UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2009/2010

April/May 2010

IWK 302 – Wood Engineering
[Kejuruteraan Kayu]

Duration: 3 hours
[Masa: 3 jam]

Please check that this examination paper consists of FIFTEEN pages of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi LIMA BELAS muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

Instructions: Answer any **FIVE (5)** out of six questions. You may answer the question either in Bahasa Malaysia or in English.

*[**Arahan**: Jawab mana-mana **LIMA (5)** daripada enam soalan. Anda dibenarkan menjawab soalan sama ada [untuk KBI] dalam Bahasa Malaysia atau Bahasa Inggeris.]*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai].

1. (a) Explain the stages involved in crack growth.

(5 marks)

(b) Based on Irwin-kies Relationship and Figure 1, indicate that strain energy release rate (G) is

$$G = P_c^2/2B(dC/da),$$

where

P_c = Crack load
B = Thickness
C = Compliance
a = Crack length

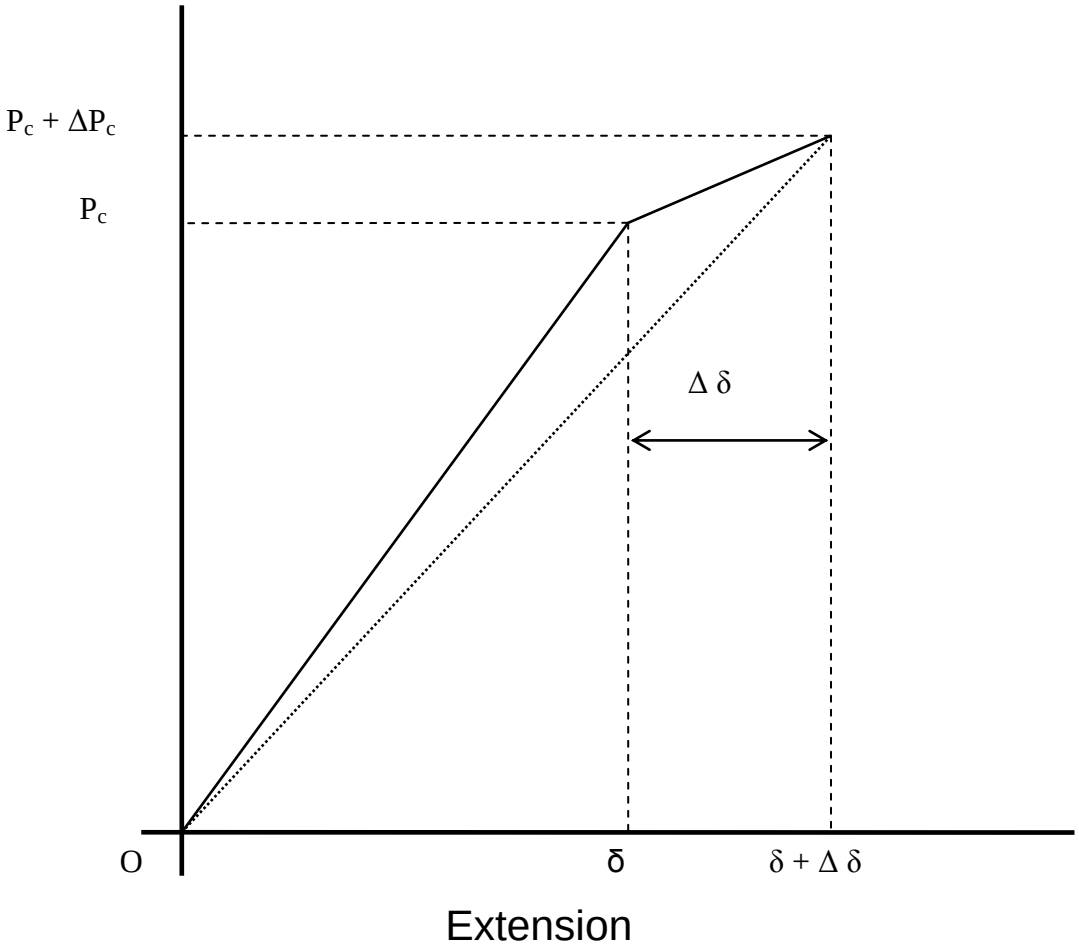

Figure 1

(15 marks)

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2. (a) For Figure 2, determine the following using integration method.

