Software support is available through the PCASE website at WWW.PCASE.COM.

Significant Changes in PCASE2.09.06 (Since release of PCASE2.09.05)

        Changed install to place uninstaller in correct location for
Windows 10

        Replaced PCASE ESALS with estimated AASHTO ESALS in the Design
module

        Mimimum thicknesses for roads are now calculated using AASHTO ESALS

        Changed Load Transfer correlation

        Added an unloaded version of the M988B RTCH Forklift
        Added Boeing 737-7 Max Aircraft
        Added Boeing 737-8 Max Aircraft
        Added Boeing 737-9 Max Aircraft
        Added Boeing 737-10 Max Aircraft
        Added Boeing 787-8 Aircraft
        Added Boeing 787-9 Aircraft
        Added Boeing 787-10 Aircraft

        Changed ACN computations

        Changed Reports to eliminate issues and enable users to print
reports

        Added check box to analysis tab of evaluation, to allow switching
between CBR alpha
        and beta criteria. PCASE will remember this setting the next time
the program is run

Significant Changes in PCASE2.09.05 (Since release of PCASE2.09.04)

        Added 13 new traffic patterns.
        Corrected error in display of overlays for composite pavements in
LEEP
        Changed CBR value used to select minimum thickness in evaluations
when no base layer existed from 100 to 80.
        Verified Unsurfaced design is not using the CBR beta criteria

        Added three new vehicles

                Boeing 787-8
                Boeing 787-9
                Boeing 787-10

Significant Changes in PCASE2.09.04 (Since release of PCASE2.09.03)

     Updates the evaluation module to adjust the vehicle load to 75
percent for traffic areas C and D.
     Updates the evaluation module to allow load transfer to be adjusted
from 0 to 25 percent for rigid road evaluation.
     Corrects usage of pass to coverage ratios in evaluation.
     Corrects depth of frost calculation to consider high quality
stabilized base.

     Added one new vehicle

          Combi-LIFT SC3T container carrier

     Corrected names of the following Army standard traffic patterns

          ARMY IV <= 5000 FT (C-130)   to   ARMY CLASS IV <= 5000 FT
(C-130)
          ARMY IV <= 5000 FT (C-17)   to   ARMY CLASS IV <= 5000 FT
(C-17)
          ARMY IV > 5000 FT AND < 9000 FT to   ARMY CLASS IV > 5000
FT AND < 9000 FT
          ARMY IV > 9000 FT   tO   ARMY CLASS IV > 9000 FT
          ARMY V   to   ARMY CLASS V

Significant Changes in PCASE2.09.03 (Since release of PCASE2.09.02)

     Eliminated runtime error in view alternatives
     Corrected column heading in report for design of PCC Shoulder to
read "K" instead of "CBR".
     Renamed Equivalent Single Wheel Load (ESWL) to Equivalent Single
Axle Load (ESAL)
     Fixed Heavy and Modified Heavy Standard Traffic Patterns to match
UFC.
     Made corrections to the surface thickness and base layer thickness
tables.
     Added permission instructions for Office 2010
     Added permission instructions for Office 2013
     Fixed error causing duplication of tires in the vehicle editor.
     Corrected load for C17A to 585,000 from 580,000
     Modified evaluation results to show overlays if pavement ACN/PCN
ratio > 1
     Made corrections to the calculations for the estimated depth to
bedrock for asphalt pavements
     Fixed error in reading KUAB FWD file.
     Added ability to read GPS data from FWD file and LAT and LONG in
data table
     Default slip for stabilized base in rigid LED change to zero to
match UFC.

Added message to show when either asphalt or base thickness is less than the minimum.
Modified reports to show controlling vehicle and passes for mixed traffic designs
Fixed display error in LEEP evaluation with evidence of frost.
Fixed error in evaluation of unsurfaced pavements.

