

The `flushend` package

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v2.0 from 2014/03/03

1 Introduction

The package is used to balance columns on any page in twocolumn mode. By default it is switched on at the end of document. It is expected to work with footnotes, top floats and column break before one line section title.

2 Usage

Just load the package to balance the last page: that's all. To balance some page in middle of document use command `\flushcolsend` at that page.

<code>\flushend</code>	This macro switches on column balancing on the last page. It is used by default.
<code>\raggedend</code>	This macro switches off column balancing on the last page.
<code>\flushcolsend</code>	This macro switches on column balancing on the current page.
<code>\raggedcolsend</code>	This macro switches off column balancing on the current page.
<code>\atColsBreak</code>	<code>{\tokens}</code> Adds <code>\tokens</code> in place of the original column break (made without balancing). <i>Example:</i> <code>\atColsBreak{\vskip-2pt}</code>
<code>\atColsEnd</code>	<code>{\tokens}</code> Adds <code>\tokens</code> at the end of right column. <i>Example:</i> <code>\atColsEnd{\vfil}</code>
<code>\showcolsendrule</code>	It can be used just for debugging: adds rule to the bottom of columns.

2.1 Package options

<code>autobase</code>	It is used to guess <code>\baselineskip</code> value on original columns break.
<code>noauto</code>	It is used to switch off the previous option behaviour.
<code>debug</code>	Adds rules to the bottom of columns (just for debugging) and leftcolumn break place. Adds some additional log info.

3 Implementation

```

1 \NeedsTeXFormat{LaTeX2e}
2 \ProvidesPackage{flushend}[2014/03/03 v2.0 Balancing columns in twocolumn mode]

3 \newif\if@auto@baselineskip \@auto@baselineskiptrue
4 \newif\if@balance@debug \@balance@debugtrue
5 \DeclareOption{autobase}{\global\@auto@baselineskiptrue}
6 \DeclareOption{noauto}{\global\@auto@baselineskipfalse}
7 \DeclareOption{debug}{\global\@balance@debugtrue}
8 \ProcessOptions

9 \newskip\flushend@@lastskip@a
10 \newskip\flushend@@lastskip@b
11 \newskip\flushend@@lastskip@c
12 \newcount\flushend@@penalty@a
13 \newdimen\flushend@@lastkern@a
14 \newdimen\var@@temp@spread
15 \newdimen\var@@temp@a
16 \newdimen\flushend@@page@rule \flushend@@page@rule\z@
17 \def\showcolsendrule{\global\flushend@@page@rule=.4pt}

\top@@floatbox@min {\float size} This value is used to catch possible float on right column top.
18 \gdef\top@@floatbox@min{4\topskip}

19 \newbox\flushend@@varbox@a
20 \newbox\flushend@@varbox@c
21 \newbox\flushend@@tempbox@a
22 \newbox\flushend@@tempbox@c
23 \@ifundefined{viper}{\newbox\viper}{}
24 \@ifundefined{hold@viper}{\newbox\hold@viper}{}

25 \newtoks\atColsBreak \atColsBreak={}
26 \newtoks\atColsEnd \atColsEnd={}

27 \@ifundefined{fmt@box@adds}{\def\fmt@box@adds#1{#1}}{}
28 \@ifundefined{fmt@vbox@adds}{\def\fmt@vbox@adds[#1]#2{#2}}{}

\remove@lastbox@at@balancing It is used to remove empty box at the right column end.
29 \gdef\remove@lastbox@at@balancing{%
30 \unskip\unkern\unpenalty
31 \unskip\unkern\unpenalty
32 \unskip\unkern\unpenalty

```

```

33 {\setbox\z@\lastbox}%
34 \unskip\unkern\unpenalty
35 \unskip\unkern\unpenalty
36 \unskip\unkern\unpenalty
37 }

```

Macros used in debug mode.

```

38 \def\show@@box#1{%
39   \bgroup
40     \showboxbreadth=20000\showboxdepth=20000%
41     \showbox#1\relax
42   \egroup
43 }
44 \def\wlog@balance@debug#1{\if@balance@debug \wlog{#1}\fi}
45 \def\log@box@info#1{<box\the#1>(\the\ht#1+\the\dp#1)x\the\wd#1}
46 \let\show@@box@next\@gobble