(i) the area, A
(ii) the centroid
(iii) the moment of inertia, I_x

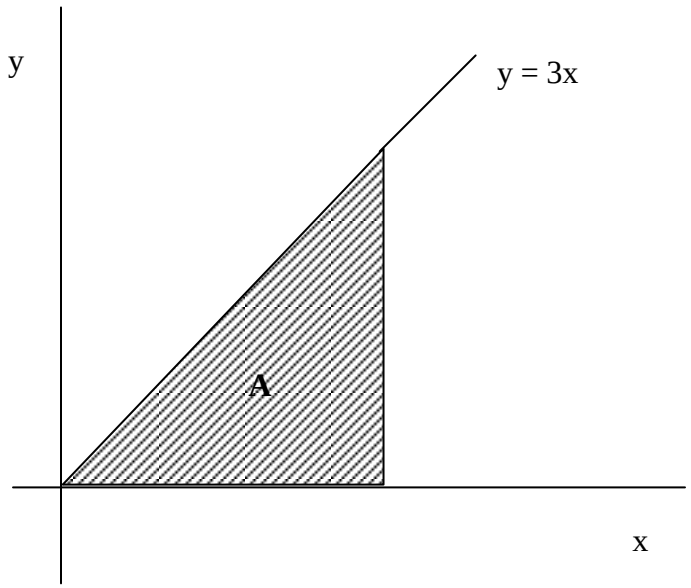


Figure 2

(10 marks)

(b) For the composite area shown in Figure 3, determine

(i) the coordinate of the centroid
(ii) the moment of inertia with respect to the x-axis, I_x.

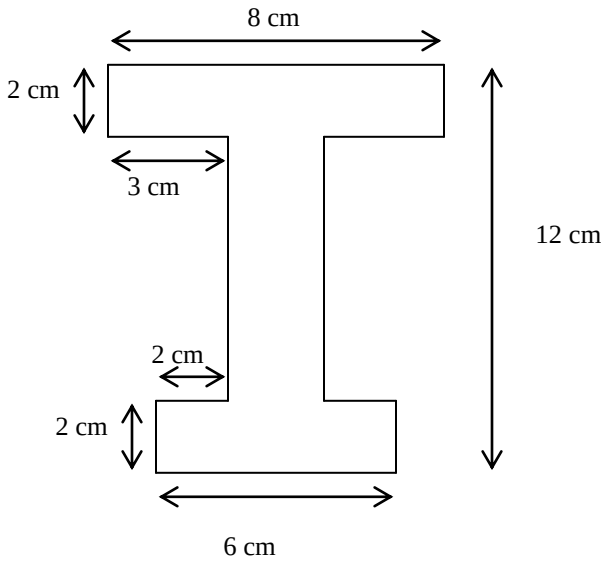


Figure 3

(10 marks)

3. A beam is loaded by a distributed force at its center as shown in Figure 4, the specifications of the beam are as follow;

F_{bo} = 7500 kN/m^2
F_{vo} = 850 kN/m^2
b = 20 cm

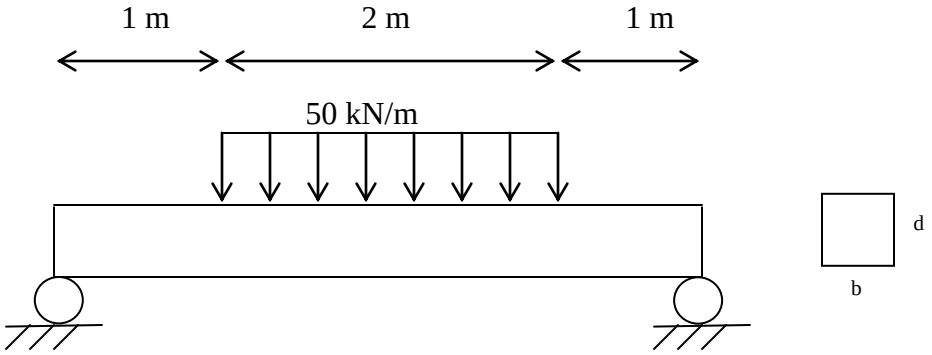


Figure 4

Determine the allowable minimum depth (d).