Added 50 new vehicles

AASHTO AML
AASHTO H15-44
AASHTO H20-44
AASHTO HS15-44
AASHTO HS20-44
AASHTO HS25-44
AASHTO P5
AASHTO P7
AASHTO P9
AASHTO P11
AASHTO P13
ATLAS 6000 LB CARRIAGE LOADED
ATLAS 6000 LB CARRIAGE UNLOADED
ATLAS 10000 LB CARRIAGE LOADED
ATLAS 10000 LB CARRIAGE UNLOADED
C-146A Wolfhound
C-160 TRANSALL
DROTT 650A1 C TRAVELIFT CRANE
FAA DUAL TAN-100
FAA DUAL TAN-150
FAA DUAL TAN-200
FAA DUAL TAN-300
FAA DUAL TAN-400
FAA DUAL WHL-10
FAA DUAL WHL-20
FAA DUAL WHL-30
FAA DUAL WHL-45
FAA DUAL WHL-50
FAA DUAL WHL-60
FAA DUAL WHL-75
FAA DUAL WHL-100
FAA DUAL WHL-150
FAA DUAL WHL-200
FAA SNGL WHL-3
FAA SNGL WHL-5
FAA SNGL WHL-10
FAA SNGL WHL-12.5
FAA SNGL WHL-15
FAA SNGL WHL-20
FAA SNGL WHL-30
FAA SNGL WHL-45
FAA SNGL WHL-60
FAA SNGL WHL-75
FAA SWL-50
MJ 100 TRAVELIFT CRANE

```
              MJ 750 D TRAVELIFT CRANE
              NASA INTER TANK ON KAMAG
              NASA LH2 TANK ON 4 SPMTS
              NASA LOX TANK ON 4 SPMTS
              TE TRANSPORT ERECTOR
```

Significant Changes in PCASE2.09.02 (Since release of PCASE2.09.01)

    ACN/PCN Subgrade Category Ranges: The subgrade category ranges in
PCASE were changed to be
    consistent with those ranges published by the Federal Aviation
Administration. The following
    tables illustrate the changes made.

Subgrade category	Old	New!	Representative value
A	CBR > 13	CBR >= 13	15
B	8 <= CBR <= 13	8 < CBR < 13	10
C	4 <= CBR < 8	4 < CBR <= 8	6
D	CBR < 4	CBR <= 4	3

Subgrade category	Old [psi/in.]	NEW! [psi/in.]	Representative value [psi/in.]
A	k > 400	k >= 442	552.6
B	200 <= k <= 400	221 < k < 442	294.7
C	100 <= k < 200	92 < k <= 221	147.4
D	k < 100	k <= 92	73.7

    CBR-Beta Criteria: The new CBR-Beta criteria for the design and
evaluation of airfields
    was accepted by DoD for implementation into PCASE 2.09 and later
versions. The final
    CBR-Beta equation is as follows:

$$Log10(Beta) = (1.5441 + 0.0730 log10(Coverages)\ ) / (1 + 0.2354\ log10(Coverages))$$

    Implemented the revised ICAO Alpha Factors for Calculation of ACN.
A letter on 16 October 2007 by ICAO directed the
    following action be taken with regard to defining the ALPHA factor
used in computing the ACN for aircraft: 1)The
    ALPHA factor for four wheel gear be changed from the current 0. 825
to 0.80; and 2) The ALPHA factor for six wheel
    gear be retained at 0.72.

    Set the interface condition for the layered elastic design and
evaluation of rigid pavements over
    a stabilized base to 10 from the previous value of 1000. Reason: A
value of 10 is more representative
    of a partial bonded condition which is considered to be the most
realistic interface condition.

Set the default modulus of a stabilized base in the layered elastic design and evaluation of
flexible pavements to 100,000 psi from the previous value of 650,000 psi. Reason: A modulus of
100,000 is more in agreement with the modulus that would be obtained from the chart in the manual
using typical values of the unconfined compression strength of the stabilized material.

Change the relationship for converting CBR to modulus for the purpose of establishing the minimum
thickness. Reason: The relationship, 1500*CBR, was developed for fine grain soils and seems to give
satisfactory results up-to CBRs of 10. Above 10 CBR the materials tend to be more granular the
1500*CBR will yield CBRs that are too large. For CBRs above 10 the new relationship, $e = 3214 * CBR^{.669}$
was developed to better agree with the modulus values for granular material as determined from En+1
procedure as given in the layered elastic design procedure.