```

To get more or less proper result we need to know about footnotes at the left column end, top floats at the right column top, skips and so on. This part of the package is responsible for such analysis.

```

47 \gdef\analyze@lastbox@box#1{%
48   \setbox\flushend@@varbox@a\vbox{%
49     \unvbox#1%
50     \global\flushend@@lastskip@a\lastskip
51     \unskip
52     \global\var@@temp@a\lastkern
53     \unkern
54     \global\flushend@@penalty@a\lastpenalty
55     \unpenalty
56     \ifdim\lastskip>\z@
57       \global\flushend@@lastskip@a\lastskip
58     \fi
59     \unskip
60     \ifdim\lastkern>\z@
61       \global\var@@temp@a\lastkern
62     \fi
63     \unkern
64     \ifnum\lastpenalty>\z@
65       \global\flushend@@penalty@a\lastpenalty
66     \fi
67     \unpenalty
68     \global\setbox\flushend@@tempbox@a\lastbox
69   }%
70   \wlog@balance@debug{^^J::analyze@lastbox@box::\log@box@info{#1}%
71     ^^J::unvbox: \log@box@info{\flushend@@varbox@a}%
72     ^^J::lastbox: \log@box@info{\flushend@@tempbox@a}%
73     ^^J::lastskip: \the\flushend@@lastskip@a;
74     lastkern: \the\var@@temp@a;
75     lastpenalty: \the\flushend@@penalty@a

```

```

76     }%
77 }

\analyze@leftcolumn@box {(\box)}
78 \gdef\analyze@leftcolumn@box#1{%
79 \splittopskip\z@ \vfuzz\maxdimen \vbadness\maxdimen
80 \flushend@@lastskip@b\ht#1%
81 \wlog@balance@debug{^^Jmainbox: \log@box@info{#1}}%
82 \setbox\flushend@@varbox@a\vbox{%
83   \unvbox#1%
84   \global\flushend@@lastskip@a\lastskip
85   \unskip
86   \global\flushend@@lastkern@a\lastkern
87   \unkern
88   \global\flushend@@penalty@a\lastpenalty
89   \unpenalty
90   \global\setbox\flushend@@tempbox@a\lastbox
91   }%
92 \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
93 \advance\flushend@@lastskip@b -\ht\flushend@@tempbox@a
94 \wlog@balance@debug{.-box: \log@box@info{\flushend@@varbox@a}%
95   ^^J.-lastbox: \log@box@info{\flushend@@tempbox@a}%
96   ^^J.-lastskip: \the\flushend@@lastskip@a;
97   lastkern: \the\flushend@@lastkern@a;
98   lastpenalty: \the\flushend@@penalty@a
99   ^^J.-diff: \the\flushend@@lastskip@b
100 }%
101 \check@@footnoterule@@box\flushend@@tempbox@a\flushend@@lastskip@b\flushend@@varbox@a
102 \check@@baselineskip@@skip\flushend@@lastskip@a\flushend@@lastskip@b\flushend@@lastskip@c
103 \ifvoid\flushend@@tempbox@a
104   \ifdim\ht\flushend@@varbox@a>\topskip
105     \flushend@@lastskip@b\ht\flushend@@varbox@a
106     \var@@temp@a\ht\flushend@@varbox@a
107     \loop
108       \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\var@@temp@a
109       \ifvoid\flushend@@varbox@a
110         \setbox\flushend@@varbox@a\vbox{\unvbox\flushend@@tempbox@c}%
111         \advance \var@@temp@a -3\p@
112       \else
113         \var@@temp@a=-1\p@
114       \fi
115     \ifdim \var@@temp@a>\z@
116     \repeat
117     \setbox\flushend@@varbox@a\vbox{\unvbox\flushend@@varbox@a}%
118     \setbox\flushend@@tempbox@c\vbox{\unvbox\flushend@@tempbox@c}%
119     \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
120     \advance\flushend@@lastskip@b -\ht\flushend@@tempbox@c
121     \wlog@balance@debug{.--box: \log@box@info{\flushend@@tempbox@c}%
122       ^^J.--lastbox: \log@box@info{\flushend@@varbox@a}%
123       ^^J.--diff: \the\flushend@@lastskip@b}%

