SHORTER COMMUNICATION

PREFABRICATED CONSTRUCTION FOR INDUSTRIAL AND DOMESTIC BUILDINGS

by

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SUMMARY

The need for using new methods and materials for reducing costs and construction time for light industrial and domestic buildings is emphasized. Two relatively new methods involving use of two materials, precast reinforced concrete and cold formed light gauge steel are described. These methods can be used for large scale light industrial and housing projects in rural as well as in urban areas. The designs are such that they can be executed with local talents available in even rural areas.

1. INTRODUCTION

The majority of the people in the country still live in sub-standard houses. From time to time the Government takes steps to provide suitable houses for the people. However these steps fall far too short to meet the demand. Moreover, there are many housing activities to be started to provide spaces for factories, warehouses, markets etc. Therefore, there is an urgent need to build houses on a large scale and at low cost. Large scale housing projects should provide,

(a) in urban areas: organised means of production and assembly of building components at a rapid rate

(b) in rural areas: development of schemes which would provide rural employment as well as yield quick results by way of additional tenements and

(c) cost: both in the urban and rural areas there should be a significant reduction in cost when compared to the traditional method of construction.

Two methods involving two materials of construction will be discussed here, so as to highlight their scope in the fields of light industrial buildings and low-cost housing.

2. PRECAST REINFORCED CONCRETE STRUCTURES

Even though the assembly line and its potentialities were realised in the automobile and manufacturing industries as early as in the first decade of the twentieth century, application of the very same principles in a large way to housing, dates back only to the post-war period. Even as in a machine, we mass produce various components in separate shops and assemble them together on an assembly line, so too it is possible to produce building components and assemble them on site. The Scandinavian countries and the U.S.S.R. have given a lead to the world in this area. In a multi-storey building, it may be necessary only to erect the columns on site and then erect beams and slabs which are prefabricated in a factory under strict quality control. Many of the systems of industrialised housing use precast, prestressed elements. In order to keep the cost of houses down and speed up the construction, it would be desirable to avoid prestressing, as we still have to import costly prestressing steel. That leaves us with the traditional materials, steel and concrete.

The following is a proposal for building industrial sheds[1] of 40 ft. (12.2 m) and 50 ft. (15.2 m) span without crane facilities. The basic structural element is taken as the rigid portal frame hinged at the supports and the ridge, and provided with a tie bar at the springing level. The outline of the frame is shown in Figure 1. The portal is of reinforced concrete which could be erected at 12 ft. (3.66 m) centres. Purlins could be steel unequal angles spaced at 5 ft. 5 in. (1.65 m) along the rafter. The roof covering consists of asbestos corrugated sheets. Figure 2 shows the reinforced concrete frame broken into four components, two each of types I and II. A pin-joint is required at sections A, B and C, and moment-carrying splices could be readily incorporated by using steel face plates and bolts as shown in Figure 3.

The details of hinge at section B (at ridge) are shown in Figure 3. These components of type I and II can be conveniently precast and assembled in a horizontal position and then lifted up to the vertical position. Where hoisting machinery is not available, a set of two gin poles with two 5 tonnes capacity winches and pulley

