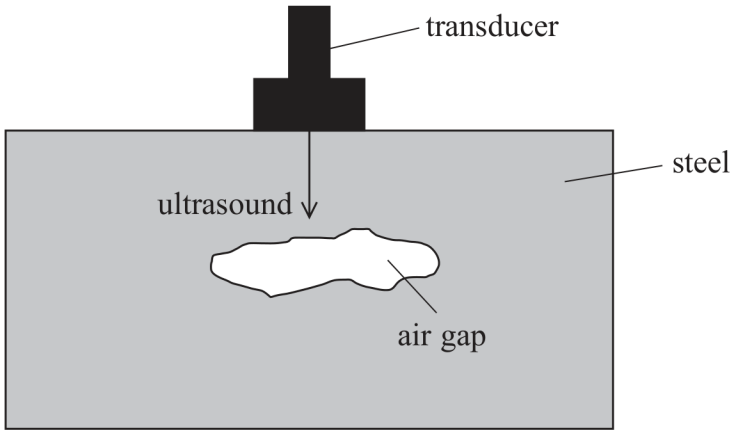
12 Rolled steel joists (RSJs) are used in the construction of buildings, as shown.

(Source: © Jon Kempner / Shutterstock)

The strength of an RSJ is greatly reduced if there are air gaps within the steel. Ultrasound is used to detect any air gaps in the RSJ.

Pulses of ultrasound are sent by a transducer into an RSJ as shown. Any returning ultrasound is detected by the transducer.



(a) Explain how this arrangement can be used to show whether the RSJ contains an air gap.

(4)

(b) Ultrasound is a sound wave with a frequency greater than 20 kHz. The frequency of ultrasound used by the transducer in this method is 5 MHz.

Explain why a much higher frequency than 20 kHz is needed in this method.

(3)

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(Total for Question 12 = 7 marks)