```

```

124         \check@@footnoterule@@box\flushend@@varbox@a\flushend@@lastskip@b
125         \flushend@@tempbox@c
126         \check@@baselineskip@@skip\flushend@@lastskip@a\flushend@@lastskip@b
127         \flushend@@lastskip@c
128         \ifdim\ht\flushend@@varbox@a>.5\topskip
129         \analyze@lastbox@box\flushend@@varbox@a
130         \fi
131         \setbox\flushend@@varbox@a\vbox{\unvbox\flushend@@tempbox@c}%
132     \else
133         \wlog@balance@debug{lastbox: \log@box@info{\flushend@@varbox@a}}%
134     \fi
135 \fi
136 \ifdim\ht\flushend@@varbox@a>\topskip
137     \expandafter\analyze@leftcolumn@box\expandafter\flushend@@varbox@a
138 \fi
139 }

```

\get@@footnoterule@@box

```

140 \def\get@@footnoterule@@box{%
141     \splittopskip\z@ \vfuzz\maxdimen \vbadness\maxdimen
142     \setbox\flushend@@varbox@a\vbox{\strut
143         \vskip\z@
144         \footnoterule
145         \unskip\unkern\unpenalty
146         \unskip\unkern\unpenalty
147     }%
148     \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\ht\strutbox
149     \xdef\footnoterule@@box@@ht{\the\ht\flushend@@varbox@a}%
150     \xdef\footnoterule@@box@@dp{\the\dp\flushend@@varbox@a}%
151     \xdef\footnoterule@@box@@wd{\the\wd\flushend@@varbox@a}%
152     \wlog@balance@debug{:footnoterule: \log@box@info{\flushend@@varbox@a}}%
153 }

```

\check@@footnoterule@@box $\{\langle box \rangle\}\{\langle skip \rangle\}\{\langle box \rangle\}$

```

154 \def\check@@footnoterule@@box#1#2#3{%
155     \ifdim\ht#1=\footnoterule@@box@@ht
156     \ifdim\dp#1=\footnoterule@@box@@dp
157     \ifdim\wd#1=\footnoterule@@box@@wd
158     \ifdim#2>\topskip
159         \xdef\main@box@height{\the\ht#3}%
160         \xdef\main@box@skip{\the#2}%
161     \fi
162 \fi
163 \fi
164 \fi
165 }

```

\check@@baselineskip@@skip $\{\langle dimension \rangle\}\{\langle dimension \rangle\}\{\langle var \rangle\}$

```

166 \def\check@@baselineskip@@skip#1#2#3{%