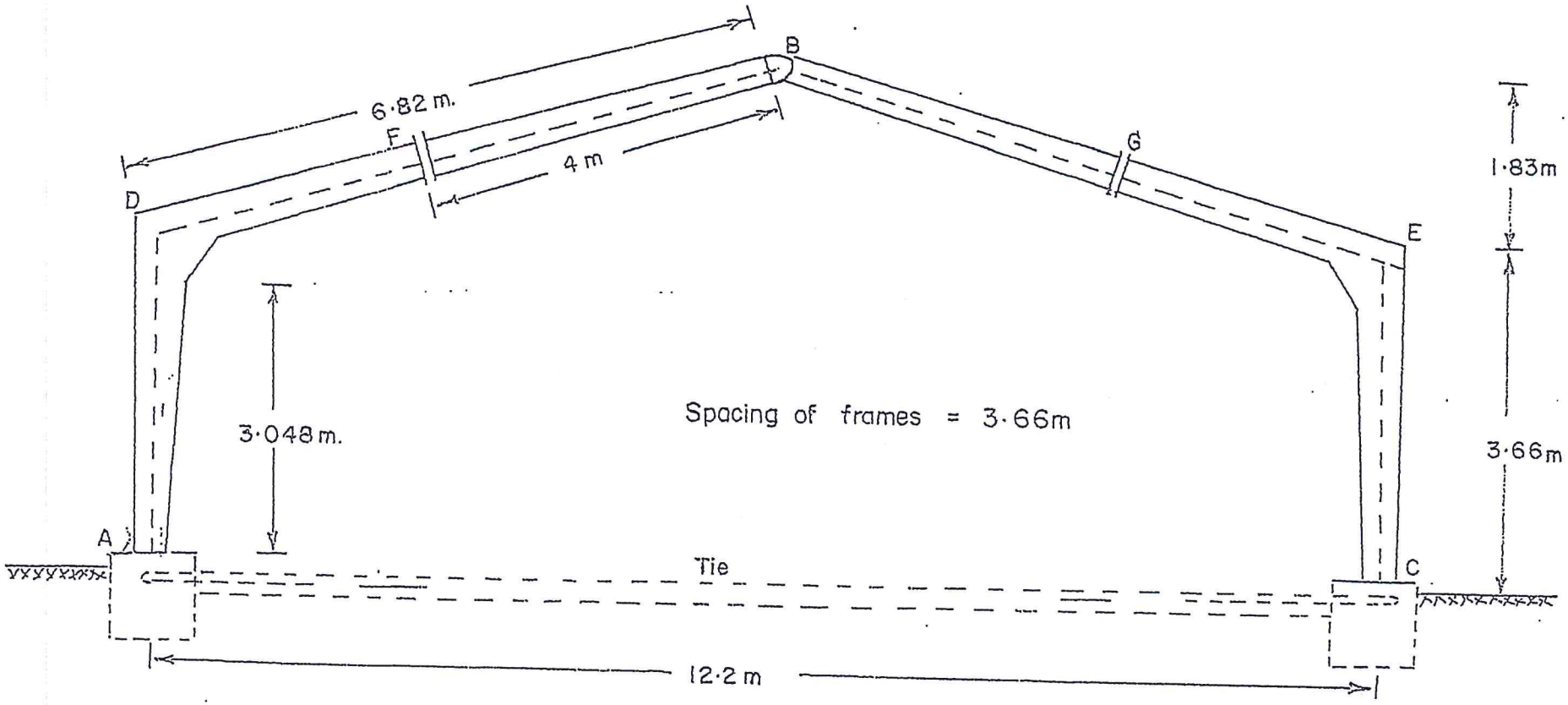


Fig 1 Precast Reinforced Concrete Frame For Industrial Sheds.