(20 marks)

4. A cantilever beam is loaded as shown in Figure 5. Indicate that the maximum deflection is $PL^3/3EI$, where;

   P = load
   L = length of the beam
   E = modulus of elasticity
   I = moment of inertia computed about the neutral axis

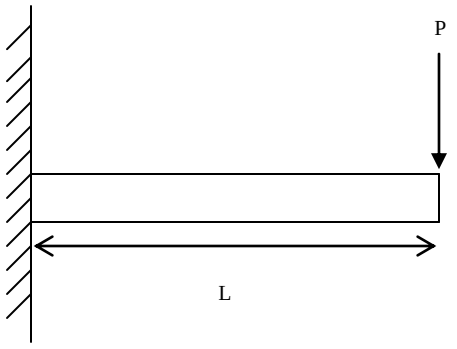


Figure 5

(20 marks)

5. A roof beam made of solid wood has the following specifications;

   C_d = 1.05 (load duration factor)
   L = 16ft (length of the beam)
   S = 2ft (space between beams)
   dl = 20Ibf/ft^2 (dead load)
   ll = 10 Ibf/ft^2 (live load)
   F_{bo} = 1600 Ibf/in^2 (allowable bending stress)
   F_{vo} = 750 Ibf/in^2 (allowable shear stress)
   E = 1800000 Ibf/in^2 (modulus of elasticity)
   P_o = L/180 (allowable deflection)

   Test the suitability of a section with size 1.5 in x 9.25 in.

(20 marks)

6. A two dimensional structure in Figure 6 has dimensions in arbitrary units. Using Finite Element Method, determine

   (a) the displacement of each node
   (b) the reaction force at node 1, 3 and 4
   (c) the axial force in each element

Element	E	A
12	1	1
23	1	1
24	1	1

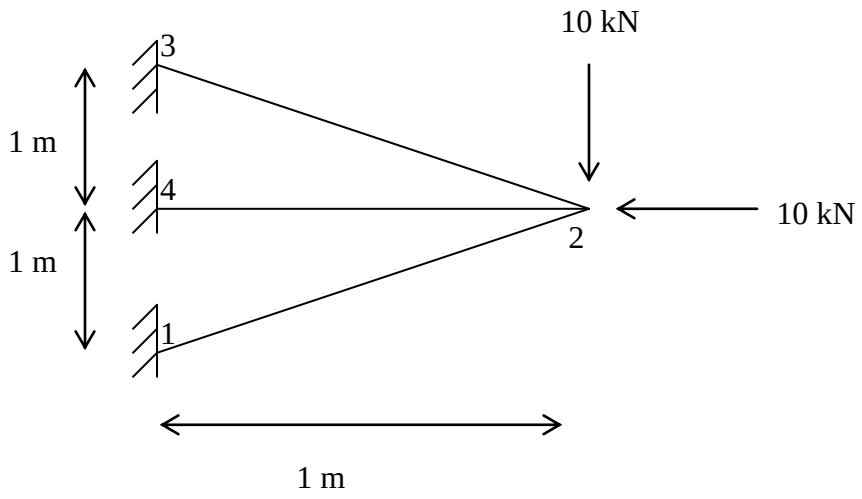


Figure 6

(20 marks)

List of formulations

Z = $bd^2/6$ (section modulus)
I = $bd^3/12$ (moment of inertia)
L_e = $L - 2d$ (effective length)
V = $wL_e/2$ (maximum shear force)
M = $wL^2/8$ (maximum bending moment)
F_b = M/Z (actual bending stress)
F_v = $3V/2A$ (actual shear stress)
P = $5wL^4/384EI$ (actual deflection)
C_f = $(12/d)^{1/9}$ (size factor)
C_c = $1 - 2000\ (t/R)^2$ (curve factor)
F_r = $3M/2R_mA$ (actual radius stress)