```

```

167     \ifdim#1>\z@
168         \ifdim#2>\z@
169             \global#3=\the#1%
170             \gdef\check@@baselineskip@@skip##1##2##3{}%
171         \fi
172     \fi
173 }

\analyze@rightcolumn@box {(\box)}

174 \def\analyze@rightcolumn@box#1{%
175     \bgroup
176     \xdef\top@@floatbox@ht{\z@}%
177     \xdef\top@@floatbox@skip{\z@}%
178     \xdef\top@@section@skip{\z@}%
179     \splittopskip\z@ \vfuzz\maxdimen \vbadness\maxdimen
180     \wlog@balance@debug{^~J(R)mainbox: \log@box@info{#1}}%
181     \var@@temp@a3\p@
182     \setbox\flushend@@varbox@a\vbox{\strut
183         \vskip\z@
184         \unvcopy#1%
185     }%
186     \splittopskip\z@
187     \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\ht\strutbox
188     \flushend@@lastskip@a\ht\flushend@@varbox@a
189     \loop
190         \flushend@@lastskip@b\ht\flushend@@varbox@a
191         \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\var@@temp@a
192         \ifvoid\flushend@@tempbox@c
193             \advance \var@@temp@a 3\p@
194             \ifdim\var@@temp@a>\flushend@@lastskip@b
195                 \var@@temp@a=-1\p@
196             \fi
197         \else
198             \setbox\flushend@@tempbox@c\vbox{\unvbox\flushend@@tempbox@c}%
199             \ifdim\ht\flushend@@tempbox@c>\top@@floatbox@min
200                 \advance\flushend@@lastskip@b -\ht\flushend@@tempbox@c
201                 \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
202                 \xdef\top@@floatbox@skip{\the\flushend@@lastskip@b}%
203                 \flushend@@lastskip@b\flushend@@lastskip@a
204                 \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
205                 \advance\flushend@@lastskip@b -\top@@floatbox@skip
206                 \xdef\top@@floatbox@ht{\the\flushend@@lastskip@b}%
207                 \var@@temp@a=3\p@
208             \else
209                 \advance\flushend@@lastskip@b -\ht\flushend@@tempbox@c
210                 \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
211                 \ifdim\ht\flushend@@tempbox@c>\topskip
212                     \else
213                         \xdef\top@@section@skip{\the\flushend@@lastskip@b}%
214                     \fi

```

```

215         \var@@temp@a=-1\p@
216     \fi
217 \fi
218 \ifdim \var@@temp@a>\z@
219 \repeat
220 \ifvoid\flushend@@tempbox@c
221 \else
222     \ifdim\top@@section@skip>\z@
223     \else
224         \ifdim\ht\flushend@@tempbox@c>\z@
225             \setbox\flushend@@varbox@a\vbox{\unvbox\flushend@@tempbox@c}%
226         \fi
227         \flushend@@lastskip@b\ht\flushend@@varbox@a
228         \var@@temp@a=3\p@
229         \loop
230             \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\var@@temp@a
231             \ifvoid\flushend@@tempbox@c
232                 \advance \var@@temp@a 3\p@
233                 \ifdim\var@@temp@a>\flushend@@lastskip@b
234                     \var@@temp@a=-1\p@
235                 \fi
236             \else
237                 \ifdim\ht\flushend@@tempbox@c>\z@
238                     \var@@temp@a=-1\p@
239                 \fi
240             \fi
241 \ifdim \var@@temp@a>\z@
242 \repeat
243 \loop
244     \setbox\flushend@@varbox@a\vbox{%
245         \unvbox\flushend@@tempbox@c
246         \unskip\unkern\unpenalty
247         \unskip\unkern\unpenalty
248         \unskip\unkern\unpenalty
249         \setbox\flushend@@tempbox@c\lastbox
250     }%
251 \flushend@@lastskip@b\ht\flushend@@varbox@a
252 \setbox\flushend@@varbox@a\vbox{%
253     \unvbox\flushend@@varbox@a
254     \unskip\unkern\unpenalty
255     \unskip\unkern\unpenalty
256     \unskip\unkern\unpenalty
257 }%
258 \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
259 \ifdim\flushend@@lastskip@b>\topskip
260     \xdef\top@@section@skip{\the\flushend@@lastskip@b}%
261 \fi
262 \ifdim\ht\flushend@@varbox@a>2\topskip
263     \setbox\flushend@@tempbox@c\vbox{\unvbox\flushend@@varbox@a}%
264 \repeat