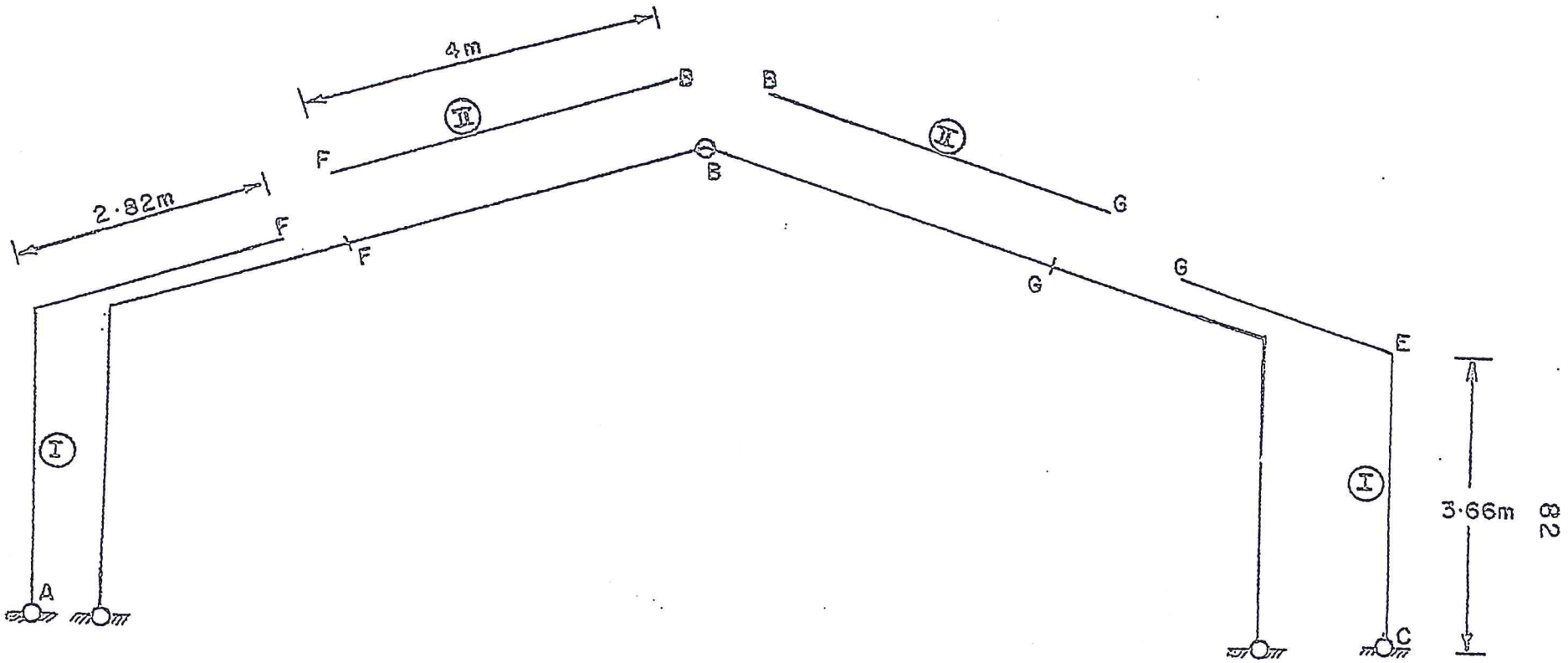
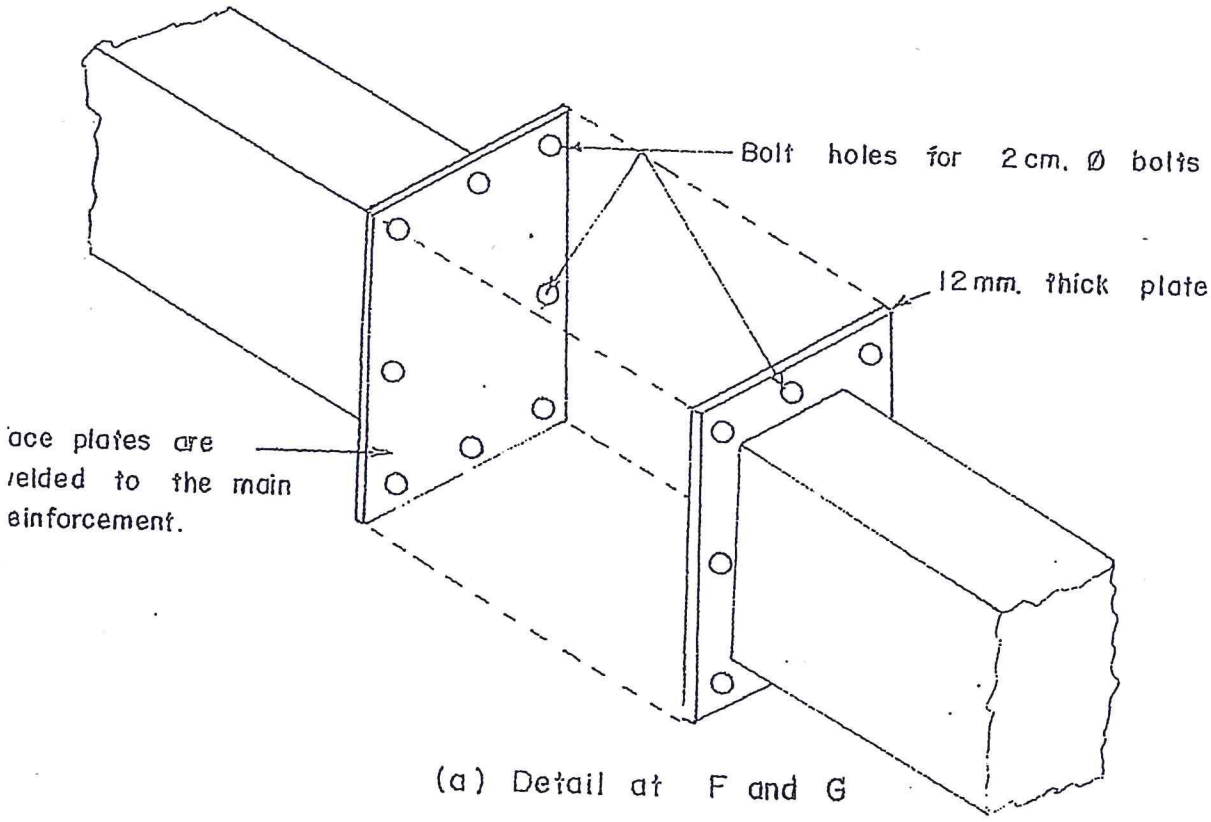