Added standard Hardstand traffic patterns.

Fixed PCASE 2.09.02 to work with files changed in PAVER 6.5.1 or 6.5.2.

Added an Air Force 14 Group report showing all numeric values for allowable loads.

Layered elastic design – Corrected the edit button in the layer grid and corrected the rigid design so it does not
allow you to set all layers to "Calculate".

Corrected the UAV Warrior "ERMP".

Design Builder, rigid K screen – corrected subgrade description.

Cost Module – changed units for Mat from "SY" to "SF".

Added message for layered elastic flexible design when unable to satisfy asphalt strains.

Added an unloaded M988B to the vehicle database.

Added Terex TFC 45 LX Superstacker W/35K LOAD to the vehicle database.

Added Terex TFC 45 LX Superstacker UNLOADED to the vehicle database.

Corrected evaluation for Mats.

Corrected evaluation for Unsurfaced.

Restricted stabilized base strength to 100 CBR.

Significant Changes in PCASE2.09.01 (Since release of PCASE2.09)

The rigid pavement calculations were corrected to properly account
for the change made in PCASE2.09 from constant
    contact area to constant contact pressure. In PCASE 2.09 constant
contact area was used for rigid pavements, but
    in PCASE 2.09.01 this was corrected to use constant contact
pressure. This change has little impact on calculated
    thicknesses as long as the design loads are close to the maximum
load of the vehicle. If the design load is close
    to the maximum load, the contact area more closely matches the tire
loads and pressures in the database. However, as
    the design loads move way from the maximum load (greater difference
in load) the re-calculated contact area will have
    a greater influence on the calculated thicknesses.

    The pass-to-coverage ratio were corrected to account for the change
from constant contact area to constant contact
    pressure. The impact on design calculations is minimal.

    The rigid pavement routines were modified to improve the tolerances
when checking for thickness, allowable passes
    and allowable loads. This was necessary to smooth the creation of
design and evaluation curves.

    Air Force 14 Groups Report corrected to allow the use of both New
and Old 14 Group trafficpatterns.

    Modified the evaluation report tool to allow the use of section or
branch or both, in either order.

Significant Changes in PCASE 2.09 (since release of PCASE2.08)

    Design Builder module added with capability to do frost and
drainage calculations (multiple designs are calculated
    on one screen).

    Cost module added (ability to assign costs to material types for
design result cost comparison).

    GIS capabilities added and GIS data added to the BAAF file shipped
with setup to use as an example.

    Incorporated the renovated CBR procedure for road design (only
applicable for asphalt and aggregate surfaces).

Design Index removed from road design. Minimum thickness and compaction requirements are now based on 18-
kip equivalent single axle load (ESAL) range.

Smoothed the fundamental CBR curve.

Longer calculation time for tracked vehicles; more stress points are being calculated. Recommend users keep
designs for tracked vehicles in a separate file/database.

Design module will automatically set traffic type to Individual for a layered elastic design.

Minimum asphalt required for roads changed to 2-inches.

Additional stations added to the database for calculating depth of frost.

Updated default densities and moisture contents used for calculating frost depth.

User-requested data added to the design and evaluation reports.

In the Evaluation module, the frost defaults changed to zero.

In the Evaluation module, overlays for thaw and non-thaw seasons are now calculated using full mission passes
and loads.

Flexible pavements with no structural requirement for an overlay may still require an overlay to guarantee the
minimum thickness requirements for surface and base layers are met.

Added ability to use the Evaluation module for Roads.

Changed the calculation procedure for equivalency factors.

More vehicles added to the database.

Renamed original Air Force 14 Group vehicles to Old Air Force 14 Group vehicles and added New Air Force 14
Group vehicles

Vehicle data updated; affects the ACN values for some aircraft.

Changed constant contact area to constant contact pressure.

Navy Standard Design traffic patterns added.