1. (a) *Terangkan peringkat-peringkat yang terlibat dalam perebakan rekahan.*

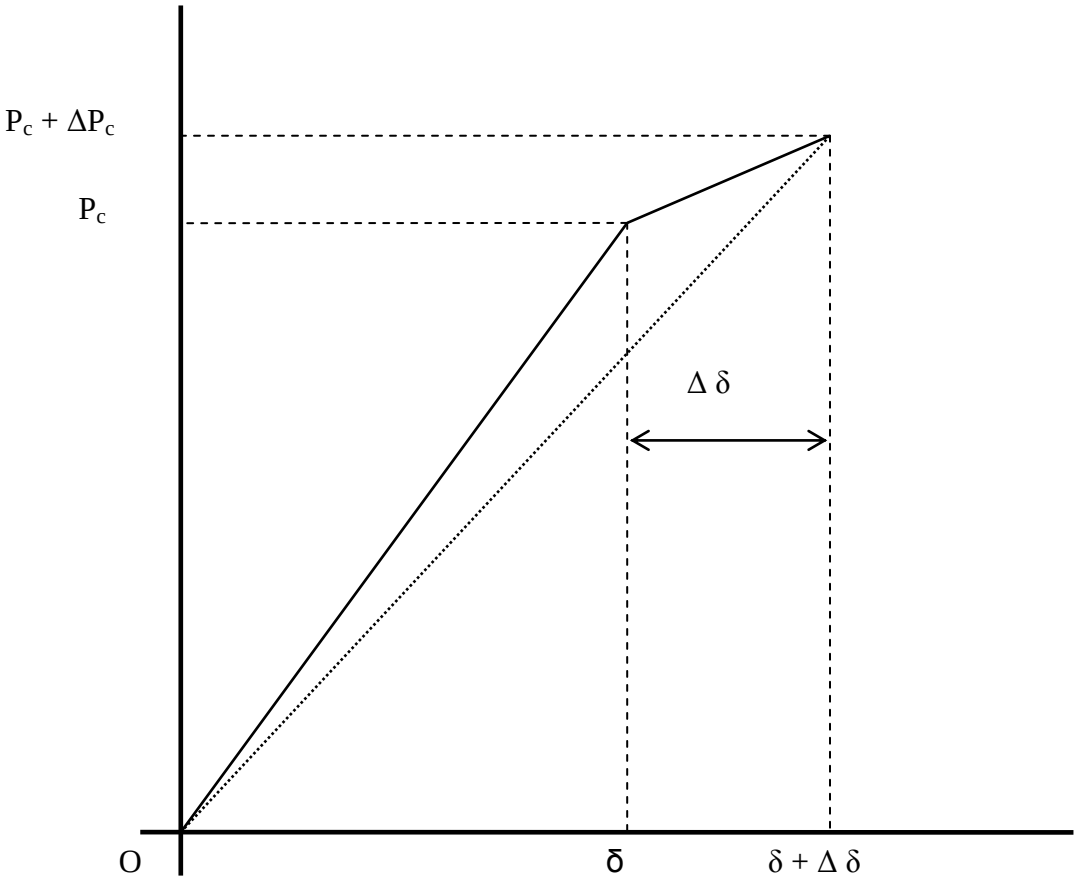
(5 markah)

(b) *Berdasarkan hubungan Irwin-kies dan Rajah 1, tunjukkan bahawa kadar pembebasan tenaga terikan (G) adalah diberikan oleh*

$$G = P_c^2/2B(dC/da),$$

dengan

P_c = *Beban rekahan*
B = *Ketebalan*
C = *Komplians*
a = *Panjang retak*



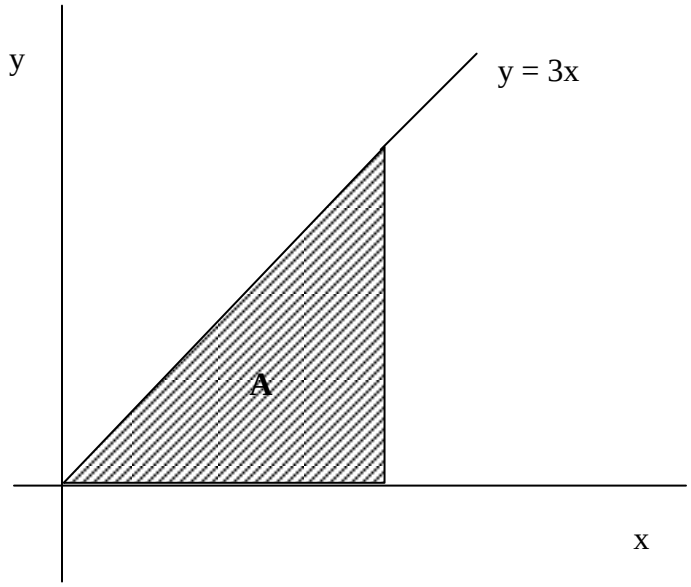
Extension
Rajah 1

(15 markah)