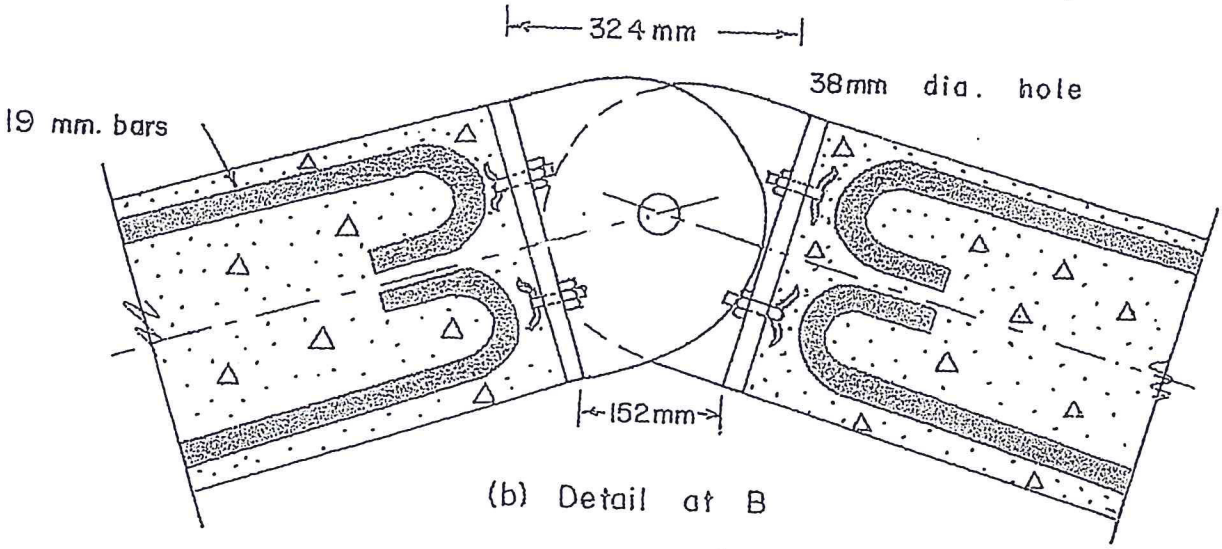