```

```

265         \fi
266     \fi
267 \egroup
268 }

```

\last@outputdblcol Columns balancing of the twocolumn mode page.

```

269 \def\last@outputdblcol{%
270   \if@firstcolumn
271     \global \@firstcolumnfalse
272     \global \setbox\@leftcolumn \box\@outputbox
273   \else
274     \global \@firstcolumntrue
275     \@tempdima\ht\@leftcolumn
276     \splittopskip\topskip \splitmaxdepth\maxdepth
277     \var@@temp@spread=\wd\@outputbox
278     \if@auto@baselineskip
279       %% Trying guess baselineskip value on column break
280       \get@@footnoterule@@box
281       \xdef\main@box@height{\the\ht\@leftcolumn}%
282       \xdef\main@box@skip{\z@}%
283       \global\flushend@@lastskip@c\z@
284       \setbox\flushend@@varbox@a\vbox{\unvcopy\@leftcolumn}%
285       \analyze@leftcolumn@box\flushend@@varbox@a
286       \setbox\flushend@@varbox@a\vbox{\unvcopy\@outputbox}%
287       \analyze@rightcolumn@box\flushend@@varbox@a
288       \ifdim\main@box@skip>\z@
289         \splittopskip\z@
290         \setbox\flushend@@varbox@a\vsplit\@leftcolumn to\main@box@height
291       \else
292         \setbox\flushend@@varbox@a\box\@leftcolumn
293       \fi
294     \ifdim\var@@temp@spread>\z@
295       \setbox\@outputbox\vbox{\strut
296         \vskip\z@
297         \unvbox\@outputbox
298       }%
299       \splittopskip\z@
300       \setbox\flushend@@tempbox@c\vsplit\@outputbox to\ht\strutbox
301       \ifdim\top@@floatbox@skip>\z@
302         \setbox\flushend@@tempbox@c\vsplit\@outputbox to\top@@floatbox@ht
303         \setbox\flushend@@tempbox@c\vbox{\unvbox\flushend@@tempbox@c}%
304       \fi
305       \setbox\@tempboxa\vbox{%
306         \unvbox\flushend@@varbox@a
307         \unskip\unkern\unpenalty
308         \vskip\flushend@@lastskip@c
309         \the\atColsBreak
310         \hrule\@height\flushend@@page@rule width\columnwidth
311         \ifdim\top@@section@skip>\topskip
312           \vskip\top@@section@skip

```



```

313         \fi
314         \unvbox\@outputbox
315         \remove@lastbox@at@balancing
316         \the\atColsEnd
317     }%
318     \ifdim\top@@floatbox@skip>\z@
319         \setbox\@outputbox\vbox{\unvbox\flushend@@tempbox@c}%
320     \fi
321 \else %% rightcolumn empty
322     \setbox\@tempboxa\vbox{%
323         \unvbox\flushend@@varbox@a
324         \remove@lastbox@at@balancing
325         \the\atColsEnd
326     }%
327 \fi
328 \else
329     %% Ignore baselineskip value on column break
330     \ifdim\var@@temp@spread>\z@
331         \setbox\@outputbox\vbox{\strut
332             \vskip\z@
333             \unvbox\@outputbox
334         }%
335         \splittopskip\z@
336         \setbox\flushend@@tempbox@c\vsplit\@outputbox to\ht\strutbox
337         \setbox\@tempboxa\vbox{%
338             \unvbox\@leftcolumn
339             \setbox\z@\lastbox
340             \unskip\unkern\unpenalty
341             \the\atColsBreak
342             \hrule\@height\flushend@@page@rule width\columnwidth
343             \unvbox\@outputbox
344             \remove@lastbox@at@balancing
345             \the\atColsEnd
346         }%
347     \else
348         \setbox\@tempboxa\vbox{%
349             \unvbox\@leftcolumn
350             \remove@lastbox@at@balancing
351             \the\atColsEnd
352         }%
353     \fi
354 \fi
355 \ifdim\main@box@skip>\z@
356     \@tempdimb\ht\@tempboxa
357     \advance\@tempdimb -\main@box@skip
358     \advance\@tempdimb -\ht\@leftcolumn
359     \@tempdimb .5\@tempdimb
360     \splittopskip\topskip \splitmaxdepth\maxdepth
361 \loop
362     \setbox\flushend@@varbox@a\copy\@tempboxa