Renamed original Air Force 14 Groups Traffic Pattern to Old Air Force 14 Groups Traffic Pattern and added New
Air Force 14 Groups Traffic Pattern

Default weight for C-17 now set at 585,000 pounds (previously 580,000 pounds).

Contact area is recalculated when a vehicle weight is changed in Vehicle Edit.

Help/Utilities: UFC designations updated and unused tools removed.

Ability to pack databases to a specific location (packing a database allows a user to send design and/or evaluation results to another user).

Changes to PCASE2.09 Affecting Calculated Results (from PCASE2.08)

There are four changes we have made to the criteria that will affect the calculations and the results obtained with PCASE 2.09. These changes are listed below along with a brief explanation.

1.   Changed constant contact area to constant contact pressure: The standard flexible pavement design procedure is based on the classical CBR equation. In its current form, this equation applies to only single-wheel loads. In order to handle multi-wheel gear assemblies, the equivalent single-wheel load (ESWL) concept was introduced. To simplify the calculations of the ESWL, a procedure was devised where the contact area of a tire imprint was to remain constant. This assumption gave relatively good results as long as the tires in a gear were all the same size and the number of tires selected was small. With the introduction of the new beta criteria and the ability of today's computers to performed millions of calculations per second, it was deemed appropriate at this time to change to a more logical constant tire pressure assumption, since it is well known that tire contact area changes significantly at different loads while maintaining the tire pressure relatively constant. However, it is expected that this change will only introduce small changes in the results (thickness, allowable passes, allowable gross loads, etc). This change will also affect rigid pavement calculations since the resulting tire contact area is now based on a constant contact pressure.

2.   Smoothing of fundamental CBR curve: The classical CBR curve that has been used for many years was digitized and put in a lookup table. New procedures and software utilizing this table to generate design and evaluation curves for specific aircraft have brought to light that this digitized curve is not as smooth as previously thought. Design curves at high CBR subgrade values (thin pavement sections) had a tendency to be jagged and resulted in

design/evaluation curves with kinks in them. This fact did not show up before because these curves were drawn by
hand and were smoothed out manually. To resolve this problem and use the automated software, it was necessary to
take a look at the CBR digitized curve and perform a new smoothing procedure. This change also results in small
differences in the calculations from PCASE 2.08 to PCASE 2.09.

3.   Equivalency factors procedure: The procedure that handles how the equivalency factors are applied for
pavement layers with less than the minimum thickness was changed to always apply the minimum equivalency factors
even when the actual thickness was less than the minimum. This was done to stay consistent when performing forward
(design) and backward (backcalculation) calculations.

4.   Vehicle database updates and enhancements: The new vehicle data to be used in PCASE2.09 was updated during
an internal validation and enhancement effort. Numerous corrections and optimization of evaluation points and number
of tires selected for a specific calculation were implemented for a number of vehicles in the database. These changes
will impact, also to a minor extent, the resulting calculations from PCASE 2.09 and will significantly speed up
calculations for vehicles with a large number of tires.

ENABLING GIS IN PCASE 2.09

To enable GIS in PCASE2.09:

Start PCASE 2.09

On the second menu bar click on "Visual Menu"

When the Visual Menu form is displayed click on "Reports"

The right side of the form select GIS Reports and click "Continue".

A new form will be displayed listing the reports available:

    LASTACNPCNRATIO
    LASTSUBGRADECATEGORY

Click "Close" on each form

The PCASE reports will now be available from the GIS Reports menu option on the PCASE tool bar

PCASE 2.09 Criteria

This software is based on the following criteria:

Pavement Design For Airfields
UFC 3-260-2 (Unified)

Airfield Pavement Evaluation
UFC 3-260-3 (Unified)

Pavement Design for Roads
UFC 3-250-01 (Unified)

Download Software

Download the latest version of all PCASE programs at:

http://www.pcase.com or https://transportation.erdc.dren.mil/pcase/

Support

For support contact: George.W.VanSteenburg@usace.army.mil

Readme file

This readme file is also located on the Utilities/Help menu under Help +
.txt.