Fig. 2 Schematic breakup for pre – casting



(a) Detail at F and G



(b) Detail at B

Fig. 3 Working details.

blocks can be used as shown in Figure 4. The concrete used for casting the frame is proportioned to have a cube strength of $20N/mm^2$.

The specific advantages of the above system are:

(a) Rapidity in construction and greater rigidity;

(b) No dependence on rolled steel sections - which are scarce and costly items;

(c) As compared to conventional roofing systems, it would work out to be economical in cost.

3. COLD FORMED LIGHT GAUGE STRUCTURES

For single-storeyed houses which are very common in Trinidad, a rigid portal built of cold formed sections[2] of galvanised sheet could be used. The sections for single-storeyed houses can be as small as gauge 14 (2 mm) formed as shown in Figure 5. These frames are spaced one metre apart along the length of the shed and connected by light-gauge purlins and sheets. One whole portal of this design would weigh less than 300 lbs (146 kg) and can be easily handled by a crew of three men. Brake-forming the light gauge sections out of galvanised sheets and welding are well within the capability of a skilled worker. Side walls could be precast concrete panels of 10-15 cm thickness and the roofing provided with asbestos cement sheeting.

Some doubts may be raised regarding the strength of 14 gauge sheet of 2 mm thickness. But the author would like to emphasize that the strength of such a sheet is quite adequate provided it is galvanised or metallized for protection against atmospheric corrosion. In fact, such light-gauge sheets have been used for three storeyed residential flats in West Germany as early as 1961.

4. CONCLUSIONS

The two examples illustrated above can help not only in effecting economy but in increasing speed of construction. The designs are such that they can be executed with local talent available even in rural areas. Their chief merit lies in the provision of rural employment and scope for small scale entrepreneurs. It may also be emphasized that such structures will reduce the possibility of fire hazards considerably.