```

```

363 \setbox\flushend@@tempbox@a\vsplit\flushend@@varbox@a to\@tempdimb
364 \setbox\flushend@@tempbox@c\ vbox{%
365 \unvcopy\flushend@@tempbox@a
366 \vskip\main@box@skip
367 \unvcopy\@leftcolumn
368 }%
369 \setbox\flushend@@varbox@c\ vbox{\unvbox\flushend@@varbox@a}%
370 \var@@temp@spread=\ht\flushend@@tempbox@c
371 \advance\var@@temp@spread by-\ht\flushend@@varbox@c
372 \wlog@balance@debug{Left x: \the\ht\flushend@@tempbox@a
373 +\the\dp\flushend@@tempbox@a=\the\ht\flushend@@varbox@a
374 +\the\dp\flushend@@varbox@a::\the\@tempdimb
375 ^^JLeft 0: \the\ht\flushend@@tempbox@c
376 +\the\dp\flushend@@tempbox@c::\the\@tempdimb
377 ^^JRight x: \the\ht\flushend@@varbox@c
378 +\the\dp\flushend@@varbox@c=\the\ht\flushend@@varbox@a
379 +\the\dp\flushend@@varbox@a::\the\@tempdimb
380 ^^JExtra height:\the\var@@temp@spread\space when \the\@tempdimb
381 }%
382 \ifdim\var@@temp@spread<\z@ \advance\@tempdimb 1\p@ \repeat
383 \flushend@@lastskip@a\the\ht\flushend@@tempbox@c
384 \flushend@@lastskip@b\the\@tempdimb
385 \setbox\flushend@@tempbox@a\vsplit\@tempboxa to\@tempdimb
386 \setbox\@leftcolumn\ vbox to\@tempdima{%
387 \vbox to \flushend@@lastskip@a{%
388 \unvbox\flushend@@tempbox@a
389 \vskip\main@box@skip
390 \unvbox\@leftcolumn
391 \vss
392 }%
393 \hrule\@height\flushend@@page@rule width\textwidth
394 \vss
395 }%
396 \global\ht\@leftcolumn=\the\@tempdima
397 \wlog{- LAST -}%
398 ^^JExtra skip:\the\var@@temp@spread
399 ^^JLeft:\the\ht\@leftcolumn/\the\dp\@leftcolumn
400 ^^JRight:\the\ht\@tempboxa/\the\dp\@tempboxa
401 ^^JOutput:\the\@tempdimb
402 }%
403 \setbox\@outputbox\ vbox to\@tempdima{%
404 \vbox spread\var@@temp@spread{\unvbox\@tempboxa}%
405 \vss
406 }%
407 \else
408 \@tempdimb \ht\@tempboxa
409 \ifdim\top@@floatbox@skip>\z@
410 \advance\@tempdimb \top@@floatbox@skip
411 \advance\@tempdimb \top@@floatbox@ht
412 \fi