…10/-

2. (a) *Untuk kawasan yang terlorek dalam Rajah 2, tentukan yang berikut dengan menggunakan kaedah pengamiran.*

(i) Keluasan kawasan terlorek, A
(ii) Pusat bentuk
(iii) Momen inersia terhadap paksi x, I_x

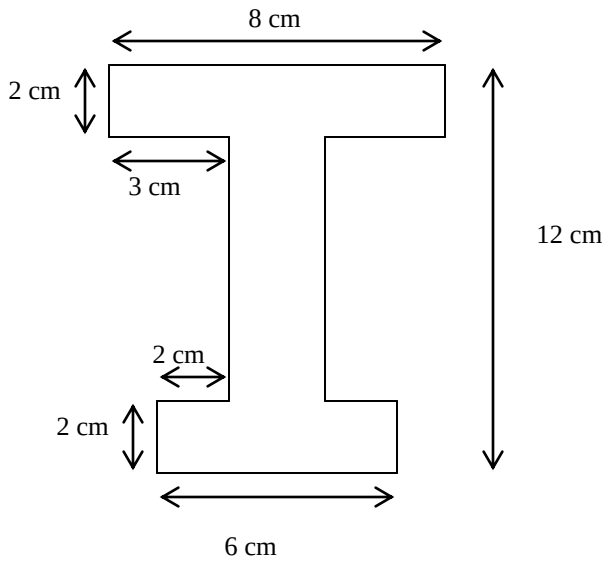


Rajah 2

(10 markah)

(b) Untuk rajah komposit yang ditunjukkan dalam Rajah 3, tentukan

(i) Kordinat pusat bentuk
(ii) Momen inersia terhadap paksi x, I_x.

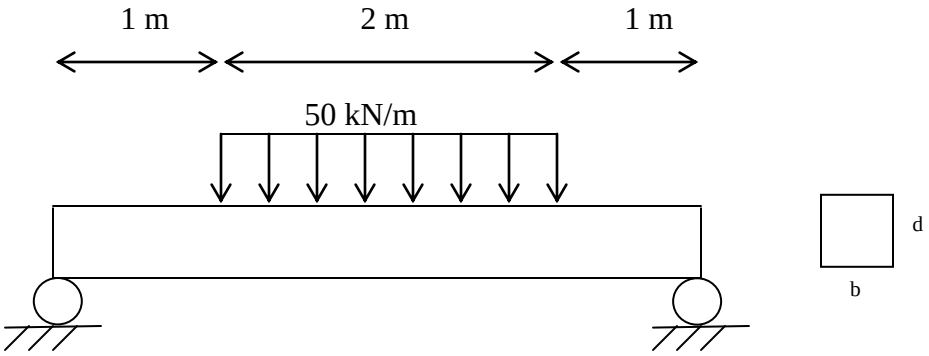


Rajah 3

(10 markah)

3. Suatu bim dibebankan dengan daya tertabur di bahagian tengahnya seperti yang ditunjukkan dalam Rajah 4 dan spesifikasi bim dalam seperti berikut

F_{bo} = *7500 kN/m^2* *(tegasan lenturan izin)*
F_{vo} = *850 kN/m^2* *(tegasan ricih izin)*
b = *20 cm* *(lebar bim)*



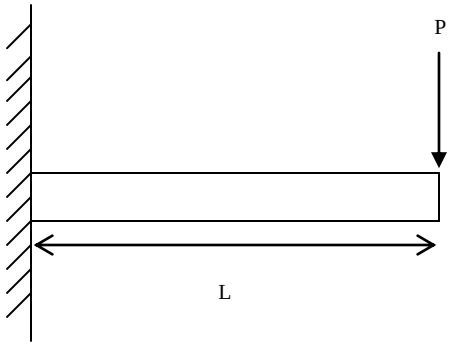
Rajah 4

Tentukan kedalaman/ketebalan (d) minimum yang dibenarkan.

