	108	253	234	408	609	446	618	A
	II	+	56	70	+	104	107	120	282	261	451	675	526	732	240
	III	+	63	79	+	+	127	142	334	309	526	787	+	+	295
	IV	+	76	94	+	+	+	179	+	389	+	+	+	+	373
T24C	I	+	57	+	+	+	+	+	352	338	+	+	580	714	358
	II	+	66	+	+	+	+	+	375	359	+	+	+	771	396
	III	+	74	+	+	+	+	+	+	397	+	+	+	+	453
	IV	+	+	+	+	+	+	+	+	467	+	+	+	+	+

*A - the pavement cannot support the minimum weight of any aircraft in the aircraft group  
+ - the pavement can support more than the maximum weight of any aircraft in the group*

<b>Aircraft Classification Numbers (ACN) &amp; Pavement Classification Numbers (PCN)*</b>			
<b>Feature</b>	<b>ACN</b>	<b>PCN</b>	<b>Rating</b>
A15B	66/R/D/W/T	17/R/D/W/T	Red
R12A	54/R/C/W/T	44/R/C/W/T	Yellow
R13C	56/F/B/W/T	80/F/B/W/T	Green
R14A	49/R/B/W/T	35/R/B/W/T	Yellow
T24C	50/F/A/W/T	51/F/A/W/T	Green
*Based on C-17 aircraft at 50,000 passes			

<b>Facility</b>	<b>Feature</b>	<b>Allowable Passes of C-17 @ 500 kips</b>	<b>Allowable Load for 100,000 passes of F-15E (kips)</b>
Runway	R14C	4,974	57.4
Taxiway	T24C	76,000,000	73.2
Apron	A15B	30	40.0