```

```

413 \@tempdimb .5\@tempdimb
414 \splittopskip\topskip \splitmaxdepth\maxdepth
415 \loop
416 \setbox\flushend@@varbox@a\copy\@tempboxa
417 \setbox\flushend@@tempbox@a\vsplit\flushend@@varbox@a to\@tempdimb
418 \setbox\flushend@@tempbox@c\ vbox{\unvcopy\flushend@@tempbox@a}%
419 \ifdim\top@@floatbox@skip>\z@
420 \setbox\flushend@@varbox@c\ vbox{%
421 \unvcopy\@outputbox
422 \vskip\top@@floatbox@skip
423 \unvbox\flushend@@varbox@a
424 }%
425 \else
426 \setbox\flushend@@varbox@c\ vbox{\unvbox\flushend@@varbox@a}%
427 \fi
428 \var@@temp@spread=\ht\flushend@@tempbox@c
429 \advance\var@@temp@spread by-\ht\flushend@@varbox@c
430 \wlog@balance@debug{Left x: \the\ht\flushend@@tempbox@a
431 +\the\dp\flushend@@tempbox@a=\the\ht\flushend@@varbox@a
432 +\the\dp\flushend@@varbox@a::\the\@tempdimb
433 ^^JLeft 0: \the\ht\flushend@@tempbox@c
434 +\the\dp\flushend@@tempbox@c::\the\@tempdimb
435 ^^JRight x: \the\ht\flushend@@varbox@c
436 +\the\dp\flushend@@varbox@c=\the\ht\flushend@@varbox@a
437 +\the\dp\flushend@@varbox@a::\the\@tempdimb
438 ^^JExtra height:\the\var@@temp@spread\space when \the\@tempdimb
439 }%
440 \ifdim\var@@temp@spread<\z@ \advance\@tempdimb 1\p@ \repeat
441 \@tempdimb\ht\flushend@@tempbox@c
442 \wlog{- LAST -}%
443 ^^JExtra skip:\the\var@@temp@spread
444 ^^JLeft:\the\ht\flushend@@tempbox@c/\the\dp\flushend@@tempbox@c
445 ^^JRight:\the\ht\flushend@@varbox@c/\the\dp\flushend@@varbox@c
446 ^^JOutput:\the\@tempdimb
447 }%
448 \setbox\flushend@@tempbox@c\vsplit\@tempboxa to\@tempdimb
449 \setbox\flushend@@varbox@c\ vbox{\unvbox\flushend@@tempbox@a}%
450 \setbox\@leftcolumn\ vbox to\@tempdima{%
451 \vbox to\@tempdimb{\unvbox\flushend@@varbox@c\vss}%
452 \hrule\@height\flushend@@page@rule width\textwidth
453 \vss
454 }%
455 \global\ht\@leftcolumn=\the\@tempdima
456 \ifdim\top@@floatbox@skip>\z@
457 \setbox\@outputbox\ vbox to\@tempdima{%
458 \vbox spread\var@@temp@spread{%
459 \unvbox\@outputbox
460 \vskip\top@@floatbox@skip
461 \unvbox\@tempboxa
462 }%

```

```

463         \vss
464     }%
465 \else
466     \setbox\@outputbox\vbox to\@tempdima{%
467         \vbox spread\var@@temp@spread{\unvbox\@tempboxa}%
468         \vss
469     }%
470 \fi
471 \fi
472 \setbox\@outputbox \vbox {%
473     \hb@xt@\textwidth {%
474         \hb@xt@\columnwidth {%
475             \fmt@box@adds{\box\@leftcolumn}\hss}%
476             \hfil
477             \vrule \@width\columnseprule
478             \hfil
479             \hb@xt@\columnwidth {%
480                 \fmt@box@adds{\box\@outputbox}\hss}%
481             }%
482         }%
483     \global\let\@outputdblcol\saved@orig@@outputdblcol
484     \global\atColsEnd}%
485 \ifvoid\hold@viper
486 \else
487     \setbox\@outputbox\vbox{\box\hold@viper\box\@outputbox}%
488 \fi
489 \@combinedblfloats
490 \@outputpage
491 \begingroup
492     \@dblfloatplacement
493     \@startdblcolumn
494     \@whiles\if@fcolmade\fi
495         {\@outputpage\@startdblcolumn}%
496     \ifvoid\@viper
497     \else
498         \global\setbox\@viper\vbox{%
499             \vskip-\stripsep
500             \unvbox\@viper
501         }%
502         \csname @viperoutput\endcsname
503     \fi
504 \endgroup
505 \fi
506 }

```

Adds default balancing of the last page at the end of document.

```

507 \usepackage{etoolbox}
508 \AtBeginDocument{%
509     \global\let\saved@orig@@outputdblcol\@outputdblcol
510     \global\let\balanced@@outputdblcol\last@outputdblcol

```

```

511 \preto\enddocument{\let\@outputdblcol\balanced@@outputdblcol}%
512 \appto\footnoterule{\vskip\z@}%
513 }

```

User interface commands for the balancing pages.

```

514 \def\flushcolsend{\global\let\@outputdblcol\last@outputdblcol}
515 \def\raggedcolsend{\global\let\@outputdblcol\saved@orig@@outputdblcol}
516 \def\flushend{\global\let\balanced@@outputdblcol\last@outputdblcol}
517 \def\raggedend{\global\let\balanced@@outputdblcol\saved@orig@@outputdblcol}

518 \if@balance@debug
519 \showcolsendrule
520 \fi

```