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BEHAVIOR OF FRAME CONSTRUCTION IN THE 1937 OHIO RIVER FLOOD

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As a part of its general researches on the more efficient utilization of the nation's timber resources, the Forest Products Laboratory is particularly interested in studying the performance of frame structures, so that the serviceability of wood may be improved. The Laboratory therefore studied the damage caused to frame construction by the Ohio River flood of 1937, and made a brief inspection of a few typically flood-damaged houses in Louisville, Ky., and Jeffersonville, Ind.

The inspection included: (1) Houses that had been subjected to very high waters and strong currents with resulting structural damage, and (2) houses in somewhat higher areas where the water reached only a few feet above the first floor, with little or no structural damage resulting, although the damage caused by long-continued soaking was considerable.

The houses inspected in Louisville that had been submerged were of the modest bungalow, or small low-cost one-story type. The foundations were either timber posts, or piers of concrete, brick, or stone. Only a few had a concrete wall foundation with basement. Many of these houses had been shifted from their foundations. As a whole, the houses in Jeffersonville that had been submerged were of a somewhat better type, but many of these had also suffered structural damage, but not to the extent as did those in Louisville.

The primary cause of the structural damage in these submerged houses was nonuniform bearing, as a result of the shifting of the house from its foundation. Lack of sufficient anchorage was primarily responsible for the houses being shifted. In most of the houses that had been shifted, overturned, or even floated away, in fact, no evidence of any anchorage whatever could be found. Where anchorage was found in houses that had shifted, it was entirely inadequate and much below what ordinary good building practice would call for.

The following are examples of insufficient anchorage observed:

1. Wood posts driven only about 18 inches into the ground. The buoyant effect of the water and the force of the current were sufficient to lift the house and pull the posts from the ground, the posts remaining attached to the building.

2. Studs mortised into wood plates, but not otherwise attached to the floor system. The house had apparently been lifted from the first floor, leaving the floor system and sills attached to the post foundation.

3. Tying of the house to the foundation by thin metal straps screwed into the side of the house and anchored into the ground. The straps were few and the fastening inadequate, allowing the house to shift from its foundation.

4. Drift pins which were anchored into masonry piers and were of sufficient length to extend through the sills, but evidently were not intended to resist lifting of the house. Only the piers were left, the house apparently having been lifted by the water and then floated away.

5. Overturning of concrete piers on account of not having been extended far enough into the ground.

There was no appreciable structural damage found in the houses that had been only partly submerged. The partly submerged houses did, however, suffer severely from dirt and muck swept into them, from buckling, warping, and swelling of the floors and woodwork, from damaged natural finishes, ruined interior paint finishes and wall papers, and in some instances, badly damaged plaster.

Suggested Methods for Reducing Structural Damage to Frame Construction by Floods

The general survey of the flood damage to frame construction indicates that most of the structural damage could have been prevented if ordinary good construction principles had been rigidly adhered to, especially as concerns the anchoring of buildings to well-designed foundations, such as would result from taking the following precautions:

Timber Post Foundation.--Where the use of timber posts is permissible, they should be given a preservative treatment to prevent decay, and should extend into the ground at least 36 inches. They should, of course, be of sufficient size, and spaced closely enough together, to safely carry the load. If less penetration is used, the anchorage should be supplemented by bolting treated anchor boards to the lower end of each post, the anchor boards being placed horizontally in previously excavated trenches. The sills should be securely anchored to the posts. It is very desirable that the corner posts be diagonally braced to the sills. It is also good practice to brace intermediate posts.

Concrete, Brick, or Masonry Piers.--These piers should rest on firm soil, preferably below the frost line, or at least 18 inches below the ground on spread footings.

The brick or stone piers should be well bonded with a good cement mortar. An anchor bolt of good size should be imbedded an ample depth in each pier, and of sufficient length to project through the sill and be provided with good sized washers and nuts, thereby firmly tying the sill and foundation together.

Continuous Concrete or Concrete Block Foundation.--Concrete blocks should be well bonded with a good cement mortar. The wall should be provided with sufficiently large anchor bolts, spaced not over 8 feet on centers, and extending at least 18 inches into the foundation. These bolts should project through the sill and be provided with washers and nuts. A bolt should be used at or near each corner and angle of the building. If the house is without basement, the walls should extend below the frost line.

Framing Members.--Diagonal sheathing securely nailed to the sill and wall plates is very effective in anchoring a building to its sill. Where diagonal sheathing is not used, each joist should be securely toenailed to the sill. Where platform construction is used, each stud should be securely toenailed to the plate. Obviously, for good construction all parts must be securely fastened together.

While it cannot be definitely said that the adherence to the foregoing principles of anchorage will in all cases prevent structural damage to flood-exposed buildings by dislodgment, the danger of such damage occurring will be greatly reduced.