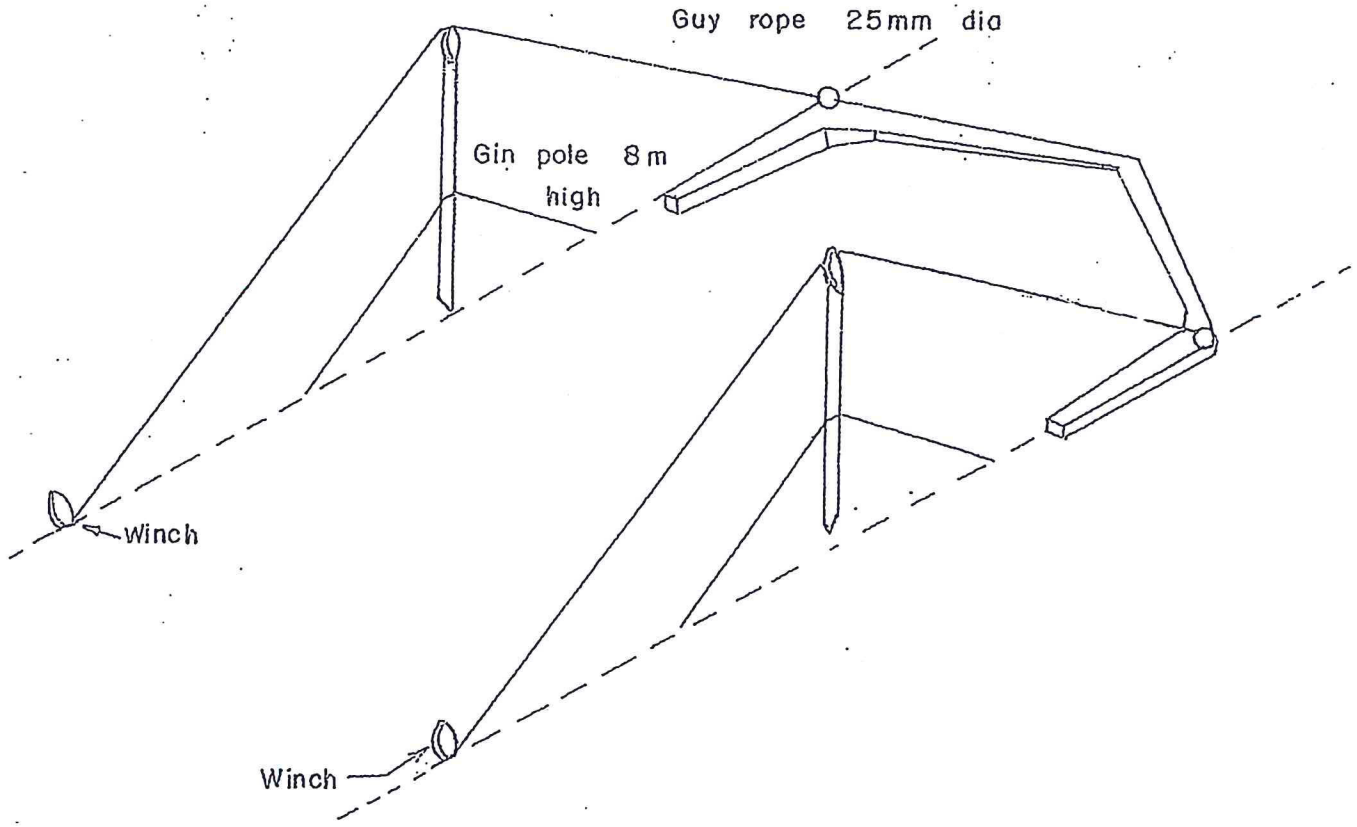
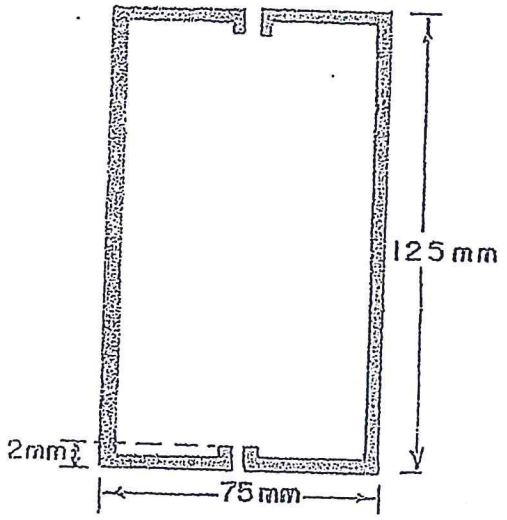
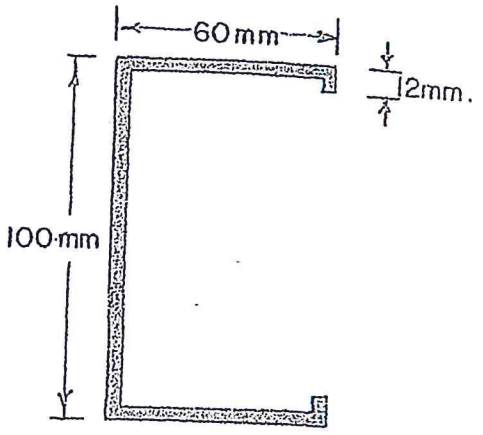


Fig. 4 Schematic diagram for erection.