(20 markah)

4. *Suatu bim kantilever dibebankan seperti yang ditunjukkan dalam Rajah 5. Tunjukkan pesongan maksimum bim tersebut adalah bersamaan dengan $PL^3/3EI$, dengan;*

   P = Beban
   L = Panjang bim
   E = Modulus kekenyalan
   I = Moment inersia terhadap paksi neutral



Rajah 5

(20 markah)

5. *Suatu bim bumbung lurus yang diperbuat daripada kayu pejal mempunyai spesifikasi berikut;*

   C_d = *1.05 (factor tempoh masa pengenaan beban)*
   L = *16ft (panjang bim)*
   S = *2ft (jarak antara bim)*
   dl = *20Ibf/ft^2 (beban mati)*
   ll = *10 Ibf/ft^2 (beban hidup)*
   F_{bo} = *1600 Ibf/in^2 (tegasan lenturan izin)*
   F_{vo} = *750 Ibf/in^2 (tegasan ricih izin)*
   E = *1800000 Ibf/in^2 (modulus kekenyalan)*
   P_o = *L/180 (pesongan izin)*

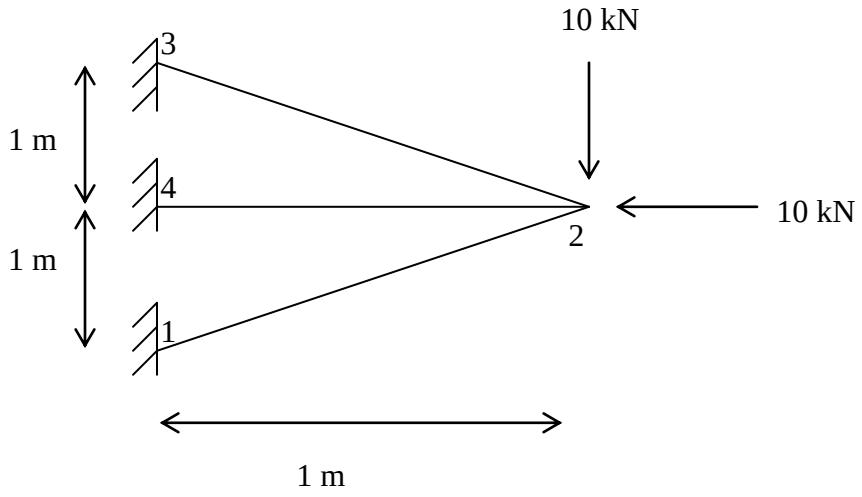
   Uji kesesuaian keratan yang bersaiz 1.5 in x 9.25 in

(20 markah)

6. *Suatu struktur dua dimensi dalam Rajah 6 dengan ukurannya diberikan dalam unit sebarangan. Dengan menggunakan Kaedah Elemen Terhingga, tentukan*

   (a) Sesaran setiap nod
   (b) Daya tindak balas pada nod 1, 3 and 4
   (c) Daya paksian setiap elemen

Elemen	*E*	*A*
12	*1*	*1*
23	*1*	*1*
24	*1*	*1*



Rajah 6

(20 markah)

Senarai formula

Z = $bd^2/6$ *(modulus keratan)*
I = $bd^3/12$ *(momen inertia)*
L_e = $L - 2d$ *(panjang berkesan)*
V = $wL_e/2$ *(tegasan ricih maksimum)*
M = $wL^2/8$ *(momen lenturan maksimum)*
F_b = M/Z *(tegasan lenturan sebenar)*
F_v = $3V/2A$ *(tegasan ricih sebenar)*
P = $5wL^4/384EI$ *(pesongan sebenar)*
C_f = $(12/d)^{1/9}$ *(faktor saiz)*
C_c = $1 - 2000\ (t/R)^2$ *(faktor lengkukan)*
F_r = $3M/2R_mA$ *(tegasan jejarian sebenar)*

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