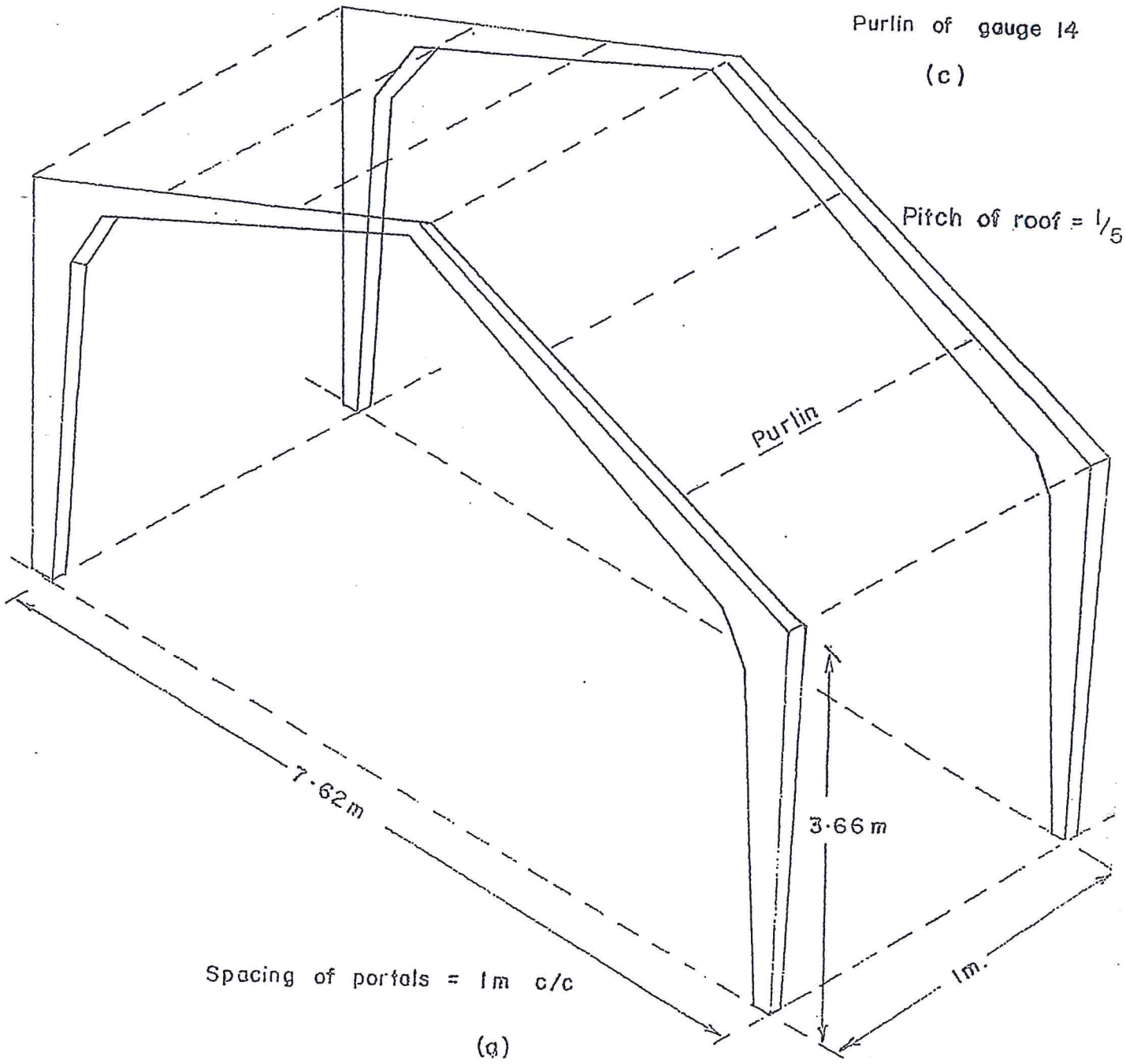
Sheet gauge 14
Thickness = 2mm

(b)



Purlin of gauge 14

(c)



(a)

Fig. 5 Light gauge pent roof frame with spacing.

REFERENCES

1. Constructional Steel Research and Development Organisation, "Steel Designers' Manual", Crosby Lockwood Staples, London (Fourth Edition), 1977, pp. 299-411.

2. Indian Standard Institution, "I.S. 811 - 1961, Specifications for Cold Formed Light-Gauge Structural Steel Sections", 1961.